1C4PV

Miguel Angel Delgado Molina

Isotrol

3 Isaac Newton Street, Seville (Spain) / madelgado@isotrol.com

isotrol

FOSS
Research Centre for
Sustainable Energy

Tegnatia
EPC SOLUTIONS

Index

1. Company profile

2. Project
   - Consortium
   - Main results
   - Takeaways

Company profile

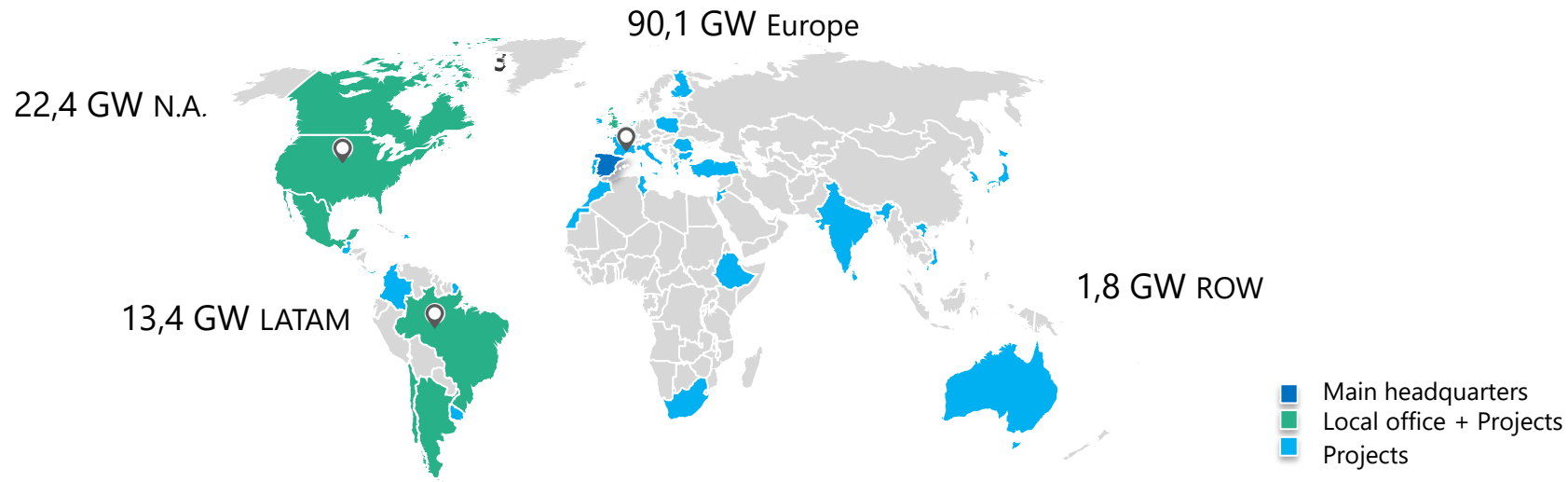**Covering the World with our Solutions**   +120 GW and outstanding references in +40 countries

Renewable generation   Monitoring, control & advanced performance management of renewable assets

Energy Trading   Solutions to optimize energy management in wholesale markets

90,1 GW Europe

22,4 GW N.A.

