# Energy and Environmental Sciences

**Faculty Mathematics and Natural Sciences, University of Groningen**

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# CONTENTS



This report was finalised on 5 November 2015

# Report on the master's programme Energy and Environmental Sciences of University of Groningen

This report takes the NVAO's Assessment Framework for Limited Programme Assessments as a starting point.

## Administrative data regarding the programme

**Master's programme Energy and Environmental Sciences**

| | |
|---|---|
| Name of the programme: | Energy and Environmental Sciences |
| CROHO number: | 60608 |
| Level of the programme: | master's |
| Orientation of the programme: | academic |
| Number of credits: | 120 EC |
| Specializations or tracks: | Specialization System Studies<br>Specialization Experimental Studies |
| Location(s): | Groningen |
| Mode(s) of study: | full time |
| Expiration of accreditation: | 30-06-2016 |

## Administrative data regarding the institution

| | |
|---|---|
| Name of the institution: | University of Groningen |
| Status of the institution: | publicly funded institution |
| Result institutional quality assurance assessment: | postive, d.d. 30 June 2014 |

## Composition of the assessment panel

The panel that assessed the master's programme Energy and Environmental Sciences consisted of:

- Prof. W.A. Hafkamp, chair, professor in Environmental Sciences, Erasmus University Rotterdam;
- Prof. I. Janssens, research professor at the University of Antwerp, research group of Plant and Vegetation Ecology;
- Dr. M.P.J. Pulles, retired senior project manager and scientist at TNO;
- Mrs. L.H.A. van der Sanden MSc, graduated student of Social and Political Sciences of the Environment, Radboud University Nijmegen (student member).

The panel was supported by dr. M.J.V. Van Bogaert, who acted as secretary.

Appendix 1 contains the curricula vitae of the members of the panel.

## Reasons and context

The Energy and Environmental Sciences master's programme at the University of Groningen was assessed in September 2013 by an assessment panel chaired by professor Hafkamp. The panel finalised its report in December 2013. One standard according to the NVAO framework was assessed 'unsatisfactory', namely standard 2. The other standards were assessed 'satisfactory'.

At the time of the site visit by the panel, the EES programme had just completed the revision of the curriculum. According to the panel, this revision already addressed a number of the concerns it had. However, the implementation of the revision was too recent for the panel to be able to judge if the proposed changes would adequately solve all concerns as given in the 2013 report. Furthermore, some concerns the panel had were not covered in the proposed revision. In the period since the 2013 site visit the EES programme has continued with the implementation of the new curriculum, intertwining both the original redesign and additional measures as written down in the improvement plan. In its assessment of the recovery period, the panel refrains to the assessment of the topics that were described in the improvement plan of 7 April 2014.

The NVAO has decided to prolong the accreditation of the Energy and Environmental Sciences programme with two years (until 30-06-2016) and to grant a recovery period. The proposed changes of the improvement plan that were accepted by the NVAO not only concern Standard 2, but also Standards 1 and 3 and consist of the following thirteen topics:

A. Intended learning outcomes (S1);
B. Basic teaching qualification (staff, S2);
C. Strengthening of Systems Group (staff, S2);
D. Intake of students (student numbers, S2);
E. Methodology course (courses, S2);
F. Social Sciences content of the EES curriculum (courses, S2);
G. Content of lectures (courses, S2);
H. Study efficiency (research thesis, S2);
I. Tutor system, students' choice of research topics (research thesis, S2);
J. External location master thesis (research thesis, S2);
K. Involvement of students in research groups (strengthen research education, S2);
L. Tutor system, students' choice of courses (strengthening research education, S2);
M. Assessment protocols (assessment, S3).

The University of Groningen should apply for reaccreditation for the programme by 31 December 2015. This application should include an assessment report by a panel of experts. The panel includes the effects of changes that were proposed in the recovery plan. All members of the panel that were involved in this assessment were also part of the original panel that recommended the recovery period.

The University of Groningen has written a report on the implementation of the improvement plan that accurately reflects the situation after the implementation of all measures taken.

## Working method of the assessment panel

*Preparation*
In order to prepare for the additional assessment, the management of the master's programme provided a report describing the current state of affairs. After the secretary checked the report and other documentation for completeness of information, it was forwarded to the members of the assessment panel.

