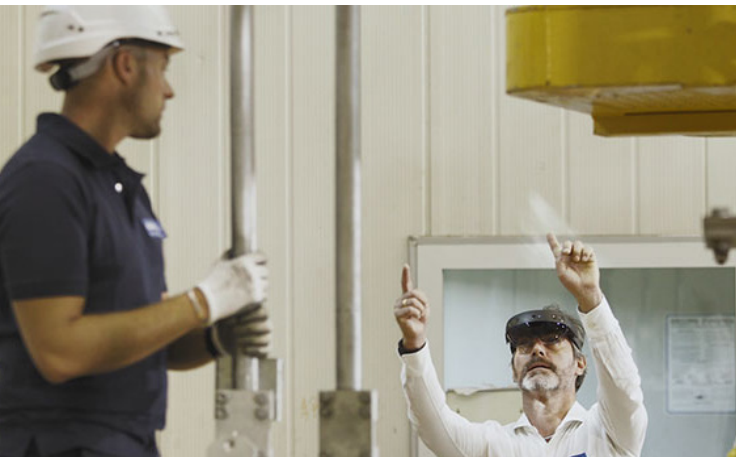
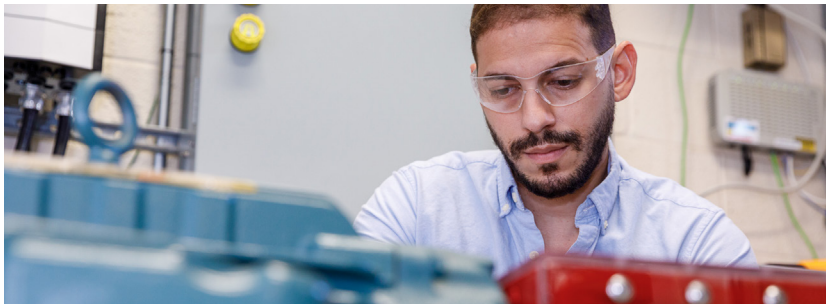
DERlab

DERlab
European Distributed
Energy Resources Laboratories

Activity Report 2021-2022

Pan-European Collaboration & the Role of Remote Testing in the Recovery Plan





supported by

PANTERA

EIRIE smart grids

EUROPEAN INTERCONNECTION FOR RESEARCH INNOVATION & ENTREPRENEURSHIP
PANTERA

Contents

Photo: Turku University of Applied Sciences

Nomenclature

BES Battery Energy Storage

CHIL Controller Hardware in the Loop

CHP Combined Heat and Power

CVC Coordinated Voltage Control

DER Distributed Energy Resources

DG Distributed Generation

DMS Digital Measurement System

DRMS Demand Response Management System

DSM Demand Side Management

DSO Distribution System Operator

EH Energy Hub

EHV Extra High Voltage

EMSP E-Mobility Service Provider

ESCO Energy Service Companies

EVSE EV Supply Equipment

EVSEO Electric Vehicle Supply Equipment Operator

FMI Functional Mock-up Interface

FRT Fault Ride Through

G3M Grid Management and Maintenance Master Framework

GHG Greenhouse Gas

HIL Hardware in the Loop

HVDC High Voltage Direct Current

I-V or (V-I) Current-Voltage

LV Low Voltage

LVRT Low Voltage Ride-Through

MPPT Maximal Power Point Tracking

MV Medium Voltage

OEM Original Equipment Manufacturer

OGEMA Open Gateway Energy Management Framework

OVRT Over-Voltage Ride Through

P2G Power-to-Gas

PCC Point of Common Coupling

PEID Power Electronic Interfaced Devices

PHIL Power Hardware in the Loop

PID Controller Proportional Integral Derivative Controller

PID Potential Induced Degradation

PLC Programmable Logical Controller

PMU Phasor Measurement Unit

PV Photovoltaics

RES Renewable Energy Sources

RI Research Infrastructure

R&I Research & Innovation

RUE Rational Use of Energy

SDK Software Development Kit

SGAM Smart Grid Architecture Model

SIL Software in the Loop

SMX Smart Meter Extention

SRA Strategic Research Agenda

TRL Technology Readiness Level

TSO Transmission System Operator

V2X Vehicle-to-Everything

WECC Western Electricity Coordination Council

Photo: PNDC

DERlab Association

DERlab is the network of leading research institutes working together for the grid integration of distributed power generation. The association develops joint requirements and quality criteria for the connection and operation of Distributed Energy Resources (DER) and strongly supports the consistent development of DER technologies. DERlab offers testing and consulting services on grid integration of distributed generation and conducts research on a wide range of related topics, such as:

- Interconnection requirements of DER
- DER and smart grids related R&D
- Grid-connected storage
- Electromagnetic compatibility requirements for DER
- Static converters in grids
- DER testing procedures
- Ancillary services
- ICT
- Photovoltaic modules
- Hardware-in-the-loop and co-simulation investigations and testing
- Network protection
- E-mobility
- Cybersecurity

DERlab e. V. Board

From left to right:
Prof. Graeme Burt (University of Strathclyde, UK),
Maria-Luciana Rizzi (RSE, Italy), Roland Bründlinger (AIT, Austria),
Dr. Philipp Strauss (Fraunhofer IEE, Germany),
Prof. Peter Vaessen, Spokesperson (KEMA Labs, Netherlands)

Foreword

The COVID-19 pandemic was and still is a disruptive world event as was 9/11. The world as we know it changed irrevocably, and it will never be the same again. This crisis also serves as a wake-up call with respect to sustainability and climate change, as is clearly demonstrated in several sectors of the economy. Any crisis also stimulates innovative thinking and creativity, and technology developments often accelerate in such times. This is also reflected in the well-known quotation of Winston Churchill: "Never waste a good crisis."

The energy transition and worldwide electrification tsunami leads to exponential growth of renewable energy, notably wind and solar. At present more than 1000GW solar and 850GW wind are globally installed, and there are no signs of a slowdown. The dependency of our society on a reliable electricity supply is further increasing, and the demand is forecasted to double to 2050. Cars with internal combustion engines see the end of their life cycle, as legislation has come into place forcing all future cars to comply with zero-emission goals. Initiatives of greening the industry using hydrogen and recycling are gearing up, and large oil-majors start to change. As the intensity of weather-related disasters (flooding, storms, droughts, forest fires, heatwaves) increases, grid owners and operators must be prepared.

The above-mentioned developments lead to the clear necessity of managing replacement, expansion, and operation of electrical energy in a safe, sustainable, and controlled manner. There is also a need to hybridise and integrate with green gas and (local) heating systems. All this is happening in a changing environment where consolidated balances and rules have been broken, not only at the power grid level but also closer to the customer: think of electric vehicles, charging facilities and community battery storage systems.

The EU launched Next Generation EU (NGEU), a temporary instrument designed to boost the recovery, which is the largest stimulus package ever financed in Europe. A total of €2,018 trillion in current prices will help rebuild a post-COVID-19 Europe that is greener, more digital and more resilient. This new long-term budget increases flexibility mechanisms to guarantee it has the capacity to address unforeseen needs. It is a budget fit not only for today's realities but also for tomorrow's uncertainties.

Two items mentioned in the recovery plan - pan-European collaboration, and conformity and suitability of equipment - are a perfect fit to the expertise of our DERlab Association.

DERlab established pan-European cooperation within our network and facilitated researcher exchange through online knowledge day events. These activities can and must be further enhanced, expanded and intensified for the coming years as key to successful innovations and large-scale industrial roll-out. The validation and testing procedures offered by the state-of-the-art facilities of the DERlab members are essential in providing pathways to accelerated de-risking and fit-for-purpose proving for the sustainable energy system of the future. DERlab and its members continue to propose test procedures for new equipment like supercapacitors and electrolysers and formalise testing standards that enable solutions required for integrated energy system operation. Remote testing has developed quickly into a valuable client benefit in the course of testing at our DERlab member facilities, and it will continue to gain more importance. As DERlab, we seize the opportunities created by this crisis and translate them into contributions to accelerate the energy transition.

Prof. ir. Peter Vaessen
DERlab Spokesperson as of 2019
KEMA Labs
TU Delft

DERlab Association

DERlab Members

Introduction

At the beginning of the COVID-19 pandemic, the scientific community suddenly faced strong communication barriers, which were promptly addressed with innovative digital solutions for international collaboration and for knowledge and best practice exchange. The shift to virtual environments for meetings and networking events brought both new challenges and benefits to the scientific community. The ability to attend technical events virtually increased the worldwide accessibility of conferences, technical workshops, project and scientific working groups meetings and more. The DERlab Association participated in this transformation and supported its members with tools and opportunities to continue their successful research collaboration and knowledge exchange in the field of DER equipment and systems, development of joint requirements and quality criteria for the connection and operation of DER. In this we seamlessly supported the consistent development of DER technologies and the energy transition.

This Activity Report presents the activities of DERlab and its members focusing on international networking and knowledge exchange within the period 2021-2022.

Special emphasis is given to the activities of the EU Coordination and Support Action "PAN European Technology Energy Research Approach" (PANTERA), coordinated by DERlab member FOSS University of Cyprus. Despite the significant impact of the pandemic, this project is successfully building up an efficient and sustainable European platform, which brings together stakeholders active in the fields of smart grids, storage and local energy systems, including policy makers, standardization bodies and experts in both research and academia, representing the EU energy system. The European Interconnection for Research, Innovation and Entrepreneurship (EIRIE) Platform offers a single reference point facilitating access to information ranging from potential funding, to scientific reports and papers on various energy-related topics, to the scientific community active in the energy sector, and to potential project partners. It interlinks various information sources, like information access and networking platforms, initiatives, associations, and databases. It is an innovative platform supported by DERlab and the PANTERA project partners, addressing the needs of the European Energy R&I Community in terms of knowledge sharing and exchange, as well as of collaboration enhancement among energy stakeholders. This is foreseen as contributing to the acceleration of the energy transition.

Going beyond the mere online attendance of scientific events, the DERlab community has explored and exploited the potential of remote testing in the framework of the European project European Research Infrastructure supporting Smart Grid Systems Technology Development Validation and Roll out 2.0 (ERIGRID 2.0). The project is based on a holistic, cyber-physical systems based approach to enhance the research activities focusing on development, analysis, testing and validation of modern power supply systems, the integration of renewable energies, the digitalisation of the networks and intelligent energy systems.

In this report, we present DERlab members' latest infrastructure developments and highlights in terms of research advancements. Coping with challenges caused by the pandemic, DERlab members have developed effective remote operation and testing procedures, as highlighted in this report. Furthermore, the healthy levels of cooperation maintained across the DERlab community during the last two years is reflected in a number of scientific publications, several of which are listed in the final part of the report.

Dr. Diana Strauss-Mincu
DERlab General Manager

Towards FIT 55%: Activities of Horizon Europe, ETIP SNET, BRIDGE and PANTERA EIRIE Platform

Mario Dionisio
EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ENERGY

Directorate B. Just Transition, Consumers, Energy Efficiency and Innovation
Unit B5. Innovation, Research, Digitalisation, Competitiveness

With the European Green Deal, the European Union aims at becoming climate neutral by 2050 and reducing greenhouse gas emissions by 55% by 2030. To reach these ambitious objectives, the "Fit for 55" package sets a whole range of measures covering all sectors of the economy, in particular transport, agriculture and energy.

At least 30% of the EU budget of EUR 1.8 trillion (Multiannual Financial Framework for the next 7 years and the recovery plan) will be spent on fighting climate change, which represents the highest share ever.

Responsible for 75% of EU greenhouse gas emissions, the energy system has a central role in the transition to a climate neutral economy. The transformation of the power sector will involve a huge growth in wind and solar power production over the coming decades. Contextually, the grid architecture will evolve from a centralised to a decentralised smart, secure and sustainable energy system with a wide penetration of DC technologies and systems. These are key for the integration of the future huge offshore RES generation and to cope with the increasing penetration of Power Electronic Interfaced Devices (PEID). These challenges, addressed with innovative technologies, can be taken as a real economic opportunity, which will bring new investments, jobs and growth.

The EC supports the energy system transition through initiatives and funding research and demonstration projects in Horizon Europe, which is the EU's key funding programme for research and innovation with a budget of € 95.5 billion. It tackles climate change, helps to achieve the UN's Sustainable Development Goals and boosts the EU's competitiveness and growth. The programme facilitates collaboration and strengthens the impact of research and innovation in developing, supporting and implementing EU policies while tackling global challenges. It supports creating and better dispersing of excellent knowledge and technologies.

The BRIDGE initiative unites R&I projects of Horizon Europe and the previous Horizon 2020 in the areas of smart grid, energy storage, sector coupling, islands and digitalisation to create a structured view of cross-cutting issues encountered in the demonstration projects. BRIDGE has released the 2021 BRIDGE initiative project factsheets, which provide a very good overview of the technologies and innovations, the projects' partners, and the geographical coverage.

The Strategic Energy Technology Plan (SET Plan), the technology pillar of the EU's energy and climate policy, sets out a long-term energy research, demonstration and innovation agenda for Europe, including concrete strategic milestones to be achieved in the coming years.

The ETIP SNET (European Technology and Innovation Platform Smart Networks for Energy Transition) guides research, development and innovation to support Europe's energy transition with innovation for the transmission and distribution systems. ETIP SNET released the ETIP SNET R&I Roadmap 2020-2030, which synthesises consolidated and balanced stakeholders' views on the future R&I needs of the Integrated Energy System with electricity as its backbone.

The EU Coordination and Support Action "PANTERA" is working to deliver a multi-dimensional platform to leverage R&I in EU countries that are less involved in energy systems research. Within the project, the dynamic pan-European multifunctional collaborative online platform EIRIE "(European Interconnection for Research, Innovation and Entrepreneurship)" aims at connecting, collecting, elaborating data sources from the projects of the entire R&I family (JRC, EXPERA, ERA-Net SES, Smart Grids+, ETIP SNET, CORDIS, BRIDGE, etc.) and delivering output services to the stakeholders in the energy sector and to EU citizens. Through the EIRIE platform, each Euro of tax money paid by EU citizens and invested in EU-funded projects throughout Europe does not stop having effect at projects' end but goes beyond through the services provided by EIRIE, which can trigger new activities, new jobs, markets and economies.

Virtual Research Infrastructure for Smart Grids and Energy Systems Development, Validation and Testing

Dr. Thomas Strasser

Coordinator of ERIGrid 2.0
AIT Austrian Institute of Technology

The current transformation and digitalisation of the energy system, while ensuring security of supply, require new approaches for the conversion, storage, and distribution of energy in different areas. The EU-funded ERIGrid 2.0 project addresses the challenges of the energy transition by widening and advancing access to European research infrastructures. Serving as a single-entry point for researchers active in smart grids and energy systems as well as in the integration of renewables, the project develops a broad spectrum of improved development, validation, and testing services as well as corresponding methods and tools. Furthermore, starting from April 2020 and up until 2024, ERIGrid 2.0 grants external users free physical and virtual lab access to perform their research activities.

Virtual access is a novel feature of ERIGrid 2.0; it provides the opportunity to access virtual infrastructures for researchers worldwide. With this addition to the first ERIGrid project, the aim is to provide access to virtual data and services needed for research and development in the domain of power and energy systems. This access is made available free of charge, to open, valuable resources such as databases, real-time data, or simulation platforms. It aims at facilitating casual access with minimal administrative overheads compared to the more elaborate application and selection process used in the corresponding lab access program.

With the provided virtual services, the project focuses on the publication of existing software projects and data sets under open access/source licenses to a broader audience. Moreover, the virtual access programme seeks to supply the access providers with the needed feedback from users and experts to improve their services. In addition, since the kick-off of ERIGrid 2.0 practically coincided with the start of the global Covid-19 pandemic, the virtual access programme turned out to offer a viable alternative to physical lab access given heavy restrictions on worldwide travel. At the same time, the virtual access programme is capable of reaching out and attracting new users for upcoming physical lab access calls.

The ERIGrid 2.0 virtual access services are accessible via erigrid2.eu/lab-access.

About ERIGrid 2.0:

- 20 partners from research, academia, and industry
- 21 first-class European laboratories and 9 virtual facilities involved
- 13 European countries represented in the consortium
- Duration: 1 April 2020 – 30 September 2024
- Budget: € 10M funded by the European Commission
- More about ERIGrid 2.0 on page 15 and at erigrid2.eu

ALL | ON-SITE AND REMOTE TRANSIENT POWER SYSTEM DYNAMICS AND CONTROL VALIDATION | ON-SITE AND REMOTE SMART ENERGY SYSTEMS INTEGRATION AND VALIDATION | VIRTUAL FACILITIES

DER-TF DaaS of RSE

Virtual Lab of ICCS-NTUA

SmartEST Sim Lab of AIT

OpenAFPM of ICCS-NTUA

SESA Virtual Sim of OFFIS

VLab of RWTH Aachen

SYSLAB VA of DTU

SGRID of HEDNO

Smartgrid MVP of University of Strathclyde

ERIGrid 2.0 virtual services at the project website erigrid2.eu

IEA-ISGAN Working Group 5 SIRFN: Facilitating Sustainable Energy Transition Through a Global Smart Grid Validation Group

The DERlab Association continues to coordinate the work of the ISGAN Working Group 5 Smart Grid International Research Facility Network (SIRFN) in its role as the Operating Agent.

Among other duties, the Association supported the updating of the working programme and assisted the organisation of several online meetings, such as 21st and 22nd ISGAN Executive Committee Meetings and the webinar on DER testing protocols and power system testing in August 2021. The Association published general and technical factsheets, collaborated in multiple technical publications, and maintained SIRFN related content, publications and dissemination materials.

SIRFN is continuously evaluating current and anticipated research infrastructure requirements, from units to systems, from the state-of-the-art to new methodologies needed for smart grid testing and validation. In addition, SIRFN opens new doors for research by matching research topics with its global and collaborative communities.

Currently, SIRFN maintains four active technical projects dealing with topics ranging from automated compliance testing up to holistic system validation:

1. Distribute Energy Resource Testing Protocols: increasing testing capabilities through national and global automated grid code testing and evaluation
2. Microgrid Testing: identifying KPI of microgrid functionalities in varied environments, analysing microgrid testing opportunities and forming a general validation process
3. Power System Testing: generation of a universal applicable and valid procedure for holistic power system studies and testing in a laboratory environment
4. Advanced Laboratory Testing Methods: surpassing lab limitations by innovative and cost-efficient application of novel testing methods and procedures, such as real-time simulation, remote lab and HIL

In 2021, the Association supported the relaunch of the paused technical project "Advanced Laboratory Testing Methods".

The main task and strength of the collaborative community around SIRFN and DERlab is to produce scientific publications and public events that take into account the high level of expertise in the world and thus cover every necessary aspect. In 2021 joint publications have been released and events have been held, summarising innovative tests and validations of smart grid components and systems. The overview can be found at www.iea-isgan.org/our-work/annex-5.

