

2nd International Workshop on

# Integration of Solar Power into Power Systems

12 - 13 November 2012, Lisbon, Portugal 



## PROGRAM

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## SOLAR TIMETABLE

Sunday, 11 November		Monday, 12 November		Tuesday, 13 November	
Tutorials		Solar Workshop Day 1		Solar Workshop Day 2	
		08:00 - 09:00	Foyer -1		
			Registration		
		09:00 - 09:10	Room Castelo I/II		08:40 - 10:40
			Opening & Welcome		
				SESSION 5A: Results of Smooth-PV	Castelo VIII/IX
				SESSION 5B: PV Grid Integration II	
		09:10 - 10:50	Room Castelo I/II		
			SESSION 1: Keynote Session		
			Coffee Break (20 min)		11:00 - 12:15
			Castelo I/II	Castelo VIII/IX	
				SESSION 6A: Modelling	SESSION 6B: Networks with PV
		11:10 - 13:00	Castelo I/II	Castelo VIII/IX	12:15 - 13:00
			SESSION 2A: Solar Inte- gration Studies: Europe	SESSION 2B: Solar Power Prediction	
				CLOSING SESSION: Podiums Discussions	
			Lunch (1h)		Lunch (1h)
14:00 - 15:45	Room Castelo III	14:00 - 16:00	Castelo I/II	Castelo VIII/IX	
	SOLAR TUTORIALS I: Modelling, diagnostics, and monitoring for PV arrays // PV inverter structures, topologies, and control		SESSION 3A: Solar Inte- gration Studies: USA	SESSION 3B: PV, Storage, and DSM	
	Coffee Break (30min)		Coffee Break (30min)		
16:15 - 18:00	Room Castelo III	16:30 - 18:30	Castelo I/II	Castelo VIII/IX	
	SOLAR TUTORIALS II: Grid Requirements for PV Systems and Grid Interactive PV Inverters		SESSION 4A: Distribution Networks and PV	SESSION 4B: PV Grid Integration I	
		20:00	Solar Dinner		

## MONDAY 12 NOVEMBER 2012

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08:00 – 09:00 Registration  
09:00 – 09:10 Opening: Welcome and introduction, Thomas Ackermann

09:10 – 10:50	<b>SESSION 1: KEYNOTE SESSION</b>
> Session Chair	Thomas Ackermann (Energynautics, Germany)
09:10 – 10:30	<b>Presentations (20 min. each)</b>
	<ul style="list-style-type: none"><li>▶ <b>PV Grid Integration. Technologies and Trends.</b> R. Teodorescu (Aalborg University, Denmark) <a href="#">SIW12-1_2</a></li><li>▶ <b>Experiences with Large-scale Integration of Solar Power into the German power System</b> J. Jahn (SMA Solar Technology, Germany) <a href="#">SIW12-1_3</a></li><li>▶ <b>Experiences with Large-scale Integration of Solar Power into Spanish Power System</b> A. Rivas, M. Sánchez, J. J. Peiró, M. de la Torre, T. Domínguez (REE, Spain) <a href="#">SIW12-57</a></li><li>▶ <b>Sub-Hourly Impacts of High Solar Penetrations in the Western United States</b> D. Lew, G. Brinkman, A. Florita, M. Heaney, B.-M. Hodge, M. Hummon, E. Ibanez (NREL, USA), J. King (RePPAE, USA) <a href="#">SIW12-26</a></li></ul>
10:30 – 10:50	<b>Discussions</b>

