



European Research Infrastructure supporting Smart Grid Systems Technology Development, Validation and Roll Out

Work Package 6

NA2 - Dissemination, Communication and International Collaboration

Deliverable D6.5

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All Authors/Partners Maria Sosnina, Anna Gerbig / DERlab
 Carlo Tornelli / RSE

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Abbreviations

<i>AC</i>	Alternating Current
<i>CIM</i>	Common Information Model
<i>DC</i>	Direct Current
<i>DER</i>	Distributed Energy Resources
<i>DG</i>	Distributed Generation
<i>DMS</i>	Distribution Management System
<i>DRTS</i>	Digital Real Time Simulator
<i>DSO</i>	Distribution System Operator
<i>EERA</i>	European Energy Research Alliance
<i>EU</i>	European Union
<i>HIL</i>	Hardware-in-the-Loop
<i>H2020</i>	Horizon 2020
<i>ICT</i>	Information and Communication Technology
<i>IEC</i>	International Electrotechnical Commission
<i>IoT</i>	Internet of Things
<i>JaNDER</i>	Joint Test Facility for Smart Energy Networks with Distributed Energy Resources
<i>JP</i>	Joint Programme
<i>JRA</i>	Joint Research Activities
<i>LV</i>	Low Voltage
<i>NA</i>	Networking Activities
<i>R&D</i>	Research and Development
<i>RES</i>	Renewable Energy Sources
<i>RI</i>	Research Infrastructure
<i>ROS</i>	Rest-of-the-System
<i>SG</i>	Smart Grids
<i>TA</i>	Trans-national Access
<i>TC</i>	Technical Committee
<i>TSO</i>	Transmission System Operator
<i>TU</i>	Technical University
<i>UC</i>	Use Case
<i>WP</i>	Work Package

Executive Summary

This report outlines the collaboration activities, undertaken by the ERIGrid consortium, with international and national R&D projects, networks, initiatives and platforms in the field of smart grids. These have been planned and performed primarily during the fourth year of the ERIGrid project (1st November 2018 – 31st October 2019). Cooperation with 8 EU-funded (H2020, ERA-Net SG+) projects, 7 national projects, 7 networks, and 2 platforms and initiatives, all dealing with different aspects of smart grids, has been established. The main collaboration activities in this period have covered several topics in the scope of testing and validation methods, and needs and requirements of the research infrastructures. Furthermore, the collaboration covered the topics of real-time simulation, co-simulation and HIL testing, co-simulation, specification of scenarios/use cases/test cases, power system operation and protection, TSO/DSO collaboration, ICT/cyber-security and metrology. This collaboration and information exchange, realised through email exchange, webinars, events and joint papers, was planned and described within the ERIGrid NA2 work package “Dissemination, Communication and International Collaboration”.

1 Introduction

1.1 International and National Collaboration as an Objective of ERIGrid Project

The integration of Renewable Energy Resources (RES) into the power system has increased over the past years. This has introduced further complexity into the electric power system. The increased availability of advanced automation and communication technology, along with novel intelligent solutions for system operation, has transformed the traditional power system into a cyber-physical energy system, which is called a smart grid. The research activities so far have mainly focused on validating certain aspects of the smart grid. Until now, a holistic and integrated approach for analysing and evaluating such a complex system has not yet been developed. The ERIGrid project aims to support the technology development and roll out of smart grid approaches, solutions and concepts in Europe by addressing the aspect of system validation for smart grids and developing common methods, concepts and procedures by integrating eighteen European research centres and institutions with outstanding research infrastructures [1].

In order to address the gaps within smart grid evaluation approaches, the current testing and evaluation methods that are being developed and used for relevant research activities should be identified and analysed. In addition, it is necessary that the holistic approach for system evaluation, which has been developed by the ERIGrid project, is validated for different applications in relevant ongoing research activities in the scope of smart grids. In this regard, one of the objectives of the ERIGrid project is to create synergies with such Research and Development (R&D) activities within the framework of the Networking Activities (NA) in the project.

1.2 Purpose and Scope of the Document

The purpose of this document is to summarise the progress of the collaboration activities that were planned and carried out within the ERIGrid NA2 work package “Dissemination, Communication and International Collaboration”, during the fourth year of the project. These knowledge exchange activities are realised through regular contact in the form of webinars, newsletters, emails exchange, joint papers, and joint physical meetings and workshops.

In addition to collaboration activities, a short description and an overview of each international/national project, initiative, network, or platform is provided. Additionally, the contact persons leading these collaboration activities are indicated.

The information provided in this document was gathered through an input template circulated to all ERIGrid partners.

1.3 Structure of the Document

This document is organised as follows: Section 2 provides information about the performed, ongoing and planned collaboration activities with relevant smart grid project consortia. In addition, short descriptions of these projects are provided. Section 3 describes collaboration activities with international initiatives, networks, and platforms dealing with relevant activities for ERIGrid. Finally, a conclusion of the report is provided in Section 4.

2 Collaboration and Information Exchange with relevant European and National Projects

2.1 European Projects

The following table provides a brief overview of European projects that have been cooperating with ERIGrid during the fourth year of the project or have the potential of performing collaboration activities with the project in the near future.

