



Programme syllabus

[An accessible version of the syllabus can be found in the Course and programme directory.](#)

Master's Programme, Energy Innovation 120 credits

Masterprogram, innovativ energiteknik

Valid for students admitted to the education from autumn 21 (HT - Autumn term; VT - Spring term).

This is a translation of the Swedish, legally binding, programme syllabus.

Programme objectives

The master's programme in Energy Innovation (InnoEnergy) is an umbrella programme which is directed towards a completely new type of education in the energy field, mobilising the innovative and entrepreneurial spirit of the students. At the same time, the full energy knowledge students receive in "classical" two year energy master programmes is kept. This will give the graduates a very deep understanding of the world's energy challenges paired with a significant insight into how energy businesses are created and into the industrial perspective of the energy side in different fields.

The KIC InnoEnergy MSc programmes are specially designed to accommodate the EIT/InnoEnergy label criteria.

Objectives of the study tracks:

- Smart Cities (SMCS)

This specialization deals with the concepts of “Smart Cities” based on scientific literature and reports from case studies.

Studies to investigate, analyze and explore “Smart City“ concepts and solutions in relation to the energy and climate mitigation challenges for important urban development sectors, such as transportation, buildings, consumption, lifestyle, energy production, waste management, water management, etc.

Team-based projects, related to energy and climate mitigation on an urban level together with a relevant stakeholder such as a waste company, the municipality, or a local energy or water utility.

- Smart Electrical Network and Systems (SENS)

SENS focus on how new technological developments electric power in combination with modern information technologies can transform the existing electric power grid infrastructure towards a more 'smart' power network.

After completion of SENS the students should be able to identify, explain, analyze and solve classical problems within the field of electric power engineering, but also analyze new concepts and innovations and their possibilities and limitations - all from idea to final product.

Be able to use models for: analysis of power flows, dynamic behaviour, stability conditions, regulations, electricity market, etc for the electric power system.

Know and apply principles for design, control and monitoring of the electric power grid and its components.

Be able to apply fundamental electromagnetic and physical principles in order to develop models and design criteria for electric power apparatuses and components including technologies that makes them 'smarter'.

Analyze and synthesize different methods for electric energy conversion based on rotating machines and power electronics.

- Renewable Energy (RENE)

This specialization focuses on renewable energy technologies, such as wind power, solar energy (thermal and solar cells), as well as efficiency methods and innovation potential in energy conversion, thermal power systems and polygeneration processes.

- Nuclear Energy (NUEY)

This specialization focuses on nuclear energy engineering. The specialization is run in close collaboration with industrial partners and provides the latest trends in innovation in nuclear energy.

The track aims at giving the students not only technical knowledge, but also economical, organisational and managerial knowledge.

Knowledge and understanding

For the degree of Master of Science from the programme Energy Innovation the student shall

- have knowledge and understanding of cutting-edge research and development and trends within industry
- have knowledge and understanding of processes, methods, and tools used for development of specific technologies;
- have knowledge of how to implement a business development process from idea to product.

Skills and abilities

For the degree of Master of Science from the programme Energy Innovation the student shall

- be able to apply his/her knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to the field of study.
- have the ability to think beyond boundaries and systematically explore and generate new ideas. (creative skills)
- have the ability to use knowledge, ideas or technologies to create new or significantly improved products, services, processes or policies or new business models. (innovation skills)
- have the ability to transform innovations into feasible business solutions. (entrepreneurial skills)
- have the ability to transform practical experiences into research problems and challenges. (intellectual transforming skills), and have the capability to work in cross-disciplinary teams in the thematic field of the KIC. (research skills)
- demonstrate leadership and decision-making, based on a holistic understanding of the contributions of higher education, research and business to value creation, in limited sized teams and contexts. (leadership skills)
- have the ability to communicate his/her conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously, both orally and in writing. (communication skills)

Ability to make judgements and adopt a standpoint

For the degree of Master of Science from the programme Energy Innovation the student shall

- have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information;
- demonstrate an appreciation of ethical, scientific and sustainability challenges

Extent and content of the programme

The programme lasts for two academic years (120 ECTS) on the advanced level (second cycle). The language of instruction throughout the programme is English.

Tracks:

- Smart Cities (SMCS)
- Smart Electrical Networks and Systems (SENS)
- Renewable Energy (RENE)
- Nuclear Energy (NUEY)

Eligibility and selection

General admission requirements and the following special admission requirements must be fulfilled in order to be admitted:

Smart Cities (SMCS)

Bachelor's degree in electrical engineering or mechanical engineering. Degrees in Sciences, Economics or Management are eligible, but may be subject to preparatory courses.

