

Interoperable and Efficient Solutions for the Control and Operation of Distributed Renewable Energy Systems

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1. DESCRIPTION OF THE PROPOSAL

Distributed renewable energy resources (DRES) along with energy storage are intended to become a viable and widespread option for energy production and utilization playing a pivotal role in energy transformation. The integration of DRES involves a number of actors with highly variable behavior, posing objectives in terms of development and management of the electric networks with relevant controls and regulations, requiring a variety of power conversion hardware with specific features and design goals, and raising specific needs for the monitoring and sensing of the DRES in an autonomous way improving low maintenance, interoperability, reconfigurability and retrofit capabilities.

This process implies the pursue of specific innovations in view of flexible, coordinated and resilient DRES, by addressing a set of technical challenges, including highly efficient power converters, energy hubs and microgrids, advanced monitoring and sensing technologies, efficient communication systems. The implementation of DRES is tackled by the development of hardware components and subsystems, intelligent energy/power management and control algorithms and secure communication technologies.

In this context, this open invited track proposal will deal with the different research and development needs for the management and control of decentralized energy supply and storage, including, but not limited to, the following themes:

- modular, bidirectional and multi-modal power converters enabling secure operation in different conditions;
- innovative EV charging stations including wireless technologies and green hydrogen;
- efficient retrofittable sensor nodes;
- solutions for power quality;
- algorithms and software for the optimal integration, operation and management of DRES in electric grids;
- applications of microgrids and energy hubs;
- state monitoring with predictive maintenance solutions;

- secure and low-latency communication;
- energy tracing through blockchain-based green certificates.

This open invited track is framed in the dissemination of the project HORIZON-KDT-JU_2023-1-IA “Electronic Components and Systems for flexible, coordinated and resilient Distributed Renewable Energy Systems (ECS4DRES)”, started in July 2024 on the CHIPS JU focus topic 4, and involving 29 partners from 5 nations (Germany, the Netherlands, Spain, Italy, Slovakia), providing the application of research outcomes by means of five complementary use cases focusing on:

- Smart microgrid with local green source, H2 generation and green certificates for better reliability;
- AC and DC EV charging grids with improved power quality;
- Intelligent cooperative buildings in microgrids;
- Microgrid in the framework of local energy community to increase flexibility and coordination;
- Monitoring, sensing and communication to improve distributed renewable energy systems.

The open invited track proposal is devoted to regular contributions and discussion contributions according to IFAC SENSYS 2025 general rules, welcoming the contributions from ECS4DRES project partners as well as further contributions.