IRED 2018

International Conference on Integration of
Renewable and Distributed Energy Resources

17-19 October 2018

Vienna

Federal Ministry
Republic of Austria
Transport, Innovation
and Technology

ISGAN
INTERNATIONAL SMART GRID ACTION NETWORK

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY

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DERlab
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SMARTGRIDS AUSTRIA

EGSTON

1. Welcome

History meets future - The 8th International Conference on the Integration of Renewable and Distributed Energy Resources in Vienna, Austria

Today's power sector worldwide has been observing dramatic changes. The main reasons behind these changes are the growing shares of renewable and distributed energy resources (DER) and their advanced functionalities, the introduction of advanced communication technologies, rising volumes of data and the evolution of electricity markets. Within the 8th International Conference on the Integration of Renewable and Distributed Energy Resources – IRED 2018, the future of distributed energy resources and their participation in the power system management and operation will be discussed in the historic ambience of the city of Vienna.

IRED is a global conference gathering experts from industry, government and academia to share information on state-of-the-art technologies, research and know-how and engage in lively discussions related to the integration of renewable and distributed energy resources into the power systems. The conference will focus on the technical, market, and regulatory issues that challenge the integration of these resources into the grid. The goals of this conference are to:

- Share status and latest results of research projects
- Better understand and communicate the visions from various stakeholders and players
- Learn from individual national programs and policies
- Discuss main issues and barriers and identify other needed research and potential solutions
- Stimulate international, national, and regional project and program coordination

The conference will include several opportunities for in depth discussion within pre-conference sessions, post-conference breakouts, a poster session, and evening events.

Conference Chairs

Helfried Brunner
AIT Austrian Institute of Technology

Michael Hübner
BMVIT Federal Ministry for Transport, Innovation and Technology

2. Scientific Committee

IRED 2018
International Conference on Integration of Renewable and Distributed Energy Resources

Hirohisa	Aki	National Institute of Advanced Industrial Science and Technology (AIST), Japan
Josef	Ayoub	National Resources Canada, Canada
Atul	Bali	Power Grid India, India
Minnesh	Bipath	SANEDI South African National Energy Development Institute, South Africa
Roland	Bründlinger	AIT Austrian Institute of Technology, Austria
Graeme	Burt	University of Strathclyde, UK
Mihai	Calin	DERlab e.V.
Remy	Denos	European Commission
Abraham	Ellis	Sandia National Laboratories (SNL), US
Wolfgang	Gawlik	University of Technology Vienna, Austria
Nikos	Hatziargyriou	National Technical University of Athens and HEDNO, Greece
Reza	Iravani	University of Toronto, Canada
Thomas	Key	Electric Power Research Institute (EPRI), US
Benjamin	Kroposki	National Renewable Energy Laboratory (NREL), US
Reji	Kumar Pillai	India Smart Grid Forum, India
Nobuhiko	Kusunose	New Energy and Industrial Technology Development Organization (NEDO), Japan
Andreas	Lugmaier	Nationale Technologieplattform Smart Grids Austria / Siemens AG, Austria
Luciano	Martini	Ricerca sul Sistema Energetico Spa., Italy
Mark	McGranaghan	Electric Power Research Institute (EPRI), US
Satoshi	Morozumi	New Energy and Industrial Technology Development Organization (NEDO), Japan
Alexandre	Prieur	Natural Resources Canada, Canada
Mark	Rawson	California Energy Commission, US
Jim	Reilly	Reilly Associates, US
Yap Choon	Soh	Energy Market Authority, Singapore
Philippe	Strauss	Fraunhofer IEE, Germany
Kazuyuki	Takada	New Energy and Industrial Technology Development Organization (NEDO), Japan
Dan	Ton	Department of Energy, US
Peter	Vaessen	DERlab e.V.
Patrick	Van Hove	European Commission
Weisheng	Wang	CEPRI (SGCC), China
John	Ward	CSIRO, Australia
Karin	Widegren	ISGAN Chair
Chae	Woo-Kyu	Korea Electric Power Research Institute, Korea
Wang	Yibo	China Academy of Science, China

3. Conference Venue

Parkhotel Schönbrunn

Hietzinger Hauptstraße 10-14

1130 Vienna, Austria

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4. Program at a glance

IRED 2018
International Conference on Integration of Renewable and Distributed Energy Resources

History meets future - The 8th International Conference on the Integration of Renewable and Distributed Energy Resources in Vienna, Austria

Time	Tu 16.10.		We 17.10.	Th 18.10.	Fr 19.10.
Morning		ERI Grid SideEvent @ AIT	DERlab side event	IRED 2018 Session 2 Session 3	IRED 2018 Session 5 Session 6
Lunch					
Afternoon	NEDO side event		IRED 2018 Opening Session 1 Session 2	IRED 2018 Session 4	IRED 2018 Session 7
					Site visit Seestadt ASPERN, Vienna
Evening			Hosted Dinner	Poster Session & Reception	

Registration:
Kaiserlounge

Lunch and Coffee breaks:
Kaiserlounge

All sessions:
Ballsaal

Poster reception:
Gallery in the Ballsaal


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5. Conference Programme

Wednesday, October 17th, 2018

Registration and lunch 12:00-1:30 pm

Opening Session – Welcome and Introductions 1:30 p.m.-2:00 p.m.

Chairs: Helfried Brunner, AIT Austrian Institute of Technology
Michael Hübner, BMVIT Austrian Federal Ministry for Transport, Innovation and Technology

Title of talk	Speaker name	Speaker Affiliation
Welcome Speech	Helfried Brunner	AIT Austrian Institute of Technology
Welcome Speech	Michael Hübner	BMVIT Austrian Federal Ministry for Transport, Innovation and Technology
Keynote: DOE Grid Modernization Initiative	Kevin Lynn	US Department of Energy

Session 1: Policies & Programs 2:00 p.m.-3:50 p.m.

