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CENTER OF TECHNICAL
EXCELLENCE



SMARTLAB

Smart Grid Laboratory of EDP

November, 2018

Agenda



1. Context

The constant challenges of the evolution of SmartGrid technologies

2. The SmartLab - Overview

Main characteristics

3. The SmartLab - Implementation

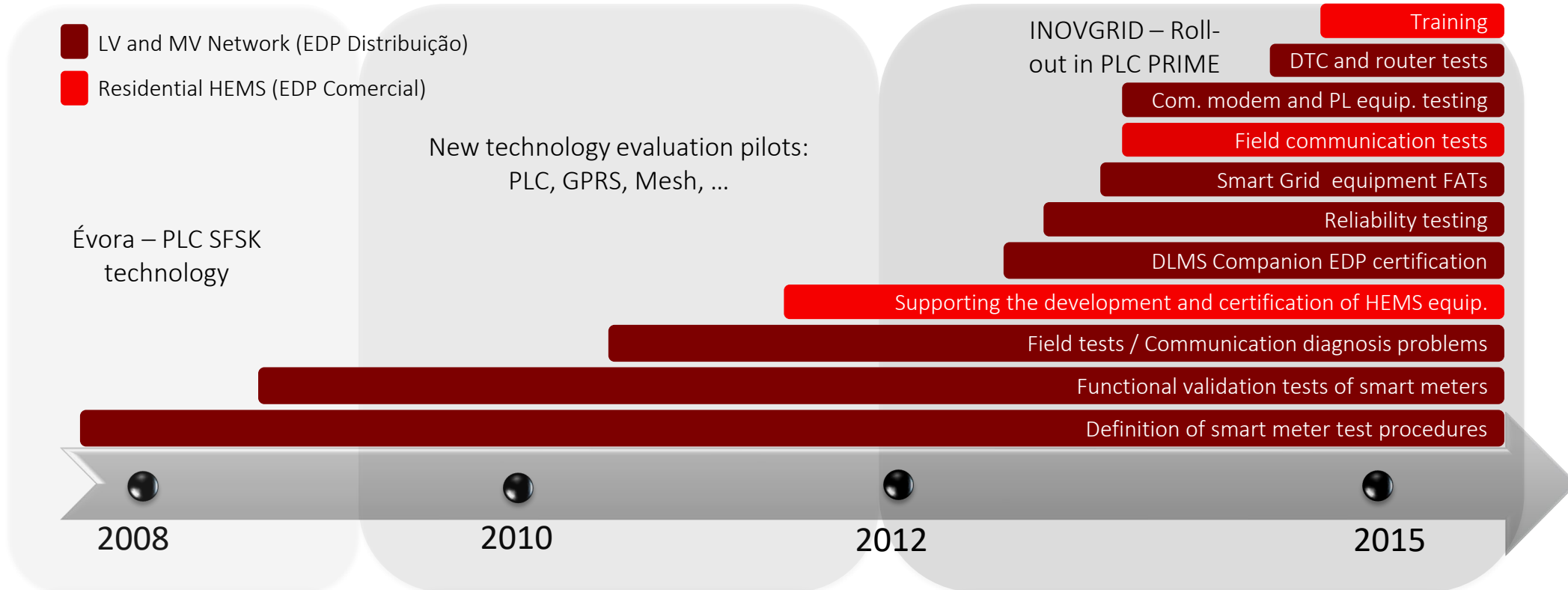
Technical description and projects

4. Summary

Main benefits and future developments

Smart Lab Context

The constant challenges of the evolution of SmartGrid technologies



EDP Labelec has been EDP Group's benchmark laboratory partner in ensuring the compliance of SmartGrid equipment

Smart Lab Context

The constant challenges of the evolution of SmartGrid technologies



Metering Group (2007 - 2014)



Automated Meter Reading (AMR)

HAN, WAN, LAN

Specifications

New technologies validation

Smart Metering Lab (2014 - 2017)



Advanced smart metering

Demand-response

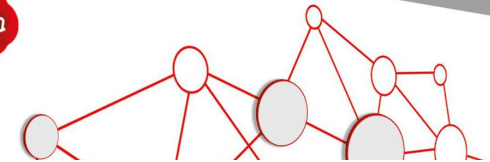
HEMS

Communication protocols

Automation

SmartLab (2017 - ?)

