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M Energy and Environmental Sciences
University of Groningen

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Contents

Summary

Standard 1. Intended learning outcomes

The profile of the Energy and Environmental Sciences programme demonstrates an academic master's level, with a strong focus on research and options for specialisation. The programme's current and new intended learning outcomes align with the requirements of the academic field and professional expectations. The panel supports that the ILOs are updated once a year, because of the many developments in the discipline. The panel recommends the programme make social science a more explicit part of the curriculum and suggests developing an overview of the content of the courses to make the social science elements already present in the programme more visible.

Standard 2. Teaching-learning environment

The curriculum has a clear structure, and the panel concludes that the curriculum is well-designed and there is a good alignment between the ILOs and the curriculum. The panel is confident that the new curriculum with four profiles is a well-thought-out improvement of the programme. The panel advises increasing the visibility of the learning pathways to emphasize the coherence of the curriculum for students.
The panel appreciates the responsiveness of the management to the needs of the students. The students are supported and guided by the programme. Staff mentoring could be further improved by informing students about what they can expect and what their entitlements are during the programme.

The teaching staff is suitably qualified to teach the programme and is appreciated by students. The panel has concerns about the hiring stop and urges the faculty to invest in teaching staff, especially with the upcoming retirement of experienced staff members. More junior staff could help in reducing workload. Furthermore, the panel recommends the programme to increase efforts to improve the gender balance of the EES employees. The mixed background of the staff contributes to the international teaching and learning environment. The panel finds the use of English as the language of instruction well justified. The quality of the EES and ESRIG facilities are an asset.

Standard 3. Student assessment

The EES programme has a valid, transparent, and reliable system of assessment. Sufficient quality assurance mechanisms are in place to ensure that students individually achieve the learning outcomes of the programme. The panel recommends that calibration is also formally included in the programme's cycle of quality control. Assessment criteria and procedures are transparent and information about this is easily available to students. The thesis assessment procedure is up to standard. Each thesis is graded independently by two examiners using a rubric to align the grading criteria. The panel recommends that a third examiner take an extra look at it in case of very low or high-graded theses. The BoE is in control and has a proactive role in the quality assurance of assessment in the programme.

Standard 4. Achieved learning outcomes

The panel concludes that the theses show that the intended learning outcomes are achieved. The panel was pleased with the quality level of theses. Theses are clearly of the level and quality that may be expected from a master programme. The programme prepares graduates adequately for the working field, and alumni feel the programme prepared them well for their careers. They find employment in relevant jobs, both inside and outside academia.

Score table

The panel assesses the programme as follows:

Master's programme Energy and Environmental Sciences

Standard 1: Intended learning outcomes	meets the standard
Standard 2: Teaching-learning environment	meets the standard
Standard 3: Student assessment	meets the standard
Standard 4: Achieved learning outcomes	meets the standard
General conclusion	positive

Em. prof. dr. J.T.A. (Hans) Bressers, panel chair

Drs. (J.) Jessica van Rossum, panel secretary

Date: 17 September 2024

Introduction

Procedure

Assessment

On 11 and 12 June 2024, an independent peer review panel evaluated the Master's programme Energy and Environmental Sciences of the University of Groningen as part of the Environmental Sciences Cluster Assessment. The assessment cluster consisted of 17 programmes, offered by the institutions Open University, University of Amsterdam, Wageningen University, Delft University of Technology, Radboud University, Vrije Universiteit Amsterdam, University of Groningen, Maastricht University, Leiden University, and Utrecht University. The assessment followed the procedure and standards of the NVAO Assessment Framework for the Higher Education Accreditation System of the Netherlands (September 2018).

The Quality Assurance Agency Academion coordinated the assessment at the request of the Environmental Sciences cluster. Peter Hildering and Jessica van Rossum acted as coordinators and as panel secretaries. Annemarie Venemans, Esther Poort, Anne-Lise Kamphuis, Linda te Marvelde, Carlijn Braam, and Jessica van Rossum also acted as secretaries in the cluster assessment. They have been certified and registered by the NVAO. Jessica van Rossum acted as panel secretary in the assessment of the programme of the University of Groningen.

Preparation

Academion composed the peer review panel in cooperation with the institutions and taking into account the expertise and independence of the members as well as consistency within the cluster. On 15 December 2023, the NVAO approved the composition of the panel. The coordinator instructed the panel chair on his role in the site visit on 19 December 2023 according to the Panel chair profile (NVAO 2016).

The programme composed a site visit schedule in consultation with the coordinator (see Appendix 3). The programme selected representative partners for the various interviews. It also determined that the development dialogue would be made part of the site visit. A separate development report was made based on this dialogue.

The programme provided the coordinator with a list of graduates from the period January 2022 – October 2023. In consultation with the coordinator, the panel chair selected 15 theses. They took into account the diversity of the final grades and examiners. Before the site visit, the programme provided the panel with the theses and the accompanying assessment forms. It also provided the panel with the self-assessment report and additional materials (see Appendix 4).

