

The Important Role of Research Infrastructures in Context of Smart Grid Technology Development, Validation, and Roll-Out



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*Special Session “Multi-lab Interconnections for
Large-Scale Simulation and Hardware-in-the-Loop”*

Manchester, UK, June 19, 2017

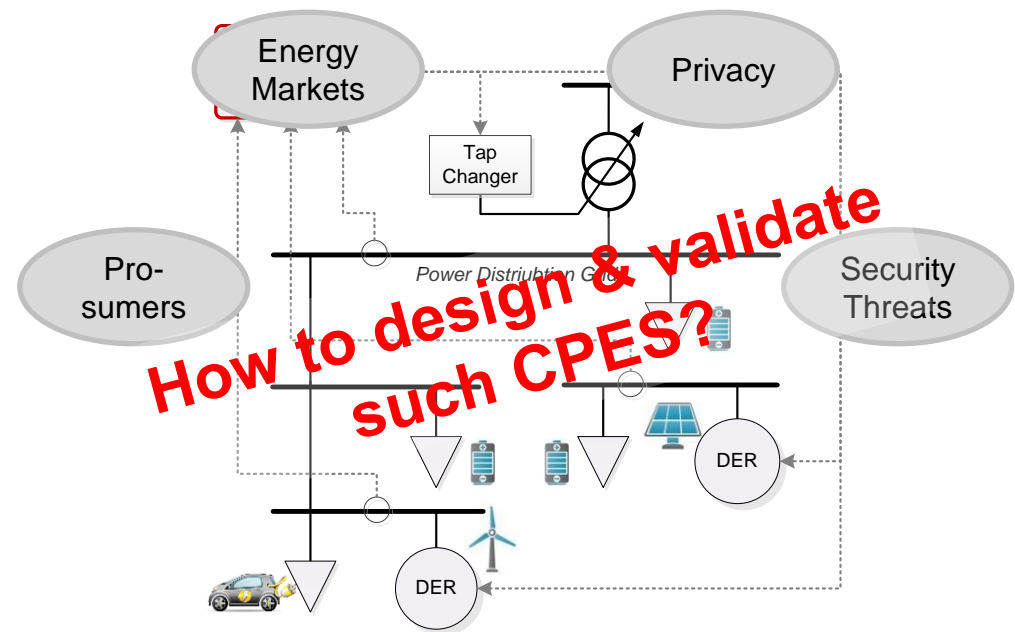


Outline

- Motivation
- Status Quo in Validation
- Future Needs
- The ERIGrid Approach
- Validation Example
- Conclusions

Background and Motivation

- Planning and operation of the energy infrastructure becomes more complex
 - Large-scale integration of renewable sources (PV, wind, etc.)
 - Controllable loads (batteries, electric vehicles, heat pumps, etc.)
- Trends and future directions
 - Digitalisation of power grids
 - Deeper involvement of consumers and market interaction
 - Linking electricity, gas, and heat grids for higher flexibility and resilience



→ *Cyber-Physical Energy System (CPES)*

Status Quo in Validation

- In the past individual domains of power and communication systems have been often designed and validated separately
- Available methods and approaches are