*Site visit and report*
Based on the report on the implementation of the improvement plan and additional documentation, the assessment panel Energy and Environmental Sciences decided that a site visit to the Faculty Mathematics and Natural Sciences of University of Groningen was not required. Instead, the committee met in Utrecht on 8 October 2015 to discuss its findings based on the material provided by the programme. The assessment panel focussed on the topics that were part of the improvement plan, primarily standard 2 and small parts of standard 1 and standard 3. Based on the panel's findings the secretary drafted a report that was commented upon by the panel members. Subsequently the programme was given the opportunity to check for factual irregularities. Comments by the programme were discussed between secretary and chair and – when necessary – with other panel members. After this the report was finalized.

*Decision rules*
In accordance with the NVAO's Assessment Framework for Limited Programme Assessments (as of 22 November 2011), the panel used the following definitions for the assessment of both the standards and the programme as a whole.

**Generic quality**
The quality that, from an international point of view, can reasonably be expected from a higher education bachelor's or master's programme.

**Unsatisfactory**
The programme does not meet the current generic quality standards and shows serious shortcomings in several areas.

**Satisfactory**
The programme meets the current generic quality standards and shows an acceptable level across its entire spectrum.

**Good**
The programme systematically surpasses the current generic quality standard.

**Excellent**
The programme systematically well surpasses the current generic quality standards across its entire spectrum and is regarded as an international example.

## Summary judgement

Based on findings of the panel in 2013 and its suggestions for improvement, the master's programme Energy and Environmental Sciences (EES) implemented a number of improvements. In addition to outlining the intended learning outcomes (Standard 1) and introducing new procedures concerning the assessment of thesis work (Standard 3) a number of changes were introduced in order to repair the criticism by the panel on Standard 2.

The quantity and quality of staff was significantly increased by the hiring of a new full professor and three assistant professors. Also, most teachers now hold a university teaching qualification (UTQ). Improvements were made on the content of courses, materials used and a new course on statistics was introduced in order to strengthen the curriculum. The panel was pleased to notice that an active and functional system is in place to remediate problems.

The relation between research and education has been improved. This was partly the result of the hiring of new staff, and in addition the programme introduced measures that allow for a closer connection between research and education. Students now seem to be more part of the academic community, specifically during the research projects. The number of students enrolling lacks behind the ambition, but is adequate to run a programme like EES.

Finally, a number of measures were taken to improve supervision of students during research projects and the writing of the thesis. The panel is confident that this will lead to improved supervision and less study delays.

The panel is fully confident that the programme has implemented all proposed changes adequately, at some points even beyond adequate. For that reason, the panel assesses the programme as 'satisfactory'.

The panel assesses the standards from the Assessment framework for limited programme assessments in the following way:

| | |
|---|---|
| Standard 1: Intended Learning Outcomes | satisfactory |
| Standard 2: Teaching-learning environment | satisfactory |
| Standard 3: Assessment and achieved learning outcomes | satisfactory |
| | |
| General conclusion | satisfactory |

The chair and the secretary of the panel hereby declare that all members of the panel have studied this report and that they agree with the judgements laid down in the report. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 5 November 2015

Prof. dr. W. Hafkamp

dr. M.J.V. Van Bogaert

## Description of the standards from the Assessment framework for limited programme assessments

**Standard 1: Intended learning outcomes**
The intended learning outcomes of the programme have been concretised with regard to content, level and orientation; they meet international requirements.

**Explanation**:
As for level and orientation (bachelor's or master's; professional or academic), the intended learning outcomes fit into the Dutch qualifications framework. In addition, they tie in with the international perspective of the requirements currently set by the professional field and the discipline with regard to the contents of the programme.

### Findings and points of attention 2013

The panel verified that the intended learning outcomes were conform the demands of an academic master's level, but observed differences between the two tracks. For one track (Experimental Studies on Energy and Climate) clear learning outcomes were articulated, while for the other track (System Studies on Energy and Environment) these were rather general.

