M.Eng. Energie- und Umweltmanagement / *Energy and Environmental Management*:

Modulhandbuch / *module guide book*

Inhaltsverzeichnis / *table of contents*

Modul 1: Energiemanagement

Studiengang:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung:	Energiemanagement
ggf. Kürzel	EM
ggf. Untertitel	-
ggf. Lehrveranstaltungen:	-
Semester:	Spring term
Modulverantwortliche(r):	Prof. Dr.-Ing. Gerd Hagedorn
Dozent(in):	Prof. Dr.-Ing. Gerd Hagedorn
Sprache:	Deutsch
Zuordnung zum Curriculum	M. Eng. Energie- und Umweltmanagement, Industrieländer Pflichtveranstaltung
Lehrform / SWS:	Vorlesung (Übung)/ 4 SWS
Arbeitsaufwand:	Präsenzstudium: 60h Eigenstudium: 90h
Kreditpunkte:	5 ECTS
Voraussetzungen nach Prüfungsordnung:	keine
Modulziele / angestrebte Lernergebnisse / Kompetenzen:	Vertiefte Kenntnisse zur Vorgehensweise und in der Anwendung von Methoden des Energiemanagements, die zu einer Reduzierung des Endenergieeinsatzes in den Anwendungssektoren für die Deckung des Nutzenergiebedarfs führen.
Inhalt:	1. Einführung und Grundbegriffe 2. Energiemanagementsysteme (DIN EN 50001) 3. Vorgehensweise betriebliches Energiemanagement 4. Gewinnen und Verarbeiten energetischer Daten 5. Benchmarking/Vergleich von Energiekennzahlen 6. Erstellen von Stoff-, Leistungs- und Energiebilanzen 7. Erstellen von Betriebskennlinien 8. Auswahl und Priorisierung von Maßnahmen 9. Querschnittstechnologien 10. Bsp.: Raumheizung und Klimatisierung 11. Bsp.: Energieanwendung im Verkehr
Studien- Prüfungsleistungen:	Klausur (120 min.)
Medienformen:	Pdf-Versionen von VL-Skript, UE-Aufgaben und zahlreichen Publikationen (download), Powerpoint-Präsentationen/Folien, Tafel
Literatur:	Rudolph, M.; Wagner, U. Energieanwendungstechnik – Wege und Techniken zur effizienteren Energienutzung Springer-Verlag, 2008

Modul 2: Green Engineering Theory

Studiengang / course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Green Engineering Theory
ggf. Kürzel / abbreveation	-
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	Green Engineering Theory
Semester / semester:	Spring term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr. Jens Born
Dozent(in) / person teaching the seminar:	Prof. Dr. Jens Born Dipl.-Ing. Peter Heßbrüggen
Sprache / language:	English
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energy and Environmental Management for 'Industrial Countries' Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	Workshop and Project Work (exercise) 4 teaching hours per week
Arbeitsaufwand / student workload:	Attendance: 60 h Private study: 90 h
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	none
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	• Ability to apply scientific methods of sustainable engineering and Management Engineering to solve procedural problems • Ability to design processes in a step-by-step approach • Ability to identify problems in complex projects with partners from practice in a targeted and structured manner and development until a first draft for decision makers • Ability to solve problems fulfilling sustainability criteria
Inhalt / subjects covered:	Methodologies and ontologies to develop sustainable business cases • Identify stakeholder demand with sustainable design thinking methods. • Conduct sustainable framing analysis and identify reference scenarios. • Design innovative ideas and conceptual prototypes Application of these principles in cases of • Integration of renewable energy, waste and wastewater treatment in respective process chains

	• Renewable energy systems integration • Project work: solving real world problems • Integration of process chains • Feed-back and discussion of approaches chosen, solution of occurring problems during workshops
Studien- Prüfungsleistungen / form of examination:	Presentation (prerequisite) and written group report (4500 to 5000 words per student) marked
Medienformen / media used:	Blackboard, Power Point Presentation
Literatur / literature:	➢ Allen, Shonnard: Green Engineering ➢ Graedel, Allenby: Industrial Ecology and Sustainable Engineering ➢ Heßbrüggen: Sustainable Innovation Design ➢ Hill: Sustainable Resource Use

Modul 3: Green Engineering Project

Studiengang / course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Green Engineering Project
ggf. Kürzel / abbreveation	-
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	Green Engineering Project
Semester / semester:	Autumn term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr. Jens Born
Dozent(in) / person teaching the seminar:	Prof. Dr. Jens Born Dipl.-Ing. Peter Heßbrüggen
Sprache / language:	English
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energy and Environmental Management for 'Industrial Countries' Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	Workshop and Project Work (exercise) 4 teaching hours per week (SWS)
Arbeitsaufwand / student workload:	Attendance: 60 h Private study: 90 h
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	none
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	Ability to apply scientific methods and ontologies of sustainable engineering and Management Engineering to solve procedural problems Ability to design processes in a step-by-step approach Ability to implement complex projects with partners from practice in a targeted and structured manner Ability to solve problems fulfilling sustainability criteria
Inhalt / subjects covered:	Advanced application of methods and ontologies to real world projects with external partner Identify stakeholder demand with sustainable design thinking methods. Conduct sustainable framing analysis and identify reference scenarios. Design innovative ideas and conceptual prototypes Design sustainable feasibility models Varying assignments on the integration of process chains fulfilling criteria of energy and resource efficiency Integration of renewable energy, waste and wastewater treatment in respective process chains Renewable energy systems integration Project work: solving real world problems

	Integration of process chains Feed-back and discussion of approaches chosen, solution of occurring problems during workshops Oral and written presentation of results
Studien- Prüfungsleistungen / form of examination:	Presentation (prerequisite) and written group report (4500 to 5000 words per student) marked
Medienformen / media used:	Blackboard, Powerpoint Presentation
Literatur / literature:	Allan, Shonnard: Green Engineering Graedel, Allenby: Industrial Ecology and Sustainable Engineering Heßbrüggen, Peter: Sustainable Innovation Design

Modul 4: Schweißtechnik

Studiengang / course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Schweißtechnik
ggf. Kürzel / abbreveation	ST
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	Schweißtechnik
Semester / semester:	Autumn term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr-Ing. Michael Dahms
Dozent(in) / person teaching the seminar:	Prof. Dr-Ing. Michael Dahms Dipl.-Ing. Ingo Rausch, SFI
Sprache / language:	Deutsch
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement, Wahlpflichtmodul
Lehrform / SWS / form of seminar / teaching hours per week:	Vorlesung / 4 SWS
Arbeitsaufwand / student workload:	Präsenzstudium: 60 h Eigenstudium: 90 h
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	keine
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	Die Studenten erwerben Wissen in einem im Energie- und Umweltmanagement wichtigen Spezialgebiet – Schweißtechnik. Die Inhalte sind so ausgewählt, dass die Studierenden sich die bestandene Klausur als Teil I des internationalen Schweißfachingenieurlehrganges anerkennen lassen können. Damit wird der erste Schritt eines Prozesses absolviert, der den Berufseinsatz des Ingenieurs als Schweißaufsicht o.ä. ermöglicht.
Inhalt / subjects covered:	Hauptgebiet 1: Schweißverfahren Hauptgebiet 2: Schweißen des unlegierten Stahls Hauptgebiet 3: Schweißkonstruktion Die Inhalte orientieren sich am Katalog des internationalen Schweißfachingenieurlehrganges, Teil I.
Studien- Prüfungsleistungen / form of examination:	Klausur (120 min.)
Medienformen / media used:	Skript, Tafel, PC/Beamer, Stud.IP
Literatur / literature:	DVS: Fügetechnik Schweißtechnik (7. Auflage)

Modul 5: Entwicklung und Bewertung energietechnischer Systeme

Studiengang:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung:	Entwicklung und Bewertung energietechnischer Systeme
ggf. Kürzel	EBES
ggf. Untertitel	-
ggf. Lehrveranstaltungen:	-
Semester:	Autumn term
Modulverantwortliche(r):	Prof. Dr.-Ing. Gerd Hagedorn
Dozent(in):	Prof. Dr.-Ing. Gerd Hagedorn
Sprache:	Deutsch
Zuordnung zum Curriculum	M. Eng. Energie- und Umweltmanagement für Industrieländer Wahlpflichtmodul
Lehrform / SWS:	Vorlesung/Übung 4 SWS
Arbeitsaufwand:	Präsenzstudium: 60h Eigenstudium: 90h
Kreditpunkte:	5 ECTS
Voraussetzungen nach Prüfungsordnung:	keine
Modulziele / angestrebte Lernergebnisse / Kompetenzen:	Verständnis des rekursiven Zusammenhangs zwischen Technikbewertung und Technikentwicklung. Vertiefte Kenntnis ausgewählter Bewertungsmethoden und Kennzahlen zur Beschreibung energietechnischer Anlagen und Systeme. Zielgerichtetes Management von komplexen technischen Entwicklungsprozessen unter realen betrieblichen Randbedingungen.
Inhalt:	Teil A: Bewertung 1. Technikbewertung 2. Wirtschaftlichkeit (Lebenszykluskosten) 3. Energieaufwand (Kumulierter Energieaufwand) 4. Umweltverträglichkeit (Lebenszyklusanalyse) 5. Verfügbarkeit 6. Software und Datenbanken 7. Praxisbeispiele Teil B: Entwicklung 1. Effektivität und Effizienz von Entwicklungsprozessen 2. Vorfeldbetrachtungen 3. Markt-, Kunden- und Wettbewerberanalysen 4. Konzept- und Produktplanung 5. Produktentwicklung 6. Produkteinführung und Erfahrungsrückfluss 7. Methodische Instrumente 8. Praxisbeispiele
Studien- Prüfungsleistungen:	Hausarbeit (ca. 15 Seiten)
Medienformen:	Pdf-Versionen von VL-Skript, UE-Aufgaben und zahlreichen Publikationen (download), Powerpoint-Präsentationen/Folien, Tafel

Literatur:	Bullinger/Warschat (Hrsg.) Forschungs- und Entwicklungsmanagement, B.G. Teubner Stuttgart Literatur und Internetadressenverzeichnis

Modul 6: Applied Environmental Science

Studiengang / course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Applied Environmental Science
ggf. Kürzel / abbreveation	-
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Spring Term
Modulverantwortliche(r) / person in charge of module:	Dr. rer. nat. Hermann van Radecke
Dozent(in) / person teaching the seminar:	Dr. rer. nat. Hermann van Radecke et al.
Sprache / language:	English / Deutsch
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management for 'Industrial Countries' Core elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	Lectures with practical exercises 4 SWS
Arbeitsaufwand / student workload:	Attendance: 60 h Private study: 90 h
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	none
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	Through investigation of the effects of wind on wind energy plants the students will acquire advanced knowledge of energy meteorology and through study of the impact of wind energy plants on the environment gain advanced knowledge of types and levels of emissions. Students will be able single-handedly to make and evaluate prognoses of wind-energy potential. They will know and understand the physical, technical and legal aspects of wind energy plants with regard to their emissions. They will be able to calculate and evaluate emissions. They will be able to predict whether the installation and operation of projected wind energy plants will comply with the approval procedures for land. They learn to serve the very common software tool for wind farm design (WindPRO, WAsP) which is used in another Master Module "Windparkprojektierung"
Inhalt / subjects covered:	1. Practical exercises including program modules (WindPRO, WAsP) in a computer lab on subjects as

	energy potential, noise and shadow emission, costs, visibility, photomontage. 2. Calculation of environmental data and emissions with Program modules of WindPRO, WAsP et al. 3. Energy meteorology (global and regional wind systems, boundary layers, profile, turbulence, WAsP, mesoscale models, wind atlases, reference outputs according to Technical Directives Parts 5 and 6, long-range dependency (wind index), measurement, short-term forecasts) 4. Emissions and influences on the environment, noise (measurement and calculation), shadow measurement, calculation, control), critical values, turbulence as a form of emission, landscape aesthetics (planning, assessment, visualisation), measurement of environmental data (IEC Directives, Technical Directives)
Studien- Prüfungsleistungen / form of examination:	Sonstige Prüfungsleistung: Laborbericht
Medienformen / media used:	Whiteboard, transparencies, PC-Laboratory with Lab-Manual, e-learning platform, lecture notes
Literatur / literature:	CEwind, Hrsg.: Understanding Wind Power Technology, Theory, Development and Optimisation. Chapter 3 van Radecke: Wind resources site assessment and ecology, Wiley Ltd., Chichester, 2014 WindPRO3.1 User Manual. EMD International A/S, see https://www.emd.dk/windpro/downloads/ and http://help.emd.dk/knowledgebase/ Aalborg 7/2016 Access 11/2017 Troen, I. and E.L. Petersen: European Wind Atlas. Risø National Laboratory, Roskilde, 1989 Technische Richtlinien (FGW-Richtlinien) Teil 1 Bestimmung der Schallemissionswerte, Teil 5 Bestimmung und Anwendung des Referenzertrages, Teil 6 Bestimmung von Windpotenzial und Energieerträgen, FGW, Kiel 1998 bis Berlin 2017 ff IEC 61400: Power performance testing IEC 61400-12 Wind Turbines Design Requirements IEC 61400-1

Modul 7: Applied Informatics in Energy Planning

Studiengang / course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Applied Informatics in Energy Planning
ggf. Kürzel / abbreveation	AIEP
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Spring term
Modulverantwortliche(r) / person in charge of module:	Dipl.-Ing. Wulf Boie
Dozent(in) / person teaching the seminar:	Dipl.-Ing. Wulf Boie
Sprache / language:	English
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management For 'Industrial Countries': core elective For 'Developing Countries': compulsory
Lehrform / SWS / form of seminar / teaching hours per week:	Seminar with group work on a case study 4 SWS
Arbeitsaufwand / student workload:	60 contact hours 90 hours individual work
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	none
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	The overall goal of the module is to enable students to assess energy supply and demand scenarios with the help of state of the art computer software for the analysis of energy systems. **Specific Objectives** The participants • understand and are able to analyse energy statistics • understand and are able to apply the basic parameters for power planning, such as capacity factors, availability, capacity credits, load curves, merit orders etc. • are able to develop demand projections applying econometric and end use models • have an overview of energy accounting, optimisation and simulation software, their characteristics, advantages and disadvantages and an in depth knowledge of the Long Range Energy Alternative Planning (LEAP) software
Inhalt / subjects covered:	After an introduction into the basic terms of energy modelling and some of the most common modelling

	software on the market the module emphasises on the elaboration of a case study, applying the LEAP software. For the case study one of the home countries of the students will be selected to make the elaboration of the energy model as practical as possible. The module follows the following structure: • Introduction into energy statistics and energy data sources • Introduction into energy modelling and energy modelling software • Overview of different accounting, optimisation and simulation software such as LEAP, TIMES, MARKAL, Enpep/Balance • In depth introduction into LEAP • Energy Demand: Hierarchical accounting of energy demand (activity levels, energy intensities) • Energy Conversion: Simulation of any energy conversion sector (electric generation, transmission and distribution, CHP, oil refining, charcoal making, coal mining, oil extraction, ethanol production, etc.) • Electric system dispatch • Exogenous and endogenous modeling of capacity expansion • Energy Resources: base year resource, yields, imports and exports. • Systems Costs: capital, O&M, fuel, costs of saving energy, environmental externalities • Environment: Emissions and direct impacts of energy system. • Non-energy sector sources and sinks • Scenarios and evaluation of scenarios • Case studies (in groups of 3-4 students) • Identification of energy data of home countries of the participants • Selection of countries for the case studies based on availability of data • Organising the energy data for the case study, filling gaps • Elaborating a reference demand and supply scenario • Elaborating alternative scenarios • Comparing and analysing alternative scenarios
Studien- Prüfungsleistungen / form of examination:	Report (approx. 15 pages per student) and presentation (approx. 15 min. per student) of alternative energy scenarios as a group work with assessment of the team performance as well as the individual performance
Medienformen / media used:	Black-/ whiteboard, power point presentations, computers for introductory exercises and case studies
Literatur / literature:	*D. Connolly*, *H. Lund*, *B.V. Mathiesen* and *M. Leahy*, A *review* of *computer tools* for *analysing* the *integration* of

	renewable energy into various energy systems, Applied Energy 87 (2010) Brian C. O'Neilla, Mausami Desaib, Accuracy of past projections of US energy consumption, Energy Policy 33 (2005) 979–993 Paul P. Craig, Ashok Gadgil and Jonathan G. Koomey: What can history teach us? A Retrospective Examination of Long-Term Energy Forecasts for the United States, Annu. Rev. Energy Environ. 2002. 27:83–118 Coordinated use of energy system models in energy and climate policy analysis - lessons learned from the Nordic Energy Perspectives project (April 2010) Bhattacharyya, Timilsina (2010):A review of energy system models, Development Research Group, The World Bank SEIB Stockholm Environmental Institute: LEAP Long-range Energy Alternatives Planning System – User Guide, Boston (USA) (latest edition) SEIB Stockholm Environmental Institute (2003): LEAP Long-range Energy Alternatives Planning System – Training Exercises, Boston (USA) OECD/IEA (2004): Energy Statistics Manual UNEP/Risoe International Laboratory (1997): Integrated resource Planning International Energy Agency: World Energy Outlook (latest edition) International Energy Agency: Non-OECD Energy Balances (latest edition)

Modul 8: Energy Storage Systems

Studiengang / course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Energy Storage Systems
ggf. Kürzel / abbreveation	ESS
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Autumn term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr. Jens Born Prof. Dr. Lothar Machon
Dozent(in) / person teaching the seminar:	Prof. Dr. Jens Born Prof. Dr. Lothar Machon
Sprache / language:	English
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energy and Environmental Management for 'Industrial Countries' Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	Workshop 4 teaching hours per week (SWS)
Arbeitsaufwand / student workload:	Attendance: 60 h Private study: 90 h
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	none
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	Knowledge of the functionality, properties, and application of physical and chemical energy storage systems Knowledge of integration options of storage technologies into other processes and sector coupling
Inhalt / subjects covered:	Mechanical storage Systems - Potential energy storage systems (pumped hydro storage etc.) - Kinetic energy storage system (fly wheels etc.) - Elastic storage systems (CAES etc.) Electrical storage systems - Capacitors - SMES Electrochemical systems - Fundamentals - Batteries - Fuel cells - Osmotic power plants Chemical Storage systems - Fundamentals - Hydrogen and Electrolysis - Methane und methanation

