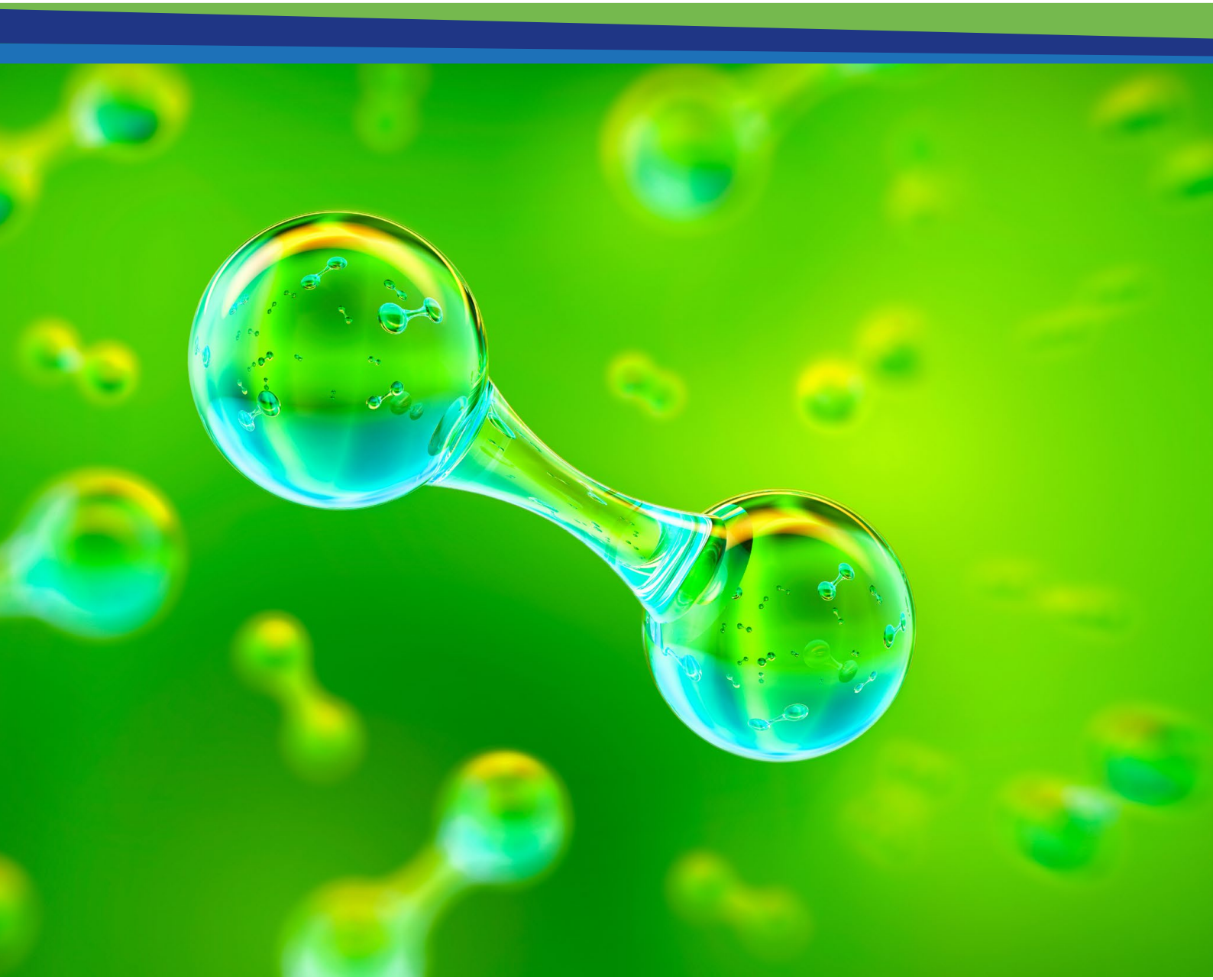
Research Roadmap 2021 Summary

HYDROGEN

European Gas Research Group



GERG
THE EUROPEAN GAS RESEARCH GROUP

INTRODUCTION

GERG is a **pioneering association at European level** for research on the implementation of **hydrogen** as an energy carrier for transmission and distribution in gas networks. In the last two decades we have launched several notable projects that have been crucial for understanding the potential of this gas and the key role that it will play for the **energy transition** towards a sustainable future.