1,8 GW ROW

13,4 GW LATAM

■ Main headquarters
■ Local office + Projects
■ Projects

Consortium

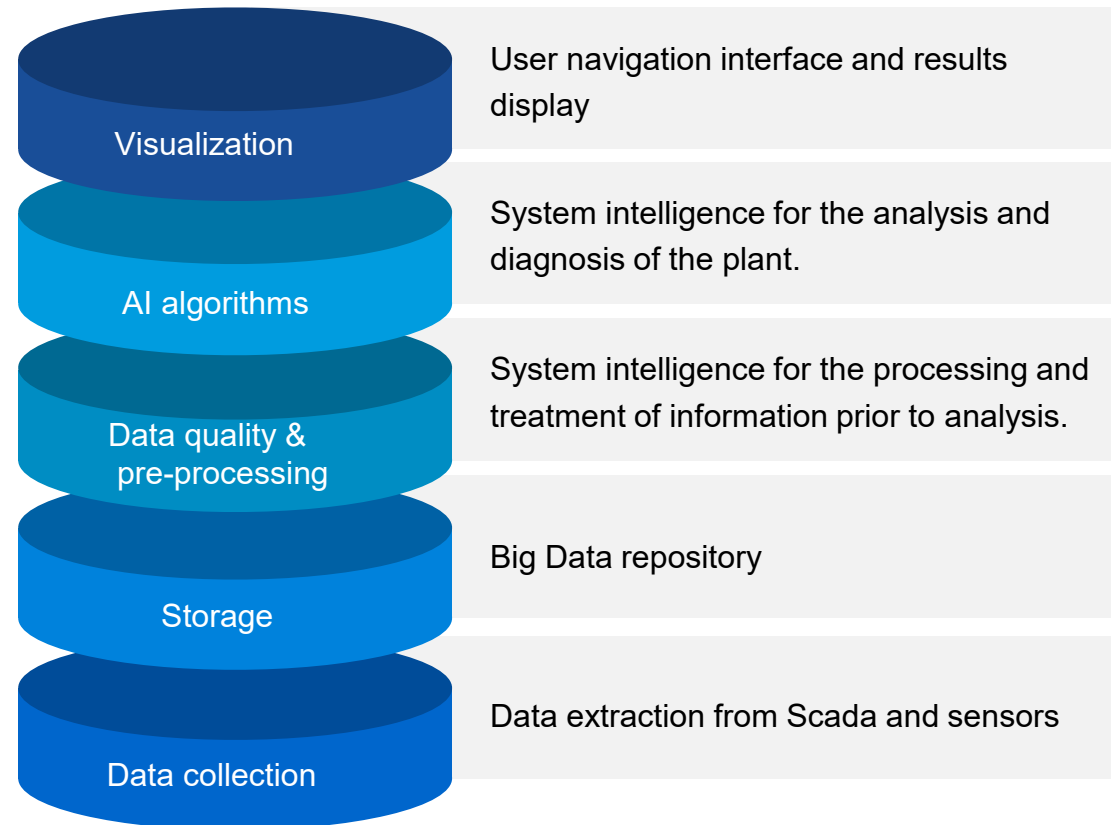| Partner	Main business	Challenges
ISOTROL	Monitoring and control systems for renewable assets	Big Data management, monitoring and control systems as well as development of algorithms for performance problems detection in renewable assets.
TEGNATIA	O&M services	Improvement of O&M policies and validation of the Decission Support System (DSS).
FOSS	University, technological centre	Detection and classification of failures, using its outdoor facilities for validation of algorithms under controlled conditions and participation in the final integration of the solution.

Main results: Workflow

Modular infrastructure

A set of different steps are provided for transforming data in insights

Visualization	User navigation interface and results display
AI algorithms	System intelligence for the analysis and diagnosis of the plant.
Data quality & pre-processing	System intelligence for the processing and treatment of information prior to analysis.
Storage	Big Data repository
Data collection	Data extraction from Scada and sensors

isotrol   FOSS Research Centre for Sustainable Energy   Tegnatia EPC SOLUTIONS

1C4PV

Main results: Detection of faults

3. Out-of-normality

Pattern & Outliers analysis for predictive maintenance
Alarm analysis
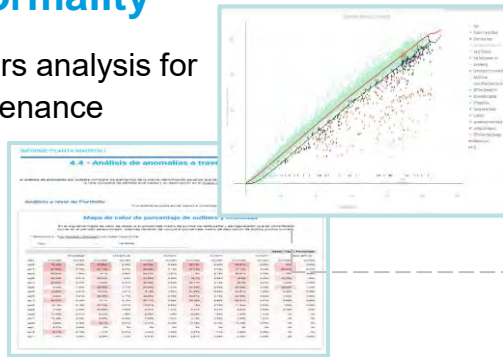
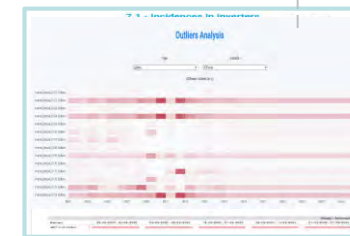### 4. Performance and energy losses

