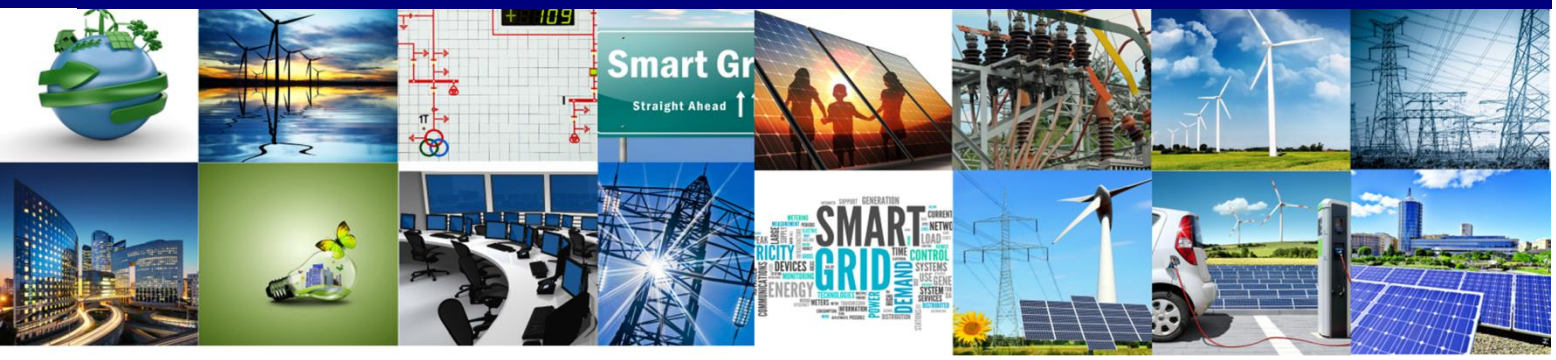
Project No. 609687

FP7-ENERGY-2013-IRP

ELECTRA

European Liaison on Electricity Committed Towards long-term Research Activities for Smart Grids



WP 2

Development of Joint Research Facilities

Deliverable D2.1

European smart grids research infrastructure database

28/04/2015

ID&Title	**D2.1** European smart grids research infrastructure database	**Number of pages:**	33

Short description (Max. 50 words):

This deliverable describes the European smart grids research infrastructure database developed within the project ELECTRA. The database is offering an overview on the facilities, research focus, test labs capabilities, testing accreditations, testing compliance and available equipment of ELECTRA consortium and beyond.

Version	Date	Modification's nature
V0.01	09/09/2014	First Draft
V1.00	23/09/2014	Under Review
V1.01	15/10/2014	Update
V2.00	29/10/2014	Released
V3.00	28/04/2015	Revised – The document was revised in order to include a chapter that presents the detailed extension plans for the RI Database. The database will be extended to cover as many Smart GridsRI at European level as possible.

Accessibility

☐	PU, Public
☒	PP, Restricted to other program participants (including the Commission Services)
☐	RE, Restricted to other a group specified by the consortium (including the Commission Services)
	CO, Confidential, only for members of the consortium (including the Commission Services)

If restricted, please specify here the group:	-

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Executive summary

A Powerful European Research Infrastructure is necessary to reach consensus on harmonized solutions that allow collaboration on the technical level and thereby accelerate the development and implementation of smart grids. In order to foster and support the collaboration of IRP ELECTRA as well as non-ELECTRA partners Deliverable 2.1 and the related task is aiming in setting up and sharing a comprehensive knowledge-base of research infrastructure, testing facilities and important demonstration facilities.

For that reason the existing DER Lab research infrastructure database, is updated by integrating further research infrastructure available within Europe and including the ELECTRA consortium as well as within the IEA ISGAN SIRFN consortium and additional features like available simulation/optimization tools, related libraries and testing protocols.

This database provides information with respect to provisional users' access to specific research infrastructure or testing facilities available within the ELECTRA consortium, as well as publicly available information on the infrastructure use cases and technical results. The entire database is available on the DERlab website at [1]; moreover, a link is also available on the ELECTRA website at [2].

The specific information on the available testing infrastructure of ELECTRA participants is available by accessing the DERlab website at [3].

Terminologies

Abbreviations

AC	Alternate Current
AMI	Automated Metering Infrastructure
BIPV	Building Integrated Photovoltaic
CHP	Combined Heat and Power Plant
DC	Direct Current
DG	Distributed Generation
DER	Distributed Energy Resources
DSO	Distribution System Operator
ES	Energy Saving
EV	Electric Vehicle
GIS	Gas Insulated Systems
HES	Higher Education Sector
GPS	Global Positioning System
HV	High Voltage
HVAC	Heating, Ventilating and Air Conditioning
ICT	Information and Communication Technology
IEA	International Energy Agency
IND	INDustry
IRP	Integrated Research Program
ISGAN	International Smart Grid Action Network
LV	Low Voltage
MV	Medium Voltage
PDC	Phasor Data Concentrator
PLC	Power Line Communication
PMU	Phasor Measurement Unit
PV	Photovoltaic
RES	Renewable Energy Resources
RI	Research Infrastructure
R&D	Research & Development
RTO	Research and Technology Organisation
RUE	Rational Use of Energy
SIRFN	Smart Grid International Research Facility Network
TOQA	Technical Office for Quality Assurance
UV	Ultra Violet
V2G	Vehicle To Grid

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1. Introduction

A Powerful European Research Infrastructure is necessary to reach consensus on harmonized solutions that allow collaboration on the technical level and thereby accelerate the development and implementation of smart grids. Complementing the research activities in ELECTRA WP7, the objective of the deliverable is to create and share a comprehensive knowledge-base of research infrastructure, testing facilities and important demonstration facilities that can be used by IRP participants as well as external users to compare and identify essential capabilities.

The approach of the task is to update the existing database, by integrating further research infrastructure available within Europe including the ELECTRA Consortium as well as the SIRFN/ISGAN Consortium and to further develop it by integrating further features like: available simulation/optimization tools and related libraries, testing protocols.

This database will also provide information with respect to provisional users' access to specific research infrastructure or testing facilities available within ELECTRA Consortium, as well as publicly available information on the infrastructure use cases and technical results.

