

Energy and Environmental Systems Engineering

Curriculum
2026/2027

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information at
hslu.ch/eese



Structure of the Bachelor program

Core Modules
At least 90 ECTS credits are to be earned

Advanced

6th semester	Electrical Power Grids 3	Applied Sustainable Systems 3	Environmental Engineering 3
	Energy, emissions, and certificate trading 3	Renewable Energy Technologies 3	Strategic Management and Product Management 6
5th semester			Corporate Ethics and Sustainability 6

Intermediate

4th semester	Fluid Dynamics 3	Sustainable Energy Systems 3	Environmental Analysis and Ecology 6
	Thermo Dynamics 3	Applied Process Control 3	
3rd semester	Physics 2A 3	Systems Modelling 3	Materials Lab 3
	Mathematics 3A 3	Energies, Fluids & Processes Laboratory Thermo 3	Principle of Sustainable Environmental Systems 3

Basic

- Compulsory modules
- Core elective modules
- Elective modules

6 Quantity of ECTS (here 6)

2nd semester	Physics 1A 3	Technical Mechanics 3	Electrical Engineering with Laboratory work 3	Marketing Management and Accounting 6
	Mathematics 2A 3	Energies, Fluids and Processes – Laboratory Fluid 3	Chemistry and Biology of the Environment 3	
1st semester	Mathematics 1A 6	Python Basics 3		
		Systems Engineering for Energy & Environmental Systems 3	Chemistry 3	

Project Modules

At least 39 ECTS credits are to be earned

Related Modules

At least 15 ECTS credits are to be earned

Bachelor Thesis 12		New Sustainable Business Development 3	Operational Excellence 3	Energy Storage Systems 3
Technical Writing 3	Practical Module 3/6	Digital Business Process Engineering 3	Supply Chain Management 3	Digital Business Models 3
Industrial Project 6	International Project 6	Sales Management 3		
		Service Innovation 3	Energy Optimization with Pinch Analysis 3	Introduction to Aerospace Technology 3
Engineering Product Development Project 2 6		Innovation Financing 3	Controlling 3	Energy Data Analytics & Forecasting (intensive week) 3
		Applied Machine Learning and Predictive Modeling 3		Leadership (intensive week) 3
Engineering Product Development Project 1 6			Usability 3	Design, build & commission Photovoltaic in Ethiopia (intensive week) 3
		Statistical Data Analysis 3	Python Advanced 3	International Marketing 3
		Research Fellow 3		
Context 2 3		Linear Algebra 3	Design Fundamentals 3	B2B Marketing 3
Context 1 6		CAD and Simulation 3		Windpower and Ecotechnology (intensive week) 3

Core modules – Compulsory

Applied Process Control Compulsory E

The concepts of systems and signals will be elucidated. They will be characterized in the time domain and the s-domain (by means of the Laplace-Transformation). Students will get familiar with feedback loops and will learn to analyze and design controllers that guarantee stability and performances. Simulink exercises, lab demonstrations, and a MAIN case study will help to consolidate the acquired knowledge.

Applied Sustainable Systems Compulsory E

In this module, students will have the opportunity to combine many of their acquired competencies in the topics of energy, environment, system engineering and modeling to solve a real-life sustainability challenge. The challenge of the module will stem from an existing research project running at HSLU and parts of the proposed solutions generated in the module could be implemented in the research project. The students will have the chance to interact with external partners connected to the actual research project.

Corporate Ethics and Sustainability Compulsory E

Fundamentals of Business Ethics (BE) and Corporate Responsibility (CR) for practical use in different management positions. Based on case studies, students learn how to get in contact with practitioners and exchange experiences. Basic and well-grounded overview about BE / CR and central concepts, the empirical situation, theoretical discussion and the implementation in management practice. Students will apply gained knowledge in an energy-related simulation game, thus allowing them to experience real-world ethical challenges.

