



# **Systemintegration of Photovoltaic and Wind**

## **Examples from the IEA PVPS & IEA Wind**

### **Implementing Agreements**

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Technikum Wien



# Systemintegration means Integration into

- The Energy/Electricity-System
- The (built) Environment

- IEA-PVPS Task 14 – High penetration of PV in Electricity Networks
- IEA-PVPS Task 15 – Building Integrated PV
  - IEA-PVPS Task 1 – Subgroup Self consumption Schemes
- IEA-Electricity Coordination group
- IEA-Wind Task 27 Small wind turbines



PVPS

## The Dynamics of IEA-prospects...

**IEA 2005:** By 2050, however, solar's (PV and CSP) share in global power generation will still be below 2% in all scenarios.

**IEA 2009:** The first IEA PV-Roadmap targets up to 11% share of global electricity from solar PV

**IEA 2014:** The new IEA PV-Roadmap targets up to 16% share of global electricity from solar PV by 2050 + 11% from CSP



## Austria's Role in IEA PVPS

- ExCo Deputy Chair & Management Board (H.Fechner, FH TW)
- Task 14: High Penetration of PV in Electricity Networks - Chair (Bründlinger, Mayr, AIT)

### Participation:

- Task 1 – Strategy and Outreach (H.Fechner, FH TW)
- Task 12 – Environmental Health and Safety (S.Schidler; FH TW)
- Task 13 – Monitoring, Testing of PV Systems (Berger AIT, Oreski PCCL-Leoben)
- Task 15 – Building integrated PV (AIT, OFI, ASIC, FH TW) - planned

