GERG Activity Report 2017 -8

Introduction

2017 -18 marked a year when the ideas of an integrated, sector-coupled energy system really took hold, and the recognition of the role hydrogen will play became almost mainstream. It is gratifying to see around 2 decades of hard work and foresight that GERG and its members' R&I departments have shown in pushing the agenda for hydrogen now start to realise the value for the community. GERG worked to persuade the Comission to establish the NaturalHy project in the early years of this century. This and the subsequent HIPS project laid the groundwork for much of the activity which today sees multiple demonstrations of H_2 blending and power to gas, and an official recognition of the importance of these technologies in our future energy system. GERG continues to push the hydrogen agenda, with its technical depth hand robust engineering approach also feeding the policy agenda. In this respect GERG was invited to present at two panel discussions on Sector Integration by senior commission representatives.

Focus within gas innovation increasingly addresses the place of gas in a low-carbon, more integrated energy system, and the work which GERG is doing increasingly reflects this focus.

The organisation remains strong, and this year numbers have been consolidated rather than grown. We welcomed the return of Polish Oil and Gas, and the arrival of TIGF, now Terega. The constant churn of reorganisations in the industry led us to lose both Gasum and DEA. A number of new membership enquiries are in progress at this time. The gas industry both upstream and downstream remains a challenging and continuously changing environment in Europe and we continue to work hard with our members to create an Association which adds value for their diverse interests and priorities.

We continue to look for new partnerships and are working more closely than ever with other Associations and stakeholders in Brussels and beyond. A number of activities with Marcogaz, Eurogas, GasNaturally, CEN, and the European Commission will be covered in this report. Additionally we continue to have a presence at Parliamentary level through a Management Board position on Knowledge for Innovation, which this Autumn organised a dinner debate on the Power to Gas in association with DVGW.

We continue to work to construct strategic technology roadmaps in priority areas which will form the basis of future activities, calls and targeted European level initiatives. For the moment GERG continues to operate with two Programme Committees, broadly speaking dealing with gas infrastructure and applications and LNG respectively. In parallel with these we now have Working Groups establishing priorities in hydrogen, utilisation, methane emissions and asset health.

Questions are increasingly being asked by policy makers about the future role of gas. GERG now has activities dealing with the main challenges facing the gas industry as we move through the energy transition, and look to demonstrate the key role gas will play in the future.

Broadly speaking these activities include:

Methane emissions

How can the industry demonstrate that it understands the extent of methane emissions and the challenges of reducing these? The MEEM project, led by DBI in Germany has worked to establish an accepted Europe-wide methodology for the estimation of methane emissions, initially focussing on Europe's gas distribution networks. This project reached a successful outcome and follow on activities are now underway. In addition GERG was invited to present at a UN workshop in Geneva led by Marcogaz which brought together many stakeholders in the third of a series of such meetings

Renewable gas

Significant flagship projects are now underway in biomethane introduction in the gas grid, and in understanding how to push forward the limitations of hydrogen introduction to ensure that the energy

system is meeting the flexibility and low carbon challenge. Phase 2 of the GERG biomethane project, funded by the European commission and several members is now underway. We are working closely with CEN (the European Standardisation Agency) to ensure the relevance of this work. Work has focused on the need to understand what threshold values are needed for trace components to allow us develop robust European standards and therefore remove barriers to biomethane injection in the gas network. The Phase 2 project focuses on siloxanes in heavy duty engines and boilers, sulphur, oxygen in underground storage and health impacts.

In the case of hydrogen, the HIPSNET, European Power to Gas and Hyready projects are developing a deeper understanding of current knowledge of hydrogen injection into the grid, and recommended practices for network operators. GERG is also closely involved in the CEN and European Commission led Sector Forum Energy Management (SFEM) Working Group Hydrogen, and the new CEN TC6 on hydrogen. The ELEGANCY project is developing a robust view of the HH2/CO2 value chains which can be created through H2 production from natural gas followed by CCS.

Health of our networks and gas transport and use

if we are rightly arguing that our networks are the ideal existing source of energy transport into the future, we also need to ensure that they are fit for that future – lifetime extension, integrity and SMART operation are key here. Asset health R&D has been a traditional strength of GERG, with system operators forming a large part of our membership. This work is as important as ever, and is being supplemented by work to understand how our networks can become smarter and more flexible. Several projects developed by our member companies continue in these areas. Additionally, we are developing closer ties with Marcogaz to ensure that our work aligns technical needs with R&D outcomes. GERG has worked closely with Marcogaz and Eurogas on defining the Gas Smart Grid, and on understanding future scenarios for utilisation and for billing in a regime increasingly reliant on new gases.

LNG and the new markets it opens

Our LNG project portfolio continues to focus on metrology and the safety of small-scale systems. Industry standard projects on inline measurement (using Raman Spectroscopy), metrology of small-scale systems and small-scale LNG safety are underway or have been completed. Our members are hoping to develop the Raman technique to the point where it can become a standard method for direct determination of liquid composition. We are also developing models for release behaviour from small-scale facilities which are being validated against experiment at our state-of-the-art member facilities in the UK and France.

In summary, GERG continues to stay relevant to the evolving needs of the gas and energy community and the increasingly interconnected energy system. The GERG model for open collaboration in innovation is still giving us positive results and benefitting our members, partners and stakeholders in the wider community.