Table 1: List of European projects

ID No.	Name	Funding Framework	Website	ERIGrid Partners involved	ERIGrid Contact Persons	Project Contact Persons
01	INTERPLAN	H2020	http://interplan-project.eu/	Yes	Ata Khavari (DERlab)	Giorgio Graditi (ENEA) Helfried Brunner (AIT)
02	SmartNet	H2020	http://smarnet-project.eu/	Yes	Thomas Strasser (AIT) Carlo Sandroni, Marco Rossi (RSE) Julia Merino (TECNALIA)	Gianluigi Migliavacca, Marco Rossi (RSE) Carlos Madina (TECNALIA)
03	MAGNITUDE	H2020	https://www.magnitude-project.eu/	Yes	Carlo Sandroni (RSE)	Edoardo Corsetti (RSE)
04	CloudGrid	ERA-Net SG+	http://www.eranet-cloudgrid.eu/	No	Merkebu Zenebe Dergefa (SIN)	Elisabetta Tedeschi (NTNU)
05	Sci4All	H2020	http://sci4all.eu/	No	Thomas Strasser (AIT)	Munir Merdan (PRIA)
06	M2M-GRID	ERA-Net SG+, H2020	http://m2m-grid.eu	Yes	Quoc Tuan Tran (CEA)	Phuong Nguyen (Eindhoven University of Technology)
07	LarGo!	ERA-Net SG+	http://www.largo-project.eu/	Yes	Davood Babazadeh (OFFIS)	Filip Prössl Andrén (AIT)
08	SmILES	H2020	https://www.ecria-smiles.eu/	Yes	Oliver Gehrke (DTU) Edmund Widl (AIT)	Elisa Gil Bardaji (KIT)

2.1.1 INTERPLAN: INTEgrated opeRation PLANning tool towards the pan-European network

Funding Framework: H2020

Coordinator: ENEA (Italy) – Giorgio Graditi

Website: <http://interplan-project.eu/>

Contact persons on behalf of the ERIGrid Consortium: Ata Khavari (DERlab)

Contact persons on behalf of the INTERPLAN Consortium: Giorgio Graditi (ENEA), Helfried Brunner (AIT)

Project duration: 11.2017 - 10.2020

Description:

INTERPLAN is a project that aims to provide an INTEgrated opeRation PLANning tool towards the pan-European network, to support the EU in reaching the expected low-carbon targets, while maintaining network security. INTERPLAN will provide a methodology for a proper representation of a “clustered” model of the pan-European network, with the aim to generate grid equivalents as a growing

library able to cover all relevant system connectivity possibilities occurring in the real grid, by addressing operational issues at all network levels (transmission, distribution and TSOs-DSOs interfaces).

Collaboration activities:

INTERPLAN project gathered information on ERIGrid scenario descriptions as well as ERIGrid focal UC collection. The INTERPLAN consortium analysed and used this information to define INTERPLAN UCs and future EU grid scenarios.

2.1.2 SmartNet: Smart TSO-DSO interaction schemes, market architectures and ICT Solutions for the integration of ancillary services from demand side management and distributed generation

Funding Framework: H2020

Coordinator: Gianluigi Migliavacca (RSE)

Website: <http://smartnet-project.eu>

Contact persons on behalf of the ERIGrid Consortium: Thomas Strasser (AIT), Carlo Sandroni, Marco Rossi (RSE), Julia Merino (TECNALIA)

Contact persons on behalf of the SmartNet Consortium: Gianluigi Migliavacca (RSE), Marco Rossi (RSE), Carlos Madina (TECNALIA)

Project duration: 01.2016 - 12.2018

Description:

SmartNet aims to compare different architectures for optimised interaction between TSOs and DSOs in managing the purchase of ancillary services (reserve and balancing, voltage regulation and congestion management) from subjects located in the distribution segment [2].

Collaboration activities:

For the lab-based testing of the SmartNet TSO/DSO coordination schemes in AIT's SmartEST laboratory, the ERIGrid holistic validation approach has been successfully applied. Lessons learned will be communicated to the ERIGrid consortium.

2.1.3 MAGNITUDE: Bringing flexibility provided by multi-energy carrier integration to a new MAGNITUDE

Funding Framework: H2020

Coordinator: Belhomme Regine (EDF)

Website: <https://www.magnitude-project.eu/>

Project duration: 10.2017 - 03.2021

Contact persons on behalf of ERIGrid: Carlo Sandroni (RSE)

Contact persons on behalf of the MAGNITUDE Consortium: Edoardo Corsetti (RSE)

Description:

MAGNITUDE aims to develop business and market mechanisms as well as supporting coordination tools to provide flexibility to the European electricity system, by increasing and optimising synergies between electricity, gas and heat systems. The results developed will be validated on 7 real life case studies in Austria, Denmark, France, Italy, Spain, Sweden, and the United Kingdom. These case studies form and provide the data foundation for:

- the model validation and the simulations of the defined scenarios including new operation schemes, services and markets that are being developed as part of the project
- a reliable impact assessment of the project

Collaboration activities:

The analysis of test cases directly derived from case studies, or from the identified improvements, is simulated by specific partners with their own simulation tools. The need to represent each test case leads to share common representation schemas enabling homogeneous descriptions. MAGNITUDE considered the Holistic Test Case Description templates developed in ERIGrid in order to design the simulation and in-field tests, according to the different cases identified in the project.

2.1.4 CloudGrid: Transnational Cloud for Interconnection of Demonstration Facilities for Smart Grid Lab Research and Development

Funding Framework: ERA-Net SG+

Coordinator: Emil Hillberg (STRI AB)

Website: <http://www.eranet-cloudgrid.eu/>

Contact persons on behalf of the ERIGrid Consortium: Merkebu Zenebe Degefa (SINTEF)

Contact persons on behalf of the CloudGrid Consortium: Elisabetta Tedeschi (NTNU)

Project duration: 03.2016 - 03.2019

Description:

The goal of the CloudGrid project is to provide recommendations and strategies to meet the challenges of the future power system, to facilitate a larger amount of intermittent renewable generation together with less nuclear production while providing a secure and reliable electrical power supply [3].

Collaboration activities:

As a result of a TA project 'Real-time Price-based Energy Management Strategies of Commercial building (ROCOF)', the user group working on CloudGrid used the experience gained in the ERIGrid TA as added value for CloudGrid WP5 – Ancillary Services and Energy Management.

2.1.5 Sci4All: Science is for All of us

Funding Framework: H2020

Coordinator: Practical Robotics Institute Austria (PRIA) - Munir Merdan

Website: <http://sci4all.eu>

Contact persons on behalf of the ERIGrid Consortium: Thomas Strasser (AIT)

Contact persons on behalf of the Sci4All Consortium: Munir Merdan (PRIA)

Description:

The main goal of Sci4all is to bring the general public and especially young people closer to the exciting world of research and to show that science is fun and accessible for everyone. Scientists from most of highly significant research institutions in Vienna participate in the event and present their recent research results in order to generate enthusiasm among young people for science and research. The focus is on the fields of science, technology, engineering and mathematics and the exiting topics cover informatics, mobility, energy, construction, biology, chemistry, mathematics, and automation [4].

