



PhD IN **SUSTAINABLE DEVELOPMENT**
AND **CLIMATE CHANGE**

Educational Programme

37th Cycle

Academic Years 2021/2022 – 2023/2024

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General information for the PhD course

The Italian inter-university and multi-disciplinary Doctoral School in Sustainable Development and Climate Change (PhD-SDC) aims to produce a new generation of knowledgeable people and future decision makers, able to accelerate the move to a more just, sustainable and low carbon society. There is a need to reorganize economic growth according to a new paradigm which includes management of resources to achieve for sustainable lifestyles that minimize use of natural resources and promote efficient and circular economies. The COVID-19 pandemic has shown clearly that human beings will face extreme and increasingly complex challenges which will require new global organization of people, production sectors and natural resources use. This situation has underlined the need for a re-thinking of education frameworks and the skills that will be required of future generations.

There is increased demand for actions to address climate change, innovate production processes, replace fossil-fuels with alternative sources of energy, and confine coal, oil and gas underground and implement sources of green energy.

The changes required must take account of the UN sustainable development goals and the impact on communities: the transformation to a green, sustainable future must ensure that no one is excluded and must guarantee fairer access to energy and natural resources.

We need to provide multidisciplinary education to produce experts able to propose effective development strategies which take account of the interactions between economic and technological aspects, societal issues such as justice and migration, health, pollution and climate change, and access to water and food.

The present initiative and the design of a unique inter-university, multi-disciplinary doctoral course considers all of these aspects.

The PhD-SDC has sustainability and climate change as its two key cross-disciplinary themes which link the specialized educational and research topics in its six curricula (Fig. 1):

1. Earth system and environment
2. Socio-economic risks and impacts
3. Technology and territory
4. Theories, institutions and cultures
5. Agriculture and forestry
6. Health and ecosystems.

The PhD degree course aims to equip candidates with in-depth knowledge and technical expertise in their chosen specialty, and high-level, cross-disciplinary and robust education in the other five curricula.

The objective is to give all candidates the opportunity to choose among the expertise available in 30 Italian universities and to work in inter-disciplinary teams on 'hot topics' related to sustainability and climate change. Students will be able to design their education programmes in terms of the courses and topics studied, to learn how to solve problems from different angles, and how to engage in effective discussion with experts in other domains.

We know that the reality is complex and requires highly trained individuals able to find solutions to multi-faceted problems. The curricula aim to expose the PhD candidates to a range of real-life challenges, and provide an education experiences that as much as possible mirrors real-life.

During the PhD-SDC multi-disciplinary events, candidates will work in inter-disciplinary teams on key aspects of the complex problems facing humanity, to try to guarantee “a healthy and just future” for coming generations. They will be asked to propose effective ways to achieve the 2030 Sustainable Development Goals (SDGs) defined by the United Nations.



Figure 1 – The 6 curricula offered by the PhD course in Sustainable Development and Climate Change

Programme structure

It is expected that the PhD-SDC community will include 100+ PhD candidates enrolled in the 30 supporting universities, along with their 100+ academic supervisors and the even more numerous individuals involved in delivering the lectures and training. We expect the community to meet together for around 2 weeks annually to discuss and work on sustainability and climate change issues.

Candidates will be assigned to scholarship in one of the areas within the six curricula. Candidates will be enrolled in the universities offering the relevant specializations and will follow an education roadmap that include activities at three levels:

- the multi-disciplinary PhD level;
- the multi-disciplinary level of the student’s particular curriculum;
- a more focused level related to the particular disciplinary area.

The students’ work will focus mainly on the focal discipline, although we expect some 50% of the training and around 20% of the time will be devoted to study in other disciplines.

To guarantee a multi-disciplinary and inter-university education experience, students will participate in three types of educational events (including seminars, courses, workshops):

- multi-disciplinary (MD) events, which will include all the PhD SDC candidates;
- Curriculum (CU) events, which will include all PhD candidates following that particular curriculum;
- focused (mostly single-discipline) (FD) events, to be agreed with supervisors and which will mostly be held at the universities where students are enrolled.

Table 1 summarizes the minimum hours devoted to MD, CU and FD events. Table 2 present an example of the structure of MD workshops.

Apart from the final year multi-disciplinary workshop, all educational events will take place during the first 18 months of the PhD course, leaving the final 18 months for the doctoral research project.

Event		Organizer	Minimum Number of hours
(MD) Multi-disciplinary events	MD-Workshop 1 (year 1)	PhD board	48 hours
	MD-Workshop 2 (year 3)		
(CU) Curriculum events	CU-Seasonal School (year 1)	Curriculum board	48 hours
	CU-Workshop (year 2)		
(FD) Focused and mostly single-disciplinary events	Thematic courses	Supervisors	64 hours
Total			160 hours over 3 years

Table 1. PhD-SDC education events at the three levels: multi-disciplinary, curriculum, and focused and mostly single-disciplinary and minimum number of hours

Multi-Disciplinary Events (MD)

The MD events aim to expose all PhD candidates to the full complexity of designing and implementing a transition towards a more just, sustainable, and zero net-emissions society to manage weather and climate-risks. These events will take the form of two MD workshops (MD-WS):

- Year 1 (MD-WS1): Complexity of sustainability and climate change: an overview
- Year 3 (MD-WS2): Complexity of sustainability and climate change: final report.

MD-WS1 will take place in the first months of the PhD course. It will include lectures delivered by academics working in all six curricular areas which will provide candidates with high-level knowledge on the key themes of sustainability and climate change. This will add to their understanding of the multiple challenges we face, and will help to identify the most effective solutions.

In MD-WS1, candidates will work in small multi-disciplinary teams on a research project which will be completed and presented during the week of the workshop.

MD-WS2 will include lectures delivered by academics working in the six areas and presentation of PhD research projects. Discussion, constructive criticism, comparison of methods, tools and ideas will help the students in their doctoral research.

Tables 2 and 3 present the format of the two MD workshops.

