N°3 – December 2025

Newsletter

pre-Normative Research on Hydrogen Releases Assessment

As the year comes to an end, we're proud to reflect on almost 2 years of progress since the NHyRA project began. Our partners have collaborated tirelessly to advance the project's goals.

Here's a snapshot of some key activities implemented over the past months!

The NHyRA consortium wishes you a pleasant holiday season and a successful New Year!

This issue

Co-funded by the European Union

Clean Hydrogen Partnership

This project has received co-funding from the European Commission and the Clean Hydrogen Partnership under Grant Agreement No. 101137770. This Partnership receives support from the European Union's Horizon Europe Research and Innovation program, Hydrogen Europe and Hydrogen Europe Research.

H2LeakQuant: Benchmarking Methods for Hydrogen Leak Quantification

In September, within the framework of the NHyRA project, a testing campaign was carried out at the Fugitive Emissions Test Bench of the Metrology and Innovation Centre of Enagas in Zaragoza (Spain). The goal was to evaluate the most advanced methods available for hydrogen leak quantification:

- Assess prototype methods for quantifying hydrogen (H_2) leaks.
- Characterize the accuracy, reliability, and uncertainty under controlled conditions with real equipment.
- Identify strengths and limitations of each prototype for use in real-world environments.
- Prepare for pilot trials in operational H_2 installations by selecting the most promising technologies.
- Contribute to standardization and best practices in H_2 leak rate quantification.

A total of 7 different methods were tested, including various bagging techniques and acoustic cameras with integrated quantification models. It was a two-day testing campaign where different leaks were generated in a controlled environment.

The tests were conducted single blind, i.e. participants had no access to actual leak rates for each test.

We are now in the analysis phase, and the results will help us design future quantification campaigns in operational facilities next year.

As a pioneering initiative, we will also have the collaboration of an academic team for the publication of the results (LSCE).

The team that made this possible included: NPL, INIG and also Intero Integrity, Bureau Veritas Group, CEA, Distran, Sorama, and Enagas.

Below an overview of the quantification methods involved:

	High Flow Sampler - NPL's Prototype	High Flow Sampler - The Sniffers Prototype	Fluke ii900 acoustic camera operated by The Sniffers	Distran acoustic camera - operated by INIG team	Distran acoustic camera - operated by Distran operator	Sorama acoustic camera	Bagging Method with N2 by Bureau Veritas
Picture of the equipment							
Equipment used	The leaking component is enclosed by bagging, the HFS is composed of a pump, flow meter and a gas analyser	The leaking component is enclosed by bagging, the HFS is composed of a pump, flow meter and a gas analyser. Gas analyser: Catalytic sensor / thermal conductivity (high range) GS700 de [illegible]	Acoustic Camera	Ultrasonic Camera	Ultrasonic Camera	Acoustic Camera	Inert and antistatic bag (e.g.Tedlar),and injecting a carrier gas such as N2 to create a homogeneous mixture. An analyzer continuously measures the concentration in this mixture
ATEX	Non atex for HFS due to pump	Non atex for HFS due to pump (for the gas analyser: II 2G Ex db ia IIC T4 Gb)	Non Atex		ATEX for Zone II (II 3G Ex ic IIC T3 Gc)	Non Atex	Non Atex
Mass Flow Quantification method	The HFS is designed to measure H2 concentrations, and, combined with measurements of flow through the instrument, express these as leak rates per unit time	The HFS is designed to measure H2 concentrations, and, combined with measurements of flow through the instrument, express these as leak rates per unit time	The components are scanned using acoustic sensors for leak indications by pointing the acoustic sensor in that direction. The emission rate is then determined by modeling by the device	The components are scanned using acoustic sensors for leak indications by pointing the acoustic sensor in that direction. The emission rate is then determined by modeling by the device	The components are scanned using acoustic sensors for leak indications by pointing the acoustic sensor in that direction. The emission rate is then determined by modeling by the device	Sorama CAM IV64EX Acoustic camera. The Sorama CAM IV64EX uses an array of microphones to localize pressurized air and gas leaks. Leak Quantification is based on the obtained beamformed acoustics coming from a leak and analyzing it on device through use a trained AI model	[illegible] leaking element in an inert and antistatic bag (e.g.Tedlar),and injecting N2 to create a homogeneous mixture. An analyzer continuously measures the concentration in this mixture, allowing the emission rate to be calculated.
Maximum mass flow rate	The max mass flow rate of the leak is 8 l/min for safety reasons (43 g/h)	The max mass flow rate of the leak is 35g/h for safety reasons (6.5 l/min)	n/e	to be confirmed	to be confirmed	to be confirmed	Not absolutely defined yet, but we think we should be able to quantify a leak at 40 L/min (220 g/h)
Duration of measurements	10 min max	15 min max	5 min max	5 min max	5 min max (10 min for some tests to gather more data)	5 min max	Installation time (0.5 hours) / Uninstallation time (0.2 hours) for each measurement -> 4 5 min max
	Total max time needed per test: 1h 20 min for the test participating all methods / 1h for the tests where HFSs are not participating / 15 min for the tests with only acoustic cameras involved						