Removing Barriers to Biomethane injection – the GERG Biomethane Project

Biomethane and its introduction into the gas network

Renewably derived gases, whether biomethane or hydrogen, have the potential to make an enormous contribution to the long-term development of a low carbon energy system in Europe and beyond. Although volumes injected into our gas networks are currently small, they are showing rapid growth in some European countries. In the case of biomethane a pan European understanding of the steps needed to remove any technical barriers will greatly support the development of a viable and sustainable growth industry. To approach the removal of these barriers in a consistent and effective manner requires close cooperation with those developing the standards for use of biomethane.

Discussions on biomethane quality standard definition for network injection have been ongoing for several years now. However, a lack of scientific and tangible network data has held back a full understanding of the real impact of biomethane trace compounds on gas infrastructure as well as end-users.
Two European standards on biomethane have been published in 2016 / 2017:

- EN16723-1: Specifications for biomethane for injection in the natural gas network;
- EN16723-2: Automotive fuel specifications

Yet, they are only of voluntary application, and some thresholds values are either missing, or were set through stakeholder agreement but are not always based on real technical data, which has been lacking at a European level.

Therefore to ensure and secure the future of the whole biomethane industry, we need to define threshold values which ensure gas infrastructure integrity, and end-users' equipment integrity, without being unnecessarily stringent and therefore imposing unnecessary extra costs on producers.

The GERG Biomethane Project

In 2016, a GERG project was set up and launched at the initiative of several European gas grid and gas storage operators. This project was led by Engie Lab CRIGEN (representing the French gas infrastructure operators GRTgaz, GRDF, STORENGY). Partners included the Danish Gas Technology Centre, DGC (representing Danish gas operators) , DNVGL UK (representing the four UK gas distribution companies, National Grid/Cadent, SGN, NGN and Wales and the West), Gasum, Gaz System, Innogy, Snam Rete Gaz, and TIGF. Kiwa and DNVGL Netherlands provided additional technical input and delivery based on existing Dutch industry knowledge and their known expertise in this area.

Since there is no precise knowledge about the choice of trace components to follow and the definition of threshold values, the aim of the GERG biomethane project is to gather robust technical information regarding the impacts of biomethane trace components on the gas infrastructures and on the end-users' equipment to propose revision of the standards using strong technical arguments.
The first step, completed this year, is a literature and operational data review to identify the gaps of knowledge. It focuses on two aspects:

- Corrosion: impact of the biomethane trace components in terms of corrosion: CO, HCN, H_2S, NH_3, HCl, HF, organo-halides, micro-organisms;
- Siloxanes: impact of silica compounds found in biogas sources both on the gas infrastructure (pipes, compressors, valves) and on end-users (boilers, engines).

A unique set of data regarding real biomethane quality

Phase 1 of the GERG biomethane project has allowed us to collect a unique set of data regarding real biomethane quality. These data were collected by partners who need to perform biomethane analysis

prior to its injection into their gas networks. As there is very little public documentation on trace compounds concentrations in biomethane, this set of data is highly valuable.

These data are very helpful to aid understanding of the real biomethane composition in the gas networks and in the end-users' appliances. The data sets also give some clues on the ease with which biomethane producers can meet the current requirements of EN 16723-1 or the thresholds that may be suggested at the end of coming phases of the project.

The extensive review performed highlighted the gaps of knowledge regarding the impact of biomethane trace compounds on gas infrastructure and on gas users: in particular, the study shows that the impact of siloxanes on heavy duty engines and on some boilers needs further understanding, as well as the impact of biomethane on some materials, especially in the presence of water (which is the case in underground gas storage).

Phase IIa – The Horizon 2020 European Supported Project

In January 2018 the GERG partners of the Phase I project, with the addition of PGNIG and Gasunie began a 15 month project designed in conjunction with CEN TC408 and DG Ener. The project has gathered stakeholders (biomethane producers, boilers manufacturers, engines manufacturers, gas grid or storage operators, etc.) in its supervisory board in order to obtain a consensus on values that should be used as thresholds in the future European standards.

- Bench tests to understand the impact of siloxanes on heavy duty engines;
- tests regarding the impact of siloxanes on boilers and other stationary appliances;
- review on the impact of oxygen on underground gas storages;
- review on the impact of Sulphur on vehicles;
- Impact on health (which is to be studied through the expert group EG4 of CEN TC408).

This project is helping to obtain threshold values in agreement with the interests of all the stakeholders needed to develop a successful biomethane industry in Europe:

- Biomethane producers: need to have limited treatment / upgrading costs to guarantee the economic viability of the projects, and thus the development of the biomethane sector;
- Grid operators: need to protect the grid infrastructure while including renewable gases in the grid;
- End-users: need to protect their equipment (boilers, engines, etc).

A Scania engine on the DNVGL Siloxane test bed in Groningen

Methane Emission Estimation Method for the Gas Distribution Grid

The project *Methane Emission Estimation Method for the Gas Distribution Grid (MEEM)* is the second phase of the project *Analysing the Methods for* Determination *of Methane Emissions of the Gas Distribution Grid* which was initiated in November 2014 by members of the European Gas Research Group (GERG). The aim of the project was to improve the accuracy and reliability of national emission estimations, to increase the transparency of the associated results, and to provide a basis for a consistent methane emission estimation. The subject of methane emissions from gas infrastructure is very high profile in Europe, and this project is important in demonstrating a harmonised understanding of gas emissions across European industry.

Background and Motivation

The first project phase was finished in October 2015 and developed the fundamentals of the MEEM project. Best practices and optimization potential of existing methods of determining methane emissions of the gas distribution grid were identified. System boundaries have been aligned for the scope of the gas distribution grid, and sources as well as categories of emissions were defined. It was found that some of the methods in place are very detailed and require a high effort to collect input data. Other methods, which are less detailed and easier to apply, lead to less accurate and more conservative results. Ideally, a pan-European method for the determination of emissions from the gas distribution grid should combine the advantages of the different methods depending on their relevance to different emission categories.

