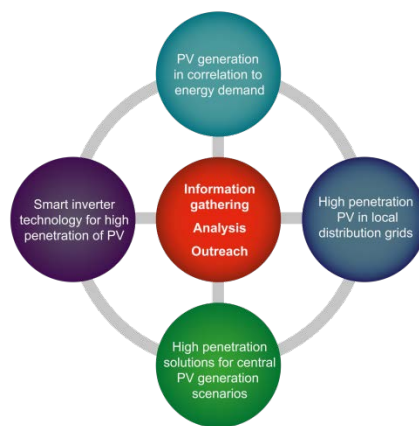


IEA International Energy Agency Photovoltaic Power Systems Programme

Task 14 – High Penetration PV in Electricity Grids

TASK 14 STATUS REPORT

25. October 2014 Revision 0



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1. Task 14 - Objectives and Strategies

The main goal of Task 14 is to promote the use of grid connected PV as an important source in electric power systems on a high penetration level where additional efforts may be necessary to integrate the dispersed generators in an optimum manner. The aim of these efforts is to reduce the technical barriers to achieving high penetration levels of distributed renewable systems on the electric power system. Due to the fact that a number of distribution system integration-related issues are emerging first for PV systems, Task 14 will focus on working with utilities, industry, and other stakeholders to develop the technologies and methods enabling the widespread deployment of distributed PV technologies into the electricity grids.

The objectives of this task are

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

Task 14 will address mainly technical issues to high penetration of PV in electricity networks. Technical issues include energy management aspects, 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.

Work in pursuit of the foregoing objectives will be performed by photovoltaic system specialists and engineers working in the fields of planning, installation and research in the Participants' countries. The work programme is organized into four main subtasks and one cross-cutting subtask, which will be a hub to all subtasks.

2. Task 14 key matters for ExCo meeting discussion:

In particular with the high priority Task 14, the active support of the national Task 14 participants by their national ExCo is highly appreciated.

- **Finalization of Task 14:** The ExCo is asked to support their national representatives to actively contribute to the final reporting of the activities and subtasks of Task 14 according to the actual work plan and commitments, especially for activities with reports pending.
- **Moving to Task 14 2.0:** The members of the Executive Committee are requested to discuss the draft Work Plan for the new and slightly adapted activities within Task 14 with their national task representatives and to identify their national interests.
- **Active support of national Task 14 participants:** The IEA PVPS ExCo is asked to enable national task representatives and named participants to actively contribute to the planned activities, to lead and coordinate the work of Task 14 2.0 in the new term.
- **Resources:** The ExCo members are strongly asked to support their experts in funding their participation in the second term of Task 14. The commitment by the member countries is

essential to perform the work and to produce the reports according to the work plan within the project life time.

As of October 2014, the following experts have confirmed their participation in Task 14 (experts who joined since April 2014 marked in light green, experts who left are crossed out):

Name	Country	Company/Organization
Iain McGill	AUS	University of NSW
Anna Bruce	AUS	University of NSW
Glenn Platt	AUS	CSIRO
Christoph Mayr	AUT	AIT Austrian Institute of Technology
Roland Bründlinger	AUT	AIT Austrian Institute of Technology
Karel de Brabandere	BEL	3E
Alex Masolin	BEL	KU Leuven
Paul Luukkonen	CAN	CANSIA
Ravi Seethapathy	CAN	Hydro ONE
Lionel Perret	CHE	Planair
Pierre Renaud	CHE	Planair
Davy Marcel	CHE	Planair
Christof Bucher	CHE	Basler Hofmann
Jan Remund	CHE	Meteotest
Wang Yibo	CHN	Chinese Academy of Sciences
Martin Braun	DEU	Fraunhofer IWES
Daniel Premm	DEU	SMA Technology AG
Gunter Arnold	DEU	Fraunhofer IWES
Thomas Stetz	DEU	Fraunhofer IWES
Holger Ruf	DEU	Hochschule Ulm
Gerd Heilscher	DEU	Hochschule Ulm
Kenn H. B. Frederiksen	DNK	Energimidt
Vicente Salas	ESP	Universidad Carlos III Madrid
Moshe Ohayon	ISR	Israel Electrical Company
Giorgio Graditi	ITA	ENEA-Portici Research Centre
Adriano Iaria	ITA	RSE
Daniele Bacchiocchi	ITA	GSE – Gestore Servizi Energia
Toshihiko Takai	JPN	NEDO
Kazuhiko Ogimoto	JPN	University of Tokyo
Takashi Oozeki	JPN	AIST
Catarina Calhau	PRT	EDP - Energias de Portugal
Antonis Marinopoulos	SWE	ABB AB, Corporate Research
Thomas Reindl	SGP	SERIS
Benjamin Kroposki	USA	NREL
Barry Mather	USA	NREL
Manoël Rekingier	EUR	EPIA
Ioannis-Thomas Theologitis	EUR	EPIA
Arnulf Jäger-Waldau	EC	European Commission
Ali Askar Sher Mohamad	MYS	SEDA
Azah Ahmad	MYS	SEDA