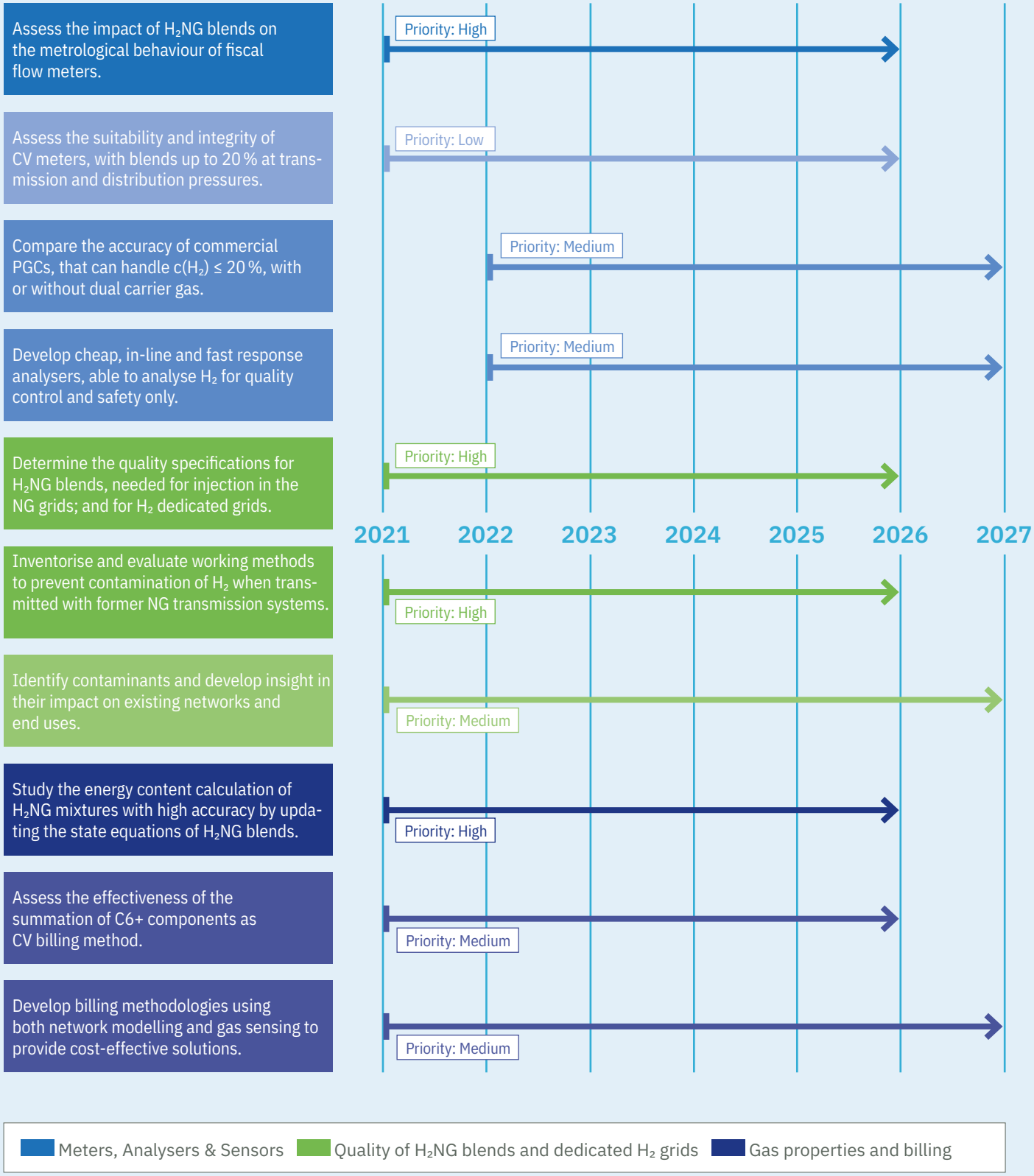
In 2004, GERG helped to initiate the **NATURALHY** project to facilitate the transition towards hydrogen using existing gas infrastructure to convey hydrogen blended with natural gas (H_2NG); other GERG projects like **HIPS** and **HYREADY** also developed detailed technical understanding of the requirements for using H_2NG blends in European gas networks. Ongoing projects like **THYGA** assess the impact of H2NG admixtures in domestic and commercial appliances and the **GERG – CEN H_2 PNR** project investigates removal of technical barriers through pinpointing the pre-normative research requirements for the introduction of hydrogen in European natural gas grids and for end users.

With circa **115 research topics**, this new GERG hydrogen research roadmap attempts to identify the gaps in realising the ambition of achieving full technical compatibility of gas infrastructure with the introduction of hydrogen.

It is important to highlight that the aims of this roadmap align with the European Commission's Green Deal, which aims to achieve **carbon neutrality** for Europe by 2050. The gas industry can play a major role in the push towards decarbonisation, and **innovation** is central in allowing us to make this contribution.

Six **timelines** have been produced; darker colour shades mean higher priorities. Figure 1 is an example with ten research topics.

