MS ISEE Study track: Energy systems, Study Plan and Courses Table: 2017/2018.

Year 1 at Aalto University: Department of Mechanical Engineering. Contact: Mika Järvinen
Year 2 at KTH: Department of Energy Technology. Contact: Mark Howells and Shahid H. Siyal

General program goals

The purpose of the Nordic Master Program in "Innovative Sustainable Energy Engineering" is to provide state-of-the-art education in the fields of conventional and renewable energy sources like conventional and new power generation, solar energy, biomass energy, wind power, geothermal power, and energy utilization in the built environment by means of economically and environmentally sustainable systems and technologies. The term 'sustainable energy engineering' comprises a wide array of practices, policies and technologies (conventional and renewable/alternative) aimed at providing energy at the least financial, environmental and social cost. A strong emphasis is placed on dealing with energy engineering tasks with due consideration of technical, environmental and socio-economic issues. Another strong emphasize is put on the Innovative and Entrepreneurial aspects of the energy society, especially related to how existing and new efficiency improvement innovations can be brought to the market in different countries. The innovative aspects inside the program are both related to the advanced renewable concept in the Nordic countries as well as regards to new businesses in the energy sector. Advanced methods are applied to identify, describe, quantify and find solutions to a diverse range of energy engineering problems. Participants gain proficiency in project design and implementation, operation and maintenance, as well as in crucial phases of policy generation. Advanced training in a research-oriented perspective is also included.

Study track:

Energy Systems

Cooperating universities:

1. Year	**2. Year**
Aalto	*KTH*
Department of Mechanical Engineering	*Department of Energy Technology*
Mika Järvinen	*Mark Howells/Shahid Hussain Siyal*

Study track focus and goals:

Background

Affordable access to essential services underpins development. Energy fuels many such services. The 'energy-system' harnesses resource, transforms it to energy carriers that are used in *appliances and machinery* to provide those services. In order to provide services to current and future generations, the 'energy-system' itself needs to be sustainable. This 'energy system' may impact and interact with the economy, the environment (including other physical resource or commodity systems) and society. The effects of this impact and interaction should also be sustainably managed. The energy decision maker is thus concerned with: (i) enabling appropriate, affordable and adequate service access; (ii) ensuring the energy-system can do so in a sustainable manner; and (iii) ensure that the broader interactions between systems do not compromise the planet's sustained development.

The goal of the program is to:

Expose the student to the context, role and process of energy systems analysis for medium to long term decision making; Have the student apply a range of standard energy modeling techniques to stereo-typical problems; Elucidate the role of energy modeling for Policy, technology, economic assessments; Have the student design, implement and apply a fully-fledged optimization energy systems model to a given assessment.

In the process, the student should be understand:

Why Energy Systems (rather than descrete energy technology) is important and how systems are analysed and modelled. The process of energy-environment-economic (3E) modeling: knowing why modelling is important, as well as who the stakeholders and decision makers are. - Introduction to the formulation of accounting, econometric, input-output, CGE and optimization modeling. Development of energy service and energy demand projections. Characterization of resources, technologies, economic, policy, and other elements to be considered within the modeling process. The role of scenarios and assumptions (forecasting, back casting etc…) and the importance of transparency. The relationship between modeling and action (policy / investment formulation / technology development). Typical model scopes, types and their application; Assessment of limitations and dealing with uncertainty

Course table:

1. Semester	2. Semester	3. Semester	4. Semester
Aalto		*KTH*	
Introduction to Advanced Energy Solutions, EEN-E1000, 5 ECTS, I-II	*EEN-E3002 Power process simulation (5 ECTS) III*	*MJ2475 Theory & methodology of science in energy research (6 ECTS)*	*MJ248x Thesis, 30 ECTS*
EEN-E2007 Energy, Environment and Emission Control (5 ECTS), II	*EEN-E3001 Fundamentals of industrial energy engineering (5 ECTS), III*	*MJ2383 Energy system economics modeling and indicators for sustainable development (6 ECTS)*	
EEN-E1010 Power Plants and Processes (5 ECTS), I-II	*PHYS-E0483 Advances in New Energy Technologies (5 ECTS), III- IV*	*MJ2382 Energy data, balances and projections (6 ECTS)*	
EEN-E3007 Process Integration and Energy Optimization (5 ECTS), II	*31E01310 Energy and Environmental Economics (5 ECTS), V*	*MJ2440 Measurement techniques (3 ECTS)*	
MS-E2140 Linear programming (5 ECTS), I	*Elective courses from list2*	*MJ2409 Applied energy technology project course 9 (ECTS)*	
Elective courses from list1			
= 30 ECTC	**= 30 ECTS**	**= 30 ECTS**	**= 30 ECTS**

Elective course list 1

PHYS-E6572 Advanced Wind Power Technology (5 ECTS) (I-II) (alternate years, lectured in autumn 2016)
PHYS-C6370 Fundamentals of New Energy Sources (5 ECTS) (I-II)
EEN-E2005 Bioenergy I (5 ECTS) (I)
EEN-E2006 Bioenergy II (5 ECTS) (II)
EEN-E3006 Energy Markets (5 ECTS), (I)

Elective course list 2

EEN-E3004 District heating and cooling (5 ECTS) (V)
PHYS-C1380 Multi-disciplinary energy perspectives (5 ECTS) (III-V)
PHYS-E6570 Solar Energy Engineering (5 ECTS) (III- IV) (alternate years, lectured in spring 2016)
CHEM-E5145 Materials for Renewable Energy P (5 ECTS) (III–V)
EEN-E3005 Exercises in Energy Technology (5 ECTS) (IV-V)

Research areas for projects / master thesis

Professors and researchers at KTH i.e. 2nd-year university.	**Professors at Aalto i.e. 1st-year university.**	**Research area**
Following Professors and Researchers are available in the field of Energy Systems Analysis, Department of Energy Technology, KTH. - Mark Howells - Francesco Gardumi - Shahid Hussain Siyal - Dimitris Mentis - Constantinos Talitios - Vignesh Sridharan - Alexandros Korkovelos - Georgios Avgerinopoulos	*Mika Järvinen, Aalto, Department of Mechanical Engineering* *Martti Larmi, Aalto, Department of Mechanical Engineering* *Risto Lahdelma, Aalto University, Department of Mechanical Engineering*	*Development of a local, national, regional or global energy assements. Focusing on relevant issues such as: The role of specific technologies or systems of technologies, the impact on the environment, system economics.*

Degree requirements for admission process

A BSc degree corresponding to a minimum 180 ECTS credits in the following fields:	*Economics. Engineering.*
Applicants that are enrolled in an integrated five year degree with no bachelor level:	*Economics. Engineering.*
A BEng in … Engineering is accepted for start at …	*Economics. Engineering.*
Applicants with a BEng in …, or a BSc or BEng in …, will be considered on an individual basis.	*Economics. Engineering.*
The applicant's qualifications must include a strong working knowledge of mathematics and …, and applicants must document that they have fulfilled the following minimum requirements:	*The minimum requirements include the following:* *- Mathematics: 20 ECTS including linear algebra, calculus and differential equations.* *- Statistics and probability theory: 5 ECTS.* *- Thermodynamics and heat transfer: 5 ECTS* *Moreover, the applicant must have sufficient qualifications within numerical methods and elementary programming using e.g. MATLAB or a similar programming language.*
Applicants with a Polytechnic (FI), Högskoleingenör (SE) and Diplomingeniør (DK) degree may be expected to do extra course work to qualify for the programme.	*No*