Integrating photovoltaics into the grid – Research collaboration within the IEA PVPS Task 14

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Energy research strategy AUSTRIA e2050

IEA FORSCHUNGS KOOPERATION

Österreichs Beteiligungen in der IEA

Vorteile:

- Frühzeitiges Erkennen von intern. Trends und Entwicklungen
- Zusammenarbeit bei technologisch anspruchsvollen Fragestellungen
- Frühzeitiges Erkennen von internationalen Marktchancen und erfolgreiche Positionierung österreichischer Stärken

Maßnahme:

- Ausbau der IEA-Forschungskooperationen in öster. Schwerpunktbereichen
- Finanzierung österreichischer Beiträge und nationaler Ergebnisverbreitung

Österreichische ExpertInnen und Unternehmen sind in 17 von 42 IEA-Programmen aktiv:

- Erneuerbare Energieträger
  - Solares Heizen und Kühlen, Photovoltaik, Bioenergie, Windenergie, Solarkraftwerke
- Effiziente Endverbrauchstechnologien
  - Wärmepumpen, Demand-Side Management, Fahrzeuge mit Hybrid- und Elektroantrieb, fortschrittliche Motortreibstoffe, Effiziente elektrische Geräte, Brennstoffzellensysteme, Stromnetze, Energieeffizienz in Gebäuden und Kommunen
- Fossile Energieträger
  - Fortschrittliche Ölförderung, Kohle, Wirbelschichttechnologie, Treibhausgase

Nationales Webportal:
www.energytech.at/IEA

Energieforschungsstrategie für Österreich 29 Internationale Kooperationen

Quelle: Energieforschungsstrategie für Österreich e2050, M. Paula et al. 2009

The IEA PVPS Mission

To enhance the international collaboration efforts through which photovoltaic solar energy becomes a significant renewable energy option in the near future

IEA PVPS in brief

- One of > 40 IEA Programmes on technology co-operation
- 25 members: 22 countries, EC, EPIA, SEPA
- Most recent member: China
- Activities are carried out collaboratively on a country basis along a number of technical and non-technical subjects
- Currently, 7 Tasks are active

PVPS

The PVPS Objectives

- To stimulate activities that will facilitate a cost reduction of PV power systems applications;
- To increase the awareness of PV's potential and value and thereby provide advice to decision makers from government, utilities and international organisations
- To foster the removal of technical and non-technical barriers of PV power systems for the emerging applications in OECD countries;
- To enhance co-operation with non-OECD countries and address both technical and non-technical issues of PV applications in those countries.

PVPS

IEA PVPS Tasks

Tasks with relevance to grids

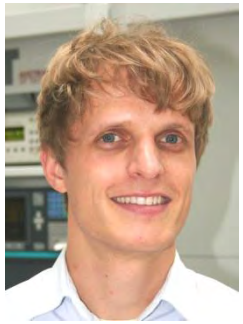
- Task 1 - Exchange and dissemination of information on PV power systems
- Task 2 - Operational performance, maintenance and sizing of PV power systems and subsystems (concluded 2008)
- Task 3 - Use of PV power systems in stand-alone and island applications (concluded 2004)
- Task 5 - Grid interconnection of building integrated and other dispersed PV systems (concluded 2001)
- Task 6 - Design and operation of modular PV plants for large scale power generation (concluded 1997)
- Task 7 - PV power systems in the built environment (concluded 2001)
- Task 8 - Very large scale PV power generation systems
- Task 9 - Deployment of PV technologies: co-operation with developing countries
- Task 10 - Urban Scale PV Applications (concluded 2009)
- Task 11 - PV hybrid systems within mini-grids
- Task 12 - PV environmental, health & safety activities
- Task 13 - PV performance, quality and reliability (new 2010)
- Task 14 - High-penetration of PV systems in electricity grids (new 2010)

PVPS

Start of new Task 14
“High-Penetration of PV Systems in Electricity Grids”

