



# Course guide

## 820732 - EMAM - Energy and Environment

Last modified: 16/04/2024

**Unit in charge:** Barcelona School of Industrial Engineering  
**Teaching unit:** 713 - EQ - Department of Chemical Engineering.

**Degree:** ERASMUS MUNDUS MASTER'S DEGREE IN ENVIRONMENTAL PATHWAYS FOR SUSTAINABLE ENERGY SYSTEMS (Syllabus 2012). (Compulsory subject).  
MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Compulsory subject).  
MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).  
MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2022). (Compulsory subject).

**Academic year:** 2024    **ECTS Credits:** 5.0    **Languages:** English

### LECTURER

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**Coordinating lecturer:** Valderrama Angel César A.

**Others:** Valderrama Angel César A.

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Specific:**

CEMT-3. Assess the economic, social and environmental impact of the production, use and management of energy, with a holistic view of the life cycle of the different systems, and recognise and value the most remarkable developments in the fields of energy efficiency and the rational use of energy.

**Transversal:**

CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

### TEACHING METHODOLOGY

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The course is divided into four types of sessions:

- a) Theoretical Lectures
- b) Project-based learning
- c) Case studies
- d) Conferences and Webinars

### LEARNING OBJECTIVES OF THE SUBJECT

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At the end of the course the student will be able to:

- Distinguish between the concepts of the use of energy resources and energy efficiency in terms of sustainable development
- Demonstrate a good knowledge and understanding of the tools used for emissions assessment with emphasis on carbon footprint and Life cycle assessment.
- Determine the sources of pollution and the effects on the environment caused by energy systems and their environmental impact.
- Identify and assess the factors that determine the transport and dispersion of atmospheric pollutants.
- Evaluate the technological, environmental and economic feasibility of an energy system through the life cycle perspective



## STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	24.90
Self study	80,0	66.39
Hours small group	10,5	8.71

**Total learning time:** 120.5 h

## CONTENTS

### Sustainability, Energy and Environment

**Description:**

Sustainability conceptual introduction  
Sustainability assessment  
Sustainability and Energy  
Energy Efficiency  
Sustainability integrated into current public policy making  
Energy Efficiency in EU  
EU Green deal

**Specific objectives:**

At the end of this topic, students will be able to:  
Identify the elements of the sustainable development and the social, economic and environmental challenges related to the energy management  
Distinguish between the concepts of the use of energy resources and energy efficiency in terms of sustainable development

**Full-or-part-time:** 10h

Theory classes: 4h  
Guided activities: 2h  
Self study : 4h

### Life Cycle Assessment

**Description:**

Standards and guidelines  
Life Cycle Thinking  
Types of analysis  
Framework  
Inventory analysis  
Allocation  
Impact assessment  
Carbon Footprint

**Full-or-part-time:** 16h

Theory classes: 6h  
Guided activities: 4h  
Self study : 6h



### Life Cycle Costing

**Description:**

LCC as a complement to LCA  
LCC Methodology  
Key concepts of LCC  
Working flow for an LCC

**Full-or-part-time:** 8h 30m

Theory classes: 4h  
Guided activities: 2h  
Self study : 2h 30m

### Social Life Cycle Assessment

**Description:**

Background and aim of Social LCA  
Technical framework  
Databases  
Social impacts screening  
Hotspot's identification

**Full-or-part-time:** 8h 30m

Theory classes: 4h  
Guided activities: 2h 30m  
Self study : 2h

### Air Pollution and Atmospheric Dispersion

**Description:**

Types and sources of outdoor air pollution  
Overview of environmental air policies  
Meteorological factors affecting transport and dispersion  
Atmospheric stability  
Dispersion modelling  
Gaussian model

Characteristics of a contaminant plume.  
Inversion.  
The Gaussian dispersion model

**Specific objectives:**

At the end of this topic, students will be able to:  
Identify concepts, dispersion, transport and the effects of meteorological parameters on the dilution of pollutants  
Identify the different levels of complexity in modelling the dispersion of pollutants  
Apply mathematical representations (Gaussian model) to describe the process of dispersion of pollutants under different situations (Inversion, linear source pollution, etc. .)  
Interpret the results obtained from the point of view of air pollution reduction and also of air quality control

**Full-or-part-time:** 11h 20m

Theory classes: 3h  
Guided activities: 3h  
Self study : 5h 20m



### Effects of air pollution and Gas Treatment

**Description:**

Ozone layer depletion  
Acid deposition  
Photochemical smog  
Gas cleaning systems  
NOx control technologies  
Flue Gas Desulfurization  
VOCs Thermal oxidation and Catalytic combustion  
Environmental prices for air pollution

**Specific objectives:**

At the end of this topic, students will be able to:  
Distinguish between local and global effects of air pollution  
Recognize the implications of air pollution

**Full-or-part-time:** 7h

Theory classes: 3h  
Guided activities: 2h  
Self study : 2h

### Climate Change and Carbon Capture and Utilization

**Description:**

Earth's energy balance  
Radiative forcing  
Forcings vs Feedbacks  
Paris agreement  
Climate change effects  
Environmental carbon price  
Carbon capture systems  
Cost of carbon capture and storage  
Carbon capture and utilization

**Full-or-part-time:** 7h

Theory classes: 3h  
Guided activities: 2h  
Self study : 2h

### Circular Economy and Technological Challenges

**Description:**

Circular Economy Framework  
Urban Mining  
Waste to Energy/Resources  
Technological Challenges for the Energy Transition

**Full-or-part-time:** 7h

Theory classes: 3h  
Guided activities: 2h  
Self study : 2h

## GRADING SYSTEM

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Written exams: 35%  
Work done individually or in groups during the course: 15%  
Project progress through the course: 40%  
Quality and performance of project: 10%

## BIBLIOGRAPHY

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### Basic:

- Vallero, Daniel A. Fundamentals of air pollution [on line]. 5th ed. Waltham, MA: Academic Press, cop. 2014 [Consultation: 19/04/2023]. Available on: <https://www.sciencedirect-com.recursos.biblioteca.upc.edu/book/9780124017337/fundamentals-of-air-pollution>. ISBN 9780124017337.
- Sioshansi, F.P. Energy, sustainability and the environment: technology, incentives, behaviour. Amsterdam: Elsevier/Butterworth-Heinemann, cop. 2011. ISBN 9780128103760.
- Tiwary, Abhishek; Willians, Ian. Air pollution: measurement, modelling and mitigation. 4th ed. Boca Raton: CRC Press, 2019. ISBN 9781138503663.
- Fay, James A. ; Golomb, D. Energy and the environment. New York: Oxford University Press, 2002. ISBN 0195150929.

### Complementary:

- Hill, Marquita K. Understanding environmental pollution. 4th ed. Cambridge ; New York: Cambridge University Press, 2020. ISBN 9781108423083.
- Arons, Jakob de Swaan; Kooi, Hedzer van der; Sankaranarayanan, Krishnan. Efficiency and sustainability in the Efficiency and sustainability in the energy and chemical industries [on line]. New York; London: Marcel Dekker, 2014 [Consultation: 19/09/2022]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=216130>. ISBN 9781280096815.
- Schnelle, Karl B. ; Russell Dunn ; Mary Ellen Ternes.. Air pollution control technology handbook [on line]. 2nd ed. Boca Raton [etc.]: Taylor & Francis, 2016 [Consultation: 13/10/2022]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=4009619>. ISBN 042915643X.