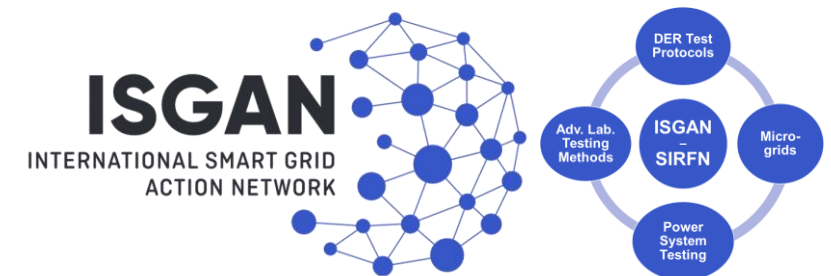# Overview of the ERIGrid 2.0 Validation Infrastructure for Smart Grids and Energy Systems

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IEA ISGAN-SIRFN Advanced Lab Testing Methods (ALTM) Monthly Meeting
*24 January 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
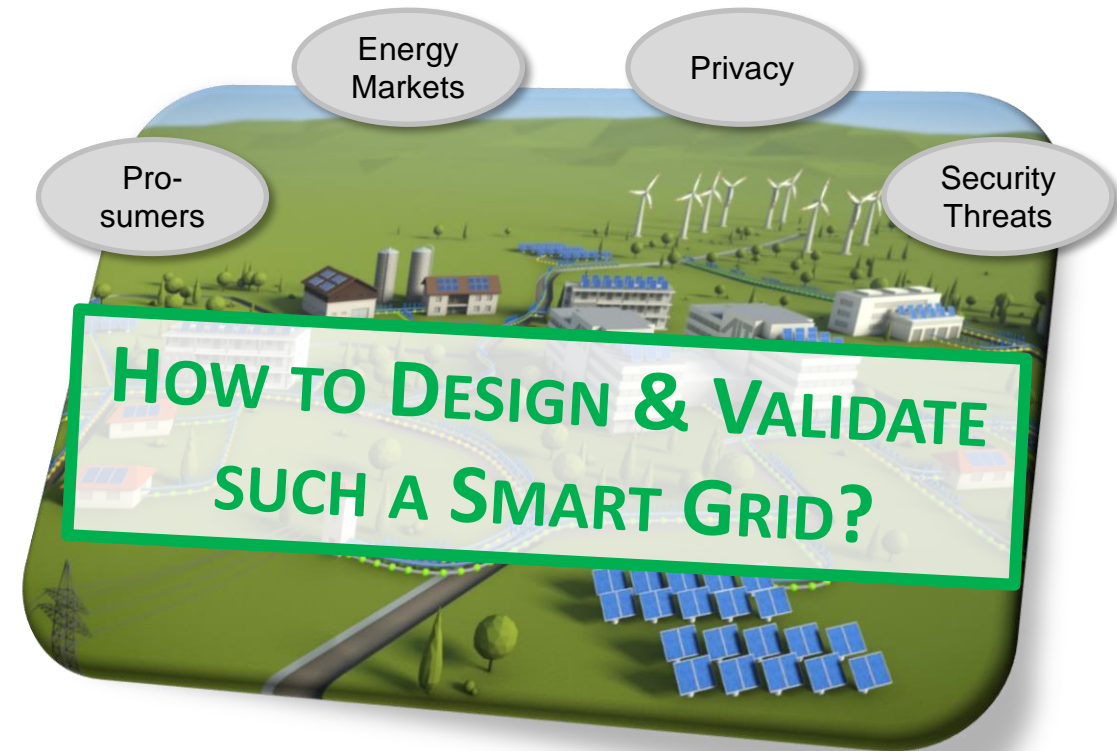
Vision and Research Directions

- Support for the integrated design, implementation, validation, and installation of smart grids and smart energy systems