Chair: Masayuki Dewaki, New Energy and Industrial Technology Development Organization (NEDO), Japan

Title of talk	Speaker name	Speaker Affiliation
Opening	Masayuki Dewaki	New Energy and Industrial Technology Development Organization (NEDO), Japan
Status and challenges on the power system in Japan	Kazuhiko Mutoh	Smart Community Department, NEDO, Japan
Overview of Policy support of Canada's Renewable Energy Initiatives	Josef Ayoub	Natural Resources Canada
Renewable Research Strategy and Programmes in Austria	Elvira Lutter	Klima- und Energiefonds, Austria
EU leadership in the integration of renewables	Piotr Tulej	European Commission, DG Research and Innovation

Coffee break

Session 2 part 1: Reporting on Results of Large Projects Portfolios 4:20 p.m.-6:30 p.m.

Chairs: Benjamin Kroposki, National Renewable Energy Laboratory (NREL), US
Patrick Van Hove, European Commission, DG Research and Innovation

Title of talk	Speaker name	Speaker Affiliation
Opening	Benjamin Kroposki	National Renewable Energy Laboratory (NREL), US
Opening	Patrick Van Hove	European Commission, DG Research and Innovation
German SINTEG program – Smartgrid Showcase	Tom Ryssel	Federal Ministry for Economic Affairs and Energy, Germany
US DOE Grid Modernization Initiative and Laboratory Consortium	Kevin Lynn	US Department of Energy
European CROSSBOW Project	Manuel Serrano Matoses	ETRA, Spain
Field Test Project for RES Penetration in Niijima Island Grid	Jun Johkaji	Tokyo Electric Power Company, Japan
Recent Developments in Smart Grid Investments in Canada	Josef Ayoub	Natural Resources Canada, Canada
Smart Grid Demonstration Project on Shanghai Chongming Island	Peichao Zhang	Shanghai Jiao Tong University, China

Hosted Dinner
Wiener Rathauskeller
Wiener Rathauskeller
Rathausplatz 1, A-1010 Wien,
www.wiener-rathauskeller.at

Public transport: U4 (Hietzing; close to the conference venue) till station Karlsplatz; change to U2 till Rathaus.

Thursday, October 18th, 2018

Morning coffee

Session 2 part 2: Reporting on Results of Large Project Portfolios 9:00 a.m.-10:30 a.m.

Chairs: Benjamin Kroposki, National Renewable Energy laboratory (NREL), US
Patrick Van Hove, European Commission, DG Research and Innovation

Title of talk	Speaker name	Speaker Affiliation
Recap / Welcome	Benjamin Kroposki	National Renewable Energy laboratory (NREL), US
	Patrick Van Hove	European Commission, DG Research and Innovation
Monitoring 9000 MW photovoltaics worldwide	Javier Sanjuan	DNL-GL, Norway
Prospering from the Energy Revolution: Building scalable business models for the UK	Harsh Pershad	Innovate UK, UK
Evaluating impact of high solar PV penetration considering both the transmission and distribution grid for an Islanded grid (Singapore Grid)	Yap Choon Soh	Power System Operation Division Energy Market Authority, Singapore
Vienna's test bed for the future of energy provision in urban areas	Alfred Einfalt	Siemens Corporate Technology, Austria

Coffee break

Session 3: Markets and Regulatory Frameworks 11:00 a.m.-12:30 a.m.

Chairs: Luciano Martini, Ricerca sul Sistema Energetico – RSE SpA, Italy
Mark Rawson, California Energy Commission, US

Title of talk	Speaker name	Speaker Affiliation
Opening	Mark Rawson	Sacramento Municipal Utility District, US
Opening	Luciano Martini	RSE SpA, Italy
Decarbonisation at least cost - how the consumers can contribute in the new energy landscape	Anne Vadasz Nilsson	Swedish Energy Markets Inspectorate
DER integration as driver for market, operational and infrastructure measures	Christine Materazzi-Wagner	E-Control, Austria
The ETIP SNET Vision 2050 and related market implications	Tbc.	ETIP SNET

Lunch

Session 4 part 1: Transmission and Distribution Interaction, System Integration, Modelling & Simulation 2:00 p.m.-3:40 p.m.

Chairs: Jim Reilly, Reilly Associates, US
Nikos Hatziargyriou, National Technical University of Athens and HEDNO, Greece

Title of talk	Speaker name	Speaker Affiliation
Opening	Jim Reilly	Reilly Associates, US
Opening	Nikos Hatziargyriou	National Technical University of Athens and HEDNO, Greece
ENTSOE (European TSOs) and EDSO (European DSOs) Views on TSO/DSO Collaboration	Norela Costantinescu	ENTSO-e
	Robert Zagrandi	EDSO
EPRI TSO DSO project	Alison O'Connell	Electric Power Research Institute (EPRI), US
Reliability Issues related to transmission and distribution interaction	John N. Moura	North American Electric Reliability Corporation, US
Transmission Distribution co-simulation modelling	Ning Kang	Argonne National Laboratory, US

Coffee break

Session 4 part 2: Transmission and Distribution Interaction, System Integration, Modelling & Simulation 4:10 p.m.-5:30 p.m.

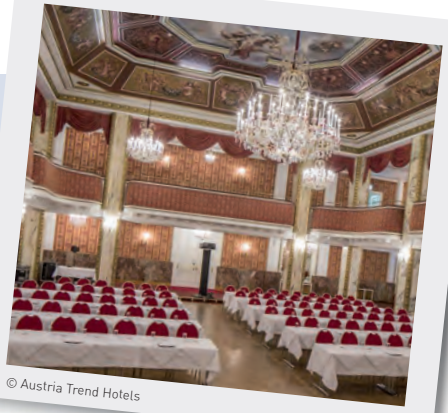
Chairs: Jim Reilly, Reilly Associates, US
Nikos Hatziargyriou, National Technical University of Athens and HEDNO, Greece

Title of talk	Speaker name	Speaker Affiliation
Data exchange and ICT- requirements for TSO-DSO interaction: an international best practice analysis	Mark Stefan	AIT Austrian Institute of Technology
OpSim: test- and simulation- environment for grid control and aggregation strategies	Martin Braun	Fraunhofer IEE, Germany
The approach to high renewable penetration grid and next challenges in Japan	Takeshi Maeno	New Energy and Industrial Technology Development Organization (NEDO), Japan;
SmartNetProject - TSO and DSO coordination for the provision of ancillary services	Gianluigi Migliavacca	EU SmartNet project, RSE, Italy

Poster reception

6:00 p.m.-9:00 p.m.