In addition, the following experts already contribute to the work or have regularly attended Task 14 meetings as observers:

Name	Country	Company/Organization
Kulwaree Buranasajjawaraporn	THA	Bureau of Solar Energy Development Department of Alternative Energy Development and Efficiency (DEDE) Ministry of Energy
Stathis Tselepis	GRE	CRES

3. Progress with Task 14 activities

3.1 Accomplishments of the previous six months

Overview

The Task 14 was planned for a period of four years from April 2010 to April 2014. Task 14 is now continuing in a second term with a new activities and an extended workplan. This report covers the period running from March 2014 to October 2014, describing task structure and the final outcomes of the first term.

IEA PVPS Task 14
<p>Cross-cutting Subtask: Information Gathering, Analysis and Outreach</p> <p>Activity CC.1: Setup a repository for information and models exchange</p> <p>Activity CC.2: Collect state of the art information about existing high penetration PV installation</p> <p>Activity CC.3: Gather a collection of existing modeling cases for existing installations</p> <p>Activity CC.4: Select and refine a set of pertinent cases for publication</p>
<p>Subtask 1: PV Generation in Correlation to Energy Demand</p> <p>Activity 1.1: Prediction Tools</p> <p>Activity 1.2: Network driven demand side management</p>
<p>Subtask 2: High Penetration PV in local distribution grids</p> <p>Activity 2.1: Review of State-of-the-Art</p> <p>Activity 2.2: Optimized Reactive Power Balancing</p> <p>Activity 2.3: Optimized Active Power Control Strategies</p> <p>Activity 2.4: Change from Distribution to Supply Grids and Dynamic Studies</p>
<p>Subtask 3: High penetration solutions for central PV generation scenarios</p> <p>Activity 3.1: Power system wide PV generation forecasting for high penetration PV</p> <p>Activity 3.2: Power system operational planning</p> <p>Activity 3.3: Power system transmission/generation augmentation planning</p> <p>Activity 3.4: Final report</p>
<p>Subtask 4: Smart inverter technology for high penetration of PV</p> <p>Activity 4.1: Opportunities for Smart PV inverters in High-Penetration scenarios</p> <p>Activity 4.2: Technical capabilities and Inverter Topologies</p> <p>Activity 4.3: Remote control and communication for Smart Inverters</p>

Workshops

In the last 6 months, one workshop was organized jointly by Task 1 & Task 14.

- On Monday the 22nd of September 2014, the IEA PVPS Task 1 & 14 Workshop “Self-consumption business models - Technical and economic challenges” as an official event of the 29th EU PVSEC, was jointly organised by IEA - International Energy Agency, EPIA and the EU PVSEC.

While the cost of PV electricity is going down, the question of how business models based on the self-consumption of PV electricity becomes more acute. This workshop explored the challenges associated with producing electricity with PV for local needs from a technical and economical point of view. An in-depth analysis of the potential and challenges of self-consumption based business models was discussed, with a focus on storage and “Demand Side Management”. In addition, the need to integrate in the electricity system and especially the question of the integration into the distribution grids was linked to the question of self-consumption.

Task 14 Workshop presentations of workshops held in 2013/2014 as well as documents from previous events are publicly available for download at the Workshops section of the IEA-PVPS website:

<http://www.iea-pvps.org/index.php?id=212>

Progress on Subtasks

In detail, the following accomplishments have been reported by the Subtask coordinators:

Cross-cutting Subtask: Information Gathering, Analysis and Outreach (lead currently pending)

The scope of this subtask is to collect and share state of the art information amongst the various tasks as well and collating information for the general public. The objective is to review and document worldwide implementations of high penetration PV scenarios into electric power systems and based on subtasks work, generalize and refine them to generate a set of convincing cases of safe and reliable implementation.

