NHyRA

N°2 – August 2025

Newsletter

pre-Normative Research on Hydrogen Releases Assessment

It’s been over a year and a half that the NHyRA project has been launched and project partners have worked hand in hand to help the project reach its objectives.

You will find below an overview of some of the activities implemented by the project partners in the past months!

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.

Tool Development for H2 Emissions Quantification

Since the main archetypes' characterization has been completed in the past months, the NHyRA project is starting to develop an open-source and user-friendly tool for estimating H2 emissions over the whole H2 value chains. Specifically, a bottom-up approach will be implemented. Correlations based on emission and activity factors will be introduced in newly developed algorithms for all the emissions source types (e.g., fugitive, vented, and incomplete combustion emissions) and for each archetype.

For this purpose, WP1 will support WP4 by updating the already published H2 emission inventory to include more accurate data to improve the statistical significance of the analysis. In fact, in addition to the gaps already known in the natural gas sector regarding the availability of inventories for emission factors despite the long experience, little to no information is published on H2 emission rates with such detail, requiring a great effort from researchers to elaborate general equations to be used for emission quantification.

Figure 1. Illustration of possible tool interface (generated by AI)

While the project partners are developing correlations, the NHyRA project is collaborating with other projects, and it will contact stakeholders in order to ask for new data, feedback, and any valuable inputs for the tool's development and success. A first example of calculation involving a simple plant consisting of an electrolyzer directly connected to a storage tank will be shared and tested internally by the end of 2025 and a first version of the tool will be shared publicly in 2026.

The project team has started designing the tool to be developed focusing on defining its core objectives and audience target. An internal workshop was held to prioritise functionalities. Below are presented some of these functionalities:

- Possibility to model value chains as networks of different archetypes;
- Calculation with default or user-defined values: based on its simple and user-friendly interface, users will be able to perform calculations using default values or changing them to focus on a specific plant layout.
- Plant vs Scenario analysis: the user can exploit the tool focusing on a specific plant or, by enlarging its focus, performing scenario analysis.
- Graphical overview of the results. The tool will provide graphics about the distribution of the H2 emissions, making it possible for the user to identify where to intervene to mitigate emissions easily.

H2 Emissions Scenarios

WP5, led by FBK, aims to quantify the H2 emissions from future hydrogen economy scenarios and provide recommendations in terms of mitigation strategies. To do so, WP5 partners have firstly identified relevant future H2 demand and value chain Scenarios. The ongoing Task 5.1's aim is to select relevant H2 economy development strategies among the available energy outlook reports available in literature.

Since the project aims to provide quantitative estimations of potential hydrogen emissions associated with a European hydrogen economy, the analysis began by reviewing major European energy strategies that have emphasized hydrogen over the years. In particular, the following policy frameworks were considered:

EU Hydrogen Strategy (2020):

This strategy sets out a roadmap for scaling up hydrogen production and use in Europe, with a focus on green hydrogen produced from RES aligned with the European Green Deal. It defines key targets for electrolyser capacity in the short term (2020-2024), mid (2025-2030) and long term (2030-2050), investment and the creation of a hydrogen infrastructure to support industrial decarbonization, heavy transport applications, and energy storage

Fit for 55 Package (2021):

This package is designed to align EU policies with the goal of reducing greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. It includes measures to support hydrogen adoption, such as carbon pricing mechanisms such as the CBAM and EU ETS, stricter renewable energy targets, and incentives, common internal market rules etc. for hydrogen-based technologies in industry and transport

Repower EU (2022):

Developed in response to the energy crisis related to geopolitical instability, this initiative aims to reduce dependence on fossil fuel imports, particularly from Russia, and speed up the transition to RES. Focuses also on hydrogen deployment by increasing the EU's renewable hydrogen production target to 10 million tons per year by 2030, with an additional 10 million tons of imported hydrogen. The plan also supports the development of hydrogen corridors, infrastructure investments, and market mechanisms to enhance supply chain resilience.