Smart Electrical Networks and Systems (SENS)

- electrical engineering (including three phase electrical circuits or machines) equivalent to 60 higher education credits
- mathematics (calculus, numerical methods, algebra, probability theory) equivalent to at least 30 higher education credits.

Renewable Energy (RENE)

Bachelor of Science in Mechanical or Chemical Engineering and related disciplines

Coursework in engineering thermodynamics, heat transfer, and fluid mechanics, with 6 hp as the approximate minimum threshold.

Nuclear Energy (NUEY)

Bachelor degree (180 ECTS) in Engineering Physics, Mechanical Engineering, Materials Engineering, Chemical Engineering, or Power Engineering.

Selection process

The selection process is handled by the coordinating institution of each track. However it should be in accordance with KTH's admission regulations.

Implementation of the education

Structure of the education

Each academic year consists of two semesters which are 20 weeks each, and each semester is further divided into two study periods.

Within the European Institute of Innovation and Technology (EIT) KTH participates in the Knowledge and Innovation Community (KIC) InnoEnergy. The Energy Innovation programme is an umbrella structure for the different master's programmes offered within EIT KIC InnoEnergy. InnoEnergy provides education programmes at master level with significant elements of innovation and entrepreneurship. All these programmes take place in cooperation with several other universities as well as partners in industry which offers internships to the students.

The Master's programme in Energy Innovation offers a heavy technical component in the traditional engineering sense combined with significant business and entrepreneurship activities throughout the whole curriculum to educate fresh engineers with either a broad overall view of the energy area, a specialized education in one of the thematic areas of the CCs, or an overview of the "well-to wheel" polygeneration perspective.

The Master's programme in Energy Innovation is given at two different European universities. The placement for the second year of studies is preliminary and may change depending on the orientation of the studies. Students can apply for "double degrees" from the two universities after completion of the studies.

For the different track, the following mobility options apply:

Smart Cities (SMCS)

First year: KULeuven, KTH

Second year: KULeuven, KTH, UPC, Grenoble INP

Smart Electrical Networks and Systems (SENS)

First year: KTH

Second year: INP Grenoble, KU Leuven, TU/e Eindhoven and UPC Barcelona

Renewable Energy (RENE)

First year: ParisTech, IST, UPC, KTH

Second year: ParisTech, IST, UPC, KTH

Nuclear Energy (NUEY)

First year: KTH, UPC

Courses

The programme is course-based. Lists of courses are included in appendix 1.

Grading system

Courses in the first and the second cycle are graded on a scale from A to F. A-E are passing grades, A is the highest grade. The grades pass (P) and fail (F) are used for courses under certain circumstances.

Grading scale is found in the course syllabus.

Conditions for participation in the programme

Participation requires admission to courses within the programme and course registration.

For further studies, special admission requirements for the course are to be fulfilled. Special admission requirements are listed in the respective course syllabus.

Degree project

The degree project is the final part of the education and comprises 30 higher education credits. The project work may begin when special admission requirements for the course are fulfilled.

The thesis should be implemented within the main field of study (depending on the selected track) and it is encouraged to link the thesis to industry.

Degree

The degree is entitled “Teknologie masterexamen” - Master of Science (120 credits). The main field of the degree is indicated in the text of the diploma.

Students graduating from the programme receive a degree from KTH and from the other university where they have studied a part of the program. The dual examinations are supplemented with an InnoEnergy certificate that documents the specific learning goals that meet the EIT Quality Score.

Appendix 1 - Course list

Appendix 2 - Programme syllabus descriptions



Appendix 1: Course list

Master's Programme, Energy Innovation
(TIETM)

Track, Nuclear Energy (NUEY)

Year 1

Mandatory courses (26.0 Credits)

| Code | Name | Credits | Edu. level |
|------------------------|--|---------|--------------|
| SH2600 | Nuclear Reactor Physics, Major Course | 9.0 hp | Second cycle |
| SH2702 | Nuclear Reactor Technology | 8.0 hp | Second cycle |
| SH2706 | Sustainable Energy Transformation Technologies | 9.0 hp | Second cycle |

