

Energy networks for the Hydrogen Economy

Sara Kärki, SVP Hydrogen development, Gasgrid Finland Oy

Gasgrid Finland Oy

State-owned company.
Acts as the TSO with system responsibility for gas transmission in Finland.



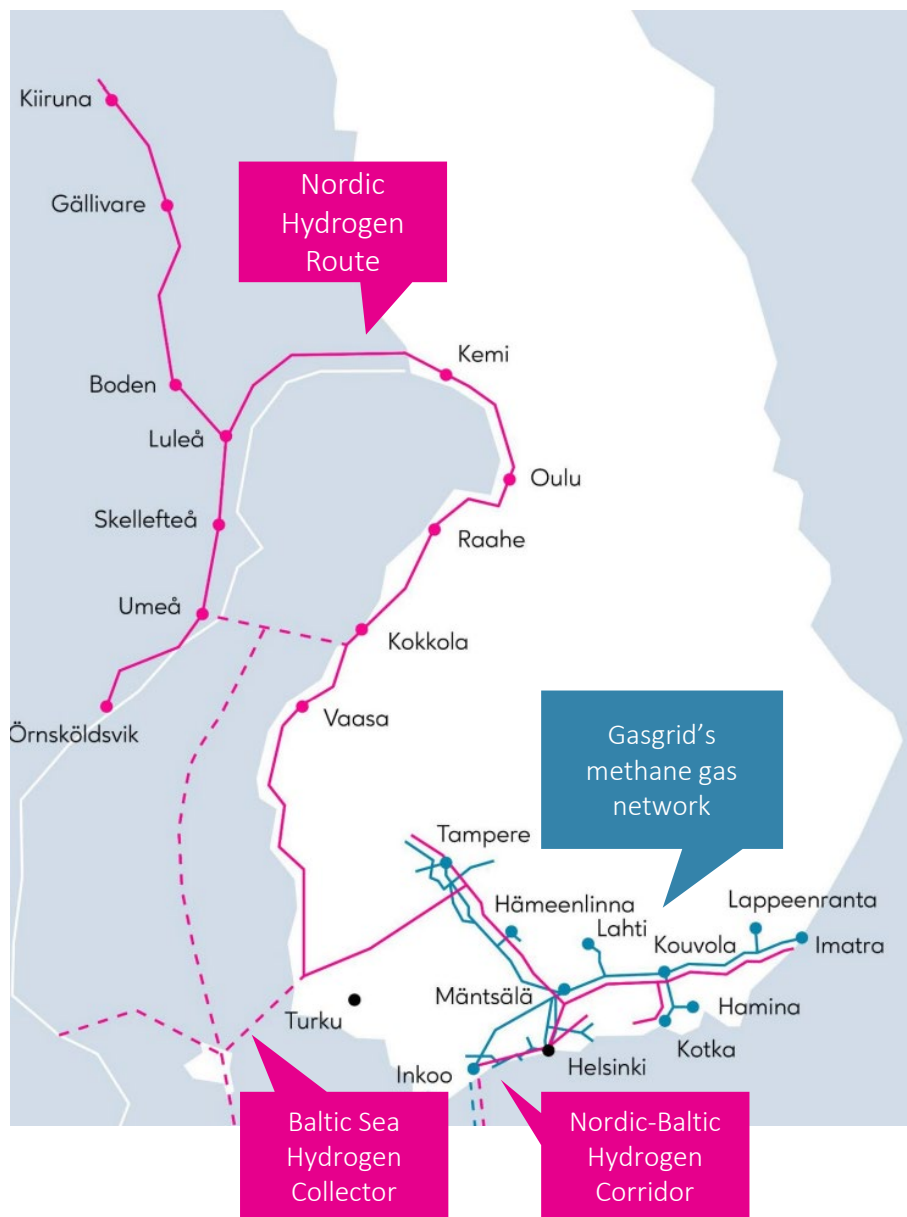
Our mission


We offer our customers safe, reliable and cost-efficient transmission of gases.

We actively develop our transmission platform, services and the gas market in a customer-oriented manner to promote the carbon-neutral energy and raw material system of the future.

Gasgrid is developing the national hydrogen infrastructure

- The Finnish Government has given Gasgrid a task to promote the development of the national hydrogen infrastructure, international infrastructure cooperation and the hydrogen market in the Baltic Sea Region as soon as possible
 - The aim is to attract new investments and jobs to Finland and to support Finland's energy security and self-sufficiency
 - Hydrogen networks create new business opportunities for different actors through the development of new value chains, products and services.
- Gasgrid Vetyverkot Oy was established in 2022



