EMRP Call 2010 - Industry & Environment

Topic number: SRT-05e

Title: Traceability for Green House Gases

Abstract

Climate change is one of the most severe challenges for mankind today. Pollutant emissions are regulated under international agreements and European directives, including Kyoto protocol, the proposed Industrial Emissions Directive, and the National Emissions Ceiling Directive. These emissions controls are being tightened and there is a need for improved measurement capabilities to enable industry and regulators to quantify emissions and to improve the emission factors. The EC has decided to fight against climate change by reducing its GHG emissions substantially within the next years, i.e. up to 30 % until 2020.

Fugitive emissions of GHGs from area sources (e.g. landfills) and from large-scale industry are a significant GHG source alongside stationary source emissions (such as from industrial stacks). The ability to measure these emissions remotely and in the field (using portable measurement sensors) to obtain traceable reliable measurements will provide accurate quantification of a key area of uncertainty in European emissions budgets and help define and improve emissions factors. This SRT outlines requirements for validated and reliable measurements and methods with traceability wherever possible covering four aspects of GHG measurement.

Conformity with the Work Programme

This Call for JRPs conforms to the EMRP 2008, section on "*Grand Challenges"* related to *Industry & Environment* on pages 8 and 24.

Page 8 addresses the specific challenge of measuring flow and concentration of species under regulation such as the Kyoto protocol. It also targets the most urgent research aims of "validated and traceable measurement techniques, sensors and measurement standards".

Page 24 states:

"Research into innovative new systems and technologies that mitigate environmental impacts. These require:

- Internationally-recognised standards to underpin measurements of the flow and concentration of species regulated under the Kyoto protocol and EU's emission trading schemes."

Keywords

Greenhouse Gases, Emissions, Regulated Species, Air Pollution, Reference Methods, Reference Materials, Calibration, Traceability, Uncertainties, Fugitive Emissions, Static Emissions, Remote Sensing, On-site Measurements, Area Sources, Validated Analytical Measurements.

Background to the Metrological Challenges

According to the Kyoto protocol, the EC reports its GHG emission to the UN. Accurate values of its GHG emissions with defined and accepted uncertainties based on acknowledged values for emission factors and infrared absorption coefficients are indispensable for the comparison with emissions reported from other parts of the world.

Emission limit values are being reduced, for example by the proposed new EU Industrial Emissions Directive (IED) which will propose more harmonised emission limits across member states, and new pollutants are being brought under control, for example greenhouse gases not currently regulated such as fluorocarbons under the Kyoto agreement. As emissions reduce, current monitoring systems

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The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

are being challenged to provide measurements at low enough concentrations to meet current and future requirements. The uncertainties achievable are in many cases unable to meet the requirements of the Directives. The provision of traceability by developing calibration standards is not in itself sufficient. This SRT therefore aims to underpin the development of traceable, validated measurement methods to meet EU requirements, and therefore support the EU's overall objective to drive down GHG emissions.

The current state of the art can be inferred from the fact that the European Commission has mandated CEN to “establish a programme of standards for assessing the greenhouse gas (GHG) emissions in energy-intensive industries” (M/431). This mandate is a strong indicator that deficiencies exist either in the number or the quality of standards dealing with these topics. This project is expected to finish in June 2010 with a list of identified gaps and missing standards.

The main GHGs in the Earth's atmosphere are water vapour (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and ozone (O_3). Methane and carbon dioxides, and other species such as nitric dioxide (NO_2) or sulphur dioxide (SO_2) are considered to be precursors of O_3. In addition to its greenhouse effect, ozone is toxic (responsible of animal or human respiratory diseases) and its daily measurement (including its precursors) using real time methods will have a crucial role in observing future changes in atmospheric composition and in verifying policies on emission controls are working.

ICOS is a new European Research Infrastructure for quantifying and understanding the greenhouse balance of the European continent and of adjacent regions. The ICOS infrastructure will integrate terrestrial and atmospheric observations at various sites into a single, coherent, highly precise dataset. These data will allow a unique regional top-down assessment of fluxes from atmospheric data, and a bottom-up assessment from ecosystem measurements and fossil fuel inventories. The target is a daily mapping of sources and sinks at scales down to about 10 km, to understand the exchange processes between the atmosphere, the terrestrial surface and the ocean.

The Intergovernmental Panel of Climate Change (IPCC) is the leading body for the assessment of climate change, established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) to provide the world with a clear scientific view on the current state of climate change and its potential environmental and socio-economic consequences. It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. Thousands of scientists from all over the world contribute to the work of the IPCC on a voluntary basis.

Measurements of greenhouse gases in ambient air must therefore be traceable and accurate, to allow all measurements to be compared by organizations at the European level such as ICOS and at the International level such as IPCC which lead or review studies to evaluate the impact of GHGs.

Fugitive emissions contribute a significant amount to total GHG emissions, including emissions of methane from area sources such as landfill and VOC compounds from industry. The measurement of fugitive emissions is difficult and has traditionally involved localised sampling and the use of emissions factors and models, e.g. GasSim™ for landfill methane emissions or American Petroleum Institute (API) methods for fugitive emissions. There is evidence from work on air pollutants from industrial plant that significant emissions arise from unknown or unexpected sources. Remote sensing technologies could offer significant benefits. A key part of these techniques is the determination of emissions flux (mass emission rate) by calculation from measured concentration.