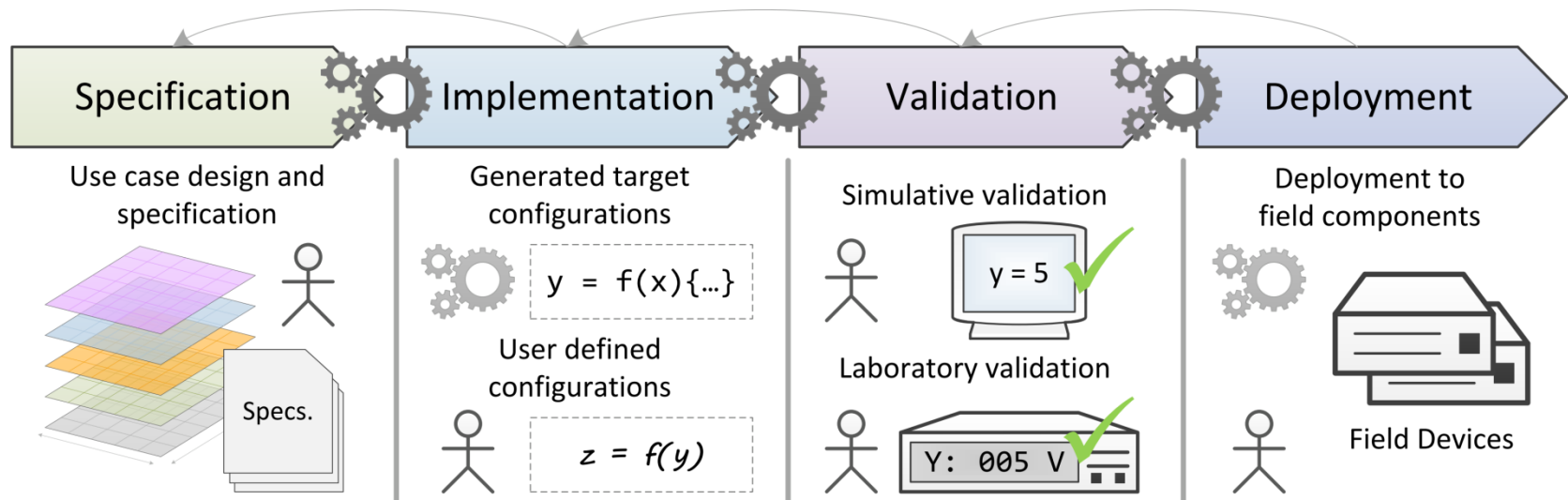
	<i>Req. & Basic Design Phase</i>	<i>Detailed Design Phase</i>	<i>Implementation & Prototyping</i>	<i>Deployment / Roll Out</i>
Software Simulation	+	++	○	-
Lab Experiments and Tests	-	-	++	+
Hardware-in-the-Loop (HIL)	-	-	++	++
Demonstrations / field tests / pilots	-	-	-	++

Legend:

- ... less suitable, ○ ... suitable with limitations, + ... suitable, ++ ... best choice

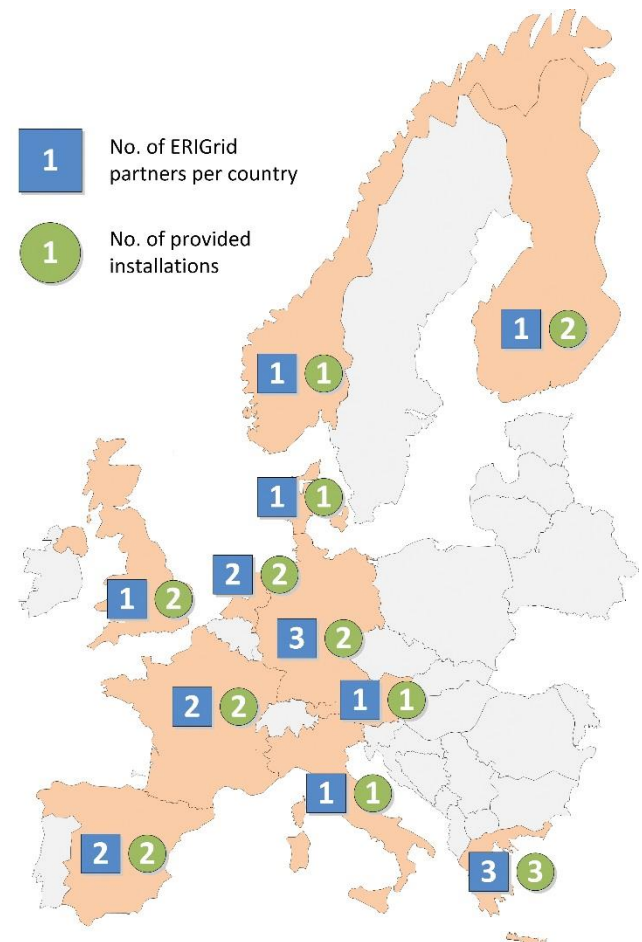
Future Needs

- Vision: *“Providing support from design to implementation & installation”*
 - Integrated system design
 - Validation and testing
 - Installation and roll out