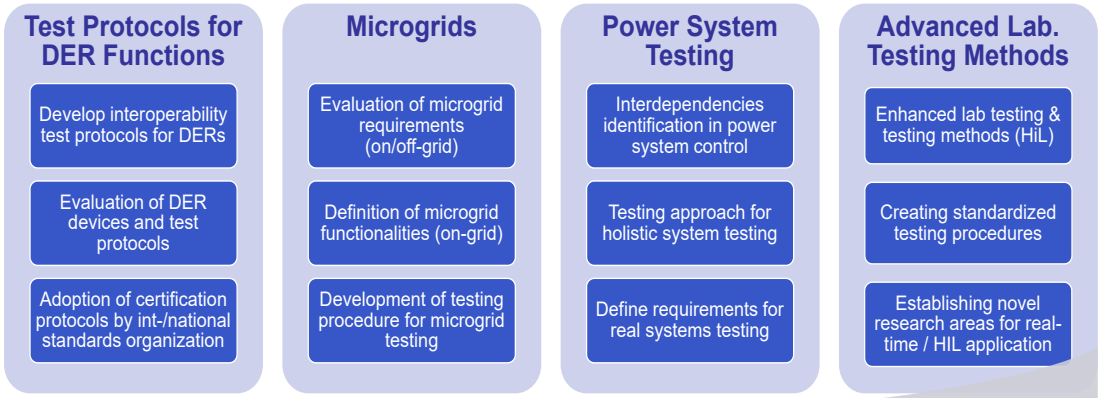
The Association continues to integrate DERlab members as external partners into the SIRFN community, enabling them to actively participate in the four technical projects of SIRFN. This involvement provides SIRFN the opportunity to benefit from scientific contribution of DERlab members, also serving as a platform for knowledge exchange with them. As a result, DERlab members have an opportunity to increase the depth of technical engagement with global partners, advance co-authorship opportunities, and attract greater attention to their high quality scientific publications.

SIRFN enables a strong and interactive focus on accelerating the integration of sustainable resources in a holistic power system. The knowledge transfer between SIRFN, DERlab members and related collaborating projects and networks enables an active scientific community.

SIRFN
ISGAN Annex 5

CLEAN ENERGY MINISTERIAL · iea Energy Technology Network · ISGAN

www.sirfn.net



SIRFN focus areas

eNeuron: GreEN Energy HUbs for Local IntegRated Energy COmmunities optimisatioN

The main goal of eNeuron is to develop innovative tools for the optimal design and operation of local energy communities (LEC) for use by such communities. These tools focus in particular on integrating multiple energy carriers at different scales to identify the potential benefits achievable for the community and its stakeholders by adopting the Energy Hub (EH) concept. In order to ensure both the short-term and the long-term sustainability of this new energy paradigm and thus support an effective implementation and deployment, economic and environmental aspects will be taken into account in the optimisation tools through a multi-objective approach.

Some of the project partners are members of the DERlab Association. These members are involved in every stage of development from state-of the art analysis, regulatory and grid code analysis, use cases and requirements definition, tool development to the testing, validation, replicability and scalability analysis. They support the project activities relying on their years of experience in developing and validating smart grids and local energy communities. Moreover, the whole network of DERlab members present a great opportunity for the project consortium to gain valuable feedback. With this goal the DERlab network will be consulted through workshops and consultation forms about project alignments and activities.

Up until now the project consortium has developed the following resources freely available on the project website www.eneuron.eu:

- reports presenting technical limitations, shortcomings and obstacles to innovation, which may prevent the intended transformation of the European energy landscape towards local multi-vector energy systems with a high level of decarbonisation
- a report on identification of the "Local Integrated Energy Community" subject based on the most recent regulatory developments and policies in Europe and in the countries represented in the consortium, as well as a detailed mapping of the main enabling technologies and the key actors with potential interests in the implementation of this new energy paradigm at local level

In the eNeuron project, four pilot demonstrations distributed across Europe (Poland, Norway, Portugal and Italy) are planned, which will be used for validating the tool and the related technical solutions. Among others, the pilot test solutions entail emerging conversion technologies, such as: HVAC systems, PV systems, local battery storage, CHP generators, power-to-heat (e.g., HVAC heat pumps) and EV charging stations.

DERlab will exploit project results to:

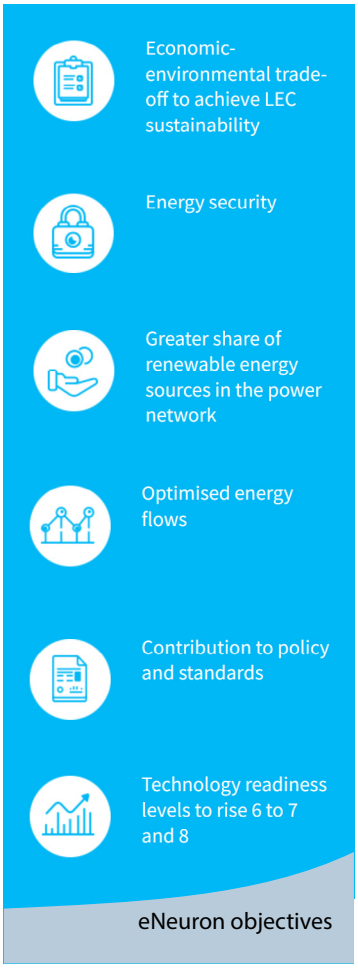
- develop advanced testing procedures for EH and expand their testing services
- support in pre-standardisation activities for the energy hubs through standardisation working groups

The eNeuron consortium has established a number of partnerships with key stakeholders in the domain of smart grids, involving research, academia and industry. These include joint activities with networks and initiatives, such as the DERlab Association, ETIP SNET, EERA Joint Programme on Smart Grids and the European Commission BRIDGE initiative. The main goal is to exchange knowledge on topics like regulation, data management, consumer and citizen engagement, business models, replicability and scalability analysis.

eneuron
optimising local energy communities

eNeuron: greEN Energy hUbs for local integRated energy cOmmunities optimizatioN
Duration:
November 2020 – October 2024
Funding: H2020 grant agreement no. 957779, Innovation Action (IA)
Partners: 17 partners, including DERlab Office

www.eneuron.eu



eNeuron objectives

ERIGrid's Holistic Approach for Validating Smart Grids

ERIGrid: European Research Infrastructure supporting Smart Grid Systems Technology Development, Validation and Roll out
Duration:
November 2015 – April 2020
Funding: RIA - Research and Innovation Action
Partners: 18 partners, including DERlab Office

www.erigrid.eu

ERIGrid Coordinator Thomas Strasser (AIT) holding the "Good Practice of the Year" award

Aiming for a holistic, cyber-physical systems based approach, the ERIGrid consortium designed a Holistic Testing Description (HTD) method to enhance the necessary research services for analysing, validating, and testing smart grid configurations. With the ERIGrid method, research laboratories can combine their unique qualities to devise meaningful system tests. The approach applies to all scales of experiments, combinations of physical and simulated testbeds, and many engineering disciplines. In 2020 ERIGrid won the "Good Practice of the Year" award for its HTD method in the category "Technological Innovation & System Integration", organised by the Renewables Grid Initiative.

Furthermore, ERIGrid has further developed smart grids validation methods such as laboratory-based methods and HIL techniques, co-simulation methods and tools as well as a laboratory coupling approach. The developments within the project are also offered in the form of training materials and tools.

As most of the ERIGrid consortium members are also members of the DERlab Association, their valuable expertise in development and evaluation of smart grid configurations has contributed to the progress in the project. ERIGrid has thus obtained useful information about the current testing and evaluation methods and procedures, as well as research infrastructure/laboratory needs and requirements for performing different types of tests. Having analysed this information and identified the gaps, ERIGrid has developed its HTD methodolody.

Furthermore, ERIGrid developed a large set of open access resources on co-simulation based assessment methods, real-time/HIL simulation, and remote/ICT labs. In 2020 ERIGrid published an open access white book "European Guide to Power System Testing: The ERIGrid Holistic Approach for Evaluating Complex Smart Grid Configurations" (doi:10.1007/978-3-030-42274-5) with Springer. This publication presents the overview of developed holistic system integration and testing procedures as well as developments on co-simulation based assessment methods and integrated laboratory-based assessment methods. All open access solutions and resources developed by ERIGrid, including the white book "European Guide to Power System Testing", are available on the project website erigrid-project.eu.

Within the frame of its Transnational Access (TA)/lab access programme, ERIGrid has provided open access to 19 laboratories of the ERIGrid consortium. Through this opportunity Europe's leading smart grid and DER testing facilities opened their doors to external users from research, academia and industry for their own experimental research – free of charge. Nearly a hundred user teams from academia, research, and SMEs received funding through ERIGrid TA and carried out their experimental projects at world-class research facilities. These user projects dealt with detailed characterisation of smart grid components as well as testing and validation of small-scale system configurations such as microgrids, however co-simulation and HIL were also applicable.

Several DERlab members including AIT, CRES, DTU, G2Elab, ICCS, Fraunhofer IEE, and the University of Strathclyde trained and provided education material to power systems and ICT professionals, researchers and students in the field of smart grid systems (smart grid operation, validation / testing, rollout scenarios). Through this activity, the project partners involved professionals working on power systems and ICT.

The ERIGrid consortium has established a number of partnerships with key stakeholders in the domain of smart grids, involving research, academia and industry. These include joint activities with networks and initiatives such as the DERlab Association, EERA Joint Programme on Smart Grids, ISGAN Annex 5 SIRFN, and several international H2020 and national projects. With this effort ERIGrid ensures efficient dissemination of own results and integration of the already available outcomes. Developing this synergy has enabled ERIGrid to reach its objectives in the most efficient way, ensuring the cooperation and knowledge exchange with relevant stakeholders along the way.

ERIGrid 2.0: Free Access to European Research Infrastructures

ERIGrid 2.0 is the successor project of ERIGrid. Based on its results ERIGrid 2.0 will expand the research services and tools of European research infrastructures for validating smart energy networks with the electric power system as the main backbone in order to fulfil the challenging goals of the European Union towards a clean, secure, and efficient energy transition. Committed to the holistic and cyber-physical systems-based validation approach, ERIGrid 2.0 will foster system-level support by providing lab access and education for industrial and academic researchers in power and energy systems research and technology development.

As members of the DERlab network are involved in the project, their years of experience in development and validation of smart grid technologies and cyber-physical energy systems will be exploited in the project activities, and it will foster the planned developments within the project. It will also lead to synergies in the common activities among DERlab members and the ERIGrid 2.0 project, such as provision of education and training materials. Additionally, the several years of DERlab members' interaction with industry and research community will bring more visibility to the project activities, including the provision of free lab access.

ERIGrid 2.0 provides a unique range of open access services and opportunities for the smart energy research community, including:

- free physical or remote lab access to 21 facilities of project partners
- free access to 9 virtual facilities
- a wide range of educational materials on topics of co-simulation, real-time/HIL simulation, modern power system validation, remote/ICT labs, and microgrids and DERs
- a number of reports relevant to validating concepts and implementations of smart grid technologies to be further used in the ERIGrid 2.0 project and by interested external users

Similar to the activities in ERIGrid, ERIGrid 2.0 addresses power and energy systems and ICT professionals, researchers and students by providing them a wide range of educational resources. Several DERlab members including AIT, VTT, RSE, KEMA labs, RWTH Aachen university, CRES, DTU, ICCS, FOSS, Fraunhofer IEE, TECNALIA, and the University of Strathclyde provide educational materials in the field of smart energy systems (smart grid operation, validation / testing, rollout scenarios). These materials are freely available on the website erigrid2.eu and include webinars, e-learning tools, data sets, remote and virtual labs, and others.

The ERIGrid 2.0 consortium cooperates with stakeholders from research, academia, and industry in the domain of smart energy systems. Joint activities are carried out with networks and initiatives, such as the DERlab Association, ETIP SNET, EERA Joint Programme on Smart Grids, ISGAN Annex 5 SIRFN, and several international H2020 and national projects. The project is also supported by a strong Advisory Board and a stakeholder group, which had resulted in signed supporting letters from 70 well-known European and international institutions.

ERIGrid 2.0: European Research Infrastructure supporting Smart Grid and Smart Energy Systems Research, Technology Development, Validation and Roll Out – Second Edition
Duration:
April 2020 - September 2024
Funding: RIA - Research and Innovation Action
Partners: 20 partners, including DERlab Office

www.erigrid2.eu

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

INTERPLAN

INTERPLAN: Integrated Operation Planning Tool towards the pan-European Network
Duration:
November 2017 – January 2021
Funding: RIA - Research and Innovation action
Partners: 6 partners, including DERlab Office

www.interplan-project.eu

INTERPLAN partners AIT, FOSS, Fraunhofer IEE and DERlab Office are members of the DERlab Association. The involved members will transfer the knowledge to future research and innovation projects where industry will be also involved. This will lead to further development and finalisation of the integrated tool making it ready to be used by final targeted stakeholders - network operators. Additionally, the outcome of the project will be a good basis for training researchers in the scope of network operation planning.

The INTERPLAN consortium has established a number of partnerships with key stakeholders in the domain of smart grids, involving research, academia and industry. These include joint activities with the goal to exchange knowledge on use cases, scenarios, methodologies, etc. Among the collaborators were networks and initiatives, such as the DERlab Association, ETIP SNET, EERA Joint Programme on Smart Grids, European Commission H2020 Smart Grids and Storage projects cluster, as well as several international and national projects.

INTERPLAN aimed to provide an integrated operation planning tool for the pan-European electricity network, with a focus on the TSO-DSO interfaces in order to support the EU in reaching its expected low-carbon targets. Novel control strategies and operational approaches were investigated in order to ensure the security of supply and flexibility of the interconnected EU electricity grids, based on a close cooperation between TSOs and DSOs.

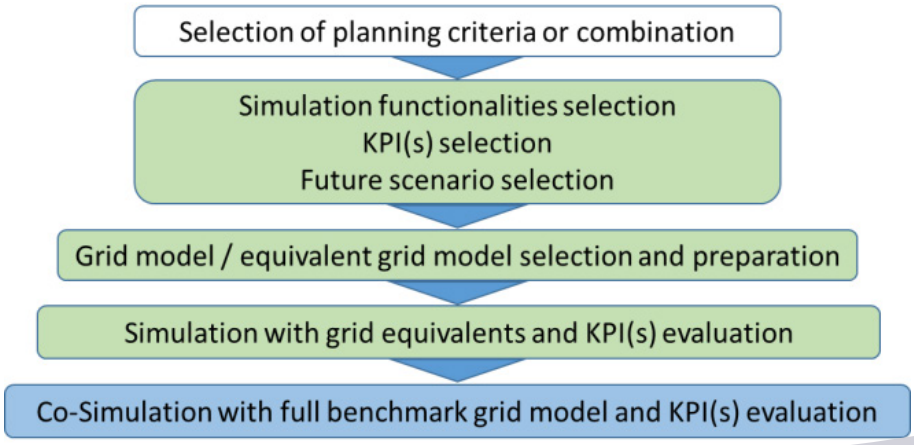
Besides, a methodology for proper representation of a "clustered" model of the pan-European network has been developed, aiming to generate grid equivalents as a growing library able to cover all the relevant system connection possibilities occurring in the real grid.

Out of six project partners in INTERPLAN four are members of the DERlab Association. These members were involved in every stage of developments from the state-of-the-art analysis, regulatory and grid code analysis, use cases and requirements definition, and tool development right to the testing and validation. They supported the project activities relying on their years of experience in developing and validating smart grids systems and technologies. Moreover, some of DERlab members were consulted through workshops and consultation forms about project alignments and activities. This proved to be a great opportunity for the project consortium to gain valuable feedback.

Throughout its duration INTERPLAN developed a number of resources, all of which are publicly available on the project website www.interplan-project.eu:

- an integrated operation planning tool for the pan-European electricity network, in order to support the system operators with regards to integration of high share of renewable energy resources and other emerging technologies, such as EVs and demand response
- a methodology for proper representation of a "clustered" model of the pan-European network and generation of grid equivalents
- a set of use cases and developed control functions integrated in the tool that addresses operation planning challenges of a network
- reports on analysis of grid codes and regulatory framework at European level within the scope of project solutions

At the end of the project, the consortium delivered a demonstration of the developed tool. In this demonstration, three partners performed simulations at different levels of the electrical network: transmission and distribution. These simulations were synchronised and coordinated remotely through the co-simulation platform OpSim.



High-level overview of INTERPLAN methodology

Grid Control 2.0: Control and Stability in Inverter Dominated Power Systems

The electrical power systems, including the grid control of the power supply in Germany, are currently in a transformation process. Today's grid control is based on big power plants with synchronous generators. However, the steadily growing renewable power production is mainly connected to the grid via static converters.

The project Grid Control 2.0 shall prove that the interconnected electrical power system can be operated, even in case of a system split, with a high share of static converters by using suitable control methods. The project is investigating how static converters can form the grid voltage and contribute to the electrical inertia that is required to operate the interconnected central European power system in a stable way.

DERlab Association, being one of the 14 partners of the project consortium, contributes by analysing the previous knowledge and results from international projects in the field of control of power converter dominated networks. Furthermore, DERlab brings the international aspects concerning different grid topologies, power system demands and grid code requirements into the project. Finally, DERlab supports international networking activities in particular the IEA / SIRFN-ISGAN activities on the topics "Advanced converter testing methods" and "Power systems testing".

The project partners investigate the behavior of newly developed controls for grid forming units in grid studies and laboratory tests. The stability and performance of the new controls is shown, and the benefit for the power system is analysed. An OVRT test facility was developed. The new converter controls are also tested in PHIL setups. The tests focus on converter control stability and robustness, as well as on developing new testing procedures concerning, e.g. electrical inertia and their behavior during grid faults. Finally, the interaction of many grid-forming inverters is studied utilising a powerful, high precision real-time power analyser system.

The Technical University Braunschweig / elenia, Kassel University and Fraunhofer IEE's SysTec testing laboratory are performing a variety of laboratory tests including testing the performance and robustness of the converter control under normal and disturbed system conditions. Furthermore, system tests are being organised in order to test the interaction of inverters with grid supporting and grid forming functionalities. In addition, the interaction of inverters with synchronous generators is under investigation. A series of tests and simulations concern the islanding behavior of the units. Protection schemes have also been investigated in HIL environments. The project plans to set up a real-time testing environment for multiple converter interaction studies as well as the testing of newly developed protection schemes that give converters the task to signal problems in the system via the power line.

Results

Grid Control 2.0 gives consolidated answers to key research questions concerning the stable operation of converter dominated power systems. Technical results include:

- Robust controls for grid forming converters and advanced methods for current limitation
- Testing procedures for grid forming converters
- Analysis of frequency stability in power systems with different share of conventional generation, grid supporting converters and grid forming converters
- Analysis of long-term voltage stability in converter dominated grids
- Emergency support schemes for transmission system voltage

Grid Control 2.0 (Netzregelung 2.0): Control and Stability in Inverter Dominated Power Systems
Duration:
December 2017 - August 2022
Funding: Federal Ministry for Economic Affairs and Energy
Partners: 14 partners, including DERlab Office

Partnerships

Together with DERlab the project actively supports the national and international information exchange. In the frame of the "International Cluster on Inverter Dominated Power Systems - INDORSE" and of the "Knowledge exchange days", DERlab organised a series of workshops, in which the project coordinators and research teams presented and discussed results from different related projects.

