Energy Systems
Master of Science

FACULTY 10
ENERGY TECHNOLOGY

FH AACHEN
UNIVERSITY OF APPLIED SCIENCES


Nicht
öffnen

You will find all relevant information with respect to the course of studies Energy Systems in the internet. For that purpose, just photograph the QR code and use the adequate reader of your mobile phone*.

* Please note: Costs may arise upon initiating the web page.

Introducing the degree programme

Introduction to the Master of Science in Energy Systems

Both energy consumption and its impact on the environment are currently major issues in modern society and will be of great significance in the future. These topics raise many questions. If energy consumption increases over the next few decades, what effect will this have on global warming? How will we secure reliable energy sources if energy consumption continues to increase? How can renewable energy take over a larger share of the energy market in the future? Could nuclear energy be part of the solution? What is the best way of reducing CO_2 emissions?

One thing is certain: many more engineers will be needed in the future for the development of new energy conversion technologies, the improvement of the efficiency of conversion processes, along with the development of biofuel technologies, solar and wind energy as well as hydrogen technology.

The FH Aachen, Jülich Campus, has long-standing experience in the field of energy technology. The Jülich Campus was founded in 1971 to train and educate mechanical and electrical engineering students in the field of energy technology, especially those with a nuclear background. The Campus is located near the Research Centre Jülich. With more than 1000 scientists and 4000 employees, the Research Centre Jülich is the largest of its kind in Europe. One of the major research fields conducted there concerns energy, in terms of the development of fuel cells, high temperature materials and energy efficiency.

The Master of Science in Energy Systems is conducted in cooperation with

the Research Centre Jülich. Many of the scientists from the Centre give lectures during the course. Two professors in this department are leading members of the Institute for Fuel Cell Development at the Research Centre Jülich.

The Solar Institute Jülich was founded in the early 1980's and has long been a major player the field of renewable energies. Four professors of the supervisory board of the Solar Institute Jülich are also closely involved in the organization and teaching of the M.Sc. in Energy Systems.

The medium of instruction is English, the students are from many different countries, and the course is designed mainly for holders of a Bachelor's degree in mechanical, electrical or chemical engineering. The entire range of energy technology is covered and students have a large choice of elective courses in the third semester. The Master's thesis can be conducted in research institutes, in industry or at the university.

Graduates of this program are very well-received in industry and research institutes as well as in the civil service.

The area of energy and environmental technology holds great perspectives for young, dynamic engineers, both male and female. Climate change is a much-discussed topic at present, and will remain so in years to come.

Energy Systems

Career opportunities worldwide successful

Career opportunities for graduates of the Master of Science in Energy Systems programme span many areas, ranging from fossil fuel production and renewable energy sources, through to nuclear power-related industries. However, not only energy companies are interested in the graduates of this Master's course; the topic of energy efficiency and CO_2 conversion is gaining importance for almost all industries and organisations.

What can be said about the new developments in the energy industry?

- The petroleum industry is and will continue to be the dominant energy provider and is still a growing industry.
- The natural gas and coal industries are growing much faster than the petroleum industry.
- Renewable energy sources will play a significant role in the energy market only on a long-term basis.
- Satisfying the global demand for energy remains a huge challenge.
- Energy prices will rise to unknown levels in the future.

This means that the demand for experts working in these industries will rise dramatically. The energy industry will earn huge amounts of money, which must be re-invested in better, more efficient technologies and new development. This is true for all energy sectors, from crude oil production to hydrocarbon products, from coal mining to coal consumption in power plants and chemical industries, from biofuel production to the newly-developed combustion processes and from the development and industrial use of renewable energy plants such as solar power plants, wind generators, and geothermal energy.

Find more information at:
http://infobub.arbeitsagentur.de/berufe/
Suchbegriff: Ingenieur/in Maschinenbau - Regenerative Energietechnik

New, improved energy conversion technologies, energy efficiency and research in the field of renewable energies will become major issues over the next few decades. The utilisation of nuclear energy may also be of great significance in the future.

All these undertakings, from the improvement of the efficiency of existing plants, vehicles, HVAC systems, through to the implementation of new energy technology such as fuel cells, solar power plants, the production and use of biofuels or hydrogen technology, are all challenges which will create many new jobs for young, ambitious engineers.