  - Integrated system design

  - Validation and testing

  - Installation and roll out

- Future research needs

  - Improved development and testing services and tools

  - Extended and advanced research infrastructures and laboratories

  - Well educated researchers and engineers ("multi-domain understanding")
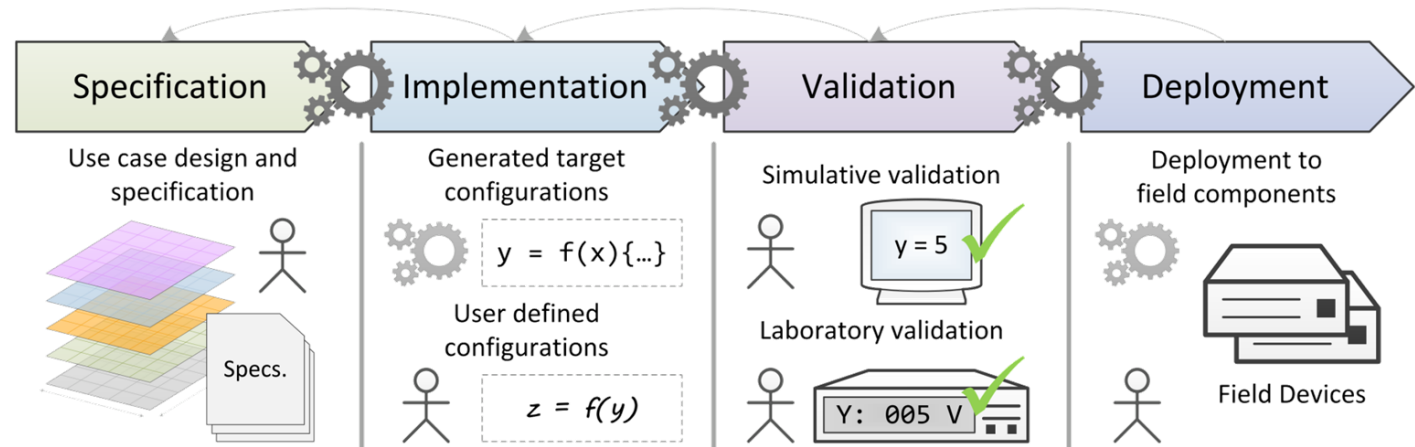
Integrated Smart Grid and Energy Systems RI's

ERIgrid 2.0
Connecting European
Smart Grid Infrastructures

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

2024

DERlab
European Distributed Energy Resources Laboratories

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

DERri
Distributed Energy Resources Research Infrastructure

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

ERIgrid
Connecting European Smart Grid Infrastructures

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

ERIgrid 2.0
Connecting European Smart Grid Infrastructures

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

2005

Legend:

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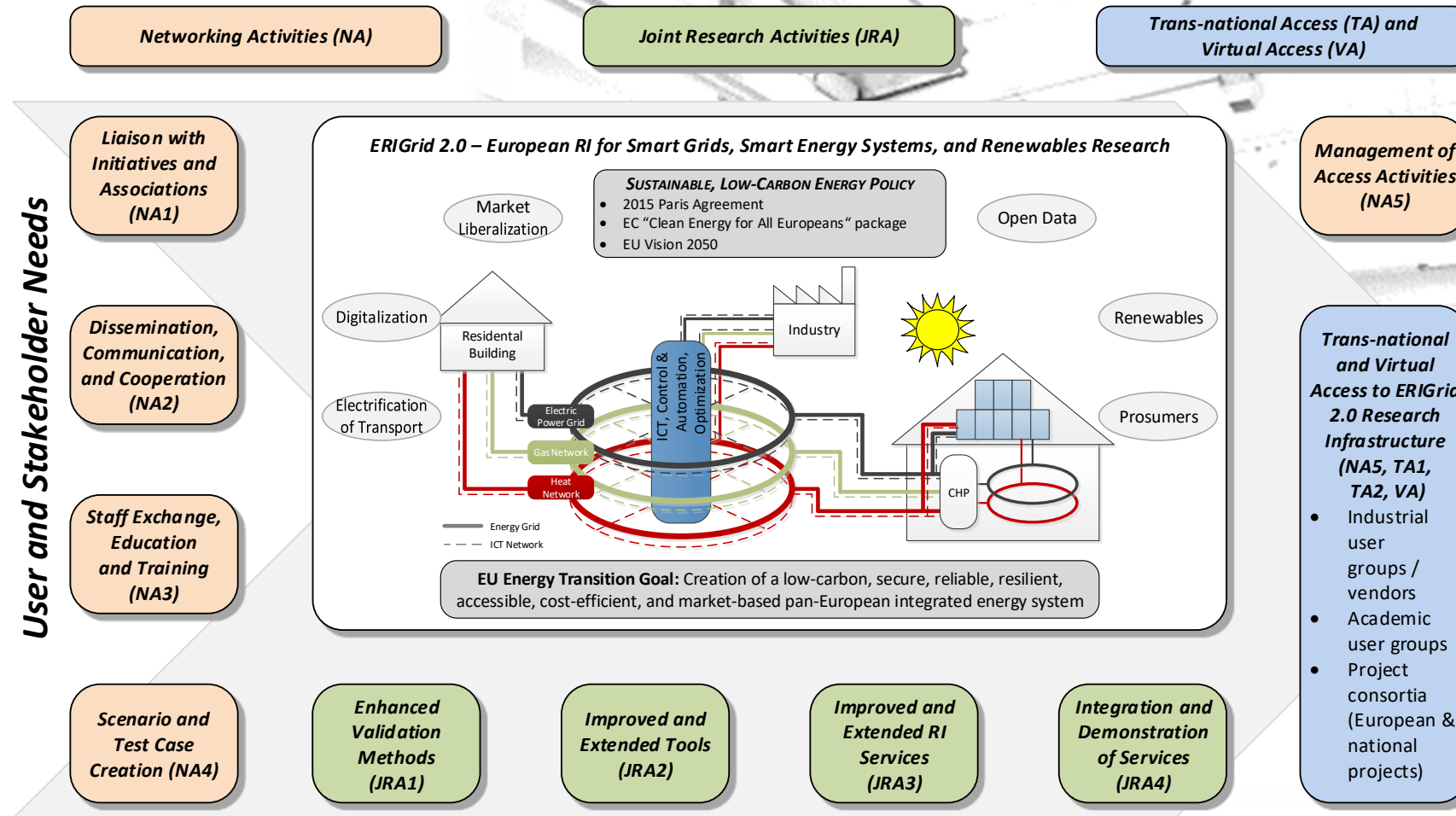NoE ... Network of Excellence

