POLITECNICO DI MILANO

PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 39th cycle

PNRR 117 Research Field: OPTIMAL PLANNING OF ENERGY NETWORKS: INCREASING RENEWABLE ENERGY SOURCES PENETRATION, DISTRIBUTION NETWORKS FLEXIBILITY, AND ELECTRIFICATION OF END-USE CONSUMPTION IN THE ENERGY TRANSITION CONTEXT

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"), under the specifications of the DM 117 delivered on March 2nd 2023. Specifically, the goal of the 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 energy system is undergoing a phase of profound transformation. As European Union and Italy progress towards decarbonization targets, the transition to all-electric buildings, electric mobility, and the adoption of renewable energy will increase the dependency on electrical distribution networks. Therefore, innovative research solutions are needed to meet the growing electricity demand and the distributed generation while maintaining a safe, affordable, and reliable grid operation. In this context, the research activity will focus on three main objectives: •The first goal is to study the evolution of the urban energy system under different scenarios, considering, in particular, the development of electrical loads and distributed generation. Moreover, the expected impacts on the energy infrastructures will be investigated. •The second goal is to develop artificial intelligence

	techniques as a basis to improve research topics of growing interest, including but not limited to 1) Energy distribution system planning and operation; 2) Data forecasting and clustering; 3) Reliability, resilience, and climate adaptation of infrastructure. •The third goal is to set up new methods for integrated distribution network planning, with potential research topics including but not limited to 1) distribution network design; 2) distribution energy resources integration; 3) incorporating resilience into traditional reliability assessments. The methods will include and investigate the potential benefits of local flexibility, sector coupling - progressively and increasingly inter-linking the electricity, gas, heating, transport and industrial production sectors, and energy communities. Companies need highly qualified figures who combine academic knowledge with company expertise to achieve the aforementioned innovative goals. Politecnico di Milano will contribute to the research program by understanding the theoretical approaches to power systems' modeling and optimization. At the same time, UNARETI will support the study through its expertise in designing and managing urban distribution networks.
Methods and techniques that will be developed and used to carry out the research	Several statistical and deterministic methods and algorithms will be used and developed for the network modeling and analysis. 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. The following entities are expected to cooperate in the research: Unareti, the University of Birmingham, ARERA, and technology providers working in the energy sector. In particular, Unareti is directly involved and will provide data, expertise on the practical use of the tools developed, and the possibility to experience the real application to the distribution system operation and

	application to the distribution system operation and planning.
Educational objectives	Educate researchers with high scientific qualifications 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.
Job opportunities	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.
Composition of the research group	2 Full Professors 3 Associated Professors 1 Assistant Professors 8 PhD Students
Name of the research directors	Prof. Alberto Berizzi

Contacts
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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)	Unareti S.p.A.
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	University of Birmingham, UK
By number of months abroad	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. Thereare 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.