



Master's in Advanced Energy Systems and AI

Courses and Syllabus



Master's in Advanced Energy Systems and AI

Master the Future of Energy with AI-Powered Innovation

General Description

This programme is at the forefront of energy innovation, focusing on the transformative potential of artificial intelligence and digital technologies. Students will explore how AI can optimise energy use, enable advanced electrification solutions, and drive behind-the-meter applications such as energy storage, EV charging, and demand-side management. The curriculum blends technical expertise with practical digital skills, preparing graduates to design and implement intelligent, decentralised, and sustainable energy systems that meet the demands of a rapidly evolving industry.

This programme is powered by:



This programme is organised by the team of Master's in Energy for Smart Cities.

Your Future Study Location

Year 1

Embark on an exhilarating journey in the first year of our Master's in Advanced Energy Systems and AI programme, where you have the exciting choice between [KU Leuven](#) in Belgium or [KTH: Royal Institute of Technology](#) in Sweden. During this transformative year, you'll delve into a stimulating blend of electrical and mechanical engineering courses intertwined with energy-related socio-economic subjects. At KU Leuven, students will experience a deeper dive into electrical engineering topics, making it ideal for those with a strong background in the field.

Year 2

In your second year, the world is your classroom as you select from prestigious institutions across Europe:

- [KU Leuven](#) in Belgium
- [KTH Royal Institute of Technology](#) in Sweden
- [INP: Grenoble Institute of Technology](#) in France
- [UPC: Universitat Politècnica de Catalunya](#) in Spain

Here, you'll tailor your studies with a diverse range of elective courses, allowing you to specialise in your areas of passion. From power electronics to energy efficiency in buildings, electrical machines to city networks, the options are limitless. Students can explore solar, wind, hydrogen, biomass and marine energy, storage and energy economics, and innovation strategy and management with the diverse catalogue of elective available at each partner university. A key feature of the first year is the emphasis on collaborative learning and international exposure. Students work in multicultural teams, engage in case studies, and participate in site visits to energy facilities and innovation hubs. This immersive environment fosters a global perspective and a deep understanding of the challenges and opportunities in the energy sector.



Your Master's Thesis

In your second year, dive into an exciting research project focusing on electrical or thermo-mechanical energy, or explore the technical-economic aspects of energy for your Master's thesis. This is your chance to put your knowledge and skills into action, integrating what you've learned throughout the programme. As you immerse yourself in your thesis, you'll gain invaluable experience and insights, honing your expertise and making a tangible impact in the field of energy innovation. Plus, every year, the programme team and the directors of EIT InnoEnergy Benelux award prizes for the most outstanding theses on innovation and entrepreneurship. Seize this opportunity to showcase your creativity and entrepreneurial spirit and be recognised for your groundbreaking contributions to the energy sector.

Involvement of Industry

As an InnoEnergy Masters+ student, you get exposed to much more than traditional academics. That is why all our students get to combine their know-how with real life consulting cases from companies in our ecosystem. Whether you work with one of our start-ups or with a shareholder, you will have the chance to show your talent during your study journey.

Students also benefit from the broader InnoEnergy ecosystem, with access to over 500 partners across Europe, offering innovation projects, venture support, and a vibrant community of energy professionals.

Courses & syllabuses – year 1

KTH Royal Institute of Technology

Required credits: 60 ECTS

Mandatory credits: 34.5 ECTS

Elective credits: 25.5 ECTS

Additional information and further requirements:

Students are required to: take the 34.5 ECTS mandatory courses and 25.5 ECTS from the list of elective courses based on their interests. Please check the most up to dated KTH syllabus for this programme by searching [Master's Programme, Energy Innovation \(TIETM\)](#) in this [link](#), select Programme syllabus for studies starting in Autumn “Year” (e.g., for academic year 2025-2026, it’s Autumn 25).

