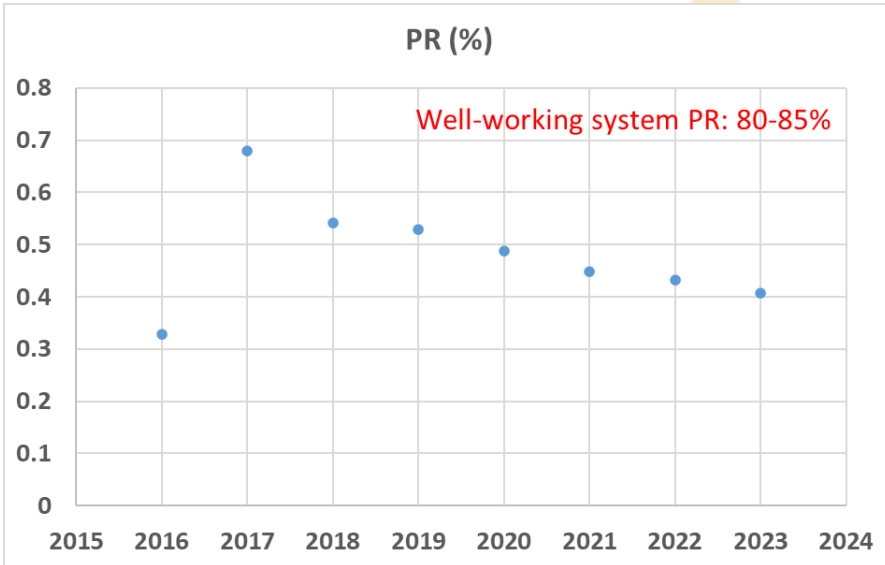


Business case #2 Utility-scale PV plant

1. Analysis of monitoring data

The annual performance PR of the PV plant in 2017 is ~70% (a relatively low initial value compared to a conventional PR of ~80-85% for a state-of-the-art plant). Since then, the PR is decreasing annually by more than 5%.



2. Diagnosis

String-level electroluminescence (EL) allows detecting underperforming PV sub-arrays. On **site IV curve tracing** - followed by **laboratory testing** on selected PV modules - allowed ascribing the severe decrease of the modules to a sub-standard quality of the modules. The series resistance of the module is bad and increases over time leading to a severe underperformance of the modules. Root-cause: most likely a poor ribbon soldering process in manufacturing.

...CONTINUES



Plant details

- Location: Piedmont (44°N, 8° E), Italy
- Plant description: ~4.5 MWp utility-scale ground mounted.
- Connection to the grid: mid 2016
- Business model: power purchase agreement (PPA)



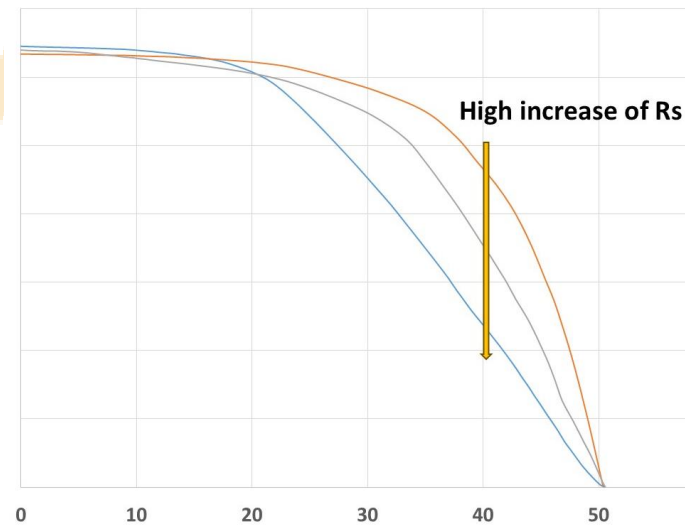
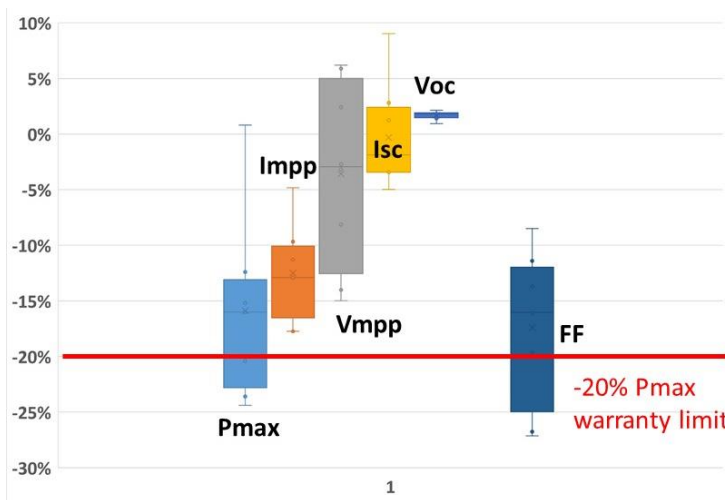
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Business case #2 Utility-scale PV plant



Average power (Pmax) loss of 20 selected modules flashed at an ISO 17025 accredited partner laboratory. Most degradation can be attributed to a strong reduction in the FF due an increased series resistance R_s (R), mostly attributable to poor soldering contacts of the ribbons in solar cells.

Lessons learnt

- **Check monitoring** data regularly.
- When underperformance is suspected, react swiftly.

3. Proposed interventions

- Full repowering of the underperforming PV strings
- Start of a legal claim against the module manufacturer for performance warranty infringement and sub-standard module quality.
- Substitution of the underperforming PV modules (~0.85 MWp) after reaching an agreement between parties.
- Pls note: the PV modules were certified products according to the relevant industry standards.



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