2ND LEVEL SPECIALIZING MASTER'S PROGRAMME

CLIMATE CHANGE: ADAPTATION AND MITIGATION SOLUTIONS

2022 EDITION

PROGRAMME SYLLABUS

Programme director
Prof. Marco Piras

Politecnico di Torino

master school

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Programme Timetable

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An Introduction to Climate Change (30h)

January 31st – February 4th

Lecturer in charge of the module

Prof. Pietro Salizzoni (Full Professor, École Centrale de Lyon) - PS
pietro.salizzoni@ec-lyon.fr

Module Learning Objectives and Skill Acquisition

The introductory part of the course summarises our knowledge of the climate system and the way that it operates. We begin by looking at radiative transfer in the atmosphere and how energy moves between different levels and forms. We will introduce the concepts of radiative forcing, climate sensitivity and show have simple models predicts peculiar behaviour of the climatic system, notably resulting in multiple equilibria.

We move next to the atmosphere, ocean, and cryosphere. We look at the polar vortex, the jet stream, and other mechanisms by which energy is transferred within the atmosphere. Similarly, we will explain fundamental process characterising the oceanic circulation, notably the presence of gyres, coastal and equatorial upwelling, the formation of the density driven circulation and how this interacts with the cryosphere.

Then we look at the climates of the past, including the extreme past before the climate was cool enough to exhibit periodic ice ages. Explain these historical oscillations of climate requires examining how carbon transfer processes affect, and modulate, climate change, over a wide range of different time scales.

Once introduced the main elements of the climate system we will examine the basic principles on which climate models are based and which are their main limitations. This will help us in interpreting modelling results for different future scenarios.

Detailed Teaching Agenda

Part I: Climate system

Lecture topic	*Lecturer*	*Hours*
Introduction to the climate system and climate change	PS	2
Radiative transfer in the atmosphere	PS	2
Raditive forcing, Climate sensitivity	PS	2
Climate sensitivity	PS	2
Feedbacks	PS	2

Part II: Atmosphere, ocean and carbon cycle

Lecture topic	*Lecturer*	*Hours*
Basics in atmosphere dynamics	PS	3
Basics in ocean dynamics	PS	3

Ocean – atmosphere interactions	PS	2

Part III: Paleoclimatology and carbon cycle

Lecture topic	*Lecturer*	*Hours*
Paleoclimate	PS	3
The carbon cycle	PS	3

Part IV: Modelling and future scenarios

Lecture topic	*Lecturer*	*Hours*
Climate modelling	PS	3
Future Scenarios	PS	2
Exam	PS	1

Assessment and grading

Written examination at the end of the module.

Climate Policy, Economics, and Finance (30h)

February 7th – February 11th

Lecturer in charge of the module

Prof. Valeria Costantini (Department of Economics, University of Roma Tre)
valeria.costantini@uniroma3.it

Module Learning Objectives and Skill Acquisition

This module consists in three parts. The first deals with basic concepts in energy economics as the distribution of sources and consumption patterns at the geographical level, the analysis of demand and supply of different energy sources and the use of energy by sectors. World energy outlook scenarios are investigated under the lens of scenario building approaches. The second part allows students gathering main analytical tools to consider jointly energy issues and climate change impacts and policies. The economic analysis of policy impacts over the long term and burden sharing issues in the international bargaining process are also analysed. The third part provides elements of the three pillars forming the EU long-term energy strategy, with emphasis on clean energy technologies, emission trading scheme and green finance.

Detailed Teaching Agenda

Part I: Energy economics, markets and outlooks

Lecture topic	*Lecturer*	*Hours*
Introduction to the energy markets, composition of the energy mix	Costantini	2
Global energy markets, outlook and scenario building	Costantini	2
Energy security, energy efficiency, energy poverty	Costantini	2
The EU Energy strategy: targets and policy instruments	Costantini	2
Energy price and tax mechanisms	Costantini	2

Part II: Climate policy, adaptation and mitigation options

Lecture topic	*Lecturer*	*Hours*
Climate change impacts and economic damage	Costantini	2
The climate-conflict nexus from a georeferenced impact analysis	Costantini	2
Adaptation and mitigation options	Costantini	2
The linkages between mitigation and economic performance	Costantini	2
Scenario building and policy impact evaluation with a dynamic CGE model	Costantini	2

Part III: Eco-innovation, technical change and green finance

Lecture topic	*Lecturer*	*Hours*
Clean energy technologies (CETs): taxonomy in the energy balance	Costantini	2
Public policy support for CETs development and deployment	Costantini	2
ETS and carbon markets	Costantini	2
Green finance: economic impact of climate risks	Costantini	2
Green finance: financial instruments and policies	Costantini	2

Teaching material

Teaching material is available to students in a dedicated Dropbox folder divided into three folders, one for each module. A dedicated folder contains datasets for empirical replications.

Involved stakeholders

N.A.

Assessment and grading

The assessment is based on a common discussion of an empirical case study presented during the course. Students final grades are based on active participation at the discussion and on their contribution to the construction of the narrative of the case study.

Earth Observation and Climate Monitoring (30h)

February 21st – February 25th

Lecturer in charge of the module

Prof. Marco Piras (Department of Land, Environmental and Infrastructure Engineering - DIATI – Politecnico di Torino) (MP)
marco.piras@polito.it

Lecturer(s) contributing to the module

Prof. Fabio Giulio Tonolo (Department of Architecture and Design - DAD – Politecnico di Torino) (FGT)
fabio.giuliotonolo@polito.it
Prof. Gianpaolo Balsamo (Researcher, Earth System Modelling/Coupled Processes, ECMWF) (GB)
gianpaolo.balsamo@ecmwf.int

Module Learning Objectives and Skill Acquisition

The main learning objective of the Earth Observation (EO) and Climate Monitoring module is to get the attendees aware of the synergistic role of Earth Observation satellites and geospatial data in providing crucial data for monitoring Climate Change and for mapping climate-related events. As far as the acquired skills are concerned, attendees will learn how to identify and access the proper EO data source for both qualitative and quantitative analyses, integrating and processing data in a GIS environment to extract added/value information. This module is organized in three parts.

The first part is focused on the fundamentals of optical and radar sensors installed ons EO satellites as well as on basic processing workflows.

The second part allows students gathering elements about GIS model and geospatial data, starting by the data format and GIS design. Moreover, a short introduction will be done about the geoprocessing tools, the problem related to reference system and digital elevation models. Each part will be supported by examples and exercises.

The third part is composed by 3 main thematic areas dedicated to the water cycle, the carbon cycle and the applications to explore how global models work for making weather prediction and integrating Earth Observations to reconstruct climate data records.