Conditionally elective courses

| Code | Name | Credits | Edu. level |
|--------|---|---------|--------------|
| SH2302 | Nuclear Physics | 8.0 hp | Second cycle |
| SH2603 | Radiation, Protection, Dosimetry and Detectors | 6.0 hp | Second cycle |
| SH2605 | Radiation Damage in Materials | 6.0 hp | Second cycle |
| SH2610 | Leadership for Safe Nuclear Power Industry | 6.0 hp | Second cycle |
| SH2611 | Small Reactors | 6.0 hp | Second cycle |
| SH2612 | Nuclear Power Safety | 6.0 hp | Second cycle |
| SH2613 | Generation IV Reactors | 6.0 hp | Second cycle |
| SH2614 | The Nuclear Fuel Cycle | 6.0 hp | Second cycle |
| SH2701 | Thermal-Hydraulics in Nuclear Energy Engineering | 6.0 hp | Second cycle |
| SH2704 | Monte Carlo Methods and Simulations in Nuclear Technology | 6.0 hp | Second cycle |
| SH2705 | Compact Reactor Simulator- Exercises in Reactor Kinetics and Dynamics | 6.0 hp | Second cycle |
| SH2772 | Chemistry and Physics of Nuclear Fuels | 8.0 hp | Second cycle |
| SH2774 | Numerical Methods in Nuclear Engineering | 6.0 hp | Second cycle |

Information regarding conditionally elective courses

At least six courses of the conditionally elective courses should be selected.

Track, Renewable Energy (RENE)

Year 1

Mandatory courses (45.0 Credits)

| Code | Name | Credits | Edu. level |
|------------------------|--|---------|--------------|
| MJ1432 | Practical Energy Related Project | 9.0 hp | First cycle |
| MJ2405 | Sustainable Power Generation | 9.0 hp | Second cycle |
| MJ2407 | Sustainable Energy Utilisation | 9.0 hp | Second cycle |
| MJ2411 | Renewable Energy Technology | 6.0 hp | Second cycle |
| MJ2413 | Energy and Environment | 6.0 hp | Second cycle |
| MJ2438 | Modeling of Energy Systems - Heat and Power Generation | 6.0 hp | Second cycle |

Conditionally elective courses

| Code | Name | Credits | Edu. level |
|------------------------|---|---------|--------------|
| AL2115 | Transdisciplinary Approaches for System Innovations | 7.5 hp | Second cycle |
| AL2160 | Environmental Management | 7.5 hp | Second cycle |
| ED2200 | Energy and Fusion Research | 6.0 hp | Second cycle |
| EG2110 | Power System Stability and Control | 7.5 hp | Second cycle |
| EG2210 | Electricity Market Analysis | 7.5 hp | Second cycle |
| EG2220 | Power Generation, Environment and Markets | 7.5 hp | Second cycle |
| EJ2230 | Control in Electrical Energy Conversion | 6.0 hp | Second cycle |
| MJ2424 | Computational Methods in Energy Technology | 6.0 hp | Second cycle |
| MJ2426 | Applied Heat and Power Technology | 6.0 hp | Second cycle |
| MJ2443 | Heating, Cooling and Indoor Climate | 6.0 hp | Second cycle |
| MJ2500 | Large Scale Solar Power <i>Replaces MJ2441</i> | 6.0 hp | Second cycle |
| MJ2501 | Solar Energy Systems for Buildings and Cities <i>Replaces MJ2442</i> | 6.0 hp | Second cycle |

Information regarding conditionally elective courses

Conditionally elective courses: select at least 15 credits.

One conditionally elective cour in Energy Mangement for 7.5 credits will be added to the course list.

Year 2

Mandatory courses (12.0 Credits)

| Code | Name | Credits | Edu. level |
|------------------------|---|---------|--------------|
| MJ2503 | Small Scale Polygeneration | 6.0 hp | Second cycle |
| MJ2507 | AI applications in Sustainable Energy Engineering | 6.0 hp | Second cycle |

Conditionally elective courses

| Code | Name | Credits | Edu. level |
|------------------------|--|---------|--------------|
| AG2116 | City Networks in Regional Contexts | 7.5 hp | Second cycle |
| ED2235 | Atomic Physics for Fusion | 6.0 hp | Second cycle |
| EG2100 | Power System Analysis | 6.0 hp | Second cycle |
| EG2200 | Power Generation Operation and Planning | 6.0 hp | Second cycle |
| EG2340 | Wind Power Systems | 7.5 hp | Second cycle |
| EI2455 | Smart Electrical Networks and Systems | 7.5 hp | Second cycle |
| EJ2201 | Electrical Machines and Drives | 6.0 hp | Second cycle |
| EJ2301 | Power Electronics | 6.0 hp | Second cycle |
| ME2086 | Global Energy Markets and Systems in Transition | 6.0 hp | Second cycle |
| MJ2383 | Energy System Economics, Modelling and Indicators for Sustainable Energy Development | 6.0 hp | Second cycle |
| MJ2460 | Green Building - Concept, Design, Construction and Operation | 6.0 hp | Second cycle |
| MJ2505 | Practical Optimization of Energy Networks | 6.0 hp | Second cycle |
| SG2218 | Turbulence | 7.5 hp | Second cycle |
| SG2226 | Wind Energy Aerodynamics | 6.0 hp | Second cycle |

