



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

**PNRR\_352 Research Field: EVOLUTION OF URBAN ENERGY SYSTEMS: EXPECTED IMPACT ON ELECTRIC DISTRIBUTION INFRASTRUCTURES, PROCUREMENT OF LOCAL FLEXIBILITY SERVICES, NEW SOLUTIONS FOR THE ADVANCED MONITORING AND OBSERVABILITY OF NETWORKS TO INCREASE GRID RESILIENCE**

**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

This PhD position is proposed as a part of the National Recovery and Resilience Plan (PNRR), Mission 4, component 2 ("From Research to Business"), in accordance with the specifications of DM 352 of 09-04-2022.

Specifically, the goal of scholarship is to carry out a research project in the area of the green transition and digital transformation pillars, as defined by Regulation (EU) 2021/241.

The electricity system is undergoing a phase of deep transformation. The decarbonization processes, the transition to electric mobility, and the adoption of renewable energy will increase their impact on distribution networks. Urban areas, characterized by a high load density, are a particularly significant example of this evolution. In this context, the research activity will focus on two main objectives:

- The first goal is to study the evolution of the urban energy system under different scenarios, considering the development of loads and distributed generation. Then, the expected impacts on the infrastructures of different load profiles will be analyzed, evaluating possible investments to improve the efficiency of the electrical distribution network.



	<ul style="list-style-type: none"> <li>• The second goal will focus on the potential benefits of local flexibility schemes to level the load curve, improve the voltage profile and increase network reliability and resilience. The functional requirements of flexibility services, possible market models, and remuneration schemes will be explored. The research activity will also focus on the technological solutions needed to procure local flexibility services on medium- and low-voltage networks.</li> </ul> <p>To achieve the aforementioned innovative goals, the companies need highly qualified figures who have to combine academic knowledge with the company expertise.</p> <p>Politecnico di Milano will contribute to the research program through its knowledge of the theoretical approaches to power systems' modeling and optimization, while UNARETI will support the study through its expertise in the design and management of urban distribution networks.</p>
<p><b>Methods and techniques that will be developed and used to carry out the research</b></p>	<p>Several statistical and deterministic methods and algorithms will be used and developed for the network modeling and analysis, to estimate the load evolution, and to define the optimal criteria to collect local flexibility services. For instance, traditional PF or OPF algorithms may be used to evaluate the grid behavior, while probabilistic procedures (Montecarlo), fuzzy logic, neural networks, or genetic algorithms could be adopted to model phenomena affected by uncertainties. Forecasting methodologies could also be used based on artificial intelligence and big data analysis tools.</p> <p>Several stakeholders will take benefit from the results of the research and could cooperate in the program:</p> <ul style="list-style-type: none"> <li>• Other distribution system operators managing grids in urban contexts (E-Distribuzione, Areti, etc.)</li> <li>• The Italian Energy Authority (ARERA)</li> <li>• Technology providers of automation and protection systems (ABB, Siemens, Schneider Electric, ..)</li> </ul>



	<ul style="list-style-type: none"> <li>Universities (University of Waterloo and others, concerning the development of new methodologies for the study and optimization of MV/LV grids)</li> </ul>
<b>Educational objectives</b>	Educate researchers with high scientific qualification and autonomous research ability in the power system area: this includes specific skills in modeling technical and economic issues, simulations, critical analysis, and validation of results.
<b>Job opportunities</b>	The main opportunities are typically offered by R&D Departments of small and large innovative companies and manufacturers, research centers, transmission, and distribution operators, regulating authorities, and generation companies. Finally, academia is also an option.
<b>Composition of the research group</b>	5 Full Professors 4 Associated Professors 3 Assistant Professors 15 PhD Students
<b>Name of the research directors</b>	Prof. Davide Falabretti

<b>Contacts</b>	
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Email:	davide.falabretti@polimi.it

<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>	700.0 €
<b>By number of months</b>	6

<b>National Operational Program for Research and Innovation</b>
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<b>Company where the candidate will attend the stage (name and brief description)</b>	Unareti S.p.A.
<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>	University of Waterloo, Canada
<b>By number of months abroad</b>	6

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

**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.

**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.

**Computer availability:** individual use.

**Desk availability:** individual use.

**Accommodation** in Politecnico's Residences (<http://www.residenze.polimi.it>) is available for PhD candidates; special rates will be applied to selected out-of-town candidates (detailed info in the call for application).

**Research period abroad:** 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.