M.Sc.
Energy Engineering
Foreword Dean

Energy is of crucial importance to global development. Challenges in the power sector are nowadays more far-reaching than to any other point in time, facing significant political, economic, social and ecological consequences.

In order to tackle these complexities, highly qualified engineers with awareness of the true scope of most recent needs of the energy sector are urgently required. The Campus El Gouna of Technische Universität Berlin provides young passionate engineers with most necessary skills to achieve excellence.

Pursuing a master program at TU Berlin Campus El Gouna offers the exceptional opportunity to study at two very distinct locations that differ tremendously not only in size but also in their social, cultural, and ecological characteristics.

The campus houses apart from the energy department, a water department and urban development department. Consequently, students from more than 20 nations are exposed to a true interdisciplinary and international surrounding.

This unique set-up constitutes ideal conditions for the students of Energy Engineering to apply their newly gained knowledge to a wide number of diverse conditions, environments and applications.

In great hopefulness, that this brochure can not only reveal the true potential of the master program Energy Engineering but also catch your personal interest. In any case we succeeded in reaching your curiosity, we are very much looking forward to your application and meeting you soon at the campus.

Sincerely,

Prof. Tetyana Morozyuk
Dean of Energy Engineering Department
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I. Why study Energy Engineering?

Certainly energy is of crucial influence to global development. Due to the increasing requirements for energy and its carbon based generation, however, a range of serious problems have evolved, such as the exhaustion of resources, air pollution and global warming. Concerns in the power sector confront major political, economic, social and ecological consequences. Renewable energy technologies include biofuels, solar heating and cooling, solar power, as well as water and wind power. Research and development at universities and industries faces the challenge of how to find innovative concepts for a safe, sustainable, and economic energy supply in the future.

The Energy Engineering Master’s program at TU Berlins Campus El Gouna is trying to cover the real scope of energy and to provide students with the necessary skill and mindset to tackle most recent challenges in the energy industry, in particular energy challenges in the MENA region. The EE program deals with the design, development, optimization and realization of fossil fuel- and renewable energy-based energy-conversion plants. Meanwhile the EE Program covers the application of information technologies developed in the energy domain. Main application areas are within electricity generation, energy storage and consumption. Students will learn how to analyze, design, and implement their knowledge to significant and complex urgencies in the field of energy, e.g. increasing energy efficiency and cost- and environmental effectiveness of energy conversion processes. Both winter terms of the 2-year program take place at the brand new Campus in El Gouna. In summer the whole campus travels to Berlin. Students are thus exposed to two very different study environments, offering a unique interdisciplinary and intercultural experience. The Master’s degree program offers advanced education for students and young professionals holding a Bachelor’s degree or academic equivalent in engineering or natural sciences. On successful completion of the program, students will graduate with an official Master’s of Science degree in Energy Engineering from Technische Universität Berlin.
II. Why Campus El Gouna?

On 28 October 2012, the Technische Universität Berlin has initiate its first satellite campuses in El Gouna a touristic town in Egypt. With three departments: Energy Engineering, Urban Development and Water Engineering the campus scientific focus addresses the main issues of the MENA (Middle East and North Africa) region at present. Acting as the scientific hub of TU Berlin in the MENA region. As a scientific field office of Technische Universität Berlin in Egypt, the campus provides a fully equipped environment for studying, research and development as well as for cultural and scientific events.

The practical orientation of the master's programs offered at the Campus El Gouna necessitate high quality equipment. The large technical hall of the energy department along with different laboratories, field and testing equipment offers a wide range of research opportunities. The Campus El Gouna allows lab-scale testing of most recent technologies, such as a solar thermal energy assisted absorption chiller or a fuel cell training system. As well an extraordinary variety of education plants and test benches is available (e.g. desalination unit, ice stores in refrigeration, steam power plant).
Apart from the photovoltaic (PV) test field comparing eight different PV panel technologies and various system configurations, the campus is equipped with its own weather station. Recently the installment of a combined power system on campus ground started (PV, Wind, Battery storage and variable consumer). Furthermore all computers in the campus’ PC pool are equipped with latest software such as (Aspen, Dymola, EpsilonProfessional, Matlab, Modelica, Meteonorm, Polysun etc.) extending the analysis and performance tests with simulation and calculation tools.

Not only the brand new campus and its facilities offer unique study environment but as well its location. As TU Berlin’s professor are flown in only for the purpose of teaching their module in intensive classes, students are awarded an out of the ordinary attention. In addition, classes are kept at about 30 students, allowing a large variety of most effective teaching method and a personal contact to most renowned professors.
III. Why TU Berlin?

The Technische Universität Berlin counts to Germany’s internationally renowned technical universities. With nearly 32,000 students at Technische Universität Berlin, the main campus is not only a significant contrast to the offshore Campus El Gouna but also one of the largest and most traditional universities in all Germany. Technische Universität Berlin not only stands out in its size but rather with its exceptional education and outstanding research achievements. TU Berlins’ core goal is “to facilitate the development, implementation and transfer of innovative technologies”. The seven faculties of Universität Berlin bridge the gap between natural and technical science, planning, economics and social science and humanities. About 100 different programs are offered by a total of 40 institutes.

