5th International Conference on

Integration of Renewable and Distributed Energy Resources

December 4-6 2012 | Berlin, Germany

CONFERENCE SUMMARY AND PROCEEDINGS

PREPARED BY: SANDIA NATIONAL LABORATORIES

MARCH 2013

Table of Contents

5th International Conference on

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December 4-6 2012 | Berlin, Germany

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5th International Conference on
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Message from the Conference Co-Chairs

The growing share of renewable and distributed energy resources in power systems requires the development of efficient measures for their integration. Since the first International Conference on Integration of Renewable and Distributed Energy Resources that took place in Brussels 2004, grid integration technology has continuously improved. Many technical and non-technical issues have been solved or are now better understood. However, as the scale of deployment increases, new important challenges are emerging.

In the last few years, the topic of new smart grid approaches that support the efficient grid integration of small generators, storage units and controllable loads has gained considerably higher attention. A number of deployment projects including large-scale field demonstrations have been conducted in many countries. This conference will offer the opportunity to learn about these projects and to discuss results with the partners involved.

Like at the previous events, the latest technical, market and policy aspects related to integration of renewable and distributed energy resources and smart grids will be discussed in plenary sessions. It is the intention of the conference to support the interdisciplinary discussion among different stakeholders promote lasting collaboration among key players from all over the world. Conference side events like workshops, and committee meetings on standardization and other related topics that will take place before and after the conference will give attendees the opportunity to further develop and deepen the knowledge in special topics.

Dr. Philipp Strauss | Fraunhofer IWES, Kassel, Germany
Dr. Abraham Ellis | Sandia National Laboratories, Albuquerque, New Mexico, USA
Masaaki Yamamoto | NEDO, Kawasaki City, Japan

The goals of this conference were to:

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

The weeklong conference included pre-conference workshops, post-conference breakouts, tours, two poster sessions, and evening events.

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Conference Proceedings

Conference Opening and Welcome Remarks

Tuesday, December 4 | 8:30 a.m. – 8:40 a.m.

Philipp Strauss| Fraunhofer IWES and DERlab e.V. | Kassel, Germany

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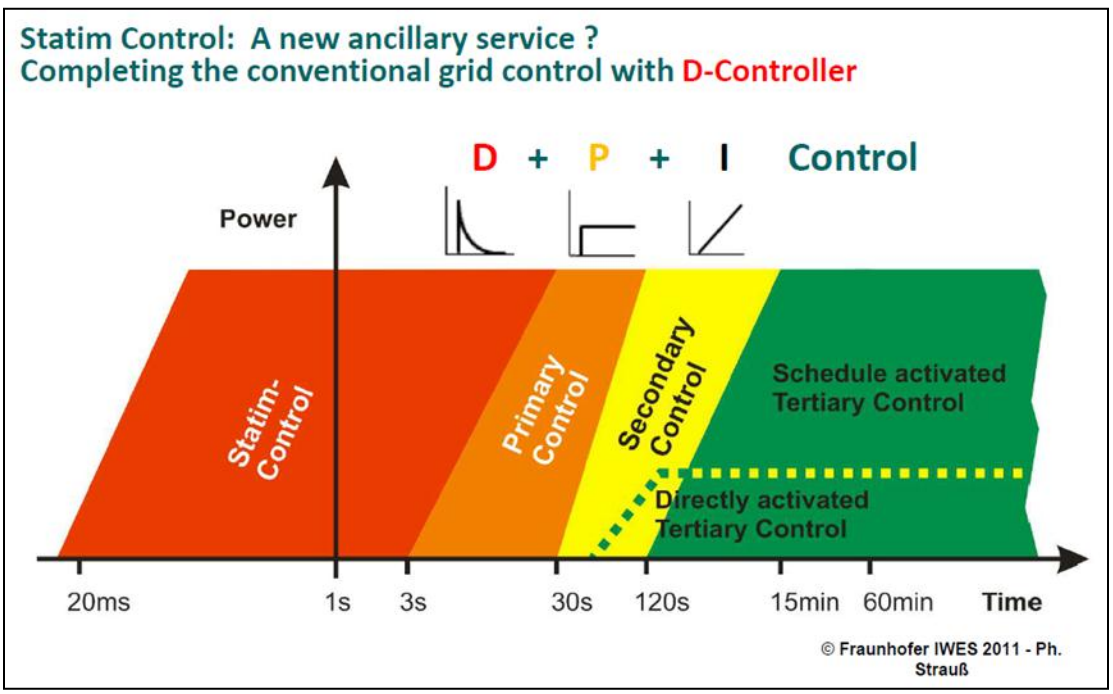
Opening remarks outlined conference goals and objectives and served to bridge previous conferences with future meetings.

Transforming the Power Systems: Welcome and Introduction - Philipp Strauss, Division Director Systems Engineering and Grid Integration, Fraunhofer IWES / DERlab e. V., Kassel, Germany

- Exponential growth in worldwide wind and PV capacity being grid integrated at various voltage levels is evolving the grid into an inverter dominated system
- Statim control (a faster-responding capability compared to primary—inertia—control) provides synthetic inertia missing from an inverter dominated grid. Challenge is to reduce the system's time constant.
- The technical problems are known, and inverters are flexible enough to provide solutions



From: **Transforming the Power Systems: Welcome and Introduction** *(Philipp Strauss)*

5th International Conference on
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Policies and Programs

Tuesday, December 4 | 8:40 a.m. – 12:40 p.m.

Session Chairs:

Abraham Ellis | Sandia National Laboratories | Albuquerque, USA
Masaaki Yamamoto | New Energy and Technology Development Organization (NEDO) | Kawasaki City, Japan
Philipp Strauss | Fraunhofer IWES / DERlab e. V. | Kassel, Germany

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Policies and programs implemented at the national and international levels are guiding the transformation of the electric power grid toward smart grid concepts and higher share of renewable generation. This session provided an updated overview of significant policies and programs worldwide, which are driving research, development, demonstration and deployment activities presented during the course of the conference.

Transformation of the Energy System in Germany: Adapting to High Shares of Renewable Energy - Berthold Goeke, Deputy Director General, Head of Directorate KI III "Renewable Energies" German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), Berlin, Germany (*presentation not available*)

- Presentation described Germany's national policies to increase the share of renewable generation
- Policies have been a major driver of renewable energy deployment in Germany

The European Strategic Energy Technologies Plan – Patrick van Hove, European Commission Directorate General for Research and Innovation, Brussels, Belgium

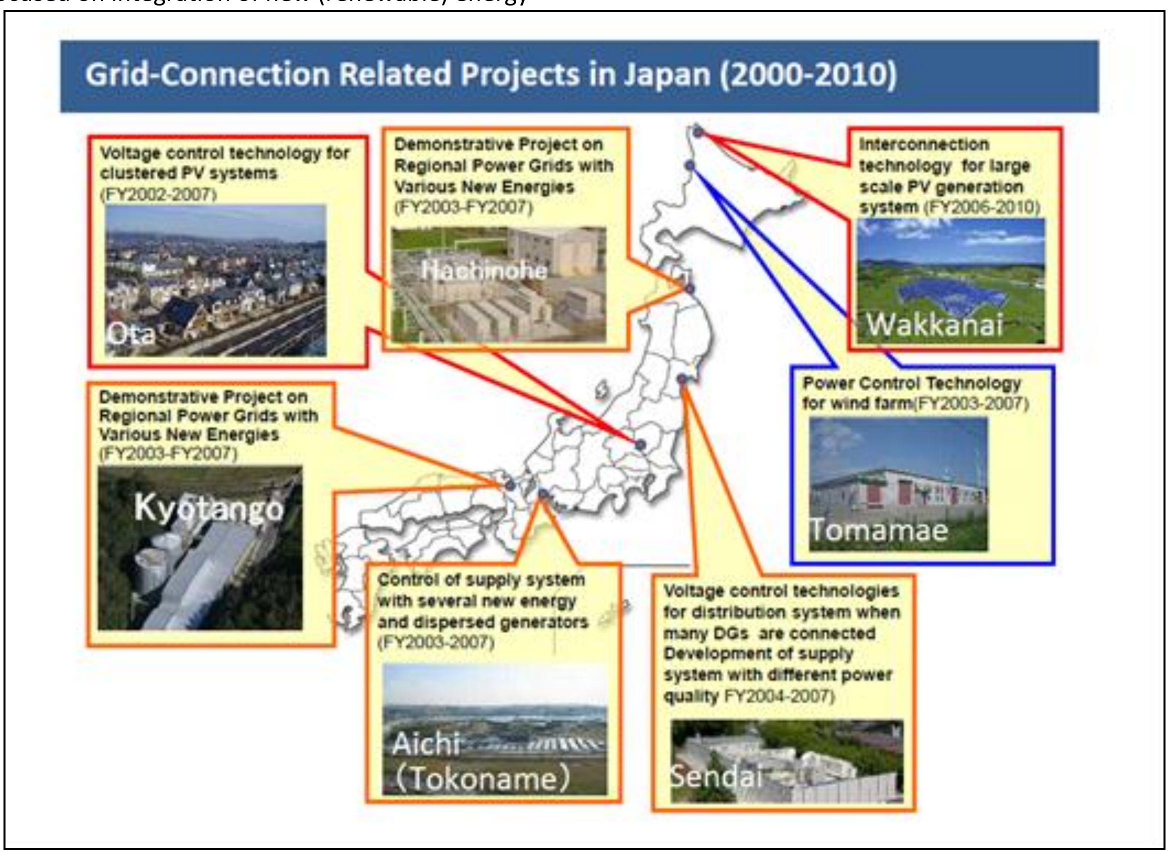
- Integration of renewable and distributed energy sources is an important challenge for Europe; supported by 2030 decarbonization objectives of 60% and by 2050 from 80% to more than 95%
- Strategic Energy Technologies (SET) Plan is a European priority to support the necessary changes in the energy system. Leverages industrial leadership with research, with a common vision driven by an agreed-upon, long term roadmap.
- Integrates specific actions and priorities, including increased energy efficiency, investments in the electricity grid, and specific generation targets for RE technologies
- SET Plan will accelerate research, innovation and market uptake of low-carbon technologies