Chair: Wolfgang Gawlik



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Morning coffee

Session 5: Standards and Evolution of Grid Codes for the Integration of Higher Penetrations of renewable and Distributed Resources 9:00 a.m.-11:10 a.m.

Chairs: Roland Bründlinger, AIT Austrian Institute of Technology
Tom Key, Electric Power Research Institute (EPRI), US

Title of talk	Speaker name	Speaker Affiliation
Opening	Tom Key	Electric Power Research Institute (EPRI), US
	Roland Bründlinger	AIT Austrian Institute of Technology
The Grid Interconnection Standard IEEE 1547 2018	David Narang	National Renewable Energy Laboratory (NREL), USA
Standard for specification of microgrid controllers (IEEE 2030.7) and P2030.11 DERMS	Geza Joos	MCGill University Montreal, Canada
European Network Code Requirements for Generators – update on national implementation in Europe	Thomas Schaupp	European Committee for Electrotechnical Standardization (CENELEC)
Update on Developments in Australia	John Ward	CSIRO, Australia
Challenges of high penetration of renewable DERs into existing grids	Kenji Otani	Fukushima Renewable Energy Institute, Japan

Coffee Break

Session 6: Panel Discussion: Running the Grid Mostly on Renewable Energy 11:40 a.m.-1:00 p.m.

Chair: Abraham Ellis, Sandia National Laboratories (SNL), US

Title of talk	Speaker name	Speaker Affiliation
Moderation	Abraham Ellis	Sandia National Laboratories (SNL), US
Managing RE with flexible thermal energy	Alexandre Prieur	Natural Resources Canada, Canada
Working with high RE penetration in So. Japan	Hirohisa Aki	Tsukuba University, Japan
Managing RE at the bulk system level	Thibault Prevost	RTE, France
Glimpses of 100% RE in Hawaii	Debbie Lew	GE Power, US
Transmission and Large-scale RE	Jingran Wang	State Grid Corporation, China

12:30-1:30 Lunch

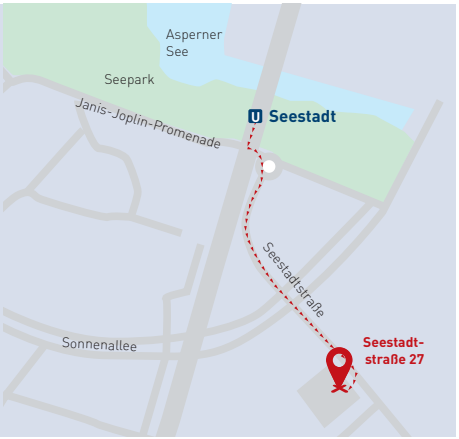
Session 7: Closing Session 1:00 p.m.-3:00 p.m.

Chair: Helfried Brunner, AIT Austrian Institute of Technology

Title of talk	Speaker name	Speaker Affiliation
Opening	Helfried Brunner	AIT Austrian Institute of Technology
Summary Session 1	Masayuki Dewaki	New Energy and Industrial Technology Development Organization (NEDO), Japan
Summary Session 2	Benjamin Kroposki	National Renewable Energy Laboratory (NREL), US
	Patrick Van Hove	European Commission, DG Research and Innovation
Summary Session 3	Mark Rawson	California Energy Commission, US
	Luciano Martini	RSE SpA, Italy
Summary Session 4	Jim Reilly	Reilly Associates, US
	Nikos Hatziargyriou	National Technical University of Athens and HEDNO, Greece
Summary Session 5	Tom Key	Electric Power Research Institute (EPRI), US
	Roland Bründlinger	AIT Austrian Institute of Technology GmbH
Summary Session 6	Abraham Ellis	Sandia National Laboratories (SNL), US
Announcement of IRED 2020 Australia	John Ward	CSIRO, Australia
Closing remarks	Michael Hübner	BMVIT Federal Ministry for Transport, Innovation and Technology

4:00 p.m.-6:00 p.m.
Site visit: Testbed Aspern Smart City Research

Directions: Starting from the conference venue at Parkhotel Schönbrunn, take the Underground line U4 in the direction Heiligenstadt and change at the station Schottenring for the line U2 in the direction Seestadt and go to the final stop. It will take one hour to go there.



Sponsor Technologieplattform Smart Grids Austria

Mission Statement

The Technology Platform Smart Grids Austria is an association of relevant stakeholders in the field of electrical power supply. The Platform was founded in 2008 with the support of the Climate and Energy Fund, the Ministry of Transport, Innovation and Technology and the Ministry of Economy.
The aim of the Platform is to pool joint forces for future intelligent electricity grids in order to support an energy- and cost- efficient system operation. Synergies through coordination of different stakeholders from industry, energy sector, research and public bodies should be used efficiently.
Austrian expertise in smart grids should be strengthened by flagship projects and made visible internationally.

The Technology Platform Smart Grids Austria ...