Smart Energy Systems "ERIGrid 2.0" - Overview

- 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 smart grid, energy systems, and DER labs

  – 8 virtual facilities
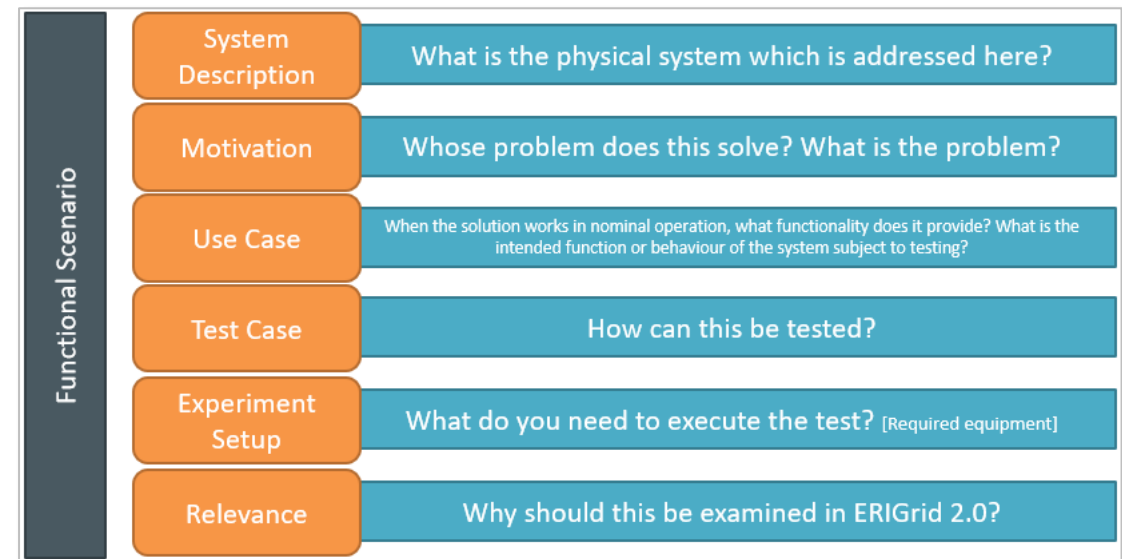
Smart Energy Systems "ERIGrid 2.0" - Approach

Networking Activities (NA)

Joint Research Activities (JRA)

Trans-national Access (TA) and Virtual Access (VA)

User and Stakeholder Needs

Liaison with Initiatives and Associations (NA1)

Dissemination, Communication, and Cooperation (NA2)

Staff Exchange, Education and Training (NA3)