Graduates of the Master of Science in Energy Systems at the FH Aachen are equipped to work on all the problems described above: the reduction of CO_2 emissions, the development of new energy technologies, and the reduction of environmental damage.

This is indeed an exciting perspective for young, dynamic graduates.

The Master of Science in Energy Systems programme has been part of the University's Master's Program since 2001 and from experience already gained, we know that our students usually are able to find places to complete their Master's thesis in relevant industries, in research institutes or partner universities, and occasionally in civil service. The same applies to our graduates.

Topics such as the efficient use of resources, the development of renewable energy systems, biofuel development, the influence of energy conversion technologies on the environment, and new energy transfer technologies are under discussion daily; such issues will be instrumental in determining our future. Due to the looming threat of energy shortages and increasing climate changes (carbon dioxide emissions), interesting areas of employment have arisen for young engineers, for example, in the modernisation of power stations in Germany and abroad. In Germany alone, around 20 billion euros will be invested in new power plants over the next few years. This means that a large number of new engineering positions will become available in this area. The type of knowledge and training required to take advantage of this corresponds to a large extent with the course profile offered here.

Over the last few years, the renewable energy sector has enjoyed a growth rate in double figures. Included here are solar technology, wind and biomass energy. Career opportunities in this area will multiply over the next few years.

Research in the area of combustible fuel cells is becoming ever more practically-oriented, opening up a wide area of possible employment to engineers. Energy-saving technology will

be introduced in all areas of industry, and engineers specialising in energy and the environment will be in demand. All large industrial plants, especially power plants, must now comply with strict planning and authorisation restrictions.

The authorisation processes are complicated and need appropriately qualified engineers to undertake this work. In all branches of industry, changes in the use of energy will take place and compliance with environmental regulations will be required. Similarly, in this area, energy and environmental engineers will find employment.

The construction of plants that produce electricity as well as heat (combined heat and power generation) is an area where German technology leads the world. This is also a typical area of employment for engineers educated in our programs. Mention here should also be made of the engineers who work to secure our daily energy supply.

Because of the strong tendency towards obsolescence in this field, many new positions are regularly created, giving young engineers ideal employment opportunities.

German technology is in great demand all over the world, which means that many young engineers are employed in the export sector, whether in planning, construction, maintenance and service, or in consultancy. Career opportunities here are good, in some cases excellent.

Graduates of the Master of Science in Energy Systems programmes can expect to enjoy a wide choice of career opportunities in their field once qualified. The areas of possible employment are extremely varied, and offer career advancement for engineers of differing aptitudes.

Skills and Expertise
energy and environment

The Master of Science in Energy Systems programme is designed in way that Bachelors with good basic engineering knowledge get the skills needed in the energy sector for positions as engineering manager, research and development engineer, engineer in higher administrative positions, and leading construction engineer.

Energy and economics semester | The energy and economics semester includes the following modules:

- Industrial Energy Technologies,
- Modelling of systems and processes,
- Energy economics and policy,
- Business Administration.

Knowledge in industrial energy technologies is an essential part of the course, with the topics of power plant engineering, renewable energies and thermodynamic laboratory practices. Module modelling of systems and processes is an introduction to modern modelling techniques which will become very important in the near future. Our graduates shall have a sound knowledge in energy economics, business administration and energy policy; this is taught in separate modules.

Energy-Related Elective Semester | During the third semester, the student can select from a large list of electives in a wide range of energy- related specialisations. This is possible due to the fact that many of the elective modules and lectures are conducted by the scientists of the Research Centre Jülich (FZJ), the Solar Institute Jülich (SIJ) and experts from energy-related industries. One of the modules can be completed as assignment at a company, research institute or engineering office. The resulting scientific report will be defended in front of the supervisors from the university or industry.

Master's Thesis Semester | The fourth semester is reserved for the Master's thesis and the final colloquium which concludes the Master of Science in Energy Systems programme. The Master's thesis is normally the result of research activity and demonstrates the ability of the candidate. It should be related to the energy sector where the student plans to be employed.

Before you start

Admission and language requirements

We are happy to receive your application and consider you for admission. For actual admission requirements, please refer always to our homepage. Admission requirements are a Bachelor of Science, Bachelor of Engineering, Dipl.-Ing., Dipl.-Ing.(FH) degree or equivalent in mechanical engineering, electrical engineering or chemical engineering.