Concentration measurements will be perform also for each test in the air around the leaking element by INIG team. Sniffer GS 700 H will be used for this.

Site-Level measurements with LSCE Gas Chromatograph performed during some of the tests. Instrument was located downwind the leaking componets, to a distance from 2-3 meters.

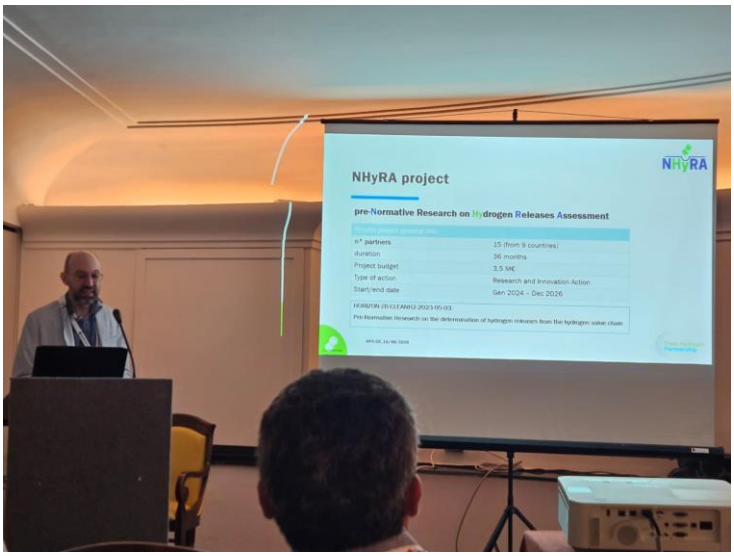
NHyRA Project Presented at EFCH2 2025 Conference

The European Fuel Cells and Hydrogen – Piero Lunghi Conference (EFCH2 2025) was held from 17 to 19 September 2025 in Capri, Italy, confirming its role as one of the most influential international forums on hydrogen and fuel cell technologies. The event gathered over 250 participants from 23 countries, representing more than 90 institutions, and featured 150 oral presentations and 50 posters, reaffirming its status as a vibrant platform for sharing ideas and accelerating the transition towards a sustainable hydrogen ecosystem.

The conference also addressed strategic and technical aspects crucial for the hydrogen economy including: 1) large investments in innovation and H2-valleys across Europe, aiming to create regional ecosystems for hydrogen production and use; 2) significant progress in PEM electrolyzers, which have scaled from 0.15 MW to 300 MW, marking a major technological leap; and 3) the main challenges facing the hydrogen economy, such as high costs of hydrogen technologies and materials security issues, as critical elements like Platinum (Pt) and Iridium (Ir) are sourced from countries with geopolitical risks.

During the Opening Plenary, Gilberto Pichetto Fratin, the Italian Minister of Environment and Energy Security, emphasized hydrogen as a pillar of the national energy strategy, calling for a robust market supported by investments. ENEA's long-standing commitment to hydrogen R&D and its role in shaping a low-carbon economy was also highlighted.

