Mapping the Relevance of Digitalization for Photovoltaics

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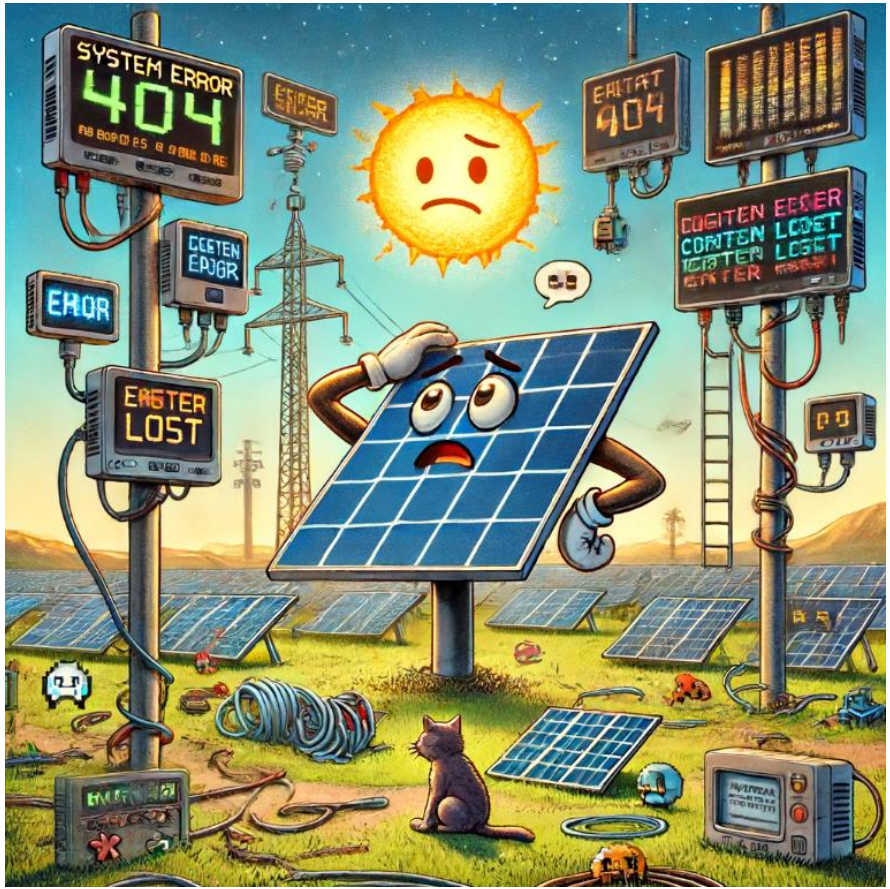