- connects industries
- promotes innovation
- has a systemic approach towards the power industry
- fosters Austria as an innovation and business location
- is technologically and vendor-neutral
- acts politically independent

The Technology Platform Smart Grids Austria has become a

- Hub for cross-sectoral knowledge exchange
- Pioneer for technology implementation
- Driver for innovation in Austria

The Technology Platform Smart Grids Austria sees itself as

- Cross-sectoral information hub – access to know-how
- Communication forum – exchange with (inter)national experts
- Cross-sectoral coordination platform – shaping the regulatory framework

Learn more about the current flagship project of the Technology Platform Smart Grids Austria:

Project IES -
Integrating the Energy System

IES Integrating the Energy System

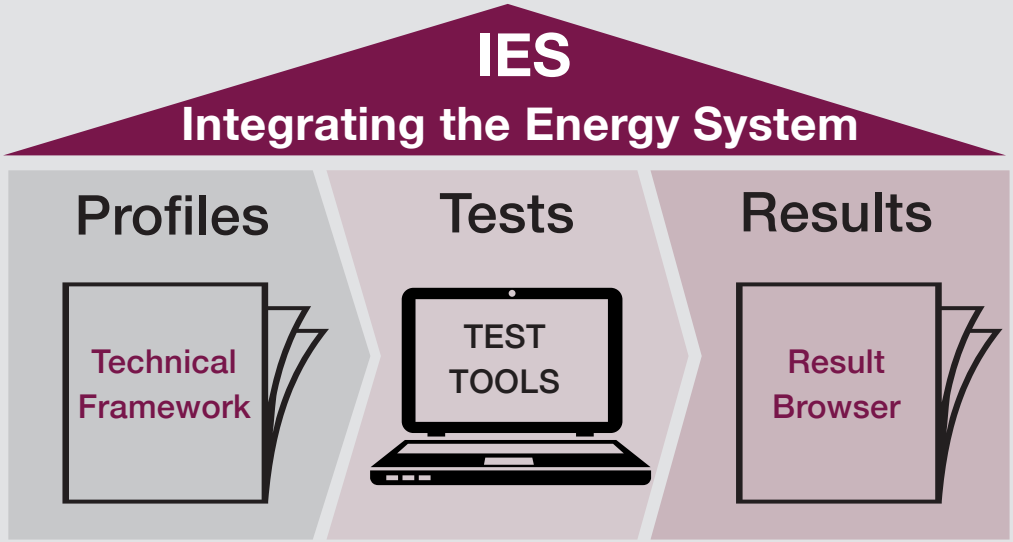
Interoperability represents a key factor for the successful transition of the energy system. The research project Integrating the Energy System (IES) develops a modular process chain to ensure the interoperability of data exchanges in smart grids and smart energy systems.

The IES-approach

IES adapts and implements a vendor-neutral and cooperative method to achieve interoperability of ICT-systems in smart grids. It is based on an existing method from ICT in healthcare, where interoperability of systems has long been achieved. Integrating the Healthcare Enterprise (IHE) is a global non-profit organisation that engages actors in the health system to achieve interoperability of ICT-systems in healthcare. IHE developed a fair, cooperative and participatory method to engage vendors, manufacturers and users alike. By initiating a cross-sector knowledge exchange, the IES team draws from years of IHE-experience and know-how in the health system.

The three IES pillars

IES provides the framework for the development of integration profiles based on real world use cases (pillar profiles). Vendors use IES software tools to test their software products for interoperability and conformity with relevant standards (pillar tests). IES compiles integration profiles into implementation guides called 'Technical Frameworks' and publishes successful test results in an online results browser (pillar results).



IES Connectathon ENERGY
SET-Plan Symposium on Interoperability
January 28-31 - 2019 - Vienna/Austria

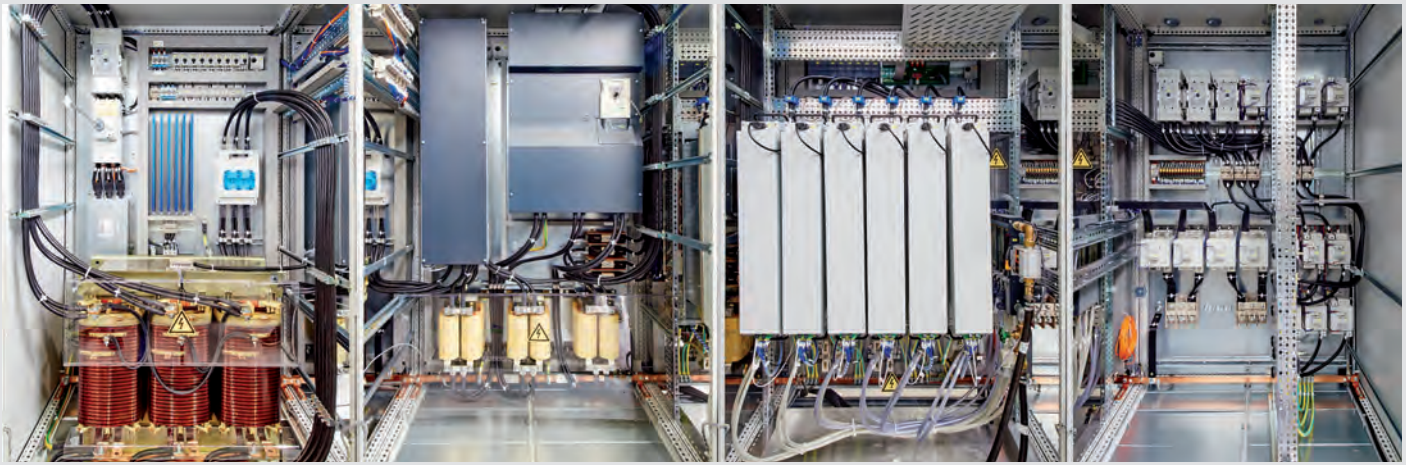
EGSTON Power Electronics GmbH

Perfect power amplification to test your P-HIL harmony

When testing power electronics for electric drives, energy storage or utility interfaces with simulation software, the process must be supported by Hardware-in-the-Loop (HIL) systems based on electronic emulators. For such applications, the Austrian company EGSTON Power Electronics offers galvanic isolated, high-speed Power Electronic Test Benches based on P-HIL technology with a power range of 100kVA up to 2MVA.

Applications and emulation models run on real-time FPGA and standard HIL platforms that are an integrated part of the test system. The high voltage bandwidth is 5 kHz at 440 VRMS and harmonics can be generated up to 15 kHz. That allows the EGSTON P-HIL system to be used as AC source/sink, DC source/sink, smart grid-, aerospace grid-, PV-module-, battery- or electric machine emulator and more, even at the same time. This multipurpose test bench approach reduces the number of test devices that are needed in the lab radically. At the same time, it offers flexibility to have exactly the type of test bench needed by just selecting the mode that is needed in the software that is delivered with the system.

