

Overview of the ERIGrid 2.0 Smart Grid and Energy Systems Research Infrastructure Activities and Access Opportunities

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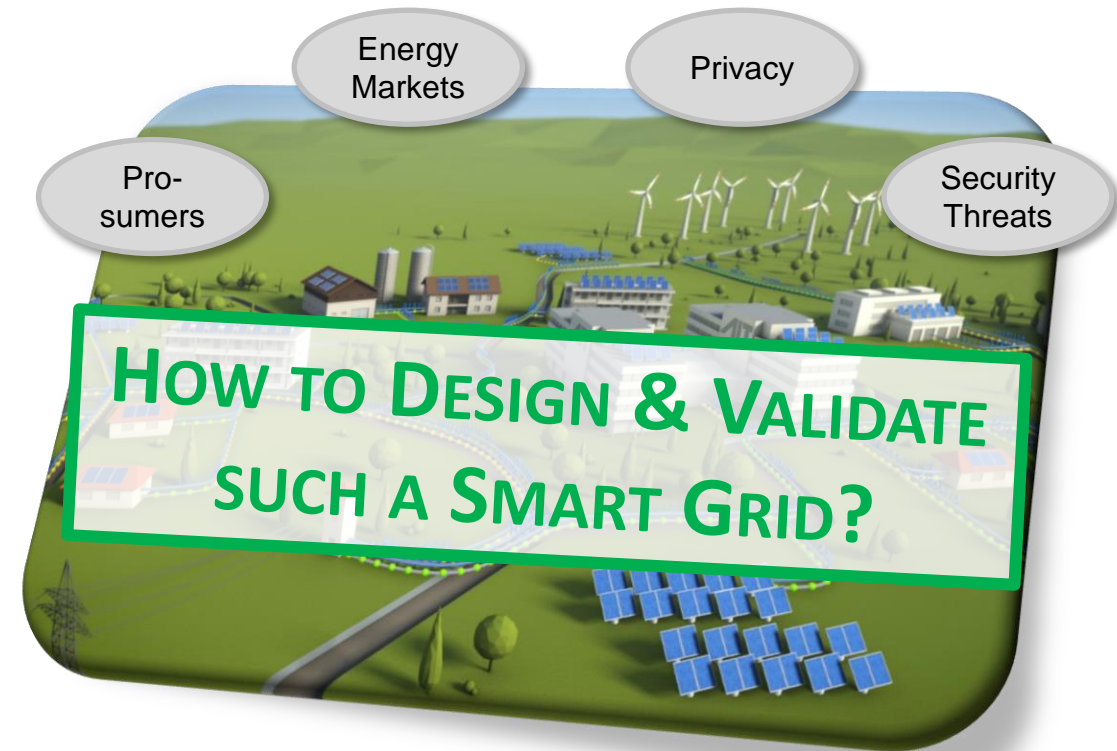
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*Meeting with H2020 SINERGY
08 July 2022 | online*



Background and Motivation

- Planning and operation of the energy infrastructure becomes more complex
 - Large-scale integration of renewable sources (Distributed Energy Res./DER – like PV, wind, etc.)
 - Controllable loads (battery storages, electric vehicles, heat pumps, etc.)
- Trends and future directions
 - Digitalisation of energy infrastructure
 - Deeper involvement of consumers and market interaction
 - Sector coupling (linking electricity, gas, and heat grids) for higher flexibility and resilience



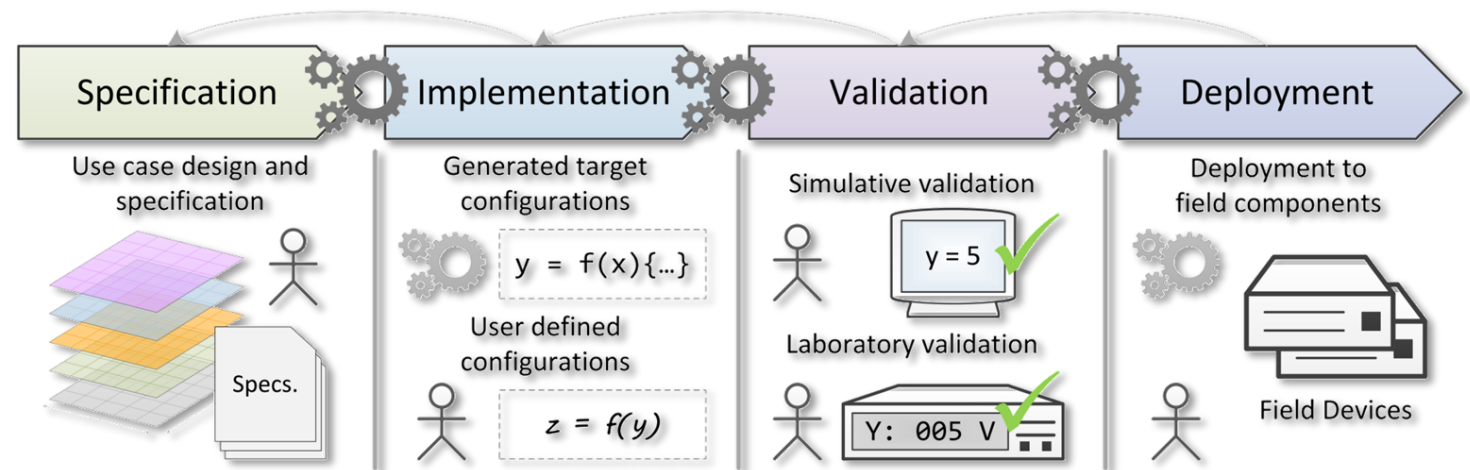
Vision and Research Directions

- Smart energy systems support for integrated ...

- Systems design and implementation
- Validation and testing
- Installation and roll-out

- Future research needs

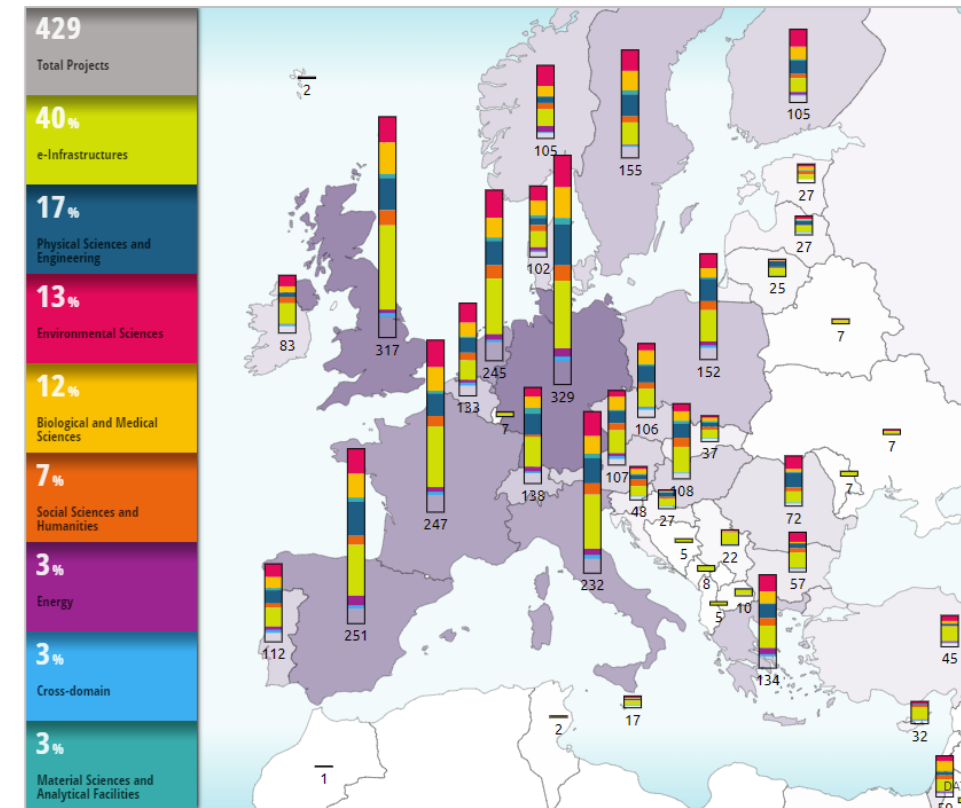
- Improved development and testing methods/services/tools
- Extended and advanced research infrastructures and laboratories
- Well-educated researchers and engineers (“multi-domain understanding”)



European Research Infrastructures (RI)

- Provide resources (major scientific equipment) and services to communities
- Conduct research and foster innovation
- Are strategic investments in scientific and technological excellence
- Act as knowledge and innovation hubs (collections, archives or scientific data)
- Essential pillar of the European Science Area

→ *Only a few cover energy-related topics*



Source: [European Commission](#) & [RICH2020](#)

Integrated DER, Smart Grid, and Energy Systems RI's

- Long-term, Pan-European cooperation
- Advanced community

2024



- GA-ID 5189299
- FP6 NoE (11/2005-10/2011)
- 3 Mio EUR funding
- 12 partners
- Networking of DER labs, pre-standardization



- GA-ID 228449
- FP7 RI IA (09/2009-12/2013)
- 5 Mio EUR funding
- 16 partners from 12 countries
- TNA to DER labs, pre-standardization



- GA-ID 654113
- H2020 RI IA (11/2015-04/2020)
- 10 Mio EUR funding
- 18 partners from 11 countries
- TNA to Smart Grid and DER labs, pre-standardization



