



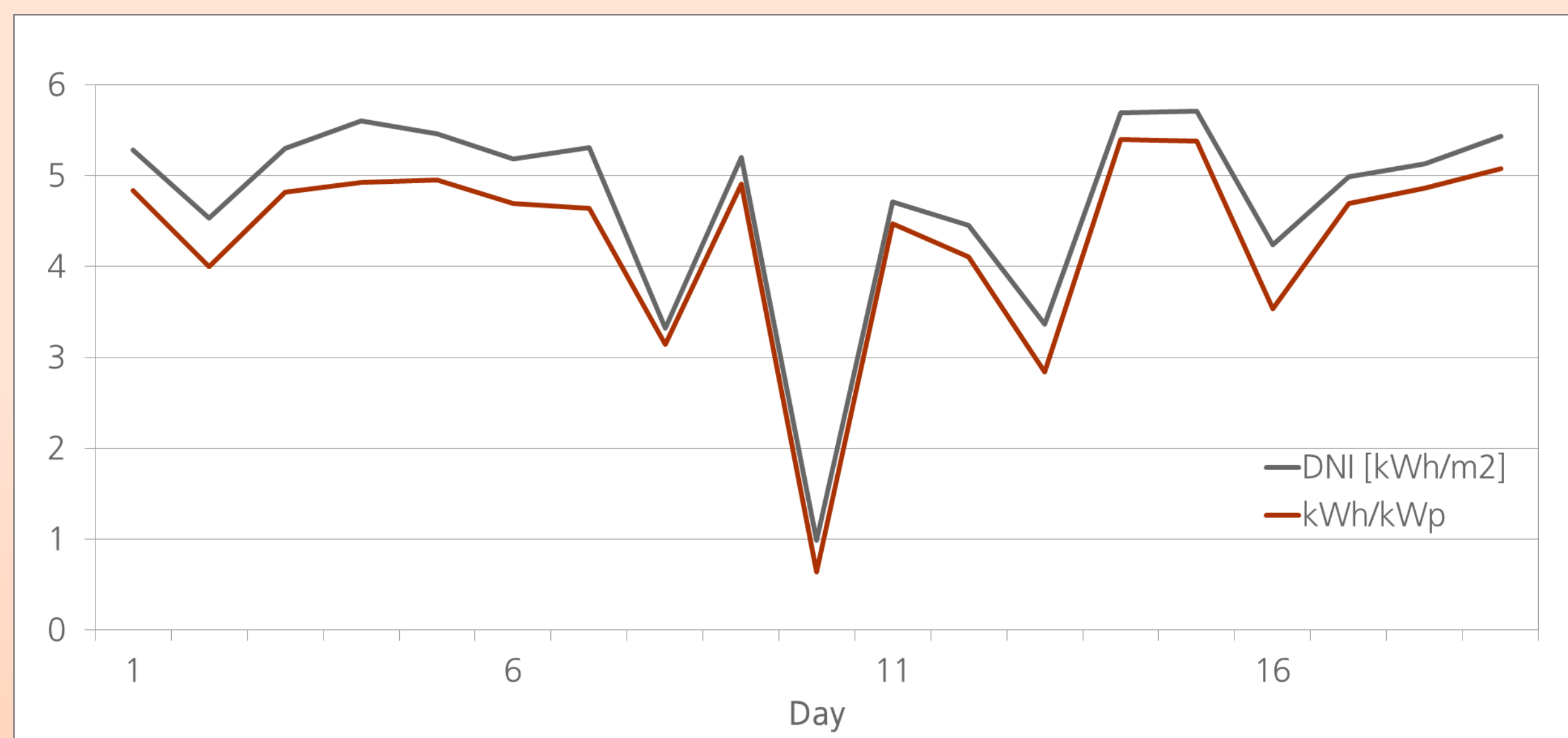
ABENGOA SOLAR

Abengoa Solar develops and applies technologies to generate electricity from the sun, working to limit climate change and to develop local communities using mostly concentrating solar thermal, but also photovoltaic technologies.