10:50 – 11:10 Coffee Break

11:10 – 13:00	<b>SESSION 2A: SOLAR INTEGRATION STUDIES: EUROPE</b>
> Session Chair	TBA
11:10 – 12:30	<b>Presentations (20 min. each)</b>
	<ul style="list-style-type: none"><li>▶ <b>Connecting The Sun: Competing in the Energy Sector – On the Road to Large Scale PV Grid Integration</b> M. Rekingier, I. T. Theologitis, G. Masson (EPIA, Belgium), P. Kreutzkamp, K. De Brabandere, M. Croufer (3E, Belgium) <a href="#">SIW12-64</a></li><li>▶ <b>Techno-economic Analysis of Large-scale Integration of Solar Power Plants in the European Grid</b> P. Tielens, H. Ergun, D. Van Hertem (KU Leuven, Belgium) <a href="#">SIW12-31</a></li><li>▶ <b>Large-Scale PV Grid Integration</b> P. Ribeiro (TU Eindhoven, Netherlands), A. Oliveira, M. Carmo, L. Resende, H. Souza (CEFET-MG, Brazil) <a href="#">SIW12-40</a></li><li>▶ <b>Benchmark Networks for Grid Integration Impact Studies of Large PV Plants</b> B.-I. Crăciun, T. Kerekes, D. Sera, R. Teodorescu (Aalborg University, Denmark), A. Timbus (ABB, Switzerland) <a href="#">SIW12-06</a></li></ul>
12:30 – 13:00	<b>Discussions</b>

<b>11:10 – 13:00</b>	<b>SESSION 2B: SOLAR POWER PREDICTION</b>
<b>&gt; Session Chair</b>	<b>TBA</b>
<b>11:10 – 12:40</b>	<b>Presentations (18 min. each)</b>
	<ul style="list-style-type: none"> <li>▶ <b>SIPRESOLAR: Solar Power Forecasting System</b> S. Fresnillo Velasco, J. Díaz García, J. Dorronsoro Ibero (Instituto de Ingeniería del Conocimiento, Spain), C. Rodríguez Huidobro, M. García Casado, P. Martín Muñoz (REE, Spain) <b>SIW12-12</b></li> <li>▶ <b>Describing and Predicting Large Concentrating Solar Power Plants</b> H.-P. Waldl (Overspeed, Germany) <b>SIW12-66</b></li> <li>▶ <b>Advancing Satellite-based Solar Power Forecasting through Integration of Infrared Channels for Automatic Detection of Coastal Marine Inversion Layer</b> V. Kostylev, A. Kostylev, C. Carter, C. Mahoney, A. Pavlovski, T. Daye (Green Power Labs, Canada), D. Cormier, L. Fotland (San Diego Gas and Electric, USA) <b>SIW12-63</b></li> <li>▶ <b>Improved Solar Power Forecasting Using Cloud Assimilation into WRF</b> P. Mathiesen (GL Garrad Hassan, USA), J. Parkes (GL Garrad Hassan, UK), C. Collier (GL Garrad Hassan, USA), L. Landberg (GL Garrad Hassan, Denmark) <b>SIW12-05</b></li> <li>▶ <b>Using Analytical Expressions for the Location-Pair Correlation to Determine the Output Variability of a Solar Power Plant</b> J. Widén (Uppsala University, Sweden) <b>SIW12-44</b></li> </ul>
<b>12:40 – 13:00</b>	<b>Discussions</b>

**13:00 – 14:00**      **Lunch**

<b>14:00 – 16:00</b>	<b>SESSION 3A: SOLAR INTEGRATION STUDIES: USA</b>
<b>&gt; Session Chair</b>	<b>Charlie Smith (UVIG, USA)</b>
<b>14:00 – 15:40</b>	<b>Presentations (20 min. each)</b>
	<ul style="list-style-type: none"> <li>▶ <b>Impacts of Reserve Methodology on Production Cost in High-penetration Renewable Scenarios</b> G. Brinkman, D. Lew, M. Hummon, E. Ibanez, E. Ela, B.-M. Hodge (NREL, USA) <b>SIW12-42</b></li> <li>▶ <b>A Solar Reserve Methodology for Renewable Energy Integration Studies Based on Sub-hourly Variability Analysis</b> E. Ibanez, G. Brinkman, M. Hummon, D. Lew (NREL, USA) <b>SIW12-41</b></li> <li>▶ <b>Sub-hour Solar Data for Power System Modeling from Static Spatial Variability Analysis</b> M. Hummon, E. Ibanez, G. Brinkman, D. Lew (NREL, USA) <b>SIW12-43</b></li> <li>▶ <b>Hawaii Solar Integration Study: Solar Modeling Developments and Study Results</b> R. Piwko (GE Energy, USA), D. Corbus (NREL, USA), M. Schuenger (Energy Systems Consulting Services, LLC, USA), M. Matsura, L. Roose (Hawaii Electric Company, USA), K. Orwig (NREL, USA) <b>SIW12-37</b></li> <li>▶ <b>A Statistical Characterization of Solar PV Power Variability at Small Timescales</b> B.-M. Hodge, S. Shedd, A. Florita, K. Orwig (NREL, USA) <b>SIW12-23</b></li> </ul>
<b>15:40 – 16:00</b>	<b>Discussions</b>