Course name	Course code	ECTS	Course type
Power System Analysis	EG2100	6	Mandatory
Power Electronics	EJ2301	6	Mandatory
Smart Cities and Climate Mitigation Strategies	MJ2686	9	Mandatory
Transdisciplinary Approaches for System Innovations	AL2115	7.5	Mandatory
Heating, cooling and indoor climate	MJ2443	6	Mandatory
FACTS and HVDC in Electric Power Systems	EG2121	7.5	Conditionally elective
Innovation and Entrepreneurship in Electric Power Engineering	EI2600	6	Elective
Electrical Machines and Drives	EJ2201	6	Elective
Project Management: Leadership and Control	ME2016	6	Elective
Renewable Energy Technology	MJ2411	6	Elective
Urban Economics and Cost Benefit Analysis	AI2155	7.5	Elective
Waste Management	AL2130	7.5	Elective
Environmental Management	AL2160	7.5	Elective
Power System Stability and Control	EG2110	7.5	Elective
Communication and Control in Electric Power Systems	EG2130	7.5	Elective

Course name	Course code	ECTS	Course type
<u>Electricity Market Analysis</u>	EG2210	7.5	Elective
<u>Control in Electrical Energy Conversion</u>	EJ2230	6	Elective
<u>Leading People and Organizations in Different Contexts</u>	ME2163	6	Elective
<u>Introduction to Energy Systems Analysis and Applications - Minor Course</u>	MJ2381	6	Elective
<u>Energy Demand and Supply Distribution Systems in the Built Environment</u>	MJ2518	6	Elective



Courses & syllabus – year 1

KU Leuven

Required credits: 60 ECTS

Additional information and further requirements:

Students are required to: take 60 ECTS mandatory courses. Further information on the courses at KU Leuven can also be accessed via this [link](#) (Option: Energy for Smart Cities, Phase 1 representing Y1 courses and Phase 2 representing Y2).

Course name	Course code	ECTS	Course type
Power Systems	B-KUL-H04A0A	3	Mandatory
Power Electronics	B-KUL-H04A2A	3	Mandatory
Power System Calculations	B-KUL-H04A9A	3	Mandatory
Energy Markets and Regulation	B-KUL-H04C2A	3	Mandatory
Energy Economics	B-KUL-H04C4A	3	Mandatory
Smart Distribution Systems	B-KUL-H00P3A	3	Mandatory
Hands-on integrated Project on Innovative Energy Systems, part 1	B-KUL-H00U5A	3	Mandatory
Hands-on integrated Project on Innovative Energy Systems, part 2	B-KUL-H00U6A	3	Mandatory
Numerical Methods in Energy Sciences	B-KUL-H9X34A	6	Mandatory
Nuclear Energy: Basic Aspects	B-KUL-H04B5B	4	Mandatory
Combustion Engines	B-KUL-H04S6B	4	Mandatory
Renewable Energy	B-KUL-H04C1B	6	Mandatory
Electrical Drives: Energy Efficiency of Electrical Machines	B-KUL-H04A4B	4	Mandatory
Thermal Systems: Basic Aspects	B-KUL-H9X52A	3	Mandatory
Energy Challenges	B-KUL-H9X53A	3	Mandatory
Technology Entrepreneurship and New Business Development	B-KUL-D0S18A	6	Mandatory

Courses & syllabus – year 2

KTH Royal Institute of Technology

Required credits: 60 ECTS

Mandatory credits: 43,5 ECTS

Elective credits: 16,5 ECTS

Additional information and further requirements:

Students are required to: take the 43,5 ECTS mandatory courses and select 16,5 ECTS from the list of elective courses based on their interests.

Course name	Course code	ECTS	Course type
Degree Project in Industrial Ecology, Second Cycle (Master Thesis)	AL227X	30	Mandatory
Smart Cities and Climate Mitigation Strategies – Project Based	MJ2685	7.5	Mandatory
Innovation and Entrepreneurship in Electric Power Engineering	EI2600	6	Mandatory
Sustainable Buildings - Concept, Design, Construction and Operation	AF2507	7.5	Elective
City Networks in Regional Contexts	AG2116	7.5	Elective
Environmental Aspects of the Built Environment	AG2806	7.5	Elective
Transport Data collection and Analysis	AH2170	7.5	Elective
Management of Projects	EH2720	7,5	Elective
Electrical Machines and Drives	EJ2201	6	Elective
Introduction Industrial Ecology, larger course	MJ2615	7,5	Elective

Courses & syllabus – year 2

KU Leuven

Required credits: 60 ECTS

Mandatory credits: 41 ECTS

Elective credits: 19 ECTS

Additional information and further requirements:

Students are required to: take the Master's Thesis (30 credits, including Industrial Traineeship), choose min. 24 ECTS from the categories of 'Courses Electrical Energy', 'Courses Thermo-Mechanical Energy', 'Courses General Techno-Economic Energy Knowledge' and/or 'Courses Complementary Technical Knowledge', choose 3 ECTS 'General Interest Course (from the list), and to attend the joint Capita Selecta Smart Cities II.1. (3 credits). Further information on the courses at KU Leuven can also be accessed via this [link](#) (Option: Energy for Smart Cities, Phase 1 representing Y1 courses and Phase 2 representing Y2).