Berlin, Germany’s Capital city, is at “the heart of Europe” and thus TU Berlin has a broad international outreach. Berlin houses headquarters to many high-ranked international companies enabling TU Berlin to ensure a close cooperation between science and industry.
Moreover, Technische Universität invests large effort into promoting gender equality and increasing the involvement of women in study and research. There are a lot of initiatives at TU Berlin supporting e.g. women, young families, young entrepreneurs and entry level graduates. Students of TU Berlin Campus El Gouna are able to take part in all activities offered in TU Berlin being considered and matriculated as regular students.

This includes entrance to most modern libraries, personal internet access at most universities across Europe, career advisory services, as well as leisure at TU Berlin Sports, discount prices for most activities (e.g. cinemas, concerts, museums etc.), free public transportation in Berlin, foreign language training and much more. Number of famous scientists and researcher graduated from TU Berlin such as Konrad Zuse (1910-1996) First Process-Controlled Calculating Machine.

Activities offered at TU Berlin main campus
(Power-Fitness-Mix class, Berlin Long Night of Science, Berlin Firmenlauf 2015, TU Berlin gym)
IV. Study content

The Master’s degree program “Energy Engineering” at Campus El Gouna focuses on fundamental and applied aspects of energy engineering, including both conventional and renewable energies. Energy engineering is considered in its whole, including most recent issues such as integration of renewable energies and energy storage, as well as energy systems design, evaluation and optimization. While it integrates the latest scientific developments and methods, it also pays attention to the economic, ecological, social and industrial applicability.

To complement the theoretical studies, the students work on projects that address most frequent applied problems.

The curriculum for the Master’s program “Energy Engineering” focuses on four different study areas:

- Energy Conversion and Components
- Energy Systems and Economics
- Electrical Energy Engineering
- Interdisciplinary Studies and Projects
- Master thesis, Electives and Internship

Curriculum of the Energy Engineering Master’s program at TU Berlin Campus El Gouna
Energy Engineers need a detailed knowledge of energy conversion system design and operation on system and component level. The modules “Energy Engineering” emphasizes applied and advanced thermodynamic as well as economic and environmental aspects for analysis and optimization of energy-conversion systems. The energy conversion processes in the field of renewable energies, are discussed in a separate module. In order to cover energy engineering at its whole, apart from energy generation, its counterpart, consumption of energy needs to be addressed. Refrigeration and air condoning is one of the most energy intense sectors respecting special (hot temperature) climatic conditions.

Generally the study area Energy Systems and Economics debates the challenges and obstacles while applying energy technologies. One of the biggest challenges is the Integration of Renewable Energies without compromising a secure, stable and affordable energy supply. Respectfully the economic, ecological, political and social framework is issued in an independent term project. Energy economics and systems further deals with the complex structure of diverse energy markets, economic calculation, fundamentals of energy trade and market incentives. Apart from this, direct and indirect methods to reduce the energy consumption in buildings is elaborated in the module “Energy for Buildings”.

As electrical energy is the form of energy used for transmission and distribution Electrical Energy Engineering is treated as a separate module group. As the program aims to target issues most common in the MENA region, special consideration is given to photovoltaics. In the detached module Photovoltaics is particularized from its fundamental electrical and physical properties, production methods, most recent research to system design. With a higher penetration of renewable energies and for off-grid application, energy storage systems are unavoidable. Energy Storage and Conversion discusses diverse stationary energy storage systems along their application and potentials.
Electives, Internship and Master thesis

Social skills, intercultural competence, fruitful group work, managerial and presentation skills along with analytical thinking in problem solving are core competencies essential for a successful career. Obviously, soft skills cannot be learned by the book. At TU Berlin Campus El Gouna more than 20 nations and most diverse backgrounds meet, offering an exceptional exposure. The modules Project Management and Intercultural Communication as well as Interdisciplinary Project take advantage of the unique multicultural and diverse environment in order to encourage students to learn essential skills while independently carrying out, managing and finally presenting project work.

The German higher education system is dominated by learning of self-management and organization along with an independent and systematic approach to scientific tasks. Thus students have the opportunity to choose among electives, locate the company for their two month industrial internship and independently select the subject of their projects and their Master's thesis topic, supervising institution and professors individually.
a. Energy Conversion and Components

Energy Engineering I and II

Modern energy systems need to be on the one hand energy efficient and on the other hand cost efficient without compromising environmental restrictions. A competent energy engineer must be able to design and optimize an energy system accordingly, the module energy engineering aims to provide the students with necessary understanding and skills set to do so.

The module Energy Engineering is dissected into fundamentals and advanced energy engineering. Both modules have a capacity of six credit points, the modules take place in the first and second semester. The Module Project Energy Systems continues the content taught in Energy Engineering I and II in a term project in third semester.

Students familiarize themselves with modern methods of analysis and evaluation of thermal systems and principles from the operation and design of the most commonly used energy conversion devices.

Thereby, students learn to:

- be able to optimize energy supply systems by ensuring a good compromise among efficiency, cost of product(s) and environmental impact,
- be able to identify the inefficiencies of energy conversion systems and develop options for improvements,
- process creativity to optimize energy-conversion systems,
- have skills in preparing data and information for the design of such systems.
Substance to the module covers diverse energy resources, discussing availability, supply, and prices of energy carriers. Thermodynamic and economic analysis of energy systems, starting with thermodynamic principles aiming to acquire skills in exergy based system evaluation and optimization (incl. Exergoeconomic and exergo-environmental analysis).

