PEARL PV

Data analytics applied to monitoring and field data for performance optimization in large PV plants

Pearl PV Workshop

Rodrigo Moretón

12-January

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A Red Queen Race for PV

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General context

- Very low energy prices (~ €15/MWh)
- Increasing stress in CAPEX, OPEX and WACC.
- Financial scenarios with increasingly longer periods (25-30 years).
- **Performance and O&M optimization** become critical to ensure projects' profitability.

Year	Project duration (years)	OP/CAP Ratio (%)	
2014	20	30	*(IRENA, 2014)*
2019	25-30	45-55	*(Vartianen et al., 2019)*

A particular challenge in PV operation

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PV operation needs to…

- Optimize performance with decreasing budgets and less staff available
- Manage large and geographically dispersed portfolios
- Deal with huge amount of monitoring data
- Integrate new techniques: cleaning, measurement campaigns, market integration…

¿How to assure optimized performance?

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Apply advanced data analytics to field data **and** to monitoring data to…

a. Automate performance analysis and anticipate operational failures
b. Optimize interventions and remote operation
c. Facilitate decision making

Achieving…

- Reduction and better management of operational risks
- Increase asset quality, transparency and predictability
- Feed back for improving future projects

A gap to fill

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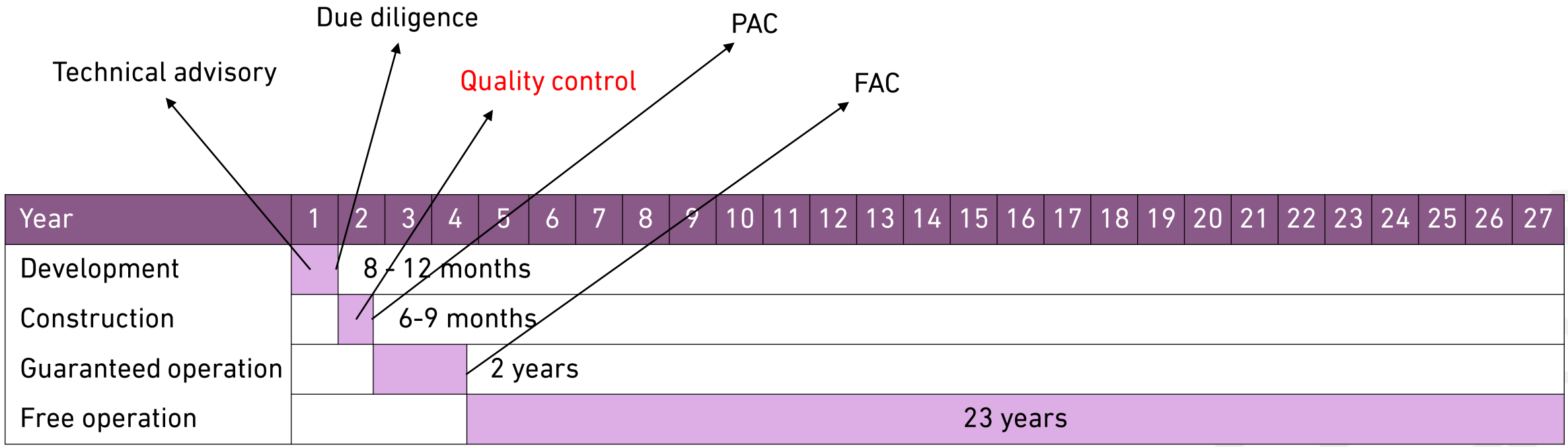
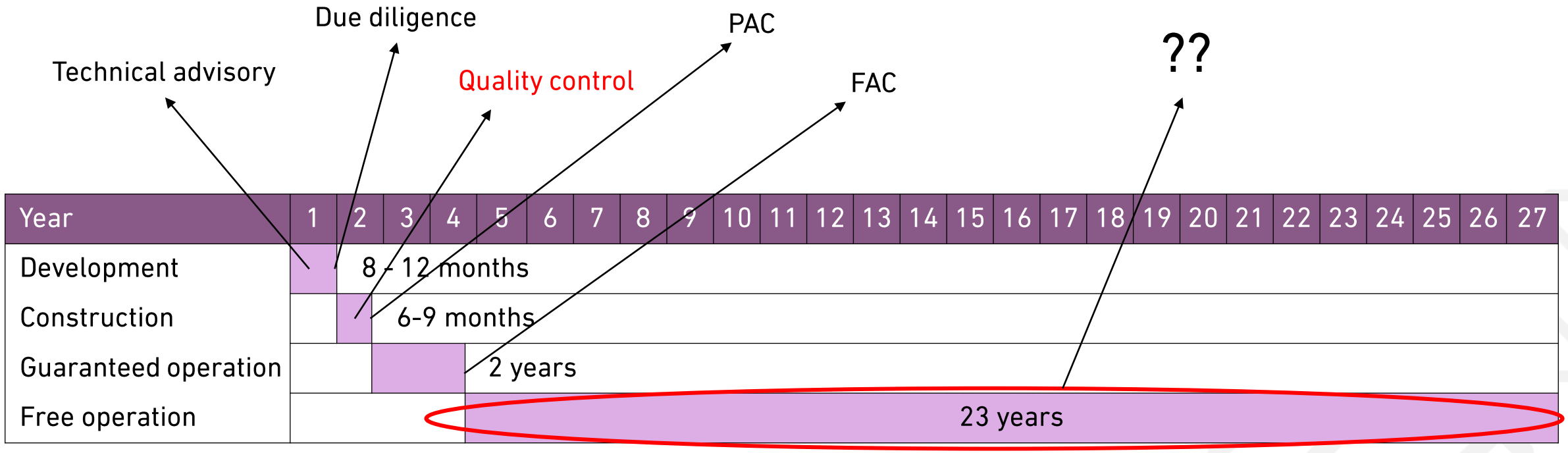
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Development		8 - 12 months																									
Construction			6-9 months																								
Guaranteed operation				2 years																							
Free operation					23 years																						