The cross-cutting subtask has completed the deployment of the collaboration platform to task experts as well as domestic experts that use the platform to be informed about and support the activities of the task. Task 14 is currently reaching roughly 100 users in the IEA-PVPS participating countries

Due to the decision of Canada to resign from Task 14 the leadership position for the CC subtask has been open since spring 2012. Up to now, none of the other participants committed to take over the lead. Therefore, the work in this subtask is currently on hold.

Subtask 1: PV generation in correlation to energy demand (lead: PLANAIR, Switzerland)

The objective of the task is to show and determine how with better prediction tools, an optimized local energy management and a better understanding of temporal fluctuation PV penetration level can be improved in grid.

In activity 1.1, the analysis of the questionnaire "*Use of solar and PV forecasts for enhanced PV integration*", which was made in the year 2011, has been integrated in an official IEA report about "Photovoltaic and Solar Forecasting: State of the Art" (IEA PVPS T14-01:2013). The report has been published in October 2013.

Results of this work have been presented in March 2014 Bad Staffelstein, „Meteonorm 7.1 – Weltweite Satellitendaten in 8 km Auflösung“ by Jan Remund, Meteotest. The future work will concern other forecast horizons (day ahead forecast 6-72h), as well as the review of needs and tools.

In activity 1.2, the local energy management to increase PV penetration was discussed and compiled to the report "*Network driven demand side management in households*". It gives a general overview of local energy management concepts together with photovoltaic, as well as an analysis of Demand Side Management (DSM) and storage solutions in conjunction with decentralized photovoltaic systems. Typical data from other areas will illustrate the effect of various climates. The shifting potential of the consumption is also estimated based on household profile. Self-consumed PV potential is estimated depending on the country and the load profile. A collaboration with IMT, Institute of Microengineering in Neuchâtel (CHE) and with Fraunhofer IWES, in Kassel (DE) is in progress for studies about PV local storage solutions to integrate renewable energies into the distribution system.

This report is available as draft document and is planned to be published by December 2014.

The scope of activity 1.3 (EDP, Portugal) has been redefined in order to make a literature review and analysis about PV variability characterization and prediction models, with the involvement of international partners. The Portuguese plant and information shared by participating countries serve as case studies to apply the relevant variability models identified in existing international studies. A draft of the report "variability prediction models" has been circulated within the Task 14 group by the end of 2013. The involved experts are asked to give their contribution to this report and reply to EdP. The final report should be available by December 2014.

Subtask 2: High PV penetration in local distribution grids (lead: Fraunhofer IWES, Germany)

Subtask 2, addresses the Identification and Interpretation of the Role of PV in Distribution Grids and includes an Impact Analyses of high PV penetration in national Distribution Grids. The outcome of subtask 2 will be recommendations for the transition from consumption to supply grids on a technical as well as regulatory level.

Subtask 2 comprises three Activities dealing with a review of the state-of-the-art and national case studies (Activity 2.1), optimized reactive power balancing and optimized active power control strategies (Activity 2.2) and the change from consumption to supply grids (Activity 2.3).

In 2011, a questionnaire for scenarios of high PV penetration on distribution feeders was created and some first country specific high penetration scenarios were gathered within Activity 2.1 (including US, German and Canadian contribution). A joint IEA Task 14 paper on the state-of-the-art, progress and future prospects of PV grid integration was published in the journal *Progress in Photovoltaics* (DOI: 10.1002/pip.1204).

An Excel based literature data base was set up and uploaded on the project repository within the first half of 2012. Relevant papers for Subtask 2 can now be shared among the participating countries, showing the state-of-the-art of active and reactive power control strategies by PV inverters.

For Germany, relevant publications from the last 12 years were studied and technical as well as scientific trends were identified. The results of this analysis together with a first draft of the report structure were presented at the IEA Task 14 Meeting in Tokyo, Japan in November 2012.

After the Tokyo meeting, a draft report for subtask 2 was written by Fraunhofer IWES (Germany) and NREL (USA) and sent out to the participating countries.

As of March 2014, a total of eleven participating countries (Australia, Austria, Germany, Japan, China, Italy, Belgium, Greece, Spain, Switzerland, USA) submitted a country-specific draft version for the joint ST2 report.