Intersolar Conference 2024

Utility-scale Solar Power II:
Digitalization in PV Power Plants

Enhancing O&M through Digital Twinning,
Data and Process Integration

Tuesday 18 June 2024, Munich

Jonathan Leloux, LuciSun, Belgium

IEA PVPS

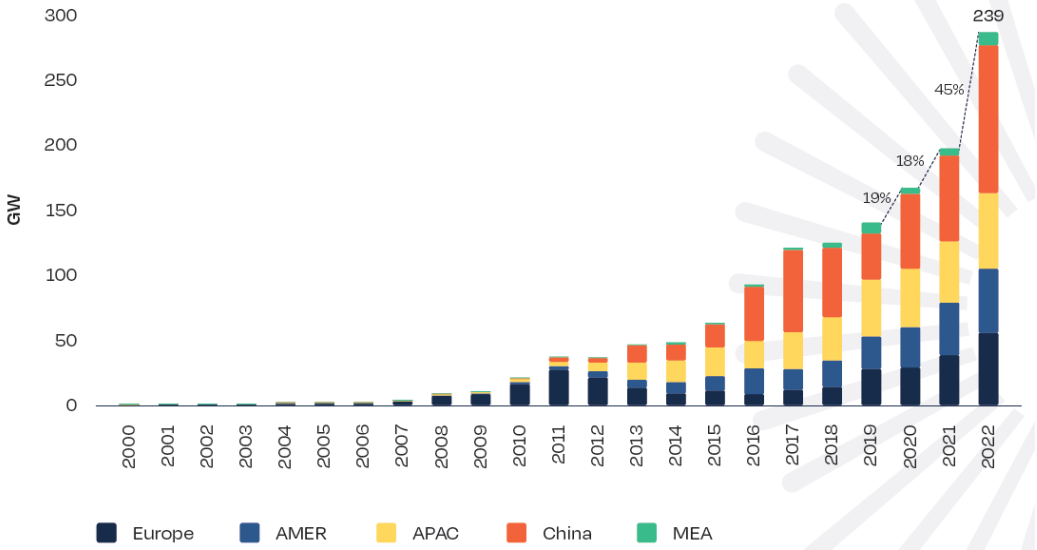
COPLASIMON

SERENDIPV

LUCI SUN
Casting a new light on solar energy

Rapid growth of PV, expert scarcity and product lag necessitate adapted services

FIGURE 6 ANNUAL SOLAR PV INSTALLED CAPACITY 2000-2022



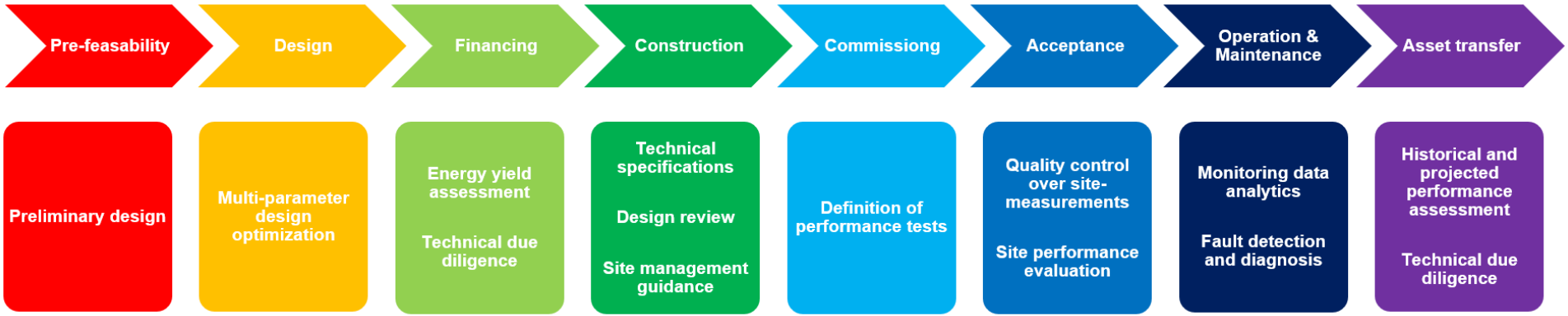
Source: SolarPower Europe

PV Sector Challenges

