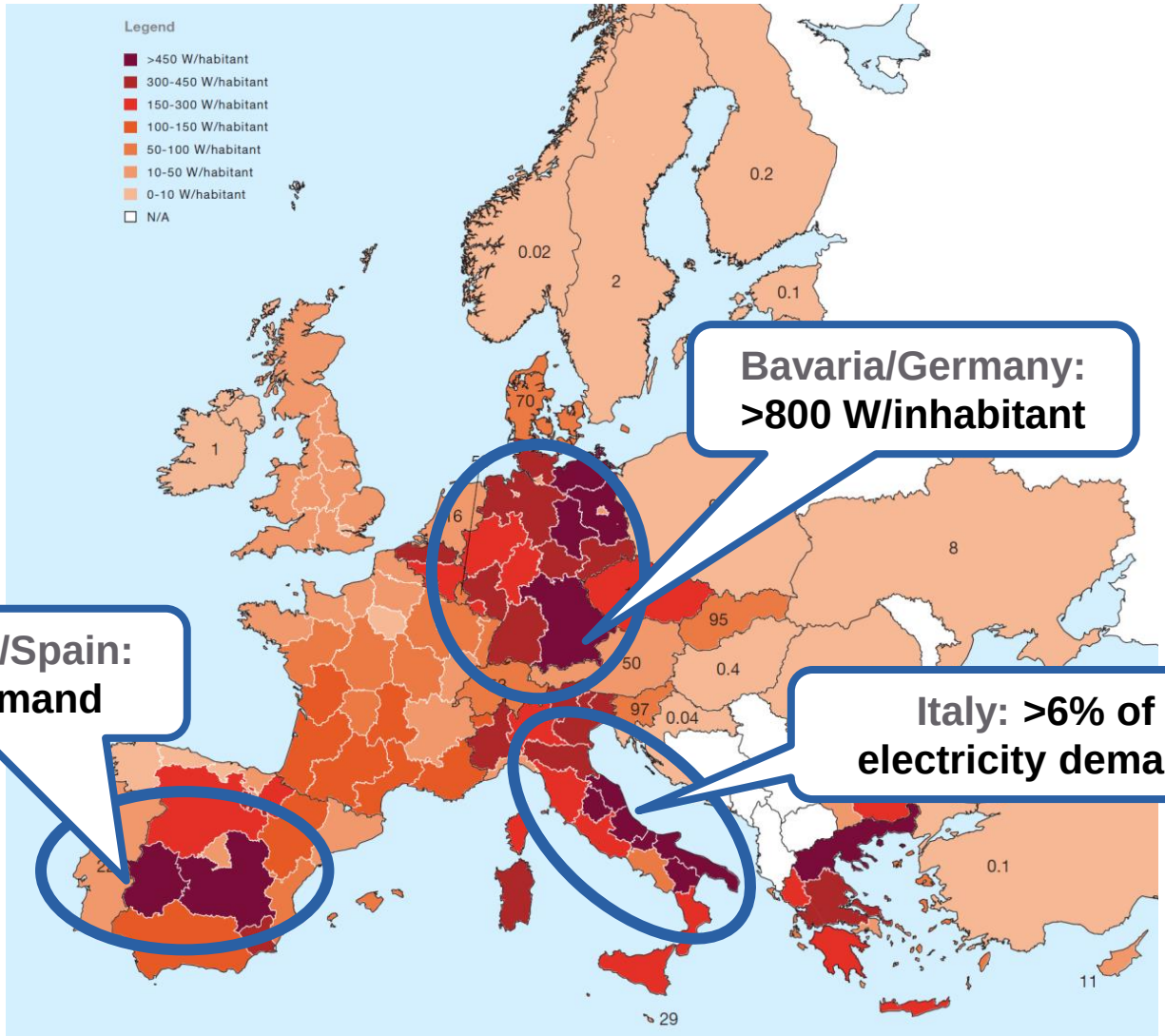
Introduction to IEA-PVPS Task 14: High Penetration PV in Electricity Grids

Roland Bründlinger & Christoph Mayr
Operating Agents IEA-PVPS Task 14

High Penetration of PV in the power system has become reality.



