

DIGITAL PROCEEDINGS

# 8<sup>th</sup> Solar Integration Workshop

International Workshop on Integration  
of Solar Power into Power Systems



16 - 17 October 2018 | Stockholm, Sweden

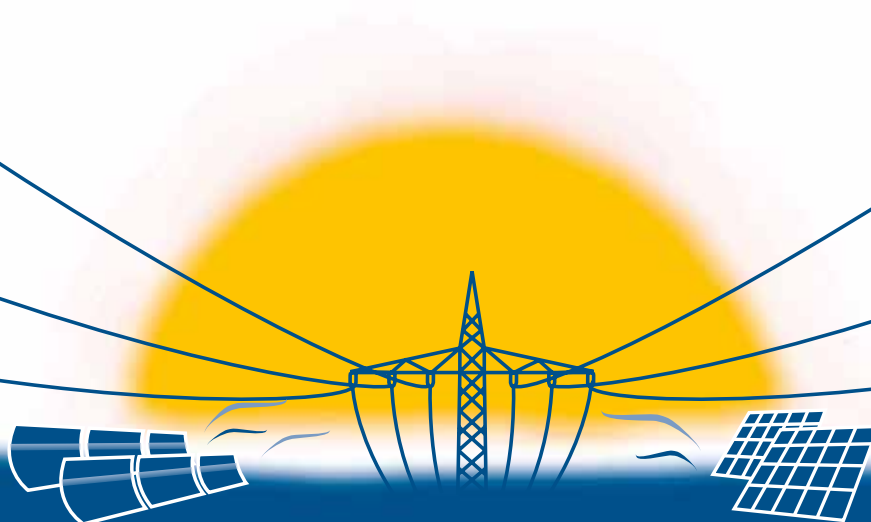
Giga Sponsor:



Organizer:



Co-Organizer:



## **IMPRINT**

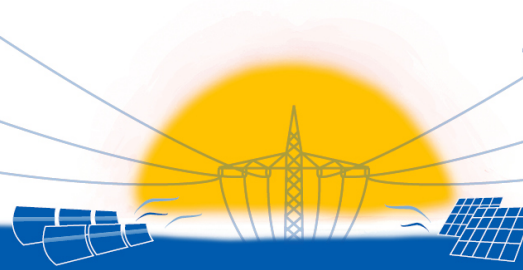
Digital Proceedings  
of the 8th International Workshop on Integration of Solar Power into Power Systems  
published in 2018 by:

**Energynautics** GmbH  
Robert-Bosch-Straße 7  
64293 Darmstadt  
Germany  
[www.energynautics.com](http://www.energynautics.com)  
[info@energynautics.com](mailto:info@energynautics.com)

All rights reserved. No part of this publication may be reproduced, transmitted or stored  
in a retrieval system in any form or by any means without permission in writing  
from the respective author.

ISBN: 978-3-9820080-0-4

Cover Design by:  
Ines Drewianka, **Energynautics** GmbH, Germany



## DIGITAL PROCEEDINGS – TABLE OF CONTENTS

### TUESDAY, 16 OCTOBER 2018

#### 09:10 – 10:50 SESSION 1 – KEYNOTE SESSION

> Session Chair T. Ackermann (Energynautics, Germany)

- **Can the Nordic Countries become CO<sub>2</sub> Negative by 2040?**  
Kenneth Karlsson (ETSAP / DTU, Denmark)
- **TBA**  
Peerapat Vithayasrichareon (IEA, France)
- **Overview: Grid Integration of Renewables in Australia**  
Jennifer Crisp (DlgSILENT Pacific, Australia)
- **Presentation 4**  
Autor (Affiliation, Country)

The contributions and discussions of this session are not part of the proceedings.

#### 11:20 – 13:00 SESSION 2A – POWER SYSTEM STUDIES I

> Session Chair TBA

- **TBA**  
C. Hart, P. Vithayasrichareon (IEA, France)
- **Renewables Integration Grid Study for the 2030 Japanese Power System**  
R. Kuwahata, P. Merk (Elia Grid International, Germany), T. Wakeyama (Kyushu University, Japan), D. Pescia (Agora Energiewende, Germany), S. Rabe (GridLab, Germany), S. Ichimura (Japan Renewable Energy Institute, Japan)  
(Submission-ID SIW18-17)
- **Interaction Analysis of Large-Scale PV Power Plants Considering the AC Network**  
J. Montero-Casinello, E. Prieto-Araujo, R. Ferrer-San-José, O. Gomis-Bellmunt (CITCEA-UPC, Spain)  
(Submission-ID SIW18-55)
- **Resource Adequacy at Continental Scale: Methodological Insights from Joint Assessments of Interconnected North American Power Systems**  
G. Stephen (NREL, USA) (Submission-ID SIW18-299)