Collaboration activities:

ERIGrid organised a stand at the European Researcher's Night (represented by H2020 Sci4all project) on 27th September 2019 in Vienna (AT).

2.1.6 M2M-GRID: From micro to Mega-GRID

Funding Framework: ERA-Net SG+, H2020

Coordinator: Magnus Brolin (RISE)

Website: <http://m2m-grid.eu>

Contact persons on behalf of the ERIGrid Consortium: Quoc Tuan Tran (CEA)

Contact persons on behalf of the project: Phuong Nguyen (Eindhoven University of Technology)

Description:

The project "From micro to Mega-GRID" (m2M-GRID) will develop solutions to overcome these challenges within the following themes:

- Enhancement of the distribution grid planning process
- Development of control functions for effective coordination with distribution grids
- Development of a tool-box to exploit the potential flexibility of microgrids

The results will be validated in a range of test environments, and three dedicated demonstration sites – one in France and two in Sweden – will facilitate validation and replicability analyses based on real conditions [5].

Collaboration activities:

Several of the members of CEA and Grenoble INP team are involved in both M2M and ERIGrid. ERIGrid provides perspectives for implementation and demonstration of M2M-GRID test cases.

2.1.7 LarGo!: Large-Scale Smart Grid Application Roll-Out

Funding Framework: ERA-Net SG+, H2020

Coordinator: AIT Austrian Institute of Technology GmbH

Website: <http://www.largo-project.eu/>

Contact persons on behalf of the ERIGrid Consortium: Davood Babazadeh (OFFIS)

Contact persons on behalf of the project: Filip Prösl Andrén (AIT)

Description:

LarGo! is a cooperative transnational research project focusing on the large-scale roll out of smart grid applications. LarGo! enables the mass roll out of smart grid applications for grid and energy management by defining a seamless, safe and secure application deployment process for the grid and customer domain. The critical challenge of stable and resilient system operation is addressed in a setting where communication systems are used for both smart grid run-time operation, including monitoring and control, and ICT maintenance, such as application deployment and remote configuration. To assess the large-scale effects of application deployment, system maintenance and operations, a utility-scale, but highly accurate, emulation of the required ICT systems will be developed. Potential suboptimal operational states are analysed in-depth, and appropriate measures for resilient system operation will be designed and tested. In local testbeds at the DSO (Austria) and customer (Germany) level, selected smart grid applications are deployed to demonstrate and verify the LarGo! deployment process [6].

Collaboration activities:

Research synergies between LarGo! and ERIGrid JRA2¹ can be found. Discussions about the analysed topics are taking place among OFFIS researchers involved in either of the two projects. Based on this, concepts that have been analysed in ERIGrid are likely to be pushed forward and demonstrated in LarGo!.

2.1.8 SmILES: Smart Integration of Energy Storages in Local Multi Energy Systems for maximising the Share of Renewables in Europe's Energy Mix

Funding Framework: H2020

Coordinator: Elisa Gil Bardaji (KIT)

Website: <https://www.ecria-smiles.eu/>

Project duration: 12.2016 - 11.2019

Contact persons on behalf of ERIGrid: Oliver Gehrke (DTU) and Edmund Widl (AIT)

Contact persons on behalf of the project: Elisa Gil Bardaji (KIT)

Description:

The SmILES project aims to obtain fundamental knowledge about linking and optimising heterogeneous energy carriers and systems including storage and renewable energy technologies. It will also develop and disseminate guidelines for modelling, simulating and optimising such systems.

Collaboration activities:

SmILES tries to generate common simulation test cases, which can be simulated by different partners with different simulation tools as well as being distributed to the general public. This is different from ERIGrid's approach to simulation in JRA2 (building a joint simulation platform) but very similar to ERIGrid's approach to laboratory testing (JRA3² and JRA4³), which recognises that experiments

¹ JRA2: "Co-Simulation based Assessment Methods" work package in ERIGrid project

² JRA3: "Integrated Laboratory-based Assessment Methods" work package in ERIGrid project

³ JRA4: "Implementation and Demonstration of Use Cases/ Scenarios in the Integrated Research Infrastructure(s)" work package in ERIGrid project

must be adapted to the capabilities of the individual laboratories. Due to this obvious similarity of the challenge (despite the different application area), SmILES decided to adopt the holistic testing methodology developed and described by ERIGrid NA5⁴, as well as the ERIGrid terminology developed in JRA1⁵. SmILES has also used an adapted version of the ERIGrid use case template to generate its own use cases.

ERIGrid will benefit from the feedback on the application (and applicability) of the ERIGrid testing methodology within the framework of another project. As SmILES starts doing actual simulations, both projects can contribute to the refinement of the NA5 methodology based on practical experiences obtained. Adopting the ERIGrid terminology and methods allowed SmILES to skip the alignment phase which took 6 to 12 months at the beginning of ERIGrid.

2.2 National Projects

The following table provides a brief overview of national projects, which have been in cooperation with ERIGrid during the fourth year of the project or have the potential of being involved in collaboration activities with the project in the near future.