Research Approach

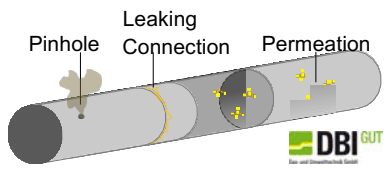
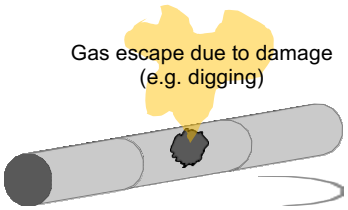
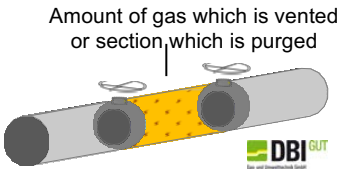
The project comprised eleven representatives from grid operators, research institutes and associations of ten European nations: Belgium, Czech Republic, Denmark, France, Germany, Italy, the Netherlands, Spain, Switzerland and Turkey. Supported by representatives from Marcogaz and Eurogas (who joined selected meetings and contributed to the discussion of important documents) the partners provided information and practical expertise as a basis for the development of a method for the estimation of methane emissions of the gas distribution grid. External requirements (e.g. for the reporting of greenhouse gas emissions for the United Nations Framework Convention on Climate Change) were collected within the project by contacting national environmental agencies and were considered for the development of the method.

To evaluate promising methods for the emission estimation, a questionnaire was prepared and sent to multiple distribution system operators (DSO). The results of the questionnaire showed which data are already available in several countries, and gave an indication on the effort for providing additional data. The benefit of combining elements from existing methods was investigated with a model in MS Excel, especially developed for the MEEM project.

Results

Methane emissions originate from pipelines (main lines and service lines) and gas facilities (e.g. pressure regulating stations). Since many different names exist for the same categories of emissions, the partners of the MEEM project agreed to use the terms *Intrinsic Emissions*, *Incident Emissions*, and *Operational Emissions*. According to the definition, *Intrinsic Emissions* include minor holes or cracks which are detected by survey, all technical leaks (e.g. leaking connections), as well as permeation. *Incident Emissions* are the result of damage to the pipeline and are reported by own staff of a DSO or third-parties (e.g. the public or staff of companies working near pipelines or facilities). *Operational Emissions* occur during commissioning and decommissioning, as well as during the renewal and maintenance of existing pipelines or facilities (Table 1)

Table 1: Categories of Emissions and Emission Types Covered by the Categories

Intrinsic Emissions	Incident Emissions	Operational Emissions
		
Emissions arising from: minor holes or cracks which are detected by survey, all technical leaks, as well as permeation	Emissions arising from: incidents/ accidents occurring e.g. due to landslide or third party damage and reported by third-parties or staff of DSO	Emissions arising from: venting and purging during commissioning, renewal, and decommissioning

Source: Own Illustration DBI Gas- und Umwelttechnik

For some emission types (e.g. permeation) an accurate emission estimation is possible without high effort and the best available method is already applied by many countries in Europe. For operational emissions (e.g. venting during pipeline maintenance) an accurate emission estimation is also rather easy, since only parameters which are exactly known by the DSO are considered. Nevertheless, the data collection for event-based approaches can be time- consuming.

For other emission types (e.g. leaks detected by survey) the estimation is challenging. Basically, the emissions can be estimated by defining the amount of gas escaping in a certain time span, and by defining a duration of gas escape as well as the number of leaks detected per year by survey. The number of leaks is known to the DSO. The emission rates are not known and different approaches exist for their determination. On the one hand, emission rates can be determined by direct measurements. On the other hand, it is possible to determine soil coefficients and calculate the emission rates with the help of leak size and pipeline pressure. Both approaches have advantages and disadvantages. Other challenges occur in the determination of the duration of gas escape for leaks detected by survey, since the exact time period between start and detection of a leak is unknown.

Summary

The new developed method (MEEM) provides equations and suggests input parameters/default values and assumptions for all types of emissions mentioned in Table 1 to support a consistent use of the method. MEEM combines best practice approaches of individual countries and is the starting point of an Europe-wide trusted emission estimation. With MEEM it is possible to make emission estimations for countries, e.g. for national emission inventories, but also for individual DSO, e.g. for sustainability reports. Moreover, MEEM helps DSOs to identify and show already achieved emission reductions, to coordinate further measures and to visualize further improvements.

The requirements for a possible verification of MEEM via the European Committee for Standardization (CEN) were collected and the MEEM report was structured in accordance to a CEN Technical Report. The partners have agreed to work alongside CEN to begin a standardisation process, with the support of Marcogaz. if this scientific work from GERG will be transferred to CEN, remains open and subject to the partners. In parallel, GERG is in the process of establishing projects which will test and validate the method in different countries.

Conclusions, Recommendations and Outlook

The key findings of the MEEM project can be summarised as:

- MEEM (the method) addresses all the relevant sources and types of emissions in the gas distribution grid within the boundaries as defined in the project.
- MEEM is as accurate as possible with reasonable effort, enabling a pan-European application.
- MEEM provides the potential for a very detailed emission estimation. Some countries in Europe already have the capability to apply a more sophisticated and complete emission estimation with elevated number of input data and advantages e.g. in terms of accuracy and transparency. Additionally, MEEM provides opportunities for a less complex emission estimation if data is not available at the required level of detail.
- Some challenging input parameters have been identified. Those parameters are currently estimated by expert assumptions from the group and should be validated in future follow-up research.
- Not all relevant input parameters are available in every country, the need for further measurements, updating of statistics, etc. has been identified.
- MEEM contributes to a more consistent methane emission estimation within Europe, also with an excel model, which includes all relevant equations and assumptions to support national or company emission estimates.