Electrical Engineering with Laboratory Work Compulsory E

Introduction to the basics of electrical engineering. Use of exercises and corresponding laboratory exercises to get to know the basic building blocks and laws of electrical engineering in a clear way.

Chemistry Compulsory E

Introduction to the fundamentals of chemistry. Overview of technical terminology. Knowledge of the structure of atoms and molecules. Formulating reaction equations. Understanding of the chemical principles underlying cell biological processes and the properties of materials.

Energies, Fluids and Processes – Laboratory Fluid Compulsory E

Introduction to the basics of energy technology. Balancing systems (mass, impulse and energy), energy forms and energy conversion, fundamentals of fluid motion. Flow regimes and losses. Laboratory tests with different flow channels, pumps and turbines.

Energies, Fluids and Processes – Laboratory Thermo Compulsory E

Introduction to the basics of energy technology. Balancing systems (mass, material and energy) and state variables, energy forms and energy conversions, fundamentals of heat transfer, energy conservation (first law for closed and open systems) energy conservation. Laboratory tests with heat exchangers, fuel cells, compressors.

Environmental Analysis & Ecology Compulsory E

Introduction to fundamental concepts of environmental analysis and ecology, including sustainability, ecosystems, biodiversity and climate system; environmental impact assessment; implications of CO₂ emissions and other pollutants on natural systems and human mankind; application of analytical and economic tools for evaluating environmental impacts and causes of environmental problems.

Chemistry and Biology of the Environment Compulsory E

Introduction to environmental chemistry and biology. Essential characteristics of the Earth's spheres: geosphere, hydrosphere, atmosphere, biosphere, and anthroposphere, supplemented by laboratory experiments. Element cycles and hazardous substances that interact with organisms.

Fluid Dynamics Compulsory E

In-depth analysis of conservation laws in fluid mechanics. Potential theory and application with respect to frictionless flows. Importance of friction (dissipation), boundary layers and their effect in practical applications. Flow resistance of bodies surrounded by flows. Dimensional analysis, similarities and non-dimensional numbers. Analysis of compressible flows (supersonic).

Marketing Management and**Accounting Compulsory G/E**

Basics of marketing, knowledge and application of methods used in marketing research, concepts, implementation and controlling, use of financial accounting, reporting and analysis, cost accounting, accounting records, and calculation as a decision-making tool with application in a simulation throughout the entire semester.

Materials Lab Compulsory E

Introduction to Material Science and Engineering. Understanding the correlation between atomic structure, microstructure and properties of materials as well as resulting applications. Theory and hands-on experience in a lab environment with respect to various materials and material testing methods. Consideration of sustainability aspects in material selection.

Mathematics 1A Compulsory G/E

Elementary functions, differential calculus with applications, introduction to the integral calculus of functions of a variable with applications.

Mathematics 2A Compulsory G/E

Complex figures: normal and polar forms, Euler's formula, roots of complex numbers. Differential equations of the first order: basic definitions, Euler's method, variable separation method and constant variation method. Differential equations of the second order: different types of differential equations, in particular homogeneous and inhomogeneous linear equations. Various applications in relation to real problems, in particular harmonic oscillations.

Mathematics 3A Compulsory E

Functions of multiple variables, partial derivatives, total differential, gradient, linear and non-linear optimization of functions of multiple variables, double and triple integrals, applications in science, engineering and economics, especially using numerical software such as Python.

Physics 1A Compulsory G/E

Teaching of the fundamentals of mechanics. Dynamics of the mass point based on Newton's laws, work, energy, impulse and their conservation laws. Statics and motion of fluids: gravitational pressure, buoyancy, continuity equation, Bernoulli's equation, flow resistance.

Physics 2A Compulsory E

Teaching the fundamentals of thermodynamics, oscillations and waves. The focal topics are the ideal gas, the first and second law of thermodynamics, cyclic processes in the pV diagram, and efficiency. Harmonic, damped and excited oscillations are studied and harmonic waves are studied, especially sound waves.