Course name	Course code	ECTS	Course type
<u>Master's Thesis</u>	B-KUL-H09L7B	30	Mandatory
<u>Design and Management of Electric Power Systems</u>	B-KUL-H04C6A	6	Electrical Energy
<u>Electromobility</u>	B-KUL-H04C8A	3	Electrical Energy
<u>Industrial Automation and Control</u>	B-KUL-H04D0A	6	Electrical Energy
<u>Electromagnetic Processing of Materials</u>	B-KUL-H04B1A	3	Electrical Energy
<u>Measurement and Testing, including High Voltages</u>	B-KUL-H04D2A	3	Electrical Energy
<u>Light and Lighting Systems</u>	B-KUL-H04D4A	3	Electrical Energy
<u>Materials in Electrical Engineering</u>	B-KUL-H04D6A	3	Electrical Energy
<u>Flexible Electrical Power Systems</u>	B-KUL-H0T47A	3	Electrical Energy
<u>Electrical Energy Conversion for Renewable Energy and Storage</u>	B-KUL-H0O42A	3	Electrical Energy
<u>Aerodynamics</u>	B-KUL-H04O1A	6	Thermo-Mechanical Energy
<u>Numerical Techniques in Fluid Dynamics</u>	B-KUL-H04U8A	3	Thermo-Mechanical Energy
<u>Turbulence</u>	B-KUL-H04Y7A	3	Thermo-Mechanical Energy

Course name	Course code	ECTS	Course type
<u>Aircraft Engines</u>	B-KUL-H04Z8A	5	Thermo-Mechanical Energy
<u>Two-Phase Flow: Theory and Applications</u>	B-KUL-H0A21A	3	Thermo-Mechanical Energy
<u>Advanced Measurement Techniques in Fluid Mechanics</u>	B-KUL-H0E66A	3	Thermo-Mechanical Energy
<u>Turbomachinery, Part 2</u>	B-KUL-H04Y6A	3	Thermo-Mechanical Energy
<u>Advanced Thermodynamics and Plasma Physics</u>	B-KUL-H04Q1B	6	Thermo-Mechanical Energy
<u>Environmental Economics</u>	B-KUL-D0M36A	3	Techno-Economic Energy Knowledge
<u>Environmental Economics</u>	B-KUL-D0M36B	6	Techno-Economic Energy Knowledge
<u>Fundamentals of Financial Mathematics</u>	B-KUL-G0Q20C	4	Techno-Economic Energy Knowledge
<u>Optimization Problems in Energy Systems</u>	B-KUL-H0P08A	3	Techno-Economic Energy Knowledge
<u>Energy Law</u>	B-KUL-H06R6A	4	Techno-Economic Energy Knowledge
<u>Electricity and Gas Markets</u>	B-KUL-H06P1A	3	Techno-Economic Energy Knowledge
<u>Optimization</u>	B-KUL-H03E3A	6	Complementary Technical Knowledge
<u>Quantum Physics</u>	B-KUL-H06E2A	3	Complementary Technical Knowledge
<u>Measurement Systems</u>	B-KUL-H05F7A	3	Complementary Technical Knowledge
<u>Building Simulations, Part 1</u>	B-KUL-H03T4A	3	Complementary Technical Knowledge
<u>Experimental Design</u>	B-KUL-G0B68A	4	Complementary Technical Knowledge
<u>Statistical Data Analysis</u>	B-KUL-G0O00A	6	Complementary Technical Knowledge
<u>Mechatronic Drive Systems</u>	B-KUL-H0T49A	3	Complementary Technical Knowledge
<u>Innovation Management and Strategy</u>	B-KUL-D0H36A	6	General Interest

