

## MS ISEE Study track: Bio-Energy, Study Plan and Courses Table: 2018/2019.

**Year 1 at KTH:** Department of Energy Technology. Contact: Mark Howells and Shahid Hussain Siyal

**Year 2 at Aalto University:** Department of Mechanical Engineering. Contact: Mika Järvinen

### 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:

Bio Energy
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### Cooperating universities:

1. Year	2. Year
<i>KTH</i>	<i>Aalto University</i>
<i>Department of Energy Technology</i>	<i>School of Engineering/Department of Mechanical Engineering</i>
<i>Mark Howells</i>	<i>prof. Mika Järvinen</i>

### **Study track focus and goals:**

Bio energy track provides state-of-the-art education in thermal conversion of biomass into power and biofuel production. Thermal conversion of biomass is considered one of the main methods to reduce carbon dioxide emissions and in the replacement of fossil carbon sources. This is due to the fact that biomass is a carbon neutral fuel as the emitted CO<sub>2</sub> was previously captured from the atmosphere by the plants being thermally processed. Power generation technology from biomass can be achieved through different processes, for example: combustion, gasification, pyrolysis and combined processes. While biofuel production technology can be achieved through pyrolysis, gasification, fermentation and/or distillation process.

Bio energy track at Aalto University for second year includes two modules: Power Generation from Biomass and Bioenergy in Transport. The Power Generation from Biomass module focuses on sustainable production of power from biomass which includes all aspects related to bio-boilers principles, planning, structure and operation. The Bio energy in Transport module focuses on the use and usability and combustion of bio-derived fuels in transport. On-road, off-road and marine transport is covered. The basics of bio-fuel production principles are covered too. The courses of both modules consist of lectures, literature, simulation exercises, excursions, seminars and group project work.

#### Learning outcomes:

- Student acquire a state-of-the-art education and training in the fields of sustainable power generation from biomass and biofuel; become familiar with the principles, planning, structure and operation of bio-boilers, combustion and gasification techniques in different types of boilers; obtain constructive knowledge in biofuel production, use, combustion and relevant environmental aspects.
- Student become skilled in calculation, simulation, design and analysis of thermal processes in bio energy power plant through training in multidisciplinary problem analysis and solving with emphasis on critical thinking
- Close collaboration with industry during thesis work and organizing excursion for many courses (especially project work courses) to provide students with enough knowledge about biomass technology both in theory and practice.

**Course table:**

1. Semester	2. Semester	3. Semester	4. Semester
<b>KTH</b>		<b>Aalto University</b>	
		<b>Bioenergy:</b>	
<i>Introduction to Energy Technology, MJ1402, 3 ECTS</i>	<i>Computational Methods in Energy Technology, MJ2424, 6 ECTS</i>	<i>Biofuel &amp; bioenergy, AAE-E3050, 5 ECTS</i>	Thesis , 30 ECTS
<i>Renewable Energy Technology, MJ2411, 6 ECTS</i>	<i>Energy Management, MJ2410, 6 ECTS</i>	<i>Energy, Environment and Emission Control, EEN-E2007, 5 ECTS</i>	
<i>Sustainable Power Generation, MJ2405, 9 ECTS</i>	<i>Renewable Energy Technology, Advanced course, MJ2412, 6 ECTS</i>	<i>Energy Markets, EEN-E3006, 5 ECTS</i>	
<i>Sustainable Energy Utilization, MJ2407, , 9 ECTS</i>	<i>Applied heat and power technology, MJ2426, 6 ECTS</i>	<i>Process Integration and Energy Optimization, EEN-E3007, 5 ECTS</i>	
<i>Energy and Environment, MJ2413, 6 ECTS</i>	<i>Elective course from list 1</i>	<i>Foreign language studies, Kie-98., 3 ECTS</i>	
		<i>Elective courses from list 2</i>	
<b>= 33 ECTC</b>	<b>= 30 ECTS</b>	<b>= 30 ECTS</b>	<b>= 30 ECTS</b>