Python Basics Compulsory G/E

Introduction to Python programming with a focus on variables, datatypes, operators, branches, loops and functions. Introduction and applying of libraries such as numpy, pandas and matplotlib for calculations and data analysis.

Sustainable Energy Systems Compulsory E

Addressing the question of "how can we decarbonize our energy systems?", this module provides the essential knowledge to understand decarbonization challenges and potential solutions. It investigated state-of-the-art technologies concerning energy "generation", conversion, distribution and storage. Focus is also placed on understanding the various sectors to be decarbonized as well as important restrictions and boundary conditions (e.g. policies and economics).

Principle of Sustainable Environmental

Systems **Compulsory** E

Introduces sustainable environmental engineering: analysis/improvement of systems/processes. Covers sanitation, noise, emissions, waste, water, micropollutants. Via lectures, labs, excursions, cases, students gain skills for sustainable solutions.

Systems Engineering for Energy & Environmental Systems **Compulsory** E

Introduction to the design and management of complex systems over their life cycles. Appropriate delimitation of systems. Illustration of the complexity of energy and environmental systems. Possibilities to structure systems and to reduce complexity of systems.

Systems Modeling **Compulsory** E

Fundamentals of mathematical/physical description of systems and introduction into modelling tools. Students learn how to describe mathematically and physically a system, as well as different approaches to solve the model. The students will learn how to model systems in the modeling environment Modelica. The basics from system thinking and modeling will be applied in practical examples.

Technical Mechanics **Compulsory** E

This course enables students to calculate simple static problems within the field of mechanics to pre-evaluate the support reaction, forces, momentum, stress and strain acting inside a body to determine its strength and safety.

Thermodynamics **Compulsory** E

In-depth analysis of conservation factors in thermodynamics, examination of changes in state and their impact in practical applications, irreversibility and the second law of thermodynamics, advanced introduction to heat transfer, clockwise and counter-clockwise cycles.

Core modules – Electives

Electrical Power Grids **Elective** E

The following topics are covered: Transformation of primary into electrical energy. Fundamentals of the main grid components of a power system (generators, transformers, substation and transmission lines/ cables). Grid analysis techniques such as load-flow and short-circuit calculation. Methods of power system control. Analysis of blackouts and concepts of protection systems. Renewable generation and their integration in power grids. Smart grid technologies and modern power system management with flexibility.

Energy, emissions and certificate trading – International policies for renewable energies **Elective** E

Understand the drivers of today's energy agenda. Learn the tools of energy trading as a commodity. Examine structures and trends of trading renewable energies as opposed to trading "grey" energies as commodity, trading CO certificates and related products, innovations in this area, political guidelines, and their international ramifications. Discover the policy tools to incentivize and promote the proliferation of renewable energies.

Environmental Engineering **Elective** E

This module provides an overview of the key concepts and technologies used in modern environmental engineering. Students will explore the principles and practical applications of air and noise pollution control and water and wastewater treatment. Through lectures, case studies, and laboratory sessions, the course introduces smart technologies for environmental monitoring, methods for sampling and assessing air pollutants, and the design of treatment systems. Legal frameworks at the EU, Swiss, and international levels are also covered to contextualize engineering practices within current regulations.

Renewable Energy Technologies **Elective** E

This module provides a comprehensive overview of renewable energy technologies—solar, hydropower, bioenergy, and others (e.g. wind, geothermal)—and their integration into modern power systems. It covers core technical principles, system sizing and grid connection, plus the economic, regulatory and environmental contexts that shape deployment.

Core modules – Electives for Business Certificate

Strategic Management and Product Management **Elective E**

Fundamentals of strategic management, strategic analysis, corporate objectives, strategy selection and implementation. Fundamentals of product and innovation management, including product lifecycle and portfolio analysis, requirements engineering and market launch. Application within the framework of a business plan game.

