

HORIZON EUROPE PROGRAMME

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Demonstration pilot lines for alternative and innovative PV technologies

(Novel c-Si tandem, thin film tandem, bifacial, CPV, etc.)

GA No. 101084046

Digitalised pilot lines for silicon heterojunction tunnel interdigitated back contact solar cells and modules



PILATUS

PILATUS - Deliverable report

**<<4.1 Protocol of indoor and outdoor measurement
setup>>**



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Deliverable Background:

The aim of PILATUS's work package 4 is to ensure and assess the quality of the solar modules coming out of the PILATUS pilot lines. Therefore, the silicon heterojunction (SHJ) tunnel-interdigitated back contact (IBC) solar cells and modules are to be tested extensively and the results are thoroughly evaluated. In this report, the indoor and outdoor measurement setups at EURAC, EPFL and FZU are discussed. This measurement setup protocol is important to verify the quality and consistency of the measurements and to ensure comparability between the results.

Publishable summary

This deliverable summarizes all foreseen indoor and outdoor measurements and tests to be carried out within the PILATUS project together with the corresponding setups. These tests are crucial to assess the quality and reliability of the developed SHJ tunnel-IBC cells and modules produced in the framework of this project. Inline metrology will be used to assess indoor module reliability and will be compared to outdoor analyses of module performance reliability.

Indoor measurements will be conducted at the premises of CSEM/EPFL, EURAC, PASAN and FhG-ISE to characterize the SHJ tunnel-IBC cells and modules. PASAN supports the measuring partners with their expertise to ensure high quality and repeatability of the indoor measurements including flash testing under Standard Test Conditions (STC) as well as power rating according to IEC 61853-1. These tests will be supported by acquisition of electroluminescence (EL) and photoluminescence (PL) images.

Additionally, ageing tests for solar modules according to IEC 61215, building integrated photovoltaic (PV) tests according to IEC 63092 and solar rooftop tests according to IEC 61730 will be performed to verify the quality and durability of the products produced in the pilot lines of this project. These tests will help to detect, if any, possible premature degradation modes developing in the modules affecting the performance and safe operation of the PV modules. A feedback loop to production will be established to reduce and eliminate potential issues.

Indoor testing will be complemented by outdoor exposure to study the solar modules under real operating conditions. Module level monitoring tests are to be carried out at the outdoor facility of EPFL benchmarking the PILATUS modules with other high quality state-of-the-art PV technologies. Additionally, a larger set of modules will be exposed outdoors at EURAC and FZU for several months. During this period, periodical inspection including visual inspecting, current-voltage (IV) curve acquisition, infrared (IR) imagery, electroluminescence (EL) and photoluminescence (PL) will be conducted. Furthermore, single modules will be exposed outdoors at the facilities of FhG-CSP and taken periodically to the indoor laboratory to be examined in greater detail.

Usually, the performance of PV modules and systems is assumed to follow a bathtub curve experiencing higher performance losses during infant and wear-out phase. By conducting this measurement campaign, we will be able to study the infant phase of PV system operation to ensure that no premature performance losses above the guaranteed threshold will take place. The insights from performing individual inspection activities will be used to correlate any unpredicted performance losses with its root causes. Again, the insights gained during the outdoor measurement campaign will be fed into the cell and module production line to improve any possible shortcomings.