After completion of the module energy engineering, students should have a wide knowledge about modern methods of analysis and evaluation of thermal systems and principles from the operation and design of the most commonly used energy conversion devices as well as skills in engineering economics. Moreover students should be able to optimize an energy supply system by ensuring a good compromise among efficiency, cost of products and environmental impact. After learning exergy based analysis, students possess the ability to identify the sources of inefficiencies and costs in energy conversion systems, to develop options for improvements and to own the creativity to optimize energy-conversion systems and skills in preparing data.

Prof. Dr.-Ing. Prof. e.h. Dr. h.c. George Tsatsaronis, Institute for Energy Engineering, Technical University of Berlin

After completion of his Diploma in mechanical engineering at NTU Athens, Greece, Prof. George Tsatsaronis received both MBA, a Ph.D. in combustion, and a Doctor Habilitatus Degree in Thermoeconomics, at RWTH Aachen, Germany. Counting above forty years of experience and related scholastic background Prof. Tsatsaronis is an expert in the fields of exergy-based methods, combustion technology as well as the development, design, simulation and analysis of energy-conversion processes and the optimization of design and operation of energy systems. His contribution to the fundamentals of exergoeconomics is significant. Apart from publishing over 250 papers and co-editing 20 bound volumes, Prof. Tsatsaronis co-authored the book “Thermal Design and Optimization”, which is base to the modules “Energy Engineering I and II” and “Project Energy Systems”.

Complementary to increasing the efficiency of energy supply and introducing higher penetration of renewable energy sources, the reduction of energy demand is an even more relevant manner while aiming for a more sustainable energy system. Especially in countries of the MENA region and generally hot regions, the electricity required for air conditioning and refrigeration dominates the overall electricity consumption, resulting in power fadeouts on hot summer days as the power supply does not meet the demand.

The course Refrigeration and Air Conditioning firstly introduces principles of operation of compression refrigeration machines and principles from the design of the most commonly used types of components. Furthermore modern methods of analysis and evaluation of compression refrigeration machines are taught.

After completion of the module, students are able to choose an adequate tool for the optimization of a system. Moreover students should gain the creativity to design new tools for the optimization of processes, have skills in preparing data and information for the design of the system and have the ability to independently solve tasks in the field of thermal design of compression refrigeration machines starting with insulation, thermodynamic cycles, working fluids, main and additional components for single and multi-stage refrigeration machines. As well cascade refrigeration machines, special refrigeration machines and thermally driven refrigeration machines are part of the class.

For each topic the terminology, historical background, rational field of application as well as energy and exergy analyses, economic aspects, ways for improving or optimizing the machines, principles of control and automatic systems will be discussed.

Prof. Dr. Tetyana Morozyuk, Institute for Energy Engineering, Technical University of Berlin

Tetyana Morozyuk is professor at the Institute for Energy Engineering at the Technical University Berlin, Germany. She studied refrigeration engineering in the Odessa State Academy of Refrigeration, Ukraine, and received her Diploma in 1990. She received her Ph.D. in 1994 and a Doctor Habilitatus Degree in 2001, all in Ukraine. Professor Morozyuk has over twenty years teaching experience in the fields of refrigeration and energy engineering (development, design, simulation and analysis of energy conversion processes) and applied thermodynamics (exergy-based methods). She is the author or co-author of 7 books and more than 250 research publications, and has 10 patents. Professor Morozyuk is associated with several scientific organizations (ASME - USA and IIF/IIR – France) as well as many international energy-related conferences and recognized International Journals.

Modules: Refrigeration and Air conditioning, Energy Engineering, Project Energy Systems
Conversion Technologies of Renewable Energies

Environmental concerns, escalating and highly volatile fossil fuel prices and an ever-rising energy demand pushed the power sector towards an energy transition: from conventional fossil fuel based power generation towards low-emission renewable energy generation. Especially wind and solar power have recently experienced a significant boost in globally installed capacity. This module is aiming to introduce the students to the full range of renewable energy conversion technologies.

The generation, conversion and utilization of renewable energies form the focus of this module. The direct and indirect utilization of solar energy including photovoltaic panels, concentrating power plants and wind power plants is presented in its fundamental principle and technical resource assessment. The diverse exploitation possibilities of biomass and waste as an energy carrier with biochemical and thermochemical conversion technologies also content of the course, as well as hydropower plants and geothermal heat.

Students will have the possibility of deepening their knowledge in practical laboratory experiments regarding fuel characterization and fluidized bed conversion. Students should subsequently be able to understand, evaluate and design conversion systems of various renewable energies sources.

Prof. Dr. rer. nat. habil. Frank Behrendt, Institute for Energy Engineering, Technical University of Berlin

Prof. Behrendt is an expert in the field of biomass combustion. Prof. Behrendt received his Ph.D. degree at Heidelberg University, continued his academic career at Chalmers University of Technology at Gothenborg, Sweden and the Combustion Research Facility of Sandia National Laboratories, California, USA. He conducted his habilitation at Stuttgart University. Apart from teaching at TUB Campus EL Gouna, Prof. Behrendt is Professor for Energy Process Engineering and Conversion Technologies for Renewable Energies at TU Berlin as well as CEO at the TU-Campus EUREF. In 2007 Prof. Behrendt took on the responsibility for coordination of the entire energy-related research at TU Berlin, as a speaker of the Innovation Centre Energy. Moreover, he is the German representative of the International Energy Agency (IEA) implementation agreement titled “Emissions Reduction in Combustion”.