	- Methanol Thermal energy storage systems - Sensitive thermal energy storage - Latent heat energy storage - Thermochemical energy storage Integration - Fundamentals - Bio energy as complementary energy - Temporary CCS - Regional self-supply - Base load supply of chemical industry
Studien- Prüfungsleistungen / form of examination:	Poster Presentation (oral and written)
Medienformen / media used:	Blackboard, Power Point Presentation
Literatur / literature:	• Huggins: Energy Storage; Springer; 2010 • M. Sterner, I. Stadler: Energiespeicher 2nd Ed.); Springer, 2017

Modul 9: Wind Energy Technology – State of the Art

Studiengang / course:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Wind Energy Technology – State of the Art
ggf. Kürzel / abbreveation	-
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Autumn term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr.-Ing. Torsten Faber
Dozent(in) / person teaching the seminar:	Prof. Dr.-Ing. Torsten Faber
Sprache / language:	English
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management for ‚Industrial Countries' Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	Lecture / 4 SWS
Arbeitsaufwand / student workload:	Attendance: 60h Private study: 90h
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	none
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	• Knowledge and understanding of general items about Structure, Loads, Standards and Guidelines, Type and Project Certification • Possibility to connect this knowledge about Loads, Rotorblades, Tower and Foundation with practical background of the person who is teaching this course
Inhalt / subjects covered:	• General Items • Load Calculation • Rotor blades • Tower and Foundation • Standards and Guidelines • Type Certification • Project Certification
Studien- Prüfungsleistungen / form of examination:	Written examination (approx. 90 min.) or oral examination (approx. 15 min.)
Medienformen / media used:	White board, power point presentation, beamer
Literatur / literature:	• CEwind eG, Alois Schaffarczyk: Einführung in die Windenergietechnik, Carl Hanser Verlag, München, 2012

	• Hau, E.: Windkraftanlagen. Springer Verlag, Berlin, 2008 • Manwell, J.F. et.al.: Wind Energy Explained. Wiley Ltd, Chichester, 2009 • Heier, S.: Windkraftanlagen im Netzbetrieb, Vieweg u. Teubner Verlag, Wiesbaden, 2009 • Gasch, R., Twele, J.: Windkraftanlagen. Vieweg u. Teubner Verlag, Wiesbaden, 2010 • CEwind eG, Alois Schaffarczyk: Einführung in die Windenergietechnik, Carl Hanser Verlag, München, 2012 • Guideline for the Certification of Wind Turbines On- and Offshore, 2013 • DIBt Regulations, 2012

Modul 10: Energy Modelling Project

Studiengang/course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Energy Modelling Project
ggf. Kürzel / abbreveation	-
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	Energy Modelling Project
Semester / semester:	Autumn and spring term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr. Olav Hohmeyer
Dozent(in) / person teaching the seminar:	Simon Hilpert Ulf P. Müller
Sprache / language:	Englisch / Deutsch
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management for ‚Industrial Countries' Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	Supervised Project / 3 SWS
Arbeitsaufwand / student workload:	45 hours of attendance/meetings and 105 hours of student work
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen / preconditions:	none
Lernziele / Kompetenzen / aims of the module / competencies:	Students are able to transform a problem in a result-oriented project. Students will learn to apply scientific methodologies and write a scientific report. They are able to prepare and present the results. Competencies covered: • problem solving • analytical thinking • methodological competence • self organisation and teamwork • project organising skills • programming • academic writing • presentation of results
Inhalt / subjects covered:	The following topics will be covered in the module: Students will work on their own project and specific research question of the field of energy modelling and write a report. Regarding topics students can contact persons teaching or suggest own ideas. Workload will include meetings with teachers to discuss methodology and progress.

	Subjects covered: - formulation of research questions - choice of methodology to address this questions - mathematical abstraction of problems - formulation of a model - implementation of the model using a programming language (e.g. R/Python) - data research and evaluation - processing data using software - applying and validating of models - documentation and presentation of the results
Studien-Prüfungsleistungen / form of examination:	Presentation + report. - presentation on the project (approx. 15 min.) - report in form of research paper with: problem description, methodology, analysis and interpretation including graphics, discussion of results, annex: source code (digital) (approx. 15 pages) Evaluation criteria: complexity of the model / clearly structured report / source code is comprehensible and well commented / list of references
Medienformen / media used:	Lectures with beamer based presentations and interactive exercises
Literature / basic literature for the module:	Ligges, U. (2007). Programmieren mit R. Steiner, R. (2009). Grundkurs Relationale Datenbanken. Vieweg + Teubner. Kallrath et al. (2009). Optimization in the Energy Industry. Springer. Kallrath, J. (2002). Gemischt-Ganzzahlige Optimierung - Modellierung in der Praxis. *Springer Spektrum*

Modul 11: Advanced Power Plant Technology

Studiengang / course:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Advanced Power Plant Technology
ggf. Kürzel / abbreveation	-
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Autumn term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr.-Ing. Ilja Tuschy
Dozent(in) / person teaching the seminar:	Prof. Dr.-Ing. Ilja Tuschy
Sprache / language:	Englisch, wahlweise Deutsch
Zuordnung zum Curriculum / attribution to courses:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management for ‚Industrial Countries' Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	Workshop mit Vorlesungsanteilen 4 SWS (max. 20 Personen)
Arbeitsaufwand / student workload:	60 h Präsenzstudium, 90 h Eigenstudium
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	keine
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	Die Studierenden sind in der Lage, Anlagen der thermischen Energietechnik zu abstrahieren, mit Hilfe professioneller Simulationssoftware abzubilden und zu simulieren. Sie können dadurch selbständig entwickelte Fragestellungen aus dem Bereich der Kraftwerkstechnik auf gehobenem wissenschaftlichen Niveau bearbeiten, wobei insbesondere technisches Betriebsverhalten und Auslegung unterschiedlicher Anlagen im Kontext sich ändernder energiewirtschaftlicher Rahmenbedingungen behandelt werden. Die Studierenden beherrschen unterschiedliche wissenschaftliche Kommunikationsformen.
Inhalt / subjects covered:	1. Introduction (5 % of Workload - Course objectives, content and methods) 2. Using simulation software for engineering (30 % of Workload) 2.1 Plausibility checks (Cycle design and calculation based on heat balance diagrams)

	2.2 Identify the impact of technical limitations (Variation of design parameters) 2.3 Accuracy and modelling effort (Simulation of off-design operation) 2.4 Variation of structual design (Analytical approaches for cycle assessment and development) 3. Individual Projects (45 % of Workload) 3.1 Choice of Technologies (e.g. Advanced CHP, CSP, Multi fuel PP, CAES) 3.2 Set-up of advanced cycles (Creation of advanced cycles based on literature review) 3.3 Design alternatives (Development of comperative assessment methods) 3.4 Operation to suit changing boundary conditions (techno-economical assessment of technology perspective) 4. Final Symposium (10 % of Workload – Presentation and discussion of methods, results and lessons learned)
Studien- Prüfungsleistungen / form of examination:	Projektarbeit mit mündlicher, schriftlicher und Poster-Präsentation
Medienformen / media used:	Powerpoint-Präsentationen, Moderierte und eigenständige Nutzung von kraftwerkstechnischer Simulationssoftware, individuelles Coaching und Feedbackgespräche sowie wechselseitige Präsentation und Diskussion der Gruppenergebnisse
Literatur / literature:	Zahoransky: Energietechnik. Springer Vieweg, Wiesbaden Epple, B.; Leithner, R.; Linzer, W.; Walter, H.: Simulation von Kraftwerken und Feuerungen. Springer-Verlag, Berlin

Modul 12: Energieeffizienz versorgungstechnischer Systeme

Studiengang / course:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Energieeffizienz versorgungstechnischer Systeme
ggf. Kürzel / abbreveation	EEVS
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Autumn term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr.-Ing. Dirk Volta
Dozent(in) / person teaching the seminar:	Prof. Dr.-Ing. Dirk Volta
Sprache / language:	Deutsch
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement für Industrieländer Wahlpflichtveranstaltung
Lehrform / SWS / form of seminar / teaching hours per week:	Vorlesung 4 SWS; maximal 25 Studierende
Arbeitsaufwand / student workload:	Präsenzstudium: 60h Eigenstudium: 90h
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	keine
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	Die Studienenden sind in der Lage, wesentliche Zusammenhänge der Anlagentechnik und dessen Betriebsführung zu erkennen und daraus Optimierungspotentiale abzuleiten. Anlagen, weisen im realen Anlagenbetrieb eine andere (meist schlechtere) Effizienz auf, als im stationären, ausgelegten Leistungsbereich. Hinzu kommt der individuelle Bedarfsmix der Betriebe an Technischen Medien wie bspw. Kälte und Druckluft. Die Studenten lernen daher auch das dynamische Verhalten komplexer Verbundstrukturen zu erfassen, und daraus Verbesserungsmaßnahmen abzuleiten. Die Erkenntnisse können in der Praxis sowohl in der Planung, als auch in der Optimierung bestehender Anlagensysteme angewendet werden. Anlagen beziehen sich im Kontext der Vorlesung auf: • die Kälte-, Druckluft-, Wasser- und Wärmeversorgung,

	• sowie jeweils deren Verbrauchern und Kopplungssystemen (z.B. Wärmerückgewinnung (WRG))
Inhalt / subjects covered:	1. Einleitung 2. Grundlagen versorgungstechnischer Systeme 3. Bewertung von Energie- und Stoffeffizienz 4. Versorgungstechnische Systeme o Kälteversorgung und -nutzung o Wärmeversorgung und -nutzung o Druckluftversorgung o Wasserversorgung und -nutzung 5. Kopplungssysteme und –Methoden 6. Systematiken zur Steigerung der Energie- und Stoffeffizienz
Studien- Prüfungsleistungen / form of examination:	Klausur (120 min.) Ggf. Alternativ Erarbeitung einer Projektarbeit mit anschließender Präsentation
Medienformen / media used:	Skript, Anhang zur Vorlesung, Tafel/Board, Präsentation (Power-Point), Kurzfilme.
Literatur / literature:	Recknagel: Taschenbuch für Heizung + Klimatechnik Arbeitskreis der Professoren für Regelungstechnik in der Versorgungstechnik (Hrsg.): Regelungs- und Steuerungstechnik in der Versorgungstechnik. VDE Verlag, 7. Auflage, 12. September 2014. Blesl, M./Kessler, A.: Energieeffizienz in der Industrie. Springer-Vieweg, 2013. Hesselbach, J.: Energie- und Klimaeffiziente Produktion. Grundlagen, Leitlinien und Praxisbeispiele, Springer Vieweg, 2012. Meyer, J.: Rationelle Energienutzung in der Ernährungsindustrie. Vieweg, Dezember 2000.

Modul 13: Grid Integration

Studiengang / course:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Grid Integration
ggf. Kürzel / abbreveation	GI
ggf. Untertitel / subtitle	Mutual effects between wind turbines and power systems
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Autumn term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr. Clemens Jauch
Dozent(in) / person teaching the seminar:	Prof. Dr. Clemens Jauch
Sprache / language:	Englisch
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management for 'Industrial Countries' Core Elective Course Master Course Wind Engineering (HS Flensburg) Mandatory-optional course
Lehrform / SWS / form of seminar / teaching hours per week:	Seminar / 4 SWS
Arbeitsaufwand / student workload:	Attendance: 60h Private study: 90h
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	none
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	• Understanding of fundamental principles of power systems • Understanding of behaviour of grid connected wind turbines • Understanding the effects grid connected wind turbines have on power systems • Understanding the effects transient and dynamic events in power systems have on wind turbines

Inhalt / subjects covered:	• Power system basics
	  ○ Basic characteristics and quantities
	  ○ Flicker
	  ○ Power system stability
	• Power system simulation
	• Wind farms in power systems
	• Interactions between wind turbines and power systems
	  ○ Long term effects

	○ Feed-in management ○ Inertial response ○ Flicker ○ Low voltage ride through and other transient events • harmonics
Studien- Prüfungsleistungen / form of examination:	Written examination (120 min.)
Medienformen / media used:	Beamer based presentation, blackboard
Literatur / literature:	• B.M. Weedy, B.J. Cory; Electric Power Systems; John Wiley • S. Heier; Grid Integration of Wind Energy Conversion Systems; John Wiley & Sons

Modul 14: Offshore Wind Energy – Operation and Maintenance

Studiengang / course:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Offshore Wind Energy – Operation and Maintenance
ggf. Kürzel / abbreveation	OWE; O&M
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Autumn term
Modulverantwortliche(r) / person in charge of module:	Dr.-Ing. Axel Birk, Hanseatic Renewable Consulting GmbH
Dozent(in) / person teaching the seminar:	Dr.-Ing. Axel Birk, Hanseatic Renewable Consulting GmbH
Sprache / language:	Englisch
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management for 'Industrial Countries' Core Elective Course Master Course Wind Engineering Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	Seminar / 4 SWS
Arbeitsaufwand / student workload:	Attendance: 60h Private Study: 90h
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	none
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	• The students have a profound knowledge of the general set up and the functionalities of offshore wind power plants (OWPP) • They understand the market, the potential and the economics of offshore wind energy. They are able to select technical solutions based on a balanced evaluation of yield and costs. • The students are able to describe the operational and environmental conditions offshore and their impact on the OWPP. • They know the different types of offshore foundations and are able to select the best solution for given environmental conditions. • The students are able to describe the logistical processes for construction, transport, installation and servicing of OWPPs.

	• The module will create general understanding to manage processes to operate and maintain wind turbines. • The competence to use planning methods for intervention (scheduled and unscheduled) will be teached. • The student will learn to create documentation and use life cycle management techniques. • In the course the ability to identify and influence main cost elements of O&M phase will be explained.
Inhalt / subjects covered:	• Differences between onshore and offshore applications • Offshore markets and potential • Economics of offshore wind parks • Operational and environmental conditions offshore • Types of fixed foundations • Construction and installation of offshore WECs • Business process O&M (elements, interfaces) • Scheduled interventions (resources, timing and costs) • Unscheduled interventions (resources, timing and costs) • Health and safety • Documentation needs for Life Cycle Management • Spare part management for tear and wear parts or regular spares • Work instructions for O&M • RDS-PP as tool to describe wind power plants
Studien- Prüfungsleistungen / form of examination:	Oral examination
Medienformen / media used:	Beamer based presentation
Literatur / literature:	• Heier, S.: Grid Integration of WIND ENERGY CONVERSION SYSTEMS. 2nd Edition, John Wiley & Sons Ltd. Chichester, New York, Weinheim, Brisbanem, Singapore, Toronto, 2006. Translated by Rachel Waddington, Swadlincote, IK • Lesny, Kerstin: Foundations of Offshore Wind Turbines, VGE, 2010 • Det Norske Veritas (DNV): Regulations of the Design of Offshore Wind Turbine Structures, 2005 • Prasixhandbuch Schnittstellenmanagement Offshore Wind EEHH, Maritimes Cluster ISBN: 978-00-05402024-0

Modul 15: Energieautomation

Studiengang:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung:	Energieautomation
ggf. Kürzel	EAT
ggf. Untertitel	-
ggf. Lehrveranstaltungen:	-
Semester:	Spring term
Modulverantwortliche(r):	Fachhochschule Flensburg/Fachbereich Technik Prof. Dr.-Ing. J. Wendiggensen
Dozent(in):	Prof. Dr.-Ing. J. Wendiggensen
Sprache:	deutsch
Zuordnung zum Curriculum	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management for ‚Industrial Countries' Ingenieurinformatik - Wahlpflichtveranstaltung
Lehrform / SWS:	Vorlesung 2 SWS / Simulationsübungen 2 SWS
Arbeitsaufwand:	Präsenzstudium: 60 h Eigenstudium: 90 h
Kreditpunkte:	5 ECTS
Voraussetzungen:	keine
Lernziele / Kompetenzen:	Die Studierenden kennen die Strukturkomponenten moderner Leitsysteme und können diese den verschiedenen leittechnischen Aufgaben zuordnen. Die Studierenden sind in der Lage R/I-Fließbilder zu lesen und verfahrenstechnischen Beschreibungen zusammen mit Aufgabenstellungen in CFC und SFC Plänen zu interpretieren. Sie erhalten einen Überblick über den Aufbau, das Verhalten von Regelungen für energietechnische Komponenten, Leitungsnetze und Kraftwerke und lernen die Konzeption fortgeschrittener Regelkonzepte in energietechnischen Anlagen kennen.
Inhalt:	Überblick über die Ziele und die Historie der Automatisierungstechnik, Begriffsklärung, Darstellung von Aufgabenstellungen in der Automatisierungstechnik, R/I-Fließbilder, Kraftwerks-Kennzeichnungssystem KKS, Strukturkomponenten und struktureller Aufbau von Prozessleitsystemen, Prozessnahe Komponenten, Prozessferne Komponenten, Bussysteme und Kommunikation in der Automatisierungs- und Prozessleittechnik. Primär-, Sekundär- und Tertiärregelung, Modellierung des Netzverhaltens durch ein einfaches Netzdynamikmodell. Modellierung des Kraftwerks- bzw. Regelzonenverhaltens durch die Dynamikvorgaben der entso-e und einfache Kraftwerksmodelle. Regelkonzepte für Kraftwerkskomponenten, Blockführung und Blockregelung. Leistungs- und Pitchregelungen bei WKA.

