



# PhD in INGEGNERIA STRUTTURALE, SISMICA, GEOTECNICA / STRUCTURAL SEISMIC AND GEOTECHNICAL ENGINEERING - 38th cycle

**PNRR\_351\_TRANSAZ\_DIG\_AMB Research Field: AGRIVOLTAICS: INTEGRATED  
STRUCTURAL OPTIMIZATION AND DATA ANALYTICS FOR DECARBONIZATION AND  
SMART AGRICULTURE\***

**Monthly net income of PhDscholarship (max 36 months)**

**€ 1195.5**

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**

Agrivoltaics is the integration of energy production and crop production and quality in smart farming, hopefully in accordance with landscape design for the countryside. This integration does not look simple, since crops and photovoltaics sometimes have competing requirements in relation to solar radiation. Structural solutions need to be optimized in their shapes and data need to be continuously collected and processed with powerful data analytics methodologies, so that detrimental effects of climate change could be limited.

This project is therefore going to address some of the problems clearly stated in the PNRR, specifically in mission 2, also in accordance with the European Green Deal. Within the action M2C1, this is going to improve the environmental performance, the yield and the competitiveness of farms thanks to the design of a sensor-driven, smart water irrigation system in line with precision agriculture (see investment 2.3 regarding new technologies and digitalization). Agrivoltaics is specifically mentioned as investment 1.1 in action M2C2.

Furthermore, in action M2C4 the investment 1.1 envisages the use of sensor networks to reduce the risks related to climate change; in this project the idea is developed to increase the safety of crops, and thereby the resilience of the entire system, against extreme events.



	Some additional information has been added by the "Linee Guida in materia di Impianti Agrivoltaici", recently released by the Ministry of Ecological Transition.
Methods and techniques that will be developed and used to carry out the research	<p>Recent events linked to the climate change have caused a huge loss of money in relation to vinery and, more generally, fruit farms. For instance, due to hailstorms and spring frosts it has been reported that, only in 2021 and in Lombardia, around 20M Euros were lost in the revenues linked to local production. Solutions giving benefits in case of extreme events, in accordance e.g. to a structural design which is going to be filed as a patent in the coming weeks by the proposer, can substantially help in making our agriculture, not only in the Pianura Padana, more resilient against such possible events.</p> <p>By means of Agro-Photovoltaics or Agrivoltaics, the integration of photovoltaic panels in the farms would provide a benefit in terms of decarbonization, as power would be locally produced and made at disposal for a continuous monitoring of the health conditions of the structure carrying the panels and the entire energy production system, and also of the crops, if not to be sold to the network.</p> <p>Since data brought from satellite observations are not time-continuous and might be affected by temporary cloudy conditions at the time they are collected, a local network of sensors, together with agro-hydrological models to monitor the health of plants would provide a means to increase by a large amount the crop production, if possible, or at least the quality and, therefore, the revenues for farmers. In this way, as a side effect in the global situation we are living, we do expect that also irrigation procedures can be improved to make attractive some cultivations currently not remunerative in Italy, so to make our agriculture a bit more independent of the import from other Countries.</p> <p>Overall, an impact to our Country is expected thanks to the decarbonization and green transformation linked to the smart use of a renewable energy.</p>
Educational objectives	Besides the interaction with EDF and the other research centers mentioned below, the current activities show a



	clear interdisciplinary approach to be adopted in this project. The PhD student will learn how extreme events and climate change can affect the response of smart structures and the simultaneous energy production.
<b>Job opportunities</b>	Through the interaction with a company leader in renewable energies, and with a number of research centres and universities in Europe, job opportunities are going to be at the international level, to possibly build landmarks as policy makers.
<b>Composition of the research group</b>	0 Full Professors 4 Associated Professors 0 Assistant Professors 1 PhD Students
<b>Name of the research directors</b>	Stefano Mariani and Chiara Corbari

<b>Contacts</b>	
Stefano Mariani stefano.mariani@polimi.it +39-0223994279	
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<b>Additional support - Financial aid per PhD student per year (gross amount)</b>	
<b>Housing - Foreign Students</b>	--
<b>Housing - Out-of-town residents (more than 80Km out of Milano)</b>	--

<b>Scholarship Increase for a period abroad</b>	
<b>Amount monthly</b>	597.76 €
<b>By number of months</b>	6

<b>National Operational Program for Research and Innovation</b>	
<b>Company where the candidate will attend the stage (name and brief description)</b>	EDF (Electricité de France), <a href="https://www.edf.fr/">https://www.edf.fr/</a> , which is owner of some demonstrators to carry out the activity related to data collection and analytics. The link with them has been already established around three years ago and the interaction has led to a couple of Alta Scuola Politecnica projects run in sequence in relation to the structural design, and the definition of key performance indicators for crop yield optimization and data analytics.
<b>By number of months at the company</b>	6
<b>Institution or company where the</b>	Same as above. Alternatively, due to the participation in some



<b>candidate will spend the period abroad (name and brief description)</b>	activities that has led to common project proposals: INRAE (Institut National de Recherche Pour L'agriculture, L'alimentation et L'environnement), <a href="https://www.inrae.fr/">https://www.inrae.fr/</a> Fraunhofer Gesellschaft zur Forderung der Angewandten Forschung Ev, <a href="https://www.fraunhofer.de/">https://www.fraunhofer.de/</a> Katholieke Universiteit Leuven, <a href="https://www.kuleuven.be/english/kuleuven/index.html">https://www.kuleuven.be/english/kuleuven/index.html</a> SYstèmes de COmmunication et Microsystèmes (ESYCOM), Université Gustave Eiffel, ht
<b>By number of months abroad</b>	6

<b>Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information</b>
<p><u>Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research:</u></p> <ul style="list-style-type: none"> <li>•Electricité de France</li> <li>•Institut National de Recherche Pour L'agriculture, L'alimentation et L'environnement</li> <li>•Fraunhofer</li> <li>•KU Leuven</li> <li>•Université Gustave Eiffel</li> </ul> <p><u>Educational activities</u> (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences): The Ph.D. course supports the educational activities of its Ph.D. students with an additional funding equal to 10% of the scholarship, starting from the first year.</p> <p><u>Teaching assistanship</u> (availability of funding in recognition of support to teaching activities by the PhD student): Ph.D. students are encouraged to apply, upon prior authorization, to the calls to support teaching activities at the undergraduate and Master levels at Politecnico, being paid for that. The teaching assistantship will be limited up to about 80 hours, maximum half of them devoted to teaching and classroom activities and the rest to support classworks and exams.</p> <p><u>Computer availability and desk availability:</u> Each Ph.D. student has his/her own computer for individual use. Each Ph.D. student has his/her own desk, cabinet and locker.</p>