Modules: Conversion Technologies of Renewable Energies
Components of Energy Conversion Systems

So as for any energy system to run properly, each of the numerous interrelated components needs to function correctly. In order to supervise the design, installment and operation of a complex energy system, energy engineers need to be familiar with each component's behavior and limitation, as even a malfunctioning water pump in the cooling system can cause system failure.

This module focuses in detail on the most important components of all kinds of energy conversion systems. These include pumps, compressors, turbines and heat rejection devices (cooling towers) as well as internal combustion engines, Stirling engines, Organic Rankine Cycles and Fuel Cells. The theoretical knowledge will be demonstrated on a practical basis in the technical hall with the various test rigs for the respective machines. In addition to this, fundamental measuring techniques for parameters, such as temperatures and pressures, are also presented on an experimental basis, along with the uncertainty, which is of the utmost importance for scientific work. With the calculation of state variables, the machines can be balanced by the students using the measured data.

The students shall know the basic physical phenomena which are used for mechanical energy conversion systems and they shall know associated methods of design, evaluation, and improvement of technical solutions. The students will be able to design and optimize components of the energy systems with regard to economic and ecologic aspects.

Prof. Dr.-Ing. Felix Ziegler,
Institute for Energy Engineering, Technical University of Berlin

Prof. Felix Ziegler is the Dean of the Faculty for Process Science of TU Berlin. Apart from his responsibility for the faculties undergraduate program and the graduate program “Renewable Energy Systems”, he studied mechanical engineering in Technische Universität München, and received his Diploma in 1981. In TU München Prof. Ziegler also completed his Ph.D. in 1991 and a Doctor Habilitatus Degree in 1998. His research field is Evaporation, Absorption and Desorption; Absorption Chillers, Heat and Mass Transfer; Heat Pumps and Transformers; Sorption Power and Storage Cycles; Closed and Open Sorption Cooling Systems; Steam Jet Processes; Energy Systems Engineering.

Modules: Components of Energy Conversion Systems
b. Energy Systems

Integration of Renewable Energies

Dominated by environmental concerns, as in local pollution and global warming, limited economic fossil fuel resources, escalation of fossil fuel prices accompanied by price volatility and rapid increase in energy demand the power sector decided for a shift towards higher penetration of renewable energy production. Yet the drastic modification from conventional on-demand power generation based on fossil fuel to non-dispatchable strongly intermittent renewable energy generation is only successful under careful consideration of technical feasibility, policy framework, environmental and social impact.

The module Integration of Renewable Energies teaches the most important systemic, ecologic and economic connections for the effective integration of renewable energies in electrical grids, supply systems and markets under the constraints of sustainability with respect to the different solutions. Furthermore, the students will be able to assess the information concerning energy potentials, demand scenarios, systems solutions and market strategies using scientific methods with regard to economic decisions.

The description of obstacles enables the students to create the conditions for a possible transition of the electricity industries to sustainable concepts and allows the assessment of respective actions. The lecture introduces different analytical methods and instruments which help to understand the complex interdependencies. The focus lays not on detailed technical design and engineering but on strategic assessment and implementation of learned context.

Dr. Franz Trieb, Institute of Engineering Thermodynamics, German Aerospace Center

Dr. Franz Trieb achieved his Diploma in mechanical and process engineering at the Technical University of Clausthal, Germany. At Oldenburg University he accomplished his PhD degree. Being a senior research associate in the Department of Systems Analysis and Technology Assessment at the Institute of Technical Thermodynamics at DLR in Stuttgart, Germany, specialized in scenario analysis, solar thermal technology assessment and resource exploration.
Energy for Buildings

The building sector make up above 60% of the global energy consumption. In particular in the MENA region a noteworthy part of this share can easily be reduce by simple indirect and direct measures, making the module Energy for Buildings essential to the Master of Energy engineering program.

This module focuses on energy systems in buildings in order to understand the complex energy flows and media required in the context of sustainable aspects in the MENA region to comply with human needs. In terms of the physiology of people with respect to thermal comfort and air quality, the measurement of meteorological data such as solar radiation, air temperature, humidity and winds are crucial in respect of comfort. The goal is to enable students to understand the different energy flows in a building and to use calculation methods for planning and constructions with respect to different building purposes.

This also includes the design of thermal heat insulation and the suitable materials. This will be explained using the primary energy consumption for the heating and cooling system. Comparisons between the annual energy needs for heat/cold generation as well as losses of transfer and distribution are discussed. The course provides examples of classical and solar heat supply systems in terms of primary energy consumption for ventilation and air conditioning. It also includes theoretical exercises to develop the learned methods, as well as practical experiments in specially designed test rooms e.g. for visualizing air flows.

Univ.-Prof. Dr.-Ing. Christoph Nytsch-Geusen, Institute for Energy Engineering, Technical University of Berlin

Prof. Nytsch-Geusen conducted his diploma in energy engineering and his PhD on energy efficiency of buildings at the Technical University Berlin. With work experience as an project engineer and as a research assistant at two different institutes of the Fraunhofer Gesellschaft, Prof. Nytsch-Geusen was assigned as university professor in the field of "Care Planning and Supply Technology " within a degree program in Architecture at the University of Arts in Berlin.