The following post-project activities are in discussion and are partly already initiated:

- A decision of the GERG Board in the Autumn 2017 Board Meeting: task force to plan actions on methane emissions research needed in follow-up to the MEEM-project,
- GERG/ Kiwa Technology (Netherlands) project proposal on suction measurements on underground gas leaks and a coordinated European measurement program,
- DVGW project on methane emissions of the gas distribution grid in Germany, including measurements on above and underground gas leaks,
- Gas Natural Fenosa/ SEDIGAS project on intrinsic emissions of PE gas distribution network in Spain.

Self regulating gas condensing boilers able to cope with gas quality variation: State of the art and performance. A new GERG project

Combustion controlled condensing boilers (CCCB) were first introduced 2001 and and offered by 11 European manufacturers in 24 European countries. The technology mainly relies on use of an ionization signal in combination with a smart control including a fail-safe function. In contrast to the established market introduction, the knowledge of grid operators, installers, members of standardization committees, and from independent lab- and field investigation seems to be poor.

Project goal and approach

With developing gas markets in Europe – e.g. market liberalization, integration of renewables, European standardization - gas application technologies providing a high flexibility to gases from different sources and renewable production (biomethane and hydrogen) become more important. Against this background five project partners (CETIAT; DGC; ENGIE, EON, GAS.BE) decided to conduct this project. The first phase of the project was executed as desk research from February to September 2017 and provides results on the technology of CCCB, standardization, market and existing literature. Appliance tests are being conducted in a second phase of the project. Project organization and the compilation of the report are supported by the project sponsors Gasunie Transport Services B.V, NL and Cadent Gas, UK.

Results of Phase I

Technical background

Despite strong efforts to standardize gas qualities in Europe, the Wobbe range is still defined nationally and differs from member country to member country. UK for example specifies a narrower band from 47.2 MJ/m³ to 51.4 MJ/m³, whereas Belgium allows a range from 46.6 MJ/m³ to 53.9 MJ/m³. Effective gas qualities and fluctuations at single exit points are rarely documented in Europe. Published measurements from France and Germany document a maximum local variation of the Wobbe number in ranges from 3.4 MJ/m³ to even 6 MJ/m³. As injection of renewable gases increases, gas quality will fluctuate even more.

Standard condensing boilers

Standard condensing boilers are designed to cope either to the group H (45.7 MJ/m³ to 54.7 MJ/m³) or E (40.9 MJ/m³ to 54.7 MJ/m³) respectively or the group L (39.1 MJ/m³ to 44.8 MJ/m³) defined in EN437. Within the gas group they should operate safely, reliably and cleanly. Comprehensive lab investigation within the GasQual project on new condensing boilers revealed the following:

- New condensing boilers adjusted to the nominal value of the gas group H cope with the whole bandwidth of gas quality within the group H
- Emissions of CO and NOx as well as efficiency depend partially strongly on the Wobbe number of the supply gas even within group H.
- Once the nominal adjustment of condensing boiler is changed (which may occur in the field, when gas quality is fluctuating) the appliance does not cope any more to the whole Wobbe range required.
- No experiences are documented for older, long-time installed condensing boilers.

The new technology of combustion controlled appliances may overcome these difficulties, as they adjust steadily to the nominal operation point avoiding an increase of emissions and false adjustments due to varying local gas qualities.

Technology of CCCB

Intensive desk research on this technology comprising literature research, technology analysis and market investigation has been conducted by the project partners. Information on different gas quality sensors on the market has been compiled, including direct and indirect measuring methods as well as sensors measuring before, within and after the combustion zone. The easiest method applicable for fully premixed burners used in condensing boilers is the measurement of the ionization current within the combustion zone. The signal responds quickly on gas quality change, so that a fast control is realizable. The form of the ionization curve depends strongly on the air factor, which itself depends on the gas quality. However the absolute value of the ionization signal may depend on the age of the probe and the boiler etc. This problem is solved by smart control software including a recalibration mechanism. Different systems based on patents from Kromschröder, Siemens and others are incorporated in different boilers. Condensing boilers from one manufacturer are equipped with a CO-probe to control air factor and gas quality. This manufacturer is also expected to switch to ionization controlled boilers. The construction and assembly of the actuator elements, fan and gas valve in the combustion controlled condensing boilers are very similar: The fan with an electronic speed control is the leading element. Gas is introduced in a venturi tube sitting in the inlet of the fan so that the air flow rate determines the pressure on the outlet side of the gas valve. The simple gas valve controls inlet pressure and an orifice often regulated by a step motor. The fail-safe function is given by the smart control. Within the standard EN437 CCCB are approved due to the category I2N comprising all gas groups within family 2, i.e. (39.1 MJ/m³ to 54.7 MJ/m³).

Market investigation CCCB

First CCCB entered the market in 2001 on a boiler with a maximum load of 15 kW. 12 manufacturers now offer this technology with in a load range from 12kW up to 150 kW. Not only single family houses, but also smaller flats up to multi-family houses and light to medium commercial buildings boilers may be equipped with this technology. The technology is offered on the wide panel of models. The technology is offered in at least 25 European countries. The technology is even offered in countries, where the category of EN437, I2N, is not yet accepted, for example UK. In these countries CCCB are approved due to I2HL or I2EL and their technical advantage may not be obvious for installers, customers and grid operators. Few reliable data of the market penetration of this technology are available. An inquiry of the Federation of German Heating Industry for DVGW revealed that nearly one third of the sold heating appliances in 2014 were combustion controlled condensing boilers. Installed capacity seems to depend very much on the region and on the local preferred manufacturers.

