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Lappeenranta University of Technology

Self-Assessment Report for International Accreditation  
– Bachelor’s and Master’s degree programmes  
in Environmental Technology

Editors: Kati Koikkalainen, Lassi Linnanen, Risto Soukka, Annikka Nurkka

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**Self-Assessment Report for International  
Accreditation – Bachelor's and Master's degree  
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## 1. Formal Specification

### 1.1 Name of the degree programme and contact details

Name of the Degree Programme (Finnish)	Ympäristötekniikan koulutusohjelma - tekniikan kandidaatti - diplomi-insinööri
Name of the Degree Programme (English)	Degree Programme in Environmental Technology - Bachelor of Science (Tech.) - Master of Science (Tech.)
Language of instruction	Finnish
Contact person	Head of Department, Professor Lassi Linnanen e-mail: Lassi.Linnanen@lut.fi Mobile: +358 50 550 3305 Fax: + 358 5 621 6399
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The site of execution of the Degree Programme in Environmental Technology is the Department of Environmental Technology at Lappeenranta University of Technology. The Department of Environmental Technology belongs to the Institute of Energy Technology (LUT Energy) that operates under the administration of the Faculty of Technology. LUT Energy brings together the energy and environment related education and research at Lappeenranta University of Technology. LUT Energy coordinates three departments: Environmental Technology, Energy Technology and Electrical Engineering. LUT Energy is the largest education and research organisation in the energy sector in Finland.

### 1.2 Type of the programme

Both the Bachelor's degree programme and the Master's degree programme are classified as "more research-oriented" full time programmes. The Master's degree is consecutive to the Bachelor's degree.

The Bachelor's and Master's degree programmes are aimed at Finnish students, and teaching is mainly given in the Finnish language. However, some modules taught in English can be included in the studies. Obligatory studies in foreign languages are included in the degree programmes: the total of 8 ECTS credits in the Bachelor's and 4 ECTS credits in the Master's degree.

Studying abroad is not obligatory, but the Department of Environmental Technology encourages students to do so. Studies in foreign universities can be included in the student's degree in LUT, if they are suitable to substitute studies in the LUT degree programme. The Department of Environmental Technology also has foreign teachers and researchers, which makes it possible to widen both the educational and cultural perspective.

Studying is a full-time activity, and teaching events are scheduled on weekdays from 8 to 19. Modules can last from one to four periods; the recommended length of the courses is one to two periods. However, the university also offers modules as intensive modules. The Department of Environmental Technology offers two intensive courses and one book examination. Most modules are offered every year, but some of them are offered every second year. All the module details are given in the module descriptions available in the Study Guide. Mainly all courses require the presence, but in some courses it is possible to make some assignments over a distance. Learning platform (Blackboard) is also used in almost every course.

### **1.3 Final Degrees**

The degrees to be awarded in the Degree Programme in Environmental Technology are Bachelor of Science (Technology) in Environmental Technology and Master of Science (Technology) in Environmental Technology.

The Universities Act (558/2009) (Appendix C1) and the Government Decree on University Degrees (794/2004) (Appendix C2) grant the right to award these degrees to Lappeenranta University of Technology<sup>1</sup>.

### **1.4 Standard period of study and credit points gained (according to ECTS)**

The extent of studies required for a lower university degree (Bachelor) is 180 credits and for the higher university degree (Master) 120 credits. The university must arrange the education to enable the student to complete the lower degree in three years, and the higher degree in two years of full-time study (The Government Decree on University Degrees 794/2004, Appendix C2).

The extent of studies is measured by credit units. Courses are quantified according to the work load required. The average input of 1600 working hours needed for the studies of one academic year corresponds to 60 credits (The Government Decree on University Degrees 794/2004, Appendix C2).

The study guide (Appendix ENV1) presents how the courses are divided between the study years. The scheduling of courses is planned accordingly.

### **1.5 Expected intake for the programmes**

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<sup>1</sup> As a result of the implementation of the Bologna process in the Finnish Universities, the present degree structures have been effective since 2005. The transition period (terminated 31 July 2010) to the new curricula has naturally had its effects on various statistical data, which has to be taken into account when interpreting these data.



Faculty council makes a proposal to the rector on the student intake for faculty degree programmes. There are various options to the entrance to the degree programmes. In joint application, the students who are accepted in the Bachelor's degree programme are also accepted in the Master's degree programme at the same time. The number of the expected intake through joint application is defined between the rector and the degree programmes yearly basis. During the last few years, the expected intake has been constant. In future, the expected intake will slightly increase.

There are several separate variants of entrance to the B.Sc. degree programme and directly to the Master's degree programme without a separate application. The Bachelor's degree programme includes applicants who have succeeded in specific competitions in the fields of mathematics and natural sciences, IB/EB applicants, students who have attended a forest industry line in the upper secondary school or have studied in the Open University. The Master's degree programme with separate application is not included in the accreditation process.

The expected intake for the academic year 2011-2012 was 30 for consecutive programmes (Bachelor's + Master's degrees). In Finland it is typical that the students continue directly to the Master's degree programmes after having passed their B.Sc. studies.

**Table 1.** The expected intake for academic year

	Joint application	Separate application
2009-2010	30	60 <sup>(*)</sup>
2010-2011	30	35 <sup>(*)</sup>
2011-2012	30	30 <sup>(*)</sup>

(\* including also the students in M.Sc. degree programmes which are not included in the accreditation process)

### **1.6 Programmes start dates within the academic year and first time the programmes are offered**

The degree programme in Environmental Technology is the second youngest in LUT. The first students were selected to the degree programme in 2001.

During 1990 - 1999, Environmental Technology was offered in the Degree Programme in Energy Technology as a field of specialisation under the name "Environmental Engineering in Energy Production". In 2000, the degree programme in Environmental Technology was established as a separate field of specialisation. In 2001, the degree programme in Environmental Technology was established as a separate degree programme, and then began the close educational co-operation with the universities of Kuopio and Joensuu.

The academic year of the university starts on 1 August and ends on 31 July. The academic year is divided into two semesters. The autumn semester (divided into periods 1 and 2) and the spring semester (divided into periods 3 and 4) each include two standard periods lasting seven weeks and at least one additional examination week. The Degree Programmes in Environmental Technology can be commenced in every intake semester. The courses being offered are coordinated to ensure this.

## **1.7 Amount and type of charges**

According to the Universities Act, education leading to a university degree and entrance examinations relating to student admission shall be free of charge for the Finnish students.

The students of Lappeenranta University of Technology must register each academic year as attending or non-attending. Each student who wishes to take part in lectures, assignments, examinations or other forms of teaching must register as attending and pay the Student Union membership fee. For the academic year 2011-2012 the fee is 103 Euros. This fee covers, for instance, the health care of the students.

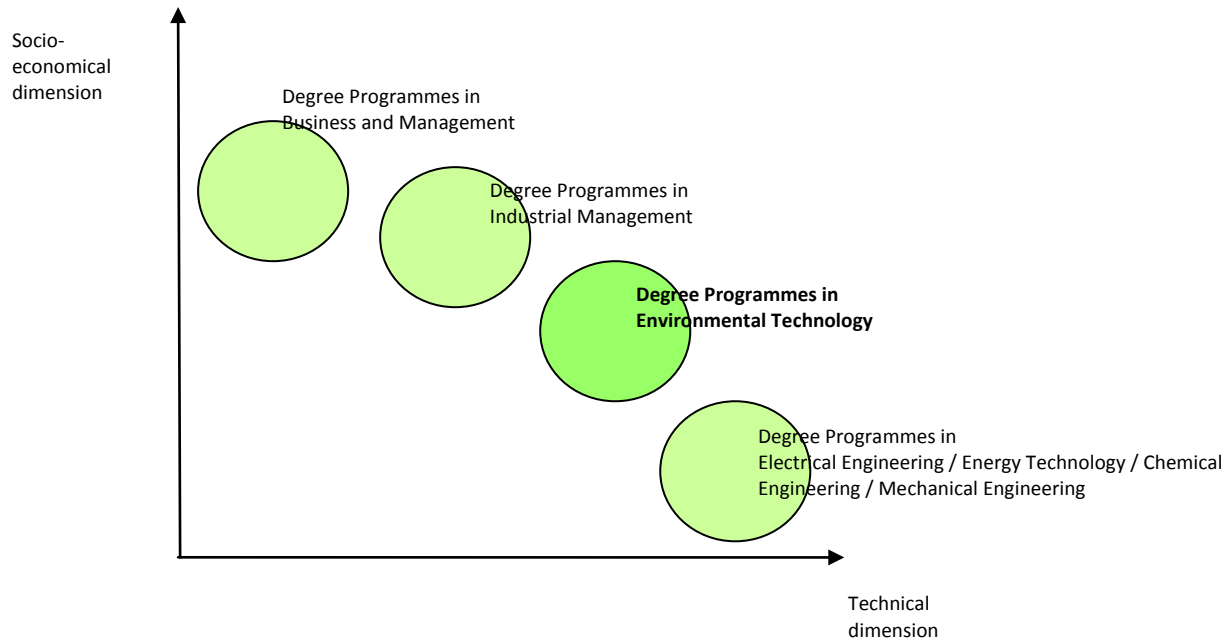
## **2. Degree Programme: Content, Concept and Implementation**

### **2.1 Aims of the programme of studies**

The strategic areas of expertise in the Lappeenranta University of Technology are energy efficiency and the energy market, strategic management of business and technology, scientific computing and modelling of industrial processes, and expertise in Russian business and industry related to the areas above. This strategy and its implementation are further specified and put into practice in faculty strategies and six reform programmes. The educational objectives of the Degree Programme in Environmental Technology reflect the mission of Lappeenranta University of Technology (Appendix C3, LUT Strategy 2013). The strategic areas of expertise are shown in the contents of the degree programmes in Environmental Technology (e.g. in the minor subjects in Sustainable Business Management and Energy Technology and in the obligatory courses like Advanced course in Life Cycle) and in the research.

The Degree Programmes in Environmental Technology are truly hybrid, interdisciplinary programme. In these Degree Programmes, engineering is combined with environmental economics and management. A lot of co-operation with the other degree programmes is included in the teaching. The research and education of environmental technology in universities is typically based on one of the following three fields of expertise: energy technology/thermodynamics, chemistry, and systems thinking/technical and economic systems. In LUT, the Degree Programmes in Environmental Technology are built from the bases of these fields of expertise. During the last years, the development of the content and the research in the degree programmes has concentrated especially on the strengthening of the knowledge in systems thinking.

The figure below shows the relation of the Degree Programmes in Environmental Technology and the other Degree Programmes at LUT. It can be seen that the Degree Programme in Environmental Technology is not a traditional engineering programme, but is also close to the Degree Programme in Industrial Management.



**Figure 1.** The Position of the Degree Programmes in Environmental Technology in the Socioeconomical and Technical axes.

The Degree Programmes in Environmental Technology aims at training top national and international professionals for the needs of both corporate life and public administration. Students are trained to work in international, multidisciplinary, and multicultural environments by offering them opportunities for student exchange and courses that are common with the students of the international Master's degree programmes.

The superordinate educational objectives for the Bachelor's degree and Master's degree are based on Finnish university legislation and are defined in the University's Regulation on Education and Completion of Studies, which have been approved by the Rector on 21 June 2011 (Appendix C4). The superordinate objectives are accessible to all students, staff members, and all other interest groups on LUT's web pages.

### 2.1.1 Aims of the Bachelor's Degree Programme in Environmental Technology

According to the University's Regulations on Education and the Completion of Studies, the studies leading to the lower university degree shall provide the students with the following:

- knowledge of the basics of major and minor subjects or equivalent modules or studies included in the degree programme, as well as the competencies required to follow the development of the field,
- a capacity for scientific thinking and the application of scientific working methods,
- the knowledge and skills required in education leading to the higher university degree and in life-long learning,

- the ability to apply their knowledge and skills in the world of work, and
- sufficient communication and language skills.

The education is based on scientific research and practices in the relevant professional field. These superordinate educational objectives form a basis for the learning outcomes of Bachelor's degree in Environmental Technology.

The major in Environmental Technology provides the students with basic knowledge and skills, both theoretically and in practice. The studies comprise the basics in environmental technology, environmental management, environmental jurisprudence, and environmental economics. In the general studies, the student acquires mathematical, scientific, and general skills that are required in the major and minor subject studies.

### **2.1.2 Aims of the Master's Degree Programme in Environmental Technology**

According to the University's Regulations on Education and the Completion of Studies, the studies leading to the higher university degree shall provide the students with the following:

- a good knowledge of their major subject/advanced studies and a fundamental knowledge of their minor subjects,
- the ability to apply scientific knowledge,
- the ability to take on duties as an expert in and developer of their professional field,
- the capacity to carry out scientific postgraduate studies,
- good communication and language skills, and
- good presentation, cultural, and leadership skills.

The studies are based on research and professional practices in the field in question, and promote team and project work skills. These superordinate educational objectives form a basis for the learning outcomes of Master's degree in Environmental Technology.

After completion of the Bachelor's studies, the student normally continues his/her studies in the Master's degree programme. A Master of Science in Environmental Technology has knowledge and skills to work in expert, development, and management positions, both in multidisciplinary and multicultural environments. A Master of Science in Environmental Technology is also well prepared for postgraduate studies.

The objective of the Degree Programme in Environmental Technology is to train top professionals for the needs of both corporate life and public administration. Upon completion of the education in Environmental Technology, the students with wide-ranging knowledge will have possibilities to seek employment in diversified jobs on different branches of industry and society.

## 2.2 Learning outcomes of the programmes

Learning outcomes for the Degree Programmes in Environmental Technology are defined separately for Bachelor's and Master's degrees. Learning outcomes are presented in the Study Guide (Appendix ENV1) which is accessible on the LUT web site to all students, staff members, and all the other parties interested.

Professors, course teachers, and also a number of students have participated in the definition of the learning outcomes. Labour market's needs are transmitted through research projects and research staff. Postgraduate study requirements are also reflected to learning outcomes.

The relationship between the learning outcomes according to ASIIN's subject specific criteria and the aims of the degree programme (Bachelor's and Master's levels separately) according to the Study Guide are evaluated in Appendix ENV2. Further, each course module is also evaluated according to ASIIN's criteria. Finally, an overview of both degree programmes is compiled for curricular analysis (Appendix ENV3).

There are no Technical Committee and subject specific Criteria (SSC) for Environmental Technology. The Technical Committee 01 for mechanical/process engineering (TC01) was chosen because the learning outcomes of the B.Sc. and M.Sc. degrees according to ASIIN's subject-specific criteria for TC01 suited the best. Also Technical Committee 06 for industrial engineering is reviewed. The curricular analysis (Appendix ENV3) is performed according to the criteria for Process Engineering, Biological, and Chemical Engineering. Each course is classified into curricular categories.

