6th Solar Integration Workshop
International Workshop on Integration of Solar Power into Power Systems

14 - 15 November 2016 | Vienna, Austria
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- The Speed of PV Development World-Wide - A New Dimension for Power Systems
  T. Ackermann (Energynautics, Germany)

- The Impact of Renewables and Strategies for Integration in Wiener Netze Distribution Grid
  T. Schuster (Wiener Netze, Austria)

- Optimization of the Balancing Market in Austria
  Ch. Todem (APG, Austria)

- Communication in the Tension Between Renewables and Power Grid Development
  F. Wöber (APG, Austria)

## Session 2A: Grid Integration Studies and Experience
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  E. Taibi, F. Gafaro, P. Journeay-Kaler, I. Portugal (International Renewable Energy Agency [IRENA], Germany), J. Gómez, F. Fernandez (DigSILENT, Germany)

- Demonstration of Active Power Controls by Utility-Scale PV Power Plant in an Island Grid
  V. Gevorgian, B. O'Neill (NREL, USA)

- Maximizing the Penetration of Inverter-Based Generation on Large Transmission Systems: the MIGRATE Project
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## Session 2B: PV and Smart Grid Concepts
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- Decentralized Battery Energy Storage System – Application and impact in a Distribution System with Cloud Connection
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- Automatic Integration of Photovoltaic Inverters in a Smart Grid System to establish Additional Power Grid Beneficial Functions
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- Modular PLC-Based Control Concepts for Integration of PV Plants to Power Distribution Grids
  T. Oesselke (Phoenix Contact Electronics, Germany)
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A Comprehensive Study on the Actual Potential of Grid Support Functions to Enhance the Hosting Capacity of Distribution Networks with a High PV Penetration
S. Kadam, B. Blatterie (AIT, Austria)

Testing and Validation of Simultaneous Multiple Use of Photovoltaic Storage Systems
F. Lobas-Funck, F. Soyck, B. Engel (Technical University Braunschweig, Germany)

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R. Luthander, D. Lingfors, J. Widén (Uppsala University, Sweden)

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T. Nacht, M. Tragner (4ward Energy Research, Austria)

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W. Shan, M. Shan (Fraunhofer IWES, Germany)

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J. C. Boemer, E. Vittal, M. Rylander (EPRI, USA), B. Mather (NREL, USA)

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S. Reichert, B. Stickan (Fraunhofer ISE, Germany)

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I. Maqbool (Fraunhofer IWES, Germany), G. Lammert (University of Kassel, Germany), A. Ishchenko, (Phase to Phase BV, Netherlands), M. Braun (Fraunhofer IWES | University of Kassel, Germany)

A Transient Stability Improvement by Decentralized Non-Liner Control of Active and Reactive Power of PV
K. Furubayashi, T. Tsuji, T. Oyama (Yokohama National University, Japan), K. Uchida (Waseda University, Japan)
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14:00 – 15:45 / 14 November 2016 / Room Grand Waterfront 3 / Session chair: D. Lew (GE, USA)

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**Synthetic Natural Gas Production and Utilization in the North European Power System in 2050**  
J. Ikäheimo, J. Kiviluoma (VTT, Finland)

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S. Ott (University of Applied Forest Sciences Rottenburg, Germany), P. Lilje (M.F.E., Germany), M. Brunotte (University of Applied Forest Sciences Rottenburg, Germany)

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**Integration of PV-Units in the Tertiary Control Ancillary Services Market in Switzerland**  
A. Chacko (Swissgrid, Switzerland), V. Wyss, M. Koller, S. Poelzig (Electricity company of canton Zurich (EKZ), Switzerland), F. Carigiet, F. Baumgartner (Zurich University of Applied Science (ZHAW), Switzerland)

Session 4B: Economics and Storage

16:00 – 18:15 / 14 November 2016 / Room Grand Waterfront 2 / Session chair: P. Gardner (DNV GL - Energy, United Kingdom)

**Energy Storage: Is There a Business Case?**  
D. Lew (GE Energy, USA)

**Through the Valley: The Impact of PV Penetration Levels on Price Volatility and Resulting Revenues for Storage Plants**  
M. Hartner (Vienna University of Technology, Austria)

**Quantifying the Storage Requirements Needed To Achieve High PV Penetration in the U.S.**  
P. Denholm, R. Margolis (NREL, USA)

