

# Research Roadmap

# HYDROGEN



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# INTRODUCTION

**Hydrogen** is an essential part of the energy transition:

- A **feedstock**, a **fuel**, an **energy carrier** and an **energy storage solution**;
- Can be used in various sectors, from industry to transport through power and building sectors.
- The **gas infrastructure** will play an important role in providing a vector for moving hydrogen from production to a range of users.
- Technical and **research challenges** remain: it is necessary to identify and prioritise these **research gaps** to ensure the most efficient use of R&D resources.



# GERG'S RESEARCH ROADMAP PROCESS

The process is a **collaborative effort** by industry experts that **defines research and development gaps** and integrates the results of other ongoing initiatives in Europe and internationally. It will be used as a tool to inform the larger R&D community, as well as policy makers, facilitating the creation of targeted research projects.





# GERG'S HYDROGEN RESEARCH ROADMAP

Gas Quality	Asset Materials	End-Uses	Maintenance and Safety	Underground Storage	New Technologies
Meters, analysers and sensors	Pipeline integrity	Industrial end-use	Odorisation	Salt caverns, Aquifers and Depleted O&G Fields	H <sub>2</sub> injection & blending
Quality of H <sub>2</sub> NG blends & dedicated H <sub>2</sub> grids	Impact of H <sub>2</sub> on other components & new materials	Domestic and commercial appliances	Safety: leak, flammability & explosivity		Ammonia & other H <sub>2</sub> carriers
Gas properties and billing	Impact of H <sub>2</sub> on compressors	Combustion of H <sub>2</sub> NG blends	Maintenance & monitoring		Separation of H <sub>2</sub> & natural gas from the blend

>100  
Hydrogen Experts

16  
Categories

6  
Timelines

115  
Research Topics



# GAS QUALITY TIMELINE



Assess the impact of H<sub>2</sub>NG blends on the metrological behaviour of fiscal flow meters.

Assess the suitability and integrity of CV meters, with blends up to 20 % at transmission and distribution pressures.

Compare the accuracy of commercial PGCs, that can handle c(H<sub>2</sub>) ≤ 20 %, with or without dual carrier gas.

Develop cheap, in-line and fast response analysers, able to analyse H<sub>2</sub> for quality control and safety only.

Determine the quality specifications for H<sub>2</sub>NG blends, needed for injection in the NG grids; and for H<sub>2</sub> dedicated grids.

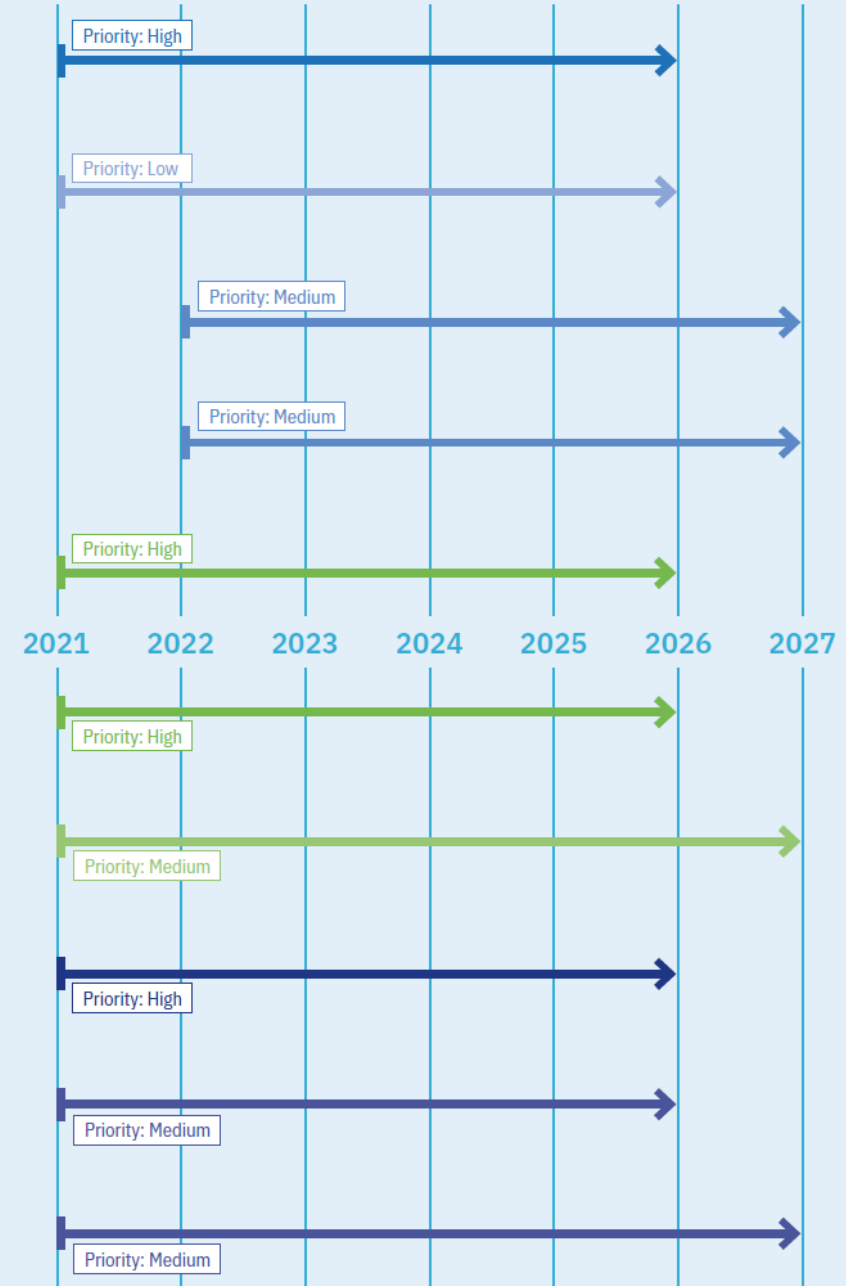
Inventorise and evaluate working methods to prevent contamination of H<sub>2</sub> when transmitted with former NG transmission systems.