### 2.2.1 Learning outcomes of Bachelor's Degree

Students who have completed their Bachelor of Science degree in Environmental Technology are able to:

- define the field of environmental technology, including its basic concepts, the central available methods, and related theories,
- identify different emissions and their sources, and explain the technology with the help of which different emissions could be cleaned,
- discuss the meaning of environmental technology, including its possibilities, challenges, and future visions also with experts from other fields,
- follow and interpret the current legislation, and independently apply the official legal norms related to environmental issues to practical work,
- work in projects and teams consisting of experts from different fields,
- report (e.g. on corporate environmental and social responsibility issues) in his/her mother tongue and in English, and
- gather and analyse scientific information related to environmental issues, and analyse the reliability of the sources.

Students also possess the basic knowledge and skills needed for Master's level studies. Detailed learning outcomes related to life cycle assessment, different kind of emissions and wastes, and sustainable development in business, are presented in Study Guide (Appendix ENV1). Learning outcomes of the minor subjects are also presented in Study Guide.

### **2.2.2 Learning outcomes of Master's Degree**

Students who have completed their Master of Science degree in Environmental Technology are able to:

- select the most cost-effective methods to reduce emissions and recognise their meaning for the business,
- estimate the competitiveness of a certain technology, product or service in various operating environments with regard to environmental impacts and costs,
- recognise the environmental impacts of industrial, service, community and primary production processes and systems, and evaluate technological possibilities to minimize them,
- explain complex interdependencies between environmental problems, both local and global,
- adapt theories and the latest scientific knowledge to solve problems related to environmental issues,
- operate as an environmental expert in a company on various decision-making situations, and produce and pass information to various interest groups to support environmental decision-making,
- operate as a project manager capable of independent work and decision-making, and
- adopt and innovate new technological solutions to develop the field of environmental technology.

Master of Science graduates also have the basic knowledge required for postgraduate studies. Detailed learning outcomes related to life cycle assessment, waste management and energy systems, gaseous emissions, and corporate and social responsibility, are presented in Study Guide (Appendix ENV1). Learning outcomes of the minor subjects are also presented in Study Guide.

### **2.3 Learning outcomes of the modules/module objectives**

The learning outcomes of the programme are put into practice within the individual courses of the programme. The learning outcomes (LO) for individual courses are defined in the Study Guide (Appendix ENV1), which is available on the university web pages. First year students receive also printed Study Guides.

The descriptions of learning outcomes of the courses are written by teachers of modules. LUT teacher's Quality Manual (Appendix C5) was used as help to describe skills, knowledge and

competences acquired in the courses. Also the latest research results are taken into account in teaching, because most of the researchers act also as teachers.

The contribution of the individual course in learning outcomes of the programme is indicated in the Objective Matrix (Appendix ENV2). The B.Sc. degree and M.Sc. degree are described separately. The courses' contribution within the learning outcomes of the programmes were classified with terms low (L), average (A), and high (H). Professors and other teachers of the courses participated in the description and classification work.

Learning outcomes of Environmental Technology courses were specified for the academic year 2011-2012. During the accreditation process, more development targets have been found. There will be some improvements in the course descriptions for the academic year 2012-2013.

The B.Sc. degree in Finland is primarily considered as a way to M.Sc. degree studies, introducing students to the scientific thinking and methods. The B.Sc. degree starts with general studies, e.g. mathematics and physics, the portion of which is significant.

The content of the Bachelor's Degree in Environmental Technology was compared to ASIIN's subject-specific criteria (The Technical Committee 01, TC 01). The table below shows the ASIIN's recommendations to the contents of the B.Sc. degree and the contents of the B.Sc. degree in Environmental Technology. MS in the table refers to the Minor Subjects (MS 1=Energy Technology, MS 2=HVAC Engineering, MS 3=Green Chemistry, and MS 4=Sustainable Business Management). Further information can be found in Appendix ENV3.

**Table 2.** Content of the B.Sc. Degree Programme

	The Degree Programme ECTS [%]			
	MS 1	MS 2	MS 3	MS 4
Mathematic-scientific fundamentals	21	21	21	21
Engineering fundamentals	18	17	19	16
Subject in process engineering	13	9	12	7
Engineering applications	4	6	4	2
Subject in engineering and natural sciences for the creation of focal points of studies	12	16	12	12
Cross-subject studies	13	13	13	26
Bachelor's Thesis	6	6	6	6
Practical training	3	3	3	3

Depending of the selected minor subject, the portion of elective studies is 9-11 %. The student may include any courses taught at LUT in the elective studies. Elective studies are usually Cross-subject studies or Subject in process engineering studies.

It can be seen that there are some differences between the minor subjects. Table 2 shows that the content of Minor Subject 4 (Sustainable Business Management) is strongly interdisciplinary. Cross-subject studies include non-technical studies and economics. Therefore, the comparison

was also made with ASIIN's subject-specific criteria The Technical Committee 06 (Industrial engineering). Based on the comparison, the criteria TC01 is more suitable for the degree programme.

The same comparisons were also made for the Master's Degree (Appendix ENV3). The Master's Degree Programme in Environmental Technology meets the ASIIN's requirements very well.

**Table 3.** Content of the M.Sc. Degree Programme

	The Degree Programme ECTS [%]			
	MS 1	MS 2	MS 3	MS 4
Advanced fundamentals and application of mathematics, natural, and engineering sciences	49	47	48	30
Cross-subject contents	9	9	9	28
Master's Thesis	25	25	25	25
Practical engineering activity	4	4	4	4

MS 3 = Minor Subject in Sustainable Community

In the Master's Degree Programme the portion of elective studies is 13-15 %. The student may include any courses taught at LUT in the elective studies. Elective studies are quite often studies with cross-subject content, but especially the students from the minor subjects 1, 2, and 3 also select engineering science courses. Again it can be seen that the content of the minor subject 4 (Sustainable Business Management) is strongly interdisciplinary.

The credit points of some courses are divided among several categories in this analysis. The results of the analysis shows that both degree programmes (Bachelor's and Master's) meet quite well the requirements of percentage portion of each SSC (subject-specific criteria) and the requirements of minimum ECTS credit amounts according to ASIIN's criteria. Some of the courses produced by the Department of Environmental Technology are closer to the studies in industrial management than traditional technical studies. For this reason, the contents of the degrees were compared also to the criteria of The Technical Committee 06 (Industrial Engineering). However, the studies of the degree programmes do not meet the requirements of the TC 06 criteria of the extent of the Economics studies (B.Ms. 48 ECTS cr and M.Sc. 34 ECTS cr).

## 2.4 Job market perspectives and practical relevance

The fields of education of the Finnish universities are defined by the Ministry of Education and Culture. The Board of Lappeenranta University of Technology decides the number of new entrants. The contents of the degree programmes are decided by those in charge of the programmes.

In Finland's engineering education system, the Bachelor's degree is generally considered as an intermediate phase in the progress towards a Master's degree. For Finnish industry and other companies the Bachelor's degree is relatively new, and therefore there has been a little demand



for it so far. However, the competency profile of Bachelor's degree graduates of Environmental Technology shows good preparedness both for industrial work and consecutive Master's level studies.

Agora 2020 project (in Finnish "Kestävän kehityksen torille 2020") of the Finnish Ministry of Education was funded by the European Social Fund (ESR). In the project, both the quantitative and the qualitative needs for the environmental education on the university level were evaluated up to the year 2020. The project brought together experts from different fields, the discussions of whom produced concrete visions of the future needs. In the final report of the project it is mentioned that within the environmental field, the internationalisation plays an important role, and that the collaboration should be enhanced between separate fields. The report emphasises the terms "multidisciplinary" and "interdisciplinary". The education should combine a large scale of fields that are normally treated separately. In LUT, the degree programmes in Environmental Technology is an interdisciplinary hybrid programme described in the report. The teaching is realised in close co-operation with LUT's other degree programmes.

According to the results of the former mentioned project, in future the central foundation stones of the competencies of environmental experts are the understanding of the challenges of globalisation and the possibilities and challenges of internationalisation. Essential is also the holistic conceptualisation of the phenomena and problems related to all dimensions of sustainable development. The future expert will have to be able to combine for example the dimensions of sustainable development, empirical and explicit information and marketing together. According to the report, especially the competencies in business economics and marketing should be developed more. Additionally, technological innovations are expected to show an upward trend, and thus the education within the technological fields should be taken care of. The educational system should encourage the students also to unusual combinations in the studies, because new innovations arise precisely on the interfaces. In LUT, the degree programmes in Environmental Technology cover these various sectors thoroughly.

The employment rate (Table 17) after graduation reflects the demand from industry for the graduates of Environmental Technology. Graduates have been employed well even during the economic downturn. This signals that the graduates are well qualified to work in industry and that their skills fit the demand. Graduates from the Degree Programme in Environmental Technology are not tied to any specific industry; instead, they are employed by a wide spectrum of industries. The graduates have good future career prospects, as they are equipped to learn and adapt to different job profiles and industrial contexts. As a result, the success or failure of individual industries does not have a significant impact on the graduates' career prospects.

Also in the future, there will be a strong demand for graduates from the Degree Programme in Environmental Technology. The Finnish Association of Graduate Engineers (Tekniikan Akateemiset, TEK) and the Confederation of Finnish Industries (Elinkeinoelämän keskusliitto, EK) have forecasted the future demand for graduates at the Master of Science level. According to TEK, there will also be a need for interdisciplinary engineers. According to the Finnish Union of Environmental Professionals (Ympäristöasiantuntijoiden keskusliitto, YKL), the unemployment rate of the environmental experts is clearly lower than the Finnish average. Based on the age group distribution, the amount of retiring people will increase up to the year 2020 and will be

stable after that. All this promises good career prospects for the graduates of Environmental Technology.

Alternative jobs and careers for Masters of Science in Environmental Technology are for instance specialist tasks (e.g. life cycle consult, eco-efficiency consultant), design and product development (e.g. research and development engineer, project designer), production and operation (e.g. environmental engineer, project engineer), management (e.g. energy and environmental manager), sales and marketing (e.g. sales manager, product manager), research and teaching (e.g. junior researcher) and authorities and professional organisations (e.g. environmental auditor).

The research at the Department of Environmental Technology is characterised by multidisciplinary research in the fields of technology and business. The department carries out both basic and applied research. The emphasis is on applied research, which is conducted in collaboration with industries with the aim to achieve synergy benefits. The industrial cooperation carried out in the research project provides a forum of information exchange about the needs and expectations of the industry. The content of the Degree Programme is reviewed annually.

The courses in Degree Programmes (B.Sc. and M.Sc.) involve laboratory and project work, as well as practical training in order to provide an adequate connection to the professional practice and to prepare the students to commence work in existing or foreseeable professional fields. The courses in the degree structure are also closely linked to the research conducted in the department and provide a path to post graduate studies. Moreover, a large majority of Bachelor's and Master's theses are completed in cooperation with industry in various projects either at the university or in companies, and thus provide a link to the professional field and a path to future employment in specialist tasks in these research areas. Examples of recent B.Sc. and M.Sc. theses topics can be found in Appendix ENV18.

Practical training is included both in the Bachelor's and Master's degree. The total value of obligatory practical training is 2 ECTS credits both in the Bachelor's and Master's degree. In addition to the obligatory practical training, the student has a possibility to include max 8 ECTS credits of practical training in the elective studies of the Master's degree.

The practical training in the Bachelor's degree is typically so called work environment training. The objective of the work environment training is that the student, working as a member of a work community, gets an idea of paid work. After completing his/her work environment training, the student is able to define and explain, what it is like to be working as an employee, and what are the basic rules in working life from the view of an employee. He/she can anticipate how to act in various situations in a work community. All work assignments can be included in the work environment training.

The objective of the practical training in the Master's degree studies is that the student gets basic knowledge of the work, work environment and work community in his/her own field. After completing his/her practical training in his/her Master's degree, the student is able to use and generalise the knowledge and skills he/she has obtained on various courses in practise in his/her own field. With practical training, the student acquires practical experience and skills of the work assignments, production equipment, and software. Typical tasks include for example

assignments related to planning, research and development, production, and operation. Also various research tasks are suitable for the practical training in the Master's degree, as well as working in supervisory positions. More detailed information about practical training and the modes of completing the training can be found from Study Guide (Appendix ENV1, page 143).

## 2.5 Admissions and entry requirements

According to the Finnish Universities Act (2009/558), the board of the university decides the number of new students to be selected each year. The Rector decides annually the selection process and basis of the selection criteria of the prospective students after hearing the opinion of the faculties. In practice student selection into the Bachelor's degree for Finnish matriculation examination graduates is mainly organised by a joint universities application system, DIA (joint-application to Studies of Bachelor and Master of Science in Technology). This joint application system is common for seven technical universities in Finland. The joint application system is coordinated by a joint application committee. This process enables an applicant to apply for five degree programmes in order of preference in one or in several technical universities using the same application form and examinations. The applicant is given 3 points for the programme he/she has prioritised. The application system enables prospective students to apply for several degrees at the same time, but the applicant can accept only one student place in degree education in a given academic year.

### 2.5.1 Entry requirements for Bachelor's degrees

The Finnish Universities Act (2009/558, 37§) rules the entry requirements for the Bachelor's degree. Prospective students applying in the Bachelor's degree are:

- Applicants who have completed the Finnish matriculation examination or who have completed the Finnish matriculation examination and received a blue certificate.
- Applicants who have completed the EB, IB (European and International Baccalaureate) or Reifeprüfung degree (from die Deutsche Schule Helsinki).
- Applicants who will complete the EB or IB or Reifeprüfung degree either in Finland or abroad during the application year. These applicants must include their degree certificate or a certificate of participation in the respective examination from their school with their application form.
- Applicants who are not upper secondary school graduates but who have completed a polytechnic higher vocational degree, vocational polytechnic degree or at least a three-year vocational degree.
- Applicants from other Nordic countries who are eligible for application.
- Applicants who have not completed upper secondary education in Finland are eligible to apply for Bachelor's degree courses if they are eligible for to study at a university in their own country.

DIA applicants have three different quotas where they can be selected in: 1. Success in matriculation examinations; 2. Success in matriculation examinations and in the entrance examinations; and 3. Success in entrance examinations. To be selected by success in matriculation examination, the prospective student must have at least grade C in physics or

chemistry and passed advanced course in mathematics or he/she must have at least M in advanced course in mathematics. Six best grades in matriculation examinations are graded as points which count in the selection process. 50 % of the applicants accepted into degree can be selected based on their success in the matriculation examination. DIA organizes also this selection. The results are communicated to the applicants before the entrance examinations and students accepted based on their success in the matriculation examination are not allowed to participate in the entrance examinations. 70 % of the remaining study places are selected based on the success in the matriculation examinations and entrance examinations. In this case, the success in six examinations in matriculation examinations counts along with the points received in the entrance examinations. 30 % of the remaining study places after the selection based on the success in the matriculation examination are selected based on only the success in the entrance examinations.

The entrance examinations are organized by the joint application procedure. The entrance examination is based on the Finnish upper secondary school curriculum in mathematics, physics and chemistry. There are three separate examinations. Department of Environmental Technology requires applicants to take the mathematics exam and an exam in physics or chemistry. Prospective students must pass the entrance examination to be selected even if there are fewer applicants than places attained. This guarantees minimum knowledge level in science of all selected students.

Other applicants, meaning applicants who have performed their matriculation examinations abroad, have a separate application system, but they take part to the same entrance examinations as the DIA applicants.