Curriculum events (CU)

The CU-events will include content and formats related to the relevant curriculum and will provide a broad overview of the curriculum research topics. The CU-events will be organized in two sessions:

- year-1 CU Seasonal School (CU-SS) will provide an opportunity for the PhD candidates to attend topical lectures on some of the themes related to their work;
- year-2 CU (CU-WS) will be held during months 18 and 24 of the PhD course, and will provide opportunities to attend topical lectures and present their doctoral research to colleagues to obtain feedback and trigger discussion.

Focused and disciplinary events (FD)

These refer mostly to single-theme and single-disciplinary courses.

FD-events will be defined by the PhD students with their supervisors. They will involve a minimum of 32 hours to be completed during the first 12 months of the PhD course.

	Morning (9.00-12.30)	Afternoon (14.00-17.30)	Evening (21.00-22.00)
Day 1 (Mon)	Arrival, registration (by 12.00)	Welcome and Opening Meet & know each other (game) Team definition (5-6 people per team)	Ice-break event
Day 2 (Tue)	Curriculum A: 3h lectures	Curriculum A: 3h lectures	Lecture on Sustainability
Day 3 (Wed)	Curriculum B: 3h lectures	Curriculum B: 3h lectures	free
Day 4 (Thu)	Curriculum C: 3h lectures	Curriculum C: 3h lectures	Lecture on Climate Change
Day 5 (Fri)	Curriculum D: 3h lectures	Curriculum D: 3h lectures	free
Sat	Free time / excursion		
Sun	Free time / excursion		
Day 6 (Mon)	Curriculum E: 3h lectures	Curriculum E: 3h lectures	
Day 7 (Tue)	Curriculum F: 3h lectures	Curriculum F: 3h lectures	Team work assignments
Day 8 (Wed)	Team work	Team work	Team work
Day 9 (Thu)	Teams present project's proposal to get first feedback (each team will have 15min to present and will get a 15min feedback)	Team work	Team work
Day 10 (Fri)	Teams present research work (20min presentation plus 10min Q&A) and hand over essay (max 4000 words)	Closure by 13.00	

Table 2. Proposed structure of the 1st Multi-Disciplinary workshop

	Morning (9.00-12.30)	Afternoon (14.00-17.30)	Evening (21.00-22.00)
Day 1 (Mon)	Arrival, registration (by 12.00)	Welcome and Opening Lectures on Sustainability (1.5h) and Climate Change (1.5h)	Ice-break event
Day 2 (Tue)	Curriculum A: 3h lectures	Presentations of research work by Curriculum A candidates	Lecture on Sustainability
Day 3 (Wed)	Curriculum B: 3h lectures	Presentations of research work by Curriculum B candidates	Free
Day 4 (Thu)	Curriculum C: 3h lectures	Presentations of research work by Curriculum C candidates	Free
Day 5 (Fri)	Curriculum D: 3h lectures	Presentations of research work by Curriculum D candidates	Lecture on Climate Change
Sat	Free time / excursion		
Sun	Free time / excursion		
Day 6 (Mon)	Curriculum E: 3h lectures	Presentations of research work by Curriculum E candidates	Lecture on Sustainability
Day 7 (Tue)	Curriculum F: 3h lectures	Presentations of research work by Curriculum F candidates	Free
Day 8 (Wed)	Class activity (e.g. on presentation skills)	Class activity (e.g. on negotiation)	Free
Day 9 (Thu)	Class activity (e.g. on how to structure essays)	Class activity (e.g. on how to prepare a CV)	Lecture on Climate Change
Day 10 (Fri)	Class activity (e.g. on how to give feedbacks)	Closure by 13.00	

Table 3. Proposed structure of the 2nd Multi-Disciplinary workshop

Supporting inclusion and diversity

Inclusion and diversity are fundamental values required for education and scientific excellence. Scholars with diverse talents, backgrounds and perspectives will contribute insights and innovative approaches to tackle difficult scientific problems and societal challenges. Everyone involved in this PhD Program will promote and support inclusion and diversity, and foster an environment where the brightest, most creative minds from every segment of society and every part of the globe can achieve their full academic and professional potential.

PhD program language

All PhD candidates are expected to have a good knowledge of the English language. Note that all MU and CU events and most FD events will be conducted in English. The PhD thesis can be in Italian or English.

CU1. Earth System and Environment

Education aims and method

The education plan for this curriculum is a novel training module that leverages and exploits the diverse and multidisciplinary expertise of the research theme supervisors. The aim is to train the PhD candidates to deal with the challenges raised by climate change and sustainable development in the different fields included in this curriculum and to introduce them to the questions on which the scientific community is currently working.

Approach

The PhD candidates will be expected to develop qualitative and quantitative methodological skills through a bottom-up problem solving approach.

Teaching methods

The module will include two-hour lectures focusing on different areas; they will provide general background information targeted at non-experts and also will explore certain questions, specific to the curriculum areas, in great depth. The curriculum lectures will be mostly face to face. In addition, the students will be actively engaged in a range of activities including writing up notes from lectures not related to their chosen research theme and conducting team projects on some of the issues discussed in these lectures. The training module will foster interaction and collaboration among all participants, from lecturers to students, for building a common core of advanced knowledge.

CU teaching modules

Title	Hours	Abstract/Objectives
Challenges and open questions in Earth System and Environmental Sciences Part I	24	Introduction to open questions and directions currently being explored by this community to find concrete solutions to Climate Change and Sustainable Development issues. The teaching methods will include lectures and open discussions
Challenges and open questions in Earth System and Environmental Sciences Part II	24	In-depth study of the relationships between climate change and real sustainable development. A strong, active and cooperative learning approach will be applied through teamwork.

FD teaching courses

The specific training activities will be tailored to each candidate based on their backgrounds. The courses will be chosen from among the range of courses being offered by all the universities contributing to the curriculum and will include both general and specialized and methodological courses. The course offerings will span climate dynamics and future projections, European directives, observation of radiatively active and species observations for modelling environmental processes, and risk assessment and decision support system related to environmental impacts.

Candidates will have the option to customize their training. They will be able to participate for a minimum of 64 hours in the curricula and the 40 different courses offered by any of the universities involved in the doctoral course.