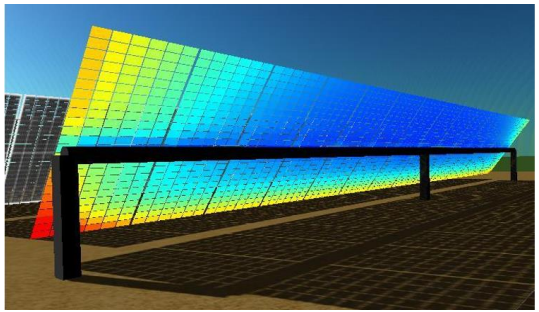
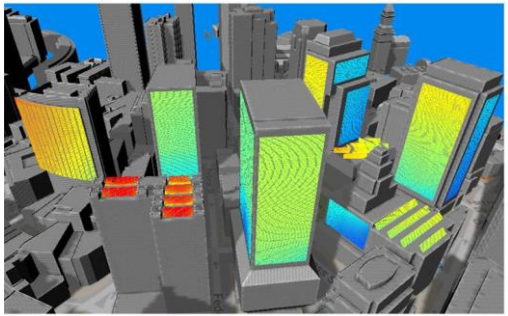
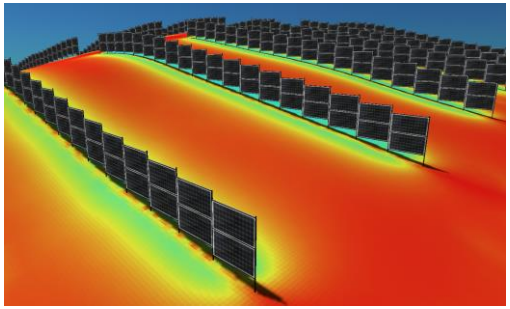
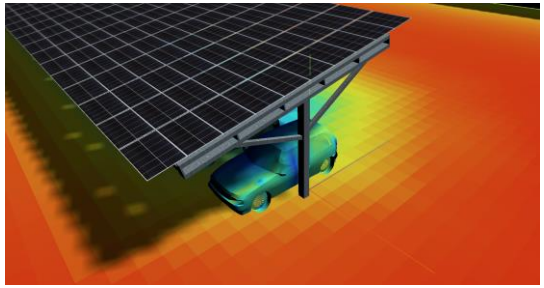
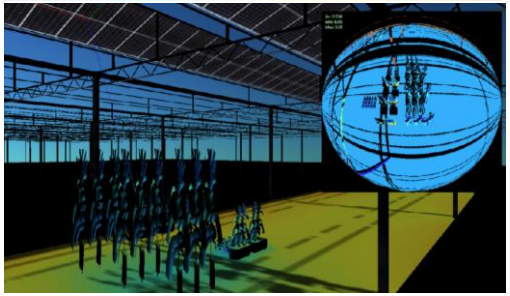
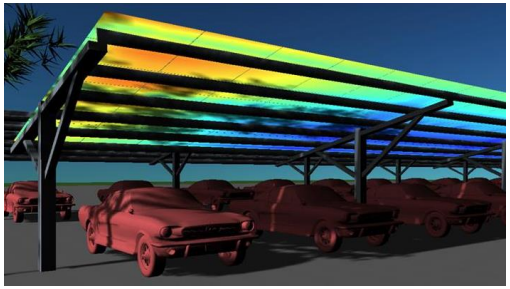
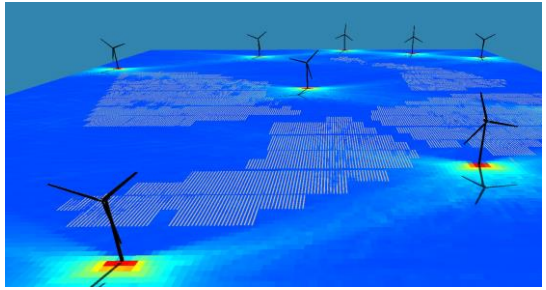
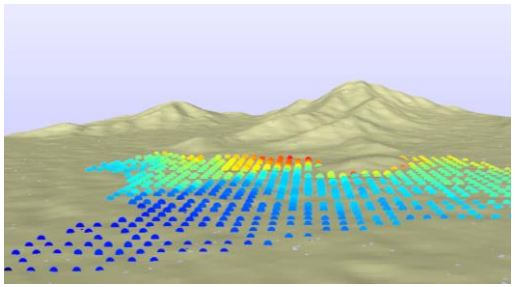
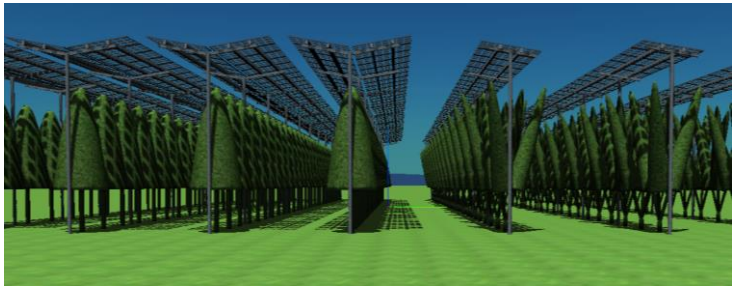
- Products and technical services are not keeping up with the pace of technological evolution
- The growth rate of projects is too fast for too few experts
- Need for adapted products and technical services to support growth