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SMART GRID LAB

Micro-grids

Electric-Vehicles

Storage

IoT

Cyber-security

Performance and robustness

Debugging field tests

Integration

Key Aspects:

Global Investment: 300 k€

Timeframe: Between 2015-2017

Smart Lab Context

The constant challenges of the evolution of SmartGrid technologies



1. : Variable real loads

2. and 3. : Network Li-ion and Supercaps Storage
(Sensible Project)

4. : StorageLab

5. and 6. : Interconnection SmartLab-StorageLab

7. : Smart Lab / Smart Home systems

8. : PV system



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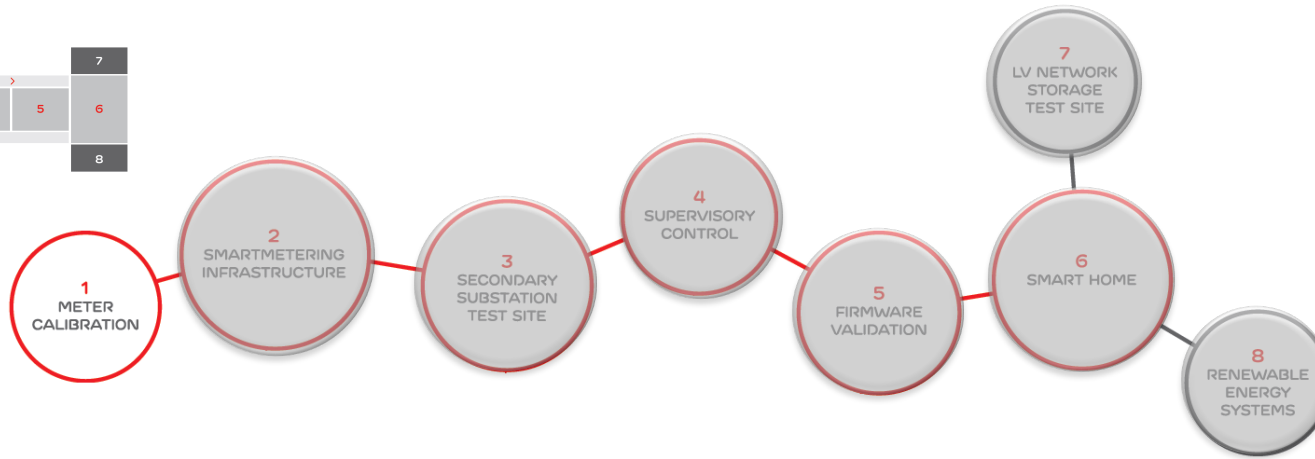
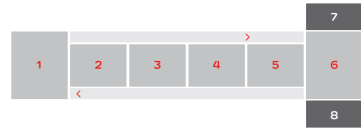
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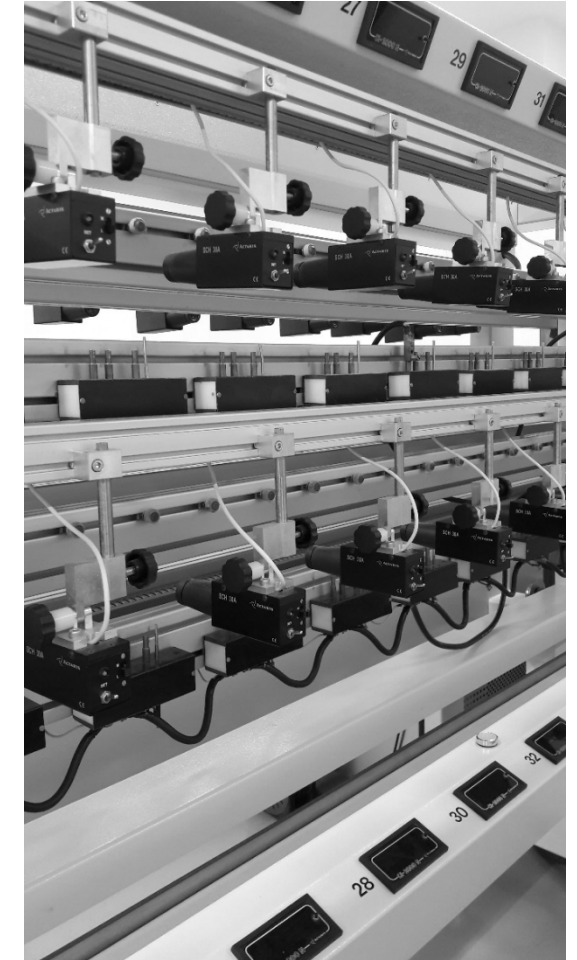
Resources