A gap to fill


Technical advisory
Due diligence
Quality control
PAC
FAC
Year
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Development
8 - 12 months
Construction
6-9 months
Guaranteed operation
2 years
Free operation
23 years

A gap to fill


Technical advisory
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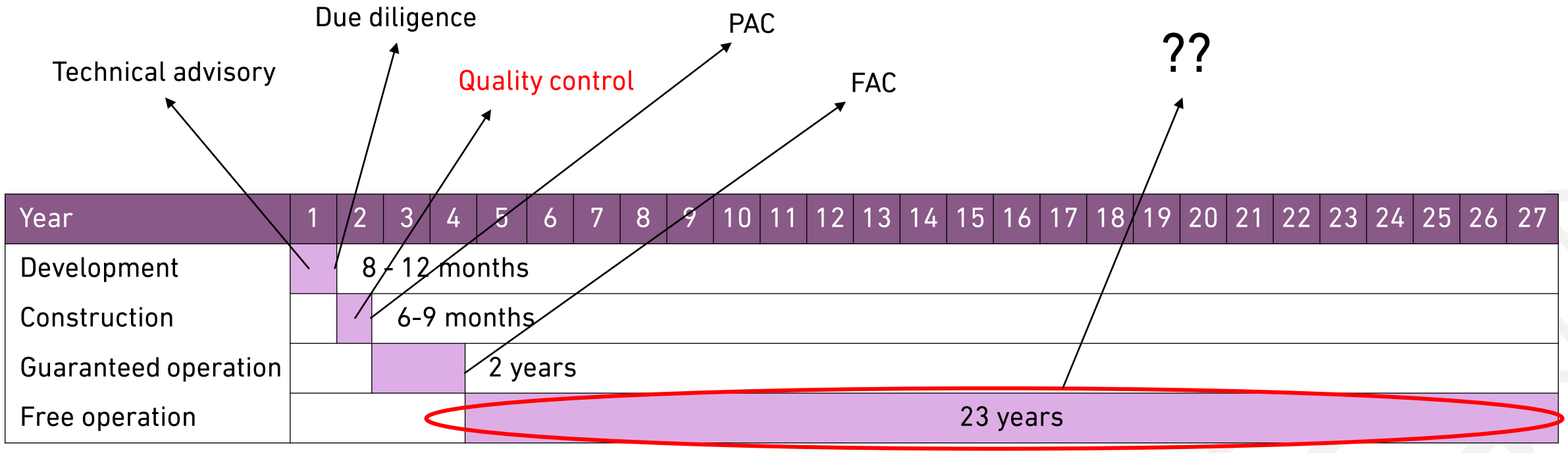
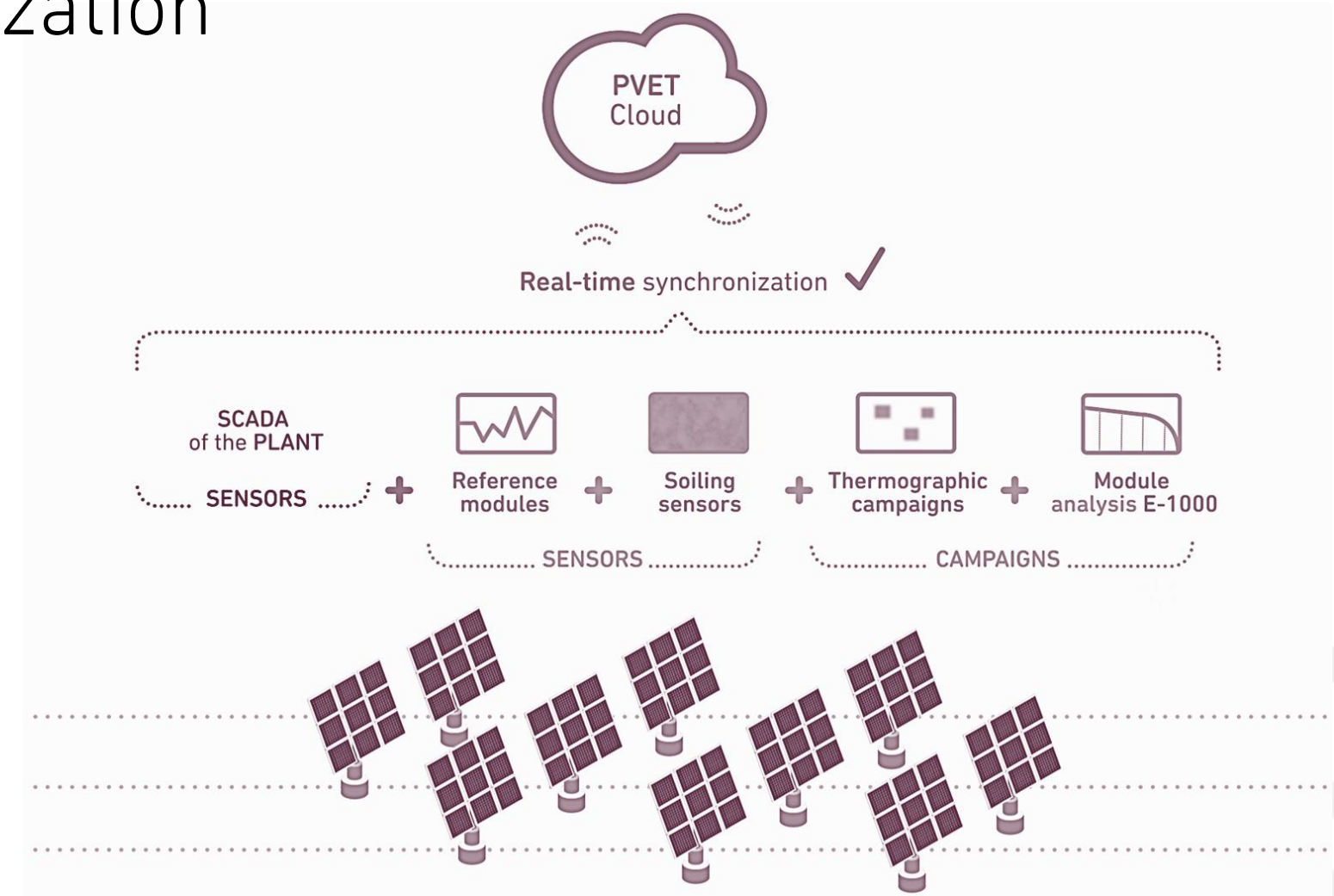
A gap to fill