**Elective course list 1**

*MJ2438 – Modeling of Energy Systems – Heat and Power Generation, 6 ECTS*

*MJ2470 Climate Change Mitigation Tools, 6 ECTS*

*MJ 2473 Energy Policy Design, 6 ECTS*

**Elective course list 2**

**Elective courses for Bioenergy module:**

*PHYS-C6370 Fundamentals of New Energy Sources (5 ECTS) (I-II)*

*EEN-E1010 Power Plants and Processes (5 ECTS) (I-II)*

*AAE-E3000 Advanced Energy Project (10 ECTS) (I-II)*

*EEN-E1000 Introduction to Advanced Energy Solutions (5 ECTS) (I-II)*

*Kie-98.1114 Communicating Technology (3 ECTS) (I-II, III-IV, IV-V)*

*Kie-98.1115 Persuasive Communication (3 ECTS) (I-II, III-IV, IV-V)*

*Kie-98.1410 Industrial Communications (3-5 ECTS) (III)*

### Possible supervisors for master thesis supervision at Aalto University

Professors at Aalto i.e. 2 <sup>nd</sup> -year university.	Research area
<i>prof. Mika Järvinen, Aalto University, department of Mechanical Engineering</i>	<i>Combustion and gasification, Fuel spraying and modeling</i>
<i>prof. Martti Larmi, Aalto University, department of Mechanical Engineering</i>	<i>Biofuel production and combustion</i>
<i>prof. Risto Lahdelma, Aalto University, department of Mechanical Engineering</i>	<i>Energy: Modeling, Simulation and optimization</i>
<i>Prof. Sanna Syri, Aalto University, department of Mechanical Engineering</i>	<i>Energy market, Societal and economic impact of energy technologies</i>
<i>Prof. Ville Vuorinen, Aalto University, department of Mechanical Engineering</i>	<i>Computational fluid dynamics, Mathematical modelling, Combustion</i>

### Possible supervisors for master thesis supervision at KTH University

Professors and researchers at KTH i.e. 1 <sup>st</sup> -year university.	Research area
<p>Following Professors and Researchers are available in the field of Energy Systems Analysis, Department of Energy Technology, KTH.</p> <ul style="list-style-type: none"> <li>- Mark Howells</li> <li>- Francesco Gardumi</li> <li>- Shahid Hussain Siyal</li> <li>- Dimitris Mentis</li> <li>- Constantinos Talitios</li> <li>- Vignesh Sridharan</li> <li>- Alexandros Korkovelos</li> <li>- Georgios Avgerinopoulos</li> </ul>	<p>Development of a local, national, regional or global energy assessments. Focusing on relevant issues such as: The role of specific technologies or systems of technologies, the impact on the environment, system economics.</p>

### Degree requirements for admission process

A BSc degree corresponding to a minimum 180 ECTS credits in the following fields:	Energy Engineering or Mechanical Engineering and Chemical Engineering
Applicants that are enrolled in an integrated five year degree with no bachelor level:	
A BEng in ... Engineering is accepted for start at ...	
Applicants with a BEng in ..., or a BSc or BEng in ..., will be considered on an individual basis.	
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:	<p>The minimum requirements include the following:</p> <ul style="list-style-type: none"> <li>- Mathematics: 20 ECTS including linear algebra, calculus and differential equations.</li> <li>- Thermodynamics and heat transfer: 5 ECTS.</li> <li>- Energy &amp; Environment: 5 ECTS</li> <li>- Statistics and dynamics: 5 ECTS.</li> <li>- Fluid mechanics: 5 ECTS.</li> <li>- Materials science: 5 ECTS.</li> </ul> <p>Moreover, the applicant must have sufficient</p>

	qualifications within numerical methods and elementary programming using e.g. MATLAB or a similar programming language.
Applicants with a Polytechnic (FI), Högskoleingenör (SE) and Diplomingenjör (DK) degree may be expected to do extra course work to qualify for the programme.	