	Wechselnde (aktuelle) Themen der Automation im Bereich energietechnischer Systeme. Exkursion.
Studien- Prüfungsleistungen:	Ausarbeitung (ca. 15 Seiten) und Vortrag (ca. 15 min.) oder Klausur (ca. 120 min.)
Medienformen:	Folien (Powerpoint, PDF), Tafel, Übungsblätter. Stud.IP: Dokumente, Beispieldateien für Simulationen, Simulationssoftware Matlab/SIMULINK
Literatur:	M. Polke: Prozessleittechnik J. Bergmann: Automatisierungs- und Prozessleittechnik Klefenz, G.: Die Regelung von Dampfkraftwerken Smith, C. A.: Automated Continuous Process Control Verschiedene Fachpublikationen des VGB, VDE und IEEE Unterlagen der entso-e, Grid Codes und Policies 2007

Modul 16: Power Grid Modelling

Studiengang/course:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Modellierung elektrischer Netze / Power Grid Modelling
ggf. Kürzel / abbreveation	PGM
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Autumn term
Modulverantwortliche(r) / person in charge of module:	Ulf Philipp Müller (M. Eng.)
Dozent(in) / person teaching the seminar:	Ulf Philipp Müller (M. Eng.)
Sprache / language:	English (bei ausschließlich Deutsch-sprachiger Gruppe auch Deutsch)
Zuordnung zum Curriculum / attribution to courses:	M.Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management for ‚Industrial Countries' Ingenieurinformatik - Wahlpflichtveranstaltung
Lehrform / SWS / form of seminar / teaching hours per week:	Seminar und Labor / 4 SWS / max. 16 students
Arbeitsaufwand / student workload:	60 hours of teaching and 90 hours of student work
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen / preconditions:	keine
Lernziele / Kompetenzen / aims of the module / competencies:	Understanding of the technical and economical layout of isolated and interconnected grids. The students will be able to model, calculate, plan, and optimize such grids with the help of several software applications (such as Siemens SINCAL, PyPSA and HOMER Energy". The software SINCAL is widely used by grid operators. Therefore, the course will enable the students to manage electrical grids in a grid operating perspective. Furthermore, the students will be able to tackle scientific problems by building up models with adequate assumptions and data use.
Inhalt / subjects covered:	The following subjects are relevant for isolated (island) as well as for interconnected grids: - technical and economic system design - technical restrictions (given by official guidelines) - interconnection of different types of demand and supply (fluctuating and flexible power sources) - residual load concept - problem identification and solving for asynchronous demand and supply situations - load flow calculations - load profile calculations - short-circuit calculations

	- economic feasibility - economic and technical optimization - data handling and usage of databases
Studien- Prüfungsleistungen / form of examination:	Presentation (approx. 15 min.) and report (approx. 15 pages)
Medienformen / media used:	Beamer, work at the computer with engineering software, laboratories
Literatur / basic literature for the module:	50 Hertz Transmission GmbH, Amprion GmbH, TenneT TSO GmbH, TransnetBW GmbH (2013). *Netzentwicklungsplan Strom 2013*. Available at: http://www.netzentwicklungsplan.de/NEP_2013_2_Entwurf_Teil_1_Kap_1_bis_9.pdf , Accessed on 03.09.2013 Agricola, A.-C., Rehtanz, C., Brunekreeft, G. (2012). *Ausbau- und Innovationsbedarf der Stromverteilnetze in Deutschland bis 2030 (kurz: dena-Verteilnetzstudie)*. Berlin. Available at: http://www.dena.de/fileadmin/user_upload/Projekte/Energiesysteme/Dokumente/denaVNS_Abschlussbericht.pdf , Accessed on 03.09.2013 Homer Energy (2011). *Getting Started Guide for HOMER Legacy (Version 2.68)*. Available at: http://homerenergy.com/pdf/homergettingstarted268.pdf , Accessed on 03.09.2013 Konstantin, P. (2009). *Praxisbuch Energiewirtschaft: Energieumwandlung, -transport und –beschaffung im liberalisierten Markt*. Berlin: Springer-Verlag, 2. Auflage. Lambert, T. (2006). *Publications Relating to HOMER*. Available at: http://homerenergy.com/pdf/HOMERPublications.pdf , Accessed on 03.09.2013 Schwab, A. J. (2012). *Elektroenergiesysteme. Erzeugung; Transport, Übertragung und Verteilung elektrischer Energie.* Berlin: Springer-Verlag, 3. Auflage Siemens AG (2012). PSS Sincal 9.0 – Manuals: • Database Description • Input Data • Load-Flow • Optimizations • Short-Circuit BDEW Bundesverband der Energie- und Wasserwirtschaft e. V. (2008). *Technische Anschlussbedingungen für den Anschluss an das Mittelspannungsnetz: TAB Mittelspannung 2008*. Available at:

	http://www.vde.com/de/fnn/dokumente/documents/tab_mittelspannung_bdew2008-05-29.pdf , Accessed on 03.09.2013

Modul 17: Introduction to Energy System Modelling and Optimization

Studiengang/course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Introduction to Energy System Modelling and Optimization
ggf. Kürzel / abbreveation	IESMO
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Autumn term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr. Olav Hohmeyer
Dozent(in) / person teaching the seminar:	Clemens Wingenbach Simon Hilpert
Sprache / language:	Englisch / Deutsch
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management for ‚Industrial Countries' Ingenieurinformatik - Wahlpflichtveranstaltung
Lehrform / SWS / form of seminar / teaching hours per week:	Seminar and weekly exercise / 4 SWS / max. 20 students
Arbeitsaufwand / student workload:	60 hours of teaching and 90 hours of student work
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen / preconditions:	none
Lernziele / Kompetenzen / aims of the module / competencies:	Students will learn the fundamentals and basic skills for the modelling and optimization of energy systems. They will gain a basic knowledge in working with complex data, different modelling approaches and a high-level programming language (python). They will learn how to prepare, process, and verify large amounts of data, develop and implement algorithms, and visualize and analyse the results. Competencies covered: • Engineering informatics • Problem solving • Analytical thinking • Economic competence • Technical competence • Ecological competence • Methodological competence • Self organisation and teamwork • Project organising skills • Academic writing
Inhalt / subjects covered:	The following topics will be covered in the module: - Introduction to working with complex data

	- Introduction to working with a high-level programming language (python) - Validation of data - Processing Data - Introduction to optimization and solvers - Applying skills on an example from the field of energy - Analysis of the results - Visualisation of the results - Working on an own example - Potentials of Open Source Software and Open Data
Studien-Prüfungsleistungen / form of examination:	Multiple assignments Grading based on final report (approx. 15 pages): Solving an own problem from the field of energy modelling and optimization including processing data, writing code and interpretation of the result with the help of visual representation: - student work during the semester parallel to the course - each student has her/his own problem but help is given during the exercises - report with problem description, methodology, analysis and interpretation including graphics Evaluation criteria: clearly presented / source code is comprehensible and well commented / format of the three pages and list of references / one graphic representation that shows the basic conclusion
Medienformen / media used:	Lectures with beamer based presentations and interactive exercises
Literature / basic literature for the module:	Reddy (2011) Applied Data Analysis and Modeling for Energy Engineers and Scientists. Springer. Kallrath (2012) Gemischt-Ganzzahlige Optimierung: Modellierung in der Praxis. Springer. Kallrath et al. (2009) Optimization in the Energy Industry. Springer.

Modul 18: Sustainable Energy Systems A

Studiengang/course:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Sustainable Energy Systems A
ggf. Kürzel / abbreveation	SES A
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	Sustainable Energy Systems
Semester / semester:	Summer term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr. Olav Hohmeyer
Dozent(in) / person teaching the seminar:	Prof. Dr. Olav Hohmeyer
Sprache / language:	Englisch
Zuordnung zum Curriculum / attribution to courses:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management for ‚Industrial Countries' Compulsory Course
Lehrform / SWS / form of seminar / teaching hours per week:	Seminar / 6 SWS
Arbeitsaufwand / student workload:	90 hours of teaching and 210 hours of student work
Kreditpunkte / credit points:	10 ECTS
Voraussetzungen / preconditions:	none
Lernziele / Kompetenzen / aims of the module / competencies:	Students will learn to analyse present energy systems concerning their sustainability. Students will learn to design consistent scenarios of sustainable energy systems avoiding major interference with the global climate system and avoiding large and long term risks and irreversible damages. Students will learn to design their own hourly power system simulation model and apply it to a small island country based on real energy demand data (hourly demand curve) and on hourly wind and solar data. They will learn about the new key concept of residual load and the special role storage systems and their dispatch will play in future 100% renewable energy systems. Based on real data and their energy model students will analyse possible 100% renewable energy supply scenarios for the small island state analysed. The work will be carried out in groups of 5 to 10 students. The students will learn to organize their work as a group research project and to regularly report on their progress in English. At the end of the course they will be able to analyse energy systems towards their sustainability and to design a supply strategy based on up to 100% renewable energy sources. Competencies covered:

	• problem solving • analytical thinking • life long learning • interdisciplinary knowledge • economic competence • technical competence • ecologic competence • methodological competence • social and ethical responsibility • self organisation and teamwork • project organising skills • conflict solving skills • interdisciplinary communication
Inhalt / subjects covered:	The following topics will be covered in the module: • Climate change and the sustainability of energy systems • Major problems of present energy systems towards sustainable development • Analysis of driving factors of the development of energy systems • Detailed analysis of the energy systems of small island developing states (SIDS) and their non sustainable aspects • Analysis of the probable future development of the energy system of a selected small island developing state under a business as usual scenario • Assessment of the different renewable energy potentials of small island states • The role of meeting residual load in energy systems with high shares of wind and solar energy • The role of storage and its dispatch in systems with high shares of wind and solar energy • The role and necessity of back-up capacity in systems with high shares of wind and solar energy • Hourly modelling of small island energy systems with high shares of wind and solar energy • Design of a functioning hourly energy system simulation model • Retrieval of hourly demand and weather data necessary to run the model from international sources • Building a consistent sustainable energy scenario for the selected small island developing country • Analysis of the costs and economic implications of a transition to a 100% renewable energy system for the country in question
Studien- Prüfungsleistungen / form of examination:	Continuous presentation of the results of the different teams in the seminar and a final written report (approx. 15 pages) by each team (includes modelling work)
Medienformen / media used:	Group work and lectures with beamer based presentations

Literatur / basic literature for the module:	Costanza, Robert (ed.) (1991): *Ecological Economics: The Science and Management of Sustainability*. New York, Columbia University Press Costanza, Robert, John Cumberland, Herman Daly, Robert Goodland, and Richard Norgaard (2007): *Introduction to Ecological Economics,* http://www.eoearth.org/view/article/150045. IPCC (Intergovernmental Panel on Climate Change) (2012): *Renewable Energy Sources and Climate Change Mitigation.* Special Report of the Intergovernmental Panel on Climate Change. Cambridge U.K. Hohmeyer, Olav and Sönke Bohm (2014): Trends toward 100% renewable electricity supply in Germany and Europe – a paradigm shift in energy policies. In: *WIREs Energy Environ* 2015, 4:74-97. Doi: 10.1002/wene.128 Hohmeyer, Olav (2015): *A 100% renewable Barbados and lower energy bills – A plan to change Barbados' power supply to 100% renewables and its possible benefits.* ZNES Discussion Papers 5, Flensburg OECD (2015): World Energy Outlook 2015. Paris SRU (German Advisory Council on the Environment) (2011): *Pathways towards a 100% renewable electricity system.* Special Report. Berlin WEC (World Energy Council) (2015): *2015 Energy Trilemma Index. Benchmarking the Sustainability of National Energy Systems*. London World Commission on Environment and Development (1987): *Our Common Future*. Oxford Plus specialised literature and statistics on the countries analysed.

Modul 19: Sustainable Energy Systems B

Studiengang/course:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Sustainable Energy Systems B
ggf. Kürzel / abbreveation	SES B
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	Sustainable Energy Systems
Semester / semester:	Summer term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr. Olav Hohmeyer
Dozent(in) / person teaching the seminar:	Prof. Dr. Olav Hohmeyer
Sprache / language:	Englisch
Zuordnung zum Curriculum / attribution to courses:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management for ‚Developing Countries Compulsory Course
Lehrform / SWS / form of seminar / teaching hours per week:	Seminar / 3 SWS
Arbeitsaufwand / student workload:	45 hours of teaching and 105 hours of student work
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen / preconditions:	none
Lernziele / Kompetenzen / aims of the module / competencies:	Students will learn to analyse present energy systems concerning their sustainability. Students will learn to design consistent scenarios of sustainable energy systems avoiding major interference with the global climate system and avoiding large and long term risks and irreversible damages. Students will learn to design their own hourly power system simulation model and apply it to a small island country based on real energy demand data (hourly demand curve) and on hourly wind and solar data. They will learn about the new key concept of residual load and the special role storage systems and their dispatch will play in future 100% renewable energy systems. Based on real data and their energy model students will analyse possible 100% renewable energy supply scenarios for the small island state analysed. The work will be carried out in groups of 5 to 10 students. The students will learn to organize their work as a group research project and to regularly report on their progress in English. At the end of the course they will be able to analyse energy systems towards their sustainability and to design a supply strategy based on up to 100% renewable energy sources. Competencies covered:

	• problem solving • analytical thinking • life long learning • interdisciplinary knowledge • economic competence • technical competence • ecologic competence • methodological competence • social and ethical responsibility • self organisation and teamwork • project organising skills • conflict solving skills • interdisciplinary communication
Inhalt / subjects covered:	The following topics will be covered in the module: • Climate change and the sustainability of energy systems • Major problems of present energy systems towards sustainable development • Analysis of driving factors of the development of energy systems • Detailed analysis of the energy systems of small island developing states (SIDS) and their non sustainable aspects • Analysis of the probable future development of the energy system of a selected small island developing state under a business as usual scenario • Assessment of the different renewable energy potentials of small island states • The role of meeting residual load in energy systems with high shares of wind and solar energy • The role of storage and its dispatch in systems with high shares of wind and solar energy • The role and necessity of back-up capacity in systems with high shares of wind and solar energy • Hourly modelling of small island energy systems with high shares of wind and solar energy • Design of a functioning hourly energy system simulation model • Retrieval of hourly demand and weather data necessary to run the model from international sources • Building a consistent sustainable energy scenario for the selected small island developing country • Analysis of the costs and economic implications of a transition to a 100% renewable energy system for the country in question
Studien- Prüfungsleistungen / form of examination:	Continuous presentation of the results of the different teams in the seminar and a final written report (approx. 15 pages) by each team
Medienformen / media used:	Group work and lectures with beamer based presentations

Literatur / basic literature for the module:	Costanza, Robert (ed.) (1991): *Ecological Economics: The Science and Management of Sustainability*. New York, Columbia University Press Costanza, Robert, John Cumberland, Herman Daly, Robert Goodland, and Richard Norgaard (2007): *Introduction to Ecological Economics,* http://www.eoearth.org/view/article/150045. IPCC (Intergovernmental Panel on Climate Change) (2012): *Renewable Energy Sources and Climate Change Mitigation.* Special Report of the Intergovernmental Panel on Climate Change. Cambridge U.K. Hohmeyer, Olav and Sönke Bohm (2014): Trends toward 100% renewable electricity supply in Germany and Europe – a paradigm shift in energy policies. In: *WIREs Energy Environ* 2015, 4:74-97. Doi: 10.1002/wene.128 Hohmeyer, Olav (2015): *A 100% renewable Barbados and lower energy bills – A plan to change Barbados' power supply to 100% renewables and its possible benefits.* ZNES Discussion Papers 5, Flensburg OECD (2015): World Energy Outlook 2015. Paris SRU (German Advisory Council on the Environment) (2011): *Pathways towards a 100% renewable electricity system.* Special Report. Berlin WEC (World Energy Council) (2015): *2015 Energy Trilemma Index. Benchmarking the Sustainability of National Energy Systems*. London World Commission on Environment and Development (1987): *Our Common Future*. Oxford Plus specialised literature and statistics on the countries analysed.

Modul 20: Environmental Economics

Studiengang/course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Environmental Economics
ggf. Kürzel / abbreveation	-
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Autumn term
Modulverantwortliche(r) / person in charge of module:	M. Eng. Marina Blohm
Dozent(in) / person teaching the seminar:	M. Eng. Marina Blohm
Sprache / language:	English
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management for ‚Industrial Countries' and ‚Developing Countries' Compulsory Course
Lehrform / SWS / form of seminar / teaching hours per week:	Lecture / 4 SWS
Arbeitsaufwand / student workload:	Attendance: 60 h Private study: 90 h
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen / preconditions:	none
Lernziele / Kompetenzen / aims of the module / competencies:	The course covers a broad range of interactions between the environment and economics and issues of sustainable development. Students will learn different methodologies to analyse ecological and economic influences on the environment, different approaches on valuing the environment and the resulting problems. Students will become acquainted with different economic instruments to deal with external effects on the environment and its resources and they will be able to examine the effectiveness and efficiency of these instruments. In case studies they will apply their knowledge and analyse and evaluate the implementation of environmental economic instruments. Competencies covered: • analytical thinking • target-oriented thinking • specific knowledge in environmental economics analysis • interdisciplinary knowledge • economic competence • ecologic competence • social and ethical responsibility

	• self organisation and teamwork • project organising skills • conflict solving skills • interdisciplinary communication
Inhalt / subjects covered:	• Sustainable Development • Economic analysis of external market effects • Implementation and evaluation of different environmental policy instruments • Valuing the environment • Introduction in natural resource economics • Greening the economies • International dimension of environmental problems • Analysis and discussion about the presented concepts and techniques
Studien- Prüfungsleistungen / form of examination:	Oral presentation (approx. 15 min.) plus group discussion and written report (approx. 15 pages)
Medienformen / media used:	Power point, blackboard, printed material, group work
Literatur / basic literature for the module:	• Barbier, Edwar B., Markandya, Anil (2013) *A new blueprint for a green economy*, New York. • Harris, Jonathan M. (2015) *Environmental and Natural Resource Economics: A contemporary Approach*, 3rd Edition, Armonk. • Perman, Roger, Ma, Yue, McGilvray, James and Common, Michael (2003) *Natural Resource and Environmental Economics,* 3rd. Edition, Essex, UK. • Smith, Stephan (2011) *Environmental Economics A very short introduction,* New York. • Tietenberg, Tom, Lewis, Lynne (2012) *Environmental and Resource Economics*, 9th Edition, Boston.