Modules: Energy for Buildings, Interdisciplinary Project
Energy Economics and Systems

Energy markets have complex structures and regulations determining prices and market behavior of key actor groups e.g. developers, investors, generators, shippers and customers. It is crucial for energy engineers to understand market behavior in order to be a successful player for instance while introducing new energy technologies to the market.

The course considers markets for different energy carriers along with markets for electricity and heat which have different properties and include both renewable and non-renewable sources. The key elements of this course include methodological issues, such as cost calculations including external costs, and energy modeling on the basis of energy balances and scenarios. A focus is also put on the market liberalization of the grid business and the related trading at energy exchanges and over the counter. In addition to the supply side of energy markets, the demand side is also covered by analyzing energy efficiency measures and instruments. Understanding the particularities of energy markets is crucial for managers in the energy business, even if their key competence is energy or environmental engineering. In the first part of this module students gain a general understanding of methodological instruments for analyzing energy markets, secondly a practical insights into advanced energy markets by cooperating with companies and experts in industry is given.

Prof. Dr. rer. pol. Georg Erdmann, Department of Energy Systems, Technical University of Berlin

Prof. Georg Erdmann is Professor for Energy Systems at the Department of Energy Technology at TU Berlin. Research area of Prof. Erdmann includes but not limited to energy economics containing energy market reform, market modeling and forecasting, energy trade and investment strategies along with financing and risk management. His field of study was Mathematics and Economics, and he is holding a PhD degree in Economics from Münster University. His research includes market admission of novel energy technologies comprising for instance electric vehicles, battery storage and fuel cells. He published several books. Prof. Erdmann is the President of the Board, KSB Energie AG Berlin, envolved in energy trading services and among several other mandates, chair of the GEE German member institution of the International Association for Energy Economics (IAEE).

Modules: Energy Economics
a. Electrical energy engineering

Energy Storage and Conversion

Most renewable energy sources are neither capable to provide constant nor on-demand power generation. Energy storage and the production of alternative energy carrier such as Hydrogen are the most commonly discussed approaches to ensure a secure and stable energy supply dealing with the introduction of intermittent renewable energy generation.

The module Energy Storage and Conversion is split into two sections. An overview on diverse energy storage systems is content to the first set of lectures. The second part will specifically discuss electrochemical energy storage.

The overview on stationary electrical and thermal energy storage systems includes large scale technologies such as pumped hydro, compressed air, long and short term thermal energy storages, Power-to-gas-concepts, decentralized electric technologies like cell batteries (Lead Acid, Sodium Sulfur, Lithium Ion), Flow batteries (Vanadium, Zinc Bromide), flywheels and double layer capacitors.

Each technology will be explained in terms of functionality and application cases, where necessary the underlying working principles are presented. Consequently, students will learn to perform a comparative analysis of different storage technologies and to define typical application cases in the context of system integration of intermittent renewable energies. Special attention will be paid to understand thermodynamical mechanisms in order to optimize selected storage technologies such as thermal storages in Compressed Air Energy Storage and thermal management of cell batteries.

Dr. Daniel Wolf,
System Engineering, Heliocentris Energy Solutions AG

Dr. Wolf is researcher at Heliocentris Energy Solutions AG, a technology leader in the fields of distributed power solutions and energy efficiency services. Dr. Wolf conducted his PhD at the chair of thermodynamics of Ruhr-University Bochum. His research focus is on integration of renewable energy, particularly compressed air energy storage. As well the design of energy market mechanisms caught his attention.

Modules: Energy Storage and Conversion
In the second set of lectures and lab work, the students get familiar with basic concepts and experimental methods of Electrochemistry, Surface Catalysis, electrochemical energy conversion and storage, such as fuel cells, batteries, electrolyzes, photo electrochemical cells and others. The students will also be exposed to some additional concepts at the borderline of electrochemistry and catalysis and solid state physics, surface science, materials science. Participants are able to independently research and analyze topics related to electrochemistry, catalysis, electrochemical energy storage and conversion and will be given an opportunity to present their literature research to the course in form of a short slide presentation.

Prof. Dr. Peter Strasser, Department of Chemistry, Technical University of Berlin

Prof. Peter Strasser is Head of The Electrochemical Catalysis, Energy, and Materials Science Laboratory at TU Berlin. Both his Master degree from Tübingen University and his PhD Fritz-Haber Institute of Max-Planck-Society, Berlin were obtained in Physical Chemistry. Moreover, he is a member of the excellence cluster UniCat. Together with colleagues from the US, Prof. Strasser was able to significantly reduce fuel cell costs which was published in “Nature Chemistry”.

Modules: Energy Storage and Conversion

Dr. Stefan Gall, Institute of Silicon Photovoltaics, Helmholtz-Zentrum Berlin

Dr. Gall conducted his Ph.D. thesis at TU Berlin. Dr. Gall gained experience in Industry as Technology Director for Polycrystalline silicon thin-film solar modules at CSG Solar AG, Thalheim and as Development Engineer within the central research division of Infineon Technologies AG and Siemens AG, both based in Munich. Now Dr. Gall is the senior researcher at the Helmholtz-Zentrum Berlin at the Institute of Silicon Photovoltaics.

Modules: Photovoltaics
Photovoltaics

The harvest of energy emitted by the sun and convert it to electrical energy in only one step is not only brilliant but also has the largest range of applications. Photovoltaics is available and economically feasible at any scale and the most attractive renewable energy technology for off-grid application particularity in the MENA region. The module Photovoltaics introduces the students to the true scope of semiconductor technologies.