Detailed Teaching Agenda

Part I: Fundamentals of Satellite Remote Sensing and mapping of climate related events

Lecture topic	*Lecturer*	*Hours*
Sun-synchronous satellite platforms: optical and radar sensors. Spatial, Spectral, Radiometric and Temporal resolution. Spectral signatures.	FGT	2
Main open data sources and related historical archives: Landsat, Modis and Copernicus Sentinels. Focus on Sentinel 1 (SAR) and 2 (Optical). Access to Copernicus data: SciHub and EO Browser.	FGT	2
How to display multi-spectral information for qualitative analyses: examples in EO Browser. Spectral indices and image classification.	FGT	2

Flood mapping exercise (recent flood event) by means of optical or radar satellite imagery.	FGT	2
Qualitative analysis (e.g. timelapses) of multi-temporal phenomena, e.g. drying-up lakes, ice melting, etc.: examples in EO Browser	FGT	2

Part II: **Climate-change, Weather and Environmental Extremes**

Lecture topic	*Lecturer*	*Hours*
Water-cycle modelling and data assimilation (Earth System Models schemes for precipitation, evaporation, runoff, land storage; use of ensemble & variational techniques to assimilate global EO data)	GB	4
Carbon-cycle modelling and data assimilation (ESM schemes for photosynthesis, respiration, human activity and transport of CO_2 emissions; use of global inversions techniques with EO data). Use of climate change model and repository.	GB	4
Environmental and climate change applications (flooding, droughts, fires, pollution outbreaks, low-frequency variability and trends)	GB	2

Part III: Geospatial data management and Visualization using GIS platform

Lecture topic	*Lecturer*	*Hours*
GIS MODEL and Vector data. Examples	MP	4
Queries and analysis. Examples.	MP	2
Reference system – DTM/DSM. Examples	MP	2
Geoprocessing: examples	MP	2

Teaching material

The teaching material used during lectures will be made available to attendees through a dedicated sharing folder. Additionally the recordings of the lectures will be accessible (only with remote lessons). Suggested reading material will be also proposed.

Assessment and grading (remote or in presence)

Students will be assessed on two assignments, specifically they will be requested to:

1. summarize in a document the main steps related to the analysis of a real-word case study that will be addressed during the lectures (e.g. recent flood event), in terms of input datatest, processing workflow and outcomes, critically discussing the results;
2. identify a Climate Change related phenomena to be highlighted by means of satellite based time-lapses and/or weather and environmental variable trend comparison

The final grade will be based on the final report (point 1 above) and related annex(es) (point 2 above). The final score will be defined considering the following parameters: completeness, correctness and quality of the assignment, focusing on the capacity of the student to critically discuss the assignment.

Energy Transition and Global Sustainability (25h)

February 28th – March 4th

Lecturer in charge of the module

Prof. Manlio Coviello (Associate Professor, Department of Engineering, Catholic University of Chile)
manlio.coviello@terna.it

Lecturer(s) contributing to the module

Alessandro Costa, Falck Renewables
Niccolò Sartori, ENEL Foundation
Piero Ravetto, Politecnico di Torino
Alberto del Bianco, ENI
Dario Colozza, ENEL X
Rosario Polito, TERNA
Silvia Ruta, ENEL X
Giovanni Valtorta, ENEL
Ruggero Recchioni, TERNA

Module Learning Objectives and Skill Acquisition

This module consists in two parts:

- The first part of the module (*The Challenges of Energy Transition & Global Sustainability*) will be the background vision on energy transition, aiming to identify and investigate the main challenges related to this process; in particular, it will explore elements of global sustainability, geopolitics & economics, and availability of resources. This first part of the module will end with an analysis of the strategies that could be implemented to materialize the energy transition, in synergy with the challenge of climate change
- The second part of the module (*Sustainable Production and Consumption)* will provide students with updated and practical information on the various forms of clean &/or smart ways to produce and use energy , as key elements to contribute to the energy transition process

Detailed Teaching Agenda

Part I: The Challenges of Energy Transition & Global Sustainability)

Lecture topic	*Lecturer*	*Hours*
Introduction to Energy Transition	Manlio Coviello Univers. Cattolica Chile	2
Global Sustainability	Alessandro Costa Falck Renewables	2
Geopolitics and Economics	Niccolò Sartori ENEL Foundation	2
Resources availability	Niccolò Sartori ENEL Foundation	2
Strategies	Manlio Coviello Univers. Cattolica Chile	2

Part II: Sustainable Production and Consumption

Lecture topic	*Lecturer*	*Hours*
Nuclear Energy	Piero Ravetto, PoliTO	2
Clean Fossil Fuels	Alberto del Bianco, ENI	2
Energy Management	Dario Colozza, ENEL X	2
Energy Storage	Rosario Polito TERNA	2
Role of Prosumer and Circular Economy	Silvia Ruta ENEL X	2
Smart Grids	Giovanni Valtorta ENEL	2
Innovation on Grids	Ruggero Recchioni TERNA	2

Assessment and grading (remote or in presence)

To be defined

Carbon Capture and Negative Emission Technologies (25h)

March 14th – March 18th

Lecturer in charge of the module

Prof. Rajandrea Sethi (DIATI, Politecnico di Torino) - RS
rajandrea.sethi@polito.it

Lecturer(s) contributing to the module

- Andrea Lanzini (DENERG – Politecnico di Torino) – AL
- Massimo Santarelli (DENERG - Politecnico di Torino) – MS
- Jean Marc Christian Tulliani (DISAT - Politecnico di Torino) – JT
- Renzo Motta (DISAFA – Università di Torino) - RM
- Vincenzo Andrea Riggio (DIATI - Politecnico di Torino) -VR

Module Learning Objectives and Skill Acquisition

The module will provide an overview on the topic of Carbon Capture (CC) with a focus on the available technical options for the reduction or removal of CO_2 emissions from the atmosphere. The course will analyze the different approaches aimed at capturing and separating carbon dioxide from a dilute source, such as the flue gas of a power or industrial plant. Absorption, adsorption, membrane systems and the most advanced capture technologies will be extensively analyzed. The program will also review how the captured CO_2 can be utilized (CCU) to produce fuels, chemicals or other commodities.

The last part of the course will examine the Negative Emission Technologies (NET) – i.e., afforestation, biochar, bioenergy production with carbon capture (BEECS), direct air capture (DAC) – that can be implemented to decrease the CO_2 content in the atmosphere with the final goal of mitigating climate change.

Detailed Teaching Agenda

Lecture topic	*Lecturer*	*Hours*
Introduction to Carbon Capture and Storage (CCS), Carbon Capture and Utilization (CCU), Negative Emission Technologies (NET).	RS	4
Introduction to CO2 separation. Absorption. Adsorption. Physical Separation.	AL	2
CCS in the energy sector. Post-combustion CC. Oxyfuel Combustion.	AL	2
Integrated gasification combined cycle with pre-combustion CC. Chemical looping combustion.	AL	2
CCU, Industrial processes for CO2 conversion to fuels and chemicals. Enhanced commodities production. CO2 production and capture in iron/steel making.	AL	2
Seminar by ENI: The Ravenna's hub for CCS (Roberto Ferrario)	RS	2
Virtual visit to a research Lab (CO2 Circle Lab @ EnviPark).	MS	2
CO2 in construction. NET enhanced weathering.	JT	2
NET, Forest sequestration, afforestation reforestation, Climate-Smart-Forestry	RM	2
NET, BEECS and algae.	VR	2
NET, Biochar, Direct Air Capture and conclusions.	RS	2

Involved stakeholders

ENI, Climeworks, Environmental Park.

