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Appendices for the Master's degree programme in Energy and Environmental Sciences

Appendix I. Learning outcomes of the Master's degree programme (Art. 3.1)

The Master's graduate in Energy and Environmental Sciences (hereinafter referred to as 'EES'):

1. *Knowledge and Understanding*
   a. understands basic and advanced concepts of the field of Energy and 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 analyse 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 analyse and evaluate current and future developments in the energy and 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 analyse 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 and 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 and environment.

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Skills table

	Period/Semester this appears in	1A	1B	2A	2B	3	4	Modules
Academic/Prof Skills (learning phase	**Bloom's taxonomy**	rem	und	apply	ana	eval	crea	
1. Personal Development	1a. Why am I here							ECOS, EAR, MES, RES, SUS
	1b. My Strengths & Weaknesses							ECOS, EAR, MES, Electives, Projects
	1c. My Career perspectives							SUS, Electives, Projects
2. Literature & Referencing	2a. Finding Literature on a Subject							ECOS, Electives, Projects
	2b. Literature Searching							ECOS, Electives, Projects
	2c. Quoting of Referencing Literature							ECOS, Electives, Projects
	2d. Scientific Integrity & Plagiarism							DSI + whole programme
3. Scientific Approach	3a. Formulating Scientific Questions							DSI, Electives, Projects
	3b. Formulating Hypotheses							DSI, Electives, Projects
4. Group work	4a. Working in multidisciplinary groups							ECOS, EAR, MES, RES, SUS, Electives
	4b. Working in multicultural groups							ECOS, EAR, MES, RES, SUS, Electives
	4c. Dividing work and workload							ECOS, EAR, MES, RES, SUS, Electives
	4d. Integrating work/findings							ECOS, EAR, MES, RES, SUS, Electives
5. Presenting	5a. Making/Preparing presentations							ECOS, RES, SUS, Electives, Projects
	5b. Presenting other people's work							ECOS, RES, SUS, Electives, Projects
	5c. Presenting group work							ECOS, RES, SUS, Electives, Projects
	5d. Presenting your own work							Electives, Projects
6. Data Analysis + Statistics	6a. Data Analysis + Statistics primer							DASM, MES, Electives
	6b. Adv. Data Analysis & Stats (courses + project)							MES, Electives, Projects
7. Research	7a. Experimental Design							DSI, Electives, Projects
	7b. Setting up your own research project							DSI, Projects
	7c. Making a research proposal for own project							Projects
8. Writing	8a. Writing an abstract							Electives, Projects
	8b. Writing a report							Electives, Projects
	8c. Writing a paper							Projects

Legend		
Bloom's taxonomy	rem	Remember
	und	Understand
	apply	Apply
	ana	Analyse
	eval	Evaluate
	crea	Create
Courses/modules	ECOS	Ecology and Ecosystem Sustainability
	EAR	Energy, Atmosphere and Resources
	MES	Modelling Energy Systems
	RES	Renewable Energy Systems
	SUS	Sustainable Society
	DASM	Data Analysis and Statistical Methods
	DSI	Doing Science with Integrity

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Appendix II. Tracks/specialisations (Art. 3.6)

The Degree Programme is not divided into tracks/specialisations.

Appendix III. Content of the degree programme (Art. 3.7.1)

Table 1: Overview of the compulsory courses and modules

Course unit	Course code	ECTS	Practical	Entry requirements
Ecology and Ecosystem Sustainability	WMEE021-05	5	Yes	None
Energy, Atmosphere and Resources	WMEE028-05	5	Yes	None
Modelling Energy Systems	WMEE025-05	5	Yes	None
Renewable Energy Systems	WMEE023-05	5	Yes	None
Sustainable Society	WMEE020-05	5	Yes	None
Data Analysis and Statistical Methods	WMEE001-05	5	Yes	None
Scientific Integrity (EES)*	WMEE019-00	0	No	None
Career Perspectives (EES)	WMEE018-00	0	No	None
Colloquia Master Energy and Environmental Sciences	WMEE017-00	0	No	None
Writing a Research Proposal (EES)	WMEE030-00	0	No	None

* AI literacy for students is incorporated in the Scientific Integrity (EES) module.

