The general objective of the course is to introduce students to the problems associated with energy management in our society and the consequences and effects on the environment in terms of pollution with special emphasis on air pollution. The course aims to identify the effects of energy production and to introduce principles and tools, especially those aimed at preventing and minimizing gas emissions. Familiarize students with the tools to predict the behaviour of contaminants using basic models of transport and dispersion and to determine the air quality at a specific point. Introducing the basic knowledge that allows selecting the most appropriate technology for a treatment according to the type of pollutant, environment, and relevant environmental laws and regulations.
laws and regulations.

### Study load

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours (h)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total learning time</strong></td>
<td>30</td>
<td>24.00%</td>
</tr>
<tr>
<td>Hours large group:</td>
<td>15</td>
<td>12.00%</td>
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<tr>
<td>Guided activities:</td>
<td>80</td>
<td>64.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Sustainability, Energy and Environment

**Description:**
Sustainable development
Sustainable use of resources
Energy efficiency

**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

<table>
<thead>
<tr>
<th>Learning time: 10h</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 4h</td>
<td></td>
</tr>
<tr>
<td>Guided activities: 2h</td>
<td></td>
</tr>
<tr>
<td>Self study : 4h</td>
<td></td>
</tr>
</tbody>
</table>

### Air Pollution

**Description:**
Air pollutants resulting from energy generation processes
Primary and secondary pollutants
Overview of environmental policy and legislation relevant to air pollution

**Specific objectives:**
At the end of this topic, students will be able to:
Identify the most important constituents of the atmosphere and their importance for living organisms, climate, etc.
Classify the most representative pollutants and their emission sources arising from energy production
Identify the types of pollutants and distinguish the maximum permitted levels of emissions and air quality legislation

<table>
<thead>
<tr>
<th>Learning time: 13h</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 2h</td>
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<td>Practical classes: 3h</td>
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<tr>
<td>Guided activities: 4h</td>
<td></td>
</tr>
<tr>
<td>Self study : 4h</td>
<td></td>
</tr>
</tbody>
</table>
# Effects of air pollution

**Description:**
Global effects: ozone layer depletion
Local and regional effects: acid rain, photochemical smog,
Climate change. Global energy balance and radiative forcing, International agreements, commitments within the EU.
Prevention measures and international emissions trading system

**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 on climate change and identify the principles that determine the emissions trading

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# Emission inventories and Carbon Footprint

**Description:**
Emissions inventory
European regulation of air emissions inventories. International regulations.
General methodology. Specific methodologies for different types of sources
Carbon Footprint Methodology

**Specific objectives:**
At the end of this topic, students will be able to:
- Identify standards and methodologies for emissions inventories
- Develop a basic inventory from an industrial process, from a natural or urban system.
## Treatment and control systems for particles and dust

**Learning time:** 5h  
Theory classes: 1h  
Practical classes: 1h  
Guided activities: 1h  
Self study : 2h

**Description:**  
Treatment types  
Dry treatments  
Wet treatments  
Filtration treatments

**Specific objectives:**  
At the end of this topic, students will be able to:  
Classify technologies according to process parameters (flowrate, particle size distribution)  
Calculate treatment system efficiencies from design parameters and working conditions.

## Gas cleaning systems

**Learning time:** 8h  
Theory classes: 2h  
Practical classes: 0h  
Guided activities: 2h  
Self study : 4h

**Description:**  
Prevention systems: low emission burners, chemical reduction methods  
Absorption, adsorption, condensation, biofiltration.  
Thermal oxidation.  
Catalytic an non-catalytic combustion  
CO2 capture and sequestration technologies

**Specific objectives:**  
At the end of this topic, students will be able to:  
Distinguish among different treatment and cleaning technologies, and to identify the most suitable technology for each pollutant in a given regulation environment.  
Identify the design parameters for each technology, and to apply them to real air pollution cases.
### Atmospheric dispersion

**Learning time:** 20h  
- Theory classes: 4h  
- Practical classes: 2h  
- Guided activities: 4h  
- Self study: 10h

**Description:**  
Emission, transport and receptor point concepts  
Meteorological factors influencing the dispersion.  
Point and linear sources of pollution.  
Characteristics of a contaminant plume.  
Inversion.  
Overview of dispersion models and reaction of pollutants in the atmosphere  
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

### Management of radioactive waste

**Learning time:** 6h  
- Theory classes: 2h  
- Practical classes: 0h  
- Guided activities: 0h  
- Self study: 4h

**Description:**  
Management of low and intermediate level radioactive waste  
Management of high level radioactive waste  
Multi-barriers system description  
Long-term performance assessment analysis

**Specific objectives:**  
At the end of this topic, students will be able to:  
- Identify the management criteria for safe disposal of low, intermediate and high level radioactive wastes  
- Recognize the technological challenges associated to the management of this type of waste
820732 - EMAM - Energy and Environment

Qualification system

Written test control of knowledge: 50%
Work done individually or in groups during the course: 25%
Attendance and participation in practical activities: 15%
Quality and performance of group work: 10%

Bibliography

Basic:


Complementary:

