European gas technology innovation - GERG and the energy transition

National Grid Future of Gas Seminar, 29th November

Robert Judd, The European Gas Research Group, GERG
Introducing GERG

The European Gas Research Group
Introducing GERG

- Industry collaborative R&D group for gas
- Industry network for R&D information exchange

Priorities for our research and innovation programme:
- Gas at the heart of our SMART energy infrastructure
- Renewables integration and adapting to the Energy Transition
- Ensuring the safety and Integrity of our network
- Integration of new and small LNG into the market
Who are we?

- Over 30 members from 12 countries - all active in technology
- Friends of GERG – Associate Membership includes Universities
- Academic Network – finding and presenting the best students
- Working with Brussels Institutions and External Organisations
Why GERG?

- R&D is essential to the gas industry to meet our commitments to:
  - customers
  - the environment
  - the position of gas in the future market

- Collaborative R&D is vital, as it enables:
  - shared costs, shared expertise
  - high acceptance of results
  - industry to prepare for the worst eventualities

The GERG collaborative model is becoming even more important
How we work

Establish Industry R&I Priorities

Facilitate Projects

EU Engagement

European Initiatives

Work With Partners
Some examples
This is GERG - example

Equations of state-GERG – “best in class”

The GERG equation of state is at the heart of most commercial software packages that are managing flow in our networks.
This is GERG - example

PRESENSE

- Working with third party agencies
- Satellite surveillance of the European high pressure pipeline grid
- Looking for
  - Third party interference (TPI)
  - Subsidence & landslip
  - Methane leakage

(Images courtesy of E.ON & PRESENSE consortium)
Some LNG examples

- LNG PC activity growing
- Major Projects include:
  - LNG Flow calibration facility (VSL)
  - Integral Safety Programme for Small-scale LNG supply Chain
  - Small-scale LNG release tests and Model Improvements
  - Raman Analysis for CV determination
- Looking for higher level of engagement with wider LNG Community
Some ongoing project initiatives

- **Trace components in Biomethane**
  - Supporting CEN process for removing technical barriers
  - So far 8 countries representing over 20 operators agreed to join.
  - Phase 1 to kick-off in June/July, led by Engie
  - Support expected from EU for Phase 2

- **MEEM – methane emissions estimation methodology from gas network (DBI)**
  - Phase 1 complete, report issued
  - Phase 2 about to begin, segmented for distribution and transmission – Marcogaz input

- **HIPSNET / European P2G Platform**
Biomethane – removing barriers

GERG actions:

- Analysis and assessment of the impact
  - Evaluation of impact
    - To assess prioritised impacting compounds
    - Quantification of target compounds in gas
  - To carry out experiments (labs, test benches) to evaluate impact of selected compounds

CEN scope:

- Standardization process
  - Specification of pertinent values for impacting compounds (standards)
  - Specification of pertinent values

Missing Data: S, Health criteria, O2, Corrosive compounds (Cl, F, microorganisms), Si

There is still a R&D effort to ensure the right use of new gases
Hydrogen and Network Adaptation
Overview of GERG activities

Network adaptation and hydrogen – the networks of the future are the networks of today.
Back to the Future

A hydrogen based gas network based on gasification was first installed in London in 1807.
Enabling the future

- Renewable gas
- Power to Gas
- Increasing hydrogen and renewable gas distribution
- Smart energy grids
- Fuel cells and hydrogen infrastructure
- Low cost electrolysis

Increasing renewables integration
Gas and Renewables

- Gas is a strong partner to renewable energy, and complements its non-dispatchable nature
  
  - Power generation – flexible support of intermittency, Use of the gas network for storage – “Power to Gas”
  
  - Provision of heat and distributed power through end use of gas
  
  - Biomethane and hydrogen injection and storage are reducing the carbon intensity of the network
  
- Transport

- Supporting the gas grid as part of a smart energy system will enable a lower cost transition to a low carbon economy
Power to Gas

Integrate Renewables

- Load-Following Renewables
- Surplus RE

Conversion by Electrolysis

- Relieve Congestion + Defer Tx Capex

Renewable Gas

- Energy Content
  - Hydrogen
  - SNG

- Seasonal Storage
- GHG Abatement

- Renewable H2
- Renewable Gas

Reports | Power to Gas

Power to Gas Research Roadmap
Offering a Solution to the Energy Storage Problem?