14:00 – 16:00	<b>SESSION 3B: PV, STORAGE, AND DSM</b>
> Session Chair	TBA
14:00 – 15:40	<b>Presentations (20 min. each)</b>
	<ul style="list-style-type: none"> <li>▶ <b>Sizing Energy Storage Systems to Make PV Tradable in the Iberian Electricity Market</b> H. Beltrán, E. Perez, N. Aparicio (University Jaume I de Castelló, Spain), P. Rodriguez (Polytechnical University of Catalunya, Spain) <b>SIW12-08</b></li> <li>▶ <b>Flywheel Sizing for the Secure Operation of an Isolated Network with a High Level of Variable Generation</b> H. Vasconcelos, J. A. Peças Lopes, João Abel (INESC Porto, Portugal) <b>SIW12-09</b></li> <li>▶ <b>Location of Energy Storage Units &amp; Base-Load Generation Scenarios</b> D. I. Doukas, A. Marinopoulos, P. Bakas (ABB Corporate Research, Sweden) <b>SIW12-72</b></li> <li>▶ <b>Control, Regulation and Storage Systems to Optimize the Integration of Solar Power</b> M. Gasco (Universidad de Alicante, Spain), A. Rios (Universidad Europea, Spain) <b>SIW12-16</b></li> <li>▶ <b>Design and Implementation of a DSP Based Solar Converter for PV Systems</b> O. Ustun (Istanbul Technical University, Turkey), E. Caliskan (TUBITAK - MAM, Turkey) <b>SIW12-68</b></li> </ul>
15:40 – 16:00	<b>Discussions</b>

16:00 – 16:30 **Coffee Break**

16:30 – 18:30	<b>SESSION 4A: DISTRIBUTION NETWORKS AND PV</b>
> Session Chair	TBA
16:30 – 18:15	<b>Presentations (17 min. each)</b>
	<ul style="list-style-type: none"> <li>▶ <b>Increasing the Hosting Capacity of Distribution Networks for Distributed Generation Utilizing Reactive Power Control - Potentials and Limits</b> D. Mende, Y. T. Fawzy, D. Premm, S. Stevens (SMA Solar Technology AG, Germany) <b>SIW12-39</b></li> <li>▶ <b>Comprehensive Approach for Determining Distribution Network Hosting Capacity for Solar PV</b> J. Smith, M. Rylander, T. Key (EPRI, USA) <b>SIW12-73</b></li> <li>▶ <b>Maximum Penetration of Microgeneration Photovoltaic Panels in Distribution Network</b> H. Morais, P. Faria, Z. Vale (IPP - GECAD, Portugal) <b>SIW12-49</b></li> <li>▶ <b>Assessment of PV and Wind Microgeneration's Impact in the Power Quality of Low and Medium Voltage Distribution Networks</b> P. Bonifacio, S. Viana, L. Rodrigues, A. Estanqueiro (LNEG, Portugal) <b>SIW12-27</b></li> <li>▶ <b>Renewables Integration into Distribution Networks</b> R. Kuwahata, B. Hasche, J. Boemer, K. Burges (Ecofys, Germany) <b>SIW12-33</b></li> <li>▶ <b>Priority-based Local Voltage Control in Distribution Systems with High PV Penetration</b> O. Gehrke, F. R. Isleifsson (DTU, Denmark) <b>SIW12-47</b></li> </ul>
18:15 – 18:30	<b>Discussions</b>

