POLITECNICO DI MILANO

PhD in ARCHITECTURAL URBAN INTERIOR DESIGN - 41st cycle

INTERDISCIPLINARY Research Field: GENERATIVE AI IN LANDSCAPE ARCHITECTURE_OPTIMIZING AGRIVOLTAICS FOR ENERGY AND ECOLOGY

Monthly net income of PhDscholarship (max 36 months)
1300.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Interdisciplinary PhD Grant The PhD research will be carried out in collaboration with research groups of the PhD programme in "**STRUCTURAL SEISMIC AND GEOTECHNICAL ENGINEERING**". See https://www.dottorato.polimi.it/?id=422&L=1 for further information. The recent expansion of solar photovoltaics, as outlined in the Ecological Transition Plan (PTE) and the National Recovery and Resilience Plan (PNRR), needs a paradigm shift in the design, implementation, and management of ground-mounted photovoltaic systems (>1 MW). Beyond optimizing energy production, storage, and transmission, these systems must mitigate adverse effects on soil, vegetation, water systems, microclimates, and landscape perception. Regarding agrivoltaics, the optimization process looks even more complex, since energy production on one side and crop production on the other might require diverging working conditions and surely work in a competing environment. Recent research activities have shown preliminary proof that sun can be multiply harvested in “providing low carbon electricity, food production and water conservation on the same land area”. It is also noted that agrivoltaics system are exposed to a number of natural hazards, recently increased in frequency and severity by the climate change.This research aims to establish conceptual frameworks and

	operational guidelines that leverage generative AI to minimize negative environmental impacts and foster synergies with agricultural uses. The study seeks to enhance energy efficiency while improving landscape quality and biodiversity by integrating AI-driven design, simulation models, and data-informed decision-making. Supporting on top of all **SDG 15 (Life on Land)**, this research advances biodiversity, soil health, and ecosystem services in agrivoltaic systems. Unlike conventional photovoltaics that degrade land, AI-driven design strategies will be exploited to restore habitats, optimize land use, and integrate water retention and soil/crop protection measures. This model exemplifies how renewable energy expansion can align with ecological resilience and sustainable land management.
Methods and techniques that will be developed and used to carry out the research	**:** The project bridges landscape architecture, information science/engineering, agronomy, and digital innovation through generative AI tools to analyze the interdependencies between nature, technology, and human activity. The methodology is structured as follows: **1. State of the Art and Case Studies** •AI-assisted literature review: NLP models will systematically extract key insights from agrivoltaic research. •Case study analysis: Machine and deep learning models will identify challenges and opportunities in biodiversity management, agricultural practices, environmental rehabilitation, and agrivoltaics system optimization. **2. Experimental Applications and Pilot Projects** •Generative AI for landscape design: Parametric tools (Grasshopper, Rhino AI, Autodesk Generative Design) will generate spatial layouts optimizing energy efficiency and agricultural co-use. •Climate and microclimate simulations: AI-enhanced GIS models will assess shading effects on biodiversity and crop yields. •AI-assisted monitoring: IoT and AI-driven sensors will

	•AI-assisted monitoring: IoT and AI-driven sensors will track in real-time agrivoltaic interactions, informing adaptive management strategies. **3. Guidelines and Policy Recommendations** •AI-driven scenario modelling: Deep learning and simulation tools will forecast long-term sustainability outcomes. •Decision-support systems: Interactive AI dashboards will assist policymakers and planners in balancing energy infrastructure with ecological and cultural landscapes.
Educational objectives	This research pioneers an integrated approach to agrivoltaics, placing landscape architecture at the core of system design while employing AI-driven optimization—an area largely unexplored in this context. It positions agrivoltaics as multifunctional infrastructures that enhance ecosystem services, optimize land use, and promote sustainable agricultural models. The interdisciplinary collaboration between landscape architects and engineers, further supported by agronomists and AI specialists, will bridge disciplinary gaps, fostering participatory design processes to improve social acceptance and governance. The expected result of this interdisciplinary PhD program is a new researcher profile, capable of develop an integrated approach to the planning, design, implementation and management of large-scale agrivoltaics fields that is effective in fully meeting the objectives of increasing energy production from renewable sources and food production within the framework dictated by the UN 2030 Agenda for Sustainable Development. This integrated and multidisciplinary approach includes the use of AI in differente fields: 1. landscape design: Parametric tools (Grasshopper, Rhino AI, Autodesk Generative Design for generating spatial layouts optimizing energy efficiency and agricultural co-use) 2. Climate and microclimate simulations: AI-enhanced

	GIS models will assess shading effects on biodiversity and crop yields. 3. AI-assisted monitoring: IoT and AI-driven sensors will track in real-time agrivoltaic interactions, informing adaptive management strategies. This would make it possible to go beyond the separation or sometimes opposition between the technical-functional objectives that guide the "engineering" design of the plant and the qualitative objectives relating to the resolution of critical issues in the relationship with the ecological-environmental systems, human systems and in general with the landscape, understood as the physical and cultural place of human interaction with the environment and the territory the plant.
Job opportunities	Phd candidates trained with this profile have suitable skills to be employed by Italian and international academic institutions, public bodies and research centers, public development agencies in research, consultancy and design in relation to architectural and urban transformations.
Composition of the research group	14 Full Professors 14 Associated Professors 0 Assistant Professors 111 PhD Students
Name of the research directors	Matteo Poli, Sara Protasoni

Contacts

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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

Scholarship Increase for a period abroad	
Amount monthly	650.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Some of the universities that are cooperating in the research

- Katholieke Universiteit Leuven, Campus Sint-Lucas, Ghent
- Aarhus School of Architecture
- TU Delft, School of Architecture
- TU Berlin, Institute for Architecture
- University of Ljubljana, Faculty of Architecture
- Paris Val de Seine
- Xian University
- SJTU University

Educational activities (purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences): financial aid per PhD student per year **("DOTE"- research budget)** ***total amount: 5.300,25 euro:***

1st year: max ***1.766,75 euro***
2nd year: max ***1.766,75 euro***
3rd year: max ***1.766,75 euro***

***Teaching assistantship (*availability of funding in recognition of supporting teaching activities by the PhD student)**
There are various forms of financial aid supporting the teaching practice.
The PhD candidate is encouraged to take part in these activities, within the limits allowed by the regulations.

Workspace:
In the AUID hall, on the 4th floor of Bldg. 12 in Leonardo Campus, are available workstations for shared use. All the Ph.D. students can use their laptops with a wireless connection.
Workstations and other equipment are available in the various departmental laboratories (Dastu) linked with the doctoral Program.