Programs and Policies Promoting the Deployment of Distributed Energy Resources in the U.S. - Patricia A. Hoffman, Assistant Secretary, United States Department of Energy, Washington, USA

- Many states with existing and goals for renewable energy policies are helping to drive renewable deployment. There are also grid modernization initiatives at the state and federal level. U.S. Smart Grid value at stake is $130B+ annually.
- Target is grid modernization using an integrated Smart Grid. DOE Office of Electricity Delivery and Energy Reliability's role focuses on: *Reliability*: reduced power interruptions; *Efficiency*: improved asset utilization, increased operational and energy efficiency; *Resiliency:* mitigation of impact, restoration time; and *Flexibility*: clean energy, diversified generation with management of load.
- Simulation, modeling and control enable the integration of forecasting and renewable energy production tools into grid resource planning and operation tools
- Smart feeders and microgrids have successfully demonstrated operational efficiency and resiliency, respectively; simulation, modeling, and control, and storage being evaluated to increase grid flexibility
- Examples of exciting projects involving utilities: Storage Project at Southern California Edison, Smart Grid Demonstration Project at Duke Energy and the Pricing Pilot at Oklahoma Gas and Electric
- Moving forward on multiple fronts: planning, renewable integration, weather patterns, workforce development, resiliency, policy, grid modernization, and planning

Japanese Energy Policy and Grid Integration - Masaaki Yamamoto, Smart Community Department, NEDO, Kawasaki City, Japan

- The Fukushima incident was a game-changer. Out of 54 nuclear reactors in Japan, only two are functioning today. The incident changed public attitudes around safety. Safety, stable energy supply, and global warming were identified by Japan's National Policy Unit to rank higher as public concerns than cost.
- It is expected that renewable energy will fill a larger share of energy supply in Japan by 2030. Existing RE (not including hydro) was 9 GW in 2010, now projected in some scenarios to increase to 108 GW by 2030.
- As of July 2012, all renewable technologies and system sizes are eligible for Japan's feed-in tariff
- Three-phase approach to smart grid: Promote renewable energy/build microgrids to integrate interconnection on supply side; develop related systems and promote energy efficiency on demand side; accelerate "Smart Community" in policy
- NEDO's activities on Smart Grid demonstrations, including various large-scale demonstration projects conducted over 10 years, have focused on integration of new (renewable) energy



From: **Japanese Energy Policy and Grid** Integration (*Masaaki Yamamoto)*

Australia's Clean Energy Initiatives - David Green, Chief Executive, Clean Energy Council, Melbourne, Australia

- Australian energy production dominated by coal
- Key factors driving increased interest in RE: Rising consumer electricity prices; falling energy demands, but increased peak demands; need for carbon reduction; and increasing cost-competitiveness of renewable energy (quickly becoming cheaper than conventional generation in Australia). Rapid uptick in household solar (about 800,000 solar rooftop installations).
- Market reforms need to fully embrace options for decentralizing the energy supply and employing demand side solutions
- Focus on empowering consumers to drive improvements in the market, and on ending the "predict and provide" paradigm of network investment
- Rapidly developing storage technologies to deal with extraordinary peaks in energy demand throughout the country
- Energy efficiency identified as one of the most important policies government can deliver

The Coordinated Research Program on Smart Grids of the European Energy Research Alliance - Luciano Martini, T&D Technologies Department, RSE SpAIEA-ISGAN, Milan, Italy

- European Energy Research Alliance (EERA) program is open to research organizations across Europe; aims to accelerate development of new technologies. EERA coordinated Joint Programme (JP) on Smart Grids (part of European SET plan).
- International Smart Grid Network (ISGAN) is a collaborative international effort (currently 22 contracting parties); objectives include measuring and benchmarking current "smartness" of networks; rationalizing business model for Smart Grids; sharing knowledge, success stories, failures; and addressing barriers
- The JP on Smart Grids is open to international cooperation. Example: DOE / EERA Smart Grid R&D Workshop of 2011 held at NREL included Oak Ridge National Laboratory, Pacific Northwest National Laboratory and Sandia National Laboratory; 80 researchers and electric utility stakeholders from U.S., EU and Japan.
- Five-pronged approach to JP research: (1) network operation, (2) energy management, (3) information and control system interoperability, (4) electrical storage technologies, and (5) transmission networks.
- EERA document deliverables: https://sites.google.com/site/eerasmartgrids/documents-download

Research and Demonstration Projects in the European Electricity Grids Initiative - Patrick Van Hove, European Commission Directorate General for Research and Innovation, Brussels, Belgium

- Current 2020 target for renewable energy is 20%. Roadmap out to 2050 shows renewable contribution at least doubling form 2020 targets. Energy efficiency is also a major component.
- Electricity grids are an European priority for policy and for research
- EEGI (European Electricity Grids Initiative) is an example of European action for development and demonstration of smart grids; program is industry-led
- European actions cover full chain, from technology to legislation and regulation
- Push for standardized, interoperable solutions; focus on high levels of cooperation, knowledge-sharing, and replicable actions

Reality of Energy Supply on Islands – Insights from EURELECTRIC – David Padfield, EURELECTRIC, Network of Experts for Island Systems

- 286 European islands, ~10 million inhabitants; currently highly dependent on oil for electricity
- Focus is on establishing an island sustainable Energy Action Plan 2020; improving security of supply through diversified generation and interconnection; and adapting marketplace to size and isolations issues to apply exemptions appropriately. Storage is also critical for island solutions.
- Plan to use the islands as test beds to develop innovative technologies for smart grids, energy storage and renewable energy

Reporting on Results of Large Project Portfolios

Tuesday, December 4 | 2:00 p.m. – 5:45 p.m.

Session Chairs:

Britta Buchholz | ABB AG | Mannheim, Germany
Thomas S. Key | Electric Power Research Institute | Knoxville, USA

In many countries, the policy context has enhanced pilot projects that show possible solutions for a secure and sustainable energy system with a high share of renewable and distributed generation. Project teams have developed solutions, proven concepts and studied interaction of different market players. Challenges vary widely from country to country depending on the existing grid infrastructure as well as on local regulatory and market environments. Learning from each other´s experiences is key to success for this unprecedented transformation process for our energy system. Goal of this session was to learn about best practices in different regions with their specific challenges. Presentations included the aspects of integrating wind, PV, CHP and storage mainly on distribution systems. The panelists showed results from projects that are in their final stages, and discussed the near-term outlook of on-going projects.

Smart Country: successful integration of distributed generation in rural areas - Thorsten Hammerschmidt, RWE Deutschland AG, Essen, Germany

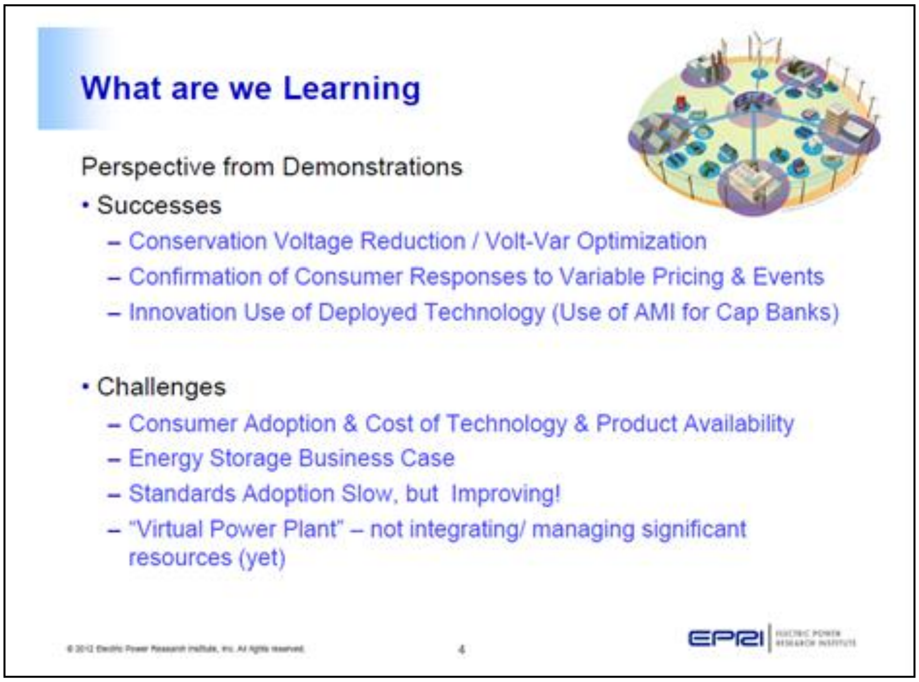
- RWE conducting verification phase of large-scale demonstration of distributed generation deployment in Germany. The test area is a hot spot renewable generation.
- Different innovative technical solutions were implemented in test grid area
- Local voltage control at medium voltage lines, at substations, and at service connections to increase grid capacity
- Biogas storage (3.2 MWh biogas and 220 kVA CHP) used in coordination with PV generation works as virtual electricity storage

U.S. SunShot Initiative and Portfolio of Solar Integration Research and Development Projects - Kevin Lynn, Solar Systems Integration, U.S. Department of Energy, Washington, USA, and Benjamin Kroposki, National Renewable Energy Laboratory (NREL), Golden, USA

