INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

DPT GENIE ENERGETIQUE ET ENVIRONNEMENT
ENERGETICS AND ENVIRONMENTAL ENGINEERING
INSA Campus LyonTech - 9 rue de la Physique
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Energy

Energy transition: from fossil fuel to renewable energy

IDENTIFICATION

CODE : GEN-5-S1-EC-EX-REN
ECTS : 8.0

HOURS

Lectures :	40.0 h
Seminars :	8.0 h
Laboratory :	0.0 h
Project :	8.0 h
Teacher-student contact :	56.0 h
Personal work :	24.0 h
Total :	80.0 h

ASSESSMENT METHOD

Multiple Choice Questions: 50%
Project: 50%

Project deliverable:
- 1 project review
- 1 final PowerPoint presentation of 45 minutes including questions

Project evaluation:
50% by the professors
50% by the students
Step 1: professors give a grade to the group (for example 12/20)
Step 2: each student of the group gets half of this grade (in the example a basis of 6/20)
Step 3: each student will give an anonymous participation grade to the other students of the group except himself
Step 4: a weighted average of this note is added to the basis grade for each student

TEACHING AIDS

Slide shows

TEACHING LANGUAGE

English

CONTACT

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AIMS

OBJECTIVES OF THIS COURSE :
To present the main non-technological issues related to the energy sector in the context of energy transition.
To apply the knowledge acquired in the lessons, in the frame of a project involving groups of 3 to 5 students. During this project, the students will have to work on the energy mix of a chosen country.

As an introduction to this course, a synthesize of the main lessons of the report on "the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways" issued by the International Panel on Climate Change (IPCC) in October 2018 is presented. A particular focus is placed on the current use of land and energy and the scenarios to be implemented to limit their impact on the climate.

The first part of this course presents a history of the use of energy and land by human activities is presented. Starting with agriculture era, it then introduces the different energy sectors and the barriers that had to be removed to allow their development. This introduction makes it possible to become aware of the challenges and the issues to be taken up in order to implement a rapid energy transition towards decarbonated energies.

The second part of this course is dedicated to renewable energies.
At the end of this part, the student will have knowledge of the different ways of converting primary renewable energy into useful energy as well as the different economic and technical stakes related to each of the sectors: management of intermittency, supply, etc. He will be able to carry out a first dimensioning of the main elements of the installation as well as to conduct annual performance studies using dedicated simulation tools. Energy sources covered: solar (PV, thermal and thermodynamic), hydraulic, wind, geothermal.

The third part of the course is dedicated to fossil and nuclear energy. At the end of this course, students should understand the operation of a nuclear power plant and compare its advantages and disadvantages compared to other sectors. They will also have acquired the knowledge necessary to understand the issues related to the fossil fuel sector, from exploration/production to refining.

The fourth part of this course aims to provide engineering students with the main keys to understanding the major non-technical issues related to energy.

SKILLS :
This course contributes to the following skills:
A1 Analyze a real or virtual system (or problem) (Level 2)
C6 Integrating the major challenges of the energy transition: technical, economic, legal and environmental aspects (level 2)
B5 Acting responsibly in a complex world (Level 2)

In addition, it requires the mobilization of the following skills:
C1 Designing, dimensioning, managing and optimising energy systems in complex and varied contexts (city, industry, transport)
C2 Design, size, and optimize process engineering facilities

By allowing the student to work and be evaluated on the following knowledge:
- Knowing the wind, photovoltaic solar, thermal and thermodynamic, geothermal and hydraulic sectors: history, definition, evaluation of the potential, typical technological solutions, regulations, etc.
- Knowing the nuclear industry: history, fuel cycle, waste treatment, risk management, nuclear power plant principle
- Knowing the resources, the stakes and the major stages of the upstream to downstream hydrocarbon industry
- Knowing the issues related to mining materials for energy
- Knowing the issues and principles of the electricity market

By allowing the student to work and be assessed on the following abilities:
- Being able to discuss the benefits and risks of the wind, solar, geothermal and hydraulic sectors in a reasoned manner.
- Be able to discuss the benefits and risks of the nuclear industry in a well-argued manner.
- Be able to discuss the benefits and risks of the hydrocarbon sector in a reasoned manner.
- Be able to discuss the benefits and risks of mining resources for energy in a reasoned manner.
- Be able to discuss the electricity market in an argumentative manner.

CONTENT

Lessons and tutorials
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Climate change
This introduction synthesizes the main lessons of the report on ¿the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways¿ issued by the International Panel on Climate Change (IPCC) in October 2018. In this presentation, some historical perspectives on the earth past climate are presented, as well as the current state of global warming and its consequences at +1°C, +1.5°C and beyond. An analysis of the remaining carbon budget not to exceed the 1.5°C limit is also presented, as well as the techno-economic scenarios that make it possible to achieve this objective and their impact on the 17 sustainable development objectives proposed by the United Nations.

History
This section presents a human history of energy. It discusses the evolution of human energy consumption from food needs and energy resources for agriculture, the advent of fossil fuels and their uses, and finally the history of the use of renewable energy.

Renewable energies (solar, wind, hydro, geothermal)
Introduction and approach: history, advantages, disadvantages, dimensioning elements, potential, limits, development strategies, etc.
Introduction to GIS (Geographical Information System)using Qgis.

Nuclear
- The energy situation worldwide and in France (reserves, production). The share of nuclear power
- Fission, kinetics and dynamics of reactors
- The various nuclear sectors, including the supergenerator and the EPR
- Pressurized water reactors, neutron balance, operation, technological description
- Waste, fuel, environmental safety, human reliability (Chernobyl, Three Miles Island, etc.)

Fossil Fuels
- The place of fossil resources in the energy mix
- Presentation of the upstream hydrocarbon: concept of reservoir, reserves, extraction methods, etc.
- Presentation of the downstream hydrocarbon: notions of refining, oil markets, etc.

Materials for energy transition
- Overview of mineral requirements and resources that play a role in energy transition

Project
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During this project, the students will have to work in groups of 3 to 5 on the energy mix of a chosen country. They have to trace the energy profile of this country including:
- Historical evolution
- Geographical profile
- Energy consumption and production
- Electrical Energy and other energy sectors
- Importation & exportation
- CO2 content of electricity
- Cost/ politics
- Policies
- Population acceptability

The work must be based on well referenced facts (figures, graphs, tables) and not declarative sentences.

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