Modul 21: Umweltmanagement

Studiengang/course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Umweltmanagement
ggf. Kürzel / abbreveation	UM
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Autumn term
Modulverantwortliche(r) / person in charge of module:	Prof. Hohmeyer
Dozent(in) / person teaching the seminar:	Dirk Storm
Sprache / language:	Deutsch
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management für Industrieländer Wahlpflichtmodul
Lehrform / SWS / form of seminar / teaching hours per week:	Vorlesung / 4 SWS
Arbeitsaufwand / student workload:	Vorlesung: 60 Stunden Vor- und Nachbereitung, Klausurvorbereitung: 90 Stunden
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen / preconditions:	keine
Lernziele / Kompetenzen / aims of the module / competencies:	Die Studenten erhalten einen Einblick in die Logik und den Aufbau von Managementsystemen im allgemeinen und Umweltmanagement im speziellen. Begriffe wie Plan-Do-Check-Act (PDCA), kontinuierlicher Verbesserungsprozess (KVP), Umweltaspektelisten sowie Begriffe aus den relevanten Normen werden erläutert und zum Teil in Gruppenarbeiten selbst erarbeitet und den anderen Kursteilnehmern vorgestellt. Der Fokus liegt neben praktischen Beispielen auf der Schnittstelle Ökonomie und Ökologie sowie einem Gebot der Verhältnismäßigkeit. Was soll vermittelt werden? Praxisanwendungen, allgemeines Wissen und Spezialwissen im Bereich Umweltmanagement, Projektmanagement, Verknüpfung von Managementsystemen, Prozessdarstellung, Verständnis für Managementnormen, Top-Down-Ansatz, Grenzen vom UM, unternehmerisches Denken, Methodenkompetenz, Problemlösungsfähigkeit, Fähigkeit zu erfolgreichem und zielgerichtetem Handeln, Fähigkeit zur Projektorganisation, Strategische Handlungskompetenz und Unternehmerisches Denken
Inhalt / subjects covered:	Umweltmanagement - Grundlagen Strategisches Umweltmanagement

	Organisation des betrieblichen Umweltschutzes Umweltorientiertes Personalwesen Öko-Controlling Betriebliche Umweltkennzahlen EMAS – ISO 14001/Greenwash Integrierte Managementsysteme Übungen zu Prozessdarstellungen und Umweltaspekten
Studien- Prüfungsleistungen / form of examination:	Klausur (ca. 120 min.)
Medienformen / media used:	Power Point
Literatur / basic literature for the module:	Vorlesungsfolien und verteilte Unterlagen Baumast, Annett und Jens Pape (Hrsg.) (2003): Betriebliches Umweltmanagement. Theoretische Grundlagen, Praxisbeispiele. 2. aktualisierte Auflage. Ulmer Stuttgart. Schaltegger, Stefan, Roger Burritt und Holger Petersen (2003): An introduction to corporate environmental management: striving for sustainability. Greenleaf Sheffield. Welford, Richard (2004): Corporate environmental management. Part 1: Systems and Strategies. 2. edition. Earthscan London. Welford, Richard (1997): Corporate environmental management. Part 2: Culture and Organization. Earthscan London. Welford, Richard (2000): Corporate environmental management. Part 3: Towards sustainable development. Earthscan London.

Modul 22: Trading Energy

Studiengang/course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Trading Energy
ggf. Kürzel / abbreviation	TE
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	Trading Energy
Semester / semester:	Autumn term
Modulverantwortliche(r) / person in charge of module:	Jörn Higgen
Dozent(in) / person teaching the seminar:	Dipl.-Wi.-Ing. Jörn Higgen, Dipl.-Wi.-Ing. Marcel Ketterer, M.Eng Larissa Leienbach Dipl.-Wi.-Ing. Johannes Viehmann
Sprache / language:	Englisch
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management for 'Industrial Countries' and 'Developing Countries' Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	Seminar / 4 SWS / max. 20 Students
Arbeitsaufwand / student workload:	60 hours of teaching and 90 hours of student work
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen / preconditions:	none

Lernziele / Kompetenzen / aims of the module / competencies:	During the seminar students will obtain a thorough overview of the most important aspects of many the different energy markets globally and learn about the various methods used to analyse and instruments available to trade liberalized commodity markets. The lecturers will also provide insights from their professional backgrounds working at the major European utilities & energy trading houses and explain how markets are used for physical asset optimization and risk management activities. Students will also be conducting asset portfolio optimization exercises and perform their own fundamental and technical market analyses using simple spreadsheet tools as well as professional software solutions applied in the industry. Competencies covered: • analytical thinking • problem solving skills • lifelong learning • specific knowledge in energy markets • specific knowledge in financial instruments • specific knowledge in fundamental and technical analysis of energy markets • economic competence • international competence • methodological competence • self organisation and teamwork skills • project organising skills • entrepreneurial thinking • conflict solving skills
Inhalt / subjects covered:	The following topics will be covered in the module: ● Introduction to energy markets: ○ oil & coal ○ natural gas & LNG ○ carbon (EU ETS) ○ electricity market ● How to trade energy & why ○ Markets & market participants ○ Instruments & products ○ Reasons for trading energy ■ risk management & hedging ■ portfolio optimization ■ speculation ● Practical insights & exercises - trading energy ○ fundamental analysis ○ technical analysis ○ Market Channel Optimization ○ Optionality in energy markets & delta hedging

	○ Portfolio management & trading in not fully liberalized markets ● Case Studies ○ applying concepts taught in the seminar on various cases related to trading energy & asset optimization ○ Discussion of case frameworks and deliverables ○ Presentation of case findings and discussion of implications & open questions
Studien- Prüfungsleistungen / form of examination:	Oral presentation (approx. 15 min.) of the methodology used and results of the different case study teams
Medienformen / media used:	Case studies as group work and lectures with beamer based presentations, case studies and interactive business games, introduction to and use of commercial software solutions from the energy trading industry
Literatur / basic literature for the module:	Kleinman, George (1997): Mastering Commodity Futures and Options – The Secrets of Successful Trading. Financial Times Management, London Schwager, Jack D. (1995): Schwager on Futures – Technical Analysis. John Wiley and Sons, New York, N.Y. Schwager, Jack D. (1995): Schwager on Futures – Fundamental Analysis. John Wiley and Sons, New York, N.Y. Schwager, Jack D. (1996): Futures, Study Guide: Fundamental Analysis. John Wiley and Sons, New York, N.Y. Schwager, Jack D. (1997): Schwager on Futures – Study Guide to Accompany Technical Analysis. John Wiley and Sons, New York, N.Y. Mack, Iries Marie (2014): Energy Trading and Risk Management: A Practical Approach to Hedging, Trading and Portfolio Diversification (Wiley Finance) Burger, Markus et. al (2014): Managing Energy Risk: An Integrated View on Power and Other Energy Markets Hull, John (2011): Options, Futures and other derivatives Krishna, Vijay (2002): Auction Theory. Elsevier Science (USA).

Modul 23: External Costs of Energy and Climate Change

Studiengang/course:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	External Costs of Energy and Climate Change
ggf. Kürzel / abbreveation	ECE
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	• Analysis of external costs of energy – methodology and major studies • Impacts and external costs of climate change
Semester / semester:	Autumn term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr. Olav Hohmeyer
Dozent(in) / person teaching the seminar:	Prof. Dr. Olav Hohmeyer
Sprache / language:	Englisch
Zuordnung zum Curriculum / attribution to courses:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management for ‚Industrial Countries' and ‚Developing Countries' Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	Seminar / 3 SWS
Arbeitsaufwand / student workload:	45 hours of teaching and 105 hours of student work
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen / preconditions:	none
Lernziele / Kompetenzen / aims of the module / competencies:	Students will learn different methodologies to analyse external costs. Students will be able to analyse major international studies of external costs of energy (ExternE and USDOE/RFF/Oak Ridge National Lab) and understand the specific differences of the competing approaches. Students will understand the major impacts of climate change and the possibilities and difficulties of deriving the external costs of these impacts. Competencies covered: • analytical thinking • life long learning • specific knowledge in external cost analysis • interdisciplinary knowledge • economic competence • ecologic competence • methodological competence • social and ethical responsibility • self organisation and teamwork • project organising skills • conflict solving skills • interdisciplinary communication

Inhalt / subjects covered:	The following topics will be covered in the module:
	• The basic concept of external and social costs
	• Internalisation of external costs versus policies securing strong sustainability
	• Damage costs versus control cost approach
	• Marginal versus average costs
	• Impact pathway approach and marginal costing
	• Valuation approaches
	  o Market prices and cost measures of value
	  o Travel cost method
	  o Hedonic pricing
	  o Contingent valuation method
	  o Discrete choice methods
	• Major external international studies of external costs of energy
	• Impacts of man-made climate change
	  o The Fifth IPCC Assessment Report
	  o Mitigation, adaptation and impacts
	  o Impacts on hydrology and water resources
	  o Impacts on ecosystems
	  o Impacts on human settlements, energy and industry
	  o Impacts on insurance and finance
	  o Impacts on human health
	  o Impacts on the different regions of the world
	• Possibilities and problems of monetization of external costs of climate change
	• Internalization of external costs in the context of sustainable development

Studien- Prüfungsleistungen / form of examination:	Oral presentation (approx. 15 min. per student) of the results of the different teams in the seminar and a final written report (approx. 15 pages per student) by each team
Medienformen / media used:	Group work and lectures with beamer based presentations
Literatur / basic literature for the module:	Bickel, Peter and Rainer Friedrich (2005): ExternE – Externalities of Energy. Methodology 2005 Update. EUR 21951. Luxemburg Cline, William R. (1992): The Economics of Global Warming. Institute for International Economics, Washington D.C. European Commission (1995): ExternE – Externalities of Energy. Volume 1 – 9. Office for Official Publications of the European Commission, Luxemburg Garrod, Guy and Kenneth G. Willis (1999): Economic Valuation of the Environment – Methods and Case Studies. Edward Elgar, Cheltenham

Hohmeyer, Olav (1988): Social Costs of Energy. Springer, Berlin

Hohmeyer, Olav (2015): The Benefit of Climate Change Mitigation. Why the 5th Progress Report of the IPCC falls short. Flensburg

Koomey, Jonathan and Florentin Krause (1997): Introduction to Environmental Externality Costing. In: CRC Handbook on Energy Efficiency. Boca Raton, FL, USA

IPCC (2014):
Climate Change 2014: Impacts, Adaptation, and Vulnarability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge UK

Markandya, Anil et. Al (eds.) (2010):
The Social Costs of Energy. Scenarios and Policy Implications. Chaltenham, UK

National Research Council (USA) (2010):
Hidden Costs of Energy – Unpriced Consequences of Energy Production and Use. Washington, D.C.

Nestle, Ingrid (2010):
The Costs of Climate Change in the Agricultural Sector – A Comparison of Two Calculation Approaches. Dissertation. Flensburg

Office of Technology Assessment (OTA) (1994):
Studies of the Environmental Cost of Electricity. OTA-BP-ETI-134, Washington, D.C.

Ottinger, Richard et al. (1990) : Environmental Costs of Electricity. Oceana Publications, Dobbs Ferry N.Y.

Oak Ridge National Laboratory and Resources for the Future (1994): External Costs and Benefits of Fuel Cycles – A Study by the U.S. Department of Energy and the Commission of the European Communities. Utility Data Institute, no place

Umweltbundesamt (2012):
Methodenkonvention 2.0 zur Schätzung von Umweltkosten - Ökonomische Bewertung von Umweltschäden. Berlin

Modul 24: Energy and Environmental Policy

Studiengang / course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Energy and environmental policy
ggf. Kürzel / abbreviation	-
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Autumn term
Modulverantwortliche(r) / person in charge of module:	Marion Wingenbach
Dozent(in) / person teaching the seminar:	Marion Wingenbach
Sprache / language:	English
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management of 'Industrial Countries' and 'Developing Countries' Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	4 SWS Seminar, Discussion, Role Play
Arbeitsaufwand / student workload:	Attendance: 60 h Private study: 90 h
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	none
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	• Basic knowledge of political analysis • Understanding limits and chances of energy and environmental policy, esp. in the context of globalization. • Understanding the dimensions of ethics and power within political processes • Understanding the implementation of policy tools in practice as compared to theory • Knowledge of important stakeholders in energy and environmental policy • Basic knowledge of lobbying and legislation processes in the EU • Developing and representing their own position in the political context (role play), analysing the positions of fellow stakeholders, analysing strategic planning to reach political goals Competencies covered:

	• specific knowledge in political analysis • interdisciplinary knowledge • social and ethical responsibility • self organisation and teamwork • project organising skills • conflict solving skills

Inhalt / subjects covered:	• Polity, policy, politics
	• Concepts, questions and application of political analysis
	• Introduction to policy instruments
	  o Criteria for the selection of instruments
	  o Criteria for the evaluation of instruments
	  o Types of instruments and examples
	• Historical overview on German and EU environmental and energy policies
	• Legislation in the EU
	• Discussion and analysis of current issues

Studien- Prüfungsleistungen / form of examination:	Group presentation (approx. 15 min. per student) plus discussion and written semester paper (approx. 15 pages per student)
Medienformen / media used:	Flipcharts, Brainstorming cards, Power point, current news, LEGO planning game (introduction)
Literatur / literature:	Wallace et al. 2005: Policy-Making in the European Union Jänicke 2003: Lern- und Arbeitsbuch Umweltpolitik: Politik, Recht und Management des Umweltschutzes in Staat und Unternehmen Current issues of journals, e.g. Energy Policy David Jacobs 2012: Renewable Energy Policy Convergence in the EU. The Evolution of Feed-in Tariffs in Germany, Spain and France. Ashgate Publishing Company

Modul 25: Energierecht

Studiengang / course:	M. Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Energierecht / Energy law
ggf. Kürzel / abbreviation	-
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Autumn term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr. Olav Hohmeyer
Dozent(in) / person teaching the seminar:	Dipl.-Wi.-Ing. Sönke Dibbern
Sprache / language:	Deutsch / English
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management for 'Industrial Countries' Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	Seminar / 3 SWS
Arbeitsaufwand / student workload:	Präsenzstudium: 45 h, in 3 Wochenendblöcken Eigenstudium: 105 h
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	Keine
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	Erwerb von Grundlagen- und vertieften Kenntnissen im deutschen und europäischen Energierecht. Die Studierenden sollen befähigt werden, in ihren Berufen auftretende rechtliche Zusammenhänge zu erkennen, Problemlagen zu analysieren und dafür auch jeweils unterschiedliche Lösungsansätze methodisch erarbeiten zu können. Lösungsangebote Dritter, auch die des eigenen Rechtsberaters, sollen eingeschätzt und kompetent diskutiert werden können. Des Weiteren sollen Grundkenntnisse der zugrundeliegenden nationalen und internationalen politischen Prozesse vermittelt werden, so dass die Studierenden Entwicklungen im politischen Raum fächerübergreifend bewerten können.
Inhalt / subjects covered:	- Einführung in die Rechtswissenschaft (u.a. Quellen und Erscheinungsform des Rechts, juristische Methodenlehre); - Europarecht (u.a. Arten des Gemeinschaftsrechts, innerstaatliche Wirkungen des Gemeinschaftsrechts);

	- Zulässigkeit nach Bauplanungs-, Bau-, Immissionsschutz- und Naturschutzrecht; gesetzliche Privilegierung
	- Gegenstand und Geltungsbereich des Energierechts, systematische Einordnung
	- Energieversorgung als öffentliche Aufgabe
	  - Gemeindewirtschaftsrecht
	- Energiewirtschaftsgesetz
	  - Ziele
	  - Versorgungspflicht
	  - Unbundling
	  - Preisrecht, Anreiz-Regulierung
	  - Wegerecht / Konzessionsabgaben
	- Energielieferver trag, Netznutzung durch Dritte
	- Erneuerbare-Energien-Gesetz
	  - Ziele
	  - Hauptpflichten des Netzbetreibers
	  - Gesetzliche Vergütung als Beihilfe?
	  - Netzanschlussvoraussetzungen
	  - Alternative (sog. marktnahe) Vermarktungsinstrumente im EEG
	- Untergesetzliche technische Regelwerke EE-Anlagen

Studien- Prüfungsleistungen / form of examination:	Klausur (120 min.)
Medienformen / media used:	Folien
Literatur / literature:	- Gesetzestexte und andere Rechtsnormen (z.B. in der Reihe Beck-Texte im dtv). - Horn, Norbert (1996): Einführung in die Rechtswissenschaft und die Rechtsphilosophie. C.F.Müller Verlag Heidelberg. - Hans-Joachim Koch (Hrsg., 2010): Umweltrecht, 3. Auflg.; Vahlen, München - Franz Jürgen Säcker (Hrsg., 2014): Berliner Kommentar zum Energierecht, 3.Aufl.;, Verlag Recht und Wirtschaft, Frankfurt a.M. - Zeitschrift für neues Energierecht, Ponte Press, ISSN 1434-3339

Modul 26: Klimaschutz und Klimaschutzkonzepte

Studiengang/course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Klimaschutz und Klimaschutzkonzepte
ggf. Kürzel / abbreveation	KSK
ggf. Untertitel / subtitle	-

ggf. Lehrveranstaltungen / seminar:	• Grundlagen zu Klimaschutz und Klimaschutzkonzepten
	• Erstellung von Klimaschutzkonzepten
	  • Status-Quo-Analyse
	  • Klimaschutzmaßnahmen
	  • Erstellen von Szenarien
	  • Entwickeln von Handlungsplänen
	  • Partizipativer Ansatz
	• Klimaschutz(konzepte) in der Praxis
	• Umsetzung von Klimaschutzkonzepten/Klimaschutzmanagement
	• Fördermöglichkeiten

