MASTER

ENERGY SCIENCE AND TECHNOLOGY

EPFL

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Energy conversion and energy systems have shaped and will shape the evolution of mankind. Future generations will rely on energy made available by massive renewable resources.
The inherent nature of these resources is posing unprecedented technical and management challenges to engineers.

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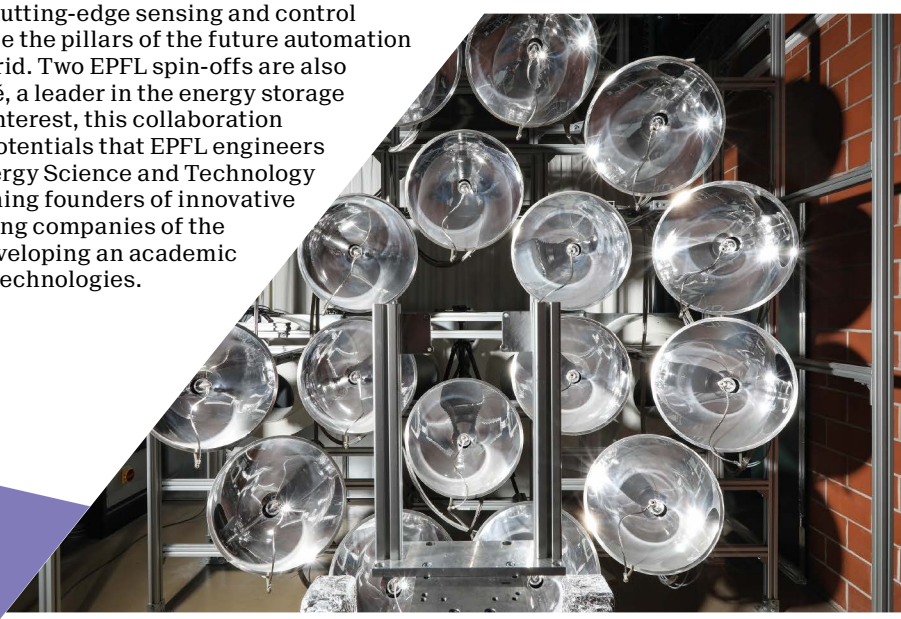
Developing the pillars of power grids' future automation

Prof. Paolone – Distributed Electrical Systems Laboratory

The energy system of the future has to be environmental-neutral, distributed and electricity-based. This system will require highly qualified engineers for the development of innovative solutions for its planning, operation, and control. The Aigle demonstration project, undertaken in collaboration with the local distribution system operator Romande Energie, gives a glimpse of this future by accommodating a variety of distributed stochastic resources that challenge the power grid operation and control. At this unique experimental site, a team of young engineers of the EPFL Distributed Electrical Systems Laboratory works on the development of cutting-edge sensing and control technologies that may be the pillars of the future automation of the power distribution grid. Two EPFL spin-offs are also involved along with Leclanché, a leader in the energy storage sector. Beyond the scientific interest, this collaboration reflects the multiple career potentials that EPFL engineers with a Master's degree in Energy Science and Technology can pursue, including becoming founders of innovative start-ups or experts in leading companies of the energy sector, as well as developing an academic career on state-of-the-art technologies.

Anaëlle Dury:
"What can I do that is useful for society and interesting for me? This is the question that led me to this Master's degree. Almost as indispensable as food, energy combines technological, economic and social issues and it is in this complex field that I found my way."

Amara Slaymaker:
"Not only are the courses interdisciplinary, but the students in the program come from various backgrounds – incl. physics, life sciences, numerous engineering disciplines and more – I love that everyone is able to bring a unique perspective to the issues and topics we explore."



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New energy conversion devices for solar fuel production with sunlight

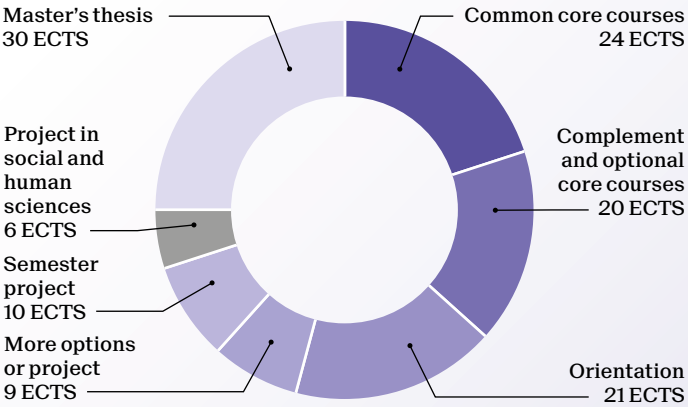
Prof. Haussener – Laboratory of Renewable Energy Science and Engineering