The EGSTON Compiso Power-HIL System is a customer specific turn-key solution which is based on modular blocks. It is connected to a 50 or 60 Hz low voltage supply grid through a bidirectional converter and grid transformer which also provides galvanic isolation. Groups of 4 or 6 Compiso digital amplifiers are connected to a DC-BUS. Voltage and current is measured at each amplifier output terminal. All measurements are available in the HIL real-time processor as inputs for the simulation models. The amplifiers are shown as voltage or current source in the HIL architecture. The HIL drives the amplifiers through high speed fibre optic links. The user can run its individual real-time model on the HIL. To guarantee a save operation between the HIL and the amplifiers a high speed low latency SFP Interface is provided.



AIT Austrian Institute of Technology GmbH

AIT Austrian Institute of Technology GmbH is Austria's largest Research and Technology Organization (RTO) and belongs to the first league worldwide in many areas of research. This makes it a powerful development partner for industry and one of the top employers in the international scientific scene.

AIT is strategically positioned as a key player in the Austrian and European innovation system by performing applied research for and enabling the market exploitation of innovative infrastructure related solutions. The functionality of "bridging the gap" between research and technology commercialization is a key aspect of developing new technologies and enabling an economic boom.
With regard to the Austrian innovation landscape, the AIT fulfils this role by its new orientation, providing a research environment to help key industries facing mid- to long-term challenges.
Unlike universities that are focusing on basic research and addressing short-term exploitation, AIT covers the entire spectrum from taking up emerging technologies, first proof of concepts, applied research to transferring these emerging technologies into specific applications up to demonstrators and prototyping. This allows us to connect basic research and the usage of new technologies for the industry and thereby pave the way for commercialization.

The AIT is developing solutions to ensure a holistic view on the future energy and mobility system. Our research services are based on longstanding experience based on international co-operations, scientific excellence, and state-of-the-art laboratory infrastructure. The topics on energy are: smart grids, electric drive technologies, photovoltaics, electrochemical storage systems, vehicle2grid technologies, thermal energy systems, smart cities and smart buildings. In the field of mobility AIT investigates new technologies and processes in the pillars transport infrastructure, low-emission transport and multimodal mobility systems, that are safe, efficient and ecologically sustainable.
We act as a leading innovation partner for national and international industry providing applied research services that give our customers the required cutting-edge expertise to open up future markets.

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6. Side Events

Tuesday, October 16th, 2018

AIT Laboratory-based Services for Smart Grids: Best Practices from the ERIGrid Project

Venue: AIT Austrian Institute of Technology, Giefinggasse 2, 1210 Vienna

Time: Registration starts at 8:30 am

Workshop 9:00 am-17:00 pm

Event summary

Power system testing issues have not been much considered in laboratory context up to now. Up till now supporting future development of smart grid solutions and technologies was done on component level, but system level issues need to be considered too. Pure simulation and current laboratory-based approaches need to be combined and enhanced, since they are not always sufficient to tackle complex problems. Therefore, there is a need for harmonizing the existing flexible simulation and co-simulation tools, advanced validations methods using hardware-in-the-loop testing environments and for improving laboratory testing of component and small-scale power system.

The proposed workshop intends to bring together the relevant stakeholders, initiatives and projects to discuss the state-of-the-art and future aims. The discussions should also support the knowledge exchange of running projects.

The following research topics will be considered in the workshop:

- Improvement of existing laboratories with ICT systems
- Developed advanced testing scenarios and corresponding methods form a systems integration point of view
- Improvement of hardware-in-the-loop approach fostering system integration tests, combining co-simulation and real setups for advanced system integration tests

Contact: Thomas.Strasser@ait.ac.at. https://erigrid.eu

NEDO NEDO Smart Community Showcase 2018 – Let's talk about technology demonstration

Venue: Parkhotel Schönbrunn, Hietzinger Hauptstraße 10-14, 1130 Vienna,
Souterrain: Room Franz Joseph I+II

Time: 13:30 pm - 19:00 pm

Event summary

NEDO has carried out 17 international smart community Demonstration Projects. More than half of these are done in Europe with European Partners.

NEDO wants to enhance our demonstration project with your knowledge and suggestions. Stakeholders of Japan and partner country related to NEDO demonstration projects mainly in Europe introduce the project plan and results for discussion.

The following topics will be discussed in the Symposium (tentative)
1) Transmission / Distribution reliability improvement: Poland Project: Slovenia Project
2) Battery application: Niedersachsen Project, Speyer Project, California Project
3) Demand response: Lisbon Project

Contact: nedo_smart_showcase2018@nedo.go.jp

DERlab Grid Control for Inverter Dominated Power Systems

Venue: Parkhotel Schönbrunn, Hietzinger Hauptstraße 10-14, 1130 Vienna: Room Österreich-Ungarn

Time: 8:00 a.m. -12:30 p.m.

Event summary

The power quality and reliability of today's power systems is mostly based on synchronous generators. In order to operate the future power systems securely and stably with very high shares of inverters, appropriate control algorithms and operation procedures have to be developed. Inverter systems can partially reproduce physical properties similar to those of synchronous generators. Selected new characteristics have to be implemented in grid codes and suitable testing procedures have to be developed.

Following research questions are relevant in this area:
Under which conditions and control methods can inverters be operated stably?

- How many voltage-controlled inverters are required at the different voltage levels? What are the requirements concerning spatial distribution and control capabilities?
- What shares of rotating generators, current controlled and voltage-controlled inverters can guarantee power system stability?
- To which extent can "must-run-units" be reduced and replaced by inverter-based generation with enhanced functionalities?
- What is the target scenario for frequency and voltage regulation in the future interconnected power systems with very high shares of inverter coupled generation?

The proposed workshop intends to bring together the relevant stakeholders, initiatives and projects dealing with the topic for discussing the state-of-the-art and future aims. The discussions should also support the knowledge exchange of running projects. This event will be the kick-off for the international research cluster "Grid control for inverter dominated power systems".