Assessment and grading

To be defined

CO2 and H2 Underground Storage (20h)

March 21st – March 25th

Lecturer in charge of the module

Prof. Francesca Verga (DIATI, Politecnico di Torino) - FV

francesca.verga@polito.it

Lecturers contributing to the module

- Prof. Dario Viberti (DIATI - Politecnico di Torino) – DV
- Prof. Fabrizio Pirri (DISAT Politecnico di Torino/IIT) - FP
- Dr. Barbara Menin (IIT) - BM
- Dr. Angelica Chiodoni (IIT) - AC
- Dr. Sergio Bocchini (IIT) - SB
- Claudio Geloni (ENI) - CG

Module Learning Objectives and Skill Acquisition

The module will provide an overview of CO2 and H2 storage in geological formations to accomplish the energy transition process.

The course will deal with hydrogen production from renewable sources and recombination with captured CO2 in an integrated industrial approach for an effective CO2 utilization, and the need for large storage facilities will be discussed.

Then the course will analyze the different aspects involved with a temporary or permanent CO2 and H2 safe underground storage: system characterization, storage volume quantification, definition of injection/withdrawal rates, assessment of potential bio-geo-chemical issues, monitoring. The course will also offer an overview of the laboratory analysis and on-site data collection and elaboration performed to design and operate an underground storage.

Instruments for a preliminary suitability assessment of a geological site for storage purposes will be provided.

Detailed Teaching Agenda

Lecture topic	*Lecturer*	*Hours*
Introduction to Underground Storage: depleted reservoirs and deep saline aquifers. Capacity, integrity and injectivity. Overview of trapping mechanisms, workflow and risks.	FV	2
Hydrogen production	AC	2
CO2 and H2 reduction for green methane production	SB	2
Fundamentals of fluid and rock properties and their interactions. Geological and fluid-flow modeling.	DV	4
Volumetric and injectivity calculations.	FV	2
Geochemical issues	CG	4
Biochemical issues	BM	2
Virtual visit to SEASTAR Research Labs @ EnviPark	FP	2

Involved stakeholders

ENI, IIT, Environment Park.

Assessment and grading

To be defined

Carbon Footprinting and Carbon Trading (25h)

March 28th – April 1st

Lecturer in charge of the module

Claudio COMOGLIO
claudio.comoglio@polito.it

Lecturer(s) contributing to the module

Rita VALOROSO (Senior Lead Auditor)
Alessandro VENTURIN (Senior Consultant)
Giorgio BONVICINI (Senior Consultant)

Module Learning Objectives and Skill Acquisition

This module is structured in three parts. The first provides basic concepts about sustainable development and emission reductions policies and framework with reference to: Kyoto Protocol, Paris Agreement, SDG (Sustainable Development Goals – Climate Action), flexible mechanism defined in the Kyoto Protocol (International Emissions Trading, Clean Development Mechanism, Joint Implementation). Drivers, processes and case studies will be presented. The second part is focused on: (a) ISO Standard related to quantification and reporting of GHG (ISO14064-1, ISO14064-2), carbon footprint (ISO14067), life cycle assessment (ISO14040 – ISO14044 climate declaration). Drivers, processes and case studies will be presented. The third part is focused on carbon off-set and carbon market.
Most lectures will be a combination of formal lecture followed by practice exercises and in class-discussion of the reading assignments.

Detailed Teaching Agenda

Part I: Policy and Framework outlooks

Lecture topic	*Lecturer*	*Hours*
Climate Change policy and Framework	COMOGLIO	2
International Emission Trading Clean Development Mechanism Joint Implementation	VALOROSO	3

Part II: ISO Standard

Lecture topic	*Lecturer*	*Hours*
ISO 14064-1 Quantification and reporting of GHG and removals at the organization level ISO14064-2 Quantification and reporting of GHG and removals at the project level	VENTURIN BONVICINI	6
ISO14040-ISO14044 Life Cycle Assessment (carbon declaration)	VENTURIN BONVICINI	6
ISO14067 Carbon footprint of products	VENTURIN BONVICINI	5

Part III: Carbon off-set

Lecture topic	*Lecturer*	*Hours*
Carbon off-set mechanisms Registry system Carbon market	VALOROSO	3

Assessment and grading
To be defined

Sustainable Transport Systems (25h)

April 4th – April 8th

Lecturer in charge of the module

Prof. Bruno Dalla Chiara (Dept. DIATI, Transport systems, Politecnico di Torino) - BDC
bruno.dallachiara@polito.it

Lecturer(s) contributing to the module

- Prof. Marco Diana, Ph.D., Transport planning (Dept. DIATI, Transport systems, Politecnico di Torino) - MD
- Prof. Francesco Deflorio, Ph.D, Traffic engineering and transport networks (Dept. DIATI, Transport systems, Politecnico di Torino) - FD
- Dr. Claudia Caballini, Ph.D. Freight transport and Logistics, M.Sc. Ind. Eng. (Dept. DIATI, Transport systems, Politecnico di Torino) - CC
- Dr. Miriam Pirra, Ph.D. Data analysis for transport systems, M.Sc. Math. Eng. (Dept. DIATI, Transport systems, Politecnico di Torino) - CC

Module Learning Objectives and Skill Acquisition

This module consists of three parts. The 1st part deals with basic concepts of transport sustainability, in terms of planning, operations and technologies, with reference to:

- Energy consumption of *each transport mode*, energy carriers for vehicles, ships and aircrafts, new powertrains as well as mitigation aspects in climate change;
- Transport *planning*, with reference to mode choice in favor of less polluting mobility and transport;
- Transport *networks*, in terms of adaptation in presence of anomalous events as well as mitigation, in terms of control of traffic flows when disruptions occur.

A particular attention is devoted to the energy consumption of rail transport (transport mode of the year 2021 by European Commission, within the main goals of the Green Deal), besides that associated to road and air modes, given the current implicit independence of transport systems operated on fixed electrified guideways from oil-derived fuels.

The application of *optimization techniques* represents a key point for improving the sustainability of transport chains, which may bring to massive mitigations, besides traffic reductions.

The 2nd part deals with *transport globalization* and related environmental issues: global transport and logistics, shipping and containerization. Given high volumes of handled freight, both at international level and at local scale when cargoes of ships are reversed on roads and rails, the impact on traffic, energy consumption and consequent emissions is utmost when we deal with optimization of shipments.

The 3rd part allows the attendants to apply to practical cases:

- by using data collected directly on board through a CAN device named OBD scanner, applied on automobiles during the module;
- by optimizing transport and shipments through a software package, named Lindo.