As for the scientific program, four parallel sessions explored hydrogen production and storage, fuel cells for transport and industry, applications in hard-to-abate sectors, and global policy strategies. Special focus was given to aviation decarbonization, with projects like ALRIGH2T, funded by the European Commission, presenting simulation tools for liquid hydrogen integration at Heavy transport (buses and trucks) and maritime sectors were also discussed together with the possibility of small adoption of green hydrogen in industrial sectors such as glass, ammonia and refining, where even small adoption of green hydrogen would represent a significant step forward.



Moreover, the event fostered exchanges among academia, industry, and policymakers, promoting joint efforts to overcome technical and regulatory challenges and accelerate hydrogen adoption and allowing for consolidation of international research networks and identification of priority actions for hydrogen deployment.

During the conference, Valerio Palmisano (ENEA) presented the NHyRA project. The project aims include the development of validated measurement techniques for hydrogen emissions, the creation of an open-access inventory of hydrogen releases, and the provision of recommendations for standards and technical specifications to minimize climate impact and ensure safe hydrogen deployment.

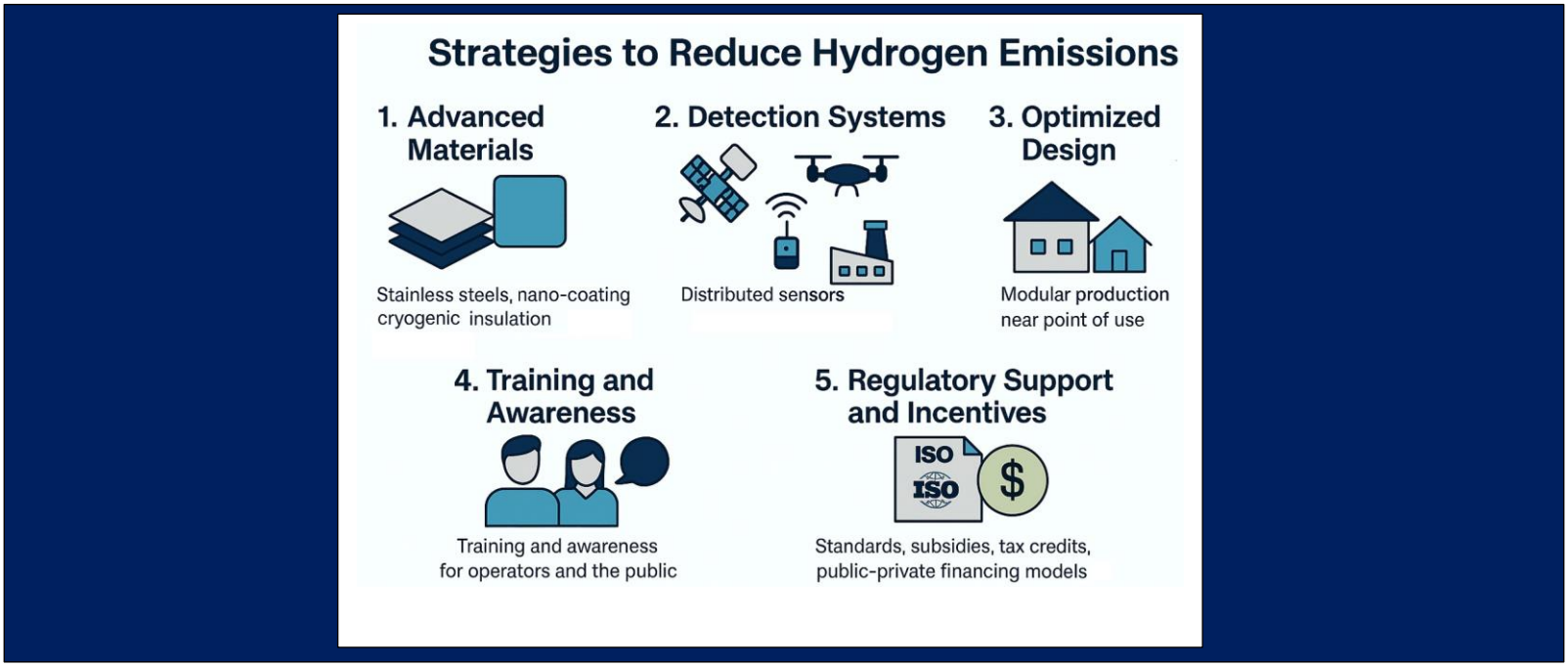
The presentation attracted strong interest, underlining the importance of quantifying hydrogen leaks to avoid underestimating their indirect greenhouse effect and supporting future mitigation strategies. Two representatives of NHyRA project partner INIG, namely Tomasz Kuchta and Anna Kròl, attended the presentation and contributed to the project's visibility by taking pictures for communication purposes.