Identify contaminants and develop insight in their impact on existing networks and end uses.

Study the energy content calculation of H<sub>2</sub>NG mixtures with high accuracy by updating the state equations of H<sub>2</sub>NG blends.

Assess the effectiveness of the summation of C<sub>6</sub>+ components as CV billing method.

Develop billing methodologies using both network modelling and gas sensing to provide cost-effective solutions.



■ Meters, Analysers & Sensors 
 ■ Quality of H<sub>2</sub>NG blends and dedicated H<sub>2</sub> grids 
 ■ Gas properties and billing



# KEY FINDINGS: RESEARCH ACTIONS

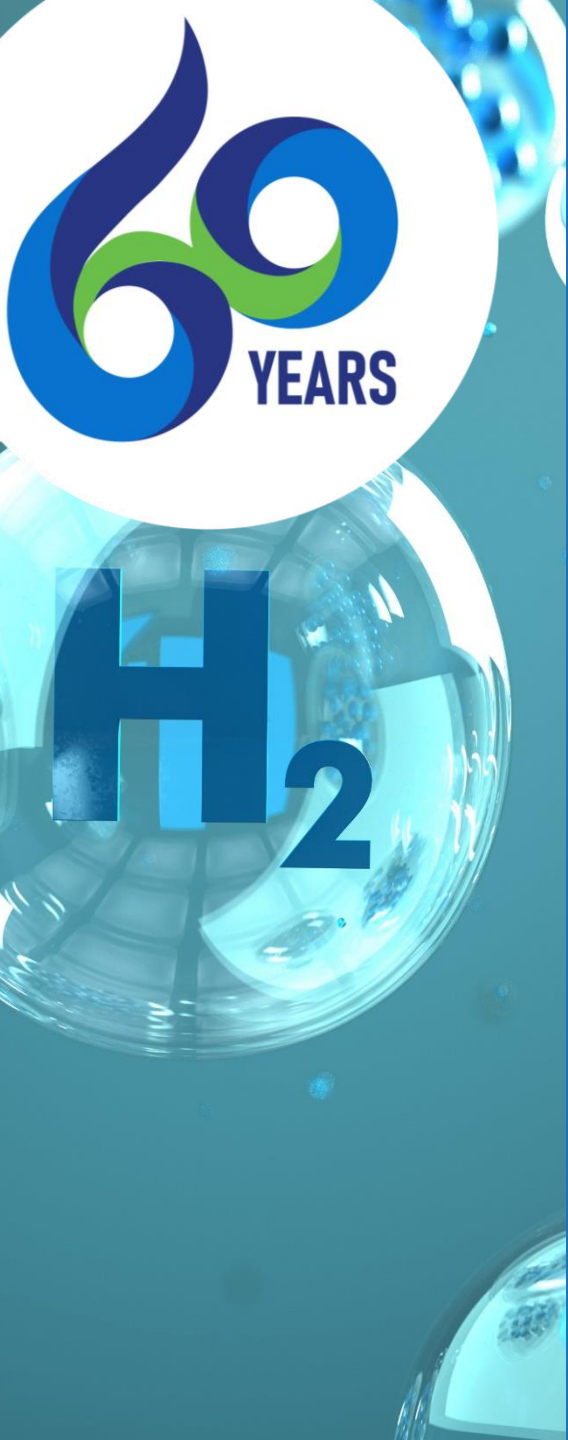


## Gas Quality

- ↳ Impact of H2NG blends on the **metrological behaviour** of fiscal flow meters.
- ↳ **Quality specifications** for H2NG blends, needed for injection in the NG grids; and for H2 dedicated grids.
- ↳ Working methods to **prevent contamination** of H2 when transmitted with former NG transmission systems.
- ↳ **Energy content** calculation of H2NG mixtures with high accuracy by updating the **state equations** of H2NG blends.

## Asset Materials

- ↳ **Defect assessment** criteria as function of H2% in metallic pipelines.
- ↳ Interaction of hydrogen with metallic and polymer pipeline **welds**: this is dependent on the welding technique used.
- ↳ Best practices of **oxygen passivation** for steel under H2NG is essential to mitigate the effect of hydrogen.
- ↳ Suitability of existing **valves** components for H2NG blends.
- ↳ Impact of H2NG blends on existing **pressure regulators**.
- ↳ Performance and operational envelope of reciprocating and centrifugal **compressors** for increasing concentrations of H2 for existing NG machines.