Detailed Teaching Agenda

Part I: Sustainable transport systems, transport planning and transport network modelling

Lecture topic	*Lecturer*	*Hours*
Sustainable transport systems: energy used as a whole, for each transport mode, within each transport mode and the consequent	BDC	4

environmental aspects, both at local level and global one (GHG). Energy carriers (electric batteries, fuel cells, etc.) for transport, evolution of powertrain technologies and fuels for road vehicles. Various modes and related impact; use of energy in each transport mode. Possible practical applications for mitigation: driving cycles, powertrains and use of vehicles including their sharing, modal choice and hierarchic approach (including HSL and micro-mobility), network equilibrium, optimisation techniques in mobility and logistics [*mitigation*].		
Transport planning activities are more and more focused in mitigating the impacts of passenger transport systems, with special focus on urban areas where most traffic flows are concentrated. The contribution will review related techniques mainly at the European level, focusing on the recent release of the second edition of the guidelines for developing and implementing a Sustainable Urban Mobility Plan (SUMP) and providing practical examples of best practices in different cities where important results have been achieved; a specific attention to modal choice and sharing mobility will be devoted [*mitigation*].	MD	4
Transport network modelling: simulation of network performance (nodes, links and routes) in relation to capacity reduction and transport services interruptions (resilience and vulnerability of the road network); traffic flow estimation on road networks and effects on CO_2 emissions [*adaptation and mitigation*].	FD	2
The use of **mathematical optimization** as a mitigation strategy, with applications (exercises): ▪ Introduction to optimization techniques ▪ Numerical examples by using Excel/Lingo software for pursuing a reduction in CO_2 emissions. The level of filling up and loading of vehicles, as well as the number and size of related operations, is much influenced by the variable "time", both in case of advanced planning and real-time management. A Practical application with attendants [*mitigation*].	CC	2.5

Part II: The climate change in the land based transport modes and in shipping sector: impacts and mitigation strategies

Lecture topic	*Lecturer*	*Hours*
Energy Consumption and consequent emissions in **rail transport and air transport**: their impact on the energy network, evolutions related to HSL, optimisation techniques, rail operation and planning [*mitigation*].	BDC	1
Trends on powertrains and energy carries for road transport	BDC	1

Introduction to the **shipping sector**: ▪ Macro-economic and transportation trends ▪ The naval gigantism: motivations and effects [*mitigation*]	CC	1
The impacts of climate change (high wind, precipitation and fog, low and high temperature, storm and storm surges, sea level rise) on shipping and related **mitigations strategies** [*adaptation and mitigation*]	CC	1.5
The impacts of shipping (environmental pollution, greenhouse gas emissions,..) on climate change and related intervention strategies: ▪ Adaptation ▪ Mitigation: o Shipping companies actions o Ports actions o Hinterland actions o Policymakers and regulators actions [*adaptation and mitigation*]	CC	1.5

Part III: Applications

Lecture topic	***Lecturer***	***Hours***
Collection and analysis of data obtained directly on board during a short travel by automobile, through an OBD scanner collecting data from the on board CAN, applied during the module.	MP	2
The use of **mathematical optimization** as a mitigation strategy, with applications (exercises), numerical analyses by using Excel/Lingo software for pursuing a reduction in CO_2 emissions. Practical applications with attendants [*mitigation*].	CC	3/3.5
Sustainable transport and calculation of emissions, using the GLEC methodology; The **GLEC** Framework for Logistics Emissions Methodologies combines existing methods for comparing GHG into one framework. It enables a company to understand its carbon footprint alongside cost and time to decide the best way to transport its goods.	Xavier Lluch Oms	2

Involved stakeholders

A number of relationship with the territory, administrative bodies and companies will be mentioned and used as practical examples at the occasion.

Assessment and grading

A multiple choice test, lasting 20-25', dealing with almost all subjects of the module, at a very general level, i.e. the level of knowledge that an expert in Clime change is expected to know dealing with moderns and sustainable transport system, also in order to be able to assign a personal mark to each mature attendants, as requested by the Master.

Energy-Efficient Buildings (25h)

April 25th – April 29th

Lecturer in charge of the module

Prof. Stefano Paolo Corgnati (DENERG, Politecnico di Torino)
stefano.corgnati@polito.it

Lecturer(s) contributing to the module

- Arch. Cristina Becchio (Department of Energy, Politecnico di Torino)
- M.Sc. Civ. Eng. Sara Viazzo (Department of Energy, Politecnico di Torino)

Module Learning Objectives and Skill Acquisition

Even if buildings sector energy intensity has improved in recent years and high energy efficient technologies are developed by HVAC industry, the energy demand of buildings is continuously increasing. Moreover, the buildings-related CO2 emissions is constantly rising up as well as the household air pollution in urban areas. This scenario seems to be in contrast with the deep effort of the international and European community to support the development of energy-efficient and low-carbon solutions for individual buildings and buildings communities, acting through policies and standards, introducing also market incentives.
The worldwide recognized target of "zero energy building" is not a dream but it has to be reached considering not only technical aspects, but also economical, financial and social ones.
To face this wide and crucial topic, this module is divide in four parts. The first part introduces the general and global picture of the thematic. The second part is the core one: the zero-energy building concept is introduced and deepened, analyzing the role of the final users in influencing the actual energy consumption. The third part focuses on calculations, in order to provide practical example about energy performance assessment: a case study is analyzed and developed. The part four shows interesting and significant case studies that drive to final conclusions.

Detailed Teaching Agenda

Part I: Background (5 hours)

Lecture topic	*Lecturer*	*Hours*
Context and reference scenario about building indoor environmental quality, energy consumptions and performances, GHG emissions and environmental impact.	Corgnati	3
European framework and approach	Corgnati	2

Part II: Towards zero energy buildings, districts and communities (10 hours)

Lecture topic	*Lecturer*	*Hours*
Nearly zero energy buildings (nZEB) and communities: concept and principle	Corgnati	2
High performing building envelope and energy system	Corgnati	2
nZEBs, cost optimality and carbon neutrality: principle	Corgnati	1
Cost Optimatity: calculation approach and application to case studies	Becchio	4
From cost-optimal to cost-benefit approach	Becchio	1

Part III: Project and calculation (5 hours)

Lecture topic	*Lecturer*	*Hours*
Calculation of energy demand and performance of high performing buildings and communities	Viazzo	5

Part IV: Conclusions (5 hours)

Lecture topic	*Lecturer*	*Hours*
Best practices and case studies	Corgnati	2
Focus: a trip inside CorTau House	Corgnati	2
Conclusions	Corgnati	1

Involved stakeholders

During the module, a number of examples and practical cases will be mentioned in connection to experiences developed by public bodies and industrial partners.

Assessment and grading

To be defined

Renewables (20h)

May 2nd – May 6th

Lecturer in charge of the module

Prof. Davide Poggi (DIATI, Politecnico di Torino) - DP
davide.poggi@polito.it

Lecturer(s) contributing to the module

Prof. Alessandro Casasso (DIATI,Politecnico di Torino) - AC
alessandro.casasso@polito.it
Prof. Vincenzo Riggio (DIATI,Politecnico di Torino) - VR
vincenzo.riggio@polito.it

Module Learning Objectives and Skill Acquisition

This module aims at introducing a general overview of the renewable energy sources and the main technologies, both already developed and under development, that can be employed for their correct use. The module consists in two parts. The first part defines the concepts of renewable energy and quantifies its potential on a global scale. In the second part, the basic knowledge related to the principles of operation and the performance of wind farms, hydroelectric, solar, biomass and geothermal plants will be provided. For each part, the state of the art and the short and long-scale future prospects are analyzed. The objective of the module is to acquire the fundamental knowledge related the operating principles and the performances provided by wind, hydroelectric, solar, biomass and geothermal plants.