Bavaria/Germany: >800 W/inhabitant

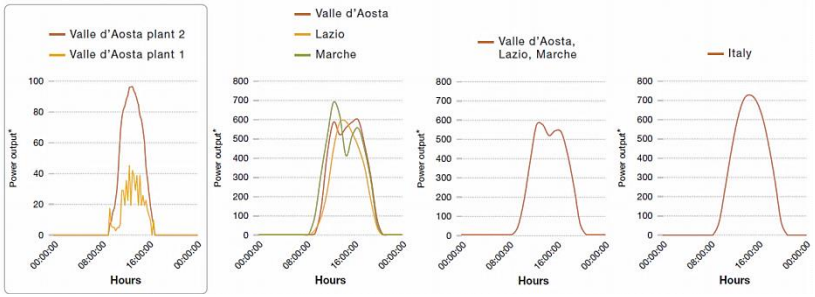
Extremadura/Spain: >18% of demand

Italy: >6% of electricity demand

(Source: EPIA-Global Market Outlook 2013)

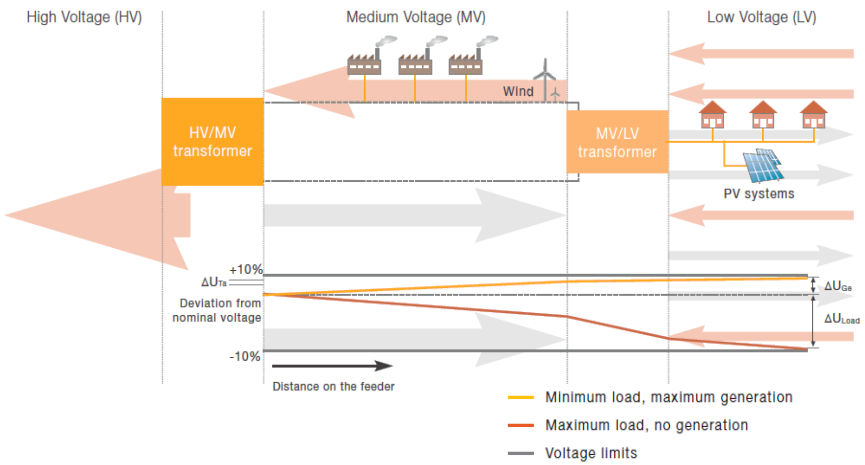
High Penetration PV Integration Challenges

- **PV integration challenges in the overall power system**
  - Managing **variability of supply** with PV
  - Ensuring **security of supply**
  - Matching **supply and demand**
  - Ensuring **frequency stability**



Source: EPIA, "Connecting the sun", September 2012

- **PV integration challenges on the distribution level**
  - **Managing voltage** profiles
  - **Avoiding overloading** of components
  - Transforming **passive to active** grids
  - Integrating **PV in Smart Grids**



From challenges to solutions IEA-PVPS Task 14

Goals & Objectives

- Promote the use of grid connected PV as an important source in electric power systems
- Develop and verify technical requirements for PV and electric power systems to allow for high penetrations of PV systems
- Discuss the active role of PV systems related to energy management and system control of electricity grids
- Reduce the technical barriers to achieve high penetration levels of distributed renewable energy systems on the electric power system

From challenges to solutions IEA-PVPS Task 14 outcomes

- **Support PV integration** on high penetration levels by
  - access to more transparent technical analyses
  - guidelines and best practices for industry, network operators, energy planners as well as authorities in the energy business
  - comprehensive international studies for high penetration PV

- **Develop key methodologies** for
  - PV Power Forecast
  - Active management and control of grid integrated PV
  - Grid interconnection studies
  - Technical standards and interconnection requirements

- **Active dissemination** of objective and neutral high-quality information
  - Task 14 Reports
  - Task 14 Workshops
  - National information networks of Task 14 members

Task 14 High Penetration of PV Systems in Electricity Networks

16 Countries

European commission

Experts from

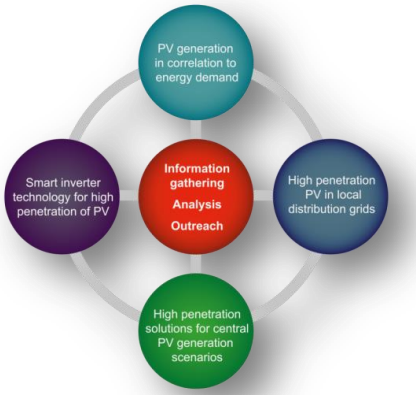
- Utilities, DNOs
- Industry, manufacturers, consultancies
- Applied research
- Universities
- Agencies

