PRESS RELEASE

Fraunhofer ISE evaluates common UV tests for TOPCon modules for practical relevance

Reports of UV-induced degradation in TOPCon-based photovoltaic modules are currently a concern for the PV industry. The Fraunhofer Institute for Solar Energy Systems ISE is therefore investigating common test methods for their validity. The latest results of their comparative indoor and outdoor tests show that the currently used UV tests rate the degradation of TOPCon silicon PV modules significantly higher than the actual performance reduction. To achieve more meaningful test results in the laboratory, the PV modules must be stabilized after UV exposure and before performance measurement. This week, the institute presented comprehensive analyses of the recovery dynamics of TOPCon modules at the SiliconPV conference.

UV-induced degradation of TOPCon PV modules is emerging as a problem that is increasingly concerning project developers, operators and banks, as evidenced by various reports and initial scientific publications. However, the latest research by Fraunhofer ISE shows that common UV tests can significantly exaggerate the degradation effect.

For results that are more relevant to degradation in the field, the PV modules must be stabilized after testing. Only in this way can UV-sensitive module types be distinguished from less sensitive ones and evaluated comparably. The reason for this is observed by research scientists at Fraunhofer ISE in a meta-stable behavior of commercial TOPCon PV modules. This behavior had led the researchers to further investigate the test procedure and to initiate additional outdoor tests in parallel.

"Unfortunately, many module types of the current generation of commercial TOPCon PV modules react sensitively to UV irradiation. This is also confirmed by modules returning from the field and comparisons between modules aged in the laboratory and in the field. However, the degradation rate does not appear to be as drastic as previously assumed," summarizes Daniel Philipp, head of the Department for Module Characterization and Reliability at Fraunhofer ISE. "We recommend that users test PV modules according to the latest findings. In research, it remains necessary to further analyze the phenomenon to more accurately predict the long-term effects of UV-induced degradation on module yield."

The investigations by the Fraunhofer ISE research team indicate that UV irradiation during the tests destabilizes the modules to such an extent that they lose a great deal of efficiency during dark storage after UV exposure. Subsequent irradiation with sunlight, on

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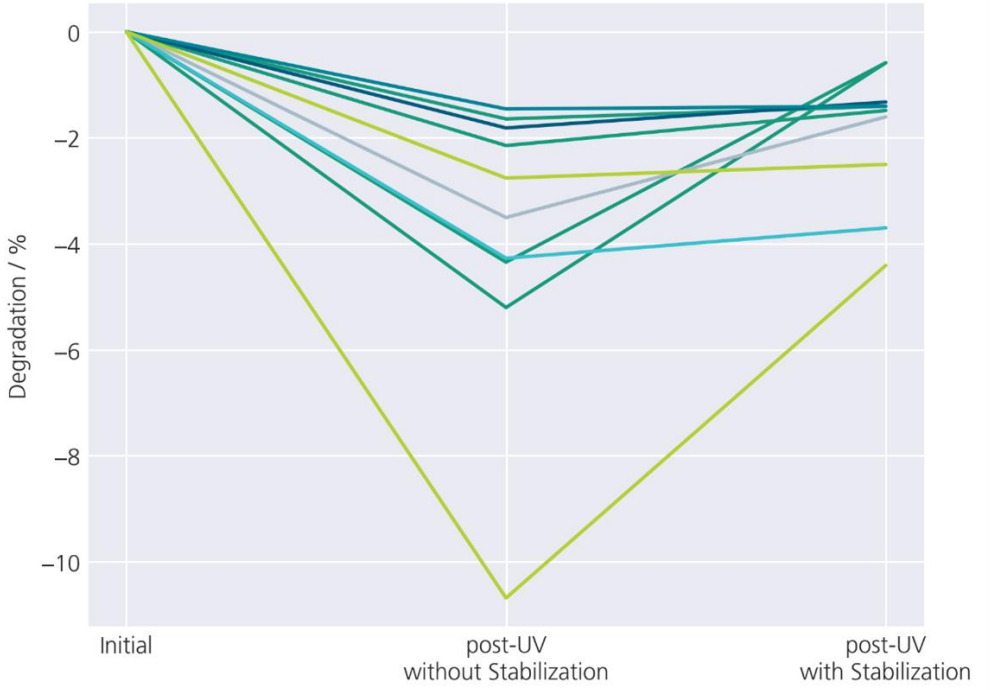
the other hand, leads to a significant recovery effect. Field tests at the Fraunhofer ISE Outdoor Performance Lab with TOPCon modules and analyses of 'field returns' at the institute's CalLab PV Modules, indicate that this stabilization process provides degradation measurements that are significantly closer to the values measured in practice.

Some PV modules showed hardly any degradation after UV testing at 60 kilowatt hours per square meter, which roughly corresponds to the UV exposure in one year in Germany, and subsequent stabilization under sunlight. Other modules still showed significant power losses of up to 5 percent even after stabilization. Overall, however, the degradation is significantly less drastic than the standard UV tests suggest.

Laboratory UV tests simulate the natural UV radiation to which PV modules are exposed in the field and on roofs, but significantly increase the intensity of the irradiation to accelerate aging and thus be able to predict long-term power losses.



The graph shows the relative power loss of various commercial module types after UV testing. The modules were measured first without and then with stabilization. After stabilization, there is a significant recovery, although not to the initial level. Lines of the same color represent tests on the same module types. © Fraunhofer ISE