PhD in SCIENCE, TECHNOLOGY AND POLICY FOR SUSTAINABLE CHANGE - 38th cycle

Number of scholarship offered	4
Department	DIPARTIMENTO DI ELETTRONICA, INFORMAZIONE E BIOINGEGNERIA

Description of the PhD Programme
The PhD program in Science, Technology, and Policy for Sustainable Change (STEP-CHANGE) prepares the future generation of scientific experts for addressing the challenge of global change and steering society towards a sustainable and inclusive transition, including accelerating the penetration of green technologies, fostering industry decarbonization, and designing sustainable policies from cross-sectoral perspectives. With faculty from all the departments, the program offers a multicultural and trans-disciplinary research environment. Students will acquire research capacity and skills and in-depth knowledge about the complexity of Earth¿s natural and artificial systems; will learn advanced methodologies to understand and model physical, industrial, societal, and digital processes impacting our planet ecosystem; and will develop projections of technological, ecological, and social trends to envision new sustainable solutions and systems, assessing their global environmental and societal impacts as well as related philosophical and ethical issues. The program aims to train the next generation of scientific experts to design feasible and effective pathways that can assure the planet's prosperity and preservation through state-of-art scientific methods. At the end of the program, PhD candidates are expected to possess the competencies and capacities required to support and inform the process of policy and strategy design for innovation-driven responses towards sustainable development.

POLITECNICO DI MILANO

PhD in SCIENCE, TECHNOLOGY AND POLICY FOR SUSTAINABLE CHANGE - 38th cycle

THEMATIC Research Field: *CUTTING TOOLS REGENERATION BY MEANS OF ENVIRONMENTALLY SUSTAINABLE VACUUM TECHNOLOGIES

Monthly net income of PhDscholarship (max 36 months)
€ 1325.0
In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Reasearch, during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	The mechanical industry consumes annually an enormous amount of cutting tools. High speed steels (HSS) and hard metals (HM), coated with high performance ceramic films, are the important materials for tools. The coating and the body of HSS or HM tools undergo deterioration during mechanical machining. An important part of the cost of a coated cutting tool is represented by HSS and, in particular, of HM (tungsten carbide and cobalt) materials. Therefore, the problem is the regeneration of deteriorated tools in order to reuse them and reduce the consumption of critical raw materials, such as cobalt and tungsten. The project takes into consideration innovative environmentally green techniques that would allow the regeneration of tools in a completely new way and never explored by the mechanical industry, based on the ablation of the coating by means of the LEHCEB (Low Energy High Current Electron Beam) technique. It is a multicultural and trans-disciplinary research project.The surface modification of substrates, in particular HM, by means of pulsed electron beams could lead to a radical change of the microstructure of the surface of the tool which in this way, without the use of ceramic coatings, would already increase its service life. Similarly, the formation of surface alloys obtained by deposition of metal films (PVD magnetron sputtering) and alloying them with the substrate by using the LEHCEB technique could further improve the performance of HSS and HMs. As regards the interaction of electron beams with end-of-life

	tools, this operation is expected to lead to the elimination of the coating and the restoration of the tool for a new deposition. Finally, the deposition of ceramic coatings with reactive magnetron sputtering technique offers the possibility to carry out the full regeneration of the cutting tools.The project outcomes can carry new technological opportunities for circular and regenerative economy build on new concepts of production, design, distribution, and consumption. This change requires to rearrange products manufacturing in order to facilitate the extension of shelf life, recycling, reuse, as well as energy and material recovery.
Methods and techniques that will be developed and used to carry out the research	In order to carry out the research program it will be necessary to develop knowledge on the use of finite elements software (e.g. Comsol) for the simulation of the temperature and mechanical stresses fields generated in the surface region of a component irradiated with low-energy, high-current electron beams. The candidate will learn how to use a vacuum equipment whose operation is based on LEHCEB and PVD magnetron sputtering techniques (Laboratory of applied electrochemistry and surface engineering "Roberto Piontelli" of the CMIC Department). Master of science level knowledge of metallurgy and surface engineering is required. The research work requires the use of investigation techniques such as optical and electronic microscopy, profilometry (laser and AFM), durometry, elemental composition spectroscopy (EDS, GDOES, XRF).
Educational objectives	The candidate will learn to conduct a proper bibliographic research, to safely work in a specialized surface engineering laboratory, to carry out materials characterization measurements, to develop suitable protocols for the regeneration of worn out hard metals tools and to work in an international multidisciplinary team.
Job opportunities	The job opportunities deriving from the PhD educational period fall into the following sectors: surface treatment, mechanical processing and raw materials.