Recommended courses

| Code | Name | Credits | Edu. level |
|------------------------|--|---------|--------------|
| MJ2386 | Energy Storage Technology | 6.0 hp | Second cycle |
| MJ2506 | Energy Technologies for Sustainable Transportation | 6.0 hp | Second cycle |
| MJ2513 | Circular Economy and Energy System | 6.0 hp | Second cycle |
| MJ2517 | Heat pumping technologies | 6.0 hp | Second cycle |
| MJ2520 | Energy Systems for Smart Cities | 6.0 hp | Second cycle |
| MJ2521 | Integrated Energy Systems for Buildings | 6.0 hp | Second cycle |
| MJ2523 | Aircraft Propulsion, General Course | 6.0 hp | Second cycle |

Information regarding conditionally elective courses

Conditionally elective courses: select at least 24 credits.

Track, Smart Electrical Networks and System (SENS)

Year 1

Mandatory courses (43.5 Credits)

| Code | Name | Credits | Edu. level |
|------------------------|---|---------|--------------|
| EG2100 | Power System Analysis | 6.0 hp | Second cycle |
| EI2455 | Smart Electrical Networks and Systems | 7.5 hp | Second cycle |
| EI2600 | Innovation and Entrepreneurship in Electric Power Engineering | 6.0 hp | Second cycle |
| EI2610 | Industrial Innovation Project | 12.0 hp | Second cycle |
| EJ2201 | Electrical Machines and Drives | 6.0 hp | Second cycle |
| EJ2301 | Power Electronics | 6.0 hp | Second cycle |

Conditionally elective courses

| Code | Name | Credits | Edu. level |
|--------|--|---------|--------------|
| AK2030 | Theory and Methodology of Science (Natural and Technological Science) <i>Conditionally elective advanced course</i> | 4.5 hp | Second cycle |
| EG2110 | Power System Stability and Control <i>Conditionally elective advanced course</i> | 7.5 hp | Second cycle |
| EG2120 | FACTS and HVDC in Electric Power Systems <i>Conditionally elective advanced course</i> | 7.5 hp | Second cycle |
| EG2200 | Power Generation Operation and Planning <i>Conditionally elective basic course</i> | 6.0 hp | Second cycle |
| EG2210 | Electricity Market Analysis <i>Conditionally elective advanced course</i> | 7.5 hp | Second cycle |
| EG2220 | Power Generation, Environment and Markets <i>Conditionally elective advanced course</i> | 7.5 hp | Second cycle |
| EG2340 | Wind Power Systems <i>Conditionally elective advanced course</i> | 7.5 hp | Second cycle |
| EH2221 | The Sustainable Electric Power Engineer <i>Conditionally elective advanced course</i> | 1.5 hp | Second cycle |
| EH2741 | Communication and Control in Electric Power Systems <i>Conditionally elective basic course</i> | 6.0 hp | Second cycle |
| EH2745 | Computer Applications in Power Systems <i>Conditionally elective advanced course</i> | 4.5 hp | Second cycle |
| EI2430 | High-voltage Engineering | 7.5 hp | Second cycle |
| EI2436 | Power Grid Technology and Substation Design <i>Conditionally elective basic course</i> | 6.0 hp | Second cycle |
| EI2440 | Electrotechnical Design | 7.5 hp | Second cycle |
| EI2460 | Batteries for Energy Storage in Electrical Systems | 6.0 hp | Second cycle |
| EI2490 | Seminar Course in Electrotechnical Design and High Voltage Equipment <i>Conditionally elective advanced course</i> | 1.5 hp | Second cycle |
| EJ2420 | Seminars in Electrical Machines and Power Electronics <i>Conditionally elective advanced course</i> | 1.5 hp | Second cycle |
| EL2450 | Hybrid and Embedded Control Systems <i>Conditionally elective advanced course</i> | 7.5 hp | Second cycle |

Supplementary information

The programme consists of mandatory and conditionally elective courses.

A new project course consisting of 9 credits will replace EI2610 Industrial innovation project as a mandatory course for the academic year 21/22.

Information regarding conditionally elective courses

Select a minimum of 6 credits from the conditionally elective basic courses.

Select a minimum of 13,5 credits from the conditionally elective advanced courses.

EH2770 cancelled.

