



Transformers | Motors | Generators

| 19-21 May 2026

● A Hyve Event

Simulating DERs' behavior in critical grid conditions

Outcomes from the Italian pilot of TwinEU Project



Our strategic goal

TwinEU will leverage a unique set of competences coming from grid and market operators, technology providers and research centres to create a concept of Pan-European digital twin based on the **federation of local twins** so to enable a reliable, resilient, and safe operation of the infrastructure while facilitating **new business models** that will **accelerate the deployment of renewable energy sources** in Europe.

TwinEU's Italian pilots

CWIEME
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Design Validation

The adoption of **BIM methodology** in energy grids is complex, but necessary to build a digital replica of energy assets as a pillar for **digital twins**.

The validation process guarantees a standardized structure of the BIM models starting from the design phase.

Defence System

The Defence System encompasses a series of devices, strategies and rules to **preserve the stability of the energy system**.

Leveraging on **Realtime Simulations**, the pilot addresses the analysis of new stability rules in the peculiar scenario of the **Sardinian grid**, facing with a complex energy transition challenge.

Sardinia, beyond the postcard

The energy grid perspective

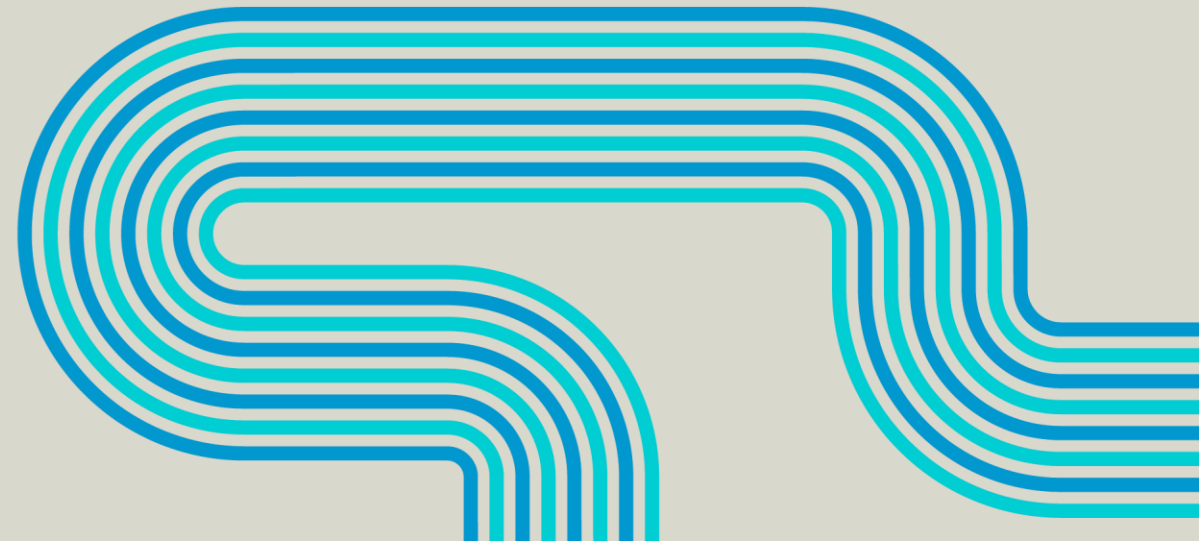
- The Sardinian grid is connected in DC to the mainland
- Coal plants' phase-out
- Constant increase of distributed generation
- Highly variable concentration of electricity demand during the year (seasonal/tourism)



The pilot implementation

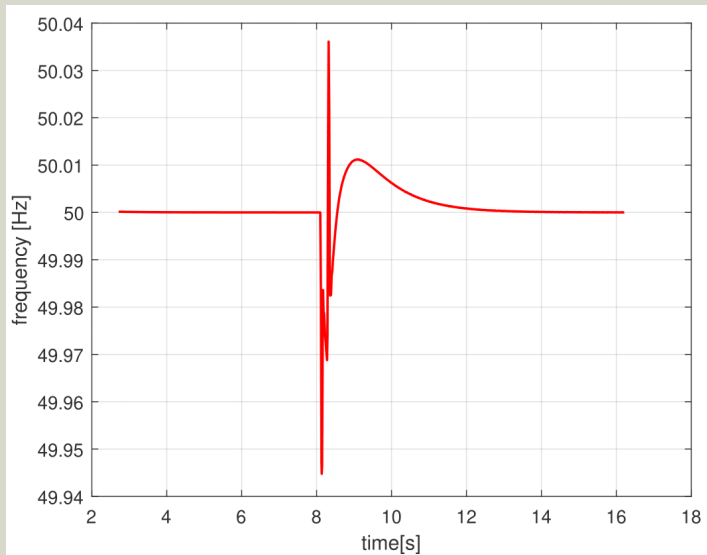
Leveraging on federated approach

- Two independent laboratories interconnected, one on Terna's premises in Cagliari, the other in Politecnico di Torino.
- Combination of Hardware in the loop techniques, with advanced models of real TSO and DSO grids.
- Aggregated DERs was modeled to verify their responsiveness in critical conditions