Services

Fraunhofer IEE offers research and testing services of grid forming control of converters. This supports hardware and controller development, as well as testing of products.

For advanced testing of converters PHIL and CHIL test facilities are available. CHIL and SIL systems are in particular useful for systems with high power rating.

Furthermore, Fraunhofer IEE offers consultancy services in the context of grid forming inverters and network technologies like STATCOMs. Fraunhofer IEE offers development of grid models and unit models for simulation systems like Powerfactory, PSSE, Modellica, etc., as well as tools for studying power stability in converter dominated grids and grid studies.

PANTERA: PAN European Technology Energy Research Approach

PANTERA aims at setting up a European forum composed of Research & Innovation stakeholders active in the fields of smart grids, storage and local energy systems, including policy makers, standardisation bodies and experts in both research and academia, representing the European Union energy system.

PANTERA: Pan European Technology Energy Research Approach
Duration:
January 2019 – December 2022
Funding: CSA - Coordination and support action; H2020 grant agreement no. 824389
Partners: 9 partners, including DERlab Office
Coordinator: FOSS University of Cyprus

www.pantera-platform.eu
contact@pantera-platform.eu

Find us as "PANTERA EIRIE Platform" on LinkedIn, Facebook, Twitter and YouTube.

Vision

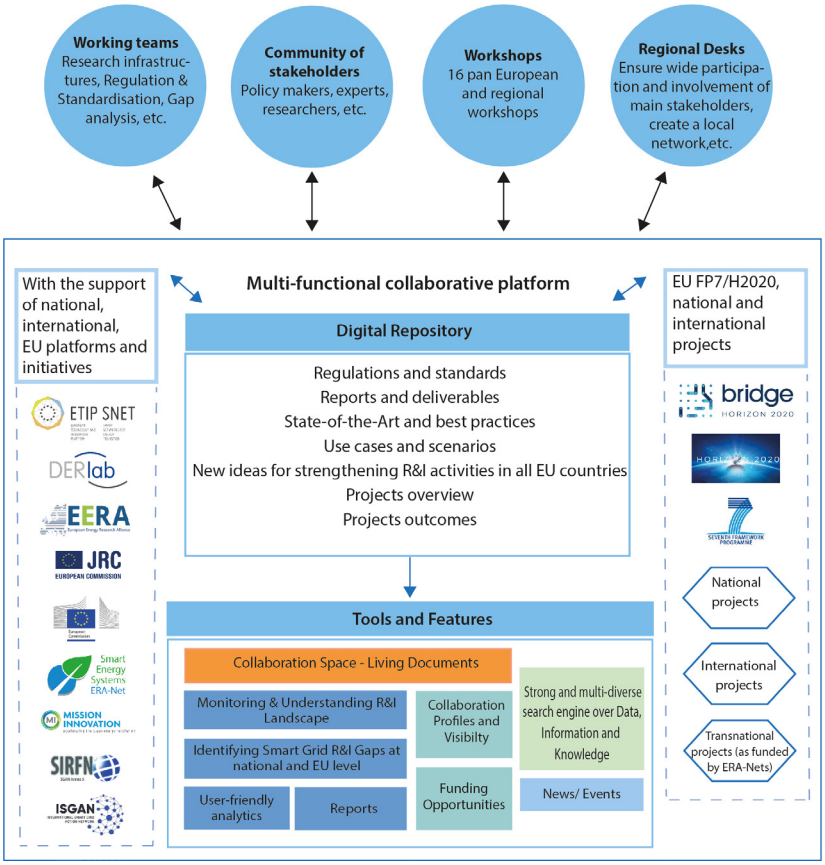
PANTERA's vision is to connect and bring together the European Union's R&I community in one place, to enable collaboration, increase wider interest and give access to all the resources needed to play an active role within the European research community.

Alignment and collaborative work are essential to create the pan-European modus operandi envisioned within PANTERA. The feedback and continuing support of stakeholders, along with national, international, EU platforms, and initiatives, H2020, national and international projects, will enable EIRIE to become a reference operational point.

Climate change is driving the transition to a zero-emission society. Some countries are well-prepared to implement this transition while other countries have much further to go. If Europe wants to achieve its greenhouse gas emissions reduction targets, it is essential that all European countries have access to knowledge and research collaboration opportunities.

PANTERA's main objective is to help bridge the gaps that currently exist in the energy field in Europe between Member States. To do so, PANTERA developed two main instruments:

1. The EIRIE (European Interconnection for Research Innovation & Entrepreneurship) multi-functional collaborative platform (www.pantera-platform.eu/eirie), a reference operational point to unify European activity.
2. The Regional Desks, an important mechanism that will support the PANTERA process through assistive activities at regional level.



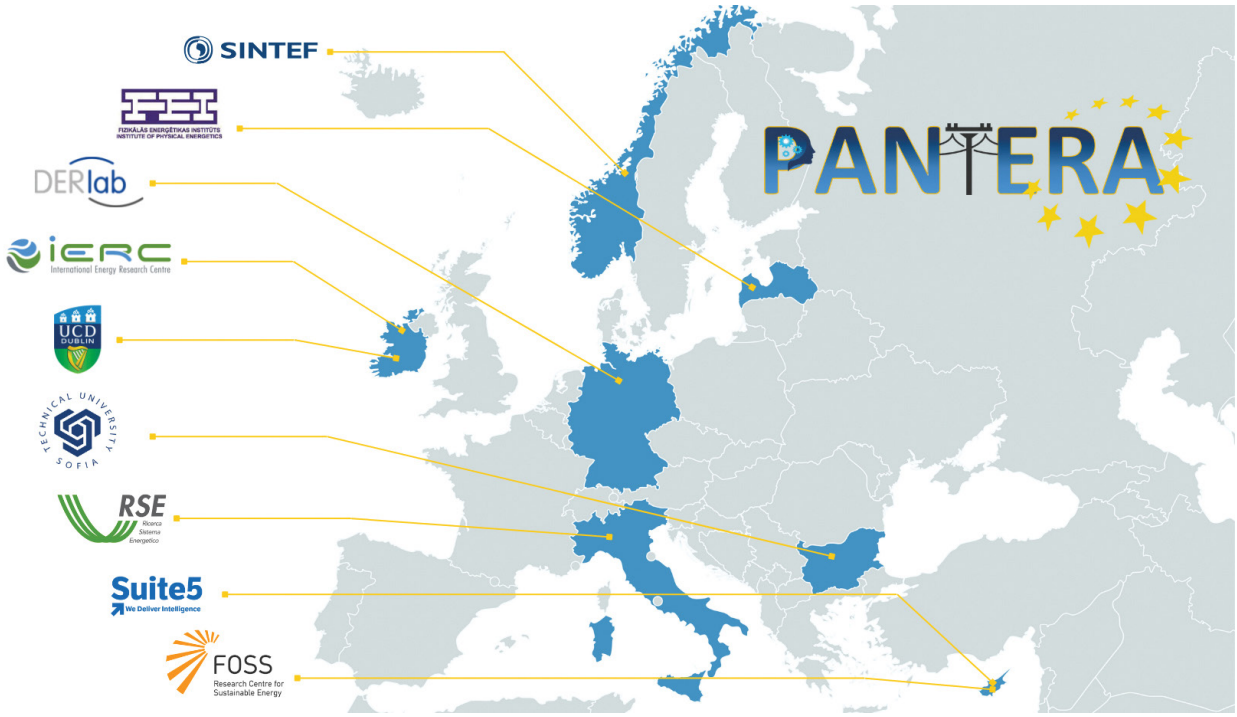
Expected impacts and role of the DERlab network in PANTERA

PANTERA is a key contributor towards ensuring effective Research & Innovation in European countries by promoting increasing levels of transnational collaboration within the European energy sector.

The main expected impact is to create a reference point via the EIRIE platform and bring together all actors active in the R&I community in Europe from all Member States, including all European initiatives focused on smart grids such as JRC, ETIP-SNET, BRIDGE, Mission Innovation, ERA-NET SES, etc. The aim is to give the same chances to all interested stakeholders to get access to the needed knowledge and information to take part in transnational collaboration within the European energy sector and thus contribute to the development of solutions for a smooth energy transition and zero-carbon society.

By connecting the EU R&I community, PANTERA expects enhanced collaboration, wider interest and use of the project results, avoid redundancy and lost financing and strengthen the participation of all Member States in support of the fifth pillar of the Energy Union (RIC) and energy transition mentioned in "A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy".

The PANTERA consortium



DERlab network in PANTERA

PANTERA partners FOSS, RSE, Technical University of Sofia, UCD and IERC are members of the DERlab association. They are involved in the entire PANTERA process, including the development of the EIRIE platform and the Regional Desks and contribute to the dissemination activites of the project on a pan-European level. Additionally, the whole DERlab network is involved in the project by providing valuable feedback through continuous cooperation within the project activities.


PANTERA kick-off meeting, Nicosia (CY), 2019

The PANTERA Regional Desks

To achieve the PANTERA ambition of creating a true pan-European R&I community that will respect and highlight each region competences and strengths, the project consortium came up with the concept of Regional Desks. The aim is to strengthen national participation rates in smart grid investments by making national stakeholders' needs and expectations more visible on the European arena. It is a place for raising discussions with national decision makers, sharing experience and challenges in research and innovation, inviting local stakeholders to interact more actively with PANTERA and other EU-level initiatives.

PANTERA Regional Desks' main objectives are:

- To link research and innovation with the regional priorities and competences in close cooperation with local actors
- To link regions and local assets and capabilities to external sources of knowledge and value chains
- To understand the local context and propose best practices that can be applicable for designing policies and strategies for regional and national goals

Their operation is fully aligned with the national/regional Research and Innovation Strategies for Smart Specialisations (RIS3) in content and approach. RIS3 is a critically important activity that will support the PANTERA process through collaborative work within the regions.

Find out more about the Desks and their actions through the PANTERA Regional Desks Magna Carta booklet (www.pantera-platform.eu/pantera-regional-desks).

Reference person: Dr. Anna Mutule (IPE)
Contact: amutule@edi.lv

The PANTERA 6+1 approach

The PANTERA 6+1 approach is an integral part of the PANTERA process, which aims to strengthen national participation rates in smart grid investments by making national stakeholders' needs and expectations more visible on the European arena. It is a place for raising discussions with national decisionmakers, sharing experience and challenges in research and innovation, inviting local stakeholders to interact more actively with PANTERA and other EU-level initiatives. Thus, it is a key opportunity to achieve the PANTERA ambition of creating a true pan-European R&I community that will respect and highlight each region competences and strengths.

The PANTERA 6+1 approach includes six PANTERA Regional Desks targeting countries which appear to have a lower rate of smart grid investment, and one best-practice Desk elaborating on gathering and systemising good experiences in projects and R&I governance from more successful countries, that can be selectively replicated under matching frameworks.

The six main Desks will serve as a PANTERA project's contact point for all potential stakeholders from the defined region and for any other interested stakeholders from other countries.

The Desk leader, i.e. the relevant project partner, is responsible for the Desk operation and for establishing working relations with an active stakeholder who will act as a contact person for the relevant associated country's stakeholders.

The Desk is a dynamic structure, where contact persons and stakeholders may join and express different level of activity and commitment during the desks' implementation. It supports the organisation of stakeholder consultations and workshops, dissemination activities on a regional level, generating country specific reports and publications, and developing and updating the PANTERA country profiles.

Through this process, the regional contexts will be provided for the PANTERA Working Teams and the EIRIE Platform.

Stakeholders who will participate in the PANTERA Regional Desks process and give their support will gain valuable access to SG R&I communities, initiatives and information.

Learn more about it on https://pantera-platform.eu/pantera-regional-desks/

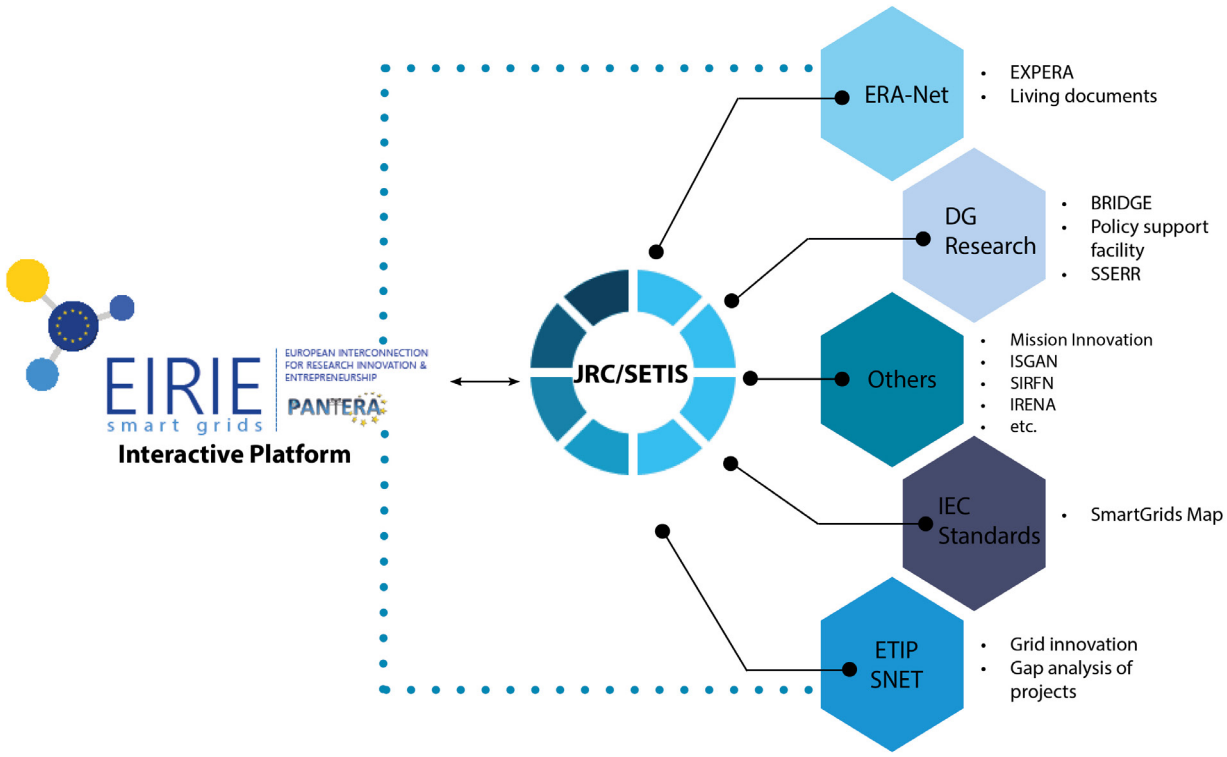
The EIRIE platform: European Interconnection for Research, Innovation and Entrepreneurship

A sustainable multifunctional platform

The EIRIE platform has been developed to be a sustainable multifunctional platform and a single point of reference for the EU Research & Innovation family in the field of Smart Energy Systems and technologies, in support of the energy transition and the low carbon economy.

Through EIRIE, the aim is to bridge the gaps that currently exist in the energy field in Europe between Member States, by bringing together data, information, knowledge and lessons learned from successful partnerships being national, regional or European.

The platform users will get access to information on potential funding and consortium building, projects data collection (results and outcomes, best practices, reports and deliverables, etc.), references to standards and regulations, all of these searchable via an easy-to-use search tool.



The key objective of the EIRIE platform is to connect and bring together the European Union's Research & Innovation community in one place, to enable collaboration, increase wider interest and give access to all the resources needed to play an active role within the European research community.

Furthermore, to ensure the success and sustainability of the platform, the PANTERA consortium is working closely with JRC (EC Joint Research Centre), under the guidance of DG Energy of the European Commission, to develop EIRIE as a linked extension of their Smart Energy Systems platform. The platform will also be serving the needs of ETIP SNET (ETIP Smart Networks for Energy Transition) and be in close collaboration with well-known platforms in Europe such as the ERA-Net SES (ERA-Net Smart Energy Systems), DERlab and Mission Innovation.

Key functionalities

Data area, with search and linking functions:

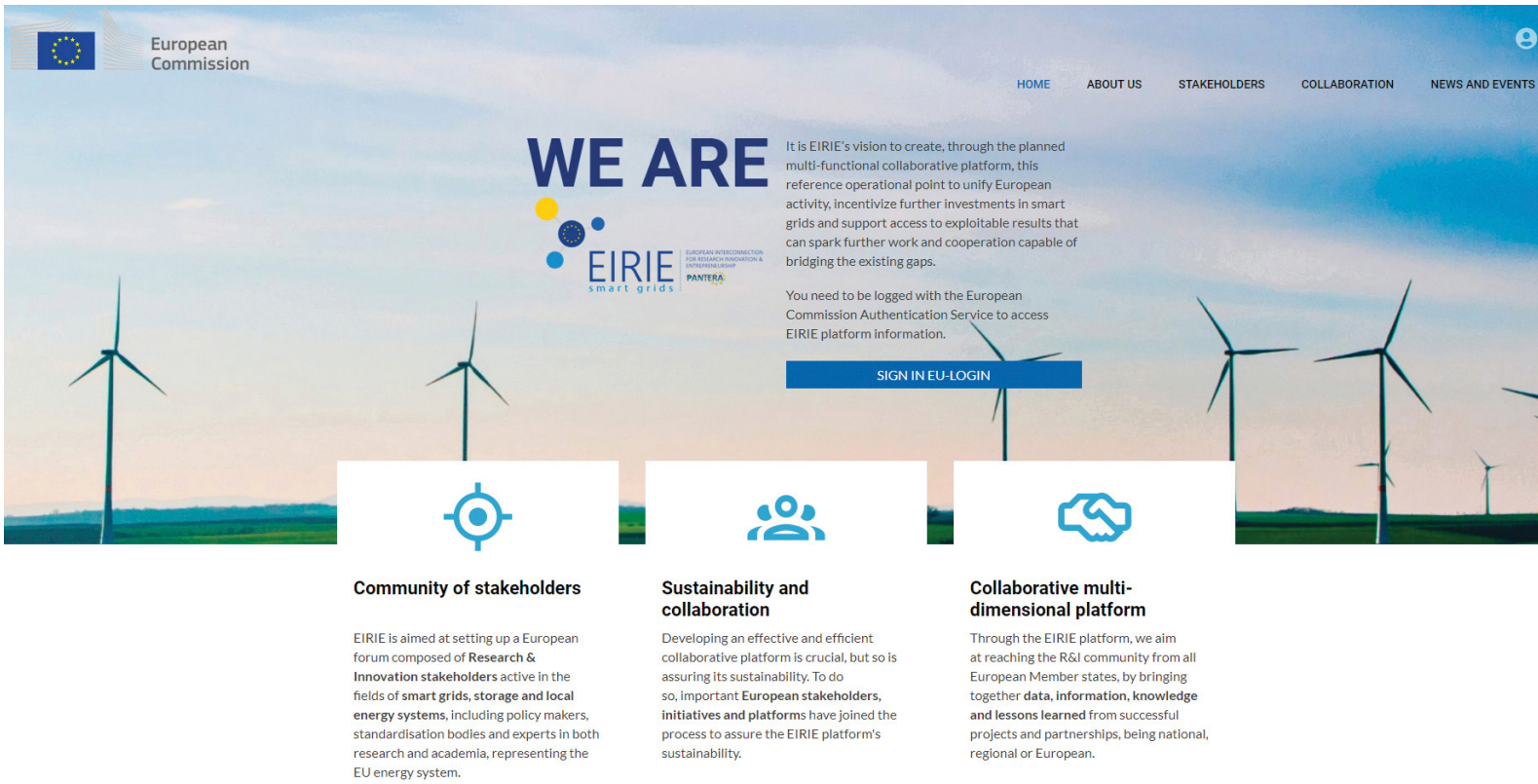
- Projects data collection (results and outcomes, best practices, reports and deliverables, etc.)
- Standards and regulations

Information area, with search and linking functions:

- Project-related information through integration with JRC, CORDIS, Mission Innovation, ETIP SNET, BRIDGE, EXPERA, etc.