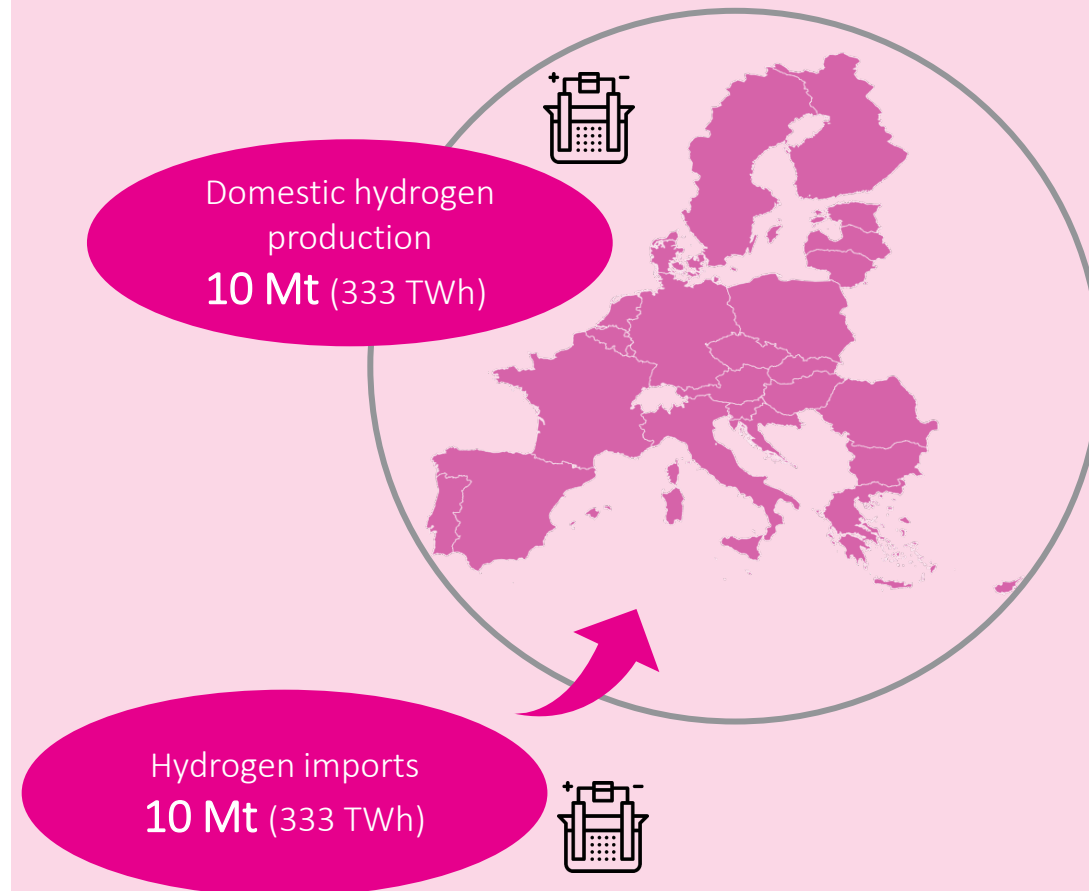
A photograph of an industrial hydrogen production facility. The scene is dominated by large, horizontal, cylindrical vessels and complex piping systems, all painted in a bright yellow color. The sun is low on the horizon, creating a strong lens flare and casting a warm, golden light across the scene. In the background, there are trees and a clear sky. The overall atmosphere is one of industrial scale and clean energy production.

Hydrogen has a key role in the European energy transition

Hydrogen plays a key role in Europe's green energy transition

- Scalable, clean energy solutions are needed to achieve carbon-neutrality by 2050 in Europe
- Clean hydrogen is one of the central solutions
- Clean or green hydrogen refers to hydrogen production with electrolyser, which use electricity to split water into hydrogen and oxygen
- When electricity required to power the electrolyser is emission-free, the process does not lead to greenhouse gas emissions nor use fossil resources

RePowerEU Hydrogen strategy

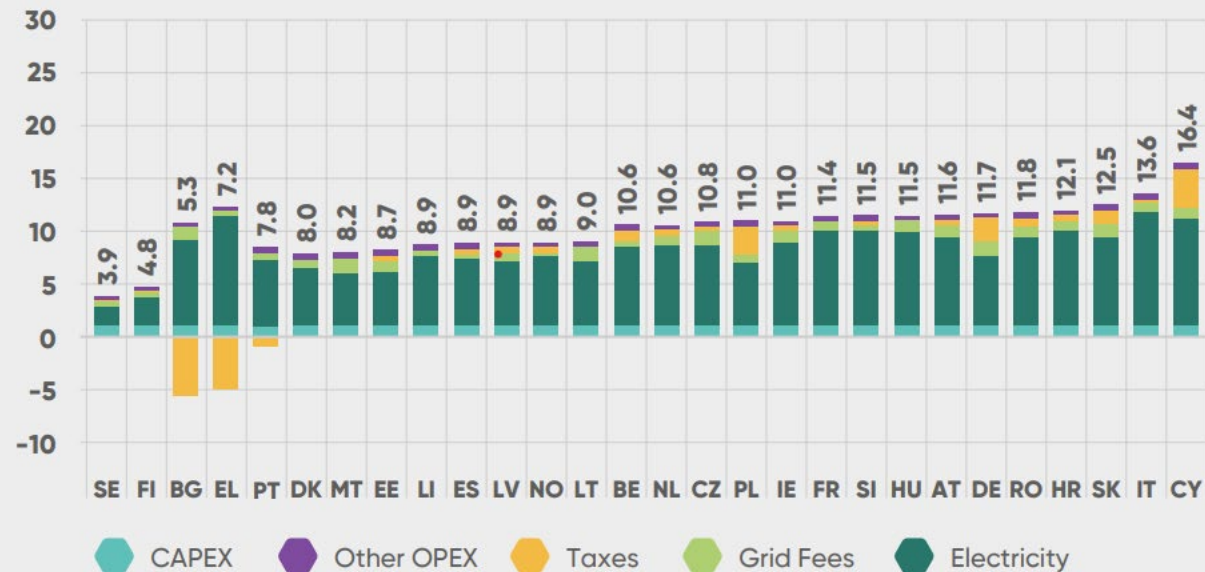


What can Finland's role be?

Finland and the Nordics can play a significant role in the energy transition of Europe

FIGURE 3.4

Grid-connected electrolysis hydrogen production costs in the EU (+NO) in 2022 (EUR/kg)



Source: Hydrogen Europe.

- Excellent renewable energy resources
- Cost competitive electricity and hydrogen production costs
 - Availability of land and water
 - Strong electricity grids and continuous investments to the development of the electricity grid
- Excellent possibilities to produce high-value P2X products
 - Availability of biogenic CO₂ for production of synthetic fuels or chemicals
 - High-level technological know-how from energy and biorefining industry that can be utilised in the P2X sector

Excellent renewable energy resources available in Finland

Grid connection inquiries

Power production*

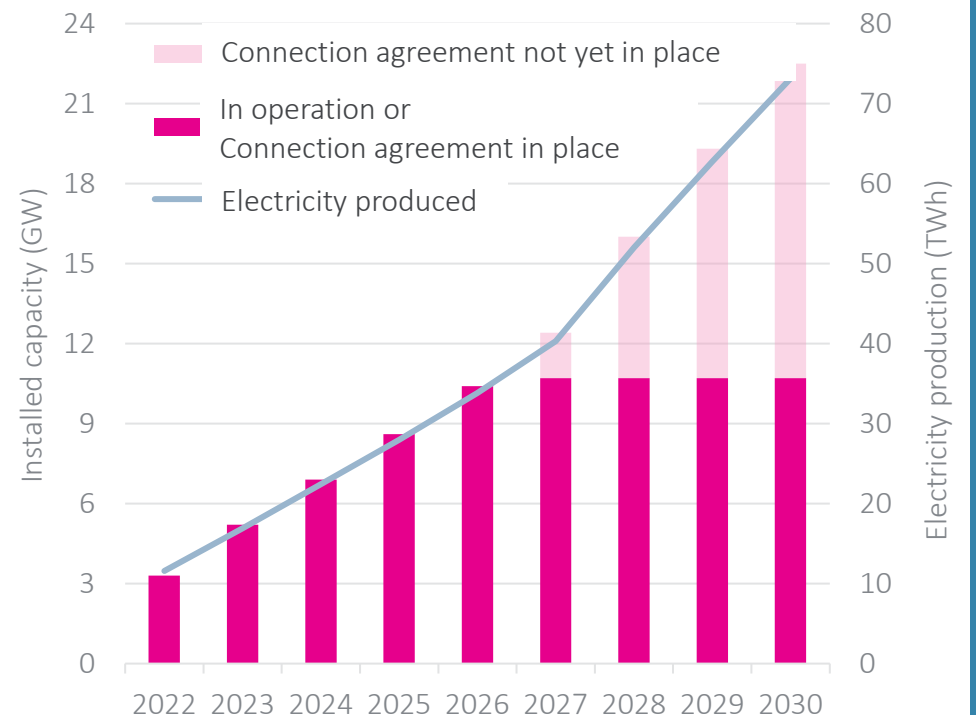
340 GW / ~1000 TWh

Power consumption

22 GW / ~150 TWh

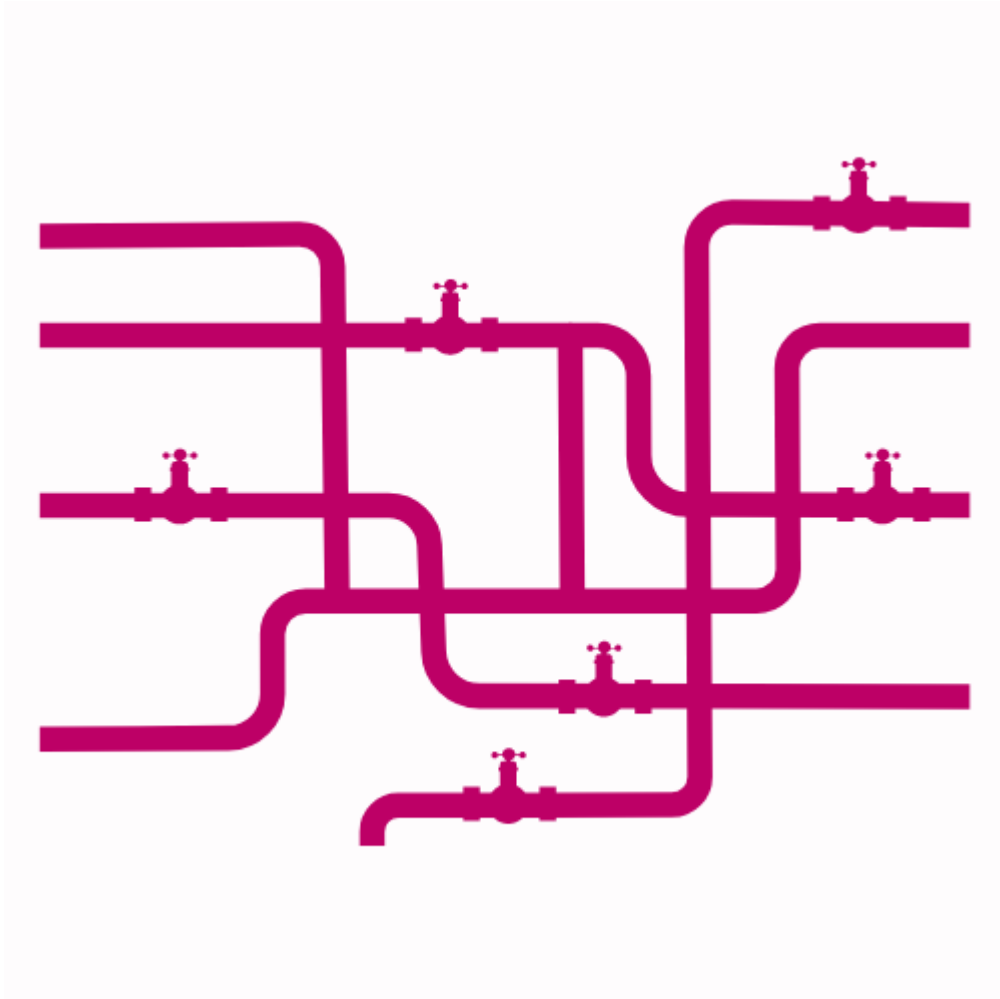
*Includes onshore wind, offshore wind and solar power

Wind power development (Fingrid's estimate Q3/23)



Source: Gasgrid & Fingrid. (2023). Energian siirtoverkot vetytalouden ja puhtaan energijärjestelmän mahdollistajina. Available at: [Energian siirtoverkot vetytalouden ja puhtaan energijärjestelmän mahdollistajina - Loppuraportti](#)

Hydrogen infrastructure enables market expansion, derisking of investments and flexibility for operation



- Transmission pipelines enable
 - Efficient energy transportation
 - Establishes connection between multiple H2 producers, refiners and end users
 - Creation of an open market for hydrogen
 - De-risking of individual investments
 - Possibility for more economical upscaling of own business without the need to invest in local storage
 - Flexibility in the operation of chemical processes through storage (availability of European cavern storages through pipeline)
 - Balancing the electricity prices through ability to utilize stored H2 when the circumstances do not support online electricity / H2 production.

Preliminary hydrogen network “connection inquiries”

Hydrogen production:

>80 TWh/year

(2,4 Mton H₂/year)

Hydrogen consumption:

>20 TWh/year

(600 kton H₂/year)

*Industrial market actors' indications about connecting to hydrogen network in the future from Gasgrid Finland's hydrogen market consultation as of

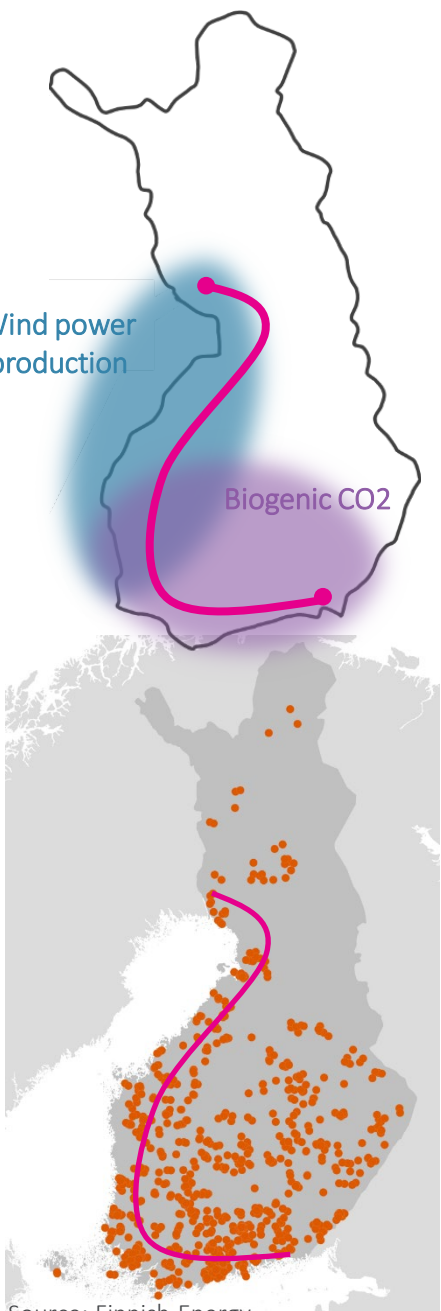
Source: Gasgrid & Fingrid. (2023). Energian siirtoverkot vetytalouden ja puhtaan energiajärjestelmän mahdollistajina.



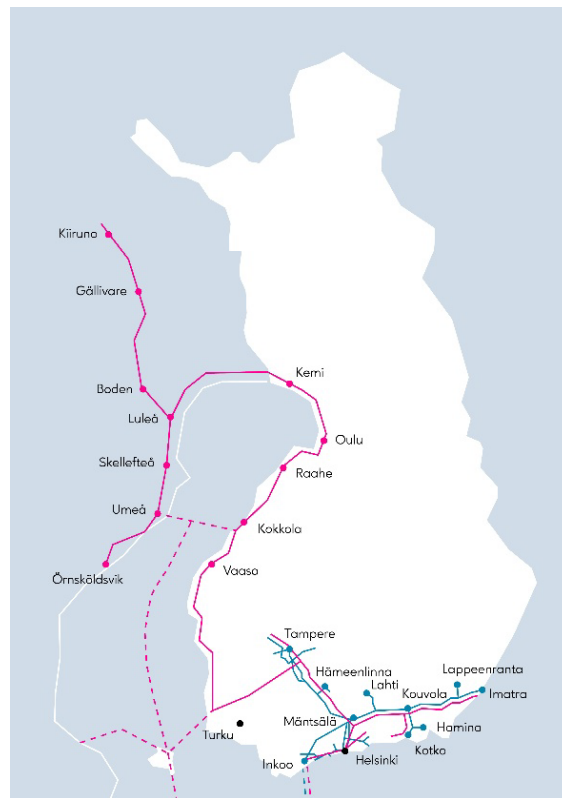
Large infrastructure projects within Finland

Vision for Finnish hydrogen backbone development

- Finnish hydrogen network will locate close to wind power projects and CO2 point sources
- Hydrogen network connects hydrogen production and consumption points and enables efficient energy transport as hydrogen and energy storage in pipelines
- The hydrogen backbone connects the local Hydrogen Valleys
- It is beneficial to co-develop hydrogen and power infrastructures to achieve a cost-efficient energy system
- Extensive district heating networks provide a platform for side-product heat utilization



Gasgrid's vision for hydrogen backbone 2030



Baltic Sea Region – Globally the Most Efficient Hydrogen Market by 2030

Baltic Sea Hydrogen Collector (BHC)



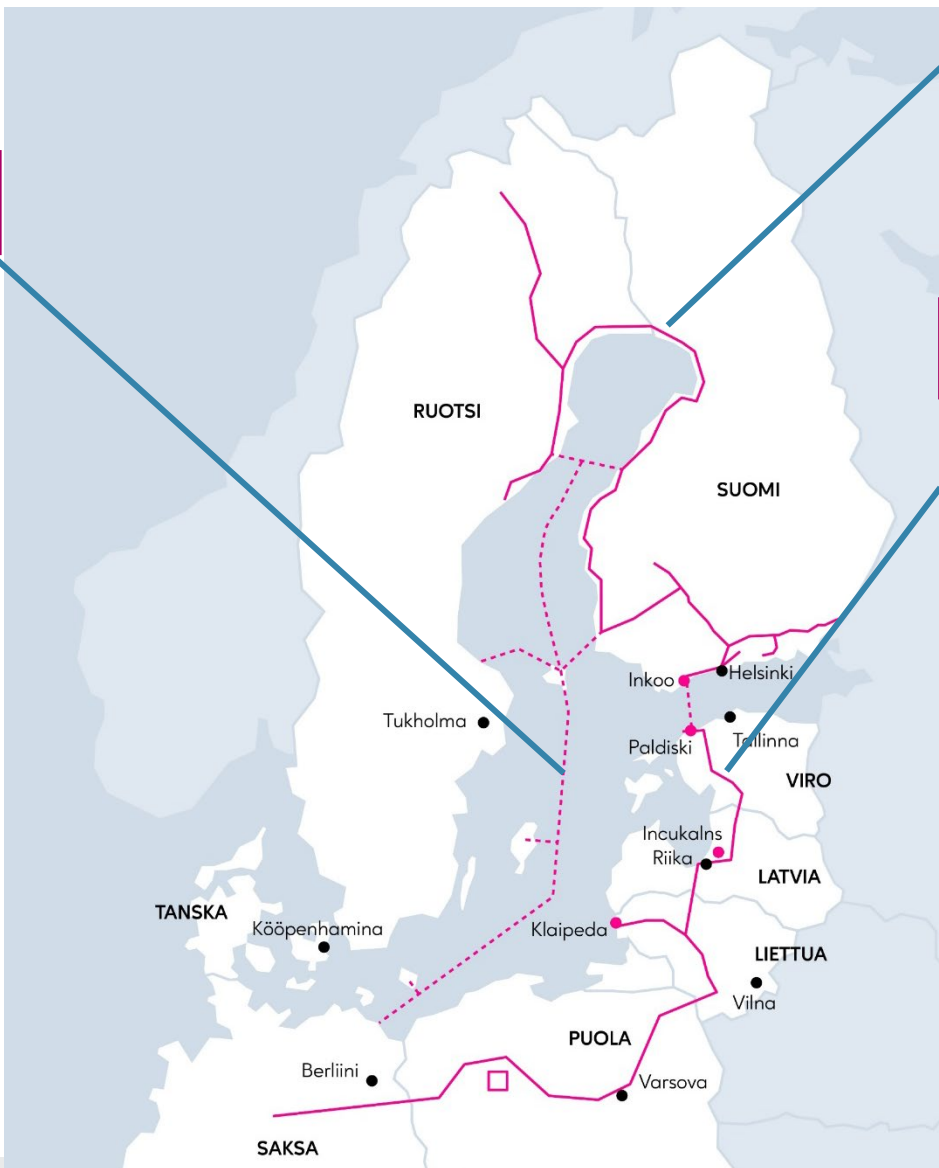
NORDION ENERGI



Nordic Hydrogen Route (NHR)



Nordic-Baltic Hydrogen Corridor



Nordic Hydrogen Route

The Nordic Hydrogen Route (NHR) is an initiative between Gasgrid Finland and Nordion Energi to drive decarbonization, support regional green industrialization, economic development, and European energy independence.

-  Connects all the H₂ projects in the Bothnian Bay, which has potential to be a major green hub.
-  Support creation of an efficient and harmonized cross-border hydrogen market to enable price competition and security of supply.
-  Accelerate new renewable energy investments to support Europe's energy transition, regional economic development, and European energy independence.
-  Create investments and jobs through new value chains within hydrogen economy.



Nordic-Baltic Hydrogen Corridor

- In the project, building a hydrogen network from Finland through Estonia, Latvia, Lithuania and Poland to Germany by 2030 is studied
- Gas TSOs are involved: Gasgrid Finland (Finland), Elering (Estonia), Conexus Baltic Grid (Latvia), Amber Grid (Lithuania), Gaz System (Poland) ja ONTRAS (Germany)
- Project has been nominated for PCI status, confirmation awaited in Q2/2024.
- In the first phase, pre-feasibility study will be conducted by Afry.
- After pre-feasibility study, the project can proceed through design and permitting phases to construction phase
- Gasgrid focuses especially on developing hydrogen network covering the whole Southern Finland and hydrogen market in the Baltic Sea Region



Baltic Sea Hydrogen Collector

- In development project, the possibility to build an offshore hydrogen pipeline connecting Finland, Sweden and Germany is studied.
- Involved partners: Gasgrid Finland, Nordion Energi and industrial companies OX2 ja Copenhagen Infrastructure Partners
- The planned route goes from mainland Finland and Sweden to Åland and further through Southern Baltic Sea to Germany by 2030
- Project has been nominated for PCI status, confirmation awaited in Q2/2024.
- Gasgrid focuses especially on enabling harnessing the wind power potential in Finnish territorial sea and developing hydrogen market in the Baltic Sea region



Dashed line refers to offshore hydrogen pipeline



NORDION ENERGI

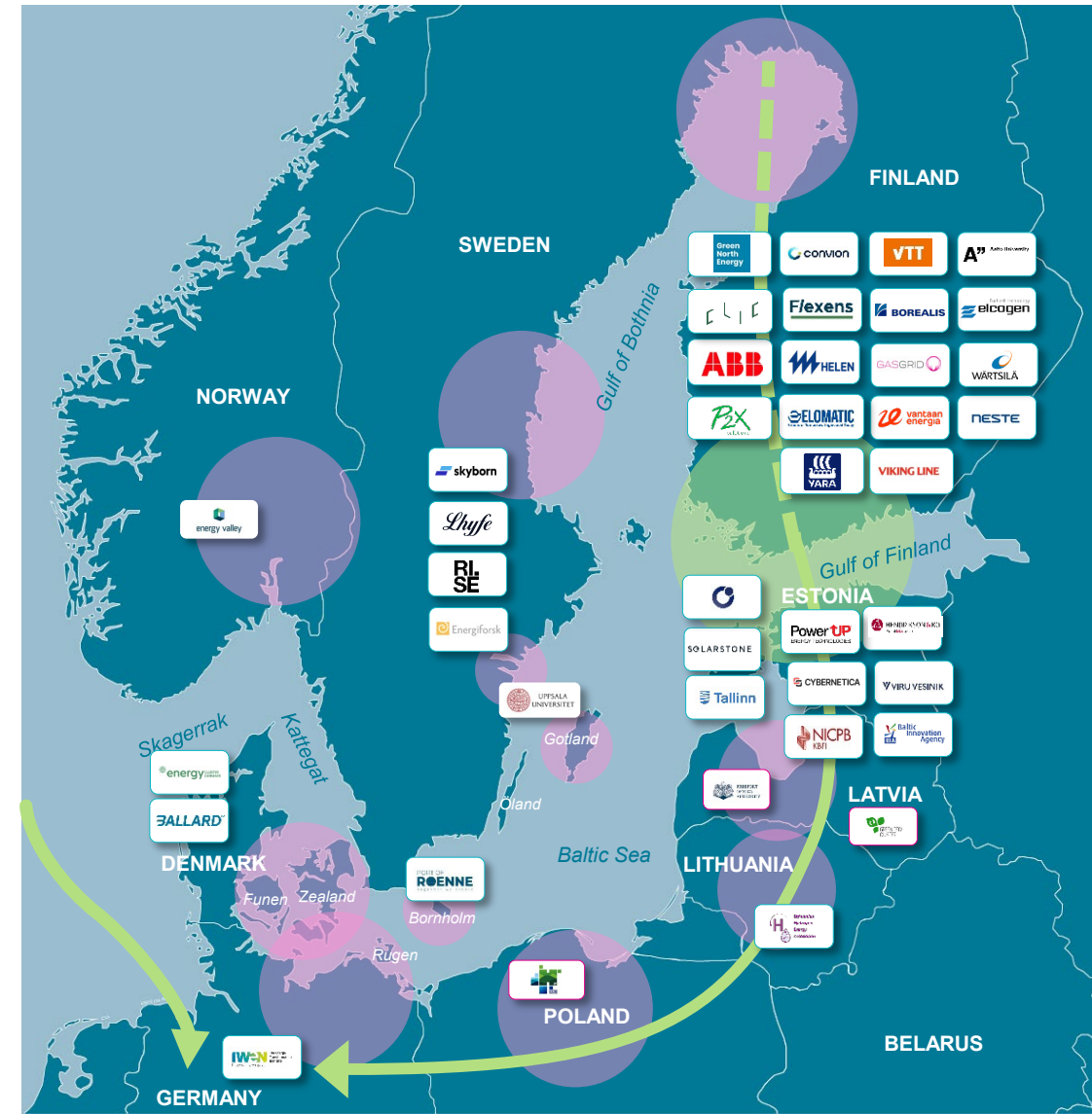


A photograph of a gas processing plant. The scene is dominated by large, industrial-scale pipes and machinery, painted in a bright red color. The pipes are arranged in a complex network, with various valves and fittings visible. In the background, there are tall towers and a bright sun low on the horizon, creating a lens flare effect. The sky is a clear, pale blue. The overall atmosphere is one of industrial activity and infrastructure development.

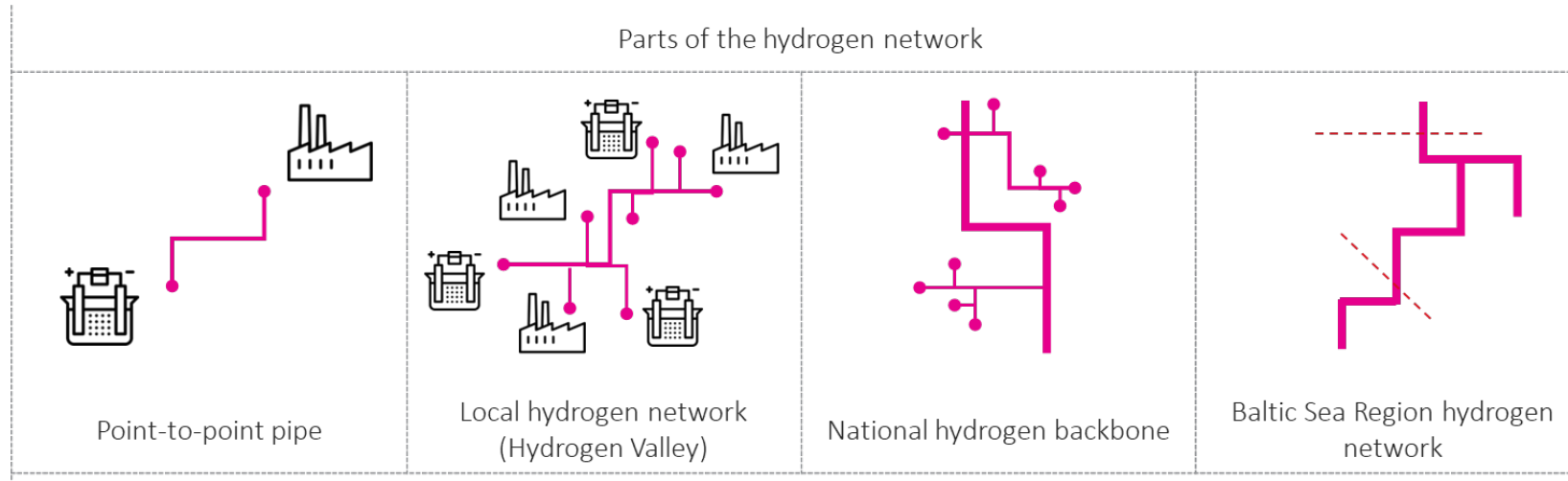
Gasgrid promotes regional approach in the infrastructure development

BalticSeaH₂ project

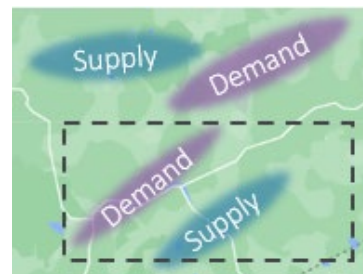
- Cross-border, sector-coupled hydrogen valley initiative with 40 partners in 9 countries
- Main Valley Southern Finland – Estonia
- 7 connected Valleys around the Baltic Sea
 - H₂ production > 5000 tons/yr
 - H₂ valley criteria work ongoing, possibility to extend into a profiling tool
 - Use Cases for H₂ production and consumption
 - Developing a digital H₂ marketplace platform and model for system integration
 - Technical studies like existing gas pipeline re-purposing for H₂



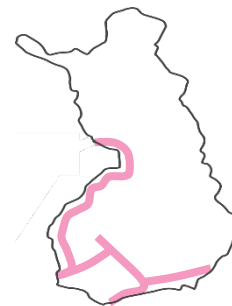
Hydrogen infrastructure is developing on multiple levels at the same time



Customer projects



Regional development



National infrastructure development

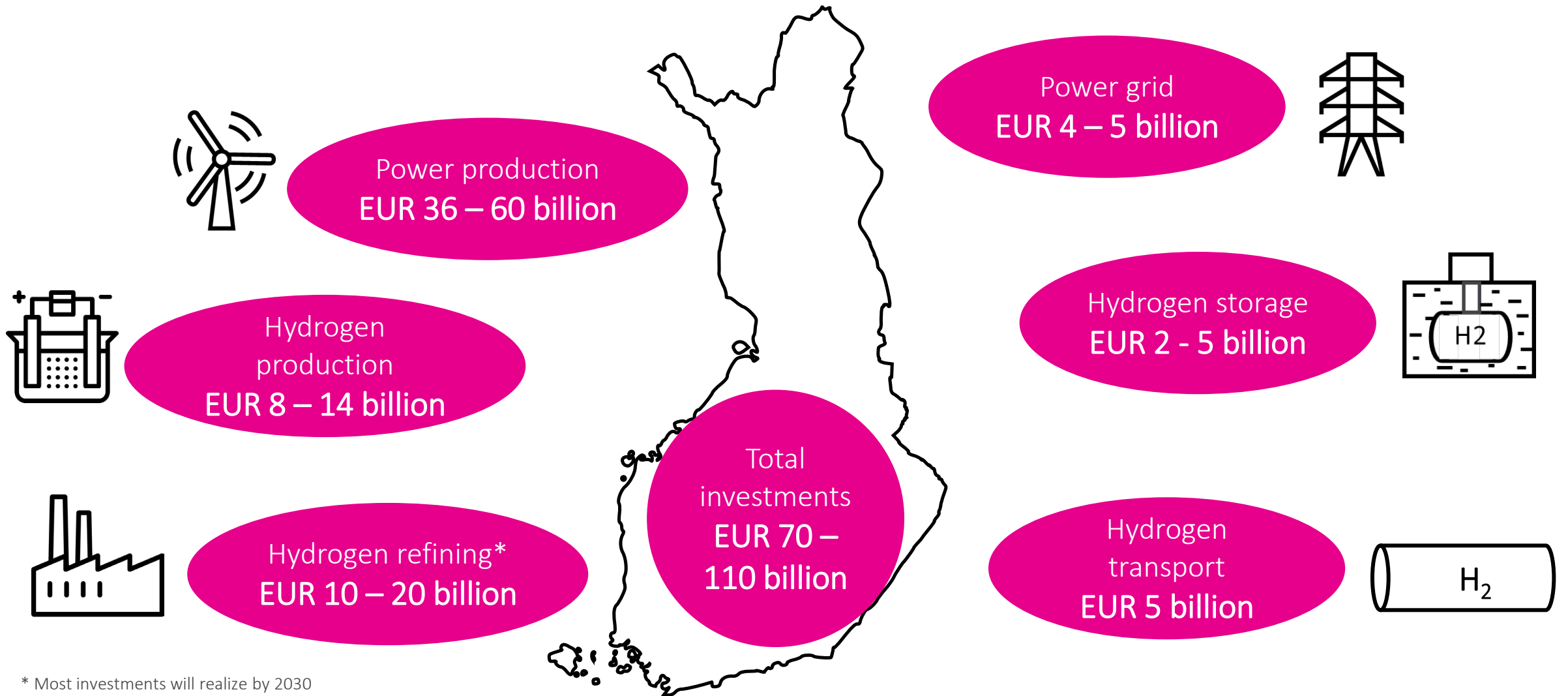


Baltic Sea infrastructure development



Bright future for Finnish hydrogen economy

Billion-scale investments in Finland by 2040

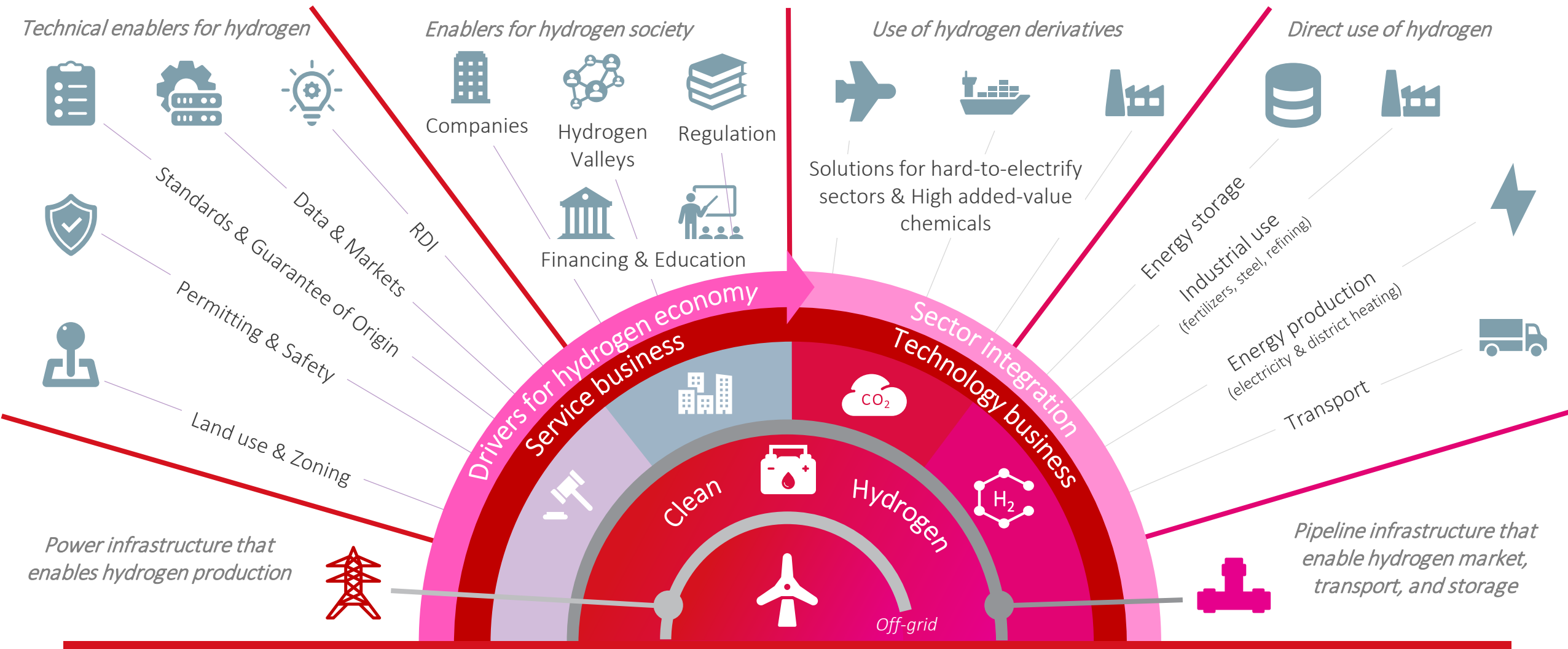


* Most investments will realize by 2030


Source: Confederation of Finnish Industries. Green investments in Finland. Data Dashboard.

Source: Gasgrid & Fingrid. (2023). Energian siirtoverkot vetytalouden ja puhtaan energijärjestelmän mahdollistajina. Available at: [Energian siirtoverkot vetytalouden ja puhtaan energijärjestelmän mahdollistajina - Loppuraportti](#)

Energy infrastructure as an enabler for new H2 value chains



(Figure: Gasgrid Finland)



The future of hydrogen will be created together

Thank you!

Sara Kärki
SVP, Hydrogen development
sara.karki@gasgrid.fi