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.