# KEY FINDINGS: RESEARCH ACTIONS

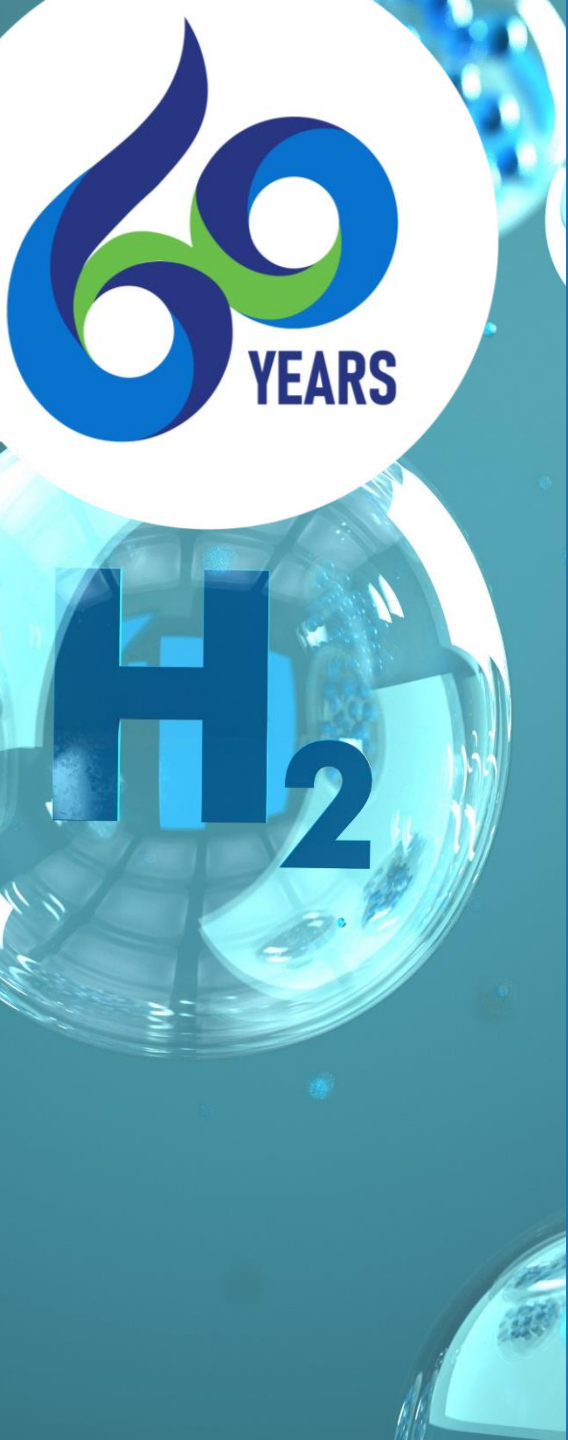


## End-Uses

- ↳ Impact of hydrogen **on burners**.
- ↳ Impact of the **speed of change of H2** concentration on industrial applications.
- ↳ Impact of H2/H2NG on main **industrial processes** in order to evaluate the need of modifications/retrofitting.
- ↳ **Appliance adjustments** in the presence of hydrogen, including H2% sensors.
- ↳ Hydrogen **detection** for combustion control (CHP, boilers).
- ↳ Cost-effective adaptation of sensitive existing appliances to **H2/H2NG**.
- ↳ Impact of H2/H2NG on **energy efficiency** compared to natural gas.
- ↳ Reference **test gases** suitable for H2NG blends.

## Underground Storage

- ↳ **Tubing and casing** compatibility with hydrogen for UGS environments.
- ↳ Other tubing components (packers, valves, wellheads etc.) compatibility with hydrogen for UGS environments.
- ↳ Suitability of **high-pressure equipment** during hydrogen transmission and storage stages.



# KEY FINDINGS: RESEARCH ACTIONS



## Maintenance & Safety

- ↳ Assessment of existing **odorants** compatibility with various H2%.
- ↳ Odorants for 100% H2 and **removal techniques** for end-use applications requiring pure H2.