- Field measurements with low uncertainty
- Extend quality control procedures along the operational phase
- Increase feedback between phases

Sensorization



- ✓ Installing low uncertainty sensors is worth it
- ✓ Detailed monitoring by sampling allows optimizing costs

QC of PV modules

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WHAT	HOW	WHEN
Power claims	Massive I-V testing in the field Low uncertainty (<2.5%) High testing rates (+1k modules/day)	Commissioning
Degradation	First measurement with very low uncertainty (0.1% - 0.2%)	Commissioning
Optimizing O&M	Integration of testing campaigns with monitoring information	Operation
Feedback for estimations	Power rating Temperature coefficients	Commissioning

QC of PV modules

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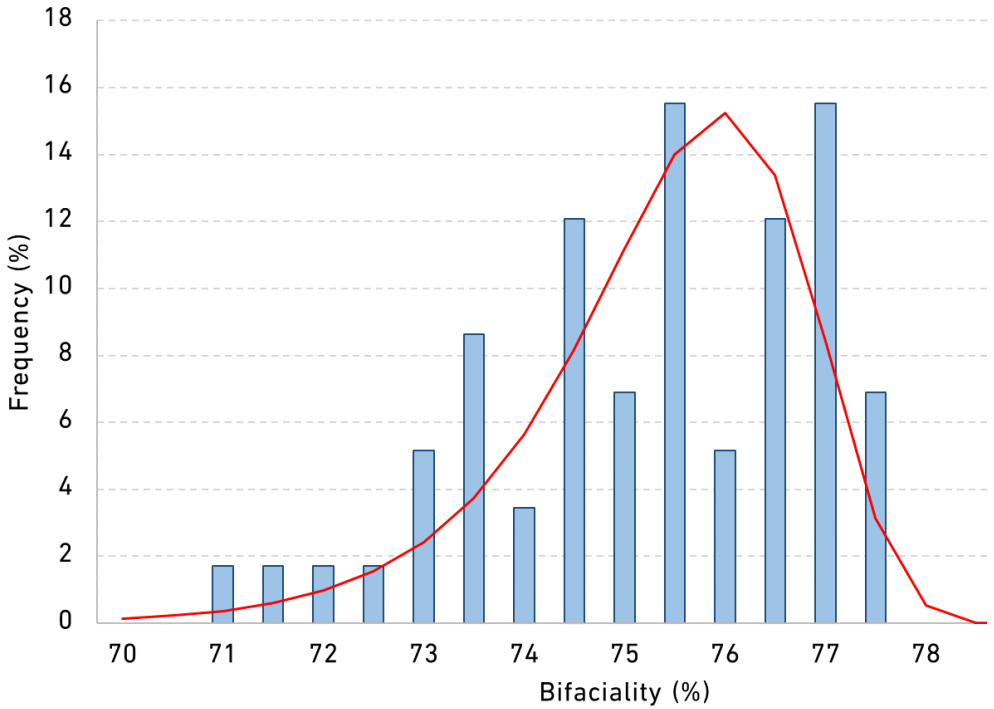
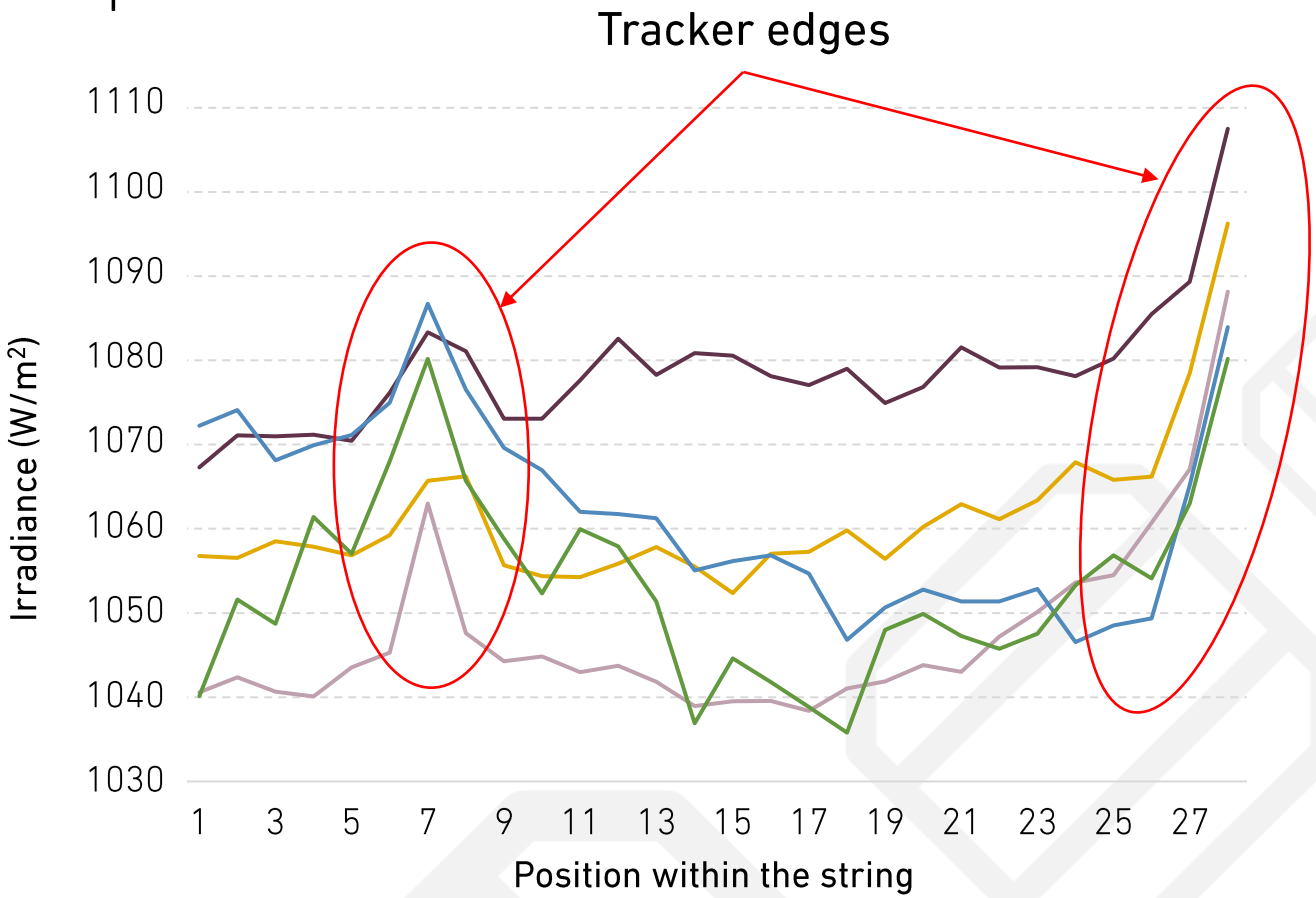
Bifacial: data analytics become more important