Energy losses breakdown
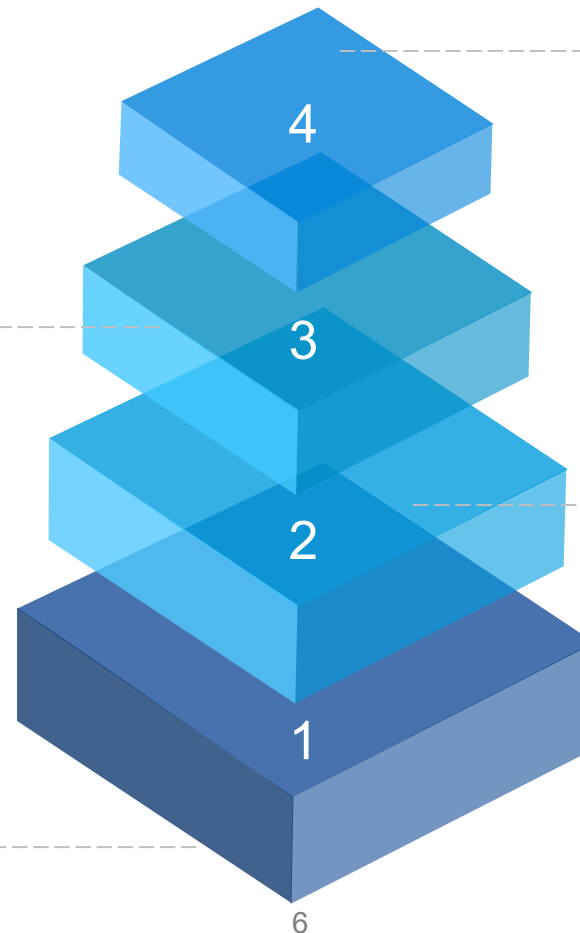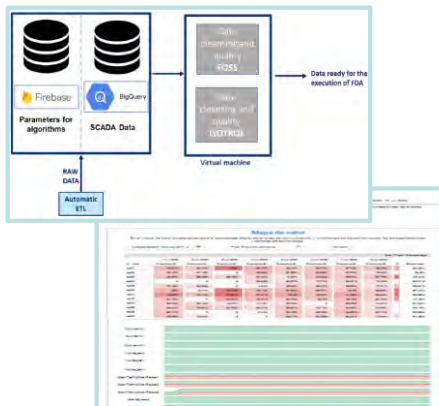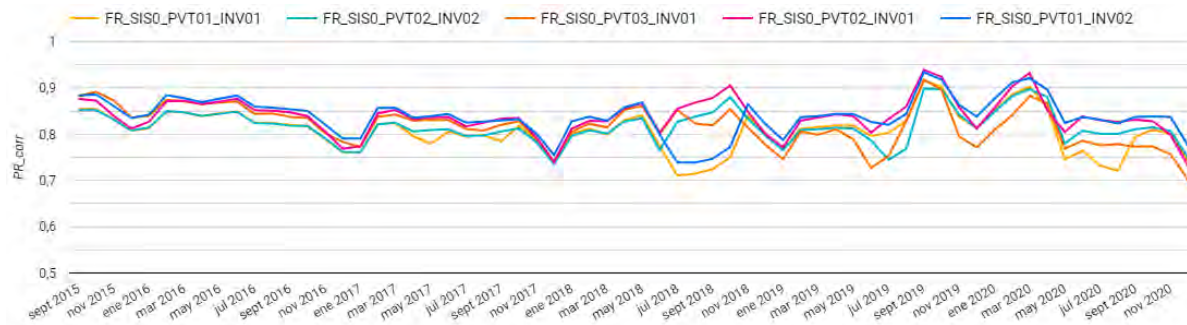Plant status dashboard
Recommendation engine