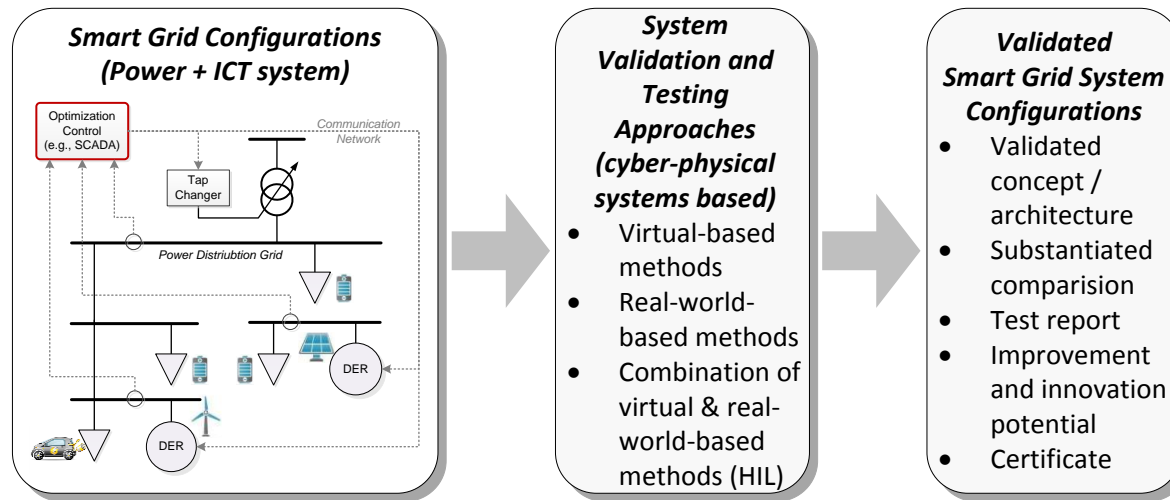
The ERIGrid Approach

- H2020 INFRAIA-1-2014/2015 call
 - Integrating and opening existing national and regional research infrastructures of European interest
- Funding instrument
 - Research and Innovation Actions (RIA)
 - Integrating Activity (IA)
- 18 Partners from 11 European Countries
- Involvement of 19 first class Smart Grid labs
- 10 Mio Euro Funding from the EC (~1000 Person Month)



The ERIGrid Approach

- Development of a holistic validation framework and the corresponding research infrastructure with proper methods and tools

