POLITECNICO DI MILANO

PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 39th cycle

PNRR 118 INTERDISC Research Field: METHODS FOR THE INTEGRATED PLANNING AND OPERATION OF ENERGY AND DATA NETWORKS IN URBAN DISTRICTS

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 1 ("Enhancement of the offer of education services: from nursery schools to the University"), in accordance with the specifications of Ministerial Decree 118 of 02-03-2023. 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, in compliance with art. 8 of DM 118. The integration between energy infrastructures (electricity, gas, heat) and telecommunications is at the basis of the Smart Cities paradigm. The application of Information and Communication Technologies to energy transport networks makes it possible to improve their reliability and performance, enabling a series of new functionalities. The new edge computing paradigm, based on the widespread installation of data centers throughout the territory, is the ideal approach for interconnecting Smart City devices, thanks to low latency, and is an enabling tool for developing infrastructure serving urban contexts, according to the concepts of Positive Energy District or Energy Community. Therefore, an interdependence between electricity and communication networks emerges: to ensure good power supply reliability and efficient use of renewable resources, a reliable communication network is necessary and, on the contrary, to guarantee an economic and reliable communication

	network, an efficient and reliable electricity network is necessary. The joint planning of the two networks is therefore a substantial element for achieving a modern and sustainable Smart Cities model.
Methods and techniques that will be developed and used to carry out the research	The research aims to develop methodologies for managing the problem of planning and designing energy networks and data networks in an integrated way, with specific reference to electric power distribution and telecommunication infrastructures serving cities. In particular, the research will focus on routing and clustering techniques with the aim of defining the optimal location of the equipment (electrical substations/base stations) and the configuration of the network infrastructure according to the constraints and needs of use of the urban space. Integrated energy management methods will also be explored, useful for coordinating energy demand from ICT systems with distributed production, using artificial intelligence techniques for predicting energy profiles. The use of available flexibility resources will also be evaluated, such as modular load (electric mobility, heat pumps) and electrochemical storage, to minimize the impact of ICT infrastructure withdrawals and maximize service continuity.
Educational objectives	Educate researchers with high scientific qualification and autonomous research ability in the power system and information engineering areas: these include 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. Several stakeholders will benefit from the results of the research and could cooperate in the program: - Electric power system and telecommunication operators - Energy Authorities - Technology providers

	- Universities
Composition of the research group	5 Full Professors 7 Associated Professors 0 Assistant Professors 15 PhD Students
Name of the research directors	Prof. Davide Falabretti - Prof. Giacomo Verticale

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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

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.