



PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 39th cycle

**PNRR 118 PNRR Research Field: ARTIFICIAL INTELLIGENCE AND BIG DATA-BASED
MANAGEMENT AND OPTIMIZATION OF ELECTRIC ENERGY IN AC AND DC GRIDS**

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 among the Mission of the PNRR Programme, specifically with M2C2.

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 main purpose of the research is to develop and test innovative optimization models for the energy management system (EMS) of a multi-good microgrid (electricity, heat, potable water), to ensure its secure and efficient operation in the presence of high penetration of renewable generations, including the impact of electric vehicles (EV) into the microgrid itself and the micro-grid as distributed smart-storage/generation system.

This research is meant to adopt a multidisciplinary approach by integrating competences on machine-learning solutions for Big Data analysis, with innovative techniques integrating field-gathered data, resulting in a system that can be experimentally validated and find immediate application in smart-grid and micro-grid contexts.



	<p>This research activity is directly inspired by and will be tested in the experimental multi-good micro-grid facility (MG2Lab) of Politecnico di Milano, Dept. of Energy.</p>
<p>Methods and techniques that will be developed and used to carry out the research</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 renewable energy systems which have a highly stochastic behavior in term of power (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 expected to interact with a multidisciplinary team of researchers.</p>
<p>Educational objectives</p>	<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&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>
<p>Job opportunities</p>	<p>This research activity will qualify the candidate for future academic and research positions, as well as for a highly</p>



	qualified professional career in industries in the energy and electrical mobility field.
Composition of the research group	3 Full Professors 4 Associated Professors 3 Assistant Professors 6 PhD Students
Name of the research directors	Prof. Sonia Leva

Contacts	
Email	
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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

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	
By number of months at the company	0
Institution or company where the candidate will spend the period abroad (name and brief description)	The project promotes collaboration with relevant international universities and research centers. The foreign institution will be selected during the 3 years research program
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>Educational activities: 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>Teaching assistantship: 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>



Computer availability: individual use.

Desk availability: individual use.