CU2. Socio-economic risks and impacts

Education aims and method

The overarching goal of this education plan is to provide the next generation of scholars with the tools to develop frontier research on issues that are at the crossroads of sustainable development, climate change, economics, engineering, management studies, statistics and other related fields. The aim is to training scholars able to interact with academics from a range of other disciplines and develop sound scientific research that will inform practice and policy making. The PhD candidates' research projects should be aimed at current urgent sustainability and climate change issues.

The **CU 2 Socio-economic risk and impacts** programme is structured in two main compulsory modules: (i) a Methodological Toolbox module, which will provide an overview of the most relevant sources of data and most relevant methodologies that the students can draw on for their PhD research projects; (ii) a Thematic Module, which will introduce the issues and theories at the core of this curriculum (see CU teaching modules below). The CU 2 programme will also include some additional (optional) courses; details to be provided later.

Approach

The PhD candidates will be expected to develop strong quantitative methodological skills although qualitative methods will also be important. The emphasis will be on the assessment of environmental policies and analysis of public-private interactions in the social, economic and technological realms.

Teaching methods

Teaching methods will include traditional and interactive lectures combined with individual and team activities, including essays, class discussion groups, laboratory-oriented activities and group data analysis.

CU teaching modules

Methodological Toolbox (24 hours)
Research Design (2h) A broad framework which includes specifies objectives, data collection and analysis methods, time, costs, responsibility, probable outcomes and actions related to conducting the doctoral research. The lecture will provide an overview of all these issues.
Economic Models (6h) Economic Agent-Based Models: introduction to agent-based modelling and related techniques (e.g., Monte Carlo simulations, scenario and sensitivity analysis), comparison with standard models (e.g., Dynamic Stochastic General Equilibrium or DSGE models) and a brief overview of alternative programming paradigms. Input-Output (IO) models: Introduction to single-regional and multiregional input-output analysis; environmentally-extended IO analysis; links between environmentally extended IO and Life Cycle Assessment or LCA models.
Data science models (10h)

<p>Introduction to the most common scientific data models: data acquisition (primary, secondary); unsupervised (cluster, network models); supervised (regression, trees, neural networks) and model comparison.</p>
<p>Life Cycle Methods (6h)</p> <p>Introduction to the main LCM: Life Cycle Assessment, Life Cycle Costing and Footprint labels.</p>
<p>Thematic Module: Part A - Physical and transition risks (12 hours)</p>
<p>Physical and other risks: causes and consequences (6h)</p> <p>Seminars focused on physical, rather than economic, scenarios for natural events including hazards, i.e., characterization of natural events; exposure, i.e., identification of the areas liable to be damaged (objects, systems); vulnerability, i.e., what makes certain areas more or less resistant to hazard events. The various scenarios will be evaluated in terms of potential damage and risks.</p>
<p>ESG risk management (6h)</p> <p>How to measure economic sustainability risks and the impact of Environmental Social Governance (ESG) factors on economic risk and performance.</p>
<p>Thematic Module: Part B - The power of policies (12 hours)</p>
<p>Corporate and Industry level policies (4h)</p> <p>Why firms self regulate and what are the impacts of voluntary and legally binding initiatives on socio-economic and environmental performance. A set of lectures that will link environmental policy theory to the static and dynamic effects on socio economic performance and innovations (macro, meso, micro based evidence).</p>
<p>Corporate Sustainability Reporting (2h)</p> <p>Seminar on Corporate Sustainability Reporting: an overview of the main International frameworks. A seminar on the role of entities and their accountability, and accounting and reporting issues in the context of sustainable development. Corporate social and environmental accounting and reporting involves measuring, managing and communicating the social and environmental effects of a corporation's economic actions to particular stakeholders and to society at large. The focus of this seminar is on the adoption of international frameworks such as Global Reporting or GRI Standards, International Integrated Reporting or IIRC frameworks and global indicator frameworks for the UN Sustainable Development Goals.</p>
<p>Impacts and evaluation of public policies on sustainability: behavioural changes and acceptability (6h)</p> <p>A set of seminars aimed at describing: (a) why sustainability is a problem that affects many productive activities including transportation; (b) which types of policies (e.g. command and control, regulation, taxation, subsidies or soft policies including educational campaigns) would most reduce the environmental impacts of these activities;(c) the benefits and drawbacks of each policy type; and d) policy evaluation methods. Case studies of the transport sector and the utility of different sustainable mobility policies will be presented.</p>
<p>Optional courses</p>
<p>How to write academic papers: the writing, peer review, publishing and reviewing processes</p> <p>A set of seminars to provide students with some basic information related to producing manuscripts of the quality required by peer reviewed journals. Guidance on manuscript submission and the peer review process; and information on the actual review process and becoming a good reviewer.</p>

Understanding which contributes to scientific impact

Seminar to raise awareness about the main determinants of scientific impact in published papers, discussion of impact pathways and a set of guidelines on how to increase overall impact.

FD teaching courses

Each Local University is offering an impressive selection of PhD (and, in some cases, Master's) courses that the PhD candidates can attend. In collaboration with thesis advisors, candidates must design a study plan that includes both their compulsory and optional courses. The full list of FD courses will be made available to the successful applicants. These courses will include methodological courses on issues such as Big data analysis, Risk management, Data analytics for science and society, Applied econometrics of health decisions and Machine learning for quantitative economics. The thematic courses will cover a range of climate change (e.g., Urban planning for climate change, Transport decision making and sustainability, Transport planning and climate change: challenges and solutions, Innovation economics), environmental management (e.g., Environmental economics and policy, Behavioural economics for the environment, Economic analysis of global environmental issues,) and sustainability more generally (e.g., sStakeholder theory, Business and society, Policies for sustainability and local development).

CU3. Technology and Territory

Education aims and method

The training in this curriculum is aimed at developing transdisciplinarity to allow exchanges among the various thematic and disciplinary approaches included in this curriculum.

A bottom-up problem solving approach will be adopted to identify different analytical profiles and potential innovative methodologies. This will involve a recursive method of analysis of methodologies and the problems they raise, and the solutions proposed to address them.

Teaching methods will include joint working sessions to examine real (technological/ territorial) problems and will include problem presentation, group work, comparison, collection and processing of common elements, transferability and exportability.