- Single phase testbench with 40 positions
- Three phase testbench with 20 positions
- 6 Portable Test Equipment
- Climatic chamber for temperature stress tests

Functionalities

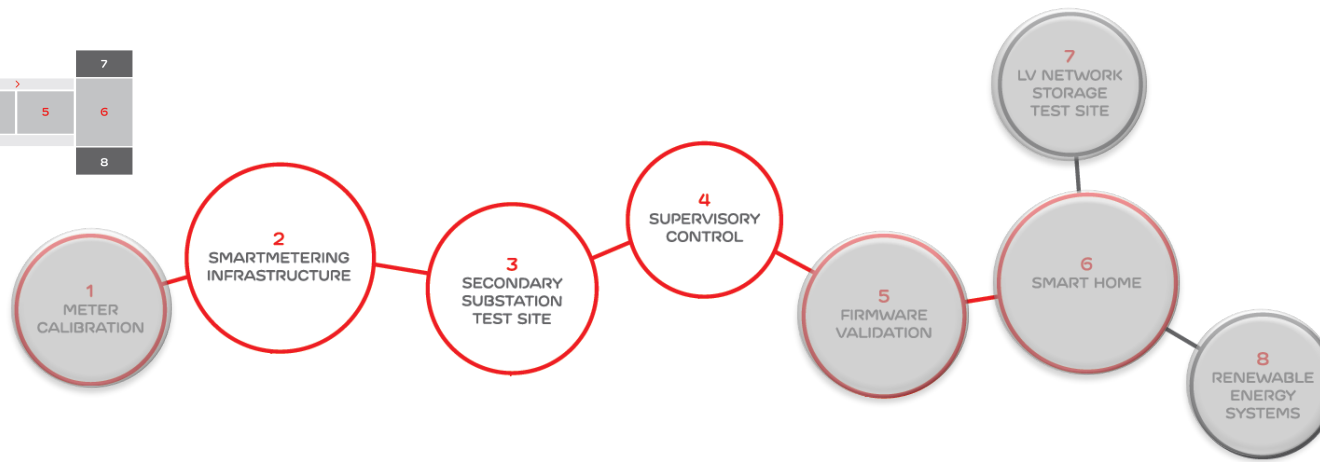
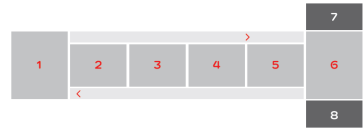
- LV\MV Meter Calibration *
- Clock Verification *
- External Metering System Verification – Industrial and Commercial *
- Hardware Verification

* Accredited tests by the portuguese accreditation body



Smart Lab Overview

Main characteristics



Resources

- 400 Smart Meter positions (flexible configuration, from 50 to 400)
- 4 full equipped Secondary Substation
- Field condition simulation, including 1 km LV network cable
- 8 network analyzers (fixed and portable). Monitoring system