- ↳ **Effect distances** for H2NG and H2 leakages.
- ↳ Effectiveness of **leak detection** technologies for H2NG & H2.
- ↳ Effect of H2 on **blow-down**.
- ↳ Need of an authoritative documentation on the **GWP of H2**.
- ↳ Work approach applicable to incidents with large H2/H2NG **leakages**.
- ↳ Effectiveness of **repair methods** for pipelines under H2NG blends.

## New Technologies

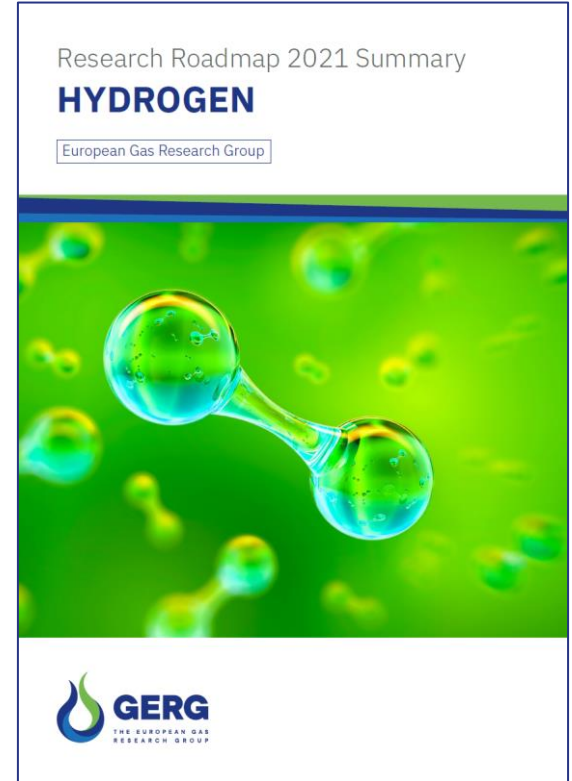
- ↳ **Blending** methods and potential improvements to fulfil metrology and quality requirements of the final H2NG admixture.
- ↳ Assessment of existing **H2 carriers** and their impact on CO2 footprint performance, safety, and pollutants emissions.
- ↳ Benchmark suitable H2NG **separation technologies** for low- and high-pressure networks.





# CONCLUSION

- The development of hydrogen as an energy vector will play a crucial role in the energy transition.
- **Collaborative R&D** and knowledge sharing is key to ensure the its efficient development.
- The GERG Research Roadmap is an example of such a collective initiative, and follow-up actions are already ongoing.
- A Summary Brochure of the Roadmap will be publicly available after the conference.



<https://www.gerg.eu/anniversary-conference/>

