

## Appendices Master's degree programme Energy and Environmental Sciences

### Appendix A: Teaching outcomes of the Msc. Energy and Environmental Sciences (art. 1.3)

<b>EES Master General</b>
<b>A KNOWLEDGE</b>
A1) The Master has knowledge of principles, basic assumptions and historic development and the interdisciplinary and international character of EES.
A2) The Master has extensive knowledge of basic concepts and methods of EES and has knowledge of the interdisciplinary context of these concept and methods.
A3) The Master has knowledge of the quantitative and qualitative character of EES and has knowledge of the methodologies used in EES, including application and design of models.
A4) The Master has specialised knowledge of a number of recent issues and related methods within EES.
<b>B SKILLS AND ATTITUDES</b>
<b>B1 Performing research</b>
The Master can independently make a research plan and complete the research based on his specialism. The Master can deal with the complexity of the research process and if necessary can redirect the research with regard to external circumstances and/or new insights. The master is capable of evaluating and reflecting on scientific research within his specialism.
<b>B2 Solving (design) problems</b>
The Master can independently and based on his specialism formulate research questions and can address and evaluate them. The master can participate in an interdisciplinary team in order to jointly solve complex (design) problems.
<b>B3 Collecting data</b>
The Master can collect relevant information and data and is able to critically assess its scientific value. The Master is able to draw conclusions based on incomplete or limited information.
<b>B4 Cooperating</b>
The Master can cooperate in a multidisciplinary team aimed at solving complex problems.
<b>B5 Communicating</b>
The Master can verbally and in writing communicate, in English, his research as well as the underlying knowledge, motives and considerations to an audience of specialists and/or non-specialists.
<b>B6 Reflecting</b>
The Master can act critically and largely independently in an academic, scientific and professional context. The Master takes into account social and ethical considerations related to his research. The Master can make relevant choices with regard to the start of his career.

Final qualifications for IVEM- and CIO-track

The EES Master's degree programme has two tracks, or specialisations:

"Energy and Environmental Sciences" or IVEM-track

"Experimental studies of greenhouse gases and climate history" or CIO-track

"Energy and Environmental Sciences" is the more interdisciplinary track and is referred to as the IVEM-track. The teaching outcomes for this track are:

***IVEM-track teaching outcomes (in addition to “EES master general”).***

<b>IVEM-track</b>
<b>A KNOWLEDGE</b>
A1-1) The master has knowledge of the complex relations between energy and other resources (renewable en non-renewable) and societal functions related to various scales in space and time in the context of a transition to sustainability and environmental quality.
A1-2) The Master has knowledge of the relation between production and consumption systems in the context of a transition to sustainability and environmental quality.
A1-3) The Master has knowledge of technological and scientifically based methodologies within EES and can consider them within an individual, societal and policy context from an interdisciplinary perspective.
<b>B SKILLS AND ATTITUDES</b>
B1-1) The Master can independently perform scientific research based on methodologies to analyse and evaluate energy and resource issues from an integrated systems perspective.
B1-2) The Master can design realistic models and scenarios of energy and resource issues within clearly delineated system boundaries. The Master can evaluate model and scenario results with respect to sustainability, feasibility and acceptability.
B1-3) The Master can critically evaluate various data sources and can integrate them in his own research.

The track referred to as "Experimental studies of greenhouse gases and climate history" is the experimental and laboratory track related to CIO-research and therefore called CIO-track. The teaching outcomes for this track are:

***CIO-track teaching outcomes (in addition to “EES master general”).***

<b>CIO-track</b>
<b>KNOWLEDGE</b>
A2-1) The Master has knowledge of the various characteristics of the earth climate system, especially climate history, climate change and its contributing factors and more specifically the carbon cycle.
A2-2) The Master has knowledge of naturally occurring stable and radioactive isotopes. This comprises especially the chemical and physical aspects of the variation in isotope occurrence.
A2-3) The Master has knowledge of the use of natural isotopes as tracers, especially regarding applications in climate history and global cycles like that of water and carbon.
A2-4) The Master has knowledge of various techniques for the accurate measurement of isotope concentrations.
<b>SKILLS AND ATTITUDES</b>
B2-1) The Master can independently perform experimental scientific research using laboratory equipment and methods, especially those used at CIO (in particular isotope ratio measuring facilities).
B2-2) The Master is able to apply sophisticated software systems to run measuring equipment, analyse data, and to design and execute basic models.

## Appendix B: Specializations of the degree programme (art. 2.2)

The Msc. Energy and Environmental Sciences programme has two specializations:

1. Energy and Environmental Sciences (IVEM-track)
2. Experimental Studies of Greenhouse Gases and Climate History (CIO-track)

## Appendix C: Content of the degree programme (art. 2.3)+ Appendix E: compulsory order of examinations (art. 3.2)

### 1. Energy and Environmental Sciences (IVEM-track):

module	ECTS	entry requirements	assessment	practical
Introduction to Energy and Environmental Sciences (Intro EES) **	5	-	paper, oral presentation, assignments, exam **	
Resources and Sustainable Development (R&SD)**	15	Intro EES	assignments, presentations, papers, exam **	computerlab
Energy and Materials (E&M)	10	R&SD	projectwork, presentations, assignments, reports, exam	computerlab
Current Topics in Energy and Environmental Sciences (Current Topics)	5	R&SD	assignments, written report	
Optional modules	25	see appendix D	see appendix D	see app. D
Training Thesis*	25-45	R&SD, E&M, Current Topics	plan, process, presentation, written report	research
Master Thesis*	25-45	R&SD, E&M, Current Topics, optional courses, training thesis	plan, process, presentation, written report	research

\* training thesis and master thesis together at least 60 ECTS; \*\* all separate parts that are assessed have to be passed.

