Course guide
820730 - REG - Energy Resources

Last modified: 08/04/2026

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 748 - FIS - Department of Physics.

Degree: 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: 2026 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: Batet Miracle, Lluis

Others: Arranz, Pol
Rives Sanz, Ronny

PRIOR SKILLS

The typical of the Master's accessing degrees.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMT-1. Understand, describe and analyse, in a clear and comprehensive manner, the entire energy conversion chain, from its status as an energy source to its use as an energy service. They will also be able to identify, describe and analyse the situation and characteristics of the various energy resources and end uses of energy, in their economic, social and environmental dimensions, and to make value judgments.

Transversal:
CT2. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

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

The course is structured around a series of sessions, which provide the skeleton supporting the other course activities. Sessions include conferences and practical exercises (which are ideated to be synchronous), and are complemented with asynchronous learning materials that students must watch, read or, in some cases do, before the synchronous session.

The conferences will equip the students with elements of thought and reflection about several aspects of the energy systems. A number of "practical" sessions will be programmed, which will be of two types. In some sessions, students (working in teams) will try to solve a set of exercises related to the contents of the course, under the guidance of the teacher. In other sessions, students will participate in workshops, discussions, and debates, incorporating some aspects of the social sciences related to energy.

In parallel, students will have to work in the asynchronous part of the course (readings, essays, exercises, and one project). Students will be proposed a series of exercises and activities to be developed out-of-the-classroom. The statements and guidelines for these activities will be posted in the digital campus ATENEA.

During the semester the students will work, in teams of 3 or 4 people, on a tutored project about a specific energy topic, and will write a technical report on that topic, which they will defend in front of their tutor. In some cases, depending on the subject, it will be possible to write a general scope article instead of the technical report.

An online version of the sessions will be available for SELECT students at KTH and UNITE! mobility students.

LEARNING OBJECTIVES OF THE SUBJECT

The course intends to provide an overarching outlook of the energy systems from different standing points. In order to do so, during the course, transversal concepts complementing and synthesising the contents of other courses will be introduced. Moreover, the analyses will encompass a broad spectrum of disciplines, from science and technology to economics, and to other social sciences and humanities.

General Learning Objectives:

Knowledge. Upon the completion of the course, the student should be able to:
- Reflect on the need for energy and its relationship to sustainable human development.
- Analyse the implications of all the transformations converting "energy source" in "energy service", by acknowledging the complexity of the energy system.
- Discuss the multiple implications (for society, environment, economy, etc.) of an energy system's structure.

Skills. Upon the completion of the course, the student should be able to:
- Perform basic calculations about the performance of different energy systems: energy balances (input-output), environmental impact, economic cost, energy storage needs, etc.
- Express and support their ideas in an effective manner both in spoken debates and in written communications.

Attitudes. The course intends:
- To raise students' awareness of the interrelationship of aspects such as energy efficiency, economy, human development, environmental impact, security of supply, etc.
- To raise students' awareness of social aspects of energy use.
- To develop in the students the values of justice, solidarity and equality from the fact of relating conflict and underdevelopment situations with the global energy needs.

STUDY LOAD

Type	Hours	Percentage
Self study	80,0	64.00
Hours large group	45,0	36.00

Total learning time: 125 h

CONTENTS

Course contents

Description:
The contents of the course are transversal and aimed to summarize a knowledge which, in most of the cases, is the object of other courses. In the context of this course, it is considered important to explore the interrelationships of all the concurrent factors in the structure of the energy system and the implications of this structure.

Full-or-part-time: 125h
Theory classes: 45h
Self study : 80h

ACTIVITIES

Course sessions

Description:
The course is structured around a series of sessions, which provide the skeleton supporting the other course activities. Sessions include conferences and practical exercises (which are thought to be synchronous), and are complemented with asynchronous learning materials that students must watch, read or, in some cases do, before the synchronous session.