Semester / semester:	Herbstsemester
Modulverantwortliche(r) / person in charge of module:	M.Eng. Martin Jahn
Dozent(in) / person teaching the seminar:	M.Eng. Martin Jahn M.Eng. Jördes Wüstermann
Sprache / language:	Deutsch
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management für Industrieländer Wahlpflichtmodul
Lehrform / SWS / form of seminar / teaching hours per week:	Seminar / 4 SWS
Arbeitsaufwand / student workload:	60 h Lehre, 90 h Eigenarbeit
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen / preconditions:	keine
Lernziele / Kompetenzen / aims of the module / competencies:	Geförderte Kompetenzen: • Problemlösungsfähigkeit • Fähigkeit zu erfolgreichem und zielgerichtetem Handeln • Befähigung zu lebenslangem selbständigem Lernen • Fachübergreifendes Vertiefungswissen • Ökonomische Kompetenz • Technische Kompetenz • Ökologische Kompetenz • Methodische Kompetenz • Gesellschaftliches und ethisches Verantwortungsbewusstsein • Fähigkeit zur Selbstorganisation • Fähigkeit zur Projektorganisation

	• Fähigkeit zu fächerübergreifendem Denken • Strategische Handlungskompetenz • Fähigkeit zur interdisziplinären Kommunikation • Fähigkeit analytisch zu Denken • Teamfähigkeit

Inhalt / subjects covered:	Lerninhalte (stichpunktartig):
	- Grundlagen zu Klimaschutz und Klimaschutzkonzepten
	  - Theoretische Grundlagen Klimawandel
	  - Klimaschutz auf internationaler, europäischer, nationaler und lokaler Ebene
	  - Einführung in Klimaschutzkonzepte
	  - Arten von KSK
	  - Förderung von KSK
	  - KSK in der Praxis
	- Erstellung von Klimaschutzkonzepten
	  - Status-Quo-Analyse
	  - Theoretische Grundlagen (Backcasting, Transition-Management)
	  - Datenerhebung, -erfassung und -auswertung
	  - Klimaschutzmaßnahmen
	  - Maßnahmen der verschiedenen Sektoren
	  - Auswahl und partizipative Maßnahmenentwicklung
	  - Erstellen von Szenarien
	  - Forecasting
	  - Visionserstellung Energie und Klimaschutz
	  - Potenzialanalyse
	  - Entwickeln von Handlungsplänen
	  - Multiplikatortheorie
	  - Integration von Teilergebnissen
	  - Suffizienz
	  - Partizipativer Ansatz
	- Klimaschutz(konzepte) in der Praxis
	- Umsetzung von Klimaschutzkonzepten/Klimaschutzmanagement
	- Fördermöglichkeiten und Finanzierung von Klimaschutz

Studien- Prüfungsleistungen / form of examination:	Hausarbeit (ca. 15 Seiten)
Medienformen / media used:	Powerpoint-basierter Vortrag, Hand-outs
Literatur / basic literature for the module:	• Fischer, Kallen (1997), Klimaschutz in Kommunen - Leitfaden zur Erarbeitung und Umsetzung kommunaler Klimakonzepte, Hrsg.: Deutsches Institut für Urbanistik • Pehnt (Hrsg.) (2010), Energieeffizienz - Ein Lehr- und Handbuch, Springer Verlag

	• Recknagel, Schramek, Sprenger (2010), Taschenbuch für Heizung und Klimatechnik, Oldenbourg Industrieverlag • Quist (2007), Backcasting for a Sustainable Future, The impact after ten years, Eburon Academic Publishers • Rogers (2003), Diffusion of Innovations, Fifth Edition, Free Press • Hohmeyer, Kovač, Maas, Beer (2011), Integriertes Klimaschutzkonzept für Flensburg

Modul 27: Investment Analysis and Financing of Energy Projects

Studiengang / course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Investment Analysis and Financing of Energy Projects
ggf. Kürzel / abbreviation	-
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Spring term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr. Olav Hohmeyer
Dozent(in) / person teaching the seminar:	Dr. Lena Kitzing, Dr. David Mora
Sprache / language:	English
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management for 'Industrial Countries' and 'Develping Countries' Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	3 SWS (en-bloc sessions) lecture and exercises
Arbeitsaufwand / student workload:	Attendance: 45 h (3 en-bloc sessions on Friday/Saturday) Private study: 105 h
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	keine
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	• Knowledge and understanding of important economic feasibility criteria for project evaluation and financing of energy projects • Ability to develop and interpret business plans for energy projects • Ability to evaluate investment projects with focus on cash flow simulation • Knowledge of a variety of financing schemes for investment projects and their special features • Knowledge of decision making criteria in Project Financing
Inhalt / subjects covered:	- Investment analysis: Economic project valuation concepts, Discounted Cashflow calculations, key financial indicators, levelized cost of electricity, balance sheet and business case interpretation, modelling in Excel incl. exercises - Financing:

	- general financing sources, options and criteria, framework and investor conditions - principles of corporate finance in relation to capital-intensive projects - principles of project financing - assessment and optimisation of business cases for financing, incl. exercises in excel (for both corporate and project financing)
Studien- Prüfungsleistungen / form of examination:	Group Case (groups of 3-4 students) with report (15 pages + excel model) and group presentation (20min) plus questions (20 min.)
Medienformen / media used:	Cash flow model in Excel Teaching: white board, power point slides, and excel (own laptops required)
Literatur / literature:	A.o. extracts from Brealey & Myers „Principles of Corporate Finance" (4th Edition), Stefanno Gatti (2013): Project Finance in Theory and Practice, Elsevier Inc. Extracts from McKinsey & Company, „Valuation", Finnerty, John D. (2007): Project Financing. Asset-Based Financial Engineering. Second edition. John Wiley & Sons. Böttcher, Jörg (2009) Finanzierung von Erneuerbaren-Energien-Vorhaben. Oldenbourg Wissenschaftsverlag GmbH Gatti, Stefano (2008) Project Finance in Theory and Practice. Designing, Structuring, and Financing Private and Public Projects. Academic Press Advanced Finance Series. Elsevier. Böttcher, Jörg; Blattner, Peter (2006) Projektfinanzierung. Oldenbourg Wissenschaftsverlag GmbH

Modul 28: Windparkprojektierung

Studiengang / course:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Windparkprojektierung
ggf. Kürzel / abbreveation	-
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Frühjahrssemester
Modulverantwortliche(r) / person in charge of module:	Prof. Dr. Olav Hohmeyer
Dozent(in) / person teaching the seminar:	Dipl.-Wi.-Ing. Ulf Ehlers Dipl.-Wi.-Ing. Marcus Kosel, Dipl.-Met. Eva-Maria Nikolai
Sprache / language:	Deutsch
Zuordnung zum Curriculum / attribution to courses:	M.Eng. Energie- und Umweltmanagement für Industrieländer Wahlpflichtmodul
Lehrform / SWS / form of seminar / teaching hours per week:	3 SWS, 10 bis 30 Studenten Vorlesung, Übungen, Baustellenbesichtigung, Labor WindPro, Projektarbeit
Arbeitsaufwand / student workload:	Präsenzstudium: 45 h, evtl. Wochenendblöcke, Eigenstudium: 105 h
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	Keine
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	Die Studenten kennen wichtige Wirtschaftlichkeitskriterien und rechtliche Rahmenbedingungen sowie technische Grundlagen für die Projektierung von Windparks. Sie können Business Pläne in diesem Bereich erstellen und interpretieren. Die Studenten erlernen Grundkenntnisse der Software WindPRO und können grobe Ertragsabschätzungen, Schall- und Schattenberechnungen durchführen. Die Studenten erlernen den Projekt-Ablauf der Windparkprojektierung: von der grünen Wiese bis zur Inbetriebnahme aus der Sicht eines Projektierers.
Inhalt / subjects covered:	1. Grundlagen der Projektentwicklung eines Windparks 2. Grundlagen Wind & Site Assessment 3. Grundlagen Realisierung und Bau 4. Grundlagen Wirtschaftlichkeitsbetrachtung
Studien- Prüfungsleistungen / form of examination:	Präsentation ca. 30 Minuten mit Projektvorstellung, Schriftliche Ausarbeitung beinhaltet: Exceltabelle mit Wirtschaftlichkeitsbetrachtung, Ergebnisse aus WindPro Berechnungen Ergebnisse aus Aufgabenstellung Realisierung & Bau

Medienformen / media used:	Tafel Folien (Powerpoint, PDF, Videos)
Literatur / literature:	

Modul 29: Green Entrepreneurship

Studiengang / course:	M. Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Green Entrepreneurship
ggf. Kürzel / abbreviation	-
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Spring term
Modulverantwortliche(r) / person in charge of module:	Thomas Neumann
Dozent(in) / person teaching the seminar:	Thomas Neumann
Sprache / language:	German
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management for 'Industrial Countries' Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	3 SWS Lecture, workshops & meetings
Arbeitsaufwand / student workload:	45 hours of teaching and 105 hours of student work
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	none
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	Students should learn how to start a business and to judge foundations of enterprises of others Students learn how to identify new business ideas and to conceptualize, to plan, to finance and to manage them successfully Competencies covered: - problem solving competence - ability to act target-oriented - ability for live-long learning - basic knowledge - interdisciplinary knowledge - economic competence - ecological competence - methodical competence

	- Social and ethical sense of responsibility - self-organization - project organizing skills - ability for project organization - ability to deal constructively with criticism - ability to act strategically - ability to think entrepreneurial - collaborative skills - ability to think analytically - interdisciplinary communication - teamwork skills
Inhalt / subjects covered:	This unit introduces the students to the field of entrepreneurship and planning for new business initiatives in the global business environment. Topics include entrepreneurial attitudes, abilities and behaviors; innovation; opportunity recognition; first-mover advantages and disadvantages and internationalization. The focus of the course are green business foundations and how to harvest green opportunities. The objective of this course is to get familiar with required skills to start a business and evaluate business ideas of others. In this context, it is relevant to identify, conceptualize, plan, finance, launch, manage and harvest new ventures in its particular environment. These topics are therefore discussed in this course. Lectures, class discussions, readings, presentations and workshops are the learning tools in this course.
Studien-Prüfungsleistungen / form of examination:	Continuous examination: basis plan, status report, final project paper (approx. 15 pages per student) and oral team project presentation (approx. 15 min. per student)
Medienformen / media used:	Power point, flip charts, board, business model canvas
Literatur / literature:	*Hisrich, R. D. & Peters; M. P.*: Entrepreneurship, 8th or 9th Edition, McGraw Hill, 2009/2013. *Westhead, P., Wright, M. & McElwee, G.:* Entrepreneurship: Perspectives and Cases, Prentice Hall, 2011. *Zimmerer, T. W. & Scarborough, N. M.:* Essentials of Entrepreneurship and Small Business Management, 5th Edition, Pearson Education, 2007 or *Scarborough, N.M.:* Essentials of Entrepreneurship and Small Business Management, 7th Edition, Pearson Education, 2013.

	Hall, Carl: The Environmental Capitalist 2015 Current Articles Case Studies

Modul 30: Geographical Information in Sustainable Energy Systems

Studiengang / course:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Geographical Information in Sustainable Energy Systems
ggf. Kürzel / abbreveation	GISES
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Spring term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr. Bernd Möller
Dozent(in) / person teaching the seminar:	Prof. Dr. Bernd Möller
Sprache / language:	English
Zuordnung zum Curriculum / attribution to courses:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management for ‚Industrial Countries' Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	4 SWS / Vorlesung, Übungen, Labor GIS, Projektarbeit, max. 3-6 Teilnehmer
Arbeitsaufwand / student workload:	Präsenzstudium: 60 h, Eigenstudium: 90 h
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	none
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	Students know the basics of geographical information systems and can apply standard GIS software. Students have acquired operational knowledge of the spatial characteristics of elements of sustainable energy systems: renewable energy sources, energy demand, and infrastructure. Students can identify and acquire relevant data and assess their validity and applicability. Students can carry out spatial analysis of vector, network and raster data and interpret, visualise and communicate results.
Inhalt / subjects covered:	• Introduction to Geographic Information Systems and Science • Introduction to and application of GIS software • Commercial and open source GIS and data • Mapping energy demand and energy access • Mapping renewable energy sources • Mapping energy infrastructures and supply • Geographical data acquisition and management • Vector analysis: queries, overlay and zoning • Network analysis: supply basins, allocation • Raster analysis: surface models for visual impact; distance modelling; multi-criteria suitability models;

	cost-supply modelling of distributed energy resources • Introduction to Peta, the Pan-European Thermal Atlas and to global models of energy access. • Each student is provided with a full ArcGIS license for 1 academic year and has to bring a laptop to each seminar session.
Studien- Prüfungsleistungen / form of examination:	Oral presentation of project results (30 min.) and written report (20 pages). Possibility of group work.
Medienformen / media used:	Board, power points, GIS-software and data.
Literatur / literature:	- De Smith, Goodchild and Longley: Geospatial Analysis (also available under www.geospatialanalysisonline.com) - Longley, Goodchild, Maguire and Rhind: Geographic Information Systems & Science - Getting to know ArcGIS (several Pdf-documents by ESRI Press provided on Moodle) - Extending ArcGIS, ESRI Press - Several research papers provided on Moodle.

Modul 31: Sustainable Energy Planning in Rural Areas

Studiengang:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung:	Sustainable Energy Planning in Rural Areas
ggf. Kürzel	SEPRA
ggf. Untertitel	-
ggf. Lehrveranstaltungen:	-
Semester:	The module takes place in the first semester (spring term) and is offered once in a year.
Modulverantwortliche(r):	Prof. Dr. Bernd Möller
Dozent(in):	Prof. Dr. Bernd Möller
Sprache:	English
Zuordnung zum Curriculum	M. Eng. Energy and Environmental Management for 'Developing Countries', 1. Semester, Compulsory Module
Lehrform / SWS:	4 SWH seminar The seminar consists of inputs through lectures, exercises and moderated working sessions. The students have to prepare small presentations on selected topics. These can be done in groups or individually, depending on the topic. The seminar is complemented by a case study which allows the students to practice the knowledge acquired from these inputs. A fine-tuning of the seminar contents will take place at the beginning of the seminar in order to incorporate the knowledge and experience of students who dispose of professional experience in the fields concerned.
Arbeitsaufwand:	Attendance: approx. 60 hours Self-study/Group work: approx. 90 hours
Kreditpunkte:	5 ECTS
Voraussetzungen:	none
Lernziele / Kompetenzen:	The overall goal of the module is to enable students to prepare rural and regional energy plans, to consult stakeholders in rural energy planning processes and to moderate such processes. The module thereby complements the competencies gained in the technical and management modules of the first semester. Specific objectives The students - are able to critically reflect the interrelation between energy, environment, social and economic development in rural areas - understand the relevance of stakeholder involvement and participation in rural energy planning - know the different approaches to rural energy planning

	- are able to design and apply tools and instruments for data collection - are able to assess local energy demand and resources - are able to develop and assess local energy scenarios - can draft energy programme and project proposals
Inhalt:	The module focuses on energy planning in rural areas of developing countries. After introducing the interrelationship between rural development and energy and different planning approaches, it emphasizes the different steps of a participatory rural energy planning process. The theoretical course is complemented with a comprehensive case study and planning exercise. Contents • Rural Development and Energy Planning - Rural Demographics - Economic Development and Energy - Social Development and Energy - Environment and Rural Energy • Energy Access and rural electrification • Community Mobilisation • Community Energy Planning • Integrated Resource Planning • Geospatial aspects of Energy Planning o Introduction to Geographical Information Systems o Geospatial data for energy planning o Geospatial analysis of energy access • The Rural Energy Planning Process - Assessment of Baseline Situation Resources, Demand and Technologies Data Sources Rural Energy Uses - Development Scenarios - Local Energy Strategies and Policies - Energy programmes and Projects for Rural Development • Institutional Aspects • Planning Exercise
Studien- Prüfungsleistungen:	Presentation (30 min.) and written paper (approx. 15 pages) Alternatively, if too many students attend the course, the presentation can be replaced by a more extensive written paper (approx. 30 pages)
Medienformen:	Media • Power point presentation, Flip chart, Pin board, cards, transparencies, Notebooks/Planning tools • ArcGIS software and geodata

	• Handouts, e-books, exercises and weblinks are available through the Moodle system.
Literatur:	- Barnes, D.F (ed): The Challenge of Rural Electrification – Strategies for Developing Countries. ESMAP and RFF Press, 2007. - Singh, S. and Bajpai, U. (2010) Integrated energy planning for sustainable development in rural areas: A case study from Eastern Uttar Pradesh, Energy and Environment, Vol.1, Issue 6, pp.1083-1096, Journal homepage: www.IJEE.IEEFoundation.org - Tsoutsos, T. et. al. (2009) Sustainable energy planning by using multi-criteria analysis applicationenergy planning by using multi-criteria analysis application in the island of Crete, Energy Policy, Vol.37, 1587–1600, journalhomepage: www.elsevier.com/locate/enpol - Lund, H. (2007) EnergyPLAN - Advanced Energy Systems Analysis Computer Model, Documentation Version 7.0, Aalborg University, Denmark - Economic and Social Commission for Asia and the Pacific (2003): Guidelines on the Integration of Energy and Rural Development Policies and Programmes, New York, United Nations - Basnet, Suman (1999): District energy planning and implementation guidelines, Lalitpur, Rural Energy Development Programme - Kleinpeter, Maxime (1996): Energy planning and policy, Chichester, Wiley - Swisher, Joel N.; de Martino Jannuzi, Gilberto and Redlinger, Robert Y. (1997): Tools and Methods for Integrated Resource Planning- Improving Energy efficiency and Protecting the Environment, UNEP/Risø National Laboratory

Modul 32: Organisational Behaviour and Diversity Management in International Development Cooperation

Studiengang / course:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Organisational Behaviour and Diversity Management in International Development Cooperation
ggf. Kürzel / abbreveation	OB
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	Organisational Behaviour and Diversity Management
Semester / semester:	This module is offered annually in spring term. (1st semester)
Modulverantwortliche(r) / person in charge of module:	Dorsi Germann
Dozent(in) / person teaching the seminar:	Dorsi Germann
Sprache / language:	English
Zuordnung zum Curriculum / attribution to courses:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management for ‚Developing Countries' Compulsory Module
Lehrform / SWS / form of seminar / teaching hours per week:	Seminar / 4 SWS / up to 25 participants
Arbeitsaufwand / student workload:	Contact hours: 60h Self study: 90h
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	none
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	Overall goal: Students have acquired knowledge, skills and attitudes to manage organizations and people in organizations (team building, human resource management, motivation, intercultural communication, leadership etc.) Studying this module, students get the competence to handle people in organizations and to work in intercultural teams. The so acquired competences are applied and practiced during the international classroom in Scotland at the end of the second semester (for example: students take over roles and responsibilities; leadership and coordination, collaboration in an international team, intercultural communication with the Scottish partner organisations…). At the end of this module students have developed competencies in:

	- subject matters and methods; - handling processes and people; - analysis, reflection and assessment; - negotiation, conflict and problem solving; - coordination, presentation and facilitation; - organization management - intercultural communication and collaboration - leading, coaching and motivating people - organizations and organizational development - self- and project organization and time management; - team work and socio-cultural collaboration; - ethical behaviour, taking over responsibilities and self development. Teaching and learning methods are student oriented, build on existing knowledge and skills, are interactive and use a variety of methods for the transfer of information, for example group exercises, role plays, case studies, drawings, cartoons, videos, visualised lectures and moderated working sessions on the various topics based on the relevant literature and internet sources. There are practical, individual, pair and group work; interactive internet use, exchange of experience, and orientation towards practice. Theories and findings are related to past and actual experience of students and equally discussed and related to the future research study in Scotland at the end of the 2nd semester. Students from all over the world take over responsibilities; learn to accept different cultures, communicate and collaborate, form effective teams, solve problems, coordinate and lead and motivate each other.
Inhalt / subjects covered:	All technical projects have a human component which is generally more complex and complicated to manage than technical aspects. Therefore, this module focuses on theories and concepts, models and practical applications concerning structures and cultures of organizations and human behaviour in the work place, combining findings for example from Sociology, Economy, Politics, Social Psychology and Biology, as well as elements from System Theory, Diversity Management and theories of Organizations. Among others, the following topics will be discussed during the seminar: Organisational structures, cultures and settings; individual differences and gender; values and diversity; communication pattern and channels; self-perception, perception of others and perspectives of reality; leadership; management and motivation, groups and teams; power and politics; conflicts and negotiation; change management and ethical behaviour. A successful handling of a diverse workforce requires knowledge about these topics.