<b>16:30 – 18:30</b>	<b>SESSION 4B: PV GRID INTEGRATION I</b>
<b>&gt; Session Chair</b>	<b>TBA</b>
<b>16:30 – 18:12</b>	<b>Presentations (18 min. each)</b>
	<ul style="list-style-type: none"> <li>▶ <b>Economic Evaluation of Grid Support from Photovoltaics: Methodology and Analysis</b> C. Dierckxsens, K. De Brabandere, A. Woyte (3E, Belgium), W. Deprez (Infrac, Belgium) <b>SIW12-29</b></li> <li>▶ <b>Three-phase Unbalanced Load Flow Tool for Distribution Networks with PVs</b> E. Demirok (Department of Energy Technology, Denmark), S. B. Kjær (Danfoss Solar Inverters, Denmark), D. Sera, R. Teodorescu (Department of Energy Technology, Denmark) <b>SIW12-69</b></li> <li>▶ <b>International Possibilities for Test and Verification of PV Power Plant Integration based on German Experiences</b> S. Vieluf (GL Garrad Hassan, Germany), Z. Fan, T. Wehrend, M. Scholz, T. Gehlhaar (Germanischer Lloyd, Germany) <b>SIW12-77</b></li> <li>▶ <b>Coordinated Voltage Control and Minimization of Losses in Smart Grids Using a Fair Contribution of Reactive Power</b> M. Kolenc, I. Papic, B. Blazic (University of Ljubljana, Slovenia) <b>SIW12-04</b></li> <li>▶ <b>Solar Power Management in Smart Grids with Storage Systems</b> M. Gasco (Universidad de Alicante, Spain), A. Rios (Universidad Europea, Spain) <b>SIW12-15</b></li> <li>▶ <b>Development of a Cloud Model to Generate High-Frequency Solar Irradiance and Power Data</b> M. Brower, P. Beaucage, J. Frank, J. Vidal (AWS Truepower, Spain) <b>SIW12-48</b></li> </ul>
<b>18:12 – 18:30</b>	<b>Discussions</b>

**20:00**      **Solar Dinner**

## TUESDAY 13 NOVEMBER 2012

<b>08:40 – 10:40</b>	<b>SESSION 5A: RESULTS OF SMOOTH-PV</b>
<b>&gt; Session Chair</b>	<b>TBA</b>
<b>08:40 – 10:22</b>	<b>Presentations (17 min. each)</b>
	<ul style="list-style-type: none"> <li>▶ <b>Comparison of a Transient and RMS Model of a Three Phase Single Stage PV System in PSCAD and Power Factory</b> A. Samadi, R. Eriksson, D. Jose, F. Mahmood, L. Soder (KTH, Sweden) <b>SIW12-21</b></li> <li>▶ <b>Evaluation of Reactive Power Support Interactions Among PV Systems Using Sensitivity Analysis</b> A. Samadi, R. Eriksson, L. Soder (KTH, Sweden) <b>SIW12-46</b></li> <li>▶ <b>Evaluating the Impact of PV Module Orientation on Grid Operation</b> E. Tröster (Energynautics, Germany) <b>SIW12-76</b></li> <li>▶ <b>The Economic Inefficiency of Grid Parity: The Case of German Photovoltaics in Scenarios until 2030</b> C. Jägemann, S. Hagspiel, D. Lindenberger (EWI University of Cologne, Germany) <b>SIW12-78</b></li> <li>▶ <b>Cost-optimal Power System Extension Under Flow-based Market Coupling and High Shares of Photovoltaics</b> S. Hagspiel, C. Jägemann, D. Lindenberger (EWI, Germany), S. Cherevatskiy, E. Tröster (Energynautics, Germany) <b>SIW12-67</b></li> <li>▶ <b>Determining the Maximum Feasible Amount of Photovoltaics in the European Transmission Grid with Optimal PV Utilization</b> S. Cherevatskiy (Energynautics, Germany) <b>SIW12-75</b></li> </ul>
<b>10:22 – 10:40</b>	<b>Discussions</b>