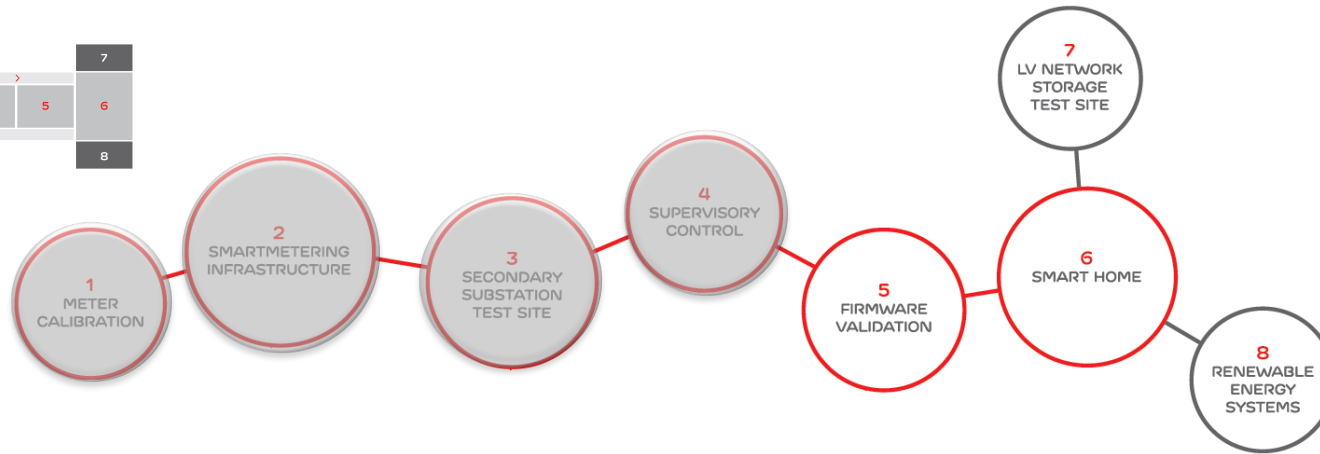
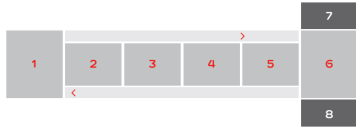
Functionalities

- Integration, Compatibility and Data Security End-to-End tests
- Smart Grid infrastructure capability to withstand noise and attenuation
- Performance and fine tuning of the communication solution
- Control and Supervision of communication infrastructure



Smart Lab Overview

Main characteristics



Resources

4 Power Supplies associated with automated tools for firmware validation

3 "Smart Home" installations with microgeneration (PV), residential storage systems

50 m of real LV cable

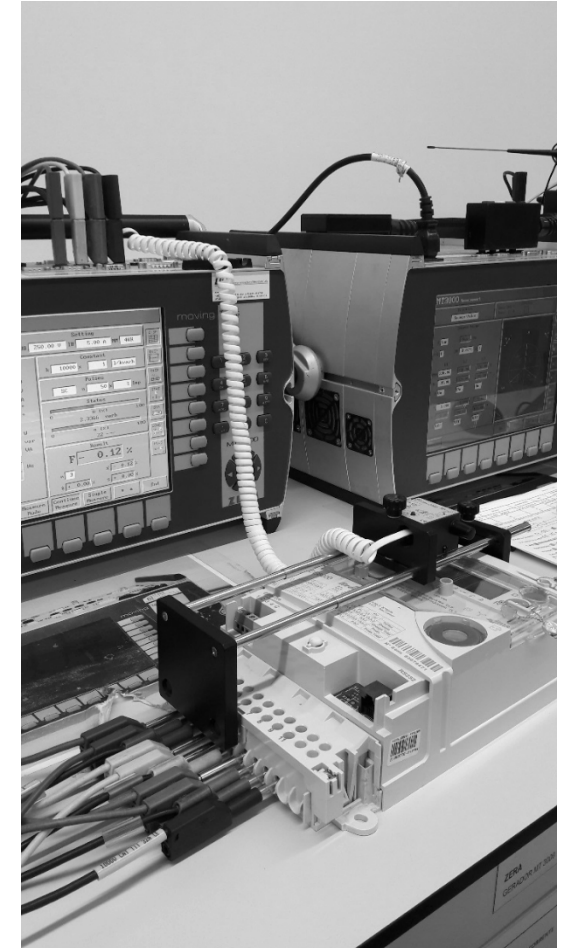
Functionalities

Unitary performance testing

Control and validation of new firmware versions

Functional and performance tests of HEMS systems

Performance tests of LV storage systems



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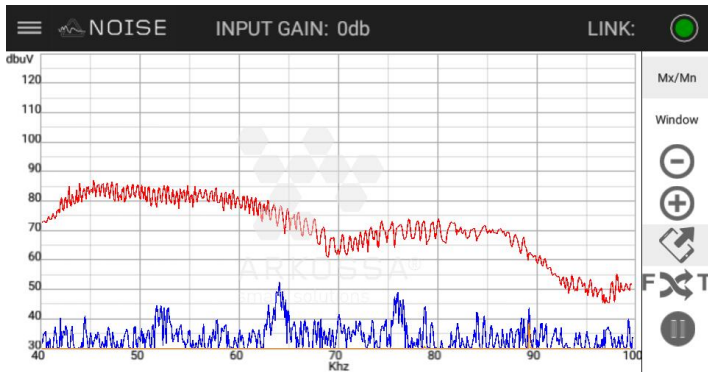
Technical description



