

Title: Metrology to support Carbon Capture and Storage

Abstract

A European measurement infrastructure is required which will support the development and uptake of carbon capture and storage, a key climate change mitigation mechanism. Specifically, newly developed measurement capabilities are needed to improve the measurement of CO₂ streams and process side-streams to support CO₂ networks/clusters and to detect and quantify CO₂ leaks.

Conformity with the Work Programme

This Call for JRP's conforms to the EMRP Outline 2008, section on "Grand Challenges" related to Energy and Environment on pages 23 and 24.

Keywords

Climate Change, Carbon Capture, Carbon Storage, Carbon Sequestration, Monitoring, Verification, CO₂ Emissions, Traceability, Novel Technology, Standardisation, CO₂ Measurement, Phase Change, Leak Detection

Background to the Metrological Challenges

Fossil fuel power plants provide 56 % of the total electricity demand in Europe. The European Commission is actively committed to carbon capture and storage (CCS) to transition to a low carbon economy through the EC's strategic initiative "Preventing dangerous climate change". The Commission has demonstrated its commitment through the Directive on the geological storage of carbon dioxide. [1]

CCS is a key technology solution to provide short to medium term mitigation for the continued use of fossil fuel in primary power production. The EU has stated that "The environmental integrity of CCS is the Commission's overriding concern. This is partly a matter of ensuring that the CO₂ captured and stored remains isolated from the atmosphere in the long term; and partly about ensuring that the capture, transport and storage elements do not present other health or ecosystem risks." [2]

A key requirement is for networks to act as CO₂ hubs for multiple capture processes and industrial CO₂ producers. These hubs will provide scale-up to allow CCS to be cost-effective. There are a number of European CCS cluster initiatives which are developing transport networks for combining CO₂ from multiple capture sources. These are uncovering new measurement requirements which should be addressed at a common European level. Clusters require measurements of composition, physical parameters and flow to manage and control their operation. Particular metrology requirements relate to on-line composition analysis, metering, process control and leak detection.

Commercial field instrumentation is presently not able to provide measurements of low concentrations of contaminants in the presence of high concentrations of CO₂. In-situ measurements are currently not possible due to a lack of spectroscopic data and little understanding of the state/phase of contaminants in dense phase CO₂ matrices. On-line determination of the density of the streams (dense phase CO₂ plus contaminants) is necessary to allow mass flow rates of the contaminants to be calculated. High performance techniques will be required to validate and monitor the capture efficiency of operational plants. There is no European standardised reference method for CO₂ mass emission measurement, or for the measurement of emissions of amines and other degradation products resulting from amine post capture processes.

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 JRP shall focus on the traceable measurement and characterisation of carbon capture and storage systems.

The specific objectives are:

1. To provide accurate traceable flow measurements of high-pressure dense phase CO₂.
2. To develop on-line measurement of the composition and physical parameters of CO₂ capture streams: sampling, phase changes, minor contaminants, water vapour concentration enhancement, density, viscosity and their possible inter-relations.
3. To develop traceable standardised methods for the quantification and localisation of CO₂ losses from the carbon capture and storage chain. This will imply measurement of the mass emission rate of CO₂ in emission streams from capture facilities with an uncertainty of 1.5 % and realisation of new set-ups (such as novel on-line laser-based measurement techniques).
4. To develop traceable standardised methods for the measurement of emissions of the by-products of CO₂ capture.

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 R&D work, the involvement of the user community such as industry, and standardisation and regulatory bodies, as appropriate, is strongly recommended.

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

EURAMET expects the average size of JRPs in this call to be between 3.0 to 3.5 M€, and has defined an upper limit of 5 M€ for any project. The available budget for integral Research Excellence Grants is 30 months of effort.

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 (e.g. letters of support) is encouraged.

You should detail how your JRP results are going to:

- feed into the development of urgent documentary standards through appropriate standards bodies.
- transfer knowledge to the carbon capture and storage sector.

You should detail other impacts of your proposed JRP as detailed in the document “Guide 4: Writing a Joint Research Project”

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 and includes 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 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 NMI and DI to be involved in the work.

Time-scale

The project should be of up to 3 years duration.

Additional information

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

- [1] EU Directive 2009/31/EC: Geological Storage of Carbon Dioxide
- [2] COM(2006) 843 final COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT Sustainable power generation from fossil fuels: Aiming for near-zero emissions from coal after 2020