Bifaciality sample: 82 modules



Irradiance non-homogeneity

QC of PV inverters

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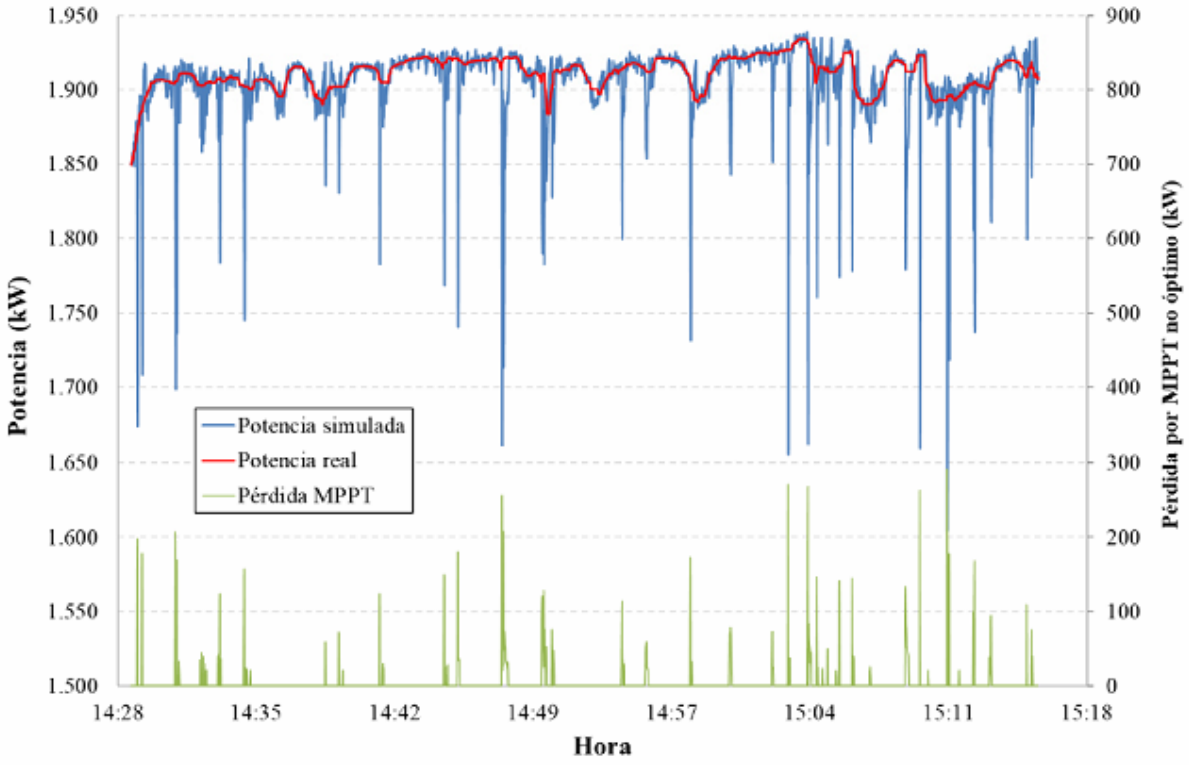
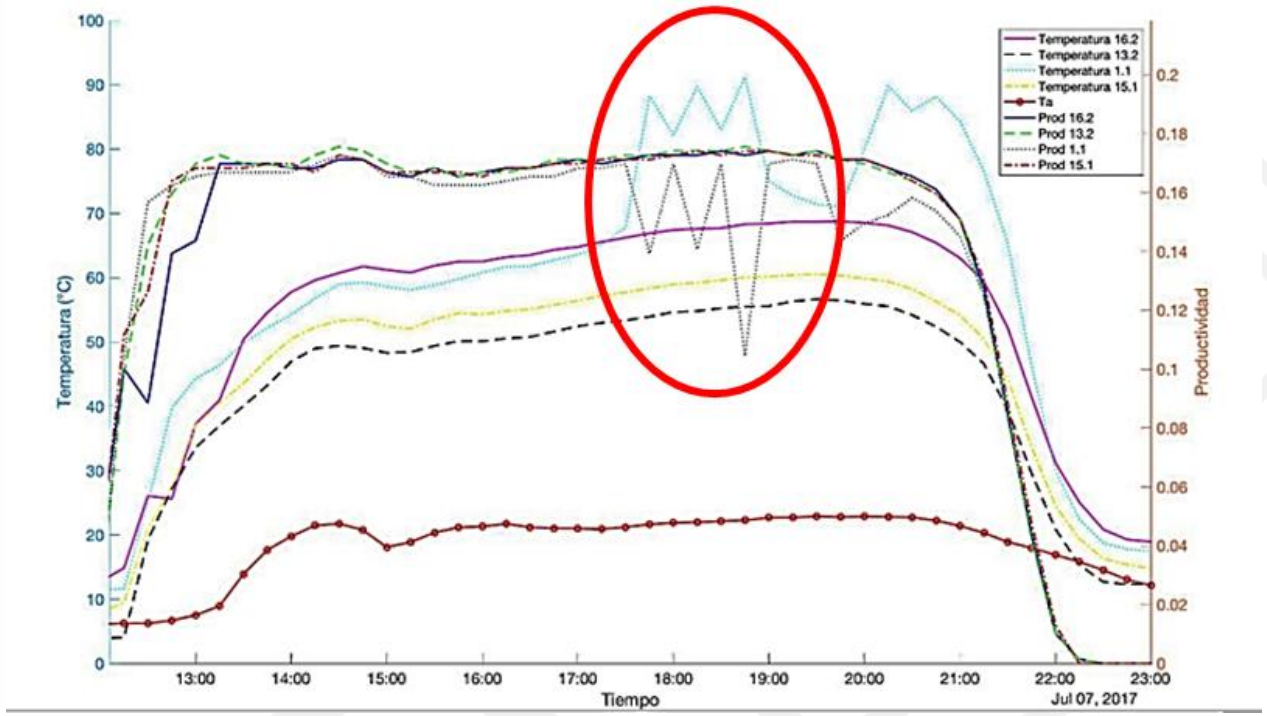
WHAT	HOW	WHEN
Asses real performance	**Measure efficiency in the field** Variation of voltage Real temperature, altitude, cooling, dust	Commissioning
Asses real performance	**MPPT testing in the field**	Commissioning
Performance Losses	Ancillary consumptions Clipping threshold Temperature derating and limitations	Operation
Feedback for estimations	Efficiency rating Ancillary consumption	Commissioning

