UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

# Energy and water for a sustainable world

**2526-BbetweenSDG-08-04**

## Module description

Without energy and water, we cannot satisfy basic human needs, produce food for a rapidly growing population or achieve economic growth. Water–Energy Nexus deals with the efficient integration of water and energy resources in order to tackle a wide range of design, operation and optimization issues for systems including both of these two resources. Many problems such as the supply and the continuous availability of the resources, their quality and safety, the environmental and social impacts, along with the cost and/or profit emerged from their exploitation, are problems encountered in a very wide range of real situations. Food is in most cases involved due to its strong interaction with the other two utilities. The course has the intention of analyze the strict relationship between water and energy. In our modern society, a large quantity of water is used for energy production, including both electricity and sources of fuel including oil and natural gas. In parallel, energy is consumed to extract and purify materials, deliver, heat/cool, etc. Moreover, energy is consumed also to treat and dispose water (and wastewater) and to purify drinking water. Water-Energy Nexus is not truly a closed loop as the water used for energy production need not be the same water that is processed using that energy. In turn, all the forms of energy production require some input of water making the relationship inextricable. However, both water and energy are within a delicate equilibrium which need to undergo a sustainable approach. Sustainable utilization of water and energy and their interconnection will be highlighted and discussed.

## Learning goals

This course is an introduction to the topic of Water-Energy Nexus.

## General goal

To educate to critical thinking, the students need to first identify the problems related to a certain topic. The Water-

Energy Nexus course intend to create an adequate awareness of the importance of water (and its quality) and energy (and its quality) in the modern society. This will be done explaining and highlighting the inextricable relationship existing between the two and the consequences that the society can face if a misuse of these resources is pursued.

## Specific skills and competences

The students will acquire competences on the entire water cycle and on the scarcity of the resource identify the quality standards needed in the society. The students will acquire knowledge on climate change and man global warming. The students will also acquire knowledges related to wastewater treatment and drinking water treatment through a “virtual” travel within a treatment plant identifying and discussing the different treatment sections. The students will acquire competences also on energy and the different energy sources that are currently used: fossil and renewable. Advantages and disadvantages will be discussed also in the view of sustainability. The students will learn about the interconnection between water and energy and its cardinal equilibrium.
The course aims to stimulate the critical thinking of the students, educate them towards the critical utilization of important resources such as water and energy by integrating transversal and different disciplinary fields. The evaluation of a technology for water treatment or energy generation in terms of energy used (first case) or water utilized (second case) give to the students the possibility of select the most sustainable technology. By understanding the problems, it is possible to face them and solve them through a critical analyzing, knowing the possible solutions.

## Sustainable Development Goals of the 2030 UN Agenda

The course proposed is coherent with at least three goals of the 2030 UN Agenda and particularly:
GOAL 2: Zero Hunger (sustainable solutions for cleaning water will be discussed)
GOAL 6: Clean Water and Sanitation (Water treatment and drinking water treatment will be discussed proposing alternatives)
GOAL 7: Affordable and Clean Energy (Energy consumptions in relationship with water availability and treatment will be discussed proposing alternatives)

## Breakdown of meetings

The course water-energy nexus will be divided in 6 classes of 2 h each.
Meeting 1 (2 h). Water and its importance. Cycle of water. Carbon and its importance. Cycle of carbon. Water and Carbon as greenhouse gas and their effects on global warming.
Meeting 2 (2 h). Wastewater treatment. Large scale and small-scale treatment plant. Energy used.
Meeting 3 (2 h). Drinking water treatment. Large scale and small scale. Energy used.
Meeting 4 (2 h). Energy production and utilization. Fossil vs Renewable energies: advantages and disadvantages, outlook and perspectives.
Meeting 5 (2 h). Energy for water and water for energy. Mass and Energy balance with roadmap.
Meeting 6 (2 h). Water-Energy-Food Nexus.

## Number of participants

No limitation of participants

## Language used in meetings

English

## Delivery period of the module

Online and recorded.
Recorded classes from previous years are already available.
Classes will be recorded also this year, however the contents are identical of the one already available.

## Methods of assessing the outcomes of the learning process

30 questions multiple choice.

Eventually, the instructor might ask a supplementary oral exam to evaluate the knowledge of the student.
If asked by the instructor, the oral exam becomes mandatory for completing the exam. In this case, if the student refuse to make the oral exam, the student will not be able to do any further multiple choice exam within the year.

- Exam 8/04 room U9-05 (106 posti). time of the exam: 16.30-18.30
- Exam 14/05 room U1-04 (97 posti). time of the exam: 15.30-17.30
- Exam 22/05 room U9-06 (270 posti). time of exam: 15.00-17.00

## Department of affiliation of the teacher

Department of Materials Science

## Sustainable Development Goals

ZERO HUNGER | CLEAN WATER AND SANITATION | AFFORDABLE AND CLEAN ENERGY