Knowledge area, with search and linking functions:

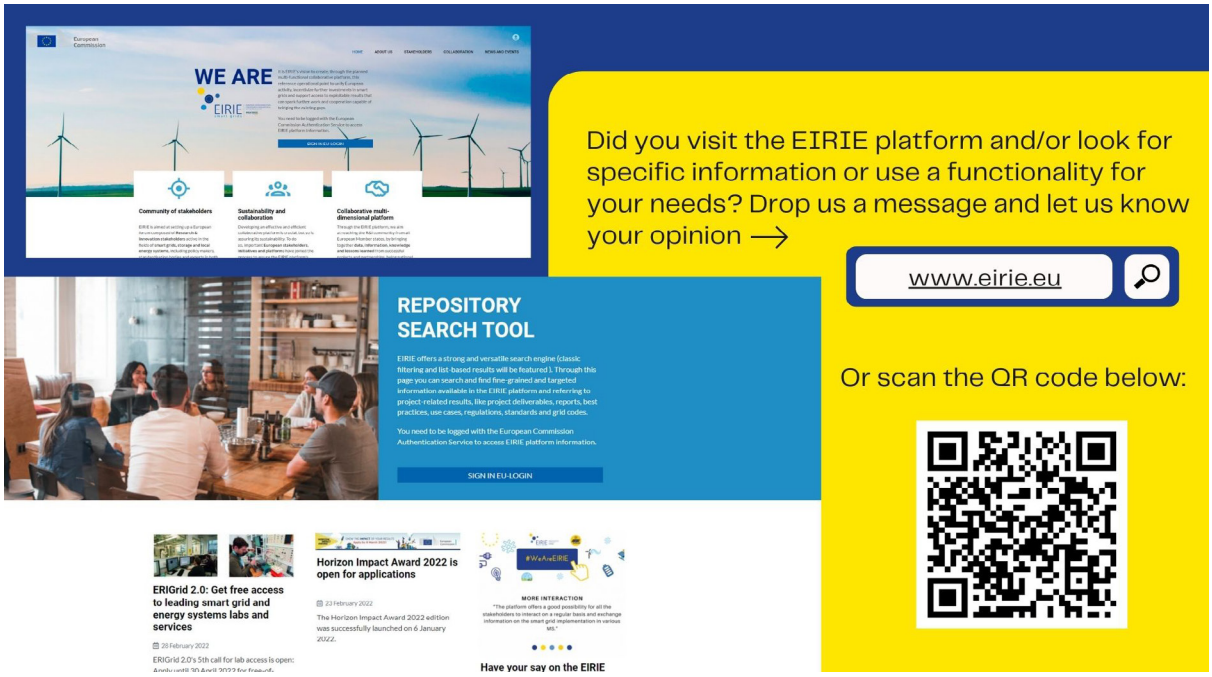
- Living documents



EIRIE smart grids
EUROPEAN INTERCONNECTION FOR RESEARCH INNOVATION & ENTREPRENEURSHIP
PANTERA

Benefits of using the platform

- An easy access to information on potential funding and consortium building, useful for all the actors of the Research & Innovation community in Europe, be it researchers, industrial parties, academia or SMEs
- A central point for collaborating on the issues relevant for the energy sector in general, and particularly to the decarbonization of the European energy system
- An active role in the community and a support in providing input to European policies, that will better reflect European national needs



Your opinion matters

The EIRIE platform is still growing and does not yet offer all planned services and tools. However, it is very important for the consortium to gather valuable insights and feedback from an early stage to create a platform that will effectively reply to the stakeholders' needs.

The consortium has been conducting a serie of interviews with the PANTERA EIRIE Platform Advisory Board members to receive their feedback and comments regarding the tools and functionalities available on the EIRIE platform.

This consulting process will continue after 6 and 12 months to receive more insights as the EIRIE platform gradually grows.

Did you also check out the EIRIE platform and/or look for specific information or use a functionality for your needs?

Share your thoughts.

EIRIE Platform Testimonials

"The EIRIE platform is a much-needed crucial step to make the low-carbon sustainable future as envisioned by the European Commission, a reality. What makes EIRIE different from other platforms? EIRIE facilitates connectivity with all sources (platforms, initiatives, etc) of data / information / knowledge, making it the single point of reference for the related R&I community, enriching the original content that it generates".

Mario Dionisio, DG Energy - European Commission and PANTERA project officer

"The European Commission's Joint Research Centre (JRC), as the science and knowledge service of the European Commission, will support the development, hosting and knowledge management of EIRIE, based on its experience in the analysis of digital energy projects and the regular issue of the Smart Grid Outlook Report."

Marcelo Masera, Head of Unit "Energy Security, Distribution and Markets", Directorate "Energy, Transport and Market" Joint Research Centre – European Commission

"EIRIE platform builds on the good work currently done through the active WGs of ETIP SNET, offering the triangle of knowledge enriched to the degree needed for the development of 10-year R&I roadmaps and respective implementation plans."

Venizelos Efthymiou, Vice-chair of ETIP SNET

"EIRIE platform is an innovative tool responding to the needs of the European Research & Innovation community in the energy field. A place of interactive communication, knowledge sharing and enhanced collaboration available to all energy system stakeholders."

Luciano Martini, Coordinator of the EERA JP on Smart Grids and co-Lead of Mission Innovation IC1 smart grids

"EIRIE is an innovative platform addressing the needs of the European Energy R&I Community in terms of knowledge sharing and exchange, as well as of collaboration enhancement among energy stakeholders, thus supporting the acceleration of the energy transition."

Diana Strauss-Mincu, General Manager of European Distributed Energy Resources Laboratories (DERlab)

"EIRIE platform is an innovative tool that Europe was missing, linking the Research & Innovation community in the energy field in supporting ERIGrid's mission and objectives of connecting and unleashing the European smart grid and smart energy systems infrastructures."

Thomas Strasser, Coordinator of Horizon 2020 ERIGrid and ERIGrid 2.0 projects

Access the platform now:
https://ses.jrc.ec.europa.eu/eirie/ or
https://eirie.eu/

Interview with Venizelos Efthymiou

Dr. Venizelos Efthymiou

Coordinator of the PANTERA project, Chairman at FOSS, University of Cyprus

Venizelos Efthymiou. He graduated the University of Manchester Institute of Science and Technology completing all his degrees BSc, MSc and PhD in Electrical Engineering and Power Systems. Following that he completed a diploma course in Management in Cyprus.

He worked for the Electricity Authority of Cyprus from March 1979 up to November 2013 and he left the Company from the post of Executive Manager Networks / Distribution System Operator of Cyprus.

He is a member of the Governing Board and Chairperson of Working Group 5 of ETIP SNET, the Steering Committee of ETIP PV, of the DSO committee of EURELECTRIC, of the Steering Committee of the SET Plan and of the Horizon Europe Programme Committee. He is the chairman of the Research Centre FOSS of the University of Cyprus.

Through his extensive experience in EAC, the close and continuous cooperation with the University of Cyprus but also through the active participation in the work of EURELECTRIC and the European Technology and Innovation Platforms of SNET and PV, he is the writer of many reports and papers of technical content with relevant publications in international magazines and proceedings.

How is PANTERA contributing to the achievement of a clean energy transition?

Energy transition means evolution into the use of low carbon technologies to achieve zero emissions by 2050 as a setout high-level objective of the European Union. This target is achievable but all countries should raise their Research & Innovation activities to develop what is required in time.

As it is well-documented that more than half of the Member States are not doing enough in R&I, PANTERA stepped in to find ways for boosting the R&I activities of the low contributors. Based on extensive work in this direction, the PANTERA consortium has managed to launch the multifunctional EIRIE platform, aiming to act as the required bridge for low-activity countries to act. In reality, the EIRIE platform is an innovative tool responding to the needs of the European Research & Innovation community in the energy field. A place of interactive communication, knowledge sharing and enhanced collaboration available to all energy system stakeholders.

Using the rich functionalities of the EIRIE platform and the add-ons of regional corner collaboration work, working teams, with selected enabling thematic and workshops, organized in sensitive areas of Europe the push towards the respective stakeholders of these countries, which was and still is high enough to raise interest and generate the much wanted enhanced R&I activities. In this process, close collaboration with the stakeholders of high activity countries is fundamental in raising interest and bring positive results. The EIRIE platform is playing a catalyst role in this direction.

The PANTERA consortium has been interacting and consulting with experts active in the fields of smart grids, storage and local energy systems since the beginning of the project. What are the key takeaways from these exchanges?

Interaction with the stakeholders and experts in the field of smart grids, storage and local energy systems has been focal since the initiation of the PANTERA project. The interaction was in all directions but mostly aimed towards those active in the countries with low activity in R&I. We, as the PANTERA consortium, are now more informed about the needs and requirements of experts in the field, helping us to offer improved solutions through our activities but more importantly through the tools provided in the EIRIE platform.

What did we learn from this intensive interaction?

- Progress in systems, solutions and technologies is not well-documented hence, experts are not well-informed in planning their R&I work to be responsive to real needs and requirements.

- Needs and requirements built into R&I objectives were reflecting progress in countries that lead the work in the field. The real needs and requirements of countries falling behind could not influence the EU objectives and this further handicapped the weaker countries and regions.
- R&I experts coming from low-activity countries find it hard to build collaborative work with leaders in the field due to a lack of visibility.
- Stakeholders of low-activity countries did not link their country strategy to the primary needs of their region but to the primary needs of Europe, as set out in the EU strategy. Hence, local and regional needs are not adequately addressed, hence undermining the competitive advantage of regions and low activity countries.

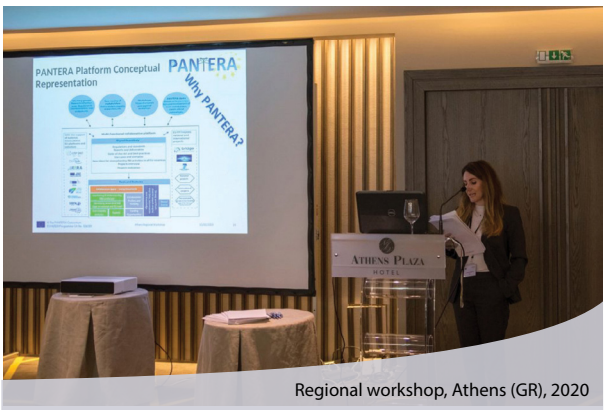
All the above identified limitations and shortcomings were carefully addressed through the functionalities put forward in the EIRIE platform to create an interactive platform through which all the above receive the appropriate attention for initiating corrective action.

What are the main benefits provided by the EIRIE platform? How can the platform contribute to boosting collaboration between all EU member states?

As indicated in my response to the previous question, the EIRIE platform has introduced the following functionalities that are designed in a way to bring solutions to the above identified problems:

- Linked repository with all known platforms in the EU that host projects results in the field of smart grids, storage and local energy systems. Hence, build the EIRIE single point of reference for bringing together the state-of-the-art in the related evolution of systems, solutions and technologies and be accessible by all R&I experts throughout the EU.
- Provide valuable data from systems and solutions to feed the R&I endeavours of all experts in the field hence, leaving no one behind with possibilities and capabilities.
- Bring on the same platform, through the above indicated linked environment, access possibilities to all the prevailing knowledge in the field.
- Build and operate a functional collaboration area that brings together all experts in the field and separately offers the possibility of regional activity where specific needs prevail. Hence, country or regional specifics can be promoted separately by local experts collaborating through the developed functionalities of the EIRIE platform.
- Related educational material is smartly linked to the EIRIE platform, offering valuable training possibilities to R&I experts throughout the EU. This service is targeted to grow with time as more and more material is made available online through financed projects in the EU. The structured environment has been put in place to help this hosting activity run into the future with no limits.

PANTERA consortium, regional workshop, Dublin (IE), 2019

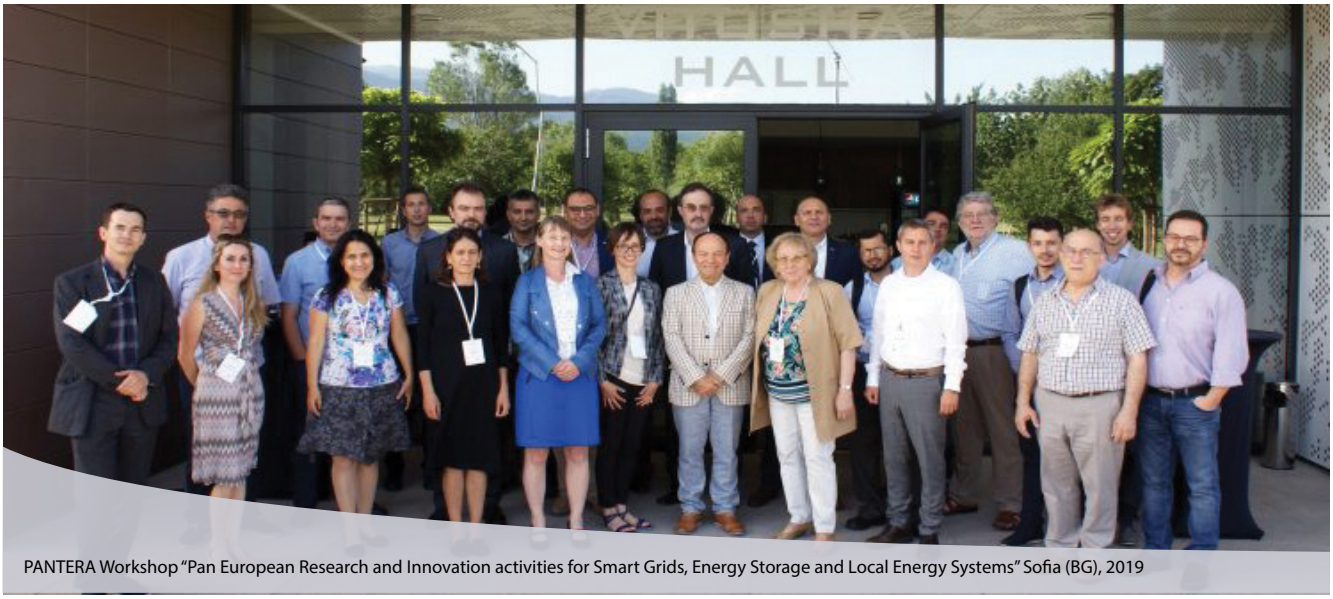


Regional workshop, Athens (GR), 2020

What are the actions in place to ensure the sustainability of the project outcomes?

The PANTERA project is a 4-year Coordination and Support Action (CSA) project therefore, once the allocated operational time runs out, all related activities seize. However, the Commission and DG Energy have seen this limitation and have stepped in to support the solutions offered through the EIRIE platform, to gain a future and be operational in the years to come thus continue serving the R&I community in the EU. What has been achieved in this direction?

- The EIRIE platform will be hosted on the Joint Research Centre (JRC) servers within EUROPA and their Smart Energy Systems area, thus offering operational capability in the future.
- The EIRIE platform will be handed over to the SPRING project at the end of the PANTERA project, which is a Service Contract operated by DG Energy with the responsibility of serving ETIP SNET and BRIDGE. This handover will mean that the consortium of the SPRING project and any future service contract that will take over, will be vested with the responsibility of serving the needs of the EIRIE platform, hence assuring safeguarded sustainability in the operation of the EIRIE platform for the years to come.



PANTERA Workshop "Pan European Research and Innovation activities for Smart Grids, Energy Storage and Local Energy Systems" Sofia (BG), 2019

Get in touch with the PANTERA team

www.pantera-platform.eu

Global Smart Grids Infrastructure in DERlab Database

DERlab offers a unique service – the DERlab Database of DER and Smart Grid Research Infrastructure, which connects global research infrastructures and research centres with end users and potential customers. Currently, the Research Infrastructure Database holds information on over 220 laboratories, testing capabilities and services, spanning over 60 institutes worldwide.

The database presents extensive information about the testing infrastructures to potential customers and researchers, such as:

- Static and mobile equipment
- Power range of the equipment
- Simulation and optimisation tools
- Offered testing services within the laboratory
- Quality management and standards compliance of the offered testing services

DERlab plans to extend the database with new facilities and labs. Moreover, DERlab is working, in close cooperation with the PANTERA project, on developing an API (Application Programming Interface) that will connect the DERlab Research Infrastructure Database with the EIRIE (European Interconnection for Research Innovation & Entrepreneurship) platform, which is hosted by JRC (Joint Research Centre, European Commission). This connectivity will allow the integration of all the research infrastructures from the DERlab database in the EIRIE platform and will increase their exposure to the broader smart energy audience.

Database of DER and Smart Grid Research Infrastructure

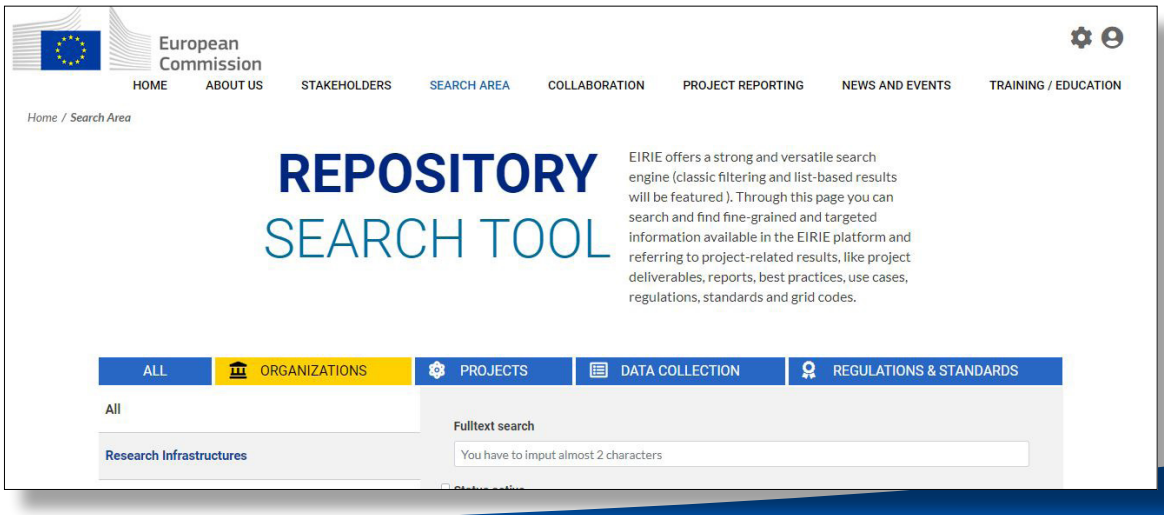
Database of DER and Smart Grid Research Infrastructure

Maintained by DERlab since 2012, the DERlab Database of DER and Smart Grid Research Infrastructure openly provides coordinated information on smart grid and DER laboratories, testing facilities and similar competencies. The database is strongly supported by the ISGAN Annex 5 SIRFN and the EU-funded projects ERIGrid 2.0, ERIGrid, ELECTRA IRP, COTEVOS, SOPHIA. Starting from January 2019, the PANTERA project is also supporting the database and contributing to its extension.