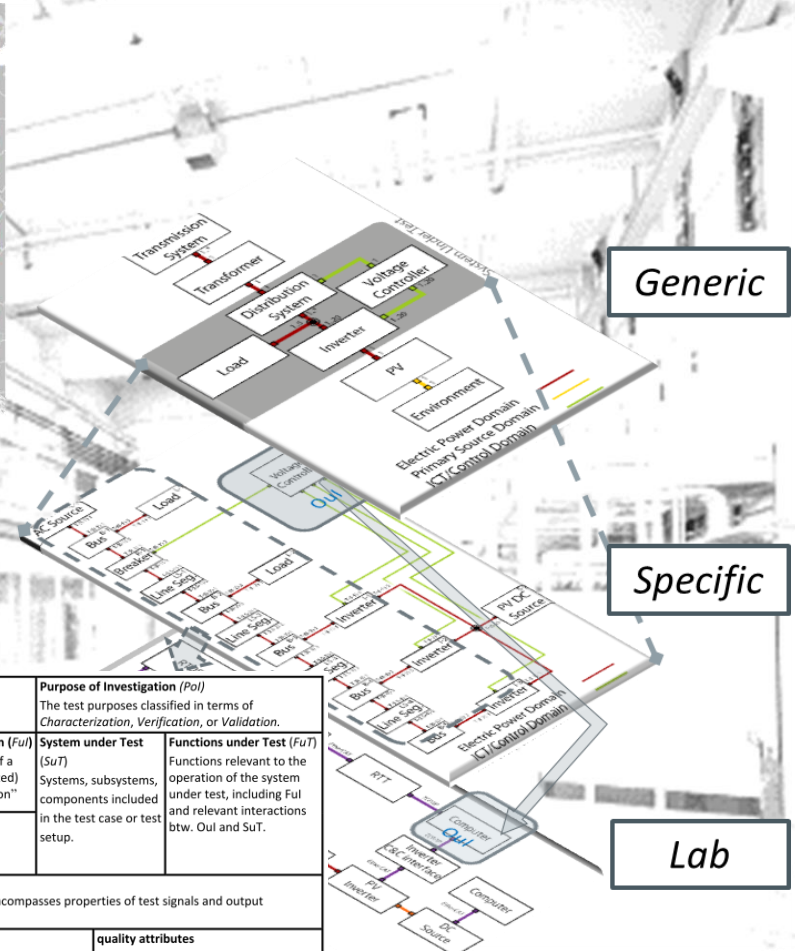
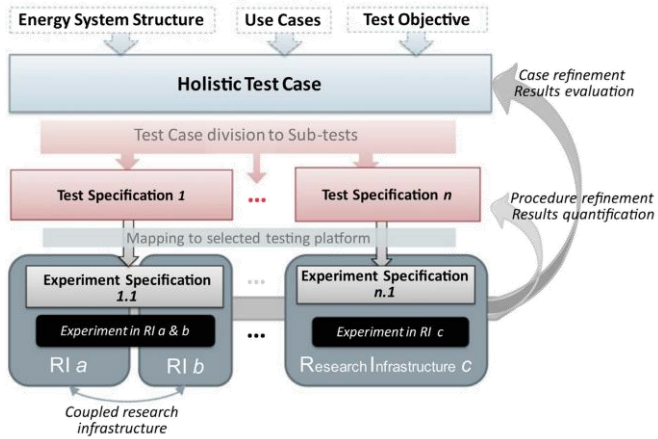
- GA-ID 870620
- H2020 RI IA (04/2020-09/2024)
- 10 Mio EUR funding
- 20 partners from 13 countries
- TNA & VA to Smart Grid, Smart Energy Systems and DER labs, pre-standardization

Legend:

- DER ... Distributed Energy Resources
- RI ... Research Infrastructure
- TNA ... Trans-national Access
- VA ... Virtual Access
- NoE ... Network of Excellence



Smart Grid RI “ERIGrid” – Achievements



- Advanced testing methods and tools
- Holistic validation approach for smart grids
- Approach for specifying test cases, test specifications and experiments
- Coupling approach for smart grid labs
- Virtual Pan-European Smart Grid RI

Test Objectives Why is the test needed? What do we expect to find out? A short narrative of context and goals of the test.		Purpose of Investigation (PoI) The test purposes classified in terms of Characterization, Verification, or Validation.	
Object under Investigation (OUI) "the component(s) (1..n) that are to be qualified by the test"	Function(s) under Investigation (FuI) "the referenced specification of a function realized (operationalized) by the object under investigation"	System under Test (SuT) Systems, subsystems, components included in the test case or test setup.	Functions under Test (FuT) Functions relevant to the operation of the system under test, including FuI and relevant interactions btw. OUI and SuT.
Domain under Investigation (DUI): "the relevant domains or sub-domains of test parameters and connectivity."			
Test criteria: Formulation of criteria for each PoI based on properties of SuT; encompasses properties of test signals and output measures.			
target metrics Measures required to quantify each identified test criteria	variability attributes controllable or uncontrollable factors and the required variability; ref. to PoI.	quality attributes threshold levels for test result quality as well as pass/fail criteria.	

Smart Grid RI “ERIGrid” – Achievements

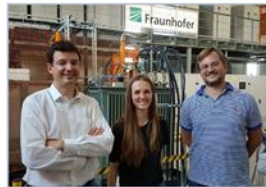
73
user projects from
all over the world
gained lab access



175
engineers accessed
best labs of Europe
free of charge



20
had companies
involved



4
multi-side projects
(involving more than
one laboratory)

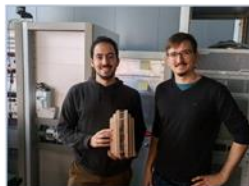


1,000
for over 1,000 days
collectively ERIGrid
labs were in use



14
projects came from
outside Europe

14
projects were led by
companies



7
projects were from
ERIGrid partners
("internal TA")



Free access for user groups to

- Power system,
- Smart grid and
- DER laboratories

Smart Grid RI “ERIGrid” – Summary

- Validation methods and tools
 - Integrated pan-European RI
 - System-level validation method and test chain concept
 - Set of open access/source tools (co-/real-time/HIL sim)
- Training activities
 - Education material (450 impacted students, 450 workshop and 290 webinar participants)
- Lab access programme
 - 73 out of 97 TA user projects supported (~175 persons, ~1,000 lab days)
- Various reports (~50) and over 160 scientific publications ...



ERIGrid Summer School, Athens (GR), June 2019

Training of researcher and engineers

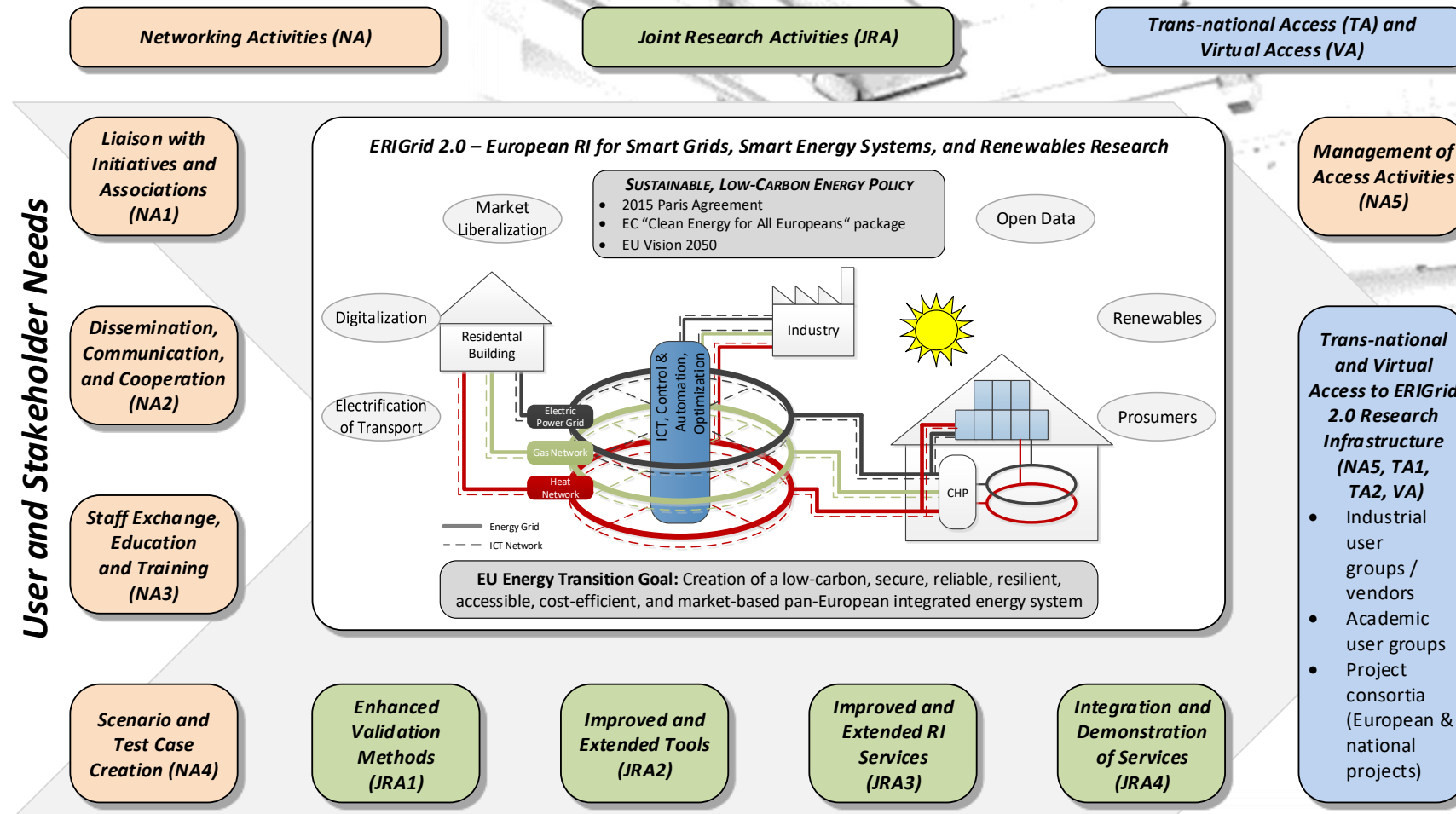
- Training schools
- Course/education material
- Tutorials and webinars

Smart Energy Systems RI “ERIGrid 2.0” – Key Facts

- Extended and applied research based on ERIGrid topics and achievements for
 - Smart grid and smart energy systems
 - Digitalization with lab interfacing and data exchange for physical/virtual access
- Tight collaboration of partners
 - 13 European countries involved
 - 20 Partners from research and industry
 - 21 top-class DER, smart grid, and energy systems labs + 8 virtual facilities
 - 10 Mio funding (~900 person months)