Course name	Course code	ECTS	Course type
<u>Philosophy of Technology</u>	B-KUL-W0EN7A	4	General Interest
<u>Engineering Economy</u>	B-KUL-H00K1A	3	General Interest
<u>Management and Information Technology</u>	B-KUL-H00K2A	3	General Interest
<u>Dutch Language and Cultures</u>	B-KUL-H06B4A	3	General Interest
<u>ICT Service Management</u>	B-KUL-D0I69A	6	General Interest
<u>Introduction to Management and Strategy</u>	B-KUL-D0R78A	4	General Interest
<u>Ecodesign and Life Cycle Engineering</u>	B-KUL-H00O3A	3	General Interest
<u>Intellectual Property Management</u>	B-KUL-G0B01A	4	General Interest
<u>Project Management</u>	B-KUL-H04X2A	3	General Interest
<u>Engels in de bedrijfsomgeving</u>	B-KUL-H04B3A	3	General Interest
<u>Capita Selecta Smart Cities II.1.</u>	B-KUL-H09G7A	3	Broadening Programme

Courses & syllabus – year 2

Grenoble Institute of Technology

Required credits: 60 ECTS

Mandatory credits: 15 ECTS courses + 30 ECTS masters thesis

Elective credits: 15 ECTS

Additional information and further requirements:

In Year 2, students following the Nuclear Reactor Physics and Engineering (NRPe) track must follow the below courses.

Students are required to: take a total of 30 ECTS per Semester. There are two majors (Major 1 on power electronics, and Major 2 on power systems). In Major 2, three tracks are available (Smart grid, Smart Building and energy storage, respectively major 2-1,2-2 and 2-3). Each track proposes two elective courses.

Course name	Course code	ECTS	Course type
Master's Thesis	WEUS4PFE	30	Mandatory
ICT for Smart Grids and Smart Cities	5EU5ICT6	5	Mandatory
Smart Energy Systems, Methods, and Tools	WEU9SES1	3	Mandatory
ICT for Smart Grids and Smart Cities	To be defined	5	Mandatory
French Language	WEU1FRE6	2	Mandatory
Professional Skills Support	WEU3MAP7	0	Elective
Design Models for Power Electronics	5EU9DMP9	5	Mandatory (Major 1)
Power Electronics Semiconductor Devices	5EU9PES9	5	Mandatory (Major 1)
Power Electronics Project	5EU9PEP9	5	Elective (Major 1)
Machine Learning and Optimization	5EU9MLO0	5	Elective (Major 1)
Research Project	5EUS5PR1	5	Elective (Major 1)
Energy Markets and New Stakeholders	5EUS5IME	5	Mandatory (Major 2)
Distributed Generation	WEUS3DGE	5	Mandatory (Major 2)

Course name	Course code	ECTS	Course type
Modelling and Operation of Electrical Grids	5EUS5MFR	5	Elective (Major 2-1)
MicroGrids, SmartGrids and SuperGrids	5EUS5SMA	5	Elective (Major 2-1)
Machine Learning and Optimization	5EU9MLOO	5	Elective (Major 2-1, 2-2, and 2-3)
Energy Management and Energy Efficiency of Buildings	5EUS5GEB	5	Elective (Major 2-2)
Overall Multidisciplinary Project	5EUS5PRI	5	Elective (Major 2-2 and 2-3)
New Sustainable Technologies	5EUS5NTD	5	Elective (Major 2-3)

Courses & syllabus – year 2

Universitat Politècnica de Catalunya

Required credits: 60 ECTS

Mandatory credits: 35 ECTS

Elective credits: 24 ECTS

Additional information and further requirements:

Students are required to: take 30 ECTS master's thesis (in quarter 4), and to choose 4 elective courses (20 ECTS); at least one of them has to be a core one. More information can be accessed via this [link](#).

Course name	Course code	ECTS	Course type
Master's Thesis	820775	30	Mandatory
Control and Automation for the Efficient Use of Energy	820771	5	Core elective
Data Science Applied to Electrical Energy Systems	240209	5	Core elective
Energy storage	820773	5	Core elective
Smart Grids	820755	5	Core elective
Advanced Course on Heat and Mass Transfer	820761	5	Elective
Biogas and Biofuels	820742	5	Elective
Challenge Based Module	240EN38	5	Elective
Computational Methods in Energy Technology	820757	5	Elective
Electric Energy Conversion	240257	5	Elective
Energy Economy and Comprehensive Energy Planning Models	820767	5	Elective
Energy Management and Optimization of Electrical Power Systems	240208	5	Elective
Energy, Technology and Society	240287	5	Elective
Experimental Energy Technology	820758	5	Elective
Heat Exchange	820764	5	Elective

