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IEA PVPS Task 16

Solar resource for high penetration and large scale applications

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Summary

IEA PVPS Task 16 (2023) is currently in the third phase which started in June 2023 and will go on until June 2026. Jan Remund of Meteotest leads the Task as Task Manager on behalf of the PVPS Technology Collaboration Program with support of SFOE. From Switzerland additionally SPF Institute for Solar Technology of the HSR University of Applied Sciences is taking part in Task 16.

The main goals of the Task are to lower barriers and costs of grid integration of PV and lowering planning and investment costs for PV by enhancing the quality of the forecasts and the resources assessments. The work is organised in four subtasks:

- Subtask 1: Evaluation of current and emerging resource assessment methodologies
- Subtask 2: Enhanced data & bankable products
- Subtask 3: Evaluation of current and emerging solar resource and forecasting techniques
- Subtask 4: Dissemination and Outreach

Meteotest is mainly involved in leading, presenting and organizing the Task (Subtask 4). This intermediate report of the Swiss supporting project includes the overview of the work done in the last year. 47 participating organisations from 19 countries had to be kept together. In 2023 one hybrid Task meetings took place.

The main result of the first three year of the Task 16 – the update of the Solar Resource Handbook – written throughout the year 2023. It will be published in spring 2024. The work for the 4th edition has been started.

In the first 5 months of the project (third phase of the Task) no workshop was given, no paper and no report were published. One peer reviewed paper was published, many presentations were given at different conferences and two reports drafted.

Seite absichtlich frei

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List of abbreviations

IEA	International Energy Agency
GHI	Global horizontal irradiance
PVPS	Photovoltaic (PV) Power Systems TCP
SFOE	Swiss Federal Office of Energy
SHC	Solar Heating and Cooling TCP
SolarPACES	Solar Power and Chemical Energy Systems TCP
TCP	Technology collaboration programme
TMY	Typical Meteorological Year

Introduction

IEA PVPS Task 16 (T16) started in June 2017 is currently in the 3rd phase which will go on until June 2026. This report covers only the period since starting the 3rd phase in Juli 2023.

T16 is a joint Task with the TCP SolarPACES (Task V). It will keep also minimal collaboration with the Solar Heating and Cooling (SHC) – the Technology Collaboration Programme of the preceding solar resource and forecast Tasks.

Meteotest leads the Task as Task Manager on behalf of the PVPS TCP with support of Swiss Federal Office of Energy (SFOE). Manuel Silva of Univ. of Sevilla, Spain leads the Task V since summer 2018 on behalf of SolarPACES. The main work of Meteotest was to organise to ongoing work of the Task – meetings, workshops and reports – and informing the Exco about the updates.

Meteotest works actively dissemination, in the benchmarking activity as well as in modelling firm PV power, where a separate project in Switzerland was conducted in 2021, 2022 and 2023.

From Switzerland additionally SPF Institute for Solar Technology of the HSR University of Applied Sciences is taking part in Task 16.

1 Workplan

The main goals of third phase of T16 are to lower barriers and costs of grid integration of PV and to lower planning and investment costs for PV by enhancing the quality of the forecasts and the resources assessments.

To reach this main goal the Task has the following objectives:

- Lower uncertainty of satellite retrievals and Numerical Weather Prediction (NWP) models for solar resource assessments and nowcasting.
- Develop enhanced analysis of long-term variability and trends in solar resource with an additional focus on effects of climate change.
- Develop and compare methods for
  - Estimating the spectral and angular distributions of solar radiation (clear and all-sky conditions)
  - Modelling point to area forecasts
  - Probabilistic forecasting
- Organize international benchmarks of solar resource and forecast datasets.

In this phase the following focus have been defined:

1. Analysing long term trends and variability changes induced by climate change (activity 2.4)
2. Modelling of meteorological data and albedo for bifacial modules (activity 2.7)
3. Providing models and information for firm power production (new activity 3.5)

The scope of the work in Task 16 concentrates on meteorological and climatological topics needed to plan and run PV, solar thermal, concentrating solar power stations and buildings. As in the preceding Task solar resource assessment and forecasting are the main focus.