This module starts with the physical fundamentals for understanding the concept of semiconductors and function of this technology, as well as the respective raw materials. In addition to the physical understanding of the solar cells, new techniques such as thin layer cells are also explained and characterized. This includes material supply, component design, component characterization and integrated circuits.

After successful completion, students should be able to work effectively in the development of solar cells, solar modules and systems. As part of the module, students are expected to acquire a basic understanding particularly in the following areas of photovoltaics (PV): Electrical and physical properties and relationships, radiation of the sun, interaction between radiation and PV materials, preparation and properties of PV materials, as well as PV components, characterization of PV materials and PV components. Standard concepts as well as special concepts will be discussed. The course combines the transmission of knowledge (lecture) with the theoretical (exercise) and practical (laboratory) application.

Prof. Dr. Bernd Szyszka, Institute of High-Frequency and Semiconductor System Technologies, Technical University of Berlin

Prof. Bernd Szyszka is an expert in applied physics and electrical engineering in the field of thin film photovoltaics and oxide electronics. He received his PhD from TU Braunschweig. Meanwhile Prof. Szyszka built up the area "Large Area Coating" at the Fraunhofer IST. Moreover Prof. Szyszka is chair of smart materials in the Society of Vacuum Coaters of Vacuum.

Modules: Photovoltaics
a. Interdisciplinary Studies

**Intercultural Communications and Project Management**

Communication skills, team work in an intercultural context, working in international networks, conflict management, mediation, facilitation, presentation, as well as computer-mediated communication are key aspects in work life. Moreover, time management is of crucial importance. Hence, more and more companies ask for managerial and project coordination expertise in a new employee.

The aim of the course Intercultural Communications and Project Management is on the one hand to provide students with an awareness of cultural differences and to equip them with skills required for tackling problems of intercultural communication in a global setting, and on the other hand to introduce them with project management and its application in different situations.

As the study program takes place in Germany and Egypt, the cultural differences and similarities within the Western and the Arab World are of particular interest. Multiple aspects of communication and intercultural competencies will be provided. In addition, the following fields will be covered in form of theoretical inputs, role games, working groups and interactive exercises:

Basic knowledge about culture, cultural dimensions, communication, diversity and intercultural competence. Reflected dealing with different cultural values, behavior, perceptions, working patterns, stereotypes and prejudices and conflicts resulting out of diversity. Develop basic competencies, interpersonal skills and strategies for successful inter-cultural and -gender communication. Develop basic knowledge for establishing continuous dialogue with stakeholders from science, industry, NGOs as well as with customers, employees or the local population.

Within the Project Management taught in the module, students acquire knowledge of die law on the implementation of projects, particularly in the energy sector, from the perspective of clients and of service providers. Knowledge about the management tasks, management techniques and leadership means written for the planning and execution of projects mediated by the lifecycle orientation will be discussed. Project organization, schedule management, cost management, quality management, project management tools will be explicated within case studies.
Interdisciplinary Project

Energy engineers are continuously confronted with diverse issues external to their background or expertise. Furthermore, companies generally prefer to employ people with dissimilar proficiency in order to create a diverse and strong team. An interdisciplinary work environment and tasks freestanding from ones familiarities necessitate a large scale of skills that can only be gained with experience.

The goal of the module is to familiarize students with:

- Analysis and research methods of scientific working
- Independent completion of research and studies in interdisciplinary groups
- Work on unfamiliar challenging topics
- Report writing and presentation skills.

Goal of this module is to teach the students the significance of interdisciplinary collaboration as well as to make students experience the challenges and benefits of intercultural and cross-disciplinary team work. After participating in this module, the students will be able to tackle a problem, formulate the right research questions, find and evaluate possible solutions, conduct a feasibility study, and present their research work.

The topics tackled in the Interdisciplinary Project alter annually. The content is adjusted to confront latest issues in the field of sustainability and will differ from contents of other modules as energy engineering, water engineering and urban development students participate. In interactive input sessions the students will be provided with the necessary concepts, knowledge and skills to tackle the Interdisciplinary Term Project. Visiting professors, external experts, and the organizing team will conduct lectures, workshops and seminars to cover the related subjects. Determined by the terms task technical background, sustainability, feasibility study, questionnaire design, and report writing will be issued. Interactive lectures, Group work, discussions, and presentations dominate the project. Result of the Project is a joint report.

Students from TU Berlin Campus El Gouna during project work, lecture and presentation.
Project Energy Systems

Mastering the design and planning of Energy systems is an asset that any energy engineer must master. The arrangement of a number of complex interrelated components needs to be carefully considered, simulated or tested and optimized. As well economic, ecologic and environmental aspects may not be neglected. Concept realization, process synthesis, economic analysis, exergoeconomic analysis and iterative process improvement, are methods that need to be taught and applied in the module Project Energy Systems.

The planning and design of energy supply systems for power, heat and cold systems forms the focus of this project. The analysis and evaluation under energetically, exergetical, economic and ecologic aspects will also form part of the project. The students will be separated into smaller project groups and cluster the specified problem. The size of the groups depends on the respective topic. to begin with, the problem is outlined and possible solutions are discussed. The participants in the project organize themselves to solve sub-problems on the way to developing the overall solution. They are responsible for their time management, reporting and results. The tutors may also teach several technological topics in addition. Finally, there is a written report and a final presentation. Students are also required to participate in a cross-disciplinary seminar.