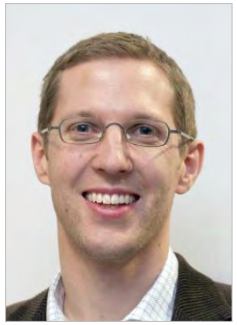
- The first IEA PVPS task led by Austria
- Stared in April 2010
- Duration of 4 years

PVPS Task 14 Operating Agents



Christoph Mayr

- IEA PVPS Task 11 - Representative for Austria since 2008
- Senior Scientist at Austrian Institute of Technology
- Fields of research: PV Inverter, Integration of DG into Electricity networks



Roland Bründlinger

- IEA PVPS Task 1 - Representative for Austria since 2002
- Senior Scientist at Austrian Institute of Technology
- Fields of research: PV Inverter, Integration of DG into Electricity networks,
- Member of the Board of the European Laboratory for Distributed Energy Ressources (EU DER-Lab)

„High Penetration PV“ – Definition by Task 14

- High penetration situation exists if **additional efforts** will be necessary to integrate the dispersed generators in an optimum manner.

- The aim of these efforts is to **reduce the technical barriers to achieve high penetration levels** of distributed renewable energy systems on the electric power system

Overall Goal of this international collaboration

- **Promote the use of grid connected PV** as an important source in electric power systems **also on a high penetration level** where additional efforts may be necessary to integrate the dispersed generators in an optimum manner.

- Develop and verify **mainly technical requirements for PV systems and electric power systems** to allow for high penetrations of PV systems interconnected with the grid

- Discuss the **active role of PV systems** related to energy management and system control of electricity grids

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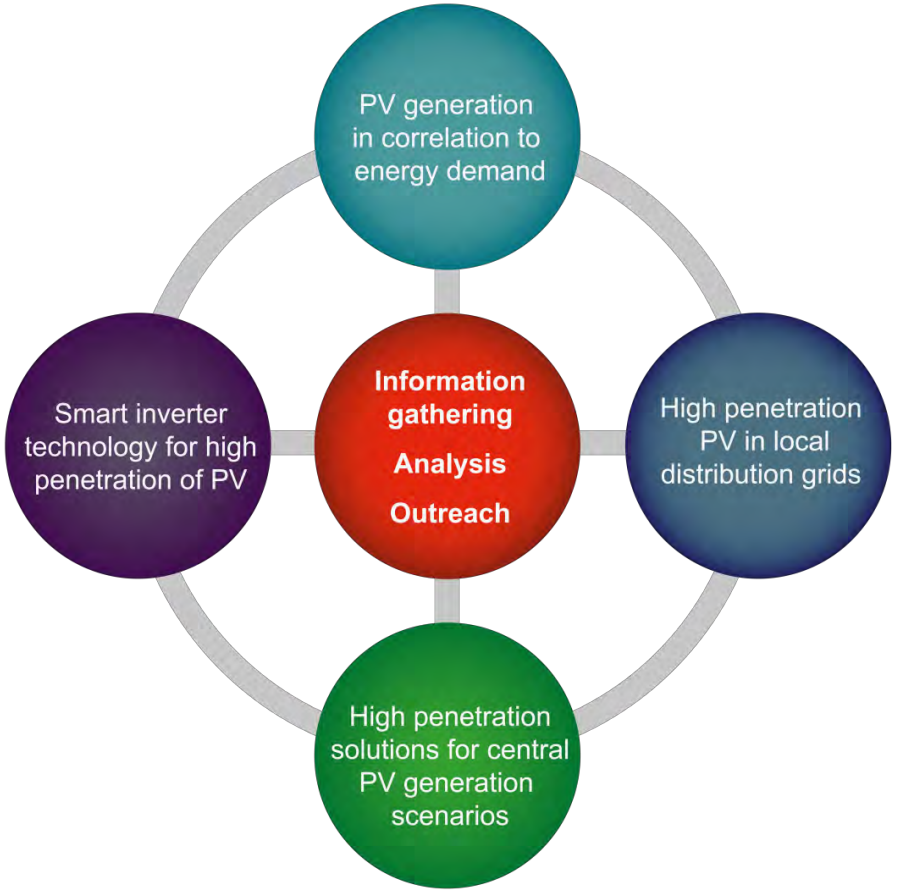
Technical issues include

- Aspects related to the fluctuating nature of PV in relation to electricity demand
- Grid interaction and penetration related aspects related to **local distribution grids** and
- **Central PV** generation scenarios.
- A strong focus will be on **inverters with multifunctional characteristics** aiming the smart interface between the generator and the electricity network.
- In order to evaluate the aforementioned technical issues, **modeling and simulation techniques** will be applied.