### Findings and considerations 2015

The programme changed from two separate tracks with separate learning outcomes to one programme with two specializations. The intended learning outcomes were reformulated and now are identical for both specializations and are part of the Teaching and Examination Regulations (OER).

Although the intended learning outcomes were considered to be satisfactory in 2013, the panel was pleased to learn that both specializations now have identical intended learning outcomes. This strengthens the fact that all students enrol in one programme and by graduation comply with the same learning outcomes. The current intended learning outcomes are based on the 2013 Experimental Studies on Energy and Climate track, which are considered to be clearly articulated and satisfactory.

### Conclusion

*Master's programme Energy and Environmental Sciences:* the panel assesses Standard 1 as satisfactory

**Standard 2: Teaching-learning environment**
The curriculum, staff and programme-specific services and facilities enable the incoming students to achieve the intended learning outcomes.

**Explanation**:
The contents and structure of the curriculum enable the students admitted to achieve the intended learning outcomes. The quality of the staff and of the programme-specific services and facilities is essential to that end. Curriculum, staff, services and facilities constitute a coherent teaching-learning environment for the students.

### Findings and points of attention 2013

*Staff*

Highly motivated staff from appreciated research groups was involved in the programme. However, none of the teachers had obtained a university teaching qualification (UTQ). Furthermore, there were some concerns regarding the understaffing, leading to an unacceptably high workload, specifically in the System Studies on Energy and Environment

track. This was most clearly observed in the difficulties to provide students with adequate supervision on their research project and master thesis.

*Student numbers*
The panel established that the intake was dangerously low during the years 2007 – 2010. More recently, the number of students entering the programme has increased.

*Courses*
According to the panel the content of some courses of the old curriculum was weak and did not meet the required academic level. The new curriculum dealt with this problem, but during the time of the site visit, results were not yet visible.

One course the panel was missing was one that addressed theories and research matters, in particular those of the social sciences. A methodology course was missing that served as a foundation for scientific research in the broad scope of the programme. With a strong focus on academic research, the programme provided too little practical training of skills and competences that were required in the professional field.

*Strengthening research education*
In 2013 students did not feel part of the research culture of ESRIG (Energy and Sustainability Research Institute Groningen) and it was not always clear to them how the lecturers' research fitted in with the teaching; interaction between research and education should and could be strengthened.

*Research thesis*
The panel felt that some students would benefit from a more intensive supervision process during the master thesis.

**Findings and considerations 2015**

*Staff*
In January 2015 33% of EES teaching staff had obtained their UTQ, this increased up to 93% in September 2015. New staff members enrol in a UTQ programme as will the programme coordinator.

The Faculty Board decided that a long-term solution was required regarding the high workload for staff members and created a number of tenured scientific positions. The arrival of a full professor in August 2014 was a key change, in addition a total of three tenure track positions were created and filled. One more vacant position will be filled in 2016. These staff members all participate in both research and education.

The panel is very positive on the increase of staff members with an UTQ as well as on the policy that all new staff members should obtain one. More important, the panel was pleased to notice the way the University of Groningen, the Faculty and the programme have taken up the concerns regarding the quantity of staff. The appointment of a full professor as head of IVEM as well as three tenure track assistant professors demonstrates the sincere efforts that were made to strengthen the staff, both in a quantitative and a qualitative way. The panel considers the hiring of these new and highly qualified staff members to be one of the most important measures for the improvement of the programme.

*Student numbers*
The minimum required intake of students by the Faculty Board for a master's degree is now 20 per year. The actual intake fluctuates around this number and in addition exchange students follow part of the courses. The programme is aiming for increased enrolment of both national and international students, up to 30-35 students per year.

Although the number of enrolling students still lags behind with the ambition, the panel is positive on measures that were taken. In communication towards prospective students the systems approach of the programme should be highlighted. This aspect gives the programme a distinctive feature with respect to other environmental programmes in the Netherlands.

*Courses*
The new curriculum starts with five new, compulsory course units in order to introduce students to the general theories and methodology of the EES research field, and to acquaint students with system thinking. These courses were evaluated and discussed in staff meetings and with the Programme Committee in order to further improve them. The second year these courses were part of the curriculum; they were once more evaluated and improved when required. Specific attention was given to methodology, for which a new course unit – Data Analysis and Statistical Methods – was introduced.