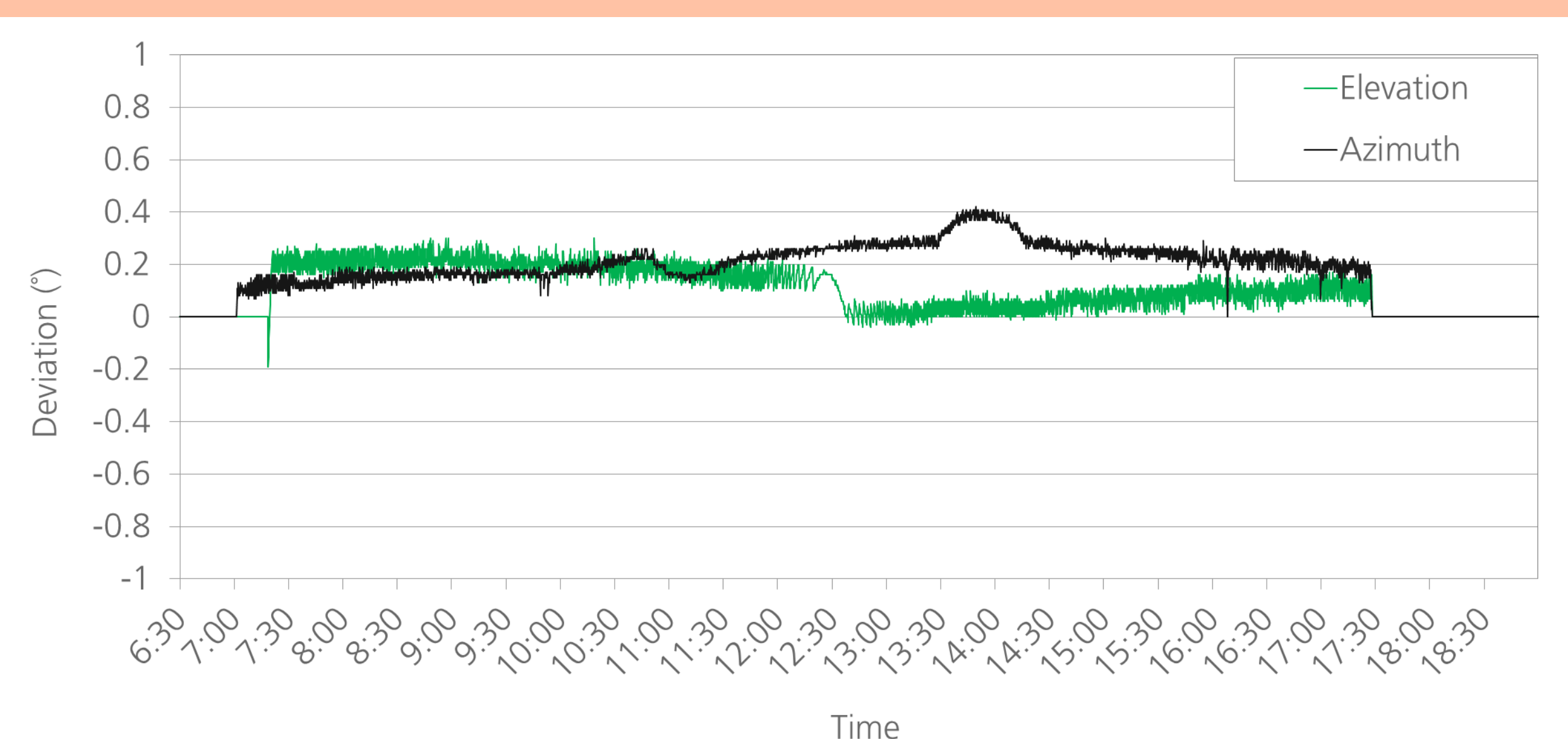
Abengoa Solar CPV field testing capabilities

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Abengoa Solar operates a field testing Photovoltaic Laboratory in the south of Spain, located in the Solúcar Platform, a 300 MW solar generation facility. This laboratory provides the capabilities to evaluate new PV technologies, such as CPV, comparing them with other commercial and under development technologies. The systems in the laboratory are monitored exhaustively, analyzing the performance under different operating conditions and the evolution over time. Monitoring these systems is important to understand the technology and identify reliability issues. The information generated is critical to introduce new technologies in the market, providing backtrack data and increasing the confidence in the technology.



