



From Digitalization to Cognitive Infrastructure: The Future of AI-Orchestrated Energy Systems

“The future of energy systems will not be defined only by connectivity or automation, but by the emergence of cognitive infrastructures capable of orchestrating resilience, sustainability, and intelligence at large scale”

Artificial intelligence is rapidly transforming the way modern energy infrastructures are designed, operated, and managed. As power systems evolve toward highly decentralized, digitalized, and data-intensive ecosystems, conventional automation and monitoring approaches are becoming insufficient to address the increasing complexity introduced by renewable energy integration, decentralization of energy resources, storage systems, and dynamic energy markets. In this context, the energy sector is entering a new paradigm in which infrastructure is no longer only connected and automated, but progressively cognitive, adaptive, and orchestrated through artificial intelligence.

This keynote explores the transition from traditional digitalization toward the emergence of cognitive infrastructure in future energy systems. The talk introduces the concept of AI-orchestrated energy systems, where artificial intelligence acts not merely as an analytical tool, but as an operational and coordination layer capable of enabling predictive awareness, autonomous decision-making, distributed optimization, and resilient system behavior. The presentation discusses how technologies such as machine learning, edge AI, digital twins, synchrophasor analytics, and autonomous monitoring platforms are reshaping the architecture of modern power and energy networks.

The keynote further examines the role of AI in enabling self-healing grids, intelligent microgrids, autonomous energy communities, and predictive maintenance frameworks to evolve with a forward-looking vision of future energy systems as cognitive, distributed, and AI-orchestrated ecosystems capable of supporting resilient and sustainable societies in the coming decades.

David Celeita Ph.D. (david.celeita@unisabana.edu.co)

Profesor Asociado || IEEE Senior Member || IAS Member-at-Large

Department of Infrastructure and Mechanical Systems

Faculty of Engineering, Universidad de la Sabana

Office FABLAB 310