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

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Appendix I. Learning outcomes of the degree programme (art. 3.1)

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 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 & 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 & 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
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/specializations (art. 3.6)

The Degree Programme is not divided into tracks/specializations.

Appendix III. Content of the degree programme (art. 3.8)

Table 1: Overview of the obligatory courses

Course unit	Course code	ECTS	Practical	Entry requirements
Ecology and Ecosystem Sustainability (ECOS)	WMEE021-05	5	Yes	None
Energy, Atmosphere and Resources (EAR)	WMEE028-05	5	Yes	None
Modelling Energy Systems (MES)	WMEE025-05	5	Yes	None
Renewable Energy Systems (RES)	WMEE023-05	5	Yes	None
Sustainable Society (SUS)	WMEE020-05	5	Yes	None
Data Analysis and Statistical Methods (DASM)	WMEE001-05	5	Yes	None
Scientific Integrity	WMEE019-00	0	Yes	None

Table 2: Overview of the different variants

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

Variant 40/30				
YEAR 1				
Obligatory courses		30		
Electives, see Table 4 and 5		20 are required for electives in total		
YEAR 2				
Research Project 1 *including instructions on academic writing*	WMEE905-40	40	Yes	Obligatory courses ECOS, EAR, MES, RES, SUS, DASM, and Scientific Integrity EES module
Research Internship/Research Project 2	WMEE906-30	30	Yes	Research Project 1 and sufficient credits for electives
Variant Science, Business and Policy				
YEAR 1				
Obligatory courses		30		
Research Project 1 *including instructions on academic writing*	WMEE905-30	30		Obligatory courses ECOS, EAR, MES, RES, SUS, DASM, and Scientific Integrity EES module
YEAR 2				
Introduction Science & Policy	WMSE002-10	10		
Introduction Science & Business	WMSE001-10	10		
Work Placement Business and Policy	WMSE902-40	40		Research Project 1, Introduction to Science and Policy, Introduction to Science and Business

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 Table 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 is (are) not mentioned in Table 4 or 5. The student needs to motivate its choice. The mentor and the Board of Examiners have to approve this choice.
- Research Project 1 must be an internal project, performed at an ESRIG (Energy and Sustainability Research Institute) or affiliated group, under 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 organization has to be on academic level. The external supervisor is not an examiner, but is requested to give advice on the assessment.
- The subject of the SBP-work placement must be clearly related to the scientific domain of the EES master 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.
- 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), and *Scientific Integrity (EES)* (WMEE019-00).

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.

Appendix IV. Electives (art. 3.9.1)

Table 4: Overview of the electives offered by EES

Course unit	Course code	ECTS	Practical	Entry requirements
Global Change (GC)	WMEE008-05	5	Yes	
Climate Modelling (CM)	WMEE010-05	5	Yes	Global Change
Renewable Energy Technology (RET)	WMEE027-05	5	Yes	
Conceptualizing and Modelling Sustainability (CMS)	WMEE022-05	5	Yes	
Energy and Complexity Nexus (ECN)	WMEE012-05	5	Yes	
Experimental Methods in Environmental Science (EMES)	WMEE026-05	5	Yes	
Radiocarbon Dating and Analysis (RDA)	WMEE013-05	5	Yes	
Nuclear Power Technology (NPT)*	WMEE014-05	5	Yes	
Fuel Cell Systems (FCS)	WMEE015-05	5	Yes	
Energy and Sustainability in Practice (ESP)	WMEE024-05	5	Yes	
Geo-Energy and Subsurface Processes**	WMEE004-05	5	Yes	
Engineering Design Integration (EDI)	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 order of examinations are listed in Ocasys.

Appendix VI. Admission to the degree programme (art. 2.1A.1 + 2.1B.1)

Requirements for admission to the MSc Energy and Environmental Sciences:
Holders of the following Bachelor's degrees from the University of Groningen 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
- Applied Physics
- Artificial Intelligence
- Astronomy
- Biology
- Biomedical Engineering
- Chemical Engineering
- Chemistry
- Computing Science
- Industrial Engineering and Management Science
- Life Science and Technology
- Mathematics
- Pharmacy
- Physics

Appendix VII. Pre-master programmes

1. FSE offers Pre-Master's programmes of a maximum of *60 EC* for access to the MSc Energy and Environmental Sciences. Admission to the Pre-master's programme is granted on an individual basis by the Admissions Board.

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

- Chemical Engineering
- Chemistry
- Environmental Sciences
- Mechanical Engineering
- Other natural sciences and related engineering studies

The overview below shows an example of a standardized Pre-Master's programme based on one of the abovementioned types of qualifications:

Semester	Course Unit	Course Code	ECTS
Whole Year	Paper Energy	WBEE005-05	5
1a	Calculus 1 (for IEM)	WBIE003-05	5
1a	Introduction to Energy Systems	WBPH084-05	5
1b	Introduction to Energy & Environment	WBPH019-05	5
1b	Air Pollution*	WBPH035-05	5
1b	Solar Cells	WBCH018-05	5
2a	Physical Geography*	GEPG	5
2a	Applied Physics & Society: Ethical & Professional Aspects	WBPH082-05	5
2b	Climate System and Atmosphere	WBPH048-05	5
2b	Geo-Energy	WBPH018-05	5
Total			45

2. For HBO programmes not listed above, the Board of Admissions decides:
   a. The content and the student workload of a tailormade Pre-Master's programme.
   Or
   b. Admission is not accepted.

* Air Pollution or Physical Geography; this depends on previous education and knowledge and skills.

Appendix VIII. Transitional provisions (art. 7.1)

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 that did 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.

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Appendix IX. Additional Requirements Open Degree Programmes (art. 3.10)

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.