Technical Investigation documented

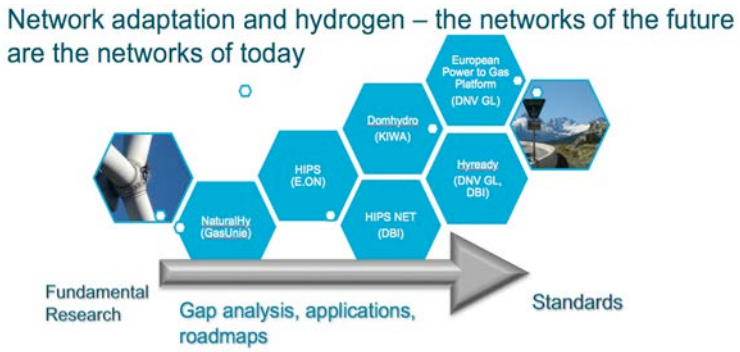
Literature research revealed an immense amount on publication on different sensor technology, gas quality studies and very specific details, but a lack on independent lab tests and field test of CCCB technology. Some few older publications document manufacturer-independent measurements of functionality, emissions and praxis behavior of CCCB. Against the background of gas quality standardization in Europe and the intent of some countries to enlarge their legal Wobbe range it is of great interest to make a new effort to measure and evaluate the technology of combustion controlled condensing boilers in the lab for the praxis.

Evaluation in the lab of existing boilers equipped with combustion control

The goal of the lab tests is to investigate –within the limited time and budget – five selected CCCB under conditions relevant for the current and future praxis. As gases we defined the whole range of test gases due to EN437 with a slight extension at the lower end due to the German group LL (34,3 MJ/m³ - 54,7 MJ/m³) including a bio methane and mixtures up to 30% Hydrogen. Test will be conducted in stationary and unsteady conditions. The calibration process will be investigated too.

Hydrogen in the Energy System – the year of acceleration

GERG has been at the centre of European innovation activities on hydrogen in the gas network for almost 20 years, since its work to establish the NaturalHy project. GERG set another European research benchmark in 2012 with the production of the HIPS report, with over 30 member companies from the energy community gathering a unique dataset of current knowledge of the impacts of hydrogen in pipeline systems. In 2018 the number of network-led activities on hydrogen accelerated and many of these activities are looking to impact policy to raise the allowable concentration in the gas network. At the same time the recognition of the potential of hydrogen to decarbonise heat was given a major lift through substantial funding for projects such as HH21 and the Elegancy ACT project (described later). GERG continues to play its role with a focus on the research requirements which will help to clear the way for hydrogen introduction by removing further technical barriers.



Examples of GERG recent activities and involvement include:

- The HIPSNET project, led by DBI, continues into its sixth year, and is seen as an important centrepiece in the understanding of the current state of the art in understanding hydrogen injection issues.
- The Hyready Project, led by DNVGL is finally underway in 2017. This project aims to develop recommended practices for network and industry operational managers for hydrogen injection.
- The European Power to Gas Platform (DNVGL) will reach the end of its five year programme at the end of 2018, having successfully met its aim of highlighting business cases for Power to Gas.
- GERG has continued to play a role, (GERG members and Secretary) in developing the Sector Forum Energy Management Working Group Hydrogen. The WG aims to continue to develop a gap analysis for R&I and standardisation issues, with a final report due soon.
- GERG now has an official Liaison role in the new Hydrogen TC6 which was formed as a direct recommendation from the first Phase of the SFEM WG hydrogen.
- GERG has attended the first three meetings of the Hydeploy Advisory Group at Keele University and in London. At the end of year one of the project papers were submitted to the UK Health and Safety Executive which were able to justify an exemption from the UK G(S)MR requirement which allows only 0.1vol% H_2 in gas. The private gas network in Keele University is being prepared to allow blending of up to 20 vol% hydrogen. This is a huge step forward for hydrogen blending in European Gas networks and the potential for realising power to gas at the distribution level. At the time of writing it is understood that the next phase, HYDEPLOY 2 has been granted funding from the UK regulator.
- GERG has now become a member of Hydrogen Europe Research, placing it alongside the key reseach players in the mainstream hydrogen and fuel cells community.

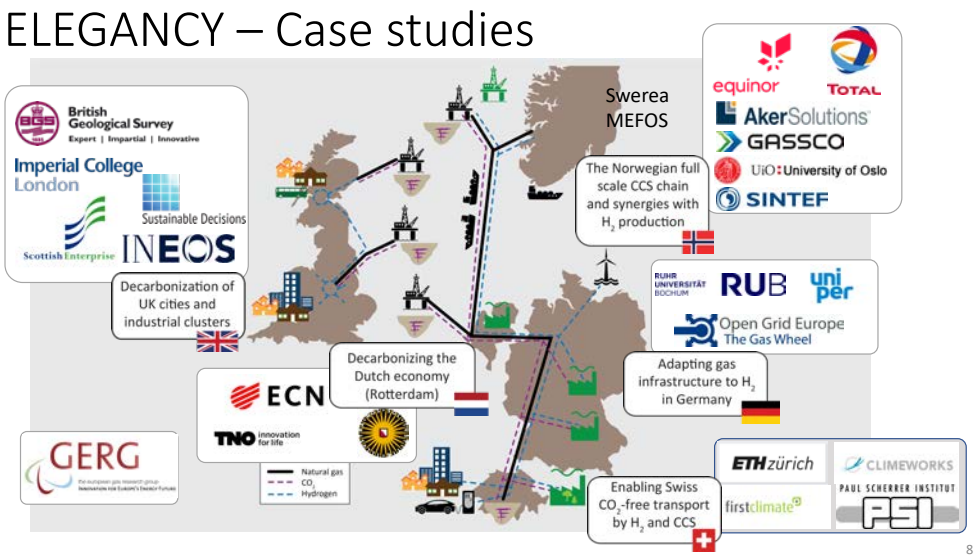
Project ELEGANCY - Accelerating CCS Technologies in the hydrogen domain

