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Tools for Enhanced Photovoltaic System Performance

Results in Brief

New tools to make PV systems a more attractive option

An EU-funded consortium has developed a series of tools and models to make photovoltaic (PV) systems more reliable and cost effective and also improve their overall performance.



ENERGY



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The solar power industry has transformed its practices and technologies to increase the reliability of PV system components – notably, modules and inverters. The performance of solar power systems, however, depends on, but is not limited to, the operation of the installation's individual components. There are still further improvements that can be achieved on a system level in both the design and operation phases.

With EU funding, the project [PERFORMANCE PLUS](#)  (Tools for enhanced photovoltaic system performance) focused on such system-level improvements. Experts from five European countries joined efforts to develop new concepts and tools that should help increase the performance as well as lifetime of PV installations. A unique user group supported the project consortium with valuable input on the results.

The success of any solar energy installation depends largely on the availability of solar radiation data at a specific location. With this in mind, researchers successfully developed and validated new sensor prototypes called ESA at five different locations in Europe. The ESA sensor can measure both direct and indirect solar irradiation. Compared to conventional land-based stations, ESA offers an economical yet reliable solution for measuring solar irradiance levels.

A ground-based sky camera was used to analyse and forecast spatially and temporally highly variable surface solar irradiance. The consortium processed sky images to extract the cloud distribution and their motion as well as the resulting surface shadow and solar irradiance fields.

A new model-predictive control framework allowed control of the PV plant together with other systems on the site to ultimately optimise integration to the electricity grid.

Other important tools developed were a tool for on-site testing of PV modules and inverters, a web-based tool for financial optimisation of PV systems and a health scan system for fault recognition from operational PV system monitoring data.

The project team also published best practice guidelines for uncertainty in PV modelling and monitoring of grid-connected PV systems. The guidelines should help PV project developers and investors manage and assess financial risks. According to the team, a newly developed method combining satellite- and ground-based measurements can improve by up to 30 % output estimates that are subject to uncertainties due to variations in solar radiation and the performance of each component.

Consortium members had access to 25 PV systems distributed across Europe, ranging from small residential to large utility-scale PV systems, to demonstrate and validate the ability of models to improve existing designs and of tools to reliably detect faults. PERFORMANCE PLUS developments should help plant operators to improve the performance of PV systems over their entire lifetime.

Keywords

PV systems, photovoltaic, Tools for performance improvement, PERFORMANCE PLUS, solar irradiance, electricity grid integration

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Project Information

PERFORMANCE PLUS

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[Project website](#) 

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Project closed

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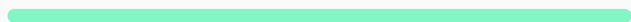
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