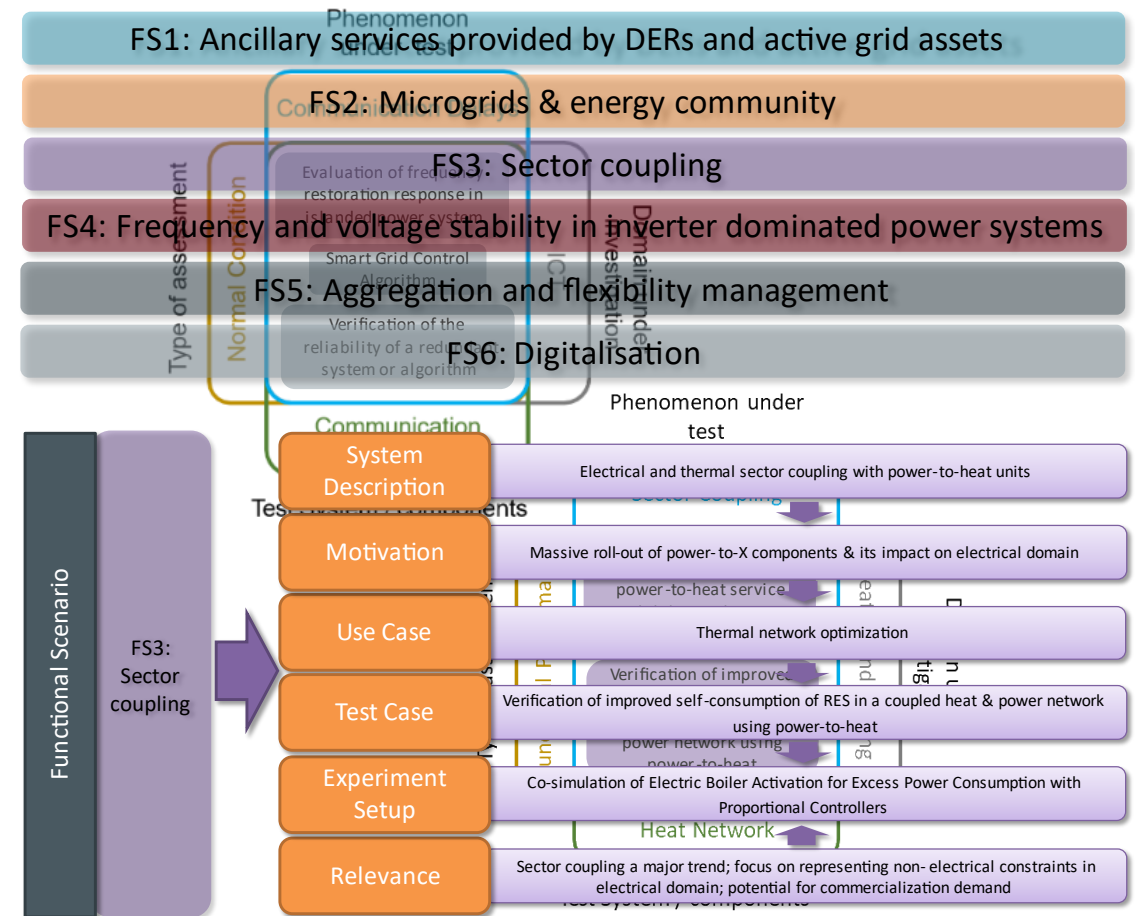


Smart Energy Systems “ERIGrid 2.0” – Approach



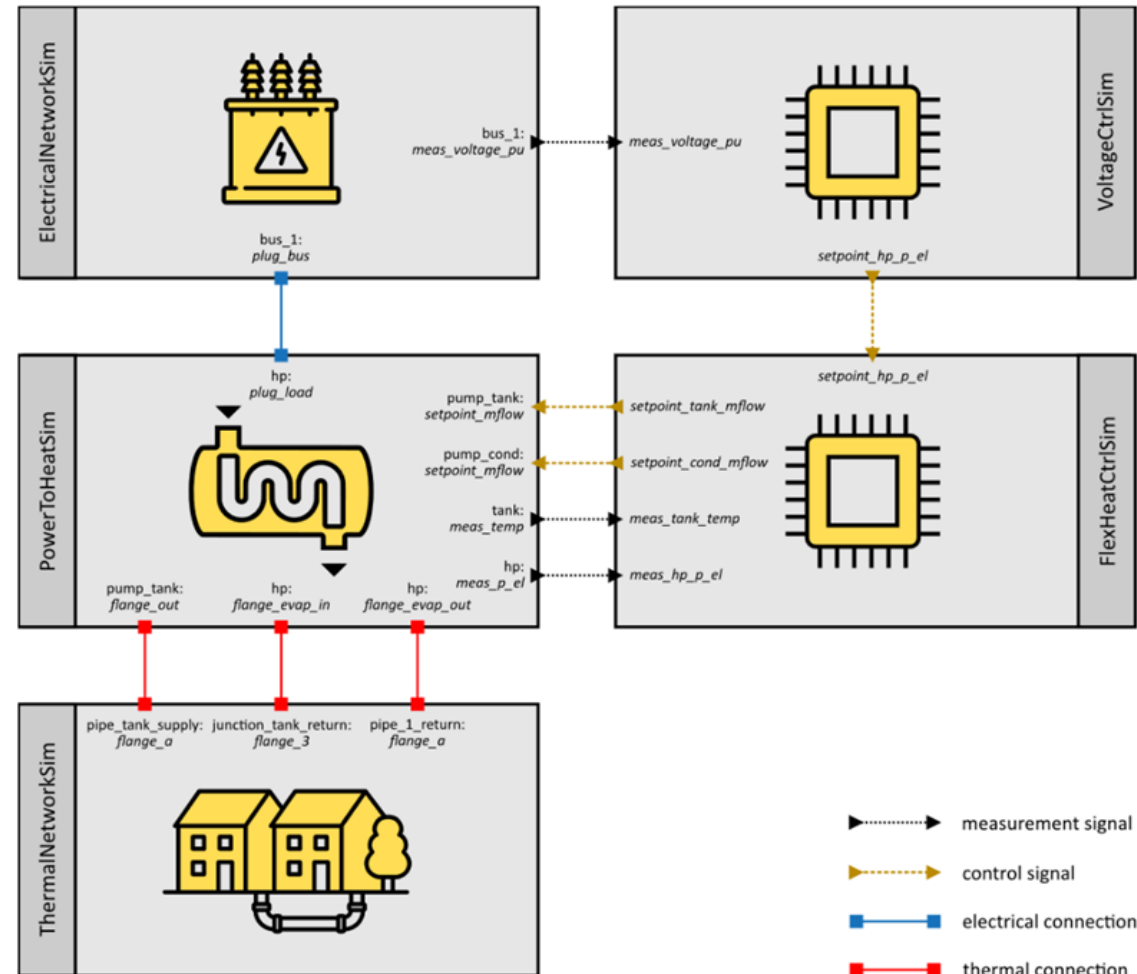
Smart Energy Systems “ERIGrid 2.0” – Test Cases

