Module Skill Energy BSR

- Study course:

Technology and Management of Renewable Energy and Energy Efficiency (TMEE)

(Amended on 12.06.2013)

Module #/Code:	**BSR 1 (T 7)**
Topics:	**Energy Efficiency and thermal insulation in buildings**
Type of course:	**Compulsory module**
Title of module:	**Energy efficiency and heat insulation in buildings**

Aims of the course [Intended competencies]:

Energy efficiency and thermal insulation in buildings are important issues of sustainable energy policies. In fact, there is great (saving) potential in this field of building management and equipment to be used and promoted in the coming years. Professional consulting, planning and implementation of selected measures is the essential prerequisite for product and processes knowledge and taking into account legal requirements and building physics.

The Students

- Can perform thorough analysis of the energy requirements of a building and plan economically and environmentally sustainable energy supply
- Are able to identify existing buildings energy vulnerabilities and develop and present proposals (plans) for efficient restoration
- Know the relevant legislation, especially the EEG, the Renewable Heat Act, the Energy Conservation Code, the Energy Saving Ordinance and the EU Directives applicable to the overall efficiency of practical building renovation
- Can justify the need for enhancing energy performance of buildings, identify energy savings options and advise customers on energy efficiency in compliance with subsidy programs
- Take into account the physical requirements of building materials and insulation materials in terms of thermal protection in course of planning
- Can run and evaluate calculations for components and thermal bridges
- Can plan and computer-simulate measures of thermal insulation of external walls, windows, roofs and basements in course of planning
- Can evaluate building insulation test methods, interpret measurements and economically and ecologically assess and quantify remedial actions
- Can choose innovative building technologies and specific components and qualitatively and quantitatively present their benefits to a customer in course of counseling

Teaching and learning methods	Lecture with integrated activities, experimental setups and exercises	4 SWS Ø weekly hours per semester
Language of teaching	German	
Admission Requirements	No	
Applicability of the module for other courses	The module is compulsory in the dual Bachelor Degree: - Technology and Management of Renewable Energy and Energy Efficiency - TMEE	
Type of study, requirements for the award of credit points	The exam is taken in the form of the presentation and a related technical discussion. Prerequisite for admission to the exam is regular attendance. The language of the exam is German	
If necessary. Number of sessions in the module	N/A	
Frequency of occurrence	Each academic year	
Workload	A total of 150 hours	6 ECTS
Total workload of the module	66/84 (Lectures/self-study)	
Responsible	Prof. Dipl.-Ing. Schradieck	
Name of lecturer	Dipl.-Ing. v. Stosch	
Duration of module	0,5 Academic year	
Semester	3. Academic year	
Grade weight in the final grade	6/180	
Special Notes	–	

Module Skill Energy BSR

- Study course:

Technology and Management of Renewable Energy and Energy Efficiency (TMEE)

(Amended on 12.06.2013)

Content	Lectures	Self-study	Hours total
Project: Energy efficiency and thermal insulation in buildings	**60**	**76**	**136**
Energy savings, identification of energy vulnerabilities	2	2	4
Legal and policy requirements (especially EEG, EEWärmeG, EnEG, Energy Saving Ordinance, EU General Efficiency Directive, Heating regulations	6	8	14
Potential energy rehabilitation measures and their funding	10	12	22
Construction materials, heat flux, heat bridges, insulation materials (selection, processing and cost)	9	12	21
Low-energy, passive house standard, energy certificate	9	12	21
Energy balance calculations and heat protection, detection methods of thermal protection	9	10	19
Cost of building refurbishment measures	7	8	15
Computer-aided planning, calculation and modeling	7	8	15

Suggested reading
(The lecturers provide criteria for the selection and use of literature)

- *Bauer, Helmut (2008):* Handbuch Gebäudeenergieberatung. Praxisleitfaden Gebäudeenergieberater/in (HWK) ; [energieoptimiertes Bauen und Sanieren ; Grund- und Fachwissen zum Lernen und Nachschlagen für alle Gewerke ; EnEV und Energieausweise ; mit Ausblick EnEV 2009]. 2. überarb. und aktualisierte Aufl. Geislingen/Steige: Maurer.
- *Burgtorff, Walter (2009):* Energieausweise verstehen. Technik, Kosten, Konsequenzen. Stuttgart: Fraunhofer-IRB-Verl.
- *Kadel, Peter (2008):* Gebäude-Energieberatung. Grundlagen und Praxis. 2., durchges. Aufl. München: Hüthig & Pflaum (de-Fachwissen).
- *Kerschberger, Alfred; Brillinger, Martin; Binder, Markus (2007):* Energieeffizient Sanieren. Mit innovativer Technik zum Niedrigenergiestandard. 1. Aufl. Berlin: Solarpraxis AG.
- *Schulze Darup, Burkhard (2009):* Energieeffiziente Wohngebäude. 3., vollst. überarb. Aufl. Berlin: Verl. Solarpraxis (BINE-Informationspaket).
- *Simon, Günther (2009):* Das energieoptimierte Haus. Planungshandbuch mit Projektbeispielen. 2., überarb. u. aktualis. Aufl. Berlin: Bauwerk.