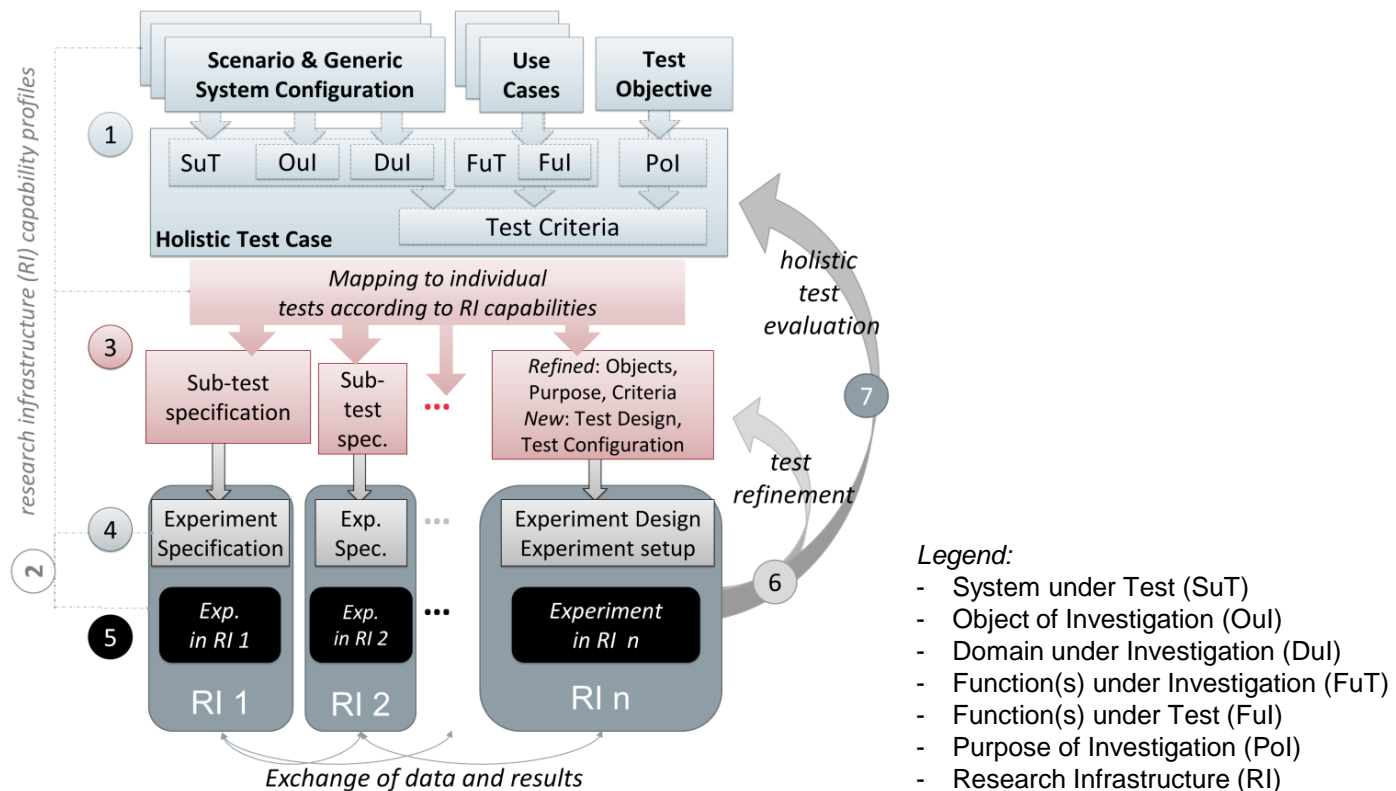


- Improved simulation and lab-based validation approaches
- Harmonized and standardized evaluation procedures
- Provision of training and education material

The ERIGrid Approach

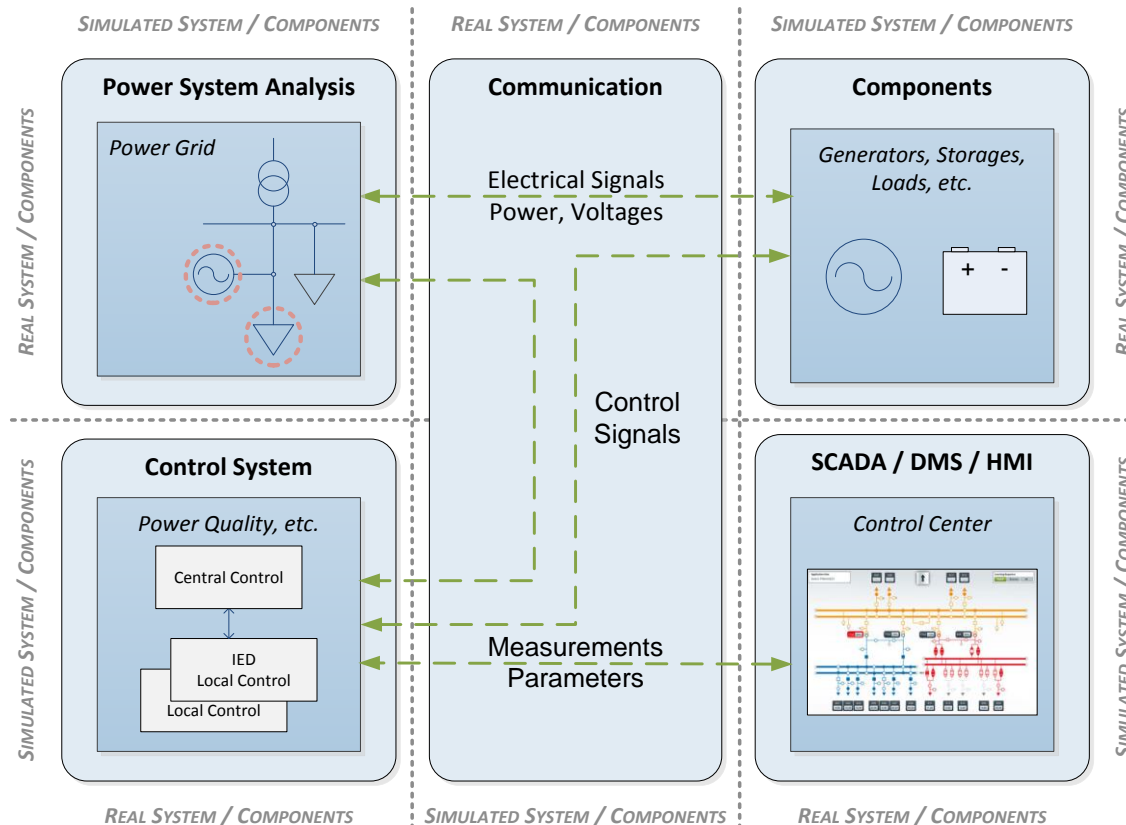
■ Towards formalized validation

“From validation needs to evaluated integrated Smart Grid Configurations”