- 25 test cases based on 6 functional scenarios
- Test cases documented with the ERIGrid-1 Holistic Test Description (HTD)
 - Facilitates the implementation at RI level
- Keywords assigned to test cases for the definition of characteristics of technological areas
 - Useful tool for users selecting test cases
 - Test case profiles formed based on keywords
 - Key words focus on 4 dimensions: 1) domain under investigation, 2) phenomenon under test, 3) type of assessment, and 4) test system



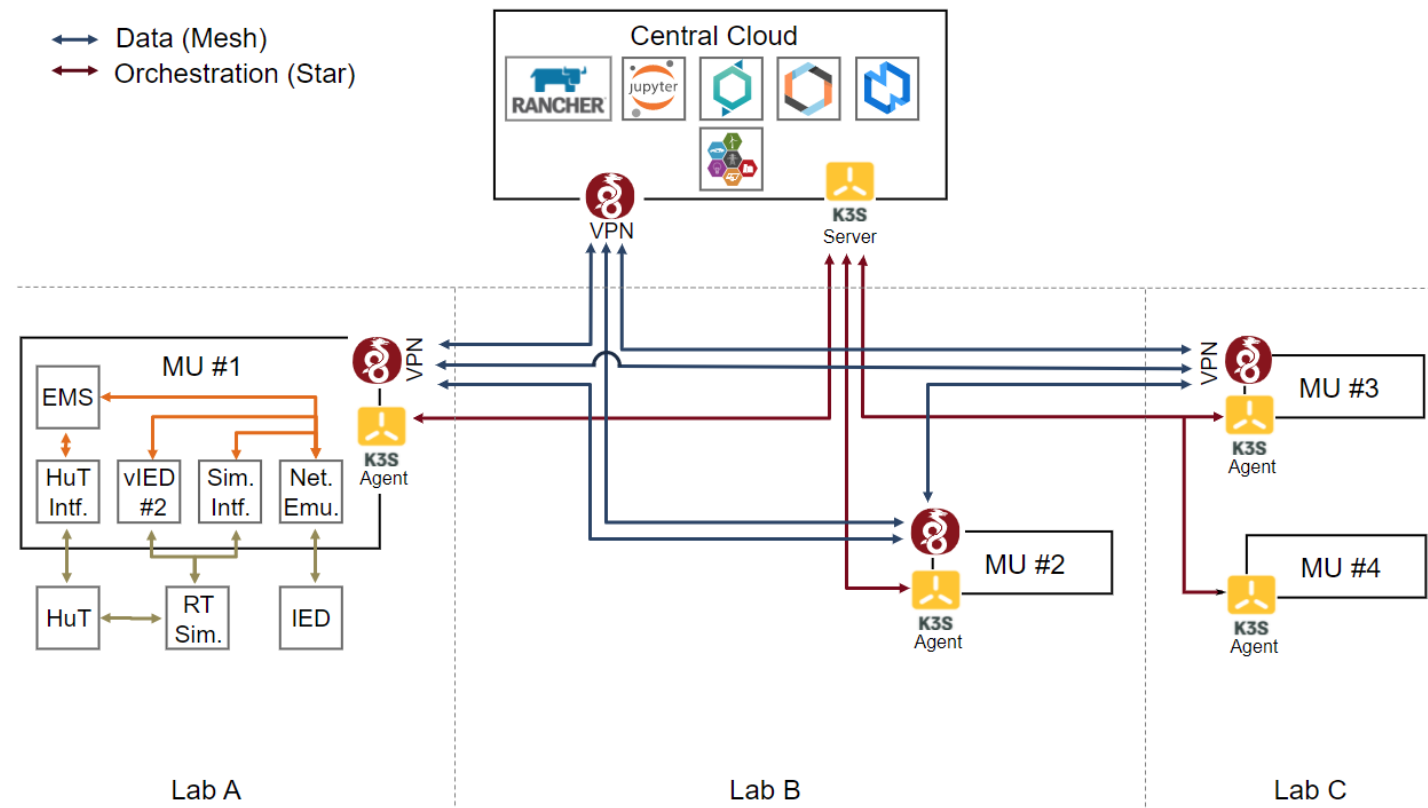
Smart Energy Systems “ERIGrid 2.0” – Benchmarks

- Three benchmarks
 1. Electrical Network
 2. Multi-Energy Networks
 3. ICT-enhanced Power System
- Extensive documentation following PreCISE approach (based on HTD)
- Current work focuses on
 - Uncertainty representation
 - Validation methods