The **results** of the training plan will be made explicit in the identification of the **main themes** of curricular training. The main themes chosen by the PhD students will be presented during the academic years of the programme and will be the topic of the final thesis.

CU teaching modules

The teaching modules will address four main themes.

The proposed themes are:

- (A) Sustainable transition of production systems and sustainable use of materials and resources;
- (B) Sustainable transition of mobility and urban and territorial systems;
- (C) Sustainable transition of energy systems;
- (D) Digital transition to support decarbonization, circular economy and mobility.

First year (24H)

Title	Hours	Abstract/Objectives
Themes (A) and (B) studied sequentially	4	Introduction and discussion
Themes (A) and (B) studied separately	10	Three groups, adopting a problem-solving approach, will work first on theme (A) 5h and then on theme (B) 5h
Themes (A) and (B) studied together	4	Innovative methodological activities to identify problem solutions
Themes (A) and (B) studied sequentially	6	Comparison, collection and elaboration of common elements. Assessment of transferability and potential for application to other areas (exportability). Focusing first on theme (A) and then on theme (B)

Second year (24H)

Title	Hours	Abstract/Objectives
Themes (C) and (D) studied sequentially	4	Introduction and discussion
Themes (C) and (D) studied separately	10	Three groups work will adopt a problem solving approach to work first on theme (C) 5h and then theme (D) 5h
Themes (C) and (D) studied together	4	Innovative methodological activities suggested by problem solutions.
Themes (C) and (D) studied in sequence	6	Comparison, collection and elaboration of common elements. Assessment of transferability and exportability based first on theme (C) and then theme (D)

FD teaching courses

The courses in this curriculum require an interdisciplinary perspective. Students can choose among the courses offered by the other universities involved.

The synergies with the Technology and Territory curriculum will be highlighted on the PhD SSCC official website.

CU4. Theories, Institutions and Cultures of the Ecological Transition

Education aims and Method

The curriculum has been designed to: i) foster transdisciplinarity and mutual understanding of different views of the ecological transition, in the humanities and social science disciplines; ii) create an environment that facilitates scientific exchanges, dialogue and critical discussion among PhD candidates; iii) structure the educational activities such that successive activities build on, develop and enable new insights on previous activities.

The curriculum will:

- a) develop theoretical and practical tools to allow current and future researchers to manage the cognitive and practical challenges posed by the issues of sustainability and climate change;
- b) provide information on the main concepts, theories and approaches that integrate the ecological transition and sustainability, in different areas of the humanities and social sciences.
- c) allow a better understanding of and deeper scientific knowledge about the ecological transition, sustainability and climate change in different areas of the humanities and social sciences.

Approach

The curriculum will adopt a transdisciplinary methodological approach based on knowledge sharing via: i) discussion of sustainability and the ecological transition from a cross-disciplinary and humanities and social sciences perspective; ii) analysis of specific topics in particular fields (especially philosophy, literary studies, law and sociology) and using lenses from the other fields; iii) PhD candidates' presentations of their research projects to an interdisciplinary panel of their peers and experts in the field.

Teaching Methods

The teaching methods will include: a) courses delivered by academics from the universities involved and external tutors with expertise in particular methodologies and topics; b) the PhD students' presentations of their research and discussion with and feedback from fellow students and lecturers; c) workshops; d) seasonal schools; e) interaction via debates, practical exercises, etc.; and e) seminars to teach skills and provide information on European research and funding opportunities.

CU teaching modules

Year I

Title	Hours	Abstract/Objectives
An introduction to the ecological transition through multi-disciplinary exchanges of ideas	3	Supervisors will propose a topic for discussion related to the ecological transition and focusing on methods and approaches and links and intersections among different perspectives.
Joint discussion of the research projects	3	The PhD candidates will present their research projects for joint discussion with fellow students and supervisors, to identify potential connections among topics and methods, which will allow insights from other perspectives.

Specialistic/disciplinary perspectives and tools	(see below)	Supervisors in each macro-area - law, sociology, ethics, philosophy of language, aesthetics, epistemology and literature - will design modules that allow a better understanding of the specificities of their disciplines, methods, perspectives and tools. Interactions with other supervisors and other PhD candidates will identify common issues and synergies.
a) Law and regulatory tools	3	Supervisors from the law field will analyse the role played by the law in shaping society and markets and will present the methodology adopted by lawyers to analyse problems related to sustainability and the ecological transition. Particular attention will be paid to: a) analysis of the 'Green Deal', as a tool to guide Europe's ecological transition and in terms of its effect on global governance; b) financial regulation from the perspective, in particular, of comparative law, to create the right incentives for engagement in and to channel funds towards more sustainable business models that contribute to achievement of the UN sustainable development goals.
b) Society	3	Supervisors from the field of sociology will analyse the part played by social science in explaining the social roots and social consequences of climate change. This will include investigation of the principal social measures that have been proposed to cope with climate change. Finally, an innovative epistemology and ontology for the social sciences will be suggested to improve understanding of socio-material phenomena and capacity to envision a horizon of sustainability.
c) Philosophy, Ethics and Aesthetics	3	Supervisors from the philosophy discipline will focus the role of ethics, aesthetics and ontology in shaping society and will propose a philosophy methodology to analyse sustainability and the ecological transition. Particular attention will be paid to: a) analysis of transgenerationality, a concept allowing a new understanding of environmental sustainability; b) the allocation of responsibilities, potential redistribution of benefits/disadvantages, mitigation of discrimination and inequalities resulting from climate change, and equality and justice among generations (theories of intergenerational justice); c) conceptual analysis of language and fundamental terms such as 'world' and 'environment', and critical assessment of the opposition between 'natural' and 'cultural'.
d) Narrative and Communication	3	Supervisors specialized in semiotics and the theory of literature will analyse the role of narrative and communication in shaping collective representations of nature and the environment, in relation to sustainability and the ecological transition. A communicative process and discourse perspective will be applied to study contemporary mediascapes, related to issues such as dis/information and debate on the so-called 'post-truth' era. A literature and art

		perspective will be adopted to enable discussion of how utopian and dystopian, post/apocalyptic and climate fiction, nature poetry, ecological theatre and the media interpret the post-Anthropocene era, the climate crisis and (un)sustainable societies and generate empowerment and agency among individuals and communities.
TOT	18	