To handle this scope the work programme is organized into three main technical subtasks (subtasks 1 – 3) and one dissemination subtask (subtask 4) (Table 1):

Table 1: Subtasks and Activities of Task 16 (2023-2026)

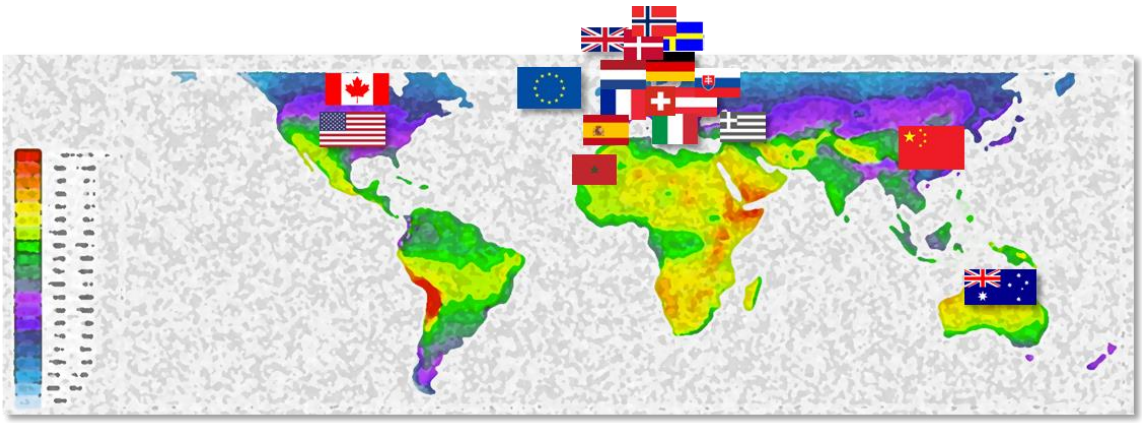
Subtask	Activity
Subtask 1: Current methodologies for solar data generation	1.1 Radiation measurements
	1.2 Radiation models
	1.4 Benchmarking solar data
	1.5 Additional meteorological parameters
Subtask 2: Enhancement of data & value-added products	2.1 Data quality and format
	2.4 Climate change and long-term variability
	2.5 Products for the end-users
	2.7: Products for upcoming, integrated technologies
Subtask 3: Solar forecasting	3.2 PV power forecasting at different spatio-temporal scales
	3.3 Probabilistic solar forecasting
	3.4 Cloud image based nowcasting (0-6 hours)
	3.5 Firm power generation
Subtask 4: Dissemination and Outreach	4.3 Webinars, workshops, publications and trainings
	4.4. Update of solar resource handbook
	4.5. Practical guide to solar data processing and modelling
	4.6. Update basic knowledge for a broad public (e.g. Wikipedia)

Whereas subtasks 1 and 3 are mainly focused on ongoing scientific work, subtask 2 and 4 are mostly focused on user aspects and dissemination.

In Table 2 and Figure 1 the Task participants are listed.

Table 2: Participating countries (19) and organizations (47) of Task 16.

Country	TCP	PM	Partners
AUS	PVPS	5	Univ. of South Australia (UniSA), Univ. of NSW (UNSW)
AUT	PVPS	4	Fachhochschule Oberösterreich (FH OOE)
CAN	PVPS	3	Natural Resources Canada
CHE	PVPS	21	Meteotest, HSR (SPF)
CHN	PVPS	4	Public Meteorological Service Center (China Meteorological Administration - CMA)
DEU	PVPS SolarPACES	42	Fraunhofer (ISE & IEE), DLR (both TCP)
DNK	PVPS	18	Danish Meteorological Institute (DMI), Technical University of Denmark (DTU)
ESP	PVPS SolarPACES	51	CIEMAT, CENER, Public University of Navarra, Univ. Almeria, Univ. Jaen, Univ. Malaga, University of Seville (US), Univ. des Las Palmas de Gran Canaria, Mactech
EU	PVPS	3	JRC
FRA	PVPS	10	MINES ParisTech, Laboratoire PIMENT, Université la Réunion, Ecole Polytechnique à Palaiseau, EDF R&D, RTE, TotalEnergies
ITA	PVPS SolarPACES	7	i-em, RSE, Uni Tor Vergata, ENEA and EURAC
NLD	PVPS	2	Univ. Utrecht
NOR	PVPS	2	IFE and Met. Norway
SWE	PVPS	5	SMHI and Univ. Uppsala
USA	PVPS	17	Dep. of Energy/National Renewable Energy Laboratory (NREL), National Aeronautics and Space Administration (NASA), State Univ. of New York at Albany (SUNY), University of Oregon, Clean Power Research (CPR), Solar Consulting Services (SCS)
GBR	SHC	4	Peakdesign Ltd.
GRE	SolarPACES	1	Univ. of Patras
MOR	SolarPACES	1	IRESEN
SVK	SHC	2	Solargis



Global horizontal irradiance. Source: www.meteonorm.com Version 8.0

Figure 1: Countries participating in the Task 16.