Table 2: List of national projects

ID No.	Name	Country	Website	ERIGrid Partners involved	ERIGrid Contact Persons	Project Contact Persons
01	MESSE	Austria	https://www.salzburgresearch.at/en/projekt/messe/	Yes	Filip Prörtl Andrén, Thomas Strasser (AIT)	Filip Prörtl Andrén, Thomas Strasser (AIT)
02	RPC2	Germany	TBA	Yes	Juan Montoya (Fraunhofer IEE)	Christian Töbermann (Fraunhofer IEE)
03	NR2.0: Grid Control 2.0	Germany	TBA	Yes	Ron Brandl (Fraunhofer IEE)	Philipp Strauss (Fraunhofer IEE)
04	PPInterop 1&2	France	http://www.energiesdufutur.eu/	Yes	Van Hoa Nguyen (CEA)	Yvon Besanger (Grenoble INP)
05	CybResLab	Germany	https://www.offis.de/en/offis/project/cyreslab.html	Yes	Davood Babazadeh (OFFIS)	Davood Babazadeh (OFFIS)
06	ENSURE	Germany	https://www.kopernikus-projekte.de/projekte/neue-netzstrukturen	Yes	Davood Babazadeh (OFFIS)	Davood Babazadeh (OFFIS)
07	Power System Research program	Italy	http://www.rse-web.it/progetti.page	Yes	Carlo Tornelli (RSE)	Claudio Cherbaucich (RSE)

2.2.1 MESSE: Model-based Engineering and Validation Support for Cyber-Physical Energy Systems

Country: Austria

Coordinator: Christof Brandauer (Salzburg Research)

Website: <https://www.salzburgresearch.at/en/projekt/messe/>

Contact persons on behalf of the ERIGrid Consortium: Filip Prörtl Andrén, Thomas Strasser (AIT)

⁴ NA5: "Holistic System Integration and Testing Procedure" work package in ERIGrid project

⁵ JRA1: "Use Case/Scenario Identification, Analysis and Selection" work package in ERIGrid project

Contact persons on behalf of the MESSE Consortium: Filip Prössl Andrén, Thomas Strasser (AIT)

Project duration: 10.2017 - 11.2019

Description:

The massive deployment of distributed generators from renewable sources in recent years has led to a fundamental paradigm shift in terms of planning and operation of the electric power system. MESSE develops a concept for a model-based engineering and validation support system, covering the overall engineering process for smart grid applications – from UC design to validation and deployment [7].

Collaboration activities:

MESSE and ERIGrid have exchanged ideas about the holistic validation procedure as well as the support for the generation of testing and validation plans/configurations. Further exchange of ideas and approaches is planned.

2.2.2 RPC2: Reactive Power Controls

Country: Germany

Coordinator: Christian Töbermann (Fraunhofer IEE)

Website: TBA

Contact persons on behalf of the ERIGrid Consortium: Juan Montoya (Fraunhofer IEE)

Contact persons on behalf of the project: Christian Töbermann (Fraunhofer IEE)

Project duration: 04.2018 - 03.2020

Description:

The objective of the project is the development and testing of possible measures to balance reactive power of electrical distribution networks in all voltage levels. For this, an active and situation-dependent use of reactive power supply potential from decentralised generation plants and compensation plants, as well as transformer in distribution networks should be carried out in order to influence the reactive power balance in a targeted manner. On the one hand, innovative decentralised processes on the LV level will be developed, as well as innovative centralised voltage level independent control management will be developed and investigated.

Collaboration activities:

Within the TA user projects DISCOVER and INTREPID, RPC2 provided a controller, a testbed and scenarios to benchmark with the controller of Ormazabal. Furthermore, Fraunhofer IEE defined scenarios and the testbed to be used in RPC2.

2.2.3 NR2.0: Grid Control 2.0

Country: Germany

Coordinator: Philipp Strauss (Fraunhofer IEE)

Website: TBA

Contact persons on behalf of the ERIGrid Consortium: Ron Brandl (Fraunhofer IEE)

Contact persons on behalf of the project: Philipp Strauss (Fraunhofer IEE)

Project duration: 12.2017 – 11.2021

Description:

The project NR2.0 deals with the controls of the electrical networks to ensure stable system behaviour. NR2.0 focuses on the pre-treatment of a converging implementation in the German part of the Central European Network, by dealing with following points:

- Description of requirements of the Central European Network
- Contribution to the proof of system stability of electrical networks
- Robust control procedures for grid-forming converters

Collaboration activities:

In NR2.0 the results of NA5 and JRA1 are used to define description templates of UCs and test case scenarios. Especially the outcome of the holistic test case descriptions is used to explain the research proposition of the NR2.0 project. Furthermore, according to the defined UCs in JRA1 of the ERIGrid project, NR2.0 is using those UCs to readapt them to align the research topics of NR2.0.

2.2.4 PPInterop 1&2: PREDIS – PRISMES Interoperability

Country: France

Coordinator: Van Hoa Nguyen (CEA)

Website: <http://www.energiesdufutur.eu/>

Contact persons on behalf of the ERIGrid Consortium: Yvon Besanger (Grenoble INP)

Contact persons on behalf of the project: Yvon Besanger (Grenoble INP)

Project duration:

PPInterop 1: 01.01.2015 – 31.03.2016

PPInterop 2: 01.01.2017 – 31.12.2018

Description:

The PPInterop 1&2 projects aim to create an interoperability framework between two technological platforms: PREDIS (Grenoble INP) and PRISMES (CEA). On one hand, it proposes and demonstrates novel interoperability architecture based on hybrid cloud and ontologies; on the other hand, the projects are a showcase of technical development of interfaces and new experimental tools for smart grid [8].

Collaboration activities:

PPInterop 1&2 are bilateral collaboration projects between Grenoble-INP and CEA, financed by CARNOT institute. Several of the members of CEA and Grenoble INP team are involved in both PPInterop and ERIGrid. PPInterop provided the physical platform for implementation of ERIGrid test case in JRA3.2.

2.2.5 CybResLab: Smart Grid Cyber-Resilience Laboratory

Country: Germany

Coordinator: Davood Babazadeh (OFFIS)

Website: <https://www.offis.de/en/offis/project/cybreslab.html>

Contact persons on behalf of the ERIGrid Consortium: Davood Babazadeh (OFFIS)

Contact persons on behalf of the project: Davood Babazadeh (OFFIS)

Description:

In this project, a test environment is established to test the concepts for system integration and management under uncertain communication and information conditions in digitalised energy supply systems. This unique laboratory design combines techniques for hazard identification and analysis of smart grid architectures with methods for detecting anomalies in information processes at different levels (OT/IT) of today's electric power systems. The purpose of the laboratory environment is to develop preventative security and resilience measures that prevent such incidents, but also to develop and test reactive measures for the rapid detection and immediate handling of physical- and cyber- induced incidents in electric power systems.

