European Metrology Research Programme

Delivering Impact

EURAMET

Improved calibrations for solar cells

Solar power offers the potential to be the world's largest source of power by 2050. This would require the adoption of new technologies; including materials other than just silicon or cells composed of multiple layers to increase efficiencies. To validate the performance of these advanced solar cells, essential to promote the uptake of this type of renewable energy, will require new or improved reference cells for calibrating them.

Europe's National Measurement Institutes working together

The European Metrology Research Programme (EMRP) brings together National Measurement Institutes in 23 countries to address key measurement challenges at a European level. It supports collaborative research to ensure that measurement science meets the future needs of industry and wider society.

Challenge

The International Energy Agency predicts that by 2050 solar power could cover 69 % of electricity generation, making it the world's largest source of power. For this to happen it will require multiple approaches such as reduced installation costs, increased solar cell efficiencies or the adoption of new technologies.

New types of solar cells, or photovoltaics (PV), entering the market often have an extended or different 'spectral response' to solar irradiance compared to the silicon semi-conducting materials conventionally used. The spectral response is the amount of electricity a cell will produce when exposed to various wavelengths of light. When the response of a PV reference device is significantly different to the cell or module under test this can affect the accuracy of the calibration. As traceable calibration and testing is the basis of assuring the worldwide comparability of efficiency and power output, inaccuracies in this can adversely affect confidence in PV technology as a reliable source of energy.

Improved reference standards for use in both existing and emerging PV technologies are therefore required to encourage the uptake of this source of power.

Solution

The EMRP project *Towards an energy-based parameter for photovoltaic classification* developed new photovoltaic (PV) reference devices with a greater stability and a wider operating spectral range than previously available.

Five silicon solar cells, with different technological variations, were selected by project partners as candidates for use as an improved reference device. Optical properties were then investigated and the most suitable chosen for further optimisation. The silicon in the cell was changed to a different variant which had an improved tolerance to degradation during continuous operation. The thermal conductance of the housing of the proto-type cell was improved two-fold – important to maintain a uniform device temperature under different measurement conditions.

The device was then compared to different PV technologies and the spectral filters, which allow a reference cell to be 'tuned' to match the spectral response of any of the solar cell technologies, were optimised.

Impact

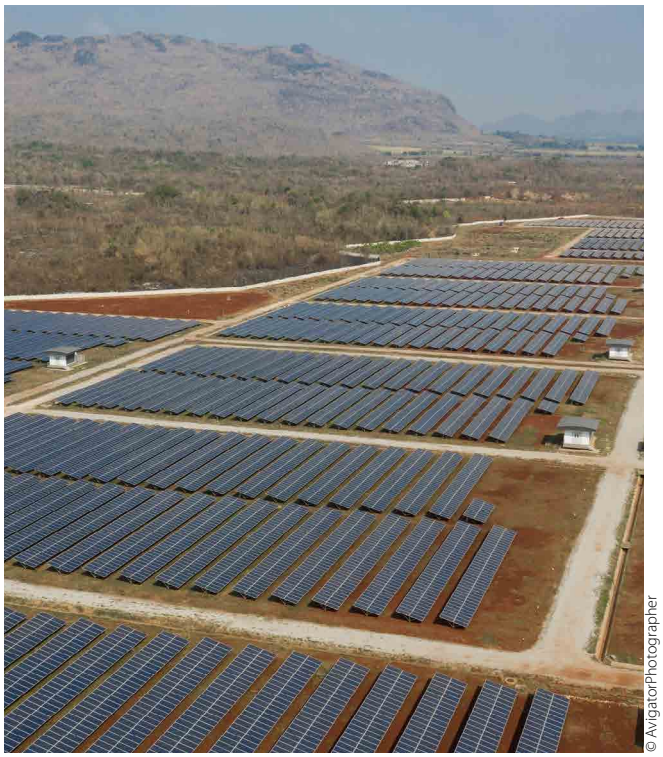
Fraunhofer ISE, the largest solar research institute in Europe, incorporated these improvements into their World Photovoltaic Scale (WPVS) cells; which are used by industry and research institutions all around the world. The WPVS represents the international standard for calibrating solar reference cells to ensure their accuracy and robust traceability to the SI. Different versions of Fraunhofer ISE cells are available which can be selected to match the measurement situation. Additional optical filtering allows the cells to match its spectral response to any module technology, both indoors and outdoors.

These new reference cells, with improved stability and greater accuracy, will contribute to the confidence of measurements made regarding a solar cell's performance. This in turn will encourage the continued uptake of new and emerging solar technologies to meet the targeted market share of renewable energies.

New energy ratings for solar cells

The EMRP project *Towards an energy-based parameter for photovoltaic classification* set out to determine how photovoltaic cells (PVs) could more realistically be measured to quantify operation in the real-world. PV performance was assessed at different climate zones across Europe, incorporating module temperature, angle of the sun and different solar intensities. The data obtained led to the development of a new model for PV rating based on energy output, rather than peak power under fixed conditions.

The project produced new facilities, calibration devices and three good practice guides on making improved measurements. Data from the project was also incorporated into three new international standards in the IEC 61853 series. These new PV ratings, which more closely match a cells performance to the conditions under which it will be deployed, will increase confidence and aid in the competitiveness of this technology.



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Co-ordinator: Dr. Stefan Winter

PTB, Germany
+49 531 592-4500 | Stefan.Winter@ptb.de

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