Project ELEGANCY was recently funded by the European Accelerating CCS Technologies (ACT) programme. The €15M project is led by Sintef in Norway, GERG has a role in convening meetings and dissemination of project information in the Brussels community.

Objectives and challenges

ELEGANCY is an ERA-Net co-funded ACT project that aims to accelerate the large-scale introduction of CCS by combining CCS with the use of hydrogen as a component or in place of natural gas. The 22 partners from five countries aim to accelerate the decarbonisation of Europe's energy system by combining carbon capture and storage and hydrogen with a full chain H_2/CCS infrastructure, linking together Norway, the Netherlands, Switzerland, the UK and Germany. The project covers:

- investigations of optimized techniques for the separation of H_2 and CO_2, problems of transport and storage of CO_2 from natural gas reforming,
- the development of a business case including general regulatory and economic issues
- the development of an H_2/CCS-chain tool that connects all approaches and algorithms developed in ELEGANCY as an open source software
- five national case studies highlighting different aspects of the combination of H2 and CCS from a national perspective.

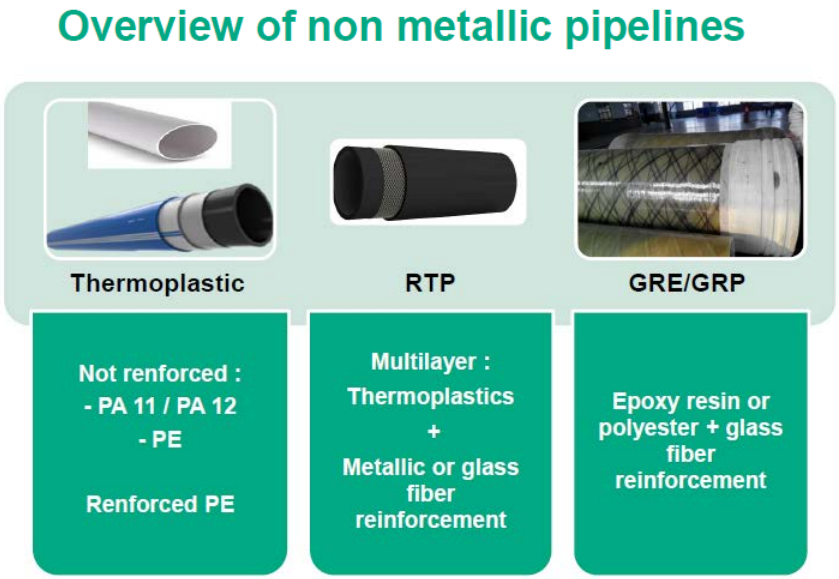


- The Netherlands: Rotterdam as a model region with its existing CO2/H2 networks.
- The UK: the complete substitution of natural gas with H_2 (from natural gas with CCS or from biomass) in large cities, building on the Leeds City Gate H21 project.
- Norway: options for establishing business models for H2/CCS from the point of view of a natural gas producer, and in addition, the established offshore storage of CO_2 is taken into consideration.
- Switzerland :decarbonisation of the transportation sector and CO_2 storage in Switzerland with regard to decarbonisation of imported natural gas.
- The German case study examines options for infrastructure connecting to a European H_2/CCS-chain.

Elegancy is now at the end of its first year, and the first anniversary of the project was marked by a conference in Brussels and a consortium meeting hosted by GERG at its Palmerston office. Further publications are expected in early 2019.

High Pressure Polymer Pipes – a new GERG Initiative

Thermoplastic pipes as PE or steel pipes are widely used for natural gas distribution whereas steel material is the only European regulated possibility to transport high pressure natural gas. In that context, E.ON, Gasunie and GRTgaz have already independently investigated the possibility to find alternative materials as polyamide or PE multilayer pipe for natural gas distribution up to 16 bar or reinforced thermoplastic pipe or glass-reinforced epoxy for gas transmission, i.e for pressure exceeding 16 bar.



The first workshop on high pressure polymer pipe was organized in Germany during the month of july. Gasunie and GRTgaz shared their knowledge about their state of the art and E.ON presented its return of experience about their several RTP and thermoplastic high pressure pipe installations in Germany. Then, it has been proposed to collect the needs of DSO and TSO on different aspects of installing, maintaining new plastic and composite piping systems in a questionnary to identify topics that required further investigations. Those technical gaps could be addressed in the scope of a new GERG project. The workshop ended up with a visit of a multilayer PE pipe installation of E.ON in Germany.