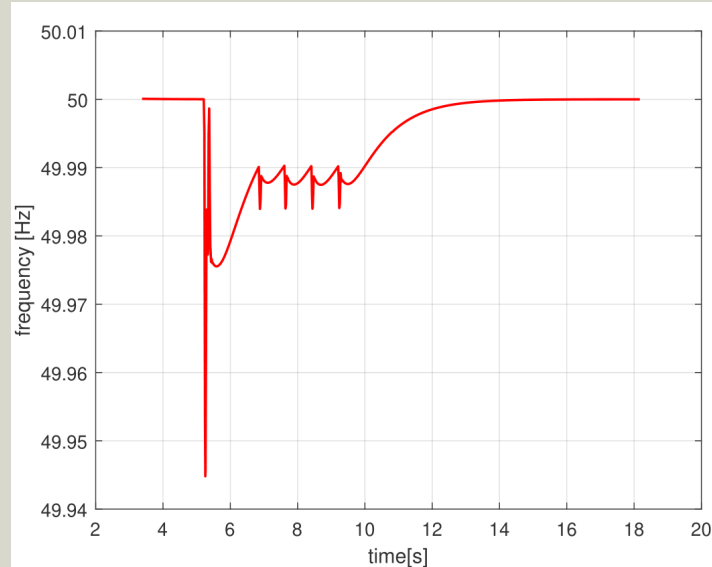
Preliminary results

Actual defence strategy



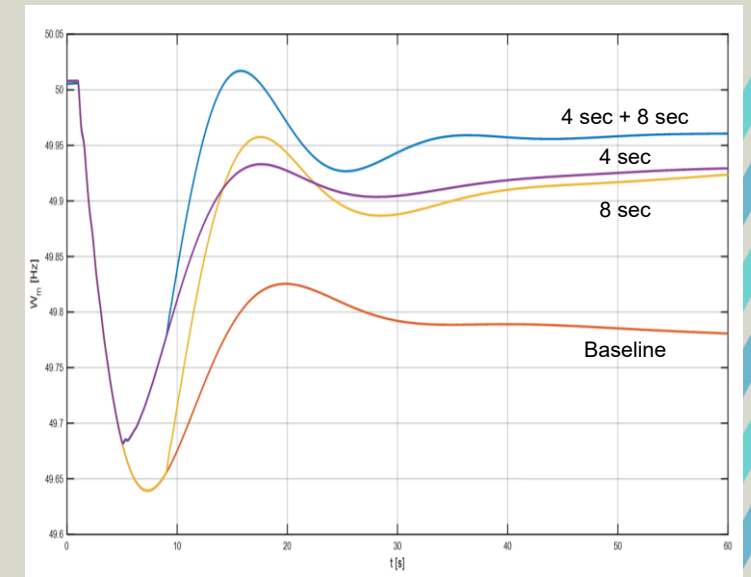
Under-Frequency Load Shedding (UFLS)

What if...?

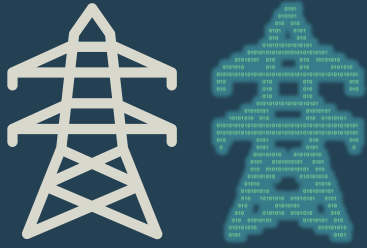


BESS series interventions

Or instead...?



Comparing Flexibility activations



Developed a real-time model of a portion of the Sardinian transmission and distribution grids



Modelled flexible assets, i.e., heat pumps and EV charging stations to assess their potential grid support



Tested existing and advanced defence logics, including virtual islanding concepts



Automated network importing tools reduce modelling effort and improve scalability



HIL techniques and federated approach have been used for the simulation, testing interoperable simulation systems

Main takeaways

This pilot shows how **real-time Digital Twin models** can be used to analyse and validate advanced defence strategies in modern power systems. A real-time model of a portion of the Sardinian transmission and MV networks was developed to test critical scenarios involving renewable generation, distributed energy resources, flexible loads, and network contingencies. This framework enables the safe assessment of both existing and innovative defence logics, including virtual islanding concepts, while capturing fast system dynamics that are difficult to address with traditional offline tools.

The results highlight the value of Digital Twins in supporting a shift toward more **adaptive** and **resilient grid operation**. When properly modelled and coordinated, distributed energy resources can provide a meaningful contribution to system stability, while tools for automated network import and real-time simulation reduce modelling effort and improve scalability. Overall, the proposed approach supports the **transition** from **traditional static defence schemes** to more **flexible, data-driven solutions** and can be extended beyond the Sardinian case to other T&D interface studies and applications.

Join our final event in Brussels (10 December)

More info in the project website and main social media

The project is almost concluded; we are finalizing the piloting phase. In the meanwhile, we are now focusing on the Pan-European scenario for exploiting the federation architecture.

All pilots' deliverables will be submitted in June and published in our website twineu.net, together with many other public deliverables and publications.

Many more events are foreseen for the upcoming months, follow us on [LinkedIn](#), [X](#) and [YouTube](#) for keeping you updated.

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