Scenario and Test Case Creation (NA4)

Enhanced Validation Methods (JRA1)

Improved and Extended Tools (JRA2)

Improved and Extended RI Services (JRA3)

Integration and Demonstration of Services (JRA4)

ERIGrid 2.0 – European RI for Smart Grids, Smart Energy Systems, and Renewables Research

SUSTAINABLE, LOW-CARBON ENERGY POLICY
- 2015 Paris Agreement
- EC "Clean Energy for All Europeans" package
- EU Vision 2050

Market Liberalization

Open Data

Digitalization

Renewables

Electrification of Transport

Prosumers

Residental Building

Industry

ICT, Control & Automation, Optimization

Electric Power Grid

Gas Network

Heat Network

CHP

Energy Grid
ICT Network

EU Energy Transition Goal: Creation of a low-carbon, secure, reliable, resilient, accessible, cost-efficient, and market-based pan-European integrated energy system

Management of Access Activities (NA5)

Trans-national and Virtual Access to ERIGrid 2.0 Research Infrastructure (NA5, TA1, TA2, VA)
- Industrial user groups / vendors
- Academic user groups
- Project consortia (European & national projects)

User Innovations

Smart Energy Systems "ERIGrid 2.0" - Methods & Tools
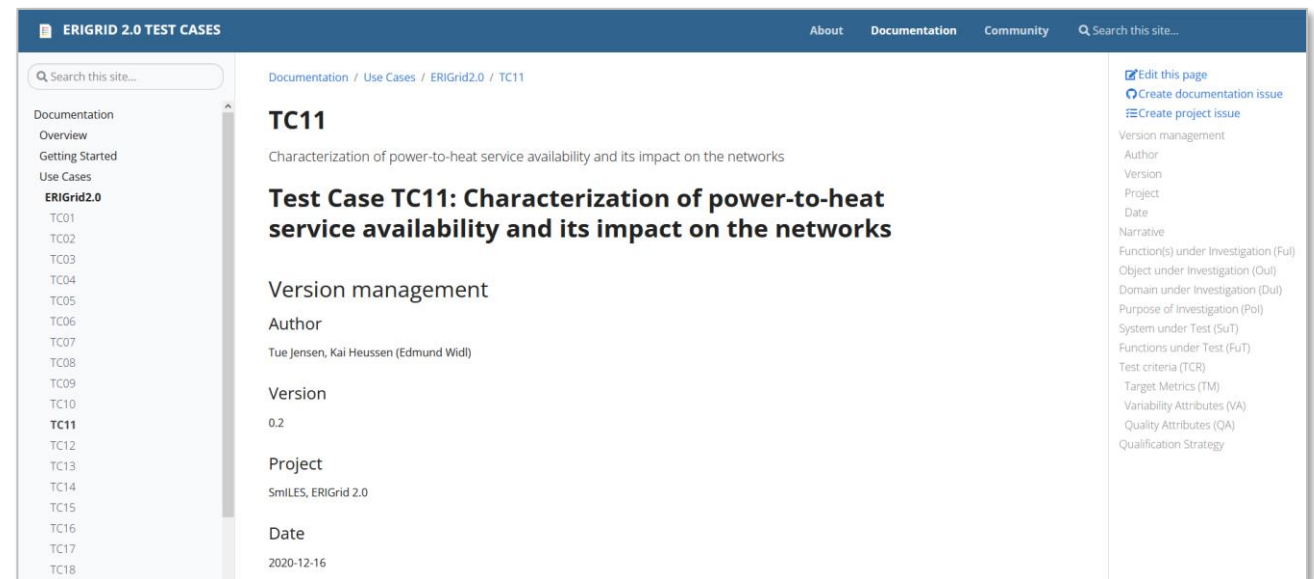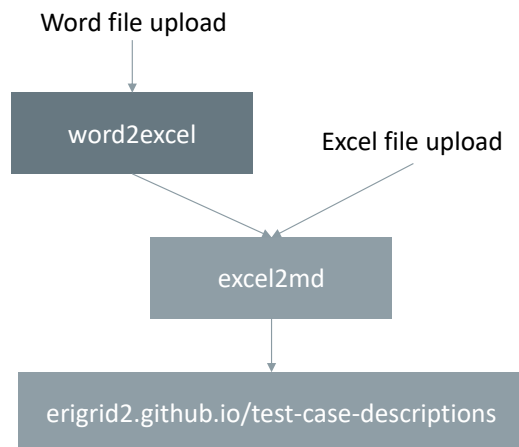
- Functional Scenarios and Test Cases (NA4)

