European Hydrogen Backbone: Boosting EU Resilience and Competitiveness

20 November 2024.

The European Union is committed to achieving its climate targets to help to keep global warming well below 2 degrees Celsius. At the same time the competitiveness of EU industry and the security of energy supply needs to be ensured. Renewable and low-carbon hydrogen, transported and stored in hydrogen infrastructure will be crucial to achieve this.

Hydrogen infrastructure enables cost-effective supply of energy to consumers
In his recent report on the future of the single European market for the European Council 'Much more than a market.' former Italian Prime Minister Enrico Letta stresses the importance of building the hydrogen backbone: *'The rapid deployment of offshore wind projects and their grid connections, reinforcing electricity grids and establishing a European backbone hydrogen network connecting consumer and producers across Europe are probably the most important steps Europe has to take to succeed in its decarbonization path.'*[1] Hydrogen infrastructure enables energy produced where it is the cheapest to be supplied to end consumers.

European Hydrogen Backbone can speed up the development of hydrogen
The European Hydrogen Backbone (EHB) infrastructure enables a cost-competitive pathway to net-zero emissions while fostering industrial competitiveness. Hydrogen pipelines, import terminals and storages can speed up hydrogen supply and demand. It can be a market forming infrastructure. Under the EU ETS, industry, electricity producers, and shipping and aviation need to achieve net zero emissions by 2044.[2] Large industrial users will want access to an interconnected market to source the cheapest available hydrogen. This means that the Backbone needs to be well developed by the early 2030's, which makes building it an urgent task. **Public support is needed** to de-risk the timely creation of hydrogen infrastructure.

Who are we?
The EHB initiative unites 33 future hydrogen network operators. The mismatch between the supply and demand of hydrogen in Europe led us to develop a pan-European infrastructure plan for a dedicated hydrogen transport network. We are now part of Gas Infrastructure Europe (GIE).This enables a stronger connection between hydrogen transport and storage, which are naturally interlinked to connect supply and demand of hydrogen.

[1] Enrico Letta, *Much more than a market. Speed. Security. Solidarity* (April 2024), p. 64
[2] Preparatory notes by DG climate for Commissioner Hoekstra ahead of EU Parliamentary hearing (October 2024)

The EHB initiative aims to accelerate Europe's decarbonisation journey by defining the critical role of hydrogen infrastructure – based on existing and new pipelines – in enabling the development of a competitive, liquid, pan-European renewable and low-carbon hydrogen market. We have created a vision on how cross border hydrogen infrastructure develops from 2030 to 2050 and analysed what it takes to build this infrastructure. This vision is already turning into action. The Netherlands has started the creation of its national backbone and the German government has provided support for the German 'Kernnetz' and construction is expected to start soon. In addition, 29 hydrogen transmission projects have been included in the 6th Projects of Common Interest list adopted by the European Commission, and are actively been developed by the EHB partners.[3]

Hydrogen network planning will be coordinated at EU level by ENNOH. We will continue to analyse, develop and propose solutions on how the hydrogen infrastructure can be built as rapidly as possible.

Renewable and low-carbon hydrogen is crucial for cost-competitive decarbonisation

The European Commission considers renewable and low-carbon hydrogen to be a cornerstone of the EU's net-zero strategy [4] [5] [6], particularly in decarbonising hard-to-abate sectors. These include difficult to electrify heavy industries that rely on fossil fuels for high-temperature energy and chemical feedstocks such as primary steel production, high value chemical production, and fuels for truck transport, international shipping, and aviation. Hydrogen will also be useful to cost-effectively balance the electricity system via energy storage, including hydrogen storage, dispatchable power and heat production and by avoiding curtailment by using surplus electricity from wind and solar-PV to produce hydrogen.[7]

A European Hydrogen Backbone enables low-cost hydrogen supply chains

In his recent report for the European Commission, former ECB president and former Italian prime minister Mario Draghi proposes a joint plan for decarbonisation and competitiveness, stating that *'the first key goal for the energy sector is to lower the cost of energy'*.[8] The use of low-cost hydrogen and the creation of a hydrogen backbone can enable this. The hydrogen backbone, together with hydrogen storages, will lower the cost of hydrogen by enabling least-cost hydrogen production and imports benefitting end-consumers across the EU. This will allow production in areas of abundant low-cost energy, and consumption in demand centres across Europe.[9]

Developing the hydrogen backbone also reduces the overall costs of the supply and value chain. By providing a connecting pan-European hydrogen infrastructure, a liquid hydrogen market with possibilities to sell and buy hydrogen from several parties becomes possible, increasing competition and the competitiveness of European industries. In addition, the hydrogen backbone will also enable increasing volumes of hydrogen to become available, increasing competition, and ensuring that energy can be secured across Europe at a low cost.

Hydrogen infrastructure for energy security

Several studies have shown the need to develop five interconnected hydrogen corridors in Europe, evolving into 58,000 km of pipelines in 2040 to ensure a secure hydrogen supply. By developing the

[3] European Hydrogen Observatory. *European Commission adopts the 6th list of Projects of Common Interest (November 2023)*

[4] European Parliament and Council, *Renewable Energy Directive III (RED III). Directive (EU) 2023/1791 on the promotion of the use of energy from renewable sources* (2023).