by Robert Judji and Dave Pinchbeck

The increasing levels of renewable generation bring challenges for our existing energy system. Their variability means that they are subject to the amount of energy needed at any moment. Instead of peak loads production, wind power output is largely being controlled by the limited capacity of the electricity grid, and the difficulty of storing electricity. Investment levels in transmission and/or storage are anticipated in the future, which is essential for renewable energy, and storage technologies have been proposed to meet this challenge. In conclusion, there is a potential benefit of using renewable sources to complement natural gas or hydrogen. This article discusses the concept and presents a route through the technical challenges that we face to make it happen.
The HIPS Project

GERG HIPS (Hydrogen in Pipeline Systems) – the benchmark in understanding the impact of hydrogen

State of the art analysis (performance, lifetime and safety):
- gas transport and storage
- gas distribution and utilisation
HIPS: Challenges for hydrogen injection

- Is all storage hydrogen ready?
- Modern gas turbines with pre-mixed burners
- Steel tanks in NGVs
- The existing appliance population. Engines?
- Electrolyser scale and costs

- What are the limits?
- What needs to be done?
- What technology advances need to be supported?
- What are the economics for the competing routes?
the following maximum hydrogen concentrations recommended:

- 2 % - if a CNG filling station is connected;
- 5 % - if no filling station, no gas turbines and no gas engines with a hydrogen specification < 5 % are connected;
- 10 % - if no filling station, no gas turbines and no gas engines with a hydrogen specification < 10 % are connected.

- The Wobbe index and methane number of the natural gas / hydrogen mixture must not be close to the existing limit values for the network (“safety margins”)

- Avoid sudden increases of the hydrogen concentration in the natural gas (e.g. speed of change < 2 % / min).
The HIPS NET Project

HIPS-NET: European Network

more than 30 partners:

establish a common understanding on the acceptable $H_2$ concentration in the gas grid by condensing knowledge and initiating projects on open issues.

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## Sector Forum Energy Management

### Working Group Hydrogen – Roadmap – Standards?

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EU Hydrogen Limits for Injection into the HP Gas Grid
Covered by a range of local laws and EU Directives
Note: interpretation of these rules is complex
Challenges?
Challenges in the Roadmap

- Level of integration and number of new technologies involved lead to long timescales before commercialization
- More planned and directed rather than market led approach to setting the innovation agenda
- We need an energy network (not electricity or gas alone) based focus
- We need incentivized access to networks for demonstrations of new approaches
- Any part of the puzzle missing in developing the multi-network demonstrations of the future will seriously risk undermining the solution
- More collaboration between network operators will be needed than ever before
- The roadmap cannot afford to exclude any players
An integrated approach

- A number of initiatives and technologies need to come together to enable the roadmap to an integrated energy system, in which gas and hydrogen play their part
  - Challenge to integrate multiple new technologies into grids
  - Challenge to integrate all our grids in a SMART way
- Market can be used to determine best options but:
  - Intervention, direction and progressive regulation needed to make things happen
  - Need to overcome the short term regulatory approach which can lead to inertia in bringing together all network players and providing access to networks
We need

- Collaboration in Innovation – both inside the industry and beyond
- New business models to encourage innovation
- Regulatory and market signals to balance the playing field
- Recognition of the role gas plays in enabling the energy system of the future
GERG is helping the Gas Industry address these common challenges through its unique approach to collaboration in innovation.
GERG
the european gas research group
INNOVATION FOR EUROPE’S ENERGY FUTURE
Gas Storage (HIPS)

- Is all Storage Hydrogen Ready?
- Depleted fields and Aquifers
  - Heterogeneity of injected and withdrawn gases
  - Hydrogen and bacteriological activity
  - Reactions with reservoir water and rock – $\text{H}_2\text{S}$?
  - Integrity of wells
  - Embrittlement
  - Potential reactions with materials
HIPS Output concluded

- In general, a case by case analysis is necessary before injecting hydrogen in the natural gas network.
- Currently porous rock underground gas storage is a major knowledge gap.
- Most gas chromatographs will require modification.
- Manufacturers' specifications should always be followed, particularly when gas turbines or gas engines are connected to the network.
- Much of the natural gas system can tolerate admixture of up to 10% by volume of hydrogen, depending on the specific local situation.
Some challenges

- How do we:
  - continue to provide the research and innovation needs of a fragmented industry?
  - leverage R&D funds to make a difference when internal R&D budgets are being squeezed?
  - demonstrate the value of gas technology innovation in enabling Europe to meet its targets for a future low carbon energy system?
  - Innovate to keep our networks fit for purpose through the transformation