



# EnergyVille Smart Grid lab

The EnergyVille Real-Time Lab is a multifunctional lab with grid emulator capabilities. Our detailed real-time power system simulators enable testing grid control functionality in close to real-life system conditions.

## Advantages

Full-detailed system tests to meet the needs of future power systems: from concept over conformity with new standards to full system integration.

### Our experienced team offers:

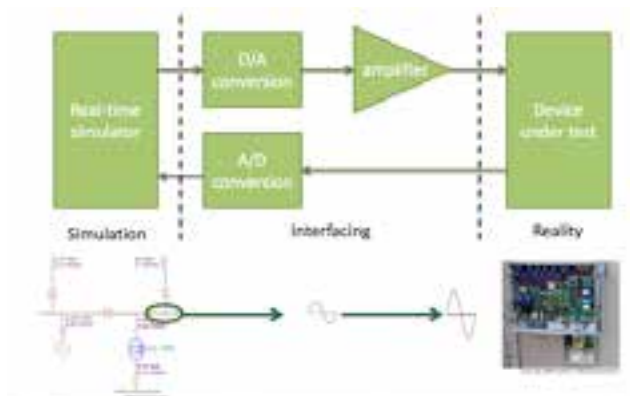
- Expertise on power system modelling (especially HVDC)
- Protection relay testing (including IEC 61850)
- Power Hardware in the Loop (P-HIL) testing through a virtual grid integration of new components (e.g. converters, battery systems, ...)

## Our offer

- Controller-Hardware-In-the-Loop (C-HIL)
  - Integration of equipment that has a control function in the grid
    - Intelligent on-load tap changer control
    - Variable and unbalanced voltage controller in systems with significant single phase infeed
  - Grid protection (relays)
    - Study of the effect of RES penetration on existing and future grid protection
- Communication infrastructure
  - e.g. Smart meters or smart substation equipment
    - Through new communication protocols Through new substation communication protocols (e.g. IEC 61850)
- Power-Hardware-In-the-Loop (P-HIL)
  - Connecting equipment through their power circuits (loads, generators, converters, breakers,...) to a grid emulator
  - Specific examples: PV installations, batteries
    - Interface studies with different RES integration levels or different grid concepts

## Applications

- Pre-tender spec validation for new grid assets
- Testing performance and configuration of new equipment
- Offline investigations of non-trivial fault situations
- Training personnel (operational and configuration of equipment)
- Verification of grid connection set-up
- Grid code compliance testing
- Pro-active testing of future standards and protocols
- Interoperability testing at neutral ground



## Customers

- Transmission System Operators
- Distribution System Operators
- RES developers
- Equipment manufacturers
- Industrial players in energy business
- Aggregators or VPP

## Technical notes

### Computational backbone

-> Real-time EMT simulations of power systems

- RTDS
  - World industry standard in real-time power system testing
    - EMT simulation of up to 720 single-phase nodes
  - Analog & Digital component interfacing (I/O channels) for P-HIL & C-HIL testing
  - Network interfacing
    - IEC 61850 GOOSE Messaging
    - IEC 61850-9-2 sampled value messaging
    - IEC 60870-5-104 SCADA communication protocol
- OPAL-RT
  - Matlab/SIMULINK based OP 5600 real-time testing platform
    - EMT simulation of up to 300 single-phase nodes
  - Optical coupling with Triphase rapid-prototyping platform

### Signal amplifiers

- 4 2x6 channel amplifiers: Testing of up to 8 protection relays simultaneously

### Linear high-bandwidth amplifier

- Spitzenberger & Spies: 4 quadrant 4 x 5 kVA (3-phase + neutral)
- High bandwidth for power-electronic control testing
  - 50 kHz small-signal bandwidth
  - 5 kHz large-signal bandwidth

### Switched-mode high-power amplifiers

- Triphase power amplifiers: Several active front ends with DC/DC capabilities
  - e.g. Triphase PM 90: 90 kVA 3-phase AC active front
  - 2x15kVA AC/DC Converter for bipolar DC grid operation
- Coupling of up to 4 Triphase amplifiers with OPAL-RT simultaneously

### SCADA Interfacing with distribution management system

- GE PowerOn Advantage ADMS

### Interfacing with other EnergyVille laboratories possible

- SmartHome Lab
  - with low voltage AC and DC grids
- Battery Lab
- Commercial Roof PV power plant



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*EnergyVille is an association of the Flemish research institutes KU Leuven, VITO and imec in the field of **sustainable energy and intelligent energy systems**. Our researchers provide expertise to industry and public authorities on energy-efficient buildings and intelligent networks in an urban environment. This includes, for example, smart grids and advanced district heating and cooling.*

*This EnergyVille lab functions according to the international quality, environment and safety standards: ISO 9001, ISO 14001 and OHSAS 18001.*

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