A second workshop has taken place in Spain the 4th of October. Involved DSO and TSO confirmed their common interest about plastic and composite piping systems for pressure exceeding 10 bar, and decided to propose a scope of GERG project such as :

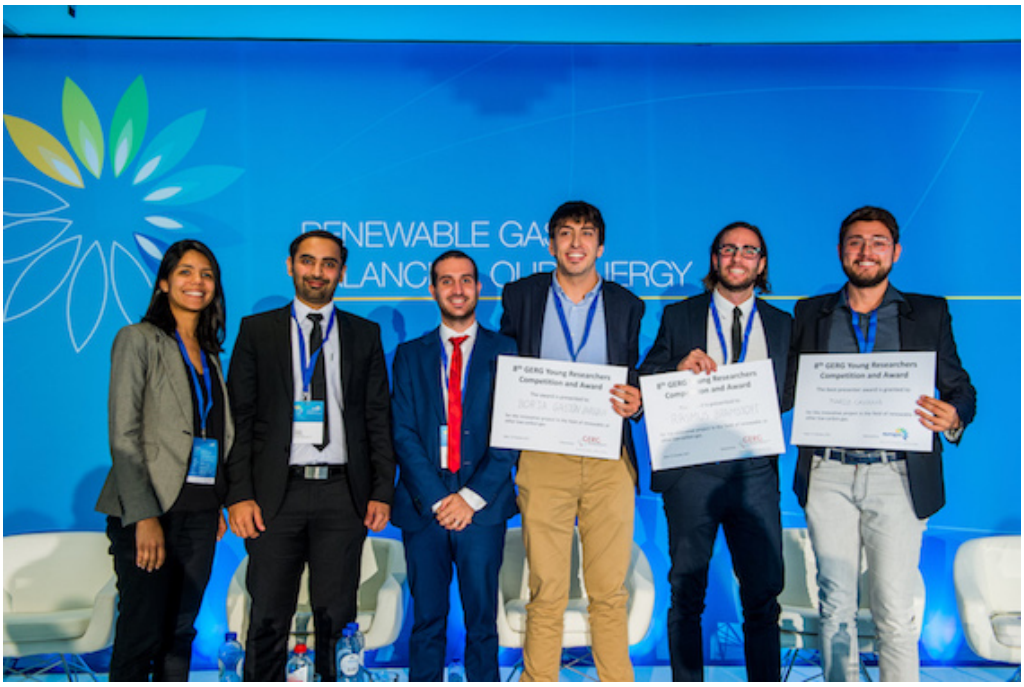
- WP0 : synthesis of the questionnary : gap analysis & sharing of experience
- WP1 : additionnal test requirements in lab for distribution and transmission and perform the tests
- WP2 : definition of a pilot facility : TSO & DSO
- WP3 : european technical guidelines

The main goal of this GERG project would be to define a European universal technical guideline (or code of practice) for plastic and composite piping systems for high pressure gas distribution and transmission.

The GERG Young Researchers Event – In Conjunction with the Eurogas Annual Conference 2017

Every one or two years, GERG hosts a competition which attempts to highlight the work currently being done by postgraduate students in the field of gas research. This work serves to illustrate that a new generation of researchers is working hard to establish gas as a key enabler of a new decarbonised energy system.

The 2017 event took place on October 27th alongside the Eurogas Annual Conference in Brussels, with the theme of renewable or low-carbon gas. Six selected students from all the applications received presented their work in posters, as well as on-stage in a 5 minute 'elevator pitch'. A panel chaired by the GERG President chose 2 winners from the 6 poster submissions, a difficult task as the quality was very high. The two winners, Rasmus Bramstoft (Denmark) and Borja Gaston (Spain) were awarded €1500 prizes by the GERG President. The assembled delegates then also chose the best presentation, the winner, Marco Cavana, receiving a special Eurogas prize.



The papers presented by the successful students can be found at the links below.

Marco Cavana - Hydrogen Blending into the Gas Distribution Grid

Rasmus Bramstoft - The Role of Renewable Gas in the Danish Energy System

Borja Gaston - Feasibility of converting a Combined cycle plant into Power to Gas Plant

Lorena De Souza - Phase behaviour in the Context of Carbon Capture

Aker Garcia - Improvement and cost analysis of Power to Gas technology through Process Simulation

Ahmed Ahmed - Real time management of the Smart Gas Grid

GERG PC LNG

The GERG PC LNG Portfolio has consolidated this year with activities on small scale LNG safety, metrology and inline analysis continuing.

Raman Spectroscopy for inline analysis of LNG Quality

Objectives

Fluxys and Shell are testing performance of Raman technology for composition measurement of LNG. For this a Raman analyser is installed on of the Fluxys LNG terminals LNG discharge lines, with the already approved Fluxys LNG method using gas chromatography as reference.

To further optimize the quality and transparency of this test, a project is underway in which GERG members and interested parties can participate in providing input to the final evaluation, draw final conclusions and share recommendations to advance this new technology as well as to participate in an industry workshop to present the final results to the wider LNG community and regulators.
Direct liquid analysis provides an excellent opportunity to enhance the continuous LNG composition measurement and calculation of physical properties required to prepare a “Certificate of Quality”. Raman technology would allow for a simpler, sensor based composition measurement directly in the LNG

Small-scale LNG release tests and model improvements

This project, led by DNV GL, focuses on the safety implications of LNG dispersion from small-scale LNG Infrastructure such as inland shipping, bunkering stations or LNG truck filling stations during & after loss of containment situations. Regulatory authorities are working on standards for safe design, site construction and operation of LNG filling stations. This requires approved physical models. The validation of these models should be done against a range of experimental data. The project aims:

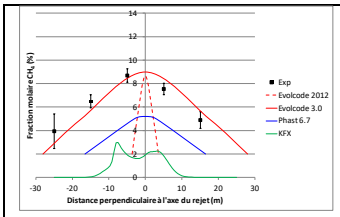
- to assess credible risks and hazards scenarios at small-scale LNG Infrastructure
- to make a significant step forward in the model improvement and development
- contribute to safety guidelines for inland shipping bunkering stations or LNG truck filling stations.

