From hydrogen valleys to a European Hydrogen Backbone

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TSOs are driving development of the EHB, leading both large-scale coordination efforts and the delivery of real projects on the ground

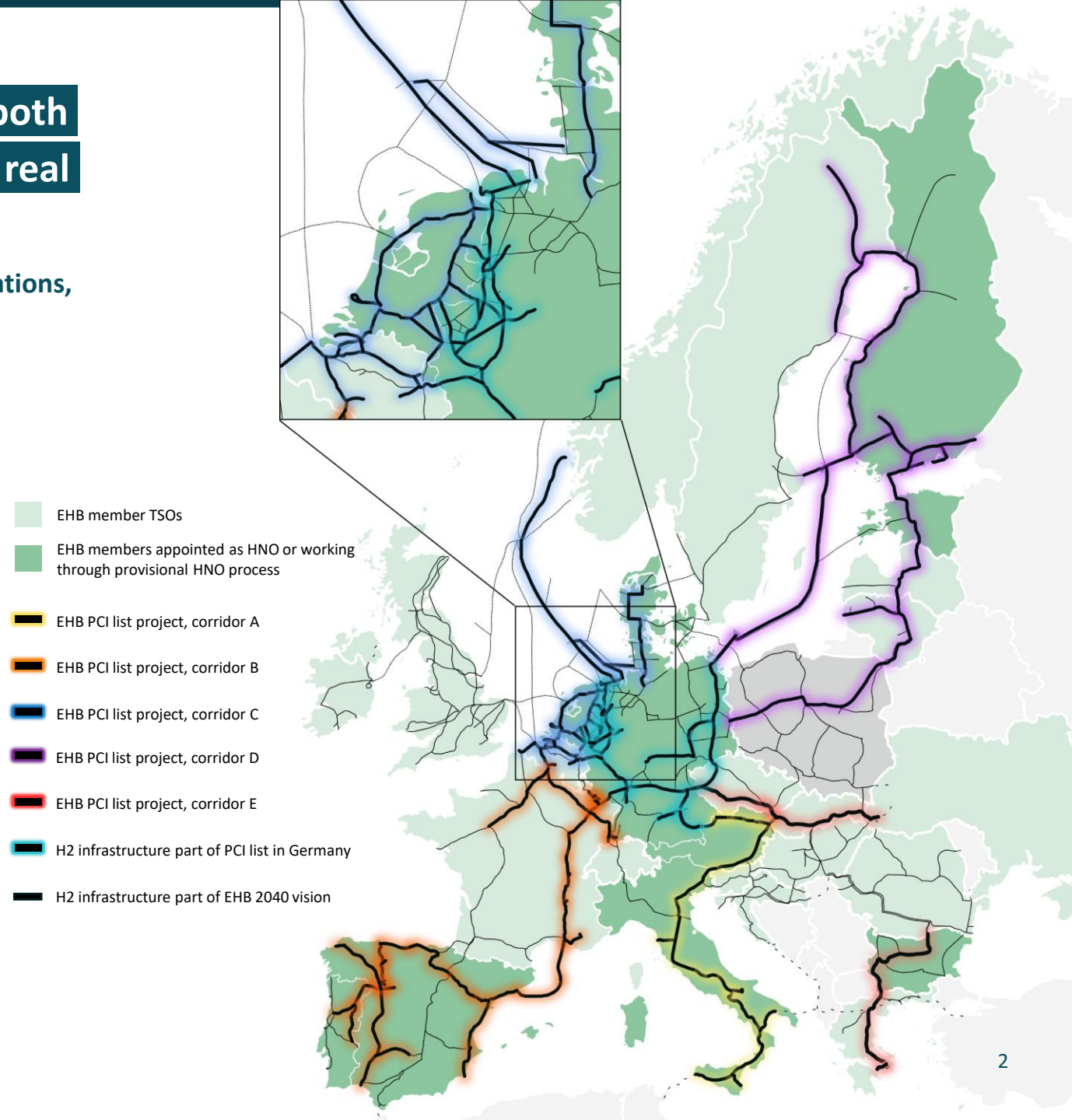
EHB members have continued to push forward with PCI and HNO nominations, market studies, and concrete project implementation

EHB members are developing concrete projects:

- 41 EHB projects awarded PCI status.
- EHB infrastructure projects included in ENTSOG's 2024 Ten-Year Network Development Plan (TYNDP).
- Development studies in Spain, Denmark, France, Germany, Lithuania, and Norway identifying supply and demand resources that support a strong business case.