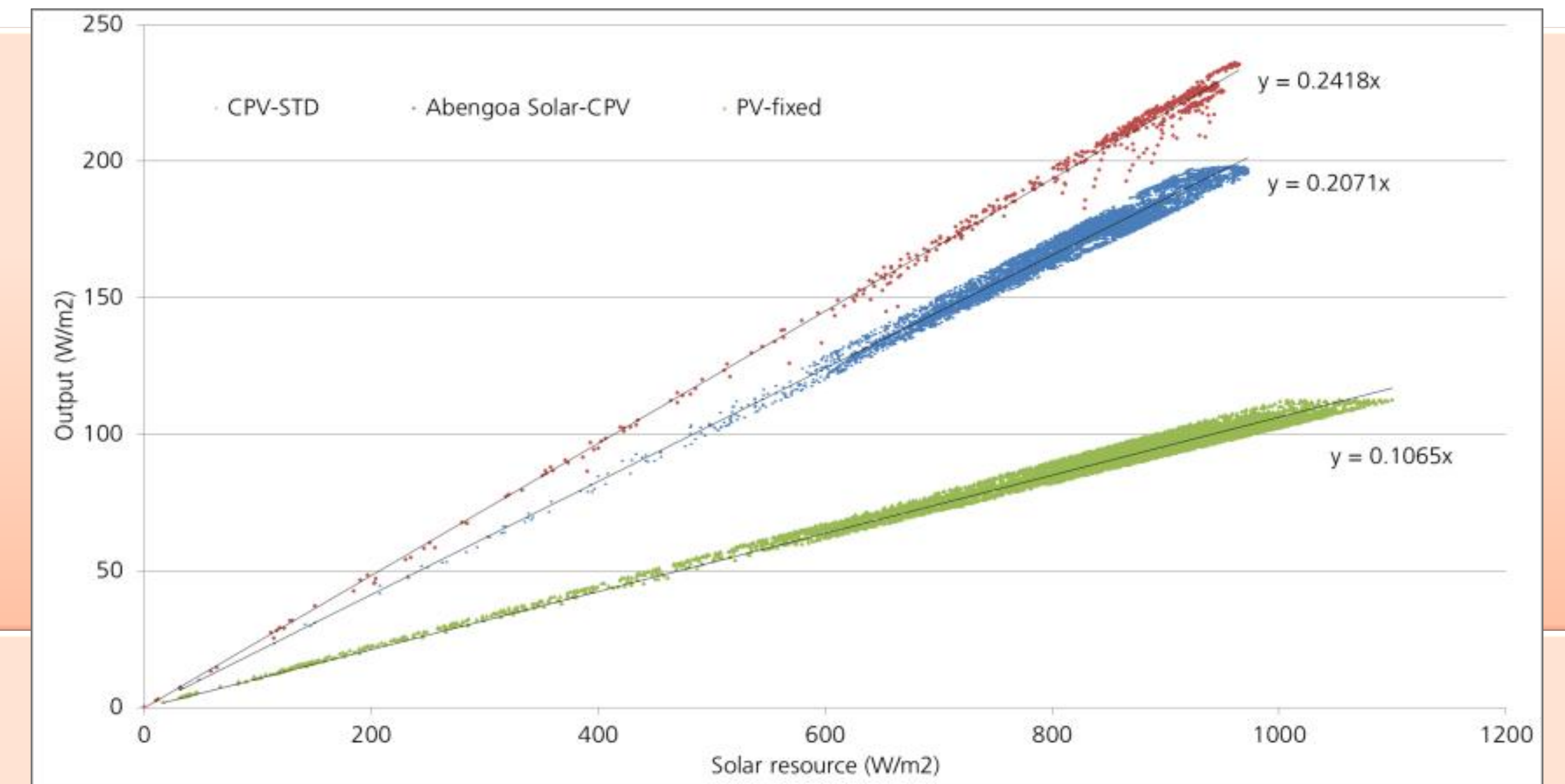
Stringed and single modules are monitored, operating at the maximum power point, analyzing the evolution over time. The availability of the installation is monitored continuously, allowing the opportunity to identify the origin of any problem in the data. The production of the CPV system is compared with the performance models for the specific meteorological conditions, identifying any variation in the performance of the system over the time. The graph above shows the energy yield of a system compared with the available solar resource.