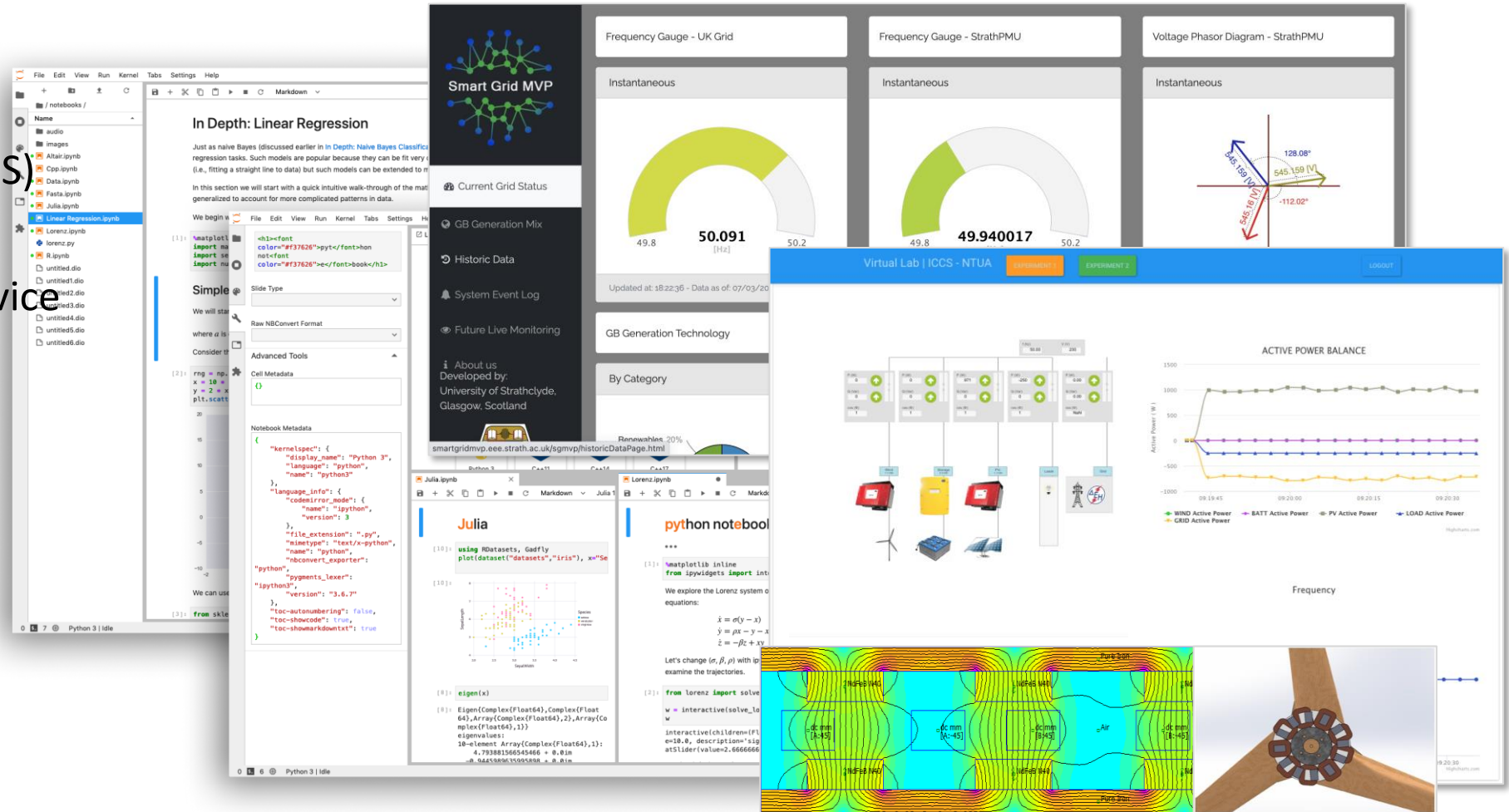
Smart Energy Systems “ERIGrid 2.0” – RI Cooperation

- Accelerating time-to-experiment for remote RI coupling via “RI-as-Code” (RIasC)
 - Prototype set of tools for automated provisioning of distributed mobile compute nodes
 - Enables transparent inter-connection via an overlay network
 - Together with other ancillary services (network monitoring, synchronisation, etc.) these tools provide the basis for a flexible lab middleware