1. Data quality

Data quality analysis
Faulty sensor analysis
Data reconstruction

2. Inverter & Solar Field incidents

Incident and underperformance detection

4

3

2

1

6

isotrol   FOSS Research Centre for Sustainable Energy   Tegnatia EPC SOLUTIONS
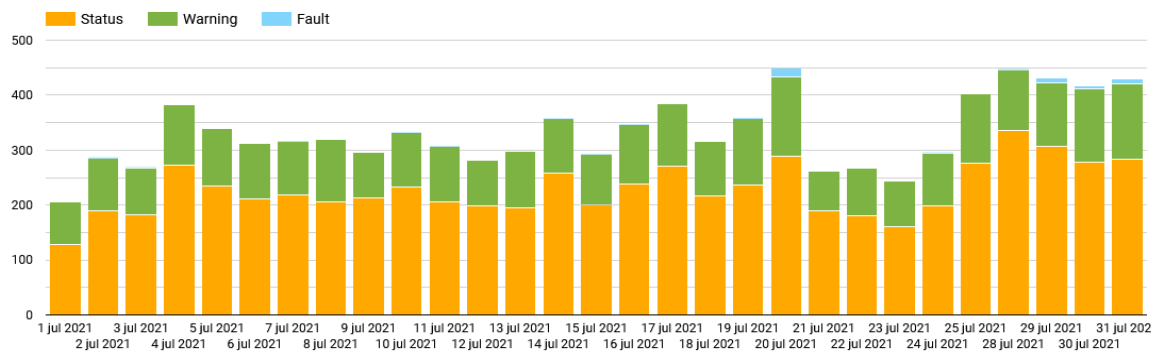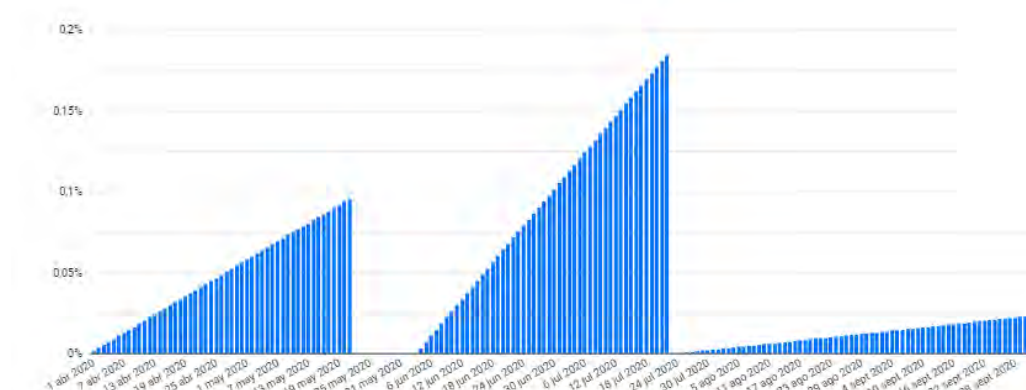
1C4PV

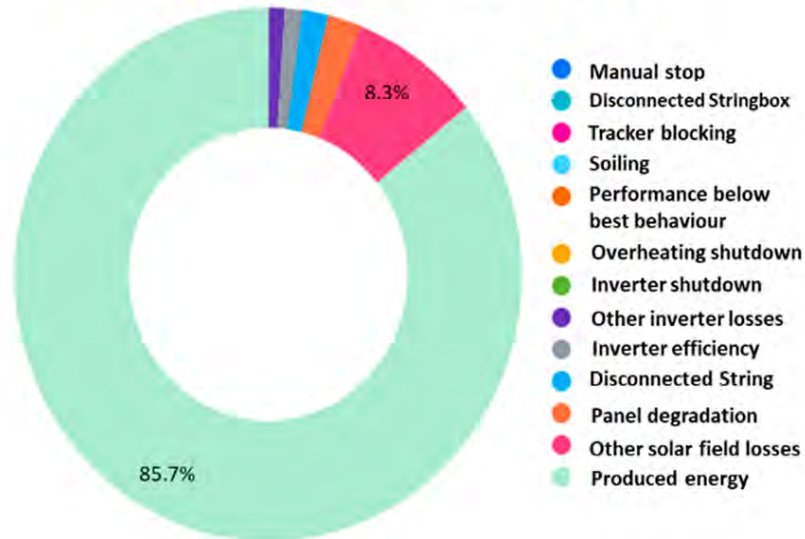# Main results: Detection of faults

Monitorization of KPIs
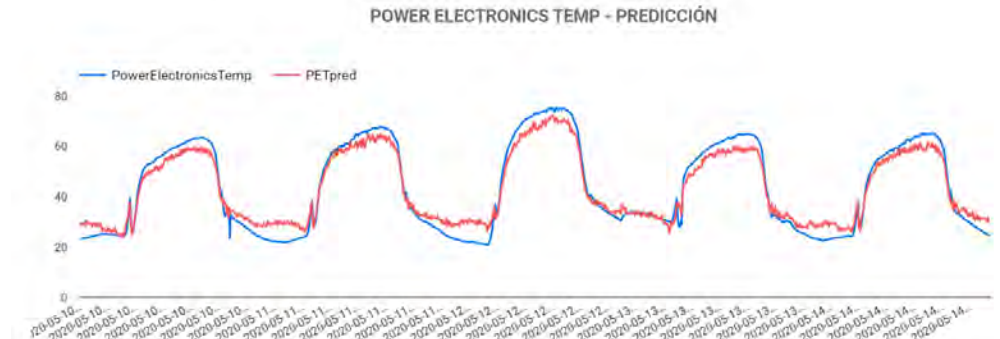
Signals prediction