  - Identification of relevant scenarios (6) and test cases (25)

  - Provision of functional scenarios with broad domain view

  - Further details at

    - D-NA4.1 Functional Scenarios (D5.1)

    - D-NA4.2 Common Reference Test Case Profiles (D5.2), and

    - https://github.com/ERIGrid2/test-cases

Functional Scenario

System Description	What is the physical system which is addressed here?
Motivation	Whose problem does this solve? What is the problem?
Use Case	When the solution works in nominal operation, what functionality does it provide? What is the intended function or behaviour of the system subject to testing?
Test Case	How can this be tested?
Experiment Setup	What do you need to execute the test? [Required equipment]
Relevance	Why should this be examined in ERIGrid 2.0?

Smart Energy Systems "ERIGrid 2.0" - Methods & Tools

- Functional Scenarios and Test Cases (NA4)

  - Harmonise the development of holistic test case procedures

  - Provision of tools for test reporting

  - Further details at https://erigrid2.github.io/test-case-descriptions/

Word file upload

word2excel

Excel file upload

excel2md

erigrid2.github.io/test-case-descriptions

Smart Energy Systems "ERIGrid 2.0" - Methods & Tools

- **Enhanced Validation Methods (JRA1)**

  - Development of benchmarks scenarios/ models for different testing set ups

  - Developing guideline for test reproducibility and representation of data and uncertainty

  - Developing methods for test upscaling and domain extension

  - Further details at

    - [D-JRA1.1 Benchmark Scenarios (D10.1)](),

    - [https://github.com/ERIGrid2/ benchmark-model-electrical-network](),

    - [https://github.com/ERIGrid2/benchmark-model-multi-energy-networks](), and

    - [https://github.com/ERIGrid2/benchmark-model-electrical-ict]()

Name	Domain	Simulation Environment
Electrical Network	Electrical	MathWorks MATLAB/Simulink
Multi-Energy Networks	Electrical, Thermal	pandapower, Modelica, Python
ICT-Enhanced Power Systems	Electrical, ICT	DIgSILENT PowerFactory, Mininet

Smart Energy Systems "ERIGrid 2.0" - Methods & Tools

- Improved and Extended Tools (JRA2)

  - Interconnecting (coupling) multiple instances of non-real-time simulators, real-time simulators, HIL components, and physical laboratory equipment(RiasC approach)

  - Demonstrate multi-domain co-simulation of physical infrastructures involving multiple time scales

  - Develop and demonstrate methods for the coupling of real-time simulators with co-simulation and HIL

  - Support distributed and remote experiments

  - Further details see https://riasc.eu/
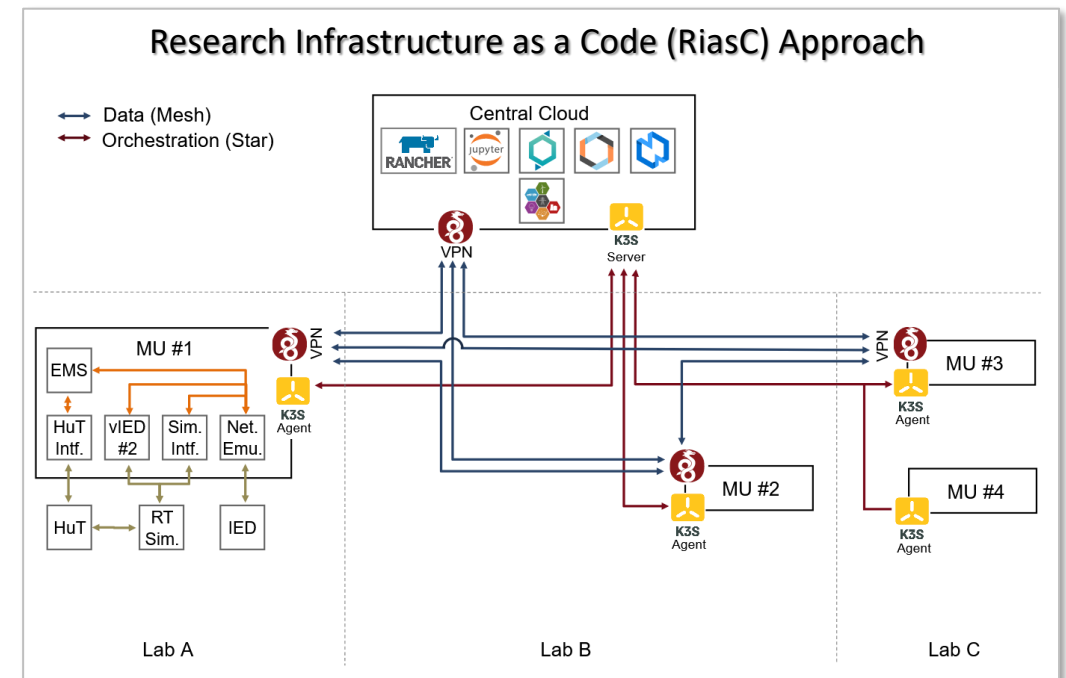
Research Infrastructure as a Code (RiasC) Approach