Year II

Title	Hours	Abstract/Objectives
Ecological transition techniques, processes and values: personal and collective achievements during year 1	3	Supervisors will discuss with students what they have achieved towards the goal of sustainability and the ecological transition in their research projects so far. They will highlight commonalities among the knowledge and methods related to different curricula and will discuss how the research projects should be developed.
Advancements in the research projects	3	Individual PhD candidates will present their research for joint discussion with fellow-candidates and supervisors, to identify potential connections between different topics and methods and obtain insights from other perspectives.
EU research and funding	4	Techniques, methods and guidelines for applying for EU funding within the Horizon2020 framework in the humanities and social sciences.
Specialistic/disciplinary perspectives and tools	(see below)	Discussion of specific issues that define particular fields, but are shared by others. The common background built during the first year will allow joint and deeper investigation of specific issues in the different fields, which will add to a shared understanding of the ecological transition. The focus will be on the major issues in each field. The main topics foreseen will include:
a) Legal tools for sustainability	4	
b) Sociological approaches to sustainability	4	
c) Understanding transgenerationality and technology to foster sustainability	4	
d) T Ecological humanities, ecocriticism and ecolinguistics for sustainable	4	

development communication strategies		
e) Ecological humanities, ecocriticism and ecolinguistics for sustainable development: aesthetics questions	4	
TOTAL	30	

FD teaching courses

The PhD candidates will be able to design their own education plan and tailor it to their proposed research projects, previous experience and education. Below, are some examples of the different courses taught at the universities involved in the PhD programme.

Host Institution	Number of Hours	Title	Coordinator	Topics
Università di Cassino	10	Collective behaviours and the ecological transition	Alessandra Sannella with faculty members of University of Cassino and external scholars	Analysis of the values that guide individual and collective actions. Analysis of collective behaviours and, especially the climate crisis which is in need of more focused attention.
	10	Behavioural economics and institutional approaches	Alessandra Sannella with faculty members of University of Cassino and external scholars	Economic and quantitative analysis of issues related to behavioural economics, businesses, organizational behaviour (national and international) and territory
	10	One Health	A. Sannella and M. Ferrara in collaboration with colleagues from ASL Frosinone and some hospitals in the region as well as health institutions and international expert.	Introduction to the WHO concept of One Health (WHO 2017), theories and research related to protecting the health of the most vulnerable people. Methods for promoting health in the digital society.
Università di Ferrara	30	Seasonal School Changing the (Cultural) Climate with Ecocriticism and Ecolinguistics	Paola Spinozzi with colleagues from the PhD programme in Environmental Sustainability and Wellbeing: Eleonora Federici (UniFe), Richard Chapman (UniFe), Andrea Casals Hill (Pontificia Universidad	How do languages, literatures and other modes of meaning-making promote ecocritical frameworks that interrogate Western and Eastern anthropocentric assumptions, biases and expectations? How do the environmental humanities test new hermeneutic tools to assess the interdependence between natural and anthropic ecosystems?

			Catolica do Chile), Fátima Vieira (Universidade do Porto), Ingrid Molderez (Katholieke Universiteit Leuven)	<p>Topics and areas of research include:</p> <ul style="list-style-type: none"> - Climate change fiction - Climate change and visual culture - Eco-poetry - Ecology and the theatre - Ecology and performativity - The formation of ecological identity - Opinion formation on environmental issues - Public awareness and social media - Sustainability of heritage <p>Contributions by scholars of ecocriticism, ecolinguistics, ecofeminism, green cultural studies, media studies, semiotics, translation studies, critical discourse analysis and corpus linguistics, heritage studies and ecotourism</p>
	10	Ecomuseum s. New Challenges for a Sustainable Heritage	Paola Spinozzi with colleagues from ESW PhD: Rachele Dubbini (UniFe), Massimiliano Mazzanti (UniFe), Saskia Stevens (Universiteit Utrecht)	<ul style="list-style-type: none"> - Heritage and sustainability - Heritage and sustainable planning of island landscapes - Sustainability of fragile territories - Managing ecomuseums: Issues and potentialities
	10	Ecology and Agency	Paola Spinozzi with colleagues from ESW PhD: Alfredo Alietti (UniFe), Sara Lagi (UniTo)	<p>The aim is to reflect on the strengths and limits of ecological pacifism.</p> <ul style="list-style-type: none"> - History of ecological pacifism and its development - Analysis of ecological pacifism with a focus on concepts, principles and major scholars - Ecological pacifism in relation to 20th and 21st century peace theories and more traditional institutional pacifism.
	10	Towards a Slower, Sustainable Life	Paola Spinozzi with colleagues from ESW PhD: Ingrid Molderez (Katholieke Universiteit Leuven), Juan Diego Martínez (Universidad Pontificia	<p>The aim is to escape from a throwaway society by envisioning alternative lifestyles.</p> <ul style="list-style-type: none"> - How can system thinking contribute to a slower and more sustainable life? - The possibility of longer consumption of products with longer life cycles?