Project modules

Bachelor Thesis **Compulsory E**

Independent execution of a very challenging task as an individual project within a company or research project. Application and further development of problem solving, project management and professional competencies learned during the course of study and under consideration of the systemic context. Creation of convincing scientific documentation and presentation of the results.

Context Module T1 **Compulsory G/E**

Handling of an interdisciplinary project in a team where various specializations are represented; communication of specialist skills and communication skills for creating scientific work and making a scientific presentation; promotion of project-oriented and systematic thinking, plus interdisciplinary cooperation.

Context Module 2 **Compulsory G/E**

Promotion of oral and written skills required for studies and professional careers; communication and application of relevant text types, speech methods, presentation methods and recipient-oriented correspondence required in the workplace, use of verbal, nonverbal and paraverbal methods in different oral communication situations depending on the target group.

Engineering Product Development Project 1

Compulsory E

Engineering project: Experiencing the development of a product in an interdisciplinary team. Elaboration of market and product requirements; developing, evaluating and verifying engineering solution concepts while taking into account common methods for finding ideas and solutions. Set-up of suitable basic tests and prototypes for proof of concept.

Engineering Product Development Project 2

Compulsory E

Exemplary engineering learning project with handling of an interdisciplinary project task in a team. As a continuation of PDP1, partial solutions will be amalgamated, the solution will be realized and implemented, and the overall concept will be tested. At the same time, presentations, visualizations and a technical documentation of the results will be prepared.

International Project **Elective E**

Ready to rethink design in an international team? This project-based course immerses you in Design Thinking, where you'll create innovative ideas and turn them into working prototypes alongside diverse, interdisciplinary peers. You'll explore concepts such as the Circular Economy and learn to rethink the future through the power of user-centered design. Plus, you'll have the opportunity to earn a Junior Coach Certificate for Design Thinking. Let's reshape the future!

Industrial Project **Compulsory E**

Independent execution of an individual project within a company. Application and deepening of problem solving, project management and professional competencies under consideration of the systemic context. Creation of convincing scientific documentation and a presentation of the results.

Practical Modules **Elective E**

Development and application of study-relevant competencies in the context of a project in a professional environment; submission of project proposals to the program director; credit for acquired competencies is awarded on a per semester basis.

Practical Experience Elective E

Acquisition and development of practical technical, methodological and social skills and/or business experience on the basis of the skills developed in the degree program. Usually in cooperation with an external company or when setting up your own start-up.

Technical Writing Elective E

The module TECW enables students to consolidate the skills they need when writing a scientific technical report on a project that are required at Advanced level in the Bachelor of Engineering degree program. Students write a scientific project report for their Industrial Project (PAIND). To this end, they prepare an Exposé to gain clarity about the initial situation and their research approach and to argue these coherently. In addition, they submit 2 more chapters of the final report (PAIND). Individual Coachings (1-1) support them to gain those skills.

Related modules

Applied Machine Learning and Predictive Modelling Elective G

Regressionsanalyse: Multiple lineare Regression mit Parameterschätzung, Graphische Validierung von Modellen, Variablentransformationen, Vorhersage- und Vertrauensintervalle für Zielvariablen, statistische Tests und Vertrauensintervalle für Parameter, Variablenselektion, Ridge-Regression, Lasso. Klassifikation: Konzepte der Klassifikation, Logistische Regression, CART, Random Forests, Support Vector Machines (SVM) und Modellevaluierung durch Cross-Validierung. Zeitreihenanalyse: Deskriptive Zeitreihenanalyse, STL Zerlegung, Autokorrelation, AR und ARIMA Modell mit Parameterschätzung, Zeitreihenprognose.

B2B-Marketing Elective G

Grundlagen, Bedeutung und Abgrenzung des B2B-Marketing inkl. der Teildisziplin des Industriegütermarketings. Erlernen und Anwenden relevanter Konzepte sowie Vermarktungsbesonderheiten im Bereich des B2B- und Industriegütermarketing. Aufbau und Steuerung einer Supply-Chain sowie Umgang, Evaluation und Zusammenarbeit mit Partnern. Diskussion und Anwendung essentieller Instrumente sowie der Geschäftstypologien (Produkt-, Projekt-, System- und Integrationsgeschäft).