Information about applicants is available according to the Finnish law of student selection register (1058/1998). Prospective students are able to apply in the Internet at [www.yliopistohaku.fi](http://www.yliopistohaku.fi). A prospective student has eligibility to appeal against the negative result of student selection within 14 days of the decision.

There are several specialised variants of the higher education entrance in the Bachelor's degree programme in Environmental Technology:

- Prospective students who have succeeded in defined competitions;
- IB/EB applicants;
- Prospective students who have completed the forest industry line METELI in upper secondary school (only in Faculty of Technology); and
- Studies in the Open University (after performing 30 ECTS including 16/19 ECTS mathematics and 5 ECTS physics, average grade at least 2.0).

These all special cases are considered and the selection process is presented on the LUT web pages.

Students applying in the Bachelor's degree are not supposed to have any former work experience or industrial placements; neither do they help in the applying process for the Bachelor's degree.

Bachelor's degree courses are fully taught in Finnish, and thus, very good Finnish skills are required. If the applicant has received education outside Finland, and he/she is a non-native Finnish speaker, proficiency in Finnish has to be demonstrated. General language degree in Finnish at level 4 or above (max. level 6) is accepted.

### **2.5.2 Entry requirements for Master's degrees**

All students accepted in the Bachelor's degree programme are also accepted in the Master's degree programme in the same field of engineering. The Master's thesis project cannot be commenced (the topic of the thesis cannot be applied for) before completing the Bachelor's degree.

If a student wants to change the field of engineering (e.g. from Mechanical Engineering to Environmental Technology) after finishing his/her B.Sc. degree, he/she can: 1) change the programme; or 2) apply to a separate Master's degree programme. These Master's degree programmes are not included in this accreditation process. Student can request for a change of the degree programme after completing the Bachelor's degree. If there are more requests than the degree applied is willing to take, quantitative and qualitative success in studies can be used as criteria for selection.

Also the Master's degree courses are taught mainly in Finnish. Applicants who have obtained their compulsory education in a language other than Finnish shall provide a certificate of their language proficiency in the Finnish language. Sufficient proof of language proficiency can be demonstrated by completing the National certificate of Language Proficiency test at level 4 or above (= intermediate level, 6 being the highest). Applicants whose mother tongue is Finnish are exempted from this requirement.

Students are supposed to have good English skills, as materials provided during the courses are often in English. The Master's degree programme can also contain courses wholly organised in English.

## **2.6 Curriculum/content**

Appendix ENV1 (Study Guide) presents the curriculum in detail. First, an overview of the curricular content of the Bachelor's and Master's programmes is presented. This is followed by a list of course modules organised by the Degree Programme of Environmental Technology.

The target of the curriculum work process is the production of a high-level curriculum in terms of both content and communication. The curriculum lays the foundation for teaching and the planning (individual study plans) and implementation of studies. The vice-rector for education and Heads of degree programmes are responsible for the curriculum work.

The curriculum work ensures the production of high-quality degrees: the expertise obtained from the degree studies is based on current, key research-based knowledge in the field of science in question, and on the development of general competencies as a part of the degree.

The curriculum work takes into account the expertise required in the increasingly diverse and international world of work and the perspective of lifelong learning. Degree programmes collaborate in curriculum work in order to secure synergy benefits as extensively as possible.

The objectives of degree programmes and courses are defined as learning outcomes. The learning outcomes of modules and courses are based on the mission of a given degree programme. Descriptions regarding instruction (e.g. learning outcomes and number of ECTS credits) follow regulations and are realistic.

The process results in degree programme and course descriptions, which are published annually in the study guide on the university web site. Publication is coordinated by the Student Affairs Office.

The quality of the process is evaluated by examining the curriculum process and degree programme development. The quality indicators for the curriculum process are: the continuous development and professional relevance of curricula and degree structures, true-to-life course descriptions that follow guidelines and the publication of the study guide on schedule. Changes to curricula are handled by the faculty councils.

On the degree programme level, in addition to the Head of the degree programme, the participants of the curriculum process include the teaching staff and the study coordinator. In the degree programmes in Environmental Technology, the degree structures are handled in the development meetings of the degree programme, in which the whole personnel of the department of Environmental Technology participate in addition to the study coordinator and the Head of the degree programme. Participant includes also four representatives of the students of environmental technology (student adviser + three representatives of the student organisation).

The department of Environmental Technology operates in close co-operation with the other LUT degree programmes. For example, some of the general studies of the Bachelor's degree are selected in co-operation with the other degree programmes. Additionally, the minor subjects offered to the students of environmental technology are designed together with the degree programmes of Energy Technology (minor subjects: Energy Technology and HVAC Engineering), Electrical Engineering (minor subject in the Master's degree programme: Sustainable Community), Chemical Technology (minor subject: Green Chemistry), and Industrial Management and Economics and Business Administration (minor subject: Sustainable Business Management). Also the courses are developed in co-operation. The aim is to eliminate the overlapping parts in the course contents and to develop the contents of the courses organised in co-operation to better correspond the needs of the degree programmes in environmental technology. Curriculum work also takes into account the needs of working life, which are identified through the collaborative project work with the industry and the public sector.

### **3. Degree Programme: Structures, Methods and Implementation**

#### **3.1 Structure and modularity**

The Degree Programme in Environmental Technology comprises two cycles, and its standard duration is five years. The first cycle takes three years and leads to a Bachelor's degree. The second cycle leading to a Master's degree takes two years.

##### **3.1.1 Bachelor's Degree Programme in Environmental Technology**

The extent of the studies required for the Degree of Bachelor of Science is 180 ECTS credits. The structure of the Bachelor's degree is described in the University Regulations on Education and the Completion of Studies, Section 31 (Appendix C4). The Bachelor's degree comprises the following studies:

1. General studies, at least 70 ECTS credits;
2. Major/intermediate studies, at least 40 ECTS credits;
3. Minor studies, at least 20 ECTS credits; and
4. Elective studies, at least 10 ECTS credits.

The general structure of the curricular content of the Bachelor's Degree Programme in Environmental Technology is illustrated in Figure 2.

The major subject in the Bachelor's and Master's Degree is Environmental Technology. The professional competence acquired in the major subject studies is further developed by minor subject choices. The minor subjects also guide students in different areas of Environmental Technology. The minor subjects offered by the Degree Programme in Environmental Technology to its own students are:

1. Energy Technology,
2. HVAC Engineering,
3. Green Chemistry, and
4. Sustainable Business Management.

The student chooses his/her minor subject in the Bachelor's degree in the spring term of the first year of study (in March). The choices are approved by the Head of Degree Programme. In exceptional cases, the minor subject can be chosen from other degree programmes, if it is suitable for the degree. The application has to be approved by the Head of Degree Programme.

In the general studies, the student acquires mathematical, scientific and general skills that are required in the major and minor subject studies. The general studies include for instance mathematics, physics, language and communication studies, practical training, and courses that form a basis for the major and minor studies. General studies also include basics in energy technology and chemical engineering, electrical and mechanical engineering, information technology, and business economics. These studies support the major studies, in which the student deepens his/her knowledge within the wide-ranged field of environmental technology.

The degrees are comprised of general studies, major and minor studies, practical training, elective studies and theses, according to the following table:

BACHELOR OF SCIENCE 180 ECTS CR (1.–3. year)	
A. General studies, total of 100 cr General scientific skills 64 cr General skills provided by the Degree Programme 36 cr	
B. Major subject 41 cr Environmental Technology Bachelor's thesis and seminar (10 cr) incl.	C. Minor subject 20 cr (min)
D. Elective studies 10 cr (min)	

**Figure 2.** Bachelor's degree in Environmental Technology, 180 ECTS cr

### 3.1.2 Master's Degree in Environmental Technology

The extent of the studies required for the Degree of Master of Science is 120 ECTS credits. The structure of the Master's degree is described in the University Regulations on Education and the Completion of Studies, Section 36 (Appendix C4). The Master's degree comprises the following studies:

1. General studies and/or Language and communication studies, at least 5 ECTS credits;
2. Major/advanced studies at least 60 ECTS credits (incl. Master's thesis worth 30 ECTS credits);
3. Minor studies, at least 20 ECTS credits; and
4. Elective studies, at least 10 ECTS credits.

After completion of the Bachelor's studies, the student continues his/her studies in the Master's degree programme. In the Degree Programme in Environmental Technology, the structure of the Master's studies is the following:

MASTER OF SCIENCE 120 ECTS CR (4.–5. year)	
A. General studies 20 cr	
B. Major subject 62 cr Environmental Technology Master's thesis and seminar (30 cr) incl.	C. Minor subject 20 cr (min)
D. Elective studies 10 cr (min)	

**Figure 3.** Master's degree in Environmental Technology, 120 ECTS cr

The degree programme (M.Sc.) consists of general studies preparing for a professional career, including for instance mathematics, language and communication skills, and practical professional training.



The major subject for all students is Environmental Technology. In the major studies, the student develops his/her professional competences in environmental technology in more detail and writes a Master's thesis (30 ECTS cr). The major studies in environmental technology concentrate on the central topics within the fields of emission control, environmental management, and life cycle assessment.

Students study the major subject studies (Environmental Technology) and the minor subject studies simultaneously. The minor subjects in the Master's degree programme are:

1. Energy Technology,
2. Sustainable Community,
3. Green Chemistry, and
4. Sustainable Business Management.

The minor subject in the Master's degree programme is chosen based on the selected minor in the Bachelor's degree. In exceptional cases, the minor subject can be chosen from other degree programmes, if it is suitable for the degree. The application has to be approved by the Head of Degree Programme. The student chooses his/her minor subject in the Master's degree in the spring term of the third year of study (in March).

In addition to these, the Master's degree contains elective studies.

The programme structure, the modules of the degrees and module sizes (duration and number of ECTS credits) are described in detail in the Study Guide (Appendix ENV1). Some courses in the undergraduate level are incorporated to the Master's Degree programme. These courses are Elective studies and provided by other Degree Programmes.

### **3.2 Workload and credit points**

The basic unit to evaluate the workload of the studies is one credit point. A module is scored by the workload required to pass it. To complete the studies of one academic year requires on average 1600 hours, which corresponds to 60 ECTS credits (Appendix C2, Government Decree on University Degrees 794/2004).

One credit point equals to approximately 26 hours workload, including face-to-face teaching hours, individual studying, as well as preparation for and taking part in the examinations. In the study guide also the individual work required from the student will be presented.

The total value of obligatory practical training in the Bachelor's degree is 2 ECTS credits, corresponding four full-time working weeks. In the Master's degree, the total value of obligatory practical training is 2 ECTS credits. 16 full-time working weeks correspond to 8 ECTS credits.

The study guides (curricula) present how the tuition (module) is divided between the study years. The scheduling of modules is planned accordingly.

The Degree Programme is composed so that by following the study guide, the degrees can be completed within the standard period of study (i.e., it is possible to take 60 credits per year on average), and the maximum of 75 credits is not exceeded in any year (Appendix ENV4). Students' individual workloads per semester might vary depending on the workload of elective studies, which they have selected. Examples of study plans in Appendix ENV12 show how the workload is divided during each semester.

If a student conducts studies in another university or educational institute in Finland or abroad, he/she can request the Head of the degree programme to credit the studies taken elsewhere. A student can credit and replace study modules also by knowledge gained otherwise. Knowledge can be proved by an oral or written examination. Also portfolios are in use as a means to validate the prior gained knowledge. Still, at least 90 ECTS credits of the Bachelor's degree (including the Bachelor's Thesis) and 70 ECTS credits of the Master's degree, including at least 45 ECTS credits of major subject studies, including the Master's Thesis, have to be passed at LUT.

More detailed description of the credit point system and inclusion of studies in other institutions are presented in the University Regulations on Education and the Completion of Studies (Appendix C4).

### **3.2.1 Workload and credit points in Bachelor's Degree**

The workload for the Bachelor's degree is presented in Table 4. The detailed workload analysis can be found in AppendixENV4. The academic year consists of four periods.

The elective studies are not included to the workload analysis in Table 4, because the student can choose to the elective studies any course taught at LUT according to his/her interest. The elective studies are recommended to be conducted in B.Sc.2 or B.Sc.3 on the basis of the workload analysis. The Bachelor thesis and seminar (10 ECTS cr) is dated to B.Sc. 3 periods 1.-4. The workload of practical training (2 ECTS cr) is also omitted from the calculations, because it is usually completed during the summer holidays.

**Table 4.** Workload per the year of study and periods, Bachelor's degree

Summary		Major subject: ENVIRONMENTAL TECHNOLOGY				
		ECTS cr	1 per.	2 per.	3 per.	4 per.
<b>General Studies (GS) and Major Subject (MS)</b>	B.Sc. 1, obligatory studies	56	18,5	13,5	10,5	13
	B.Sc. 2, obligatory studies	46	11,5	14,5	14	15
	B.Sc. 3, obligatory studies	22	5,5	2,5	7	7
	Summary, obligatory studies	124				
Minor subject 1: Energy Technology <b>(GS + MS incl.)</b>	B.Sc. 1, obligatory studies	58	18,5	13,5	12,5	13
	B.Sc. 2, obligatory studies	52	11,5	15,5	18	16
	B.Sc. 3, obligatory studies	35	11	7	8,5	8,5
	Summary, obligatory studies	145				
	Elective studies	35				
Minor subject 2: HVAC Engineering <b>(GS + MS incl.)</b>	B.Sc. 1, obligatory studies	59	18,5	13,5	13,5	13
	B.Sc. 2, obligatory studies	56	11,5	14,5	20,5	18,5
	B.Sc. 3, obligatory studies	32	10,5	7,5	7	7
	Summary, obligatory studies	147				
	Elective studies	33				
Minor subject 3: Green Chemistry <b>(GS + MS incl.)</b>	B.Sc. 1, obligatory studies	56	18,5	13,5	10,5	13
	B.Sc. 2, obligatory studies	66	15,5	18,5	21	20
	B.Sc. 3, obligatory studies	22	5,5	2,5	7	7
	Summary, obligatory studies	144				
	Elective studies	36				
Minor subject 4: Sustainable Business Management <b>(GS + MS incl.)</b>	B.Sc. 1, obligatory studies	56	18,5	13,5	10,5	13
	B.Sc. 2, obligatory studies	52	17,5	14,5	14	15
	B.Sc. 3, obligatory studies	39	10,5	8,5	10	10
	Summary, obligatory studies	147				
	Elective studies	33				

On the basis of the workload analysis, in B.Sc. 2, the spring term (periods 3 and 4) is more stressing than the autumn (periods 1 and 2). For this reason, elective studies are recommended to be completed especially during the autumn term in B.Sc. 2 and during B.Sc. 3. The workload analysis demonstrates that the second year (B.Sc. 2) of the students with the minor Green Chemistry is slightly overloaded (66 ECTS cr). The transfer of the minor subject course "BJ70A0701 Analytical Methods in Industry and Environment I" to B.Sc. 3 is being considered. Otherwise, the workload analysis indicates that the studies are distributed along the studies very uniformly.

### 3.2.1 Workload and credit points in Master's Degree

The workload for the Master's degree is presented in Table 5. The detailed workload analysis can be found in AppendixENV4.