Application | We take new students in the Master's programmes in the summer and also in the winter semester. We only accept online applications: : www. fh-aachen.de/en/programmes/energy-systems-m-sc/application.

Bachelor Degree | Applicants from outside European Union: At the time of application upload final Bachelor Degree and all academic transcripts showing grades for all years of university study (Including a official translation into English or German if necessary). Applicants from European Union: If the final Bachelor Degree will be completed before the beginning of the program, upload all academic transcripts showing grades for all years of university study.

English language certificate | IELTS 5.5 or higher or TOEFL Interned based Test 68. German Abitur or Fachhochschulreife with a minimum mark of 3 (befriedigend) in English. English is your native language: This is only valid if you have attended at least 4 years of secondary school and enclose a school certificate showing your grades for the entire period of enrollment.

German language certificate | Applicants whose native language is not German or did not attend a degree porgram taught in German at a German language university must submit proof of German language certificate at the level B1 by application.

Additional requirements for online application | Curriculum Vitae. Course comparison list (You find it in the online portal).

The practical degree programme Energy Systems

Contacts in industry

The excellent contacts with industry which exist in the field of Energy and the Environment are based, among other things, on:

- the competence platform “Energy and the Environment“ comprising 13 professors and two scientific facilities,
- the project “Education and Training“ undertaken together with selected partners in industry and the research center FZJ in collaboration with the PowerTech Training Centre in Essen and their specialist training in Energy Studies.

All the important energy conversion processes – regenerative, fossil and nuclear – are represented in this project with industry.

These contacts are cultivated through the competence platform and offer students optimal conditions to work with partners from industry early in their academic careers (during their Bachelor’s or Master’s projects) as well as in corresponding seminars. It is, therefore, possible for our students to enjoy a seamless transfer from their studies to their chosen career. The following chart shows some of our partners from industry in North Rhine-Westphalia.

Thanks to the various research activities undertaken in the Mechanical Engineering programme, professors and staff working in the area of Energy and the Environment can report excellent relations with universities and research institutes at home and abroad.

Globalisation has meant that we have been able to develop good relations with universities and research institutes

world-wide, and offer students the opportunity within their study program to spend a semester abroad. Moreover, internships and Bachelor's/Master's theses can also be completed abroad. These often take the form of specialised projects. A good knowledge of English, or, in the case of South America, Spanish, is required if students wish to participate in such programmes.

Curriculum
Starting Summer

No.	Name of module	C/E	Cr	SWS L	SWS T	SWS Lab	SWS SU	SWS ∑
1st semester								
101310	Energy Engineering	C	10	5	2	2	0	**9**
103360	Materials in Energy Systems	C	5	-	-	-	-	**-**
101320	Applied Thermodynamics and Heat Transfer	C	5	-	-	-	-	**-**
101330	Mathematical Tools and Simulation	C	10	3	2	4	0	**9**
Total			**30**	**-**	**-**	**-**	**-**	**-**
2nd semester								
102341	Power Plant Technology	C	5	2	2	0	0	**4**
102342	Renewable Energies	C	5	2	2	0	0	**4**
102301	Basics and Application of Chemical Reaction Theory	C	4	2	2	0	0	**4**
102302	Advanced Control Systems	C	4	2	2	0	0	**4**
102303	Modeling of Material Transport	C	2	2	0	0	0	**2**
102311	Business Adminsitration	C	5	4	0	0	0	**4**
102312	Energy Economics and Policy	C	5	4	0	0	0	**4**
Total			**30**	**18**	**8**	**0**	**0**	**26**
3rd semester								
103xxx	Elective Modules	E	30	-	-	-	-	**-**
Total			**30**	**-**	**-**	**-**	**-**	**-**
4th semester								
	Master‘s Thesis	C	25					
	Colloquium	C	5					
Total			**30**					

Cr: Credits
L: Lecture
C: Compulsory
T: Tutorial
E: Elective
Lab: Laboratory
SWS: Contact hours per week
SU: Seminar