Module Skill Energy BSR

- Study course:

Technology and Management of Renewable Energy and Energy Efficiency (TMEE)

(Amended on 12.06.2013)

Module #/Code:	**BSR 2 (T 8)**
Topics:	**Cogeneration, energy conversion, energy distribution and energy use**
Type of course:	**Optional**
Title of module:	**Cogeneration systems (CHP)**

Aims of the course [Intended competencies]:

The multitude of buildings requires different forms of energy and transportation. Due to the use of renewable energy sources the new technological structures and processes change and expand significantly. This can be issultrated by the use of combined heat and power (CHP) and the future development of fuel cell technology. The students should be able to advise clients and investors with regard to an economically and environmentally responsible energy supply and develop customized solutions for buildings engineering.

The Students

- Can list concepts, procedures and methods for ecologically responsible use of energy
- Are familiar with forms of energy and can grasp conversion processes
- Can perform energy calculations and load profiles based on customer data
- Can correctly measure energy storage methods and processes and evaluate economic and environmental effects
- Can assess technical, economic, and environmental aspects of energy transport systems
- Know the principle of decentralized energy supply, can evaluate building power requirements and combine different energy sources in buildings
- Can determine the cost of energy procurement, take into account energy measurement equipment and energy regulations and standards in course of planning
- Can justifiably choose and custom-tailor energy management systems for producers and consumers
- Can evaluate energy, financial and environmental benefits of CHP and present those to clients
- Can advise the customers on efficient power and heat generation using the CHP (or fuel cell)
- Can explain the procedures and methods of cogeneration (CHP and fuel cells), explain the multitude of plant options and interpret evaluation numbers and parameters for the description of performance and efficiency
- Can identify plant components, application areas and technical specifications of existing CHP installations
- Can perform a substantiated selection and dimensioning of a CHP (FC) and draw up a demand profile

Teaching and learning methods	Lecture with integrated activities, experimental setups and exercises	5,2 SWS Ø
Language of teaching	German	
Admission Requirements	No	
Applicability of the module for other courses	The module is optional in the dual Bachelor Degree: - Technology and Management of Renewable Energy and Energy Efficiency - TMEE	
Type of study, requirements for the award of credit points	The exam is taken in the form of the written test. Prerequisite for admission to the exam is regular attendance. The language of the exam is German.	
If necessary. Number of sessions in the module	Energy conversion, distribution and use Combined heat and power (CHP)	
Frequency of occurrence	Each academic year	
Workload	A total of 175 hours	7 ECTS
Total workload of the module	78/97 (Lectures/self-study)	
Responsible	Prof. Dipl.-Ing. Schradieck	
Name of lecturer	Prof. Dipl.-Ing. Schradieck	
Duration of module	0,5 academic year	
Semester	3. academic year	
Grade weight in the final grade	7/180	
Special Notes	–	

Content	Lectures	Self-study	Hours total
Decentralized energy supply (concepts, procedures, methods, virtual power plants)	15	18	33
Energy use	6	8	14
Types and extent of energy use in buildings	3	4	7
Energy use in case of economic and ecological conflicts of interest	3	4	7
Energy Conversion (example - combined heat and power – CHP)	35	49	84
Energy and environmental evaluation of the CHP (Performance, efficiency, pollution balance)	3	3	6
The basic idea of cogeneration, plant overview and estimate figures for CHP plants	3	6	9
CHP variants (combustion engine, Stirling engine micro gas turbines, steam engine)	7	8	15
Fuel cells, energy assessment	4	4	8
Approval and planning of CHP plants, on-site fuel supply and exhaust system for cogeneration plants (and fuel cells)	4	4	8
System components and technical integration into existing installations	6	12	18
Dimensioning and economic analysis of a CHP plant	7	8	15

Suggested reading
(The lecturers provide criteria for the selection and use of literature)

- *Picot, Arnold; Neumann, Karl-Heinz (2009):* E-Energy. Wandel und Chance durch das Internet der Energie. Berlin, Heidelberg: Springer-Verlag.
- *Rebhan, Eckhard (2002):* Energiehandbuch. Gewinnung, Wandlung und Nutzung von Energie ; mit 202 Tabellen. Berlin: Springer (Engineering online library).
- *Schaumann, Gunter; Schmitz, Karl W (2009):* Kraft-Wärme-Kopplung. 4., vollst. bearb. u. erw. Aufl. Berlin: Springer Berlin (VDI-Buch).
- *Schwab, Adolf J (2009):* Elektroenergiesysteme. Erzeugung, Transport, Übertragung und Verteilung elektrischer Energie. .
- *Steck, Michael Roon Serafin von (2009): Dezentrale Bereitstellung von Strom und Wärme. Effizienzvorteile,Techniken, Potenziale und das Konzept des virtuellen Kraftwerks. In: uwf - UmweltWirtschaftsForum, Jg. 2009, H. Volume 17, Number 4, S. 313–319.*
- *Suttor, Wolfgang; Johler, Matthias; Weisenberger, Dietmar (2009):* Das Mini-Blockheizkraftwerk. Eine Heizung, die auch Strom erzeugt; mit neuen Gesetzen und Fördermaßnahmen ab 1.1.2009. 5., überarb. und erw. Aufl. Heidelberg: Müller (Energietechnik).
- *Thomas, Bernd (2007):* Mini-Blockheizkraftwerke. Grundlagen, Gerätetechnik, Betriebsdaten. 1. Aufl. Würzburg: Vogel.