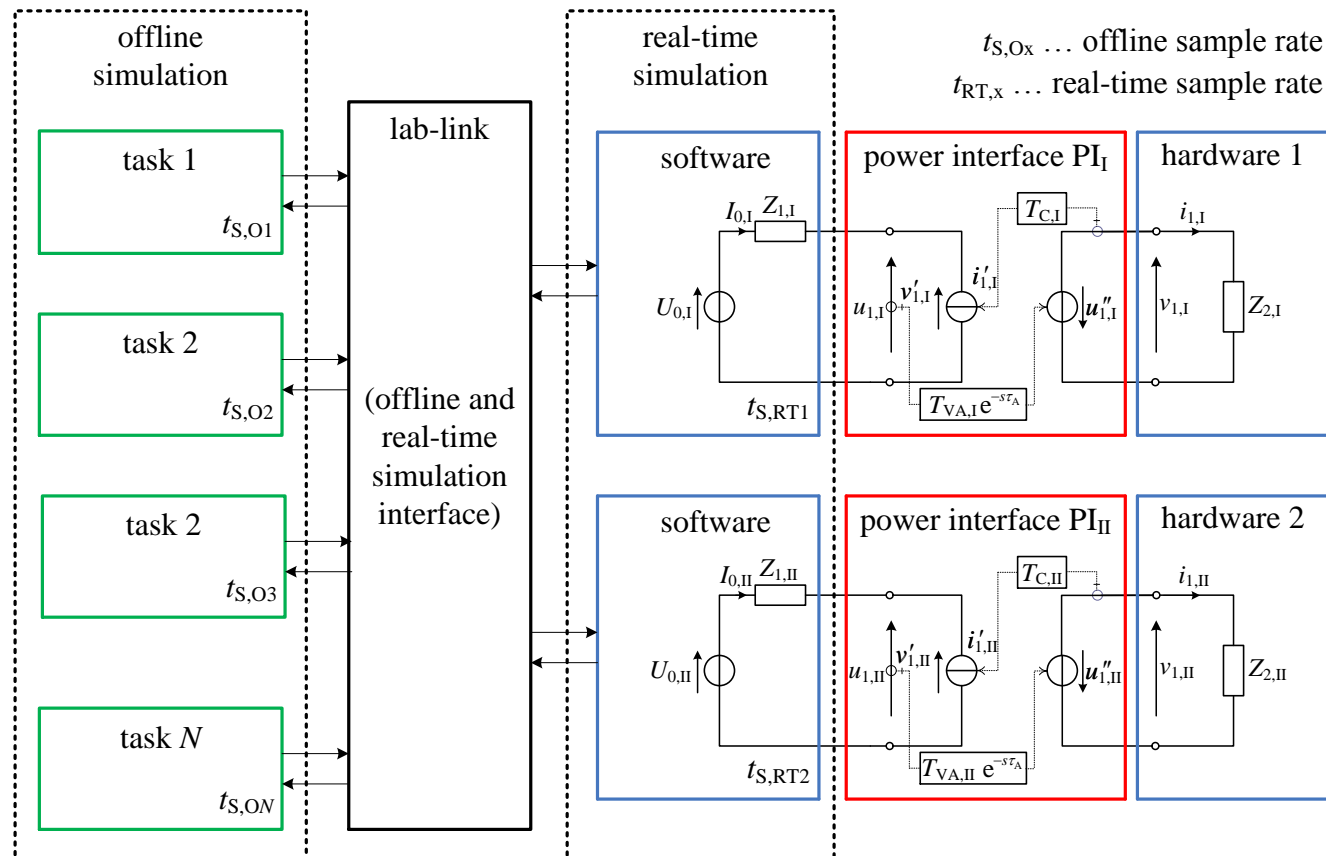
The ERIGrid Approach

- Cyber-physical (multi-domain) approach for analysing and validating Smart Grids on system level