The goal of cyber-resilient energy systems is the tolerance for temporary loss of confidentiality and integrity in data communications and other events in the primary or cyber system. One possibility, for example, is to temporarily accept limited efficiency, while still allowing the critical supply task to continue uninterrupted [9].

Collaboration activities:

The collaboration took form of presentations at conferences (i.e., IEEE Powertech 2018), contribution to ERIGrid webinars (Co-simulation based Assessment Methods, ICT standards for Smart Grids) related to the validation of cyber-physical energy systems, and a demo tutorial for ERIGrid NA4 activities.

2.2.6 ENSURE: New Energy Grid Structures for the Energy Transition

Country: Germany

Coordinator: KIT Karlsruhe Institute of Technology

Website: <https://www.kopernikus-projekte.de/projekte/neue-netzstrukturen>

Contact persons on behalf of the ERIGrid Consortium: Davood Babazadeh (OFFIS)

Contact persons on behalf of the project: Davood Babazadeh (OFFIS)

Description:

The research work will contribute to the successful economic shaping of the Energiewende. The concrete proposals emerging from the project for future structures and management strategies will lead to improvements in the performance and efficiency of the system as a whole, with the aim of reducing costs for both the operator and the end-customer.

To adapt the electricity supply to the changes accompanying the Energiewende, a rational structure

comprising both centralised and decentralised supply needs to be identified. The project divides into three key topics: researching new system structures, stable system management mechanisms and the integration of new technologies into the supply system. A further topic comprises the subsequent implementation and testing of the overall energy supply system in the form of an industrial-scale network demonstrator. All the activities are to be accompanied by a comprehensive analysis of the socio-economic factors. This element involves all stakeholders including prosumers (producer-consumers) and runs alongside the key topics above [10].

Collaboration activities:

ERIGrid concepts developed in the context of JRA2 are planned to be employed and practically demonstrated in the ENSURE project, with further collaboration on the topic of smart grid testing activities in power and ICT domains.

2.2.7 Power System Research Program (RdS)

Country: Italy

Coordinator: Claudio Cherbaucich (RSE)

Website: <http://www.rse-web.it/progetti.page>

Contact persons on behalf of the ERIGrid Consortium: Carlo Tornelli (RSE)

Contact persons on behalf of the project: Claudio Cherbaucich (RSE)

Description:

The research program of the Italian System Research on power system, funded by Ministry of Economic Development, include projects that are linked with ERIGrid activities and take the place of the previous SMART-DSYS project, ended in 2018. Namely the project P2.2 “Evolution of power system architectures and management models” and P2.3 “Application of ICT technologies to the power system” can develop synergies with the ERIGrid project.

The overall objective of P2.2 is the study, development and testing of power system technologies and architectures, including DC networks, to allow high penetration degree of distributed generation from renewable sources and high levels of quality of service. The project takes into account management, control, automation and protection of the power system, new architectural models and services for the exploitation of the flexibility of all energy resources.

The overall objective of P2.3 is the application of the newest information and communication technologies in the power system processes, and tools to improve cyber security and resilience of ICT infrastructures.

The theoretical research activities are complemented with experimental work in laboratories and in RSE test facilities, which include a real LV AC/DC distribution network (at the DER-TF lab of RSE) able to control different types of generators, loads and storage devices connected to it.

Collaboration activities:

RSE laboratories for HIL simulations and the LV AC/DC distributed generation test facility, involved in the ERIGrid activities, are updated with new technologies and control solutions thanks to the P2.2 RdS project. These laboratories are the core infrastructures for the TA activities in ERIGrid.

Moreover, many results and experiences on ICT interoperability standards developed in P2.3 project

were applied to develop the ICT platform JaNDER (Joint Test Facility for Smart Energy Networks with Distributed Energy Resources) in WP10-JRA4. IEC 61850 and CIM tools (e.g. CIMDraw) and ICT architectural solutions based on microservices developed in RdS projects were used and enhanced for ERIGrid purposes.

The collaboration activities between RdS projects and ERIGrid offered opportunities, on one side, to take advantage from already available results and, on the other side, for improvement and widening the applicability of existing solutions.

3 Collaboration and Information Exchange with Networks, Platforms, and Initiatives

The following table provides a brief overview of initiatives, networks and platforms, which have been in cooperation with ERIGrid during the fourth year of the project or have the potential of performing collaboration activities with the project in the near future.

Table 3: List of networks, platforms, and initiatives collaborating with ERIGrid

ID No.	Name	Type	Website	ERIGrid Partners involved	ERIGrid contact persons	Network/ Initiative/ Platform Contact Persons
01	EERA JP Smart Grids	Network (EU)	http://www.eera-set.eu/eera-joint-programmes-jps/smart-grids/	Yes	Thomas Strasser (AIT) Evangelos Rikos (CRES) Ron Brandl (IEE) Davood Babazadeh (OFF)	Luciano Martini (RSE) Maria Nuschke (IEE) Ángel Díaz (TECNALIA)
02	IEEE WG P2004	Network (international)	https://standards.ieee.org/develop/project/2004.html	Yes	Georg Lauss (AIT) Panos Kotsampopoulos (ICCS-NTUA) Ron Brandl (Fraunhofer IEE) Thomas Strasser (AIT) Juan Montoya (Fraunhofer IEE) Efren Sansano (USTRATH) Erik de Jong (DNV-GL)	Michael Steurer (FSU) Georg Lauss (AIT) Blake Lundstrom (NREL)
03	IEA ISGAN/SIRFN	Network (international)	http://www.sirfn.net/	Yes	Kai Heussen (DTU)	Ron Brandl (DERlab)
04	DERlab network	Network (EU)	http://der-lab.net	Yes	Ata Khavari (DERlab) Maria Sosnina (DERlab) Thomas Strasser (AIT)	Diana Strauss-Mincu (DERlab) Roland Bründlinger (AIT) Graeme Burt (UST) Nikos Hatzigiorgiou (ICCS-NTUA) Panos Kotsampopoulos (ICCS-NTUA)
05	IEEE PES Task Force on Real-Time Simulation of Power & Energy Systems	Network (international)	---	Yes	Georg Lauss (AIT) Panos Kotsampopoulos (ICCS-NTUA) Nikos Hatzigiorgiou (ICCS-NTUA) Thomas Strasser (AIT) Ron Brandl (Fraunhofer IEE)	Omar Faruque (FSU) Georg Lauss (AIT)
06	IEEE IES TC-SG: IEEE IES Technical Committee on Smart Grids	Network (international)	https://sites.google.com/view/ieee-ies-tc-sg/	Yes	Thomas Strasser (AIT)	Thomas Strasser (AIT, IEEE)
07	IEEE Systems, Man, and, Cybernetics	Network (international)	https://sites.google.com/view/ieee-smc-tc-iis/	Yes	Thomas Strasser (AIT)	Thomas Strasser (AIT, IEEE)