Based on the analysis of the national regulatory framework for the interconnection of PV systems into distribution grids and the lessons learned from selected national high penetration PV case-studies, in subtask 2 a report describing the "*Transition from One-Directional to Bi-Directional Distribution Grids on from Consumption to Supply Grids – Recommendations based on Global experience*" was produced. This work derives a roadmap with crucial technical milestones on the way to large scale high PV penetration scenarios and includes

- Definition of PV penetration scenarios
- Technical and regulatory barriers for high penetration PV in local distribution grids
- Key findings from national high penetration PV case-studies aiming at increasing the hosting capacity of distribution grids including cost-benefit-analysis

- Recommendations for the transition from consumption to supply grids
- Future prospects regarding an improved distribution grid integration of PV

To summarize, the following Subtask 2 reports have been completed and were submitted to the ExCo for approval:

- Part I: Report on state-of-the-art on active and reactive power management by PV systems under the regulatory framework of the participating countries including detailed information on national high penetration case studies
IEA–PVPS T14-02:2014 “High Penetration PV in local Distribution Grids: Case-Study Collection”
- Part II: Report on recommendations for the transition from distribution to supply grids and management summary.
IEA PVPS T14-03:2014 “Transition from Uni-Directional to Bi-Directional Distribution Grids: Management Summary of IEA Task 14 Subtask 2 – Recommendations based on Global Experience”

It has to be noticed that report 2-4 was jointly compiled as one single subtask 2 report. In general, the outcome of the subtask activities has been published at relevant conferences during 2013 and 2014 (e.g. IEEE PES General Meeting 06/13, EUPVSEC 09/14, Solar Integration Workshop 11/14).

Subtask 3: High penetration solutions for central PV generation scenarios (Lead: Japan)

Subtask 3 addresses the PV integration into power systems from the total power system view point. In order to realize high PV penetration to a power system, it is crucial to evaluate the impact and envision the future power system. The focus will be laid on grid interaction and penetration related aspects.

Subtask 3 comprises three Activities dealing with System-wide PV generation analysis and forecast (Activity 3.1), Power system operation planning with PV integration (Activity 3.2), Power system augmentation planning with PV integration (Activity 3.3).

In 2011, a questionnaire of PV generation forecast and a questionnaire of “high penetration scenarios of Renewable Energy (including PV) generation” were created have been sent to member counties. The responses of the questionnaire of PV generation forecast have been compiled into a forecast report. However, the other questionnaire was abandoned because there were enough responses from the contributing participants as of December of 2012. However, several situations of power system operation and augmentation under high penetration scenarios have been presented in the meeting and discussed.

Activity 3.2 and 3.3 are summarized in a joint report „*High penetration solutions for central PV generation scenarios*”. The current study mainly focuses on the system level aspects of demand and supply balancing of a power system assuming a strong transmission system. The report includes a discussion of impacts of PV penetration and new technologies, and it reviews the state-of-art technology for system operation planning and system augmentation planning. It further collects the case studies of system operation planning and augmentation planning including issues, solutions and R&D activities of the member countries.

Currently, the report of the PV generation forecast has been published (see Subtask 1). For Activity 3.2 and 3.3, The report “Power system operation planning with PV integration” is under final revision and soon ready for publication. An executive summary needs to be completed. Main contributions come from Japan. A paper about the outcomes of Subtask 3 was presented at the EU PVSEC in Amsterdam.

Subtask 4: Smart inverter technology for high penetration of PV (Lead: AIT Austria)

PV inverters play a key role as interface between PV generation and the electricity grid and integrate grid protection, system monitoring and control functions and also act as interface to storage. Subtask 4 addresses the inverter technology, technical requirements and standards, and system integration aspects for successful smart integration of a high penetration of PV by effectively applying the opportunities offered by modern power electronics.

Within 3 activities, Opportunities for smart PV inverters in high-penetration scenarios (Activity 4.1), Technical capabilities and Inverter Topologies (Activity 4.2) as well as remote control and communication for Smart Inverters (Activity 4.3) are investigated.

With ST4 the functional, protection, control, safety and other requirements for inverters, as they are defined in national and international Standards, Codes and Guidelines are being reviewed for different applications and connection voltage levels.

For this purpose, a questionnaire survey has been carried out. The initial round of the survey was completed by the participating countries in 2014, with results received from Japan, Austria and Italy. Based on the results, a first analysis was made, which indicated that currently only very few countries actually require advanced grid support functions from PV inverters. However, in numerous countries, the grid codes are currently under revision, re-thinking the original approach for interconnection of PV and amending the definitions with grid support functions. This ongoing process is continuously monitored by Task 14. Furthermore, Task 14 experts are actively contributing and providing inputs to the work of standardization committees and working groups.