3rd H_2 forum meeting on climate impact of hydrogen emissions: mitigation strategies

On October 28, 2025, Amici della Terra, in collaboration with Environmental Defense Fund Europe (EDFE), hosted the third webinar on hydrogen emissions, focused on policies and strategies for reducing hydrogen emissions along the supply chain. The forum was convened following the publication of the report "Hydrogen in Italy: Current Status and Prospects for Decarbonization", which examines the evolution of the national hydrogen sector within the European context and raises the emerging issue of hydrogen emissions.

The meeting was introduced by Tommaso Franci (Amici della Terra) and Massimo Micucci (Environmental Defense Fund Europe), who emphasized the importance of developing a hydrogen supply chain while simultaneously addressing the issue of hydrogen emissions, avoiding the mistakes made in the past with methane, and establishing governance from the outset based on measurement, monitoring, and shared standards.

The discussion included representatives from the Ministry of



Environment and Energy Security (MASE), the European Commission (Joint Research Centre), ISPRA, ENEA, and CIG (Italian Gas Committee).

Marcello Capra (MASE) outlined PNRR measures for hydrogen valleys, transport trials, electrolyzer manufacturing, and research calls linked to Mission Innovation and Horizon Europe.

Alessandro Arrigoni (Joint Research Centre, European Commission) presented EU efforts to integrate hydrogen emissions into technical standards and environmental assessments, mentioning NHyRA project and the importance of developing technical standards and environmental assessment methodologies.

Daniela Romano (ISPRA) confirmed IPCC's first inclusion of hydrogen emissions in national inventory guidelines.

Valerio Palmisano (ENEA) provided an update on the European **NHyRA project**—introduced in the previous meeting alongside Matteo Robino (SNAM)— briefly recalling its scope before presenting the first operational measures to mitigate hydrogen emissions. Key actions discussed included:

- Enhancing materials and seals to prevent leaks
- Designing systems to minimize valves, flanges, and potential leakage points
- Recovering hydrogen during venting and purging operations
- Developing high-sensitivity monitoring technologies
- Improving thermal insulation and cryogenic management for liquid hydrogen

He also emphasized the critical role of **training programs for operators and end users** to ensure effective implementation and safety across the hydrogen value chain.

In the final part, industry perspective was also presented:

- Proxigas: Highlighted environmental, safety, and economic implications of leaks.
- Assogastecnici: Warned against premature regulation that could hinder investments.
- Utilitalia: Called for progressive regulation, starting with voluntary monitoring and evolving toward stricter obligations as the market matures.

The forum concluded with a shared commitment to collaboration, innovation, and practical steps to mitigate hydrogen emissions, ensuring a sustainable and safe hydrogen economy.

A look back at 2025

NHyRA at other European events

NHyRA continued to gain strong visibility across major European and international events throughout 2025.

On **November 25**, the project was presented at the *EU Hydrogen R&I Days 2025* during the session on **Safety and Pre-Normative Research for Standardisation**. Alberto Javier Garcia Hombrados, Project Officer at the Clean Hydrogen Partnership, highlighted NHyRA's key role in enhancing hydrogen-sector safety through innovative methods to **quantify and measure hydrogen leakages** along the supply chain.

Earlier in the year, on September 11, Vittoria Troisi (SNAM) introduced the project at the Gastech Exhibition & Conference (Gastech2025) in Milan, during a session focused on Hydrogen and Ammonia Safety. As project coordinator, SNAM also promoted NHyRA at their exhibition booth, sharing project materials and raising awareness of its work on developing a hydrogen emissions inventory.