2 General information on the database

The European Distributed Energy Resources Laboratories (in short DERlab) is an association connecting thirty-four research institutes conducting applied research in the field of Distributed Energy Resources (DER) and Smart Grids in Europe and the U.S. With various activities in research, networking and awareness rising, the association fosters the preconditions of pre-competitive and pre-normative research for a more environmentally sustainable power generation in the future. The European member institutes are accompanied with two institutes (Sandia and NREL) in the U. S. and therefore DERlab facilitates knowledge transfer and networking also at international level. DERlab and its member institutes conduct and participate in projects in research on DER devices and systems, with the special focus on optimization of test procedures and on the development of research infrastructures.

The Consortium's research infrastructure and competence centres cover the most important fields relevant to Smart Grids. Taken together, the available testing and research services already provide a good basis for addressing future research needs. Table 1 shows each partner's main areas of expertise.

Table 1 - Partners main areas of expertise

Participant			Advanced Community (Major Smart Grid-related Projects)					Lab infrastructure / TNA access	Smart grids and DER	ICT / Cyber-security	Co-Simulation	HIL	Commercial Services	Educational Program
No	Short Name	Type	FP7 RI DERri	FP7 RI SOPHIA	DERlab e.V.	EERA JP on SG	EEGI (FP7 GRID+)							
1	AIT	RTO	X	X	X	X	X	X	X	X	X	X	X	
2	CRES	RTO	X		X	X		X	X				X	
3	DTU	HES	X	X	X	X		X	X	X	X			X
4	IWES	RTO	X	X	X	X		X	X			X	X	
5	RSE	RTO	X	X	X	X	X	X	X			X	X	
6	SINTEF	RTO		X		X	X	X	X					
7	TECNALIA	RTO	X	X	X	X		X	X				X	
8	USTRATH	HES	X		X	X		X	X			X	X	X
9	VTT	RTO	X	X	X	X		X	X				X	
10	INESC_P	HES			X	X		X	X			X		X
11	IPE	RTO				X		X	X			X		
12	IEN	RTO				X		X	X			X		
13	ENEA	RTO				X		X	X					
14	TUBITAK	RTO				X		X	X					
15	JRC	RTO				X		X	X					

The database contains systematic information on research infrastructure and related assets, testing capabilities and services of more than 30 research institutes, universities or companies from Europe and the US, which focus on Distributed Energy Resources (DER) and Smart Grids. Over 100 research infrastructures offer research and testing services of DER focusing on different technical subjects.

Detailed technical facility information of the infrastructure can be searched online in the database of DER and Smart Grid Research Infrastructure of DERlab [1]; moreover, a link is also available on the ELECTRA website at [2].

During the project, the Database will be extended to cover RI from European Research Organizations in order to have a powerful RI search tool available for public use.

Specific information on the available testing infrastructure of the ELECTRA participants is available by accessing [3]. Figure 1 presents the online user interface.

Figure 1 - Screen shot of the Database web interface

For each institute the database gives the overview of available testing facilities, as well as the available static and mobile equipment, simulation libraries, simulation and optimisation tools. The quality management as well as the standard compliance of the testing activities are also listed. Figure 2 offers an example of how the research infrastructures are presented within the database.

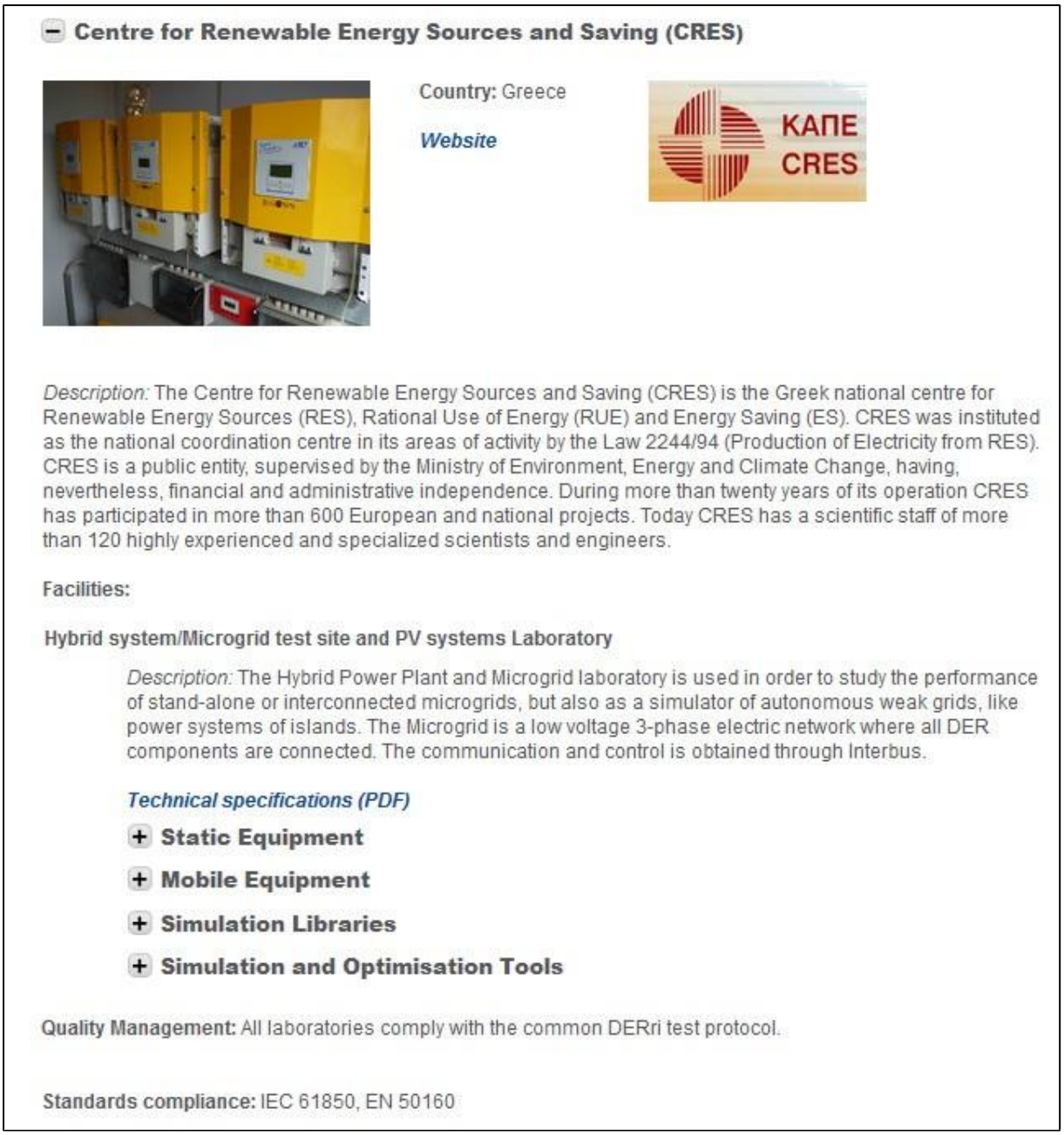

Figure 2 - Screen shot of the results in the database for Centre for Renewable Energy Sources and Saving

This database will also provide information with respect to provisional users' access to specific research infrastructure or testing facilities available within ELECTRA consortium, as well as publicly available information on the infrastructure use cases and technical results.