<b>08:40 – 10:40</b>	<b>SESSION 5B: PV GRID INTEGRATION II</b>
<b>&gt; Session Chair</b>	<b>TBA</b>
<b>08:40 – 10:20</b>	<b>Presentations (20 min. each)</b>
	<ul style="list-style-type: none"> <li>▶ <b>Short-circuit Behaviour of Inverter Coupled Generators</b> J. Jahn (SMA Solar Technology AG, Germany) <b>SIW12-35</b></li> <li>▶ <b>Fault-tolerant Topology of a Grid-connected PV System Coupled by a Scott Transformer</b> T. D. MAI (KULeuven, Belgium), Y. Cheng (VITO, Belgium), J. Driesen (KULeuven, Belgium) <b>SIW12-07</b></li> <li>▶ <b>Multidisciplinary Transformers Fault Analysis on a Large Solar Plant</b> L. Trevisan, G. Cappai, B. Heinrich (Weidmann Electrical Technology, Switzerland) <b>SIW12-19</b></li> <li>▶ <b>Determination of PV Penetration in LV Networks Considering Stochastic Behavior of Loads and PVs</b> S. Hashemi Toghroljerdi, G. Y. Yang, J. Østergaard (DTU, Denmark) <b>SIW12-61</b></li> <li>▶ <b>Stochastic Production of CSP Solar Plants for Generation Planning</b> J. Usaola (Universidad Carlos III, Spain) <b>SIW12-22</b></li> </ul>
<b>10:20 – 10:40</b>	<b>Discussions</b>

**10:40 – 11:00**      **Coffee Break**

<b>11:00 – 12:15</b>	<b>SESSION 6A: MODELLING</b>
<b>&gt; Session Chair</b>	<b>TBA</b>
<b>11:00 – 12:00</b>	<b>Presentations (20 min. each)</b>
	<ul style="list-style-type: none"> <li>▶ <b>Development of a Solar Cell Model Using PSCAD</b> S. Ramos (Electrical Engineering Institute of Porto, Portugal), S. Pinto, J. Santana (Superior Technical Institute of Lisbon , Portugal) <b>SIW12-56</b></li> <li>▶ <b>Challenges and Obstacles of large-scale PV Inverter Simulation in MATLAB</b> F. Kalverkamp, T. Sellathurai, T.-D. Nguyen, C. Scheefer, B. Schowe-von der Brelie (FGH, Germany), <b>SIW12-32</b></li> <li>▶ <b>Modelling Real Solar Cell using PSCAD/MATLAB</b> S. Ramos, M. Silva, F. Fernandes, Z. Vale (Electrical Engineering Institute of Porto, Portugal) <b>SIW12-36</b></li> </ul>
<b>12:00 – 12:15</b>	<b>Discussions</b>

<b>11:00 – 12:15</b>	<b>SESSION 6B: NETWORKS WITH PV</b>
<b>&gt; Session Chair</b>	<b>TBA</b>
<b>11:00 – 12:00</b>	<b>Presentations (15 min. each)</b>
	<ul style="list-style-type: none"> <li>▶ <b>Eskom's Network Planning Technical Strategy to Support Renewable Generation Integration to Eskom Networks</b> M. Bello, R. Smit, (Eskom Holdings SoC, South Africa) <b>SIW12-14</b></li> <li>▶ <b>PV-to-EV Schemes for Photovoltaic Integration and Power Balancing</b> P. Lund, J. Lindgren, J. Mikkola (Aalto University, Finland), <b>SIW12-65</b></li> <li>▶ <b>Challenges of Deploying Renewables from the Sun. Assessment of the Current Regulatory and Market Scenario in the Southern Mediterranean</b> D. Franzi (IMT Advanced studies Lucca, Italy) <b>SIW12-54</b></li> <li>▶ <b>Energy Challenges of Large Scale Research Infrastructures: the Square Kilometer Array and Solar Energy Integration</b> D. Barbosa (University of Aveiro, Portugal) <b>SIW12-1_1</b></li> </ul>
<b>12:00 – 12:15</b>	<b>Discussions</b>

12:15 – 13:00	CLOSING SESSION: PODIUM DISCUSSIONS
> Session Chair	TBA
12:20 – 12:55	Podium discussions
<p>▶ <b>Participants: TBA</b></p>	
12:55 – 13:00	Closing Remarks

13:00 – 14:00    Lunch

**14:00    Start Wind Integration Workshop**