Smart Energy Systems "ERIGrid 2.0" - Methods & Tools

- Improved and Extended RI Services (JRA3)

  - Improve and extend well-established frameworks for lab coupling and multi-RI experiments

  - Develop a set of extended services for seamless interconnection with various lab facilities/RIs

  - Demonstrate the application of above-mentioned services with an abstract prototype

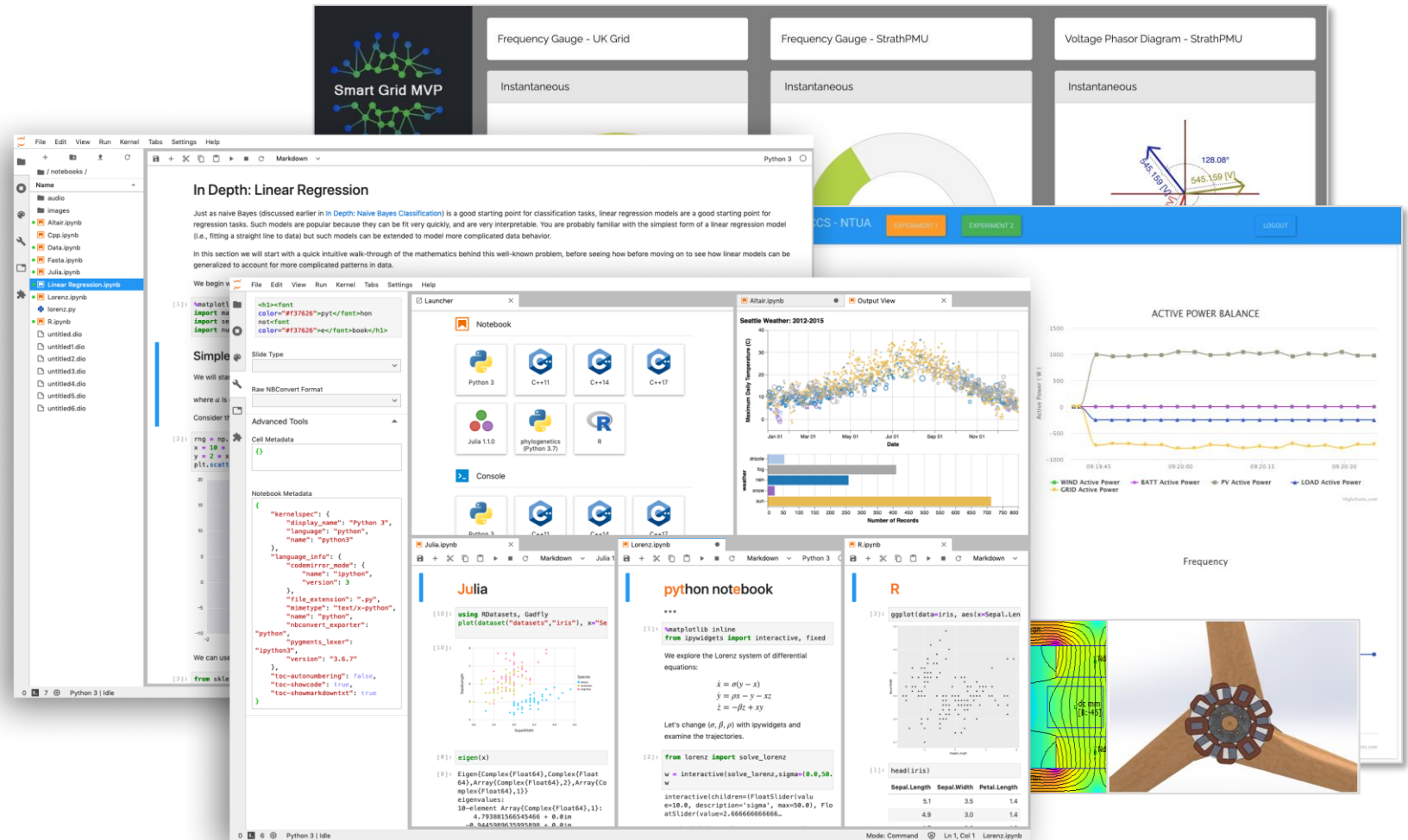 - Implement simulation specific services along with integration of automation services