3 Brief descriptions of each individual institute and related provided testing facilities

In the following subsections brief descriptions of each individual institute and related provided testing facilities are being described.

Transnational collaboration and access of universities, research institutes and industry is supported by using the below-listed available testing infrastructure.

3.1 Austrian Institute of Technology (AIT)

The AIT Austrian Institute of Technology is Austria's largest non-university research institute. Comprising five departments, the AIT is a highly specialized research and development partner to industry. Its researchers are focused on the key infrastructure issues of the future: Health & Environment, Safety & Security, Energy, Mobility, as well as Foresight & Policy Development. AIT takes a leading position in the Austrian innovation system and a key role in Europe as the RTO focuses on the key infrastructure topics of the future. As a national and international network node at the interface of science and industry, AIT enables innovation through its scientific-technological expertise, market experience, tight customer relationships and high quality research infrastructure. With more than 50 years of experience in laboratory development, research and accredited testing, international research activities are now the basis for an extensive collaboration with industry.

Facilities:

The AIT Smart Energy Systems and Technologies (SmartEST) Laboratory and the AIT Power Service Centre offer an excellent environment for testing, verification and R&D in the field of large scale distributed energy system integration, and Smart Grids applications. The laboratory infrastructure accommodates distributed generation (DG) components as inverters, storage systems, Combined Heat and Power (CHP) units, voltage regulators/controllers and other types of related electrical equipment.

Powerful controllable AC and DC sources, allow full-power testing capability up to 1 MVA (AC), including a high-performance photovoltaic (PV) array (DC) simulation.

Additional equipment for simulating control and communication interfaces and the possibility of operating the equipment under defined (extreme) temperature/humidity conditions offers extended testing capabilities going far beyond the standard.

3.2 Centre for Renewable Energy Sources and Saving (CRES)

The Centre for Renewable Energy Sources and Saving (CRES) is the Greek national centre for Renewable Energy Sources (RES), Rational Use of Energy (RUE) and Energy Saving (ES). CRES was instituted as the national coordination centre in its areas of activity by the Law 2244/94 (Production of Electricity from RES). CRES is a public entity, supervised by the Ministry of Environment, Energy and Climate Change, having, nevertheless, financial and administrative independence. During more than twenty years of its operation CRES has participated in more than 600 European and national projects. Today CRES has a scientific staff of more than 120 highly experienced and specialized scientists and engineers.

Facilities:

Hybrid system/Microgrid test site and PV systems Laboratory: The Hybrid Power Plant and Microgrid laboratory is used in order to study the performance of stand-alone or interconnected microgrids, but also as a simulator of autonomous weak grids, like power systems of islands. The Microgrid is a low voltage 3-phase electric network where all DER components are connected. The communication and control is obtained through Interbus.

3.3 Technical University of Denmark - DTU Electrical Engineering

Technical University of Denmark (DTU) is dedicated to develop and create value using the natural sciences and the technical sciences to benefit society. DTU is ranked as one of the foremost technical universities in Europe continues to set new records in the number of publications, and persistently increase and develop partnerships with industry and the public sector. DTU has a large portfolio of projects in the field of renewable energy. Centre for Electric Power and Energy (CEE) concentrate their activities in transformation of the electric power system into a sustainable, efficient and reliable infrastructure based on renewable energy resources. CEE operates the world-class experimental platform, PowerLabDK, dedicated to develop, test and demonstration of distributed energy resources, smart grids and integrated energy systems.

Facilities:

SYSLAB: Research and testing of control concepts and strategies for power systems with distributed control and integrating a number of decentralized production and consumption components including wind turbines and PV-plant in a systems context.

Intelligent Control Laboratory: The Intelligent Control Lab is dedicated to testing and development of new advanced principles for intelligent supervision and control of smart energy systems.

3.4 Fraunhofer-Institut für Windenergie und Energiesystemtechnik (Fraunhofer IWES)

Fraunhofer IWES was founded at the start of 2009 from the merger of the former Fraunhofer Centre for Wind Energy and Maritime Engineering CWMT in Bremerhaven and the Institute for Solar Energy Supply Technology ISET e.V. in Kassel. The research activities of the Fraunhofer Institute for Wind Energy and Energy System Technology IWES cover wind energy and the integration of renewable energies into energy supply structures.

Facilities:

DeMoTec: DeMoTec mainly focuses on electrification with renewable energies using modularly expandable and grid-compatible hybrid power supply systems. Subsystem within DeMoTec: The mini-grid is formed by a single-phase battery power inverter. The current supply is made by two AC coupled PV inverters, connected with Photovoltaic generators. Subsystem within DeMoTec: For Studying the effects of the parallel operation of inverters from different manufacturers, an experimental test facility with over 20 different inverters has been installed.

SysTec - Test Centre for Smart Grids and E-Mobility: In its test centre for smart grids and electromobility, Fraunhofer IWES is developing and testing new equipment and operation strategies for smart low and medium voltage grids. In addition, investigations regarding grid integration and grid connection of electric vehicles and their power generated from renewable energy sources as well as photovoltaic systems, wind energy plants, storage and hybrid systems

are carried out under realistic conditions here. A large open-air ground of approx. 80,000 m² offers sufficient space and very good conditions for solar and wind energy. Furthermore, the open-air ground provides configurable distribution grid sectors (low and medium voltage), as well as a route offering the possibility to test inductive charging systems for electric vehicles.

Battery Laboratories: The infrastructure for testing electrochemical systems comprises automated charging and discharging equipment, climate chambers, and the necessary measuring technology and safety technology. There is also a laboratory for testing fuel cell systems. These facilities are complemented by a development platform for virtual and multi-virtual electrochemical systems such as starter batteries and virtual lithium ion cells.