Subtask 4 elaborated dissemination material, oral presentations of results at international conferences and workshops, including invited presentations on specific international utility events:

Specifically Task 14 experts in this field were invited to present their experiences at important events around the world, including the “PV Distribution System Modeling Workshop”, jointly organized by EPRI and Sandia National Laboratories in May 2014, in Santa Clara, CA, USA, where Subtask 4 lead R. Bründlinger presented “European codes & guidelines for the application of advanced grid support functions of inverters”. Following the presentation, Task 14 was invited to contribute a session in the EPRI Webcast Series “Addressing Interconnection Standards” on an “Update on Grid Codes in Europe” in June 2014. Both events were directly targeting utilities and grid operators and attracted wide interest from grid planners and standardization experts.

The latest experiences from Subtask 14 will also be an important part of an invited presentation scheduled for the 2014 IRED (Integration of Renewable Energy and Distributed Generation) conference in Kyoto.

Based on the results, technical capabilities and requirements for smart inverters were developed in Activity 4.2, including a review of inverter topologies and simulation concepts.

Both reports for activity 4.1. and 4.2. will be completed in early 2015, following the ongoing changes and new trends in the field.

Due to constraints in resources and the uncertainty in ongoing developments on the international level, the originally planned extensive review of remote control practices (interfaces, communication technologies, protocols...) and currently available communication standards suitable for Smart Inverters will be postponed to the next term of Task 14 which has been started in May 2014.

Task 14 Management and Meetings

Within the reporting period from May 2014 until November 2014, an informal Task meeting was organized

- Informal Experts Meeting in the range of EU PVSEC in Amsterdam, Netherlands 23 September 2014, hosted by EPIA

Task 14 new Workplan 2014-2018

The Task 14 Work Plan for the second term of Task 14: “High penetration of PV Systems in Electricity Grids” for the period from 2014 to 2018 was submitted to the ExCo for approval. It has been prepared by experts from the Task 14 core group based on the consensus of the whole Task 14 expert group during the discussions at the recent Task 14 meetings in Sydney, Australia (Nov. 2013) and Geneva, Switzerland (April 2014).

The new Task 14 Work Plan was finally endorsed by the PVPS ExCo during their meeting in Aachen, Germany, in April 2014.

3.2 Plans for the next six months

Task 14 activities in the next 6 months will focus on the completion of the planned reports as described in section 3.3. The following action must be taken for the finalization of the first term of Task 14

- Subtask 1.2: Contribution of case studies and finalization of report summary
- Subtask 1.3: The involved experts will give additional contributions to prediction models of variability. The final report is in progress and co-ordinated by Portugal.
- Subtask 2: Building up of the Subtask2-structure for the second working period. Definition of activity responsibilities and upcoming milestones.
- Subtask 3: The report “Power system operation planning with PV integration” is under final revision and soon ready for publication. An executive summary needs to be completed. Main contributions come from Japan. A paper about the outcomes of Subtask 3 was presented at the EU PVSEC in Amsterdam.
- Subtask 4.1: Finalization of survey and development of recommendations for future interconnection specifications.
- Subtask 4.2: Investigation of inverter related requirements for high penetration PV, including interface related issues.

The successful series of utility workshops related to high PV penetration scenarios in electricity grids will be continued. Due to the dense schedule at the upcoming experts meeting in November in the range of WCPEC-6 and IRED in Kyoto, Japan, no specific Task 14 workshop will be organized. Instead, a special session of Task 14 is planned for IRED conference in Kyoto, Japan.

The next workshop will take place in conjunction with the Experts meeting in spring 2015 in Denmark.

In general, the reporting of the first term of Task 14 is planned to be completed.

Task 14 new Workplan 2014-2018

At the same time, the actions on the new work plan for the second term of Task 14 will be started. The proposed work programme for the extension of Task 14 directly addresses a number of the strategic issues of the PVPS Implementing Agreement, with a focus on grid integration, large scale

deployment and business models which will be directly covered by Task 14's activities. The defined subtasks

- Cross-cutting subtask: Market implications with High PV Penetration
- Subtask 1 (extended): Energy management with high PV penetration
- Subtask 2 (extended): High penetration PV in local distribution grids
- Subtask 3 (extended): High penetration solutions for central PV generation scenarios
- Subtask 4 (extended): Smart power converters for high penetration PV and Smart Grids
- Subtask 5 (new subtask): Communication and Control for high penetration of PV

will be started according to the workplan. The Subtasks leaders take over the responsibility for their workpackage and will start to coordinate the activities.