QC of PV inverters



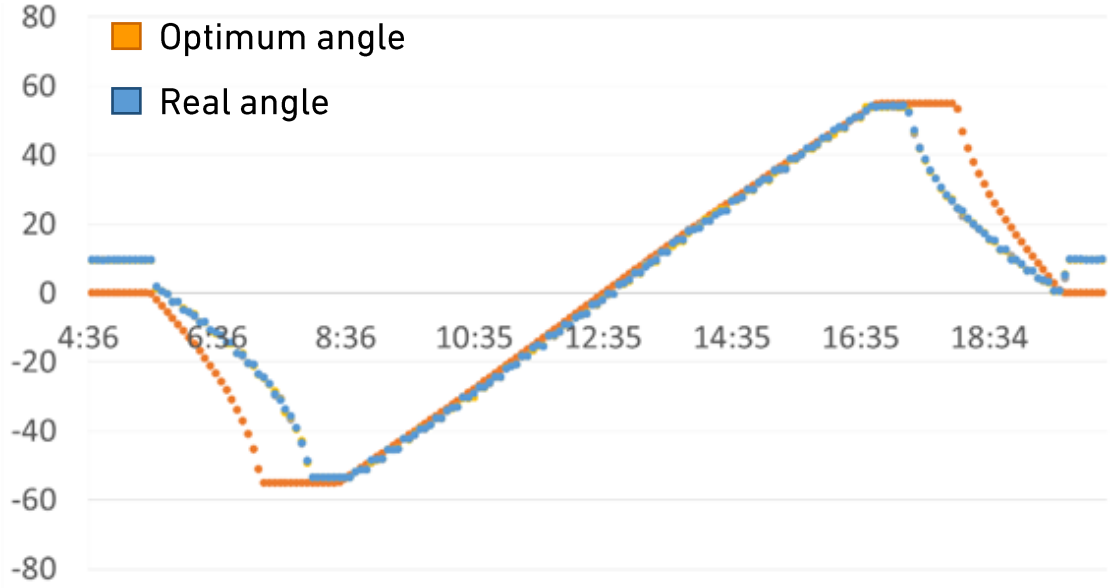


- MPPT malfunction
- Temperature limitation

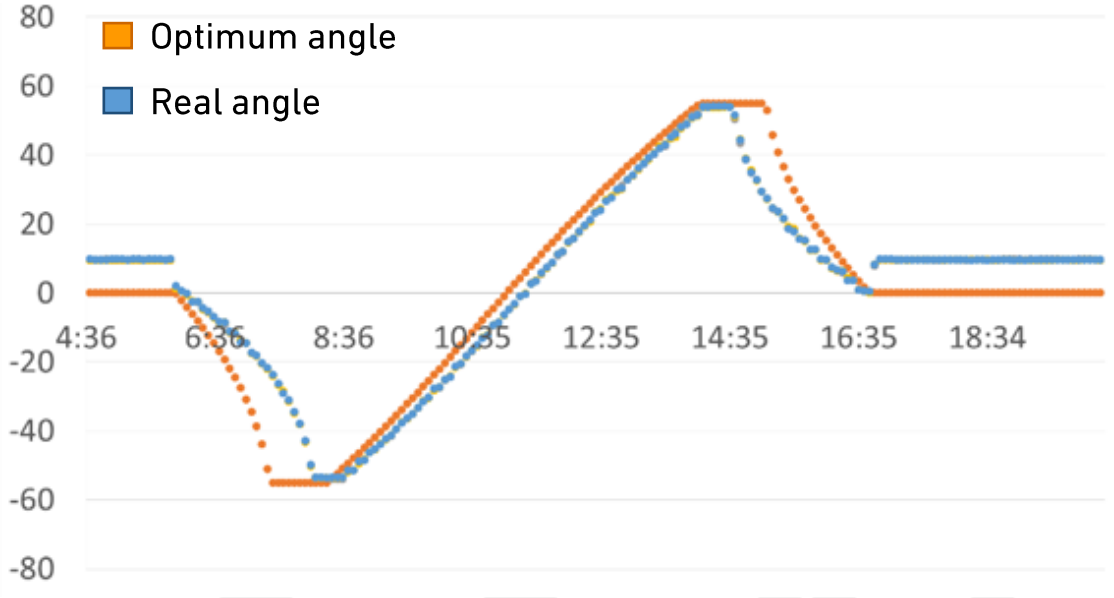
QC of trackers

- Analysis of the optimum angle
- Evaluation of Z-coordinate for backtracking

21st of June



28th of October



+100 MW PV plant: +3% recoverable energy

Performance surveillance

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Accurate monitoring system with reference modules