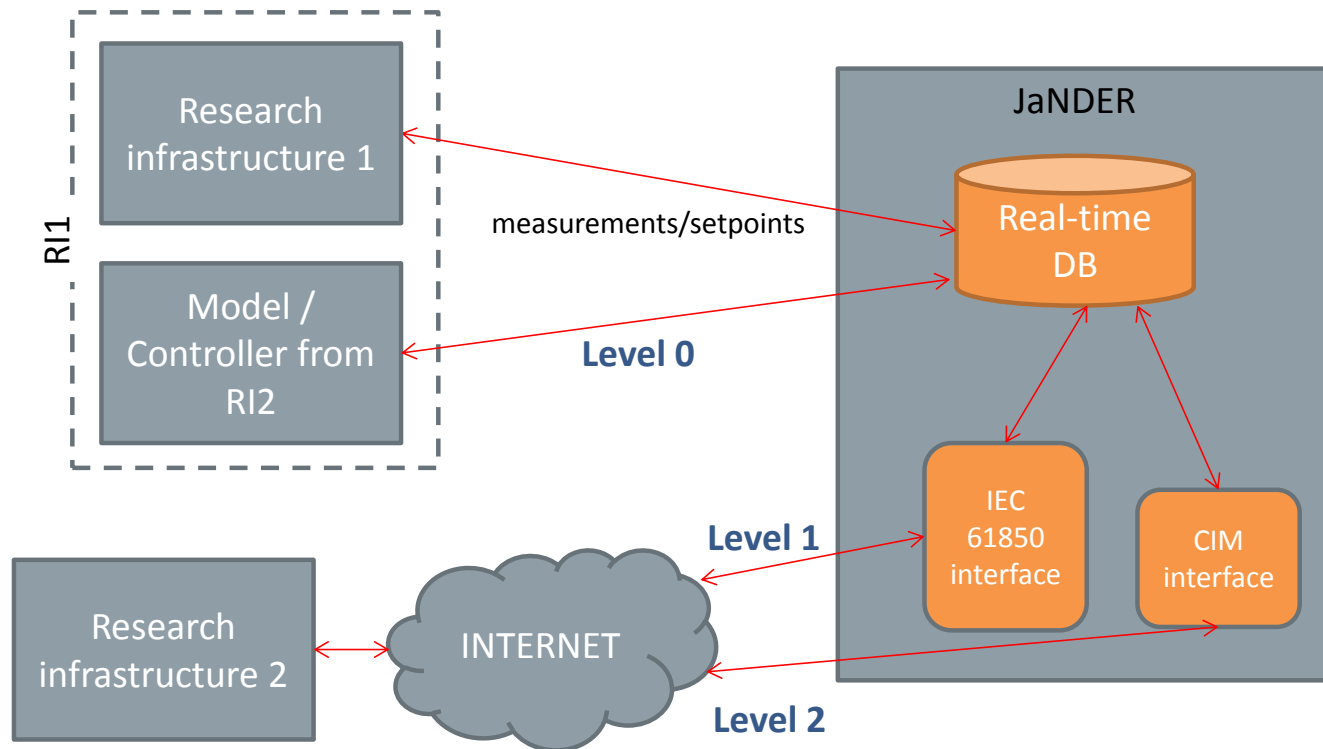
The ERIGrid Approach

- Improved validation and testing methods: focus on co-simulation and HIL



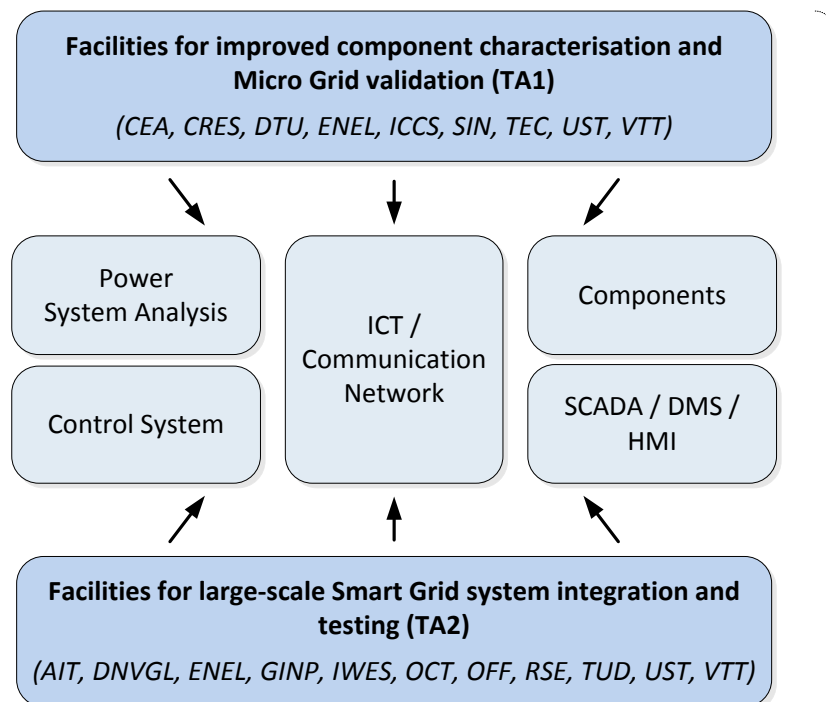
The ERIGrid Approach

- Coupling of Research Infrastructures for integrated and joint testing (multi-lab)



The ERIGrid Approach

■ User access to European Smart Grid Research Infrastructures

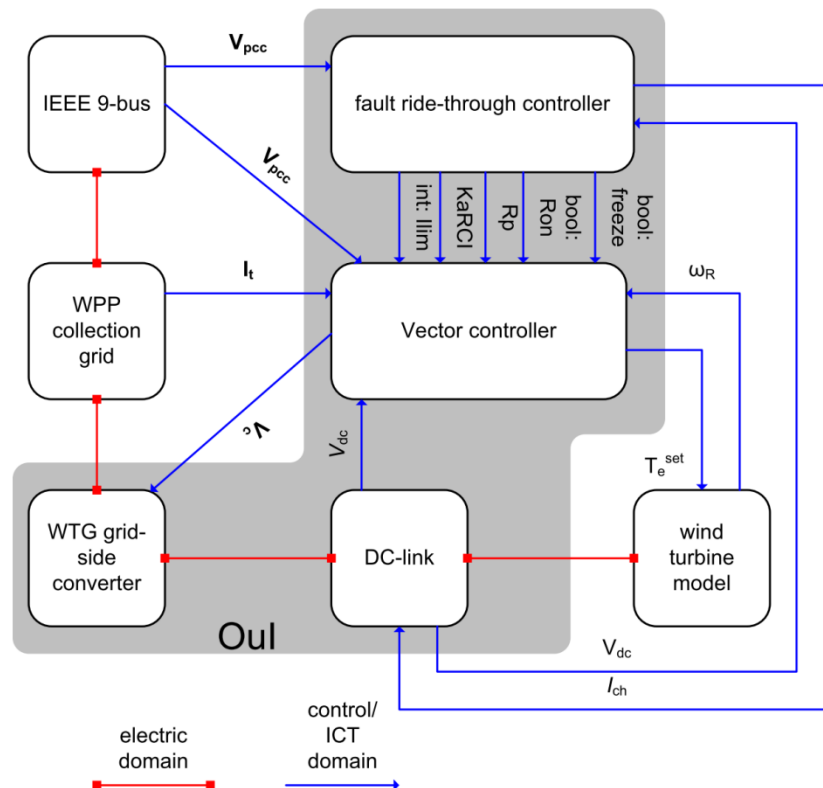


R&D topic	Provided services to external users
DER components	<ul style="list-style-type: none"> PV-inverter tests (component, integration) Storage, charging devices test (component, integration) ...
Development of new network components	<ul style="list-style-type: none"> Test of new component concepts Validation of advanced control methods for components ...
Smart Grid ICT / Automation	<ul style="list-style-type: none"> Validation of controller implementation and integration Validation of communication protocols Test of SCADA system developments and integration Cyber-security assessment ...
Co-simulation	<ul style="list-style-type: none"> Co-simulation tests power grid ↔ communication network Co-simulation tests power grid ↔ components ↔ communication network ...
Real-time simulation and HIL	<ul style="list-style-type: none"> Integration tests for inverter-based devices Validation of new power electronic component topologies ...
...	...