EHB members are actively leading national and international hydrogen development activities:

- First Hydrogen Network Operator (HNO) nominations have occurred: three EHB member TSOs awarded HNO status, two close to securing the role in their countries, and more expected to follow.
- EHB members will also be active stakeholders in the developing European Network of Network Operators for Hydrogen (ENNOH).



Hydrogen valleys: where it starts

Early hydrogen connection between supply and demand, 12 km, 2018

- Netherlands: Dow (hydrogen from process) – Yara (hydrogen for ammonia) https://www.hynetwork.nl/en/about-hynetwork/hydrogen-pipeline-dow-yara

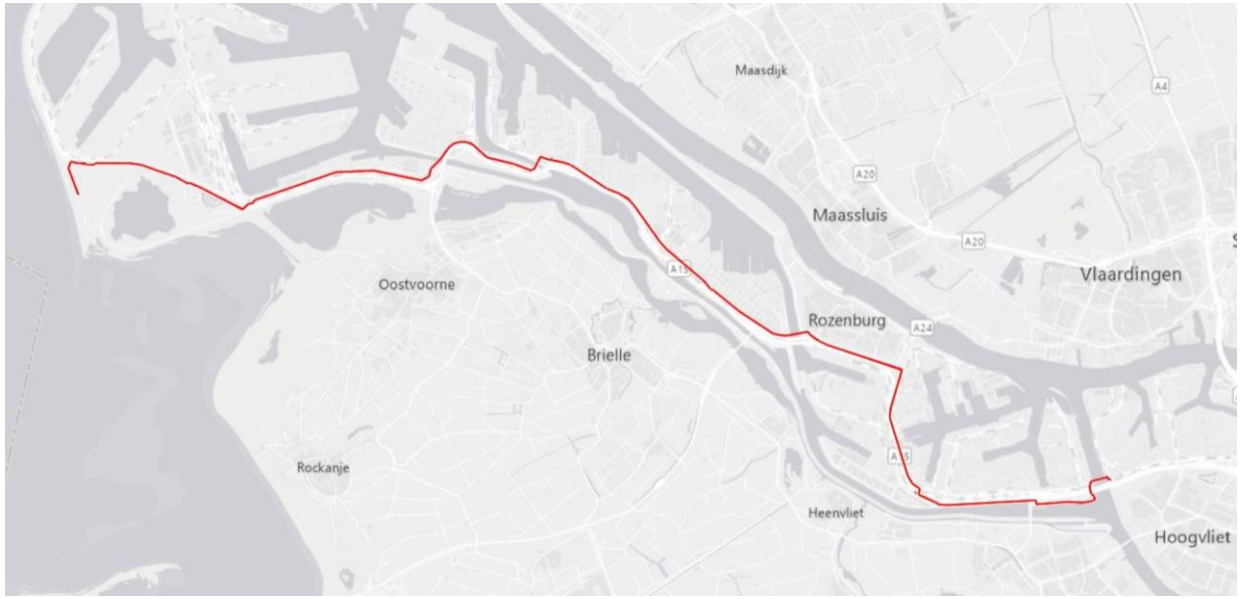
Source: hynetwork.nl

Hydrogen valleys: where it starts

First part of the Dutch national hydrogen backbone, 32 km, underground, under construction

- Maasvlakte 2 – Port of Rotterdam https://www.hynetwork.nl/en/in-your-region/rotterdam/building-the-network-in-rotterdam
- Will connect to national network, storage facilities and international backbone in phase 2.