Friday, October 19th, 2018

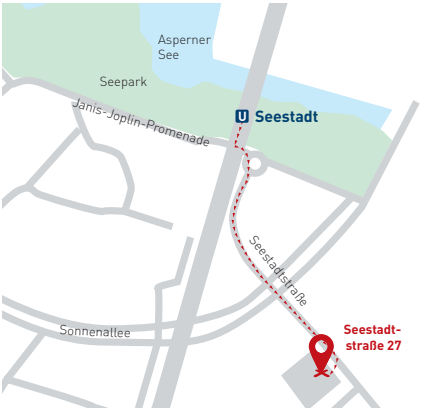
Siemens Site visit: Testbed Aspern Smart City Research

Venue: Meeting: Before the building of the Seestadt Technology Center, Seestadtstrasse 27, 1220 Vienna

Time: 4:00 p.m. – 6:00 p.m.

Directions:

Starting from the conference venue at Parkhotel Schönbrunn, take the Underground line U4 in the direction Heiligenstadt and change at the station Schottenring for the line U2 in the direction Seestadt and go to the final stop. It will take one hour to go there.



Event summary

During the visit you will be able to see the Demo Center, have a walk through the Seestadt Aspern and visit an intelligent secondary substation within the testbed.

The testbed Aspern Smart City Research focuses on energy management, smart buildings, smart grids, smart ICT and smart users. To optimize the utilization of energy, technologies and consumption, an integrative system approach is used.
ASCR was identified as the world's best Smart Project 2016. It prevailed against more than 250 projects from 45 countries at the Smart City Expo World Congress in Barcelona, the world's largest event on the subject of smart cities.

ASCR Democenter:
In an interactive showroom, visitors are given the opportunity to get to know the complex research programme and all its facets. A tour through the Demo Center demonstrates all about how the production, storage, distribution and consumption of energy can be efficiently designed in an urban context. Presentations are tailored to the interests and prior knowledge of the visitors.

Walk through the Smart City Vienna Living Lab District - Seestadt Aspern:
You will be able to see the Seestadt Aspern in real life operation – including the visit of one intelligent secondary substation. In total 12 secondary substations, 24 transformers of different types (including one variable), numerous sensors in the substations and supply lines with different measurement accuracy (including power quality measurements) as well as smart meters make up the basic infrastructure of the ASCR Smart Grid testbed. Furthermore, there are five grid storage systems in the substations with important functions both for the grid and the energy market. ASCR is investigating how to turn passive distribution network operations into actively managed smart grid operations.

In addition, three buildings – a residential building, a student home and a school campus (currently a nursery school and primary school) – constitute the smart building research objects of ASCR. Equipped with photovoltaic panels, solar thermal panels, hybrid panels, heat pumps and various thermal as well as electrical storage facilities, smart materials, building technology and IT, the buildings of tomorrow act as flexible prosumers. Complex ICT systems facilitate the optimum, automated management of energy distribution, consumption, storage and transmission. Furthermore, smart buildings can also participate in the electricity market.

Contact: anna.kaltenbaeck@siemens.com

7. Poster Abstracts

High-speed Flywheel Energy Storage System (FESS) for Frequency and Voltage Support in Low Voltage Distribution Grids

Karrari, Shahab (Karlsruhe Institute of Technology (KIT), Eggenstein-Leopoldshafen, GER); Noe, Mathias (Karlsruhe Institute of Technology (KIT), Eggenstein-Leopoldshafen, GER); Geisbuesch, Joern (Karlsruhe Institute of Technology (KIT), Eggenstein-Leopoldshafen, GER)

A high penetration level of renewables and Distribution Energy Resources (DER) has adverse effects on the power quality in low voltage distribution networks. This issue is further escalated with the introduction of e-mobility infrastructure at this voltage level. Energy storage systems with high power density such as Flywheel Energy Storage Systems (FESS) can help to improve power quality measures by voltage and frequency support, unbalanced load compensation, and harmonic compensation.

The new-generation high-speed FESS with superconducting magnetic bearings is superior to its earlier types with lower self-discharge rates (as low as 0.1% per hour, including the idle power), higher speed and therefore higher energy contents, and lower maintenance. For developing such system and its controllers having accurate real-time simulation models can help to analyze the effect of the existing parts on the rest of the systems prior to system-level testing. In this work, a FESS with superconducting bearings has been simulated in real-time with appropriate controllers for voltage regulation and frequency support in a low voltage distribution benchmark grid.

The FESS and the benchmark grid is simulated in one real-time simulator, while the controllers exchange signals in a Hardware-in-the-Loop (HIL) testing platform. The obtained real-time simulation results confirm the effectiveness of the FESS and its controllers for voltage regulation in distribution networks and contributing to grid frequency regulation. This work is part of preparation steps towards the Power Hardware-in-the-Loop (PHIL) testing of such systems.

Grid Operation and Resiliency

Data-Driven Detection of Events in Distribution Power Systems

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With the advent of Distribution Phasor Measurement Units (D-PMUs) and Micro-Synchrophasors (Micro-PMUs), the situational awareness in power distribution systems is going to the next level using time-synchronization. However, designing, analyzing, and testing of such accurate measurement devices are still challenging. Due to the lack of available knowledge and sufficient history for synchrophasors' applications at the power distribution level, the realistic simulation, and validation environments are essential for D-PMU development and deployment. This poster presents a vendor agnostic PMU real-time simulation and hardware-in-the-Loop (PMU-RTS-HIL) testbed, which helps in multiple PMUs validation and studies. The network of real and virtual PMUs was built in a full time-synchronized environment for PMU applications' validation.

