EMPIR Call 2020 – Fundamental, Industry and Normative

Selected Research Topic number: **SRT-i13**
Version: 1.0

Title: Metrology for decarbonisation of the gas grid

Abstract

The European natural gas market currently provides 24 % of the total energy supply across Europe for domestic use (e.g. boilers and cookers). International standards for natural gas are well-developed, but they have not been adapted for hydrogen enriched natural gas or hydrogen. According to the European environmental agency the energy sector emits the highest share of carbon dioxide emissions and emissions from fuels contributed to 55.1 % of total greenhouse gas. Therefore, support is needed to decarbonise the natural gas grid using mechanism already being carried out by European gas distribution networks on flow metering, physical properties measurements, gas quality analysis and monitoring of fugitive emissions.

Keywords

Decarbonisation, natural gas, hydrogen, biomethane, hydrogen enriched natural gas, carbon capture and storage, flow metering, purity, leakage

Background to the Metrological Challenges

The introduction of decarbonisation of the gas grid means current methods for calculating amounts of energy provided to customers are no longer accurate. The development of new capabilities to monitor for leaks (of hydrogen enriched natural gas and carbon dioxide) is imperative for ensuring health and safety in the gas industry. CEN/CENELC sector forum ‘Energy management’ highlighted the need to develop new capability to ensure current measurements required for the natural gas industry can be performed for the alternative low carbon fuels such as biomethane, hydrogen and hydrogen enriched natural. Complete elimination of gas networks is not a viable option due its importance in providing heat to homes across Europe. However, decarbonising the gas grid is seen as an important step forward to meet stringent targets set by the Climate Change Act (2008) and continue the use of gas for heating whilst reducing carbon dioxide emissions.

For hydrogen enriched natural gas several techniques such as speed of sound, gas chromatography and Roman spectroscopy have been proposed as promising methods for rapid calculation of hydrogen amount fraction un natural gas, but these methods have not been fully developed or validated to ensure they are fit for purpose. GCs used for natural gas composition measurements not been validated against traceable primary reference materials for hydrogen enriched natural gas. To ensure the methods is suitable, robust performance testing is required to assess accuracy, range and response time. Furthermore, calibration gas mixtures are available to measure the impurities listed in ISO/TR 27921 and gas standards are available for use with ISO 14687, but only for fuel cell vehicles, not for domestic appliances. Currently, ISO standards (ISO 2075-2) for calculation of thermodynamic properties have been validated using limited test conditions for hydrogen enriched natural gas, and the results show deviation from expected results. The current flow meter types used for metering natural gas require knowledge of fluid physical properties to determine flowrate and existing flow meter technologies is insensitive to Reynolds number and does not require input of fluid physical properties to accurately determine flowrate. Thus, the need to establish a robust metrological infrastructure and knowledge base for the flow metering of hydrogen enriched natural gas.

The European gas market is huge and a complete substitution of natural gas with hydrogen is a long-term goal for some European countries, but these strategies involve incremental increases in hydrogen amount fraction of between 20 % and 100 %, and some countries are making plans to produce 100 % hydrogen gas grid demonstration as early as 2022. A fast transition of a decarbonising gas grid could support the continued operation of the natural gas market whilst enabling new renewable technologies.

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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 to reduce carbon emission by decarbonising gas grid.

The specific objectives are

1. To develop a metrology infrastructure to support flow new metering requirements for hydrogen and hydrogen enriched natural gas in accordance with the EU Measuring Instruments Directive with errors as low as ± 1 % as well as the metering of carbon dioxide in carbon capture and storage processes in Emissions Trading System with accuracy of ± 1.5 - 2.5 %.
2. To develop validated methods for gas analysis and primary reference materials (with gravimetric uncertainties of 20 % relative) to support the gas industry un performing gas quality measurements for pure hydrogen gas (ISO 14687), biomethane (EN 16723-1) and hydrogen enriched natural gas (EN 16726) for domestic use (e.g. boilers and turbines), and purity analysis of hydrogen and carbon dioxide for use in manufacturing (e.g. food, cement and steel).
3. To develop metrological methods to support measurement of physical properties for hydrogen enriched natural gas and carbon dioxide. This will require development and validation of analytical instruments and measurements of calorific values, density, bubble point, dew point, relative density and Wobbe index as specified in ISO 6976, ISO 12213 and ISO 20765.
4. To develop a metrology infrastructure to support new leak detection requirements for use of new energy gases. This includes traceable monitoring methods for accurately quantifying leaks of hydrogen enriched natural gas from pipelines at 25 % of the lower explosive limit (health and safety reasons), and carbon dioxide leaks from pipelines or underground storage in CCS processes to meet the requirements of EU Emission Trading System (accuracy of ± 1.5 - 2.5 %).
5. To disseminate and facilitate the take up of the technology and measurement infrastructure developed in the project by the measurement supply chain (accredited laboratories, instrument manufactures), standards developing organisations (ISO, CEN/CENELC) and end users (hydrogen industry, gas net operators and suppliers)

Proposers shall give priority to work that meets documented industrial needs and include measures to support transfer into industry by cooperation and by standardisation. An active involvement of industrial stakeholders is expected in order to align the project with their needs – both through project steering boards and participation in the research activities.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this. In particular, proposers should outline the achievements of the EMPIR project 18NRM06 NEWGASMET and how their proposal will build on those.

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 1.8 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 30 % of the total EU Contribution across all selected projects in this TP.

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 Chemical industry 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.

Additional information

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

[1] M/475 Mandate to CEN for standards for biomethane for use in transport and injection in natural gas pipelines