**11:20 – 13:00      SESSION 2B – ANCILLARY SERVICE ASPECTS**

**> Session Chair      Julia Matvosyan (ERCOT, USA)**

- **Highly Accurate Method for Real-Time Active Power Reserve Estimation for Utility-Scale PV Power Plants**  
V. Gevorgian (NREL, USA) ([Submission-ID SIW18-31](#))
- **The Potential of Using Residential PV-Battery Systems to Provide Primary Frequency Control on a National Level**  
R. Luthander, S. Forsberg (Uppsala University, Sweden) ([Submission-ID SIW18-110](#))
- **Impact of Inverters with Virtual Synchronous Machine Control in Low Voltage Grids**  
F. Rauscher, E. Rebak, B. Engel (TU Braunschweig – elenia, Germany) ([Submission-ID SIW18-277](#))
- **Practical Implementation of the SNOOPI-Box for a Smart Voltage Control in the Distribution Grid**  
S. Hempel, J.-D. Schmidt, E. Tröster (Energynautics, Germany), M. Koch, U. Ohl (EWR Netze, Germany) ([Submission-ID SIW18-325](#))

**11:20 – 13:00      SESSION 2C – PROJECT EXPERIENCE**

**> Session Chair      J. Charles Smith (ESIG, USA)**

- **PV Integration with Flexible Generation and Consumption Units – Evaluation of a Quota-Based Grid Traffic Light Approach in a Field Test**  
K. Geschermann, K. Volk, C. Lakenbrink, M. Konermann (Netze BW, Germany) ([Submission-ID SIW18-69](#))
- **Enhanced Feed-in Management in Low and Medium Voltage Distribution Grids for PV Integration and Ancillary Service Provision – Experience from a Field Test**  
L. Rupp, K. Volk, M. Konermann (Netze BW, Germany), J. Imfeld (Landis+Gyr, Switzerland) ([Submission-ID SIW18-162](#))
- **Self-consumption and Self-sufficiency Level in an Energy Cell with a High Penetration of PV and a Hybrid Battery Storage System**  
L. Held, G. Weber, M. Zimmerlin, M. R. Suriyah, T. Leibfried (Karlsruhe Institute of Technology – KIT, Germany), M. Armbruster, R. Höche (Stadtwerke Bühl, Germany) ([Submission-ID SIW18-171](#))
- **Comparative Study of Three Methods of Increasing the Solar PV Hosting Capacity of an LV Grid**  
A. Kitimbo, U. Morild (Vattenfall R&D, Sweden) ([Submission-ID SIW18-94](#))

**14:00 – 15:40      SESSION 3A – POWER SYSTEM STUDIES II**

**> Session Chair      Michael Nørtoft Frydensbjerg (Vattenfall, Denmark)**

- **High Penetration of Photovoltaic Energy and Supply-Demand Balance in the Western Japan Grid, with Utilizing Interzone Transmission and Demand Response**  
A. Takehama (Ritsumeikan University, Japan), M. Utagawa (National Institute of Advanced Industrial Science and Technology – AIST, Japan) ([Submission-ID SIW18-274](#))
- **Impacts of Distributed Solar Advanced Inverters on Transmission Voltage and Reactive Power**  
B. Palmintier, I. Krad, D. Krishnamurthy (NREL, USA) ([Submission-ID SIW18-227](#))
- **Japanese Power System Operation with Large Amounts of PV using Day-ahead and Intraday Unit Commitment**  
Y. Udagawa, Y. Nishitsuji, K. Ogimoto, J. Gari da Silva Fonseca Junior (The University of Tokyo, Japan), K. Ukegawa (Kozo Keikaku Engineering, Japan), S. Fukutome, (JP Business Service Corporation, Japan) ([Submission-ID SIW18-59](#))
- **Investigation of Balancing Power Demand in the Roll-out Scenario of Solar Energy in Senegal**  
B. Koeppen, A. K. Usbeck (Hamburg University of Applied Sciences – HAW, Germany), M. L. Ndiaye, A. Ndiaye (Cheikh Anta Diop University –UCAD, Senegal) ([Submission-ID SIW-53](#))