Source: portofrotterdam.com



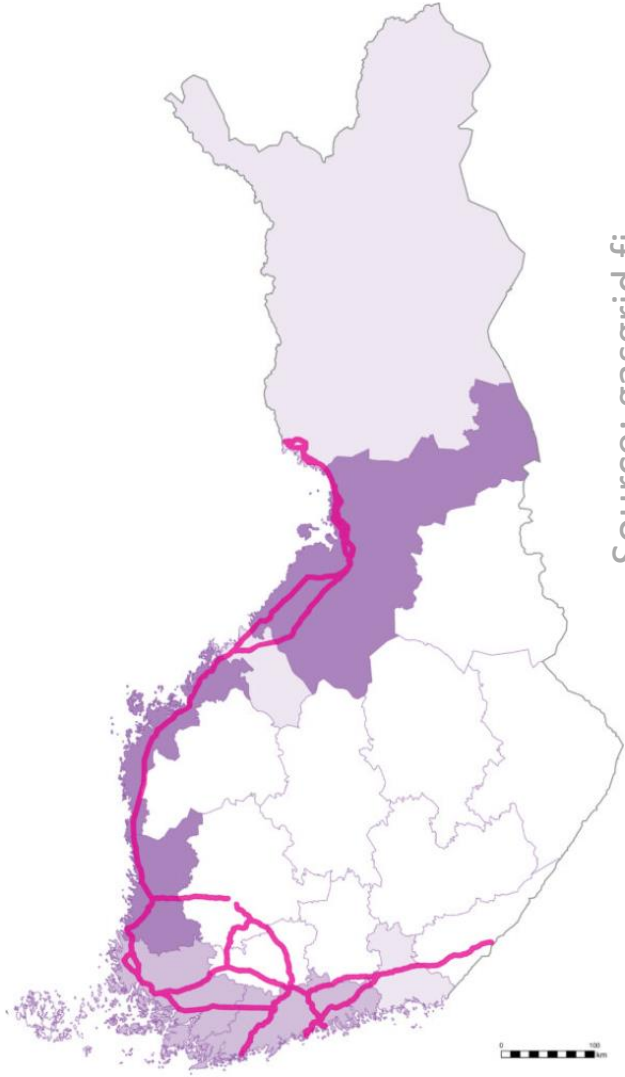
Source: hynetwork.nl

Connecting valleys, building the backbone

Gas Infrastructure Europe

Early hydrogen connections between supply and demand

- Gasgrid Finland's preliminary plans, based on market consultation, May 2024:
- "At the moment, most of the wind power projects announced are located on the west coast of Finland, and a large part of Finland's CO_2 emissions originate in Southern Finland, so in the first phase, the hydrogen infrastructure will be built mainly in coastal areas. Going forward, our goal is to involve more operators in the hydrogen sector in the implementation of a hydrogen backbone covering the whole of Finland."
  [Sara Kärki, Senior Vice President, Hydrogen Development]



Source: gasgrid.fi

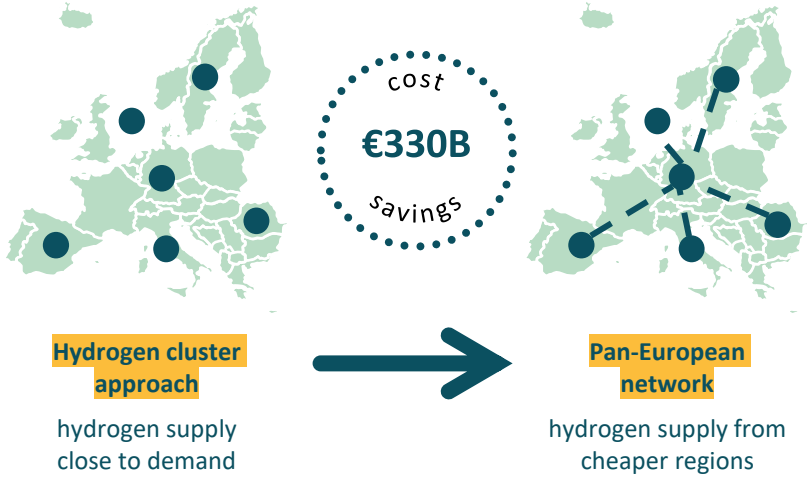
Preliminary alternative route plans for the hydrogen transmission network, which will be refined as the planning progresses.