[5] European Commission, *European Hydrogen Bank: Supporting the uptake of renewable hydrogen in the EU* (2023).

[6] European Commission, *Impact Assessment Report Accompanying the Communication "Securing our Future: Europe's 2040 Climate Target and Path to Climate Neutrality by 2050",* SWD(2024)

[7] European Hydrogen Backbone*. Analysing future demand, supply, and transport of hydrogen* (June 2021).

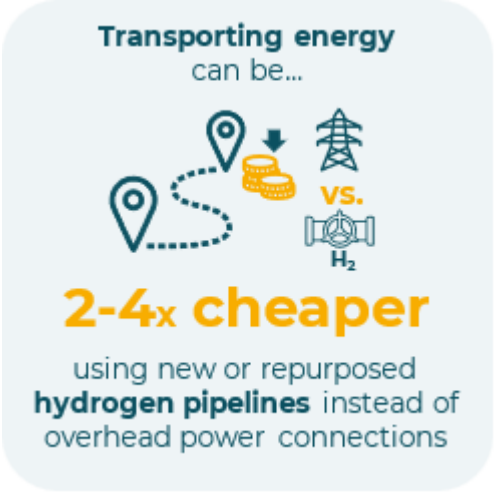
[8] As was highlighted by the recent report by Mario Draghi, *The future of European competitiveness* (September 2024), p.46.

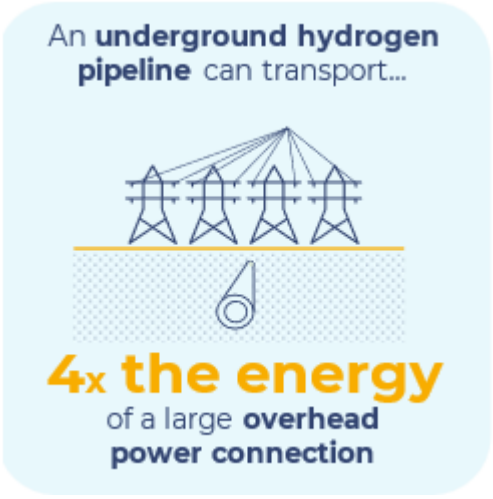
[9] Gas for Climate. *Assessing the benefits of a pan-European hydrogen transmission network* (2023)

backbone, Europe creates an integrated, resilient energy network, stabilising supply and demand across member states and neighbouring countries, reducing energy dependencies, and providing optionality and competition for industries. This goes hand in hand with a fully-fledged storage and import terminals infrastructure to provide the required flexibility to the whole energy system.

Hydrogen infrastructure for affordable decarbonisation

Hydrogen infrastructure enables low-cost emission reductions for society and the energy system. This is a key conclusion from the studies performed by the EHB consortium over the past four years. Of the 58,000km network in 2040 approximately 60% will come from repurposed natural gas pipelines.[10] Repurposing pipelines can reduce costs by around 80% compared to constructing a new pipeline. Reducing the cost of infrastructure can enable an affordable transition for all, with the full backbone in 2040 requiring a modest investment compared to alternative energy infrastructure developments.[11]





Pipelines have a **cost advantage** over electricity cables for high-volume energy transport over long distances.[12] Underground pipelines can transport large volumes of energy efficiently without negative impacts on landscapes and with minimal spatial impacts.[13] The EHB has also analysed that for distances up to several thousands of kilometres, pipelines are the most cost-effective way to transport hydrogen versus hydrogen carriers transported by ship.[14]

Public support needed to de-risk European Hydrogen Backbone infrastructure investments

To achieve the EU's climate goals and strengthen industrial competitiveness, the European Hydrogen Backbone requires immediate and robust public support. This is also emphasised in the Letta report: '*establishing a European backbone hydrogen network […] require a new alliance among the Member States involved in the projects and a strong EU-level support'*[15]

[10] European Hydrogen Backbone. *EHB initiative to provide insights on infrastructure development by 2030* (July 2023), p. 2

[11] The EHB requires investments of ~ € 120 billion by 2030 (EHB 2024). This is much lower than expected investments in power transmission and distribution grids of ~ € 600 billion (Commissioner Simson at 9th Energy Infrastructure Forum, June 2023.)

[12] High-volume transport of energy over long distances, is 2 to 4 times more cost-effective per MWh through new or repurposed underground hydrogen pipelines than via overground power lines, when the desired end-product is hydrogen, depending on distance and pipeline type (repurposed/new). European Hydrogen Backbone & Gas for Climate (2021). Analysing future demand, supply and transport of hydrogen. Page 81, Figure 39.

[13] A 48 inch hydrogen pipeline is estimated to have a capacity of 13 GW H2 (LHV) (EHB, 2021, Page 17, Table 3). This approximately the capacity (3 GW) of four 2x380 kV overhead electricity lines. This highlights that the spatial impacts of a gas pipeline a significantly lower, even without taking into account the difference in the required 'protection strip' where land use is restricted, which is significantly larger for overhead powerlines (Frontier Economics & IAEW, 2019, Page 64, Figure 40).