LuciSun: Pioneering End-to-End Solutions for All Phases of Solar Energy Projects

- **LuSim** Advanced simulation tools for solar energy projects
- **Lunalytics** Data analytics for performance analysis and fault detection
- **LuConsult** Expert consulting services / Technical Advisory
- **LuData** Datahub for solar resource and weather data
- **LuLab** Research, Development and Innovation

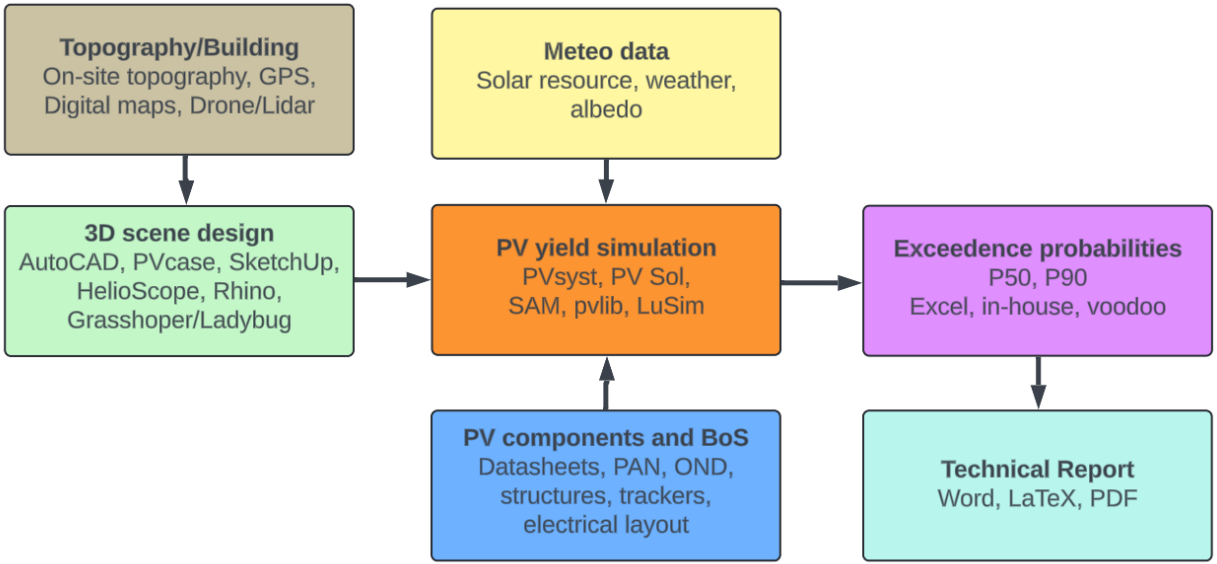


Life at LuciSun: Getting involved in complex projects that badly need digitalization

Some real projects carried out by LuciSun, using LuSim or Lunalytics

PV digitalization in the PV simulation chain: still lots of room for improvement



Current situation: Multiple steps involving different formats, frequent handoffs between users, leading to information loss and unreliability.

Current PV simulations are a bit like assembling IKEA furniture: lots of pieces, poor instructions, and someone always ends up with a leftover screw. Integrated digital platforms can help streamline the process.