Efforts need to be made to extend the traditional analytical methods currently used to detect greenhouse gases (e.g. UV photometry for ozone, mass spectrometry, FTIR etc…) by considering recently emerging sensor technologies. Advantages of new methods include their real-time or online monitoring capability allowing in-situ or remote measurements of polluting species without sample collection and preparation. Novel technologies are at the research stage, for example new sensor techniques are being developed such as cavity ring down spectroscopy, and quantum cascade lasers. These technologies need metrology support to develop into routine methods that can be deployed in the field. In many cases the sensor technologies have been developed but specific issues relate to the sampling and transport of flue gas to the sensor head. Technologies such as Differential Absorption Lidar and Solar Occultation Flux have been developed within member institutes and NMIs. Commercial adoption and wide-scale implementation of these technologies is being held up by a lack of independent validated methodologies. There must be traceability for new techniques as well as comparisons with existing methods.

Scientific and Technological 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 JRP protocol.

The overall aim of the JRP is to develop and enable the use of improved measurement technologies for monitoring GHG emissions. This shall include direct measurements of stationary source emissions (such as from industrial stacks) and the measurement of fugitive emissions from area and complex sources. The JRP should provide validated and reliable measurements/methods with traceability wherever it is practicable to do so.

The specific objectives are:

1. Improved methodologies for calibration and traceability of measurements of GHGs
2. Develop sampling technologies for stack gas and multiphase measurements, e.g. novel portable measurement sensors
3. Develop and validate analytical methods, which can be "easily" used in the field to obtain reliable measurements of greenhouse gases.
4. Deployment of remote sensing technologies for GHG fugitive emissions and flue gas measurements.

The proposers should carefully prioritise methods and species to be addressed, given the frame conditions of a typical joint research project such as budget and project lifetime.

Proposers shall give priority to work that meets documented stakeholder needs and include measures to facilitate the development of European standards and Directives. The proposers shall describe which stakeholder input their prioritisation is based on.

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

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community. This may be through the inclusion of unfunded JRP partners or collaborators, or by including links to industrial/policy advisory committees, standards committees or other bodies. Evidence of support from the “end user” community (eg letters of support) is encouraged.

Where a European Directive is referenced in the proposal, the relevant paragraphs of the Directive identifying the need for the project should be quoted and referenced. It is not sufficient to quote the entire Directive per se as the rationale for the metrology need. Proposals must also clearly link the identified need in the Directive with the expected outputs from the project.

In your JRP submission please detail the impact that your proposed JRP will have on the following Directives (see references for full details):

- Directive 2009/29/EC “to improve and extend the greenhouse gas emission allowance trading scheme of the Community”
- Directive 2004/101/EC “establishing a scheme for greenhouse gas emission allowance trading within the Community”
- Directive 2003/87/EC “Establishing a scheme for greenhouse gas emission allowance trading within the Community”

You should also detail other Impacts of your proposed JRP as detailed in the document “Guidance for writing a JRP”

You should detail how your JRP results are going to:

- feed into the development of urgent standards through appropriate standards bodies
- transfer knowledge to the emission monitoring and instrumentation sectors.

You should also detail how your approach to realising the objectives will further the aim of the EMRP to develop a coherent approach at the European level in the field of metrology. 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 Member States and countries associated with the Seventh Framework Programme whose metrology programmes are at an early stage of development to be increased
- outside researchers & research organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of 3 years duration.

Additional information

The references were provided by PRT submitters; proposers should therefore establish the relevance of any references.

Directives:

[1] Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0063:0087:en:PDF

[2] Directive 2004/101/EC of the European Parliament and of the Council of 27 October 2004 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:338:0018:0023:EN:PDF

[3] Directive 2003/87/EC EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:275:0032:0032:EN:PDF

EC decisions

[4] DRAFT: Commission Decision of xx/xx/2009 amending Decision 2007/589/EC as regards the inclusion of monitoring and reporting guidelines for greenhouse gas emissions from the capture, transport and geological storage of carbon dioxide

[5] Commission Decision 2009/339/EC of 16 April 2009 amending Decision 2007/589/EC as regards the inclusion of monitoring and reporting guidelines for emissions and tonne-kilometre data from aviation activities http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:103:0010:0029:EN:PDF

[6] Commission Decision 2009/73/EC of 17 December 2008 amending Decision 2007/589/EC as regards the inclusion of monitoring and reporting guidelines for emissions of nitrous oxide http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:024:0018:0029:EN:PDF

[7] Commission Decision 2007/589/EC of 18 July 2007 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:en:PDF

[8] Brussels European Council 8/9 March 2007 Presidency Conclusions. P10-14, p19-23 http://register.consilium.europa.eu/pdf/en/07/st07/st07224-re01.en07.pdf

Other References

[9] Kyoto protocol http://unfccc.int/kyoto_protocol/items/2830.php and http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/03/154&format=HTML&aged=0&language=EN&guiLanguage=enn

[10] European Commission International Press Release. IP/08/1998, 17/12/2008. “Climate change: Commission welcomes final adoption of Europe's climate and energy package” http://europa.eu/rapid/pressReleasesAction.do?reference=IP/08/19988

[11] 2nd International Workshop on remote sensing of emissions, US EPA, 2008 - http://www.epa.gov/ttnchie1/efpac/workshops/remotesens08.html

[12] GasSim simulates the fate of landfill gas arising from managed or unmanaged landfill sites. http://www.gassim.co.uk/

[13] American Petroleum Institute Standards: “API SMART LEAK Smart Leak Detection and Repair (LDAR) for Control of Fugitive Emissions” http://engineers.ihs.com/document/abstract/SXSHFBAAAAAAAAAA

[14] API PUBL 342 Fugitive Emissions from Equipment Leaks 1: Monitoring Manual http://engineers.ihs.com/document/abstract/TWZMCAAAAAAAAAAA

[15] API PUBL 343 Fugitive Emissions from Equipment Leaks II: Calculation Procedures for Petroleum Industry Facilities http://engineers.ihs.com/document/abstract/HTOJEAAAAAAAAAAA