CAD and Simulation Elective G/E

Learning about 3D CAD construction methods in SolidWorks and 3DExperience. Creation of engineering components, assemblies and drawings. Knowing and using the range of applications of SolidWorks in construction, visualization and simulation.

Controlling Elective G/E

Students apply the concepts and information of accounting in order to successfully manage their own company in competition with their fellow students.

Design, build and commission Photovoltaic in Ethiopia (intensive week) Elective E

Many Health Centers in Ethiopia are far from grid connections. Childbirth mortality at night and cooling of vaccines is a big challenge. A 5 kW decentral Energy System, consisting of photovoltaic panels, batteries, and controls shall help. Participants team-up with local students from AMU (Arba Minch University) and learn together the sizing of the components at AST (Advanced Solar Training Center, carried out by professionals from Sahay Solar and HSLU). The learning and the equipment are then taken to a rural Health center, where the Energy system is constructed, commissioned and handed-over to the local operator.

Design Fundamentals Elective G/E

This module gives students an understanding of the discipline and process of industrial design as well as human centered design. Sections of the design process, such as perception, ergonomics, creativity, needs analysis and prototyping are experienced in practical exercises. The module focuses on and intensively teaches the ability to think in an innovative way.

Digital Business Models Elective E

The module explains what business model innovation is and how this is embedded in strategic management. Students are introduced to the most important business model frameworks and provided with hands-on guidelines to select, develop, and apply them to digital technologies as an enabler for disruptive innovation. This will be applied to a real-life case studies.

Digital Business Process Engineering Elective E

This module provides an introduction to the fundamentals, approaches and methods required for digital business process engineering on the basis of a cycle-based framework model, which represents a typical management cycle. Different models, methods, techniques and software are applied, based on concrete practical examples. Transfer of knowledge is been facilitated and active work is necessary (group exercises, case studies).

Energy Data Analytics & Forecasting (intensive week) Elective E

In this intensive week, we consider how machine learning and optimization algorithms can be used to help solve challenges in the energy domain. The participants will apply those algorithms to specific use cases regarding photovoltaics, e-mobility, storage or self-consumption optimization in order to predict load and/or production, optimizing use of storage systems etc. Real-world data will be used, and practical experience will be provided. Through a project work students will have practical examples that can be taken forward in the academic or professional life.

Energy Optimization with Pinch Analysis Elective E

Fundamentals of Pinch Analysis and PinCH tool, processes representation in composite curves, investment and operating costs, energy and cost targets, supertargeting, heat exchanger networks design, utility systems optimization, heat pumps integration, combined heat and power systems, etc., introduction to batch and multiple base case process analysis, thermal energy storage integration analysis, case studies.

Energy Storage Systems Elective E

Principles of energy supply, focussed on renewable energies. Importance, application, overview of, planning and use of energy storage. Thermal energy: Fundamentals of thermodynamics, exergy analysis and interpretation, modeling and application, thermal energy networks. Electrical energy storage: fundamentals of electrical storage, analysis and interpretation. Modeling and applications and electrical networks. Combined use.

Innovation Financing Elective E

Introduction to corporate finance, approaches to innovation financing, determining risk and return of investments, understanding capital structure decisions, performing project and company valuation.

International Marketing Elective E

Importance of international marketing for companies being active in today's business environment, assessment of international environment, importance of cultural diversity, development of international marketing strategies and marketing instruments, management and organization of international marketing activities, application in case studies and in a business simulation in teams.

Introduction to Aerospace Technology Elective E

The module introduces the fundamentals of aerospace engineering, covering aeronautics (first half of the module) and space technologies (second half). Theoretical foundations are combined with practical examples to build a solid understanding of various aerospace vehicles, their structures, and systems and how to operate them.