The conferences will equip the students with elements of thought and reflection about several aspects of the energy systems. A number of "practical" sessions will be programmed, which will be of two types. In some sessions, students (working in teams) will try to solve a set of exercises related to the contents of the course, under the guidance of the teacher. In other sessions, students will participate in workshops, discussions, and debates, incorporating some aspects of the social sciences related to energy (this part of the course is aligned with the TEACHENER project, http://www.teachener.eu/, an ERASMUS+ project partnered by UPC).

Specific objectives:
The contents of the course are transversal and aimed to summarize a knowledge which, in most of the cases, is the object of other courses. So, listing low level objectives is unnecessary here. In the context of this course, it is considered important to explore the interrelationships of all the concurrent factors in the structure of the energy system and the implications of this structure.

Limiting the list of objectives to those of high level in Bloom's Taxonomy, at the end of this course, students will be able to:
1. Describe a certain energy conversion chain from the source to the product and make calculations of varying complexity related to it (e.g. how much energy is required to produce a tin can?).
2. Determine the suitability of a particular energy solution (expressed as pros and cons) for a particular need (e.g. use of natural gas to produce electricity, future use of electric vehicles vs. hybrid vehicles, etc.) from global data on energy economy and from environmental impact and energy efficiency analyses.
3. Discuss the geopolitical implications of the use of different energy resources.
4. Reflect on the relationship between the energy use and the human development, providing examples of different World regions (e.g. comparing per capita energy consumption vs. HDI).
5. Compare the environmental impact of different energy solutions.
6. Explain the relationship, expressed in terms of energy intensity, between energy consumption and economy in a country.
7. Analyse the security of energy supply in a region from cyclical and structural data.
8. Give a reasoned opinion on the projections and scenarios of future global and regional energy demand, considering the complexities of the energy system.
9. Give a reasoned opinion on the energy demand and the adequacy of the present coverage of energy services (e.g. railroad vs. automobile mobility) and on the essence of these services themselves (e.g. mobility vs. urban planning).
10. Synthesis of information (e.g. statistical data) from diverse sources.

Material:
In the virtual campus ATENEA all the documents related with the sessions will be made available to the students at due time, including the slides (and, if needed, a recorded video) of the presentations.

Delivery:
At the end of each practical session, the groups will deliver a copy of the work done during the session.

The attendance to synchronous sessions is mandatory. To be eligible for qualification, a minimum 75% attendance to these activities will be required.

Related competencies :
CEMT-1. Understand, describe and analyse, in a clear and comprehensive manner, the entire energy conversion chain, from its status as an energy source to its use as an energy service. They will also be able to identify, describe and analyse the situation and characteristics of the various energy resources and end uses of energy, in their economic, social and environmental dimensions, and to make value judgments.
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.

CT2. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use

technique, technology, economics and sustainability in a balanced and compatible manner.

Full-or-part-time: 40h
Theory classes: 27h
Guided activities: 13h

Tutored course project

Description:
Students, in groups of three or four, will develop a course project throughout the semester.

Specific objectives:
Students must demonstrate that:
- they have achieved the specific objectives of the various topics of the course related to their project.
- they have achieved higher level objectives in the development of the course project.

It is intended that students develop the following skills by doing the course project:
- Teamwork
- Search and processing of information related to energy and environmental issues
- Writing technical reports
- Identification of the added value
- Evaluation of the quality of a technical report
- Presentation and oral defence of technical reports

It is also intended that students:
- Develop a matrix of values regarding issues such as risk, environmental impact, security of supply, access to energy, economic optimization, societal and human development, etc.
- Think about a set of values such as solidarity, dialogue, honesty and justice.

Material:
Students will have a guide relative to the project in the virtual campus. This guide describes the requirements of form and content and of interaction with the tutor, along with the project's evaluation criteria.

Students may choose the topic of the project from a list of subjects that will be available as well on the virtual campus.

Delivery:
The project will be delivered by the end of the semester. Afterwards, the defence of the project will take place. The defence will consist of a group and an individual session. Therefore, the qualification of the project will have both team and individual components.

The detection of plagiarism or copying of this activity will cause the automatic suspension of qualification of the whole course.