+

Low uncertainty field measurements

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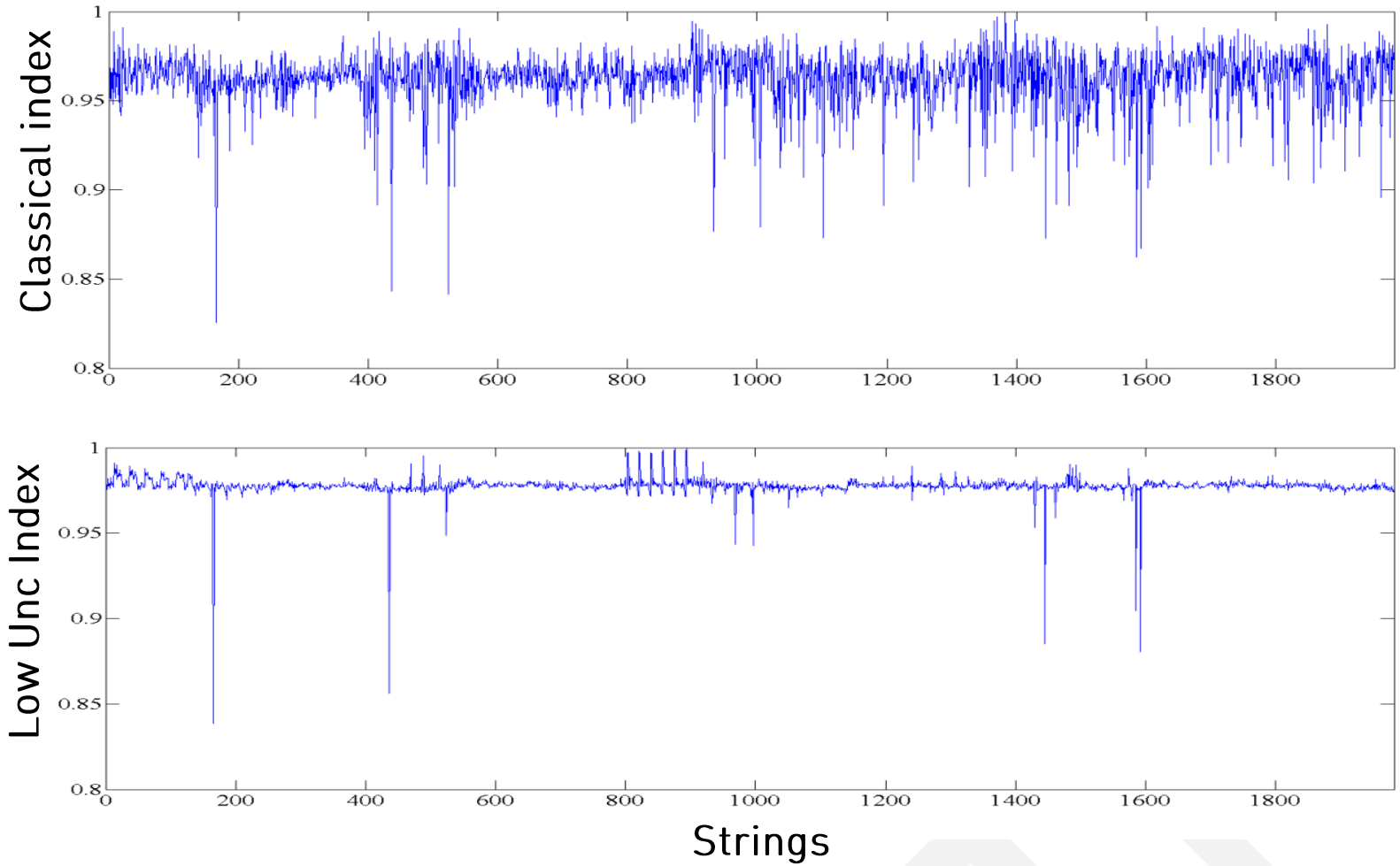
Detailed performance surveillance and optimization

Performance surveillance