A majority of the current and future energy use is in the form of fuels. However, all fuels are based on fossil resources and have no place in a sustainable energy economy. Replacing them with renewable synthetic fuels is a significant challenge. This project aims at producing solar fuels by a photoelectrochemical (PEC) approach utilizing concentrated solar radiation and thermal integration to reduce cost and increase efficiency. PEC approaches use only abundant and renewable resources, namely the sun, water, and CO_2, for producing hydrogen or synthesis gas. To develop and design operational PEC devices, we develop multi-physics computational models (i.e. digital twins) before fabricating and testing them in a controlled laboratory environment (such as in our custom-made high-flux solar simulator that can achieve concentrated fluxes above 10 MW/m^2). Once the device is optimized and the dynamics are understood, we scale the device and test it under real on-sun and outdoor conditions in our 7m-diameter solar concentrating dish. Our experimental facilities are excellent testbeds for investigating and developing solar technologies. They have already (and will continue) to spur innovation in the form of patents and startup creation.

Master of Science in

ENERGY SCIENCE AND TECHNOLOGY

2-year program - 120 ECTS



Students must choose 21 ECTS of optional courses in one of these three orientations:

A Energy conversion devices
B Energy systems
C Energy management and sustainability

Orientation	A	B	C	21
Advanced control systems		B		3
Advanced energetics		B		5
Advanced lab in electrical energy systems	A	B		4
Applied data analysis	A	B	C	8
Development engineering			C	4
Distributed intelligent systems			C	5
Electromagnetic compatibility	A			2
Energy storage systems	A			3
Energy and comfort in buildings		B		4
Engines and fuel cells	A			4
Environmental transport phenomena	A			5
Hydropower schemes and pumped-storage				4
Industrial automation	A			3
Industrial electronics II	A			4
Material and energy flow analysis			C	4
Model predictive control	A	B		4
Modelling and optimization of energy systems		B		4
Power system restructuring and deregulation			C	3
Power systems dynamics		B		3
Renewable energy (for ME)		B		4
Sanitary engineering in developing countries			C	3
Smart grids technologies	A	B	C	5
Solar energy conversion	A			4
Sustainability assessment of urban systems			C	3
Water and wastewater treatment			C	5

	Credits
Common core courses	**24**
Convex optimization	5
Electrochemical engineering	3
Energy conversion and renewable energy	4
Energy supply, economics and transition	2
Fundamentals and processes for photovoltaic devices	3
Hydraulic turbomachines	4
Thermal power cycles and heat pump systems	3

Complement	**20**
Students must follow levelling courses depending on their background and choose additionnal optional core courses to reach 20 ECTS. EE/MT: students with background in Electrical Engineering or Microengineering ME: students with background in Mechanical Engineering SIE: students with background in Environmental Science and Engineering	

Additional mandatory courses for EE/MT:	7
Heat and mass transfer	4
Life cycle assessment in energy systems	3

Additional mandatory courses for ME:	11
Fundamentals of electrical circuits and systems I	2
Life cycle assessment in energy systems	3
Principles of power systems	2
Semiconductor devices I	4

Additional mandatory courses for SIE:	14
Fundamentals of electrical circuits and systems I, II	4
Heat and mass transfer	4
Principles of power systems	2
Semiconductor devices I	4

Additional mandatory courses for students from another study program:	17
Fundamentals of electrical circuits and systems I, II	4
Heat and mass transfer	4
Life cycle assessment in energy systems	3
Principles of power systems	2
Semiconductor devices I	4

Optional core courses	3 to 13
Fundamentals of electrical circuits and systems I, II	4
Industrial electronics I	4
Principles of power systems	2
Semiconductor devices I	4
Advanced heat transfer	3
Heat and mass transfer	4
Hydroacoustique pour aménagements hydroélectriques	3
Hydropower plants: generating and pumping units	2
Two-phase flows and heat transfer	3
Applied machine learning	4
Discrete optimization	5
Energy systems engineering	3
Nuclear fusion and plasma physics	4
Thermodynamics of energy conversion and storage	3
Life cycle assessment in energy systems	3
Lifecycle performance of product systems	3
Negotiation techniques	2
Principles of finance	5
Principles of microeconomics	4
Recycling of materials	2
Solid waste engineering	4
Transitions, sustainability and technology policy	4
Water resources engineering	5

Industrial internship

The program includes a compulsory industrial internship with a minimal duration of 8 weeks.

Entry requirements

Candidates should have a Bachelor's degree from a reputable university and excellent academic performance. The strong interdisciplinary character of the Master's degree in Energy Science and Technology is reflected in the fact that the program is open to a wide range of Bachelor's degree holders in applied sciences and engineering, including but not limited to electrical, mechanical, environmental sciences and engineering.

School of Engineering
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