The students shall

- Deepen the thermodynamic, physical, economic and environmental aspects of various energy conversion processes deepen, assess the impact and act responsibly through this knowledge,
- possess the ability to evaluate innovative techniques,
- conduct and organize projects in teams and have knowledge in planning, design and optimization of energy conversion processes
- have skills in problem solving and teamwork
- Planning, design, analysis, evaluation and optimization of complex energy conversion system

Students working in the PC pool at Campus EL Gouna on the Project Energy Systems.
Electives, Internship and Master Thesis

The German higher education system is dominated by learning of self-management and organization along with an independent and systematic approach to scientific tasks. Thus students have the opportunity to choose among electives, locate the company for their two month industrial internship and independently select the subject of their projects and their Master's thesis topic, supervising institution and professors individually.

Internship (6 Credits)

The industrial internship should be completed during the summer vacation in Berlin and will last a minimum of six weeks. During the internship the students are able to gain an insight into the work flows in industry, planning companies, or servicing firms. There are several possibilities for completing an internship in Berlin and the students will be supported by the El Gouna team. Students must also, create an internship report on a weekly basis, describing their activities during their time in the company or organization.

Master`s Thesis (30 Credits)

The master's thesis requires students to develop the knowledge they have acquired during their studies and to transfer it into a novel scientific energy engineering topic on the basis of their individual research. This relates to the development of innovative energy solutions for the challenges in the MENA region in the context of a practical or theoretical study of a self-selected topic in the field of energy conversion, efficiency, systems or infrastructure. The students are encouraged to carry out their own, individual research, preferably in the framework of a research project specified by their supervisor, or possibly in cooperation with an industrial, administrative or governmental organization in a global setting. To ensure the progress of their scientific work students will also receive support from research assistants. The master's thesis ends with the presentation of the research results to supervisors and fellow students.

First intake of students of TU Berlin Campus El Gouna after their Master thesis defense.
Mohamed Magdeldin, Doctoral candidate at Aalto University, Finland

Mohamed Magdeldin, intake 2012

Mohamed Magdeldin is currently in pursuit of his Ph.D, in Energy Technology at Aalto University School of Engineering after graduating from TUB El-Gouna campus in 2015.

He joined the M.Sc. program earlier after obtaining a degree in Chemical Engineering from the University of Technology PETRONAS, Malaysia. During his enrollment and as a result of presenting a research paper on the development of Energy policy frameworks in Egypt, Mohamed received the best paper award at the 4th Desertec Energy Conference held in Rabat, Morocco in 2012.

As a partial fulfillment of the M.Sc. program, Mohamed joined Industrial Solar GmbH based in Freiburg, Germany for a two month internship period. The scope of work involved working closely with the engineering team on the development of the company’s solar direct steam generation pilot plant based on the Linear Fresnel technology.

Mohamed culminated the program with a Master thesis research titled: “The development of optimized conceptual plant designs for the supercritical water gasification of biomass process”. The thesis work was prepared and conducted at Aalto University in Finland, as part of the European mobility ERASMUS exchange program.

Mohamed’s current doctoral research is a continuation to the thesis project he started at TUB El-Gouna. According to Mohamed, the Master program enabled his personal and technical aptitude with “the necessary skill set to pursue a future career in the field of innovative energy technologies”. It also provided several opportunities to exchange knowledge and contribute within the global energy research community.
Karim Rizk, Business Development Manager at FRENELL GmbH, Germany

Karim Rizk, intake 2012

Karim Rizk is a former nuclear energy engineer from Alexandria with experience in project management and worked as research engineer at Bibliotheca Alexandria for a period of three years. Nowadays, Karim is employed by FRENELL GmbH a German company recently established resuming the work of the former company NOVATEC Solar GmbH that undertakes manufacture, supply and turnkey delivery of solar fields and thermal energy storage systems.

Karim was part of the first intake at Campus El Gouna, as a part of his master study in Energy Engineering Karim conducted his internship and his master thesis at NOVATEC in Karlsruhe, Germany. After performing market assessment on the MENA region and analyzing a the integration of “Direct-Molten-Salt-Based Integrated Solar Combined Cycle for Egypt’s Power Generation Market in 2020” at NOVATEC. Karim was offered a position as Business Development Engineer. Karim is currently engaged heavily in the Egyptian power generation market believing that Concentrated Solar power is Egypt’s future.

According to Karim, the Energy Engineering master program was a major shift from being an observant of the Egyptian power sector crisis into an actor that contributes to the solution of the energy crisis. “This shift would have never been possible without being taught and supervised by the eminent professors of the modules Energy Engineering, Integration of renewable energies and Energy Economics.”, Karim stated.

Moreover Karim shares the opinion, that TUB campus el gouna is a great example of interdisciplinary teaching in a multicultural environment, as “the topics you have out of class are unlimited and it opens the mind to new ideas and concepts from the four corners of the world”.

TUB Campus EL Gouna has a huge potential to be a leading Energy and water research institute, not only serving Egypt but the whole MENA region. Karim is always looking forward to support TUB campus el gouna to be one of the leading institutes in the MENA region.
Louay Hossam, Project Coordinator at Orascom Construction, Egypt

Louay Hossam, intake 2012

Louay Hossam was one of the first students of Campus El Gouna, starting his Master’s degree in 2012. With him being a Mechatronics undergraduate from Helwan University in Egypt, his present career in the energy sector is significantly determined by his performance in the campus’ master program Energy Engineering.

