BORSA N. 7
DAUSY

D.M. 351/2022

Ambito: PNRR
Tematica: “Smart control systems for rural energy communities”

Research theme title:

Smart control systems for rural energy communities

Contacts:

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Curriculum of DAUSY:

C2 AS for Smart Environments

Hosting University/Research Centre

Polytechnic of Bari, Italy

Department:

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Prospective Supervisors:

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Description:

Over the decades, both the rural sector and energy grids have encountered significant challenges, such as the lack of power supply to agricultural farms and the difficulties of renewable energy use in electricity networks.

To overcome and address these issues, this project will develop new decision and control techniques aimed at merging smart farms, renewable energy, and rural small consumers into Rural Energy Communities (RECs), using surplus renewable energy and distributed storage for the agriculture sector and the smart farm.
The overall objective of this project is thus to define new control architectures and frameworks for RECs, as enabling tools to transform the rural grid from a rigid and weak system to a flexible and sustainable asset. In particular, control mechanisms integrating optimization, game theory, and learning will be developed aimed at making RECs capable of conveniently integrating smart farms and greenhouses. Thanks to the innovative control framework and leveraging on loads flexibility, these REC stakeholders will be enabled to trade local energy exchanges, optimally share common energy resources, and pursue instantaneous self-consumption, while reducing overall costs and improving sustainability.
This project will devote particular attention to highlighting the peculiarities of rural energy distribution with respect to urban energy communities and will target the need of gaining substantial improvements in terms of network resilience and efficiency, favouring the introduction of innovative control frameworks in support of rural energy systems operations and of their future economic and industrial sustainability.

Specific Information:

Applicants must hold a master's degree, preferably in Engineering, with a good background in relevant areas of interest (i.e., optimization, and control). Solid mathematical and coding skills are encouraged. Proficiency in both spoken and written English is required. The candidate should be highly motivated and interested in undertaking innovative and challenging research activities involving both theoretical analysis and experimental validation.

References:

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[2]. V. Z. Gjorgievski, S. Cundeva, and G. E. Georghiou, "Social arrangements, technical designs and impacts of energy communities: A review," Renew. Energy, vol. 169, pp. 1138–1156, 2021.
[3]. S. Sen and V. Kumar, "Microgrid control: A comprehensive survey," Annu. Rev. Control, vol. 45, no. June, pp. 118–151, 2018.
[4]. E. Hammad, A. Farraj, and D. Kundur, "Cooperative microgrid networks for remote and rural areas," Can. Conf. Electr. Comput. Eng., vol. 2015-June, no. June, pp. 1572–1577, 2015.
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[6]. C. Bersani, H. Dagdougui, A. Ouammi, and R. Sacile, "Distributed Robust Control of the Power Flows in a Team of Cooperating Microgrids," IEEE Trans. Control Syst. Technol., vol. 25, no. 4, pp. 1473–1479, 2017.
[7]. A. Boccalatte, M. Fossa, and R. Sacile, "Modeling, Design and Construction of a Zero-Energy PV Greenhouse for Applications in Mediterranean Climates," Therm. Sci. Eng. Prog., vol. 25, 2021.
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[9]. R. Carli, M. Dotoli, J. Jantzen, M. Kristensen, and S. Ben Othman, "Energy scheduling of a smart microgrid with shared photovoltaic panels and storage: The case of the Ballen marina in Samsø," Energy, vol. 198, p. 117188, 2020.
[10]. C. Bersani, A. Ouammi, R. Sacile, and E. Zero, "Model predictive control of smart greenhouses as the path towards near zero energy consumption," Energies, vol. 13, no. 14, 2020.

Type of scholarship:

DM 351/2022 – Project on PNRR (Italy's Recovery and Resilience Plan)

Study and research period outside the Hosting Institution:

3. Study and research period abroad:
- period length: 6 months;
- Hosting institution:
  - Delft University of Technology – Delft Center for Systems and Control
  - C-3-250, Mekelweg 2, 2628 CD Delft, The Netherlands
  - https://www.tudelft.nl/3me/over/afdelingen/delft-center-for-systems-and-control