



## Final Report

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# IEA PVPS Task13 (2016 to 2017)

## Performance & Reliability of Photovoltaic Systems: Swiss contribution by SUPSI

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University of Applied Sciences and Arts  
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# SUPSI

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**The author of this report bears the entire responsibility for the content and for the conclusions drawn therefrom.**



## Summary

Task 13 of the IEA Photovoltaic Power Systems Programme (PVPS) aims at supporting market actors to improve the operation, the reliability and the quality of Photovoltaic (PV) components and systems. Operational data of PV systems in different climate zones compiled within the project will allow conclusions on the reliability and on yield estimations. Furthermore, the qualification and lifetime characteristics of PV components and systems will be analyzed, and technological trends identified.





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# 1 Introduction

The overall mission of the Photovoltaic Power Systems Programme (PVPS, [www.iea-pvps.org](http://www.iea-pvps.org)) of the International Energy Agency (IEA) is to enhance the international collaborative efforts which facilitate the role of photovoltaic solar energy as a cornerstone in the transition to sustainable energy systems. PVPS IEA Task 13: Performance & Reliability of Photovoltaic Systems focuses in particular on the reliability and the quality of PV components and systems.

PVPS Task 13 aims to support market actors to improve the operation, the reliability and the quality of Photovoltaic (PV) components and systems. Operational data of PV systems in different climate zones, collected and compiled within the project, gives feedback on the reliability and on yield estimations. Furthermore, the qualification and lifetime characteristics of PV components and systems are analysed and technological trends identified.

The project is divided into 3 sub-tasks:

- ST1 'Economics of PV System Performance and Reliability',
- ST2 'System Performance and Analysis',
- ST3 'Module Characterization and Reliability'.

SUPSI is primarily involved in ST3, where it is leading the ST3.2 activities on 'module energy yield data from test fields in different climates' and to a minor extent, in ST2. SUPSI is part of the expert group since 2010 and is leading ST3.2 since 2014.

The aim of the participation of SUPSI in the IEA TASK 13 is to bring the Swiss experience into the international discussion and to share testing methodologies and results on module performance and reliability achieved also from national funded projects.

The following SUPSI activities, within the IEA TASK 13, were financed under this contract:

- participation at the bi-annual meetings;
- dissemination of results;
- coordination of ST3.2;
- transfer of results of national/internationally projects into IEA consortium;
- networking activities with other Swiss PV stakeholders.



## 2 Activities in the years 2016 to 2017

### 2.1 Participation at meetings & workshops

SUPSI participated at all Task 13 meetings. Here below are listed the meetings with the host and period in which they were organised.

- 14th task meeting, April 2016, EURAC, Bozen, Italy;
- 15th task meeting, September 2016, Sandia, Albuquerque, USA;
- 16th task meeting, March 2017, SUPSI, Lugano, Switzerland;
- Final task meeting, October 2017, TÜV, Köln, Germany.

The 16th Task 13 meeting was hosted by SUPSI followed by the 7th PVPMC modelling workshop on 'PV energy rating and models for PV modules'. The two-day workshop was organised in collaboration with the Physikalisch-Technische Bundesanstalt (PTB) and Sandia National Laboratories. The workshop brought together experts from the European Metrology Research Project "Photoclass" and from the IEA PVPS Task 13 working group to discuss and share new and important technical results and issues related to the modelling and energy rating of PV modules. Topics that were presented and discussed included: module energy rating, module performance modelling, cell and module calibration methods and uncertainties and energy prediction of new technologies or features. The workshop attracted about 100 international participants from industry, universities, and national research institutes. The presentations from the workshop are available to the public on the section events of the PVPMC /website [www.pvpmc.sandia.gov](http://www.pvpmc.sandia.gov).

Final results of ST3.2 'Module energy yield data from test fields in different climates' were presented by G. Friesen at the IEA workshop entitled 'PV System Performance and PV Module Reliability'. The workshop was organised in concomitance with the 33rd EU PVSEC in Amsterdam. The presentation entitled 'Recommended Practices for PV Module Outdoor Characterization and Power Rating' can be downloaded from the PVPS home page [www.iea-pvps.org](http://www.iea-pvps.org).