4 complete LV networks and secondary substations;

400 Smart meters (4 sets);

Loads up to 16A per phase and in some positions selected up to 60A per phase



Attenuation introduced by attenuator filters

Smart Lab Implementation

Technical description



Sinoptic system with control and supervision of the state of the complete infrastructure

Smart Lab Implementation Projects



Objectives: To validate in a controlled scenario (lab) all the equipment and systems developed in the scope of Sensible project prior to the installation on the field.

Tests at the SmartLab:

- Equipment automation and protection
- Operation in different scenarios
- Integration with the ICT infrastructure
- Residential (HEMS).

Duration: 6 months





Grid Energy Storage Systems



Grid Automation and Protection



Residential Automation



- Development and building of testing skills for innovative solutions (storage, smart grids, smart homes)
- Development of FAT and commissioning procedures according to international (US & Europe) guidelines
- Development of consultancy services in smartgrids/smarthomes solutions

Smart Lab Implementation Projects



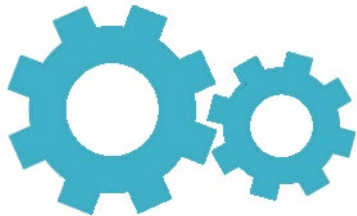
Performance



Protection



Integration



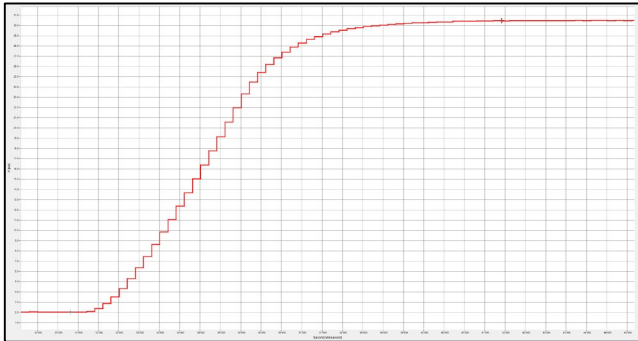
Use case



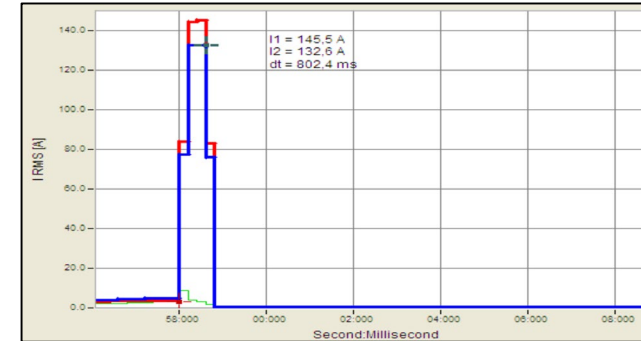
Laboratorial activities were divided into four major vectors in order to ensure full compliance for the demonstrator



