TITLE: Characterisation of Energy Gases

Abstract

A strong trend in Europe is towards greater diversity and security of fuel supply [1] and a reduction in its carbon intensity. This is driven in part by the improved environmental performance of alternative fuels such as biogas [2], and also by the requirement for Europe to import increasing amounts of (gaseous) fuel from various sources. Additionally, the introduction of carbon emission trading schemes to ensure that emission reductions are achieved in the most cost-effective way has focussed attention on important classes of fuels such as "refinery gas" and "syngas" which are traded between industries. Moreover, the EU has outlined supply security and interconnectibility of the gas delivery systems as the top priorities in developing the gas infrastructure in Europe and fair pricing is one of the fundamental objectives of EU. The application of European directives [4] for opening the gas market to competition also leads to a supply from various gas sources and to an increased number of interfaces in European networks. Thus, the gas composition flowing in the European pipes is no longer constant.

Joint Research Project(s) submitted for this topic should address the need for accurate and comparable measurements of different fuel types that can enable users to make informed commercial, environmental and safety decisions based on comparable measurements of the energy content, carbon content, moisture content and physical/chemical properties of different gaseous fuels.

Conformity with the Work Programme

This Call for JRPs conforms to the EMRP 2008, section on "*Grand Challenges*" related to *Energy* on pages 8 and 23. It addresses the identified programme priority to address new and renewable energy sources.

Keywords

Gas transport, energy, gaseous fuels, natural gas, biogas, energy content, moisture content, humidity, composition, calorific value

Background to the Metrological Challenges

There has been, and will be a substantial increase in the number of (hydrocarbon) gaseous fuels in widespread use across the EU, including for example biogas and alternative hydrocarbon gases that were unattractive in the past due to their lesser properties but now are being produced and transported. This is due to their superior environmental performance when compared to other fossil fuels and their availability now that the security of energy supply is a big issue. However, there is no recognised infrastructure for determining the energy content or other physical/chemical properties (such as the condensation properties or the moisture content) of these fuels. The proposed research area would address the need for novel analytical methods and sampling approaches that can provide traceable measurement data to sustain efficient, safe and environmentally informed trade in such fuels.

A significant capability is already in place at NMIs within EURAMET to make measurements of the calorific value (energy content) of natural gas based on highly accurate analysis of the composition of the gas. This proposed research topic concerns the extension of this metrology and measurement infrastructure to the determination of the *energy content of a range of alternative (hydrocarbon) gases and renewable gaseous fuels*.

Examples are:

- Various (unusual) natural gas qualities (for example 'wet gas', which was unattractive and not used in the past but will be in the near future)

- Biogas: - mainly methane, with carbon dioxide and other trace compounds.

- Refinery gases and "syngas" - extremely varied composition, rich in hydrogen and carbon monoxide; contains unsaturated hydrocarbons

In addition, there are a number of *physico-chemical properties of these fuels* and also of natural gas for which there are unmet requirements for traceable measurement results to underpin fair and safe trade. In particular:

- The condensation properties of natural gas determine the conditions under which it can be safely transported.

- The water vapour content of hydrocarbon fuels can be an important property in determining under what conditions they can be transported and compressed.

- The (fluctuating) moisture content in fuels from different sources will affect the calorific value of these gases.

Numerous energy technologies – established and novel – need reliable **humidity measurements** in a range of gases, at a range of pressures. Humidity measurement techniques are diverse and each presents different challenges for use and calibration in a range of pressures and gases.

Currently, testing and calibration of hygrometers is generally only available in air at near-atmospheric pressures. National humidity standards and calibration laboratories worldwide operate exclusively with atmospheric-pressure air or nitrogen. Only a few NMIs have begun making first steps towards either multi-gas or multi-pressure calibration. Lack of access to relevant traceability is a technical barrier to valid measurement, sensor improvement and, ultimately, consumer protection.

A further set of technical challenges requiring research relates to the *accurate sampling of these fuels* at different temperatures and pressures such as to maintain the integrity of the sample including any trace components present. In the absence of agreed and representative sampling methodologies, there can be no confidence in the results of measurements.

Scientific and Technological Objectives

Proposers should aim to address all of the stated objectives below. However where this is not feasible (i.e. due to budgetary or scientific / technical constraints) this should be clearly stated in the JRP protocol.

The objectives are based around the PRT submissions. As experts in the field, JRP proposers should establish the current state of the art, which may lead to amendments to the objectives - these should be justified in the JRP proposal.

The core objective of this topic is the development and validation of traceable measurement methods for the transport and trade of a variety of energy gases, which are of growing interest for the sustainable European energy supply.

Specific objectives, which should be relevant to transport and trade of energy gases, are:

- Development and validation of measurement methods for calorific value, chemical composition and specific physical quantities of alternative (hydrocarbon) gases and renewable gases

- Developing sampling methods for these fuels at different temperatures and pressures

- Development of measurement methods and humidity standards to provide valid measurement traceability for humidity measurements in energy gases, for a broad range of humidities and pressures

- Enabling harmonization of new NMI capabilities for composition, calorific value and humidity metrology in energy gases, and recognition of these in international metrology infrastructure (e.g. CIPM MRA CMC database).

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 Directive of the European Commission:
  "Second Gas Directive" 2003/55/EC [4]
  "Promotion of the use of energy from renewable sources Directive" 2009/28/EC [2]

You should detail the impacts of your proposed JRP as detailed in the document "Guidance for writing a JRP"

In response to the need for standardised measurement techniques you should detail how your JRP results are going to:
- Feed into the development of documentary standards and guidelines through CEN, or other standards developing bodies or other appropriate bodies
- Transfer knowledge to the industry, regulators and policy makers.

Additional Information

References were provided by PRT submitters; proposers should therefore establish the relevance of any references"

[1] Council Conclusion on "Second Strategic Energy Review – An EU energy security and solidarity action plan", Transport, Telecommunications and Energy Council Meeting, EU, Brussels, 19 February 2009

[2] Directive 2009/28/EC of the European Parliament and the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and

subsequently repealing Directives 2001/77/EC and 2003/30/EC http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF

[3] European Metrology Research Programme. Outline 2008 Edition - November 2008, http://www.euramet.org/index.php?eID=tx_nawsecuredl&u=0&file=fileadmin/docs/EMRP-outline2008.pdf&t=1248796946&hash=9da9ceb781370f04c322ac48068deca5

[4] 2003/55/EC of the European Parliament and of the Council of 26 June 2003 (the "Second Gas Directive") concerning common rules for the internal market in natural gas and repealing Directive 98/30/EC. http://www.energy.eu/directives/l_17620030715en00570078.pdf, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:176:0057:0078:EN:PDF