ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

DENERG/PRIN - Integrating renewable electrical energy sources into electricity markets

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Context of the research activity	The overarching goal is to investigate and develop strategies for the full integration of renewable electrical energy sources, specifically photovoltaic (PV) and wind generators, into the day-ahead and ancillary services markets. The program aims to address the challenges and capitalize on the opportunities associated with the increasing penetration of renewable energy in the power grid, ensuring reliability, efficiency, and transparency for all the market players. "Progetto finanziato nell'ambito del PNRR" - PRIN 2022 PNRR
Objectives	Electrical renewable sources play a pivotal role in mitigating European carbon emissions, contributing significantly to the continent's commitment to combat climate change. As the European Union strives to achieve ambitious targets outlined in the Green Deal and the Paris Agreement, the adoption of renewable energy sources (RESs), such as wind and solar, is paramount. These technologies offer a clean and sustainable alternative to fossil fuels, enabling a substantial reduction in greenhouse gas emissions associated with traditional energy production. By harnessing the power of renewables, Europe can diversify its energy mix, enhance energy security, and foster economic growth in the burgeoning green energy sector. The transition to electrical renewable sources not only aligns with environmental goals but also positions Europe at the forefront of global efforts to build a low-carbon, resilient energy system for a sustainable future. Unfortunately, the integration of RESs into the electrical power systems and electricity markets faces multifaceted challenges. First, the inherent intermittency and variability of sources like solar and wind pose difficulties in aligning energy supply with demand accurately. The instability introduced by rapid changes in renewable generation levels can affect grid frequency and voltage, necessitating advanced control measures. Another hurdle lies in the lack of effective energy storage solutions for renewables, demanding

	alternative backup power sources to ensure continuous energy supply during low-generation periods. This can introduce higher costs in the ancillary service markets. Adapting traditional electricity markets designed for centralized, dispatchable generation to accommodate decentralized and variable renewables involves revisiting market structures, regulations, and pricing mechanisms. The research project aims to propose technical and economical solutions for a better integration of RESs. From the technical point of view, both steady-state and dynamic analysis will be considered, to develop a novel security-constrained optimal power system scheduling model. From the economic point of view, a market clearing platform which acknowledges the actual value of energy and all the ancillary services will be developed. This will increase the fairness and transparency of the energy costs sustained by end users, will provide the right signals to the market participants and will improve the operation and planning of the system.

Skills and competencies for the development of the activity	• base knowledge in the field of electrical engineering • interest in coding • B2 in English according to the “Common European Framework of Reference for Languages: Learning, Teaching, Assessment” (CEFR) classification