Alarms evaluation

Losses calculation

Main results: State of the plant & energy losses

Group	Location	Type of losses	Losses (MWh)	Percentage
Total theoretical energy			14,686	100%
Produced Energy			12,586	85.70%
Nominal losses	Inverter	Inverter efficiency	167	1.14%
	Solar field	Panel degradation	313	2.13%
Underperformance losses	Inverter	Other performance inverter	147	1.00%
	Solar field	Performance below best behaviour	0.4	0%
		Other performance solar field	1226	8.34%
Incidences	Inverter	Shutdowns	6.5	0.05%
		Manual stop	0	0%
		Overheating	0.5	0%
	Solar field	Stringbox disconnections	0	0%
		String disconnections	238	1.62%
		Soiling	0	0%
		Tracker blocking	0	0%

Energy balance of the plant

Main results: Recommendations engine

Inverter	Subsystem	Incident detected	Start date	End date	Days	Recognized	Solved	Criticality
E	Strings	Check subsystem Strings due to String Shutdown in Stringbox E_CB6 (WARNING)	3 Apr 2021	20 May 2021	43	No	No	
D	Strings	Check subsystem Strings due to String Shutdown in Stringbox D_CB2 (WARNING)	6 Jul 2021	19 Aug 2021	43	No	No	
I	Strings	Check subsystem Strings due to String Shutdown in Stringbox I_CB4 (WARNING)	3 Apr 2021	16 May 2021	38	No	No	
F	Strings	Check subsystem Strings due to String Shutdown in Stringbox F_CB2 (WARNING)	9 Jul 2021	20 Aug 2021	38	No	No	
J	Strings	Check subsystem Strings due to String Shutdown in Stringbox J_CB1 (WARNING)	1 Jan 2021	31 Jan 2021	30	No	No	
G	Strings	Check subsystem Strings due to String Shutdown in Stringbox G_CB5 (WARNING)	31 Oct 2021	29 Nov 2021	25	No	No	
D	Strings	Check subsystem Strings due to String Shutdown in Stringbox D_CB4 (WARNING)	30 Aug 2021	27 Sep 2021	25	No	No	
E	Strings	Check subsystem Strings due to String Shutdown in Stringbox E_CB6 (WARNING)	26 Feb 2021	24 Mar 2021	21	No	No	
H	Global	Check Inverter due to deterioration between 2.3% and 3%	5 May 2021	5 Jul 2021	40	No	No	
K	Strings	Check subsystem Strings due to String Shutdown in Stringbox K_CB4 (WARNING)	6 Mar 2021	24 Mar 2021	16	No	No	
K	Strings	Check subsystem Strings due to String Shutdown in Stringbox K_CB1 (WARNING)	2 Jan 2021	18 Jan 2021	11	No	No	
J	Strings	Check subsystem Strings due to String Shutdown in Stringbox J_CB3 (WARNING)	14 Sep 2021	27 Sep 2021	12	No	No	
J	Inverter	Check subsystem Inverter due to Inverter Shutdown (WARNING)	29 Jul 2021	5 Aug 2021	4	No	No	

Recommendations orderer by criticality

Takeaways

1. Automatization of problem detection processes in solar farms
- ➤ **Inverters**
- ➤ **Solar field**
- ➤ **Trackers**

2. Real need in the market for Performance Diagnosis tools
- ➤ **Size**
- ➤ **Portfolio**

3. Platform for AM and O&M teams
- ➤ **7% of cost reduction**

References

Livera, A.; Tziolis, G.; Franquelo, J.G.; Bernal, R.G.; Georghiou, G.E. Cloud-Based Platform for Photovoltaic Assets Diagnosis and Maintenance. *Energies* **2022**, *15*, 7760. https://doi.org/10.3390/en15207760