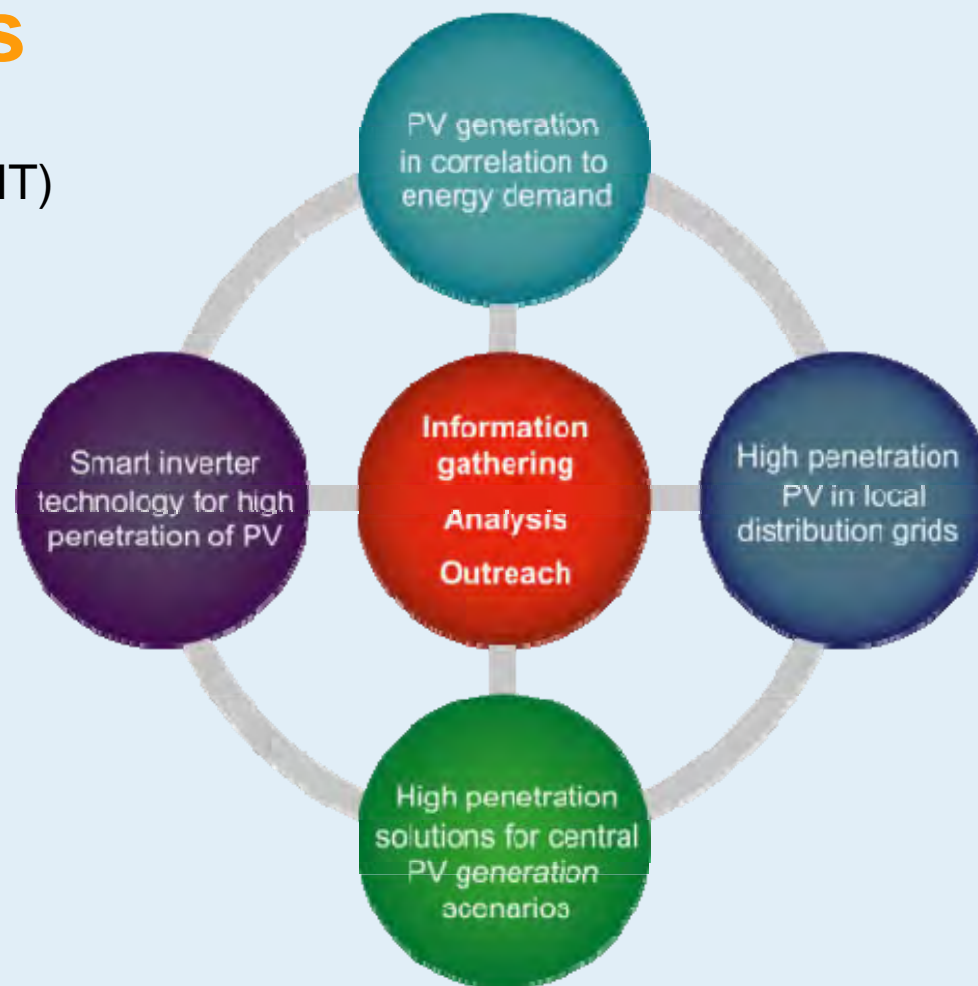


# IEA-PVPS Task 14

## High Penetration PV in Electricity Grids

Chair: Austria (AIT)

16 countries participating



PVPS





# Motivation for PVPS Task 14 2.0

## A look back...

- Task 14 has become highly visible on the international level and broadly recognized as one of the leading initiatives to bring together experts from all stakeholders in the field of PV grid integration
- A series of successful workshops with 500+ participants has been organized at locations all around the world as one of the main dissemination and networking activities.
- A number of new countries joined Task 14 during its first term (Belgium, Malaysia, EPIA, ...)
- While during at the beginning of the collaboration within Task 14 in 2010, only a limited number of high penetration cases actually existed around the globe, mostly related to research or demonstration projects and field trials, the situation has changed fundamentally since then.





# Motivation for PVPS Task 14 2.0

## ...and a look forward:

- Massive technical developments are currently ongoing following the increasing penetration of PV
- New fundamental challenges arise with PV becoming a game changer on the bulk power system level
- Bringing together technical (=Task 14) and non-technical expertise (e.g. regarding market design with PV) is strongly needed.
- There is a strong interest by the participants in continuation and extension of the successful work



