

Title: Metrology for assessing Energy Performance of Buildings under operating conditions

Abstract

The building sector is the largest energy consumer in Europe and absorbs approximately 40 % of Europe's total energy. However, currently about 75 % of buildings are energy inefficient and information regarding assessment procedures for the operational rating of energy performance under actual conditions is limited. Currently, the Energy Performance of Buildings (EPB) only measures general parameters, i.e. the global energy consumption of a household rather than single rooms or applications. In addition, environmental parameters, e.g. room temperature, humidity, lighting and airflow are not measured and a common European standard for smart metering technology does not exist. Therefore, traceable measurement methods for measuring the actual ratings of different parameters linked to the EPB are needed, as well as input to the Energy Performance of Buildings Directive (EPBD) 2010/31/EU.

Keywords

EPBD, Energy Performance of Buildings, Energy Efficiency, sensor network, smart meters, operating conditions, measurement procedure, uncertainty evaluation

Background to the Metrological Challenges

The European Union aims to replace at least 80 % of existing electricity meters with smart meters by 2020 (where it is cost-effective to do so), reflecting the crucial role that continuous monitoring and measurement of actual performance plays in identifying energy conservation. However, the implementation of such metering and monitoring poses significant metrological problems related to the measurement of the operational parameters that influence the energy consumption, since many standard electricity and gas meters do not have the necessary feedback capabilities to improve energy efficiency and to affect users' behaviour.

Currently there is an imbalance between the level of detail of the calculation inputs from sensors (i.e. conditions of use of the building) and outputs (energy use) and hence the corresponding level of detail of EPB measurements. Indeed, very often there is nearly no information on actual conditions of use (a point raised in CEN TR 15378-4). In order to address this, validated and accurate sensor networks for traceable measurements of key energy performance parameters in buildings are needed and should include, representativeness of measurement points and variability of actual conditions.

Furthermore, improvements in energy efficiency need to be associated with measurement methods for post implementation assessment. Currently there is no agreed European standard for smart metering (sensor) technology and therefore protocols for reliable and accurate measurements methods and calibration systems for sensors of key energy performance parameters in buildings are needed.

Moreover, validated models (based on the sensor network data) are required to estimate the uncertainty of EPB measurements in specific conditions of use (e.g. in actual climate and occupancy conditions) in order to meet the requirements of the EPBD. In terms of current EPB standards, these need to be updated to include assessment procedures based on accurate, reliable and smart measurements in order to support certification of metrological performance in the field and for output calculations.

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 metrology research necessary to support the development of standardisation for measuring the operational energy performance of buildings.

The specific objectives are

1. To design a validated and accurate sensor network for traceable measurements of key energy performance parameters in buildings including the;
 - Selection of parameters: in particular energy use, air and hot water flows, outdoor and indoor environment parameters (temperature, humidity, ventilation rate, lighting, air quality), and occupancy,
 - Selection of accurate sensors/meters,
 - Representativeness of the measurement points
 - Variability of the actual conditions
 - Development of traceable calibration systems for sensors of key energy performance parameters in buildings
2. To evaluate the uncertainty, based on the sensor network data, for (i) the total Energy Performance of Buildings (EPB), (ii) the outputs from the Energy Performance of Buildings Directive (EPBD) 2010/31/EU and (iii) output calculations for subsequent EPB standards requirements.
3. To develop validated methods and novel algorithms for determining the energy use of a building in actual climate and occupancy conditions.
4. To contribute to the standards development work of the technical committees (CEN TC 371 and CEN TC 228 and those associated with the EPBD 2010/31/EU) to ensure that the outputs of the project are aligned with their needs, communicated quickly to those developing the standards and to those who will use them, and in a form that can be incorporated into the standards at the earliest opportunity.

Proposers should establish the current state of the art, and explain how their proposed research goes beyond this.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 1.5 M€, and has defined an upper limit of 1.5 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 30 % 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.

The proposed research shall be justified by clear reference to the measurement needs within strategic documents published by the relevant Standards Developing Organisation or by a letter signed by the convenor of the respective TC/WG. EURAMET encourages proposals that include representatives from industry, regulators and standardisation bodies actively participating in the projects. The proposal must name a “Chief Stakeholder”, not a member of the consortium, but a representative of the user community that will benefit from the proposed work. The “Chief Stakeholder” should write a letter of support explaining how their organisation will make use of the outcomes from the research, be consulted regularly by the consortium during the project to ensure that the planned outcomes are still relevant, and be prepared to report to EURAMET on the benefits they have gained from the project.

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 building and energy sectors.

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.

Additional information

[1] CEN/CENELEC identified this topic as one of their priorities. Details are available at:

https://msu.euramet.org/current_calls/pre_norm_2017/documents/SRT_related_CEN_priorities/cen_priority_06_2016.zip