Since the literature review and scenario implementation within the NHyRA project require a detailed analysis of the different hydrogen value chains trends for key technologies identified in WP1 for the years 2030 and 2050, a more in-depth evaluation of hydrogen-related energy outlooks was necessary. European strategies do not always provide a sufficient level of detail for all major technologies; therefore, an additional step was taken to extract relevant production and demand estimates from available energy outlooks related to hydrogen.

The first step involved defining the boundaries of the analysis. Only scenarios covering at least the EU27 countries and the United Kingdom, along with technologies relevant to the NHyRA project, were considered. Further details on these selection criteria are provided in the next chapter.

Next, a preliminary screening and evaluation of the identified outlook reports was conducted to assess whether they met the defined geographic and technical criteria. This assessment considered aspects such as the areas of interest, whether the outlooks included sector-specific or technology-specific breakdowns, and other relevant dimensions. Specifically, the logic of the outlooks framing follows the contextualization for NHyRA project purposes.

Six fields of categorization were identified for each energy report:

- **Area of interest:** the NHyRA project focuses on the European Union, including hydrogen imports and exports. Consequently, for each outlook the geographical area covered has been considered.
- **Type of Scenario:** to be able to compare data derived from different outlooks, the scenarios considered for each outlook were identified.
- **Division by Sector:** during the previous WPs, different archetypes were identified and selected to give a clear overview of all the hydrogen losses sources. In this work, for each energy outlook, the possibility of gain data for different sectors has been explored to be as much as possible consistent with the other WPs.
- **Division by Region:** in the case of a global world point of view of the outlook, the possibility to obtain insight into the European case study has been considered.
- **Division by Technology:** in the same way as the division by sector, this contextualization aims to evaluate the outlooks capability to provide accurate information on the hydrogen economy scenario
- **Years considered:** the NHyRA project focuses on the estimation of hydrogen losses in 2030 and 2050. For each report the possibility of extracting data from these specific years has been considered.

The literature review has been carried out firstly analyzing and framing 28 energy outlooks that include hydrogen. For each report screened, the data collection and categorization has been conducted. The data was gathered trying to meet properly as much as possible all the archetypes identified in WP1. Practically, the quantitative information collected from the outlooks was clustered based on the year of reference and the scenario considered. This exercise has been conducted by collecting data by sector of the hydrogen value chain (demand, production and transportation), by sub-sector (e.g. for the demand sector: industry, power generation, mobility, and sub-sector: fuel cells, internal combustion engines, gas turbines etc.). Figure 2 shows an extract of the excel tables used to conduct this activity. This first screen allowed us to select the outlooks which fit with NHyRA project boundaries and requirements. For example, the reports that don't let data on European limits have not been considered in the following steps unless they align with one of the WP aims to identify possible European Hydrogen scenario.

To improve the analysis accuracy and avoid data inconsistency and overlapping, a detailed document will be