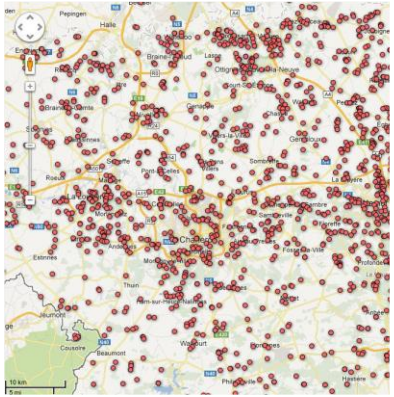
Digitalizing PV Data: Some Honorable Mentions

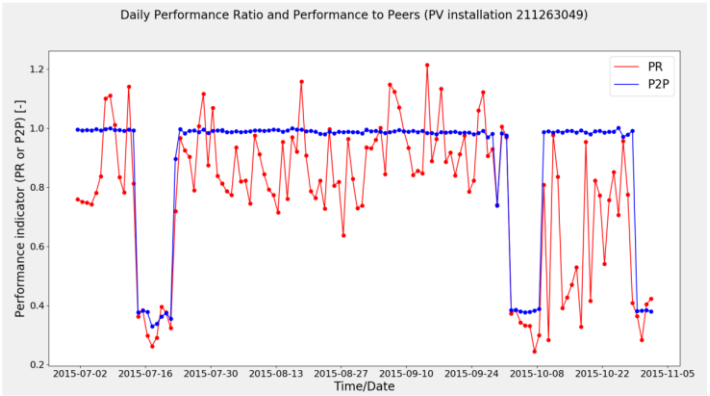
PVsyst
First to digitalize
PV modules and inverter data with PAN and OND files.
Using super modern text files.
Still practical today.

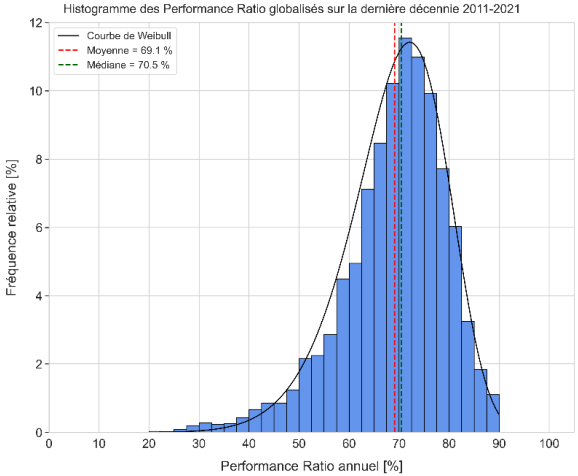
Solargis Evaluate 2.0
New proposal for PV database with quality checks,
launching at Intersolar.

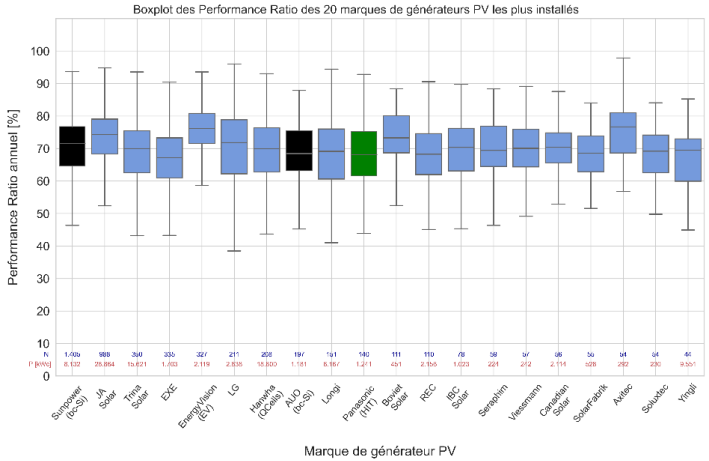
PVcase
Disrupting PV design by integrating more steps into their platform.