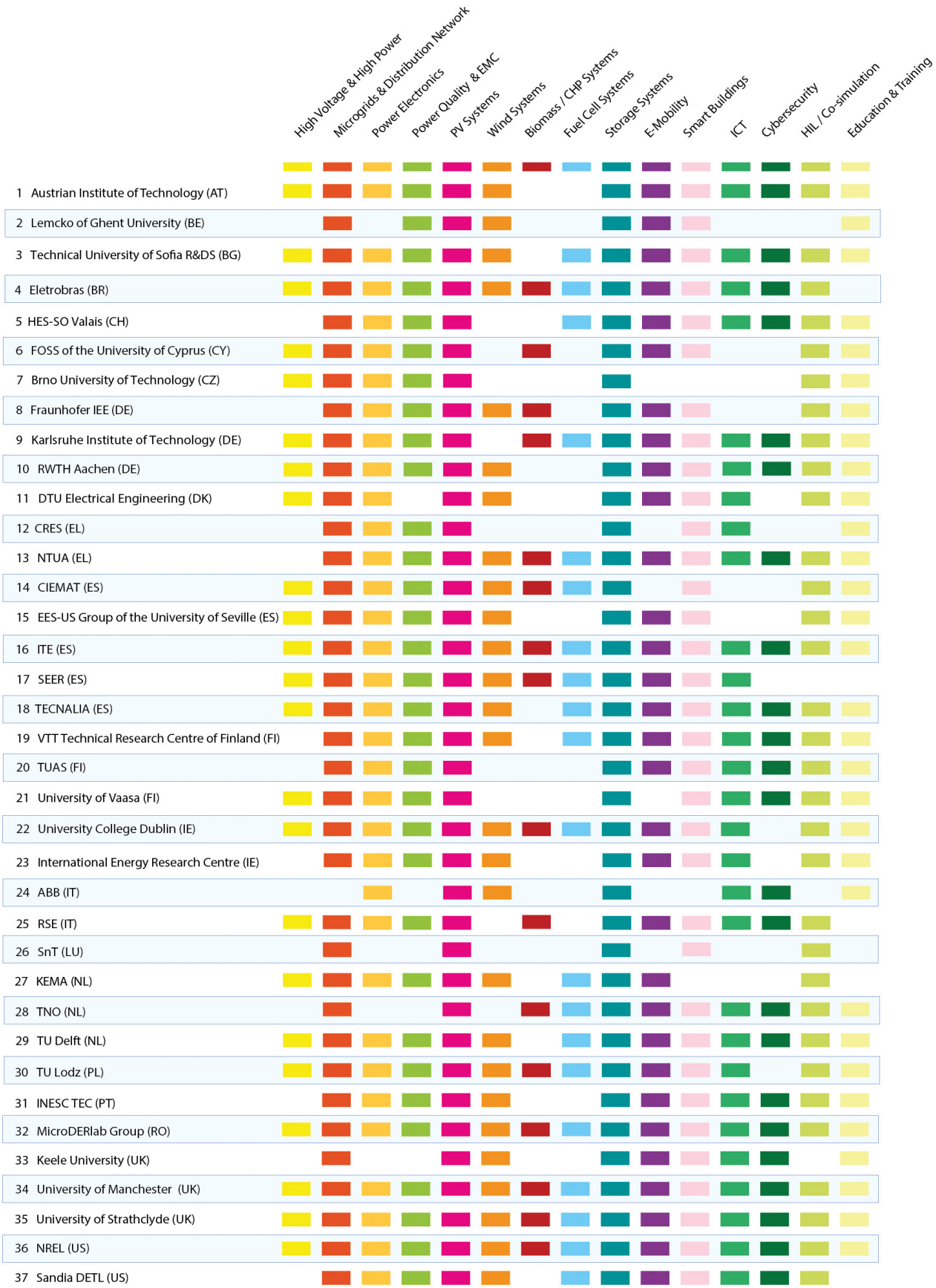
infrastructure.der-lab.net

API

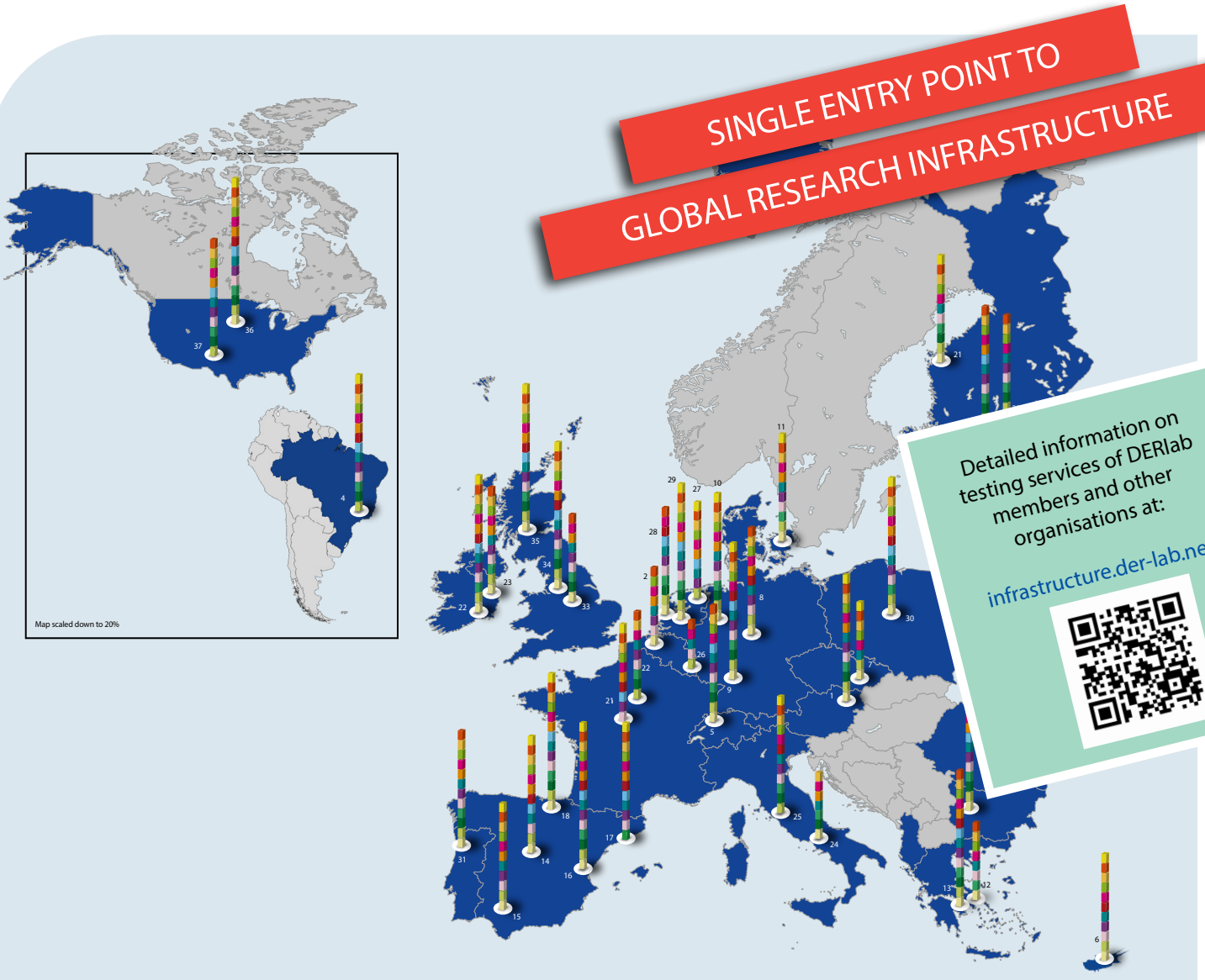
EIRIE smart grids
EUROPEAN INTERCONNECTION FOR RESEARCH INNOVATION & ENTREPRENEURSHIP
PANTERA



DERlab Research Infrastructure Testing and Consulting Services



The transition towards high shares of renewable energy and more decentralised energy supply requires a smarter grid with sufficient hosting capacity and the ability to manage the significant power fluctuations of renewable sources. High-level research and laboratory tests are vital to tackling these challenges. With the necessary expertise and capabilities, laboratories of DERlab members provide the services of testing individual components and complete systems, and verifying compliance with international and national standards or certification procedures.



DERlab members institutes as of July 2022

AIT Opens New High-Performance DC Lab

- High Voltage & High Power
- Microgrids & Distribution Network
- Power Electronics
- Power Quality & EMC
- PV Systems
- Wind Systems
- Storage Systems
- E-Mobility
- Smart Buildings
- ICT
- Cybersecurity
- HIL / Co-simulation
- Education & Training

AUSTRIAN INSTITUTE OF TECHNOLOGY

The Austrian Institute of Technology (AIT) is Austria's largest research and technology organisation. The main research areas of AIT are energy, mobility systems, low-emission transport, health and bio resources, digital safety and security, vision, automation and control, and technology experience, all paired with competence in the area of innovation systems and policy.

infrastructure.der-lab.net/ait

New capabilities

On 1 December 2021, the AIT Austrian Institute of Technology opened its new DC Lab. This state-of-the-art DC laboratory marks a significant expansion of the current facilities at Austria's largest research and technology organisation. The new facility will serve as a development and validation platform for DC components and systems, and it is specified for DC systems up to 75 MW with currents up to 80 kA. As such, the lab is the largest of its kind in Austria. With the go-live of the new facility, AIT can offer a strong set of design and testing services for industries in Europe and worldwide for the development of new DC technologies.

Consulting services

The DC Lab is a development and validation platform for DC components for manufacturers and operators of DC systems. The lab supports each stage in the entire development process, from the concept through to the startup. Typical applications include the testing of breaking capacity under operating conditions and short circuits, and short-time and surge current testing.

Accomplishments

The design and construction of the DC Lab were hugely demanding due to the absence of similar facilities. AIT worked together with its committed partners to install 30 tonnes of steel and more than 50 tonnes of copper. The switchgear houses four special transformers, which can be connected to create different testing scenarios. The total investment volume was EUR 3 million.

Remote testing

Throughout 2021, AIT has been working together with its customers to continue its research and testing activities despite the limitations of travel and physical attendance. To enable smooth collaboration between AIT test engineers and customers, state-of-the-art infrastructure has been installed at the AIT laboratories, including video and remote real-time visualisation. These technologies allow customers to virtually monitor the performance of their equipment during the testing process and allow remote access to the setup.

In addition, AIT's virtual SmartEST Sim Lab, opened in 2020, has been further developed. This virtual facility provides a simulation-as-a-service platform that is open to the public free-of-charge. Based on mosaik, Docker, JupyterLab, and JupyterHub, this co-simulation platform allows to analyse smart grids and smart energy systems comprehensively. The service is provided via the H2020 ERIGrid 2.0 project (erigrid2.eu) and is available at smartest-sim-lab.erigrid2.eu.

AIT's DC Lab

Sandia Upgrading Testing Capabilities

New capabilities

In 2021, Sandia National Laboratories has integrated a 62.5 kW Electric Vehicle Charger into the Distributed Energy Technologies Laboratory (DETL) Motor Control Center (MCC) for grid integration, microgrid control, and cybersecurity research. The team has also expanded the microgrid functionality of the lab by adding a PHIL simulation of a networked microgrid with grid-forming energy storage system, genset, and multiple photovoltaic inverters. The team has also added a back-to-back motor-generator and power electronics to emulate wind turbine operations for PHIL grid integration studies.

Consulting services

Sandia looks forward to collaborating with industry and academia. Please visit sandia.gov/working-with-sandia for more information.

Remote testing

Sandia's laboratories have remained open throughout the pandemic despite reduced travel. Research teams expanded their capabilities to collaborate virtually with other organisations and labs. For example, the team has allowed remote access to test networks over cyber-secure access points for remote workers and microgrid control vendors. This allowed work to continue with reduced risk and fewer on-site personnel.

Accomplishments

- Sung (Peter) Choi, Jay Johnson, Adrian Chavez, Tam Le, and Alan Sonntag, 2021 R&D 100 Winner, Software/Services Category, Secure-Firmware Over-the-Air (S-FOTA) Update Protocol
- David A. Schoenwald, Raymond H. Byrne, Ryan Thomas Elliott, Jason C. Neely, Brian Joseph Pierre, Felipe Wilches-Bernal, and Daniel J. Trudnowski, "Systems and Methods for active damping control of inter-area oscillations in large-scale interconnected power systems", US Patent No. 11,050,262, issued 29 June 2021
- Michael Ropp, "Systems and Methods Using Collaborative Controls to Maintain Unintentional Islanding Standards", US Patent 10,985,568 B1, issued 20 April 2021

Rachid Darbali at Sandia's DETL

Wind turbine emulator at Sandia's DETL

Microgrids & Distribution Network
Power Electronics
Power Quality & EMC
PV Systems
Wind Systems
Fuel Cell Systems
Storage Systems
E-Mobility
Smart Buildings
ICT
Cybersecurity
HIL / Co-simulation

Sandia National Laboratories

Sandia National Laboratories is a multimission engineering and science laboratory with major R&D responsibilities in the US national security, energy and environmental technologies, and economic competitiveness. The Distributed Energy Technologies Laboratory (DETL) of Sandia conducts research on generation, storage, and load management at the component and systems levels and examines advanced materials, controls, and communications to achieve a reliable, low-carbon electric infrastructure.

infrastructure.der-lab.net/sandia

Laboratory of Distributed Generation at TU Lodz

- High Voltage & High Power
- Microgrid & Distribution Network
- Power Electronics
- Power Quality & EMC
- PV Systems
- Wind Systems
- Biomass / CHP Systems
- Fuel Cell Systems
- Storage Systems
- E-Mobility
- Smart Buildings
- ICT
- HIL / Co-simulation
- Education & Training

Lodz University of Technology
Institute of Electrical Power Engineering

The Institute of Electrical Power Engineering of Lodz University of Technology (TU Lodz) performs research on distributed generation (including renewables) and its integration with electrical power grid, quality of supply, microgrids, optimisation of network and power plant operation, electricity markets, power system modelling and simulation, as well as optimisation of lighting networks and devices.

infrastructure.der-lab.net/tu_lodz

New capabilities

In 2021 TU Lodz launched a new test-bed developed to study and validate both central and local controllers for the management of prosumer PV sources and energy storage systems. The test-bed design is based on a HIL test method using an RTDS system. It includes multiple input and output cards and a set of power amplifiers. Due to the flexibility of RTDS systems, it can be applied for HIL tests of versatile prosumer infrastructures including power sources, loads, storages, AMI meters, and communication solutions needed for coordinated control of larger scale LV networks.

Additionally, the laboratory was equipped with a high-precision Omicron relay tester. In 2022 it is planned to expand the RTDS system's capabilities in the field of communication protocols and to upgrade a current controlled CSI inverter to increase its flexibility and the range of potential research applications.

SCADA system of TU Lodz

Consulting services

- Integration of loads and power sources in the power systems
- Application of energy storage systems in networks with distributed generation
- Analysis of power quality in distribution networks
- Microgrids management and control
- Control of power inverters including PHIL tests
- Monitoring and analysis of wind turbines and PV farms operation

Accomplishments

In 2021, TU Lodz developed and validated a control system for the management of operation of LV networks with a large number of prosumer installations. The system aims to reduce power congestion and regulate voltage in individual phases of the network nodes. The applied strategy assumes the use of controllable energy sources and energy storage systems, located in prosumer installations, to perform local energy management on the basis of ancillary services. The developed system was experimentally verified using the RTDS and the HIL method. The system is being implemented on real LV networks.

Furthermore, TU Lodz cooperates with Apator Elkomtech in the field of protection automatic using hardware (and software)-in-the-loop tests.

Remote testing

In the laboratory, multiple testing services were provided for external partners, including the validation of communication systems and protocols applied in the distribution network management systems.

TU Sofia Extending Laboratory Capabilities

New capabilities

Power System Stability Laboratory (PSS Lab)

PSS Pure Lab

- SCADA for interconnected labs remote testing
- AC micro/nanogrid with grid forming/following/supporting inverters
- DC micro/nanogrid 24-990V

PSS Real life living lab with remotely controlled sites for socio-cyber-physical studies:

- AC microgrids with solar, hydro, diesel and storage
- LVDC nanogrids
- Small hydro power plant 615kW

Power Electronics Laboratory (PEL)

- Bench for model based prototyping design and testing of power electronics converters and electric and hybrid vehicles using HIL and rapid-controller-prototyping
- Hardware development system: TMDSHVRESLLCKIT, an EVLSTNRG converter and a STNRG388A controller
- Evaluation boards for automated data acquisition and analysis of experimental data

Consulting services

PSS Lab

- Stability analysis of power systems with inverter interfaced generation
- Analytical and physical PS modelling
- DER generation prediction

PEL

- Model-based analyses and testing of electronic energy converters for power systems including smart grids
- Cooperation with Ultraflex Corporation Ltd., Solarpro Holding and Mantov Ltd

Accomplishments

PEL has established a collaborative project with Ultraflex Corporation Ltd entitled "Development of electronic technological system for induction brazing with improved parameters" under the national innovation fund, session 2021.

Remote testing

In the PSS Lab a real life living laboratory with remotely controlled sites is used to study complex socio-cyber-physical power systems. For the first time, analysis of the social component with human behavior models is performed.

At PEL the virtual activities include tolerance analysis, model based optimisation, automated data acquisition and automatic analysis of experimental databases. The outcomes are improved efficiency, reliability and dynamics of power electronic converters, contribution to the training and education of students and specialists in the field and experience, expertise and know-how in the industry.

High Voltage & High Power
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HIL / Co-simulation
Education & Training

Technical University of Sofia

The Technical University of Sofia (TU Sofia) educates specialists in topics essential for the industrial development: mechanical and electrical engineering, electronics, power generation, transport, automation, computer science and telecommunications, textile engineering, industrial management. The Research and Development Sector (RDS) of TU Sofia deals with the organisation, administration and services of the research activities under contract with national research programmes and industry.

infrastructure.der-lab.net/tu_sofia

Power-Hardware-In-The-Loop Lab at Energy Lab 2.0

- High Voltage & High Power
- Microgrids & Distribution Network
- Power Electronics
- Power Quality & EMC
- PV Systems
- Fuel Cell Systems
- Biomass / CHP Systems
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- Smart Buildings
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- Cybersecurity
- HIL / Co-simulation
- Education & Training

Karlsruhe Institute of Technology

Karlsruhe Institute of Technology (KIT) is a public corporation pursuing the tasks of the Baden-Wuerttemberg state university and of a national research centre of the Helmholtz Association in the areas of research, higher education, and innovation. One key facility of KIT in the area of energy is the smart platform Energy Lab 2.0, which analyses interactions of different components of future energy systems to accelerate the German "Energiewende" (energy transition) and the integration of RES in electricity production.

infrastructure.der-lab.net/kit

New capabilities

- Fully operative 1MVA PHIL
- Digital twin of 60kW flywheel energy storage system, validated by PHIL approach
- PHIL-validated digital real time model of a micro-gas turbine
- Fully operative 1MW resistive load with remote control of power consumption
- In 2022 Energy Lab 2.0 will validate a 500kW 1.6kWh supercapacitor energy storage system by means of PHIL
- In 2022 Energy Lab 2.0 will build a 50kW hydrogen power plant that will be connected to the 1MVA PHIL system

Consulting services

- Testing of power hardware up to 1MVA, 4.5kA, and 1.5kVdc
- Consultancy for energy solutions and their experimental validation, in particular for LV AC and DC applications

Micro gas turbine set-up, photo by Markus Breig

PHIL hall, photo by Markus Breig

Accomplishments

- Dr.-Ing. Giovanni De Carne has been awarded with the Helmholtz Young Investigator Group Leader project (1.5M€, 2021-2026).
- Dr.-Ing. Giovanni De Carne has been awarded the patent "Method for controlling a grid-forming converter, computer program and grid-forming converter" n. EP 3 591 820 B1.
- Dr.-Ing. Shahab Karrari has defended his doctorate "Integration of Flywheel Energy Storage Systems in Low Voltage Distribution Grids" with Summa Cum Laude.

Remote testing

Together with Maschinenfabrik Reinhausen and Kiel University, Energy Lab 2.0 is developing a virtual testing field for power electronics solutions, with a particular focus on smart transformers. The virtual testing field will allow to simulate power electronics-interconnected grids in real time simulators with high accuracy and the possibility to interface the simulated converter with real hardware.

DPSL Growing Virtual Activities

New capabilities

DPSL has seen further developments in collaboration with partners. These include:

- The DC capabilities in DPSL have been extended with new series arcing rigs. These extend facilities for resiliency assessment for grids and decarbonised transport.
- Advanced techniques that allow for PHIL testing of grid forming converters have been realised in DPSL, including for black start capability. This pushes the boundaries of known techniques for high fidelity testing.
- A new platform for the interconnection of laboratories utilising commercial web services has been advanced by DPSL, demonstrating performance suited to industrial adoption of geographically distributed simulation.

Communication and automation test platform

Consulting services

- Rapid prototyping and testing of smart grid controls
- HIL testing of control, protection, communications and automation equipment
- High-fidelity PHIL testing
- Real time simulation of DC and AC grids, including inverter dominated systems
- Evaluation of novel measurement, monitoring and control algorithms and devices
- Witness Testing

New integrated arc fault rig with sample faults

Accomplishment

In 2021-2022 DPSL published 8 journal publications.

Remote testing

DPSL has implemented remote access procedures that allow for running the laboratory remotely. This has allowed the laboratory researchers and their partners to continue their work throughout the pandemic, limiting the impact of access restrictions to abide by COVID implied health and safety regulations.

In one such case, DPSL has supported the remote delivery of an industry-focused converter testing project in a timely manner. This involved collaborating with international engineering teams.

DPSL continues to grow its virtual activities: new MATLAB based applications are being developed to be incorporated and hosted within the Smart Grid Monitoring and Visualisation Platform, a virtual access facility offered by the University of Strathclyde through the ERIGrid 2.0 project.

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- HIL / Co-simulation
- Education & Training

University of Strathclyde Glasgow

The Dynamic Power Systems Laboratory (DPSL) is a research facility of the University of Strathclyde that comprises a 100 kVA microgrid set with real-time simulation and HIL capabilities. The research objectives of DPSL are demonstration of new techniques for distributed power system control, analysis of the effects of components within a system, and testing of protection systems/devices.

infrastructure.der-lab.net/uni-strathclyde

PNDC Accelerating Innovation

- High Voltage & High Power
- Microgrids & Distribution Network
- Power Electronics
- Power Quality & EMC
- PV Systems
- Wind Systems
- Fuel Cell Systems
- Biomass / CHP Systems
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- E-Mobility
- Smart Buildings
- ICT
- Cybersecurity
- HIL / Co-simulation
- Education & Training

PNDC
UNIVERSITY of STRATHCLYDE

As part of the University of Strathclyde, PNDC brings together academics, industrial organisations, and technologists to define and execute pre-commercial research, development, testing, and demonstration of integrated energy systems. PNDC accelerates innovation in the mid-to-late technology readiness levels and delivers technology and system validation using its flexible real-world demonstration environment.

infrastructure.der-lab.net/
uni-strathclyde

New capabilities

PNDC is partnering with Energy Systems Catapult's Living Lab to establish the Whole Energy Systems Accelerator (WESA) in a world-first energy innovation ecosystem that remotely connects real consumers with energy network innovation. WESA will advance novel multi-vector and consumer-facing energy innovations to support the just transition to net-zero and long-term energy affordability for consumers. PNDC is also shaping the future of high power, high integrity transport solutions and accelerating the innovation of net-zero mobility through cross-sector collaboration with partner universities, Driving the Electric Revolution Industrialisation Centres (DER-IC), National Manufacturing Institute Scotland (NMIS) and the Low Carbon Transport Applications Centre (LOCATE).

Consulting services

PNDC is undertaking significant capability enhancement and facilities expansion that further develops its ability to support applied research in integrated whole energy systems incorporating heat, hydrogen and the electrification of transport, to complement existing smart grid activities. This includes technology future-proofing using PNDC's flexible real-world demonstration and testing environment.

Accomplishments

PNDC has continued to support major innovation projects, including Constellation, which will install pioneering intelligence in substations. PNDC was awarded £4.8M funding into pioneering equipment to support the UK's net-zero ambitions and £3 million for the decarbonisation of heavy-duty vehicles. PNDC made a number of major contributions at COP26.

Remote testing

The DEFINIT 2.0 project funded under the ERIGrid 2.0 Lab Access programme enabled Depsys, an SME from Switzerland specialising in smart grid monitoring and control, to validate new fault detection and location algorithms deployed on their GridEye platform. The solution was installed on the PNDC live network and underwent a series of fault testing scenarios. The outcomes from the testing accelerated Depsys' algorithm development leading to follow up network trials with a DSO.

Furthermore, PNDC currently develops a digital control room of the future designed to provide novel solutions for future DNO/DSO control centre operations. This initiative will accelerate innovation to support the DNO to DSO transition, positively impacting interdisciplinary socio-environmental factors.

Research on net zero mobility at PNDC

TUAS Strengthens Resources for RES Research

New capabilities

- A mobile PV lab with A+A+A+ rating based on a LED solar simulator and a high-resolution electroluminescence imaging system was commissioned. Furthermore, another Xenon-based A+A+A+ module solar simulator with temperature control was commissioned.
- An outdoor test facility for PV module benchmarking and energy rating was commissioned.
- A real-time target simulator OP 4510 now completes TUAS' set-up for HIL simulation. As an example, profiles for EV charging curves, PV production, consumers loads and AC grid conditions are implemented in the real-time target simulator. The OP 4510 will control in real time the power loads and sources of the LVDC downscale microgrid model at TUAS. The microgrid controller and local battery monitoring can communicate with any remotely accessible SCADA. The Energy Management System developed and run by other institutions can be evaluated on this platform.
- The lab is now equipped with different EV charging stations, i.e. KEMPOWER T-Series 40 kW DC EV charger.
- Environmental chamber for power electronics, battery and PV module testing was also commissioned.

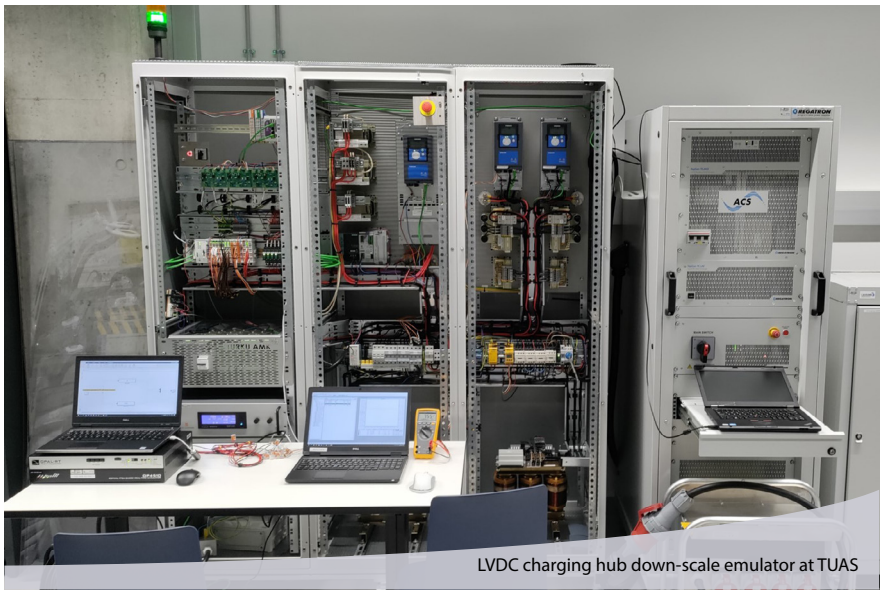
Consulting services

- PV modules and cells testing (indoor, outdoor, on-site)
- PV plant commissioning testing
- Converter testing (efficiency, standard pre-compliance for PV converters and EV battery chargers < 50 kVA)
- Grid code compliance for PV converter and battery chargers
- Power quality impact for bi-directional EV charging stations up to 50 kW
- Distributed energy systems concept development (buildings and districts): sizing, layout, components specification, control strategies, storage integration
- Power quality analysis, clean-up actions and analysis for power line communication in smart metering applications

Remote testing

TUAS has been collaborating with DERlab member HES-SO on LVDC microgrid, distributed energy storage and EV charging hub testing.

TUAS
enviromental chamber



LVDC charging hub down-scale emulator at TUAS

- Microgrids & Distribution Network
- Power Electronics
- Power Quality & EMC
- PV Systems
- Storage Systems
- E-Mobility
- Smart Buildings
- ICT
- Cybersecurity
- HIL / Co-simulation
- Education & Training

TURKU AMK
TURKU UNIVERSITY OF APPLIED SCIENCES

The Turku University of Applied Sciences (TUAS) provides education in the domains of renewable energy production, distributed energy systems, energy storage, power electronics and smart grids, in cooperation with their New Energy Research Center. The facility is equipped with a photovoltaic SOLAR Lab and a distributed energy system DES Lab. The main competences are photovoltaics, wind energy, electrochemical energy storage, power electronics, measuring techniques as well as data management.

infrastructure.der-lab.net/tuas

TECNALIA's Smart Grid Testing Tools

- High Voltage & High Power
- Microgrids & Distribution Network
- Power Electronics
- Power Quality & EMC
- PV Systems
- Wind Systems
- Fuel Cell Systems
- Storage Systems
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- Education & Training

tecnalia
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

TECNALIA Research & Innovation offers technological services, testing and certification, R&D&I projects, transfer of industrial property, business promotion, business diversification, innovation management and foreign support. Among many other experimental facilities, the Energy and Environment Division includes a Smart Grids Area, a High Power Laboratory, a High and Low Voltage Laboratory, and a Distributed Energy Resources Laboratory equipped with several types of generation, storage and controllable loads, including an electric vehicle platform and a smart metering test bench.

infrastructure.der-lab.net/tecnalia

New capabilities

TECNALIA's testing tools for smart grids are used to validate and certify the equipment that conforms to the specifications of the electricity distribution network, such as smart meters, data concentrators, gateways, routers, IEDs, etc. They cover the evaluation of communication protocols, data protocols, functionality, and cybersecurity.

Additionally to previous capabilities, in 2021 TECNALIA designed and developed tools needed for all devices that use the 61850 protocol, in order to facilitate the automation of electrical primary substations.

Consulting services

TECNALIA offers laboratory services for pre-tests, certification tests, inspection tests and training courses. TECNALIA also provides support to utilities in the course of the definition of specifications, design of product evaluation processes and performance evaluation of pilot projects.

Accomplishments

- Testing Tool PRIME 1.4 - Registration number: TXU 2-262-598
- Testing Tool DLMS Functionality - Registration number: TX 8-566-373
- Testing Tool STG - Registration number: HES - TXU 2-234-151

Remote testing

The mentioned testing tools are used by TECNALIA's laboratories, however TECNALIA offers a remote testing solution for manufacturers: by contracting temporary licenses, manufacturers can use the tools at their sites or at home to apply tests during product development and thus accelerating the time to market.

Furthermore, TECNALIA developed three other tools to facilitate the communication between clients and experts:

- myTecnalia: communication platform for the commercial and work process
- Conected Labs: access to TECNALIA labs remotely
- Connected Expertise: access to TECNALIA experts remotely

TECNALIA's Smart Grids Laboratory

CRES and Its Distributed Generation Lab

New capabilities

CRES is implementing an upgrade in the experimental microgrid in order to achieve two main goals: openness and interoperability. To this end several upgrades have taken place in terms of ICT hardware, software and communication protocols. The three main constituents of this endeavour include the use of ESP32 as the core component for data acquisition and control, MQTT as the main communication protocol and Node-RED as the environment for supervisory control. The selection of these tools enables the Distributed Generation Lab of CRES to participate in various remote testing applications while the basics of the setup are easily accessible and understandable to third parties.

Remote testing

The main application that CRES is currently working on is the remote access and operation of the experimental microgrid components. This remote lab application involves the active power balancing of three types of resources, namely PVs, batteries and loads in real time with a time resolution in the scale of seconds. In addition, another activity currently under development is the virtual lab application, which allows users to view and download environmental and PV production data while the application includes models for calculating performances of various PV systems. Both activities are part of the ERIGrid 2.0 project.

New SCADA application in Node-RED for the control of battery inverters and PVs

Consulting services

- Performance evaluation of DER components, power quality issues, microgrid operation and DSM strategies
- Evaluation of control architectures, including central, distributed, decentralised control schemes
- Characterisation of PV systems and their constituent parts based on relevant standards
- Characterisation of battery cells and conformance with relevant standards

Microgrids & Distribution Network
Power Electronics
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ICT
Education & Training

КАПЕ
CRES

The Centre for Renewable Energy Sources and Saving (CRES) is the Greek organisation for RES, RUE and energy saving (ES). Its main goal is research and promotion of RES/RUE/ES applications at national and international levels, as well as support of related activities in the context of sustainable development. CRES offers applied research and technical support to RES sectors such as geothermal energy and active solar systems amongst others.

infrastructure.der-lab.net/cres

RSE's DER - Test Facility Rolling out Hybrid AC/DC

- High Voltage & High Power
- Microgrids & Distribution Network
- Power Electronics
- Power Quality & EMC
- PV Systems
- Biomass / CHP Systems
- Storage Systems
- E-Mobility
- Smart Buildings
- ICT
- Cybersecurity
- HIL / Co-simulation

RSE SpA (Ricerca sul Sistema Energetico) carries out publicly funded national and international programmes in the fields of electrical power, energy and the environment. RSE conducts research in three main areas: all aspects linked to the sustainable development of the Italian electrical power network and related infrastructures, the safe and effective use of primary sources of energy, as well as power generation, transport and distribution, and end-use energy efficiency.

infrastructure.der-lab.net/rse

New capabilities

A new MV infrastructure consisting of two additional MV/LV substations and the possibility of MV grid faults testing and protection coordination is completed by spring 2022. Moreover, a third AC/DC converter between LVDC grid and MV/LV substation (multiterminal LVDC grid) will be installed as well as the integration of a 100 kVA grid simulator.

An experimental 200 kW district heating (gas and electric boilers, heat pumps, storage, heat exchangers) was installed and integrated into the electric grid to realise a multi energy-system which will be expanded with a P2G storage and a CH4/H2 mixture control system in 2023.

Consulting services

As partner in ERIGrid 2.0, RSE offers free access to its DER-TF infrastructure to researchers and engineers involved in the domains of power system testing, smart grids and energy systems to help them perform their own experimental research.

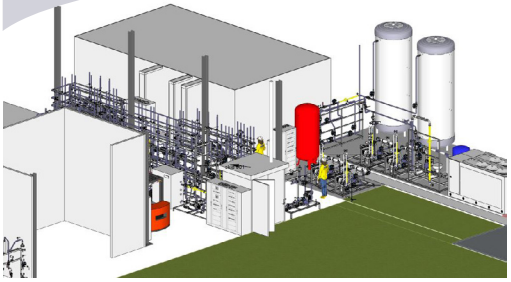
Accomplishments

In 2021, RSE was awarded with new public funding in the framework of the Mission Innovation national activity to improve DER-TF infrastructure, functionalities, and performance.

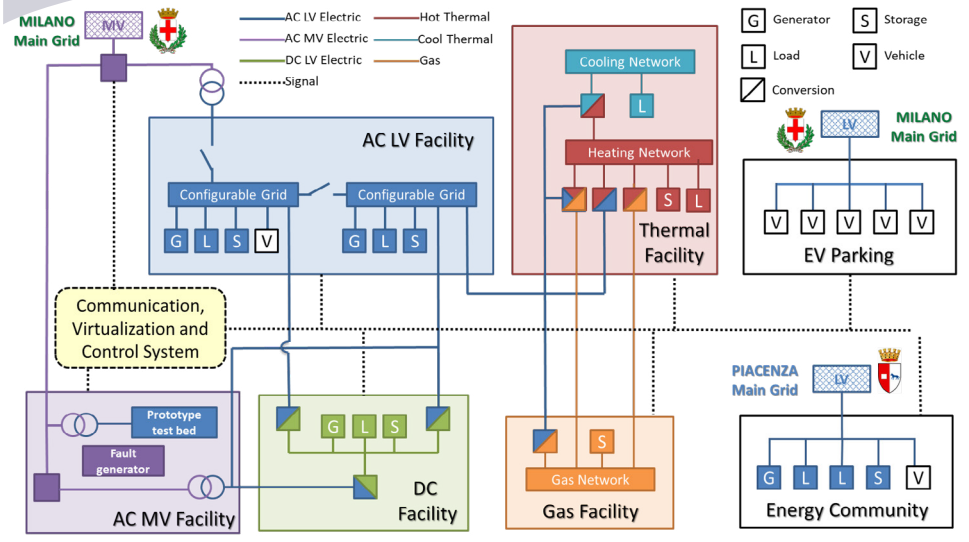
Remote testing

Within the ERIGrid 2.0 project RSE offers Virtual Access to DER-TF Facility via DER-TF DaaS platform that provides access to historical and real-time data of a real LV microgrid. The infrastructure is composed of a time series database and an object storage (topology, assets, test case description). Any user can access this platform through a web-interface that allows to explore the information both at the component and system levels. This infrastructure is cloud-based and relies on a web application, which allows simultaneous use by several users.

Experimental District Heating



Experimental District Heating



FOSS: RTDS and Load Forecasting of Smart Grids

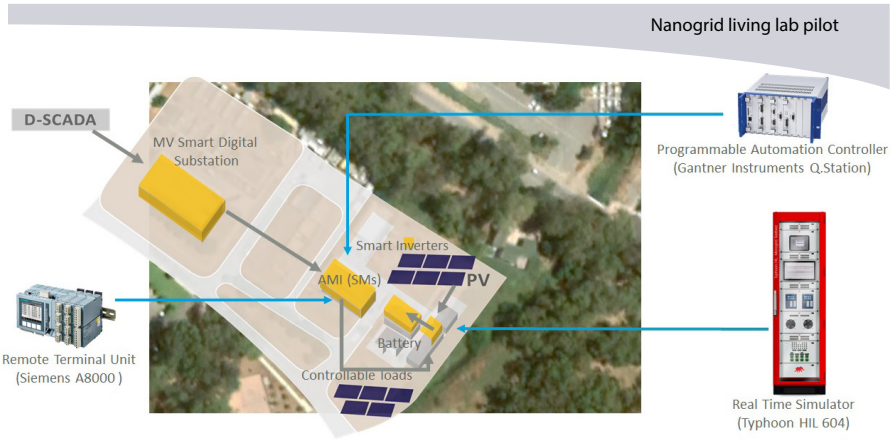
New capabilities

In 2021, FOSS acquired the following upgrades:

- Microgrid supervision and control system: Cloud-based system (programmable automation controller and cloud database) for real-time management of the University of Cyprus microgrid assets
- RTDS test-bed: CHIL smart grid test-bed
- DRMS: Demand side management demonstration platform (thermal loads)

In 2022 FOSS plans to carry out the following upgrades:

- RES and smart grid lab: FOSS has received external funding (total amount: €1.6 million) to upgrade its indoor RES and smart grid facilities.
- Nanogrid pilot: FOSS will install a renewable-powered nanogrid "living lab" for the demonstration of advanced smart grid control concepts.



Remote testing

Accurate demand forecasts present economic consequences for utilities, such as optimal scheduling and dispatching of generating capacity and fuel purchase, which in turn reduce electricity costs.

In 2021, the FOSS team was able to test remotely their advanced day-ahead net-load energy forecasting model. By leveraging machine learning principles applied to feeders of the Cypriot distribution network, the researchers carried out the implementation and performance testing.

This innovative research and testing resulted in the achievement of accurately performing net-load day-ahead forecasting model (<5 % error) as verified by data from actual distribution system feeders in Cyprus.

Consulting services

- Integration of renewable energy sources at distribution networks, standards and grid codes
- Day- and hour-ahead energy forecasting (solar photovoltaic generation and demand)
- RTDS smart grid testing (software- and CHIL)

Accomplishments

- Best poster award for innovative work in the field of solar photovoltaic generation forecasting at the 48th IEEE Photovoltaic Specialist Conference (PVSC) 2021
- Patent EP3872985A1 [01/09/2021] for the early detection of potential induced degradation in photovoltaic systems

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Education & Training

FOSS
Research Centre for Sustainable Energy

The Research Centre for Sustainable Energy (FOSS) of the University of Cyprus strives to be a regional R&I hub of excellence as well as an international state-of-the-art training and education centre. FOSS focuses its research on renewable energy sources with an emphasis on solar energy but has also expertise in energy efficiency and smart electricity grid.

infrastructure.der-lab.net/foss

EES-US Group Upgrading Power Laboratories

- High Voltage & High Power
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- Education & Training

The Electrical Energy Systems Group of the University of Seville (EES-US) carries out multiple research activities in power engineering and maintains strong connections both with the national industry and other research groups worldwide. EES-US covers a broad range of research topics, among which are energy efficiency and power quality, computational and simulation tools for power systems, renewable energy control and integration, and the contribution of distributed generation to ancillary services.

infrastructure.der-lab.net/ees-us

New capabilities

The EES-US Group is currently upgrading the capabilities of its power laboratories:

- Laboratory of scaled-down distribution networks:
  - Installment of a complete industrial SCADA to supervise the MV and LV networks including power analysers at different network nodes, PLCs for automation and IoT technologies for big data capabilities
  - Development of PV inverters with supercapacitors for providing ancillary services (inertia provision, power frequency response and primary power smoothing)

- Laboratory of secondary MV/LV substation for distribution grids:
  - New measurement capabilities in the MV cabinets (voltage and current measurements)
  - Battery energy storage system (100 kW, 50 kWh) interfaced with a converter with virtual synchronous generator capabilities (grid-connected and islanded operations)
  - On-load tap changer based on power electronics (400 kVA, 20 kV)
  - Edge computing for state estimation and voltage control within the secondary substation

Furthermore, the EES-US Group is participating in the IEEE PES Task Force Innovative teaching methods for modern power and energy systems coordinated by Dr. Hatziargyriou and Dr. Kotsampopoulos of NTUA.

Consulting services

- Assessment of grid code compliance for renewable power plants
- Power Plant Controllers of renewable and storage assets
- Optimal planning of wind farms based on NPV maximisation
- Optimal operation of large-scale wind and PV farms
- Wide-area control using PMUs for enhancing stability margins
- Integration of electronic on-load tap changers for distribution transformers
- Ancillary service provision by distributed generation

On-load tap changer

Accomplishments

- Spanish patent P202130853: J.M. Maza-Ortega, F.P. García-López, M. Barragán-Villarejo, AC static switch with extended current range
- European patent PCT/ES2019070363: J.M. Maza-Ortega, F.P. García-López, M. Barragán-Villarejo, A. Gómez-Expósito, Static on-load tap changer for transformers with discontinous regulation windings

Remote testing

The virtual activities are mainly devoted to training within the postgraduate level. The following speakers, among others, participated in webinars organised by the EES-US Group during 2021:

- Dr. Peter Palensky (TU Delft), Cyber-physical security of power systems
- Dr. Mario Paolone (EPFL), Analysis and Representation of Non-Stationary Signals in Inertia-Reduced Powergrids
- Dr. Claudio Cañizares (University of Waterloo), Stability of Microgrids and HV Transmission Grids with Converter-Interfaced Resources
- Dr. Miguel Torres (Universidad de O'Higgins, Chile), Virtual inertia for grid stability: fundamentals and applications
- Mr. Fernando Almagro (CORESO), Coordinated operation of the European network

KEMA Labs Preparing for the Energy Transition

New capabilities

KEMA labs as a division of CESI introduced remote testing for clients and upgraded their High Voltage Laboratories in Mannheim and Milan for HVDC cable testing for zero crossing oscillatory discharge and superimposed impulse testing. The High Power Lab in Arnhem is now prepared for HVDC circuit breaker testing. It was successfully demonstrated with several tests as part of the EU PROMOTioN project on meshed HVDC grids. The Metering Protection and Substation Automation lab prepared for low-power instrument transformer testing (communication, accuracy, higher harmonics and emc/emi). The Flex Power Grid Lab expanded capabilities for system level testing using power cybernetic principles with an EV emulator and insulation test method for (DC) EV chargers. Together with TU Delft, KEMA labs develops a Typhoon-HIL controlled power electronics based complex waveshape generator for medium voltage testing.

Accomplishments

KEMA labs innovation engineer Nadew Belda successfully defended his PhD thesis "HVDC Circuit Breakers – Test Requirements, Methods and Circuits" at TU Darmstadt on 22 September 2021.

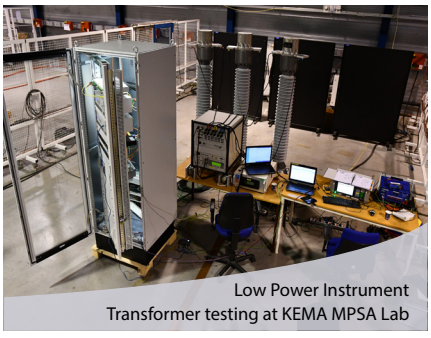
HVDC circuit breaker test at KEMA Labs in Arnhem

Remote testing

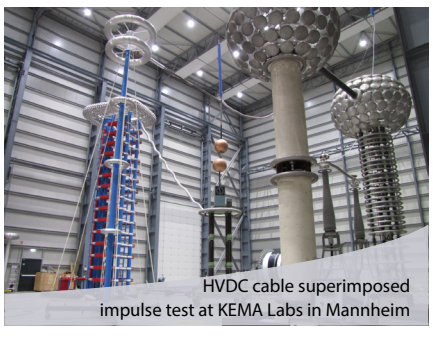
KEMA Labs introduced Remote L@b experience that allows clients to conduct testing campaigns without moving from wherever they are, saving budgets, and taking care of their employees' health and safety. Remote L@b experience consists of:

- local assembling of the test objects by qualified experts remotely guided by the clients' engineers
- test execution with real-time data shared
- qualified experts fully available to support in case of unexpected tasks

This new testing solution enables quality control and business continuity by collaborating closely between the KEMA Labs, utilities, and the manufacturer without compromising on quality.



Low Power Instrument Transformer testing at KEMA MPSA Lab



HVDC cable superimposed impulse test at KEMA Labs in Mannheim

High Voltage & High Power
Microgrids & Distribution Network
Power Electronics
Power Quality & EMC
PV Systems
Wind Systems
Fuel Cell Systems
Storage Systems
E-Mobility
HIL / Co-simulation

KEMA Labs

CESI is a world-leading technical consulting and engineering company in the field of technology and innovation for the electric power sector. Its Division KEMA Labs is the world leader in independent Testing, Inspection and Certification activities for the electricity industry. CESI operates in 70 countries around the world and supports its global clients in meeting the energy transition challenges.

infrastructure.der-lab.net/kema

INESC TEC And Its Smart Grids and Electric Vehicles Laboratory

- Microgrids & Distribution Network
- Power Electronics
- Power Quality & EMC
- PV Systems
- Wind Systems
- Storage Systems
- E-Mobility
- Smart Buildings
- ICT
- Cybersecurity
- HIL / Co-simulation
- Education & Training

INESCTEC
ASSOCIATE LABORATORY
PORTUGAL

The Institute for Systems and Computer Engineering, Technology and Science (INESC TEC) is a private non-profit institution having as associates the University of Porto, INESC and the Polytechnic Institute of Porto. The institute was created to act as an interface between the academic world, the world of industry and services and the public administration in information technologies, telecommunications and electronics (ITT&E).

infrastructure.der-lab.net/inesc_tec

New capabilities

In the recent past, the Smart Grids and Electric Vehicles Laboratory (SGEVL) at INESC TEC has upgraded its infrastructure with the following equipment:

- a new 100kW PHIL amplifier (Dual Three-Phase/Quad Single-Phase/Quad DC)
- a grid model of a synchronous generator 41kVA with synthetic inertia
- a 400 liter positive climate chamber
- electrical safety test equipment (AC-DC Withstand, ground bond, insulation resistance)
- a multiprotocol EV emulator for testing of EV chargers
- a new protection test bed with 12 V/I channels, network interfaces, GPS time server, etc. (analog and digital according to IEC 61850)

In 2022, it is planned to install two laboratory scale hydrogen electrolyzers (PEM and Alkaline) and to acquire standard compliant conducted/radiated EMI test equipment.

Consulting services

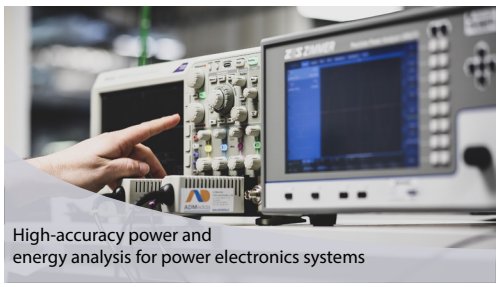
SGEVL, as a laboratory integrated in INESC TEC, has the capability to conduct consultancy work in a broad range of areas. Main expertise areas lie within: power electronics (design, testing, etc.), grid protections and automation (protocols, design, testing, etc.), real-time simulation, smart grids and microgrids (control, architectures, equipment, DER, testing), storage systems (design, control, operation, prototyping, testing) and EV charging (design, protocols, standards, equipment validation and integration).

Accomplishments

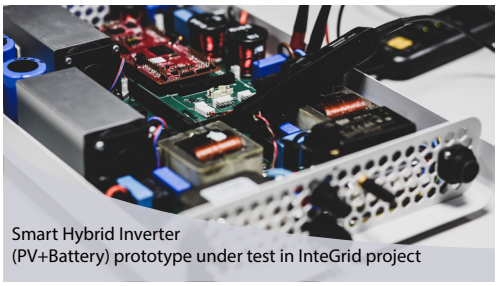
In 2021, INESC TEC obtained European Patent 3180849, regarding a new modulation strategy for matrix converters. The patent had already been previously granted in US and Japan.

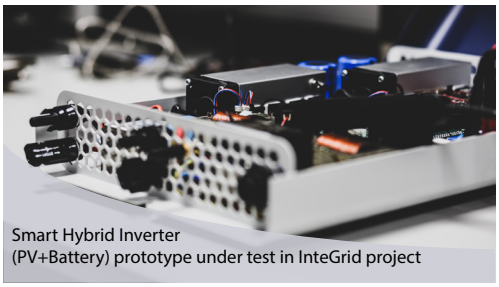
"Remote laboratory activity is quite more challenging in terms of planning and management of operations. During the pandemic crisis, we were able to work in a mixed way (remote and present) and also to work with our partners and clients in the same way. This is still an open topic for us, so we are planning to implement other technologies to help tie together teams working remotely and in the lab at the same time."

- INESC TEC Team


High-accuracy power and energy analysis for power electronics systems


2nd generator
INESC TEC EV charger in use at SGEVL


Smart Hybrid Inverter
(PV+Battery) prototype under test in InteGrid project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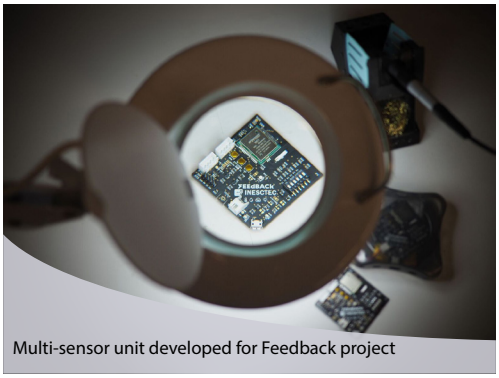

Multi-sensor unit developed for Feedback project

Remote Access Workstations at University of Luxembourg

Microgrids & Distribution Network
PV Systems
Storage Systems
Smart Buildings
HIL / Co-simulation

New capabilities

Remote access to the lab workstations has been implemented to carry out DSO-model simulations for large-scale grid integration of PV inverters and BES.

Consulting services

NetPower DemoLab offers consulting services on power system modelling and large-scale grid integration of PV and battery storage, especially recursive control, hosting capacity improvement, ancillary services and monitoring in distribution grids.

NetPower DemoLab

Accomplishments

A novel substation transformer overloading protection method utilising BES has been developed for enhancing PV hosting capacity in distribution grids via active power PV droops and reactive current from battery inverters. Through delegation of J. Sachau as visiting scientist to the EC-JRC Energy Institute, the EC Guideline EUR 30723-EN on Monitoring of Storage in Subgrids with Photovoltaic Power Generation could be incorporated in the European PV Monitoring Guidelines.

Remote testing

Lab workstations have been used for remote simulations and testing of the droop control of PV inverters and integration of BES into the 43-bus MV network, representative for Luxembourg. The extended droop control has been verified to lower the voltage profile of the feeder, resulting in reduced curtailment compared to regular droop control. The transformer direct loading control method allows for 2-3-fold increase of PV hosting capacity without transformer overloading. It works as protective failsafe control when communication between controller and the PV plants is disturbed, respectively as self-organising active power curtailment in situations with increasing PV grid-integration.

uni.lu
UNIVERSITÉ DU LUXEMBOURG

The NetPower DemoLab of the University of Luxembourg is focused on engineering foundations for recursive systems technology in temporal and spatial aggregation, towards large-scale RE and storage integration in the power grid, carrying out experimental verification of RTD works. It was created with support from Luxembourg´s utility CREOS and the Fonds National de Recherche.

infrastructure.der-lab.net/
uni_luxembourg

Uni Manchester Contributing to Engineering Campus

- High Voltage & High Power
- Microgrids & Distribution Network
- Power Electronics
- Power Quality & EMC
- PV Systems
- Wind Systems
- Fuel Cell Systems
- Biomass / CHP Systems
- Storage Systems
- E-Mobility
- Smart Buildings
- ICT
- Cybersecurity
- HIL / Co-simulation
- Education & Training

MANCHESTER 1824
The University of Manchester

The Electrical Energy and Power Systems (EEPS) and Power Conversion (PC) groups at the School of Electrical and Electronic Engineering of the University of Manchester are at the forefront of research and teaching in the field of electric power engineering. Particular areas of competency of the research groups include transformer insulation and monitoring, polymeric insulation, power system transients, design and operation of power system plants, transmission networks, and smart low-carbon distribution networks.

infrastructure.der-lab.net/
uni_manchester

New capabilities

The HV laboratory is currently moving to the Manchester Engineering Campus Development (MECD). MECD will be the single largest home for engineering in any UK university, and within this home the combination of the communities of staff and students, the spaces and the facilities will deliver a vibrant and truly inspiring environment for teaching, learning and research. The campus will contain a huge variety of adaptable workspaces to support leading research of the University of Manchester. There will be basement areas devoted to heavy duty and vibration isolation laboratories and HV facilities, which will be on full public view behind floor-to-ceiling windows looking out onto York Street.

Consulting services

The University of Manchester offers a wide range of consulting services, particularly for electricity companies, such as National Grid and Electricity North West in the UK. The services range from desk based simulations to laboratory and site tests, in line with the facilities and research interests of the University of Manchester.

AC test set
at the University of Manchester

Furthermore, testing capabilities of the University of Manchester include:

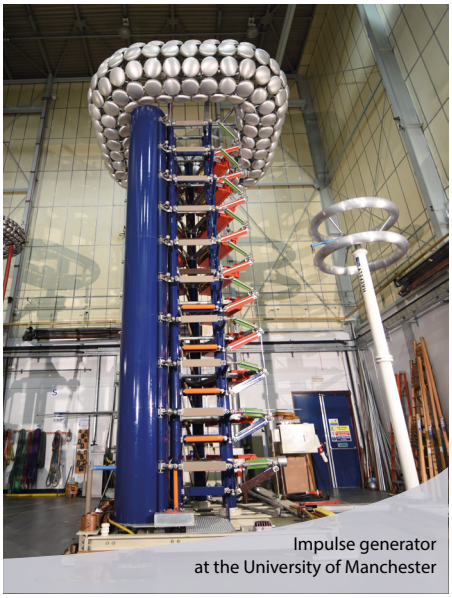
Desk based analysis
- Assessment of new tower, conductor and cable designs
- Electromagnetic field and interference studies
- Earthing analysis
- Failure mode analysis using FEA methods (electrical, mechanical and multi-stress)

Lab Testing
- Noise and corona analysis
- Insulation system design, development and testing
- Non-conventional testing of aged assets
- Condition monitoring of HV plant
- New materials and applications
- Forensic analysis

Site Testing
- Asset Management Techniques
- Long-term testing
- Design of offsite test set-up for HV plant

Accomplishments

Due to the strong research focus, the main accomplishments of the University of Manchester are in terms of publications and research grants.