Competence Centre Rotor Blades: Static and fatigue tests on full-scale rotor blades make it possible in a few months to predict the performance of a rotor blade, according to certification standards, over its 20 year life-span. Loads of up to 50 MNm are applied to rotor blades at various load points on a unique 70 m test stand. The application of the loads using hydraulic cylinders permits precise control of the loading. Fatigue testing is accomplished through cyclic loading at an eigenfrequency of the rotor blade, which provides an ideal load distribution along the blade. This is a fast testing method, with low energy consumption. Through measurement and frequency analyses, the rotor blade eigenfrequencies can be determined. Up to 250 strain gauges along with load cells, cable sensors, angle sensors and acceleration/temperature/humidity sensors provide a wealth of meaningful data.

Development Laboratories for Converters: Fraunhofer IWES develops converters for wind turbines, battery systems and other decentralized electricity generators. Several laboratories are available for the development of electronic circuits. In the laboratory for microprocessor and device-oriented software technology, control circuits for converters can be developed using the hardware-in-the-loop and rapid-prototyping methods. The reliability of equipment can be tested in climate chambers and thermographically.

EMC-Test-Laboratory: Fraunhofer IWES in Kassel carries out accredited tests in its laboratories in accordance with DIN EN ISO/IEC 17025. These are tests on the electromagnetic compatibility of electrical equipment, on the grid properties of converters for decentralized electricity generators (e.g. according to BDEW and FGW TR3), and on the efficiency of photovoltaic converters and systems.

Experimental Centre for Bioenergy System Technology: In collaboration with the Eichhof Agricultural Training and Research Centre, Fraunhofer IWES operates an experimental centre for bioenergy system technology in Bad Hersfeld (Hesse). This covers the whole process chain from biomass production through to grid integration. A biogas test plant with a raw gas capacity of up to 50 m3/h is available for demonstration purposes and pilot plant trials. Up to 6 containers with test equipment can be provided. Experiments on biomass preparation, residue treatment, thermal biogas utilization, and gas upgrading and feeding are possible. Laboratories are also available for investigating specific biological, chemical, and physical parameters.

IWES-TPE: Test Centre for Electromobility: Several Fraunhofer IWES departments have brought together their know-how to create virtual development platforms for lithium ion batteries, charging units, and grid simulators in the new Test Centre for Electromobility IWES-TPE. Based on an existing collaborative agreement with the University of Kassel, the collaborative work is being expanded via the Research Alliance for Vehicle System Technology. The focus of Fraunhofer IWES here is grid integration and the supply of renewable energies. The University of Kassel is focusing on the vehicle system technology.

Laboratory for Control Systems for large Wind Turbines: A development platform for pitch control

systems for rotor blades for large wind turbines is available in order to develop load-reducing control systems. The test stand permits realistic testing of three interacting, controlled pitch drives for individual blade pitch control. Near-real counter-moments are produced via real-time simulation of large wind turbines using synthesized inhomogeneous and turbulent wind fields. There is also a test stand for testing antagonistically controlled pitch drives which permits very low-load blade pitch control.

Offshore Test Locations: The cumulative loads at an offshore test site differ considerably from the loads on materials in laboratory tests. Materials are subjected to extreme conditions offshore: temperature fluctuations, increased UV radiation, exposure to seawater, biologically induced corrosion and mechanical loads. At four test locations – Wilhelmshaven, Sylt, Helgoland and at the mouth of the River Weser – materials and components are being tested under offshore conditions in order to acquire new knowledge about the long-term stability of sensor systems. As the environmental conditions at the locations differ, so do the damage profiles. Accordingly, customized strategies for protection are being developed. Sensors are being increasingly used in offshore wind turbines for recording material fatigue data. They can detect very small changes in the material structure and report these to the system. The results are used for validation and improvement of current laboratory test methods.

Outdoor Testfield of Photovoltaic Modules: In outdoor test fields for photovoltaic systems individual modules and complete systems are measured over a long period in accordance with European guidelines for different manufacturers.

Wind Measuring Network and 200 Meter Measuring Mast: Fraunhofer IWES has since 1990 operated a Germany-wide network of measuring masts. The network currently comprises 30 masts. All the measuring stations are close to wind farms and are fitted with MEASNET calibrated anemometers. Besides the standard 30 m masts (for wind measurement at 10 m and 30 m heights), four 50 m masts have also been erected. These allow not only wind conditions but also other meteorological data to be recorded. The measurement data are recorded at a sampling rate of 1 Hz and are transferred hourly in 5 minute data sets to the data Centre in Kassel. In addition, Fraunhofer IWES operates three mobile LIDAR measuring units and these will be complemented this year by a 200 m high measuring mast.

3.5 Ricerca sul Sistema Energetico S.p.A. (RSE)

Ricerca sul Sistema Energetico SpA has been established at the end of 2005 to take over funded research activities of national and international interest and it started operating on January 1st, 2006. The company, formed by nearly three hundred fifty technicians and researchers, carries out research in the electricity and energy sectors, with strong emphasis on experimental applications. Focus of the mission is to ensure the technology transfer in order to address the national energy, environmental and economic goals. RSE is entirely owned by GSE "Gestore Servizi Energetici" S.p.A and represents an important state-funded national research centre in the sector.

Facilities:

DG Test Facility: It consists of a LV microgrid, connected to the MV grid by means of a 800 kVA transformer. It is constituted by several generators with different technologies (renewable and conventional), controllable loads and storage systems. DER-TF can provide electricity to the main grid with a maximum power of 350 kW.

Demand side Management Experimental House (DSM-EH): The RSE DSM-EH is a 60 m^2 building representing a common residential flat with living room, kitchen, bedroom and bathroom. The central element of DSM-EH is a Home Energy Manager & Gateway (GED), combining signal received from retailer (tariffs) and distributor (emergency) and user preferences regarding comfort and energy saving. In order to succeed with this management, several functionalities have been developed and tested. The main functionality implemented is the load and heating management, i.e. the possibility of switching off some appliances when particular circumstances occur or deciding whether it is better to use electric or gas devices for HVAC purposes.

Distributed Energy Resources Test Facility - Electric Vehicles research: RSE activities in the field of Electric Vehicles have a multidisciplinary approach and aim at evaluating the effects of electric mobility on the whole power system, addressing regulatory aspects and relations with smart cities and communities. Studies concern the analysis of different scenarios of electric mobility, including evaluating their influence on air quality at local and national level; development and application of methods to predict and monitor the impact on the distribution power grid: i.e. evaluation of hosting capacity and dynamic grid behavior. Experiments deal with technological aspects: interoperability; control and communication issues of V2G services; ultra-rapid recharge and aging of batteries and super capacitors.

PV Test Facility: The PV laboratory is part of a low voltage test facility of distributed energy resources (RSE DER-TF) that can be used in conjunction with any PV system to simulate their behaviour in a dedicated grid (the test facility is already available as a RI in DERRI project, financed by EU). Peculiar aspects related to protections and to the energy quality can be analysed using the RSE DER-TF.