NHyRA was also featured in the scientific community through **ENGIE's oral presentation of a model of emissions from an electrolysis system and NPL's poster presentation of the project at the European Geosciences Union conference 2025 (EGU2025)**. This major international event gathers geoscientists from across the world to discuss research across all Earth,

Additionally, **NPL presented the NHyRA project at the Emissions & Air Quality Monitoring Conference 2025 (CEM 2025)**. This international conference and exhibition focuses on **air emissions and air quality monitoring**, offering participants insights into the latest regulations, technologies, and best practices for monitoring industrial emissions and assessing air quality.

Publications

NPL in collaboration with UNIBO, INIG, DLR, Enagas and Equinor produced the peer-reviewed paper "***Methods for detecting and quantifying hydrogen emissions over a wide range of temporal and spatial scales: a state-of-the-art review***", which was published in the open access journal **Measurement Energy** (https://doi.org/10.1016/j.meaene.2025.100069).


ScienceDirect

Measurement: Energy

Open access

Methods for detecting and quantifying hydrogen emissions over a wide range of temporal spatial scales: a state-of-the-art review

Andy Connor[1]*, Haydn Barros[1], Alessandro Guzzini[2], Marco Pellegrini[2], Cesare Saccani[2] Jad Holewa-Rataj[3], Tomasz Kuchta[3], Henning Wigger[4], Thomas Vogt[4]

[1] Environmental Emissions Metrology Group, National Physical Laboratory, Teddington, TW11 0 United Kingdom.
[2] Department of Industrial Engineering, University of Bologna, Viale del Risorgimento 2, 40136 Bol (BO) – Italy.
[3] Instytut Nafty i Gazu - Państwowy Instytut Badawczy, Cracow, Poland.
[4] German Aerospace Center (DLR), Institute of Networked Energy Systems, Department of En Systems Analysis, Carl-von-Ossietzky-Straße 15, 26129 Oldenburg, Germany.