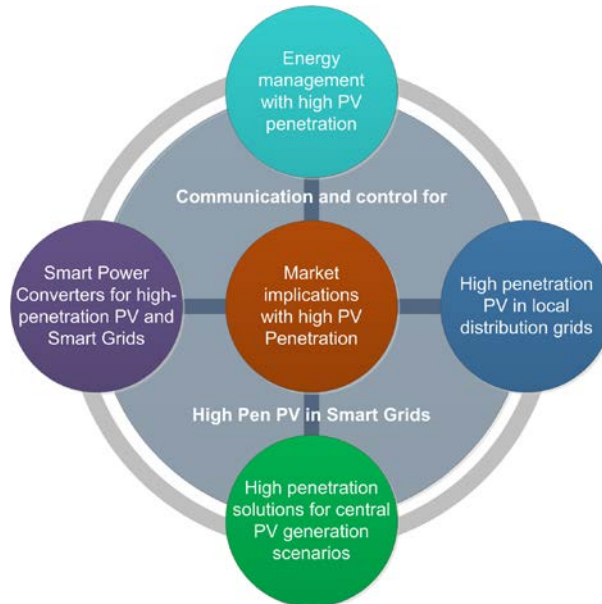


Figure 1: New Task 14 work plan structure

3.3 Summary of documents published and planned

Published documents and presentations

Activities of the last 6 months can be reported:

- April 2014 Nationale PV Tagung Schweiz, "Mehr Solarstrom im Verteilnetz: Sieben Alternativen zum Netzausbau", Christof Bucher, Basler & Hofmann AG, related to Subtask 2
- May 2014 PV Distribution System Modeling Workshop, Santa Clara, CA, USA (invited); "European codes & guidelines for the application of advanced grid support functions of inverters", R. Bründlinger, AIT Austrian Institute of Technology, related to Subtask 4.
- May 2014 PV Distribution System Modeling Workshop, Santa Clara, CA, USA (invited), "The IEA PVPS Task 14 High penetration PV in Electricity Grids", Bründlinger, AIT Austrian Institute of Technology, related to all Subtasks.

- May 2014 EPRI Smart Inverter Workshop, Santa Clara, CA, USA (invited), "Grid code experiences from Europe", Bründlinger, AIT Austrian Institute of Technology, related to Subtask 4.
- June 2014 EPRI Webcast Series Addressing Interconnection Standards, (invited); "Update on Grid Codes in Europe"; R. Bründlinger, AIT Austrian Institute of Technology, related to Subtask 4.
- June 2014 Sustainable Energy Week, Brussels, "How to match DSOs needs and PV capabilities?" T. Stetz, Fraunhofer IWES, related to Subtask 2
- July 2014 IEEE PES General Meeting, Washington D.C., "Local Voltage Control Strategies for PV Storage Systems in Distribution Grids", T. Stetz, Fraunhofer IWES, Kassel, related to Subtask 2.
- September 2014 EUPVSEC Amsterdam, "High Penetration PV in Local Distribution Grids - Outcomes of the IEA PVPS Task 14 Subtask 2" T. Stetz (et.al.), Fraunhofer IWES, Kassel, related to Subtask 2, including Keynote presentation at the EUPVSEC
- September 2014 EUPVSEC Amsterdam, "High Penetration PV in Power Systems - Outcome of the IEA-PVPS Task 14's Subtask 3", K. Ogimoto (et.al.), University of Tokyo, related to Subtask 3
- IEA–PVPS T14-02:2014 "High Penetration PV in local Distribution Grids: Case-Study Collection" ISBN: 978-3-906042-23-7
- IEA PVPS T14-03:2014 "Transition from Uni-Directional to Bi-Directional Distribution Grids: Management Summary of IEA Task 14 Subtask 2 – Recommendations based on Global Experience" ISBN: 978-3-906042-24-4
- November 2014 Solar Integration Workshop Berlin, "High Penetration PV in Local Distribution Grids - Outcomes of the IEA PVPS Task 14 Subtask 2" T. Stetz (et.al.), Fraunhofer IWES, Kassel, related to Subtask 2
- November 2014 International Conference on Integration of Renewable and Distributed Energy Resources (IRED) "Grid Codes in Europe for Low Voltage", R. Bründlinger, AIT Austrian Institute of Technology, related to Subtask 4.