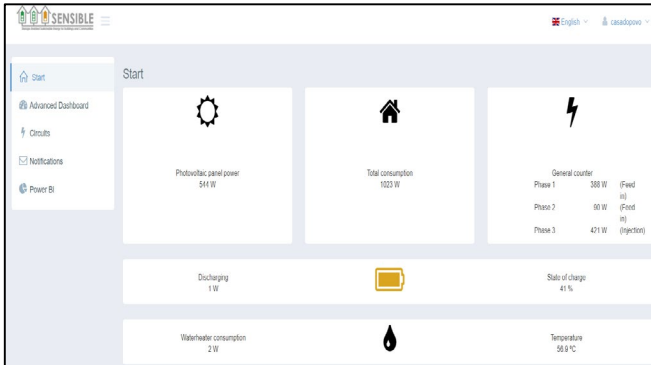
Performance



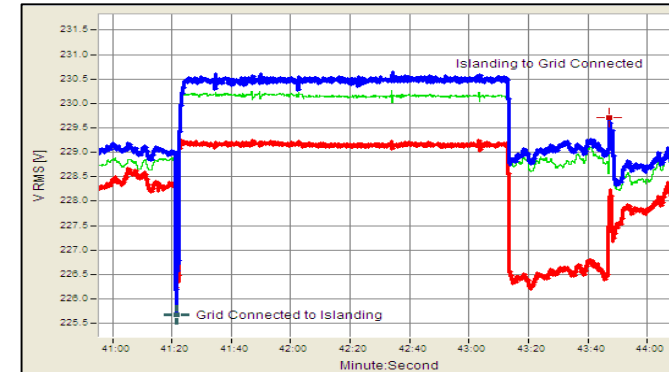
Protection



Integration



Use case



Laboratorial activities were divided into four major vectors in order to ensure full compliance for the demonstrator

Smart Lab Implementation Projects



Objectives: Assessment of charging/discharging performance of a 2nd life battery prototype and benchmark with a commercial battery.

Tests at the SmartLab:

- cycling, aging, use cases, programmable use cases for PV production and load profiles.
- Interoperability tests: inverter + batteries + use case scenarios.
- test of demand side management algorithms.

Duration: 4 months

Smart Lab Implementation Projects



Objectives: Validation of a new tool used by the DSO to perform the remote FW upgrade on smart meters

Tests at the SmartLab: Three (3) LV networks were made available in SmartLab (1 concentrator per network) each containing about 50 smart meters of the same model. These updates were carried out remotely by the DSO (EDP Distribuição).

Duration: 2 weeks

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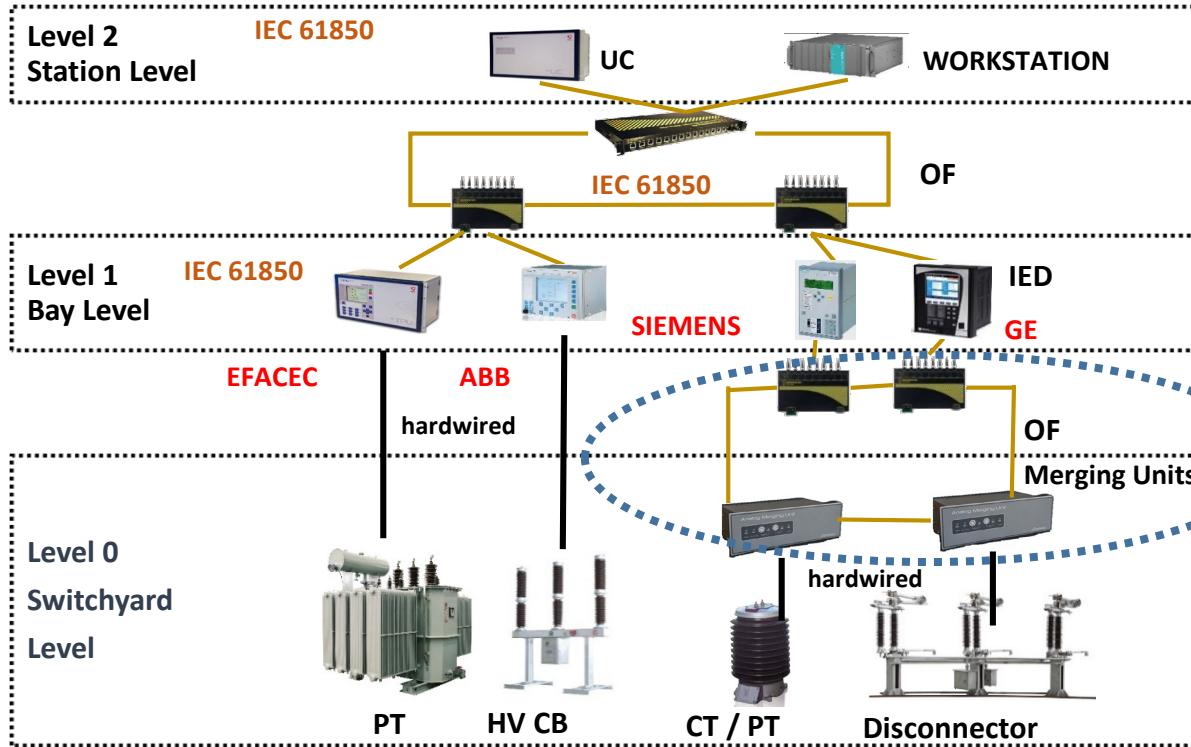
- In projects with technical complexity as SENSIBLE, laboratorial validation is a key quality step for the deployment of the real environment demonstration
- Advanced smartgrids and smarthomes require appropriate ICT infrastructure to enable grid services to DSO – integration and interoperability tests are crucial.
- Uniform protocols to test different energy storage technologies and capacities are a powerful tool to standardize laboratorial activities
- As system complexity increases, as increases the laboratorial resources and test tools to guarantee the adequate evaluation of the technical solutions impact on the system as a whole.