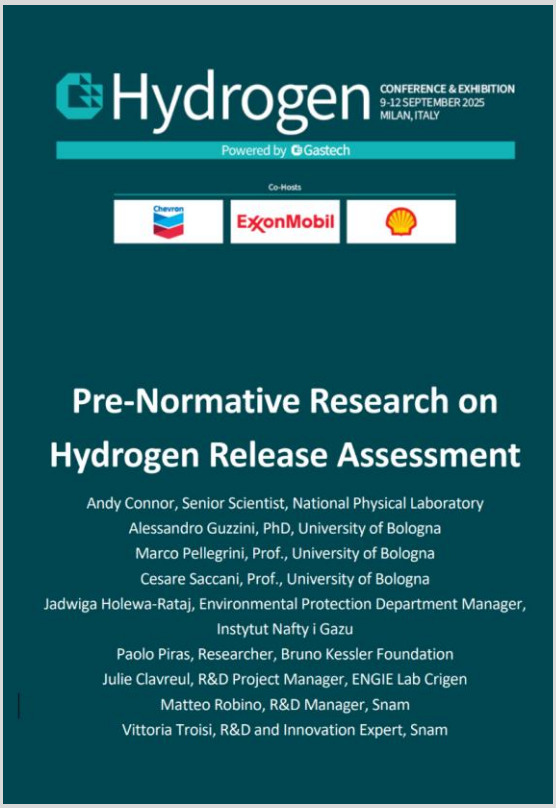
Abstract

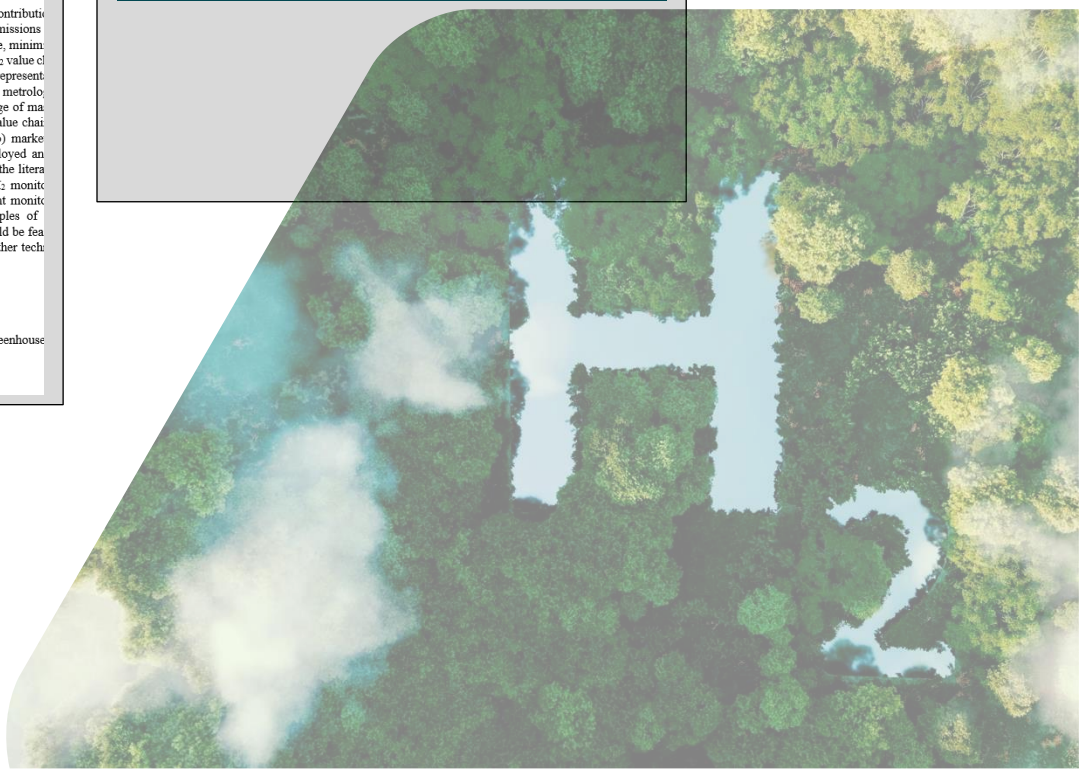
Hydrogen (H_2) is currently used in several industrial sectors. However, due to its potential contributi climate neutrality, H_2 market is expected to expand to other sectors in the near future. H_2 emissions a concern due to their potential influence on methane's persistence in atmosphere. Therefore, minim H_2 emissions would reduce any environmental impact and enhance safety and efficiency of H_2 value c Adopting measures to mitigate H_2 emissions requires data that can be trusted and are truly represent of the emissions being monitored. Such data require validated methods based on robust metrolo principles. Standard methods are needed to detect and quantify emissions over a wide range of ma volumetric ranges, spatial and temporal scales, and emission source types across the H_2 value chai addition, many instruments and associated techniques are available on the (and near to) marke measuring H_2 concentration, but their suitability depends on how the instrument is deployed an technological performance. To date, no publication reviewing these aspects is available in the litera To cover this gap, the paper will provide a foundation for the future development of H_2 monito methods. The essential constituents of a method will be defined, an overview of different monito techniques provided, followed by a discussion on future method development. Examples of monitoring techniques covered are sniffers, acoustic imaging and tracer correlation. It should be fea to develop methods to monitor emissions at component level in the near future, while further tech development is required for methods that cover larger spatial areas.

Keywords

Hydrogen emissions, hydrogen leakage, hydrogen detection, hydrogen quantification, greenhouse effect, hydrogen monitoring methods.

NHyRA partners also put together the technical paper below, which was published on the Gastech 2025 website.





Upcoming events

NHyRA is organizing a joint event with its sister project HYDRA at EHEC2026 in Seville on **March 12, 2026**.

Stakeholder Advisory Board Meeting
pre-Normative Research on Hydrogen Releases Assessment

The NHyRA first Stakeholder Advisory Board (SAB) meeting, exclusively for SAB members, will be held on **January 20, 2026**.

Project Partners

Thank you for your continued interest in NHyRA's activities!

Stay **tuned**, follow us on social media!

You want more **information**? Visit our website.

Interested in joining our SAB? Contact us.