



# PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 38th cycle

**PNRR\_352 Research Field: MULTILEVEL ENERGY MANAGEMENT SYSTEM FOR OPTIMAL  
LOCAL ESTATION MANAGEMENT, IMPROVED EV FORECASTING ALGORITHMS,  
ESTATION EXPERIMENTAL TESTING**

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

**€ 1400.0**

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**

The progressive increase of the share of renewable energy sources in the national and global energy scenario, is one of the most relevant key goals of the very next future. The decarbonization process, the so called "green revolution", and the Ecological transition are also one of the Mission of the PNRR Programme, specifically with mission M2C2.1

Sustainable mobility and Urban regeneration are main topics in national center and ecosystems in PNRR Programme specifically in M4C2 investment.

The energy system in the medium period will face a relevant increase of Electric Vehicles (EV) and Renewable Energy Sources (RES), which in general are less predictable and not dispatchable. The public fast-charging infrastructure is a key enabler for the spread of EVs; moreover, charging stations can be coupled with local RES and stationary storage systems, under the concept of eStation. This way, the eStation can be considered as a microgrid, with a unique point of connection with the main grid, able to reduce the stress on the electricity distribution system. Indeed, only a tight interaction between these systems and the grid can lead to relevant environmental benefits while keeping the safety and security of the system. This is even more relevant in case of severe climate events which can lead to overloads, unexpected failures or unavailability of



	<p>generation plants.</p> <p>The main purpose of the research is to develop and test innovative optimization models for the energy management system (EMS) of an eStation, to ensure that the charging services are provided in a reliable way at the lowest operating cost. The new optimization algorithm will consider the stochastic behavior of the EV public users, representing a highly uncertain power demand. The model will base its decision on forecasted inputs, considering both EV charging needs and variable electricity prices, in order to define both a daily operation plan of the charging station and its dispatch rules. With this aim, EV power forecasting becomes more and more challenging and important considering programmable charging and vehicle-to-grid solutions, to better exploit the load flexibility.</p> <p>This research activity is directly inspired and it will be tested in the facility of Joint Research Center of Politecnico di Milano and Free2Move eSolutions, and in real world case studies, starting from the latest state-of-the-art applications.</p>
<p><b>Methods and techniques that will be developed and used to carry out the research</b></p>	<p>Methods and techniques of this research include circuit theory, Optimization Theory, Machine Learning and, in general, Computational intelligence and numerical techniques for the analysis of microgrids, device simulation and parameters extraction, modelling of nonlinear phenomena in renewable energy systems by means of mixed approaches, estimation and prediction. In particular, the models and algorithms will leverage on and, eventually, extend the existing body of knowledge on the prediction of EV systems which have a highly stochastic behavior in term of power use (both as load and generator) and on operational optimization of aggregated energy systems.</p> <p>Numerical simulations and experimental activities will be used to carry out the research.</p> <p>The project is at the intersection of different fields of investigation: energy engineering, electrical engineering, and computer science. The PhD candidate is thus</p>



	expected to interact with a multidisciplinary team of researchers from qualified international universities and research centers.
<b>Educational objectives</b>	<p>The aim is to form a highly qualified engineer in a highly motivated and qualified research group, gaining experience, knowledge and skills in cutting edge technologies of the power generation and energy conversion field, and microgrid design and optimization with possible involvement in international and EU projects as well as in the cooperation with leading industries and R&amp;D institutions.</p> <p>The candidate will learn how to identify critical aspect specifically link to mathematical modelling of energy production and use.</p> <p>The candidate will learn how to communicate the results of the Ph.D. research presenting results and analysis in a scientific and industrial context.</p>
<b>Job opportunities</b>	This research activity will qualify the candidate for future academic and research positions, as well as for a highly qualified professional career in industries in the energy and electrical mobility fields, e.g. the industrial partner Free2Move eSolutions,
<b>Composition of the research group</b>	<p>3 Full Professors</p> <p>5 Associated Professors</p> <p>2 Assistant Professors</p> <p>6 PhD Students</p>
<b>Name of the research directors</b>	Prof. Sonia Leva, Prof. Giampaolo Manzolini

<b>Contacts</b>	
<p>Sonia.Leva@polimi.it</p> <p>Giampaolo.Manzolini@polimi.it</p>	

<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>
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<b>Amount monthly</b>	700.0 €
<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>	Free2Move eSolutions
<b>By number of months at the company</b>	6
<b>Institution or company where the candidate will spend the period abroad (name and brief description)</b>	The project promotes collaboration with relevant international universities and research centers. The foreign institution will be selected during the 3 years research program in agreement with the industrial partner.
<b>By number of months abroad</b>	6

<b>Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information</b>
<p><b>Educational activities:</b> Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years.</p> <p><b>Teaching assistantship:</b> Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid 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 regulations.</p> <p><b>Computer availability:</b> individual use.</p> <p><b>Desk availability:</b> individual use.</p> <p><b>Accommodation</b> in Politecnico's Residences (<a href="http://www.residenze.polimi.it">http://www.residenze.polimi.it</a>) is available for PhD candidates; special rates will be applied to selected out-of-town candidates (detailed info in the call for application).</p> <p><b>Research period abroad:</b> Our candidates are strongly encouraged (6 months minimum is mandatory) to spend a research period abroad, joining high-level, research groups in the specific PhD research topic, selected in agreement with the Supervisor. An increase in the scholarship will be applied for periods up to 6 months.</p>