Leadership (intensive week) Elective E

Students shall understand the concept of leadership and its different aspects and success factors by looking at themselves, their teams and organizations. The training will be based on basic theoretical concepts but to make it more applicable in real life one of the key elements of the training is practicing with tools that leaders apply to be successful. One of the aims of the training is to prepare the students for their future roles as leaders: project leaders or product managers.

Linear Algebra Elective G/E

Basics of linear algebra including matrix algebra and its applications, especially with regard to Euclidean vector space and linear maps, eigenvalues and eigenvectors; solution of mathematical problems using algebraic and numerical methods and their graphical representation, in particular, using numerical software such as MATLAB or Python.

New Sustainable Business Development Elective E

This module focuses on developing new business in the area of sustainability. Companies are analyzed using known frameworks and tools in the area of product- and strategic management, sustainability, circular economy, business model innovation, corporate finance, and project management. It uses case studies and covers sustainability, agile methods, intrapreneurship, ambidextrous organization design, corporate venturing, mergers, acquisitions and joint ventures, legal aspects, and integration/change management. Real cases and companies are analyzed and described. New ideas and concept for sustainable products and businesses are proposed. The New business development approach in the companies and results are summarized in case study in form of a book article.

Operational Excellence Elective E

Deepened analysis of the Supply Chain of industrial companies, in search of Excellence, based on the principles and tools of the Toyota Production System and its evolution into Lean Management. These concepts and tools will be explained and applied in several case studies and in a final production simulation game, so that participants will "touch with their hands" the significant difference between traditional and "lean" approaches in Operations.

Python Advanced Elective E

Object-oriented programming in Python through practical assignments, including applications on a provided Raspberry Pi. The course also covers the integration of SQL databases and communication using client-server architectures.

Research Fellow Elective G

Service learning in a research project at the Institute of the corresponding study program. Learning how to act, how to engage in research and how to contribute socially and responsibly.

Sales Management Elective E

Provides an understanding of sales organisations and teaches processes for managing and motivating sales staff as well as measuring and optimising success. You will learn how to develop appropriate sales strategies and select effective/efficient tools. You will learn to understand important features of sales psychology, apply essential sales practices, and negotiation and presentation techniques.

Service Innovation Elective E

The service innovation module equips students with key concepts like value co-creation and service-dominant logic, enabling them to blend tangible and intangible. Through case studies and hands-on guidance, students learn to evaluate strategies and design innovative services, fostering a strategic mindset for leading innovation in various industries.

Statistical Data Analysis Elective G

Grundlagen der Wahrscheinlichkeitsrechnung und frequentistischen Statistik, Verständnis von Kenngrößen und Verteilungen, Analyse von Stichproben, Auseinandersetzung mit Schätz- und Testproblemen.

Supply Chain Management Elective E

This course examines the supply chain of industrial companies using real-world examples, case studies, supply chain/material flow simulations, and, if possible, a field trip to a logistics facility. Topics include supply chain structure and strategy, logistics activities within companies, and planning and procurement as cross-functional topics. The serious game “The Fresh Connection” is used to gain practical experience in managing a supply chain in a dynamic, team-oriented environment.

Usability Elective E

The human being in direct interaction with systems, definitions of usability and user experience, human centred design process (HCD), empathy, familiarity, intuition, navigation, errors and error handling, GUI design, various interaction elements, consistency, usability and accessibility, usability and special technologies (e.g. AR/VR, hardware ...).

Windpower and Ecotechnology

(intensive week) Elective E

Basics of wind energy engineering – starting with the determination of wind power potentials – applied to different kinds of turbines and systems, including selection of materials and components up to the estimation of electrical power production. Based on actual installations, the stakeholder analysis and environmental impact analyses are applied in order to assess the impact of emissions on humans and ecosystems.

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Further information
about the Bachelor of Science
in Energy and Environmental
Systems Engineering