The panel members studied the information and sent their findings to the secretary. The secretary collected the panel’s questions and remarks in a document and shared this with the panel members. In a preliminary meeting, the panel discussed the initial findings on the self-evaluation report and the theses, as well as the division of tasks during the site visit. The panel was also informed on the assessment framework, the working method, and the planning of the site visits and reports.

Site visit

During the site visit, the panel interviewed various programme representatives (see Appendix 3). The panel also offered students and staff members an opportunity for confidential discussion during a consultation

hour. No consultation was requested. The panel used the final part of the site visit to discuss its findings in an internal meeting. Afterwards, the panel chair publicly presented the preliminary findings.

Report

The secretary wrote a draft report based on the panel's findings and submitted it to the coordinator for peer assessment. Subsequently, the secretary sent the report to the panel for feedback. After processing this feedback, the secretary sent the draft report to the programme in order to have it checked for factual irregularities. The secretary discussed the ensuing comments with the panel chair, and changes were implemented accordingly. The panel then finalized the report, and the coordinator sent it to the University of Groningen.

Panel

The following panel members were involved in the cluster assessment Environmental Sciences:

- Em. prof. dr. J.T.A. (Hans) Bressers, emeritus professor in Policy Studies and Environmental Policy at the University of Twente (chair);
- Prof. dr. A.C. (Arthur) Petersen, professor in Science, Technology, and Public Policy at the University College London (United Kingdom);
- Dr. A.R. (Ana) Vasques, lecturer at the Erasmus University College of Erasmus University Rotterdam;
- Dr. S.E. (Sarah) Cornell, associate professor at the Stockholm Resilience Centre of Stockholm University (Sweden);
- Em. prof. dr. M.C. E. (Rietje) van Dam-Mieras, emeritus professor in Sustainable Development and Innovation of Education at Leiden University, and member of the Top Consortium for Knowledge and Innovation (TKI) Biobased Circular (focus Human Capacity Agenda);
- Dr. ir. T. (Thijs) Bosker, associate professor in Environmental Sciences at Leiden University;
- Prof. dr. ir. S.E. (Siegfried) Vlaeminck, professor in Microbial Cleantech and Environmental Systems Analyses at the Universiteit of Antwerpen (Belgium);
- Prof. dr. M.P.J. (Maarten) Loopmans, professor in Human Geography and Political Ecology at the KU Leuven (Belgium);
- Dr. ir. S.G. (Gerd) Weitkamp, associate professor in Health Geography, Mobility, and Geospatial Technologies at the University of Groningen;
- Prof. dr. P. (Paquita) Perez Salgado, professor in Natural Sciences at the Open Universiteit Nederland;
- Prof. dr. E. (Esther) Turnhout, professor in Science, Technology and Society at the University of Twente;
- Em. prof. dr. ir. J.T. (Hans) Mommaas, emeritus professor in Regional Sustainability Governance at Tilburg University, and chair of the Ecological Authority;
- Dr. P. (Patricia) de Cocq, director Living Environment and Nature at HAS Green Academy;
- Prof. dr. ir. Z. (Zofia) Lukszo, professor in Smart Energy Systems at the Delft University of Technology;
- M. M. (Marisa) Beunk MSc., alumna (March 2023) of the Master's Programme Environmental Sciences (Policy Track) of Wageningen University (student member);
- F.O. (Fenna) Oostrum, alumna (September 2023) of the MA programme Environment and Society Studies of Radboud University (student member).

The panel assessing the master's programme Energy and Environmental Sciences at the University of Groningen consisted of the following members:

- Em. prof. dr. J.T.A. (Hans) Bressers, emeritus professor in Policy Studies and Environmental Policy at the University of Twente (chair);
- Prof. dr. A.C. (Arthur) Petersen, professor in Science, Technology, and Public Policy at the University College London (United Kingdom);

- Prof. dr. P. (Paquita) Perez Salgado, professor in Natural Sciences at the Open Universiteit Nederland;
- M. M. (Marisa) Beunk MSc., alumna (March 2023) of the Master's Programme Environmental Sciences (Policy Track) of Wageningen University (student member).

Information on the programme

Name of the institution:	University of Groningen
Status of the institution:	Publicly funded institution
Result institutional quality assurance assessment:	Positive
Programme name:	Energy and Environmental Sciences
CROHO number:	60608
Level:	Master
Orientation:	Academic
Number of credits:	120 EC
Specializations or tracks:	-
Location:	Groningen
Mode(s) of study:	Fulltime
Language of instruction:	English
Submission date NVAO:	1 November 2024

Description of the assessment

Organization

The Master's programme in Energy and Environmental Sciences (EES) is embedded in the Faculty of Science and Engineering (FSE). FSE is one of the eleven faculties of the University of Groningen (UG) and consists of 14 Bachelor's degree and 26 Master's degree programmes and 10 research institutes. The EES programme is part of the Physics cluster within the faculty. Each cluster is headed by a programme board, which is responsible for the content, quality, and organization of the programmes in the cluster. The Programme Board consists of a chair, a student member, and all education directors of the programmes and institutes involved. The Programme Board also interacts with one or more Programme committees and one or more Boards of Examiners. The EES programme had its own Programme Committee and Board of Examination at the time of the site visit.