The general studies and some minor subjects include also some elective studies, which the student must choose from the lists presented in Study Guide. The elective studies (which can be any courses taught at LUT) are not included to the workload analysis in Table 5, because the student can choose the courses according to his/her interest. The elective studies are recommended to be conducted in both M.Sc. 1 and 2 on the basis of the workload analysis. The Master's thesis and seminar (30 ECTS cr) are completed in the periods 3 and 4 in M.Sc. 2. The workload of practical training (2 ECTS cr) is also omitted from the calculations, because it is usually completed during the summer holidays.

**Table 5.** Workload per the year of study and periods, Master's degree

Summary		Major subject: ENVIRONMENTAL TECHNOLOGY				
		ECTS cr	1 per.	2 per.	3 per.	4 per.
<b>General Studies (GS) and Major Subject (MS)</b>	M.Sc. 1, obligatory studies	39	12	8	7,5	11,5
	M.Sc. 2, obligatory studies	37	3,5	3,5	15	15
	Summary, obligatory studies	76				
<b>Minor subject 1: Energy Technology (GS + MS incl.)</b>	M.Sc. 1, obligatory studies	58	16	12	15,5	14,5
	M.Sc. 2, obligatory studies	41	5,5	5,5	15	15
	Summary, obligatory studies	99				
	Elective studies	21				
<b>Minor subject 2: Sustainable Community (GS + MS incl.)</b>	M.Sc. 1, obligatory studies	48	15	11	10,5	11,5
	M.Sc. 2, obligatory studies	48	5,5	5,5	18,5	18,5
	Summary, obligatory studies	96				
	Elective studies	24				
<b>Minor subject 3: Green Chemistry (GS + MS incl.)</b>	M.Sc. 1, obligatory studies	49	15	14	7,5	12,5
	M.Sc. 2, obligatory studies	45	3,5	3,5	20	18
	Summary, obligatory studies	94				
	Elective studies	26				
<b>Minor subject 4: Sustainable Business Management (GS + MS incl.)</b>	M.Sc. 1, obligatory studies	49	14,5	10,5	10	14
	M.Sc. 2, obligatory studies	49	9,5	9,5	15	15
	Summary, obligatory studies	98				
	Elective studies	22				

Workload analysis showed a few development areas in the curriculum. The course "Chemical Reaction Engineering" will be transferred to M.Sc. 2 (academic year 2012-2013), because it should be studied after all the other chemistry courses. It would also be better to organize the course "Energy Efficient Environment" and the Green Chemistry courses (Advanced Course of Green Chemistry and Methods of Green Chemistry in Environmental Technology) in periods 1 and 2. Thus there would be more time for the Master's Thesis in periods 3 and 4. It should also be considered, whether one of these Green Chemistry courses could be transferred to M.Sc. 1. The above mentioned changes to the curriculum are being considered.

### 3.3 Educational methods

Both the Bachelor's and Master's programmes are full-time, on-campus programmes. The teaching methods applied in the Degree Programmes in Environmental Technology include lectures, classroom and laboratory exercises, computer training, different kinds of assignments, seminars, excursions, and Case-exercises. The courses also involve group and project work which train the social competences of the students. Computer-based Blackboard learning environment is widely used in the courses. The large variety of teaching methods used in different courses in the degree programmes in Environmental Technology is summarized in Appendix ENV5.

The table in Appendix ENV6 presents the contact teaching hours and the amounts of self-study on the courses in Environmental Technology, as well as the calculated self-study proportion of the total workload on the courses. On average, 76% of the course workload (1 ECTS cr = 26 h) is the independent work of the student. This explains itself by the variety of seminar assignments and exercises which develop the student's knowledge on legislation, as well as the skills for critical thinking, written communication, data acquisition, problem solving, lifelong learning, project management, and presentation. Various seminar assignments and exercises improve the student's knowledge on his/her own field along with the improvement of the theoretical knowledge. Many assignments also develop the students' skills for group work, negotiation, and organisation/coordination.

The group sizes are large (about 65-140 students) in approximately 39% of the courses. 48% of the courses are medium sized (30-64 students) and 13% are small sized. The large courses are mainly included in the Bachelor's degree programme. The minor in Environmental Technology is very popular among the students of other degree programmes. For this reason, the student amounts on the courses in Environmental Technology are large.

The student has a possibility to impact the content of his/her studies by choosing the subject of the final thesis and also the subject of some assignments according to his/her interest. In general the student acquires the topic of his/her Master's thesis from companies. The topic of the Bachelor's thesis the student can acquire himself/herself from companies or write from the topic given by the professor. In addition to the minor subject selection, the student may direct the contents towards his/her goals in work.

The Degree Programmes in Environmental Technology also include some courses taught in English. The target is not to use the language only after graduation or to teach the language as an

entity separate from technology. Integrated teaching also improves the ability of teachers of Environmental Technology to use the most recent reference material and research results in their teaching. These courses are also international, so students learn to act in a multicultural environment and communicate in English.

To support the educational activities, the University publishes the Teacher's Quality Manual (Appendix C5). It is designed to improve the quality of higher education and is available to all teaching staff at the University. The manual provides the teaching staff with guidance, for instance, on the following issues:

- Teaching planning
- Defining learning outcomes of a study course
- Determining the content of a study course
- Deciding the appropriate methods to evaluate the achievement of the learning outcomes
- Selecting suitable methods of teaching

### 3.4 Support and advice

The university offers academic guidance actions that together cover the entire span of studies and efficiently support studies and learning. With this guidance, students are able to complete their studies by following an appropriate study plan that they have prepared themselves and to graduate within the desired time.

The roles and duties of study guidance personnel and units are listed in the table below.

**Table 6.** The roles and duties of study guidance personnel and units

Peer tutor	Introduces new students to the university, studies and the student community, and helps them with practical arrangements at the start of studies. A peer tutor introduces new students to the university facilities, study guidance staff and other students. A peer tutor makes sure that students know the most important practices related to studies: registration for courses, attending lectures, taking examinations, preparing a course schedule, social aspects.
Tutoring coordinator	Coordinates and develops the university's peer tutoring together with faculties, Student Services and the student union.
Student adviser	Student advisers are LUT students who work part-time while they study. They provide information and guidance in studies, see to the choice of tutors and arrange their training together with the study coordinator and take part in arranging briefings for students.
Study counselling psychologist	Counsels students in problems related to studies and learning and provides expertise in issues involving learning and guidance, supporting other study guidance personnel.
Study coordinator	Coordinates study guidance for students. The duties include study and degree guidance for students, from applicants to postgraduate and partly even mature students. The study coordinator helps students in preparing their individual

	study plan (including the recognition of prior learning and studies outside LUT, e.g. through the flexible right to study) and provides guidance in administrative issues related to graduation.
Head of degree programme	A head of degree programme is in charge of evaluating and developing study guidance.
Head of study affairs	A head of study affairs is responsible for organising study guidance in the faculty. Is responsible for administration of studies and partly also for study guidance related to administrative affairs.
Teacher/tutor	A teacher/tutor helps students prepare their individual study plan and follow its progress. Teacher/tutors provide guidance in the selection of major and minor subjects from the viewpoint of career guidance. They are study guidance personnel appointed for a department or degree programme. Students may turn to them with any issues involving studies.
Teachers	Are responsible for study guidance related to the completion of the courses/modules they are responsible for.
Introductory course/module	Introductory courses are arranged in all degree programmes to help students get started with their academic studies. Introductory courses usually also guide in preparing an individual study plan.
Professors	Professors provide guidance in the selection of a research topic, and in preparing final theses for undergraduate and postgraduate studies.
International Services	International Services offers general study guidance to international students at the university and coordinates the activity of international tutors. International Services also assists Finnish students in matters related to studies abroad.
Career Services	Career Services guides students in career planning and searching for employment.
Language Centre	The Language Centre offers study guidance related to language, communication and culture studies.
Library	The Library provides guidance in information retrieval and instruction in information literacy.
Origo helpdesk	Supports services for the use of information and communication technology in studies.

At the beginning of their studies, students prepare an individual study plan (HOPS) on the course Introduction to Studies of Environmental Technology. The study plan is made for the entire duration of the studies, i.e. until the M.Sc. degree is completed. An independent study plan is a tool that helps students plan their studies. Its purpose is to help students to see their studies as a whole from the very beginning, and to support students in choosing courses and minor subjects that best suit them. The aim is also to avoid delaying graduation unnecessarily. It also awakens students to realise their own responsibility for their studies, and motivates and incites them to make a commitment to their studies. The study plan is checked by the Study Coordinator. Student will also participate in a personal conversation with the Teacher Tutor about his/her HOPS.

On the course Introduction to Studies of Environmental Technology the students receive also tips for the time management (1 lecture held by the Study counselling psychologist). One lecture is reserved for the presentation of the minor subjects and one for the presentations of the graduates from the degree programme. The objective is to make the selection of the minor

subject easier and to provide the students with ideas of the possible tasks of the graduates from Environmental Technology. In the autumn 2011, four graduates of the M.Sc. degree programme in Environmental Technology visited the course describing their work and giving recommendations which courses in their opinion should be included in the degrees.

Teachers are responsible for the modules they teach as well as supervision concerning contents of their own subjects. Persons in charge of the modules are required to have a doctorate. Teachers are available at the university mainly during office hours, but students may have guidance and individual supervision also out of these hours by fixing the time with the teacher.

### Specialised support and advice for finishing the Bachelor's and Master's thesis

In the degree programme in Environmental Technology, the writing of the Bachelor's thesis begins with introductory lectures. For the Bachelor's thesis, instructions are available for the students of Environmental Technology (Appendix ENV7), in which the process is divided into phases. The instructions help the writer, supervisor and examiner of the thesis. Schedule models are designed for the writers, in which the phases of the instructions are shown. Acting as an opponent and the presentation of one's own thesis in a seminar, in which also the supervisor and examiner participate in, are included in the Bachelor's thesis process. Instructions are available also for the acting as an opponent and the presentation of one's own thesis. The process is evaluated according to the Directive Evaluation Matrix of the Degree Programme (Appendix ENV8). Since spring 2011, the Language Centre course "Scientific Writing in Finnish 2 ECTS cr." has been integrated into the Bachelor's thesis and seminar.

At LUT, most Master's theses in engineering are prepared on topics given by companies or other sponsors, in which case the student must discuss the topic with the sponsor as well as with the professor who is acting as the supervisor or examiner. Together with the professor, the student ensures that the subject meets the scientific requirements set for academic theses.

In the degree programme in Environmental Technology, the writing of the Master's thesis begins with the Master's thesis briefing of the Faculty of Technology. For the Master's theses, instructions are available for the students of Environmental Technology (Appendix ENV9), in which the process is divided into phases. The instructions help the writer, supervisor and examiners of the thesis. At the end of the process, the student gives the final presentation to the representatives of the organisation for which the work has been done.

There are also university and faculty level common instructions available for the writing of the theses. The final thesis instructions are presented in Appendix C7, the evaluation form of Master's thesis in Appendix C6 and Guide for Master's Thesis (Degree Programme in Environmental Technology) in Appendix ENV9.



## **4. Examinations: System, Concept and Organisation**

### **4.1 Evaluation criteria**

Various types of evaluation methods are widely used. Courses are not often evaluated only by the examination. Assignment, laboratory work, home work, seminar etc. may contribute to the final grade of a course. Written examinations typically include essays, problem-solving or case-based questions and calculation problems.

Various evaluation methods used in different courses in Environmental Technology and the impact to the final grade can be found from Appendix ENV5. In the evaluation of the courses in Environmental Technology, the proportion of the written examination is approximately 57%. Various exercises, seminar and laboratory assignments play an important role in the course evaluation. Learning diaries and various home assignments are used as well. The evaluation method used in the course is described in the Study Guide.

Courses are usually evaluated on the scale excellent (5), very good (4), good (3), very satisfactory (2), satisfactory (1) and failed (0). Sometimes a pass–fail grading is used. The maximum score for each course is 100 points, and 50 points is required to pass the course. The accrual of the total score may include, for instance, examination, exercises, home assignments and seminars.

All teachers prepare and grade examinations in the subjects under their responsibility as determined by the Head of the degree programme. Teachers shall forward the grades to the Student Affairs Office and make them known to the students or post them online within a month. Teachers shall keep examination scripts and other equivalent material, and participant lists of examinations for at least six months after grades have been published. For more information see Appendix C4, sections 62-72 (University Regulations on Education and the Completion of Studies).

Grades obtained in courses are entered into the student information system, WebOodi. Students can view their grades and the weighted average of their studies at any time. Grades included in the degree, and their weighted average, are listed in the report that complements the diploma.

### **4.2 Students' rights and responsibilities**

Examinations for each course are organised four times. However, students may take part in two of them. The first two examinations are scheduled for the examination period following the teaching period during which the course is taught. Student can choose either. There are altogether seven examination weeks during the study year.

The University arranges examinations for courses in accordance with the curriculum in force. In addition to the above, teachers may arrange examinations at other times. Examination dates and times for each department and changes thereto can be found on the university web site. Therefore, the exam schedule is always up-to-date.

After the assessment, students have right to receive a duplicate of the paper assessed. Students who are dissatisfied with the assessment may request a correction to the assessment orally or in

writing from the teacher who made the assessment or the person who made the recognition decision. Pursuant to the Universities Act (558/2009), section 44 (Appendix C1), the students have the right to obtain information about the application of assessment criteria to their study attainments. They shall be given the opportunity to see the assessed study attainment.

Students who have enrolled as attending or students who have enrolled as non-attending due to student exchange or other valid reason have the right to take part in examinations. The rights shall remain in force until the end of the following semester. (Regulations on Education and the Completion of Studies, section 69)

Students register for examinations and intermediate examinations during the academic year through WebOodi. If needed, students may register by telephone or in person at the customer service desk in the Student Affairs Office or by e-mail to opinto@lut.fi. Registration starts four weeks before the examination date and ends one week before the examination. Students who have registered for an examination but are unable to take it must cancel their registration through WebOodi. Registrations are to be cancelled two working days before the examination. Registration which is not cancelled, is considered having been taken.

Late registrations are accepted until the day before the examination. Students who register late must do so in person at the customer service desk at the Student Affairs Office and pay a fee of € 5. If no one has signed up for the exam within the due period, the exam will not be organized. Teachers have no obligation to arrange an examination for a student who has not registered for it in advance.

According to LUT's Regulations on Education and Completion of Studies, the students may take the final examination for a course twice. If a student does not pass the examination after taking it twice, he or she may apply for an additional retake. A retake must be applied for in advance of the exam date in University's exam schedule and it is applied from the teacher responsible for the course. The teacher may require students to perform additional tasks in order to get an additional retake.

### **4.3 Examination connected with final theses**

The Bachelor's degree includes a Bachelor's thesis, which is an assignment related to a course in the student's major studies. The work is mainly a literature report, but it may also include an empirical research part. The Bachelor's thesis and related seminar provide a good foundation for continuing one's studies at the Master's level. The thesis and seminar are worth 10 ECTS credits.