			Bolivariana), Danny Jean Paul Mejía (Universidad Pontificia Bolivariana)	<ul style="list-style-type: none"> - How to achieve individual and collective sustainable behaviours? - The possibility of slower and more sustainable cities and societies in a fast-changing world?
	10	Waste to Energy in the Circular Economy: Technology, Institutions, Policies	Paola Spinozzi with colleagues from ESW PhD: Massimiliano Mazzanti, Luigi Russo (UniFe)	<p>Study of the circular economy and waste management by integrating socio-economic, legal and technological dimensions.</p> <ul style="list-style-type: none"> - Policies and markets for the circular economy and energy transitions - Social acceptance of renewables: cost-benefit aspects and territorial developments focusing, in particular, on biogas plants - Waste to energy: technological development and cost issues - Agro-energy business: regulatory framework, tools and incentives
	10	Green Economy Models and Innovative Dwelling: Economic and Environmental Aspects	Paola Spinozzi with colleagues from ESW PhD: Pietromaria Davoli (UniFe), Vittorino Belpoliti (University of Sharjah, UAE)	<p>The green economy and innovation related to living spaces.</p> <ul style="list-style-type: none"> - European energy systems and climate policies - LCA and LCC: tools, techniques and models. Introduction to energy analysis from the perspective of the product and process LCs: existing approaches; LC costing based on environmental/economic evaluation; LCA: environmental/economic analysis; LC energy: environmental impact. - socio-economic scenario of construction developments. Policies and dynamics of social developments for new housing spaces.
Università di Genova	30	Introduction to Sustainability Principles	Michele Siri, Eugenia Macchiavello (and other Law professors from the University of Genoa)	Sustainability and climate change from the perspectives of private law, criminal law, international law, labour law, company law, financial regulation, philosophy of law and history of law.
	30	EU financial regulation and new challenges for the ecological transition and	Eugenia Macchiavello, Michele Siri, and other (Eufimar guests, Academic Members of the centre of excellence Jean Monnet EUSFIL)	A brief introduction to the main rationales and architectures of financial regulation and supervision at the national, European and international levels, followed by analysis of European financial regulation, focused on investments and markets, sustainability and digital finance.

		sustainability		
Università Cattolica del Sacro Cuore	10	Introduction to European Union Law	Ilaria Beretta / Andrea Santini	The Institutions and Policies course provides students with knowledge about the institutional aspects of the European Union, with a focus on its legal basis and the development of environmental policies and the process of EU policy making.
	10	European Green Deal: Risks and Opportunities	Ilaria Beretta / Simone Tagliapietra	Systemic analysis of the EU Green Deal (EGD) and its implications for the sustainability transition. The range of policies and regulations associated to implementation of the EGD and linked to the Next Generation EU and Multi-annual Financial Framework 2021-2027, is presented and evaluated in terms of effectiveness and impacts. Policy coherence issues are addressed together with the public finance dilemmas raised by decarbonization and the circular economy.
	10	The Circular Economy	Ilaria Beretta / Roberto Zoboli	The aim is to provide theoretical and applied knowledge of economics and policy within an EU circular economy strategy and international framework. The environmental and industrial dimensions of the circular economy will be framed in terms of resources efficiency strategies, international economic relations and the costs and benefits to society.
	10	Socio-economic impacts of environmental policies	Ilaria Beretta	Practical analysis of the links between economy, society and environment in urban context, based on empirical research and data analysis to provide accurate assessments.
	10	Community resilience	Ilaria Beretta / Barbara Lucini	Provision of the skills and tools needed to analyse and act on complex systems under stress. Specific attention is paid to the notion of resilience (methods and strategies) and an understanding and interpretation of resilient social processes in risk contexts.
	10	Soft skills	Ilaria Beretta / UCSC Postgraduate Schools	In the context of the increasing importance attributed to soft skills in the labour market, this will provide students with the ability to work in teams and speak in public.
Scuola Superiore Sant'Anna	30	Seasonal School: The Ethics of	Alberto Pirni with SSA faculty	The Seasonal School provides concentrated, focused training on the ethical, social, political and economic

		Climate Change: Reshaping Responsibilities for Present and Future Generations	members and external scholars	issues related to climate change. The four main topics include: features of and challenges specific to climate change; intergenerational implications of climate change mitigation strategies; models of individual and collective responsibility; and the global distributive problem related to burdens and benefits of pollution.
	10	Introduction to intergenerational justice	Alberto Pirni	Introduction to concepts, methods and fundamental issues related to classical and contemporary theories of justice. The focus will be on the theories of intergenerational justice, with specific reference to sustainability and climate change issues.
	10	An introduction to political philosophy concepts and methods: global issues	Barbara Henry	A focus on the minimal skills needed to critique mainstream scientific discourse, especially in relation to <i>risk</i> , <i>danger</i> and problems. These categories are analysed to provide a sound critical basis for debate on climate change.
	10	Access to justice and transnational environmental crimes	Alberto di Martino Gianluigi Palombella	Analysis of how access to justice is more important in relation to environmental than other issues, as both a right and a (still marginal) protection of environmental goods. Environmental crimes are discussed as defined broadly by the UN Office on Drugs and Crime (any criminal behaviour that may have negative consequences for the environment). Environmental crimes are transnational in nature. However, despite international efforts to formulate coherent global responses, there remains a high level of 'sovereign sensitivity'. The course focuses on the two main categories of the TEC international framework: natural resources crimes and pollution crimes.
	10	Criminal economy and environmental crimes	Gaetana Morgante	Analysis of the relations between organized crime and environmental criminal offences within the broader perspective of the evolution of the activities of transnational criminal groups. The economic impact of environmental crimes committed by groups is studied using quantitative methodologies.

	10	The Administrative Regulation of Circular Economy in the European Green Deal	Edoardo Chiti	The European industry transition to a circular economy is one of the main processes promoted by the EGD to achieve the macro-objective of climate neutrality. The principles and rules governing transition to a sustainable model of inclusive growth are analysed along with how they differ from the traditional principles, rules and techniques in administrative law. Are these principles rules and techniques functioning well in relation to the needs of the new economic model?
	10	Agricultural Law and Human Rights. Food sustainability and climate challenges	Mariagrazia Alabrese	Study of the nexus between climate change and the human right to food, highlighting how the international climate regime addresses agricultural issues.
Università di Torino	30	Theories and practices of the socio-ecological transition	Dario Padovan Barbara Curli Cristiana Peano	Five 6-hour modules studying: 1. Theories of the ecological transition I: eco modernism, geo-constructivism, accelerationism, etc. 2. Theories of the ecological transition II: eco-socialism, ecological civilization, just transition, social ecology, degrowth. 3. Energy transition: socio-historical perspectives 4. Food transition: socio-historical perspectives 5. Fossil capitalism, green capitalism, the end of capitalism?
	10	Transgenerationality: future entities, emotions, actions, institutions	Tiziana Andina	Introduction to the concept of transgenerationality. The focus is specifically on transgenerational societies, future generations, revision to contractualist models, treatment of transgenerational actions and the role of the state. Issues related to emotions will also be addressed including emotions that strengthen the transgenerational model.
	10	Ecosemiotics: natures, cultures, imaginaries	Simona Stano	Analysis of the processes of signification and valorization underlying the definition and understanding of the concepts of