Previous accreditation's panel's recommendations

The previous accreditation of the Master Programme in Energy and Environmental Studies (EES) of the University of Groningen took place in 2018. In the self-evaluation report of the current assessment, the programme described the actions taken in response to the recommendations. Additionally, several improvements were discussed during the site visit. The panel concludes that the programme management has taken the recommendations seriously. The panel is satisfied with the improvement measures taken. Among others, this includes articulating academic skills and attitudes more explicitly in the intended learning outcomes, presenting the interdisciplinary dimensions of the programme more clearly, addressing academic and professional skills more in the curriculum, and improving the information provision. For some recommendations, it became clear that the programme was still in the process of addressing them. These issues are discussed later in this report.

Standard 1. Intended learning outcomes

The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements.

Findings

Profile and aims

The Energy and Environmental Science programme is a two-year research master's degree programme. EES aims to teach sustainability principles at an advanced level, with a sound scientific and professional education preparing students for academia, employment in society, or the industry. Students acquire a broad perspective on energy and environment with a strong focus on the natural sciences, in a multidisciplinary and multicultural setting. The energy branch in the EES programme and the broad range of electives enable students to specialize in many different topics, ranging from climate modelling to nuclear power technology and thermodynamics of energy conversion.

The panel studied the profile of the programme and concluded that it is well-elaborated with a clear research focus and a strong focus on natural sciences. During the site visit, the panel discussed the emphasis on natural science and technology in the programme. According to the panel, this approach is a valid choice, but it thinks that more multidisciplinary skills are also important for environmental scientists. Examples are working in multidisciplinary teams and knowledge of relevant elements of social science. These skills and

knowledge could also suit students' intrinsic motivation to contribute to global challenges and give them more tools to aid transitions and make an impact. The panel learned from the interview with programme management that these elements are included in the curriculum. For instance, societal impact is a main topic in at least one course. However, these topics are more embedded in the courses and as a result they are less visible. The panel recommends integrating social science more explicitly throughout the curriculum. The panel suggests the programme make the course's content more explicit, for example, by providing an overview and by working towards a learning path on social science. In addition, the panel would like to encourage lecturers to come up with more ways to include stakeholders and the social-political context of energy, environmental, and sustainability-related issues in their courses, including the electives.

Intended learning outcomes

The objectives of the EES programme have been translated into a set of learning outcomes (see Appendix 1). These intended learning outcomes (ILOs) are based on the domain-specific framework of reference. The panel learned that the ILOs are reviewed yearly (not necessarily leading to changes), and the Programme Committee contributes to this. The panel supports the annual evaluation of the ILOs and thinks that this is a good way to keep the curriculum in tune with the rapid changes and developments in the discipline of EES. Recently, the programme has set up a new curriculum, which will start in 2024-2025. This has resulted in a renewal of the ILOs, that comply with the Dublin Descriptors. The panel studied both the current and new sets of learning outcomes and concluded that they are appropriate for an academic master's programme. To keep the programme up to date, the programme management meets annually with experts from industry and alumni. The programme management discusses developments with this External Advisory Panel and uses their input to align the curriculum with the requirements of the professional field. The panel appreciates that in this way, the programme stays well-connected to the professional field.

Considerations

According to the panel, the profile of the Energy and Environment Science programme demonstrates an academic master's level, with a strong focus on research and natural sciences and ample options for specialization. The programme's current and new intended learning outcomes align with the requirements of the academic field and professional expectations. The panel supports that the ILOs are reviewed once a year, because of the many developments in the discipline. The panel recommends the programme make social science a more explicit part of the curriculum and suggests developing an overview of the content of the courses to make the social science elements already present in the programme more visible.

Conclusion

The panel concludes that the master's programme in Energy and Environmental Sciences meets standard 1.

Standard 2. Teaching-learning environment

The curriculum, the teaching-learning environment, and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.