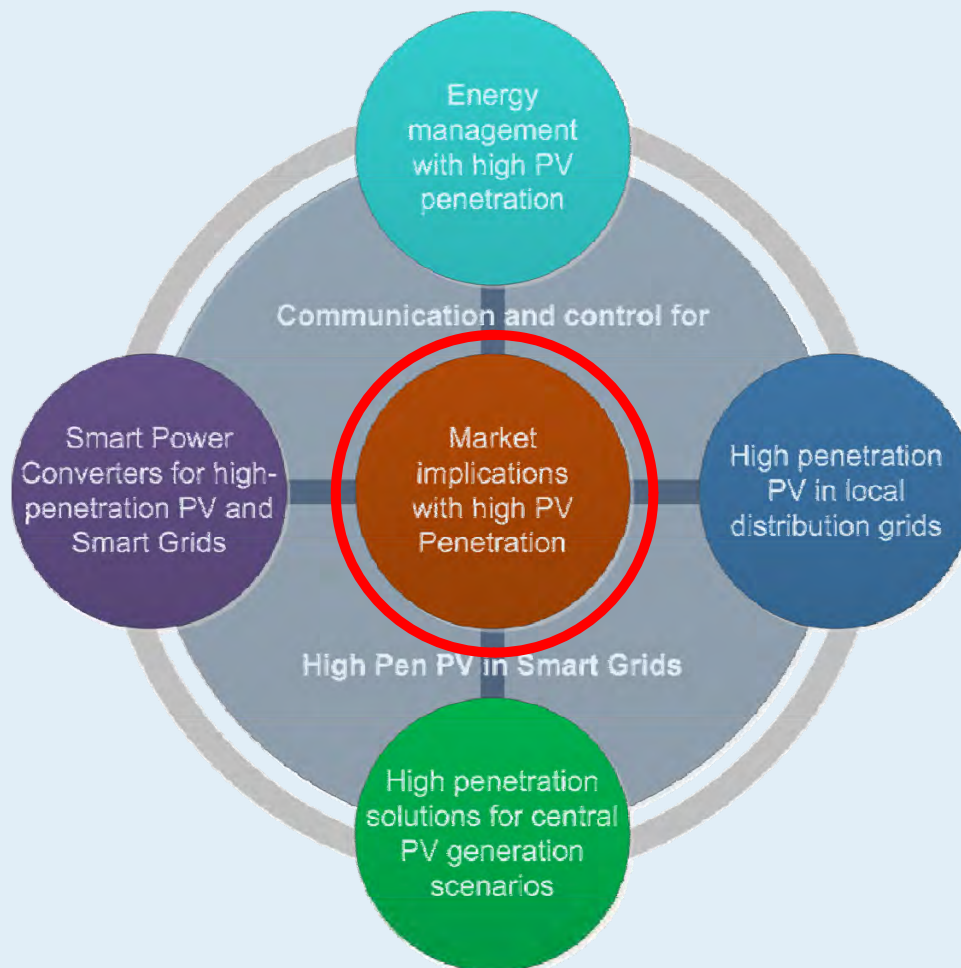


## IEA PVPS Task 14 Achievements so far (examples)

- PV forecasting – state of the art
- Analysis of energy management systems and local storages to improve the penetration of PV in local grid
- Distribution grid case studies of 11 countries
- Report on current experiences of high PV penetration and active / reactive power control strategies in distribution grids
- Report on Recommendations for managing the transition from One-Directional to Bi-Directional Distribution Grids
- Report “Power system operation planning with PV integration”
- ...







PVPS

# TASK 14 2.0 - STRUCTURE





AeroFoto by Chi Po-lin

PVPS

# TASK 15 – BUILDING INTEGRATED PHOTOVOLTAICS (STARTING 2015)





## PVPS Task 15 - BIPV

- Subtask A: BIPV database 2.0 by Tjerk Reijenga (NL)
- Subtask B: Economic transition towards sound business models (?, NL)
- Subtask C: International framework for BIPV specifications (Fraunhofer (GER); International Regulations, Standards and Requirements with relevance for BIPV products)
- Subtask D: Environmental assessment issues (NL)
- Subtask E: Demonstration projects (?? – A??)
- Subtask F: Dissemination (NL)