Flexibility Requirements in Future Power Systems

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The evolution of the modern power system includes changes impacting the grid operation such as:

- Increasing maximum utilisation, optimised operation based on economic incentives
- Differentiated utilisation pattern, influenced by demand/production and market structures
- Increasingly interconnected, with increased inter-area power transfer
- Increasing number of, and distribution of, production units
- Demand response, load types and active consumers

These changes lead to challanges to maintain a secure and stable operation, e.g.:

- Identification of true operational state and limits, even more important when increasing maximum utilisation
- New system and operational criteria, to cope with increased changes and market requirements
- Large number of participants, increasing need of information exchange
- Decreased amount of inertia and changed dynamic response

The flexibility aspect is seen as key in the future power system to cope with such challanges to plan and operate the power system in a secure and reliable manner. Requirements on flexibility in the future powe sustem may relate to e.g.:

- production: increased flexibility regarding fault-ride-through-capability, where RoCoF requirements on generators are already increasing in some power systems
- transmission and distribution: increased flexibility regarding transfer capability, where dynamic ratings and seasonal limits of OHL, cables & transformers are becoming more advanced
- demand: increased flexibility regarding acceptable voltage and frequency levels, with decreasing power quality will we see the need for revising standardised acceptance levels with increased requirements on components and systems

This poster will present an overview of how flexibility requirements may be in the future power system, including aspects from all levels in the power system.

Innovative Grid Operation Planning Tool for TSOs and DSOs

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In the H2020 project **INTERPLAN** (2017 to 2020), an INTEgrated opeRation PLANning tool towards the pan-European network is being developed to support the EU in reaching the expected low-carbon targets while maintaining network security and reliability.

A part of this research is dedicated to development of a methodology for a proper representation of a clustered model of the pan-European network, with the aim to generate grid equivalents as a growing library able to reflect all relevant system connectivity possibilities occurring in the real grid and addressing operational issues at all network levels. A thorough analysis on existing grid codes and regulations at European and national level has been carried out in the project. Shortcomings to integration of renewables, storages and electric vehicles as well as associated national practices have been identified.
Considering the identified shortcomings and practices, use cases addressing the main challenges in operating the future EU grid at all network levels have been developed. The use cases cover the following topics:

- Coordinated voltage control
- Optimal DER allocation, placement and sizing for grid congestion and energy interruption management
- Frequency tertiary control based on optimal power flow calculations
- Fast frequency restoration control
- Power balancing at DSO level
- Increased resilience of the interconnected grid with effective use of local resources
- Inertialess grid potential offering high efficiency, security and quality of supply

The poster introduces the project objectives and the concept of grid clustering. It also demonstrates the results of the grid code study as well as the defined use cases.

Regulatory Issues

Simultaneous Ascending Auction: a local flexibility mechanism tool

Abdelmotteleb, Ibtihal (Universidad Pontificia Comillas, Madrid, ESP); Chaves Avila, Jose Pablo (Universidad Pontificia Comillas, Madrid, ESP); Gómez San Román, Tomás (Universidad Pontificia Comillas, Madrid, ESP)

Coordination of local resources is required to efficiently utilize the increasingly flexibility available from customers in the short-term and investment in distributed energy resources (DERs) in the long-term. Local Flexibility Mechanisms (LFMs) complement efficient distribution network charges. Such mechanisms will lead to efficient end-user responses, integration of new flexibility services, avoidance of unnecessary network investments and consequently lower total system costs. One type of LFM is presented here: short-term LFM that operates through Simultaneous Ascending Auction (SAA). SAA operates within the day-ahead time frame. When network peak hours are expected the next day, SAA operates to utilize customers' flexibility by allowing them to book their network capacities in advance, and hedge against expected high distribution network charges.

Control, Protection and Energy Management

Engineering and Validation Support for Cyber-Physical Energy Systems

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The rollout of smart grid solutions has already started and new methods are deployed to the power system today. At the same time the massive deployment of distributed generators from renewable sources in recent years has led to a fundamental paradigm change in terms of planning and operation of the electric power system. Automation and control systems, using advanced information and communication technology, are key elements to handle these new challenges. But, with such new approaches and concepts also new challenges emerge. The implementation of such complex systems solutions is associated with increasing engineering and development complexity resulting in increased total life-cycle costs. However, with the usage of proper methods, automation architectures, and corresponding tools there is a huge optimization potential for the engineering process. Until now such a method has been missing.
We address these shortcomings with a concept for a model-based engineering and validation support system, covering the overall engineering process for smart grid applications—from use case design to validation, and finally deployment and com-

missioning. Based on a model-driven development approach, the methodology consists of three main parts: (i) specification and use case design, (ii) automated engineering, and (iii) validation as well as deployment.
In the end, the goal is to provide automatic generation and deployment of target code and configurations for smart grid applications. This will be combined with an automatic testing and validation methodology in order to improve the general quality and mitigate the current risk of developing smart grid applications.

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

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Future power systems have to integrate a higher amount of distributed, renewable energy resources in order to cope with a growing electricity demand, while at the same time trying to reduce the emission of greenhouse gases. In addition, power system operators are nowadays confronted with further challenges due to the highly dynamic and stochastic behaviour of renewable generators and the need to integrate controllable loads.

Sophisticated (systems and component) design approaches, intelligent information and communication architectures, and distributed automation concepts provide ways to cope with the above-mentioned challenges and to turn the existing power system into an intelligent entity, that is, a smart grid.

While reaping the benefits that come along with intelligent solutions, it is, however, expected that due to the considerably higher complexity of such solutions, validation and testing will play a significantly larger role in the development of future technology. As it stands, the first demonstration projects for smart grid technologies have been successfully completed, it follows that there is a high probability of key findings and achieved results being integrated in new and existing products, solutions and services of manufacturers and system integrators. Up until now, proper validation and testing methods and a suitably corresponding integrated Research Infrastructure (RI) for smart grids is neither fully available nor easily accessible.
The aim of this work is to tackle the above-mentioned issues by an integrated Pan-European RI with corresponding smart grid system-level validation methods that are being currently implemented in the framework of the European project ERIGrid.