Detailed Teaching Agenda

Part I: Renewable energy sources

Lecture topic	*Lecturer*	*Hours*
Types of renewable energy, definitions and examples	DP	1
Global distribution and quantification of renewable sources	DP	1
Energy mix and renewable energy targets	DP	2

Part II: Renewable energy technologies

Lecture topic	*Lecturer*	*Hours*
Solar power plants	DP	2
Hydropower plants	DP	2
Pumped Hydropower and Energy Storage Systems for Renewables	DP	2
Onshore and Offshore Wind Farms	DP	2
Ocean Energy and Wave Energy Converters	DP	2
Biomass for the production of energy	VR	3
Geothermal energy and Shallow geothermal for building heating and cooling	AC	3

Involved stakeholders

ENI, Wave4Energy, ENEL

Assessment and grading

To be defined

Climate-Resilient Cities and Communities (30h)

May 9th – May 13th

Lecturer in charge of the module

Prof. Lorenzo Chelleri (Int. University of Catalunya, and Urban Resilience Research Net, Barcelona) - LC
Lchelleri@uic.es

Module Learning Objectives and Skill Acquisition

This module aims at introducing how the emerging concept of urban resilience relates to vulnerability and sustainability science, and how to handle the bridges between multidisciplinary theories on urban resilience and potential implementations. Starting with an alignment among similar and complementary (but sometime conflicting) concepts – as urban vulnerability, resilience and sustainability – the classes wish to discuss with the student how resilience thinking could be applied to and in urban systems. Along the seminars, theory will be complemented by the presentation and exercises on urban and climate resilience assessments, in order to acquire the skills for understanding which should be the design, and governance processes, to effectively implement urban and climate resilience. The final aim of this module is also to contribute to the critical understanding about the role of the societies, groups, communities and individuals within urban resilience, highlighting the complexity beyond trying to implement integrated perspectives, while avoiding maladaptation, or development lock-in. Many case studies will be illustrated, from both developing and global north cities, in order to provide the students with a comprehensive picture about urban resilience thinking and its practices. Also, individual and groups exercises will confer the necessary skills to evaluate and design urban resilience strategies, at the light of the emerging framework of "urban resilience trade-offs". Much of the classes will be held by the prof. Chelleri Lorenzo, supported from the resources and network of professors from the Int. Msc. in City Resilience Design and Management. Students will be thus exposed to reading scientific papers, take part in seminars, watching short movies and recorded seminars to be discussed in class, and finally in-class debates also based on students presentations of their short-works.

Detailed Teaching Agenda

Part I: Conceptual Alignment

Lecture topic	*Lecturer*	*Hours*
Introduction to resilience thinking and urban resilience – aligning and differentiating urban vulnerability, resilience and sustainability	LC	3
Resilient Cities vs Urban Resilience: Definitions and Approaches	LC	3

Part II: Climate Plans and Urban Resilience Strategies: From Theory to Implementation

Lecture topic	*Lecturer*	*Hours*
Climate plans: structures and overview (Global and European)	LC	2
Climate plans adaptation/mitigation assessment framework	LC	4
Urban resilience strategies – 100RC experience	LC	2
Urban resilience strategies and/or climate plans? exercise and discussion about how to mainstream Urban Resilience Thinking	LC	4

Part III: Community Resilience and Sustainability Transition: Urban Resilience Trade-offs

Lecture topic	*Lecturer*	*Hours*
Defining community resilience – maladaptation and sustainability transitions (approaches and case studies)	LC	4
Exercise – community resilience and innovation governance models	LC	2
Understanding urban resilience trade-offs	LC	2
Exercise on urban resilience trade-off and city resilience strategies – case studies discussion	LC	4

Coping with Extreme Events (30h)

May 16th – May 20th

Lecturer in charge of the module

Assoc. Prof. Alberto Viglione (DIATI, Politecnico di Torino) - AV
alberto.viglione@polito.it

Lecturer(s) contributing to the module

Prof. Jost von Hardenberg (DIATI, Politecnico di Torino) – JH
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Dr. Roberto Mezzalama (Golder) – RM
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Dr. Cecilia Bittoni (Risk Management Solutions) – CB
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Laurent.Marescot@rms.com
Maurizio Savina (SCOR reinsurance) – MS
MSAVINA@scor.com

Module Learning Objectives and Skill Acquisition

This module consists in three parts. The first allows the students to familiarize with the definition and quantification of extremes as well as the associated risks. Examples on how people have coped and do cope with hydrometeorological extreme events such floods, droughts, cyclones, heat waves, etc. are illustrated. The second part is dedicated to the effects of climate change on hydrometeorological extremes and on possible adaptation strategies. Climate modelling of extremes is discussed together with ways to deal with the presence of unavoidable uncertainties in climate impact projections. The third part describes the catastrophe modelling (CAT) done by the re-insurance industry and the students will apply a simplified CAT model.

Detailed Teaching Agenda

Part I: Extremes and Risk

Lecture topic	*Lecturer*	*Hours*
Introduction and examples of hydrometeorological extremes	AV	2
Quantifying extremeness and definition of hazard	AV	2
Exercise: flood frequency analysis of the Danube at Melk	AV	2
Coping with extreme hydrometerological events: options and examples	AV	2
Exercise: Danube flood risk reduction at Melk and cost-benefit analysis	AV	2

Part II: Coping with extremes in a changing world

Lecture topic	*Lecturer*	*Hours*
Changes in flood risk, Surprises and Feedbacks hydrology-society	AV	2
Climate modelling of extremes and future projections	JH	2
Coping with uncertainty in climate impact projections	JH	2
Numerical exercise: analysis of extremes in climate model data	JH	2
Environmental Social and Climate Change Risk for infrastructures	RM	2

Part III: Catastrophe modelling in the re-insurance industry

Lecture topic	*Lecturer*	*Hours*
Catastrophe modelling and re-insurance industry	CB	2
Coping with extreme events in the insurance sector	MS	2
Use of CAT models for financial risk assessment and analysis	LM	4
Catastrophe loss modelling: showcase and application exercise	LM	4

Involved stakeholders

Risk Management Solutions (RMS, www.rms.com), SCOR (www.scor.com).

Assessment and grading

The students, subdivided in groups, are asked to reason on topics related to the course proposed by the teacher with no preparation time. First, each group has 5 min discussion time to elaborate the topic, where only the group members are allowed to participate. Second, (max) 5 min discussion time is allowed where all other students can participate. The grading is based on the the demonstrated knowledge and the clarity of exposition in the topic discussions.

