

Title: Metrology for biogas

Abstract

There is an urgent pan-European need for traceable and robust measurement methods to be developed for the analysis of biogas and biomethane. These measurements will be required to support the specifications that are being drawn up by CEN TC408 in response to the EC's Mandate M/475 [1]. The specifications cover biomethane for injection into natural gas transmission networks and for use as a vehicle fuel. Novel and traceable methods for the analysis of key trace-level impurities, water and particulates in biogas and biomethane, the critical physical properties of biogas and biomethane, and the concentration of biomethane in samples blended with natural gas are required. There is also a requirement for validated methods for sampling biogas and biomethane in the field as this will enable the biogas industry to perform robust and traceable quality assurance measurements.

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 8 and 23.

Keywords

Gas, biogas, biomethane, non-conventional gas, impurities, calorific value, dew point, physical properties, water, particles, sampling, natural gas, network, pipelines

Background to the Metrological Challenges

The European natural gas supply is being diversified because natural gas resources are declining. European Directives [2] and EC targets specify that 20 % of EC energy consumption should come from renewable sources, and that biofuels should provide at least 10 % of transport petrol and diesel consumption by 2020. As a direct result of this, European biogas production reached 10 megatonnes of oil equivalent in 2011. Also at the start of 2012, Europe had approx. 12 400 biogas plants, producing 65 300 GWh of energy. However, more of this biogas needs to be injected into natural gas networks to meet these targets. Currently, there are more than 1.5 million natural gas fuelled vehicles operating in Europe with over 3 500 natural gas refuelling stations. It is hoped that biogas (biomethane alone or blended with natural gas) can enter this market and be used as a 'green' vehicle fuel.

To support the increase in the use of biogas, the EC's Mandate M/475 instructs CEN to develop a specification for biomethane for injection into natural gas transmission networks, and for use as a vehicle fuel. CEN TC408 is developing this specification, which includes the maximum levels of impurities and contaminants within the gas, the water content and the water dew point, physical properties, determination of the concentration of biomethane in gas pipelines, and methods for biogas sampling. Relevant testing and analysis methods will be included but it will not define or put into place the requirements for the comprehensive traceable impurity analysis of biogas. At present, a large number of the measurands in this specification do not have methods available for their measurement in biogas and biomethane. Also methods need to be developed to analyse multiple components simultaneously.

Recent research has shown that the analysis of biogas is feasible and that traceable measurements are needed. Novel methods have been developed for the analysis of the composition of biogas. However, some analytes have been shown to be highly matrix sensitive. Further investigation and modelling of these characteristics is required. Also, new traceable measurements need to be developed for the measurement of water dewpoint in biogas. Raw biogas is a particular challenge due to its high water content. The water enhancement factor and the correlation between water dew point and water concentration need to be

studied in biogas as does the performance of commercially-available hygrometers. Methods to carry out the measurement of particulate number, concentration and size distribution in ambient air are well-developed, used routinely and have been standardised, but they have not yet been applied to biogas. Traceable measurements of the physical properties of biogas are urgently required and the development of industrial on-line measurements will be highly challenging. The instruments which are currently available are not suitable for use by small-scale producers of biogas. Similarly, the method of defining the methane number needs to be improved as existing calculations partially rely on proprietary information that cannot be validated. The concentration of biomethane in a mixed gas sample can be determined by the measurement of its ¹⁴C content. However, the methods involved lack robust traceability and the uncertainty of the methods requires investigation. The use of more routine techniques also needs to be investigated. Current methods for sampling reactive and unstable components in biogas give inconsistent and unreliable results and are in need of further development. Also the technology for the online analysis of impurities in biogas requires development before process biogas analysers can be deployed commercially.

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 biogas.

The specific objectives are

1. To develop novel and traceable methods for the analysis of key trace-level impurities in biogas and in biomethane. This should support the biogas specifications being developed by CEN TC408.
2. To develop robust analytical capabilities for the measurement of the particulate content and of the water content / dew point of biogas and biomethane.
3. To develop and validate methods for the measurement of the physical properties of biogas and biomethane.
4. To develop a traceable method for determining the concentration of biomethane in samples of blended biomethane and natural gas.
5. To develop robust methods for sampling biogas and biomethane in the field, and to enable the biogas industry to perform robust and traceable quality assurance measurements.

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. In particular, proposers should outline the achievements of the EMRP project ENG01 and how their proposal will build on these.

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 (eg letters of support) is encouraged.

You should detail how the JRP results are going to:

- feed into the development of urgent documentary standards through appropriate standards bodies
- transfer knowledge to the biogas sector

You should detail other impacts of the 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 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] EC Mandate M/475, Mandate to CEN for standards for biomethane for use in transport and injection in natural gas pipelines.
- [2] Directive 2009/28/EC on the promotion of the use of energy from renewable sources.