**14:00 – 15:40      SESSION 3B – INNOVATIVE SOLUTIONS**

> Session Chair      TBA

- **Secure Energy Information Network in Germany – Demonstration of Solar-, Storage- and E-Mobility Applications**  
G. Heilscher, S. Chen, F. Ebe, H. Lorenz (Ulm University of Applied Sciences, Germany), S. Hess, T. Kaufmann (Zenner Hessware, Germany), J. Wening (Meteocontrol, Germany) ([Submission-ID SIW18-317](#))
- **Coordinated Power System Services from Distributed Batteries**  
P. Nørgaard (Technical University of Denmark – DTU, Denmark), M. Florides (University of Cyprus, Cyprus) ([Submission-ID SIW18-268](#))
- **Evaluation of Datasets and Methods to Derive 3D Building Models and their Influence on PV Power Integration Studies**  
D. Lingfors, J. Widén (Uppsala University, Sweden) ([Submission-ID SIW18-193](#))

**14:00 – 15:20      SESSION 3C – CESEPS SESSION**

> Session Chair      Cihan Gercek (University of Twente, Netherlands)

- **Capabilities of Strict Power Limits at Prosumer Households for Solving Network Load Issues at LV grids: An Austrian Case Study**  
D. Reihs, S. Übermasser, S. Henein (AIT Austrian Institute of Technology, Austria) ([Submission-ID SIW18-313](#))
- **Evaluation of Heat Pumps for Balancing Grids in Combination with Solar Energy Production: A Dutch Case Study**  
C. Gercek, A. Reinders (University of Twente, Netherlands) ([Submission-ID SIW18-260](#))
- **Stability of Grid-connected Photovoltaic Inverters During and After Low Voltage Ride Through**  
Z. Zhang, R. Schürhuber, L. Fickert (Graz University of Technology, Austria), Y. Zhang (Shanghai DianJi University, China) ([Submission-ID SIW18-248](#))

**16:00 – 18:10      SESSION 4A – DISTRIBUTION GRID ASPECTS**

> Session Chair      TBA

- **DER Integration Study for the German state of Hesse – Methodology and Results for the Low- and Medium Voltage Level**  
A. Scheidler, J. Ulfers, J. Dasenbrock, D. Horst, C. Pape (Fraunhofer IEE Kassel, Germany), M. Braun (Fraunhofer IEE Kassel | University of Kassel, Germany) ([Submission-ID SIW18-297](#))
- **Calculating the Hosting Capacity of Electrical Network with High Penetration of Solar PV**  
N. Etherden, J. Ahlberg (Vattenfall R&D, Sweden), D. Lingfors (Uppsala University, Sweden), K. Kvamme (Powel A/S, Norway) ([Submission-ID SIW18-234](#))
- **Integration of PV+Storage – Technical and Economic Evaluation at Distribution Grids**  
G. Yang, P. Hou (Technical University of Denmark – DTU, Denmark), D. Sera, J. P. Rodrigues Martins (Aalborg University, Denmark), P. Douglass, S. Martens (Danish Energy, Denmark), P. M. Johansen, D. K. Svendsen (Integrate, Denmark), K. Moth (LivingPower Aps, Denmark) ([Submission-ID SIW18-72](#))
- **Coordinated Reactive Power Control of Solar PV for Thermal and Voltage Constraint Management in Distribution Network**  
N. Hieu Xuan (Yokohama National University, Japan | Vietnam National University of Agriculture, Vietnam), T. Tsuji (Yokohama National University, Japan) ([Submission-ID SIW18-233](#))
- **Identification of a Dynamic Equivalent of an Active Distribution Network from Monte-Carlo Simulations**  
G. Chaspierre (University of Liège, Belgium), G. Denis, P. Panciatichi (RTE R&D, France), T. Van Cutsem (University of Liège, Belgium) ([Submission-ID SIW18-86](#))
- **Evaluation of Power Flow Prognosis Methods for Congestion Management in Low Voltage Grids**  
K. Volk, C. Lakenbrink, N. Hatje (Netze BW, Germany), F. Sivorotka (SevenZone Informationssysteme, Germany), P. Stolle (Fichtner IT Consulting, Germany), K. Förderer (FZI Research Center for Information Technology, Germany) ([Submission-ID SIW18-85](#))