Findings

Curriculum

The EES curriculum consists of a 2-year programme of 120 EC, and has three specializations:

- Atmosphere and Global Processes;
- Environment and Society;
- Science, Business, and Policy

The first year starts with 30 EC courses, addressing the relevant theories and methodologies in the research field, and 30 EC electives (see Appendix 2). The mandatory courses give a general overview of the field and then allow for specialization towards a broad range of subjects within energy and/or sustainability, treating it from a natural science perspective. Students can choose from more than 35 electives. Each course represents 5 EC. The electives cover a wide range of subjects, from Marine Resources to Climate Modelling, Fuel Cell Systems to Social Impact Assessment. This allows the students to compose a programme that helps them specialize in one of the variants of the programme or a different direction. To support the process of specialization, students discuss their choices with their staff mentor to safeguard a coherent outcome. The second year focuses on research and consists of two research projects of 30 EC each. The first project is an internal research project within the ESRIG research institute or an affiliated institute. The second project is generally a research internship at a company, government organization, another university, or abroad.
It is also possible for students to choose a more business- and policy-related master's programme Science, Business, and Policy. The SBP programme is a faculty-wide programme at the Faculty of Science and Engineering and was not included in this accreditation report.

The EES programme uses a variety of teaching methods, to accommodate the different preferences of students and to reflect future work field situations. Many courses include group work, and some electives contain practical work. Often, a problem-based approach in courses allows students to work on topics of their interest. The groups are purposely composed of students of mixed academic and cultural backgrounds to train students to work in international and multidisciplinary settings.

The panel studied documents on curriculum renewal and discussed changes during the site visit. The programme has updated the content of the courses; the new curriculum will be implemented in the academic year 2024-2025. The new curriculum contains four profiles that reflect the developments in the fields of energy, environment, and sustainability. The arrival of new staff meant that new expertise and topics could be included in the courses. The new setup will also meet the needs of students for more practical and technological content. The four profiles will help students select electives that suit the specialization of their choice. The panel thinks that the new profiles are a suitable way to guide students in choosing their electives. The panel advises the programme to also explain to students to what types of job opportunities the new profiles can lead.

During the site visit, the panel discussed how students are educated in communication skills and cooperation. Lecturers explained that these skills are integrated into assignments such as presentations, group work, research projects, and internships. Often, at the beginning of a course, there are moments of instruction on these skills, and feedback is given by lecturers or peers. The programme has begun to build learning lines in the new curriculum. The panel supports these learning lines and advises drawing up an

overview of how each course contributes to the development of communication, collaboration, and transitional skills.

The panel was pleased to hear that courses are evaluated thoroughly. An education monitor is performed and discussed every year. Students can give feedback during a lunch meeting with the programme director, programme coordinator and academic advisor several times a year. Lecturers plan evaluation meetings with students, to reflect on group work and cooperation. In addition, the programme makes an effort to achieve a high response rate to the (anonymous) evaluation questionnaires. Student feedback is communicated to the course lecturers. The students indicated to the panel that they were pleased with the way their feedback is taken into account. For instance, in the next academic year, courses that students find difficult are scheduled more evenly throughout the semester and not in the same block.

After studying the curriculum and speaking to staff and students, the panel concludes that the curriculum is well-designed and there is a good alignment between the ILOs and the curriculum. Generic courses cover the basic content of the main topics of the programme and result in a similar level of knowledge and skills for all students. In the next semesters, students explore their interests and can deepen their knowledge in advanced specializations. This combination allows students to achieve a high level of expertise.
The panel was interested to hear about the new curriculum and thinks that the profiles and learning lines are a good addition to the programme.

Admission, feasibility, and guidance
About 45 students enrol each year, of which 30% are from other countries in and outside the European Union. The faculty and University of Groningen's policy is to maximize student numbers. However, the programme is generally content with the current student numbers, as the personal and active teaching methods are not suitable for large groups.
A bachelor's degree in one of the natural sciences or related engineering studies is an entry requirement. An admission board is responsible for the assessment of pre-education to check on sufficient background in natural sciences and academic research. The previous panel recommended conducting interviews with incoming students from abroad. The panel learned that this was not possible, due to UG policies. Instead, the programme has developed an online 'matching quiz', that prospective students are encouraged to complete. The quiz helps to see if the programme is appropriate for them.

At the start of the year, the programme pays attention to the introduction of students and how to study and co-work in the international environment of EES. The first semester courses aim to get all students up to the same level, as their backgrounds can vary. The panel feels that this contributes to the feasibility of the programme, together with the students' guidance. The high success rates are monitored closely.

Students are encouraged to address their lecturers. Due to cultural differences, not all students are used to giving their opinions in class or disagreeing with a professor. The programme tries to accommodate cultural differences, and students from abroad generally catch up with initial delays. The panel appreciates the efforts made to help international students adjust to the Netherlands.
The programme provides each student with a staff mentor, usually someone with expertise in their field of interest. A first introduction meeting is scheduled; after that, it is up to the students to get in touch with their mentor to discuss topics related to their study. For more personal matters, the Academic Advisor is available. Students reported different experiences with the mentoring system, varying from regular contacts to more distant relationships. The panel values the contribution of the mentors to the programme and agrees that students should be proactive themselves in contacting their mentors. However, the panel recommends that

the role of the mentor becomes more standardized and that the (average) mentoring time available be made clear to students to avoid inequalities in the quantity and quality of mentoring students receive.