Resilient Infrastructure Systems (20h)

May 30th – June 3rd

Lecturer in charge of the module

Dr. Lucia Tsantilis (DIATI, Politecnico di Torino)
lucia.tsantilis@polito.it

Lecturers contributing to the module

Prof. Maria Chiara Zanetti (DIATI, Politecnico di Torino)
mariachiara.zanetti@polito.it
Dr. Marco Ravina (DIATI, Politecnico di Torino)
marco.ravina@polito.it

Module Learning Objectives and Skill Acquisition

The main learning objective of this module is a comprehensive understanding of the relationship existing between civil infrastructures and climate change. The course will provide students with knowledge and practical skills on both adaptation and mitigation engineering strategies.

The first part of the course will focus on transport infrastructures. After an introductory overview of the effects of climate change on roads, railways and airports, lecture topics will focus on the concept of resilient infrastructures. The role played by transport infrastructure on climate change mitigation will be then presented analyzing aspects related to design, construction materials and technologies.

The second part of the course is about the potential impact on climate change of energy production and water treatment infrastructures. Particularly the main air pollutants and greenhouse gases will be examined highlighting their contribute to health risks, externalities and climate change and the relationship with different anthropic sources focusing on energy facilities in urban context. An applied case concerning heating district substituting boilers will be presented too.

Greenhouse gases emissions coming from typical water treatments facilities will be quantified too by means of procedures and applied examples.

Detailed Teaching Agenda

Part I: Transport Infrastructure

Lecture topic	*Lecturer*	*Hours*
The effects of climate change on transport infrastructures	L. Tsantilis	2
The design of resilient infrastructures (adaptation)	L. Tsantilis	2
Environmental analysis techniques for the decision-making process (mitigation)	L. Tsantilis	2,5
Low-emission and low-energy optimized transport infrastructures: the role of design (mitigation)	L. Tsantilis	2
Material resource efficiency: from bio-based products to reclaimed waste materials (mitigation)	L. Tsantilis	3
Sustainable technologies in transport infrastructures: actual opportunities and future challenges (mitigation)	L. Tsantilis	1

Part II: Energy Infrastructure

Lecture topic	*Lecturer*	*Hours*
Main air pollutants, greenhouse gases, main sources	M.C. Zanetti	1
Health risk analysis and externalities evaluation	M.C. Zanetti	1
Strategies for the mitigation of air pollution and greenhouse gases	M.C. Zanetti	1
Applied case thermal district heating	M. Ravina	2,5

Part III: Water Infrastructure

Lecture topic	*Lecturer*	*Hours*
Main water treatment facilities and greenhouse gas emission sources	M.C. Zanetti	1
Applied cases	M.C. Zanetti	1

Assessment and grading

Grading will be based on participation to class debates, on practical exercise sessions and on closed-answer tests.

Sustainable Management (20h)

June 6th – June 10th

Lecturer in charge of the module

Prof. Chiara Ravetti (Politecnico di Torino) - CR
chiara.ravetti@polito.it

Lecturer(s) contributing to the module

Letizia Rigazzi (Nativa Lab) TBC - LR
letizia@nativalab.com

Module Learning Objectives and Skill Acquisition

This module introduces the main issues in corporate approaches to climate change. How can companies address global warming, both in terms of mitigating climate change damages and adapting to them strategically? The first half of the module explores the relationship between climate change and the private sector. The lectures will focus on the themes of sustainability, green management, and climate risks. The second half of the module applies these concepts to a number of case studies. The main learning objectives are to understand the most relevant ways for companies to become more sustainable and the main obstacles to the process. By the end of the module students should to be able to apply these concepts to actual companies in different sectors of the economy.

Detailed Teaching Agenda

Part I: Sustainable business management: why and how

Lecture topic	*Lecturer*	*Hours*
Companies and climate change - challenges and opportunities	CR	1
What is sustainability and why should companies care? Are private companies the main culprit for climate change? Markets and externalities	CR	2
Does it pay to be green? Empirical evidence.	CR	2
Environmental risk management and stranded assets	CR	2
Green business strategies (eco-efficiency, environmental cost leadership, beyond-compliance leadership and eco-branding)	CR	2
The dark side: greenwashing and lobbying for climate change	CR	2
Spotlight on the energy sector, rural electrification and climate change	CR	2

Part II: Case studies on sustainable management

Lecture topic	*Lecturer*	*Hours*
Student-led case studies from different sectors (agriculture, consumer goods, textiles, automotive, luxury goods, services, electronics)	CR	5
Sustainability assessment (Nativa Lab)	LR	2

Involved stakeholders

Nativa Lab will provide an overview of their assessment methods and their experience supporting companies in the process of achieving the certification of B corps. Nativa was the first Benefit Corporation in Europe and the first Certified B Corporation in Italy. It is the country partner of B Lab – the main provider worldwide for this form of sustainability certification.

Assessment and grading

Each student will be assigned one company for a case study in the second half of the course. The case study should consider the various elements studied during the first part of the course (green strategy, marketing, value proposition and other elements of business model canvas, risk management, SWOT analysis). Each student will make a short presentation of 5 minutes, followed by 10 minutes of discussion in which other students selected at random will ask questions acting as potential investors in the company. The evaluation is based both on the presentation and on the comments during the discussion.

Green Procurement and Sustainable Supply Chain (20h)

June 20th – June 24th

Lecturer in charge of the module

Prof. Marco Formentini (Associate Professor in Management Engineering, University of Trento)
marco.formentini@unitn.it

Lecturer(s) contributing to the module

Prof. Paolo Taticchi (Professor in Strategy and Sustainability, University College London)
p.taticchi@ucl.ac.uk

Module Learning Objectives and Skill Acquisition

In terms of Learning Objectives:

- Understand the key role played by supply chain management (SCM) and how it has evolved towards sustainable SCM, integrating CSR and sustainability concepts in line with the Triple Bottom Line perspective.
- Provide a detailed overview of the main sustainability challenges that drive decisions related to the main supply chain processes, including a global perspective.
- Analyze in-depth the linkage between the strategic level (corporate sustainability approaches) and the operational level (supply chain processes).
- Relevant knowledge of SCM in order to identify key actors, activities and flows in supply chain processes; key theoretical SCM frameworks.
- Critical analysis of sustainability challenges in supply chains;
- Analysis of cases and best practices in sustainable SCM.

Detailed Teaching Agenda

Part I: Introduction to Sustainable Supply Chain Management

Lecture topic	*Lecturer*	*Hours*
The basics of supply chain management	MF	2
Classic supply chain strategies and sustainability issues	MF	2
Supply chain collaboration for sustainability	MF	2
The implications of a circular economy for SSCM	MF	2

Part II: Corporate Sustainability and Sustainable Supply Chain Management in Practice

Lecture topic	*Lecturer*	*Hours*
The Barilla case study: supply chain contracts for triple bottom line benefits	MF	2
Foxconn Technology Group (A)	PT	2
Esquel Group: Integrating Business Strategy And Corporate Social Responsibility	PT	2
Mercato Metropolitano. A Scalable Business Model?	PT	2
Patagonia's Sustainability Strategy: Don't Buy Our Products	PT	2
McDonald's Corp.: Managing a Sustainable Supply Chain	PT	2

Involved stakeholders

A large number of case studies are used in this module. Some of these cases come from the research and consulting work of the teachers.