Studien- Prüfungsleistungen / form of examination:	Assessment of whether the students have achieved the aims of this module is tested through • a visualised and interactive presentation (40 - 60 min.) and facilitation of a topic-related exercise based on individual or group work and a final discussion, elaboration on the presented topic in a written paper (about 15 pages).
Medienformen / media used:	In this module a wide spectrum of media is used, such as books and other documents, laptops/internet and beamer for power point presentation, transparencies, videos, drawings, cartoons, role plays, stories, cases, flip chart, posters, Metaplan/workshop cards, markers, black board, Moodle server
Literatur / literature:	Besides the basic literature available in the university library, a more elaborated list and updated internet links are distributed together with an agenda at the beginning of the seminar. Reference is made to organisations in international development cooperation which have guidelines and handbooks on project and program management. • Peterson, M.F./Thomas, D.C. (2017): Cross-Cultural Management: Essential Concepts. Sage Publication, London, UK • Mullins, Laurie J. (2013): Management and Organisational Behaviour, Pearson, London, UK • Robbins, St.P., Judge, T.A. (2013): Organizational Behavior, Pearson, Boston, New York, US • Trompenaars, F./Woolliams, P. (2007): Business Across Cultures, Cornwall, UK • Francesco, Anne Marie (2004) International Organizational Behaviour, Prentice Hall, New Jersey/USA • Stockdale, M/ Crosby, F. (eds) (2005): The Psychology and Management of Workplace Diversity. Blackwell, Victoria, Australia • Robbins, S.P. / Decenzo, D.A. (2001): Fundamentals of Management – Essential concepts and applications. Prentice Hall, New Jersey/USA • Flood, R.L./Romm, N.R.A (2000): Diversity Management. Triple Loop Learning. Wiley, West Sussex, UK

Modul 33: International Classroom

Studiengang / course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	International Classroom
ggf. Kürzel / abbreviation	IC
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	The module is offered once a year. The preparation seminar takes place during the second semester, the International Class takes place in the semester break at the end of the second semester.
Modulverantwortliche(r) / person in charge of module:	Dipl.-Ing. Wulf Boie
Dozent(in) / person teaching the seminar:	Dipl.-Ing. Wulf Boie Prof. Dr. Bernd Möller Dipl. Soz. Päd. Dorsi Germann
Sprache / language:	English
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energy and Environmental Management for 'Developing countries' Compulsory Module
Lehrform / SWS / form of seminar / teaching hours per week:	Preparation seminar: 3 teaching hours/week (3 SWS) Project: 90 teaching hours (five week block) (6 SWS) Total: 9 SWS The module is organised as a project seminar and follows the steps of the project learning approach. Methodological details are described under "contents". Max. 25 students
Arbeitsaufwand / student workload:	Preparation seminar Attendance: 30 hours Individual work: 90 hours Project Guided Project Work: 180 hours
Kreditpunkte / credit points:	10 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	Successful completion of all required compulsory and mandatory elective modules
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	The overall goal of the module is to enable the students to plan, prepare and carry out a comprehensive field study in a multi disciplinary and multicultural team Specific Objectives The students - are able to define and narrow down a comprehensive research problem to specific research questions - are able to select and apply the appropriate methods of social and technical research in the energy sector

	- are able to design and monitor an activity and time planning - have improved their project organisation skills - have improved their capability to think multidisciplinary - have improved their capability to work in intercultural and multidisciplinary teams under time pressure - have improved their problem solving and conflict resolution skills - have developed the attitudes and communicative skills to work in an unfamiliar environment - are able to write up and present a research report in a team - are able to apply and combine the knowledge learned during the course of studies
Inhalt / subjects covered:	The International Class provides the opportunity to apply and combine the knowledge and competencies, gained so far during the course of studies, in a real life situation. It is organised in close co-operation with partner organisations abroad. While the preparation class is organised at the university, the practical exercise takes place abroad, preferably in a rural community development situation. The module follows the typical phases of the project based learning approach. The first two steps take place in the preparation seminar during the winter term: 1. Defining the project: The framework and scope of the project is outlined by the partner organisation in co-operation with the University of Flensburg. The project has then to be defined more in detail and narrowed down by the students during the preparation class. 2. Preparing the project: During the preparation class the students have to obtain first information about the project site and the research topic. They develop a research plan, select appropriate methodologies and work out research instruments. The project exercise itself is carried out abroad: 3. Accomplishment: The students travel to the project site abroad. After a first introduction by the partner organisations the students split into smaller groups (if the students group comprises more than 12 students), which are accompanied by a lecturer. They improve and finalise their planning and the research instruments and thereafter collect information at their research sites, applying different social and technical research methods. This phase usually takes two weeks. Within another two weeks the students have to analyse the information, draw conclusion, elaborate suggestions and write up a report.

	4. Presentation and Evaluation: Within a public meeting the report is presented and handed over to the communities and the partner organisation. For the students the discussion with the public and the partners after the presentation constitutes a first evaluation of their work. During the past nine years the International class has been carried out in Scotland in co-operation with the Highland and Island Enterprise
Studien- Prüfungsleistungen / form of examination:	Each student has to do one individual presentation during the preparation seminar and submit an preparatory paper of 6-8 pages/student. The preparatory paper may be elaborated by teams of two students. In this case the chapters of the paper have to be assigned to individuals. During the project exercise the students elaborate and present a final report (project report) as a team (6-8 pages/student) with assigned and quantified individual contributions. The individual grades are based on the quantity and quality of the individual contribution of each student (60%) and the overall quality of the report and presentation as a teamwork (40%). The final individual grade is made up of the grade for the preparatory paper (40 %) and the grade for the project report (60%)
Medienformen / media used:	Media preparation seminar • Power point presentation, Flip chart, Pin board, cards • Handouts, e-books and weblinks available on BSCW-server project exercise • Power point presentations, Flip charts • Notebook, planning software depending on project • Measurement instruments depending on project
Literatur / literature:	As the topics of the International Classes change, specific bibliographies will be compiled for each International Class separately

Modul 34: Project Management (PME) in International Development Cooperation

Studiengang:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbe-zeichnung:	Project Management in International Development Cooperation
Kürzel	PME
ggf. Untertitel	---
Lehrveranstaltungen:	Project Management
Semester:	This module is offered annually (autumn term)
Modulverantwortliche(r):	Dorsi Germann
Dozent(in):	Dorsi Germann
Sprache:	English
Zuordnung zum Curriculum	M. Eng. Energy and Environmental Management for ‚Developing Countries'; Compulsory Module
Lehrform / SWS/ Gruppengröße:	This module is conducted as seminar taking 4 semester week hours (4 SWS) for up to 25 participants each.
Arbeits-aufwand:	Within this module students study an additional 90h on their own besides the 60h they attend the seminar. Project Management 150h: Contact hours: 4h x 15w =60h Self study: 90h
Kreditpunkte:	5 ECTS
Voraussetzungen:	none
Lernziele/ Kompetenzen	Overall goal: Students have acquired knowledge, skills and attitudes to engage themselves actively in the participatory identification, planning and implementation management of projects/programs in international development cooperation and in institutions of their home country. At the end of this module students have developed competencies in - planning, monitoring and evaluation - subject matters and methods; - analysis, reflection and assessment; - ethical behaviour, taking over responsibilities and self development.
Inhalt:	This module focuses on theories and concepts, models and practical applications of project planning and management in international development cooperation, considering the context, needs, interests and priorities of the various stakeholders (beneficiaries, donors, implementers) of development projects or programs.

	Emphasis is put on a participatory approach to identify and plan projects/programs based on scientific research techniques. Teaching and learning methods use inputs from visualised lectures and moderated working sessions on the various topics based on the relevant literature and internet sources. There are practical, individual, pair and group exercises; analysis, comparison and drafting of case studies; interactive internet use, role plays and development of scenarios. The exchange of intercultural experience of the students from all over the world in exemplary project planning steps and management skills contributes to the synergetic outputs of the seminars.
Studien- Prüfungs-leistungen:	Assessment of students participation, performance, study of relevant literature and internet sites is tested through • a visualised and interactive presentation (30 min) and facilitation of an exercise based on individual or group work preparation, • elaboration on the presented topic in a written paper (15 pages).
Medien-formen:	In this module a wide spectrum of media is used, such as books and planning documents, laptops/internet and beamer for power point presentation, OHP transparencies, flip chart, posters, workshop cards, markers, black board, BSCW server.
Literatur:	Besides this basic literature available in the university library, a more elaborated list and updated internet links are distributed together with a glossary, prior to the seminar, for example. • Chambers, R. (1997): "Whose Reality counts?" Putting the last first." Intermediate Technology Publication, London • Haines, Stephen G. (2000): The Systems Thinking Approach to Strategic Planning and Management, Library of Congress, USA • Neuman, W.Lawrence (2000): Social Research Methods. Qualitative and Quantitative Approaches. Allyn and Bacon, Toronto, Singapore • Lewis, J.P. (2011): Project Planning, Scheduling and Control. The ultimate Hands-on Guide to Bringing Projects in on Time and on Budget. McGraw Hill, New York, Toronto, US • Miller, Delbert C. / Salkind, Neil J. (2002): Handbook of Research Design and Social Measurement. Sage Publication, UK/India • Verzuh,E. (2000): The fast forward MBA in Project Management. Quick Tips, Speedy Solutions, Cutting-edge Ideas, Wiley and Sons, New York, Toronto, US

Modul 35: Sustainable Energy Innovation/Implementation in Developing Countries

Studiengang:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung:	Sustainable Energy Innovation/Implementation in Developing Countries
ggf. Kürzel	-
ggf. Untertitel	-
ggf. Lehrveranstaltungen:	-
Semester:	The module takes place in the second semester (autumn term) and is offered once in a year.
Modulverantwortliche(r):	Prof. Dr. Bernd Möller
Dozent(in):	Dr. August Schläpfer Prof. Dr. Bernd Möller
Sprache:	English
Zuordnung zum Curriculum	M. Eng. Energy and Environmental Management for ‚Developingg Countries‘, 2. Semester, Core Elective Module
Lehrform / SWS:	4 SWH seminar, max. 24 students/group The seminar consists of inputs through lectures and moderated working sessions. The students have to prepare presentations on selected topics. These can be done in small groups or individually, depending on the topic. A fine-tuning of the seminar contents will take place at the beginning of the seminar in order to incorporate the knowledge and experience of students who dispose of professional experience in the fields concerned.
Arbeitsaufwand:	Attendance: approx. 60 hours Self-study/Group wok: approx. 90 hours
Kreditpunkte:	5 ECTS
Voraussetzungen:	none
Lernziele / Kompetenzen:	The overall goal of the module is to give students an illustration/interpretation of policy frameworks and systems of innovation that are essential to the implementation of sustainable energy technologies in developing countries. They will be able to assess and contrast the impact of local and national systems of innovation on technology change and implementation, and they will be able to appraise the importance of entrepreneurship in technology transfer and capacity building in the energy sector. Specific objectives The students will be able to - discuss the current methods of energy provision in developing countries

	- demonstrate how energy policy is transformed from ideas to reality through the decision making, approvals and administrative processes - identify key elements that affect the successful introduction of renewable technologies in a development setting including needs assessment, technology transfer, capacity building, financing and gender issues - analyse energy policy for its effectiveness to accelerate deployment and access to sustainable energy in developing countries - assess the role of entrepreneurship in energy projects - differentiate between national and local systems of innovation in relation to energy provision - outline the costs and challenges of integrating increasing shares of renewable energy into energy supply systems in developing countries - describe how energy policy ideals may become compromised through the political processes involved
Inhalt:	This module identifies and appraises the linkages between renewable energy innovation and dissemination, such as the co-benefits and co-costs, mitigation potential, to achieve sustainable development in developing countries. It evaluates policy options, outcomes and conditions for their effectiveness, as well as constraints for integration into the energy supply system. The module analysis how accelerated deployment of renewable energy technologies could be achieved in developing countries in a sustainable manner. The mitigation potential and costs of renewable energy technologies are assessed and the role of entrepreneurship in the process of innovation of energy technologies is assessed. In addition the module deals with the processes and institutions that give rise to the shape, direction, and outcomes in the energy sector. Contents • Sustainable energy and development • Entrepreneurship in energy projects • Local versus national innovation systems • Policy framework • Institutional arrangements • Finance mechanisms • Assessment of renewable energy technologies and related policy and financial instruments • Capacity building • Evaluate the potential of renewable energy for the mitigation of climate change • Technology transfer

	• Assessment of the appropriateness of the range of energy technologies applicable to a developing country (social/cultural, practical, economic and environmental) • Community engagement • Renewable energy and sustainability • Gender issues • Barriers and drivers
Studien-Prüfungsleistungen:	Presentation (30 min) and written paper (approx. 15 pages) Alternatively, if too many students attend the course, the presentation can be replaced by a more extensive written paper (approx. 30 pages)
Medienformen:	Media • Power point presentation, Flip chart, Pin board, cards,transparencies, Notebooks/Planning tools • Handouts, e-books, exercises and weblinks are available on BSCW-server
Literatur:	- IPCC (2011) Special Report Renewable Energy Sources (SRREN) - Schumpeter, J. (1934) The Theory of Economic Development, Harvard, New York - Lundvall, B.Ä. (2010) National Systems of Innovation – Towards a Theory of Innovation and Interactive Learning, Anthem Press, UK - Aubert, J-E (2004) Promoting Innovation Developing Countries : A Conceptual Framework, The World Bank, on line, available: http://siteresources.worldbank.org/KFDLP/Resources/0-3097AubertPaper%5B1%5D.pdf - Suthersane, U. (2006) Utility Models and Innovation in Developing Countries, UNCTAD-ICTSD Project on IPRs and Sustainable Development, on line, available: http://www.unctad.org/en/docs/iteipc20066_en.pdf - Shane, S. (2003) A General Theory of Entrepreneurship – The Individual Opportunity Nexus, Edward Elgar Publishing Limited, UK - Martinot, E. et al (2002) Renewable Energy Markets in Developing Countries, Annu. Rev. Energy Environ. 2002. 27:309–48

Modul 36: Renewable Energy Technologies A

Studiengang / course:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Renewable Energy Technologies A
ggf. Kürzel / abbreviation	RET A
ggf. Untertitel / subtitle	-------
ggf. Lehrveranstaltungen / seminar:	Up to two workgroups to be selected. Regularly offered: Solar Energy, Wind Energy, Hydropower, Biomass, Grid Integration of RET
Semester / semester:	Spring Term
Modulverantwortliche(r) / person in charge of module:	Dipl.-Ing. Wuf Boie
Dozent(in) / person teaching the seminar:	Prof. Jens Born Prof. Clemens Jauch Dr. Hermann van Radecke Dipl.-Ing. Wulf Boie N.N.
Sprache / language:	English
Zuordnung zum Curriculum / attribution to courses:	M.Eng. Energy and Environmental Management for 'Developing countries': Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	The module follows the problem-based learning approach: After a general introduction to renewable energy technologies and a more extended introduction to one specific technology, to be selected by the students, problems are assigned to work groups of students. The students identify what their learning requirements are, acquire the knowledge they need and apply it to solve the problem. The lecturers serve as coaches/advisers/facilitators, designing the learning environment and delivering inputs on request of the students. Students can participate in up to two workgroups. Contact hours per week: 4 contact hours
Arbeitsaufwand / student workload:	150 hours workload
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	none
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	The students - have fundamental knowledge of the most important renewable energy technologies - are able to generate present and future load profiles - have deeper knowledge of at least one renewable energy technology

	- know how to assess local RE resources - are able to carry out a preliminary technical design of selected RET - are capable to assess the feasibility of RET - are aware of the structure of the technical planning process for a rural renewable energy system - are able to present, communicate and document their work results - have developed strategies to acquire/apply knowledge in order to solve a techno-economical problem - have constructed a flexible knowledge base in at least on field of renewable energy - have developed problem solving skills - have developed self-directed, life-long learning skills
Inhalt / subjects covered:	All participants participate in a general introduction to • Wind Energy, • Hydropower, • Solar Energy, • Bio Energy, • Grid Integration of Renewable Energy Technologies of 4 contact hours each. Thereafter each student participates in a work group to specialize in one of the above mentioned subjects. The work group is confronted with a real life technical case study (resp. a problem) of designing renewable energy systems. Under the guidance of the lecturer the students follow the general 'Seven-Jump' method for problem based learning (after Gijselaers, 1995): • Clarify terms and concepts not readily comprehensible • Define the problem • Analyse the problem and offer tentative explanations • Draw up an inventory of explanations • Formulate learning objectives • Collect further information through private study • Synthesize the new information and evaluate and test it against the original problem. Reflect on and consolidate learning. The students can request the lecturer to provide lectures on specific contents. The lecturer can decide to provide a series of lectures as a more specific introduction before the group work starts, if this is necessary to understand the case study. The case study represents a real life problem which were identified by the students themselves, provided by alumni of the programme or which arises from research activities of the lecturers.