Full-or-part-time: 42h
Guided activities: 2h
Self study: 40h

Other activities

Description:
Students will perform activities individually or in teams (depending on the activity) and will submit a deliverable with a given deadline. The expected duration of each activity will depend on its scope. In some cases, if the type of activity allows it, assessment by peers will be used.

Specific objectives:
Will be defined for each activity.

Material:
The description of each activity will be available to the students in the virtual campus ATENEA. The description will provide information about possible sources of information (if needed) as well as the evaluation criteria.

Delivery:
A deadline will be set for each activity. To qualify for the assessment of the activities, students must validate their work. Defence (online) sessions will be scheduled, if needed, for the validation of some of activities. Other activities will be validated by means of online questionnaires or by specific exam questions.

The detection of plagiarism or copying in the activities will cause the automatic suspension of qualification of the whole course.

Full-or-part-time: 40h
Self study: 40h

Final exam

Description:
Students will have a written final exam aimed at the assessment of their achievement of the objectives of the course. The exam will consist of a descriptive part, about the several topics addressed in the sessions, and a practical part where the student will have to solve some exercises.

Full-or-part-time: 3h
Theory classes: 3h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

The course evaluation is based on the student self-learning activities, on the tutored team project, on small activities done in the classroom and on the final exam.

The relative weight of each of the self-learning activities in the final mark will be approximately proportional to their duration.

To qualify for the assessment of the activities and the course project, students must validate their work. Defence sessions will be scheduled, if needed, for the validation of some of activities. Other activities will be validated by means of online questionnaires or by specific exam questions.

Weight of each part in the final qualification if the grade in the exam is greater than or equal to 3.5:
30% Final exam
30% Tutored course project
30% Other individual or team activities along the semester
10% Activities done in the classroom

Weight of each part in the final qualification if the grade in the exam is less than 3.5:
70% Final exam
10% Tutored course project
10% Other individual or team activities along the semester
10% Activities done in the classroom

Attendance to the synchronous activities is mandatory. In order to be evaluated of the course, a minimum 75% attendance to the synchronous sessions is required. In case this requirement is not fulfilled, the student will be considered as Not Shown. Students not meeting this requirement will have no option to retake.

EXAMINATION RULES.

Attendance to synchronous activities is mandatory. In order to be evaluated of the course, a minimum 75% attendance to the synchronous activities (conferences and practical sessions) is required. Students failing to comply with this requirement will be graded as Not-Shown and will not have option to retake.

By synchronous we mean that interaction teacher-student takes place in the same timeframe. It is the case of contact (in the classroom)
activities, and also the case of some online activities.

The evaluation of individual and team activities will depend on the results of the validation test. In the case of the course team project, the final defence (in group and individual) will be used as validation test. For other activities suitable controls will be established.

The detection of plagiarism or copying in any learning activity or the final exam will cause the automatic suspension of qualification of the whole course. In this case, students will have no option to retake.

Deadlines will be established for the different activities. Failing to meet a deadline will entail a penalization in the assessment of the activity.

BIBLIOGRAPHY

Complementary:
- Smil, Vaclav. Power density: a key to understanding energy sources and uses [on line]. Cambridge: The MIT Press, 2015 [Consultation: 12/09/2025]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5891215. ISBN 9780262529730.
- Smil, Vaclav. How the world really works : a scientist's guide to our past present and future. London: Penguin, 2022. ISBN 9780241989678.
- Rifkin, Jeremy. The third industrial revolutio : how lateral power is transforming energy, the economy, and the world [on line]. New York: Palgrave MacMillan, 2011 [Consultation: 30/03/2026]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=3136536 1. ISBN 9780230115217.
- Högselius, Per. Energy and Geopolitics [on line]. Abingdon, Oxon ; New York, NY: Routledge, 2019 [Consultation: 30/03/2026]. Available on: https://www-taylorfrancis-com.recursos.biblioteca.upc.edu/books/mono/10.4324/9781315177403/energy-geopolitics-per-h%C3%B6gselius. ISBN 9781315177403.

RESOURCES

Other resources:
Course materials, class-notes, presentations, exercises and additional material will be made available in ATENEA