Presentations of all Task 14 events organised so far are publicly available for download at the Archive section of the IEA-PVPS website: <http://www.iea-pvps.org/index.php?id=9>

Planned documents and presentations

The products of work performed in Task 14 will be designed for use by electricity network planners, specialists for photovoltaic systems and inverters, power system simulation engineers, utility engineers concerned with interconnection of distributed energy resources, equipment manufacturers and researchers on photovoltaic systems.

Results of the joint activity will include:

- Cross Cutting Subtask:
 - Currently pending

- In Subtask 1 :
 - The report “Network driven demand side management in households” about local energy management to increase PV penetration with case studies (draft document available, final report is planned to be published by November 2014)
 - A report about variability models of PV plants (a draft report has been submitted)
- In Subtask 2:
completed
- In Subtask 3:
 - The part of PV forecast of the results of the work performed in Subtask 3 has been documented in the report “Photovoltaic and Solar Forecasting: State of the Art” and has been published.
 - The other parts of the work will be summarized in a Report on System-wide PV generation analysis and forecast and a report describing high penetration solutions for central PV generation scenarios including aspects of Power system operation and augmentation planning with PV integration. The report is under final preparation by the contributing authors.
- In Subtask 4:
 - Finalization of the survey and analyzing the data replied. Reports produced by Subtask 4 will discuss the opportunities for Smart PV inverters in High-Penetration scenarios, the technical capabilities and inverter topologies. The outcomes of this subtask will be presented at the 6th IRED in Japan 2014. The final reports will be ready by spring 2015.

In addition, the successful series of utility workshops related to high PV penetration scenarios in electricity grids will be continued. Due to the dense schedule at the upcoming experts meeting in the range of WCPEC-6 and IRED in Kyoto, Japan, the next workshop will take place in conjunction with the Experts meeting in spring 2015 in Denmark. These events will bring together industry, utilities and other experts in the field of PV integration with the Task 14 group.

4. Highlights of industry involvement

As from the beginning, industry has been directly involved in the development of the concept and work plan for Task 14. In addition, a number of PV industry and utility representatives also participate in the Task 14 group.

Based on the results achieved so far within the Task 14, further activities towards integrating industry are constantly being organized, such as special workshops (see also section 3.1) for intensive knowledge exchange. The utility interest in Task 14 work is also highlighted by the broad attendance of utility representatives at the recent workshops organized by Task 14.

Furthermore, the workshops will also form the basis to present national activities related to high penetration PV, together with other relevant international projects which address research and demonstration of High Penetration PV.

Besides the country participation, increased interest from industry associations was received: EPIA the European Photovoltaic Industry Association is an official member of Task 14.

The broad interest of public stakeholders is also highlighted by the membership of the European Commission which joined Task 14 in Spring 2013.

5. Summary of inter-task coordination

Task 14 actively uses the resources of Task 1 “*Strategic PV Analysis & Outreach*” in particular regarding the development and implementation of policies focused on grid connected PV.

A direct liaison has been established between the IEA SHC Task 46 on “Solar Resource Assessment and forecasting”, focusing on issues related to solar resource availability, forecasting and spatial/temporal variability. Task 14 expert Jan Remund from Switzerland, who is also working in SHC Task 46, is coordinating the collaboration.

In addition, there are also ongoing talks with IEA-WIND Annex 25 (Lead: Hannele Holttinen VTT Finland) to contribute to their work on Integration studies. Manoel Rekingier from EPIA is establishing the inter-task cooperation.

The new IEA SHC Task 53 “*New Generation Solar Cooling & Heating Systems*” focusses on solar driven systems for both cooling and heating. AITs experts have a close link to Austria’s national representative within this task. The organization of a joint event has been discussed with the OA of SHC Task 53 as soon as first results of the work are available.

6. Summary of task participation and effectiveness

The active support of the national Task 14 participants by their national ExCo is highly appreciated.

Currently, experts from 18 countries are participating in the Task, with one additional country (Greece) attending the meetings as observer. As soon as the approval of their formal membership in IEA-PVPS is granted, these countries will become official participants in Task 14.

Thailand recently joined the PVPS Implementing Agreement. An official NoP for Task 14 can be expected, naming the experts being involved in Task 14. In addition, Singapore attended the Task 14 meeting in Geneva the first time as an observer. It looks promising, that SERIS (Solar Energy Research Institute of Singapore) will become an official partner of Task 14 and a PVPS member.