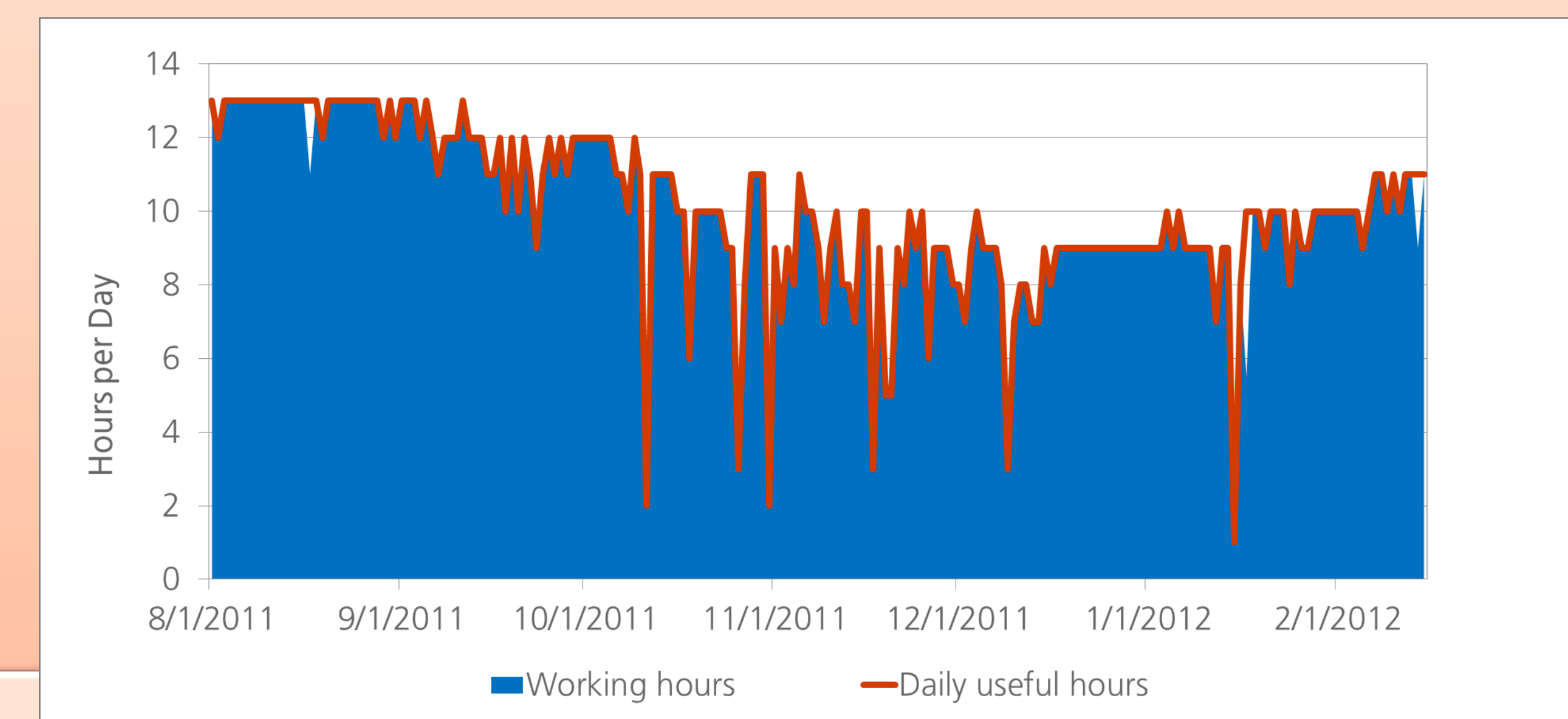
As an example of test follow up, the graph on the right shows an Statistical Process Control approach which allows for identification of deviation and variability on the performance of the systems under tests. The sample graph shows how an material assembly tests failed after heavy rain (A) period which led to >10% performance degradation after returning to dry weather condition (B) and back to standard performance after manual intervention and drying out of the assembly (C).

Abengoa Solar - CPV testing capabilities

- Monitoring of CPV individual and stringed modules operating on the maximum power point
- IV measurement of modules, strings and trackers
- Meteorological station and measurement of DNI and GNI on the trackers
- Measurement of spectral distribution
- Measurement of tracking accuracy



Comparison of various technologies under test and at different sizes in our PV Lab. Output versus input in terms of power per active area of the system is a key performance parameter that allow the direct comparison and variability evaluation for technologies deployed in different ways and sizes. Slope of the graphs are a direct measure of the efficiency of the technology. The graph above includes only quartiles 2 and 3 of the data distribution. Each data point has been collected at different intervals that may range from 5 minutes to 15 minutes. Si PV mounted on a fixed structure, first generation CPV and Abengoa Solar commercial CPV new generation are compared.



A reliable tracking system is mandatory for a commercial CPV technology. CPV trackers are monitored in the laboratory to validate the tracking accuracy, considering daily and seasonal evolution and to evaluate the availability of the system. The graph above shows the availability of a tracker over a period of six months, while the graph on the left shows the tracking accuracy measured over one day. Demonstrating the reliability and correct performance of the tracking system is critical for the commercialization of a new technology such as CPV. Other important issues related to the operation and maintenance of the trackers are also evaluated, such as the correct movement over the whole range and the energy consumption or the behavior in emergency conditions.

