



PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 38th cycle

PNRR_352 Research Field: TESTING OF SMALL SCALE BATTERY ENERGY STORAGE SYSTEMS, MODELLING AND COMMERCIAL SERVICE STACKING EVALUATION.

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	<p>The project is linked to the PNRR Missione 2: "Rivoluzione Verde e transizione ecologica" (action M2C2 "Transizione energetica e mobilità sostenibile" and M2C3 "Efficienza energetica e riqualificazione degli edifici"), in particular the focus is on the Energy Storage Systems equipment to foster renewable generation and a better energy behavior of the final users (focusing on small scale applications).</p> <p>Nowadays, Battery energy storage systems (BESS) are spreading in several applications among transmission and distribution networks. Nevertheless, it is not straightforward to estimate their performances in real life working conditions. This work is aimed at identifying test power profiles for stationary residential storage applications capable of estimating BESS performance. Moreover, focusing on the market, Opening the Balancing Markets (BMs) to Renewable Energy Sources (RES) and Battery Energy Storage Systems (BESS) could help decrease the variability and unpredictability of RES and provide reliable and fast frequency regulation. The limited energy content of BESS can be an issue for the reliability on the BMs. Revenue stacking of behind-the-meter and front-of-the-meter services on a domestic prosumer, typically equipped with photovoltaic production and BESS, are the focus of the research project. In particular, the final goal is to experimentally test performances and effectiveness of different possible control logics, comparing different storage technologies and products</p>



	available on the market.
Methods and techniques that will be developed and used to carry out the research	<p>The research project will be split among 3 pillars.</p> <p>A first pillar will be relevant to the experimental tests of small scale BESS, to characterize both the overall BESS and the electrochemical cells.</p> <p>A second pillar will be relevant to the regulatory framework of the market, to evaluate how small scale batteries could be managed, what are the possible control logics and the resulting economics.</p> <p>A third pillar will be relevant to the impact that those BESS could have on the electric system, to point out the possible role on the energy transition targets.</p>
Educational objectives	Coach researchers with high scientific qualification, and economic issues, simulations, critical analysis and validation of results autonomous research ability in the Power System, Electric Machines and Electrochemical Storage areas: this includes specific skills in modelling of both technical and economical issues.
Job opportunities	<p>The main opportunities are offered, typically, by R&D departments of both small and large innovative companies and manufacturers, research centres, Transmission and Distribution Operators, Regulating authorities, Generation Companies. Finally, the academia is also an option.</p> <p>In particular, focusing on the topics investigated in the project, many companies are active on the Energy Storage equipment, moreover an important growth is expected in the industry for the short term scenario.</p>
Composition of the research group	<p>5 Full Professors</p> <p>3 Associated Professors</p> <p>4 Assistant Professors</p> <p>15 PhD Students</p>
Name of the research directors	Prof. Marco Merlo, Prof. Luigi Piegari

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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)	ENI R&D - Istituto Donegani - Novara
By number of months at the company	6
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, e.g. Grenoble INP - G2ELab. The foreign institution will be selected during the 3 years research program in agreement with the industrial partner.
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.

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.