At the end of the first year, students begin preparing their research projects. Students do two research projects, one within the research institute ESRIG and an external project/ internship. Students that are interested in experimental research, can also do a second research project within the institute. If necessary, the programme assists students with contacts. A list of thesis topics is made available to students. The second-year internship is combined with a research project and thesis. The staff mentor guides the students during the research projects in the graduation phase.

The panel met some of the students during the site visit and learned that they were generally very happy with their studies at EES. Students appreciate the informal atmosphere, the broad curriculum, and the many opportunities in electives and research programmes. The clustering of electives in the new profiles is welcomed by students, as the many possibilities were quite overwhelming, according to several students. The panel thinks that the programme is responsive to students' needs and takes their points of improvement seriously.

Language and internationalization
The teaching staff at EES come from different academic and cultural backgrounds. During the site visit, the panel discussed the use of English as the language of instruction and the programme name with the programme management. The programme sees this as a necessity, as energy, environment, and sustainability issues are global matters. Professional literature and study materials are only available in the English language. Both staff and students come from a mix of different countries, which is an extra value to the learning process and the building up of intercultural skills. The panel considers English an appropriate choice given the research field's international orientation and the global labour market. English language proficiency is one of the academic staff recruitment requirements. The university offers courses to improve the language skills of all staff.

Some of the students that the panel interviewed mentioned that they felt that a certain mastery of the Dutch language would be helpful for students who want to work or do an internship in small to medium enterprises and certain companies in the Groningen area. The panel encourages the programme to inform students about the languages needed for different types of future jobs, and if relevant point them to the Dutch language courses available at the UG. This could create more opportunities for international students to engage regionally, and for the programme to increase the local impact of the EES programme.

Teaching staff and facilities
The programme lecturers are staff members of the Groningen Energy and Sustainability Research Institute (ESRIG). The teaching staff have different academic and cultural backgrounds. The large majority of staff has acquired the University Teaching Qualification (UTQ) or is in the process of obtaining this certificate. The first-year courses are taught by approximately 20 staff members, who are mostly tenured lecturers and guest lecturers. Teaching assistants support lecturers, for example, in practical work and assignments. They are senior students who are trained by the Centre for Teaching and Learning, as well as the course coordinator. For the research projects, students can choose from the six research groups of the ESRIG institute or other institutes of the faculty.

The programme makes an effort to establish a diverse group of lecturers. When hiring new staff, the programme checks whether candidates can link their research or expertise to societal impact. The programme makes good use of new staff to integrate new knowledge and developments into the curriculum,

for instance by creating new electives or integrating new content in the core courses. EES offers career paths specifically focused on teaching and education. From the interviews with programme management and teaching staff, the panel learned that recently the UG ordered a complete vacancy stop, while upcoming retirements of EES staff could lead to a higher workload. The panel recommends that faculty and EES invest in the replacement of staff, for instance, by hiring junior staff or by being more flexible in requirements. In addition to this, the panel recommends further increasing efforts to create a more gender-balanced team of lecturers, because at the time of the site-visit, 25% of staff were female.

The panel enjoyed a tour of the EES location and spoke to students who were very satisfied with the facilities. ESRIG has modern and state-of-the-art equipment, like a wind tunnel, mass-spectrometry, and laser lab. The panel thinks that the teaching facilities, such as laboratories and classrooms, are adequate for current student numbers.

Based on the documents reviewed and the discussions during the site visit, the panel concludes that the teaching staff is qualified to execute the programme. The panel was pleased to read that student course evaluations and the National Student Survey reveal that students appreciate teaching staff and facilities.

Considerations

The curriculum has a clear structure, and the panel concludes that the curriculum is well-designed and there is a good alignment between the ILOs and the curriculum. The panel is confident that the new curriculum with four profiles is a well-thought-out improvement of the programme. The panel advises increasing the visibility of the learning pathways to emphasize the coherence of the curriculum for students.
The panel appreciates the responsiveness of the management to the needs of the students. The students are supported and guided by the programme. Staff mentoring could be further improved by informing students about what they can expect and what their entitlements are during the programme.

The teaching staff is suitably qualified to teach the programme and is appreciated by students. The panel has concerns about the hiring stop and urges the faculty to invest in teaching staff, especially with the upcoming retirement of experienced staff members. More junior staff could help in reducing workload. Furthermore, the panel recommends the programme to increase efforts to improve the gender balance of the EES employees. The mixed background of the staff contributes to the international teaching and learning environment. The panel finds the use of English as the language of instruction well justified. The quality of the EES and ESRIG facilities are an asset.

Conclusion

The panel concludes that the Master's programme in Energy and Environmental Sciences meets standard 2.

Standard 3. Student assessment

The programme has an adequate system of student assessment in place.