### 2. Experimental Studies of Greenhouse Gases and Climate History (CIO-track):

module	ECTS	entry requirements	assessment	practical
Introduction to Energy and Environmental Sciences (Intro EES) **	5	-	paper, oral presentation, assignments, exam **	
Resources and Sustainable Development (R&SD) **	15	Intro EES	assignments, presentations, papers, exam **	computerlab
Experimental Methods of Trace Gas Research (EMTGR)	5		assignments, lab reports, exam	x
Global Change	10	R&SD	assignments, written report, exam	computerlab
Current Topics in Energy and Environmental Sciences (Current Topics)	5	R&SD	assignments, written report	
Optional modules	20	see appendix D	see appendix D	see app. D
Training Thesis*	25-45	R&SD, EMTGR, Global Change, Current Topics	plan, process, technical and/or laboratory skills, presentation, written report	research
Master Thesis*	25-45	R&SD, EMTGR, Global Change, Current Topics, optional courses, training thesis	plan, process, (technical and/or laboratory skills), presentation, written report	research

\* training thesis and master thesis together at least 60 ECTS; \*\* all separate parts that are assessed have to be passed.

## Appendix D: Optional modules of the degree programme (art. 2.4)

1.

Each specialization has a separate package of optional modules.

### 1. Energy and Environmental Sciences (IVEM-track):

The IVEM track has 25 ECTS of optional modules. At least 15 ECTS have to be chosen from the following list of modules:

Optional course	EC	Faculty/Department
Experimental Methods of Trace Gas Research	5	FWN/EES (CIO)
Global Change A (+B)	5 (+5)	FWN/EES (CIO)
Introduction to Development Studies	6	Center for Development Studies
Zonnecellen (in Dutch)	5	FWN/Chemistry
Infrastructure Planning	5	Spatial Sciences
Environmental Planning	5	Spatial Sciences
Introduction GIS	5	Spatial Sciences
Water Management and Integrated Coastal Zone Management	5	Spatial Sciences
Projectmanagement (in Dutch)	5	Economics & Business
Environmental Economics	5	Economics & Business
Environmental Psychology	5	Behavioural & Social Sciences
Omgevingsrecht 1 (in Dutch)	6	Law School
Omgevingsrecht 2 (in Dutch)	6	Law School
Energy Law	5	Law School
European Environmental Law	6	Law School

After approval of the Board of Examiners 10 ECTS from the optional modules can be chosen from other modules than the courses in the list or can be added to the Training Thesis or Master Thesis.

### 2. Experimental Studies of Greenhouse Gases and Climate History (CIO-track):

The CIO-track has 20 ECTS of optional modules. At least 10 ECTS have to be chosen from the following list of modules (Possibilities depend on your background):

Optional course	EC	FWN Department
Energy & Materials	10	IVEM
Mathematical Methods for Physicists	5	Physics
Physics of Continuous Media	5	Physics
Physics of Electronic Devices	5	Physics
Principles of Measurement Systems	5	Physics
Statistical Methods in Physics	5	Physics
Signal Analysis	6	Physics
Sensors and Detectors	3	Physics
Zonnecellen (in Dutch)	5	Chemistry
Biocatalysis & Green Chemistry	5	Chemistry

After approval of the Board of Examiners 10 ECTS from the optional modules can be chosen from other modules than the courses in the list or can be added to the Training Thesis or Master Thesis.

## **Appendix F Admission requirements (art. 4.1; 4.2)**

The Msc. Energy and Environmental Sciences programme has two specializations:

1. Energy and Environmental Sciences (IVEM-track)
2. Experimental Studies of Greenhouse Gases and Climate History (CIO-track)

Each specialization has its own admission requirements.

### **1. Requirements for admission to the specialization Energy and Environmental Sciences (IVEM-track):**

Holders of the following Bachelor's degrees from the University of Groningen are considered to have sufficient knowledge and skills and will be admitted to the specialization Energy and Environmental Sciences (IVEM-track) of the Master's degree programme in Energy and Environmental Sciences on that basis:

- a Bachelor's degree in Biology
- a Bachelor's degree in Life Science and Technology
- a Bachelor's degree in Pharmacy
- a Bachelor's degree in Pharmaceutical Sciences
- a Bachelor's degree in Chemistry
- a Bachelor's degree in Chemical Engineering
- a Bachelor's degree in Physics
- a Bachelor's degree in Applied Physics
- a Bachelor's degree in Astronomy
- a Bachelor's degree in Mathematics
- a Bachelor's degree in Applied Mathematics
- a Bachelor's degree in Computing Science
- a Bachelor's degree in Industrial Engineering and Management

### **2. Requirements for admission to the specialization Experimental Studies of Greenhouse Gases and Climate History (CIO-track):**

Holders of the following Bachelor's degrees from the University of Groningen are considered to have sufficient knowledge and skills and will be admitted to the specialization Experimental Studies of Greenhouse Gases and Climate History (CIO-track) of the Master's degree programme in Energy and Environmental Sciences on that basis:

- a Bachelor's degree in Chemistry
- a Bachelor's degree in Chemical Engineering
- a Bachelor's degree in Physics
- a Bachelor's degree in Applied Physics
- a Bachelor's degree in Astronomy

## **Appendix G Application deadlines for admission (art. 4.5)**

<b>Deadline of Application</b>	<b>Non-EU students</b>	<b>EU students</b>
Nanoscience	February 1st 2009	February 1st 2009
Behavioural and Cognitive Neurosciences	February 1st 2009	June 1st 2009
Biomolecular Sciences (topprogramme)	February 1st 2009	April 15 <sup>th</sup> 2009
Evolutionary Biology (topprogramme)	February 1st 2009	February 1st 2009
Remaining FMNS Masters	April 15 <sup>th</sup> 2009	June 1st 2009