

Title: Metrology support for the development of standardised methods for methane emission detection and quantification

Abstract

Methane, the second largest contributor to anthropogenic greenhouse gas emissions, causes global warming. Therefore, methane emissions need to be reduced to tackle climate change. To achieve this, the EU's Methane Action Plan will support the Global Methane Pledge to reduce global methane emissions by 30 % by 2030. The EU is also proposing methane regulations for the energy/mining sectors which support the COP26 Methane Pledge. To meet these important targets, reliable, comparable, validated and standardised methods need to be developed, in response to needs identified by CEN TC264 [1,2], in order to provide regulators and the industry with the tools they need to detect, quantify, report and reduce methane emissions at both source and site scales.

Keywords

Emissions, methane, validated detection and quantification methods, oil and gas, methane-reduction, regulated emissions

Background to the Metrological Challenges

There are many sources of methane emissions from a wide range of industries and there are voluntary industrial methane reduction schemes, including the oil and gas methane partnership (OGMP). However, better data on the detection and quantification of methane emissions needs to be provided. This will support industrial self-reporting and regulation, thus enabling methane emissions to be reduced more efficiently. Some companies implement leak quantification using a source level approach (a bottom-up approach) using direct measurements (e.g. hi-flow samplers). In contrast, the OGMP 2.0 reporting framework requires site level quantification measurements (a top-down approach) for comparison with the bottom-up source level approach. To achieve this, a standardised performance assessment approach needs to be developed.

In Europe, there have been almost no large-scale assessments of methane emissions from the oil and gas industry. Partly, because there are no internationally standardised methodologies for methane emission quantification. In addition, there has been no harmonised assessment of the capabilities of GHG emission measurement techniques and an independent verification protocol needs to be developed for assessing the capabilities of these techniques. Therefore, metrology support is needed by the industry so that they can undertake emissions studies and have confidence in the results obtained.

Current source-based methods for methane leak detection and repair, and the European Standard EN 15446, are based on US EPA method 21. In addition, historical correlation data is still in use for the conversion of concentration readings to estimated methane emission rates. These data do not fully reflect current methane emissions in Europe, especially if measured using this standard (> 100 000 ppmv). Therefore, correlation curves need to be updated and extended and new pegged factors need to be developed. The associated metrology infrastructure also needs to be improved through the provision of traceable reference leaks and proficiency testing for operators. EN 15446 is referenced within draft European regulations, and it is used by industries as the primary tool to identify and control leaks and to drive reductions in methane emissions. Therefore, CEN TC264 identified a need for revisions to EN 15446 [1] so that it better reflects industrial requirements and to address leak detection in new energy systems such as anaerobic digesters.

In the oil and gas industry fugitive source-based emission rates are usually directly quantified using the EN 15446 correlations approach. Given the poor accuracy of pegged factors (applied to leaks > 100 000 ppmv), the precise quantification of major individual leaks is performed de-facto using the bagging method (blow through / suction method as per the EPA-453/R-95-017 protocol). This method is in use in hi-flow samplers and in other new instruments, however a standardised method needs to be developed for their use.

In addition, performance standards and methods need to be developed for hi-flow samplers and updated correlation factors are needed for use in the direct methane leak quantification section of EN 15446 [1].

Measurements of methane emissions at industrial site, and at sub-site, levels are required within the oil and gas methane partnership (OGMP 2.0) as an independent check on bottom-up reported emissions. These checks have been proposed within the draft European regulations on methane emissions. Although, the existing EN 17628:2022 standard method for determining diffuse emissions of volatile organic compounds into the atmosphere can be used for methane, it is not optimised and it does not address all applicable methods. A methane-specific technical specification is in development by CEN TC 264 WG38, but further technical input has been identified by CEN TC264 as a requirement for its completion [2].

Site methane mass emission rate measurements require the measured methane concentration to be multiplied by the air flow, which is often determined from the wind field in the atmosphere using a range of different methods. These methods make different assumptions about the concentration field and the rate of air flow. Therefore, a standard air flow measurement method is needed for use with site methane mass emission measurement methods e.g. Differential Absorption Lidar (DIAL), Optical Gas Imaging (OGI), Tracer Correlation (TC) and Reverse Dispersion Modelling (RDM). In addition, performance requirements are not yet available for meteorological sensors such as wind anemometers, wind vanes and wind lidars. Although EN 17628 covers some general aspects, standardised methods need to be developed for the aforementioned meteorological parameters (or for the tracer flow rate in the case of tracer gas dispersion) in order to facilitate reliable site methane mass emission rate measurements.

Inter-laboratory comparisons have been undertaken to compare different methane measurement methods, including large controlled-release campaigns and comparison studies at industrial sites. However, standardised validation protocols were not followed and full uncertainty calculations are not available for these methods. In addition, the influence of the meteorological data on the uncertainties has not been rigorously assessed. Although uncertainties are available for some specific methods, common approaches and methods need to be developed.