Curriculum Starting Winter

No.	Name of module	C/E	Cr	SWS L	T	Lab	SU	∑
1st semester								
102341	Power Plant Technology	C	5	2	2	0	0	**4**
102342	Renewable Energies	C	5	2	2	0	0	**4**
102311	Business Administration	C	5	4	0	0	0	**4**
102312	Energy Economics and Policy	C	5	4	0	0	0	**4**
103xxx	Elective Module 1	E	10	-	-	-	-	**-**
Total			**30**	**12**	**4**	**-**	**-**	**16**
2nd semester								
101310	Energy Engineering	C	10	5	2	2	0	**9**
103360	Materials in Energy Systems	C	5	-	-	-	-	**-**
101320	Applied Thermodynamics and Heat Transfer	C	5	-	-	-	-	**-**
101330	Mathematical Tools and Simulation	C	10	3	2	4	0	**9**
Total			**30**	**13**	**8**	**6**	**0**	**27**
3rd semester								
102301	Basics and Application of Chemical Reaction Theroy	C	4	2	2	0	0	**4**
102302	Adcanced Control Systems	C	4	2	2	0	0	**4**
102303	Modeling of Material Transport	C	2	2	0	0	0	**2**
103xxx	Elective Modules	E	20	-	-	-	-	**-**
Total			**30**	**6**	**4**	**0**	**0**	**10**
4th semester								
	Master‘s Thesis	C	25					
	Colloquium	C	5					
Total			**30**					

Cr: Credits C: Compulsory E: Elective SWS: Contact hours per week
L: Lecture T: Tutorial Lab: Laboratory SU: Seminar

No.	Name of module	C/E	Cr	SWS L	T	Lab	SU	∑
Elective modules (examples, the offer can change in winter and summer term)								
103301	Finite Element Methods	E	5					
103623	International Management I+II	E	5					
103611	Plant Design	E	5					
103613	Lifecycle Assesment	E	2.5					
103618	Simulation Methods	E	5					
103626	Assessment of Energy Systems	E	5					
103617	Management Techniques of Engineers	E	5					
103621	Simulation and Optimization in Virtual Engineering	E	5					
103101	Fuel Cells for Stationary Application	E	2.5					
103608	Aerosol Technology	E	2.5					
103105	Fusion Technology	E	2.5					

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E: Elective
Lab: Laboratory
SWS: Contact hours per week
SU: Seminar

Compulsory modules

101310 **10 Credits**

Energy Engineering | *Prof. Dr.-Ing. Herbert Lauter*

The students shall be able to analyze existing process systems and design simple chemical and thermal plants. They should be able to calculate the process parameters for those systems and identify adequate process for different problems.

Fundamentals of Chemistry | *Prof. Dr. rer. nat. Ulrich Scherer*

Students know fundamental principles of Chemistry to understand chemical reactions and analyse relationships between structure and molecular properties. They know the Periodic Table of Elements and its relationship to atomic structure. Students can formulate balanced chemical equations and predict the outcome of simple basic reactions (neutralisation, precipitation, and redox). They are able to use the law of mass action and calculate equilibrium constants as well as the composition of reaction mixtures in equilibrium and can interpret them. They can apply the law of mass action to calculate pH of strong and weak acids and bases, as well as buffer solutions and to quantitatively predict the outcome of precipitation reactions. They understand the electrochemical series and can calculate the potential of redox couples and predict the outcome of redox reactions based thereupon.

Electrical Engineering | *Prof. Neubauer*

The students get the ability to design networks for normal operation and operation in some fault situations. They will be able to explain and assess the task and structure of important components of electric power networks. The students get the ability to explain, assess and analyze the operation of electric power networks.

101320 **5 Credits**

Applied Thermodynamics | *Prof. Neubauer*

Students are able to apply, analyze, design and assess thermodynamic systems, including the 1st and 2nd Law of Thermodynamics for closed and open thermodynamic systems; assessment of thermodynamic cycles; They can design and evaluate heat exchangers with the 3 heat transfer principles: conduction, convection, radiation.

101360 **5 Credits**

Materials for Energy Systems | *Prof. Dr. W. J. Quadakkers*

Students are able to select construction materials to be used for components in power generation systems. They can work with strengthening mechanisms used in the different classes of metallic materials for low and high temperature applications. They can select the right materials for use in boilers, heat exchangers and waste heat recovery boiler. They can select the proper methods to protect the metallic components against the aggressive service environments at the high service temperatures.