Smart Energy Systems “ERIGrid 2.0” – Virtual Services

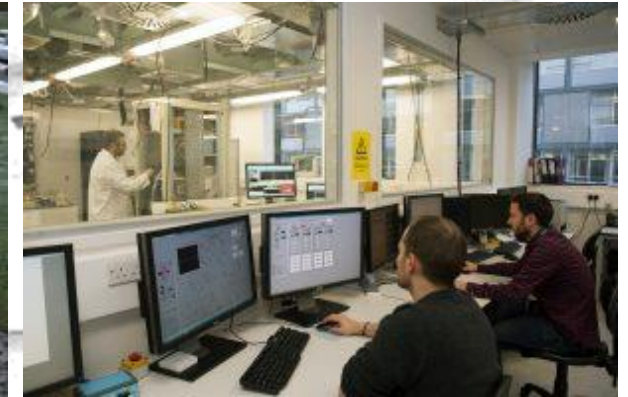
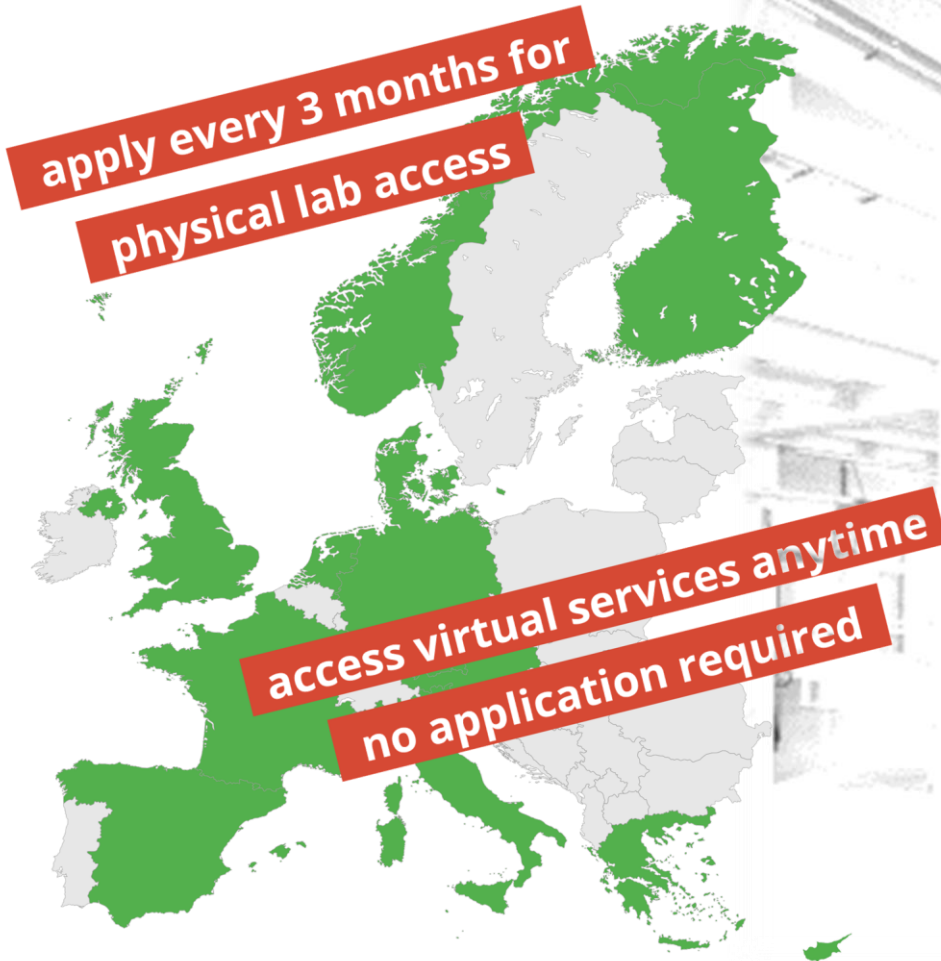
- Focus on
 - Simulation-as-a-Service (SaaS)
 - Open data, Data-as-a-Service (DaaS)
 - Virtual labs



www.erigrad2.eu/lab-access



Smart Energy Systems “ERIGrid 2.0” – Lab Access



www.erigrd2.eu/lab-access

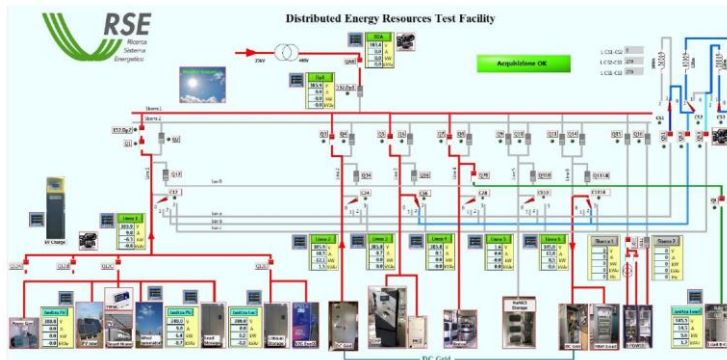
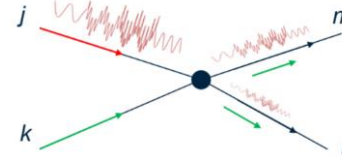
Smart Energy Systems “ERIGrid 2.0” – Access Example

- User project “ColourPower” at the Distributed Energy Resources Test Facility (RSE), Italy
 - Wavelet-transform based signal processing for the validation of power flow tracing approach
 - Prove the power sharing principle for power flow tracing to determine the share of losses in active distribution grids
 - 183 tests records were obtained

University of
Glasgow, UK



RSE, Italy



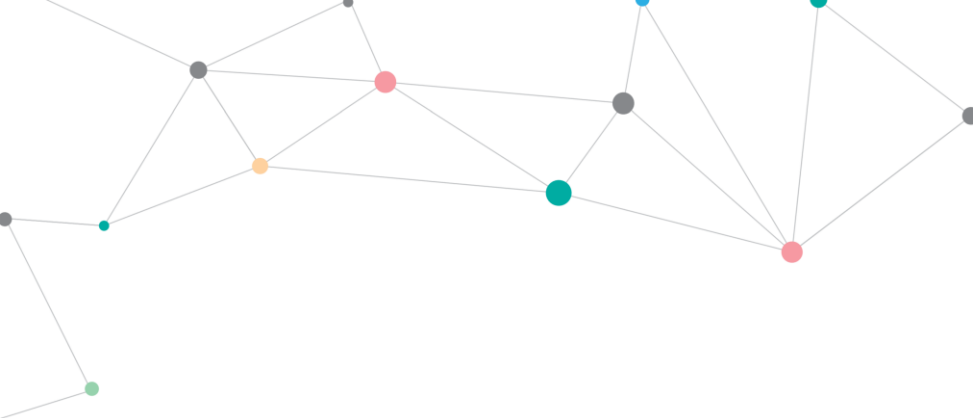
Start date 26/07/2021

End date 06/08/2021

No. of access days 10

No. of stay days 14





www.erigrd2.eu



@ERIGrid 2.0 Project

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