	All case studies should include the following aspects as far as applicable: • Resource assessment • Assessment of generation profile • Technology assessment and selection • Selection, design and dimensioning of technology • Economic and Environmental Assessment As far as available the application of industry standard design software should be part of all case studies. The work group on Grid integration should cover the following aspects: • Basics of electrical systems: current, voltage, power, energy, power factor, losses on line, capacitance, inductance, transformers, generator, Transmission lines of different voltage levels (overhead lines and underground cables), electrical network design. • Power Quality: harmonics, flicker, voltage dips, Transients voltage dips and frequency variations • The principle of maintaining the balance between generation and demand • Preliminary analysis for integration of renewable technologies to the electricity grids: power flow analysis, short circuit analysis, stability studies and covering a given load profile. A typical case study can for example be the replacement of fossil fuels by renewable energy technologies in an isolated rural grid. In that case different work groups (e.g. wind, solar, hydro, grid integration) would have to cooperate and integrate their work results at the end.
Studien- Prüfungsleistungen / form of examination:	The groups document their active participation in weekly progress reports. In each plenary meeting the groups will report on their project progress. The group will present their results in the last week of the semester and submit a project report, based on the weekly progress reports (6-8 pages per student). The individual contributions to the report have to be distinguishable. Assessment - Group mark for final presentation and documentation: 40% - Individual mark for final presentation and documentation: 60%
Medienformen / media used:	Black-/ whiteboard, Power point presentations, Software simulation tools
Literatur / literature:	Wind Energy - Manwell, J. F. et. al.: Wind Energy Explained., Chichester, 2009 - Burton, T.: Wind energy handbook, Chichester, 2002 - Troen, I., Petersen, E. L.: European Wind Atlas. Risoe Nat. Lab., 1991,

	- Gasch, R., Twele, J.: Wind Power Plants. Fundamentals, Design, Construction and Operation. Solarpraxis AG, Berlin, 2002 Hydropopwer - Harvey, A. (2002): Micro-Hydro Design Manual, ITPublications Ltd., London (Library) - DCS - Technology Development (1998): Manual for Survey and Layout Design of Private Micro-hydropower Plants, International Centre for Integrated Mountain Development (ICIMOD)Kathmandu, Nepal (BSCW) - European Small Hydropower Association (2004): Guide on how to develop a small hydro site (Moodle) Bio energy - Jay Cheng (2009): Biomass to Renewable Energy Processes; CRC Press - Sergio Capareda (2013): Introduction to Biomass Energy Conversions; CRC Press - Tim Pullen (2015): Anaerobic Digestion - Making Biogas - Making energy; Routledge - Dieter Deublein, Angelka Steinhauser (2010): Biogas from Waste and Renewable Resources: An Introduction: 2nd Edition; Wiley-VCH Solar Energy - Konrad Mertens (2013): Photovoltaics: Fundamentals, Technology and Practice - Geoff Stapleton (2012): Grid-Connected Solar Electric Systems - Chen, C. Julian Physics of Solar Energy - Klaus Jäger, Olindo Isabella, Arno H.M. Smets, René A.C.M.M. van Swaaij, Miro Zeman (2014): Solar Energy: Fundamentals, Technology, and Systems Grid Integration - B.M. Weedy, B.J. Cory; Electric Power Systems; John Wiley - S. Heier; Grid Integration of Wind Energy Conversion Systems; John Wiley & Sons

Modul 37: Renewable Energy Technologies B

Studiengang / course:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Renewable Energy Technologies B
ggf. Kürzel / abbreviation	RET B
ggf. Untertitel / subtitle	-------
ggf. Lehrveranstaltungen / seminar:	Up to two workgroups to be selected. Regularly offered: Solar Energy, Wind Energy, Hydropower, Biomass, Grid Integration of RET
Semester / semester:	Spring Term
Modulverantwortliche(r) / person in charge of module:	Dipl.-Ing. Wuf Boie
Dozent(in) / person teaching the seminar:	Prof. Jens Born Prof. Clemens Jauch Dr. Hermann van Radecke Dipl.-Ing. Wulf Boie N.N.
Sprache / language:	English
Zuordnung zum Curriculum / attribution to courses:	M.Eng. Energy and Environmental Management for 'Developing countries': Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	The module follows the problem-based learning approach: After a general introduction to renewable energy technologies and a more extended introduction to two specific technologies, to be selected by the students, problems are assigned to work groups of students. The students identify what their learning requirements are, acquire the knowledge they need and apply it to solve the problem. The lecturers serve as coaches/advisers/facilitators, designing the learning environment and delivering inputs on request of the students. Students can participate in up to two workgroups. Contact hours per week: 8
Arbeitsaufwand / student workload:	300 hours workload
Kreditpunkte / credit points:	10 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	none
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	The students - have fundamental knowledge of the most important renewable energy technologies - are able to generate present and future load profiles - have deeper knowledge of at least one renewable energy technology

	- know how to assess local RE resources - are able to carry out a preliminary technical design of selected RET - are capable to assess the feasibility of RET - are aware of the structure of the technical planning process for a rural renewable energy system - are able to present, communicate and document their work results - have developed strategies to acquire/apply knowledge in order to solve a techno-economical problem - have constructed a flexible knowledge base in at least on field of renewable energy - have developed problem solving skills - have developed self-directed, life-long learning skills
Inhalt / subjects covered:	All participants participate in a general introduction to • Wind Energy, • Hydropower, • Solar Energy, • Bio Energy, • Grid Integration of Renewable Energy Technologies of 4 contact hours each. Thereafter each student participates in two work groups to specialize in up to two of the above mentioned subjects. The work groups are confronted with a real life technical case study (resp. a problem) of designing renewable energy systems. Under the guidance of the lecturer the students follow the general 'Seven-Jump' method for problem based learning (after Gijselaers, 1995): • Clarify terms and concepts not readily comprehensible • Define the problem • Analyse the problem and offer tentative explanations • Draw up an inventory of explanations • Formulate learning objectives • Collect further information through private study • Synthesize the new information and evaluate and test it against the original problem. Reflect on and consolidate learning. The students can request the lecturer to provide lectures on specific contents. The lecturer can decide to provide a series of lectures as a more specific introduction before the group work starts, if this is necessary to understand the case study. The case studies represent real life problems which were identified by the students themselves, provided by alumni of the programme or which arise from research activities of the lecturers.

	All case studies should include the following aspects as far as applicable: • Resource assessment • Assessment of generation profile • Technology assessment and selection • Selection, design and dimensioning of technology • Economic and Environmental Assessment As far as available the application of industry standard design software should be part of all case studies. The work group on Grid integration should cover the following aspects: • Basics of electrical systems: current, voltage, power, energy, power factor, losses on line, capacitance, inductance, transformers, generator, Transmission lines of different voltage levels (overhead lines and underground cables), electrical network design. • Power Quality: harmonics, flicker, voltage dips, Transients voltage dips and frequency variations • The principle of maintaining the balance between generation and demand • Preliminary analysis for integration of renewable technologies to the electricity grids: power flow analysis, short circuit analysis, stability studies and covering a given load profile. A typical case study can for example be the replacement of fossil fuels by renewable energy technologies in an isolated rural grid. In that case different work groups (e.g. wind, solar, hydro, grid integration) would have to cooperate and integrate their work results at the end.
Studien- Prüfungsleistungen / form of examination:	The groups document their active participation in weekly progress reports. In each plenary meeting the groups will report on their project progress. Each group will present their results in the last week of the semester and submit a project report, based on the weekly progress reports (6-8 pages per student). The individual contributions to the report have to be distinguishable. Assessment - Group mark for final presentation and documentation: 40% - Individual mark for final presentation and documentation: 60%
Medienformen / media used:	Black-/ whiteboard, Power point presentations, Software simulation tools
Literatur / literature:	Wind Energy - Manwell, J. F. et. al.: Wind Energy Explained., Chichester, 2009 - Burton, T.: Wind energy handbook, Chichester, 2002 - Troen, I., Petersen, E. L.: European Wind Atlas. Risoe Nat. Lab., 1991,

	- Gasch, R., Twele, J.: Wind Power Plants. Fundamentals, Design, Construction and Operation. Solarpraxis AG, Berlin, 2002 Hydropopwer - Harvey, A. (2002): Micro-Hydro Design Manual, ITPublications Ltd., London (Library) - DCS - Technology Development (1998): Manual for Survey and Layout Design of Private Micro-hydropower Plants, International Centre for Integrated Mountain Development (ICIMOD)Kathmandu, Nepal (BSCW) - European Small Hydropower Association (2004): Guide on how to develop a small hydro site (Moodle) Bio energy - Jay Cheng (2009): Biomass to Renewable Energy Processes; CRC Press - Sergio Capareda (2013): Introduction to Biomass Energy Conversions; CRC Press - Tim Pullen (2015): Anaerobic Digestion - Making Biogas - Making energy; Routledge - Dieter Deublein, Angelka Steinhauser (2010): Biogas from Waste and Renewable Resources: An Introduction: 2nd Edition; Wiley-VCH Solar Energy - Konrad Mertens (2013): Photovoltaics: Fundamentals, Technology and Practice - Geoff Stapleton (2012): Grid-Connected Solar Electric Systems - Chen, C. Julian Physics of Solar Energy - Klaus Jäger, Olindo Isabella, Arno H.M. Smets, René A.C.M.M. van Swaaij, Miro Zeman (2014): Solar Energy: Fundamentals, Technology, and Systems Grid Integration - B.M. Weedy, B.J. Cory; Electric Power Systems; John Wiley - S. Heier; Grid Integration of Wind Energy Conversion Systems; John Wiley & Sons

Modul 38: Rational Use of Energy and Renewable Energy Applications

Studiengang / course:	M.Eng. Energie- und Umweltmanagement / M.Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Rational Use of Energy and Renewable Energy Applications
ggf. Kürzel / abbreveation	RUEREA
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	The module takes place in the second semester and is offered once in a year.
Modulverantwortliche(r) / person in charge of module:	Dipl.-Ing. Wulf Boie
Dozent(in) / person teaching the seminar:	Dipl.-Ing. Wulf Boie
Sprache / language:	English
Zuordnung zum Curriculum / attribution to courses:	M.Eng. Energy and Environmental Management for ‚Developing Countries‘; Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	- Rational Use of Energy and Energy Auditing: 2.5 SWH, seminar, max. 24 students/group - Project Exercise: Energy Audit/Energy Retrofit Concept: 1.5 SWH project, max 8 students/group The seminar consists of inputs through lectures and moderated working sessions. Small individual and group exercises allow the students to practice the knowledge acquired from these inputs. The participants have to do a part of these exercises as homework. The successful submission of the homework is a precondition for admission to the module exam. In addition the students have to prepare a small presentation on a selected technical topic . This can be done in small groups or individually, depending on the topic. A fine-tuning of the seminar contents will take place at the begin of the seminar in order to incorporate the knowledge and experience of students who dispose of professional experience in the fields concerned. The seminar is complemented by a project exercise. During the project exercise the student either - design and carry out an energy audit in a small to medium size public building in Flensburg or - develop a concept for an energy retrofit for a building in a tropical country. The data for this project will be supplied by alumni, working in the building sector.

	For this purpose, they form teams of 3-5 students, assign a team leader and responsibilities for the different topics to be covered by the audit, resp. the energy retrofit concept (usually lighting, appliances, HVAC and application of renewable energy on small scale). The exercise results in a report, which has to be presented by the students.
Arbeitsaufwand / student workload:	Lectures: 36 contact hours, 30 hours self study Project Exercise: 24 contact hours, 60 hours self study
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	none
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	The overall goal of the module is to enable the students to assess the energy efficiency of small and medium premises, to carry out energy audits and propose appropriate energy saving measures. Specific objectives The students - are aware of the relevance of energy efficiency as a resource in sustainable energy systems - have basic knowledge of energy efficient technologies for small and medium scale residential and commercial premises - know the relevant sources of information on energy efficient technologies - have developed the skills to access information on energy efficiency through internet, literature and personal contacts - know and are able to apply energy auditing methodologies - are able to write up and present an energy audit report - have improved their ability to work in a team
Inhalt / subjects covered:	The module provides the basic knowledge and skills to assess the energy efficiency of small and medium premises, to carry out energy audits and propose appropriate energy saving measures. • Introduction - Trends of energy consumption and energy intensity globally and in selected countries - The role of energy efficiency in the evolution of energy intensity - Technical and economical potential of energy efficiency - The energy flow: from primary energy to energy service - Demand Side Management • Energy Auditing - Energy management in facilities: structure and management targets

	- Energy indexes as a basis for energy accounting - Methodologies of Energy Auditing • Technical aspects - Lighting - Electrical Appliances in Households and Offices - Electrical motors - Heating, Ventilation and Air Conditioning • Practical Exercise: Energy Audit in a small or medium size building - Planning and conducting an Energy Audit - Developing an energy retrofit concept - Writing up a Report - Presenting Results
Studien- Prüfungsleistungen / form of examination:	Each group will present their results in the last week of the semester and submit a project report, based on the weekly progress reports (6-8 pages per student). The individual contributions to the report have to be distinguishable. Assessment - Group mark for final presentation and documentation: 40% - Individual mark for final presentation and documentation: 60%
Medienformen / media used:	Media • Power point presentation, Flip chart, Pin board, calculation simulation software, Measuring Instrument for energy audits, • Handouts, e-books, exercises, weblinks available on BSCW-server
Literatur / literature:	Thumann, P.E. (2013): Handbook of Energy Auditing, 9th Edition (e-book) Benya, James R. und. Leban, Donna J (2011): Lighting Retrofit and Relighting: A Guide to Energy Efficient Lighting (e-book) Haines, Roger W.: Myers, Michael E. (2010) HVAC systems design handbook Howell, Ronald Hunter (2009): Principles of heating, ventilating, and air conditioning: a textbook with design data based on the 2009 ASHRAE Handbook - fundamentals, ASHRAE, Atlanta Koenigsberger, O. H, et al (2011): Manual of Tropical Housing and Building: Climatic Design. Publisher: Universities Press Hyde, Richard (2000): Climate Responsive Design: A Study of Buildings in Moderate and Hot Humid Climates, Taylor & Francis

	(A more specific bibliography on the different aspects of energy auditing will be distributed at the begin of the seminar)

Modul 39: Development Strategies and Organizations in International Development Cooperation

Studiengang:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbe-zeichnung:	Development Strategies & Organisations in International Development Cooperation
Kürzel	DS-OIDC
ggf. Untertitel	---
Lehrveran-staltungen:	Seminar: Development Strategies and Organisations in International Development Cooperation
Semester:	Both courses of this module are offered annually in the first semester (spring term)
Modulverant-wortliche(r):	Prof. Dr. Bernd Möller
Dozent(in):	Prof. Dr. Bernd Möller
Sprache:	English
Zuordnung zum Curriculum	M. Eng. Energy and Environmental Management for 'Developing Countries'; Core Elective Course
Lehrform / SWS: Gruppengröße	This module is conducted as a seminar, taking 4 semester hours (4 SWS) for up to 20 participants each. In the seminar teaching and learning methods use inputs from visualised lectures and moderated working sessions on various topics, based on the relevant literature and internet sources. There are practical individual, pair and group exercises, based on analysis, comparison and drafting of case studies, interactive internet use, and development of scenarios.
Arbeits-aufwand:	In this module students study an additional 45h on their own besides the 30h they attend the seminar. Contact hours: 60h; Self-study: 90h
Kreditpunkte:	5 ECTS
Voraussetzungen:	There are no formal preconditions for the participation in this module. The courses are recommended, however to those students who do not have much knowledge in and experience with international organisations in development cooperation and/or development strategies to assist the work done in the module on Project Planning and Management.
Lernziele / Kompetenzen:	Overall: From this module students gain knowledge, skills and attitudes which enables them to compare, assess and relate development policies/strategies, and to collaborate actively with organisations in international development cooperation. In this seminar students get subject matter knowledge on the decades of development strategies within their historical, cultural and socio-economic context. They develop competencies in critical reflection, comparison and assessment of political and economic concepts of development as well as

	the ability to handle interdisciplinary processes in intercultural team work. Furthermore, this seminar enables the students to critically assess international development organisations, as well as actively collaborate with and use the services of selected organisations in international development cooperation. They develop economic, political and international competencies and methodological skills, as well as the ability to analyse, communicate and work in intercultural teams.
Inhalt:	General: The module gives an overview on the interdependent socio-cultural, political, technical and economic change of societies and the relevant theories, models, strategies and organisations of international development cooperation towards sustainable development in a globalized world. Development Strategies include the study of the impact of under and over development in its historical context of industrialised nations as well as developing countries. Concepts of development aid and sustainable development are critically considered as well as measurement of development (Human Development Index) and the impact of development assistance in the framework of the Millennium Development Goals (MDG). The decades of development strategies are analysed with a focus on energy development. The various interpretations and concepts, strategies and indicators of development are reflected in the profiles of bilateral and multilateral organisations of international development cooperation (e.g. World Bank, Regional Development Banks, selected UN-organisations, European Commission, OECD etc.). They are introduced, elaborating on their major structures, policies, objectives, funding, working areas, procedures and services of their projects and programs. Selected concepts and cross section topics of various organisations are analysed and compared, and procedures are shown on how to collaborate actively with them. Part of the seminar is a 3-4 day excursion (subject to funding by DAAD) to German organisations of development cooperation, such as BMZ, DAAD, GIZ, CIP, GFA, GermanWatch, UNFCCC etc.) This core elective module is linked to the module Project Planning and Management. It is recommended to all those students with little knowledge and experience in International Organisations and Development Policy and Strategies. It assists the modules in the technical sector in so far as it provides the organisational framework and historical context of energy and environmental development and policy. Furthermore, the seminar can help to make contacts with relevant organisations, when preparing for the project of the International classroom as well as for the Master's theses research.