CPV Test Facility: RSE has set up a test facility located at Piacenza, in the North of Italy for performance of PV outdoor measurements. The testing facility is located in a place characterized by a global solar annual radiation of about 1400 kWh/m2 year. The test facility is also utilised in the frame of the large integrated Project APOLLON where round robin testing of CPV modules are performed to get comparable and reliable data.

3.6 Stiftelsen SINTEF

The SINTEF Energy Research is developing solutions and systems in the fields of power production, conversion, transmission and distribution, and the efficient end use of energy. A substantial part of the institutes R&D and demo activities are within the electrical power engineering domain. By January 2014 SINTEF Energy Research had a staff of approx. 240 persons. In cooperation with Norwegian University of Science and Technology (NTNU), we have 7000 m^2 of modern laboratories available for research, development and education. In 2012, the Company participated in 25 EU projects and coordinated three of them. In addition, we actively participate in a number of the EU's technology platforms which design the strategies related to our various disciplinary areas.

Facilities:

Renewable Energy Laboratory (REL): The Renewable Energy Laboratory – a collaboration between NTNU (local university) and SIN – is presently the most developed power system laboratory in Norway. The existing laboratories include: the renewable energy laboratory, the energy storage laboratory, the converter and control activities connected to the power electronics laboratory, the installation laboratory and the PV solar panels at the campus. The Renewable Energy Laboratory with its high power rating of 150 kVA and its wide range of network components

is well suited for modelling both transmission and distribution voltage networks with a variety of different generators. The lab includes equipment to emulate distribution and transmission networks as well as energy storage technologies.

The laboratories will be extended to the National Smart Grid Laboratory & Demonstration Platform, which includes for examples a smart house demonstration, remote access, charging for electric vehicles and a shared monitoring and control infrastructure.

3.7 TECNALIA RESEARCH & INNOVATION

TECNALIA Research & Innovation is the first private Research, Development and Innovation (R&D&I) organization in Spain and one of the leading ones in Europe, with a staff of 1500 experts (including 192 Doctors), 22 headquarters and a turnover of 120 million Euro. The mission of TECNALIA is to transform knowledge into GDP, improving people's quality of life by generating business opportunities for companies. To accomplish this, TECNALIA is organized in 7 interconnected sectorial Divisions: Energy and Environment Division, Sustainable Construction Division, Industry and Transport Division, ICT – European Software Institute Division, Innovation Strategies Division, Health Division, and Technological Services Division. TECNALIA's offer includes different activities: technological services, testing and certification, R&D&I projects, transfer of industrial property, business promotion, business diversification, innovation management and foreign support.

Facilities:

INGRID - SMART GRIDS LABORATORY AND INTEROPERABILITY CENTRE: The key research and testing activities of this laboratory are: advanced power system architectures, microgrids for buildings and districts, new power converters for grid connection, smart metering and grid automation, electric mobility (infrastructure, V2G), demand side management and demand response. The Laboratory consists basically on a set of interconnected testing and research platforms, most of them already in operation: - Electrical equipment testing platform (includes high power lab and MV&LV lab) - Microgrid and Distributed Energy Resources (DER) testing platform - Energy storage platform - Smart grids communication platform - Renewable energy testing platform - Electric Vehicle testing platform - Power electronics and energy conversion platform INGRID – TECNALIA Smart Grids Lab, is an accredited laboratory according to EN ISO/IEC 17025 and a member among others of IEC/TC57 ("Power systems management and associated information exchange"), CENELEC/TC210 ("EMC"), Group of Notified Bodies under the EMC Directive (ECANB), and many Technical Committees of AENOR (Spanish Association for Standardization and Certification).

Centre for Development and Demonstration of DER Technologies (Microgrid): Coupled to the 30 kV radial network, the microgrid formed by different generation, storage devices, loads, with a manageable power of 200 kVA. The facility deals with the connection, integration and validation of technologies related to DER including EV, as well as with the operation and control strategies of the entire microgrid.

Characterization and accelerated test lab: The lab includes techniques for : Substrate, cell and encapsulates chemical composition, microstructural morphology and optical properties characterization. The instrumentation comprises SEM-EDS, AFM, XPS, FTIR, Raman and UV-Vis spectroscopy; Equipment for adhesion, hardness and scratch resistance of the encapsulation system; equipment for gloss and color change measurements of the modules; An equipment and test procedure specifically developed for wind particle abrasion testing. - equipment for accelerated

lab tests include chambers for UV aging chamber, temperature and humidity cycling, and salt spray.

ELECTRICAL EQUIPMENT LABORATORY: Conformity Assessment and Certification Services of Electrical Equipment for T&D networks and industrial applications, to certify compliance with national and international standards, regulations and technical specifications from utilities and manufacturers. The facility includes: + Power Laboratory (short-circuit, making and breaking, etc.) 150 kA at LV (under 1000 V) 16 kA at MV (up to 36 kV) + HV Laboratory (dielectric, PD, Tan Delta, etc.) 550 kV at power frequency 800 kV at lightning impulse + LV Laboratory (PI, temperature-rise, climatic, etc) + Power Electronics Laboratory + Environmental Tests Laboratory

EMC Semi-anechoic Chamber: The semi-anechoic chamber is the main facility for EMC tests in TECNALIA. It has the following inner dimensions: 8.4 x 4.9 x 5.4 m (height). Walls and ceiling are covered by a double absorbing system: ferrite tiles and polyurethane foam absorbers. The chamber is used for radiated emission measurements from 10 kHz to 12 GHz and for radiated immunity tests in the range of 80-3000 MHz. Equipment to be tested are placed in a 2m diameter rotatory platform, which is designed for supporting more than 500 kg. Usual distance between equipment under test and antenna is 3 m. TECNALIA is accredited by ENAC (the Spanish member of EA, ILAC and IAF) for the most employed European EMC standards and it is a Notified Body under the 2004/108/CE Directive (European EMC Directive).

Interoperability Centre for Electric Vehicles: TECNALIA has an advanced platform for characterising, developing and validating mechanical and electrical components which can be combined with high performance electric vehicles. TECNALIA especially focuses on EV integration within the smart grid, BMS development, test benches, business models analysis, fast charge and other advanced power electronics based systems. Further fields of research include tele-management as well as data collection systems (EVSE, EVSP, DSO). For wireless charging TECNALIA has developed a system based on are sonant magnetic coupling, able to charge an EV at 3.3 kW with a performance above 93%.TECNALIA complements the research with accredited testing capabilities to measure and assess the compliance of products with Standards and Regulation. TECNALIA already offers services for assessing compliance for EV and their charging infrastructure: Low Voltage and EMC Directives; 61851: Charging Systems for EVs; IEC 15118: EV communication interface and EN61439-7 Low-voltage switchgear, and control gear assemblies.