Course name	Course code	ECTS	Course type
Hydrogen and Fuel Cells	820748	5	Elective
Integration of Renewables in the Electric Grid	820747	5	Elective
Photovoltaic Solar Energy	820740	5	Elective
Power Electronics and Electrical Machines Application in Electrical Mobility and Industrial Application	240206	5	Elective
Power Quality	820753	5	Elective
Solar Photovoltaics	820743	5	Elective
Solar Thermal Energy	820744	5	Elective
Thermal Equipment Generating Heat and Cold	820760	5	Elective
Turbulence: Phenomenology, Simulation, Aerodynamics	820762	5	Elective
Power Electronics Applied to Distributed Resources	820750	5	Elective
Wind power	820739	5	Elective

Innovation & Entrepreneurship Journey

Academics+

Exciting, right? But with this master's programme, you will go beyond academics as you embark on an exciting journey in innovation and business alongside your master's programme, unlocking a realm of unique possibilities in the energy sector.

Elevate your skills with our MBA-level training, empowering you with tools for venture creation, investor pitches, fostering creative thinking, embracing ambiguity, and harnessing digital advancements like data science, machine learning, and blockchain technologies specifically tailored for the energy industry.

Master's in Advanced Energy Systems and AI students take part in a blended training designed together with UnternehmerTUM (start-up accelerator of TU Munich), a leader in innovation and business creation. This journey connects students with the network of start-ups from TU Munich, placing them at the heart of Germany's Energiewende. The training includes:

- Winter School in Munich
- Online Spring School
- One-day pitching competition (pre-Master School Connect)
- One-week summer school in Munich with trainers, speakers and members of UnternehmerTUM's start-up ecosystem

Students also get immersed in the Munich entrepreneurship ecosystem, benefiting from workshops on innovation, self-leadership and guest lectures by successful entrepreneurs and corporate executives. They also gain access to the MarkerSpace and its prototyping facilities.

Finally, students are onboarded into UTUM's unique entrepreneurial community in the Munich ecosystem with +8000 innovators, future thinkers, and entrepreneurial talents who are all alumni of UTUM programmes.

Exclusive content for Innoenergy Masters+ students

- **Start-up Engagement:** Through internships, thesis projects, and networking events, students engage with start-ups supported by EIT InnoEnergy, gaining first-hand experience of the entrepreneurial ecosystem.
- **Industry consulting projects:** As an InnoEnergy Masters+ you will have the opportunity to combine your know-how with real-life consulting cases from companies in our ecosystem. Whether you work with one of our start-ups or with shareholders, you will have the chance to show your talent during your study journey.
- **Data Science & AI for Energy:** Master+ will offer you the chance to follow several courses to equip yourself with practical skills in data science and AI for the energy sector, either in an engineering context or to create new business models.

You can explore key modules such as:

- **Data Science & AI for Energy**
- **Data driven business decision making**
- **Digital business & venturing for energy engineers**

Degrees and certifications

Academics+

After successfully completing the two-year programme, you will receive:

- A degree from each of your two chosen universities:
 - KU Leuven: EIT-KIC master in Energy
 - KTH: Master of Science
 - INP: International Master of Science in Electrical Engineering for Smart Grids and Buildings
 - UPC: Master of Energy Engineering
- A Certificate of Innovation and Entrepreneurship from UnternehmertUM
- A Certificate of Data Science and AI for Energy
- An EIT Label Certificate (from the European Union) *

The EIT Label is a quality seal awarded by the European Institute of Innovation and Technology (EIT) to a KIC educational programme that has been assessed positively by the EIT on the implementation of the EIT Quality Assurance and Learning Enhancement (EIT QALE) system and the application of specific quality criteria with focus on the EIT Overarching Learning Outcomes (EIT OLOs), robust entrepreneurship education, highly integrated, innovative 'learning-by-doing' curricula, international mobility and outreach.

InnoEnergy continually strives to improve the quality, structure and content of our Masters+ programmes. Therefore, some changes may occur as part of our quality control process.

InnoEnergy continually strives to improve the quality, structure, and content of our Masters+ programmes. Therefore, some changes may occur as part of our quality control process. The partner universities reserve the right to make changes to the curriculum and content of some courses, and the programme consortium reserves the right to change this list of activities or format of delivery at any time without prior notice. If any changes are made, the revised plan and calendar will be immediately informed to students.