Composition of the research group	0 Full Professors 2 Associated Professors 1 Assistant Professors 5 PhD Students
Name of the research directors	Prof. Massimiliano Bestetti

Contacts
Prof. MAssimiliano Bestetti Telephone: 02 2399 3166 Email: massimiliano.bestetti@polimi.it Web-pages of the research group:https://www.cmic.polimi.it/ricerca/elenco-gruppi-di-ricerca/surfacelab/

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	662.5 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Educational activities (funding for participation in courses, summer schools, workshops and conferences) - financial aid per PhD student about 1.800 euros per year **Teaching assistantship**: availability of funding in recognition of supporting teaching activities by the PhD student: There are various forms of financial of for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities within the limits allowed by the regulation.

POLITECNICO DI MILANO

PhD in SCIENCE, TECHNOLOGY AND POLICY FOR SUSTAINABLE CHANGE - 38th cycle

THEMATIC Research Field: AFRICA INTEGRATED ASSESSMENT MODEL: TECHNOLOGY AND POLICY FOR A JUST ENERGY TRANSITION

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0
In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Reasearch, during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Quantitative assessment and reduction of the impact that modern industrial and productive systems have on the planer while assuring prosperity for the people is one of the major challenges in engineering and environmental sciences. This claim is quite evident in both the new Agenda 2030 and the climate debate as well stated during COP26. The claim is even more urgent for the African Continent, which is due to play a crucial role within sustainable development policies, climate change mitigation or/and adaptation actions, and energy transition including raw materials). Africa needs to implement a sustainable transition to respond to the aspiration of the AU Agenda 2063; at the same time, to support the global implementation of the Paris Agreement, Europe and the world need Africa to proceed in the right pathways of he the energy transition to unveil the international impact of the EU Green Deal. Robust, transparent, open, and integrated modelling tools are requested in order to inform the policy-making process with evidence-based results.
Methods and techniques that will be developed and used to carry out the research	Theoretical tools: Linear and MILP programming, constrained Optimisation, Multiobjective Analysis, Input-Output analysis, Life Cycle Assessment, Computational tools: Matlab, Python and open source energy & industrial ecology models, GIS.

Educational objectives	The objectives are 1) to develop a bottom up energy models; 2) to integrate it with a top-down meso- economic model; 3) to analyse the effectiveness of decarbonisation policies; 4) to set up comparative assessment of the effects of different regional policies
Job opportunities	Energy Analyst for energy utilities and/or for NGOs and international organizations or public institutions.
Composition of the research group	2 Full Professors 0 Associated Professors 2 Assistant Professors 2 PhD Students
Name of the research directors	Emanuela Colombo, Fabio Inzoli

Contacts
Prof. Emanuela Colombo, Ph.D Rector's Delegate to Cooperation and Development UNESCO CHAIR in Energy for Sustainable Development SESAM group - Sustainable Energy System Analysis and Modelling Department of Energy Politecnico di Milano Via Lambruschini 4, 20156 Milano, ITALY ph:+39.02.2399.3820

Additional support - Financial aid per PhD student per year (gross amount)			
Housing - Foreign Students	**1st year**	**2nd year**	**3rd year**
	1000.0 € per student	1000.0 € per student	1000.0 € per student
	max number of financial aid available: 1, given in order of merit ..		
Housing - Out-of-town residents (more than 80Km out of Milano)	--		

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
There are various forms of financial aid for teaching assistant activities. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

POLITECNICO DI MILANO

PhD in SCIENCE, TECHNOLOGY AND POLICY FOR SUSTAINABLE CHANGE - 38th cycle

THEMATIC Research Field: MACHINE LEARNING FOR TROPICAL CYCLONES CHARACTERIZATION, MODELLING, AND PREDICTION

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0
In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Reasearch, during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Extreme Climate Events (ECE) are expected to increase in both frequency and intensity in many regions of the world challenging the sustainable and efficient management of water, energy, and food systems. The research will explore the potential for Machine Learning to improve existing ECE process understanding and physically-based models' capability of characterizing and predicting ECEs. The focus will be on Tropical Cyclones as part of the H2020 Climate Intelligence project, in particular on how Machine Learning can be used to forecast the genesis and trajectory of Tropical Cyclones at specific lead times, and how the characteristics of genesis and trajectory may vary across different ocean basins.
Methods and techniques that will be developed and used to carry out the research	State-of-the art Machine Learning approaches (e.g., adversarial neural networks, encoder-decoder convolutional neural networks, transformers) will be adopted and novel approaches developed. The target data (wind speed, cyclone position, etc) will come from the IBTrACS dataset, while the input data will consist of climatological variables (precipitation, vorticity, etc) from the ERA5 reanalysis dataset, as well as various ENSO indices.
Educational objectives	The doctoral program offers advanced training organized in three pillars:

	- Basic Research, which includes methodological courses related to key aspects of theoretical and applied research in science, policy, and technology of sustainable change; - Specific Research, designed to strengthen candidates' knowledge on specific topics aligned with their research interests and increase their presence in the international scientific community through participation in conferences and presentation of their scientific work in academic contexts. - Development of the Doctoral Thesis, which allows candidates to develop leading-edge research competencies and produce original scientific work on a topic that contributes to scientific debate and has societal impacts. A period of study in worldwide most recognized research institutions is supported by the doctoral school and the supervisor.
Job opportunities	The PhD graduates will be equipped with distinctive skills and advanced trans-disciplinary knowledge that open up career opportunities as analysts, researchers, or planners at universities, international research centers, public and international institutions, R&D departments, regulatory authorities, policy institutions, and other public bodies.
Composition of the research group	1 Full Professors 0 Associated Professors 1 Assistant Professors 4 PhD Students
Name of the research directors	Andrea Castelletti

Contacts
Andrea Castelletti, PhD, PE Professor Head, Environmental Intelligence Lab Dept. of Electronics, Information, and Bioengineering Politecnico di Milano Piazza Leonardo da Vinci, 32 I-20133 Milano, Italy Phone: +39 (0)2 2399 3584

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http://www.ei.deib.polimi.it/

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
A desk in the lab offices and a personal laptop will be provided over the duration of the PhD programme. Teaching assistantship opportunities might be available over the triennium. Super computing facilities are available both at the department and with external associated partners.

POLITECNICO DI MILANO

PhD in SCIENCE, TECHNOLOGY AND POLICY FOR SUSTAINABLE CHANGE - 38th cycle

THEMATIC Research Field: SPATIALLY-EXPLICIT MODELS FOR SUSTAINABLE FISHERIES MANAGEMENT UNDER CLIMATE CHANGE

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0
In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Reasearch,during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Conserve and sustainably use of the oceans, seas and marine resources for sustainable development is one of the sustainable development goals (SDG 14) set by the United Nations, and has among its specific targets the achievement of sustainable fishing. Fisheries sustainability must reconcile biodiversity conservation and socioeconomic viability, but fisheries management design is made challenging by the complex spatiotemporal interactions between fish and fisheries. In the context of the European research project "SEAwise (Shaping ecosystem-based fisheries management)", this PhD research aims to develop spatially explicit mathematical models based on Earth Observation Data to support sustainable fisheries management under climate change.
Methods and techniques that will be developed and used to carry out the research	The candidate will 1) develop dynamic metapopulation models for selected fish stock in multi-species/multi- fleet fisheries contexts; 2) design area-based management policies and 3) assess them with suitable indicators of biological conservation and fishery productivity under different environmental scenarios, including climate change; 4) develop decision methods and optimization algorithms to prioritize management policies from a multi-criteria perspective

Educational objectives	The doctoral program offers advanced training organized in three pillars: - Basic Research, which includes methodological courses related to key aspects of theoretical and applied research in science, policy, and technology of sustainable change; - Specific Research, designed to strengthen candidates¿ knowledge on specific topics aligned with their research interests and increase their presence in the international scientific community through participation in conferences and presentation of their scientific work in academic contexts. - Development of the Doctoral Thesis, which allows candidates to develop leading-edge research competencies and produce original scientific work on a topic that contributes to scientific debate and has societal impacts. A period of study in worldwide most recognized research institutions is supported by the doctoral school and the supervisor.
Job opportunities	The PhD graduates will be equipped with distinctive skills and advanced trans-disciplinary knowledge that open up career opportunities as analysts, researchers, or planners at universities, international research centres, public and international institutions, R&D departments, regulatory authorities, policy institutions, and other public bodies.
Composition of the research group	1 Full Professors 2 Associated Professors 0 Assistant Professors 1 PhD Students
Name of the research directors	Paco Melià

Contacts
Paco Melia', PhD Associate Professor of Ecology and Environmental Impact Assessment Dipartimento di Elettronica e Informazione, Politecnico di Milano Via Ponzio 34/5, I-20133 Milano, Italy

POLITECNICO DI MILANO

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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
A desk in the Department premises will be provided over the duration of the PhD programme. Teaching assistantship opportunities will be available over the triennium; the PhD student is encouraged to take part in teaching activities, within the limits allowed by the regulations. The PhD student will be directly involved in the SEAwise project (2021-2025), funded by the H2020 EU framework programme. SEAwise aims to address the key challenge preventing implementation of a fully operational European Ecosystem Based Fisheries Management: the need to increase fisheries benefits while reducing ecosystem impact under environmental change and increasing competition for space. The SEAwise network of stakeholders, advisory bodies and scientists will codesign key priorities and approaches to provide an open knowledge base on European Social-Ecological Fisheries Systems.