The thesis is independent work of student, and the topic and content are discussed with supervisor before starting the work. The examiner is required to assess the thesis. The examiner and supervisor of the B.Sc. thesis must have the degree of M.Sc. at least. The thesis is graded on the scale of 1–5. The Bachelor Seminar of Environmental Technology includes a written B.Sc. thesis, seminar presentation and also acting as an opponent to another B.Sc. thesis. All these three parts are evaluated. The directive assessment matrix is presented in Appendix ENV8 and

the Instruction to B.Sc. thesis can be found in Appendix ENV7. The assessment matrix is also presented for the students in the first lecture.

Students must prepare a written maturity test to demonstrate their language skills and how well they know the topic of their thesis. The maturity test is supervised in the Origo exam aquarium and students are not allowed to use any reference material. The test must be taken at least five weeks before the planned graduation. The maturity test is evaluated by the examiner of the Bachelor's thesis and a language reviser approved by the University.

M.Sc. thesis is the final project of the Master's degree studies. It demonstrates the student's knowledge of a scientifically or societally important topic. The thesis is a research assignment in the student's major subject organised in the form of a course (30 ECTS cr). It requires approximately six months' work. The student must demonstrate the ability to carry out the project independently and following a plan.

The thesis is evaluated by two examiners and one of them has to be a professor. The other examiner has to be at least the M.Sc. The supervisor of the M.Sc. thesis must have the degree of M.Sc. at least. The thesis is graded on the scale of 1–5. The issues evaluated in the M.Sc. thesis are for example problem definition, goals and delimitations, mastery of the methodology, results and reviewing of them and following the schedule. The detailed assessment criteria and the assessment form are presented in Appendix C6 and the Instruction to M.Sc. thesis in AppendixC7.

The student's knowledge of the topic of the thesis and his/her language skills are verified in the maturity test. The topic of the test is determined by the examiner of the student, and it relates closely to the topic of the student's thesis. The test is evaluated by the examiner. If the student has demonstrated his/her language skills in connection with the lower university degree, the language of the maturity test will not be evaluated, only the contents.

## **5. Resources**

### **5.1 Staff involved**

Within LUT Energy, there are about 180 persons working full time. The Department of Environmental Technology employs about 32 persons. The composition of teaching and research personnel in LUT is based on a new four-step system: Doctoral Student, Post Doctoral Researcher, Associate Professor and Professor, Table 7 This four-step system supports structured and consistent education and development activities. The employment contracts of the personnel range from 1 year contracts (doctoral student) to permanent positions (associate professors, professors). The number of total academic staff accounts 32 including also the researches without the teaching responsibility and staff without the research responsibility.

To ensure that the learning outcomes of the degree programme can be achieved in the expected time period enough teaching staff is needed. It must be remembered, that Degree programmes

in Environmental Technology includes also many courses produced by other Degree Programmes. Table below shows only the staff of the Department of Environmental Technology.

**Table 7.** Staff Contributing to the Degree Programme (2011)

Position type	
Professors*	4
Post-doctoral researchers*	5
Doctoral Students*	16
Other teaching or research staff	7
Total academic staff	32

\*Personnel with teaching responsibility

Staff Handbook, which is prepared according to ASIIN's criteria, shows the educational level and the scientific contribution of the teaching staff (Appendix ENV10). Also the number of supervised theses and the pedagogical training are included to the Staff Handbook forms. From the additional information it can be seen that 40% of the Department of Environmental Technology staff has some academic pedagogic studies. The Department also employs young students who are preparing their Master's theses as research assistants.

## 5.2 Staff development

Lappeenranta University of Technology aims to create a good working environment for its staff, and to support their professional development and well-being at work.

The University has a human resources committee, which is responsible among others for personnel training. Through this committee, the university personnel have representation in decision-making concerning the development of the working environment and conditions. The chair of the Committee is the Vice Rector in charge of education. The names of other members and the Committee memoranda are available on the University intranet.

The university supports its staff members in maintaining and developing their professional expertise and in career planning. The human resources committee annually revises its measures for professional development and maintaining professional expertise, which e.g. determine the focus areas of personnel training at the university. Measures for professional development and training are presented on the university intranet, in the memorandum of the human resources committee.

University also regularly organises training in university pedagogy which aims to strengthen the practical teaching competences of the teaching personnel. University pedagogy is a multidisciplinary field that deals with learning, studying, teaching and assessment in the Higher Education context. The extent of the course is 25 ECTS credits total. After taking the course, the teacher is expected to be able to evaluate and develop his/her own teaching and assessment methods.

The university supports the development of teaching by organising courses on University Pedagogy in which the staff can participate during working hours. Almost 40% of the staff of the department of Environmental Technology has pedagogical education. The majority has completed the whole 25 ECTS cr University Pedagogy education offered at LUT. In addition to this, the educational coordinator operates as a pedagogical support person for the teaching staff of the degree programme in Environmental Technology.

In addition, the University organises staff training in foreign language, utilisation of computer programmes and scientific writing. The professors are also obliged to participate in management training organised by the University (provided by JTO School of Management). The costs of staff training organised by the university are covered by general personnel training appropriations.

Each unit offers its staff members the opportunity to take part in staff training outside the university in order to support their professional development and expertise. In addition, an opportunity to participate in the international exchange programme for teachers and researchers is offered for the staff. Annually 5-10 members of the teaching and research personnel in the department of Environmental Technology participate in the international exchange programmes for teachers and researchers. Correspondingly, there are 3-4 incoming researcher visits annually. The university also supports the professional development of its personnel by allowing them to take two lessons (2 x 45 minutes) per week for independent study if the employee's supervisor and head of the unit consider that the studies serve the purposes of the working community.

The Department of Environmental Technology organises three important environmental seminars in cooperation with industry and government bodies: National Seminar on Air Pollution control in August (annually), National Waste Recovery Days in November (annually), and National Energy Efficiency seminar in April (every second year). The whole Environmental Technology personnel participate in the seminars. They offer an opportunity to update the knowledge of one's own field and to create national co-operation networks.

University staff members have annual performance and development discussions with their immediate supervisor. The parties of the discussion examine results obtained, set goals for the near future also concerning the professional development and personnel training needed. Instructions for performance and development discussions are available on the University intranet.

LUT's Research and Innovation Services help and support LUT's research staff in questions dealing with research funding, administration and practical arrangements of contracts. The main task of the persons working in the unit of Research and Innovation Services is to make it easier to transfer the results of scientific research to be utilised in the society and help to establish new enterprises and business. This unit also supports the researchers in the matters of patents and novelty criteria of inventions.

### 5.3 Institutional environment, financial and physical resources

#### 5.3.1 Institutional environment

##### Description of the institution

University education is governed by the Universities Act (558/2009) (Appendix C1) and the Government on University Degrees 794/2004 (Appendix C2). The roles and responsibilities of the management of education are defined in the Administrative Regulations of the University. The educational quantitative objectives are agreed upon annually in the negotiations between the University and the Ministry of Education and Culture. The achievement of objectives affects the financing granted to the University by the Ministry. The financing decisions are made on annual basis. The aim of the university regulations (Appendix C8) is to lay the groundwork for academically and financially productive management and high-level administration at the university. These regulations describe the objective, mission, organisation and administration of LUT. The organization of LUT is also presented in LUT Quality Manual (Appendix C10).

The University Board decides the strategic long-term goals of the university teaching and education, and the degree programmes provided by the University (LUT Strategy 2013, Appendix C3). The Rector decides the entry requirements and the total number of new entrants to each faculty. In addition, the Rector also makes the decision on the approval of new entrants to the degree programmes. The Rector also appoints, when necessary, the degree board to consider the remedial requests concerning the study attainments.

The University applies the Regulations on Education and the Completion of Studies approved by the Rector. The Regulations define the basic ways of action concerning the teaching and studying at the University, and the degree programmes provided by the University. The Regulations are published on the University's web pages.

The University has a Vice Rector responsible for education. In addition, each degree programme has an appointed head. The Vice Rector organises a meeting between the heads of the degree programmes once in every two months to discuss the leading, evaluating and developing principles of the degree programmes. The memos of the meetings are published on the University intranet. The Vice Rector also leads the University's supervisory and development group for teaching appointed by the Rector. The goal of the group is to promote the internal cooperation within the University in developing the teaching customs.

The student representation in the University's administrative bodies is determined by the Universities Act and the Regulations of Lappeenranta University of Technology. In accordance to the statutory representation in the administrative bodies, the students also have a representation in the University's supervisory and development group for teaching. In addition, the students participate in the development of teaching through the course evaluation carried out annually in each University study course, and through the teaching feedback enquiry organised by the Students' Union.

**Committees responsible for teaching in the degree programme**

The university has three faculties: the Faculty of Technology, the Faculty of Technology Management, and the School of Business. The Department of Environmental Technology, as part of the Institute of Energy Technology (LUT Energy), belongs to the Faculty of Technology.

The head of the faculty is the dean, and the highest decision-making body in the faculty is the faculty council. The dean acts as the chair of the faculty council. The dean manages the faculty and is responsible for the results of its instruction, research and societal influence. The faculty council makes decisions regarding the curricula. A Study Guide presents the aims and organisation of the education, and the course descriptions and learning outcomes of courses in the degree.

The Faculty of Technology has a development group for teaching appointed by the Dean of the Faculty. The group is responsible for developing the quality of teaching and the contents of the degree programmes within the Faculty. The group has representation from each degree programme provided by the Faculty and from the study affairs services of the faculty. The group also has three student representatives that are appointed on the basis of the recommendations of the Students' Union.

The Faculty Council is responsible for supervising the quality of teaching. The Council also decides the curricula of each degree programme. In addition, the Council makes the proposal to the Rector concerning the entry requirements and the number of new entrants accepted to the degree programmes.

The quantitative and qualitative goals of the Faculty's actions are agreed upon on yearly basis in the negotiations between the Faculty and the University. The University takes into account the results of the Faculty's operation in previous years and the Faculty's development needs in allocating the money received from the Ministry of Education and Culture.

The Faculty is responsible for the equipment needed in teaching and research. The Dean of the Faculty is responsible for the resources needed in teaching. The Dean also appoints the heads of the Faculty's degree programmes. In addition, the Dean accepts the theses of the graduate students.

The Heads of the Faculty's degree programmes are responsible for producing, evaluating and developing the degree programmes. The heads of the degree programmes accept the topics of the theses of graduate students. Each department of the Faculty also has an advisory group to support the work of the head of the programme.

The content of the Major Subject of the degree programme is decided by the professors and the head of degree programme. The major subject is congruent with the focus areas of the research. The professors are also responsible for organising teaching in their remits. They also examine the M.Sc. theses. The topics of M.Sc. theses are accepted by the head of the degree programme.

Teachers in charge of the study courses are responsible for executing, evaluating and developing their own teaching. The University has published LUT Teacher's Quality Manual to support the

teaching activity. The handbook contains information about the planning and implementation of study courses. It also gives instructions for defining the learning outcomes of the study courses, and for evaluating whether the learning outcomes have been achieved. In addition, the handbook provides the teachers with tools to measure the workloads of the courses. The handbook is published as a printed version and in electronic format on the University's intranet.

### **Main areas of research**

The Degree Programme in Environmental Technology strongly relies on the research carried out in the Department of Environmental Technology. There are two laboratories: Laboratory of Environmental Technology and Laboratory of Green Chemistry.

#### Laboratory of Environmental Technology

The key research areas in Environmental Technology are:

1. Life cycle management (topics like: ecological product design and economic impacts, ecological footprints, life cycle responsibility),
2. Waste management and recovery systems (topics like: optimisation of waste management systems, sustainable energy recovery from waste and recycling options), and
3. Environmental Management and Sustainable innovations (topics like: corporate social responsibility, producer responsibility, emissions trading and system transition).

The focus of the research of Environmental Technology is System Analysis for Sustainability. The Environmental Technology research deals with municipal and industrial systems and related managerial aspects, such as life cycle assessment and systems transition. Optimal conditions for sustainability are evaluated for municipal, industrial, agricultural, and commercial systems. Examples of the systems are waste management systems, energy production and delivery systems and biorefinery systems from raw material source to final consumer, and waste recovery and disposal. The objective is to develop the key research areas holistically taking into account the technological, environmental, economical and business perspectives. This multidisciplinary approach can be seen in the research projects that not only focus on one particular technology but combine the expertise of different fields into one, whole system wide assessment. The sustainable innovation approach is also given more emphasis. The case studies and conceptual frameworks developed in the research projects of the Laboratory are utilised in the teaching of environmental technology.

#### Laboratory of Green Chemistry

Laboratory of Green Chemistry has specialised in water analysis and water, wastewater and soil purification techniques in the following research areas:

- Adsorption ,
- Electrochemical technologies and electrokinetics,
- Advanced oxidation processes (AOP's),
- Coagulation,
- Ion mobility spectrometry,



- Electrochemical analysis, and
- Remote monitoring.

Nano-scale adsorption, functionalised adsorption materials, and nanocatalysts have especially been the key research areas in the laboratory during the recent years. Advanced oxidation processes include technologies e.g. ozonation, UV light with oxidants (e.g. hydrogen peroxide), Fenton mechanisms, photocatalysis under visible light, and LED-based photocatalysis. Electrochemical techniques are for example electrochemical oxidation and coagulation and electrokinetic treatment of soil. Environmental analysis includes techniques like ion mobility spectrometry and environmental monitoring of water quality in rivers and lakes.

The laboratory performs cutting-edge environmental research, which contributes substantially to the solving the grand challenges of basic and applied science and demands of industrial users and society. The group has extensive international research contacts in the related research fields and close contacts with the water industry sector.

LUT Energy is one of the main research institutions in Energy Technology in Finland according to the evaluation carried out by the Academy on Finland in 2006

The laboratories are also responsible for maintaining both the teaching laboratory facilities and the research laboratory facilities.

Examples of current research projects in the laboratories which are relevant also from the perspective of the degree programmes are presented below.

#### Laboratory of Environmental Technology:

**BUSINESS FROM THE INNOVATION PIPELINE – commercialisation of cleantech innovations (2009-11)**

LUT has researched social innovations and developed a business model for energy auditing service and tested it in co-operation with HAMK University of Applied Sciences. As a part of the sub-project, LUT also determined the energy efficiency impact of the other business innovations in the Cleantech project. Several Bachelor's theses were completed within the framework of the project.

**NEW ENERGY SERVICES FOR DYNAMIC MARKETS (2011-2013)**

The key objective of the research project is to support the systemic management and internationalisation of the new service oriented energy business models. The key research question is: how to develop new energy services for dynamic markets, and how to successfully manage these novel business models? The case studies and conceptual frameworks developed in the project will be utilised in the teaching of environmental management.

**NeReMa - Advanced solutions for recycling complex and new materials (2010-2011).**

The aim of the project is to make an in-depth analysis of selected waste management value chains, beginning from the waste generation and ending to the production of products and materials on the market. A systematic modelling approach will be used resulting in the identification and definition of the most significant development goals of each chain. LUT studies

the value chain, technologies, potential and future research needs in the waste-to-energy part of the material flows. The material flow and future technology information results will be used in waste management courses.

JATKE – Research based development of the regional waste management in South-Karelia and Kymenlaakso (2010-2012).

