## 9th International Conference on Clean Electrical Power



Special Session on Innovative Strategies for Advancing Rural Electrification and Sustainable Energy Access

The UN Sustainable Development Goals (SDG 7) and the global commitment to decarbonization, embodied in the Paris Agreement, emphasize the critical importance of providing affordable, reliable, sustainable, and modern energy for all. While urban areas are often at the forefront of decarbonization efforts, rural electrification is equally essential, especially given the existing energy access gap and the potential of rural areas to adopt innovative renewable energy solutions. Rural areas frequently face unique challenges, including dispersed populations, limited grid access, and higher infrastructure costs. However, they also offer significant opportunities for decentralized energy systems driven by local renewable energy resources such as solar, wind, and biomass.

Rural electrification is a critical pathway to achieving both energy access and decarbonization goals, particularly in the Global South, where energy poverty remains a pressing issue. By leveraging (i) decentralized renewable energy systems to power off-grid and weak-grid areas and (ii) integrating innovative solutions such as energy storage, demand-side management, and energy-sharing models, rural communities can transition toward sustainable and resilient energy systems. Despite the significant renewable energy potential in these regions, challenges such as intermittency, scalability, and economic viability persist. Addressing these challenges is essential to ensure that solutions not only maximize the reliability and efficiency of renewable energy systems but also deliver affordability, sustainability, and socio-economic benefits for rural communities.

This special session invites contributions addressing these challenges and opportunities, focusing on topics including (but not limited to):

- Development of large-scale, optimal electrification planning tools to guide policymakers in designing cost-effective, data-driven strategies for electrification, integrating factors such as resource availability, infrastructure needs, demand forecasting, and socio-economic impacts;
- Optimization of off-grid and mini-grid energy systems to enhance reliability, efficiency, and resilience through advanced energy management strategies;
- Innovative energy storage solutions tailored for rural applications, such as hybrid storage systems and integration of local resources (e.g., biomass and pumped storage);
- Demand-side management in rural areas, including load forecasting, dynamic tariffs, and flexible demand solutions for agricultural, residential, and small industrial loads;
- Scalable models for energy-sharing and rural energy communities, enabling access to affordable and sustainable energy through peer-to-peer trading, community-based microgrids;
- Techno-economic assessment of rural electrification projects, exploring financing mechanisms such as public-private partnerships (PPPs), community-owned models, and pay-as-you-go systems;
- Integration of energy and non-energy sectors (e.g., water, agriculture, mobility) to create synergies that improve overall rural socio-economic development;

• Addressing electrical protection challenges in small decentralized energy systems to ensure safe, reliable, and efficient operation, with a focus on innovative protection schemes tailored to off-grid and mini-grid setups;

This special session is organized by:

Aleksandar Dimovski, Politecnico di Milano, Italy – aleksandar.dimovski@polimi.it Corrado Maria Caminiti, Politecnico di Milano, Italy – corradomaria.caminiti@polimi.it Enrico Ragaini, ABB, Italy – enrico.ragaini@it.abb.com Marco Merlo, Politecnico di Milano, Italy – marco.merlo@polimi.it