

PRESS RELEASE

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Solar module output often overstated

A research team from the Fraunhofer Institute for Solar Energy Systems ISE has evaluated over 70,000 power measurements on photovoltaic modules that have been carried out in the institute's calibration laboratory, CalLab PV Modules, since 2012. In the process, the researchers found that since around 2017, the negative discrepancy between the performance data of the pv module manufacturers and the research institute's measurement results has been increasing. Until 2016, more power was measured in the laboratory on average than was promised by the manufacturer. Since then, a negative trend has emerged, particularly in the years 2020 to 2023, leading to an average power reduction of about 1.3 percent. The latest data from 2024 show a slight turnaround.

The CalLab PV Modules at the Fraunhofer ISE has been testing over 70,000 solar modules since 2012. For a comprehensive review of performance conformity, research scientists at the institute drew on this extensive data set and analyzed 1034 of the collected performance measurements taken from monocrystalline silicon PV modules under standardized conditions.

The analysis of the power measurements of PV modules showed that from 2012 to 2016, measurement deviations existed within the usual section; the difference was always less than one percent on average. In particular, positive deviations were also frequently measured. In 2016, the difference between the manufacturer's power specifications and the measured power in the institute's laboratory was 0.6 percent on average. "Since then, the data has shown a negative trend," said Daniel Phillip, head of the Department Module Characterization and Reliability at Fraunhofer ISE. "For the year 2023, this culminated in a negative deviation between the manufacturer's specification and our review of about 1.3 percent. A positive deviation was hardly ever observed."

Last year, the research scientists published statistics on the power specified by the manufacturers and the power measured in the laboratory. At the 40th PV Symposium, which is taking place this week in Bad Staffelstein, they are presenting updated data on power conformity, which now also includes data collected in 2024. "In 2024, we observe a slight trend reversal, but still on average strong negative deviations of 1.2 percent," explained Daniel Philipp. This could be an indication that the manufacturing companies have recognized the tendency towards 'optimistic' power ratings as a problem. "If we assume that our data is representative of the German installation market, an average underperformance of 1.2 percent with an additional 16.2 gigawatts in 2024

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corresponds to a total output of around 195 megawatts.” This corresponds to the nominal output of one of the largest solar parks in Germany.

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“The findings also make it clear how important a reliable, continuous and independent infrastructure is for the quality control of PV modules,” said Prof. Andreas Bett, Institute Director at Fraunhofer ISE,” especially when the German and European PV markets are over 90 percent dependent on imports of PV components.

The data was filtered according to suitable criteria for the evaluation. First, the research scientists removed inconsistent data, for example modules without a serial number, type designation, defective modules and modules without a nominal value. Further filters were then applied to exclude statistical distortions, for example due to the different number of test samples per measurement campaign of the same project and type, and to ensure that only measurement data from new modules were included in the evaluation.

To achieve a result that is representative of module purchasers, only data from projects where the client and the manufacturer do not match were considered. In addition, only module manufacturers that were among the top 10 manufacturers in the respective year under review were included in the analysis, so that modules from a total of 15 manufacturers were included in the evaluation.

Thanks to comprehensive quality assurance measures, the CalLab PV Modules at Fraunhofer ISE has been able to demonstrate a stable calibration level over many years, which is also confirmed by regular [interlaboratory comparisons](#). Only in this way can robust conclusions be drawn from such statistical long-term observations.

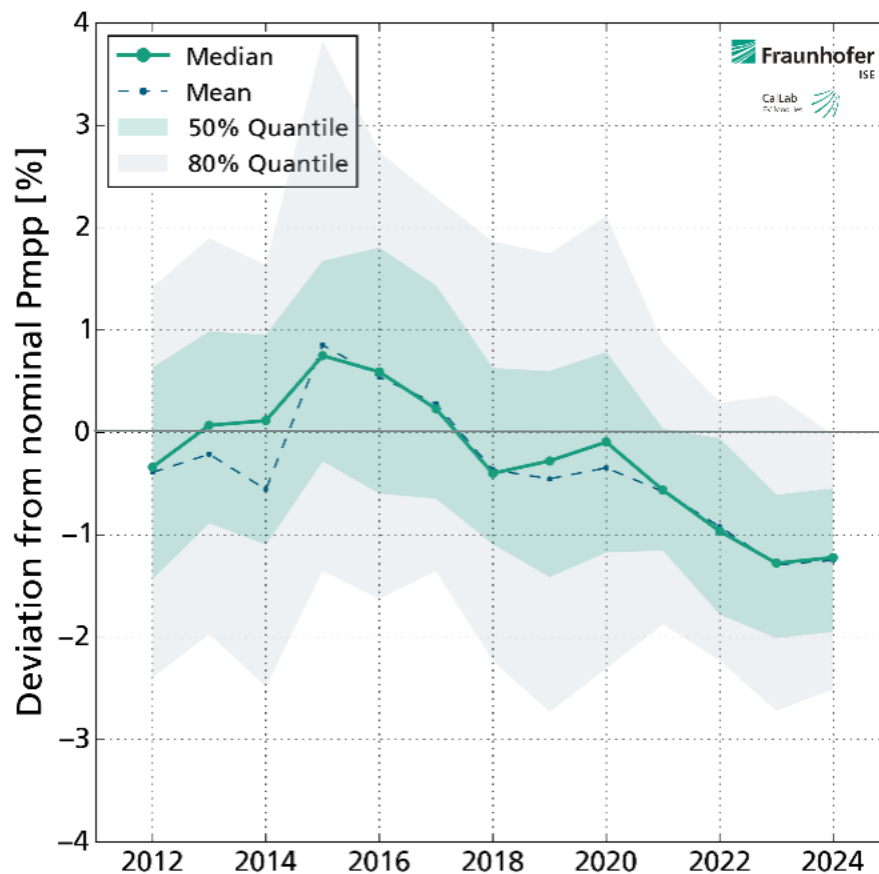


Fig.1 Until 2016, Fraunhofer ISE's laboratory measured more power on average than promised by the manufacturer. Since then, a negative trend has become apparent, particularly in the years 2020 to 2023. © Fraunhofer ISE