Impulse generator
at the University of Manchester

PHIL and Battery Cell Testing at FREESI Lab

New capabilities

The research team at the FREESI lab has recently started battery cell testing. The laboratory is equipped with operational battery cell test equipment (Neware BTS8000) with thermal chamber regulating test temperatures from -10°C to +90°C. Specific experiments have been designed, e.g. to study lithium ion battery cell performance characteristics and aging models.

Currently also a new PHIL test setup for microgrid and DER studies is being built. The development of cybersecurity research platform is also on-going. The core of this environment is OPAL-RT real time simulator with integrated communication system emulator from EXATA.

New DC sources
waiting to be commissioned

First battery cell tests successfully finalised

Consulting services

FREESI lab provides various testing and research services to external companies. Based on the long experience in power system simulation, the services offered are primarily related to modern protection and automation system solutions and devices. Furthermore, studies related to the integration of various DER are offered especially to DSOs.

Remote Testing

The real time simulator at the FREESI lab can be accessed and operated remotely utilising virtual machines that are accessible outside the campus using a secure connection. This technique has been used only in some research activities up till now, but some more advanced scenarios for remote testing capabilities are included in the future plans of the FREESI lab.

RTS setup equipped with
time synchronisation capabilities

- High Voltage & High Power
- Microgrids & Distribution Network
- Power Electronics
- Power Quality & EMC
- PV Systems
- Storage Systems
- Smart Grid / Buildings
- ICT
- Cybersecurity
- HIL / Co-simulation
- Education & Training

University of Vaasa
FINLAND

FREESI is one of the laboratories operated by the Vaasa Energy Business Innovation Center (VEBIC) at the University of Vaasa. It is utilised for various research activities related to smart grids and flexible energy resources. The focus is on grid integration of inverter based DER and protection of power systems, utilising also the facilities at the Internal Combustion Engine (ICE) laboratory of VEBIC.

infrastructure.der-lab.net/vaasa

Smart RUE of ICCS-NTUA Advancing Smart Grid Research

- Microgrids & Distribution Network
- Power Electronics
- Power Quality & EMC
- PV Systems
- Wind Systems
- Biomass / CHP Systems
- Fuel Cell Systems
- Storage Systems
- E-Mobility
- Smart Buildings
- ICT
- Cybersecurity
- HIL / Co-simulation
- Education & Training

The research and development activities of the Institute of Communications and Computer Systems (ICCS) of the National Technical University of Athens (NTUA) evolve around different aspects of telecommunications, computer systems and techniques and their application in a variety of areas. Among the research groups of ICCS are the Electric Energy Systems Laboratory (EESL), which offers experimental training for students, and Smart RUE, which focuses on smart grid research.

infrastructure.der-lab.net/iccs

New capabilities

In the recent past ICCS-NTUA gained the following upgrades:

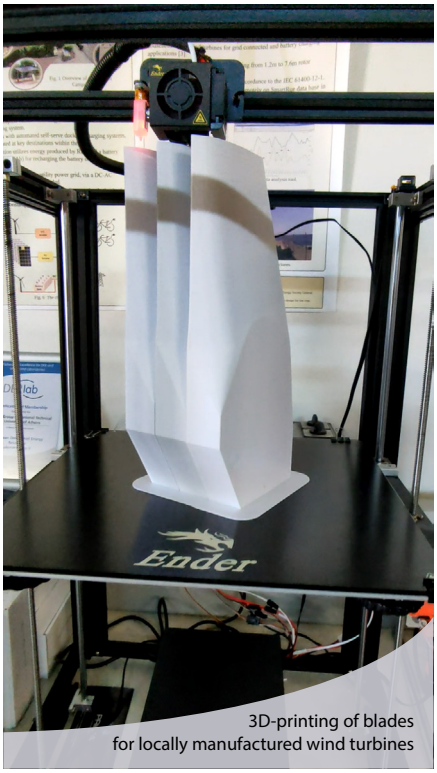
- Significant upgrade of the RTDS real-time simulator: 1 NovaCor unit with high computational capabilities and advanced communication card
- Micro-CHP unit: 6 kW electrical and 14.9 kW thermal output for heating water
- Microgrid central controller (MGCC) and feeder relays for the implementation of centralised and distributed communication schemes for optimal operation and advanced protection. Tests are performed in fully hardware and CHIL setups.
- 3 PMUs, a Phasor Data Concentrator for time-synchronisation of phasor data of multiple PMUs to produce real-time, time-aligned output data streams, and a clock to provide the time stamp, used for the implementation of EMS functionalities, like state estimation
- 3D printer for printing the blades of residential locally manufactured wind turbines

Consulting services

- Laboratory testing of automation controllers according to grid codes and standard requirements based on HIL setups for industrial companies: testing of the central controller for a PV plant connected to the transmission system.
- ICCS-NTUA collaborates with the Greek DSO HEDNO in areas related to the integration of DER and smart grids

Accomplishments

- Prof. Nikos Hatziargyriou was honoured with the prestigious 2020 Global Energy Prize Award
- Panos Kotsampopoulos was elected Chair of IEEE Young Professionals Greece and appointed Editor of IEEE OAJPE
- Kostas Latoufis was appointed Wind Empowerment Coordinator
- "A benchmark system for HIL testing of DER" received the 2020 Best Paper Award of IEEE OAJPE
- European patent application published "Islanding detection method for distribution power grids with high RES penetration"



3D-printing of blades for locally manufactured wind turbines

Remote testing

ICCS-NTUA provides two virtual services, which are also implemented in the framework of the ERIGrid 2.0 project:

- Virtual Lab is an online educational simulation tool that mimics the operation of the actual laboratory microgrid of EES lab of ICCS-NTUA. A mathematical model of the laboratory microgrid has been developed along with a friendly GUI. The tool is web-based and is also used for remote laboratory education at two university courses of ECE school of NTUA.
- OpenAFPM is a set of modelling tools for designers and practitioners to help designing AFPM generators for small scale wind electric systems.

Moreover, ICCS-NTUA provides the Virtual Hybrid Power Plant (in the framework of CROSSBOW project), which is a remote platform integrating non-dispatchable and dispatchable RES along with energy storage.

EELab/Lemcko Developing Its Infrastructure

New capabilities

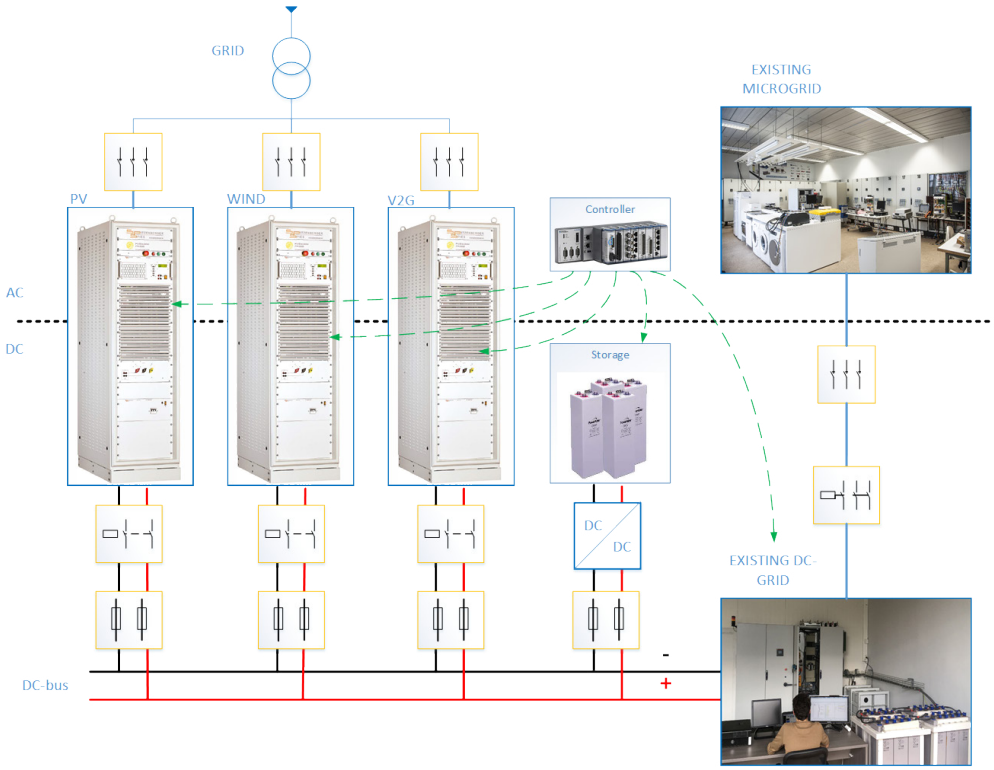
The new capabilities of EELab/Lemcko lab are the full programmable loads of both renewable and storage systems over the LV network. In 2022 it will be extended from 3 to 9 such systems. Furthermore, the development of a new DC emulator is in preparation in the framework of the Hercules Foundation in Belgium. The aim is to create a test field for the development and optimised use of storage systems to increase the hosting capacity in LV grids by analysing the dynamic behavior of renewable energy generation. The described system will have the power of 250kVA. It will be connected by a DC link to the LV grid emulator of EELab/Lemcko.

Consulting services

Both consulting and testing services that EELab/Lemcko provides to external companies are most of all related to ride-through testing for voltage dips or compliance testing.

Furthermore, main research fields of EELab/Lemcko include:

- Computational and simulation tools for power systems
- Distribution planning and operation
- Energy efficiency and power quality
- Energy interfacing with power electronic devices
- Renewable energy control and integration
- Optimal planning, control and operation of wind and PV farms
- Electricity markets
- Contribution of DG to ancillary services
- Development and design of DC backbones
- DC distribution of RES and storage
- Massive integration of EVs in both residential and industrial areas



Scheme of the DC emulator

Microgrids & Distribution Network
Power Quality & EMC
PV Systems
Wind Systems
Storage Systems
E-Mobility
Smart Buildings
Education & Training

LEMCKO Energy & Power Quality

GHENT UNIVERSITY

EELab/Lemcko is the Electrotechnical Research and Power Quality Facility of Ghent University. The facility offers consultancy and troubleshooting, courses and research on three main areas: power quality, distributed generation, and energy efficiency. One of EELab/Lemcko's main objectives is to facilitate the transition from innovative academic research to real-life integration of these innovations into the LV grid by using its expertise in low frequent power quality (<2kHz), general LV electrical installations, energy efficiency and renewable energy connected to the LV distribution grid.

infrastructure.der-lab.net/lemcko

Uni Keele Contributing to Leading Energy Research in UK

- Microgrids & Distribution Network
- PV Systems
- Wind Systems
- Storage Systems
- E-Mobility
- Smart Buildings
- ICT
- Cybersecurity
- Education & Training

Keele UNIVERSITY

The Keele University Smart Energy Network Demonstrator (SEND) – a European first since October 2019, is an at scale environment providing a platform that allows energy generation, distribution, storage, forecasting and energy balancing to be intelligently carried out across different energy sources using the Keele University campus as a genuine "living laboratory". The SEND will deliver better energy management, reduce reliance on fossil-fuel derived energy, significantly reducing energy waste, and provide the opportunity to trial innovative ways of energy use and management.

infrastructure.der-lab.net/keele

New capabilities

Funded by ERDF, the £8.1million Low Carbon Energy Generation (LCEG) project at Keele University will develop a wind, solar and battery storage park, that will generate 50% of the university's power – saving more than 1541.5 tonnes in carbon emissions each year. Up to 15,000 solar PV panels will be installed at ground level in fields on the edge of the campus along with two wind turbines, that together will connect to the Keele's campus microgrid. The LCEG will consist of 5.5MW of ground mounted solar PV, 1.7MW of wind and 1MW / 2MWh battery storage.

Consulting services

- Multi-vector energy network optimisation
- AI/ML based data analytics
- IoT network design and analysis

Accomplishments

- Keele University released multiple publications on AI applications to smart energy networks.
- Keele University is a member of the UKRI EnergyREV consortium, the leading energy research project in the UK.
- Keele University has been named Sustainability Institution of the Year at a prestigious awards ceremony to celebrate sustainability in Higher Education in March 2021.

Remote testing

Keele University has worked with over 30 SMEs on various collaborative projects, most of which happened online in 2021.

SEND facility at Keele University

CVVOZE Opening New Labs

New capabilities

CVVOZEPowerLab facilities were extended to two new laboratories:

- Laboratory for the testing of power-generating modules, battery storage systems and their equipment up to 50 kVA/50 kW (consisting mainly of simulators: Regatron TC.ACS.50.528.4WR.S.LC, Regatron G5.UNV.18.1000.54, EA-PSB 9750-40 and Chroma 62150H-1000S)
- Laboratory for the HIL testing (based on RTDS simulator with equipment: NovaCor with one licenced core, GTAO, GTAI, GTFPI, GTNETx2 w/ IEC 61850 GSE and SMV, GTSYNC; amplifiers: Regatron TC.ACS.50.528.4WR.S.LC and Regatron G5.UNV.18.1000.54)

The High Voltage and High Current Lab gained the following upgrades:

- New LED light sources for a high-speed camera
- New AC source – 2,5kA/10V
- New 3-axis measurement of forces as a function of position
- New meter of polarisation processes in thin solid dielectric materials (PVC, PE, XLPE, etc.)

Consulting services

- Integration of DERs and BESS into distribution systems in consonance with grid codes
- Implementation of RfG and DCC directives requirements for power generating modules, energy storages, EV charging stations, etc.
- Testing of PV and hybrid inverters, and BESS
- EMC of and PQ in industrial and public distribution systems
- Advanced energy management concepts and their implementation
- Consultations in the field of power engineering and testing of dielectric materials and insulation systems of HV equipment
- Simulation of electromagnetic fields in power switching devices
- Simulation of temperature field distribution in power switching devices
- Calculation of radiative properties of plasma (for various compositions)

Accomplishments

CVVOZEPowerLab has become new member of Czech Testing Laboratories Association, certifying the testing quality.

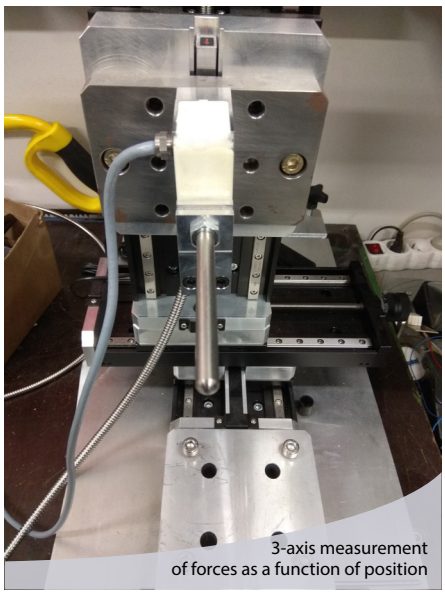
Remote testing

CVVOZEPowerLab offers remote testing possibilities: customers provide samples, and through a online meeting the tests are carried out in real-time. Thus, customers save time and travel costs, yet being part of testing through a virtual meeting.

Further virtual activities include:

- Testing of insulation systems (partial discharge measurement) and electrical strength of insulation systems of HV equipment for commercial companies (testing was performed without the presence of the customer)
- Short-circuit testing of automotive components and circuit-breakers for several customers
- Online training courses in DERs integration, small-scale energy management systems, industrial and public networks PQ and EMC, accompanied with virtual numerical simulation-based experiments

Power generating equipment test stand



3-axis measurement of forces as a function of position

High Voltage & High Power

Microgrids & Distribution Network

Power Electronics

Power Quality & EMC

PV Systems

Storage Systems

HIL / Co-simulation

Education & Training

CVVOZE
Power Laboratories

CVVOZEPowerLab was founded as part of the Centre for Research and Utilisation of Renewable Energy (CVVOZE), a research establishment of the Faculty of Electrical Engineering and Communication at the Brno University of Technology. The research infrastructure consists of laboratories dealing with high current and high voltage, power generating modules and HIL testing.

infrastructure.der-lab.net/cvvoze

Cooperative Papers

Selection of cooperative scientific articles by DERlab e.V. (DERlab member institutes) 2021-2022, www.der-lab.net

Title	Authors	Place of publication
Applicability of Geographically Distributed Simulations	M. Syed, T. Hoang, A. Kontou, A. Paspatis, G. Burt, T. Tuan, E. Guillo-Sansano, S. Vogel, H. Nguyen, and N. Hatziargyriou	IEEE Transactions on Power Systems, October 2021
A Concept for Flexible and Self-Adaptable Classification of ETIP SNET Technologies and Functionalities	C. Papadimitriou, V. Efthymiou, R. Stanev, S. Khadem	17th Conference on Electrical Machines, Drives and Power Systems (ELMA), July 2021
Hardware-in-the-Loop Modelling, Simulation and Closed-Loop Testing of a Distribution Integrated Photovoltaic Plant	C. N. Papadimitriou, C. Charalambous, A. Armenakis, Z. Miletic, W. Tremmel, A. Banjac, T I. Strasser, M. Hadjikypris, George E. Georghiou	3rd CIGRE SEERC Conference, November 2021
Analysis of the applicability of the IEEE 2030.8 standard for testing a microgrid control system	J. Jimeno, J. Merino, A. Perez-Basante, A. Gil de Muro, C. Messner, C. Seitl, T. I. Strasser, J. Hashimoto	3rd CIGRE SEERC Conference, November 2021
PAN European Approach for Strengthening Research and Innovation in Smart Grids, Energy Storage and Local Energy Systems	R. Stanev, M Cabiati , L. Martini, C. Panayi, A. Z. Morch, A. Mutule, T. Tsitsanis, G. Papadopoulos, I. Antoskova, A. Tsitsanis, A. Krusteva, C. N. Papadimitriou, V. Efthymiou, M. Georgiev, T. Todorova, M. Shalaby, P. Carroll, S. Khadem	11th Electrical Engineering Faculty Conference (BulEF), September 2019
Development of Network Codes to Facilitate the Energy Transition	P. Carroll, A. Nouri, S. Khadem, C. Papadimitriou, A. Mutule, R. Stanev, M. Cabiati	9th International Conference on Smart Grid (icSmartGrid), June-July 2021
Modeling of Power Electronics Circuits for Real-Time Simulation	G. De Carne, G. Lauss, M. Syed, A. Monti, A. Benigni, S. Karrari, P. Kotsampopoulos, M. O. Faruque	IEEE Open Access Journal of Power and Energy, February 2022

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