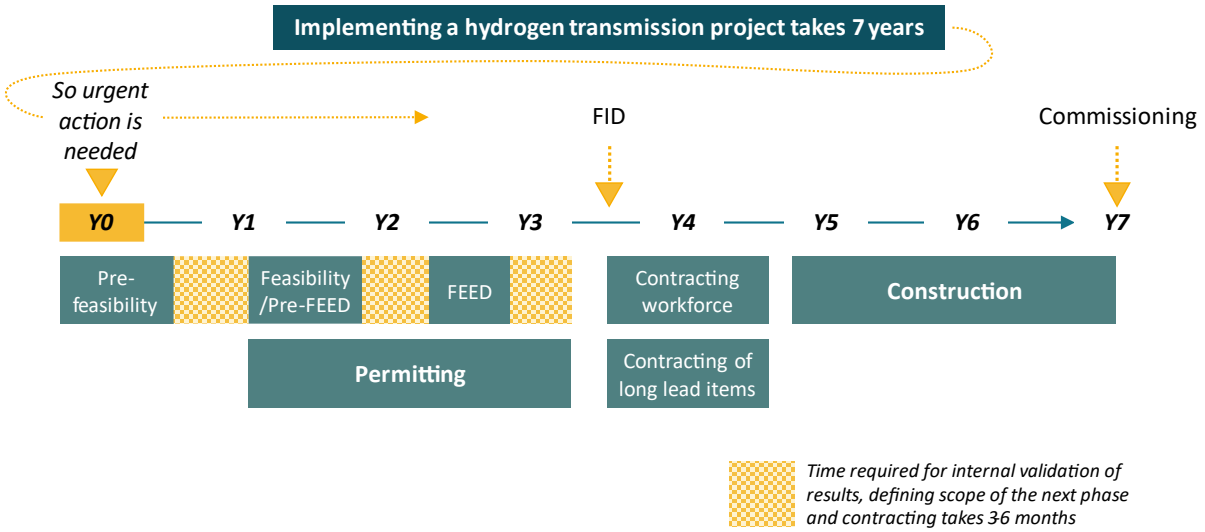
[14] European Hydrogen Backbone. *Analysing future demand, supply, and transport of hydrogen* (June 2021). p 76

[15] Letta report, p.64.

Pipelines are long-term anticipatory investments. Large volumes of hydrogen will be needed in the EU energy system in the near future. Our analysis shows that we can expect 1,350 TWh by 2040[16] and ~2,300 TWh by 2050[17] (or 140 bcm and 238 bcm of natural gas equivalent, respectively). Pipelines must be dimensioned to be 'future-proof' and capable of transporting large volumes of hydrogen when required. In the early nascent hydrogen market, 'future-proof' hydrogen pipelines will have few users in the early stages of market development. To avoid high transport fees for launching customers, it is possible to initially charge lower fees to attract more users. This, however, creates a gap between profitable operation and the revenues made from a reduced tariff. This gap is called the investment recovery challenge.

This investment recovery challenge needs to be solved to make hydrogen backbone projects attractive to private investors. De-risking of investments is required, initial examples of this can be seen in the Netherlands and Germany today.[18] [19] Support is also required in the development stages of the project. Recent EHB work shows that 44 European backbone projects require roughly € 2.5 billion in support for development stages of these plans.

This support is crucial and urgent. The EHB is an anticipatory, market-forming investment that can kick-start the European hydrogen economy. Investing in the EHB will de-risk the hydrogen sector overall, supporting low-carbon and renewable hydrogen production and securing the EU's position as a leader in hydrogen technology and sustainability. It will reduce the cost of the energy transition in Europe. On average, hydrogen backbone pipeline projects take around seven years to develop, but most projects have already passed the pre-feasibility phase. Speeding up the permitting process (e.g. via recognition of existing rights of way in general for all gases) would help to reduce the overall project duration. Through reducing permitting times and de-risking investments positive investment decisions can be enabled, and hydrogen backbone infrastructure can help Europe achieve its climate targets in time and at an affordable cost.



[16] European Hydrogen Backbone. *EHB Implementation Roadmap: Public support as catalyst for hydrogen infrastructure.* (April, 2024) p. 16. This is similar to the 2040 hydrogen demand in TYNDP 2024 which states 1690 – 2190 TWh in various scenarios.

[17] European Hydrogen Backbone. *Analysing future demand, supply, and transport of hydrogen* (June 2021). This is similar to the 2050 hydrogen demand estimates in TYNDP 2024 which estimates between 2,330 – 3,110 TWh in various scenarios.

[18] BMWK. *Wasserstoffbeschleunigungsgesetz*.

[19] Ministerie van Economisch Zaken en Klimaat. *Kamerbrief: Ontwikkeling transportnet waterstof*

The European Hydrogen Backbone by 2040

Map from EHB April 2024 study, using data from 2023. Some projects have been updated since