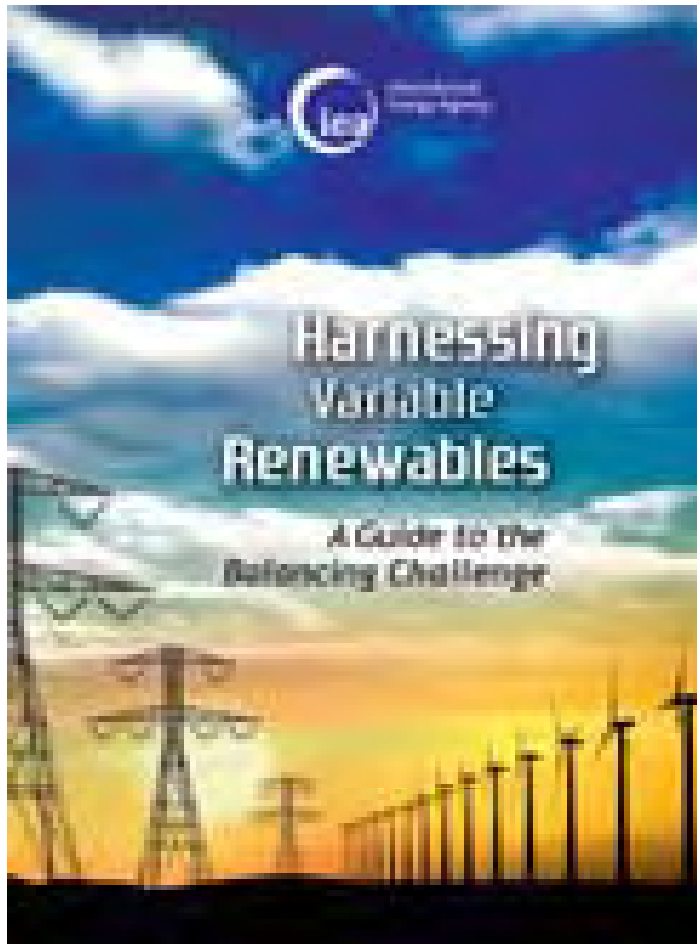
# IEA - Electricity coordination Group

**Leitung: IEA Office –  
Business Unit Renewable Energy (Paolo Frankl)**

**Wind,  
Ocean Technologies,  
PVPS,  
ENARD, ISGAN,  
DSM,  
Superconductivity,  
Hybrid Electric Vehicles,  
Energy conservation through energy storage (ECES),  
Greenhouse Gas R&D,  
RE Technological Deployment,  
Efficient Electrical End-Use Equipment**



# The GIVAR Project – Phase I



... all about Flexibility...

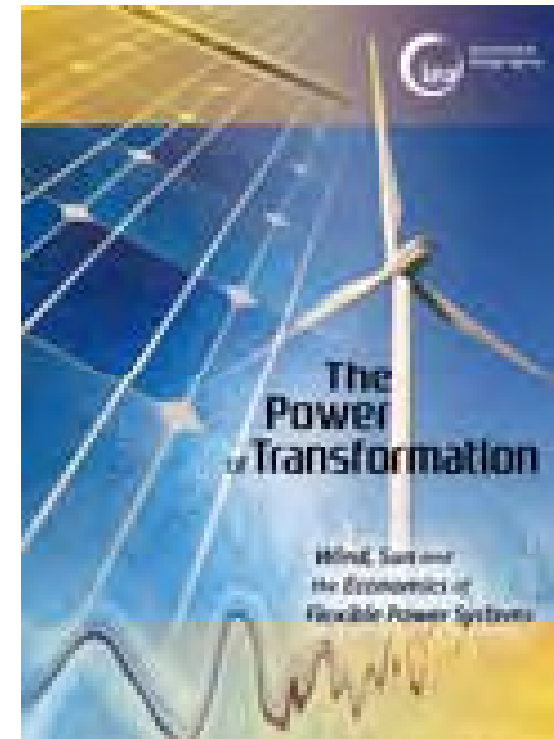
Author: Hugo Chandler, IEA

# The GIVAR Project II

It expands the work to also include an economic assessment of different flexibility options and assessing their relative cost/benefit.



The screenshot shows the IEA website's navigation menu with links for HOME, ABOUT US, TOPICS, COUNTRIES, NEWSROOM & EVENTS, and PUBLICATIONS. The breadcrumb trail reads: International Energy Agency > Topics > Renewables > GIVAR. The main heading is "Grid Integration of Variable Renewables (GIVAR)". Below this, there is a small image of wind turbines and a text block that reads: "In April 2011, the IEA published the *Managing Variable Renewables: A Guide to the Technical Challenges* analysed how to manage power systems with large shares of variable renewables, in particular wind and solar PV. Concluding the second phase of the Grid Integration of Variable Renewables project (GIVAR), it presented a step-by-step approach developed by the IEA to assess the flexibility of power systems to absorb variable renewables – the Flexibility Assessment Tool (FAST). FAST identifies the already present resources that could help meet the technical challenges of variability and uncertainty. The analysis comprises all distinct flexibility resources: flexible generation, interconnectors and storage as well as demand-side management. The FAST method provided a first approximation to what is possible in a power system with a given flexible resource, from a technical perspective." Below this, a smaller text block states: "GIVAR Phase III: The third phase of GIVAR deepens and expands IEA work on variable renewable energy (VRE) integration. It deepens the technical analysis, putting additional emphasis on solar PV and providing a revised version of FAST, FAST2. It expands the work to also include an economic assessment of different flexibility options and assessing their relative cost/benefit."