101330 **10 Credits**

Mathematical Tools and Simulation | *Prof. Dr. Martin Pieper, Prof. Dr. rer. nat. Gerd Breitbach*

The student is able to apply and evaluate mathematical methods mainly in the field of linear algebra and differential equations. In particular, the theoretical means for the investigation of technical processes are provided. Moreover, the software package MATLAB is introduced and used which, among other things, enables the students to compute even complicated nonlinear processes easily.

102341 **5 Credits**

Power Plant Techniques | *Prof. Dr.rer.nat. Boris Neubauer*

The students are able to distinguish, compose and compare different power plants and their design and operation. They can analyze, compose and evaluate electrical transmission systems and distribution networks.

102342 **5 Credits**

Renewable Energy Sources | *Prof. Dr.rer. nat. Boris Neubauer*

The students can analyze and assess the use of renewable energy sources including their economical viability and their environmental impact .

102301 **4 Credits**

Basics and Applications of Chemical Reactions | *Prof. Dr.-Ing. Ralf Peters*

The student is able to analyze and compose chemical reactors and other units of process engineering in dynamic operation. He/she can practice La place transformation; simple differential equations: analytic and numerical solution. The students are able to set up Heat transfer energy process engineering systems, Start-up and transient behavior of reactors with heat transfer and Fuel processing for fuel cell systems.

102302 **4 Credits**

Advanced Control Systems | *Prof. Dr. Martin Pieper*

The student knows the principles and procedures of modeling. He/she can derive simple models of processes based on balance equations. He/she can apply the Laplace transform to derive the transfer function of a system from its differential equation. He/she can implement these models into Matlab/Simulink. He/she can describe the behavior of simple control loops and can apply different controller tuning methods to these examples. He/she knows the most important valve characteristics and how they can influence the linearity of a control loop. He/she knows the common control strategies for the most common process variables like flow, pressure, level etc. He/she has an overview over more advanced control strategies like predictor control, adaptive and multivariable control.

102303 **4 Credits**

Modelling of Material Transport in the Environment | *Prof. Grömping*

The student is able to apply, analyze and compose the mathematical solutions of the below mentioned problems, i.e. advection/diffusion with differential equations in special geometries and the derivation of input parameters observed in the environment.

102312 **5 Credits**

Energy Economics and Policy | *Prof. Dipl.-Math. Jürgen-Fr. Hake, Prof. Dr. Ulrich Daldrup*

The students can interpret and analyze processes and trends in global, European and national economy and energy policy. They are able to debate and assess - basic facts about energy economy and energy policy - the interactions between energy economy and energy policy - the role of energy economy and energy policy in the context of sustainable development

102311 **5 Credits**

Business Administration | *Prof. Dr. Ulrich Daldrup*

The student is able to analyze and evaluate organizational structures and processes of enterprises and organizations He/she is able to realize, apply and set up business ideas leading to a business concept

Elective modules

103301 **5 Credits**

Finite Element Methods | *Prof. Breitbach*
The students can analyze and assess the basics of the theory of Finite Elements (mainly referring to mechanical problems). They can work with the application of FE software and are able to solve given problems.

103623 **5 Credits**

Plant Design | *Prof. Groß*
The students will be able to plan a power plant with the necessary technical and backround. They also will be able to consider the necessary laws.