ID No.	Name	Type	Website	ERIGrid Partners involved	ERIGrid contact persons	Network/ Initiative/ Platform Contact Persons
	Society (SMC) Technical Committee (TC) on Intelligent Industrial Systems (IIS)					
08	Institut Smart Grid	Collaboration / Initiative	---	Yes	Quoc Tuan Tran (CEA), Yvon Besanger (Grenoble-INP)	Quoc Tuan Tran (CEA), Nourredine Hadjissad (Grenoble-INP)
09	PowerWeb Institute Conference 2019	Collaboration / Platform	https://www.tudelft.nl/powerweb-institute/news-events/inclusive-energy-transition/	Yes	Rishabh Bhandia, Arjen van der Meer (TU Delft)	Arjen van der Meer (TU Delft)

3.1 Networks

3.1.1 EERA JP SG: European Energy Research Alliance Joint Programme Smart Grids

Type: Network (EU)

Coordinators: RSE (Italy) and ENEA (Italy)

Website: <http://www.eera-set.eu/eera-joint-programmes-jps/smart-grids/>

Contact persons on behalf of the ERIGrid Consortium: Thomas Strasser (AIT), Evangelos Rikos (CRES), Ron Brandl (IEE) and Davood Babazadeh (OFF)

Contact persons on behalf of the network: Luciano Martini (RSE), Maria Nuschke (IEE), Ángel Díaz (TECNALIA)

Description:

The EERA JP SG is coordinated by RSE and ENEA from Italy by means of an extended cross-disciplinary cooperation involving many R&D participants with different and complementary expertise and facilities. It aims to address one of the most critical areas directly related to the effective acceleration of smart grid development and deployment in a medium- to long-term research perspective [11].

Collaboration activities:

During the last year, a strong collaboration with EERA JP SG has been maintained. Several collaboration activities have been done as following:

- ERIGrid success stories about the holistic validation approach have been shared with the EERA JP SG community.
- As in previous years, the ERIGrid consortium is regularly informed about EERA/EU-related activities, publications, etc.
- As previously done, the ERIGrid project and the TA opportunities are advertised to a substantial number of European and international stakeholders via the EERA JP SG network.

3.1.2 IEEE WG P2004: Recommended Practice for HIL Simulation Based Testing of Electric Power Apparatus and Controls

Type: Network (international IEEE Working Group)

Coordinator: Michael Steurer (Florida State University), Georg Lauss (AIT)

Website: <https://standards.ieee.org/develop/project/2004.html>

Contact persons on behalf of the ERIGrid Consortium: Georg Lauss (AIT), Panos Kotsampopoulos (ICCS-NTUA), Ron Brandl (Fraunhofer IEE), Thomas Strasser (AIT), Juan Montoya (Fraunhofer IEE), Efren Sansano (USTRATH), Erik de Jong (DNV-GL) and others

Contact persons on behalf of the network: Michael Steurer (FSU), Georg Lauss (AIT), Blake Lundstrom (NREL)

Description:

In the development phase, WG P2004 will bring together all the stakeholders interested in HIL such as HIL equipment manufacturers, users, consultants, testing facilities, regulatory agencies, research facilities, and members of academia. P2004 will serve as a platform to further promote HIL testing and educate the broader audience about this method.

The WG P2004 is addressing the following objectives:

- Establish practices for ROS model development
- Discuss HIL specific documentation, verification and validation
- Provide guidance on requirements for power amplifiers, DRTS, and HIL interface algorithms for classes of HIL testing needs

Collaboration activities:

During the last years a closed collaboration between the P2004 WG and partners from ERIGrid was built. The WG serves as a possibility to not only publish work especially of JRA2, 3 and 4 on specific conferences supported by the WG P2004, but also to publish and raise discussion to a community of experts in the field of HIL testing. Both ERIGrid and WG P2004 are supporting and benefitting from each other on the topic of standardising advanced testing methods.

3.1.3 ISGAN-SIRFN: International Smart Grid Action Network/Smart Grid International Research Facility Network

Type: Network (international IEA network)

Coordinator: Russel Conkling (DOE, USA)

Website: <http://www.sirfn.net/>

Contact persons on behalf of the ERIGrid Consortium: Kai Heussen (DTU)

Contact persons on behalf of the network: Ron Brandl (DERlab)

Description:

SIRFN gives participating countries the ability to evaluate pre-competitive technologies and systems approaches in a wide range of smart grid implementation UCs and geographies using common testing procedures. Research test-bed facilities will be selected based on their complementary capabilities to

conduct specialised, controlled laboratory evaluations of integrated smart grid technologies including cyber security, plug-in hybrid integration, load management, automated metering infrastructure, protection, network sensing, energy management, renewable energy integration and similar applications. In this way, research within each individual member country will derive the value of the unique capabilities and environments of the other partner nations. Data from these tests will be made available to all SIRFN participants to accelerate the development of smart grid technologies and systems, and enabling policies [12].