**Merit Order Effect of Flexibility Options**  
M. Hinterstocker, B. Eberl, S. von Roon (Forschungsgesellschaft für Energiewirtschaft, Germany)

**PV Generation Share in the Energy System and Battery Utilisation Correlation in a Net Zero Emission World**  
D. Bogdanov, A. Gulagi, C. Breyer (Lappeenranta University of Technology, Finland)
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M. Schoeneberger, S. Patzack, H. Vennegeerts (FGH / RWTH Aachen University, Germany)
(Submission-ID SW16-162)

Spatio-temporal Analysis of Regional PV Generation
E. Nuño, N. Cutululis (DTU, Denmark)

Identification and Reconstruction of Photovoltaic Measurement Gaps based on Temporal Correlation and Spatial Distance

Advancing Distribution Planning Tools for DER Impact Assessments: Streamlining DER Hosting Capacity Analysis
M. Rylander, J. Smith (EPRI, USA)

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Study on Optimization Methods for Active Distribution Network with a Large Penetration of PV
Y. Shiratori, T. Tsuji, T. Oyama (Yokohama National University, Japan), Y. Nishida (Tokyo Electric Power Company Holdings, Japan)

Session 5A: IRENA & Grid Codes

08:15 – 09:55 / 15 November 2016 / Room Grand Waterfront 1 / Session chair: T. Ackermann
(Energynautics, Germany)

Scaling up Variable Renewable Power: The Role of Grid Codes
Francisco Boshell (IRENA, Germany)

The Role of Grid Codes for VRE Integration into Power Systems
P. Schierhorn, N. Martensen, T. Ackermann (Energynautics, Germany)

Status of Revision of the VDE-AR-N 4105 Application Guide for the Connection of Distributed Generation to Low Voltage Networks
J. Suckow (VDE/FNN, Germany), J. C. Boemer (EPRI, USA)

State of the National Implementation of the NC RfG in Germany
J. Möller, K. Genzmer (M.O.E. Moeller Operating Engineering, Germany)

Status of Revision of IEEE Std 1547 and 1547.1
J. C. Boemer, A. Huque, B. Seal, T. Key, D. Brooks (EPRI, USA), C. Vartanian (Mitsubishi Electric Power Products, USA)

Session 5B: Forecasting

08:15 – 09:55 / 15 November 2016 / Room Grand Waterfront 2 / Session chair: TBA

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S. Cros, M. Turpin, M. De Roubais, N. Schmutz (Reuniwatt, France)

Validation of Solar Irradiance Forecasts Using High-Resolution Numerical Prediction Models
H. Ohtake, F. Uno (National Institute of Advanced Industrial Science and Technology (AIST), Y. Yamada (Meteorological Research Institute of the Japan Meteorological Agency, Japan)

Development of Solar Forecasting in India: The Introduction of REMCs
M. Kaur, I. Mitra, M. Wypior, S. Kumar Sharma, A. Ramanan (GIZ, India)

A Combined Pyramidal Image Matcher and Analog Ensemble Method to Improve Satellite-Based Short-Term Solar Power Prediction in the Hawaiian Islands
S. Young, J. Zack (AWS Truepower, USA)

Short-Term PV Power Prediction Analysis of Different Latitudes in the Condition of PV Power Curtailment
Y. Cui, Z. Chen, P. Sun (Hubei Meteorological Service Center | Meteorological Energy Development Center of Hubei Province, Wuhan, China)
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Solving the Community Storage Dilemma – Higher Utilization by Multiple Usage
C. Stegner, A. Blockinger, J. Bogenrieder, P. Luchscheider (ZAE Bayern, Germany)

Limitations of Integrating Photovoltaic Energy into Municipal Grids Excluding and Including Storage Systems
B. Böckl, J. Vopava, L. Kriechbaum, T. Kienberger (Montanuniversitaet Leoben, Austria)

Field Assessment of PV-Home Storage Systems
C. Messner, J. Kathan, C. Seitl, S. Hofmüller (AIT – Austrian Institute of Technology, Austria), J. Wolfahrt (Fronius International, Austria)

Integration of Storage into a Renewables Portfolio to Optimise Revenue & Grid Connection Utilisation
S. Weatherhead, G. McFadzean, C. Cleary, L. Russell (TNEI Services, United Kingdom)