- Low uncertainty indexes **reduce +80%** the number of warnings by eliminating false alarms

Performance surveillance

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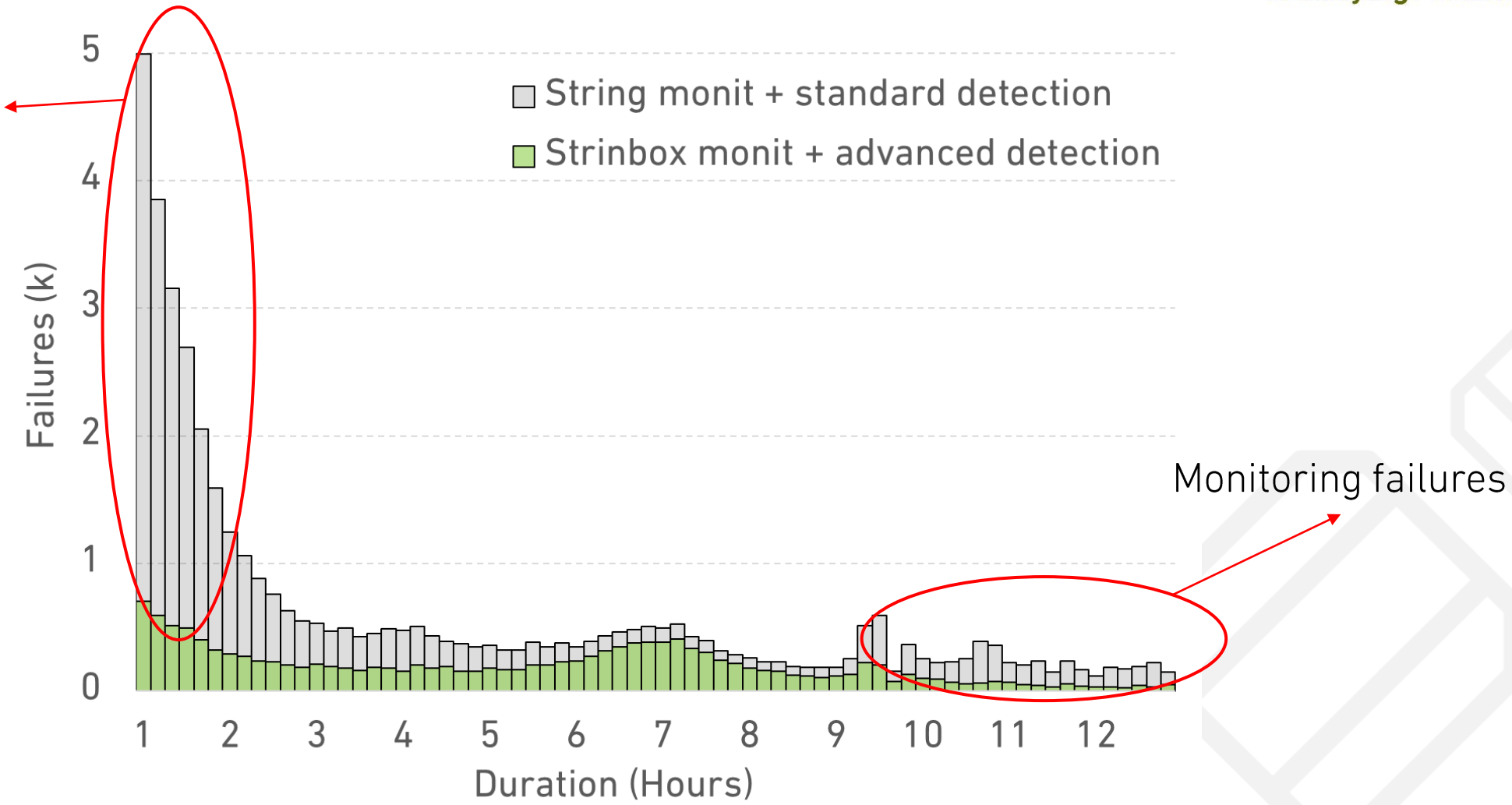
False alarms



