



PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 40th cycle

**PNRR 630 Research Field: BATTERY ENERGY STORAGE SYSTEMS MODELING FOR
APPLICATIONS ON POWER SYSTEMS AND ELECTRICITY MARKETS**

Monthly net income of PhDscholarship (max 36 months)
€ 1800.0
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	<p>Battery Energy Storage Systems (BESS) are considered an enabler for the decarbonisation of power systems, especially for those system dominated by variable Renewable Energy Sources (RES). BESS will be more and more competing in electricity markets, particularly in ancillary services markets. Large and small-scale BESS are both of interest for the provision of ancillary services and for RES integration. Therefore, studying BESS, their application and suitability with electricity markets, also considering geographical perspective and distribution of the assets (for instance, considering electric vehicle charging, where and when it occurs), becomes strategic.</p>
Methods and techniques that will be developed and used to carry out the research	<p>Modelling BESS performance via literature data, datasheets, experimental campaigns. Developed models should consider all the components of the BESS, included battery pack, power conversion system (inverter and transformer), auxiliary systems consumption.</p> <p>Data-driven models will be developed and machine learning techniques will be used to analyse the electricity markets and power system data, to both predict the market prices and to classify bids with award/reject classifiers.</p> <p>Control strategies and bid strategies will be developed considering techno-economic analysis and optimization. Geographic Information System (GIS) codes will be developed to analyse distributed resources and their interaction with the power system, eg for electric vehicles</p>



	<p>interaction with the power system, eg for electric vehicles and variable RES. Develop control strategies considering techno-economic optimization.</p>
Educational objectives	<p>The program is aimed to prepare professionals with high scientific knowledge of power systems, electricity markets and energy storage use. These include: ability to develop, select, sort efficient and effective applications and business models for energy storage; ability to understand and redesign the future power systems and electricity market regulation.</p>
Job opportunities	<p>The main opportunities are offered, typically, by R&D departments of both small and large companies in the field, research centres, Transmission and Distribution Operators, Regulatory authorities, Generation Companies. Finally, the academia is also an option.</p>
Composition of the research group	<p>2 Full Professors 3 Associated Professors 2 Assistant Professors 20 PhD Students</p>
Name of the research directors	<p>Giuliano Rancilio</p>

Contacts	
<p>https://www.e4g.polimi.it/ https://www.energia.polimi.it/it/dipartimento-di-energia/laboratori/laboratori-di-ricerca/electric-power-system-epslab/#c2478 giuliano.rancilio@polimi.it phd-elt@polimi.it</p>	

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	900.0 €
By number of months	6



National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	E2C Energy To Come Srl
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	To be defined
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*.