The objective of the project is to support regional decision making in waste management with research in South-Karelia and Kymenlaakso regions. In South-Karelia, the future source separation and recovery options of municipal solid waste (MSW) are studied using LCA for searching the optimal system from the perspective of environmental impact. In Kymenlaakso, the research helps to find the optimal solution for the recovery of the residue of anaerobic digestion. The results of the project will be used as example cases in the courses related to waste management.

BIOCRAF – Carbon footprint of traffic biofuels (2011 – 2013)

Research objectives are to find out the most potential feedstocks and production technologies for drop-in transportation fuels, to compare different options from a life cycle point of view and to find out solution to provide biofuels for transportation sector with needed volumes and minimum effects on climate change. In the teaching, the most central issue is to find out and develop the most ecological production chains, which is also the objective of the project.

#### Laboratory of Green Chemistry:

CARBON NANO-STRUCTURES FROM NATURAL RESOURCES: From Cellulose to Nano-structured Sensors (2011-2013)

Carbon nano-structures have developed into technically important components in many everyday technologies. Nano-structures are especially beneficial in sensor devices since they have properties such as (i) an increased surface area/volume ratio, (ii) an ability to be functionalised, and (iii) favourable electronic and thermal characteristics. The overall aim is to apply the results obtained in this research to the development of affordable, stable, and sensitive sensor materials, and to study the applications of the produced natural nano-carbon material. Research results will be utilised also in the teaching and M.Sc. theses.

WATSAMAN (Water Safety Management, 2011-2013)

The major goal of the project is to develop a sensor technology for the detection and continuous monitoring of hazardous organic and inorganic chemicals present in waters and to clarify the suitability of specialised laboratory instruments for controlling the water processing tasks. The detection section includes technology development for the detection of novel hazardous chemicals and testing of specialised instruments to water processing procedures. Research results will be utilised also in the teaching and M.Sc. and D.Sc. theses.

DELETE (Development of LED-based photocatalytic water treatment, 2009-2012)

Solid-state lighting devices such as LEDs offer promising and environmentally friendly alternatives to replace the conventional UV lamps in water treatment, as they provide better efficiency and higher mechanical stability, but contain no mercury or other harmful substances. This study tests the technical feasibility and engineering applicability of UV/TiO<sub>2</sub>-based

photocatalysis in water cleaning. In this process LEDs will be used as UV light sources and TiO<sub>2</sub> films as a photocatalyst. The goal of the work is to develop a system based on the following principles: low cost, high efficiency, mechanical stability, and long lifetime. Research results will be utilised also in the teaching and M.Sc. and D.Sc. theses.

DESLED (Disinfection by UV LED light, 2011-2014)

UV LED light technique would replace old UV lamps used in water purification from microbes, and it would be possible to use and find new applications. Some bacteria species are also resistant to current methods, and more effective methods are needed. The aim of the project is to develop novel, innovative UV LED products for water disinfection and find ways to manufacture them. Research results will be utilised also in the teaching and M.Sc. and D.Sc. theses.

NACEWA (Nano- and microcellulose based materials for water treatment applications, 2011-2013)

Project aims to produce and assess the applicability and potential of functionalised nano- and microcellulose-based materials for water treatment applications. The primary aim is to develop novel bio-based chemicals with improved performance and sustainability for flocculation, adsorbent and photocatalysis applications related to water treatment. During the project the production methodology, feasibility of nano- and microcellulose-based materials in the selected water treatment applications and preliminary techno-economical business potential of the produced materials will be clarified. Research results will be utilised also in the teaching and M.Sc. and PhD theses.

### **Cooperation within the institution**

Internal cooperation within the University is promoted by the supervisory and development group for teaching led by the Vice Rector in charge of education. The regular meetings of Heads of the Degree Programmes led also by the Vice Rector in charge of education.

The Degree Programmes of LUT carry out close cooperation. The B.Sc. and M.Sc. degrees in Environmental Technology include general scientific studies, foreign languages and communication studies which are produced by other degree programmes in LUT (Energy Technology, Chemical Technology, Mechanical Engineering, Electrical Engineering, Mathematics and Physics, Industrial Management, School of Business, and Language Centre). The minor subjects of the Degree Programme in Environmental Technology are produced in close co-operation with these degree programmes.

All three departments in LUT Energy collaborate closely in the main research areas which are the energy efficiency and energy markets. These also form one of the four strategic focus areas of the University. The Degree Programmes in Environmental Technology uses the same student administration services as the other two degree programmes of LUT Energy.

Student exchange is arranged by LUT International Services, which supports university's internationalisation by developing and maintaining cooperation relationships and agreements with international universities and networks. LUT has an extensive partner network all around the world. The network of over 150 higher education and research institutions forms an excellent

basis for collaboration in mobility of students, teachers and researchers, as well as joint education and research projects.

The Department also collaborate with other support services at LUT, such as library and information services.

### **External cooperation**

Department in Environmental Technology collaborates with a number of Finnish and international universities and research institutes (Appendix ENV11). In addition, co-operation in teaching and research is made with industry, business and consulting companies. The co-operation with industry and companies in teaching includes for example visiting lectures and excursions. Visiting lecturers from industry, enterprises, other universities and research institutes are used in approximately half of the courses of the Department of Environmental Technology (Appendix ENV5). Enterprises also offer topics for the final theses and planning assignments. List of the most recent B.Sc. and M.Sc. theses can be found in Appendix ENV18.

The collaborative university partners of the Department include for instance University of Eastern Finland, Tampere University of Technology and Aalto University in Finland. International university partners include for instance University of Oxford (UK), Kwangwoon University (South Korea), Nankai University (China), Moscow State University (Russia), Saint Petersburg State University of Engineering and Economics (Russia), and University of Chicago of Illinois (USA).

The important cooperation partners are:

- Industrial enterprises (e.g. Stora Enso, UPM Kymmene, Wärtsilä, Foster Wheeler, Rautaruukki, Laitex, Einco),
- The energy industry (e.g. Fortum, Vapo, municipal energy companies),
- Environmental enterprises (e.g. L&T, Kuusakoski, regional waste management enterprises),
- Finnish research institutes (other than universities) adding to LUT's range of expertise (e.g. Finnish Forest Research Institute (METLA); VTT Technical Research Centre of Finland),
- International research institutes adding to LUT's range of expertise (e.g. St. Petersburg State University of Engineering and Economics (Russia), Kaunas University of Technology (Lithuania), University of Kalmar (Sweden)), and
- Public-sector research sponsors (e.g. Tekes, South-East Finland – Russia Neighbourhood Programme, EU Framework Programmes, Academy of Finland).

### **5.3.2 Financial Resources**

The achievement of objectives affects the financing granted to the University by the Ministry of Education and Culture. The financing decisions are made on an annual basis. In allocating the money to the Faculty, the University takes into account the results of the Faculty's operation in previous years and the Faculty's development needs. The goals of the Faculty's actions are agreed upon on a yearly basis in the negotiations between the Faculty and the University.

The annual income of the Department of Environmental Technology has been around 2.5 million Euros, table 8. About half of this money comes from sources other than the university budget. These sources include the Academy of Finland, the Finnish Funding Agency for Technology and Innovation, the European Union, and private companies.

**Table 8.** Annual income from different sources.

	University budget €	Other sources €
2009	900 000	600 000
2010	1 000 000	600 000
2011 <sup>(*)</sup>	1 100 000	1 400 000
2012 <sup>(*)</sup>	1 200 000	1 700 000

(\* Figures for 2011 and 2012 from the budget)

Professors, who are normally in charge of the course modules, are mostly paid from public budget funds. This guarantees a solid founding and the continuity of the degree programme. Part of the funding for post doctoral researchers comes from external funding. The funding for doctoral students comes chiefly from research projects.

Basic teaching and teaching materials, maintenance of the teaching equipment, rents and charges of the study affairs and the university administration are financed from the budget money.

**Table 9.** Financial resources of the department.

	Staff fund total €	Other funds €
2007 <sup>1</sup>	687 557	326 719
2008 <sup>1</sup>	839 068	160 960
2009 <sup>1</sup>	809 715	192 973
2010 <sup>1</sup>	860 834	502 834
2011 <sup>2</sup>	1 550 000	800 000

<sup>1</sup> 2007–2010 actual, realised figures

<sup>2</sup> Figures for 2011 from the budget

In addition on 2011 the Department of Environmental Technology received 150 000 € investments in major equipment.

Lappeenranta University of Technology supports the development of teaching and grants annually an education quality bonus. The receivers of the bonus are selected based on an application in a specified form. The bonus can be applied by university units, groups of several actors or individuals for the support of the development of their own teaching. However, the development project must clearly relate to a degree programme or degree programmes. In 2008, the Department of Environmental Technology received a bonus of 12 500 €. The bonus was granted to encourage the degree programme to systematise its quality management system.

### 5.3.3 Physical Resources

The University has 34 lecture halls, 9 classrooms for language studies, and 14 micro computer classrooms and work premises for group work and thesis writing.

The university library provides services for university students and staff, and for outside customers. In the library area, there is also a study and work place with guidance for students - the Origo. Origo has about 100 posts, several group work premises, and two computer classrooms. The computer classrooms are available for independent studies whenever they are not reserved for teaching purposes. Origo also has a reading room that is open 24/7.

In the University premises, there are two restaurants and two cafes available for students, staff and other people. Eight rooms have been reserved for students' guilds. The University premises also host two chapels, and the two gyms support the students' physical activities. At the University campus, there is also a student health centre. The Student Union House has facilities for hobbies and meetings that are available to all students.

#### Computer facilities

University offers for personnel Windows computers for normal use or a similar computer with more memory and enhanced display adapter for those who use CAD software. Printers and scanners are available to the personnel. The computers for personnel are equipped with special programmes (Gabi and CADs) used for research and teaching purposes.

Students can use the computers that are in common use in the library area (i.e. in Origo), or in the computer classrooms. Origo's supporting team supervises the students and the supervision is also carried out with centralised electronic means. The University's Information Services and Technology (IS&T) Unit is responsible for the computers and data systems. Also printers and scanners are available for students. The computers in the classrooms are equipped with the computer programmes like Gabi and CADs, which are used in teaching.

There are about 100 computers in Origo's computer classrooms, and they are available during the library opening hours. There are altogether 325 computers in other computer classrooms. Three of the computer classrooms are equipped for CAD use. One classroom with 21 computers has a Linux setup. On passageways there are some computers that can be used only for web browsing.

Centralised services, such as the learning environments can be accessed also outside of the campus. The university offers eduroam WLAN services to enable the use of students' own computers at the campus. In addition, Saimaa University of Applied Sciences has located some of their computer equipment in the library area.

Students enrol on the modules and exams and see their credit points through WebOodi (<https://weboodi.lut.fi/oodi> --> in English). They get the course information, learning material and assignments of the modules through Noppa ([noppa.lut.fi](http://noppa.lut.fi) --> in English) and participate in the web-based courses on BlackBoard or Moodle (web-based learning environment).

### **Lappeenranta Academic Library**

LUT Library collections consist of approx. 100.000 printed monographs, 67.000 printed journals, 18.000 electronic books, and 11.200 e-journals. There are also documents in microfiche form and audio recordings. The annual procurement of printed monographs is approx. 4.200 and the number of subscribed printed journals is 600 volumes per year. Electronic material is available remotely for LUT staff and students only.

There are over 20 database vendors with more than 100 databases available for the Library customers. Most database hosts allow IP access to their information sources. Students and staff also have remote access to e-journals and electronic books.

There are no restrictions to the number of loans. The customers access the Library catalogue Wilma 397.000 times per year. The Wilma database includes information about both printed and electronic books as well as the storage information of printed journals. Electronic books can be accessed via a link to the Library catalogue.

The Library provides its customers with library and information services both on-site and online. Information literacy education for the entire University is also arranged and given by the Library personnel. The Librarians act as experts in publishing of the LUT series. The Library is an Independent Institute within the University.

The Library is open to LUT staff, students, and general public during terms on workdays: Mon-Thu 8:00–18:00 and Fri 8:0–15:30. In summer and during the holiday season the Library closes at 15:30 on each workday. The Library also offers six group work rooms.

### **Laboratory facilities**

#### **Laboratory of Environmental Technology**

The laboratory has 23 licences and eight additional databases of the life-cycle assessment software GaBi. 16 licences are available for the students in the new micro computer classroom, and seven licences are available for the postgraduate students. In the micro computer classroom, there is also an AutoCad based HVAC engineering software CADS which is utilised in the assignments on the courses related to HVAC Engineering for buildings. The acquisition of energy simulation software is also being considered, and it would be utilised in the teaching of Sustainable Community.

Laboratory has FTIR, O<sub>2</sub>, CO, CO<sub>2</sub>, NO<sub>x</sub>, and SO<sub>2</sub> analysers for gaseous emission measurements. For the determination of the caloric value of fuel, the laboratory has a new heating value analyser. For environmental analysis and field sampling, the laboratory has different sensors and probes for the measurement of particulates. Laboratory has also a full scale air-conditioning equipment (HVAC laboratory) which can be utilised for research and/or teaching purposes. For the evaluation of environmental effects, ICA software is available, both for teaching and research.

### Laboratory of Green Chemistry

Laboratory has most of the required core infrastructures for environmental research, including GC-MS and GC-FID, FTIR, CE, BET, IC, TOC analyser, UV/VIS spectrophotometer, ICP-AES, AFM, SEM, three ion mobility spectrometers and two potentiostats/galvanostats. For environmental analysis and field sampling, the laboratory has different sensors and probes. Laboratory has also laboratory/pilot scale equipment which can be utilised for research and/or teaching purposes.

The students of the Degree Programmes in Environmental Technology study also on the courses of other degree programmes. During their studies, they utilise the laboratories of energy technology, chemistry, electrical engineering, and information technology, as well as mechanical engineering. Students perform the laboratory works under the supervision of trained personnel. Supervisors can be other students that are employed by the Laboratory. At the start of their first laboratory course, the students complete an orientation that focuses especially on safe working practices in a laboratory environment. Prior to the first laboratory work, the students are required to sign a form stating that they have received guidance on work safety, and that they have familiarised themselves with first aid instructions.

## **6. Quality Management**

The key aim in the quality management and development at Lappeenranta University of Technology is to incorporate quality management into the normal activity of the university, with the underlying idea of continuous improvement. The university's quality management system covers the entire range of education provided by the university (undergraduate education, postgraduate education, continuing education and Open University education), research, societal and regional interaction, and support services.

LUT was audited in 2009 by the Finnish Higher Education Evaluation Council FINHEEC (valid until 5 March 2015; abstract of the audit in Appendix C9). The objective of the FINHEEC audit is to ensure that the higher education institution has a quality assurance (QA) system that supports continuous development of activity. The audit also ensures that a higher education institution operates in accordance with its objectives and the activity is internationally reliable.

### **6.1 Quality assurance and further development**

#### **Quality assurance at LUT**

The university's quality management system is described in the university quality manual<sup>2</sup> (Appendix C10) and the subordinate manuals of organisational units (e.g. support services). These quality manuals include also process descriptions and procedures for key processes. The university's quality management documents and other related material are available on the LUT intranet.

