



Master of Science in Technology, Smart Energy (Smart)

Master's Programme in Smart Energy consists of three major blocks: 1) Smart Grids and Power Generation, 2) Digitalisation and 3) Business Studies. Programme gives extensive and future-proof capabilities for students in order to make the ongoing energy transition into reality. Programme provides good analytical skills and extensive knowledge about key smart energy system and components related technologies (like battery storages, microgrids, big data analytics/artificial intelligence) as well as future market and business models.

Traditional power systems are changing due to global drivers like climate change, environmental issues and increasing dependency on electricity. Therefore, there is a need for large-scale integration of renewable, low-emission (CO₂) energy sources in high-, medium- and low-voltage (HV, MV and LV) networks, need to improve energy efficiency of the whole energy system and need to improve electricity supply reliability. This will have major impact on power systems and utilization of new flexible, distributed energy resources i.e. flexibilities (like distributed generation, demand response, battery energy storages and electric vehicles) utilisation enabling technologies, standardization, planning principles, regulation, market and business models are needed in order to realise future smart and flexible energy systems.

Moreover, intelligent utilisation of increased amount of data (big data analytics) through advanced communication networks like wireless 5G as well as interoperability, cost efficiency and reliability of all new management, protection and communication solutions will be in key role in smart power systems. Furthermore, the programme provides students with recent knowledge about utilisation of artificial intelligence (AI) and optimisation in future Smart Grids taking into account other energy networks (heat, gas), their integration and related storage solutions.

The general objectives of the Master's Programme in Smart Energy are:

- To provide up-to-date and high quality knowledge in smart energy systems and solutions design and analytics
- To provide broad systemic view on future smart and flexible power systems
- To provide good analytical skills and knowledge about key smart energy system and components related technologies, emerging new market, and business models
- To provide competent work force for the energy industry in the Ostrobothnia region
- To educate students to have multidisciplinary capabilities and competences
- To strengthen ties with international academics and industrial partners

Learning outcomes

A student who has completed a Master's Degree in Smart Energy will be able to

- plan, research and develop new intelligent solutions for the electrical and energy systems of the future e.g. by utilising different simulation tools
- lead and manage different production, product development and planning projects in the field of electrical engineering and energy technology
- assess and compare different ways of energy production from the technical and economical point of view and compare different alternatives in energy production
- use existing sources of information critically and produce new knowledge in electrical engineering and energy technology
- carry on their studies in doctoral level
- apply research methods in the field of electrical engineering and electrical energy engineering

**MASTER OF SCIENCE (TECHNOLOGY),
MASTER'S PROGRAMME IN SMART ENERGY
120 ECTS**

Head of Programme: Hannu Laaksonen

COMPLEMENTARY STUDIES 13-16 ECTS

OPIS0039 Personal Study Plan 0 ECTS

OPIS0025 Searching for Scientific Information 1 ECTS (if not completed in earlier University of Vaasa studies)

KENG9212 Writing Academic English 5 ECTS

KSUO5111 Finnish for Foreigners I 5 ECTS (optional language course for native Finnish speakers)

Choose at least one course from below (not included in your previous studies):

ICAT3020 C and Embedded C Programming, 3 ECTS

MATH1170 Probability and Statistics 5 ECTS

STAT1010 Statistical Analysis of Contingency and Regression 5 ECTS

STAT3120 Probability and Stochastic Processes 5 ECTS

STAT3140 Applied Multivariate Statistics 5 ECTS

SMART ENERGY STUDIES 50 ECTS

Smart Energy Studies consist of two modules: 'Smart Grids and Power Generation' and 'Digitalisation'. Students should choose at least 30 ECTS for 'Smart Grids and Power Generation' module and at least 20 ECTS for 'Digitalisation' module from courses listed below.

Smart Grids and Power Generation (30 ECTS)

SATE3210 Power Systems - Analysis and Design Principles 5 ECTS (spring 2021)

SATE3170 Smart Grids - Active Networks and Microgrids 5 ECTS (spring 2020)

SATE3180 Control and Simulation of Modern Electric Drives and Systems 5 ECTS (autumn 2019)

SATE3200 Power Electronic Applications in Smart Grids 5 ECTS (autumn 2020)

SATEB3010 Battery Energy Storages in Smart Grids 5 ECTS (autumn 2019)

SATE3130 Smart Grid Communication 6 ECTS

ENER3110 Seasonal Energy Storage and Conversion Technologies 5 ECTS (autumn 2020)

ENER3130 Modeling and Simulation of Energy Systems 5 ECTS (autumn 2019)

ENER3120 Distributed Energy Generation Systems 5 ECTS (spring 2020)

ENERFT3110 Marine and Power Plant Engines 5 ECTS

ENERFT3130 Exhaust and Flue Gas After - Treatment Technologies 5 ECTS

ENERFT3120 Engine Fuels and Lubricants 5 ECTS

FYSIFT3100 Present and Future Prospects in Energy Technology: Seminar Course with Industrial Viewpoint 5 ECTS

Digitalisation (20 ECTS)

SATE3130 Smart Grid Communication 6 ECTS

TITE3370 Management of Cyber Security 5 ECTS

ICAT3030 Computer Simulations 5 ECTS

ICAT3040 Advanced Digital Electronics 5 ECTS

ICAT3060 Energy Chains Optimisation 5 ECTS

ICAT3070 Evolutionary Computing 5 ECTS

ICAT3120 Machine Learning 5 ECTS

ICAT3160 Security of Embedded and Distributed Systems 7 ECTS

ICAT3180 Applied Signal Processing 5 ECTS

ICAT3110 Intelligent Robotics 5 ECTS

ICT3170 SoC-FPGA, 5 ECTS

BUSINESS STUDIES 25 ECTS

Students should choose at least 25 ECTS from courses below, related, for example, to future electricity and energy market structures or business models for battery energy storages.

SATE3190 Future Electricity and Energy Markets & Business Concepts 5 ECTS (autumn 2020)

SATEB3020 Business Models for Battery Storages 5 ECTS (spring 2020)

SATE3220 Smart Cities and Communities 5 ECTS (spring 2021)

ERIK2004 Introduction to Energy Market Regulation, 5 ECTS

ERIK2001 EU Energy Law and Policy 5 ECTS

TUTA3290 Sustainable Supply Chain Management and Circular Economy 5 ECTS

TUTA3230 Product and Service Design and Practice 5 ECTS
TUTA3120 Supply Chain Design and Management 5 ECTS
TUTA3030 Technology Management 5 ECTS
JOHT3019 Project Management 5 ECTS
ISAN3040 Project Portfolio Management 5 ECTS
ISAN3010 Analytics in Project Management 5 ECTS
ISAN3050 Service Design 5 ECTS

MASTER'S THESIS AND MATURITY EXAM 30 ECTS

SATE3970 Master's Thesis 30 ECTS, consists of the following parts:

SATE3971 Research Plan and Presentation 10 ECTS

SATE3972 Master's Thesis 20 ECTS

SATE3973 Master's Thesis Presentation 0 ECTS

KNÄY300X Maturity Exam 0 ECTS

OPTIONAL STUDIES 0-2 ECTS

Choose other university courses to complete the degree (120 ECTS) according to your interest.

For example:

Practical Training 1-5 ECTS (The degree may include practical training / internship improving the student's professional expertise. A two-week (à 40 hours) training period is equivalent to 1 ECTS. The student must also write a report about the training.)

Note: Those Finnish students who have not completed studies in second national language in their previous degree, have to complete studies in second national language. These studies will be supplementary and not included in the degree.

Please note that individual courses may not be available every year.