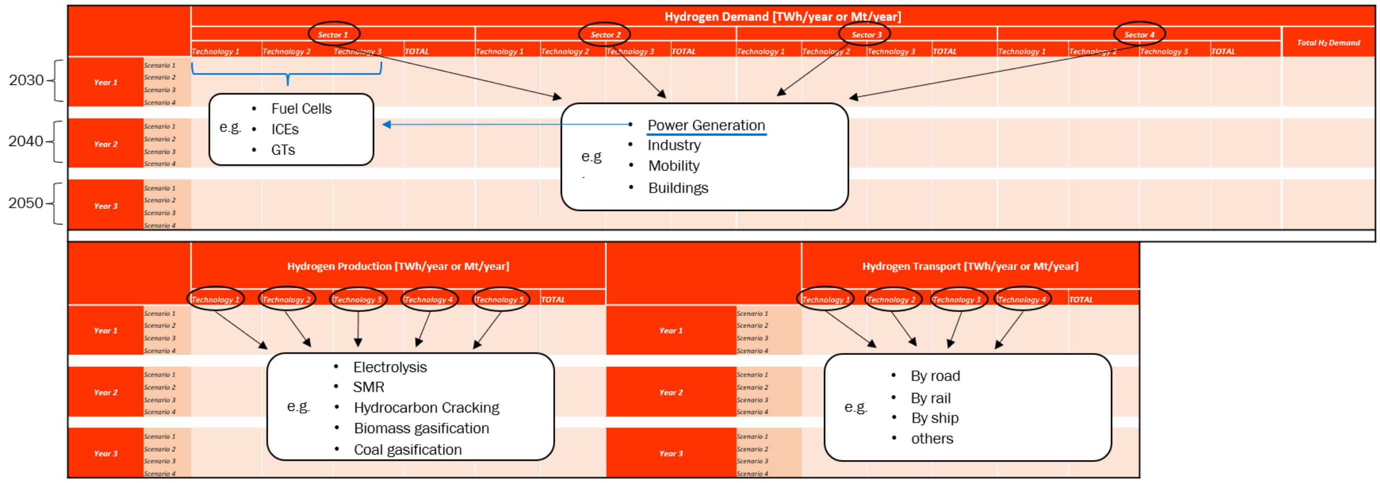

Figure 2. Hydrogen scenarios literature review.

prepared by the partners for each outlook selected.

The document meant to collect the main assumptions and information for the specific outlook analysed. This will help to make comparable coherently data extract from different sources and to include all the necessary details for each selected scenario in the Task 5.1 deliverable.

The document is divided into 5 sub-chapter: the first one summarizes general key information, assumptions, and boundaries for the specific outlook analysed, while the other sub-chapters contain the main qualitative and quantitative information for the different part of the hydrogen value chains: production, transport, storage and end-use.

This intermediate step lays the foundation for the effective data processing and elaboration that will produce Hydrogen scenarios suitable for NHyRA project purposes.

Cooperation with other EU projects

Collaborating with other EU-funded projects is a highly encouraged practice to help maximize impact and avoid duplication of effort. Currently, NHyRA experts are collaborating with partners from HYway (Climate impacts of a HYdrogen Economy: The pathWAY to knowledge) and HYDRA (Hydrogen Economy Benefits and Risks: tools development and policies implementation to mitigate possible climate impacts) projects, both funded by the European Commission. Cooperation with other EU-funded projects will allow alignment in respect to respective scientific findings and industrial exploitation, and will help avoid overlapping and any duplication of work.

The HYway project aims to develop adaptive multiscale material modelling and characterization suites for assessing interactions between hydrogen and advanced metallic materials and demonstrating their capabilities on hydrogen storage and transport components.

On the other hand, the HYDRA project aims to better understand how using hydrogen on a large scale for energy or industry might affect the climate, looking at the impact of potential hydrogen leaks and study how hydrogen is absorbed. Both of these projects share in some extent joint objectives with NHyRA. This is why it is necessary to actively collaborate with them to enhance synergies between the projects.

Furthermore, the NHyRA project is also closely collaborating with the NEST (Network for Energy Sustainable Transition) project, led by Spoke 4. The project aims to promote a technological roadmap to stimulate the technological and industrial revolution in Italy, facilitating the development of a national infrastructure based on hydrogen production and use of technologies, with the aim of promoting Italy as a European hub for this energy source. Some of NHyRA partners (UNIBO, FBK, SNAM and ENEA) are also participating in the project to facilitate cooperation between both projects.

At last, as the full name of the project (pre-Normative Research on Hydrogen Releases Assessments) states, NHyRA is a pre-normative research project. As such, partners of the project are working strategically to allow for NHyRA results to become a reference in the field of H2 emissions and thereby support standardization of the proposed approach. This process will be enhanced by the participation of some of NHyRA's partners in other EU-funded projects (such as THOTH2, H2flowtrace, PilgrHYm, etc.) which are also contributing to the development of standards.

Project Partners

Thank you for your interest in the NHyRA activities!

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