During the 2013 site visit the panel heard complaints on the quality of course materials, which are now improved and replaced. The panel did not consider it necessary to inspect new course materials, it is fully confident that improvements indeed were significant. It bases this confidence on the report of implementation, on the improved evaluations by students regarding the courses and its positive findings on updated course materials that were already available during the original site visit in 2013.

The panel has taken notice of the way student feedback is used to improve the quality of the programme. Not only do evaluations show that improvements have been made, they also show that the programme has an active and functional system to remediate problems. Furthermore, the panel is convinced that the appointment of new academic staff also has improved the content of the courses.

The panel is aware of the fact that the EES programme attracts students with a social sciences background as well as students with a natural sciences background. This will inevitably lead to some courses being difficult for part of the student population, while other students might consider the courses adequate or easy. Although it will be a continuous point of attention, it should not be a problem. In fact, the panel would like to specifically mention the positive impression on the Sustainability and Society course, which displays the way social and political sciences are connected with natural sciences in this programme.

The programme has strengthened its theory/methodology aspects throughout the curriculum in four existing course units. In addition, the following initiatives were taken:

- Weekly training meetings with students who prepare their first master project in order to train general research skills and methodologies used in environmental sciences;
- An Advisory Board for EES was installed, advising on skills, competences and scientific level of the programme with respect to the professional field.

Regarding methodology, the panel is positive on the overall improvements that have been made throughout the programme, which now displays a clear connection between education

and research. Students need to learn how to do research and formulate research questions. A course on statistics is useful, but only if the research methodology is done in a proper way. Thus, the committee once more emphasizes the importance of including research methodology in the programme

*Strengthening research education*
In general the communication between ESRIG staff and students has intensified and initiatives were developed for the students to feel part of the research community and know the people of that community. The following measures were taken:

- The frequency of ESRIG symposia was increased to at least twice a year;
- An introduction weekend for all new students in the first week after their arrival in order to minimize a mismatch between the goals of the programme and the expectations of students;
- Communication between staff and students was intensified to strengthen the relation between research and education;
- Tutors guide students through the process of electing individual package choices and finding supervisors for their research projects.

It seems unlikely to the panel that in the present situation students are unaware of the research their teachers are involved in. Already during the introduction weekend, staff members present their research to the students. More important, students become somewhat of a (junior) member of the research groups when doing their research project. They attend scientific meetings and are becoming part of the research community. The panel is specifically positive on the introduction of the tutor system.

*Research thesis*
Additional measures were taken in order to adequately supervise research projects. A new procedure, describing all steps to be taken before a project can start, was introduced and regulates the progress of the project. It is expected that this procedure guarantees closer supervision from ESRIG staff in case of external research projects, for example by the introduction of 'come back meetings'. Also, the aforementioned tutors were used to improve guidance of students in their choice of research topics as well as future careers.

Regular meetings were scheduled between students and staff, in order for students to be able to finish their training thesis within the assigned number of hours. Currently, over 80% of students have finished their training thesis in time.

The panel is of the opinion that in 2013 the major problem regarding supervision thesis work was due to the fact the programme was understaffed. This is remediated leading to a good basis for supervising and assessing thesis work. In addition, procedures were introduced and frequent staff meetings are held.

The panel is positive about the restrictions that were introduced on the selection of research topics. The choice of a topic should connect to the expertise that is available at the university, this is safeguarded by the requirement that the research plan should be approved prior to starting the thesis work. Supervision of students, specifically in external organisations, is improved.

Again the panel is positive on the introduction of tutors. Weekly training meetings and individual meetings provide students with structural support in addition to their thesis

supervisor. The panel expects that all measures taken will lead to improvements in the quality of thesis work.

**Conclusion**
*Master's programme Energy and Environmental Sciences:* the panel assesses Standard 2 as satisfactory

**Standard 3: Assessment and achieved learning outcomes**
The programme has an adequate assessment system in place and demonstrates that the intended learning outcomes are achieved.

**Explanation**:
The level achieved is demonstrated by interim and final tests, final projects and the performance of graduates in actual practice or in post-graduate programmes. The tests and assessments are valid, reliable and transparent to the students.