PV digitalization in data analytics: some examples from Belgium









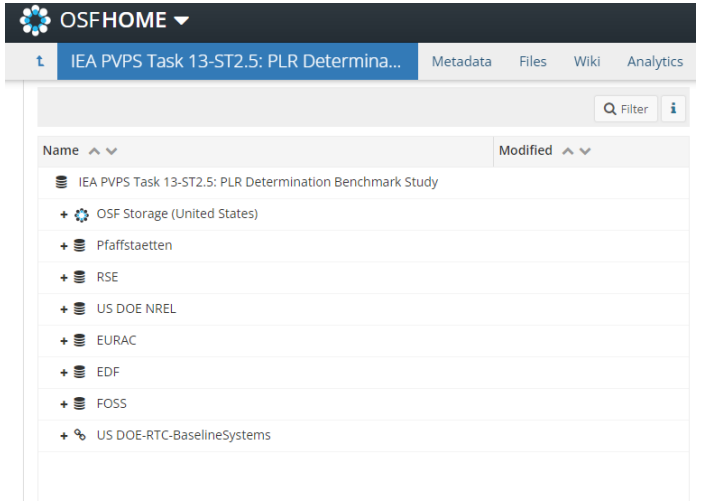
Sources:

- Leloux et al., 2020, Performance to Peers (P2P), Solar Energy, Elsevier
- Brugel, 2021, Étude du Parc Photovoltaïque en Région de Bruxelles-Capitale (11,000 PV systems)

PV digitalization in PV performance data: lots of talk, and some nice initiatives

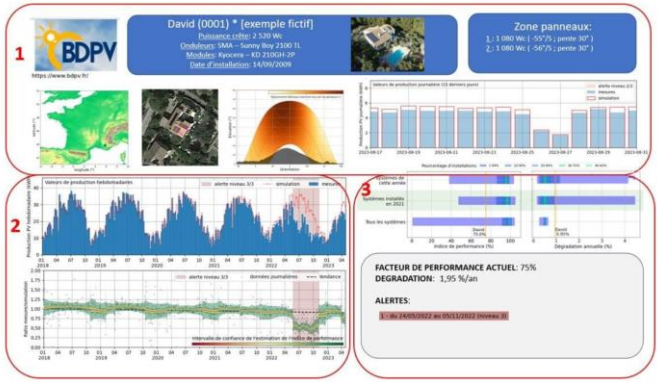
Need for more PV performance data:

- Better knowledge of real PV field performance
- Feedback loop in PV simulation.
- Improved reliability, bankability, data-driven decision-making.
- Studies assessing PV fleet field performance still too few.
- Publications in scientific papers without data access.
- USA more advanced in PV performance data sharing.

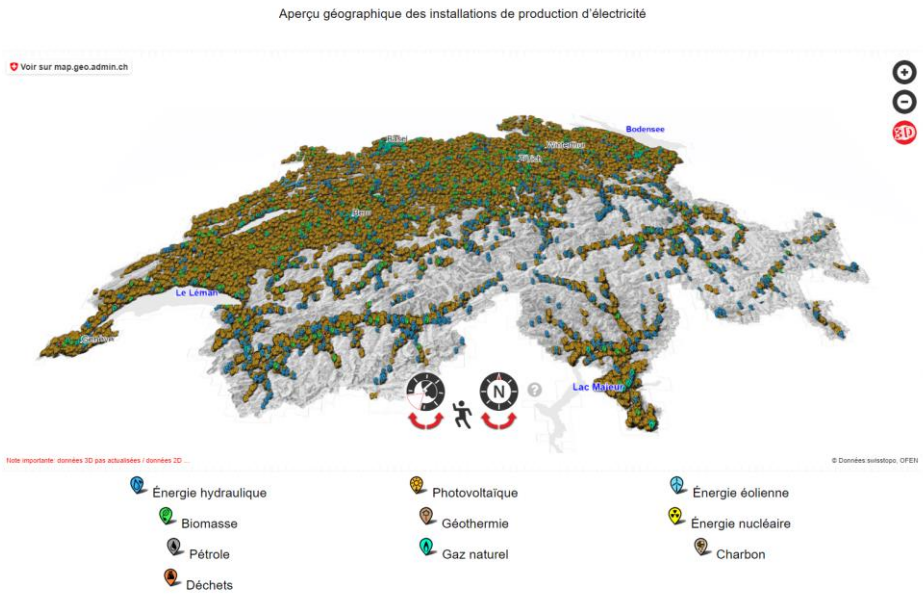


Some very interesting public data sharing initiatives:

- IEA PVPS Task 13-ST2.5: PLR Determination Benchmark
- BDPV: Database with 15k+ PV systems, 10+ years data, France
- COPLASIMON, Europe, Sharing of data and analytics
- Observatório Fotovoltaico, PV metadata, Portugal
- PV fleet performance data initiative, NREL, USA
- DOE, USA, Solar Data Bounty Prize



PV digitalization is an enabler for smarter grids and energy communities



Power production units, Switzerland.
Source: Swiss Federal Office of Energy, Swisstopo.

Definition of Renewable Energy Communities.
Source: Compile Project, EC.

Digitalization optimizes energy communities by leveraging data from smart meters, distributed generation, storage systems, EV charging, DSOs, and weather data.

Smart meters are like the Fitbits for solar panels. They track energy production, storage, and consumption.

PV Digital Twins: Enhancing and accelerating professional training

- Interact with a virtual PV system to learn component functions and maintenance tasks.
- Analyze real-time data from the digital twin to understand performance and typical issues.
- Collaborate within the digital twin environment to foster teamwork.
- Simulate harmful situations without causing real damage or safety issues.
- Teach about the entire lifecycle of PV systems.

Digital twins: the virtual reality versions of solar farms. Like a video game where you get to save the planet, one solar panel at a time!

PV digitalization: Some concluding remarks

PV Digitalization

Increased PV performance,

Better transparency

Improved reliability

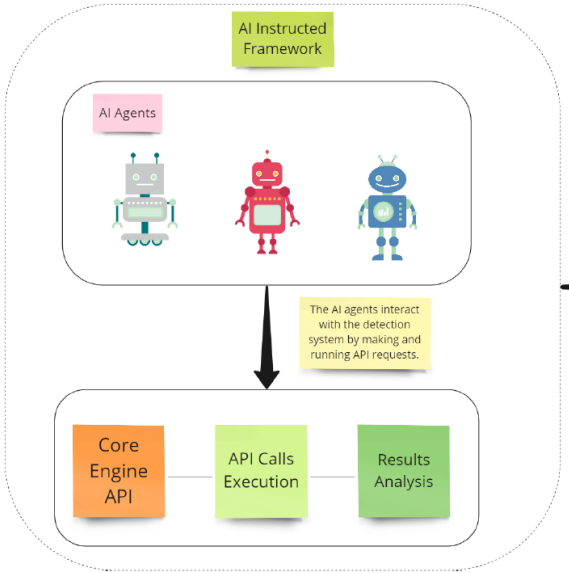
More effective processes

Lower costs

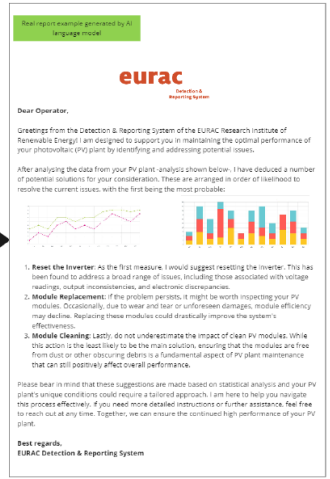
Higher trust and better bankability

Better grid integration

Higher PV grid penetration
More sustainable PV growth
Lower WACC
Lower LCOE



After analyzing and deciphering the results from the framework, the AI agents produce reports, simplifying comprehension for the operators.



courtesy of Mousa Sondoqah, Eurac Research

Use of **Artificial Intelligence (AI)** to complete human expert knowledge through pattern recognition, help automatize and accelerate PV performance diagnosis, PV performance reports.
Source: EURAC Research

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