Collaboration activities:

Close collaboration between SIRFN and ERIGrid benefits SIRFN task 'Power System Testing' where the topic of holistic test cases description is experiencing further development. Therefore, the outcome of ERIGrid will be utilised as a foundation to form a generic testing process of innovative smart grid solutions. In addition, the work of JRA 3 and 4 is directly relevant to the SIRFN task 'Advanced Lab-based Testing Methods', which will use ERIGrid results as a base for further development.

3.1.4 DERlab Network

Type: Network (international)

Website: <http://der-lab.net>

Coordinator: Diana Strauss-Mincu

Contact persons on behalf of the ERIGrid Consortium: Ata Khavari (DERlab), Maria Sosnina (DERlab), Thomas Strasser (AIT)

Contact persons on behalf of the network: Diana Strauss-Mincu (DERlab), Roland Bründlinger (AIT), Graeme Burt (UST), Nikos Hatziaargyriou (ICCS-NTUA), Panos Kotsampopoulos (ICCS-NTUA)

Description:

DERlab is an association of leading laboratories and research institutes in the field of distributed energy resources (DER) equipment and systems. The association develops joint requirements and quality criteria for the connection and operation of DER and strongly supports the consistent development of DER technologies. DERlab offers testing and consulting services for distributed generation (DG) to support the transition towards more decentralised power systems [13].

Collaboration activities:

The DERlab association is, on one hand, a member of the ERIGrid consortium and is actively participating in NA and JRA activities. On the other hand, DERlab provides a network of more than 30 research centres as potential ERIGrid stakeholders. DERlab actively promotes ERIGrid activities through its member network and events, as well as DERlab's communication channels (website, newsletters, LinkedIn). As the Operating Agent of ISGAN Annex 5 SIRFN, DERlab has supported the transfer and application of ERIGrid outcomes to the SIRFN Topic "Power System Testing". Furthermore, the Database of DER and Smart Grid Research Infrastructures [14], created and maintained by DERlab, has been updated with the announcements on ERIGrid TA and linked to the ERIGrid TA webpage.

3.1.5 IEEE PES Task Force on Real-Time Simulation of Power & Energy Systems

Type: Network (international)

Coordinator: Omar Faruque (FSU), Georg Lauss (AIT)

Contact persons on behalf of the ERIGrid Consortium: Georg Lauss (AIT), Panos Kotsampopoulos (ICCS-NTUA), Nikos Hatziargyriou (ICCS-NTUA), Thomas Strasser (AIT), Ron Brandl (Fraunhofer IEE) and others

Contact persons on behalf of the network: Omar Faruque (FSU)

Description:

The Task Force will comprehensively explore modeling and simulation techniques, hardware, software, external hardware interfacing capability and benefits of real-time simulators used in power engineering analysis. It will also document application areas where real-time simulation is used in the broader discipline of power and energy systems such as conventional bulk power systems, industrial power systems, small scale systems, drives, ship-board power systems, and alternative or renewable energy integration etc.

Collaboration activities:

During the last year, the collaboration between the IEEE PES Task Force and partners from ERIGrid was built. Both, ERIGrid and the IEEE Task Force, are supporting and benefitting from each other in several topics related to real-time simulation, while ERIGrid partners are strongly involved in Task Force publications.

3.1.6 IEEE IES TC-SG: IEEE IES Technical Committee on Smart Grids

Type: Network (international, US)

Funding Framework (if applicable): n/a

Coordinator: TC Chair Thomas Strasser (AIT)

Website: <https://sites.google.com/view/ieee-ies-tc-sg/>

Contact persons on behalf of ERIGrid: Thomas Strasser (AIT)

Contact persons on behalf of the network: Thomas Strasser (AIT, IEEE)

Description:

The IEEE Industrial Electronics Society (IES) encompasses a wide range of R&D areas that are fundamentally related to smart grids, from power and energy to communication and information technologies, and is well positioned to tackle large scale R&D issues in smart grids of cross-disciplinary nature that require an integrated multidisciplinary approach. Therefore, the IEEE IES Technical Committee (TC) on Smart Grids brings together expertise of IES members to address technical challenges from a system viewpoint for the advancement of smart grids technology.

Collaboration activities:

ERIGrid and IEEE IES TC-SG collaborated to organise joint tutorials at conferences (i.e., IEEE INDIN 2018, IEEE IECON 2018) and joint webinars (Co-simulation based Assessment Methods, ICT standards for Smart Grids) related to the validation of cyber-physical energy systems.

3.1.7 IEEE Systems, Man, and, Cybernetics Society (SMC) TC on Intelligent Industrial Systems (IIS)

Type: Network (international, US)

Coordinator: TC Chair Thomas Strasser

Website: <https://sites.google.com/view/ieee-smc-tc-iis/>

Contact persons on behalf of ERIGrid: Thomas Strasser (AIT)

Contact persons on behalf of the network: Thomas Strasser (AIT, IEEE)

Description:

The goal of the IEEE Systems, Man, and, Cybernetics Society (SMC) TC on Intelligent Industrial Systems (IIS) is to provide a platform for researchers and industrial experts to share their experiences and ideas related to the next generation of intelligent, plug-and-play, cyber-physical industrial systems. The transformation of traditional monolithic, hierarchical and centralised legacy control and data acquisition systems is supported by the latest initiatives and technologies such as Industry 4.0, cyber-physical systems, IoT, big data and internet of services.

This TC aims at concentrating the knowledge related to the research and application of these new cybernetic methods into various industrial sectors, including production control systems, smart grids and smart cities, water/waste water treatment, transportation, and others. The TC especially encourages validation of developed solutions on physical demonstrators, either in laboratory or real industrial environments.

Collaboration activities:

ERIGrid and IEEE SMC TC on IIS collaborated to organise joint tutorials at conferences (i.e., IEEE SMC 2018) and joint webinars (Co-simulation based Assessment Methods, ICT standards for Smart Grids) related to the validation of cyber-physical energy systems.