# 12. Österr. Photovoltaik Tagung 2014

3.- 5. November

Linz Redoutensäle



TECHNOLOGIE  
PLATTFORM  
PHOTOVOLTAIK



**ENERGIEAG**  
Oberösterreich

Wir denken an morgen





iea wind

# IEA Wind Task 27



- 1<sup>st</sup> period from 2008 – 2011: Development and Deployment of Small Wind Turbine Labels for Consumers
- Extension from 2012 – 2016: Small Wind Turbines in High Turbulence Sites



SWT (Type Darrieus-H) in Hamburg

## Objectives:

- Deployment of Small Wind Turbine Labels for Consumers
- Improvement of the general understanding of highly turbulent sites and the impacts on small wind turbines (production, lifetime, maintenance,...)
- Development of a recommended practice for operation and design of Small Wind Turbines in highly turbulent sites



SWT at train station Berlin



Implementing Agreement for Co-operation in the Research, Development, and Deployment of Wind Energy





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# National activities



- Establishment of a national working group "Small Wind Power Austria"
- Organization of the first Small Wind conference in Austria, planned for December 2015



SWT on the ENERGYbase

## Project "Urban Wind Energy"



- Development of methods for the assessment of small wind turbines in urban areas
- investigation of two small wind turbines at urban and rural site



SWT in Köln

## Project "Small Wind Power Systems"

- Test infrastructure "Energieforschungspark Lichtenegg"
- Development of a simplified certification procedure





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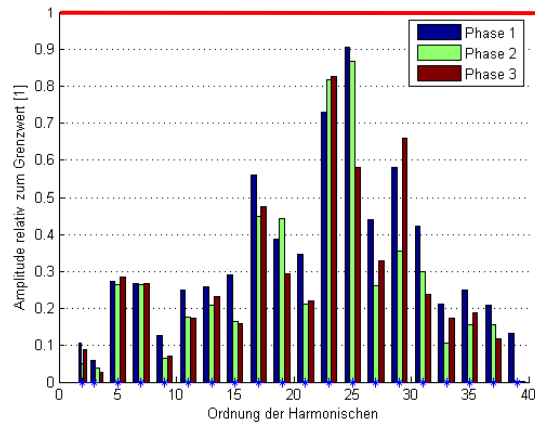
# System integration



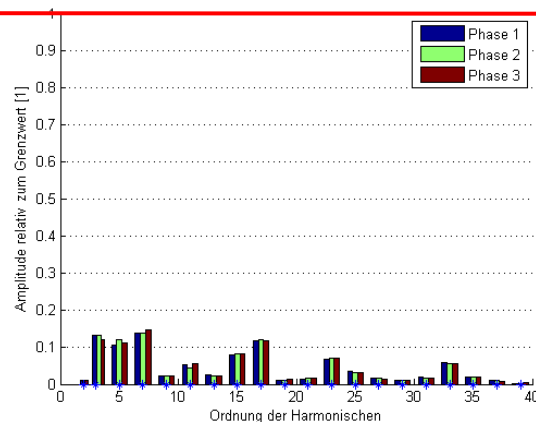
## Into the electricity system – Power Quality