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 metrology research necessary to support standardisation in methane emission detection and quantification.

The specific objectives are

1. To develop validated measurement protocols, performance standards and uncertainty budgets for source scale, component level, methane leak quantification methods (e.g. hi-flow sampling techniques and quantified optical gas imaging). Updated correlation curves should also be provided to CEN TC 264 as input for the revision of EN 15446. To develop performance standards for methane sensors and capabilities to produce methane reference leaks in the low range of admissible leaks, including methods to ensure calibration traceability. In addition, procedures should be developed to evaluate the sensitivity of portable leak detectors and quality control/quality assurance guidance should be written for use in the field. Standard methods should be developed for repairing methane leaks at source scale.
2. To develop a toolbox of standardised methods (e.g. DIAL, OGI, TC, RDM, airborne (unmanned aerial vehicles and aircraft) mounted sensors) for methane quantification at industrial site, and at sub-site, levels including the development of standardised performance evaluation approaches for methane emission quantification, performance testing protocols for methane sensors and complete measurement methods. Specific monitoring methods for detecting and quantifying methane emissions from pipelines could also be developed. In addition, method validation protocols should be developed that i) cover the range of operating environments (typically 10's to 100's of metres horizontally and a few 10's of metres vertically), ii) take into account complex topography and infrastructure and iii) determine the operating envelopes linked to the experimental protocols, (including scanning paths, wind measurements (speed, profile, direction), inversion methodology when applicable (from concentration measurements to flow rate), temperature differences, etc.).
3. To develop standardised methods for determining site methane mass emission rates. This should include determining the influence of meteorological measurements (wind speed / air flow measurement / wind direction) on the conversion of methane concentration measurements to mass

emission when different sampling approaches are used. In addition, the impact on the associated uncertainties should be quantified.

4. To develop uncertainty calculations for the specific methane measurement methods used in objectives 1 and 2 including TC, DIAL, RDM and airborne systems (unmanned aerial vehicles and aircraft). The following sources of uncertainty should be considered: the impact of wind / air flow measurement (objective 3), sampling / scanning path approaches, geometrical configuration (such as sparse to dense obstacles), vertical distribution of emissions, etc. In addition, this should include close collaboration with CEN TC 264 WG38 for the development of standardised validation protocols.
5. To contribute to the standards development work of the technical committees CEN TC 264 (air quality) and CEN TC 234 (gas infrastructure) to ensure that the outputs of the project are aligned with their needs, communicated quickly to those developing the standards and to those who will use them, and in a form that can be incorporated into the standards at the earliest opportunity. In addition, to support the Oil and Gas Methane Partnership framework (OGMP 2.0) in the development of the capabilities needed for a robust quality assurance framework to ensure the quality and comparability of reported methane emissions data. The approach should be discussed within the consortium and with other EURAMET NMs/DIs, e.g. via the EMNs for Energy Gases and Pollution Monitoring.

The proposed research shall be justified by clear reference to the measurement needs within strategic documents published by the relevant Regulatory body or Standards Developing Organisation or by a letter signed by the convenor of the respective TC/WG. EURAMET encourages proposals that include representatives from industry, regulators and standardisation bodies actively participating in the projects. The proposal must name a “Chief Stakeholder”, not a member of the consortium, but a representative of the user community that will benefit from the proposed work. The “Chief Stakeholder” should write a letter of support explaining how their organisation will make use of the outcomes from the research, be consulted regularly by the consortium during the project to ensure that the planned outcomes are still relevant, and be prepared to report to EURAMET on the benefits they have gained from the project.

Proposers should establish the current state of the art and explain how their proposed research goes beyond this. In particular, proposers should outline the achievements of the EMRP project ENG54 Biogas, the EMPIR projects 16ENG05 Biomethane and 18NRM06 NEWGASMET and the Partnership projects 21NRM04 BiometCAP and 21GRD04 isoMET and how their proposal will build on those.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 1.0 M€ and has defined an upper limit of 1.3 M€ for this project.

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

Any industrial beneficiaries that will receive significant benefit from the results of the proposed project are expected to be beneficiaries without receiving funding or associated 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,
- Facilitate improved industrial capability or improved quality of life for European citizens in terms of personal health, protection of the environment and the climate, or energy security,
- Transfer knowledge to the energy and other methane-emitting sectors.

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 the Partnership 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] *003 CEN TC 264 Air Quality: Updated correlation factors for EN 15446 Leak detection for gas industry and other new application areas.*
<http://metpart.eu/nrm-call-2023>
- [2] *004 CEN TC 264 Air Quality: Development of validated measurement method, performance standards and uncertainty for leak quantification methods – hi-flow sampling techniques and quantified optical gas imaging.*
<http://metpart.eu/nrm-call-2023>