Smart Lab Summary

Main benefits and future developments



SmartLab SAS Substation Automation Systems



IEC 61850

Process Bus

**REAL-TIME POWER SYSTEM
SIMULATOR**



- ✓ Digital I/O
- ✓ Analogue I/O
- ✓ Closed-loop control
- ✓ Hardware-in-the-loop
- ✓ Simulation of real actions



Interoperability testing of substation automation and protection systems

The SmartLab upgrade will integrate the substation simulation of equipment and functionalities based on IEC 61850

Smart Lab Summary

Main benefits and future developments

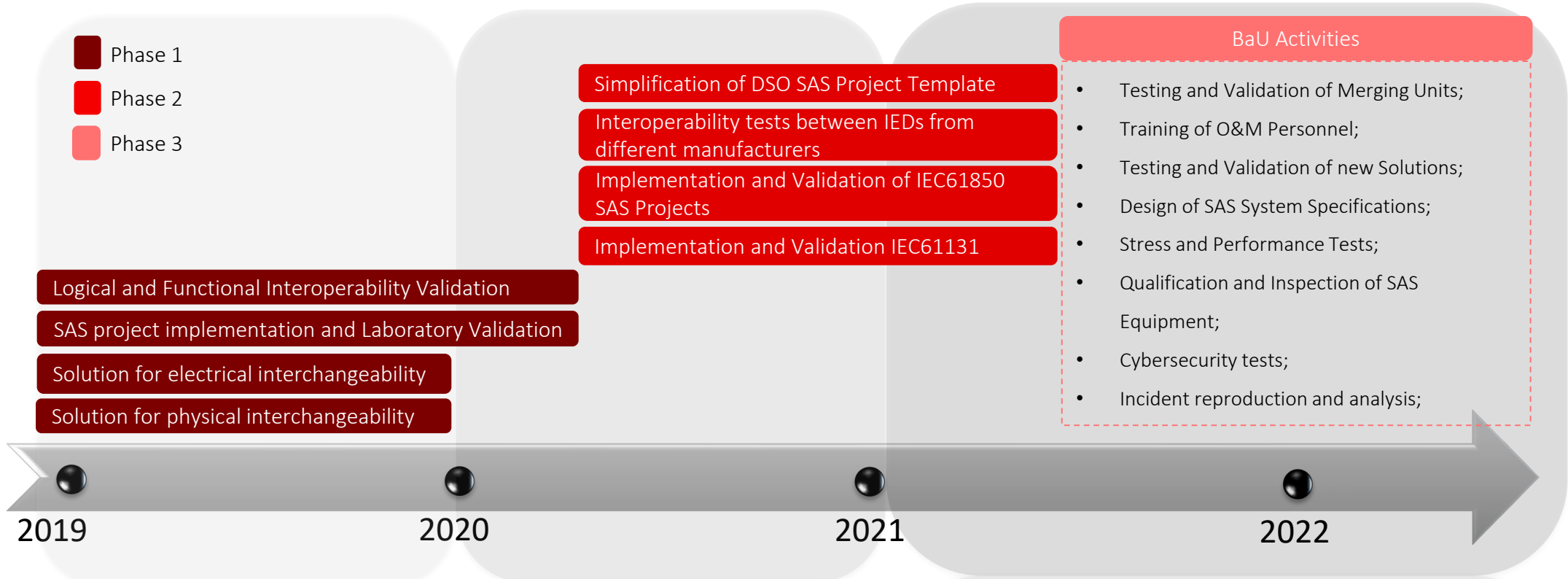


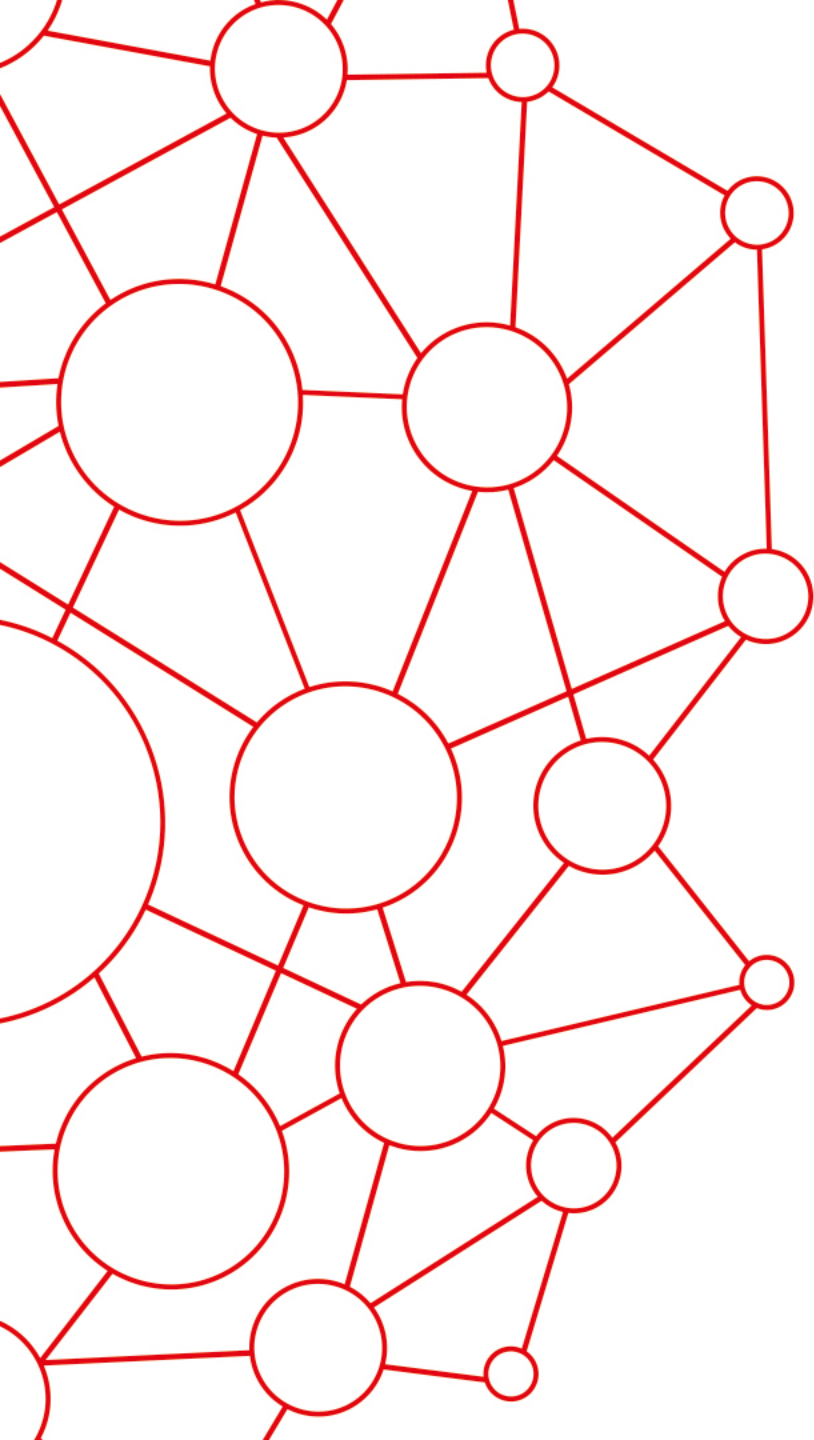
Key Aspects:

Global Investment: 650-700 k€

Timeframe: Between 2019-2021

- Phase 1
- Phase 2
- Phase 3





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