PV-ANALYTIC
Advanced photovoltaic system monitoring and analytics solution enhanced with intelligent interoperable data-driven features for efficient big data real-time analysis, failure diagnosis, automated management and integrated micro-grid control

Project duration: from 11.2019 to 10.2022
Report submitted: 09.2023

Publishable Summary

A main challenge in the scope of ensuring high photovoltaic (PV) plant performance and fully flexible plant operations towards smart grid concepts, is to ensure reliability by increasing and safeguarding production through advanced, robust and cost-effective PV system monitoring that is enhanced with efficient automatic artificial intelligent (AI) data-driven functionalities. Along this context, the key battlegrounds of technical solutions that support high PV power plant performance and smart grid integration functionalities, are associated with the capabilities of intelligent data analytic methods that provide proactive and real-time energy loss diagnostics, automated reactive maintenance and integrated control functions.

The main goal of the project was to increase the value and competence of PV technologies by addressing issues associated with increased system efficiency and improved investment cost through optimal performance, operational quality, and lifetime reliability. For this purpose, it targeted the development of an advanced multi-service next-generation monitoring and control solution, enhanced with intelligent data analytic energy loss diagnostic algorithms and interoperability features for grid-connected PV systems. Specifically, innovative monitoring and control guidelines were formulated, in order to facilitate advanced reactive and predictive health-state data analytics leveraging machine learning, for next-generation PV power plants (Solar 3.0 concepts). Ultimately, the AI-driven algorithms were integrated to a cloud-based and edge computing Internet of Things (IoT) digital system which serves as an innovative multi-service interoperable health-state monitor and advanced PV power plant controller (PPC), project end-solution (TRL7).

The achieved results emanating from the completed project activities entailed the development of guidelines for optimized and automated reactive and proactive PV system maintenance, improvement of system interoperability, standardization and auto-configuration of PV plant components, formulation of energy loss predictive and diagnostic algorithms and the construction of PV power plant digital twin technologies.

The project is expected to have significant impact on the value chain of the technology given the reduction of PV electricity costs, by increasing the lifetime output, improving the operational efficiency and optimizing system operations. Targeting further enhancement of lifetime, quality and sustainability of PV is in-line with the primary objectives of the European Strategic Energy Technology Plan (SET Plan) for Operation and diagnosis of PV plants, and new communicative, automated and interactive developments such as Solar 3.0, energy IoT (eIoT) and Industry 4.0

concepts. This is the first time such a system is demonstrated with functionalities well beyond the current state-of-the-art, and is well anticipated in the fast-growing PV market with continuously narrowing profit margins. In this domain, the advanced monitoring system can further act as the buffer between PV power plants and the smart grid, contributing with the control algorithms to grid stability supportive functions especially for the requirement by many distribution/transmission system operators (DSO/TSO) for PV power plant flexibility with the utilization of smart inverters and battery storage systems (BSS). The end-solution is therefore of prime interest to a large stakeholder target group ranging from policy makers and utilities, plant operators, engineering procurement construction (EPC) contractors, module producers and investors.

Finally, the project was based on a bilateral collaboration (Austria – Gantner Instruments GmbH and Cyprus – University of Cyprus) that facilitated the materialization of its objectives, contributing to solar energy ambitions as well as generating an innovative commercial product that will enhance the competitiveness of their research and industries.

Project consortium

Coordinator and all contact details:

Full name of organisation	Gantner Instruments GmbH
First and family name of coordinator:	Jürgen Sutterlüti
Full address:	Montafoner Straße 4, 6780 Schruns, Austria
E-mail:	j.sutterlueti@gantner-instruments.com

Participating countries and financing:

Country	**Number of organisations involved**	**Project costs in EUR**	**Public funding in EUR**
Austria	1	306 400	150 000
Cyprus	1	159 622	159 622
	2	*466 022*	*309 622*

Funding agencies involved and contracts

Funding Agency	**Contract N° and Title**
Austrian Research Promotion Agency (FFG)	873782, eCall: 24771531
Cyprus Research Promotion Foundation (RPF)	P2P/SOLAR/0818/0012 – PV-ANALYTIC