Figure 1: Participants of the 7th PV Energy Rating and Module Performance Modelling Workshop at SUPSI in Lugano, Switzerland.

## 2.2 Coordination activities (ST3.2)

The main objective of ST3.2 was:

- to assess today's module energy yield measurement practice;
- to give a guideline of how to harmonize the measurement procedures.

A survey was therefore conducted by SUPSI to assess the state of the art measurement practice between test laboratories. The outcome of the survey was summarized within the technical report "Photovoltaic Module Energy Yield Measurements: Existing Approaches and Best Practice", which will be published in spring/summer 2018.

The purpose of the report is to help anyone aiming to perform outdoor measurements to get the technical insights into the topic, to be able to set-up its own test facility or to better understand how to interpret outdoor measurements. Fifteen different institutions were involved in the survey and in the preparation of the technical report. A summary of the report was presented at the 13th IEA PVPS Task Workshop 'PV System Performance and PV Module Reliability' at the 33rd EU PVSEC 2017 in Amsterdam.

A selected number of monitoring data was selected from the survey participants to set-up an open source module data set for the validation of PV performance models. The data will be made available in 2018 through the PVPMP home page <https://pvpmc.sandia.gov/>.



## 2.3 Other contributions

Here summarised are the main contributions from SUPSI for the reporting period 2016/2017.

- Participation at a survey on module measurement uncertainties, coordinated by Fraunhofer ISE. SUPSI shared its experience both in the indoor and outdoor characterisation of PV modules.
- Participation at the module/system failure survey coordinated by ISFH, for the collection of inputs on failures and its respective PV system performance losses.
- Visual inspection of an old PV system, based on single junction amorphous silicon modules. The system was installed on the roof of the SUPSI university campus in 1987. The system was monitored and the STC power of a selected number of modules has been measured at regular intervals to assess their degradation. Within IEA Task 13, all 96 modules of the system were inspected and the STC power measured for each single module. Suggestions for the improvement of the visual inspection sheets for the thin film modules section were given. The data have been added to the 1200 Visual Inspection sheets that have been collected so far by the coordinator of this task (TüV Rheinland) within the whole IEA Task 13 consortium.
- Delivery to TNC Consulting of monitoring data from around 100 systems from canton Ticino for the analysis of field performance analysis. The data were retrieved from the database of the PV systems financed in Ticino through the FER (Fondo per le Energie Rinnovabili). The data will be merged to the Swiss grid data analysed in precedence and presented by Thomas Nordmann at the 15th Nationale PV Tagung in Lausanne – ‘Wie gut funktioniert die Schweizer KEV PV- Anlage?’.
- Contribution to the technical report on the ‘Assessment of PV Module Failures in the Field’ (ISBN 978-3-906042-54-1), with results obtained from the EU project ‘Performance Plus’ presenting an electrical performance model which takes into account the different possible failure types. CSEM contributed with its research activities on failures due to the lamination process.
- Contribution to the technical report ‘PV Performance Modeling Methods and Practices - Results from the 4th PV Performance Modeling Collaborative Workshop’ (ISBN 978-3-906042-50-3) with the presentation entitled ‘Field data from different climates for the validation of module performance models.’
- Transfer of IEA TASK 13 activities and reports towards other Swiss stakeholders from industry, research institutes or interest groups.
- Review of some of the technical reports.



### 3 Publications

IEA-PVPS T13-11:2018	<u>Photovoltaic Module Energy Yield Measurements Existing Approaches and Best Practice by Task 13, 2018</u>
IEA-PVPS T13-10:2018	<u>Review on IR and EL Imaging for PV Field Applications by Task 13, 2018</u>
IEA-PVPS T13-12:2018	<u>Uncertainties in PV System Yield Predictions and Assessments by Task 13, 2018</u>
SUPSI_PVSEC_2017	<u>G. Friesen: Recommended Practices for PV Module Outdoor Characterization and Power Rating, EUPVSEC 2017</u>