				environment and nature and their involvement , as well as their “discursivation” in contemporary cultures, with specific reference to digital communication and the dynamics related to the so-called post-truth era.
	10	Technique, nature, second nature	Maurizio Ferraris	Human nature is second nature, that is, it begins with technology. This is the premise on which environmental and sustainability questions should be interpreted i.e. in terms of rather than in terms of responsible control of second nature rather than a return to nature.
Scuola Universitaria Superiore IUSS Pavia	24	Institutional models and legal tools for the financial management of climate-related risks	Alberto Monti Lydia Velliscig	A comparative law perspective on institutional models and legal tools adopted in different jurisdictions for the financial management of climate-related risks, with a special emphasis on approaches aimed at encouraging mitigation and adaptation, to achieve sustainability goals
	16	Epistemology, science and rationality: towards a philosophy of sustainable choice	Michele Di Francesco Giulia Piredda Andrea Sereni Alfredo Tomasetta	Formulation of reliable scientific predictions and actions in a context of complex data and uncertainty. The focus is on some essential philosophical background related to the theory of sustainable choice: application of a scientific methodology to contemporary global challenges, rationality and rational choice, critical thinking and informed decision making and ethical problems related to public actions.
Università dell’Insubria	30	Critical topics in environmental law from a comparative law perspective: climate change, sustainability and the circular economy	Barbara Pozzo Valentina Jacometti Stefano Fanetti	Summer School, organized in collaboration with the universities of Marseille/Aix-en-Provence (F), Opole University (PL), Utrecht (NL), held annually in July in Como and focusing on different topics. The topic of the 2022 edition is the interconnections among climate change, sustainability and the circular economy from a comparative law perspective.
Università Ca’ Foscari - Venezia	10	Environmental Aesthetics: environment, nature, and	Luigi Perissinotto Roberta Dreon	The aim of these environmental aesthetics lectures is to enable a rethinking of the exchanges between humans and the environment, beyond disinterested contemplation of nature. Th analysis is based on an

		aesthetic (dis)interest		environmental aesthetics approach anchored in a post-subjectivity perspective and a pragmatically-oriented conception of the interactions between living beings and the environment.
	10	The Anthropocene Venice	Pietro Omodeo	The Anthropocene, an earth sciences concept has yet to be validated by the International Commission on Stratigraphy, but has already sparked wide scientific and cultural debate. The idea that we have entered a new geological epoch marked by humans as a geological force capable of having a significant and lasting impact on the earth system, is raising theoretical questions and practical concerns.
	10	The Anthropocene and sustainability: art practices and behavioural change	Cristina Baldacci Diego Mantoan	A series of lectures providing insights into how artistic practices contribute to raising public awareness about climate change, by influencing the behaviour of individuals and communities. Imagining future environmental scenarios and reconstructing ecosystems at danger of extinction – especially through virtual/augmented reality and the practices of pre-/re-enactment and embodiment – encourage forms of awareness, criticism and activism that contribute to defining an ‘eco-aesthetics’ against environmental exploitation.

CU5. Agriculture and forestry

Education aims and method

The Agriculture and Forestry curriculum will provide the PhD students with a solid, up-to-date and interdisciplinary cultural and scientific background. The aim is to trigger a paradigm change that will allow creation, analysis and evaluation of new sustainable development models and the scientific, technical and technological bases to implement transformation to sustainable agriculture and forestry in a context of ongoing climate change.

The training programme will comprise a set of short courses and modules related to different disciplines, focused on the development of three types of skills.

It will include **curriculum modules** covering aspects such as:

- i) Systemic Thinking to make students familiar with holistic approaches to and an understanding of resources management;
- ii) Climate change in terms of its biological basis, adaptation strategies and quantification and mitigation methods;
- iii) Data management based on data from precision farming equipment and sensors, and familiarity with big data and quantitative modelling.

These topics will be covered in the course of a series of short modules (1 CFU each) delivered by the universities offering PhD degrees in these specific topics. They will provide experience of other universities and promote development of specific skills.

FD teaching courses includes scientific writing, statistics, project management and sustainability in the context of agriculture. Several of the universities involved offer courses on these topics.

Individual training which will allow the PhD students to choose specific courses consistent with their personal education plan.

Approach

The core courses will provide information on generic aspects related to climate change and adaptation to climate change, from an agriculture and forestry perspective. The PhD students will have the opportunity to construct tailored study plans including a mix of courses at the universities involved.

Teaching methods

Face to face teaching and participatory group work on modelling and use of software.

CU teaching modules

Agriculture and Forestry systems (Systems thinking) 16h 2 CFR	<ul style="list-style-type: none">- Introduction to system dynamics (UNISS)- Water food energy nexus and ecosystem services (UNIPD)
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Climate change impacts, adaptations and mitigation 24h 3CFR	<ul style="list-style-type: none"> - Energy water and carbon budgets in agricultural and forestry systems (UNISS) - Soils in a changing climate (UNITO) - Plant strategies for adaptation to climate constraints (UNITO) - Forest management and climate change mitigation (UNIPD) - Climate adaptation strategies in agriculture and forestry (UNISS) - Life Cycle Assessment approach in the agro-food sector (UNICATT)
Agriculture data 16h 2CFR	<ul style="list-style-type: none"> - Hyperspectral detection and monitoring of plant diseases and stress (UNIFI) - Big data management and analytics (UNIPD) - Basics of crop modelling (UNIFI) - Copernicus: digital agriculture and environmental sustainability (IUSS)

FD teaching courses

Scientific Communication (3 CFR; 24 hours)	Scientific Writing (8 Hours) (UNISS) Dissemination of results (publication ethics, scientific graphics, scientific communication and social networks) (UNITO)
Statistics (3 CFR; 24 hours)	Basic statistics; applied statistics with R; advanced statistics with R: experimental design in the lab and in the field; spatial statistics (UNIPD)
Project writing and management (1 CFR; 8 hours)	Policies and research programmes (UNISS) Participatory networks
Sustainability (2 CFR; 16 hours)	Sustainable animal production (UNICATT/UNISS) Sustainable forestry

CU6. Health and Ecosystems

Education aims and method

We offer a novel education plan that focuses on inter- and trans-disciplinarity, aimed at forming young researchers who can tackle the sustainability issues linked to human and ecosystem health. Our ambition is to train the PhD students following curriculum 6 to handle the challenges posed by climate change and sustainable development and their effect on the health and well-being of man and the ecosystem. We want to produce trans-disciplinary able to recognize the interconnections between environmental sustainability, climate change challenges, human health and ecosystem function, including biodiversity, within a planetary and One health perspective.