IEA PVPS – Task 14
High Penetration of PV Systems in Electricity Networks

- PV generation in correlation to energy demand focusing on the consumer behavior to be better linked to the generation profile
- The effects on PV generation to the local grid as well as to the general electricity system
- Smart inverter technology dealing with requirements for inverters at high PV penetration
- Convincing case studies, Simulation



Task 14 Outcomes

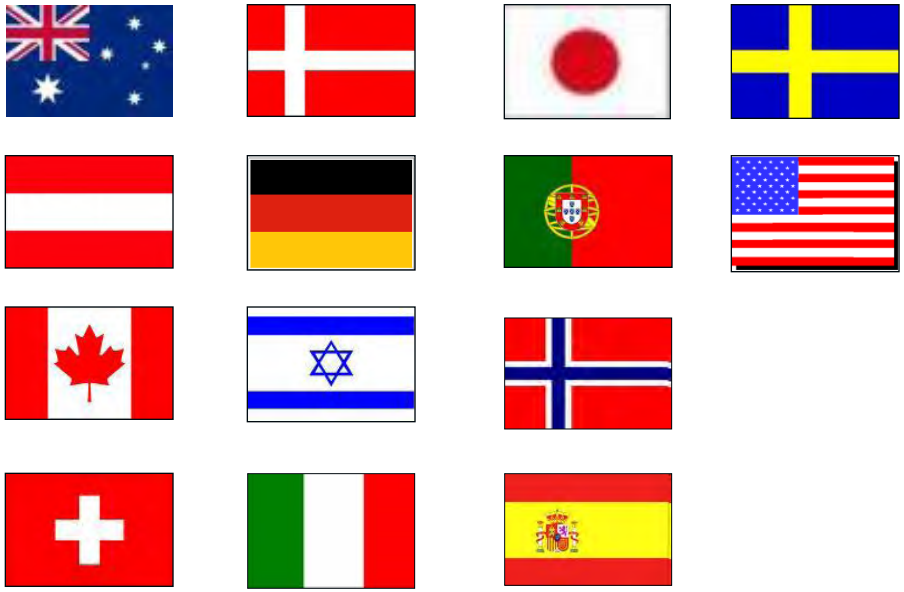
- Main goal is to **provide access to more transparent technical analyses** in order for industry, network operators, energy planners as well as authorities in the energy business to decide on steps to be taken and strategies to be developed on a sound basis.

- provide **comprehensive international studies for high penetration PV**

- Reports, (Utility) Workshops, Conferences, Providing objective and neutral high-quality Information…

Status of participation

- 14 Countries



Widespread participation

- **Utilities/DNOs:** SEPA (USA), EnergiMidt (DNK), Israel Electric Company, Hydro One (CAN), EDP (PRT)
- **Industry/Manufacturers/Consultancies:** ABB (SWE), SMA (DEU), Sputnik, PlanAir, Meteotest (CHE)
- **Applied research:** NREL (USA), AIT (AUT), Fraunhofer IWES (DEU), ENEA, RSE (ITA), CANMET (CAN)
- **Universities:** Tokyo University (JPN), Univ. Carlos III Madrid (ESP), UNSW (AUS), FH Technikum Vienna (AUT)
- **Agencies:** NEDO (JPN)