Monitoring failures

✓ Detection +75% of the energy lost with only 5% of the sensors

Performance surveillance

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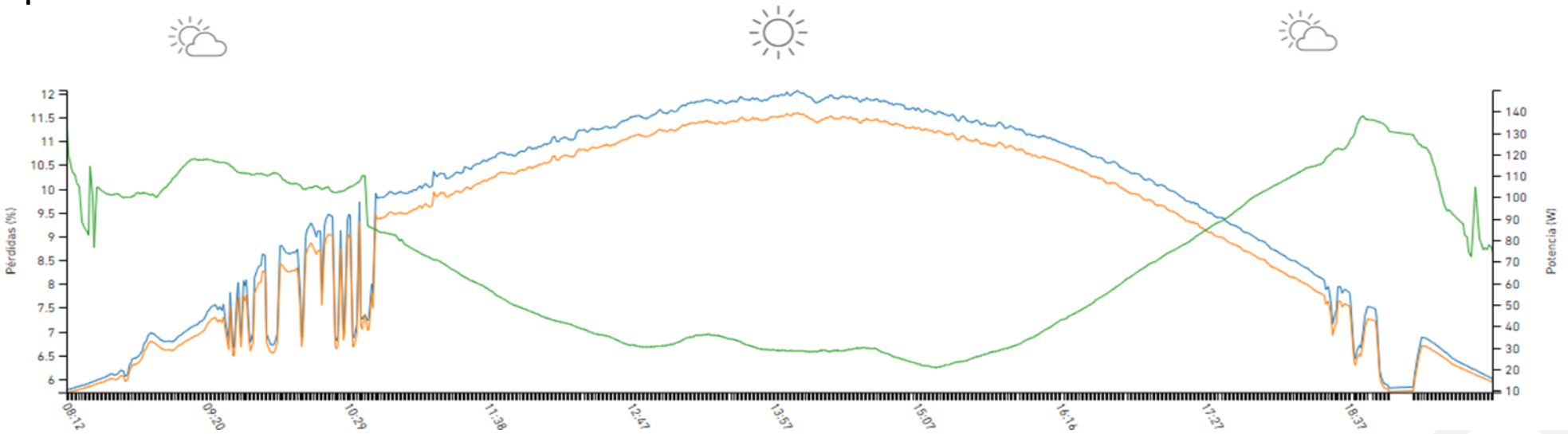
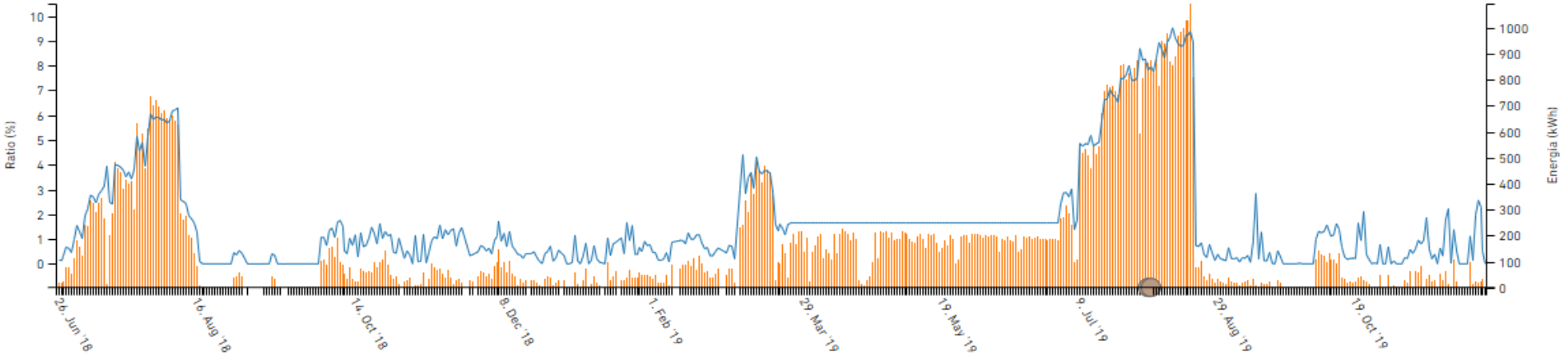
Dust impact

Day



Year



✓ Measure effective power decrease with reference modules

P ARLPV

Thank you for your attention!

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12-January-2021

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