2 Associations

EPIA European Photovoltaic Industry Association

SEPA solar electric power association

Thank you very much for your attention



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Task 14 Operating Agents

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Solar Resource and Forecast Data for High PV Penetration

Introduction

PVSEC 2013
October 1st 2013, Paris

Jan Remund

Introduction

- The higher the penetration of PV the more important is the precise knowledge of the past and future solar resource.
- engineers and meteorologists must understand each other and work closely together
- IEA tasks SHC 46 (“meteorology”) and PVPS 14 (“energy”) are working together and are holding this common workshop
  - Organized by Meteotest as member of both tasks
- on-going work of the two tasks with a focus on solar (short term) forecast.
  - Most sessions are mixed (SHC and PVPS)

Workshop program

- Session 1: High penetration of PV in distribution grids
  - FH Ulm (SHC) / Basler & Hofmann, ETH Zurich (PVPS)
- Session 2: Forecast of PV on transmission (system) level
  - Univ. Oldenburg (SHC) / Univ. of Tokyo (PVPS)
- Network / coffee break: 15:00 – 15:15
- Session 3: Solar forecasting systems on local and regional level
  - Danish Meteorological Institute (SHC)
  - 3E (PVPS)
  - NREL (SHC / PVPS)
  - Meteotest (SHC / PVPS)
  - State Univ. of New York (Albany) (SHC)
- Discussion: 16:30 – 16:45

State of the art report

- Report of state of the art of PV forecasting is published*

Source	Location of validation	Time step and forecast time	Uncertainty % of persistence	Uncertainty RMSE (relative or absolute)
DLR (DE)	Southern Spain	1 h, day 1		DNI: 50 – 64% rmse
CanmetENERGY (CAN)	Canada, USA	1 h, day 1 – 2	57%	
JWA (JP)	Japan	30 Min, 1h.		140 W/m^2
MeteoSwiss (CH)	Switzerland	-	-	-
Univ. Oldenburg / Meteocontrol (DE)	Switzerland Southern Spain Canada, Spain	1 h, day 1	65% 61% [2] 57% [2]	42 % rmse 21 % rmse
Univ. Jaen (ES)	Southern Spain	1 h, day 1	72% [2]	
DTU IMM (DK)	Denmark		68% [2]	
AIST / Waseda (JP)	Japan	1 h, day 1		100 W/m^2
Univ. GIFU (JP)	Gifu	1 h		64% rmse
UCSD (USA)	San Diego, 4 days	30 sec. 5 min.	50% 75%	
Bluesky Wetteranalyse (A)	Switzerland	1 h, day 1	65%[2]	
Irsolav (ES)	Spain	1 h, day 1		18 – 35% rmse
Meteotest (CH)	Switzerland	1 h, day 1	72% [2]	41 – 50% rmse
Weather Analytics (USA)	-	-	-	

* S. Pelland et al. (2013): Photovoltaic and Solar Forecasting: State of the Art, http://www.iea-pvps.org/index.php?id=3

Session 1

High penetration of PV in distribution grids

- Holger Ruf, FH Ulm (SHC):
  Investigation of cloud indicators for low voltage distribution grid transformers
- Christof Bucher, Basler & Hofmann, ETH Zurich (PVPS):
  Comparison of 7 measures to integrate PV in the low voltage grid, using stochastic irradiance data

Session 2

Forecast of PV on transmission (system) level

- Elke Lorenz, Univ. Oldenburg (SHC):
  PV production forecast of balance zones in Germany
- Yasushi Miwa, Chubu Electric Power Co., Inc., Kazuhiko Ogimoto, University of Tokyo (PVPS):
  Accuracy evaluation of solar irradiance forecasting technique using a meteorological model

Session 3

Solar forecasting systems on local and regional level

- Kristian Pagh Nielsen, Danish Meteorological Institute (SHC):
  Ensemble model solar forecasting for NW Europe
- Paul Kreutzkamp, 3E (PVPS):
  PV forecasting confidence intervals for reserve planning and system operation
- Manajit Sengupta, NREL (SHC / PVPS):
  Solar forecasting improvement project (USA)
- Stefan Müller, Meteotest (SHC / PVPS)
  Shortest term forecast system for PV plants and distribut grids
- Richard Perez State Univ. of New York (Albany) (SHC)
  Ramp rate mitigation using short term energy buffers

Thank you

Thank you for your attention!

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