EMPIR Call 2016 – Energy, Environment, Normative and Research Potential

Selected Research Topic number: **SRT-g11**
Version: 1.0

Title: Advanced PV energy rating

Abstract

The EMRP project ENG55 PhotoClass successfully defined and standardised a new metric for an energy based photovoltaic classification for different climate zones. This energy-rating standard was made primarily for mono-facial modules and open-rack mounted modules in the field during the first year of the project. In the meantime, the importance of including bifacial, roof-mounted, and building integrated photovoltaics in the energy rating standard series has become apparent.

Keywords

Photovoltaic, solar devices, energy rating, Standard Test Conditions (STC), bifacial solar modules, building integrated photovoltaics (BIPV), linearity, spectral responsivity, angular dependency, sky scanning, hyperspectral imaging

Background to the Metrological Challenges

EU Directive 2009/28/EC on the promotion of the use of energy from renewable sources aims to increase the percentage of renewable energy in the total energy consumption to 20 % in 2020 in order to reduce greenhouse gas emissions and the dependence on imported energy. A significant increase in photovoltaic energy generation will contribute to this goal. Photovoltaic energy generation is silent (has low noise pollution), can be decentralised and will continue to reduce costs at a faster rate than any other renewable energy technology. Thus the demand for photovoltaic installations will continue to rise, with a particular focus in the future on bifacial modules.

An increase of the European market share of photovoltaics from 0.5 % (2010) to 12 % (2020) is predicted in the Photonics21 study “Second Strategic Research Agenda in Photonics”. A McKinsey study from 2012 comes to the same result for the world-wide expansion of photovoltaics. This high market volume requires the precise measurement of solar cells and solar modules, conforming to realistic standards and traceable to the SI units. In order to predict the energy output at end users’ specific points of installation, further characterisation of the solar cells and solar modules in real-world conditions is required. This will enable, for example, seamless integration into smart grids through the accurate calculation of the power contribution dependent on the time of day and weather conditions.

Bifacial solar devices produce, according to industry claims, about 20 % more energy than conventional solar devices by harvesting the light at the backside of the module, e.g. from ground reflections. This technique boosts the energy output more than any other material improvement in recent years, with the consequence that many photovoltaics manufacturers are adding bifacial solar devices to their portfolio.

Other geometries, such as roof-mounted and building integrated photovoltaics are currently omitted from the energy rating standard series despite the fact that these account for more than 50 % of installed capacity in parts of Europe and are driven by the trend for self-consumption. A metrological assessment of these improvements requires research into the measurement conditions to enable optimised procedures at calibration laboratories as well as in the production line.

Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the protocol.

The JRP shall focus on the traceable measurement and characterisation of emerging solar module types.

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The specific objectives are

1. To define and realise Standard Test Conditions for bifacial solar devices to determine their efficiency. Different approaches for laboratory measurements and for production line measurements must be developed, realised, compared, selected and standardised.
2. To develop traceable measurements for extending Energy Rating to bifacial solar modules and modules (bifacial or monofacial) applied to or integrated into buildings.
3. To develop more accurate measurement methods for traditional and emerging solar modules including the spectral responsivity of the complete module, fast linearity measurements for modules, angular dependency of modules, and more accurate determination of the operating temperature under different ambient conditions. To improve uncertainty evaluation of the spectral mismatch correction in the calibration of solar devices when combining the spectral irradiance and spectral responsivity.
4. To enable instantaneous measurement of the spectral radiance of the complete sky for improved determination of real outdoor measurement conditions and their spectral angular distribution (e.g. by hyperspectral imaging).
5. To facilitate the take up of the technology and measurement infrastructure developed in the project by the measurement supply chain (NMIs, calibration laboratories), standards developing organisations and end users (photovoltaics industry).

These objectives will require large-scale approaches that are beyond the capabilities of single National Metrology Institutes and Designated Institutes. To enhance the impact of the research, the involvement of the appropriate user community such as industry, standardisation and regulatory bodies is strongly recommended, both prior to and during methodology development.

Proposers should establish the current state of the art, and explain how their proposed research goes beyond this. In particular, proposers should outline the achievements of the EMRP project ENG55 PhotoClass and how their proposal will build on those.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 2.0 M€, and has defined an upper limit of 2.3 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 35 % of the total EU Contribution to the project.

Any industrial partners that will receive significant benefit from the results of the proposed project are expected to be unfunded partners.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community, describing how the project partners will engage with relevant communities during the project to facilitate knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the “end user” community (e.g. letters of support) is also encouraged.

You should detail how your JRP results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Feed into the development of urgent documentary standards through appropriate standards bodies,
- Transfer knowledge to the renewable energy sector.

You should detail other impacts of your proposed JRP as specified in the document “Guide 4: Writing Joint Research Projects (JRPs)”

You should also detail how your approach to realising the objectives will further the aim of EMPIR to develop a coherent approach at the European level in the field of metrology and include the best available contributions from across the metrology community. Specifically the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of up to 3 years duration.