Figure 1: R&D Topics Gas Quality Section



HYDROGEN TODAY & IN THE FUTURE

There are two ways in which hydrogen can be used in the existing gas grid: either in its nominally **pure** form (100 % hydrogen) or **blended** with natural gas (H_2NG).

For the latter, discussions among European stakeholders are focusing today on blends within the range **0–20 % H_2** by volume and more recently up to **30 %** in some specific applications. Blends are seen as an **important enabler** of the longer term roadmap to 100 % hydrogen, and will play an crucial role in early **decarbonisation** as hydrogen supplies are ramped up over coming decades.

Hydrogen can be used as a feedstock, a fuel, an energy carrier and an energy storage solution. Therefore, hydrogen has the potential to support many different uses from **industry** to **transport** through **power** and **building** sectors and play a critical role in the energy transition if produced sustainably.

The capacity of hydrogen to act as an energy storage medium via electrolysis of renewable electricity makes it a key enabler for the deployment of Renewables and Intermittent Energy production sources in Europe. At the same time, **low-carbon** and **green** hydrogen can be used to replace fossil fuels in hard to abate sectors and complement renewable energy sources in the effort to transform our **economy**.

GERG'S RESEARCH ROADMAP PROCESS

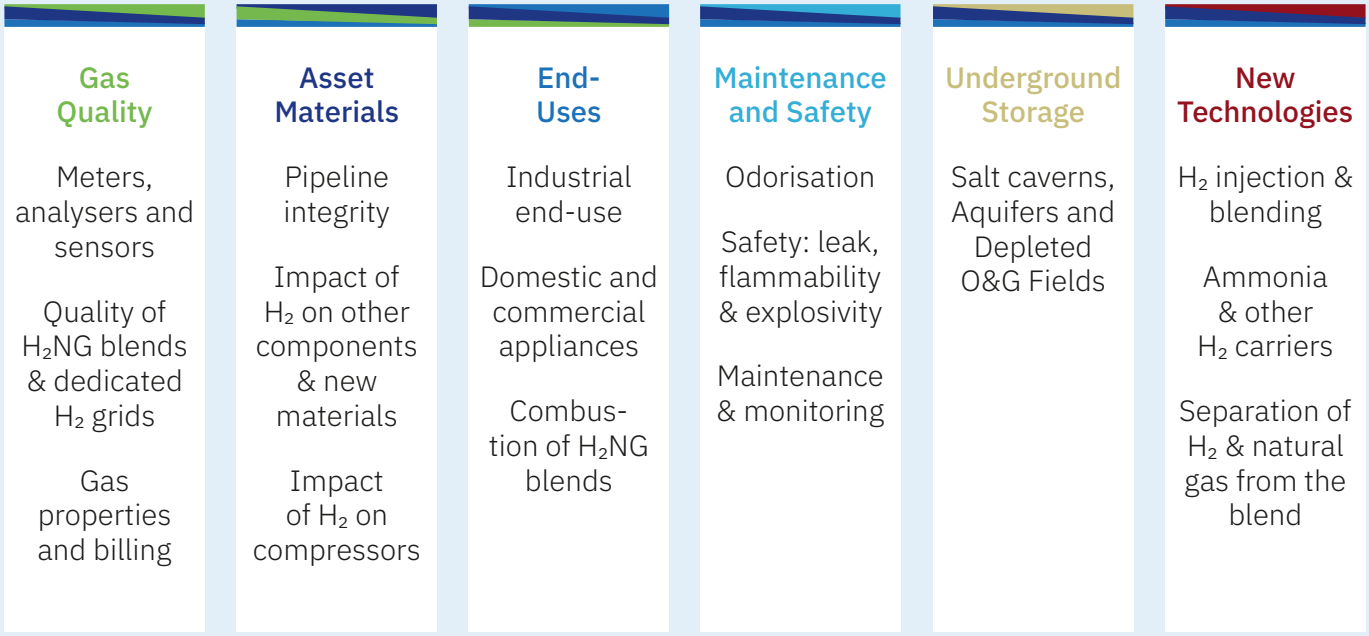
The process is a **collaborative effort** by industry experts that **defines research and development gaps** and integrates the results of other ongoing initiatives in Europe and internationally. It will be used as a tool to inform the larger R&D community, as well as policy makers, facilitating the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

It is increasingly recognised that the **gas infrastructure** will play an important role in providing a vector for moving hydrogen from production to a range of users, and will potentially displace a significant proportion of the natural gas that is transported today. However technical and **research challenges** remain, and with the extent of activity it is important to first identify which are the major and immediate **actions** that are needed in order to progress to rapid implementation.

Identifying and prioritising these research gaps will ensure the most efficient use of R&D resources, and widely sharing the results of this benchmark will avoid duplication of effort by research partners.