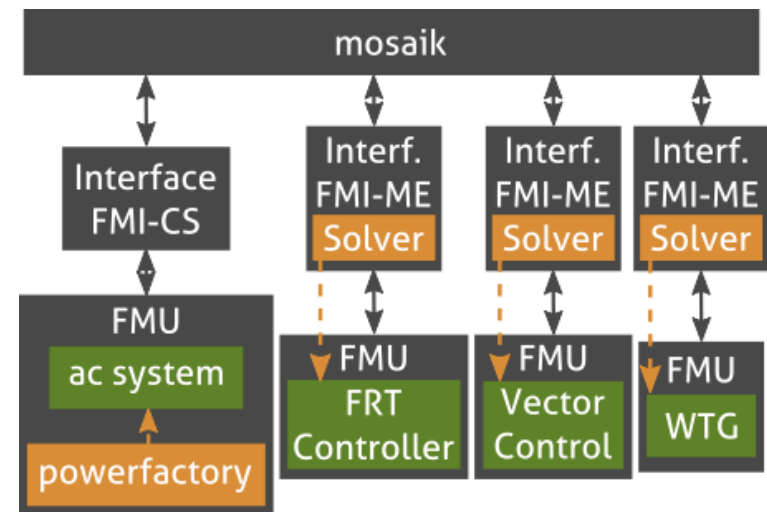
Validation Example

- Validating Fault Ride Through (FRT) controller of a Wind Power Plant (WPP)

Test System Configuration



Co-Simulation based Validation (using FMI)



Conclusions

- A large-scale roll-out of Smart Grid solutions is expected in the near future
- New approaches and methods are required to support system analysis, evaluation and testing of integrated approaches
- Advanced research infrastructures are still necessary
- A Flexible integration of simulation methods, hardware-in-the-loop approaches, and lab-based testing looks promising to overcome today's shortcomings
- Future activities and research should focus on
 - Integration of design and validation tools from different domains
 - Development of system level validation procedures and benchmark criteria
 - Improvement of research infrastructures supporting system level validation
 - Education/training and harmonization (standardization) of validation methods

Free Access to European Smart Grid Labs Apply Now!

ERIGrid calls for free transnational access:

- 1st call: 15 September - 15 December, 2016
- 2nd call: 15 March - 15 June, 2017
- 3rd call: 15 August - 15 November, 2017
- 4th call: 15 February - 15 May, 2018
- 5th call: 15 August - 15 November, 2018
- 6th call: 15 February - 15 May, 2019

erigrd.eu/transnational-access

The flyer features the ERIGrid logo at the top left, with the tagline 'Connecting European Smart Grid Infrastructures' and the website 'www.erigrd.eu'. At the top right, it states 'Supported by the H2020 Programme under Contract No. 654113' next to the European Union flag. Below the header is a collage of images showing smart grid equipment and researchers. The main title 'Free Access to Best Smart Grid and DER Laboratories of Europe' is prominently displayed. The text explains the project's aim to support smart grid development by offering free transnational access to laboratories. It lists eligibility criteria for applicants, including being employed by organizations in the EU or associated states, and being able to publicly report on the project. A map of Europe shows the number of laboratories per country. Callouts highlight benefits like free experimental research, reimbursement of expenses, promotion of research, selection of preferred host laboratories, access to concentrated know-how, and working with top experts.

ERIGrid
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654113

Free Access to Best Smart Grid and DER Laboratories of Europe

With the aim to support the development of smart grid solutions in Europe, the ERIGrid project opens its first call for transnational access. The project partners offer their infrastructure and support to the successful applicants for experimental research free of charge.

Up to 15 December, 2016, users from research, academia and industry can apply as individual researchers or with colleagues as User Groups.

Eligible applicants:

- must be employed by organisations located in the European Union or associated European states. Limited access is also provided to applicants from non-EU countries and other developing countries (please visit erigrd.eu for more information)
- must be able to publicly report about the conducted project

Conducting your own experimental research free of charge in the best testing and simulation facilities of Europe

Reimbursement of your expenses

Promotion of your experimental research through ERIGrid

Option to select your preferred host laboratories

Access to the concentrated know-how and best practices in the field of smart grid systems and DER

Working with the top smart grid experts and impacting

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