KUBIK: KUBIK is an international outstanding and unique experimental facility for R&D that provides a real live test bed for building technologies, specially focused on energy uses, aiming for the development of new concepts, products and services to improve energy efficiency in buildings. The main characteristic of KUBIK is the capability to build realistic scenarios (residential, office, schools) to analyse the energy efficiency obtained from the holistic interaction of the constructive solution for the envelope, the intelligent management of the HVAC and lighting systems and the supply from renewable energy.

Optical, thermal and mechanical modelling of PV and BIPV modules: This infrastructure is directed to the application of available software and the development of new theoretical methods and software tools in the field of computational modelling for the optical, thermal and mechanical design of PV and BIPV modules.

Polymer solar cell processing facility: The infrastructure is mainly focused on hybrid cell development with ordered nanostructures by in-situ polymerisation processes and lightweight and flexible/geometry adaptable encapsulation systems.

PV INVERTERS LABORATORY: Support to the International Certification of PV Inverters Up to 300 kW. CE Marking: EN 50178, EMC Germany: DIN VDE 0126-1, VDE-AR-N 4105, FGW-TG

Part 3 Italy: CEI 0-21 Spain: RD 1663 Other markets: EN 50438 Other standards: IEC 62116, IEEE 1547, CSA 22.2, EN 50530, IEC 61683 Voltage Dips: RD 1565/2010 The testing facilities include: LV Microgrid powered with AC and DC buses AC power supply sources: 165 kW adjustable; 450 kW fixed DC power supply sources: 150 & 300 kW adjustable 3 m Climatic chamber RLC loads for Q > 2.5 for 150 kW inverters in anti-islanding tests

SMART METERING LABORATORY: TECNALIA is an official laboratory to certificate the Spanish and Portuguese DLMS/COSEM profiles ("Companion Standards"), developing also the pre-certification testing tools for smart meter manufacturers. TECNALIA collaborates in the Meters & More Association, specifically to include the DLMS protocol in the Meters & More specification. TECNALIA participates in the Certification Task Force, writing different parts of the Test Book for Service Nodes (meters) and Base Nodes (data concentrators), selecting the official certification testing tools and being an accredited test laboratory for this type of equipment. Both PRIME and G3 comply with (ITU-T G.9955 and ITU-T G.9956) and use DLMS/COSEM protocol (IEC 62056) as the data model for the information transfer. Tests: - PRIME protocol certification - DLMS tests - Meter interoperability tests - Smart metering efficiency tests - CENELEC EN50065-1, EN50065-2-3, EN50065-7 and other EMC tests.

3.8 University of Strathclyde

The University of Strathclyde is today the third largest in Scotland with around 15,000 students and 3,700 employees. The Engineering Faculty is home to over 4000 students with 3000 undergraduate, 600 taught postgraduate and 400 postgraduate research students all studying within nine leading departments. The University has four faculties: Business School, Engineering, Humanities and Social Sciences.

Facilities:

Distributed Network and Protection Laboratory (D-NAP): The Institute for Energy and Environment at the University of Strathclyde offers the experimental facility "Distribution Network and Protection Laboratory", D-NAP. This comprises a 100kVA microgrid that can operate grid connected or variously islanded, integrated with a real-time digital network simulator and protection injection laboratory. The facility offers hardware- in-the-loop capability, and incorporates induction machines, programmable load banks and various 1/3 - phase inverters.

Power Networks Demonstration Centre (PNDC): PNDC has capabilities for researching and demonstrating the interaction between the grid and electric vehicles. The facilities include plugin AC and DC charging stations connected to the 400 V network and a wireless 60 kW inductive charging station for heavy-duty vehicles. The network is controlled using an RTDS or SCADA and can run between 49.6 – 61 Hz. This allows investigations into network effects on vehicle charging processes and battery life and the use of smart grid components such as distributed storage and generation. There is also a unique tool to investigate and model vehicle state of charge to support control and forecasting as well as passenger comfort.

High Voltage Technologies and Electrical Plant Diagnostics: The High Voltage Technologies (HVT) and Electrical Plant Diagnostics Group is engaged in fundamental and applied research covering electrical plant, pulsed power technologies and high voltage (HV) materials and components. HVT has a strong track record of pioneering research into many practical applications of HV technology and has spun out four successful companies in recent years. HVT research covers a range of challenging topics, including ultra-fast high energy switches for particle beam fusion experiments; measurement and location of partial discharges in electrical insulation; inactivation of bacteria

using electrical impulses, and diagnosis of defects in HV equipment such as GIS, transformers and cables.

3.9 VTT Technical Research Centre of Finland

VTT Technical Research Centre of Finland is a globally networked multi-technological contract research organization. VTT provides high-end technology solutions and innovation services that enhance the customers' competitiveness, thereby creating prerequisites for society's sustainable development, employment, and wellbeing.

Facilities:

MultiPower: MultiPower is a national empirical research environment where new technical solutions and products for distributed energy system can be tested in a multifunctional environment. There are several independent testing facilities connected together so that the environment may cover production, control and loading concepts. Research infrastructure for DER and other testing activities at VTT is called MultiPower system. The unit from MultiPower 100 kVA can be connected in parallel with a 1,6 MVA diesel generator and up to 1,7 MW resistor load into an internal island network. Connection to 20 kV network is possible, loading up to 200 kVA. The 1,6 MVA generator will act as a rigid network to which the other generating or consuming e. g. 100 kVA units can be synchronized.

3.10 Institute for Systems and Computer Engineering of Porto (INESC)

INESC TEC is an Associated Laboratory coordinated by INESC Porto, a private non-profit institution having as associates the University of Porto, INESC and the Polytechnic Institute of Porto. The activity at INESC TEC runs under the paradigm of the knowledge to value production chain: knowledge and results generated at basic research are typically injected in technology transfer projects and therefore they receive added social relevance. The existence of an Innovation and Technology Transfer Unit assures the effectiveness of this model.

