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

Selected Research Topic number: **SRT-v11**
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Title: Metrology for air pollutant emissions

Abstract

Meeting European goals for the climate and air quality is a major challenge, which involves many sectors, such as industry, power generation and transport. Europe's goal is an 80% - 95% reduction in air pollutant emissions by 2050 and therefore increasingly stringent emission limits are required by regulation to meet this goal. For this reason, there is an urgent need to address key metrology issues such as extending the capabilities for measuring lower emission levels of air pollutants in order to improve the reliability of annual air pollutant emission figures. Further to this, validated and representative methods for the measurement of air pollutant emissions produced by local space heaters and heating boiler systems fed with solid biomass fuels are also needed to meet the new requirements published in 2015 for the EU Ecodesign Directive 2009/125/EC.

Keywords

Emissions, pollution, regulation, stationary source, air quality, detection limit, PAHs, CO_2, biomass, combustion

Background to the Metrological Challenges

Accurate measurement of air pollutant emissions is vital for the control and reduction of air pollution. In order to protect European citizens and the environment, Europe's current target is an 80% - 95% reduction in emissions by 2050. However, evidence shows that emissions are only likely to be reduced to 30 % by 2030, and therefore more stringent air pollutant emission limits will be necessary, combined with improved measurement methods to enable monitoring and enforcement. Currently, the Best Available Technology Reference documents (BREF) are under revision and will be adopted as part of article 13 of the Industrial Emissions Directive (IED) 2010/75/EU in order to introduce lower emission limits. Therefore, for industry and its regulators to support these new lower emission limits, they need harmonised methods for reporting the uncertainties under the IED and for the verification of the Associated Emissions Limits linked to the techniques in the BREFs.

The current state-of-the-art in terms of the measurement of air pollutant emissions from industrial sources are the standard reference methods developed in support of the IED. These standard reference methods were developed to address emissions from large combustion plants and waste incineration and it is a testament to the benefit of measuring emissions that the implementation of these standard reference methods enabled the reduction of many of the target pollutants e.g. SO_2. However, these standard reference methods are not able to measure the lower concentrations now required for emission limits. Nor are they suitable for air pollutant emission monitoring from small sources such as stationary engines and medium combustion plants, which require regulation by the Medium Combustion Plant (MCP) Directive 2015/2193. In addition to this, new pollutants such as ammonia (NH_3) and Particulate Matter $(PM)_{2.5}$ (i.e. PM less than or equivalent to 2.5 μm in diameter, and that can be drawn deep into the lungs) are causing increasing regulatory concern and therefore new methods are needed for their monitoring.

Regulations require industry to report air pollutant emissions over long time periods, typically as annualised emissions. However, most measurements are made over short time periods and therefore there is a need to provide cost effective continuous long-term monitoring. This could be solved by multi species monitoring which has the capability to significantly reduce the cost of such long-term measurements for air pollutant emissions.

In April 2015, as part of the EU Ecodesign Directive 2009/125/EC, two new regulations were published for local space heaters and heating boilers fed with solid biomass fuels. These regulations' require thresholds for emissions for PM, CO, organic gaseous carbon (OGC) and NOx and energy efficiency. Currently, with the exception of COs, no standardised measurement methods exist for the determination of emissions produced by heating systems fed with biomass solid fuels. Thus, in order to achieve implementation of these regulations

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it is important to develop validated and representative methods for the measurement of air pollutant emissions produced by them.

Emissions from wood burning and coal burning are an important source of directly emitted PM, secondary organic aerosols (SOA) and carcinogenic substances such as polycyclic aromatic hydrocarbons (PAHs). These emissions come from households, and commercial and institutional facilities. Emissions of benzo(a)pyrene (BaP), a PAH formed mainly from the burning of organic material, have increased by 11 % between 2003 and 2012. However, there are currently no standards for the measurement of in-stack PM, OGC and NOx that can be applied to solid biomass local space heaters and to heating boilers. In addition to this, in 2015, the United Nations Economic Commission for Europe (UNECE) Task Force on Measurements and Modelling and the Task Force on Emission Inventories and Projections decided to combine forces and create a working group in recognition of the need to improve the knowledge of semi-volatile organic compounds (SVOCs) emissions from such sources.

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 air pollutant emissions.

The specific objectives are

1. To develop traceable and validated reference methods for new pollutants such as NH_3 and formaldehyde. The target uncertainties for the methods will meet the requirements for measuring the lower levels of air pollutant emissions defined in the Industrial Emissions Directive (IED) 2010/75/EU
2. To develop validated methods for polycyclic aromatic hydrocarbons (PAHs) measurements from small and medium combustion sources. This will include methods for the quantification of benzo[a]pyrene and of different forms of OGC from flue gases produced by heating appliances fed with solid biomass fuels. The target uncertainties for the methods will meet the requirements defined in the Medium Combustion Plant Directive 2015/2193
3. To develop validated methods for determining air pollutant emissions from biomass combustion by non-wood biomass boilers. To investigate the use of novel hyperspectral techniques for the provision of simultaneous multispecies measurements. In addition, to develop traceable and validated methods to distinguish the isotopic composition of CO_2 emissions from biomass burning using online spectroscopic techniques.
4. To determine the uncertainty and the traceability of the mass emission measurements, for flow calibrations carried out in field conditions. This will include modelling, laboratory and field measurements, the integration of the flow measurements into the annualised reporting of emissions, and the estimate of the associated uncertainty budgets. Furthermore, to establish the impact of wall effects and sensor obstruction, particularly in small ducts, on flow measurement. This will include an investigation of novel flow monitoring technologies and of the use of multiple sensors in stacks.
5. To provide input to the revision of standards related to the emissions of semi-volatile organic compounds (SVOCs), particulate matter (PM), CO, NO_x and organic gaseous carbon (OGC). In addition, to facilitate the take up of the technology and measurement infrastructure developed in the project by standards developing organisations (such as CEN TC 264 and ISO TC 146 and those linked to the EU Ecodesign Directive 2009/125/EC, MCP Directive 2015/2193 and IED 2010/75/EU) and end users (e.g. environmental monitoring and regulation bodies, the power generation sector, and the automotive 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 ENV01 MACPoll, ENV56 KEY-VOCs and ENV60 IMPRESS, 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 environmental, industrial, power generation and transport 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

The following Standardisation requests from the EC may be relevant:
M/495 Standardisation Mandate TO CEN, CENELEC and ETSI Under Directive 2009/125/EC Relating to Harmonised Standards in the field of Ecodesign
M/503 Standardisation Mandate TO CEN, CENELEC and ETSI in Support of the Implementation of the Ambient Air Quality Legislation.