The GERG Hydrogen Working Group was formed by over **100 hydrogen experts** from the GERG member and wider stakeholder community to develop this roadmap, which has been built through a series of workshops gathering the above-mentioned group of experts. The objectives were to share a common ambition among the members, sum-up the current State of the Art at the member level and converge to R&D actions based on a **gap analysis**. Eventually, more than a hundred research topics were proposed, dispatched in 6 sections and 16 categories, as well as categorised by **priority** and duration.

Figure 2: research topics categorised by priority and duration



KEY R&D ELEMENTS EMERGING

Gas Quality

- Impact of H_2NG blends on the **metrological behaviour** of fiscal flow meters.
- **Quality specifications** for H_2NG blends, needed for injection in the NG grids; and for H_2 dedicated grids.
- Working methods to **prevent contamination** of H_2 when transmitted with former NG transmission systems.
- **Energy content** calculation of H_2NG mixtures with high accuracy by updating the **state equations** of H_2NG blends.

Asset Materials

- **Defect assessment** criteria as function of H_2% 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 H_2NG is essential to mitigate the effect of hydrogen.
- Suitability of existing **valves** components for H_2NG blends.
- Impact of H_2NG blends on existing **pressure regulators**.
- Performance and operational envelope of reciprocating and centrifugal **compressors** for increasing concentrations of H_2 for existing NG machines.

End-Uses

- Impact of hydrogen on **burners**.
- Impact of the **speed of change of H_2** concentration on industrial applications.
- Impact of H_2/H_2NG on main **industrial processes** in order to evaluate the need of modifications/retrofitting.
- **Appliance adjustments** in the presence of hydrogen, including H_2% sensors.
- Hydrogen **detection** for combustion control (CHP, boilers).
- Cost-effective adaptation of sensitive existing appliances to **H_2/H_2NG**.
- Impact of H_2/H_2NG on **energy efficiency** compared to natural gas.
- Reference **test gases** suitable for H_2NG blends.

Maintenance & Safety

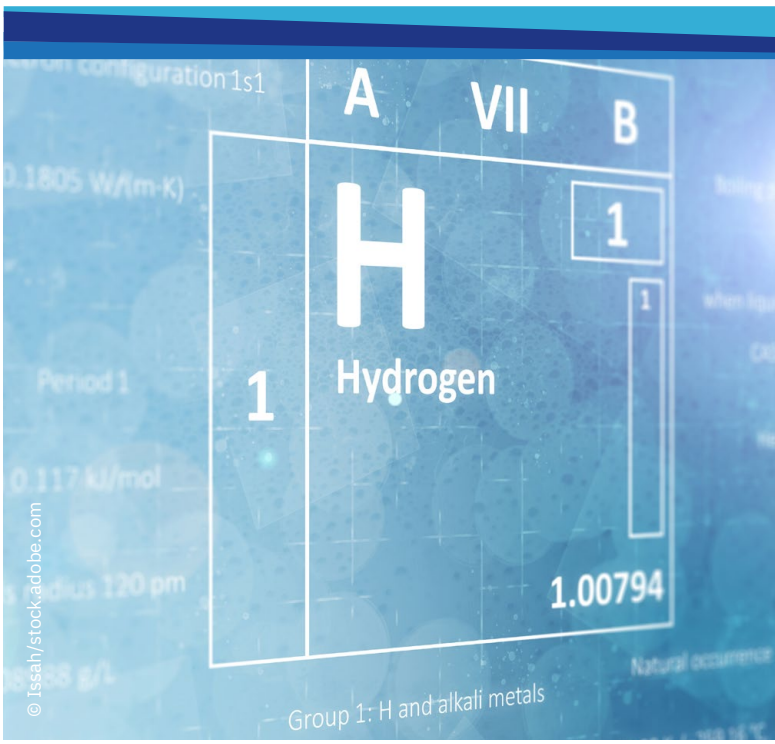
- Assessment of existing **odorants** compatibility with various H_2%.
- Odorants for 100 % H_2 and **removal techniques** for end-use applications requiring pure H_2.
- **Effect distances** for H_2NG and H_2 leakages.
- Effectiveness of **leak detection** technologies for H_2NG & H_2.
- Effect of H_2 on **blow-down**.
- Need of an authoritative documentation on the **GWP of H_2**.
- Work approach applicable to incidents with large H_2/H_2NG **leakages**.
- Effectiveness of **repair methods** for pipelines under H_2NG 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.

New Technologies

- **Blending** methods and potential improvements to fulfil metrology and quality requirements of the final H_2NG admixture.
- Assessment of existing **H_2 carriers** and their impact on CO_2 footprint performance, safety, and pollutants emissions.
- Benchmark suitable H_2NG **separation technologies** for low- and high-pressure networks.



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