**Findings and points of attention 2013**
Written feedback on thesis assessment forms sometimes was too limited according to the panel. It had the impression that supervisors were overloaded with work, therefore the panel recommended to revise the assessment protocol in order to improve the procedures and result in a proper justification of the grades given.

**Findings and considerations 2015**
The programme has introduced a new grading system for first and second research projects. New assessment protocols have been introduced for the evaluation of research projects. The programme has introduced a detailed grading scheme for staff to use when assessing thesis work. Staff members are informed on these changes and are currently using the new protocol and forms.

In contrast to the situation in 2013 staff members now have supporting procedures when supervising students and assessing thesis work. The grading scheme that was introduced is very detailed and might lead to some discussion between supervisors, which should be used as an intervision tool. The panel advises the programme to continue the procedures started, which – in addition to the recruitment of staff members – seem to improve thesis assessment. It advises the programme to evaluate and fine-tune the grading tool (once approximately 40-50 theses are available) by having staff members blindly assess the thesis that was supervised by their colleagues.

**Conclusion**
*Master's programme Energy and Environmental Sciences:* the panel assesses Standard 3 as satisfactory

## General conclusion
The panel is impressed by the way its recommendations were taken up by the programme management, the Faculty and the university. With a positive attitude all recommendations were taken up in a proactive way. The panel considers that this deserves a compliment.

While in 2013 the panel observed an out of balance programme with a shortage of staff, now its impression is that the programme is doing well. The programme now receives a confident satisfactory assessment, with a clear prospect of even going beyond that in the near future.

**Conclusion**
The panel assesses the *master's programme Energy and Environmental Sciences* as satisfactory.

# Appendices

## Appendix 1: Curricula Vitae of the members of the assessment panel

**Prof. W.A. Hafkamp** (chair of the committee) is professor in Environmental Sciences, Erasmus University Rotterdam (1994- present). He graduated in Econometrics from Tilburg University (1977), was appointed assistant professor at the Economics Faculty of the University of Amsterdam (1977-1984), and received his PhD in economics at the Free University, (thesis: 'Triple Layer Model; An Economic-Environmental Model for The Netherlands'). He was head of the Economic-Technological Department of the Institute for Environmental Studies of the Free University Amsterdam (1984-1998) and a professor of Environmental and Nature Conservation Studies of Tilburg University, Faculty of Economics and Econometrics (1990-1995). Professor Hafkamp was Dean of the Faculty of Social Sciences of Erasmus University, where he was also involved in setting up the master of Strategic Urban Studies (2001-2005). Besides being a professor, he is a consultant and practitioner. He worked for KPMG Environmental Consulting and was a member of the Management Board of the Joint Programming Initiative Urban Europe. He was scientific director of Nicis Institute, The Hague, the Netherlands Institute for City Innovation Studies. He has over 25 years of experience in research, policy and practice, on issues ranging from transport and environment, urban development and spatial policy, environmental management in industry, waste management and safety to sustainable development. He was, and in some cases still is, member or chair of numerous councils, committees and boards.

**Prof. I. Janssens** is research professor at the University of Antwerp (since 2003), affiliated to the research group of Plant and Vegetation Ecology. He studied Analytical Chemistry (Bachelor, 1987), Environmental Sciences (Master, 1991), Biology (Bachelor + Master, 1995) at the University of Antwerp. He obtained a PhD on Soil carbon cycling in 1999 (highest distinction, University of Antwerp, funded after obtaining a highly competitive grant from the Flemish National Science Foundation). After his PhD, Ivan Janssens obtained two consecutive, highly competitive, post-doctoral grants from the Flemish National Science Foundation. During this period, he worked at the Australian National University (Canberra, Australia, to get acquainted with stable isotope applications in ecology) and at the University of Tuscia (Viterbo, Italy, to specialize in the eddy covariance technique to study ecosystem-atmosphere interactions, and in ecosystem manipulation methodologies). Professor Janssens' overarching research focus is the functioning of terrestrial ecosystems, with a strong emphasis on soil processes, ecosystem biogeochemistry (carbon, nitrogen, and recently also phosphorous cycles), greenhouse gas emissions, and on how these ecosystem responses are affected by climate change and by atmospheric pollution. Prof. Janssens was a member of the Review Committee in Climate Studies at Wageningen University (2012).