103613 **5 Credits**

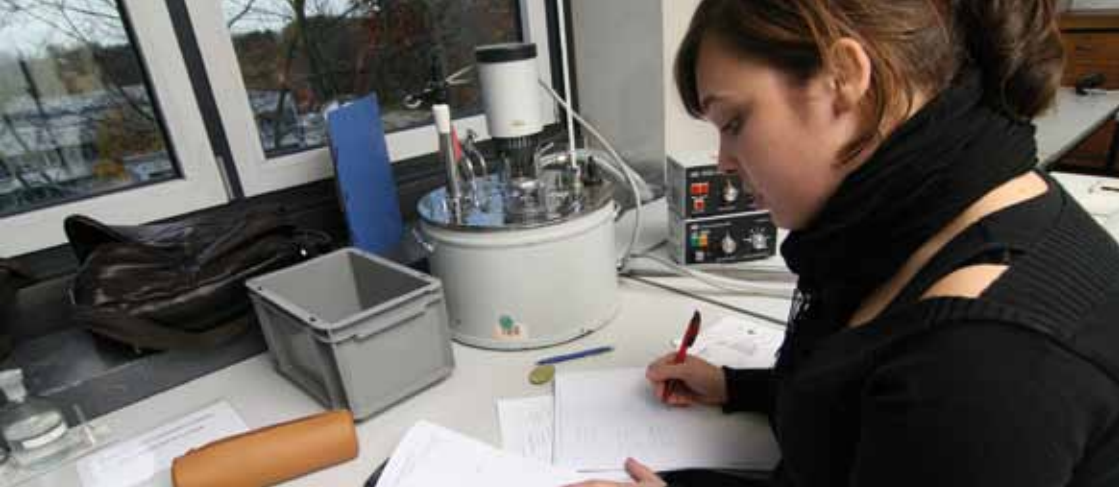
Simulation Methods | *Prof. Pieper*
The students can analyze and solve heat transfer problems. They are able to simplify the problems by exploiting symmetries and neglecting minor physical phenomena. This includes the mathematical methods and the implementation in conventional simulation software.

103617 **5 Credits**

Management Techniques of Engineers | *Prof. Butzek*
The students are able to understand the basics of project management, allowing them to work in a project team as well as leading small and medium size projects. This includes using tools and techniques of project management, risk management, general work management and understanding human factors in team work. In addition students will understand the basics of quality management.

103613 **2,5 Credits**

Lifecycle Assessment | *Dr. Zapp*
Basic introduction in ecological evaluation, tutorial into LCA guidelines and standards, goal and scope of LCA's, description of different steps during Life Cycle Inventory, assignment of emissions to ecological effects during the Impact Assessment, interpretation of results, examples, own basic calculations



103621 **5 Credits**

Simulation and Optimization in Virtual Engineering | *Prof. Pieper*

The students can analyze and solve virtual engineering problems from mechanics, electronics and thermodynamics. This includes the work and handling with standard simulation software, as well as the necessary theoretical background. They are able to identify optimization potential and to formulate these problems in mathematical terms. Further the students know how to couple simulations with optimization methods. This also includes the simplification of the underlying engineering problems by exploiting symmetries and neglecting minor physical phenomena.

103608 **2,5 Credits**

Aerosol Technology | *Prof. Helsper*

The student understands the most important effects in aerosol physics and can apply this knowledge to solve practical problems. He or she knows the common measurement principles used to determine particle size, particle mass concentration and particle number concentrations and is able to estimate which instrumentation should be used for a certain measurement problem. He or she can describe the common methods used for the generation of test aerosols e.g. for calibration purposes.

103101 **2,5 Credits**

Stationary Application of Fuel Cells | *Prof. Blum*

The student can compare, analyze and compose the function of different fuel cell systems. Furthermore he / she is able to design the process of fuel cell systems. They learn: Fundamentals of Fuel Cells, Fuel supply; Efficiency; function and design of different fuel cell types, requirements on the fuel cell installation; process engineering of different fuel cells for different applications; state of the technology

General Information

Organisational Matters

Programme duration, commencement of study and course structure | Programmes at the FH Aachen are offered in modules and ECTS-credit points are awarded. Including the Master's thesis, the standard length of the programme is two years (four semesters) or 120 ECTS-points. Lectures are held in English.

Fees and the cost of the programme | Every semester all students must pay a social contribution to the Studentenwerk (Student Services) and a student contribution, to the work of the ASTA (General Student's Committee). These include the semester ticket of the ASEAG (Aachen Public Transport Association). The amount is determined each semester. The listing of each of the current fees is at *www.studierendensekretariat.fh-aachen.de.*

Information about the living costs you find here http://www.fh-aachen.de/en/university/department-of-international-affairs/international-students/

Contact | All questions about the program „Energy Systems" please send to energysystems@fh-aachen.de

Application Documents | We only accept online applications. Please refer to our homepage, there you find all actual informations and the link to the application portal.

Application Deadline | We take new students in the Masters' programmes in the summer semester and also in the winter semester.
You find all informations on our homepage.

For further information | *www.fh-aachen.de/ en/programmes/ energy-systems-m-sc. Questions please to energysystems@fh-aachen.de*

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