Integrating Measurement and Control Technologies for DERs with Utility DMS: A Field Demonstration Project

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Distribution management systems (DMS), distributed energy resource management systems (DERMS), microgrid energy management systems (μEMS), and individual DER control systems are being deployed individually at various levels. The intent of this project is to understand the benefits and overcome the challenges of integrating these systems and their DER assets with the larger utility grid and operate them as a single system. Argonne National Laboratory along with PECO, EPRI and other DOE labs is undertaking an initiative to demonstrate the interactions of these systems in an integrated environment. This will be accomplished through; modelling, simulation, HIL testing, and ultimately field demonstration trials at PECO's planned microgrid at the Berwyn Service Center

In this poster, we will highlight some of the pre-deployment research activities carried out over a three-year (Jan 2018-Dec 2020) field demonstration project funded by the DOE where the goal is to demonstrate the interaction of these systems. This will be done through field trials with an integrated DMS that interacts with OMS and D-SCADA. The integrated DMS will offer support services to the grid, customers and markets, while providing enhanced grid resiliency and reliability from interconnected DERs. We will present the architecture for an integrated DMS and technical details for enabling the integration along with communication and messaging requirements.

Among the direct benefits of well-planned integrated DMS operating with the distribution utility are greater reliability through better integration of renewables, reduced outage duration, reduced electricity costs, carbon reduction, and the potential for revenue from access to ancillary service markets.

IEA DHC Annex TS3: Hybrid Energy Networks - District Heating and Cooling Networks in an Integrated Energy System Context

Schmidt, Ralf-Roman (AIT Austrian Institute of Technology GmbH, Vienna, AUT)

The vast integration of electricity, district heating/cooling and gas networks is an important element for the decarbonization of the energy system. The optimization of coupling points such as cogeneration, power-to-heat and power-to-gas enables the creation of key synergies.

The aim of IEA DHC Annex TS3 is to highlight the potential of district heating and cooling networks within such a hybrid energy system and at the same time address the challenges. This is including the assessment of technologies and synergy potentials, the evaluation of tools and methods for evaluation, planning, design and operation of hybrid energy networks, the review of international case studies and te development of suitable business models, legal framework conditions and political instruments.

The primary result of the Annex is a handbook summarizing the main results of the international activities. Furthermore short summaries for decision makers will be created in cooperation with IEA ISGAN. In addition, an international community will be created in which parallel and follow-up projects will be initiated.

Solar and Wind Energy Integration

Power Hardware-in-the-Loop Test Bench for the Integration of Renewable and Distributed Energy Resources

Brandl, Ron (Fraunhofer IEE, Kassel, GER); Strauss-Mincu, Diana (Fraunhofer IEE, Kassel, GER); Montoya, Juan (Fraunhofer IEE, 34121, GER)

Power Hardware-in-the-Loop (PHIL) systems proved to provide an efficient option to perform laboratory investigations focusing on stability and operation of power systems while allowing to integrate physical hardware and related controls and to consider complex and close-to-reality scenarios. Furthermore, PHIL testing environments have the advantage of offering a close-to-reality or worst-case testing environment that enables repetitive investigations, thus de-risking field tests.

A scientifically accepted and standardized procedure on how a PHIL setup should be designed is of high general interest. International working groups (e.g., IEEE P2004 WG, ISGAN-SIRFN) and projects (e.g., Horizon 2020 ERIGrid1 project) in the field of advanced testing methods depict the necessity for a standardized description of the design of PHIL testing environment setup, as well as for PHIL-based testing procedures. This publication proposes a successfully implemented approach for designing PHIL-based testing environments. This suggestion will be introduced to the above-mentioned international scientific platforms to become an internationally accepted harmonized approach.

Island Grids and Micro-Grids

Research Transfer for the Grid-stable Energy Transition of Islanded Power Grids

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Microgrids and islands need a holistic analysis to tackle grid stability as a bottleneck of their energy transition. It shall include 1) the assessment of an optimal energy mix with high shares of renewable energy sources (RES) ensuring power balance, 2) the inclusion of static stability constraints with power flow analysis, 3) the inclusion of dynamic stability constraints with time-domain analysis. These are the three columns our research transfer project "elena" (electricity network analysis) stands on and that we want to present with this poster.

We conduct the "elena" project based on our long-standing research at PIK. We transfer this research into practice by developing Open-Source code for island and microgrid planning.
We will adjust the OS-Software PyPSA (T. Brown et al., Journal of Open Research Software, 2018) to the specific needs of small power systems. It undertakes optimal power flow calculations for grid-stable unit commitment and generation asset optimizations.

Dynamic stability analysis is our core expertise. It has been identified as one of the fundamental issues with increasing RES penetration (HPoPEIPS by ENTSO-E, 2017). In our research, we found that control schemes of power electronics may cause instabilities if poorly designed. With DPSA.jl we build the first OS-software for dynamic power system analysis. Using Julia as a high-performance programming language we allow for incorporating novel features from the dynamics of RES and power electronics by making use of cutting-edge solvers (Rackauckas et. al., Journal of Open Research Software, 2017) for different types of differential equation systems.

Transmission and distribution systems in the future power system

Hillberg, Emil (RISE Research Institutes of Sweden, Borås, SWE)

To support an accelerated development and deployment of Smart Grid technologies and market solutions, a group of international experts gather and spread knowledge through ISGAN Annex 6.
The work of Annex 6, on **Power Transmission & Distribution Systems,** promotes solutions that enable power grids to maintain and improve the security, reliability and quality of electric power supply. The annex has four focus areas with the intention to lead the path forward within:

- Expansion Planning and Market analysis
- Technology Trends and Deployment
- System Operation and Security
- Transmission and Distribution System Interaction

This poster will present some recent results of ISGAN Annex 6, illustrating a global view within the areas of:

- market solutions for flexibility:
  - flexibility is gaining increased focus, and solutions for increasing flexibility are seen as one of the foundations towards the future power system.
  - To use this flexibility in a coordinated way, an ever closer cooperation between System Operators will be required.
  - Several approaches for the coordinated use of flexibility for system balancing and congestion management are imaginable, and here a concept of a single marketplace for flexibility is presented.
- holistic views on system efficiency:
  - an overall perspective of system efficiency becomes increasingly important in the era of deployment of a smarter and more sustainable energy system.
  - System efficiency is a multifaceted concept, which is here broken down in the dimensions: emissions; energy; and economics, presenting five action areas for efficiency improvements

8. Contact Information

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