Facilities:

Smart Grids and Electric Vehicle Laboratory: The Laboratory of Smart Grids and Electric Vehicles was designed in order to support the development and testing of solutions and prototypes both for hardware and software modules related to Smart Grid applications, promoting an active and intelligent management of electric grids in scenarios characterized by a progressive integration of micro-generation units and EV. A distinct feature of this laboratory relies on the integration of both commercially available solutions and in-house developed prototypes. The laboratory constitutes the physical space that integrates both equipment and software modules that allows individual and fully integrated development and testing of concepts, algorithms and communication solutions that will allow the operation of a distribution network under normal and emergency conditions.

3.11 Institute of Physical Energetics (IPE/FEI)

The Institute was founded in 1946 as the LAS Institute of Energetics and Machine-Building. As a result of the reorganization of the recent years, 12 laboratories function at the Institute, and the Latvian Technological Centre was founded in 1993 embracing 32 firms, mainly connected with the scientific research areas of the Institute of Physical Energetics.

Facilities:

PMU Test Lab: PMU Test Lab consist Phasor Measurement Unit (PMU) laboratory facility for the development and test of innovative techniques and tools for analysis of transmission technologies and identification of the best technology solutions and implemented devices, as well as evaluation of its impact on power system under liberalized market conditions, including planed HVDC interconnections. A phasor measurement unit (PMU) or synchrophasor is a device, which measures the electrical waves on an electricity grid. A phasor is a complex number that represents both the magnitude and phase angle of the sine waves found in electricity. Synchronization is complete by Global Positioning System (GPS). A phasor data concentrator (PDC) receives and time-synchronizes phasor data from multiple phasor measurements units (PMU) to produce a real-time, time-aligned output data stream and drop defective data.

3.12 Institute of Power Engineering (IEN)

The Institute of Power Engineering (IEN) is one of the largest institutes in Poland and Central Europe providing research in the field of energy technologies. The Institute is a modern state owned research and development Centre. The Institute covers a wide area of energy research from expert works for the power sector, to investigations of the most advanced technologies of energy generation, such as fuel cells, clean coal technologies and renewable energy sources. The advantage of the Institute is the experienced scientific, engineering and technical staff as well as numerous modern, sometimes unique laboratory facilities.

Facilities:

Power System Analysis Laboratory: The laboratory is based on modern PCs with a variety of professional software and is used for different kinds of power system analyses, from load flow to EMTP. More than 20 computers is available. The laboratory also contains a real-time power system simulator set up in a network environment. This simulator is capable of simulating dynamic behavior of a large power system. A part of the laboratory serves the purpose of a hardware-in-the-loop real time testing and prototyping of different devices.

Performance evaluation of AMI PLC communication Laboratory (COM AMI LAB): The COM AMI LAB is established to carry out tests for performance evaluation of PLC PRIME communication between data concentrators and electricity meters supplied by different vendors. The following performance measures can be determined: - data acquisition capability, i.e. the ratio of the number of successfully performed data reading commands and the total number of data reading commands issued by the concentrator during the test, - the average transmission delay, i.e. the average delay measured between the time of issuing data reading command by the concentrator and the time of data response to this reading command during the test.

Power System Automation Laboratory: In the Power System Automation laboratory it is possible to perform diagnostic tests and first run test of the control devices for voltage and reactive power regulation in power system. The tests are performed to confirm technical requirements of devices and to confirm the correctness of new implemented algorithms. Tests are carried out by hardware-in-the-loop simulation method.

For the needs of the laboratory a complete SCADA development system was created in the Institute. Laboratory SCADA can use IEC-60870-101, IEC-60870-103, IEC-60870-104, DNP 3.0, Modbus and S7 (Siemens) communication protocols. Other protocols e.g. ICCP/TASE.2 can be implemented by means of OPC servers.

3.13 Italian National agency for new technologies, Energy and sustainable economic development (ENEA)

The Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) is mainly called upon: to promote and carry out basic and applied research and innovation technology; to disseminate and transfer technologies, encouraging their use in productive and social sectors; to provide high-tech services, studies, tests and evaluations to both public and private bodies and enterprises. The activities on new Technologies for Energy, Renewable Sources and Energy Conservation are conducted by around 400 employees, 90% of which is made up of highly specialised and experienced researchers and technicians.

Facilities:

Smart Grid Laboratory: ENEA experience, in the development of advanced technologies for “clean” energy production, includes research activities on planning and integration of renewable and distributed energy resources in distribution systems also looking at smart grid and microgrid scenario. In particular, ENEA main technical and scientific skills/competences on this subject include: analysis and study of problems concerning the RES utilization and integration in electricity grids in presence of distributed polygeneration; design and development of innovative solutions for photovoltaic applications; storage technologies analysis including performance testing; design of smart sensors network; energy efficiency evaluation/simulation for energy districts (i.e. integration of electrical and thermal network).

3.14 TUBITAK

TUBITAK is the major RTD agency of Turkey. Energy research is ongoing in TUBITAK Marmara Research Centre (MRC) Energy Institute. Research areas include: testing and modelling power plant control systems; evaluation of the user factor; measuring type of load; evaluating the technical and economic feasibility of several distribution automation systems; analysing robustness of power systems; development of automation systems for production and distribution facilities; and determination of the criteria for the development of power systems.

Facilities:

Smart Grid Laboratory: It has a 15 kVA Programmable AC Load, 15 kW Solar Array Simulator (Programmable DC source), Programmable controllers, RF communication modules, etc.

3.15 European Commission Joint Research Centre (JRC)

The European Commission`s Joint Research Centre (JRC) has a significant activity in the field of photovoltaics, which takes place in the Renewable Energy unit of the Institute for Energy. A major feature is the European Solar Test Installation (ESTI), which is a European reference laboratory for the verification of the power and energy generation of photovoltaic devices. Within the SOPHIA project, JRC is leading the networking sub-task on energy prediction and participate in the joint research activity on module lifetime, as well as offering access to its facilities.

Facilities:

Smart Grid Simulation Centre: The Institute for Energy and Transport (IET) is one of the seven institutes of the Joint Research Centre, which is a Directorate-General of the European Commission. The IE is based both in Petten, the Netherlands, and Ispra, Italy, and has a

multidisciplinary team of around three hundred academic, technical and support staff members. The mission of the IET is to provide support to European Union policies in order to ensure sustainable, safe, secure and efficient energy production, distribution and use. One of the IET units that are based in Petten (NL) is dedicated to energy security (ESU). A research action set up within this unit is devoted to studies on smart electricity systems (SES). SES operates the Smart Grids Simulation Centre.

4 Future development plans

Regarding the future development of the RI Database, it will be extended to cover as many as possible European RI in the field of Smart Grids.