**16:00 – 18:00 SESSION 4B – GRID CODE ASPECTS****> Session Chair TBA**

- **Solar Inverter Interactions with DC Side – Some Regulatory Challenges**  
J. Crisp, R. Sharma, T. George, S. Hagaman (DIgSILENT Pacific, Australia), H. Nguyen (Leeson Group, Australia) ([Submission-ID SIW18-270](#))
- **International Communications Standard for Meeting Smart Energy Grid Code Requirements: IEC 61850-7-420 for DER**  
L. Guise (Schneider-Electric, France), F. Cleveland (Xanthus Consulting, USA) ([Submission-ID SIW18-254](#))
- **Implementation of the European Network Code on Requirements for Generators on the European National Level – Current Status – Trends and Challenges**  
R. Bründlinger (AIT Austrian Institute of Technology, Austria), G. Arnold, N. Schäfer (Fraunhofer IEE, Germany, Germany), T. Schaupp (KACO New Energy, Germany), G. Graditi, G. Adinolfi (ENEA, Italy) ([Submission-ID SIW18-82](#))
- **Generator Technical Performance Standards in the Australian National Electricity Market**  
J. Eggleston (Australian Energy Market Commission – AEMC, Australia) ([Submission-ID SIW18-41](#))
- **Pre-Certification of Grid Code Compliance for Solar Inverters with an Automated Controller-Hardware-in-the-Loop Test Environment**  
R. Bruendlinger, J. Stöckl, Z. Miletic, R. Ablinger, F. Leimgruber (AIT Austrian Institute of Technology, Austria), J. Johnson (Sandia National Laboratories, USA), J. Shi (EPRI, USA) ([Submission-ID SIW18-169](#))

**16:00 – 18:00 SESSION 4C: FORECASTING I****> Session Chair TBA**

- **Evaluation of the Impact of Intra-Day Distributed PV and Wind Generation Forecasts on Decision-making in the Operations of an Island Grid System**  
J. Zack (UL, USA) ([Submission-ID SIW18-165](#))
- **System Imbalance from Solar Energy Trading**  
T. Landelius, S. Andersson (Swedish Meteorological and Hydrological Institute – SMHI, Sweden), R. Abrahamsson (Tekniska Verken Linköping Nät AB, Sweden) ([Submission-ID SIW18-185](#))
- **Very Short-Term Solar Power Forecasting Using Ground-based Sky Images**  
D. M. Lasanthika H. Dissawa, A. P. Agalgaonkar, D. A. Robinson, S. Perera, (University of Wollongong, Australia), R. I. Godaliyadda, P. B. Ekanayake, J. Ekanayake (University of Peradeniya, Sri Lanka) ([Submission-ID SIW18-271](#))
- **On the Improvement of Day-ahead Forecasts of Solar Irradiation with Simple Ensembles and Training Data Selection in Japan: A Countrywide Assessment**  
J. Gari da Silva Fonseca Júnior, K. Ogimoto (The University of Tokyo, Japan), F. Uno, T. Oozeki (National Institute of Advanced Industrial Science and Technology – AIST, Japan) ([Submission-ID SIW18-273](#))
- **Development of Nowcasting Method of Irradiance Distribution based on Kriging and All-sky Image Information**  
T. Kato, M. Imanaka, M. Kurimoto, S. Sugimoto (Nagoya University, Japan) ([Submission-ID SIW18-239](#))

**WEDNESDAY, 17 OCTOBER 2018****08:30 – 10:15 SESSION 5A – FREQUENCY CONTROL ASPECTS****> Session Chair Math Bollen (Luleå University of Technology, Sweden)**

- **The Provision of Primary Frequency Control in the Australian National Electricity Market**  
J. Eggleston, B. Hiron (Australian Energy Market Commission – AEMC, Australia) ([Submission-ID SIW18-42](#))
- **Managing Frequency in Low Inertia Grids**  
S. Hagaman, T. George, J. Crisp (DIgSILENT Pacific, Australia) ([Submission-ID SIW18-57](#))
- **Contribution of Photovoltaic Power Systems to Frequency Control**  
J. Seidel, B. Engel (TU Braunschweig, Germany) ([Submission-ID SIW18-38](#))
- **Experiences with large Grid Forming Inverters on the Island St. Eustatius, Portability to Public Power Grids**  
O. Schömann, T. Bülo, C. Hardt, A. Falk, P. R. Stankat, (SMA Solar Technology, Germany) ([Submission-ID SIW18-252](#))