Smart Energy Systems "ERIGrid 2.0" - Methods & Tools
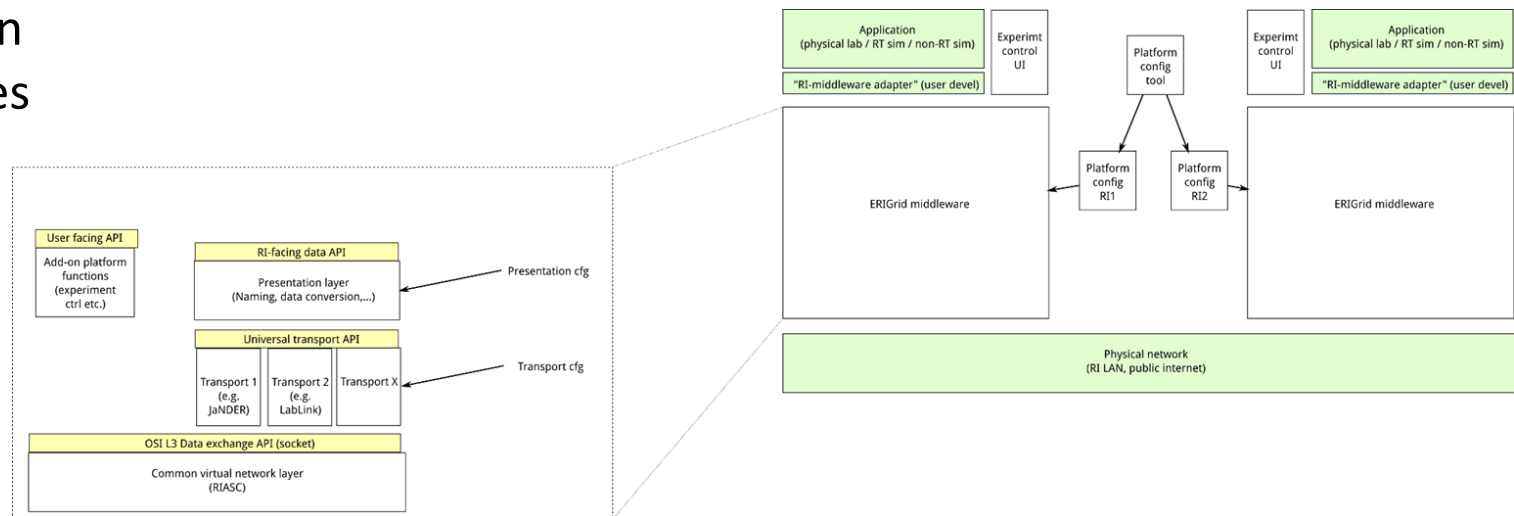
- Integration and Demonstration of RI Services (JRA4)

  - Definition of useful integration and demonstration test cases based on the scenarios and test cases defined in NA4

  - Implementation of the interconnection methodologies and the tools for the simulation, co-simulation, HIL and distributed lab developed and validated in JRA2 and JRA3