Studien- Prüfungsleistungen:	Assessment of students participation, performance, study of relevant literature and internet sites is tested through • A visualised and interactive presentation (30 min) combined with a facilitation of an exercise based on individual or group work preparation (60 min); and a written report (15 pages). Both parts count 50% each of the final mark.
Medienformen:	In this module a wide spectrum of media are used, such as books, readers and sample documents, laptops/internet and beamer for power point presentation, OHP transparencies, flip chart, posters, workshop cards, markers, black board, Moodle.
Literatur:	Besides this basic literature available in the university library, a more elaborated list and updated internet links are distributed together with a glossary prior to the seminars. All organisations in international development cooperation have internet websites. Ha-Joon Chang (2007): Bad Samaritans – Rich Nations, Poor Policies and the Threat to the Developing World, Random House Business Books, LondonCavanagh, John (2002): Alternatives to Economic Globalization, Berrett-Koehler/San Francisco/USA Rapley, John (2002): Understanding Development: Theory and Practice in the Third World, Lynne Rienner Publishers, Boulder/USA United Nations (2003): World Development Report 2003. Sustainable Development in Dynamic World, New York/USA World Bank (1999): Assessing Aid: What Works, What Doesn't, and Why, Washington/USA BMZ (2000) Partners for the Future – German Development Policy in the 21st century, Berlin www.bmz.de EC (2002) The European Development Fund in a Few Words, Brussels www.europa.eu.int/comm/development Secr. of State for Internat. Development (2000) Eliminating World Poverty: Making Globalisation Work for the Poor (White Paper on International Development), London www.globalisation.gov.uk UNDP (2005) Human Development Report, New York www.undp.org World Bank World Development Reports, Washington www.worldbank.org - Attacking Poverty (2003) - Making Services Work for Poor People (2004)

Modul 40: Organizational Change and Development in International Development Cooperation

Studiengang / course:	MA International Management Studies MIM S1 02
Modulbezeichnung / module name:	Organizational Change and Development
ggf. Kürzel / abbreveation	-
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	1. Innovationsmanagement (2 SWS, Wintersemester) 2. Wachstum, Wandel und Organisationsentwicklung (2 SWS, Sommersemester)
Semester / semester:	Herbst- und Frühjahrssemester
Modulverantwortliche(r) / person in charge of module:	Prof. Dr. Thomas Behrends
Dozent(in) / person teaching the seminar:	N N.
Sprache / language:	Deutsch
Zuordnung zum Curriculum / attribution to courses:	M. Eng Energy and Environmental Management for ‚Developing Countries' Core Elective Course
Lehrform / SWS / form of seminar / teaching hours per week:	Seminar / 4 SWS (2 SWS + 2 SWS)
Arbeitsaufwand / student workload:	60 contact hours and 90 hours of student work each
Kreditpunkte / credit points:	10 ECTs (5 + 5)
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	keine
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	Die Studierenden erhalten einen umfassenden Einblick in die disziplinäre Vielfalt des Diskurses zum Phänomen organisationaler Innovations- und Veränderungsprozesse. Ausgehend von einer Vermittlung theoretischer Grundlagen werden die Teilnehmer für das Spannungsfeld von „deterministischem Wandel" und voluntaristischer Entwicklung" in Organisationen sensibilisiert und erlernen den reflektierten Umgang mit einschlägigen Instrumenten des betrieblichen Innovationsmanagements. Lernkompetenzen / studying proficiency: • Specific knowledge in political analysis • Interdisciplinary knowledge • Social and ethical responsibility • Self organisation and teamwork • Project organising skills • Conflict solving skills
Inhalt / subjects covered:	Das Modul umfasst sowohl eine (organisations-) soziologisch informierte Erörterung einschlägiger theoretischer Erklärungen zum Verlauf organisationaler

	Wandel- und Entwicklungsprozesse als auch eine Einführung in die wesentlichen Erklärungs- und Gestaltungsansätze aus dem Bereich des organisationalen Lernens und betrieblichen Innovationsmanagements.
Studien- Prüfungsleistungen / form of examination:	Präsentation (ca. 15 min.) und Ausarbeitung (ca. 15 Seiten)
Medienformen / media used:	Active Teilnahme der Studierenden, Präsentation und Diskussion einschlägiger wissenschaftlicher Texte und Fallstudien
Literatur / literature:	Burke, W. W. (2011): Organization Change: Theory and Practice (Foundations for Organizational Science), Essex. Jäger, W./Meyer, H.-J. (2003): Sozialer Wandel in soziologischen Theorien der Gegenwart, Wiesbaden. Poole, M. S./Van de Ven, A. H. (2004): Handbook of Organizational Change and Innovation, New York. Poole, M. S./Van de Ven, A. H./Dooley, K./Holmes, M. E. (2000): Organizational Change and Innovation Processes: Theory and Methods for Research, Oxford. Tidd, J./Bessant, J. (2013): Managing Innovation: Integrating Technological, Market and Organizational Change, Hoboken, NJ.

Modul 41: Master Thesis

Studiengang/course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Master Thesis
ggf. Kürzel / abbreveation	-
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Summer term or winter term
Modulverantwortliche(r) / person in charge of module:	Prof. Dr. Olav Hohmeyer Prof. Dr. Bernd Möller
Dozent(in) / person teaching the seminar:	N.N.
Sprache / language:	Deutsch / English
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management for ‚Industrial Countries' and ‚Developing Countries' Compulsory Course
Lehrform / SWS / form of seminar / teaching hours per week:	0 SWS
Arbeitsaufwand / student workload:	900 hours of individual work
Kreditpunkte / credit points:	30 ECTS
Voraussetzungen / preconditions:	-
Lernziele / Kompetenzen / aims of the module / competencies:	Die Studierenden verfügen über die Fähigkeit zum selbstständigen wissenschaftlichen Arbeiten in einem fachwissenschaftlichen Themengebiet und demonstrieren in diesem Bereich vertieftes Fachwissen. Sie haben Kenntnis der fachlichen Relevanz und der fachlichen Bewertungsmaßstäbe, die bei der Konzeption einer wissenschaftlichen Arbeit dieser Größenordnung anzulegen sind. Sie können die eigene Arbeit in dieser Hinsicht kompetent planen und durchführen. Die Studierenden sind in der Lage, den jeweiligen Stand der Wissenschaft auf das von ihnen gewählte Themengebiet anzuwenden sowie einschlägige Fachliteratur zu recherchieren, auszuwerten und zu verarbeiten. Sie können die im Master-Studium erlernten Methoden und Inhalte sachgerecht anwenden. Dazu gehört die angemessene schriftliche Darstellung von Fragestellung, Vorgehensweise und Ergebnissen. In der Disputation sollen Studierende in Form einer mündlichen Präsentation und in einer daran

	anschließenden Diskussion die wesentlichen Ergebnisse und Thesen der Master Thesis verteiligen.
Inhalt / subjects covered:	Die Studierenden sind in der Lage, eine fachwissenschaftliche Fragestellung im Bereich des Energie- und Umweltmanagements zu entwickeln, mit geeigneten Methoden zu bearbeiten sowie ihre Ergebnisse in angemessener schriftlicher Form darzustellen. Die Studierenden verfassen eine ca. 80 seitige Master Thesis, die die selbstständige Recherche und Analyse und das grundsätzlich wissenschaftlich angelegte Erarbeiten eines Themas zum Ziel hat.
Studien- Prüfungsleistungen / form of examination:	Schriftliche Thesis (ca. 80 Seiten) und mündliches Kolloquium (30 min. Präsentation + 30 min. Diskussion) Die reguläre Bearbeitungszeit für die Thesis beträgt sechs Monate.
Medienformen / media used:	-
Literatur / basic literature for the module:	individuell

Brückenkurse
A: Brückenkurs/Preparatory Course in Energy Economics

Studiengang:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung:	Brückenkurs/Preparatory Course in Energy Economics
ggf. Kürzel:	-
ggf. Untertitel:	Foundations of Energy Economics and Energy Management
ggf. Lehrveranstaltungen:	-
Semester:	Before the 1st semester
Modulverantwortliche(r):	Prof. Dr. Bernd Möller
Dozent(in):	Prof. Dr. Bernd Möller
Sprache:	English
Zuordnung zum Curriculum:	M.Eng. Energie- und Umweltmanagement for ‚Developing Countries', pre-course, Compulsory Module
Lehrform / SWS:	Seminar with max. 25 students
Arbeitsaufwand:	4 SWS
Kreditpunkte:	5 ECTS
Voraussetzungen:	none
Lernziele / Kompetenzen:	The course introduces students to the field of Energy Economics and Energy Management as a qualification for the M.Eng. Energy and Environmental Management course. The main aims of the course are to gain basic insights into the field of energy economics and energy markets, in the first instance, neo-classical economics. Second, the students will be introduced to natural resource economics and touch on the associated environmental economics. Lastly, the course discusses the limitations of the neo-classical economic model to deal with energy and the environment and provides a brief introduction into alternative economic models, such as ecological economics.
Inhalt:	The course will focus on an international perspective of energy production and use and discusses academic and political contents. The economics of energy production and use within the concept of sustainable development form a major part of this course. It touches on possible strategies and methodologies to a more sustainable energy future. The following topics will be covered: • Introduction to energy markets • Coal, oil and gas and electricity markets • Introduction to Resource Economics • Introduction to Ecological/Biophysical Economics • Energy risks • Energy security • Energy and sustainable development • Role of government in energy economics • Innovation in energy management • Concepts of sustainability

	• Law of entropy and energy • Energy and climate change • 1-2 short excursions to local companies (e.g. Stadtwerke Flensburg, WSTECH GmbH, Danfoss Silicon Power, artefact Glücksburg, TBZ Flensburg)
Studien-Prüfungsleistungen:	Essay (10 pages) on energy economic issues and proposed management practices in the home countries of students.
Literatur:	• Tietenberg, T. and Lewis, L. (2009) Environmental and Natural Resource Economics, Pearson International Edition, Eighth Edition, Pearson Addison Wesley, Boston, ISBN 13: 978-0-321-56046-9 • Dahl, C. A. (2004) International Energy Markets: Understanding Pricing, Policies, and Profits, Penn Well Corporation, USA, ISBN: 978-0-87814-799-1 • Deutscher, G. (2008) The Entropy Crisis, World Scientific Publishing Co. Pty. Ltd. Singapore, ISBN: 13 978-981-277-968-7

B: Brückenkurs/Preparatory Course in Business Administration

Studiengang:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung:	Brückenkurs/Preparatory Course in Business Administration Course
ggf. Kürzel:	BAC
ggf. Untertitel:	Management of Small and Medium Sized Enterprises
ggf. Lehrveranstaltungen:	-
Semester:	Before the 1st semester
Modulverantwortliche(r):	Prof. Dr. Bernd Möller
Dozent(in):	Prof. Dr. Holger Hinz
Sprache:	English
Zuordnung zum Curriculum:	M. Eng. Energie- und Umweltmanagement for ‚Developing Countries', pre-course, compulsory
Lehrform / SWS:	Seminar with max. 25 students /3 SWS
Arbeitsaufwand:	150 hours
Kreditpunkte:	5 ECTS
Voraussetzungen:	none
Lernziele / Kompetenzen:	The course introduces the students to the field of "Business Administration" as a qualification for the M.Eng. Energie- und Umweltmanagement course.
Inhalt:	The course wants to introduce the students to the field of "Business Administration" • Main subjects of organization, production, marketing, finances and strategic planning • All functions are viewed from the perspective of small and medium sized enterprises, where entrepreneurship will also be discussed
Studien-Prüfungsleistungen:	Written examination (approx. 120 min.)
Literatur:	Hodgetts/Kuratko (1998) Effective Small Business Management. Dryden Press. Robbins/Coulter (2003) Management, Prentice Hall. Innovation and Entrepreneurship John Bessant, Imperial College Joe Tidd, University of Sussex ISBN: 978-0-470-03269-5. Barringer/Ireland (2010) Entrepreneurship, Pearson. Nielsen/Klyver/Evald/Bager (2009) Entrepreneurship in Theory and Practice, IDEA, Kolding, DK.

C: Brückenkurs/Preparatory Course in Economics

Studiengang:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung:	Brückenkurs/Preparatory Course in Economics
ggf. Kürzel:	-
ggf. Untertitel:	Basics in Micro- and Macroeconomics / Preperatory course
ggf. Lehrveranstaltungen:	-
Semester:	Before the 1st semester
Modulverantwortliche(r):	Prof. Dr. Bernd Möller
Dozent(in):	Prof. Dr. Roland Menges
Sprache:	English
Zuordnung zum Curriculum:	M. Eng. Energie- und Umweltmanagement for developing countries, pre-course, compulsory
Lehrform / SWS:	Seminar with max. 25 students /4 SWS
Arbeitsaufwand:	150 hours
Kreditpunkte:	5 ECTS
Voraussetzungen:	none
Lernziele / Kompetenzen:	The main objective of the course is to develop a comprehensive introduction to the world of economic thinking as a pre-requisite for a deeper investigation of problems of energy- and environmental management. Pinciples of micro and macro-economics are introduced and discussed within the context of sweeping developments concerning economic growth, the functioning of markets, market intervention, employment and global commerce.
Inhalt:	According to the basic economic literature this course includes the main subjects of micro and macro-economics. The course will focus on an international perspective and discusses academic and political contents.
Studien-Prüfungsleistungen:	Written examination (approx. 120 min.)
Literatur:	• Blanchard (2003) Macroeconomics, Prentice Hall. • Parkin (2008) Economics – seventh edition, Pearson Education. • Pindyck/Rubinfeld (2005) Microeconomics, Pearson Education.

D: Brückenkurs/Preparatory Course in Statistics

Studiengang / course:	M. Eng. Energie- und Umweltmanagement / M. Eng. Energy and Environmental Management
Modulbezeichnung / module name:	Brückenkurs/Preparatory Course in Statistics
ggf. Kürzel / abbreveation	Statistics
ggf. Untertitel / subtitle	-
ggf. Lehrveranstaltungen / seminar:	-
Semester / semester:	Before first semester
Modulverantwortliche(r) / person in charge of module:	Prof. Dr. Bernd Möller
Dozent(in) / person teaching the seminar:	Dipl. Volkswirtin Annika Groth
Sprache / language:	English
Zuordnung zum Curriculum / attribution to courses:	M. Eng. Energy and Environmental Management for ‚Developing countries': Preparatory course for students without knowledge in statistics, elective
Lehrform / SWS / form of seminar / teaching hours per week:	Seminar with exercises / 4 SWS
Arbeitsaufwand / student workload:	150 hours
Kreditpunkte / credit points:	5 ECTS
Voraussetzungen nach Prüfungsordnung/ preconditions according to examination regulations:	none
Modulziele / angestrebte Lernergebnisse / aims of the module / aspired learning outcome:	The students - acquire knowledge to decide appropriate statistics techniques to be applied depending on the type of problem that needs to be solved - are able to, given a sample, describe all relevant aspects of said sample related with the problem at hand - are able to, given a sample, infer information about the population from where the sample came from - are able to solve statistics problems with the use of computers, using special statistics software such as SPSS and utility software like Excel. - are able to write small syntax programs to automatize repetitive work - are able to manipulate existent information in order to create new relevant (to an analysis) information
Inhalt / subjects covered:	Descriptive Statistics: - Important concepts: Population, Sample, Variable, Scales, Interviews, Distribution forms, Standardized values, Outliers - Distribution Tables: Absolute, relative and cumulative distributions

	- Central tendency measures: Mode, Median and mean - Dispersion measures: Range, Variance, Standard deviation, Quartiles, Correlation coefficient - Graphical representation: Bar diagrams, Histograms, Stem and leaf Diagrams, Box plots, Scatter plots, etc. - Relationships between two or more variables: Cross tables, regression analysis Inference Statistics: - Important concepts: Confidence Intervals, Tests, significance, Distribution: Normal distribution, Chi-Square, T, F, Independent and dependent samples. - Tests: T-Test, Independent Test, Anova SPSS: - Introduction to SPSS - Data manipulation: Recoding, Computing, Selection, Index Construction.
Studien- Prüfungsleistungen / form of examination:	Written examination (approx. 120 min.)
Medienformen / media used:	Power point presentations, Computer
Literatur / literature:	Anderson, David et al: (2005): Statistics for Business and economics, South-Western Educational Publishing - McClave, James et al (2004): Statistics for Business and econonomics, 9th edition, Prentice Hall - Green, Samuel B. (2000): Using SPSS for Windows : analyzing and understanding data, N.J. Prentice Hall