Track, Smart Cities (SMCS)

Year 1

Mandatory courses (34.5 Credits)

| Code | Name | Credits | Edu. level |
|------------------------|---|---------|--------------|
| AL2115 | Transdisciplinary Approaches for System Innovations | 7.5 hp | Second cycle |
| EG2100 | Power System Analysis | 6.0 hp | Second cycle |
| EJ2301 | Power Electronics | 6.0 hp | Second cycle |
| MJ2443 | Heating, Cooling and Indoor Climate | 6.0 hp | Second cycle |
| MJ2686 | Smart Cities and Climate Mitigation Strategies, Larger Course - Project Based | 9.0 hp | Second cycle |

Recommended courses

| Code | Name | Credits | Edu. level |
|------------------------|--|---------|--------------|
| AI2155 | Urban Economics and Cost Benefit Analysis | 7.5 hp | Second cycle |
| AL2130 | Waste Management | 7.5 hp | Second cycle |
| AL2160 | Environmental Management | 7.5 hp | Second cycle |
| EG2110 | Power System Stability and Control | 7.5 hp | Second cycle |
| EG2210 | Electricity Market Analysis | 7.5 hp | Second cycle |
| EH2741 | Communication and Control in Electric Power Systems | 6.0 hp | Second cycle |
| EH2745 | Computer Applications in Power Systems | 4.5 hp | Second cycle |
| EI2600 | Innovation and Entrepreneurship in Electric Power Engineering | 6.0 hp | Second cycle |
| EJ2201 | Electrical Machines and Drives | 6.0 hp | Second cycle |
| EJ2230 | Control in Electrical Energy Conversion | 6.0 hp | Second cycle |
| ME2016 | Project Management: Leadership and Control | 6.0 hp | Second cycle |
| ME2163 | Leading People and Organizations in Different Contexts <i>Replaces ME2063</i> | 6.0 hp | Second cycle |
| MJ2411 | Renewable Energy Technology | 6.0 hp | Second cycle |
| MJ2437 | Modeling of Energy Systems - Energy Utilization | 6.0 hp | Second cycle |
| MJ2472 | Energy Planning and Applications | 9.0 hp | Second cycle |

Information regarding conditionally elective courses

EH2770 cancelled.

Year 2

Mandatory courses (43.5 Credits)

| Code | Name | Credits | Edu. level |
|------------------------|---|---------|--------------|
| AL227X | Degree Project in Industrial Ecology, Second Cycle | 30.0 hp | Second cycle |
| EI2600 | Innovation and Entrepreneurship in Electric Power Engineering | 6.0 hp | Second cycle |
| MJ2685 | Smart Cities and Climate Mitigation Strategies- Project Based | 7.5 hp | Second cycle |

Recommended courses

| Code | Name | Credits | Edu. level |
|------------------------|---|---------|--------------|
| AF2507 | Sustainable Buildings - Concept, Design, Construction and Operation | 7.5 hp | Second cycle |
| AG2116 | City Networks in Regional Contexts | 7.5 hp | Second cycle |
| AG2806 | Environmental Aspects of the Built Environment | 7.5 hp | Second cycle |
| AH2170 | Transport Data collection and Analysis | 7.5 hp | Second cycle |
| AL2181 | Environmental System Analysis and Decision making | 7.5 hp | Second cycle |
| EH2720 | Management of Projects | 7.5 hp | Second cycle |
| EJ2201 | Electrical Machines and Drives | 6.0 hp | Second cycle |
| MJ2615 | Introduction to Industrial Ecology, larger course | 7.5 hp | Second cycle |

Supplementary information

MJ273X Degree Project in Industrial Ecology, Second Cycle has been discontinued and has been replaced by AL227X Degree Project in Industrial Ecology, Second Cycle.



Appendix 2: Specialisations

Master's Programme, Energy Innovation (TIETM)

Track, Nuclear Energy (NUEY)

This specialization deals nuclear energy engineering. The track is run in close collaboration with industrial partners and provides the latest trends in innovation in nuclear energy.

Track, Renewable Energy (RENE)

This specialization focuses on renewable energy technologies that the KIC partners have expertise in, such as wind power, solar energy (thermal and solar cells), as well as efficiency methods and innovation potential in energy conversion, thermal power systems and polygeneration processes.

Track, Smart Electrical Networks and System (SENS)

This education takes a starting point in the traditional education around electric power engineering, but turns its focus towards the electric power grid of the future -that is 'smart grids' - and how new concepts and ideas can lead to innovations within the framework of smart electrical networks and systems (smart grids).

Track, Smart Cities (SMCS)

This specialization deals with the concepts of “Smart Cities” based on scientific literature and reports from case studies.