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<sup>2</sup> [www.lut.fi/en](http://www.lut.fi/en) --> Introduction --> Quality Management



The main quality manual depicts the university's quality policies and goals, key resources, the university's management practices, the university's key processes and their quality management, and practices related to the assessment, measurement and development of activities. LUT Quality Manual lays a foundation for describing the entire quality management system of the university and gives both internal and external stakeholders a comprehensive picture of the quality management of the university's different activities. The LUT Quality Manual depicts these activities and practices that apply to and obligate the entire university community.

The university has set quality targets for academic education, which have been derived from the university strategy. The following quality targets apply to education.

1. Competitiveness and internationality: LUT will be known for the best Finnish university education in technology and business, and will be a sought-after partner in cooperation at an international level.
2. High quality of degrees: International academic expertise as a result of education, which consists of a) specialist skills in one's own field, and b) transferable skills.
3. Satisfaction with studies at LUT: the students of the university and employers of graduates are satisfied with the content and implementation of the education; the teaching staff is satisfied with the tools, facilities and support for educational purposes.
4. The possibilities for lifelong learning are numerous and flexible, and the training meets the needs of target groups.

The university has also published LUT Teacher's Quality Manual (Appendix C5) in order to guide teachers to good teaching, as well as Quality Guide for Studying and Learning in LUT to strengthen the students' role in the quality of education<sup>3</sup> (Appendix C11).

One of the vice-rectors is in charge of education at the university. He/she manages the educational affairs and development of education of the university in cooperation with the heads of degree programmes and steering and development committee for teaching. The vice-rector and the Heads of degree programmes have regular meetings, where they evaluate and discuss about procedures concerning education and needs for development. The steering and development committee for teaching, in an advisory capacity, aids the vice-rector in decision making. The committee, headed by the vice-rector, coordinates and promotes the development of LUT education, and prepares the application procedure for the quality bonus for teaching and prepares the allocation decision for rector.

### **Quality assurance of the Programmes**

In each degree programme there is an advisory steering committee for the degree programme. It supports the head of the degree programme in producing, assessing and developing the degree programme. The development meetings of the Degree Programmes in Environmental Technology are held once a month. In the meetings, issues related to the administration and development of the degree programmes are handled. In addition to the personnel, four student

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<sup>3</sup>[http://www.lut.fi/en/lut/introduction/qualitymanagement/qualitymanual/Documents/Opettajain\\_Laatuopas\\_B5\\_Eng\\_www.pdf](http://www.lut.fi/en/lut/introduction/qualitymanagement/qualitymanual/Documents/Opettajain_Laatuopas_B5_Eng_www.pdf)

representatives (three students + student adviser) participate in the meetings. The Statement of Students (Appendix ENV17) was handled in this meeting on November 2011.

In autumn 2008, the internal auditing focused on the quality management system of research activities in the Faculty of Technology. The report stated that the description of quality management system had supported the faculty's management in developing the faculty. The faculty's personnel were well disposed towards auditing and development suggestions. According to the report, good practices were e.g. co-operation with the working life in research activities. The research projects presented in the auditing interview are documented carefully and appropriately. Internal audits are carried out systematically in every two years. Last year, the internal auditing focused on the Personnel Services and Administration, and this year on the Financial Services of the University.

Every spring, the Student's Union of LUT nominates the lecturer of the year and course module of the year. In 2005, the nomination of the lecturer of the year was given to Professor Lassi Linnanen.

### **Further development of the degree programme**

The key areas in terms of developing the quality of education at LUT are the following:

- development projects for teaching,
- LUT's internal quality bonus for education,
- a pay system with incentives for high-standard education and its development,
- pedagogical and other continuing education for the teaching staff,
- support services for teaching, and
- a system for the recognition of teaching qualifications.

LUT is actively involved in a number of different national and international development projects for teaching. The vice-rector in charge of education decides on development projects which LUT engages in and starts to promote.

The university grants quality bonuses for the development of education for a year at a time. The quality bonus is a reward for development measures taken and an incentive for the further development of education and teaching. The steering and development group for education makes the preparations for the application procedure and the decision to grant a quality bonus, and the rector appoints the recipients of the bonus.

The pay system provides an incentive for teachers to develop their teaching and pedagogical skills. The job classification of the teaching staff is based on scientific qualifications and their development, the development of teaching skills and the variety of teaching duties, and responsibility for one's field of science and its development (pay system guidelines on the intranet).

The university annually offers its teaching staff a study module in university pedagogy worth 25 ECTS credits. The teaching staff is also offered other training that supports their teaching and its

development, such as training in the use of information and communication technology in instruction. The training is coordinated by Personnel Services.

The support services for education allow teachers to focus on actual teaching and study guidance. The support services provide administrative services related to instruction, as well as technological support e.g. in setting up web-based instruction and educational technology. The responsibility for these support services is shared by Student Services and Information Services and Technology, which operate within the context of University Services, and by faculty support services.

Blackboard, a web-based learning environment, is in use on nearly all courses of Environmental Technology. During 2012, Blackboard will be replaced in the whole university by Moodle. Information Services and Technology will be responsible for the implementation of the new learning environment and training of the personnel.

The recognition of teaching qualifications and the adoption of teaching portfolios in the appointment of teaching personnel support the development of teaching. For teaching positions, the university recruits professionals with not only strong scientific expertise in the field in question, but with pedagogical skills, as well. To this end, applicants for teaching positions must also submit a teaching portfolio or another report on their teaching qualifications. Instructions for compiling a teaching portfolio are available on the intranet <sup>4</sup>. In addition, the appointment of professors requires a trial lecture from the applicant. The faculty in question supplies the applicant with instructions regarding the trial lecture. Instructions are also available from the university registrar's office.

The specification of the learning outcomes of the Bachelor's and Master's degree in Environmental Technology started the development of the degree programme. The degrees were renewed for the academic year 2011 - 2012. The degrees now contain a larger variety of courses from the other degree programmes, thus supporting the learning outcomes defined for the graduates and the interdisciplinarity of the degree. The experts in Environmental Technology need knowledge from various fields, and therefore, the collaboration with the other degree programmes is especially important.

Also the minor subjects were renewed for the academic year 2011 - 2012. They are based on three central fields: energy technology, chemistry, and system thinking (minor subjects in Energy Technology, Green Chemistry, and Sustainable Business Management). In addition to these, the Department of Environmental Technology produces the minor subjects in HVAC Engineering and Sustainable Community in collaboration with the degree programmes in Energy Technology and Electrical Engineering.

Historically thinking, the Environmental Technology at LUT has been built on the energy technological knowledge, and therefore, the co-operation with the Department of Energy Technology is on a very good level. Through the research and teaching of green chemistry started co-operation with the Department of Chemical Technology enables the systematic development of another competence field. The next phase will be the development of know-how related to

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<sup>4</sup> LUTnet → Tietopankki → Henkilöstö → Virantäyttö → Opetuksen meritointijärjestelmä

system thinking and technical and economic systems. On this competence field, co-operation is possible and necessary at least with the Degree Programmes in Mathematics and Physics, Industrial Management, and Information Technology, as well as with the School of Business.

For the academic year 2011-2012, a new course on Sustainable Innovation (5 ECTS cr) was established. The course aims to familiarise the students with the concepts, methods and processes of sustainable innovation, especially practice based innovation. Participatory working methods are used both to motivate the student and harness his/her knowledge in the problem solving processes. The course consists of lectures, workshops, project work, and seminar presentations. The course takes a multicultural and multidisciplinary approach and is based on real life sustainability challenges to which we seek a holistic solution. The course combines many of the laboratory's research areas and viewpoints into one package and supports the overarching research theme of system transition and innovation studies, therefore falling neatly in line with the degree programme.

The course in question is one of the laboratory's pilot courses that aim to develop the quality of the Master's degree programme. It was launched first time in October 2011, and the course will continue until the end of the academic year 2011-2012 (i.e. May 2012). The course will be integrated to the Master's Degree Programme in Environmental Technology in the upcoming academic year 2012-2013. It will be obligatory in the minor Sustainable Business Management in the Master's Degree Programme, replacing the course BH60A1101 Environmental Technology Project Work. A similar pilot course process was used to develop the course Climate Change into an annual course that is obligatory to the students of the Bachelor's Degree in Environmental Technology.

The aim of the Department of Environmental Technology is to increase the collaboration between the Degree Programmes in Environmental Technology and Chemical Technology and increase the amount of laboratory assignments in the Degree Programmes (B.Sc. and M.Sc.) in Environmental Technology. The contents of the laboratory assignments will also be renewed, with the aim that they would better correspond to the specified learning objectives of the Degree Programmes. The laboratory assignments support also the studies in Green Chemistry, which from the beginning of the academic year 2011-2012 are compulsory in the degree (B.Sc. and M.Sc.) in Environmental Technology.

## **6.2 Instruments, methods and data**

During their studies, students fill in several questionnaires with which they can give feedback and tell their opinions concerning the studies and conditions in the university. At the beginning of the studies, freshmen are asked to fill in a questionnaire concerning the progress of studies and tutoring of freshmen. A feedback questionnaire to students and peer tutors helps to evaluate whether the start of studies and initial study guidance has been successful. The feedback survey is carried out annually by the Student Affairs Office. The feedback is discussed with the peer tutors and personnel in charge of study guidance. The feedback combined with practical experiences will be used to develop study guidance for new students and tutor training.

The Student Union also compiles student feedback regularly every other year. This questionnaire mainly concentrates on the functionality of member services but also on the well being of the students.

### Monitoring of credits

A study plan is an important tool to evaluate the progress of studies of an individual student. All LUT students prepare a study plan (HOPS) at the beginning of their studies. All individual study plans are evaluated and confirmed in accordance with faculty or department procedures. The students of Environmental Technology compile their first HOPS on the course Introduction to Studies of Environmental Technology. All individual study plans are evaluated by the study coordinator, and the teacher advisers discuss the study selections with the students. The students of Environmental Technology file their plans also when selecting their minor subjects (in the spring of the 1<sup>st</sup> and 3<sup>rd</sup> year). The study coordinator checks then the progress of the studies, and the head of the degree programme approves the minor subject selection.

The Degree Programmes are designed and composed so that the completion of degrees is guaranteed within the standard periods of study (3 + 2 years). Model HOPS for B.Sc. and M.Sc. degrees are included in Appendix ENV12.

The progress of studies and the accumulation of credits is monitored by the Student Affairs Office. The compiled reports are sent to the heads of the degree programmes and the heads of study affairs twice a year, thus, the accumulation of the credits is evaluated every semester. The accumulation of the credits is followed during the first and the second year of study. The follow-up was started with the first year students on the autumn semester in 2010. In the academic year, the first year students of Environmental Technology gathered 54 ECTS credits on average.

**Table 10.** The progress of studies and the accumulation of credits of first year B.Sc. students (academic year 2010-2011)

<i>Start year</i>	<i>B.Sc.1</i>	<i>Weighted average</i>
2010	54 ECTS cr	2,68

The accumulation of ECTS credits is controlled individually for each module. Credit accumulation is a key method of performance assessment. Statistics on ECTS credits accumulated are compiled annually for each faculty, and the number of completed credits is one of the grounds for resource allocation to departments.

### Modules Development

Student feedback for modules is collected for all of the university's modules in accordance with a university-wide procedure. Teachers together with the feedback system administrators are responsible for collecting student feedback. The electronic feedback questionnaire applies the same assessment criteria to all modules. The objects of assessment include the expediency of the module and a general impression of the module.

The following questions deal with the fulfilment of these criteria:

1. The applied working methods were appropriate for the purposes of the course and they supported my learning during the course. Answers on a scale of 1-5 (5 = I agree completely, 1 = I disagree completely).
2. Overall evaluation of the course (scale of 1-5).
3. Open feedback on the course.

Table 11 shows the averages of the questions common to all courses (questions 1 and 2) organised by the Degree Programme in Environmental Technology. The averages have stayed very uniform.

**Table 11.** Course feedback reports (Academic years: autumn/spring)

	2010- 2011	2009- 2010	2008- 2009	2007- 2008	2006- 2007	Spring 2006
Question 1	3,6/3,4	3,7/3,7	3,6/3,5	3,4/3,3	3,5/3,3	3,6
Question 2	3,6/3,6	3,9/3,6	3,5/3,5	3,4/3,3	3,6/3,6	3,7

Question 1: Overall evaluation of the course (On a scale of 1 to 5).

Question 2: The applied working methods were appropriate for the purposes of the course and they supported my learning during the course (On a scale of 1 to 5).

The feedback system also allows teachers to add questions to the questionnaire, thus collecting feedback for their own purposes. This, combined with the open feedback field in all of the questionnaires, supports the teachers' own professional development. Students are motivated to give feedback by preparing course-specific questions in addition to the general ones and by sending students a response to the feedback.

Student feedback is gathered from every course of the Department of Environmental Technology. Every teachers designs the questions with the course assistants. The anonymous questionnaires are delivered to the students by the assistants, and they also handle the feedback together with the teacher in charge of the course and other teachers. Teachers send the students always a response to the feedback. In addition to this, the educational coordinator compiles a summary report of the student feedback on the degree programme's courses twice a year.

In the beginning of the report, there is a summary table containing the averages of the general questions (question 1 and 2 above). The feedback of each course is handled separately. The report presents the positive and negative sides, other comments and students' development ideas. In addition to these, the development measures planned by the teachers for the next academic year are marked to the summary of each course. Also some data of the previous year is presented, like the amount of respondents, averages of the general questions, and possibly the averages of other questions. The trends are represented by green (average has risen) and red (average has declined) arrows. Also the teachers' responses to the feedback are attached to the report.

The reports are discussed in the development meeting of the degree programme, in which also student representatives participate. Additionally, the report is available on the bulletin board of Environmental Technology. Appendix ENV13 contains examples on the course questionnaires on the courses of Environmental Technology and the summaries of the course feedbacks.

The feedback for each course is recapitulated by the system administrator every semester with a general reporting form. The reports are forwarded to the heads of degree programme and to the quality manager, who then submits the reports to the vice-rector in charge of education before the performance and development discussions between the university management and faculties. The units' performance target negotiations deal with student feedback, and if the average assessment for a course is very low (e.g. 2.5 or lower), the vice-rector in charge of education shall intervene and discuss about the topic with the head of the degree programme.

The university pedagogical studies offered by LUT and the Teacher's Quality Manual provide the teachers with methods to develop their courses (see 5.2). In addition to this, the educational coordinator operates as a pedagogical support person for the teaching staff of the Department of Environmental Technology.

### **Evaluation of the success of the degree programme**

The university management, faculty management, heads of departments and heads of degree programmes shall ensure that the education provided by the university is efficient and of a high standard. Success of the degree programme is evaluated in many ways, which are described in the following. Alumni activities and employment of graduates are evaluated systematically.

#### Competence of graduates

Skills and knowledge accumulated by students during the entire education process are demonstrated in a final thesis, which is prepared by all Bachelor's and Master's level students. Skills in the student's native language are demonstrated in a maturity test at the end of the Bachelor's degree studies.