  - Demonstration of the services of the ERIGrid 2.0 extended RI

Smart Energy Systems "ERIGrid 2.0" - Virtual Services
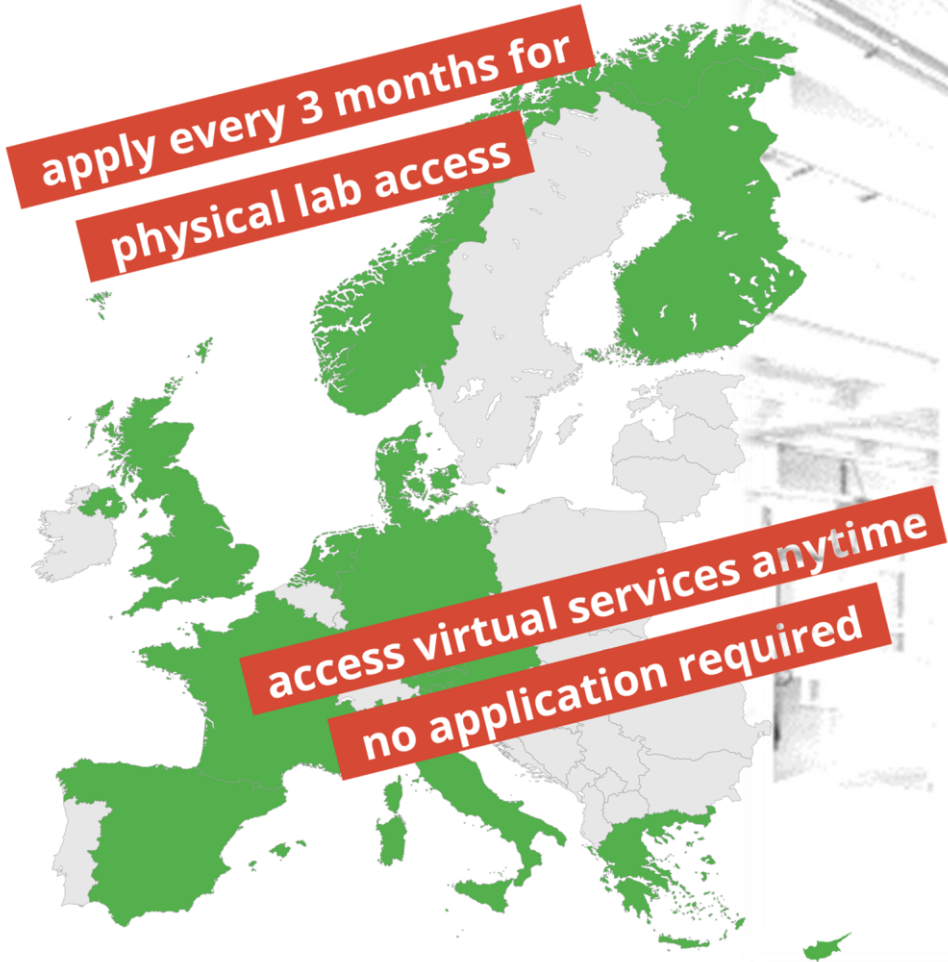
- Focus on

  - Simulation-as--a-Service (SaaS)

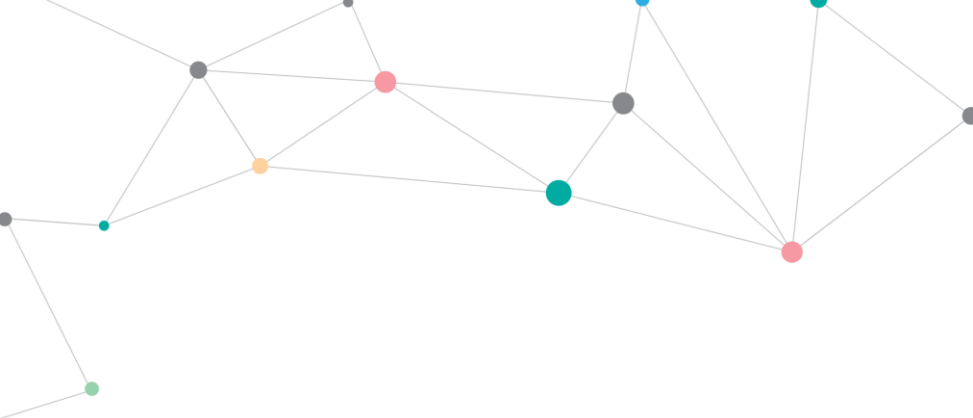 - Open data, Data-as-a-Service (DaaS)

  - Virtual labs

www.erigrid2.eu/lab-access

Smart Energy Systems "ERIGrid 2.0" - Lab Access

apply every 3 months for physical lab access

access virtual services anytime no application required

www.erigrid2.eu/lab-access

www.erigrid2.eu

@ERIGrid 2.0 Project

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