

AI4PV’s ultimate goal is to increase the operational performance of PV plants through the development of Digital Twins combined with Data Analytics of plant signals

AI4PV a boost towards decarbonisation

The Paris Agreement have defined the necessary targets to limit the global warming to 1,5° with a massive contribution by renewable energy. Despite a decrease of around 90% of the solar panels cost the last 10 years and an exponential increase in PV installation, the global solar capacity that is required to reach COP21 goals is 4,500 GW above forecast by 2025.

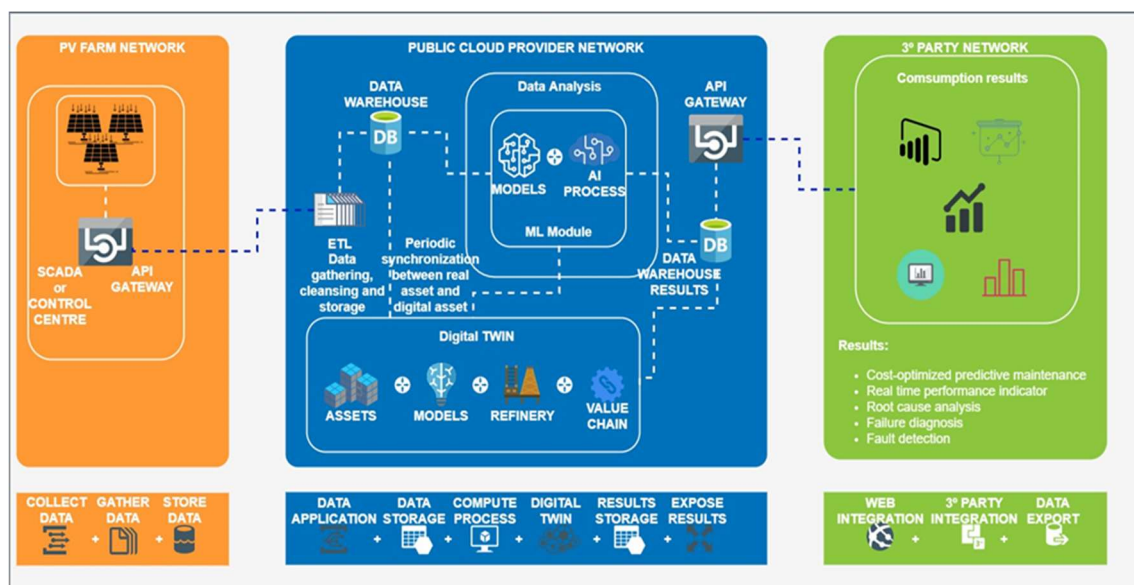
The panels efficiency has reached 21%, which is still reduced comparing with other energy sources. Finally, PV faces variability, by the daily cycles, but also because of clouds. To face these challenges the industry has been working to improve the overall performance of PV systems, but unsolved challenges remain concerning the reliability and numerous unforeseen outages and high operation and maintenance (O&M) costs, hindering a lean integration in the electrical grid.

In this context, the main goals of the AI4PV project are to increase the operational performance of PV plants. The expected result is a set of tools for PV plant O&M and Asset Managers to:

- Increase operational reliability and efficiency: high precision of early detection of failures and diagnosis.
- Improve economic performance: downtime reduction and detecting performance problems that can affect energy production.

To achieve these objectives, AI4PV will combine AI-based algorithms and physical modelling of components to build digital assets of the PV power plant, using different technologies such as: unsupervised learning (e.g., with neural networks), modelling and simulation with Monte Carlo, contextual bandit for predictive maintenance, data collection and interoperability.

An integrated platform for fault detection and diagnosis



AI₄PV solutions make up three modules:

- Descriptive analytics-module: PV plant Digital Twin (DT) for fault and failure detection and diagnosis.
- Prescriptive analytics module for O&M: PV plant data analytics for fault and failure detection and diagnosis.
- Cost-optimised predictive maintenance module: PV plant O&M recommendation system.

The **first module** concerns the study of a **DT tool for early fault and failure detection and diagnosis of PV plants components** (PV panels, Inverters, power transformers). Based on electrical data and meteorological data, a DT system will help the supervisor of the plant to detect the most common problems that may happen in solar parks.

The **second module** concerns the study of **Artificial Intelligence (AI), Machine Learning (ML) solutions for early fault detection, and the diagnosis of PV plants**. Based on historical data, AI-ML algorithms will complement DT in the detection of faults and failures in PV farms.

The **third module** envisions the development of a **recommendation system to support the O&M team of PV plants**. The combination of DT and AI is key for the root cause analysis and for the punctual identification of abnormal conditions in the PV park. Based on Root Cause analysis, a recommendation engine based on Reinforcement Learning will **recommend the best intervention to the O&M teams, that leads to the highest Return on Investment**.

Meet our consortium

EDP NEW



EDP NEW is a subsidiary of the EDP Group with the mission to create value through collaborative R&D in the energy sector. EDP NEW is the coordinator of the project, and will also lead the validation activities, providing both test sites and datasets from existing PV farms for the validation of the AI₄PV solutions.

INESC TEC



INESC TEC is an Associate Laboratory with 35 years of experience in R&D and technology transfer. In AI₄PV, it contributes with the development of root-cause analysis and intelligent maintenance strategies for PV plants.

ISOTROL



Isotrol is an ICT company specialized on services and solutions for utility-scale renewable energy generation, with over 37 years' experience. In AI₄PV Isotrol will lead the conceptual definition of the project as well as the design, implementation and validation of the Digital Twin of photovoltaic plants

AI4PV in a nutshell

Subject	Duration
Development of AI tools to enhance O&M of PV farms	24 Months (July 2021-June 2023)
Budget	Funding
813 k€	ERDF
Leader	Partnership
EDP NEW	3 EU partners – 2 Countries