**Dr. M.P.J. (Tinus) Pulles** (1948) studied mathematics and physics at the University of Leiden and completed his doctoral research there into the physico-chemical mechanisms of electron transport in photosynthesis. He worked for three and a half years as air pollution modeller and administrative official for the province of South Holland, before he was appointed in 1982 to the permanent staff of the Environmental Science Study Centre in Groningen, which fused a few years later with other groups within the University of Groningen to form the Interfaculty Working Group on Energy and Environmental Science (IVEM). His research focusses on air pollution aspects of power generation and the relationships between noise and stench on the one hand and effects on health on the other. From 1991 to May 2013 he was affiliated to the TNO where he explored the interface between scientific information and its applications in national and international policy processes. He was intensively involved in the development of standards and guidelines for reporting emissions of both greenhouse gasses and air pollution. He was the "coordinating

lead author" for the energy section of the IPCC 2006 Guidelines for Emission Inventories and was co-chair of the editorial board and of the steering committee of the IPCC Emission Factors Database. He acted as lead reviewer for national emission reports in the framework of the Kyoto Protocol. He filled comparable roles in the field of cross-border air pollution. He was the project leader and senior investigator in a large series of national and international projects in this specialism.

**Mrs. L.H.A. van der Sanden, MSc,** graduated at the Radboud University, Nijmegen in 2014. She studied Social and Political Sciences of the Environment. She also obtained her Bachelor in Environmental Sciences at Radboud University, Nijmegen and studied abroad at Aalborg Universiteit, joining the Environmental Management & Sustainability Science. She was a member of the board of the Student Union for Environmental Sciences 'Milieuprisma' (2009-2010) and of the educational committee (2008-2011). In 2013 she started working as an environmental consultant for LievenseCSO

## Appendix 2: Intended learning outcomes

**Introduction**
The first part of the learning outcomes is specific and concerns knowledge and skills. Most of this is part of the obligatory courses for all MSc EES students (Base programme and Advanced Statistics course). The second part is more general: what is our master capable of (doing independent research). This part is mostly covered by the research projects. Also see the table at the bottom.

**General Aims**
The general aims of the master's degree program EES are:

- to prepare students for an independent professional career; in this context this means being able to carry out fundamental or applied scientific research, as well as applying state of the art scientific knowledge in a wide variety of practical situations;
- to provide a learning environment for enabling students to develop skills, knowledge and insight in a specialization area of the field of study. to have students develop the ability to clearly and concisely communicate the acquired knowledge to others;
- to let students develop the ability to critically reflect, taking into account social and ethical aspects.