**08:30 – 10:15      SESSION 5B – DECARBONIZATION OF ENERGY SECTOR**

> Session Chair      TBA

- **The Role of Climate Variability in the Assessment of Roadmaps for Power Systems with High Renewable Penetration**  
R. Figueiredo, P. Nunes, M. C. Brito (University of Lisbon, Portugal) ([Submission-ID SIW18-194](#))
- **Effects on Greenhouse Gas Emissions of Introducing Lithium-ion Batteries for Stationary Power System Applications**  
S. Davidsson (Chalmers University of Technology, Sweden) ([Submission-ID SIW18-283](#))
- **Demand-side Management and Energy Storage Options for Building’s Photovoltaic Integration.**  
Z. Hoyos, P. S. Moura (University of Coimbra, Portugal) ([Submission-ID SIW18-120](#))
- **Climate Change Mitigation Potentials of Vertical Building Integrated Photovoltaic**  
T. Blanke, B. Dring (FH Aachen, Germany), M. Vontein, M. Kuhnhenne (RWTH Aachen University, Germany) ([Submission-ID SIW18-77](#))
- **Simplification Methods for Optimal Dimensioning of Energy Storage Systems and Heating Devices using Time Series Load and Infeed Data**  
M. Zimmerlin, M. Fritz, L. Held, M. R. Suriyah, T. Leibfried (Karlsruhe Institute of Technology – KIT, Germany) ([Submission-ID SIW18-192](#))

**08:30 – 10:15      SESSION 5C – FORECASTING II**

> Session Chair      John Zack (UL AWS Truepower, USA)

- **Improvements for Online Feed-in Estimations Based on PV Power Output Measurements**  
D. Lassahn, N. Riewald (meteocontrol, Germany) ([Submission-ID SIW18-2](#))
- **Using Solar and Load Predictions in Battery Scheduling at the Residential Level**  
R. Bean (Redback Technologies, Australia), H. Khan (University of Queensland, Australia) ([Submission-ID SIW18-137](#))
- **Integration of Short-term PV Forecasts in Control Strategies of PV-Diesel Systems**  
P. Besson (SteadySun, France), T.-P. Do, G. A. Koucoi, F. Bourry (National Institute of Solar Energy – INES, France) ([Submission-ID SIW18-315](#))
- **Solar Ensemble Forecasting for Distribution Power System Volt and Var Control**  
B. Uzunoglu (Uppsala University, Sweden), M. Blaschek, C. Kusmitsch (UBIMET, Austria), A. Terciyarli (ENDOKS, Turkey) ([Submission-ID SIW18-310](#))

**10:40 – 12:05      SESSION 6A -POWER QUALITAY ISSUES**

> Session Chair      Bernd Engel (TU Braunschweig, Germany)

- **Hosting Capacity of the Grid for Photovoltaic Installations – a Stochastic Approach Applied to Single-phase Connections**  
M. H. J. Bollen, E. Mulenga, S. K. Rönnberg (Luleå University of Technology, Sweden), N. Etherden (Vattenfall R&D, Sweden) ([Submission-ID SIW18-46](#))
- **Should Waveform Distortion (Harmonics) be Considered when Connecting Large Amounts of Solar PV?**  
S. K. Rönnberg, T. Busatto, M. H. J. Bollen (Luleå University of Technology, Sweden) ([Submission-ID SIW18-99](#))
- **Power Quality Measurement Campaign at a Jordan LV Grid and Determination of the Influence of a Large PV Plant**  
D. Masendorf, E. Tröster (Energynautics, Germany), S. Jankovic (International Energy Consultants, Germany) ([Submission-ID SIW18-250](#))

**10:40 – 12:05      SESSION 6B – MARKET AND REGULATORY ISSUES**

**> Session Chair      Julian Eggleston (Australian Energy Market Commission – AEMC , Australia)**

- **How to Create Value through Aggregation: A Business Model Review for Multiple Regulatory Environments in Europe**  
S. De Clercq (3E, Belgium), D. Schwabeneder, C. Corinaldesi (TU Vienna, Austria), O. Bertetti, A. Woyte (3E, Belgium) (Submission-ID SIW18-44)
- **A Comparative Analysis of PV Markets in Brazil and Sweden**  
S. Silveira (KTH Royal Institute of Technology, Sweden), W. Uturbey, H. Batista da Silva, L. S. Marques (UFMG Federal University of Minas Gerais, Brazil) (Submission-ID SIW-294)
- **Transmission, Distribution and Markets: Coordination needs in the European Power System**  
E. Lannoye, A. O’Connell (EPRI International, Ireland), M. Doering (Navigant, Germany) (Submission-ID SIW18-170)
- **A Comparative Assessment of the Small-Scale Distributed Generation Policies in the EU and Latvia**  
L. Zemite, L. Petricenko, A. Sauhats, O. Linkevics, G. Bockarjova (Riga Technical University – RTU, Latvia) (Submission-ID SIW18-117)