Apart from his Master thesis on “Exergy-based methods applied to Egyptian Concentrated Solar Power Plants” winning the best paper award, he was one of the students travelling to Morocco presenting the project output from the module - Integration of Renewable Energies - at the 4th Dii Desert Energy Conference 2013.

Since 2015, Louay is working as Project Coordinator at Orascom construction (OC) Ltd one of the biggest Egyptian companies with convincing regional presence.¹ Being in the lead as global engineering and construction contractor predominantly concentrating on commercial and industrial infrastructure projects, Orascom construction took on two of the three planned 4.8 GW gas fired Combined-Cycle Power Plants.²

Though his recent graduation, Louay was handed the responsibility to coordinate the construction of the largest power plant in the MENA region, ensuring a trouble-free cooperation of multiple large international companies.

Louay signified the Energy Engineering program at TU Berlin Campus El Gouna as “unique” and is proud to have graduated from “one of the most reputable technical universities worldwide”. The switch to the self-managerially dominated German education system he commended as a broad intellectual experience enhancing his personal endurance. In future he would like to continue to encourage scientific and commercial cooperation between Germany and Egypt, in addition to proceeding with his PhD Studies.

¹http://www.dailynewseg.com/2015/03/28
²http://www.orascom.com/
Mohamed Nabil, intake 2013

Mohamed Nabil graduated in 2011 from Helwan University with a bachelor’s degree in Energy Engineering. At the beginning of the summer term of 2015 Nabil went from being a Master’s student of the Energy Engineering program at TU Berlin Campus El Gouna to a part time energy engineer at toughTrough GmbH, a global acting solar company.

ToughTrough is a German enterprise, specialized in innovative light-weight solar application. Nabil not only had the chance to do his Master’s thesis with toughTrough but was also sent to Thailand to coordinate and supervise one of the company’s CSP projects.

According to Nabil’s narration the Energy Engineering program was a main contributor to his personal success story. Apart from the program being the motivation for him heading to Germany and learning the German language in the first place he especially complimented the push towards independent work and critical thinking in addition to the content taught. Moreover, he appreciated the focus on most critical challenges in the energy sector covering state of the art technologies for conventional and renewable energy sources.

Nabil made clear, that El Gouna’s - life as it should be - atmosphere is not as relaxing as it seems: “You will always be chased by deadlines, but the studying atmosphere is real fun.” Moreover he stated: “Although the campus is located in Egypt, you will always get the feeling that you are in one of the building extensions from Berlin. Starting from the great German professors (…)”.

All in all, the hard work was worth it and the energy engineering is very proud that Mohamed Nabil made it in the harshly competitive CSP business.

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3 http://www.toughtrough.com/
VI. What’s in it for me? – Leisure

There is no denying the fact, that the Master programs at TU Berlin Campus El Gouna are very intense in means of time and place. Students travel almost every six months back and forth between El Gouna and Berlin with hardly any break. Yet this brings along as much as it costs, despite the limited spare time, in the touristic town El Gouna on the coast of the red sea, the few free time students spend with yoga, soccer tournaments, basketball, kyte surfing, beach volleyball, social gatherings and much more. It is hard not to find pleasure in a touristic town entitled: “live as it should be”.

Attracting five million visitors yearly, Berlin is the to go to city in Europe. Specially in the recent years the German capital experienced a wave of artists, designers and media professionals. Berlin is a very diverse and alive city with unique charm and an outstanding status for cultural vitality.
Apart from their private activities, students are provided with very diverse exposure. TU Berlin Campus El Gouna strives to provide a number of excursions and cultural activity in both Egypt and Germany. The annual visit of the Hannover Messe, the most significant industrial fair worldwide, became a tradition within the energy department. Moreover, visits to different power plants such as: Reuter-West power plant, Oil fired power plant Hurghada, Wind Farm and PV power plants Germany and Egypt. Cultural activities are for instance visits of local museums, the Freshers' Day safari, visit of the German Reichstag, German and Arabic courses.

Field trip to PV power plant in Germany, excursion to Wind park in Hurghada, visit of the German Parliament, daytrip to the Hannover Messe.
VII. Application and Admission

The application and admission to one of the Master programs offered at TU Berlin Campus El Gouna can be easily broken down in four steps: **Preparation, Submission, Admission and Search for Scholarships**. Before submitting you should make sure you gathered all the requested documents. Please check our website for the detailed list of requested documents. In case you are accepted for studies, you receive a preliminary letter of acceptance. In case you need a scholarship to provide for the study fees or living expenses, search for scholarships early on. As soon as you get the preliminary letter of acceptance applying you can easily apply for scholarships. Consequently, the earlier you obtain the preliminary letter of acceptance, the higher your chances to receive funding. Due to this issue, TU Berlin Campus El Gouna is opening three different deadlines throughout the year: Early, regular and late application.

Apply NOW... [www.campus-elgouna.tu-berlin.de/y_menu/admission_process/application/](http://www.campus-elgouna.tu-berlin.de/y_menu/admission_process/application/)

- **9th of February**
- **31st of May**
- **31st of August**
And be part of TU Berlin Campus El Gounas community