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Innovative Performance Monitoring System for Improved Reliability and Optimized Levelized Cost of Electricity

Project duration: from 04.2016 to 09.2019
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Summary

Photovoltaics (PV) is a fast-growing market, with an exhibited solar PV generation increase of 31% in 2018 and represented the largest absolute generation growth (+136 TWh) of all renewable technologies. In 2018, at least 103,2 GW of new PV capacity have been installed worldwide according to the International Energy Agency (IEA), and is on track to achieve under optimal conditions a global installed capacity of 1026 GW by the end of 2022. A key factor that will enable the further increase of the uptake of the technology is the reduction of PV electricity costs by increasing the lifetime output as highlighted by the Solar Europe Industry Initiative (SEII). This can be achieved by improving the reliability and service lifetime performance through constant, solid and traceable PV plant monitoring of installed systems, hence directly impacting positively investment cost, levelised cost of electricity (LCoE) and in general PV competitiveness. In this sense, a main challenge in the quest for ensuring quality of operation especially for grid-connected PV systems is to safeguard reliability and good performance by identifying and quantifying accurately the factors behind the various performance loss mechanisms through robust performance monitoring, fault detection and reactive maintenance. The importance of optimising PV system lifetime performance is evident by the increasing number of recent international initiatives devoted to advanced condition monitoring and reliability such as the International Energy Agency (IEA) Photovoltaic Power Systems Programme (PVPS) Task 13, the PV Performance Modelling Collaborative (PVPMC) facilitated by Sandia National Laboratories, the National Renewable Energy Laboratory (NREL) workforce on reliability, degradation and performance monitoring. Ensuring operational quality is also fully aligned with the main objectives of the SEII for quality assurance, long-term reliability, active monitoring and accurate energy forecasting.

It is with this background that project IPERMON has been initiated in order to primarily monitor and assess PV system performance, through the formulation of a procedural protocol (starting from sensor installation, data acquisition and filtering, to time series analysis) for the development of algorithms to quantify performance losses, detect failures and estimate degradation rate at an early stage. The developed algorithms were integrated as an innovative web-based monitoring platform with improved operations and maintenance (O&M) functionalities. The monitoring system acts as a high-level watchdog by ensuring reliability and operational quality of PV power plants and eventually yielding increased lifetime output. In this respect, the project assisted in providing a robust and accurate platform to detect losses, failures and estimate degradation at early stages and in real-time by leveraging data measurements, statistical tools and machine learning techniques. This is the first time such a system has been demonstrated with functionalities well beyond the current state-of-the-art. These types of tools are well anticipated in the fast growing PV market with continuously narrowing profit margins.

In addition, the advanced monitoring system can further act as the buffer between PV installations and the grid, contributing with the control algorithms to supportive functions for grid stability especially for the important task and requirement by many distribution/transmission system operators (DSO/TSO) for forecasting the day-ahead energy yield. Therefore, the proposed system is of interest to a large stakeholder target group ranging from policy makers, utilities, plant operators, engineering procurement construction (EPC) contractors and investors.

Finally, the project was based on a transnational collaboration between a leading industrial partner, Gantner Instruments (GI), that provided the platform for the development of the end-product and a research organisation, the University of Cyprus (UCY), with significant track record and award winning research work and innovations in the field. The skills, complementarity and balance of the consortium greatly assisted in materialising the objectives, thus contributing to the solar energy ambitions of the participating countries, as well as generating a commercial product that enhanced the competitiveness of the European industrial partner.

Project consortium

Coordinator and all contact details:

Full name of organisation	Gantner Instruments Test & Measurement GmbH
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Participating countries and financing:

Country	**Number of organisations involved**	**Project costs in EUR**	**Public funding in EUR**
Austria	1	300’000	180’000
Cyprus	1	100’000	100’000
Total	*2*	*400’000*	*280’000*

Funding agencies involved and contracts

Funding Agency	**Contract N° and Title**
FFG	853373, eCall: 6118666
Cyprus Research Promotion Foundation	KOINA/SOLAR-ERA.NET/1214/08 – IPERMON