Findings

Assessment system

EES' assessment system is based on the UG Assessment policy 2021-2026. This policy describes the vision on assessment, its organization, and quality assurance mechanisms. The programme uses programme assessment guidelines, that include the vision of the programme on assessment:

- Assessment guides and evaluates student learning in a multidisciplinary and multicultural international context to prepare them for a research, consultancy, or (N)GO career in the

Energy and Environmental Sciences field.
- Assessment aims at stimulating students to study actively and learn from their mistakes, combining specific knowledge and skills, while still stimulating and helping each other in learning processes and in contributing to multi-disciplinary/-cultural teams.
- Assessment stimulates transparent and effective use of tools in learning, research, and communication, as a guiding principle for lifelong learning.

The 'Assessment plan MSc EES' provides details of the objectives and learning outcomes of the programme, the types of assessments used in each course, and an overview of examiners. According to the vision of the EES, a formative assessment is being implemented, both in group work and for individual assignments. The Examination Board encourages lecturers to create a good balance between formative and summative assessment and has provided a checklist for this. Group assessment is being conducted in line with the assessment policy. This means that students will be assessed individually for their contribution to the group work.

The programme is experimenting with assessment and teaching methods that incorporate benefits from Artificial Intelligence (AI) such as ChatGPT. There is a UG policy that the faculty adheres to and an accompanying faculty vision and a website with information and guidelines, and every EES course can implement these guidelines to their needs. Staff and students discuss how AI can and should be used. Students with whom the panel spoke expressed their need for clear guidelines from professors on how to use AI.

The panel has studied the assessment system and discussed it during the site visit. It concludes that the system adequately ensures the validity, reliability, and transparency of assessment. Two examiners are responsible for assessment and quality control in every course. The learning outcomes of the courses are cross-referenced with the programme learning objectives. A mandatory grading rubric makes grading very transparent. The panel learned that because there are always multiple teachers working on every course, there is a lot of discussion and calibration between staff. Course coordinators review the course plans and fill out the Course Unit Assessment Overview (CUAO). Every year, 10% of the courses are checked completely, and the Examination Board does a review of each CUAO every three years. The alignment of courses is discussed at teacher meetings and yearly seminars. The panel recommends that calibration is also formally included in the programme's cycle of quality control, for instance by planning a calibration session at the start of each semester or block.

Thesis assessment
In the second year of the programme, students write two theses on research projects. The first project is usually supervised by a university staff member of the ESRIG institute. The second research project can be conducted at UG or can be an external research internship at a company, NGO, etc. During a mid-term meeting, the student and the supervisor discuss assessment criteria to see if the student is on track and to determine improvements.
The grading form states the grading and weight of the subgrades:

A. Scientific quality of research (40%);
B. Management of research (25%);
C. Colloquium / final presentation (15%);
D. The report/thesis (20%).

The student can only pass the assessment if the four subgrades are rated with at least 5.5 points. In case of a lower subgrade, the student is offered a remediation path, after which a second assessment is performed.

Both theses are assessed by a first examiner/ supervisor and a second examiner. The examiners grade independently and after discussion, the grades are finalized. External parties can have an advisory role in the grading process.

In preparation for the site visit, the panel studied the thesis procedure and examined a sample of theses and the corresponding evaluation forms and rubrics. The panel concludes that the thesis procedure is very solid and thorough. The rubric clarifies how and why certain grades are given. The panel established that the amount of written feedback varies but is generally sufficient. In some cases, the sub-criteria were not completed in the correct place. The panel advises the programme to take care to ensure that the evaluation forms are completed in full. The Board of Examiners selects random theses for the checks and also reviews theses that have low and high grades. The panel recommends that the programme always has a third examiner taking an extra look at a thesis in case of very low or high grades, as this adds an extra step in thorough and meticulous assessment.

Board of Examiners
The Board of Examiners EES (BoE) is composed of a chair, two general members, and one external member. In the year 2024-2025, the Board will merge with the boards of the Master Programme Sustainability, Business, and Policy and the Master Programme Science Education. The BoE is responsible for the quality assurance of assessments and exams in terms of their validity, reliability, and transparency. It safeguards this task by appointing examiners and ensuring that rules and regulations are clear. Also, the BoE checks if new policies, for instance, on formative assessment, are being implemented. In addition, the BoE evaluates assessment overviews (CUAO), checks theses samples, and reviews courses. Remarks of the BoE are reported to and discussed with the course coordinators and programme director. Clear information on the rules and procedures of the BoE is available for students. The board receives very few complaints on assessment, usually no more than one or two a year.

The panel spoke to members of the board and concludes that the BoE understands its tasks and responsibilities and is accountable for them. The chair and secretary of the BoE regularly attend intervision meetings within the FSE and with all BoEs of the UG. New board members are introduced to the BoE regulations by the secretary and can follow formal training. The BoE checked the new courses of the new curriculum, in preparation for the implementation in 2024-2025.
The panel supports the BoE's repeated requests for regular calibration sessions between EES lecturers.

