

# ICSMARTGRID 2024

## 12TH INTERNATIONAL CONFERENCE ON SMART GRID

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### **Abstract**

**Title: Power Hardware In the Loop: potential, challenges, solutions**

To address the challenges of the green energy transformation, academia and industry are introducing at fast pace many novel energy solutions. This fast evolution, however, makes extremely challenging to properly address their impact on the energy systems when they are installed in the field. Classical approaches to develop prototypes and to perform weeks- or months-long field testing cannot cope with the pace of these innovations. There is a concrete risk that the field-testing represents the pace-bottleneck for introducing new technologies in the market and thus to enable the green transition.

To accelerate the introduction to market of new energy technologies, the concept of Power Hardware In the Loop (PHIL) has been proposed in recent years. The PHIL is based on simulating an electrical circuit in a digital real time simulator that is connected to the hardware under test by means of a power interface. The PHIL allows to flexible change the testing environment varying the simulation parameters, while keeping high experimental validation fidelity.

This Keynote talk will provide an overview of the current state of the art of PHIL, what are its advantages and drawbacks, the potential applications, standardization efforts, and the missing research topics. A more technical focus will be given to novel mathematical approaches, based on impedance-based stability theory, to evaluate more accurately the stability of PHIL testing.