**10:40 – 12:05      SESSION 6C – HYBRID POWER SYSTEMS AND STORAGE SOLUTIONS**

**> Session Chair      TBA**

- **Summary of Tenerife Hybrid Power Stems Workshop**  
T. Ackermann (Energynautics, Germany)
- **Sensitivities in Hybrid Energy Systems**  
M. A. Lagler, E. Schmutzner, R. Schürhuber (Graz University of Technology, Austria) (Submission-ID SIW18-9)
- **Design of a Hybrid-Power-System Dominated by Solar Power and Battery Storage Including Retro-fitting Options Driven by Future Load Increase**  
M. Kühnel, B. Hanke (DLR Institute of Networked Energy Systems, Germany), O. Weigel, I. W. Stuermer (Lower Saxony Ministry for Environmental Affairs, Energy, Building and Climate Protection, Germany), A. McMaster (Department of Economic Development, Environmental Affairs and Tourism of Eastern Cape, South Africa), S. Maebe (GIZ, South Africa), K. von Maydell (DLR Institute of Networked Energy Systems, Germany) (Submission-ID SIW18-89)
- **Decentralized Secondary Frequency Control in an Optimized Diesel PV Hybrid System**  
A. V. Turnell, P.-P. Schierhorn, D. Masendorf (Energynautics, Germany), K. Morozovska (KTH Royal Institute of Technology, Sweden) (Submission-ID SIW18-326)

**12:15 – 13:15      SESSION 7 – PANEL DISCUSSION: AUTONOMOUS GRID**

**> Session Chair      Adrian Timbus (ABB, Switzerland)**

- **Panelists**
    - Adrian Timbus (ABB, Switzerland)
    - Fredrick Carlsson (Vattenfall, Sweden)
    - Math Bollen (Luleå University of Technology, Sweden)
- more TBA

**The contributions and discussions of this session are not part of the proceedings.**



## POSTER PRESENTATION PAPERS

---

- **Modeling City Scale Spatio-temporal Solar Energy and Electric Vehicle Charging Load**  
D. Lingfors, M. Shepero (Uppsala University, Sweden), C. Good (UiT – Arctic University of Norway, Norway), J. Bright (Australian National University, Australia) J. Widén (Uppsala University, Sweden), T. Boström (UiT – Arctic University of Norway, Norway) J. Munkhammar (Uppsala University, Sweden) ([Submission-ID SIW18-76](#))
- **Agent-based Optimization of Retail Electricity Rates for PV Integration**  
M. Hinterstocker, S. von Roon (Research Center for Energy Economics – FfE, Germany) ([Submission-ID SIW18-91](#))
- **Balancing Power Capacity Analysis for Primary/Secondary/Tertiary Controls Based on AGC30 Model with PV Penetration**  
B. Jie, T. Tsuji (Yokohama National University, Japan), K. Uchida (Waseda University, Japan) ([Submission-ID SIW18-111](#))
- **Virtual Synchronous Generator Control and Grid Voltage Control by Reactive Power Coordinated for PV Plant Inverter**  
M. Tsuyuki, Y. Ota, T. Nakajima (Tokyo City University, Japan) ([Submission-ID SIW18-141](#))
- **Approach to Determine the Effect of Local Flexibility Options within the Framework of a Smart Market Platform**  
T. Estermann, M. Müller, S. Köppl, A. Weiß (Research Center for Energy Economics – FfE, Germany) ([Submission-ID SIW18-159](#))
- **Solar Energy for Residential Electric Vehicle Charging in Northern Norway – a Feasibility Study**  
C. Good, T. Boström (UiT – Arctic University of Norway, Norway) ([Submission-ID SIW18-214](#))
- **Smart Meter Design for e-Health monitoring on the Smart Grid System**  
A. Kelati, H. Tenhunen (KTH Royal Institute of Technology, Sweden) ([Submission-ID SIW18-272](#))
- **Agent Based System for improved Control and Monitoring of a Solar Driven DC Microgrid**  
D. Rwegasira (KTH Royal Institute of Technology, Sweden | University of Dar es Salaam, Tanzania), N. Mvungi (University of Dar es Salaam, Tanzania), H. Tenhunen (KTH Royal Institute of Technology, Sweden) ([Submission-ID SIW18-346](#))