Considerations
The EES programme has a valid, transparent, and reliable system of assessment. Sufficient quality assurance mechanisms are in place to ensure that students individually achieve the learning outcomes of the programme. The panel recommends that calibration is also formally included in the programme's cycle of quality control. Assessment criteria and procedures are transparent and information about this is easily available to students. The thesis assessment procedure is up to standard. Each thesis is graded independently by two examiners using a rubric to align the grading criteria. The panel recommends that a third examiner take an extra look at it in case of very low or high-graded theses. The BoE is in control and has a proactive role in the quality assurance of assessment in the programme.

Conclusion
The panel concludes that the master's programme Energy and Environmental Sciences meets standard 3.

Standard 4. Achieved learning outcomes

The programme demonstrates that the intended learning outcomes are achieved.

Findings

Thesis quality

In preparation for the site visit, the panel studied a selection of the theses of 15 students who graduated in 2022 and 2023. In the selection, a proper distribution between grades was ensured. The panel received two theses and evaluation forms from each student, as the programme includes two research projects as final works. The panel noted that some students wrote their theses in different disciplines of natural sciences, but there was generally little interdisciplinarity in the theses' subjects.

The panel found that all graduates had achieved the intended learning outcomes of the programme at the master's level. It considered that the research projects were of sufficient quality, and some were above this. The theses confirmed that the students acquired proper research skills in line with the programme's aim of educating researchers.

Alumni

After graduation, graduates continue to do a PhD or find jobs at energy companies, environmental consultancies, environmental NGOs, industry, and government. The programme analyzed the types of jobs and companies' alumni from 2019-2022 chose to work in. Out of 147 alumni, virtually all were employed, of which 65% in industry, 8% started a PhD and others worked in consultancy, NGO, or public organizations. During the site visit, the panel spoke to alumni of the programme, and learnt that alumni experience that the programme has prepared them well for the job market. Alumni value the interaction with other disciplines and cultures. They appreciate the wide choice of courses that help to decide what they want to do after graduation. The career events are also very helpful for this. The student chapter stated that after graduation, students feel well-equipped to cooperate and communicate with other disciplines and to understand other perspectives. The panel concludes that the programme prepares graduates adequately for the working field.

Considerations

The panel concludes that the theses show that the intended learning outcomes are achieved. The panel was pleased with the quality level of theses. Theses are clearly of the level and quality that may be expected from a master programme. The programme prepares graduates adequately for the working field, and alumni feel the programme prepared them well for their careers. They find employment in relevant jobs, both inside and outside academia.

Conclusion

The panel concludes that the master's programme Energy and Environmental Sciences meets standard 4.

General conclusion

The panel's assessment of the master's programme Energy and Environmental Sciences is positive.

Development points

For further improvement of the programme, the panel makes the following recommendations:

1. Highlight the elements and perspectives of the social sciences in the curriculum more, to increase the transitional and societal impact of the programme. Furthermore, an overview of the contents of the courses could be helpful, to clarify how each course and elective contributes to the interdisciplinary intended learning outcomes.
2. Clarify and standardize the role of the staff mentor to avoid inequalities in the quantity and quality of mentoring that students receive.
3. Invest in the replacement of staff, for example, by hiring junior staff or by being more flexible in requirements to prevent an increase in staff workload.
4. Increase efforts to create a more gender-balanced team of lecturers.
5. Include calibration sessions in the regular cycle of quality control.
6. Have a third examiner review thesis grading in case of very low or high grades.

Appendix 1. Intended learning outcomes

The aims of the EES programme result in the following outcomes:

EES MSc programme - Individual Learning Outcomes (until September 2024)

Specific academic knowledge and skills for the MSc EES
The graduate is able:
Sa) to analyse:

1. Energy and resource use and their impact on the environment and on the planet;
2. (Dis) advantages of the use of various energy sources from a sustainability viewpoint;
3. Current and future developments in the energy & environment research field;
4. Policy developments in the energy & environment field.

Sb) to assess how changes in societal, environmental, or technical systems will affect energy and resource use and their consequences.
Sc) to evaluate the role of other academic non-natural science disciplines in the energy & environment research field.
Sd) to determine its career perspectives within the energy & environment field.

General academic skills for the MSc EES
The graduate is able:
G1. to write a review about literature in relevant subfields;
G2. to effectively gain information within the field of Energy and Environmental Sciences (EES);
G3. to formulate a research plan based on a general problem description or question in a subfield of EES;
G4. to analyse and assess state-of-the-art research information and draw conclusions from these results;
G5. to collaborate in a multidisciplinary team;
G6. to communicate its own findings to the scientific community (oral presentation, written report and debate);
G7. to design, conduct and evaluate experiments/scenarios/other scientific methods;
G8. to evaluate its own results and conclusions compared to knowledge in the literature;
G9. to function scientifically in a situation in which knowledge and research skills within the field of EES are required;
G10. to consider its own position in society to come to a sensible choice of profession

The Individual Learning Outcomes have been redefined for the renewed curriculum (from September 2024 onwards) to the following:

New EES MSc programme Individual Learning Outcomes structured according to the Dublin descriptors

The master graduate in EES:

1. *Knowledge and Understanding*
    a. understands basic and advanced concepts of the field of Energy & Environmental Sciences in broad perspective at a level which permits admission to a PhD-programme;
    b. understands the societal, political and business aspects of the field of EES permitting an appointment in industry, government or NGO at a level of independent analyst and/or researcher;
2. *Application (of knowledge and understanding)*
    a. is able to analyze and evaluate (changes in) the use of energy and resources and their impact on the environment, the society, and for a sustainable planet;
    b. is able to analyze and evaluate current and future developments in the energy & environment research field, including policy, business and societal aspects;
    c. can design and formulate a research plan based on the description of a problem/question/hypothesis in a sub-field of EES;
    d. can conduct scientific research individually or in cooperation aiming for answers to, and/or creating solutions for a research question/problem/hypothesis;
    e. can discuss research outcomes within the relevant EES sub-field;
3. *Assessment*
    a. is able to gain and process relevant information from a sub-field of EES;
    b. is able to analyze and assess state-of-the-art research results and draw conclusions from these;
    c. is capable of evaluating and managing their own and other's actions within a scientific and professional context, taking societal and ethical aspects into account.
4. *Communication Skills*
    a. can review (orally or in writing) literature/information in a relevant EES sub-field;
    b. is able to communicate orally and/or in writing about own research outcomes towards a broader academic audience or other relevant public.
5. *Cooperation and Societal Skills*
    a. can collaborate effectively and appropriately with peers in a multidisciplinary and/or multicultural team, taking multiple perspectives into account;
    b. is able to determine career perspectives within the field of energy & environment.

Appendix 2. Programme curriculum

MSc Energy and Environmental Sciences Standard Programme				
	1a	1b	2a	2b
Year 1	Data Analysis and Statistical Methods	Sustainability and Society	Modeling Energy and Material Systems*	
	Impact of Energy and Material Systems	Systems Integration and Sustainability	Global Change*	Elective
	Sustainable Use of Ecosystems	Elective	Elective	Elective
Year 2	Research Project 1 (internal)		Research Project 2 (internal or external)	

*At least one of these two courses needs to be completed.

Appendix 3. Programme of the site visit

Tuesday 11 June 2024

Time	*Schedule*
11:30 – 11:45	Arrival and welcome
11:45 – 12:45	Panel preparation & consultation hour (including lunch)
12:45 – 13:45	Interview programme management
14:00 – 15:30	Interview students and alumni & tour of facilities
15:45 – 16:30	Interview teaching staff
16:45 – 17:30	Interview Board of Examiners

Wednesday 12 June 2024

Time	*Schedule*
08:45 – 09:00	Arrival
09:00 – 10:30	Development dialogue on curriculum, AI, and student recruitment/English language
10:30 - 11:15	Internal panel session
11:15 – 11:45	Final interview programme management
11:45 – 13:00	Lunch break and internal panel session
13:00 – 13:30	Oral report and conclusion

Appendix 4. Materials

Prior to the site visit, the panel studied 15 theses of the master's programme Energy and Environmental Sciences. Information on theses is available from Academion upon request.
The panel also studied other materials, which included:

- Self-evaluation report EES (Reading guide final version April 2024) *including the following appendices:*
    - Appendix A New curriculum overview
    - Appendix B Assessment report previous audit
    - Appendix C Midterm Report Master Energy and Environmental Sciences 2022
    - Appendix D Annual reports Admissions Board 2020-2022
    - Appendix E TER MSc EES, ILO on page 2
    - Appendix F Domain Specific Framework of Reference Environmental Science 2023
    - Appendix G Minutes for meeting with external advisory panel 2021
    - Appendix H ILOs including Skills table (Old + New)
    - Appendix I Education Monitor MSc EES 2020-2022
    - Appendix J MSc EES Assessment plan 2021-2022
    - Appendix K Description of Electives
    - Appendix L Annual reports Programme Committee 2020-2022
    - Appendix M Annual Reports Board of Examiners 2020-2022
    - Appendix N UG assessment policy 2022
    - Appendix O Assessment guidelines EES
    - Appendix P Performing quality controls
    - Appendix Q Assessment forms and rubric for research projects
    - Appendix R Labour market search
    - Appendix S Recommendations on setting up and organizing Lectures, Assignments and Exams in Online Teaching
- Reading guide table EES
- Student Chapter
- SWOT
- Link to the intranet and student portal
- Link to NSE-results 2024.
- Course information (tutorial, examples of lectures, assignments, assessment form, and course evaluation) of 4 courses:
    - Climate modelling (WMEE010-05)
    - Data Analysis and Statistical Methods (WMEE001-05)
    - Impact of Energy and Material Systems (WMEE002-05)
    - Sustainability and Society (WMEE005-05)