Session 6A: Grid Codes
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(AIT – Austrian Institute of Technology, Austria)

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N. Martensen, T. Ackermann (Energynautics, Germany)

New Zealand Guideline for the Connection of PV Solar Power and Determining Hosting Capacity for PV Solar Power
R. Strahan, S. McNab, S. Pandey, S. Lemon, A. Miller, N. Watson, A. Wood (University of Canterbury, New Zealand),
T. Crownshaw (Transpower NZ, New Zealand)

Building a Level Playing Field for Distributed Solar Photovoltaic in Australia
S. Teske, J. Rutovitz, L. McIntosh (University of Technology Sydney, Australia)

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S. Köppl, A. Zeiselmaier, A. Bogensperger, M. Müller, M. Hinterstocker, F. Samweber (FFE – Research Center for Energy Economics, Germany)

Policies of PV Self-Consumption: Desruptive Potential on Balancing Systems
M. Döring, M. Bons, S. Tiedemann (Ecofys Germany, Germany)

Constructing Offering Curves for a CSP Producer in Day-ahead Electricity Markets
I. Dimoulkas, D. Khastieva, M. Amelin (KTH Royal Institute of Technology, Sweden)

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11:30 – 12:15 / 15 November 2016 / Room Grand Waterfront 1+2+3 / Session chair: TBA

Podium discussions

The contributions and discussions of this session are not part of the proceedings.
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R. Grab, F. Ackermann, S. Rogalla (Fraunhofer ISE, Germany)

Techno-economic Optimum Control of Grid-connected Residential Battery Energy Storage Units
I. Ranaweera, O.-M. Midtgård (Norwegian University of Science and Technology, Norway)

East Asian Super Grid: Can Australia Become an Electricity Source for Asia?
A. Gulagi, D. Bogdanov, C. Breyer (Lappeenranta University of Technology, Finland)

Feeder Analyses of a Medium Voltage Grid with the Utilization of a Solar-Roof-Potential-Analyses
F. Ebe, J. Morris, H. Ruf, G. Heilscher (Ulm University of Applied Sciences, Germany), F. Meier (Stadtwerke Ulm/Neu-Ulm Netze, Germany)

Optimal Scheduling of Plug-in Electric Vehicles in Distribution Systems Including PV, Wind and Hydropower Generation
S. Zaferanlouei, I. Ranaweera, M. Korpås, H. Farahmand (Norwegian University of Science and Technology, Norway)

Copula Correlation Modeling of Aggregate Solar Irradiance in Spatial Networks
J. Munkhammar, J. Widén (Uppsala University, Sweden)

The Impact of Large-Scale Renewable Energy Integration on the Utilization of Pumped Hydro Storage in Spain
E. Rye, A. Lie, H. G. Svendsen (SINTEF Energy Research, Norway), M. Korpås, H. Farahmand (Norwegian University of Science and Technology, Norway)

Case Studies Analysis of Renewable Energy Implementation into the Mining Industry
K. Zharan, J. Bongaerts (TU Bergakademie Freiberg, Germany)

A Transient Stability Assessment Method of Power Systems by using Dynamical Systems Theory in Japanese 60Hz Power System with Photovoltaics
A. Hatano, T. Tsuji, T. Oyama (Yokohama National University, Japan)

Assessment of Probabilistic PV Production Forecasts Performance in an Operational Context
A. Bocquet, A. Michiorri, A. Bossavy, R. Girard, G. Kariniotakis (MINES ParisTech, France)

Development of a RDS-PP Guideline for Photovoltaic Power Plants
C. Bertsch-Engel (CEE Operations, Germany), A. Böser (VGB PowerTech, Germany)

Experimental Research on the Optimal Tilted Angle for PV Modules in Wuhan, China
Z. Chen, P. Sun, C. Cheng (Hubei Meteorological Service Center | Meteorological Energy Development Center of Hubei Province, China), G.-G. Yan (Wuhan Rixin Technology, China)

Application and Effect Test of A Method of Gradually Approaching Error for the Solar Radiation Prediction
Z. Chen, P. Sun, (Hubei Meteorological Service Center | Meteorological Energy Development Center of Hubei Province, China), R. Zhang (Hubei Provincial Meteorological Administration Training Center, China)