- DOE SunShot Initiative PV R&D aims to reduce the cost of PV systems. Goal for PV systems is US$1/watt.
- Solar Integration is a major thrust: Partnering with industry through a program called Solar Energy Grid Integration Systems – Advanced Concepts (SEGIS-AC). Total of eight projects focused on reducing inverter cost and increasing capabilities. https://solarhighpen.energy.gov/segis_advanced_concepts
- The SunShot initiative also funded six demonstration projects involving high penetration PV
- Vision for new initiative called "Plug & Play" is *PV as an Appliance*
- Grid Tech Team coordinating grid-related activities across DOE and accelerating modernization of the electric power system
- Vision of the Future Grid is a seamless, cost-effective electricity system, from generation to end-use, capable of meeting all clean energy demands and capacity requirements, while allowing consumer participation and electricity use as desired

International Smart Grid Demonstration Initiative: Four-Year Update on Lessons Learned - Matt Wakefield, Electric Power Research Institute (EPRI), Palo Alto, USA

- EPRI's Smart Grid Demonstration Projects focus on integration of distributed energy resources; include 23 utilities (including two in Europe) with 15 large scale demonstrations
- Recent EPRI report documents results from 13 utilities, 10 different case studies. Successes include: conservation voltage reduction/volt-var optimization; confirmation of consumer response to variable pricing and events; innovation use of deployed technology (use of AMI Cap Banks)
- Challenges include: consumer adoption and cost of technology and product availability; energy storage business case; slow adoption of standards (but improving); "virtual power plant"-not integrating/managing significant resources (yet)
- New initiative in data management and analytics; turning data into opportunity and value



From: **International Smart Grid Demonstration Initiative: Four-Year Update on Lessons Learned** *(Matt Wakefield)*

Japan's Smart Community Activities **-** Satoshi Morozumi, Director for Smart Community Department, NEDO, Kawasaki, Japan

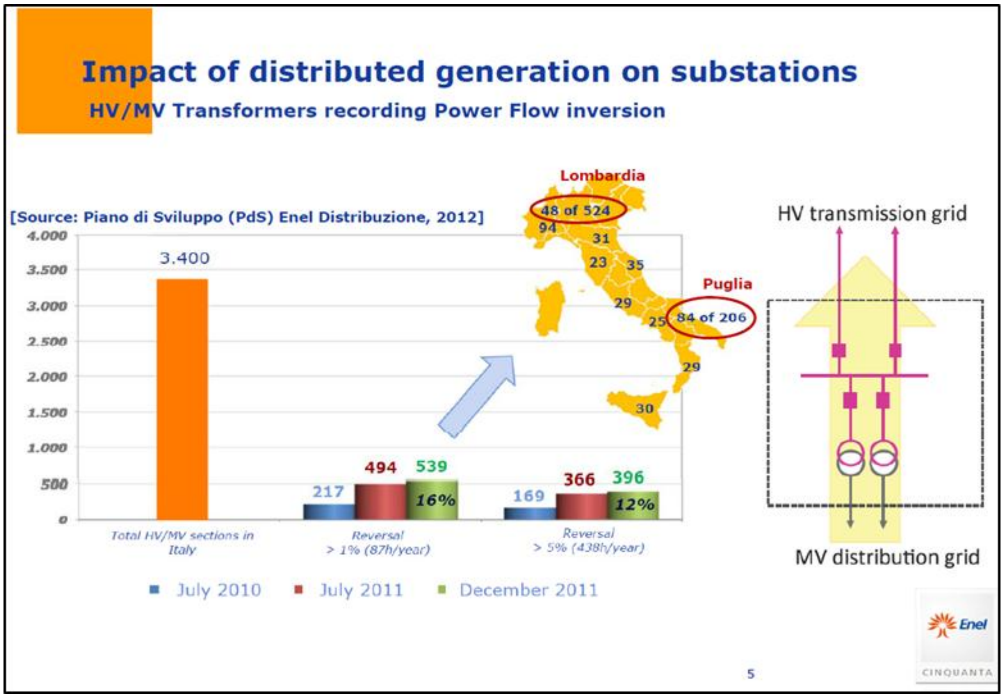
- Japan is pursuing domestic as well as international smart community demonstration projects
- Worldwide NEDO demonstration projects deployed in Lyon, France; Malaga, Spain; Congqingcheng, China; Hawaii and New Mexico USA. Also numerous domestic projects in Japan; include technology demonstrations as well as studies of human interaction with electricity systems.
- Demonstration projects evaluate a range of potential solutions to electricity grid issues and consumer interactions, including providing incentives to consumers for reducing energy use/carbon emissions, energy management systems, storage
- Kita-Kyushu project includes CEMS for demand response; projects use on a two-day planning cycle and sends price signal to consumers

Smart Energy made in Germany: Results of German Smart Grid Research and Implementation Program E-Energy - Ludwig Karg, B.A.U.M. Consult GmbH, Head of E-Energy Ancillary Research, Munich, Germany

- ICT (Information and Communication Technology) enables distributed generation without endangering grid stability
- New market function: Aggregators provide for access for small market actors (free of discrimination)
- Time-of-Use tariffs incentivize change in behaviour; sustainable results can be achieved via automated systems
- Generation units controlled via E-Energy solutions can provide for "near time" balancing energy and system services in the distribution grid
- Stability of grid can be maintained during times of high feed-in from volatile resources by means of market-based processes; evaluating distributed ICT systems used as "regional virtual power plants"

PV in Italy and Integration Challenges for ENEL **-** Gianluca Gigliucci, Enel Ingegneria e Ricerca S.p.A, Pisa, Italy

- Substantial rise of renewable energy share (15.5 GW of PV, 6.5 GW of wind) having a great impact on the way energy is managed
- Continuous match of power availability and load requires higher flexibility and smarter electric systems
- Impacts at the transmission and distribution levels; e.g., some transformers seeing reverse power flow
- Impact on conventional generation: reduction of capacity factor, dynamic operation required, increase of part load operation
- Reaction to the impacts: New requirements for DG connection and new incentives/penalties. Developing advanced Distribution network Management System (DMS); to be implemented in June 2013 for six months of field testing



From: **PV in Italy and Integration Challenges for ENEL** (Gianluca Gigliucci)

PV Hosting Capacity in Electric Distribution: Monitoring and Feeder Analysis Results from the United States – Jeff Smith, Manager Power System Studies, EPRI, Palo Alto, USA

- EPRI has evaluated multiple PV deployment scenarios and penetration levels monitoring and simulating utility feeder impacts
- Numerous nationwide utility partners include 35 feeders for hosting capacity determinations including project initiatives with EPRI, DOE, CPUC and NYSERDA
- By using detailed time-series simulations, for multiple PV deployment scenarios, the hosting capacity of a feeder can be determined. Factors include voltage, thermal loading, protection, power quality and control (LTC/voltage regulator/cap operations)
- For feeders with voltage problems, potential PV capacity is increased up to 160% with smart inverters that include volt/var control

Korea's Smart Grid Policy and Deployment – Yonghun Jung, Ministry of Knowledge Economy, Counselor to the Minister

- Current primary electricity source in Korea is thermal energy (oil, natural gas, and coal); goal for Renewable by 2050 is to reach 20%, currently at 2% (hydropower). South Korea among top ten produces of carbon dioxide emissions.
- Korean Smart Grid Stimulus Law enacted to promote deployment and acceleration of smart grid; goals are to allow technological and institutional progress for smart demonstration/pilot projects; provide solid foundation for smart grid-related businesses
- Structure of smart grid advancement: Lead by government on the policy side and driven by Korea Smart Grid Institute; Jeju demonstration consortia develops business and smart grid technology along five prongs: smart power grid, smart consumer, smart transportation, smart renewables, and smart electricity service. Structured on a five-year Master Plan.
- Korea's Jeju test bed is world's largest smart grid test bed at initial stage; objectives to foster expansion of electricity market and commercialization; review performance and extract knowledge from demo; and devise means to integrate lessons learned into next Smart Grid plan

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First-of-a-Kind Achievements in Technology, Systems Integration, Modeling & Simulation

Wednesday, December 5 | 8:30 a.m. – 12:30 p.m.

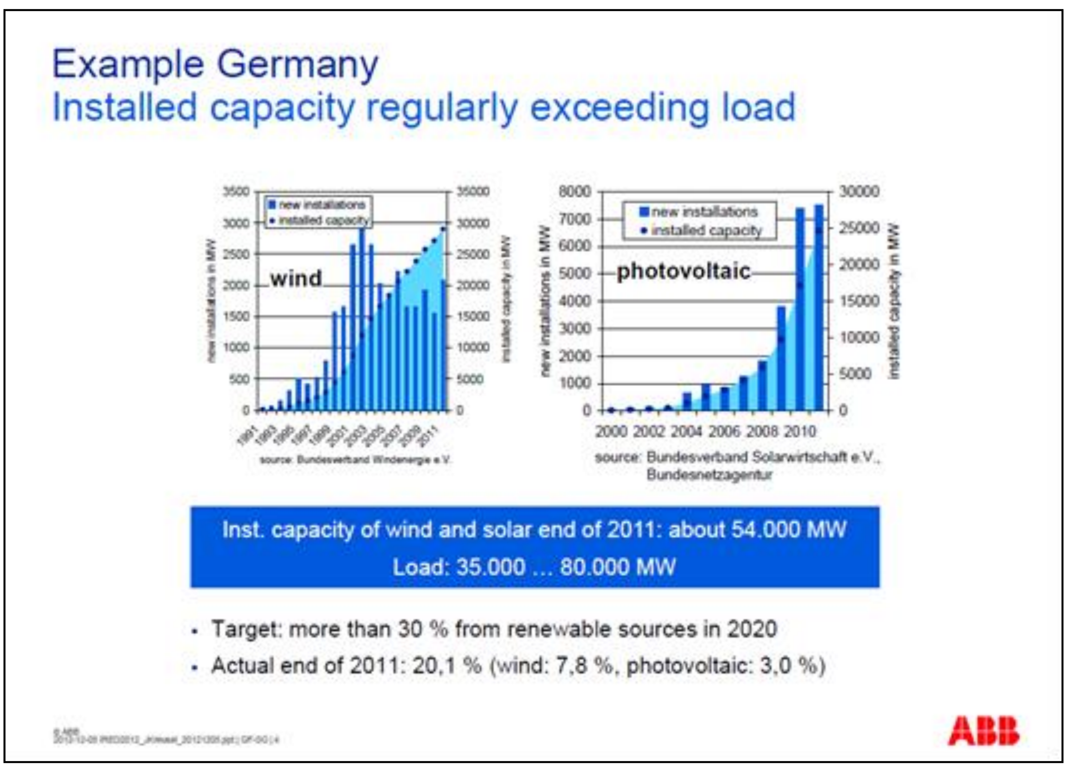
Session Chairs:

Patrick Van Hove, European Commission, Brussels, Belgium
David Green, Clean Energy Council, Melbourne, Australia

With the recent acceleration in the deployment of renewable energy generation worldwide, the large-scale integration of renewable resources in electricity grids is now supported by an increasing number of full-scale, first-of-a-kind implementation and research around the world. These achievements are formulating possible solutions to grid integration challenges posed by high share of renewable electricity.

Large-Scale Integration of Renewable Energy - Jochen Kreusel, ABB AG, Head of Global Program Smart Grids, Mannheim, Germany

- Large scale integration of renewable energy requires a fundamentally new design of power systems to account for long-distance transmission and variable conditions
- Germany's wind and PV production (about 54 GW at the end of 2011) often exceeds load in Germany (35 to 80 GW)
- Integration of all types of highly distributed resources, both on supply and demand side (e.g., RE generation on supply side, EV charging on demand side)
- High voltage direct current (HVDC) overlay grid isolates faults; research to create overlay grids focuses on DC circuit-breakers, load flow control, automatic re-closing, and high voltage DC-to-DC converters. Using HVDCs requires standardization.



From: **Large-Scale Integration of Renewable Energy** *(Jochen Kreusel, ABB)*

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Grid Integration of Large Scale PV Plants: A Global Challenge with Local Requirements - Jürgen Reekers, SMA Technologies AG, Niestetal, Germany

- Size of utility-scale PV plants is rapidly increasing; such plants are increasingly substituting for conventional power plants and need to offer similar grid integration and control functions
- As Europe faces regulatory uncertainties and declines in subsidies, focus is on an unsubsidized energy future
- "Sunbelt countries" bordering and south of the equator represent tremendous growth potential but require durable and cost-effective PV materials and systems
- Lowest levelized cost of energy (LCOE), advanced grid management functions (even in weak or unstable grids), and adaptation to local requirements are key factors for large-scale PV plants
- Next important steps will be the integration of PV in diesel hybrid systems and combination with storage systems

How Renewable Energy Forecasting Makes the Smart Grid Smarter: Advances in Solar and Wind Forecasting with Application to the Pacific Northwest Smart Grid Demonstration Project - Pascal Storck, Department of Civil and Environmental Engineering, University of Washington, Seattle, Washington, USA

- Wind energy forecasts have improved, and the business has changed from mostly trying to predict the weather to sophisticated data mining of historic production data, other local observations and numerous sources of high-quality weather forecasts
- Systems becoming more flexible, which can allow increased penetration of renewables. Includes features such as rapid-start plants, shifts in market rules, demand response tools, smart grid, etc.
- Forecasting is just one of the tools used for integration of renewables; predictions are only useful if they are accompanied by flexibility and action.
- Pacific Smart Grid Demonstration Project demonstrating a unique, de-centralized way of using incentive and feedback information signals (current state and forecasts) to achieve multiple objectives, among them increased utilization and better integration of renewables

MetaPV: PV-Powered Smart Grids in the Real World - Achim Woyte, R&D Manager, 3E SA, Brussels, Belgium

- MetaPV project – five year demonstration project (512 kW residential, 6.3 MW industrial). Objectives include >50% distribution grid hosting capacity for ~10% of grid reinforcement costs, reduction of PV curtailment, possible autonomous operation
- Active inverters substitute grid reinforcement on medium voltage (MV) networks; additional communication cost reductions required on low voltage (LV) networks
- Large scale demonstration in the real world, but significant practical challenges (including no funding for R&D)
- Specific settings for inverter and grid control proposed (e.g., finding the right reactive power to enhance voltage balance); ongoing testing
- Techno-economic analysis from 2012 demo period suggests active inverters substitute grid enforcement on LV and additional communication cost reductions are required on LV

Integration of Solar and Wind Energy into Electricity Grids and Energy Markets by Energy Forecasts – Roman Asper, Enercast GmbH, Kassel, Germany

- Forecasts address integration challenges, particularly by making RE generation more predictable
- Forecasts also address market issues by helping predict market prices and profit gains
- Smart grids used with forecasting can optimize use of RE when available, and ensure smooth transitions to conventional generation when RE is not available

Solar Mobility: Two Years of Practical Experience Charging 10 Cars With Solar Energy - Jens Merten, Program Manager, CEA INES, Le Bourget Du Lac, France

- France has goal of two million electric cars by 2020, 4.5 million by 2025. Will increase charging demand to 10.8 GW by 2025.
- Two solar PV charging stations and more than 17 electric cars used to match recharging to PV generation with Solar Mobility
- EMS is vital: With EMS, charging matches solar generation and grid demand is reduced. Without EMS, strong power demand and high grid fluctuations.

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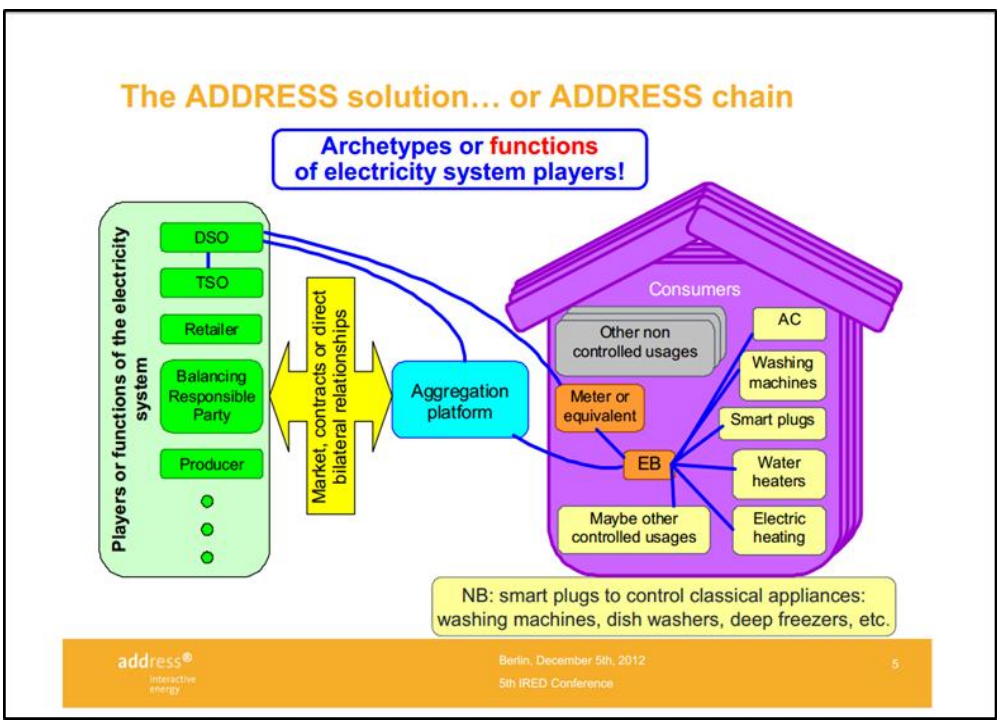
From: **Solar Mobility: Two Years of Practical Experience Charging 10 Cars with Solar Energy** (Jens Merten)

Implementation of Active Demand in the ADDRESS Project: From Concepts to Field Tests - Régine Belhomme, EDF R&D, Clamart Cedex, France

- ADDRESS (Active Distribution Network with full integration of Demand and distributed energy RESourceS) – large-scale integration project of EU 7th Framework Programme. Critical activity in Europe; from concepts to field tests with 25 Partners, 11 European countries, 40% research centers and universities, 30% utilities, 30% manufacturers.
- Objective to enable active demand (active participation of domestic and small commercial consumers. Five steps: Enable active demand; Exploit the benefits of active demand; Consumer acceptance; Validation in three test sites; and Dissemination. Includes smart plugs to control active appliances.
- Interaction based on real-time price and volume signals (15-30 min ahead or longer); modulated by geographical/topographical information; services provided on voluntary and contractual basis
- Electricity system identifies need for an AD action, such as limited peak load. This flows to a request through the market or contractual relationship, the aggregation platform translates to price/volume signals to incentivize, and consumer meter optimizes appliances and interfaces with consumer as needed.
- Three field sites identified: Italy nearing deployment; Spain and France gathering customers, some deployment has started



From: **Implementation of Active Demand in the ADDRESS Project: From Concepts to Field Tests** (Regine Belhomme)

Active Network Management in Medium and Low Voltage Grids: Results from Austrian Demonstration Projects – Andreas Lugmaier, Siemens AG Austria, Wien, Austria

- Engaging in Active Network Operation as a Smart Grid solution to address DSO challenges such as unidirectional network flows and supply security ("worst case scenario" system)
- Active Networks integrate DG and can combine with additional loads; can result in voltage band violations or component overload
- Austria has few large PV plants feeding MV networks, but increasing amount of hydro and biomass
- ZUGDE MV project integrates volt-var control with existing SCADA network control system
- LV systems require monitoring and management of voltage band and load flow

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Learning from Island Systems Solutions

Wednesday, December 5 | 2:00 p.m. – 3:15 p.m.

Session Chair:

Hubert Fechner | University AS Technikum Wien | Vienna, Austria

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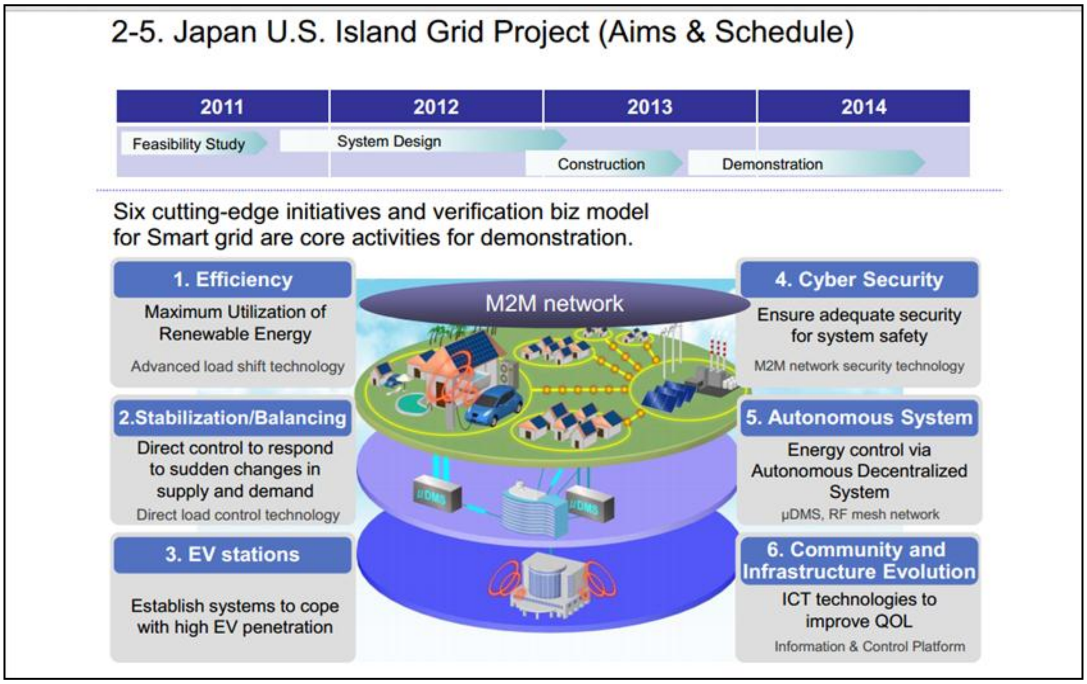
Smart grid systems with renewable generation established on islands serve as a model for the integration of high shares of clean energy into future electricity systems. Island grids provide an opportunity to investigate solutions to grid management and control, security-related matters, as well as business models. Lessons learned from these experiences will significantly contribute to the deployment of smart grid solution for mainland grids.

The Millener Project: 1500 Household Installations in French Insular Electric Systems, Aggregated for Grid Support - Jean-Christian Marcel, TENESOL S.A., La Tour de Salvagny, France

- Energy context for French overseas islands: No external grid connections; one public operator; LCOE higher than mainland, but subject to same electricity tariff; limited land for new power plants; seasonal and increasing overall power demands. Islands also vary dramatically in climate conditions.
- Millener project: Four-year pilot project to test methods and equipment to produce and store electricity from distributed renewable energy sources installed at residential customer premises. Includes assessing and optimizing process equipment to manage power demand (peak shaving / peak shifting) and energy demand, and studying customer behavior (focus on customer empowerment)
- Two configurations: (1) PV plus storage – focus on levelized PV energy into the grid, and (2) energy box plus a gateway – focus on optimal electricity consumption

US - Japan Collaborative Smart Grid Demonstration Project on Maui Island - Rick Rocheleau, Hawaii Natural Energy Institute, University of Hawaii, Honolulu, USA, and Fumitoshi Emura, Hitachi Ltd., Tokyo, Japan

- Renewable energy opportunities on the islands of Hawaii are abundant, but use is complicated: transmission and distribution issues, differences between peak and base load requirements, no island interconnections, resources not near population
- Hawaii Island Integration Studies focus on rigorous analytic models of grids on each island; analyzing the impacts of new energy systems deployed; and identifying and analyzing solutions to systems integration issues from intermittent power – advanced controls, forecasting, demand management, storage, Smart Grid
- Three Maui Smart Grid projects share partners and hardware, leverage funding, and collaboratively discuss lessons learned: Maui Smart Grid Demonstration Project, Smart Grid-Enabled PV Inverters, and Japan-U.S. Island Grid Project
- Japan-U.S. Island Grid Project targets 40% renewables by 2030. Evaluates solution for impact of EV and high penetration PV, stable supply of electric power, and maximum utilization of renewable energy.
- Proposed solutions to energy and resource fluctuations include μDMS and Smart PCS, EV charger control, battery system, demand response, and an ICT platform



From **US - Japan Collaborative Smart Grid Demonstration Project on Maui Island (**Rick Rocheleau, Fumitoshi Emura)

Smart Grids in the Greek Islands - Nikos Hatziargyriou, National Technical University, Athens, Greece

- Currently 330 MW of RE on non-interconnected Greek islands (PV, wind); capacity exists for ~415 MW more
- Greece integrating new RE technologies: hybrid wind/pump-storage/hydro; CSP and hybrid systems with storage
- Smart Grids are important for the Greek islands. Goals are to manage autonomous systems; increase RE penetration; implement new RE technologies; minimize cost; increase power quality and availability; and operate the energy market.
- Four-phase Smart Grid Roadmap: (1) Distribution Network Management (DMS, substation automation); (2) Metering Infrastructure (AMI for the Greek Islands, active demand management); (3) Energy Management (EMS system on each island, installation of integrated information system in Greek Islands); and (4) Innovative Projects (EVs, smart houses, intelligent load controllers)

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Advanced Transmission and Distribution System Operations

Wednesday, December 5 | 4:00 p.m. – 5:20 p.m.

Session Chairs:

Lisa Dignard-Bailey | Natural Resources Canada | Varennes, Canada
Eng Kiat Chan | Energy Market Authority | Singapore, Singapore

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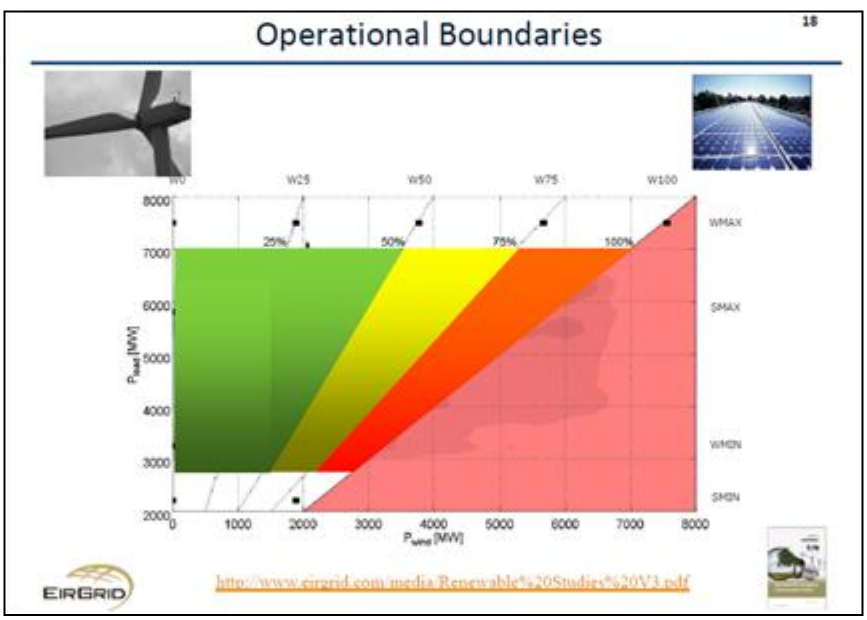
Balancing future energy systems will require a more sophisticated interaction between the major electricity players within and across jurisdictions as supply and demand profiles become increasingly dynamic. How will system operators, utilities, generators and governments influence the transition toward managing more complex and more efficient systems?

PowerShift Atlantic: Regional Collaboration Wind Integration via Load Shifting - Michel Losier, Program Director of PowerShift Atlantic, NB Power Corporation, New Brunswick, Canada

- Project to determine cost effectiveness and reliability of load shifting; understand customer's role in smart grid; evaluate how load shifting performs in sync with system balancing and forecasted wind power
- Shift customer load demands to reduce effects of variability of wind generation; provide new tool to allow system operator to more easily and efficiently balance the power grid
- Pursuing customer engagement to help drive intelligent load management (load shifting). Involves securing customer investment, behavior, trust.
- Some key learnings thus far: collaboration is key; customers are interested in participating, regulator engagement is priority

Supply–Demand Balance in a Changing World: The System Operator Challenge - Mark O'Malley, Electricity Research Centre, University College Dublin, Dublin, Ireland

- Energy Systems Integration (ESI) optimizes design and performance of electrical, thermal, and fuel pathways at all scales
- Future energy systems/supply demand balance in synchronous electrical energy systems and control
- Facilitating up to 75% renewables in real-time requires change: Frequency control, voltage control, grid flexibility



From: **Supply–Demand Balance in a Changing World: The System Operator Challenge** *(Mark O'Malley)*

Offshore Wind Integration and Operation - Peter Børre Eriksen, Head of Systems Analysis, Energinet, Fredericia, Denmark

- Political targets driving wind power (50% of electricity consumption from wind by 2020; 100% of energy supply covered by renewables by 2050). Wind power often covers the load in western Denmark.
- Measures of large scale wind power integration: robust power grid/strong interconnectors; flexibility in demand and production; Smart Grid for efficient and market-based control of power system
- International cooperation is a prerequisite for a possible offshore grid in the North Sea (North Sea Countries Offshore Grid Initiative). Offshore wind test system includes DC connections among offshore wind farms with onshore systems, as well as connections between countries.

System Operation – An Indian Perspective – Atul Shah, Suzlon Energy Ltd., India, and V.K. Agarwal, General Manager NLDC, Power System Operation Corporation of India Ltd.

- Challenges for integration of large-scale renewables in India include varying policies of renewable integration between Power Department and states; frequency management issues; weak transmission network and congestion; reduced MVAR support during system disturbances; most wind plants not FRT-capable
- Proposed integrated transmission corridor addresses intra- and inter-state concerns
- Regulations already implemented to meet RE growth include: REC; forecasting; transmission pricing regulations; inclusion of renewables in India Electricity Grid Code; introduction of ancillary market
- By 2030, estimate 164 GW Wind and 35 GW Solar; represents 21% energy or 35% of total capacity by 2030
- Existing and future interconnections with Nepal, Bhatan, and other countries

5th International Conference on

Integration of Renewable and Distributed Energy Resources

December 4-6 2012 | Berlin, Germany

Harmonization of Grid Codes and Testing Standards

Thursday, December 6| 8:30 a.m. – 10:10 a.m.

Session Chairs:

Nikos Hatziargyriou | Public Power Corporation S.A. | Athens, Greece
Dan Ton | U.S. Department of Energy | Washington, USA

The large-scale deployment of Renewable and Distributed Energy Sources in the future power networks requires standardization of grid interface requirements as well as testing procedures that are used for certification and performance characterization of components and systems. This session explored the status and evolution of grid codes and test procedures. It also described current efforts toward harmonization of standards.

Smart Grid Interoperability Standards in the United States (embedded video) **–** George W. Arnold, National Coordinator for Smart Grid Interoperability, National Institute of Standards and Technology, U.S. Department of Commerce, Washington, USA

- U.S. grid is large and aging, yet represents 22% of world consumption of electricity (with 5% of the population)
- Key U.S. grid priorities: 1) Increasing efficiency of the grid; will reduce need for asset replacement ($1.5T to $2T needed by 2030 to modernize); 2) Increasing reliability, which costs $80B/year; 3) Sustainability.
- Over the next 20 years, Smart Grid will cost in the rage of $338B to $476B but result in benefits of $1.5T to $2T
- Smart Grid Interoperability 2.0 Panel is a self-sustaining, not-for-profit public-private partnership with 780 member organizations and 1,900 participants
- SGIP Catalog of Standards database - important compendium of standards and practices supported by NIST; Testing and Certification Framework provides assurance that the smart grid will be interoperable

International Grid Codes and Local Requirements: The Evolvement of Standards for Distributed Energy Resources and Inverter Technology – Dipl.-Ing. Hannes Knopf, Director of International Product Management, SMA Solar Technology AG, Germany

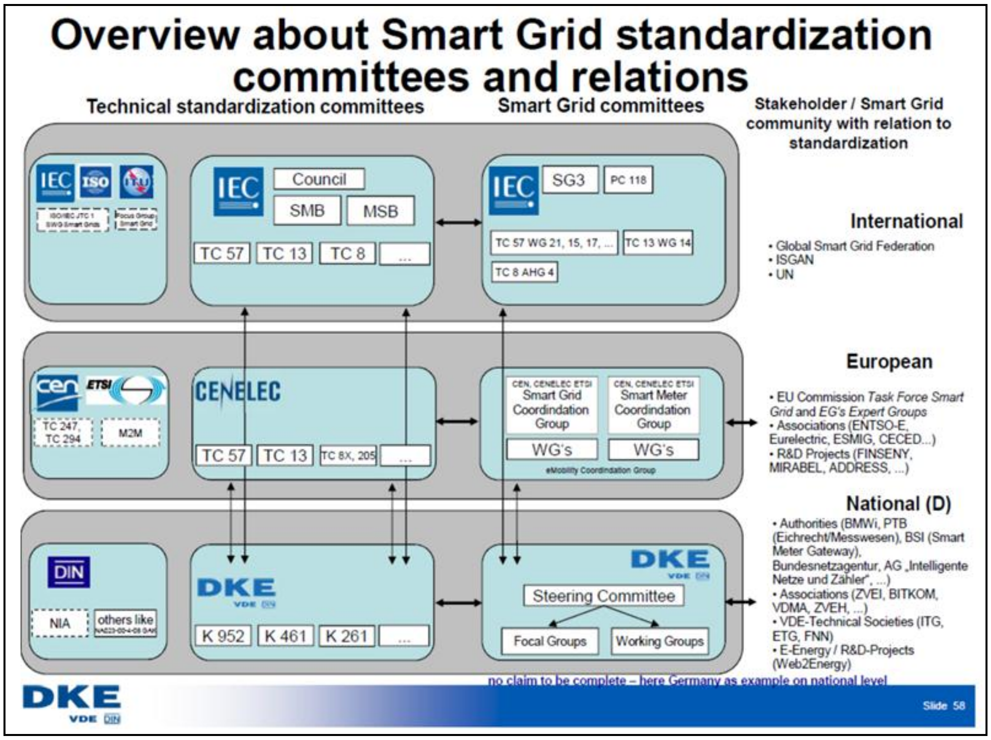
- Though international codes exist, local grid conditions (geography, grid structure, installed renewable vs. installed total power) lead to specific local requirements
- German medium voltage guideline addresses power curtailment, frequency and voltage support, fault ride-through; Italian guidelines focus on 50.2 Hz problem and communication requirements; Spain has requirements for real-time data for forecasting in addition to voltage and frequency control codes
- ENTSO-E European requirements (draft) – frequency support, reactive power and fault ride-through, regulating reserve, etc. Does *not* replace local codes nor lead to harmonization across Europe.
- Harmonized requirements will reduce complexity, while increasing reliability of grids with a high level of penetration of DG

International Coordination of Smart Grid Testing and Evaluation: ISGAN-APEC Activities - Russell Conklin, U.S. Department of Energy, Vice Chair ISGAN Executive Committee, Washington, USA

- ISGAN is a mechanism for bringing high-level government attention and action to accelerate the development and deployment of smarter electricity grids around the world; intended to build global understanding of Smart Grids and accelerate deployment
- Currently six ISGAN foundational projects (annexes); ISGAN Annex 5, approved in March 2012, is the Smart Grid International Research Facility Network (SIRFN),a coordinated network of Smart Grid research and test-bed facilities and projects in countries participating in ISGAN. SIRFN objective to address niche between R&D and commercialization.
- Asia-Pacific Economic Cooperation (APEC) Region – 21 economies, including all of North America; focus establishing a network of test beds to support Energy Smart Communities Initiative and Smart Grid Initiative
- PV Inverter Test Protocol activities build on collaborative efforts; goal to develop an internationally-accepted set of test protocols to help fill identified gap of utility DMS-to-inverter communications/functionality

System Approach of the European Smart Grid Coordination Group of CEN, CENELEC, and ETSI: Update of the German Smart Grid Standardization Roadmap - Johannes Stein, DKE German Commission for Electrical, Electronic & Information Technologies of DIN and VDE, Frankfurt am Main, Germany

- Germany subject to numerous international, regional, and local standards
- Standardization Mandate M/490 refers to Smart Grids; issued by EU Commission, worked on and agreed to by European Standardization Organizations and the Smart Grid Working Group.
- New Smart Grid approach offers flexibility on both sides of the Smart Grid Connection Point – demand side flexibility includes incentives, price signals, etc.; supply side includes load/demand, storage, etc.
- Process not limited to smart grid; in principle it is applicable to all system topics, which spans more than one domain or zone



From **System Approach of the European Smart Grid Coordination Group of CEN, CENELEC, and ETSI: Update of the German Smart Grid Standardization Roadmap** (Johannes Stein)

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Future Scenarios with Very High Shares of Renewable Energy

Thursday, December 6| 10:55 a.m. – 3:50 p.m.

Session Chairs:

Benjamin Kroposki | NREL | Golden, USA
Kazuyuki Takada | NEDO | Kawasaki City, Japan

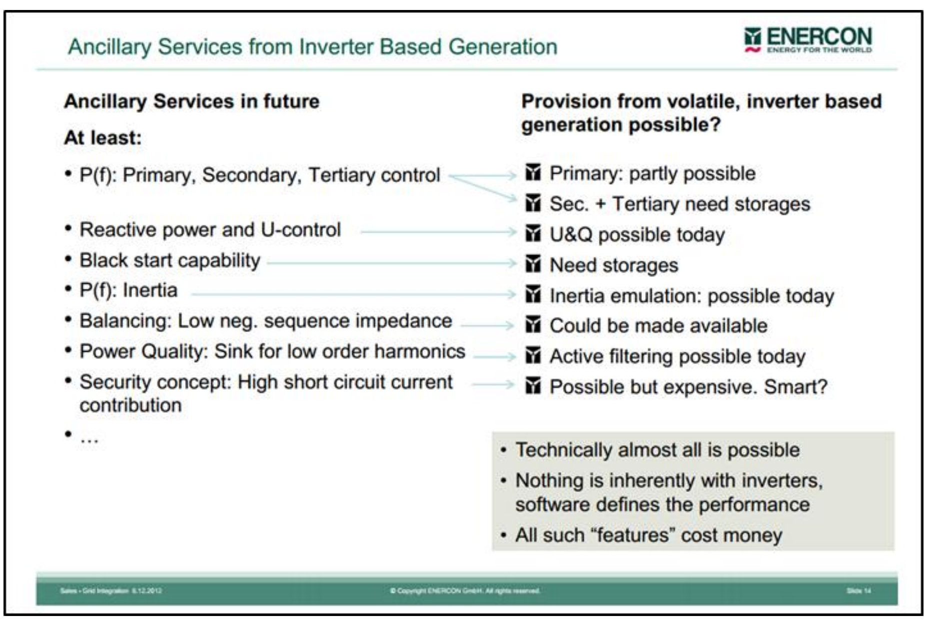
Some regions and countries are planning for a majority of their energy to come from renewable sources. How will the electrical system operate under extremely high renewable penetrations? How will renewables interact with other generation sources? This session examined what future energy systems will look like, and discussed potential challenges and solutions.

Integrating Renewable Generation: Ontario's Smart Grid Approach **-** Ken Nakahara, Ministry of Energy, Ontario, Canada

- Ontario policy calls for a "clean, reliable, modern electricity system"; goal of 10.7 GW from wind, solar, bio-energy by 2018
- Ontario's position as a world leader in Smart Grid allowing it to take a proactive role in integrating distributed renewable generation through expanded forecasting, visibility, and dispatch capabilities Ontario using domestic challenges to push innovation and leverage utility and start-up efforts into international economic success. Focus is on smart meters and TOU pricing; Ontario first in N. America to implement smart meters; first in world to mandate TOU pricing for all residential and small commercial customers

Ancillary Services from Wind Turbines and Related Grid Codes **–** Dipl.-Ing. Eckard Quitmann, ENERCON GmbH, Bremen, Germany

- Changing requirements to existing assets causes expensive retrofitting
- Traditional understanding of 'ancillary services' cannot be expected to exist in future high penetration, inverter-based generation scenarios
- Power System Operators and industry need to investigate together what technical features will be necessary when the system runs on 40%, 60%, 80% power electronics and volatile sources; i.e., which features to engage for grid stability at different points
- Industry needs a clear roadmap of priorities in order to focus R&D resources accordingly



From **Ancillary Services from Wind Turbines and Related Grid Codes** (Eckard Quitmann)

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German Government's Scenario to Supply 80% of Power Consumption by Renewable Energy in 2050 - Kurt Rohrig, Fraunhofer Institute for Wind Energy and Energy System Technology, Kassel, Germany

- Evaluating various scenarios of renewable energy generation for 80% RES by 2050; scenarios vary in the technologies included (e.g., hydrogen vehicles, methane)
- Grid development, demand side management, security of supply, and the frequency distribution of power plants were presented to achieve the 2050 goals for the various scenarios

TWENTIES Plan: Solutions for the Integration of Large Renewable Energy Resources in the Power System **-** Jose-Luis Mata, Red Eléctrica de España, S.A.U., Madrid, Spain

- TWENTIES project aims to demonstrate by early 2014 the benefits and impacts of several critical technologies required to improve the Pan-European transmission network
- Six demonstration projects, including: SYSERWIND (leader: IBR); DERINT (leader: DONG); DC GRID (leader: RTE); STORM MANAGEMENT (leader: ENERGINET); NETFLEX (leader: ELIA); and FLEXGRID (leader: REE)
- Includes 10 European Member States, one Associated Country; EU contribution of Euros31.8M; total budget Euros56.8M

Mobility: A Driver for Power-to-Gas Technology **-** Reinhard Otten, Audi AG, Ingolstadt, Germany

- Climate change pressure on mobility is very high; GHG reduction costs about 10 times more than in other sectors
- CO_2 evaluations of EV's are only favorable if the grid energy mix consists of significant amount of renewable energy in the country where the vehicle operates
- A vehicle fueled with e-gas is just as environmentally acceptable as one using electricity from wind power

Stochastic Optimization of Power Systems Planning and Operations in Future Scenarios with High Share of Renewables **–** Jean-Paul Watson, Sandia National Laboratories, Albuquerque, USA

- Stochastic optimization problems are pervasive in power systems operations and planning, particularly when considering high shares of renewable generation
- Solution of full optimization problems at scale to support system operators or resource planning entities is difficult; however, this is the best way to optimize operational and planning decisions (from a cost and risk perspective) in a high uncertainty environment
- Significant recent and upcoming algorithmic advances (e.g., decomposition algorithms) have made stochastic optimization practical in practice for power systems contexts
- High-accuracy stochastic process models can provide computational tractability while maintaining solution quality and robustness
- Efforts are underway to implement full stochastic unit commitment capability in commercial software platforms.

US Renewable Electricity Futures Study: Achieving 80% of Electricity from Renewables **-** Trieu Mai, National Renewable Energy Laboratory, Golden, USA

- RE Futures is a U.S. DOE-sponsored collaboration with more than 110 contributors from 35 organizations including national laboratories, industry, universities and non-governmental organizations. Focus is on identifying commercially available RE technology combinations that meet up to 80% or more of projected 2050 electricity demand for every hour of the year.
- RE Futures evaluates grid requirements across the United States for integrating increasingly higher amounts of electricity from various renewable energy technologies
- Analyzes opportunities created by a multiple-technology, flexible electricity system
- Confirms that direct incremental cost of high renewable generation is comparable to cost estimates for other clean energy scenarios; improvement in RE cost and performance is greatest opportunity to reduce this cost

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Summary and Key Learnings

Since its inception in Brussels in 2004, the International Conference on Integration of Renewable Energy and Distributed Energy Resources has taken place biennially in varying countries. In 2012, the event was staged in Berlin, Germany. High level experts from 17 countries discussed the latest technical, market, and policy aspects related to integration of renewable and distributed energy resources as well as Smart Grids.

At the 2012 IRED conference, distinguished speakers shared experiences and provided updated information. Topics included policy conditions, technological challenges of grid integration, new standards and testing methods, results of Smart Grid pilot projects, and projected future scenarios. The 2012 conference introduced several new sessions, including *Learning from Island Systems Solutions*.

The 2012 conference attracted 220 participants from 29 countries and contributed significantly to increase international as well as interdisciplinary dialogue among industry, utilities, and researchers. The presentation of 44 posters on specific subtopics complemented the content of the main conference.

Some key learnings and observations from IRED 2012:

- **Drivers for smart grid and renewable energy deployment –** The concepts presented throughout IRED 2012 indicate that deployment of renewable energy and smart grid technologies is going strong. The goals are similar, but the drivers and approach are different I key respects. In Europe, the emphasis is on de-carbonization of the electricity generation by increasing renewable generation. The U.S. Administration is engaged on an “all of the above strategy” for energy in the United States, which includes domestic resources like natural gas as well as renewables. Ontario indicates a continued reliance on nuclear as a low emissions energy source, while in Japan, the recent Fukushima accident has resulted in shutdown of nearly all the country’s nuclear generation. in Australia, critical factors include rising consumer energy prices and increased peak energy demands. All of these forces result in future projections with higher shares of renewable deployment and the need to modernize power systems through deployment of smart grid technologies.

- **Need for broader coordination of R&D projects –** A large amount or resources are being invested in research and demonstration projects in support various long-term R&D programs. Coordination among these projects at the national, regional and international levels is a challenge. Europe’s Strategic Energy Technologies (SET) plan leverages industrial leadership with research and organizes efforts around a common vision. The work is bound by an agreed-upon, long-term roadmap (Roadmap 2050) and coupled with a policy for near-term activities (Horizon 2020). Though other countries differ in the exact approach, many share a focus on engaging industry and developing both short- and long-term actionable goals. The US SunShot Initiative takes a similar approach by identifying and supporting inter-disciplinary research projects, motivating the engagement of industry through research projects and partnerships, and implementing near-term actions on the path to longer-term objectives. Although there are geographic, political, and climatic/resource differences, the overall challenges for integration of RE and DG do not vary significantly on a global scale. Similarly, the approaches for solving these challenges are largely aligned: demonstration/island/microgrid projects, technology research and testing, and research to identify better forecasting tools. These commonalities highlight the need for continued and enhanced international collaboration, including the sharing of information and lessons learned.

- **Learning as we go –** There are numerous small scale smart, DG and renewables demonstration projects around the world. There are also several planning and operating entities dealing with high-share renewable deployment, including Ireland, Germany, Italy, parts of the US (Hawaii) and Australia (South Wales). These experiences are producing a large volume of lessons learned and solutions that can be built upon. Islands microgrids present a unique opportunity to implement and learn from smart grid and high-share renewable energy deployment. In all these cases, there are critical aspects that need more attention, such as the need for tools and techniques to process large volumes of data into information to support planning and operations decisions. Another critical need is to better understand define the value proposition for various technical solutions including smart grid technologies, and how policy, regulatory and market structures affect that value proposition.

- **Harmonization of standards, grid codes and testing procedures –** There is a general need to harmonize technical standards, including electrical performance, interoperability and security across of aspects of electric systems. Cross-border coordination standards, equipment testing and certification, and communications interoperability is insufficient; therefore, navigating all the requirements and achieving efficiency continues to be a challenge overall. In addition to efforts by the standards organizations such as IEEE and IEC, continued regional and global collaborative efforts such Smart Grid Interoperability Panel (SGIP) in the US, harmonization of grid codes in Europe, and smart grid testing demonstration activities under ISGAN/SIRFN should be strengthened. A critical need in this area is to address standards for new emerging technologies, principally inverter-based distributed resources. The standards should allow for full deployment of inverter capabilities to mitigate voltage impacts on distribution local systems, and provide, in aggregate, valuable services to support bulk system reliability and performance.

- **Role of demand-side flexibility –** Global approaches to deploy smart grid functionality and higher levels of renewable energy include demand sides efforts. Projects in Japan, Germany, the EU, France, and United States and Canada focus on actively engaging consumers through market mechanisms such as price signals, real-time consumption models, “generation-driven” consumption, and similar demand response tools. Demand-side options may also be “low-hanging” fruit that can be implemented even before full grid modernization. A comprehensive demand-side strategy that provides tools to enable consumers to participate in grid stabilization and load balancing makes sense. However, there needs to be a clear incentive.

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5th International Conference on

Integration of Renewable and Distributed Energy Resources

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5th International Conference on

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Poster Presentations

POSTER SESSION A

1.0 Grid Integration of Centralised and Decentralised Storage Devices

1.0.1 Integrating End-User and Grid Focussed Batteries and Mid- to Long-term Power-to-Gas Storage for Reaching a 100 % Renewable Energy Supply
Christian Breyer, Reiner Lemoine Institut gGmbH, Berlin, Germany

1.0.2 Demand Side Management through Battery Storage to Increase Local Self-Consumption and Grid Compatibility of PV Systems
Dr. Jann Binder, Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg, Stuttgart, Germany

1.0.3 Orchestrating the Smart Grid - The Smart Watts-architecture for the Internet of Energy
Julian Krenge, FIR e. V. an der RWTH Aachen, Institute for Industrial Management at RWTH Aachen University, Aachen, Germany

2.0 Large-Scale Renewable Generation

2.0.1 Experiences in testing of large-scale inverter systems
Richard Houtepen, DNV KEMA Energy & Sustainability, Arnhem, the Netherlands

2.0.2 Harmonising hardware in the loop simulation procedures for power systems and distributed energy resources components
Paul Crolla, Institute for Energy and Environment, University of Strathclyde, Glasgow, UK

3.0 Renewable Power Forecasting

3.0.1 Satellite based estimation of the PV-Potential using spectrally resolved solar surface irradiance
Dr. Jochen E. Wagner, Universität für Bodenkultur, Wien, Austria

3.0.2 Spatial-Temporal Analysis of Wind Power Forecast Errors for South-Western Norway
Pål Preede Revheim, University of Agder, Grimstad, Norway

3.0.3 Local and regional photovoltaic power prediction based on satellite data and numerical weather predictions
Dr. Elke Lorenz, Universität Oldenburg, Oldenburg, Germany

4.0 Market and Business Models

4.0.1 Geographic analysis of isolated diesel grids - Assessment ot the upgrading potential with renewable energies for the examples of Peru, the Philippines and Tanzania
Paul Bertheau, Reiner Lemoine Institute, Berlin, Germany

5.0 Grid Operation

5.0.1 Coordinated voltage control in LV networks withrn high PV penetration
Boštjan Blažic , University of Ljubljana Faculty of Electrical Engineering , Ljubljana, Slovenia

6.0 Regulatory Issues

POSTER SESSION B

7.0 Successful Demonstrations

7.0.1 VITO Smart Grid Testplatform
Sven De Breucker, VITO, Mol, Belgium

7.0.2 The Orkney Smart Grid – A New Approach to Grid Management
Bryan O'Neill, Smarter Grid Solutions, Glasgow, United Kingdom

7.0.3 A Trial of Future Network Technology on Shetland
Bryan O'Neill, Smarter Grid Solutions, Glasgow, United Kingdom

8.0 Energy Management
8.0.1 Distributed Energy Management System with Distributed Energy Resources
Dr. Hirohisa Aki, Naitonal Institute of Advanced Industrial Science and Technology, Tsukuba, Japan

8.0.2 Sophisticated Energy Management for Optimizing the PV Grid Integration
Detlef Beister, SMA Solar Technology AG, Niestetal, Germany

8.0.3 Energy Management using a Scalable Dynamic Pricing System - Recent Results from Field Trials and Simulation Studies
Koen Kok, TNO, Delft, the Netherlands

8.0.4 Demonstration PV rural micro grid in the island of Santo Antão (Cape Verde, Africa) with an individual energy daily allowance
Alexandre Pineau, Trama Tecno Ambiental, Barcelona, Spain

8.0.5 Intelligent decentralized power supply and storage unit
Dr. Thilo Bocklisch, Technische Universität Chemnitz, Chemnitz, Germany

9.0 Generation and Load Management
9.0.1 SMARTV2G: Smart Vehicle to Grid Interface
Zsolt Krémer, Technomar GmbH, Munich, Germany

9.0.2 Demand Side and Battery Management in Solakiosks – Simulation and Operating ExperienceMatthias Resch, Reiner Lemoine Institut gGmbH, Berlin, Germany 9.0.3 A load model for EV parking lots Eleonora Riva Sanseverino, Università di Palermo, Palermo, Italy

9.0.4 An integrated platform for electrical modeling of microgrids
Dr. Biagio Di Pietra, ENEA Agenzia Nazionale per le nuove tecnologie, l'energia e lo sviluppo sostenibile Unità Tecnica Efficienza Energetica, Rome, Italy

9.0.5. The EU DERri Project: open use of Research Infrastructures for experimental activities in the field of integration of Distributed Energy ResourcesMaria-Luciana Rizzi, RSE SpA, Milano, Italy

9.0.6. Value of Flexible Producers and Consumers on the Day-Ahead Market
Stine Mueller, Fraunhofer-Institut für Solare Energiesysteme, Freiburg, Germany

9.0.7 Demand side management of household appliances using selforganizing virtual device
Ontje Lünsdorf, OFFIS Universität Oldenburg, Oldenburg, Germany

9.0.8 Different Household Load Profiles as a Means to Increase Direct Electricity Consumption from PV-Systems
Sebastian Gölz, Fraunhofer-Institut für Solare Energiesysteme ISE, Freiburg, Germany

10.0 Solar and Wind Energy Integration
10.0.1 Demonstration of a smart charging system for the coordinated charging of electric vehicles
Bart Beusen, VITO, Meerhout, Belgium

10.0.2 Coordinated voltage control of Photovoltaic plants in smart distribution power grids
Yehia Tarek Fawzy, SMA Solar Technology AG, Niestetal, Germany

10.0.3 Statistical processing and energy evaluation of wind- and solar data for integration in microgrids of Suriname

Anand Kalpoe, KU Leuven AdeKUvS, Leuven, Belgium

10.0.4 Transforming the Electricity Generation to a 100 % Renewable Supply on the Example of the Berlin-Brandenburg Region, Germany
Caroline Möller, Reiner Lemoine Institut gGmbH, Berlin, Germany
10.0.5 Evaluation of Competing Smart Grid Solutions
Markus Schwarz, Energy Institute at the Johannes Kepler University of Linz, Linz, Austria

10.0.6 Analysis and Comparison of Different Active Power Filtering Methods for Grid-Connected Photovoltaic Converters
Andrius Platakis, Fraunhofer IWES, Kassel, Germany

10.0.7 Optimized Power Control Of Large Offshore Wind Power Plants
Dr. Johan Driesen, KU Leuven, Leuven, Belgium
10.0.8 Characterisation of rapid fluctuations of the aggregated power output from distributed PV panels
Per Norgaard, DTU Technical University of Denmark, Roskilde, Denmark

10.0.9 Solar and Wind Energy Integration
Holger Zebner, Renewable Energies Department Lahmeyer International GmbH, Bad Vilbel, Germany

11.0 Information and Communication Technologies (ICT)
11.0.1 Buildings Energy Advanced Management System: Increasing energy efficiency in infrastructures of public use
Jose Javier Garcia, Barcelona Digital Technology Centre, Barcelona, Spain

11.0.2 Common Information Model (CIM) Extensions and Messaging for the Integration of Renewable Distributed Energy Resources
Dr. John Simmins, Electric Power Research Institute, Knoxvillle, United States

11.0.3 Generic interfaces for system services from heterogenous DER units
Oliver Gehrke, Technical University of Denmark Risø Campus, Roskilde, Denmark

12.0 Island Grids and Micro-Grids
12.0.1 Analysis of socio-economic determinants for implementing photovoltaics into island electricity systems
Enrico Howe, Reiner Lemoine Institut Humboldt-Universität zu Berlin, Berlin, Germany

12.0.2 From rural electrification to grid integration: lessons learnt
Pablo Diaz, Universidad de Alcala, Alcala de Henares, Spain

12.0.3 Fault-Ride-Through vs. Anti-Islanding
Stefan Laudahn, TU Braunschweig elenia, Braunschweig, Germany

12.0.4 Frequency Coupling in Inverter Grids -
Modelling the Mutual Interference of Voltage Source Inverters in Island Grids Source Inverters
Markus Jostock, University of Luxembourg, Luxembourg, Luxembourg

12.0.5 Compound Model of Inverter Driven Grids - Stability Analysis of Island Power Grids Containing Only Voltage Source Inverters Grids
Markus Jostock, University of Luxembourg, Luxembourg, Luxembourg

12.0.6 Distributed Renewable Energy for Distributed Generation in South Africa
Stefan Szewczuk, Council for Scientific & Industrial Reserach, Pretoria, South Africa

13.0 Transmission and Distribution

13.0.1 Energy Supply on Interconnected Renewable Based Islands in the Eastern Caribbean Sea
Guido Plessmann, Reiner Lemoine Institut, Berlin, Germany

13.0.2 Active & Smart Substations: Development and Testing of Intelligent Control Strategies for LV Networks with high share of DER
Ron Brandl, Fraunhofer Institut für Windenergie und Energiesystemtechnik IWES, Kassel, Germany