Table 2: Overview of the different variants

Course unit	Course code	ECTS	Practical	Entry requirements
Variant 30/30 ECTS*				
YEAR 1				
Obligatory courses		30		
Electives, see Tables 4 and 5		30 are required for electives in total		
YEAR 2				
Research Project 1 *including instructions on academic writing*	WMEE905-30	30		Obligatory courses ECOS, EAR, MES, RES, SUS, DASM, and Scientific Integrity EES module
Research Internship/Research Project 2	WMEE906-30	30		Research Project 1 and sufficient credits for electives
Variant 60 ECTS**				
YEAR 1				
Obligatory courses		30		
Electives, see Tables 4 and 5		30 are required for electives in total		
YEAR 2				
Research Project *including instructions on academic writing*	WMEE913-60	60		Obligatory courses ECOS, EAR, MES, RES, SUS, DASM, Scientific Integrity EES module and sufficient credits for electives

Variant Science, Business and Policy				
YEAR 1				
Obligatory courses		30		
Research Project 1	WMEE905-30	30		Obligatory courses ECOS, EAR, MES, RES, SUS, DASM, and Scientific Integrity EES module
YEAR 2				
Introduction Science and Policy	WMSE002-10	10		
Introduction Science and Business	WMSE001-10	10		
Work Placement Business and Policy	WMSE902-40	40		Research Project 1, Introduction to Science and Policy, and Introduction to Science and Business
Variant Intelligent, Efficient and Sustainable Energy Solutions* **				
YEAR 1				
Obligatory courses		30		
Electives, see Tables 4 and 5		30 are required for electives in total		
YEAR 2				
Research Internship/Research Project 1 *including instructions on academic writing*	WMEE905-30	30		Obligatory courses ECOS, EAR, MES, RES, SUS, DASM, and Scientific Integrity EES module or IESES equivalent courses.
Research Project 2	WMEE906-30	30		Research Internship/Research Project 1 and sufficient credits for electives

In addition to the above scheme, the following rules apply:

- Depending on the student's background and the topic of the intended research project(s), a package of electives (See Tables 4 and 5) is composed. This package of electives is discussed with and approved by the mentor (a senior staff member).
- The student is allowed to choose (an) elective(s) from another Master's Degree Programme, which are not mentioned in Tables 4 or 5. The student needs to motivate their choice. The mentor and the Board of Examiners have to approve this choice.
-*(Variant 30/30 ECTS) Research Project 1 must be an internal project, performed at an ESRIG (Energy and Sustainability Research Institute) or affiliated group, under the supervision of one of the examiners of the Degree Programme. For the assessment, two examiners of the Degree Programme must be involved. Research Internship/Research Project 2 may be performed at an ESRIG group, but may also be performed outside the university at a company, consultancy firm, government institution, research institute or another university. For the assessment, two examiners of the Degree Programme must be involved. The supervisor from the external organisation has to be at an academic level. The external supervisor is not an examiner, but is requested to give advice on the assessment.
-**(Variant 60 ECTS) Research Project 1 may last one year and replace Research Internship/Research Project 2 (WMEE906-30), for a workload of 60 ECTS, when the student is pursuing an academic career. The internal project requires laboratory or analytical work, or fieldwork whose effective productivity extends beyond six months. The examiners of the Degree Programme will, at their discretion, decide whether the above conditions apply to the student's project proposal and curriculum. The supervisor is also required to conduct a pre-midterm assessment in the third month of the project to determine whether the project should be rescheduled to a 30 ECTS project or proceed to a 60 ECTS project as planned. The student is required to take an additional oral exam on the project topic, which will constitute 20%/100 of the final grade. The supervisor will decide the content and structure of the exam, which will be conducted before submitting the thesis, in the presence of both examiners. It is not allowed to extend a 30 ECTS project to a 60 ECTS project.
- The subject of the SBP-work placement must be clearly related to the scientific domain of the EES Master's Programme (see Appendix I, learning outcome 2a). Therefore, two examiners must be involved in the assessment of the work placement: one SBP examiner and one examiner of the Degree Programme.
-***(Variant Intelligent, Efficient and Sustainable Energy Solutions - IESES) The first project/research internship must be performed in a facility of the hosting institution or in an industrial partner in the same country.
- To pass the final assessment of the EES programme, the student has to have completed the following modules: Colloquia Master Energy and Environmental Sciences (WMEE017-00), Career Perspectives (EES) (WMEE018-00), Scientific Integrity (EES) (WMEE019-00), and Writing a Research Proposal (EES) (WMEE030-00).

Joint project options for obtaining a master's degree in a closely related programme (see also Basic TER FSE Master's degree projects Art. 5.8.2)

Table 3: Joint project options

Course unit	Course code	ECTS credits	Entry requirements
Master's Research Project IEM-EES*	WMEE907-40	40	See entry requirements Research project 1 EES
Master's Research Project ME-EES**	WMEE909-50	50	See entry requirements Research Project 1 EES

*The joint Master's Research Project IEM-EES is available only to students enrolled in both the Energy and Environmental Sciences resp. Industrial Engineering and Management (IEM) MSc programmes. This joint project replaces, and cannot be combined with, the Research Project 1 EES. For the conditions and the entry requirements of IEM regarding this project, check the TER Appendices MSc IEM.