The template for gathering the data was prepared (see Annex 1) and will be send out in the next period. It was designed in such a way to cover all aspects of Smart Grids focusing on the technical aspects for a better description of the RI.

The following table describes the next steps for the RI Database development:

Start Date	End Date	Action	Remarks
M13	M13	Add visible links to the database	The database link on the Electra website will be made more visible on the project "Home" page (www.electrairp.eu)
M17	M18	Sending the request template to research organizations	The first round of e-mails will be sent out to contacts gathered from the ELECTRA partners and EERA members
M17	M17	Add direct link to database request template	A special visible section will be organized as a side bar of the database user interface where the RI request form can be downloaded filled and sent to the database administrators
M18	M20	Technical enhancement of the user interface	Additional search features will be implemented in the user interface in order to quickly find relevant information in the database (e.g. free text search option)
M19	M21	Gathering filled questionnaires and update of the database content	The database will be updated with information gathered both from reached contacts and organizations who completed the request form available on the database website
M18	M21	Add additional technical features to the database	
M22	M23	Second round of request	To be sent to organizations registered to DERlab newsletter and any other organizations identified through other means as well as reminders to organizations who did not reply in the first round
M24	M26	Gathering filled questionnaires and update of the database content	
M27	M28	Third round of request	To be sent to organizations any other organizations identified through other means as well as reminders to organizations who did not reply in the first two rounds
M29	M31	Gathering filled questionnaires and update of the database content	
M27	M29	Fourth round of request	To be sent to organizations any other organizations identified through other means as well as reminders to organizations who did not reply in the previous rounds
M30	M36	Gathering filled questionnaires and update of the database content	
M37	M39	Fifth round of request	To be sent to organizations any other organizations identified through other means as well as reminders to organizations who did not reply in the previous rounds
M40	M46	Gathering filled questionnaires and update of the database content	
M13	M46	Technical maintenance of the database	
M13	M46	Database promotion	The database will be promoted through newsletters and other dissemination activities and interlink with other similar or relevant websites

5 Conclusions

In order to strengthen and support the collaboration of IRP ELECTRA as well as non-ELECTRA partners a comprehensive knowledge-base of research infrastructure, testing facilities and important demonstration facilities has been created and shared. Via a public website [2] it can be used by IRP participants as well as external users to compare and identify essential capabilities.

For that reason the existing DER Lab research infrastructure database, has been updated by integrating further research infrastructure available within ELECTRA consortium as well as within the IEA ISGAN SIRFN consortium and additional features like available simulation/optimization tools, related libraries and testing protocols.

This database provides information with respect to provisional users' access to specific research infrastructure or testing facilities available within the ELECTRA Consortium, as well as publicly available information on the infrastructure use cases and technical results. The entire database is available on the DERlab website at [1]; moreover, a link is also available on the ELECTRA website at [2].

In order to extend the RI Database to European level, during the project several requests to Research Organizations outside EERA JP Smart Grids and IRP ELECTRA will be sent in order to gather as much information as possible related to the existing RI. All gathered information will be inserted in the database.

The specific information on the available testing infrastructure of ELECTRA participants is available by accessing the DERlab website at [3].

6 References

[1] Database of DER and Smart Grid Research Infrastructure of DERlab: http://www.der-lab.net/derlabsearch/public/index.php
[2] http://www.electrairp.eu (ELECTRA IRP web site)
[3] Available testing infrastructure of the ELECTRA participants: http://www.der-lab.net/derlabsearch/public/search_smartGrids-Electra_facilities.php

7 Disclaimer

The ELECTRA project is co-funded by the European Commission under the 7th Framework Programme 2013.

Annex 1 – RI information request form

Database of DER and Smart Grid Research Infrastructure

The Database of DER and Smart Grid Research Infrastructure contains systematic information on research infrastructure and related assets, testing capabilities and services of DERlab members and project partners. It presents an overview of more than 45 research institutes and companies, 215 facilities, including universities and companies from Europe and the US with the focus on Distributed Energy Resources (DER) and smart grids.

Research Infrastructure Data Collection Form

Information required for including your research institute/company in the database of DER and Smart Grid Research Infrastructure. Please complete and submit to office@der-lab.net.

1. General Information

Name of the research institute/company:

Country:

Website:

General description of the research institute/company (max. 500 words):

Please attach the logo of your research institute/company in your email.

2. Testing Facilities and Research Infrastructure

If the facilities of your research institute/company comprise more than one laboratory, please complete this Section 2. Testing Facilities and Research Infrastructure for each of them in a separate PDF form.

Name of the laboratory:

General description (max. 150 words):

If you would like to provide further technical specifications of the laboratory, you are welcome to attach technical specification factsheets, flyers, etc. in the email. This material can also be uploaded in the database.

Technical specifications:

If you would like to provide further technical specifications of the laboratory, you are welcome to attach technical specification factsheets, flyers, etc. in the email. This material can also be uploaded in the database.

Static equipment (please indicate the name and give a short description):

Mobile equipment (please indicate the name and give a short description):

Simulation/optimisation tools (please list simulation and optimisation tools and the technical topic they are being used for, e.g., PowerFactory - grid simulation and implementation of local voltage control in generating units models):

Standards compliance (please indicate the standards that can be fully or partly tested in your infrastructure):

Quality management/testing protocols (please indicate the quality standards, protocols, and certifications (e.g., ISO/IEC 17025, ISO 9001, DERri [EC FP7 2009-2013] Protocol) that your laboratory complies with):

Testing services (please indicate the testing services type and give a short description of your testing services related to DER and smart grids):

Technical contact person:

First name: Last name:

Email:

Along with this form, attached in the email are:

- ☐ Additional material on technical specifications of the laboratory (e.g., factsheets, flyers etc.)
- ☐ Logo of your research institute/company
- ☐ Pictures of your research institute/company
- ☐ Logo of the described laboratory (testing facilities and research infrastructure)
- ☐ Pictures of the described laboratory (testing facilities and research infrastructure)
- ☐ Other

Do you have any other laboratories that you would like to be presented in the database?

- ○ **yes (If the facilities of your research institute/company comprise more than one laboratory, please complete this Section 2. Testing Facilities and Research Infrastructure of this form for each of them separately in a new document.)**
- ○ **no**

3. Future Plans

(optional)

Future plans to expand and/or build new laboratories in this research field:

This form was filled out by:

First name: Last name:

Email:

Herewith I give permission for the submitted data to be used in the Database of DER and Smart Grid Research Infrastructure and related DERlab publicity services.

Date submitted: