

Hydrogen Technologies and Development in the Baltic and Nordic Regions

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HYDROGEN IN NORD EUROPE: STORYLINE



1st Period (discovery time)

1776: Hydrogen identified as a chemical element. Henry Cavendish.

1800: Electrolysis was discovered.

2nd Period (electrolysis)

1913: Harber-Bosch, Germany, NH_3 production

1927: Industrial electrolysis for fertilizer, 167 MW, Norway Rjukan

1921: Hydropower+ electrolysis for ammonia, Sweden Ljungaverk

3rd Period (steam methane reforming)

1965: Achema, Synthetic ammonia for fertilizer, Lithuania

1980: Mažeikiai refinery plant, Lithuania

1950-80s: Fossil H_2 : SMR dominates instead of electrolysis

1980s: Refineries become major H_2 users (DE, PL, FI, SE, DK, LT, NO)

4th Period (green/clean hydrogen)

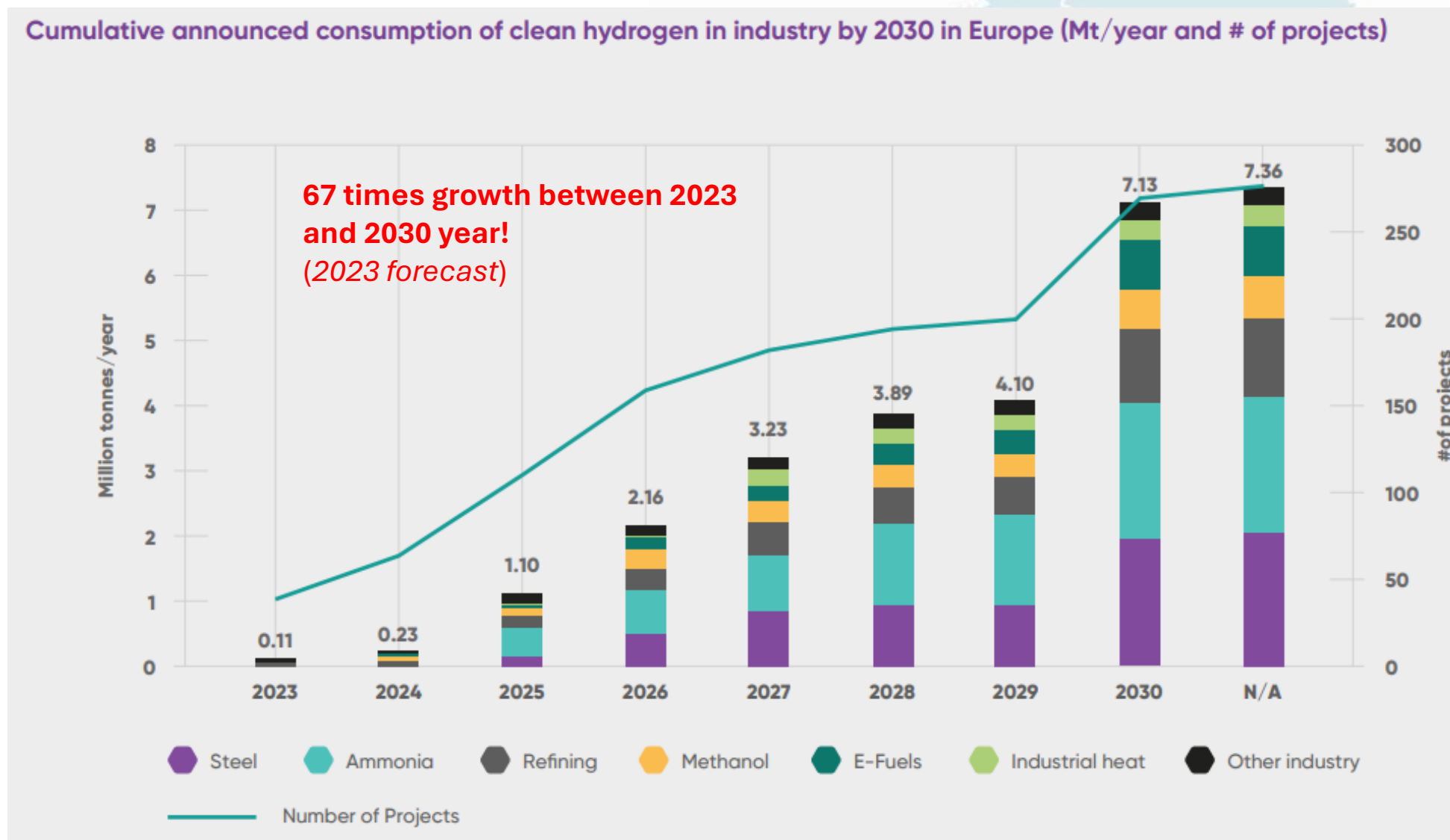
2016 – now
Regional and national H_2 strategies, financial mechanisms, demo projects, and other initiatives promoting the H_2 energy sector

4th PERIOD

- **EU climate neutrality ambitions** — the European Green Deal, Paris agreement and the EU Hydrogen Strategy positioned **hydrogen as a key tool for achieving climate neutrality** by 2050.
- **Decarbonization of hard-to-abate sectors** — growing recognition that hydrogen is needed for industries such as **steel, chemicals, fertilizers, refining, shipping and heavy transport**.
- **Rapid growth of renewable energy** — falling costs and increasing availability of wind and solar made **green hydrogen via electrolysis** increasingly attractive.
- **Energy security concerns** — the **COVID-19 recovery and russia's invasion of Ukraine** accelerated Europe's efforts to reduce dependence on imported fossil fuels and diversify energy supply.
- **Major public funding and policy support** — EU and national hydrogen strategies, subsidies, grants and programs such as **REPowerEU** stimulated project development.
- **Large industrial investment announcements** — major companies began announcing green-steel, electrolyser, ammonia, e-fuel and hydrogen infrastructure projects, creating strong market expectations.
- **Expectation of a future hydrogen market** — forecasts of rapidly growing hydrogen demand and cross-border hydrogen trade encouraged early project development and infrastructure planning.



HYDROGEN HYPE...

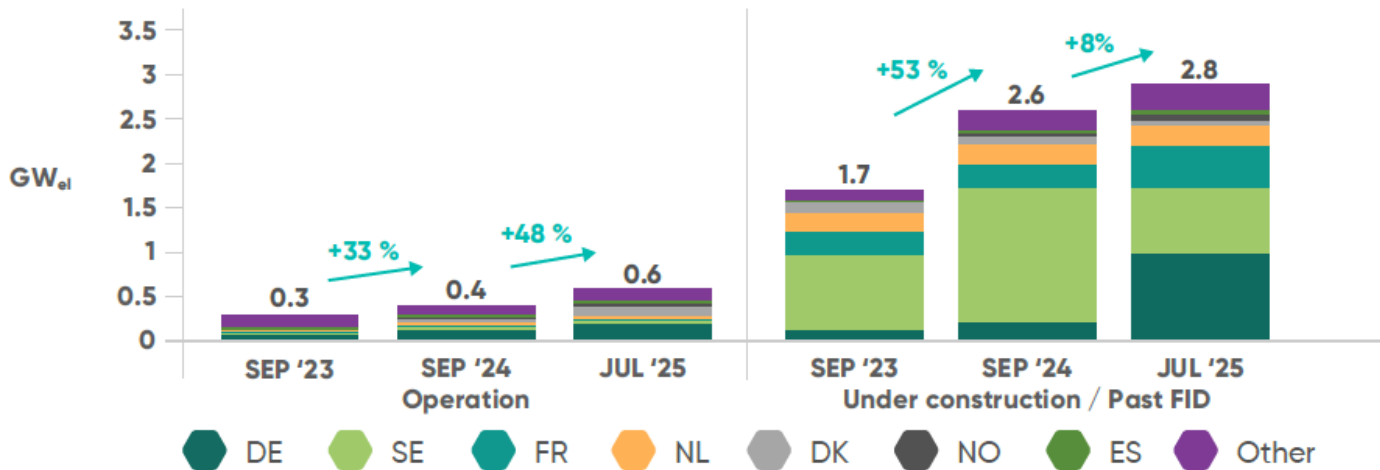


...vs REALITY

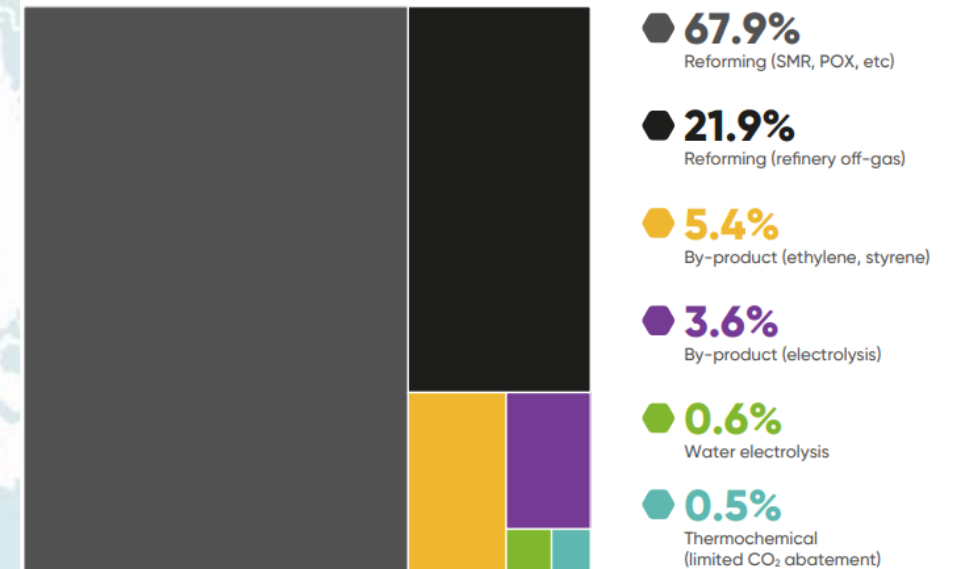


- In 2025, **571 MW of electrolysis** capacity (94 kt of hydrogen per year) is **in operation** in Europe, with another 2.8 GW under construction.
- The EU's target of **6 GW by 2024 was not met**.
- A noticeable **slowdown in final investment decisions** (FIDs) is evident: over the past year, FIDs have covered only one-quarter of the capacity required by 2030.
- Hydrogen investment is slowing as projects face **regulatory uncertainty**, high costs, **insufficient offtake certainty**, and challenging financing conditions.
- A positive signal is the **rapidly growing scale of projects**: the average size of new electrolysis projects has increased more than fivefold over the year.

Operational and under construction water electrolysis capacity by July 2025



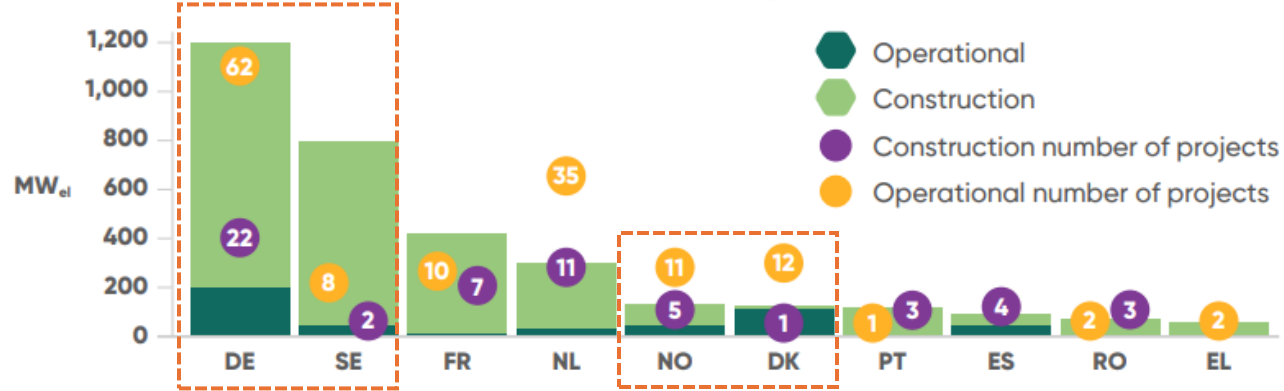
Hydrogen production capacity in 2024 in Europe by production process (% of total)



WHERE ARE NORDICS (INCLUDING BALTICS)?



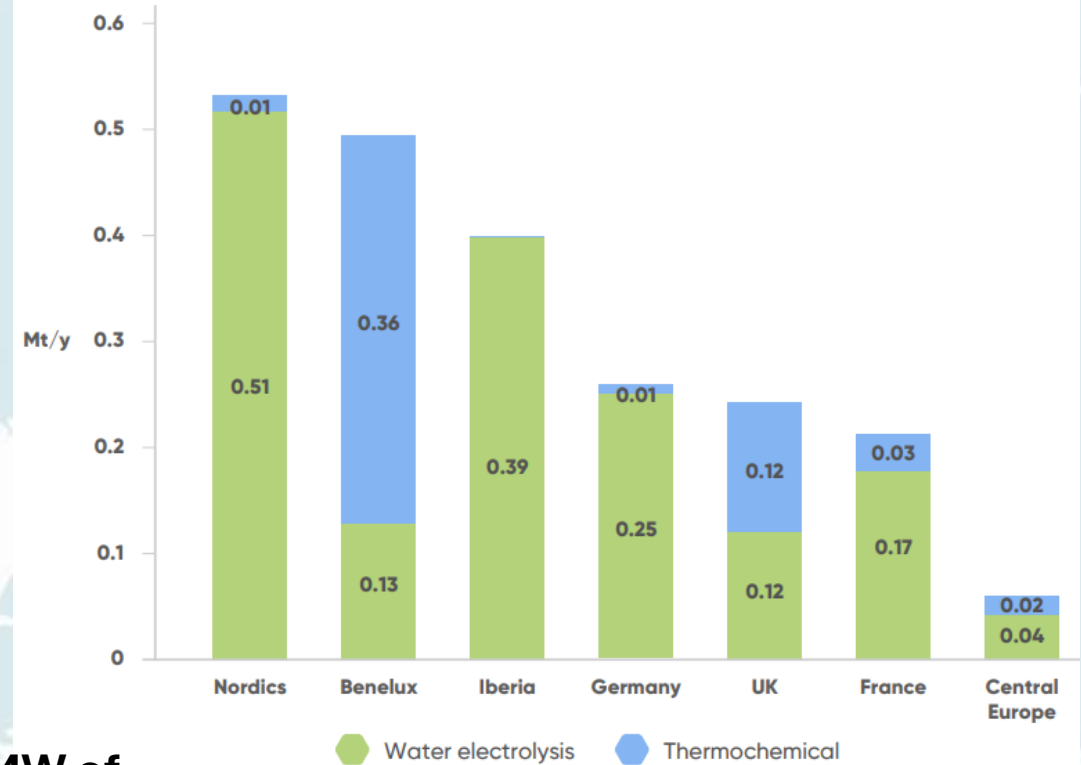
Top 10 countries in Europe with largest operational and under construction water electrolysis capacity and number of projects by July 2025



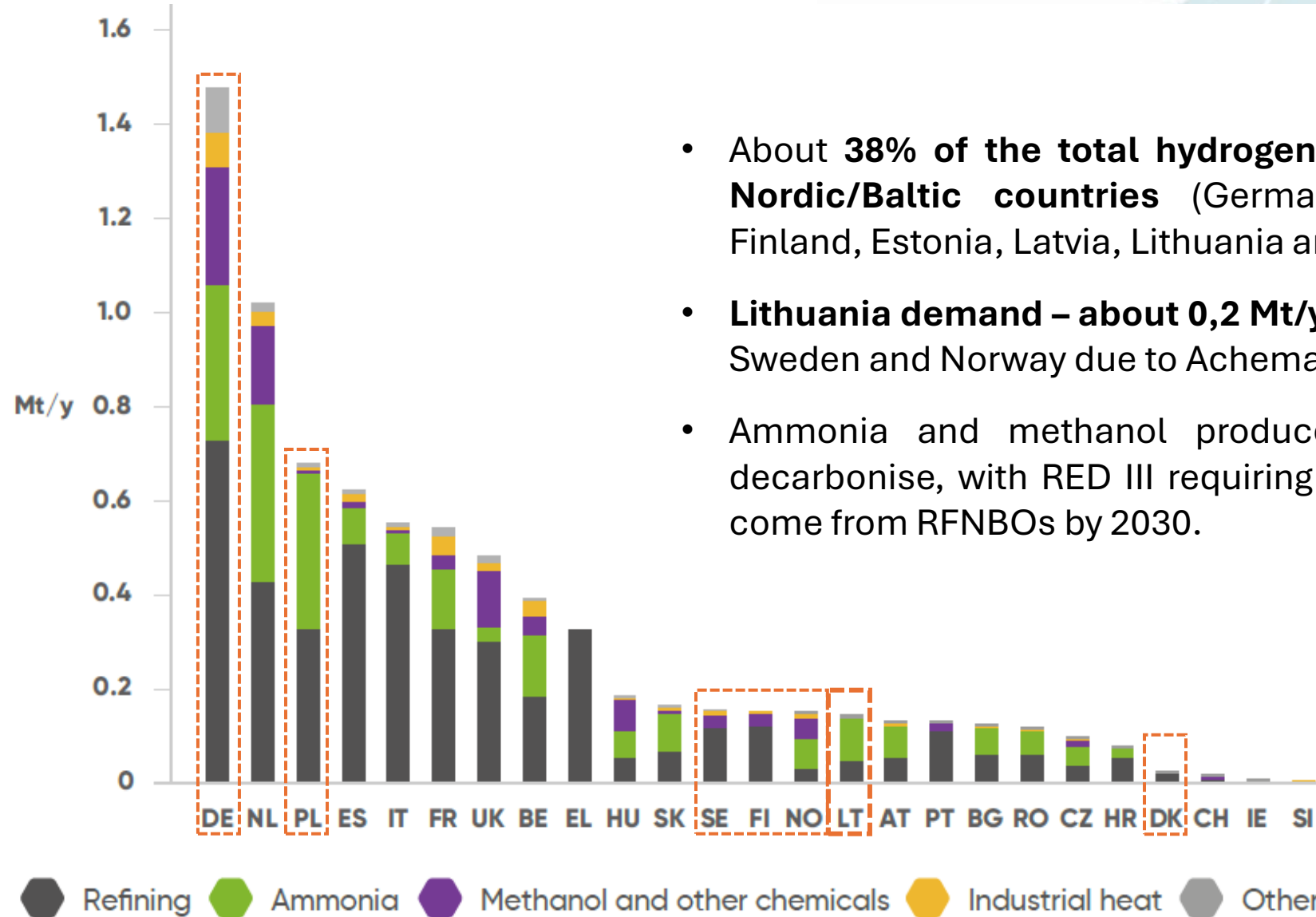
Nordics (including Baltics) dominates in Hydrogen economy development in Europe!

For today, The Baltic states currently have approximately 3.25 MW of operational green hydrogen electrolyser capacity: 2.25 MW in Lithuania and 1 MW in Estonia.

Clean hydrogen supply outlook in different regions in Europe by 2030



WHERE WE ARE NOW? H₂ DEMAND BY COUNTRY



- About **38% of the total hydrogen demand** in Europe is **located in Nordic/Baltic countries** (Germany, Denmark, Norway, Sweden, Finland, Estonia, Latvia, Lithuania and Poland).
- **Lithuania demand – about 0,2 Mt/y** near to such countries as Finland, Sweden and Norway due to Achema and Orlen Lietuva demand.
- Ammonia and methanol producers face increasing pressure to decarbonise, with RED III requiring 42% of industrial hydrogen use to come from RFNBOs by 2030.

INITIATIVES TO PROMOTE H₂: EU H2 SUPPLY CORRIDORS



- **Corridor A (North Africa & Southern Europe):** Connects production in Tunisia and Algeria through Italy to Central Europe
- **Corridor B (Southwest Europe & North Africa):** Transports green hydrogen from the Iberian Peninsula (Portugal and Spain) into France and wider Europe
- **Corridor C (North Sea):** Links offshore wind energy, regional hydrogen projects, and maritime import hubs to industrial clusters in Northwestern Europe
- **Corridor D (Nordic and Baltic Regions):** Connects clean hydrogen supplies from the Nordic and Baltic countries down through Poland and into central markets
- **Corridor E (East and South-East Europe):** Links production facilities in Eastern/Southeastern Europe—including Romania, Greece, and Ukraine—to Central European demand hubs like Germany
- **Cost Estimates:** Estimated total investment ranges between €43 billion and €81 billion.
- The EHB network itself was envisaged at about **53,000 km by 2040**.



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- The map illustrates the proposed Baltic Sea Hydrogen Corridor, connecting various national hydrogen backbones and storage sites across Northern Europe. Key features include:
- National Backbones:** Swedish Backbone, Finnish Backbone, Estonian Backbone, Latvian Backbone, Lithuanian Backbone, Polish Backbone, German Backbone, and NHR Bothnian Bay.
 - Storage Sites:** Indicated by purple triangles, primarily located in Germany and along the corridor.
 - Corridors and Pipelines:** Shown as orange lines representing the main hydrogen transport routes.
 - Interconnection Points:** Marked with 'X' symbols at key locations like Kaliningrad, Gdańsk, and others.
 - Cross-Border Capacity:** Blue arrows indicate capacity directions between countries, with values such as 100 and 200 GWh/d.
 - Support Projects:** Highlighted in green, including the Baltic Sea H₂ Collector and the Nordic Baltic H₂ corridor.
 - Legend:**
 - STORAGE SITE (Purple Triangle)
 - STORAGE SITE (PCI) (Blue Triangle)
 - NATIONAL BACKBONE (Orange Outline)
 - SUPPORTED PROJECTS (Green Outline)
 - RELATED PROJECTS (Light Green Outline)
 - CORRIDOR (Thick Orange Line)
 - CORRIDOR PIPELINE (Thin Orange Line)
 - Pipeline (Grey Line)
 - CROSS BORDER CAPACITY DIRECTION (Blue Arrow)
 - CONNECTION / LINK (Dotted Blue Line)
 - INTERCONNECTION POINT (X Symbol)
 - TERMINAL (Black Circle with Star)
 - CROSS BORDER CAPACITY [GWh/d] (Numbers near arrows)
 - Key Locations:** Umeå, Stockholm, Helsinki, Tallinn, Riga, Vilnius, Warsaw, Berlin, Hamburg, Copenhagen, Oslo, Bergen, and many others are labeled.

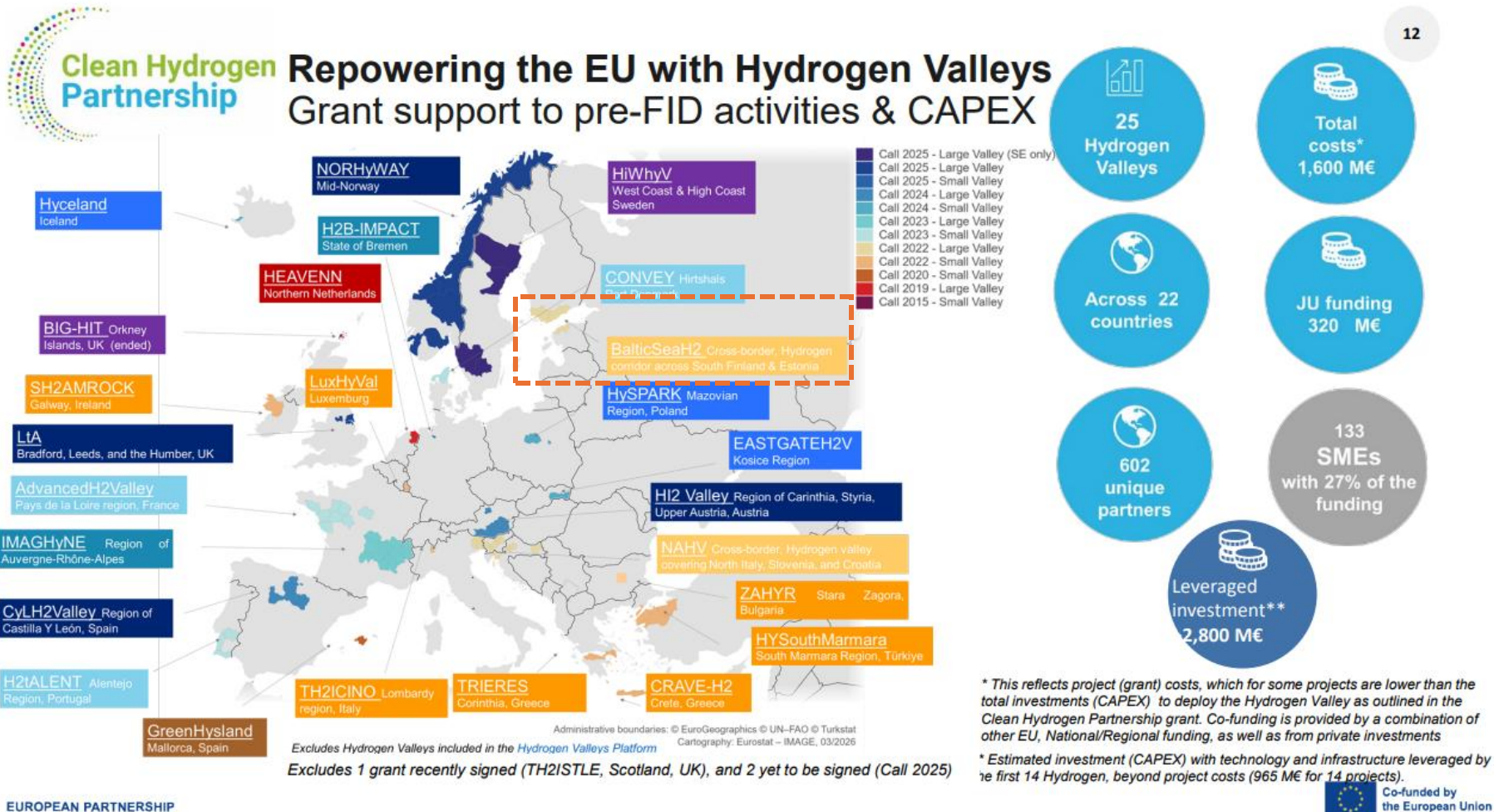
NBHC vs BHC: COMPETITORS OR COMPLEMENTS



NBHC (Corridor)	BHC (Collector)
Lead Consortium: National TSOs (Gasgrid , Elering, Conexus, Amber Grid , GAZ-SYSTEM, ONTRAS)	Lead Consortium: Public-Private Hub (Gasgrid Finland, GASCADE, CIP / EnergyIslands)
Primary Focus: Regional market integration, industrial demand hubs, and inland transit	Primary Focus: Bulk transport of off-shore wind power and island hydrogen production
As Competitors	
-Capital & Offtaker Competition: Both projects target the same primary off-taker market (German industrial demand) and compete for European infrastructure capital (CEF funding). <i>-NBHC (Onshore):</i> Faces multi-jurisdictional permitting, spatial planning across 6 border points, and land access delays. <i>BHC (Offshore):</i> Avoids complex onshore land-use permitting but carries higher subsea installation CAPEX and marine environmental hurdles.	
As complementers	
-Dual-Layer Architecture: NBHC serves as the arterial inland spine, providing local grid-balancing, connecting onshore wind assets, and supplying industrial demand centers in Poland and the Baltic States; BHC acts as the express offshore bypass, directly harvesting massive offshore Baltic wind hubs without congesting onshore grids. -Solution for critical geopolitocal energy secutiry.	

INITIATIVES TO PROMOTE H₂: HYDROGEN VALLEYS

A Hydrogen Valley is a regional ecosystem where clean hydrogen is produced, stored, transported, and consumed across multiple local industries and transport networks



BalticSeaH2

Demonstrating hydrogen economy with the largest cross-border Hydrogen Valley in Europe

The project is supported by the Clean Hydrogen Partnership and its members.



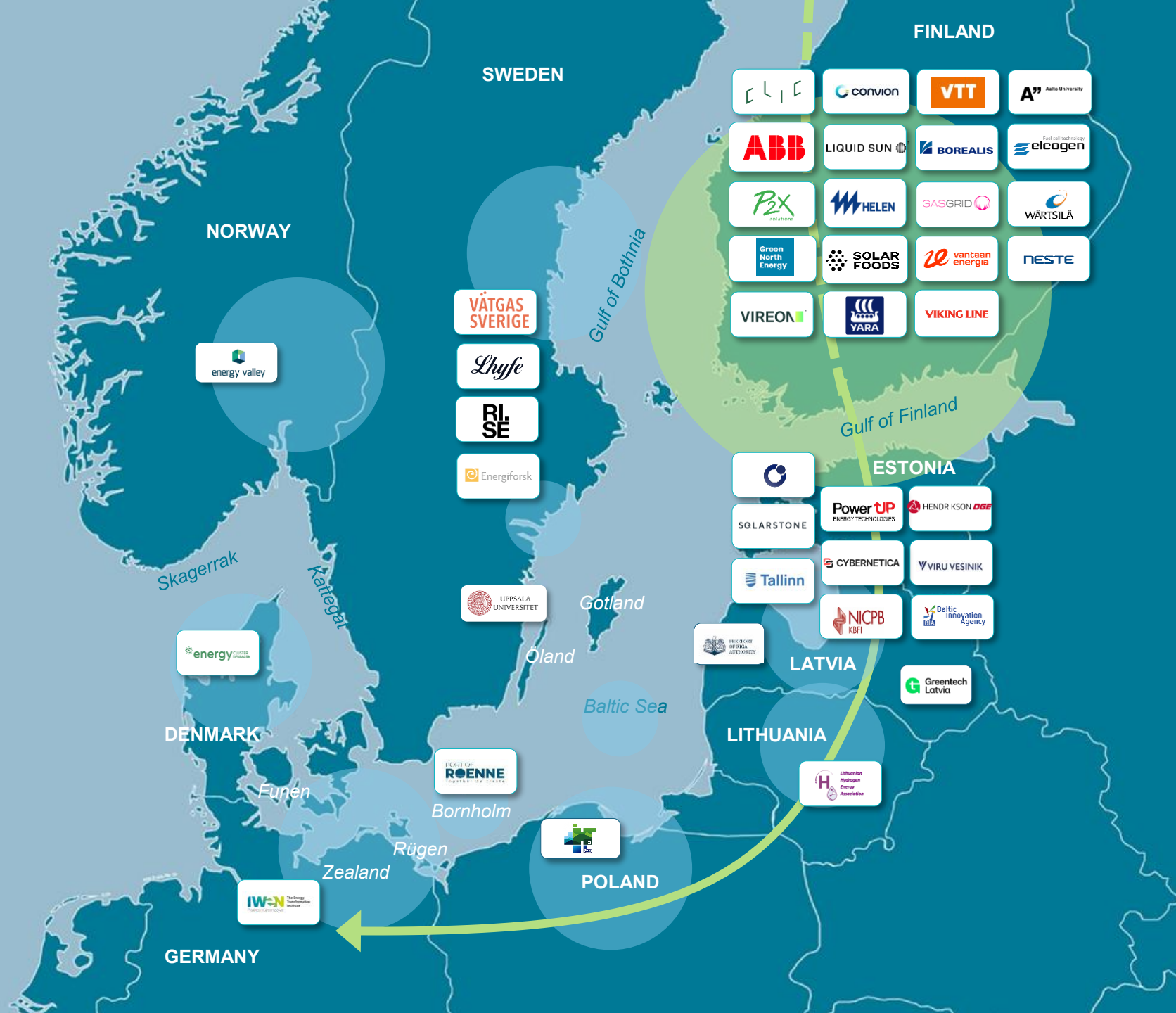
Co-funded by
the European Union

40 partners in
9 countries: main valley between
Finland and Estonia

5-year project coordinated by
CLIC Innovation and Gasgrid,
started in June 2023

Total project budget 33 M€,
European public financing 25 M€,
plus partner investments

12 investment cases and over 20
use cases build the whole
hydrogen value chain



INDUSTRIES INVOLVED IN BalticSeaH2



A production plant needs a surrounding value chain

Hydrogen economy needs offtakers, infrastructure, certification, business logic, local acceptance and a market model around production.

‘Investment cases’ integrate multiple use cases from our collection of + 20 use cases to create the hydrogen value chain simultaneously.

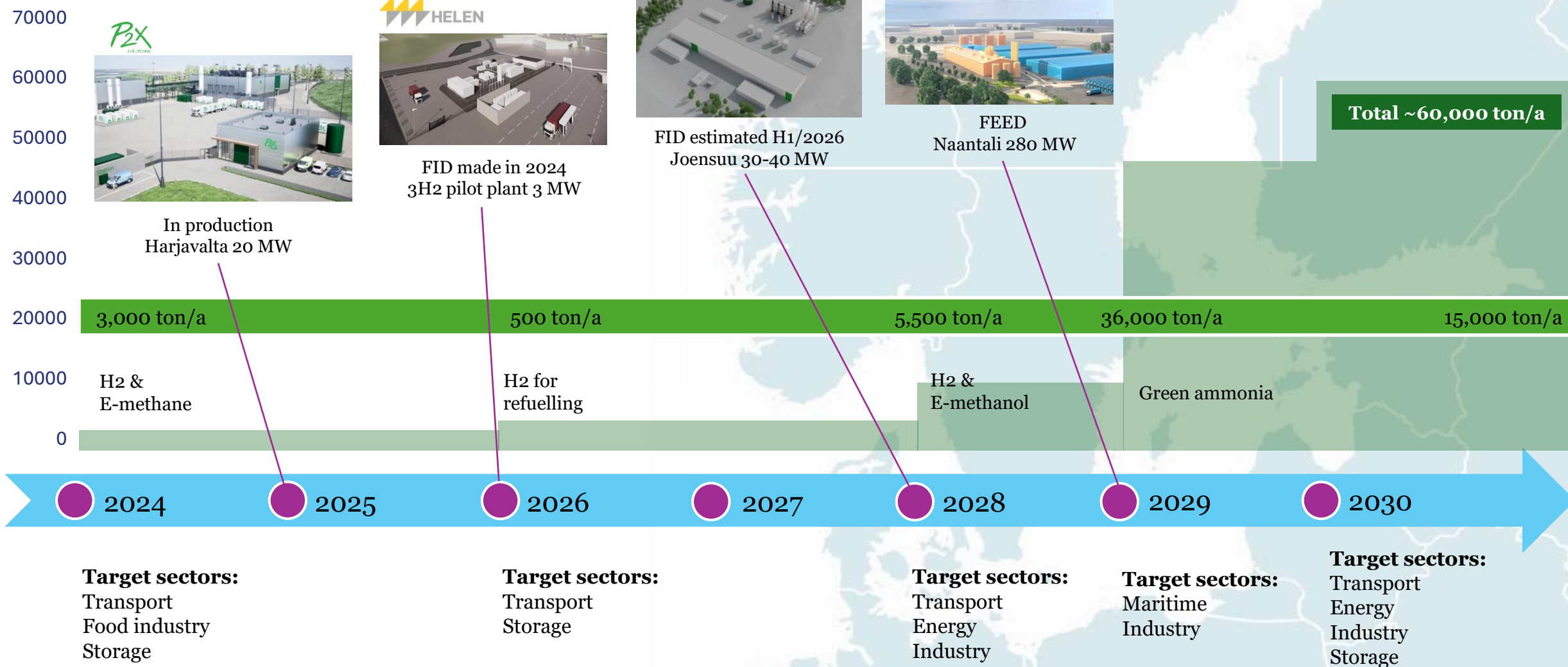
These elements form a large-scale, sector-integrated valley.



BalticSeaH2 Valley implementation plan by 2030



Renewable hydrogen production targets (tonH₂/year)

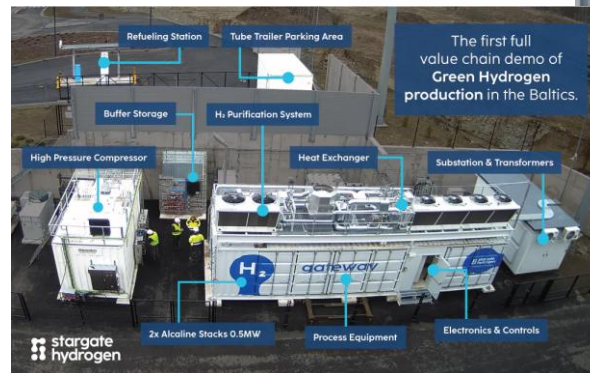


Note: The plants that are already under construction have received investment financing from the Innovation Fund, IPCEI, RRF, or other funding from the Finnish ministry or the Finnish Climate Fund.

Latvia and Estonia:



- Avia Solutions Group to build the largest and most advanced **Sustainable Aviation Fuel (SAF) plant in Northern Europe in Liepāja**. Targeted to enter service between **2030 and 2031**.
 - Investment: 500-600 mln. Eur.
 - Production: **Standard SAF**: ~61,600 metric tons per year, **eSAF (synthetic fuel from green hydrogen)**: ~38,400 metric tons per year.
- Riga operates a fleet of 10 hydrogen fuel cell-powered hybrid trolleybuses.
- Estonia: **1 MW production facility** (Stargate Hydrogen) and a **refueling station** at the Utilitas Vao complex (30 Toyota Mirai's as taxi, Bolt company).
- Elcogen launches new high-volume **solid oxide fuel cell factory** in Europe to meet global demand for clean energy solutions.
- Estonia – part of BalticSeaH2 valley.



Finland and Sweden



- **Common: Low-Cost Electricity** - abundant onshore wind, nuclear, and hydropower provide cheap, fossil-free electricity that forms the core economic foundation for large-scale electrolysis across both nations.
- Finland: **Industrial Offtake:** Strong domestic demand from steelmaking (fossil-free steel), synthetic e-fuels, and chemicals.
- Sweden: **Heavy Industry Decarbonization:** Unlike many EU nations focusing primarily on power grid balancing, Sweden's H₂ surge is driven almost entirely by **decarbonizing hard-to-abate sectors** (steel, mining, fertilizer, and shipping).
- **Biggest projects in Finland:**
 - **Blastr Green Steel**, Inkoo. Integrated ultra-low-carbon **green steel plant powered by local green hydrogen (€4B investment)**.
 - **Hy2gen**, Oulu. Developing a major synthetic **e-fuel facility** to create a Baltic Sea e-fuel hub (**200MW**).
- **Biggest projects in Sweden:**
 - **Stegra**, Boden. Commercial-scale plant producing **green steel using H₂ direct reduction (800 MW)**.
 - **Ånge Green Cluster**, Ånge. Wind-to-H₂ project supplying **green ammonia for carbon-neutral fertilizer** production (300 MW).
- **Common concern:** Nordic Hydrogen Route-Bothnian Bay, Baltic Sea Hydrogen Collector.



Denmark and Norway



- **Norway** focuses on **maritime decarbonization** (hydrogen-powered ferries and coastal shipping) and **green fertilizer production**, leveraging abundant hydropower and established natural gas/CCS infrastructure.
- **Denmark** positions itself as a central **Power-to-X hub and green hydrogen export/import powerhouse** for Europe, using offshore wind energy to fuel heavy transport, produce **synthetic e-fuels**, and supply green gas to neighboring countries like Germany.
- **Common concern:** Strengthen their positions in as dominant countries in hydrogen sector utilizing **Nordic Sea** potential.
- **Biggest projects in Norway:**
 - **Ørskog Green Hydrogen**, Alesund. Large-scale green hydrogen production plant **focusing on export, zero-emission fuel to maritime**, industrial, and transport markets (270 MW).
 - **Herøya Green Hydrogen Plant** (Yara), Porsgrunn. Europe's premier industrial-scale electrolyser replacing natural gas to make **green ammonia for zero-carbon fertilizer and ship fuel** (24MW).
- **Biggest projects in Denmark:**
 - **Host**, Esbjerg. Gigawatt-scale **Power-to-X** facility utilizing offshore wind to produce **green ammonia** for agriculture and shipping (240 MW).
 - **Kassø Power-to-X** (European Energy & Engie), Aabenraa. World's largest **e-methanol commercial facility**, supplying green fuel directly to heavy transport and global shipping giants like Maersk (52MW→150MW).



Germany and Poland



- **Germany** positioned as Europe's largest hydrogen **demand and import hub**, prioritizing midstream pipeline infrastructure (the 9,000 km national H₂ Core Network) to decarbonize heavy chemical hubs, power plants, and primary steel production.
- **Poland** focuses heavily on transitioning its coal-dependent energy grid into a regional hydrogen valley ecosystem, prioritizing green hydrogen for **refinery, fertilizer production, and synthetic fuels**, backed by Baltic offshore wind development.
- **Biggest projects in Germany:**
 - **GET H2 Nukleus** (RWE, OGE, & partners), Lingen to Gelsenkirchen. Germany's first cross-regional, open-access H₂ **pipeline network** linking green electrolysis directly to steelworks and refineries (**300+ MW electrolysis + 130 km grid**).
 - **Clean Hydrogen Coastline** (EWE), Emden. Integrated coastal H₂ hub **combining** large-scale **electrolysis with underground salt-cavern storage** to supply industrial centers (**320 MW electrolysis**).
- **Biggest projects in Poland:**
 - **Green H2 Resko** (PNE Polska), Resko. Mega-scale **wind and solar-powered facility** focused on producing green H₂ and e-fuels for industrial and export supply chains (**500 MW renewable power-to-H₂**).
 - **Hydrogen Eagle** (Orlen), south Poland. Multi-hub infrastructure program building large electrolyzers, **decarbonizing refinery operations**, and a **central European refueling network** (**700 MW electrolysis**).



Lithuania



- **Klaipėda:**
 - Port of Klaipėda opened Lithuania's first public **hydrogen refuelling station** in 2026, open to business and residents. Total electrolyser power **2,25 MW**.
 - The world's **first waste collection vessel** powered by a combination of green hydrogen and electricity.
- **Vilnius:**
 - Gijos (Vilnius) finalising **3 MW electrolysis (54 kg/h)** instalation + **mobile H₂ storage 4 x 425 kg**.
 - **16 public transport buses** in the capital, replacing diesel ones, will be equipped with green hydrogen.
- **Amber Grid:**
 - Focus on Nordic-Baltic H₂ corridor. According to Amber Grid survey: Need for hydrogen **supply to the grid – 4,5 TWh in 2033 y**, and the need for hydrogen **consumption from the grid – 8,5 TWh in 2050 y**.
- **N1Capital:**
 - **120 MW Green hydrogen and synthetic methane** plant in Panevėžys up to 2033 year.



BaHyRa project – Baltic Sea Hydrogen Regional Accelerator

BaHyRa (Baltic Sea Hydrogen Regional Accelerator) is an international cooperation project aimed at **accelerating the development of the hydrogen economy in the Baltic Sea region**. The project was established to **bridge gaps in regional cooperation, skills development, and policy-making**.

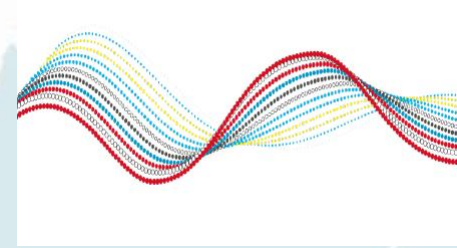
FOCUS AREAS IN THE PROJECT:

- Networking
- Competence Development
- Policy Development

Approaches:

- Mapping hydrogen projects
- Skills and education development
- Policy harmonisation
- Raising awareness

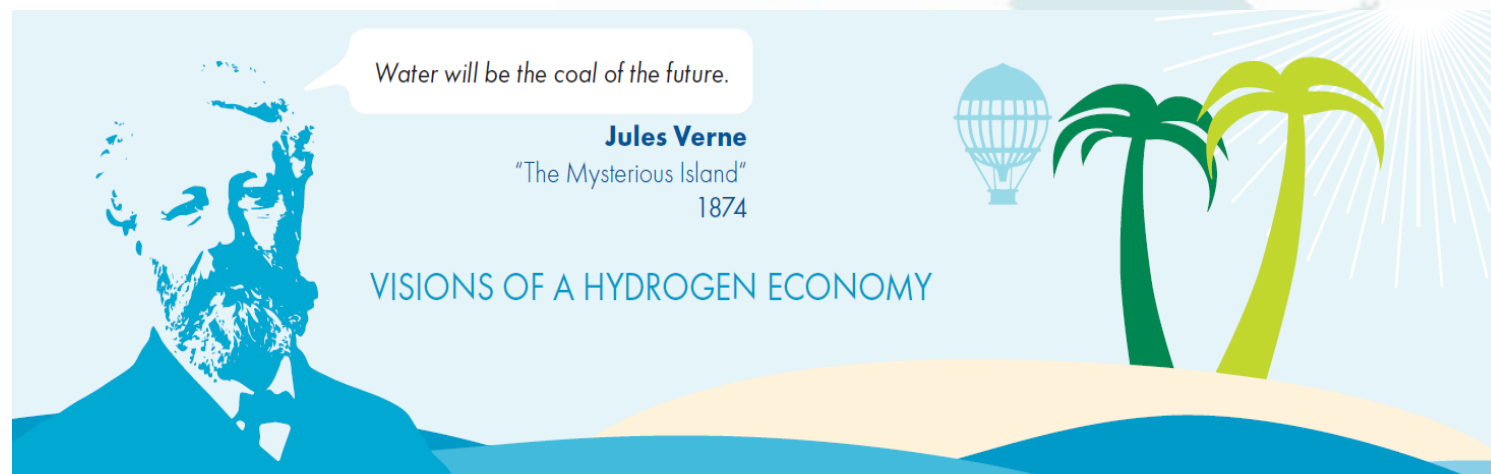
9 countries



MAIN TAKE AWAYS



- The Nordic and Baltic regions have **significant potential to become leaders in Europe's** hydrogen economy.
- Several regulatory, infrastructure, economic, and market **barriers still constrain the development of the hydrogen economy.**
- Despite a noticeable slowdown in final investment decisions, **industry continues to invest in hydrogen** and remains committed to its long-term potential.
- The **Baltic Sea Region Hydrogen Corridor could be a game changer** by unlocking significant new market opportunities and connecting emerging hydrogen supply and demand, if successfully implemented.
- The region's existing industrial hydrogen demand provides a strong foundation for scaling up renewable hydrogen and developing new applications.





Contact

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