2 Completed Tasks and achieved results

IEA PVPS Task 16 is among the biggest Tasks in PVPS TCP concerning number of participants (47) and countries (19). Additionally financial resources are not adequate in many countries. Both issues made operating the Task not an easy topic. Missing resources as well as changes of staff of participants led also to re-organisation and changes of activity and subtask leads.

As in the first two phases also for the 3rd phase the main result of Task is the update of the solar resource handbook. This report has been published in April 2021 as NREL version1 and in May in PVPS version2:. Since May 2023 the 4th edition of the handbook is written. The report will be published in spring 2024. This report included all major work done in 2021 - 2023

2.1 Papers published

A paper about the state of the art of firm power modelling has been published in September 2023 (Remund et al., 2023).

A draft version of a journal article about benchmarking of probabilistic solar forecasting is written and currently in internal review. It's foreseen to be published in spring 2024.

2.2 Reports in review

After the publication of three reports in the first half of 2023 – which were reported in the final report of the 2nd phase of Task 16- between July and December 2023 no report was in review or published.

2.3 Workshops / Webinars

An internal workshop at the Whole-of-Programme Meeting in Adelaide was organised. The topic was Firm Power Modelling. The Task Manager presented the state of the know-how about seasonal solar forecasting at the IEA Wind Task 51 workshop.

Many presentations have been given at conferences like EU PVSEC 2023, SolarPACES 2023 or ISES Solar World Congress 23.

2.4 Task meetings

As Task Manager Meteotest organised one (hybrid) meetings autumn 2023 at the Whole-of-Programme meeting in Adelaide, Australia (Figure 4).

- October 23 – 26th 13th Task meeting, Univ. of South Australia, Adalaide, AUS

The hybrid meeting was successful and the upcoming meetings will be organised in a similar form. About 16 persons attended the meeting physically and 30 online.

[1] https://www.nrel.gov/docs/fy21osti/77635.pdf

[2] https://iea-pvps.org/key-topics/best-practices-handbook-for-the-collection-and-use-of-solar-resource-data-for-solar-energy-applications-third-edition/

Figure 5: Group photo of the hybrid Task meeting in September 2023 at Univ. of South Australia, Adelaide, Australia.

The Task Manager presented the Task at the online Exco meeting in November.

3 Collaboration in Switzerland

Aside Meteotest HSR / SPF was part of the Task 16.

In the SFOE (2022) project "Firm PV Power Switzerland" we investigated the concept of Firm PV power in Switzerland (activity 3.5). The results are published on aramis website[3] and disseminated also via energeia[4]: During second half of 2023 an update of this study is made. New scenarios including more wind energy and a small amount of nuclear are modelled.

4 Outlook

In January 2024 the next (4th) edition of the Solar Resource Handbook will be ready for review. Publication is foreseen March - April 2024.

Two Task meetings are planned (April and October). The first meeting will be a hybrid meeting at DTU in Roskilde / Copenhagen, DNK together with Wind Task 51. The 2nd Task meeting will be organised in Golden CO, USA at the premises of NREL October 8-10 2024.

Publications

Remund, J., Perez, R., Perez, M., Pierro, M. and Yang, D. (2023), Firm Photovoltaic Power Generation – Overview and Economic Outlook. Sol. RRL. Accepted Author Manuscript. https://doi.org/10.1002/solr.202300497

SFOE. 2022: Firm PV power generation for Switzerland. SFOE contract number: SI/ 502286-01. https://www.aramis.admin.ch/Grunddaten/?ProjectID=49486

[3] https://www.aramis.admin.ch/Grunddaten/?ProjectID=49486

[4] https://energeiaplus.com/2022/06/27/solarstrom-im-schweizer-stromsystem-effektiv-und-wirtschaftlich-dank-ueberdimensionierung-und-abregelung/