- Harmonics
- Flicker

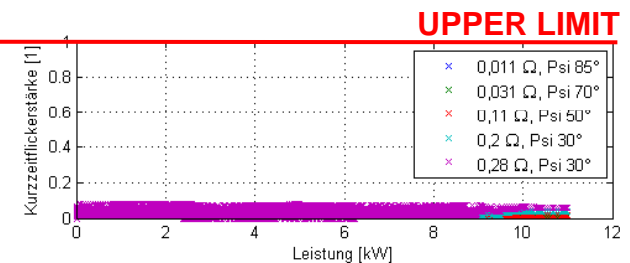
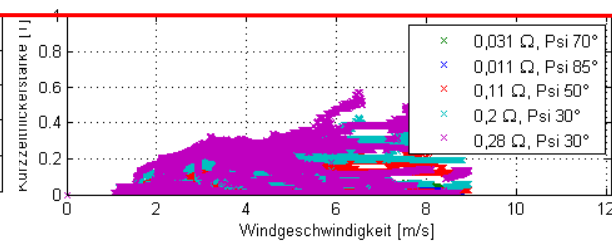
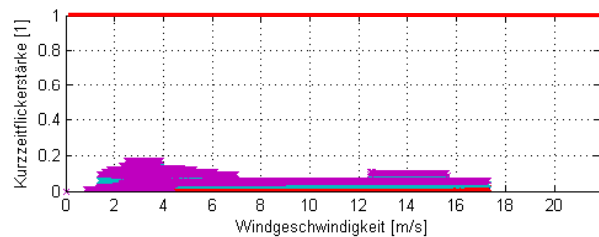
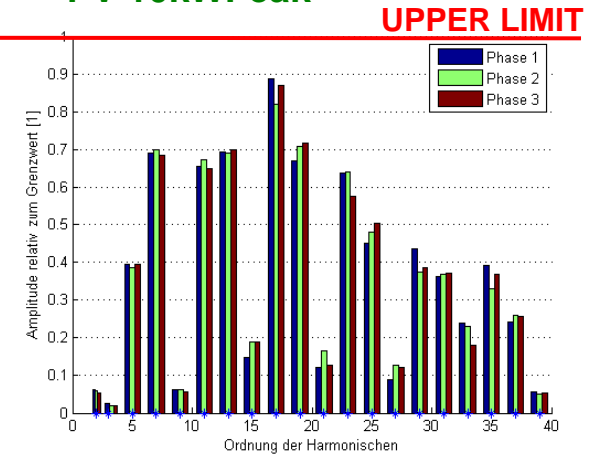
### SWT 4.8 kW with inverter



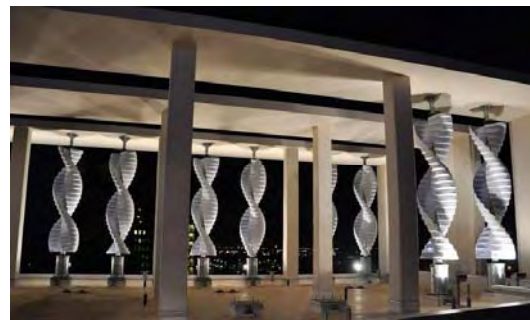
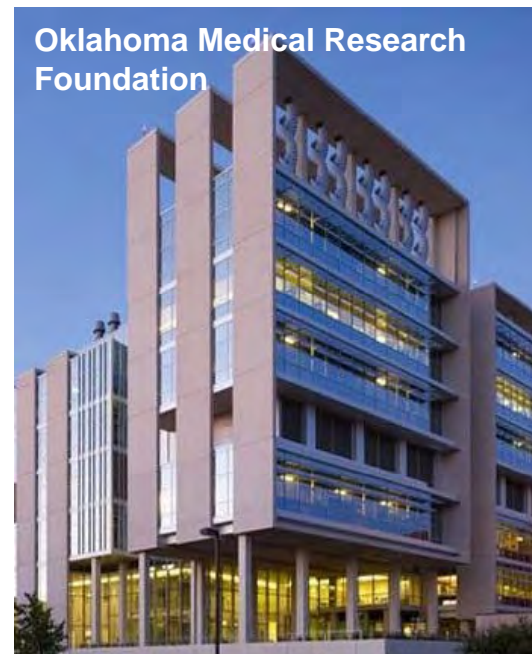
### SWT 6 kW without inverter



### PV 10kWPeak



## Into the built environment





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# Thank you for your attention!



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**Telefon: +43 1 664 61 92 586**