**The joint Master Research Project ME-EES is available only to students enrolled in both the Energy and Environmental Sciences resp. Mechanical Engineering (ME) MSc programmes. This joint project replaces, and cannot be combined with, the regular Research Project 1 EES. For the conditions and the entry requirements of ME regarding this project, check the TER Appendices MSc ME.

IESES Double degree programme (see also Basic TER FSE Conditions for awarding a University of Groningen degree Art. 5.8.3)

The MSc programme on "Intelligent, Efficient and Sustainable Energy Solutions" is a double degree offered by the Coordinating Institution, the University of Cyprus (UCY) and together with the Technical University of Denmark (DTU) and the University of Groningen (UG) as the Participating Institutions.

Students are initially enrolled and start their studies in the Coordinating Institution for their core semester, which contains introductory courses that build the necessary background for the students prior to their specialisation. During the specialisation semester the students work on one of the following specialisations:

Photovoltaics (PV) offered by UCY,

Smart Grids (SG) offered by DTU

Energy Systems (ES) offered by UG.

Students will be admitted only to one specialisation, but their thesis will be interdisciplinary and combine more than one specialisation.

During the 3rd semester PV and ES students must do a research project of 30 ECTS either in a research lab of their institution or in an industrial partner in the same country, while SG students have to attend 25 ECTS of additional courses and do a mini-capstone project of 5 ECTS.

Appendix IV. Electives (Art. 3.8.1)

Table 4: Overview of the electives offered by EES

Course unit	Course code	ECTS	Practical	Entry requirements
Global Change	WMEE008-05	5	Yes	
Climate Modelling	WMEE010-05	5	Yes	Global Change
Renewable Energy Technology	WMEE027-05	5	Yes	
Conceptualizing and Modelling Sustainability	WMEE022-05	5	Yes	
Energy and Complexity Nexus	WMEE012-05	5	Yes	
Experimental Methods in Environmental Science	WMEE026-05	5	Yes	
Radiocarbon Dating and Analysis	WMEE013-05	5	Yes	
Nuclear Power Technology*	WMEE014-05	5	Yes	
Fuel Cell Systems	WMEE015-05	5	Yes	
Energy and Sustainability in Practice	WMEE024-05	5	Yes	
Geo-Energy and Subsurface Processes**	WMEE004-05	5	Yes	
Engineering Design Integration	WMEE029-05	5	Yes	

* It is not allowed to choose Nuclear Power Technology if the student already passed the Nuclear Energy course in its Bachelor's Degree Programme at the UG.

** It is not allowed to choose Geo-Energy and Subsurface Processes if the student already passed the Geo-Energy course in its Bachelor's Degree Programme at the UG.

Electives offered by other Degree Programmes

Students can select other electives from other Degree Programmes. For the number of ECTS, Practical, and Entry requirements, see the course catalogue Ocasys. Table 5 gives an overview of possible electives offered by FSE or other faculties.

Table 5: Overview of possible electives offered by other degree programmes

Electives of other Degree Programmes in the Faculty of Science and Engineering:	
WMCE021-05	Processes and Products for a Sustainable Carbon Cycle
WMCE013-05	CFD for Engineers
WMCS035-05	Geo-Visualization
WMEC006-05	Skills in Science Communication
WMEC012-05	Citizen Science: Introduction, State of the Art, and Applications
WMIE006-05	Technology Based Entrepreneurship
WMIE021-05	Systems Engineering
WMMB008-05	Marine Ecosystem Service and Global Change
WMMB009-05	Polar Ecosystems
WMME029-05	Electrochemical Systems and Engineering
WMME018-05	Thermodynamics of Energy Conversion
WMME019-05	Hydrogen, Fuels and Electrolysers
WMSE001-10	Introduction Science and Business
WMSE002-10	Introduction Science and Policy
Electives of Faculty of Economics and Business:	
EBM192A05	Marketing and Consumer Well-being
EBM202A05	Sustainable Energy Supply
EBM148B05	Regulating Energy Markets
Electives of Faculty of Spatial Sciences:	
GEMDILEIP	Dilemmas in Infrastructure Planning
GEMSOCIMAS	Social Impact Assessment
GEMREENVPL	Reinventing Environmental Planning
GEMTRWATM	Transitions in Water Management
GEMIPS	Interdisc Perspectives on Sustainability
Elective of Faculty of Behavioural and Social Sciences:	
PSMSB-2	Environmental Psychology
TEM0110-24	Neem regie

Appendix V. Entry requirements and compulsory order (Art. 4.4)

The entry requirements and compulsory order of examinations are mentioned in Appendix III. The conditional entry requirements for individual modules (electives) and the order of examinations are listed in Ocasys.