Assessment and grading

To be defined.

Eco-innovation and Social Entrepreneurship (20h)

June 27th – July 1st

Lecturer in charge of the module

Prof. Alessandra Colombelli (Politecnico di Torino)
alessandra.colombelli@polito.it

Module Learning Objectives and Skill Acquisition

Please insert here the a descriptive summary of the module content as well as the course goals and learning objectives.

Objective of the course is to equip students with the principles, frameworks and methods of environmental economics and economics of innovation to answer the basic question "does it pay to be green?". The module consists in two parts. The first part allows students understanding how businesses can achieve cost savings and improve performance by reducing their environmental impacts. The drivers and barriers to green innovation generation and adoption, the strategic management of eco-innovation as well as the effects of environmental regulation are explored. The second part focuses on the role of new firms in the process of technological change and the achievement of the Sustainable Development Goals (SDGs). The aim is to make students understand the relevance and the dynamics of social and green start-ups formation and learn the basic tools for defining a business model.

Detailed Teaching Agenda

Part I: Eco-innovation

Lecture topic	*Lecturer*	*Hours*
General framework on economics and management of innovation	ACL	2
Drivers and barriers to green innovation	ACL	2
The effects of environmental regulation	ACL	2
Team work on Eco-innovation and Regulation	ACL	2
Strategic management of eco-innovations	ACL	2
Case study on eco-innovation adoption	ACL	2

Part II: Social Entrepreneurship

Lecture topic	*Lecturer*	*Hours*
The contribution of new firms to technological change and economic development	ACL	2
Green startups, climate change and the achievement of SDGs	ACL	2
Decision making and new business models in green startups	ACL	2
Case study on eco-innovation generation and business model	ACL	2

Involved stakeholders

During the course students will work in teams on real case studies. They will be required to apply the tools and the concepts learned during the lectures and place themselves in the role of decision makers. A green start-up will be involved to provide a real example of value proposition, business model development and social impact.

Assessment and grading

The final grade is the result of an individual and a team evaluation. Each students will be evaluated on the base of their participation to class discussion. Each team will be evaluated on the result of their team work.

Corporate Social Accountability (20h)

July 4th – July 8th

Lecturer in charge of the module

Prof. Ericka Costa (Department of Economics and Management, University of Trento)
ericka.costa@unitn.it

Lecturer(s) contributing to the module

Prof. Giovanna Michelon (Department of Accounting and Finance, University of Bristol)
giovanna.michelon@bristol.ac.uk

Module Learning Objectives and Skill Acquisition

This module consists in three parts. The first part deals with basic concepts in Corporate Social Responsibility (CSR) and Accountability and brings together different concepts and theories from a business perspective, starting from the assumption that the responsibility of a company goes beyond the profit maximization for its shareholders. The second part focuses on the reporting processes and it allows students to familiarize with the main analytical instruments (such as different reporting standards) to develop sustainability reports in light of the UN Sustainable Development Goals. The third part provides a governance perspective on CSR and CSR reporting, focusing on investors' needs for, and use of, CSR information, as well as providing an overview of recent regulatory actions on CSR reporting for financial markets.

Detailed Teaching Agenda

Part I: CSR and Accountability

Lecture topic	*Lecturer*	*Hours*
The CSR debate: from the Friedman to the Freeman' perspective	Costa	3
Stakeholder theory and stakeholder engagement	Costa	2
The accountability paradigm and accountabilities perspectives	Costa	2

Part II: Social and Environmental Accounting and Reporting

Lecture topic	*Lecturer*	*Hours*
The Social and Environmental Accountability and Reporting perspective	Costa	2
Standard of corporate social reporting (GRI – the Global Reporting Initiative; IIRC framework on Integrated Reporting)	Costa	3
The Social Impact and Social impact measurement "mantra"	Costa	2

Part III: CSR: governance, risks and financial markets

Lecture topic	*Lecturer*	*Hours*
CSR and the role of governance in stakeholder engagement	Michelon	2
CSR disclosure quality, ESG risk and financial markets	Michelon	2
The EU sustainable finance initiative and climate related financial disclosures	Michelon	2

Teaching material

Teaching material consist in:

- Ppt presentation of the course (provided by the lecturers)
- Ad-hoc readings (provided by the lecturers)
- Pre-reading case- studies (defined by the lectures and provided by the School)

All the teaching material is available to students in a dedicated platform managed by the Politecnico di Torino.

Involved stakeholders

Company seminar from Andriani S.p.A. Natural Innovators – guest speaker Filippo Capurso (confirmed)

Assessment and grading

The purpose of the final assignment is to provide a critical analysis and evaluation of a sustainability report, similarly to the cases what we have discussed in class together.

Students are required to select one European listed company (which has not been discussed in class as a case or as an example), with a sustainability report written in English and prepare a short report (max 2500 words excluding references, figures and tables) which critically discusses:

1. Nature and relationships with stakeholders
2. Content and quality of the report

Students are strongly advised to consider the GRI (Global Reporting Initiative) standards as guiding principles to assess 1. and 2. above.

Evaluation criteria:

- structure of the report
- clarity and logic of the flow of reasoning
- completeness of the report
- style and formal correctness of the written text
- proper use of research sources and bibliography

Food-Water Nexus in a Changing Climate (30h)

July 11th – July 15th

Lecturer in charge of the module

Prof. Paolo D'Odorico (University of California, Berkeley)
paolododo@berkeley.edu

Lecturer(s) contributing to the module

Prof. Marta Tuninetti (Politecnico di Torino)
marta.tuninetti@polito.it

Module Learning Objectives and Skill Acquisition

This module includes three parts and a conclusion. The first part concentrates on the food-water nexus, including the way the food and water systems work and are connected. The lectures will present drivers and processes underlying the water-food nexus, identify consumption trends and patterns of food and water redistribution. The second part will look at socio-environmental impacts of ongoing changes in global agriculture, including the effects of land use change and water withdrawals on environment and society. The third part of the course will focus on climate change and its impacts in water and food security. We will use a "flip-the-classroom" approach with students gaining first exposure to new material before coming to class, usually via reading or videos. Most lectures will be a combination of formal lecture followed by student presentations and in-class discussion of the reading assignments.