The task 14 participation in general is summarized in the table on the last page.

7. Meetings

Previous meetings

- The initial work programme that was developed after the first Task definition meeting in Sydney (November 2008). A task preparation team consisting of 6 institutes/experts from 6 countries was identified based on volunteering work to jointly prepare this work plan.
- These experts also chaired the relevant sessions at the second task definition meeting in August 2009 in Montreal where the work items were discussed in detail. After this second task definition Meeting the workplan was restructured and refined and sent out for further discussions to a significantly enlarged group of experts.
- The official Task 14 Kick-off meeting was held in Vienna, Austria 12-14 April 2010. The workplan was discussed and finalized. Confirmation of subtask leaders and allocation of Task 14 participation have been performed.
- Informal Experts Meeting in the range of EU PVSEC in Valencia, Spain 7 September 2010. Co-ordination of Subtask 2 and Subtask 3, provision of templates for data collection, industry involvement.
- The 2nd Experts meeting was held in Golden, Colorado (USA) 2-3 December 2010, hosted by NREL.
- The 3rd Experts' meeting was held in Lisbon, Portugal, 12-13 May 2011, hosted by EDP
- The 4th Experts' meeting was held in Beijing, China, 11-12 October 2011, hosted by the Institute of Electrical Engineering, Chinese Academy of Sciences.
- The 5th Experts' meeting was held in Kassel, Germany 10-11 May 2011, hosted by Fraunhofer IWES
- The 6th Experts' meeting was held in Japan, October 31-November 1, 2012, hosted by NEDO and University of Tokyo.
- The 7th Experts' meeting was held in Brussels, Belgium 6-8 May 2013, hosted by 3e and supported by EPIA and the European MetaPV Project
- The 8th Experts' meeting was held in Sydney, Australia, 26-28 November 2013, hosted by the Australian PV Association (APVA) and UNSW.
- The 9th Experts' meeting was held Geneva, Switzerland, 1-2 April 2014, hosted by Planair and HEPIA
- Informal Experts Meeting in the range of EU PVSEC in Amsterdam, Netherlands 23 September 2014. Co-ordination of Subtasks, discussion of new Task 14 workplan.

Upcoming meetings

- The 10th Experts' meeting will be held in Kyoto, Japan, 22-23 November 2014, hosted by NEDO.
- The 11th Experts' meeting will tentatively take place in Denmark, May 2015, hosted by Energimidt.

Meeting participation by Country

	04/2010 Austria	09/2010 Spain	12/2010 USA	05/2011 Portugal	11/2011 China	5/2012 Germany	10/2012 Japan	5/2013 Belgium	12/2013 Australia	4/2014 Switzerland
Country	Kick-Off Meeting Vienna	PVSEC Workshop Valencia	2nd Experts Meeting Golden	3rd Experts Meeting Lisbon	4th Experts Meeting Beijing	5th Experts meeting Kassel	6th Experts Meeting Tokio	7th Experts Meeting Brussels	8th Experts Meeting Sydney	9th Experts Meeting Geneva
AUS	1	0	1	1	1	0	1	1	4	2
AUT	3	2	2	2	2	2	2	2	2	2
BEL	0	1	0	2	1	1	1	2	0	1
CAN	1	0	3	1	1	0	1	1	0	1
CHE	2	0	1	2	1	3	1	2	1	4
CHN	0	0	0	1	1	1	0	1	0	0
DEU	2	1	1	2	1	5	3	2	1	3
DNK	1	0	1	1	1	1	1	1	1	0
ESP	1	0	1	0	0	0	1	0	0	0
EUR	0	0	0	0	0	1	1	2	1	1
GRE	0	1	0	0	0	1	1	1	1	1
ISR	1	0	1	0	0	1	0	0	0	0
ITA	0	0	0	0	0	1	0	0	1	0
JPN	3	1	2	2	3	3	5	3	3	3
MYS	0	0	0	0	0	0	0	1	3	0
NED	0	0	0	0	0	0	1	0	0	0
PRT	1	0	0	1	0	0	0	0	0	0
SWE	1	0	0	1	0	1	0	0	0	0
THA	0	0	3	0	9	1	3	0	0	0
USA	2	1	4	1	1	2	1	1	1	1
SGP	0	0	0	0	0	0	0	0	0	1
N/A	0	0	0	0	0	0	0	0	0	0
	19	7	20	17	22	24	23	20	19	20