Appendix VI. Admission to the degree programme (Art. 2.1A.1, 2.1A.2 and 2.1B.1)

Requirements for admission to the MSc Energy and Environmental Sciences:
Holders of the following Bachelor's degrees are considered to have sufficient knowledge and skills and will be directly admitted to the Master's Degree Programme in Energy and Environmental Sciences:

- Applied Mathematics (CROHO/RIO: 56965)
- Applied Physics (CROHO/RIO: 56962)
- Artificial Intelligence (CROHO/RIO: 56981)
- Astronomy (CROHO/RIO: 50205)
- Biology (CROHO/RIO: 56860)
- Biomedical Engineering (CROHO/RIO: 56226)
- Chemical Engineering (CROHO/RIO: 56960)
- Chemistry (CROHO/RIO: 56857)
- Computing Science (CROHO/RIO: 56978)
- Industrial Engineering and Management Science (CROHO/RIO: 56994)
- Life Science and Technology (CROHO/RIO: 56286)
- Mathematics (CROHO/RIO: 56980)
- Pharmacy (CROHO/RIO: 56157)
- Physics (CROHO/RIO: 50206)

Appendix VII. Pre-Master's programmes and Fast-Track programmes (Art. 2.3)

FSE offers a Pre-Master's programme of 30 ECTS for access to the MSc Energy and Environmental Sciences.

The following types of qualifications from a university of applied sciences are usually sufficient:

- Chemical Engineering/Chemische Technologie
- Chemistry/Chemie
- Environmental Sciences/Milieukunde
- Mechanical Engineering/ Werktuigbouwkunde
- Other natural sciences and related engineering studies

The overview below shows the standardised Pre-Master's programme based on one of the abovementioned types of qualifications:

Semester	Course Unit	Course Code	ECTS
1a	Calculus 1 (for IEM)	WBIE003-05	5
1a	Introduction to Energy Systems	WBPH084-05	5
1a	Climate System and Atmosphere	WBPH048-05	5
Whole Year/1b	Paper Energy	WBEE005-05	5
1b	Introduction to Energy & Environment	WBPH019-05	5
1b	Air Pollution*	WBPH035-05	5
1b	Solar Cells*	WBCH018-05	5
Total			30

For HBO programmes not listed above, the Board of Admissions decides:

a. The content and the student workload of a tailor-made Pre-Master's programme.
Or
b. Admission is not accepted.

* The Pre-Master's student chooses either Air Pollution or Solar Cells. This is based on their personal preference.

Appendix VIII. Transitional provisions (Art. 7.1)

Transitional provision for the Master's Degree Programme Energy and Environmental Sciences (cohort 2019 and earlier)
Students who started in 2019-2020 or earlier are still allowed to complete Variant 40/20 with a Research project 1 (WMEE905-40) of 40 ECTS and an Internship (WMEE903-20) of 20 ECTS. For the Internship, the student has to get the internship proposal approved by the Board of Examiners before the start.

Transitional provision for the Master's Degree Programme Energy and Environmental Sciences (cohort 2023 and earlier)
Students who started in 2023-2024 or earlier are (still) allowed to complete the following courses that cease to exist in 2024-2025:

WMEE002-05 Impact of Energy and Material Systems
WMEE003-05 Sustainable Use of Ecosystems
WMEE005-05 Sustainability and Society
WMEE006-05 Systems Integration and Sustainability
WMEE007-05 Experimental Methods of Trace Gas Research
WMEE009-10 Modelling Energy and Material Systems
WMEE011-05 Conceptualizing and Modeling Human-Environmental Systems

Students who not pass one (or more) of these courses that are going to cease to exist will be offered normal examination resit(s) according to the original course contents. More than one year after the course replacement date, the students that did not pass yet will be offered exam(s) and/or examination assignment(s) of equal value covering the original course contents.

Appendix IX. Additional requirements Open Degree programmes (Art. 3.9.2)

Students wishing to pursue an Open Degree Programme may file a request with the Board of Examiners. The Board of Examiners will evaluate whether the proposed curriculum meets the learning outcomes of the Degree Programme and can determine further conditions in their Rules and Regulations.