LNG Sparcling (formerly DISTJET)

Objectives

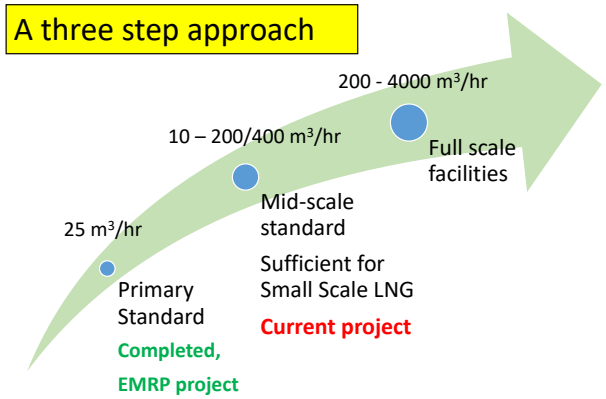
This experimental and numerical project, led by Engie, aims to better assess the consequences of an accidental LNG release and mitigate hazards close to public small-scale LNG applications. New applications for LNG such as refuelling, bunkering and power generation bring installations closer to areas of higher population density. Project results will lead to improved safety distance calculations for pressurized LNG releases, and the identification of the most relevant barriers to hazard reduction for LNG installations. The project aims to improve the accuracy of risk assessments for both authorities and the public. This improved accuracy on small-scale facilities is required because of the smaller proximity distances compared to a classic LNG import or export terminal.

The project will receive reliable measurements of gas concentration and temperatures for a large range of applications, and link these to the calculations by the model. In this way, a better understanding of release conditions, scale effects and height release should be obtained.



LNG Calibration Facility – A VSL Project

Building traceability for LNG flow metering



This €4m project is building a facility available for R&D, testing and calibration of LNG flow metering and LNG quality measurement systems, near the GATE LNG Terminal in Rotterdam. The project is in three steps, with the mid-scale loop completing construction at the end of 2018, with testing in 2019. GERG members include Shell, Fluxys, Enagas, Gasunie and Naturgy.

Events List

GERG has taken part in the following external events in the period 2017-8

- JRC Energy Storage Conference, Brussels (President)
- Energy Security for the Future, new Vision, Strategy Innovation, Monaco June 2017, President
- ISO JRC Conference, Dec 2016– "H2Market: Multi-fuel Service Stations and Power to Large Scale Hydrogen". Presentation on Hydrogen Adaptation (Secretary)
- High Level Roundtable on Sector Coupling, European Commission (Secretary), March 2018
- EUSEW Panel meeting on Energy Storage and Sectoral Integration (Secretary), June 2018
- Presentation at CEN 234 – SFEM WG hydrogen liaison workshop (Secretary)
- Presentation on Network adaptation and Cross-cutting issues at CEN TC6 inaugural meeting (Secretary)
- Eurogas Annual Conference October 2017, GERG Young Researchers' Event (President)
- UNECE workshop on Emissions organised by Marcogaz, Geneva

European Initiatives contributed to:

- SFEM Working Group Hydrogen – Task Convener, report contributor
- CEN TC6 – Liaison Organisation
- ART Fuels Forum (successor to SGAB)
- CertifHy2 Working Groups
- Hydeploy (UK) – Advisory Panel

Working with Partners

- Marcogaz - KWh / m3 conversion
- Marcogaz – Utilisation Scenarios Task Force
- GasNaturally Steering Committee
- K4i, Knowledge for Innovation Management Board

Papers Published or submitted

- GERG Update, IGU magazine, Autumn 2017
- GERG Biomethane Project – European Energy Innovation, Autumn 2017
- GERG Biomethane Project, EBA Annual conference 2017
- GERG Biomethane Project, WGC 2018

List of ongoing or newly completed GERG projects

	Renewable Gases and Low Carbon Gas	
1	The GERG Biomethane Project – removing technical barriers to the introduction of Biomethane. Funded by Industry and Horizon 2020	Engie
2	HIPSNET – A network for information exchange on Hydrogen in Pipelines	DBI
4	Hyready – Recommended Practices for hydrogen in Pipelines	DNVGL
5	Elegancy – Accelerating CCS technologies for hydrogen production and distribution. Horizon 2020	Sintef
6	European Power to Gas Platform	DNVGL
7	Field investigation with Hydrogen Injection	E.ON
	Distribution	
8	Certification of Odour-Handy (THT, TBM, SFree) for the Gas grid operator	E.ON
9	Keyhole Tests (GTI)	E.ON
10	Development of an Accurate and Consistent Method for Methane Emission Estimation of the Gas (Distribution) Phase 2 (MEEM)	DBI
11	A guideline for PE100RC	Kiwa
	Transmission	
12	State of the Art of Small Bore Robotic inspection Tools	Gassco
13	Methane Emission Estimation from the Transmission System	Gaz System
	Utilisation	
14	Self-regulated gas boilers able to cope with gas quality variation: State of the art and performances	DGC
	LNG	
15	Performance review Raman technology for LNG custody transfer update	Fluxys
16	A calibrated Flow Standard for LNG	VSL
17	LNG DistJet / SPARCLING	Engie
18	Small-Scale LNG Release Tests and Model Improvements	DNVGL
	The total GERG Project portfolio value is approximately €23M	

GERG
the european gas research group
INNOVATION FOR EUROPE'S ENERGY FUTURE