5. Technical specialization modules (Project)[1]

Modul-Nr./Code:	**TS 5 (New)**
Topics:	**Project: Biogenic Energy Technology - Energy Conversion**
Type of course:	**Optional module**
Title of module:	**Project: Heat generation from biomass**

Aims of the course [Intended competencies]:

Heat generation from biomass has a very long tradition. The increasing scarcity of fossil fuels has led to dedicated development of such resource saving technologies in recent years, in particular to increasing their efficiency and environmental compatibility.

Other advantages of this technology can be seen in the regional availability of energy sources and the primary energy rating.

These systems can be configured as mono-, bi-or multivalent heating systems. Possible integration into the existing plants and high level of automation require individual planning specialists.

The project offers students the skills related to structure, function, design, installation and operation of biomass plants. Apart from the technological view the course also looks into system-specific components, system solutions, safety and environmental aspects as well as the economics for providing expert advice and related implementation.

The Students
- Can schematically present and evaluate structure and function of biomass heating systems
- Can select and evaluate different applications of specific biogenic fuels
- Can develop and present system solutions
- Can determine detailed costs and benefits and perform long-term profitability analysis
- Can identify the on-site requirements and apply for permits
- Can calculate the dimensions of a biomass heating system and use computer tools to select the required components and calculate the performance index
- Can counsel the client and simulate the planned systems with the help of computer programs
- Can draw up works and installation and maintenance schedule for the system
- Can professionally install the plant and collect and evaluate the operating data

Teaching and learning methods	Lecture with integrated activities, experimental setups and exercises	4 SWS Ø
Language of teaching	German	
Admission Requirements	No	
Applicability of the module for other courses	The module is optional in the dual Bachelor Degree: - Technology and Management of Renewable Energy and Energy Efficiency - TMEE	
Type of study, requirements for the award of credit points	The exam is taken in the form of the presentation and related technical discussions. Prerequisite for admission to the exam is regular attendance. The language of the exam is German	
If necessary. Number of sessions in the module	N/A	
Frequency of occurrence	Each academic year	
Workload	A total of 125 hours	5 ECTS
Total workload of the module	60/65 (Lectures/self-study)	
Responsible	Prof. Dipl.-Ing. Schradieck	
Name of lecturer	Prof. Dipl.-Ing. Schradieck	

[1] These are 2 of 5 optional technical specialization modules (projects) according to the specific practical orientation and individual interests of the student. To enable review of issues particularly relevant to the market and / or innovative content, there is a provision for individual adaptation of the module in the amount of up to 12 teaching hours while maintaining the total number of hours (lecture hours, self-study) by the lecturers / if possible. The adjustments are made for the participants at the beginning of the module.

Module Skill Energy BSR

- Study course:

Technology and Management of Renewable Energy and Energy Efficiency (TMEE)

(Amended on 12.06.2013)

Duration of module	0,5 academic year
Semester	4. academic year
Grade weight in the final grade	5/180
Special Notes	Thematic adjustments on the part of teachers up to d max. 12 study hours are possible for issues relevant to the market and / or innovative content.

Contents	**Lectures**	**Self-study**	**Total**
Project: Heat generation from biomass	**60**	**65**	**125**
Fuels and combustion processes, Endothermic and Exothermic Processes	6	6	12
Boiler types, components and function, manual, semi-automatic and fully automatic operation	8	6	14
Fuel cycle, hydraulic integration, buffer dimensioning of the components	6	6	12
System concepts	6	6	12
Fuel storage, technical preparation and dimensioning	4	4	8
Exhaust system, calculation and planning, emission control, emission testing, emissions	8	8	16
Approvals and requirements, placement and installation	4	4	8
Electrical installation, control	6	6	12
Exemplary planning, specifications	4	4	8
Economic considerations	4	7	11
Documentation and presentation of the project	4	8	12

Suggested reading
(The lecturers provide criteria for the selection and use of literature)

- *Hammerschmid, Alfred und Obernberger, Ingrid (1998):* Dezentrale Biomasse – Kraft-Wärmekopplung, Band 4 Techn. Universität Graz, dbv-Verlag
- *Clausnitzer, Claus-Dieter (2008):* Biomasseheizungen für Wohngebäude, Fraunhofer irb-Verlag
- *Schulz, Marion und Westkämper, Hubert (2013):* Die neue Heizung – umweltfreundlich und wirtschaftlich mit Gas, Holz, Strom, und Sonne. Ökobuch
- *Acatech von Springer, (Juni 2012):* Biotechnologische Energieumwandlung in Deutschland, Kontext, Perspektiven, Kindle Edition

Lifelong Learning Programme

This project has been funded with support from the European Commission.

This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.