Detailed Teaching Agenda

Part I: Food-Energy-Water Nexus

Lecture topic	*Lecturer*	*Hours*
Introduction to food and water security and the food-water nexus	D'Odorico	1.5
Global demand of food and water resources. Trends in population, diets, and consumption patterns. . The challenge of feeding the planet. Water sustainability. Ecological and water footprints	D'Odorico	1.5
Food and nutrition security. Indicators to measure healthy diets.	Tuninetti	1.5
Readings on Sustainability and Population	D'Odorico	1.5
Agricultural production. What is required to grow crops? The green revolution. Yield and harvest gap in agriculture. Gender gap. Intensification vs Agricultural expansion. Impacts on water resources. How many people can the planet feed?	D'Odorico	1.5
Water Resources. Water use for agriculture. Irrigation systems. Groundwater depletion, Sustainable water use. Water security. Water scarcity: Definitions, patterns, drivers, and societal impacts; Impacts of climate change on water resources and agriculture; Water infrastructure. Large-scale water projects. Water and agricultural development. Water and conflict or cooperation?	D'Odorico	1.5
Flipped class (I): knowledge from data. Supervised exploration of relevant database pertaining to the water-food nexus: e.g., the food dashboard, water footprint network, earthSTAT for nitrogen flows,	Tuninetti	1.5

TRASE, FAOSTAT, EAT-Lancet.		
Readings on Agriculture and Water Resources	Tuninetti	1.5

Part II: Socio-environmental impacts of ongoing changes in global agriculture

Lecture topic	*Lecturer*	*Hours*
Meat consumption. Livestock production and the demand for meat and other animal products. Livestock revolution. Trends in human diets. Feed-fed vs rangeland production. Fish consumption. Collapse of capture marine fisheries? Aquaculture. Hydrological implications.	D'Odorico	1.5
Globalization. Effect of trade on food systems. Economic drivers of trade dependency. Recent history of food trade. Virtual water, virtual land, and virtual nitrogen. Trade and food shocks. Human displacement of land use. Exportation of environmental impacts. Unsustainable virtual water trade.	D'Odorico	1.5
SSPs scenarios of population, GDP, diets. RCPs scenarios of crop yield and cultivated area. Coupling SSP and RCP (mitigation). Can population be fed in the future? Future scenarios of food trade. Will globalization increase in order to fill the gap between production and demand? What countries will become key players in the future market?	Tuninetti	1.5
Readings on Globalization and Livestock Production	D'Odorico	1.5
Environmental impacts of agriculture. Land use change, deforestation and land degradation. Forest transition. Land governance.	D'Odorico	1.5
Farming systems. Small-scale/subsistence vs large-scale commercial farming. Organic or conventional agriculture? Cash crops vs staple crops. Monocultures. Industrialization of farming systems. Agroecology, conservation agriculture and sustainable agriculture.	D'Odorico	1.5
Flipped class (II-learning from I): finding out the synergies and trade-off of the food system thoguh data. The problem of balancing food supply, impacts on water resources, environmental impacts on natural resources (e.g., planetary boundaries), economic value of food, nutritional value. Addressing multiple SDGs goals.	Tuninetti	1.5
Readings on Deforestation and Farming Systems	Tuninetti	1.5

Part III: Human appropriation of natural resources: Water and food security

Lecture topic	*Lecturer*	*Hours*
Nexus between the Human Rights to Food and Water. Human appropriation of water resources and the challenge of meeting both human and environmental needs.	D'Odorico	1.5
Human appropriation of land and water resources. Water acquisitions and water grabs. The financialization of water in agriculture.	D'Odorico	1.5
Agricultural adaptation to climate change. IoT, critical role of farmers, anticipation of climate-related impacts, virtuous examples.	Tuninetti	1.5
Readings on Human Rights, Food Security, Commodification	D'Odorico	1.0
Conclusions	D'Odorico & Tuninetti	0.5

Involved stakeholders

None

Assessment and grading

Every day a group of about 4 students will lead the discussion of relevant readings based on scholarly literature and research reports (selected by the instructors). These students will make power point presentation of the readings and ask a few questions to start the in-class discussion. All students in the class need to read the articles or reports and think of 1-2 non-trivial questions per reading that will also be asked during the discussion. These questions should show that students have read the materials and identified some interesting points. Grading: will be based on clarity of presentation (25%); insightfulness of the presentation (35%); ability to lead an engaging class discussion (25%); class participation in the course of the week (15%).

Climate-Change Compliance Reporting and Communication (20h)

July 18th – July 22nd

Lecturer in charge of the module

Luciano De Propris (Head of Open Innovation & Sustainability Consorzio ELIS) - LDP
l.depropris@elis.org

Module Learning Objectives and Skill Acquisition

This model is structured in three parts. The first part concentrates on analyzing the economic framework on which sustainability sets itself. The lectures focus on giving a broad view of how companies use sustainability in their day-to-day operations and the underlying economic frameworks. The second part will focus on the impacts of climate change and ways to measure such impacts through specific tools. This module will also focus on examples of companies that have adapted to such impacts in virtuous ways. The third part of the course will focus on climate change reporting and communication, presenting the tools used for reporting, as well as addressing the existing European reporting framework. The lectures will be structured as a combination of formal lectures and first hand experiences provided by companies. Furthermore there will be a visit to Montepulciano to witness real life cases.

Detailed Teaching Agenda

Part I: Reporting and Communication

Lecture topic	*Lecturer*	*Hours*
Environmental and energy management systems for companies (ISO 14001 and ISO 50001)	LDP	
Professional roles in energy and sustainability (HSE, Energy manager and Expert in Energy Management, Sustainability manager and CSR manager)	LDP	
“Adaptation” – communicating climate change	LDP	
Visualizing sustainability	LDP	
United Nations Sustainable Development Goals	LDP	
Reporting Standards – GRI	LDP	
D.lgs 254/16 Non Financial Information Reporting	LDP	
Creating Shared Value	LDP	
Socio-Economical Impact Analysis	LDP	
Innovability [ENEL first hand experience]	LDP	

Part II: Innovative economics for Sustainability

Lecture topic	*Lecturer*	*Hours*
Sustainability for companies and main global strategies	LDP	
Innovative Approaches and Models: (Ecological Economics, Industrial Ecology, Restoration Ecology, Bio-economics, Circular Economy) towards Sustainability Science	LDP	
Eco-design	LDP	
Circular Economy	LDP	
Doughnut Economics: combining the concept of planetary boundaries with the complementary concept of social boundaries	LDP	

Part III: Addressing and measuring Sustainability

Lecture topic	*Lecturer*	*Hours*
Renewables, energy efficiency, sustainable mobility, waste and water management	LDP	
Measuring sustainability through impact (ecological, carbon and water footprint) or through life cycle (Life Cycle Assessment [LCA] and Life Cycle Costing [LCC])	LDP	
Off-grid Company [*REAL CASE*]	LDP	
Hybrid Organizations	LDP	
Benefit Corporations [*REAL CASE*]	LDP	
Forum Sostenibilità del vino [*REAL CASE*]	LDP	
Azienda Agricola Sacchetto [*REAL CASE*]	LDP	
From company environmental management to Sustainable Network Theory	LDP	
Strategic planning and design: an action plan for sustainable energy	LDP	

Involved stakeholders

Companies and B-corps will be involved in order to give first hand experience, as well as dedicated visits to witness real life cases throughout the Italian territory (eg. ENEL, Michele Manelli from azienda Agricola Sacchetto, ecc.)


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