Connective hydrogen infrastructure is central to the energy transition

Early-market public support for hydrogen infrastructure is the most cost-effective way to spur the build-out of hydrogen value chains

Hydrogen and the EHB are crucial enablers of the European energy transition.

- A successful early rollout of hydrogen infrastructure will be key to achieving Europe's decarbonisation targets by 2030 and beyond.
- Pan-European hydrogen infrastructure supports the scale-up of renewable energy and bolsters security of supply, with connectivity between supply and demand regions directly contributing hundreds of billions of euros in savings.[1]



Early market dynamics during the scale-up of hydrogen result in misaligned incentives for EHB buildout, hindering proactive early-stage investments.

Investors are willing to invest in bankable projects but require guarantees.

- Investors seek projects with firm end-user commitments, which are difficult to obtain in the early stages of market ramp-up.

Pipelines sensibly built to accommodate future demand come with early-stage financial risks.

- The EHB is most cost-effective when sized to serve mature-market volumes, preventing expensive expansion projects and infrastructure-related bottlenecks as the hydrogen market develops.
- Consequently, generating sufficient revenue in the first five-to-ten years of operation poses challenges for forward-looking pipeline developers, with low initial revenues discouraging private investment despite the decades-long durability of decarbonisation benefits.

TSOs are pushing forward with build-out but should not be required to bear all financial risk.

- Public risk sharing is needed to enable investment in the construction and operation of pipeline projects, rather than disincentivising proactive TSOs by requiring them to bear the risk alone.
- Example: A €5 billion cross-border pipeline project requires an initial investment of €125-250M for developmental studies[b] to help mature the project and make it bankable for investors.

1) Gas for Climate, 'Assessing the benefits of a pan-European hydrogen transmission network'
b) DEVEX assumed to be a percentage of CAPEX, with variability on a project-to-project basis

Why we will need a European backbone

- Areas with high demand – e.g. from industry - don't always have room for major renewables development (green hydrogen) or access to CO_2 storage (blue hydrogen)
- Hydrogen imported by ship will need to be transported to inland locations
- Hydrogen imported by pipeline will need to be transported through Europe
- Varying green hydrogen production and varying demand require access to large-scale storage locations, not evenly spread over Europe
- Areas with high renewables potential (and low production cost) need high-capacity transport to areas with high demand. One 48-inch pipeline can transport 17 GW of hydrogen.

When we will need a European backbone

- The EU ETS requires industry and electricity production to be net zero emissions by 2040.
- In the steel sector, many primary steel producers plan to transition from using coal to invest in direct reduction of iron (DRI) technology using gas. This can be natural gas to start with, that can be gradually be replaced by hydrogen (and possibly biomethane). One large primary steel plant requires around 1.5 bcm of hydrogen in natural gas equivalent. Enabling such large industries the choice to reach their EU ETS obligations in time will require access to large volumes of hydrogen well before 2040.
- Gas transmission system operators and storage operators are ready to support the industrial green deal by enabling industry to decarbonise in a cost-efficient manner. We can provide the necessary infrastructure, starting with enabling hydrogen valleys, to be connected to a functioning European Hydrogen Backbone in the course of the 2030s.

Efforts to set up the network for early success and accelerate market adoption will reduce the total amount of investment required over time

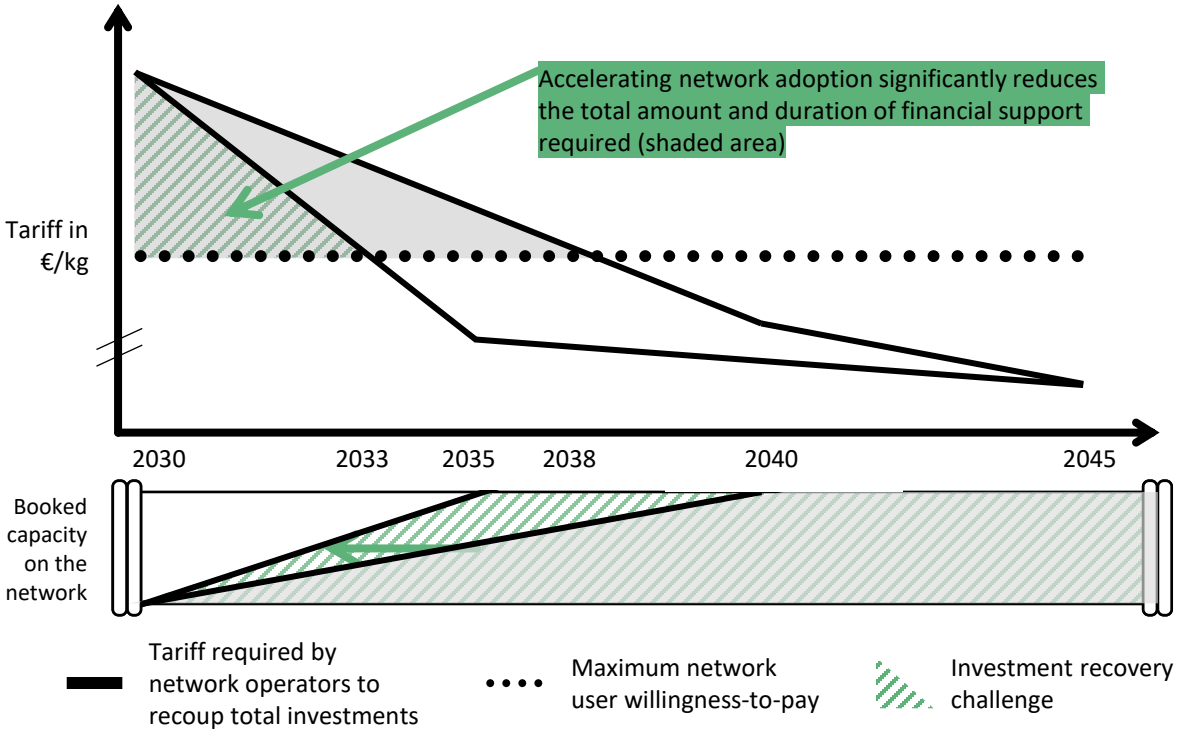
Activities that act to de-risk and mature the hydrogen market are likely to stimulate additional, simultaneous drivers of network growth

2022
2023
2024
2025
2026
2027
2028
2029
2030

Construction & Operations Phase (post-FID)

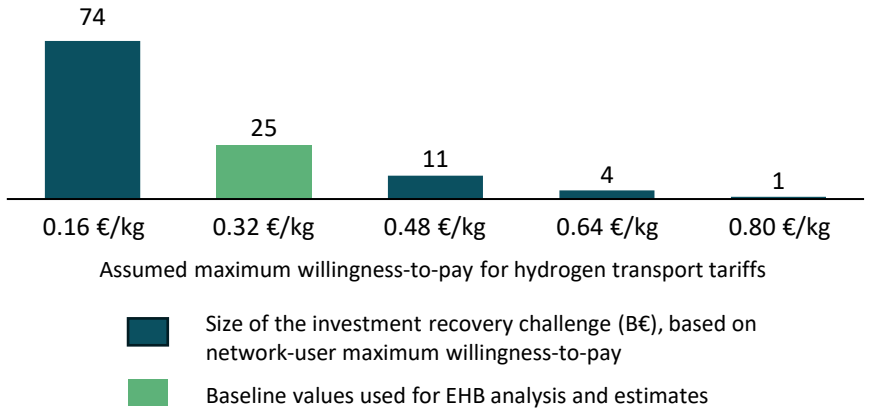
Financial, political, and regulatory efforts that work to accelerate the maturity of the hydrogen market *also* work to **reduce the size and duration of public support required for the EHB**, benefiting both policymakers and citizens that contribute to public financial pools.

Benefits of Accelerated Market Development



The gap between TSO break-even costs and network user willingness-to-pay is perhaps the most important factor for determining the amount of support required (chart below).

The impact of network user willingness-to-pay



Willingness-to-pay is likely to vary by location and end-use sector, while TSO break-even costs are driven by geographic, population, and political factors.