The training programme includes formal lectures combined with homework and joint trans-disciplinary class projects on the problems and sustainability challenges discussed in class. Our aim is to foster interactions and collaborative activities that include all those involved in curriculum 6 including faculty.

CU teaching modules

Title	Hours	Abstract/Objectives
Climate change impacts on the alpine environment	12	<p>The course will introduce the students to the impacts of climate change on the cryosphere, and terrestrial and aquatic ecosystems. The main monitoring and analysis methods will be applied. The course will comprise three 4-hour modules:</p> <ol style="list-style-type: none">1) Climate change impacts on the cryosphere (snow, glaciers, permafrost)- snow changes and their influence on the glacier mass balance and the permafrost distribution; glacier shrinkage; permafrost degradation;2) Climate change impacts on vegetation (plant species and communities) – characteristics of the alpine vegetation, distribution patterns based on elevation and the cryosphere and the main patterns of succession; main impacts of climate change on species and communities (e.g. upward migration and shrub encroachment) and impacts on ecosystem functioning3) Climate change impacts on freshwater ecosystems (productivity of phytoplankton, grazing of zooplankton, fish reproduction), characteristics of remote alpine lakes, main chemical-physical variables of lakes, typical communities of high altitude lakes. Main impacts of temperature changes on species compositions and productivity of lakes. Historical information on lakes compared to the current situation

<p>Sustainability, climate change and ecosystems</p>	<p>12</p>	<p>This module will provide all students following curriculum 6 with the a comprehensive understanding allowing analysis and exploration of the intricate interrelationships among ecosystem functions, within a climate change framework and from a sustainability perspective. The courses included in the module will address issues such as the link between sustainability and the oceans, microplastics, ecosystem functions and services, groundwater biodiversity and ecosystem dependency. The main class topics will be:</p> <ul style="list-style-type: none"> · Sustainable use of the oceans in the context of climate change · Impact of microplastics on man, the environment and the ecosystem · Ecosystem services in an era of climate change · Ecological principles underlying pandemics · Subterranean ecosystems in the Anthropocene: the effects of climate change · Groundwater biodiversity: patterns and processes on the ecological and evolutionary scales · Groundwater dependent ecosystems: review of their biodiversity, ecological characteristics, main impacts · Groundwater biodiversity: joint effect of aquifer depletion and increased pollution
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Sustainable development, climate change and human health	24	<p>This module addresses the main challenges associated with protection of human health and prevention of adverse health outcomes attributable to environmental and climate change. It covers all major aspects of the links between environmental sustainability and health and combines epidemiological and toxicological paradigms with advanced computational techniques in a One Health framework. The objective is to train young researchers to contribute effectively to the implementation of the EU Green Deal and the development of a toxic-free environment for all</p> <p>This training module includes the following topics:</p> <ul style="list-style-type: none"> · The exposome: a new measure of exposures related to health · Environmental health system dynamics and causality · Impact of environmental pollution on the nervous system · Endocrine Disrupting Chemicals (EDCs): from animal biology to humans · One Health approaches to human and ecosystem health · Effects of climate change on human health including vector-borne diseases · Computational aspects of integrated environmental health risk and impact assessments · Epidemiological modelling of epidemics and associated health risks · Design of safe and sustainable products
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FD teaching courses

Each Local University offers a large selection of PhD and graduate courses which are available to the PhD students in curriculum 6. The PhD students in consultation with their thesis advisors, are expected to construct study plans that include both compulsory and optional courses. Given the large range of available local courses and the expected diverse scientific backgrounds of the students, the final list of courses offered by the participating universities will be made available once applications have been approved.

FD teaching within curriculum 6 will take place at the University of Insubria and will consist of a summer multidisciplinary field course (48 hours) held in an alpine area in the Central Italian Alps. It will provide the opportunity to conduct and test some of the main techniques for studying some of the impacts of climate change on the cryosphere (permafrost degradation and glacier shrinkage), on vegetation (impacts on plant species and communities, impacts on ecosystem processes) and on freshwater ecosystems (sampling plankton and measure of main chemical and physical parameters).

An additional 48 hour courses will be offered, covering:

1. Methods to monitor and analyse glacier shrinkage and permafrost degradation;
2. Methods to assess and monitor climate change impacts on plants at different levels, from species level to community and landscape levels, focusing on structural, compositional, functional aspects (e.g., species composition, vegetation dynamics, biodiversity changes, phenology, photosynthetic activity, CO₂ fluxes);
3. Methods to evaluate the possible impact of climate change on organisms found in lakes. Species composition, breeding period, functional aspects of zooplankton. Evolution of productivity in relation with changes of temperatures.

Other courses offered by the universities contributing to curriculum 6 will include interdisciplinary themes such as environmental health engineering science, environmental system dynamics and the circular economy, environment and health system dynamics in relation specifically to the managing the COVID-19 emergency, chemical risk assessment, epidemiology and research methodology, causal inference in clinical epidemiology, cancer aetiology and prognosis – epigenetic research in population studies, health statistics and epidemiology, molecular epidemiology, big data analysis (studied during a summer school) in silico toxicology, human biomonitoring, principles of ecology, ecology and marine environment monitoring, ecosystem conservation and management, animal biology, biodiversity analysis (including field and laboratory activities), zoocenosis and conservation of fauna, and assessment of biodiversity.