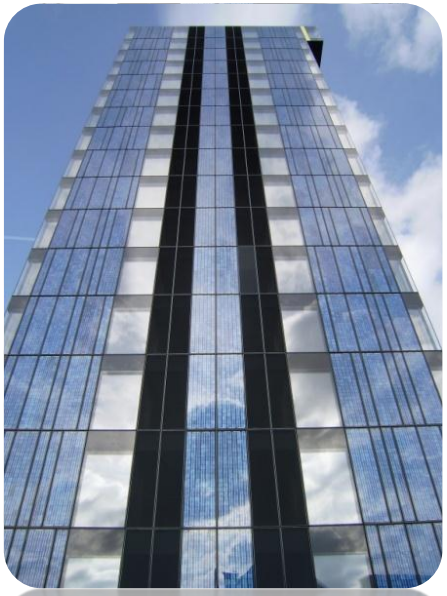
IEA PVPS Task 14 - Why ?

- PV is unevenly distributed
- Only 4 countries account for almost 80% of the global capacity installed (04/2010)

  > DEU ~ 10 Gigawatt (GW)
  > ESP ~ 3,5 GW
  > JAP ~ 2,6 GW
  > USA ~ 1,7 GW

- PV penetration is already leading to issues in some feeders…
- With installations growing in the GW range/year grid constraints will become crucial for further deployment of PV.

PV specific features



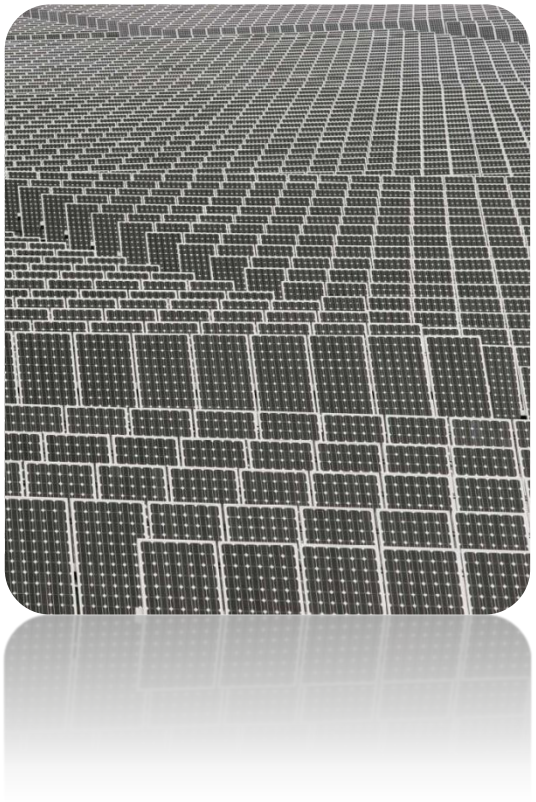
- Fluctuating generation
  - Daily profile
  - Seasonal profile
  - Variability
- Typical system size
  - Many small scale (domestic) installations
    -> aggregation
  - Large scale installations
- Connection predominantly at LV grid - Inverter connection (no transformer)
- Heavily dependent on support incentives – in only a few markets / countries
- Frequently linked to buildings
- Suited for new decentralized storage solutions

Positive Effects for the grid

- **PV production** frequently meets times of high load in networks
- **Reduction of network losses** due to more local generation and therefore decreased power transmission
- **More transmission capacity** opens space for other transmission services
- **Active network services** from multifunctional photovoltaic inverters can support the local network management

New grid interconnection requirements for PV inverters

- **In high penetration scenarios of PV, the generators must**
  - Not disconnect during grid faults
  - Contribute to short circuit current
  - Provide reactive power during normal operation
  - Reduce the active power injection when frequency increases



- **Critical issues**
  - Growing complexity and diversity of requirements may create an increasing barrier to effectively apply the potential of new inverter functionalities in practice
  - Important: International exchange of experiences and harmonized standards

Summary

- **PVPS Task 14 will**
  - act as a collaboration platform for international experts on the subject of high penetration PV
  - Work on international trends and developments of grid connected PV in an early stage
  - Use the worldwide PVPS network to disseminate information on high penetration PV and best practice models.
- IEA PVPS Task 14 fully **fits to the strategic goals of e2050**
- **Austria leads** this implementing agreement

Thank you for your attention!

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