**Objectives**
The aims of the program result in the following objectives:

**Specific academic knowledge and skills for the master's degree program EES.**
The graduate is able:

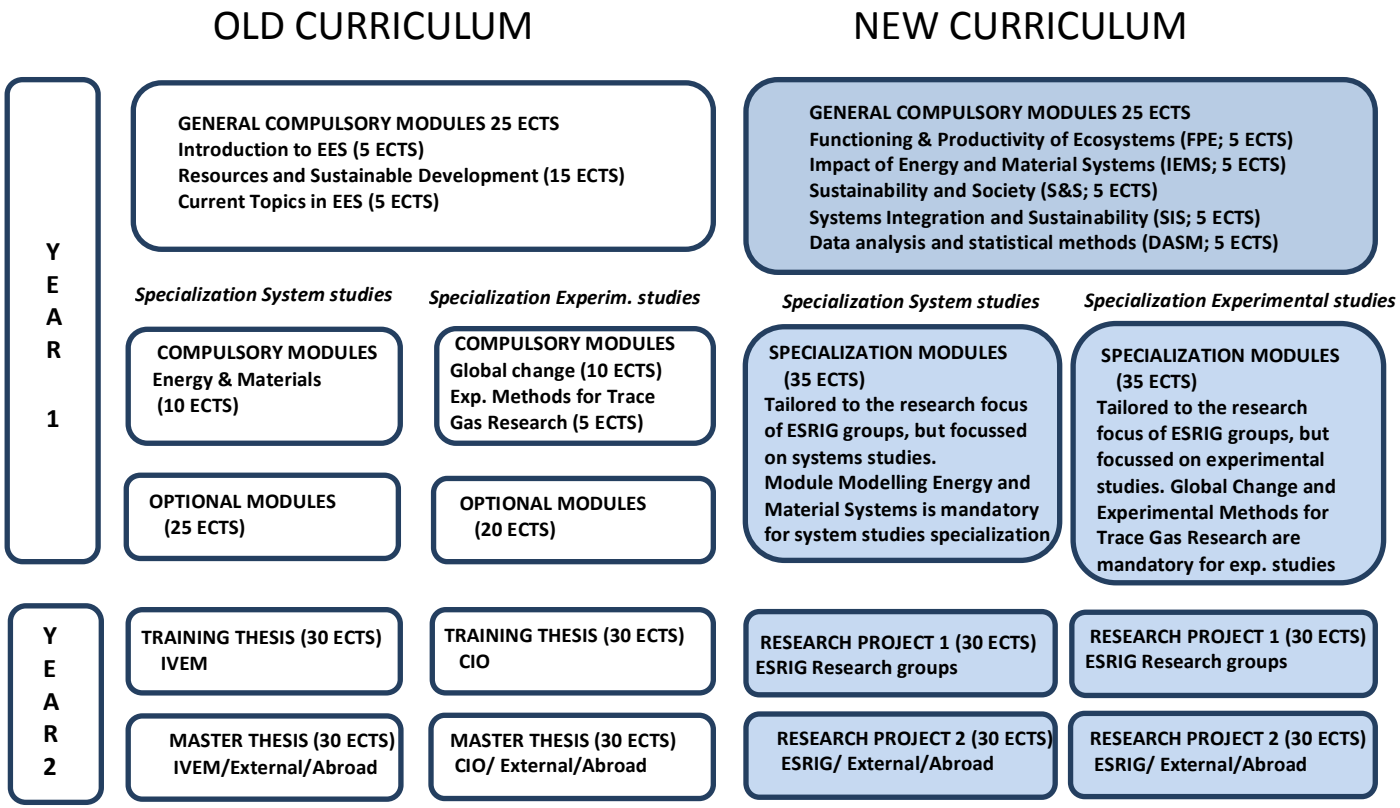
a) to analyze:
   1. Energy and resource use in societies and ecosystems and their impacts on the climate/planet;
   2. (Dis)advantages of the use of various energy sources using the people, planet, profit approach;
   3. Current and future developments in the energy/environmental research field;
   4. Policy developments in the energy/environment field.
b) to assess whether changes in systems will affect energy and resource use and their consequences.
c) to discuss the role of other academic (non-natural science) disciplines in the energy and/or environmental research field.
d) to distinguish career perspectives within the energy/ environmental field.

**General academic skills for the master's degree program EES**
The graduate is able:

1. to write a review about literature in relevant subfields.
2. to effectively gain information within the field of Energy and Environmental Sciences (EES).
3. to formulate a research plan based on a general problem description in a subfield of EES.
4. to analyze and assess state-of-the-art research information and draw conclusions from these results.
5. to collaborate in a multidisciplinary team.
6. to communicate his/her findings to the scientific community (oral presentation, written reports and debates).
7. to design, conduct and evaluate experiments / scenarios / other scientific methods.
8. to evaluate his/her own results and conclusions compared to knowledge in the literature.

9. to function scientifically in a situation in which knowledge and research skills within the field of EES are required.
10. to consider its own position in society to come to a sensible choice of profession.

## Appendix 3: Overview of the curriculum



## Appendix 4: Theses and documents studied by the panel

In addition to the improvement plan and the report of implementation, the following documents were available to the panel:

- Student Information Guide 2015-2016 (Including OER);
- Analysis of Course unit evaluations 2014-2015;
- Introduction activities EES;
- EES thesis: procedure, assessment and grading scheme;
- Members of the Advisory Board EES;
- Course descriptions OCASYS;
- Toetsplan MSc EES and CUAOs.