The distribution of the grades of B.Sc. and M.Sc. theses in Environmental Technology is demonstrated in Tables 12, 13, and 14. During 2008-2010, the most common grade for the final thesis has been 4. The students who had started to study in a University before autumn 2005 had a right to continue studies in the Master's degree programmes without a B.Sc. degree and had to graduate not later than in July 2010. This might be the main reason for some low grades in years 2009 and 2010.

**Table 12.** Results/Grades of the Bachelor's Thesis

Grade of the B.Sc. Thesis	1	2	3	4	5
no / 2010	-	-	4	9	4
no/ 2009	1	-	-	6	1
no / 2008	-	-	-	-	1

**Table 13.** Results/Grades of the Master's Thesis

Grade of the M.Sc. Thesis	1	2	3	4	5
no / 2010	1	10	14	25	5
no/ 2009	-	4	17	18	5
no / 2008	-	-	9	14	3

**Table 14.** Final grade (weighted mean) distribution of the graduates / year 2010

Degree programme	1-1,99	2 – 2,99	3 – 3,99	4 - 5
Bachelor	-	11	6	-
Master	5	34	15	1
Total	5	45	21	1

#### Graduates of a degree programme

Information on the number of graduates (table 15) and the time in which their degree was completed (table 16) is compiled into statistics by the LUT Student Services. The employment of graduates a year after graduation to M.Sc. is generated by Statistics Finland (table 17).

Before 2005, the Finnish system had no B.Sc. degree in universities of technology, and the students completed directly the M.Sc. degree. The first B.Sc. graduated in 2008. The number of graduates from the M.Sc. degree programme has been rather stable during the last five years, except in 2010. The reason for this was that Finland ratified the Council of Europe and UNESCO Convention on the Recognition of Qualifications concerning higher education in the European Region (Bologna Process) in 2005. The students who had started to study in a university before autumn 2005 had a right to continue studies in the Master's degree programmes without a B.Sc. degree according to the old syllabus until July 2010.

In the table 15, the numbers of M.Sc. graduates also include the graduates from International Master's degree programmes in years 2008-2010.

**Table 15.** Graduates per degree programme during 2006-2010

Degree prog.	2010	2009	2008	2007	2006
Bachelor	17	8	1	-	-
Master	55 <sup>3)</sup>	44 <sup>2)</sup>	26 <sup>1)</sup>	29	21
Total	72	52	27	29	21

1) 5 graduates from the International Master's Degree Programme in Bioenergy Technology are included.

2) 17 graduates from the International Master's Degree Programme in Bioenergy Technology are included.

3) 14 graduates from the International Master's Degree Programme in Bioenergy Technology are included.

Since the Finnish system is new, there is no reliable data available for the time being to separately evaluate the B.Sc. and M.Sc. degrees. Median times of study for B.Sc. and M.Sc. together are listed in table 16.



**Table 16.** Duration of the studies - from the beginning of the B.Sc. programme to the graduation from the M.Sc. programme (in years)

	2010	2009	2008	2007	2006
Time of study, median	4,63	3,58	4,74	5,21	4,97

Employability of the Graduates

A year after the graduation to M.Sc., students from the Degree Programme in Environmental Technology have placed well in the labour market, table 17. Approximately 60–80 % of the graduates have jobs. There are no covering statistics available on the B.Sc. The Bachelor's degree is also still rather unknown in the Finnish industry, which has its influence on the employment opportunities and demand for Bachelors of Science.

Graduates are employed by a wide range of organisations. They are employed in different branches and industries. This result supports the conclusion that graduates can have an influence on their career path. Companies employing M.Sc. (Tech.) graduating from the Degree Programme in Environmental Technology are found for instance in energy production field, forest industry, minerals and metals processing companies, municipal waste management companies, design and consultancy companies and research centres (more details in Appendix ENV14). Many organisations have also employed graduates year after year. Among employers are presented large, as well as small enterprises and consultancies.

On-the-job training periods have an effect and steer the graduate's career choices. In addition, career prospects are typically discussed during the final Master's degree courses, and students have the possibility to use the LUT Career Services. Quite often the first workplace of the graduate is the instance which commissioned the Master's thesis and employed the student during the thesis project.

**Tables 17.** Alumni activity a year after graduation with the M.Sc. degree.

	2009	2008	2007
Employed	61,5 %	79,3 %	76,2 %
Unemployed	7,7 %	0 %	9,5 %
Employed with part-time studies	15,4 %	20,7 %	9,5 %
Full-time studies	11,5 %	0 %	0 %
Other or unknown	3,8 %	0 %	4,8 %

Student mobility

The frequency of student mobility (table 18) is monitored annually by International Services. Student exchange statistics are compiled on the university intranet and published in the university's final accounts documents. Studying abroad is not obligatory, but the university encourages students to do so. LUT takes part in a number of international student exchange programmes (such as Erasmus and Nordtek) and has many bilateral student exchange agreements.

**Table 18.** Number of foreign students in the degree programmes

		2010	2009	2008	2007
Trainees	Incoming <sup>1)</sup>	1	1	1	1
	Outgoing <sup>2)</sup>	1	4	3	2
Exchange students	Incoming	6	17 <sup>3)</sup>	8 <sup>3)</sup>	8 <sup>3)</sup>
	Outgoing <sup>4)</sup>	13	4	14	5
Foreign students in the degree programmes		11 <sup>5)</sup>	18 <sup>6)</sup>	22 <sup>6)</sup>	8 <sup>6)</sup>

- 1) Countries: Vietnam, Japan, Thailand, Russia
- 2) Countries: Germany, Portugal, Ghana, The Netherlands, Serbia&Montenegro, Tajikistan, Latvia, India, Argentina
- 3) These figures include all of the LUT Energy incoming/outgoing students.
- 4) Most common countries for Outgoing exchange students: Germany, Italy, Spain, China, Sweden, Denmark, Australia.
- 5) Master's Degree Programme in Energy Technology; Major in Environmental Energy Technology
- 6) Master's Degree Programme in Bioenergy Technology

Foreign students in the degree programmes are students in the international M.Sc. degree programme, which is not included in the accreditation process. The number of incoming exchange students up to 2009 includes the students of LUT Energy (Energy Technology, Environmental Technology and Electrical Engineering).

#### Dropout rates

The Head of the Degree Programme receives data on the individual dropouts and dropout rates. Dropout rates are not alarming in the Degree Programmes in Environmental Technology.

**Table 19.** Number of students per course and degree programme / dropout rate

Academic year	1	2	3	B.Sc. N	4	5	M.Sc. N	Total
10/11	21	17	17	57	25	27	28	192
09/10	18	19	17	40	32	25	70	185
08/09	22	18	22	19	14	42	55	192
07/08	20	24	26	1	52	33	52	208
06/07	18	26	36	0	38	39	36	193

As described above in section 5.1, in Finland the time to complete studies has been very flexible. The first students who have had a time limit for their studies have enrolled in 2005. This phenomenon can be seen in the tables, as there are very many "N" year students, meaning students who have been studying longer than three of five years. At this moment, the Bachelor's degree takes theoretically three years, but students who have not completed their studies in six semesters, are called "Bachelor N students". Only after graduating in the Bachelor's degree the student is counted as a Master's level student. This phenomenon makes the statistics look as if we had very many Bachelor's degree students and not so many Master's degree students. This is not true, since there is no formal rule that a student should graduate in the Bachelor's degree before she/he could start Master's degree studies. At the moment, many students graduate in the Bachelor's degree only shortly before graduating in the Master's degree. This problem is under development in the University level.

#### Staff-student ratio

The table below presents the teaching staff ratios for the degrees organised by the Institute of Energy Technology (LUT Energy). The teaching staff comprises professors, associate professors,

post-doctoral researchers, and doctoral students. The student-staff ratio has been relatively stable during the past five years.

**Table 20.** Students per teacher per year

Year	2010	2009	2008	2007	2006	2005
Student-staff ratio	4.4	5.3	5.4	5.3	5.1	5.8

### Satisfaction in the education

Satisfaction in LUT education is surveyed among LUT graduates at the time of graduation and after five years in the world of work, and among their employers.

Graduate feedback is collected from all LUT students at the time of their graduation (table 21) – both Finnish and international students. The feedback is gathered together annually in February-March, and the results are reported on the university level on the intranet and divided and delivered into the degree programmes. Quality manager is responsible for this process together with Student Services.

**Table 21.** Feedback from graduated Masters of Science in 2006 -2010 (Scale 1-5)

Satisfaction of the graduate on...	2010	2009	2008	2007	2006
Course content	3,8	3,7	3,5	3,4	3,5
Professional abilities	3,7	3,4	3,7	3,4	3,5
Transferable skills	3,4	3,2	3,3	3,3	3,3
Knowledge on my own field	3,6	3,4	3,7	3,3	3,4
The ability to apply theoretical knowledge into practice	3,6	3,3	3,7	3,2	3,4
Study guidance and atmosphere in the department	3,8	3,7	3,6	3,3	3,4
Guidance of the Master's Thesis	3,9	3,7	3,3	3,6	3,5

Moreover, feedback is collected annually from LUT graduates with a Master's degree (table 22) and five years of experience in the world of work. The target group of the survey were the Masters of Science (Technology) graduated from Lappeenranta University of Technology in 2005.

The Degree Programme in Environmental Technology was first established in 2001, and for this reason, there were not very many graduates in 2005. Only six graduates answered the questionnaire. The survey is conducted by LUT Career Services as a part of a national career follow-up.

**Table 22.** Alumni activity and satisfaction five years after graduation

	2010	2005
Status in the labour market/Employed, % <sup>1)</sup>	50	50
The level of job requirement corresponds well to the academic education, %	67	67
Made use of skills learned during university studies constantly (constantly + to some degree), %	100	100
At least satisfied with the university degree in relation to career, %	67	

<sup>1)</sup> Unemployed 2010: 0% / 2005: 0%, Family leave 2010: 50% / 2005: 33%, Other 2010: 0% / 2005: 17%

The survey “Satisfaction in LUT education after nine to fifteen years of experience in the world of work” was first carried out in 2011 (table 23). The table includes the most important skills in the working life, and how well the degree programme has corresponded with the needs of the world of work in the opinion of the respondents. In general, 80 % of the respondents are satisfied with the M.Sc. degree. The most significant lack in the degree is the lack of transferable skills. The respondents have graduated from the Degree Programme in Energy Technology, and majored in Environmental Engineering in Energy Production. Environmental Technology was not a degree programme then.

**Table 23.** The meaning of some skills in the current work (9-15 years after the graduation) and the competences the degree programme provided (on the scale of 1 to 6).

	Current work	Competences provided by the degree programme
Problem solving skills	5,4	4,1
Ability for analytic, systematic thinking	5,3	4,3
Ability for continuous learning	5,3	4,5
Organising and coordination skills	5,3	3,1
Teamwork skills and further social skills	5,2	3,8
Negotiation skills	5,2	2,8
Communication skills in the mother tongue	5,1	4,0
Presentation skills	5,1	3,3
Data acquisition skills	5,0	4,1

A new procedure concerning employer feedback has been introduced in the beginning of 2010: University follows up on the satisfaction of employers/supervisors in the outcome of thesis projects and in the skills of the students as they transition into the world of work (table 24). This questionnaire is sent to the employers, and the results are annually reported by the quality manager.

**Table 24.** Feedback by the commissioner of the Master's Thesis

	2010
Basic knowledge and skills on scale 1-7	5,2
Project management and collaboration competences on scale 1-7	5,3
Communication and presentation skills on scale 1-7	4,9
Overall satisfaction on scale 4-10	8,1

Moreover, International Services collects feedback on student and support services from incoming exchange students at the end of their stay and analyses it systematically. LUT students leaving for student exchange write a report upon their return. The report is then read by International Services and published on the university web site. These follow-up practices are described in further detail in the operations manual of International and Career Services.

## 7. Documentation and Transparency

### 7.1 Relevant regulations

To receive the Degree of Bachelor of Science from Lappeenranta University of Technology, at least 90 ECTS credits including the Bachelor's thesis, have to be passed in this university (total degree 180 ECTS credits). For the degree of Master of Science in Technology, the minimum is 70 ECTS credits including the Master's thesis. The degrees and the Finnish universities that can award these degrees are defined in the Universities Act (558/2009) (Appendix C1).

The head of the degree programme makes the decision of the courses included in the degree of an individual student. Courses that are included in the Bachelor's degree cannot be included in the Master's degree.

The detailed regulations of the degree are given in the University Regulations on Education and the Completion of Studies (Appendix C4). National, Master regulations on Master's level studies for universities are given in the Government Decree on University Degrees (National degree regulations 794/2004) (Appendix C2).

### 7.2 Diploma Supplement

At LUT a diploma supplement (DS) is formulated by following the directions of the National Board of Education and always attached to the B.Sc. and M.Sc. degree certificates (the actual degree certificate are in Finnish). The DS is in English and meant for international use. Diploma supplement is attached to the degree certificate along with the transcript of records. It includes the information about the University, modules included into degree, as well as the grades of the modules and the structure of the degree (see Appendix C4, University regulations on Education and the Completion of Studies, § 22). Both major and minor subjects are given an overall grade. The overall grade is the average of all the LUT courses completed by the student in the subject in question, weighted according to the workload of each course (see instructions of calculation in

Appendix C12). More detailed information is available from the attached models of LUT diploma supplements (Appendices ENV15 and ENV16, B.Sc. and M.Sc. supplements separately).

## APPENDICES:

Appendices C1-C12, ENV7-ENV16 and ENV18 are not included in this publication

## Common:

- C1. Universities Act 558/2009
- C2. Government Decree on University Degrees 794/2004
- C3. LUT Strategy 2013
- C4. University Regulations on Education and the Completion of Studies
- C5. LUT Teacher's Quality Manual
- C6. Evaluation form of Master's Thesis
- C7. Final Thesis Introduction
- C8. Regulations of Lappeenranta University of Technology
- C9. Audit of the Finnish Higher Education Evaluation Council, Abstract 2009, Audit Certificate HEEC
- C10. LUT Quality Manual
- C11. Quality Guide for Studying and Learning in LUT
- C12. The calculation of the Final Grade

## Environmental Technology:

- ENV1. Study Guide / Module Handbook (incl. also courses in Programme in Environmental Technology offered by other Degree Programmes)
- ENV2. Objectives Matrix Models (incl. Learning outcomes of the degree programmes/ASIIN's SSC criteria)
- ENV3. Model Curricular Analysis
- ENV4. Workload calculations
- ENV5. Course evaluation and teaching methods
- ENV6. Independent Study times
- ENV7. Bachelor's Thesis Instructions
- ENV8. Evaluation Matrix for the B.Sc. Thesis
- ENV9. Master's Thesis Instructions
- ENV10. Staff Handbook
- ENV11. University Collaboration
- ENV12. Examples of study plans (B.Sc. and M.Sc.)
- ENV13. Course Feedback form (examples) and Summary of feedback (examples)
- ENV14. Data on outcomes and the statement of the head of the degree programmes
- ENV15. The Certificate including Diploma Supplement and Transcript of Records (Bachelor)
- ENV16. The Certificate including Diploma Supplement and Transcript of Records (Master)
- ENV17. Statement of Students
- ENV18. Theses (B.Sc. and M.Sc. years 2010-2011)