3.2 Platforms & Initiatives

3.2.1 Institut Smart Grid

Type: Collaboration/Institution

Coordinator: TBA

Website: TBA

Contact persons on behalf of the ERIGrid Consortium: Quoc Tuan Tran (CEA), Yvon Besanger (Grenoble-INP)

Contact persons on behalf of the project: Quoc Tuan Tran (CEA), Nourredine Hadijsad (Grenoble-INP)

Description:

The Institut Smart Grid is an initiative of the Auvergne Rhone-Alpes region to create a pole of activities for researches and developments of innovative solutions for smart grids. The initiative regroups various major energy actors in France: RTE (TSO), ENEDIS (DSO), CEA, etc. and is supported by the Lyon and Grenoble Metropolises.

Collaboration activities:

CEA and Grenoble INP team are in the consortium of Institut Smart Grid. The perspectives of development of the institute may bring potential application of ERIGrid experimental solutions.

3.2.2 PowerWeb Institute Conference 2019

Type: Conference – Netherlands (Europe)

Coordinator: Arjen van der Meer (TU Delft)

Website: <https://www.tudelft.nl/powerweb-institute/news-events/inclusive-energy-transition/>

Duration: 4th June 2019

Contact persons on behalf of ERIGrid: Rishabh Bhandia, Arjen van der Meer (TU Delft)

Contact persons on behalf of PowerWeb Institute: Arjen van der Meer (TU Delft)

Description:

The PowerWeb Institute of the Delft University of Technology organised its annual conference on 4th June 2019. This year's theme was "Inclusive Energy Transition" with a line-up of six presentations on the topics: "Technology and Operation", "Policy" and "Institutions and Case Studies" aimed at contributing to a better understanding of how and under what conditions energy innovations occur and how institutional and social innovations can accelerate technological change. The conference stressed social inclusiveness as a key value to be addressed in the design and operation of the future energy systems.

Collaboration activities:

ERIGrid's continuous cooperation with the PowerWeb Institute focuses on the knowledge exchange related to the topics of JRA2. One of the main cooperation activities in 2019 was ERIGrid's contribution to the annual conference of the PowerWeb Institute in form of presentations and poster sessions on JRA2-related topics. This contribution also facilitated project exposure to industry.

4 Conclusions and Outlook

This report summarises the ERIGrid partners’ collaborations that have been planned and performed with other international/national R&D projects, initiatives, networks, and platforms on the topics relevant to ERIGrid domains during the fourth year of the project. These networking activities were planned in the ERIGrid NA2 “Dissemination, Communication and International Collaboration” work package. Information exchange and joint activities were carried out through email communication, webinars, joint events, and joint papers.

During the past year, the ERIGrid partners have established and/or maintained lines of communication and cooperation with participants of 8 EU funded (H2020, ERA-Net SG+) projects, 7 national projects, 7 networks, and 2 platforms and initiatives, all of which are dealing with different aspects of smart grids. The topics of these activities are marked green for each project/initiative/network/platform in Table 4. The table shows that the performed collaboration activities cover all main aspects of the ERIGrid project. The activities have been focused on: testing and validation methods, needs and requirements of the research infrastructures, co-simulation, real-time simulation and HIL testing, multi-lab testing, scenarios/use cases/test cases, power system operation and protection, TSO/DSO collaboration, ICT/cyber-security and metrology.

Table 4: Topics of collaboration activities with relevant projects, networks, initiatives and networks

Topic of the collaboration activities Project / Initiative / Network / Platform	Testing and validation methods	Needs and requirements of research infrastructures	Co-simulation	Real-time simulation and HIL testing	Multi-lab testing	Scenarios / UCs / Test cases	Power system operation	Power system protection	TSO/DSO collaboration	ICT / Cyber-security	Metrology	Dissemination, Communication, and Exploitation
INTERPLAN												
SmartNet												
MAGNITUDE												
CloudGrid												
Sci4All												
M2M-GRID												
LarGo!												
SmILES												
MESSE												
RPC2												
NR2.0												
PPIinterpop 1&2												
CybResLab												
ENSURE												
Power System Research program												
EERA JP Smart Grids												
IEEE WG P2004												
IEA ISGAN /SIRFN												
DERlab network												
IEEE PES Task Force on												

<i>Topic of the collaboration activities</i>	Testing and validation methods	Needs and requirements of research infrastructures	Co-simulation	Real-time simulation and HIL testing	Multi-lab testing	Scenarios / UCs / Test cases	Power system operation	Power system protection	TSO/DSO collaboration	ICT / Cyber-security	Metrology	Dissemination, Communication, and Exploitation
<i>Project / Initiative / Network / Platform</i>												
Real-Time Simulation												
IEEE IES TC-SG												
IEEE SMC TC on IIS												
Institut Smart Grid												
PowerWeb Institute Conference 2019												

The mentioned activities have already delivered or are expected to provide mutual benefits and inputs for both sides of the collaborations. The most important points are highlighted as follows:

- ERIGrid partners acquired information about the research infrastructure needs and requirements as well as approaches and methodologies for power/control HIL testing and co-simulation for performing different types of tests in the scope of smart grids.
- ERIGrid shared the developed holistic testing methodology as the main outcome of NA5 WP with several stakeholders and experts in the relevant fields and received feedback. This methodology has been also applied in several experiments in the other projects. This will help the consortium to improve the methodology based on the practical experiences obtained for the future.
- There will be an opportunity for the external users, active in similar projects, to access the ERIGrid facilities and benefit from the harmonised testing procedures on the topics that the project covers.

It can be concluded that successful cooperation with several ongoing international/national activities on smart grids has been achieved within the fourth year of the project. This progress has been used to improve the methodologies developed within the project.

The established collaboration activities will continue until the project end. Links between institutions and single researchers created thanks to the ERIGrid project will be maintained and exploited for information exchange on the topics that the consortium dealt with (e.g., tools and methodologies for HIL testing, co-simulation and multi-lab testing) also beyond the project duration.

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