



Hydrogen Economy Roadmap in Northern Ostrobothnia

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Foreword

The hydrogen economy is developing rapidly, driven by EU regulation, technological development and increasing investments. However, the operating environment is still in transition, and development is progressing in many respects amidst uncertainties. In this situation, regions must be able to **simultaneously anticipate future developments and react quickly** to the changing operating environment. A common situational picture helps to implement **timely measures and build hydrogen economy value chains in a controlled manner**.

However, more important than the situational picture is **how we proceed in practice**. The development of the hydrogen economy requires a shared vision and concrete measures to implement it. The value chain is built simultaneously in several different stages, and a single actor or investment cannot launch the whole on its own. Therefore, **development requires coordinated cooperation between companies, research organizations and the public sector**.

This document serves as a starting point for the strategic situational picture and roadmap of the hydrogen economy in North Ostrobothnia. Its aim is to describe **the region's starting points in the hydrogen economy, identify the key development directions and outline the steps to build and manage a hydrogen economy ecosystem in the region**. The document can be used in regional decision-making, the development of investments and projects, and the strengthening of cooperation between hydrogen economy operators.

The work has been carried out as part of the JTF-funded [Oulu GH2 project](#)



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Operating environment and market

Global, European and national development of the hydrogen economy



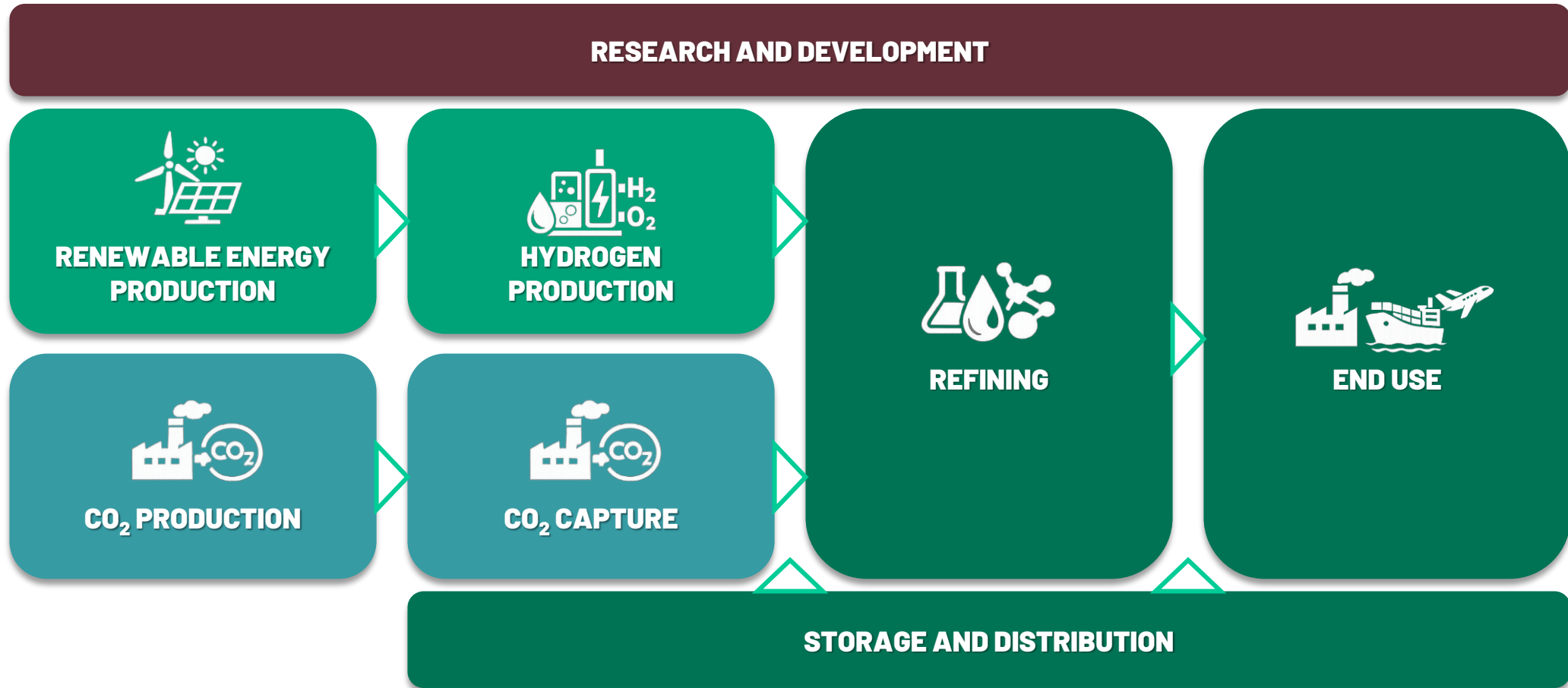
The hydrogen economy is a key part of the transformation of industry and the energy system

- **Hydrogen economy is a key solution for achieving climate goals**
 - The EU is legally committed to climate neutrality by 2050 – this will guide the transformation of industry and the energy system
- **Electrification reduces emissions in many sectors, but not all sectors can be electrified directly**
- **Hydrogen enables the replacement of fossil raw materials and fuels**
 - **in the steel industry:** replacing coal with hydrogen in the reduction process
 - **in the chemical industry:** synthetic chemicals and fuels from hydrogen
- **Hydrogen-based solutions are needed especially in sectors that are difficult to electrify**
 - **aviation and maritime transport:** e-fuels (e-SAF, methanol, ammonia)
 - **heavy-duty road transport:** hydrogen or hydrogen-based fuels

Value chains are taking shape and competition for investments between regions is ongoing



Green hydrogen and refined products value chain at the top level



The hydrogen market will be created as a result of the EU's climate and energy policy

The EU aims for the rapid scaling up of hydrogen as part of the decarbonization of industry and the energy system, and climate and energy policy creates obligations for the deployment of hydrogen and hydrogen-based fuels. Based on the mandates, the demand for RFNBO hydrogen in the EU is estimated at 2.8 Mt by 2030 ([Hydrogen Europe](#)).

INDUSTRY



EU ETS

The price of emission allowances steers industry towards low-carbon processes

RED III

Industrial hydrogen use renewable
42 % (2030) → 60 % (2035)

TRANSPORT



ReFuelEU Aviation

SAF mandates are increasing
2 % (2025) → 6 % (2030) →
34 % (2040) → 70 % (2050)

FuelEU Maritime

Reduction of emission intensity
-2 % (2025) → -6 % (2030) →
-31 % (2040) → -80 % (2050)

ENERGIA



EU Hydrogen Strategy

renewable hydrogen production
10 Mt (2030) + 10 Mt import

RED III

share of renewable energy in the
EU's energy consumption
42,5 % (2030)

The hydrogen economy is not created solely on market terms – demand is created through regulation



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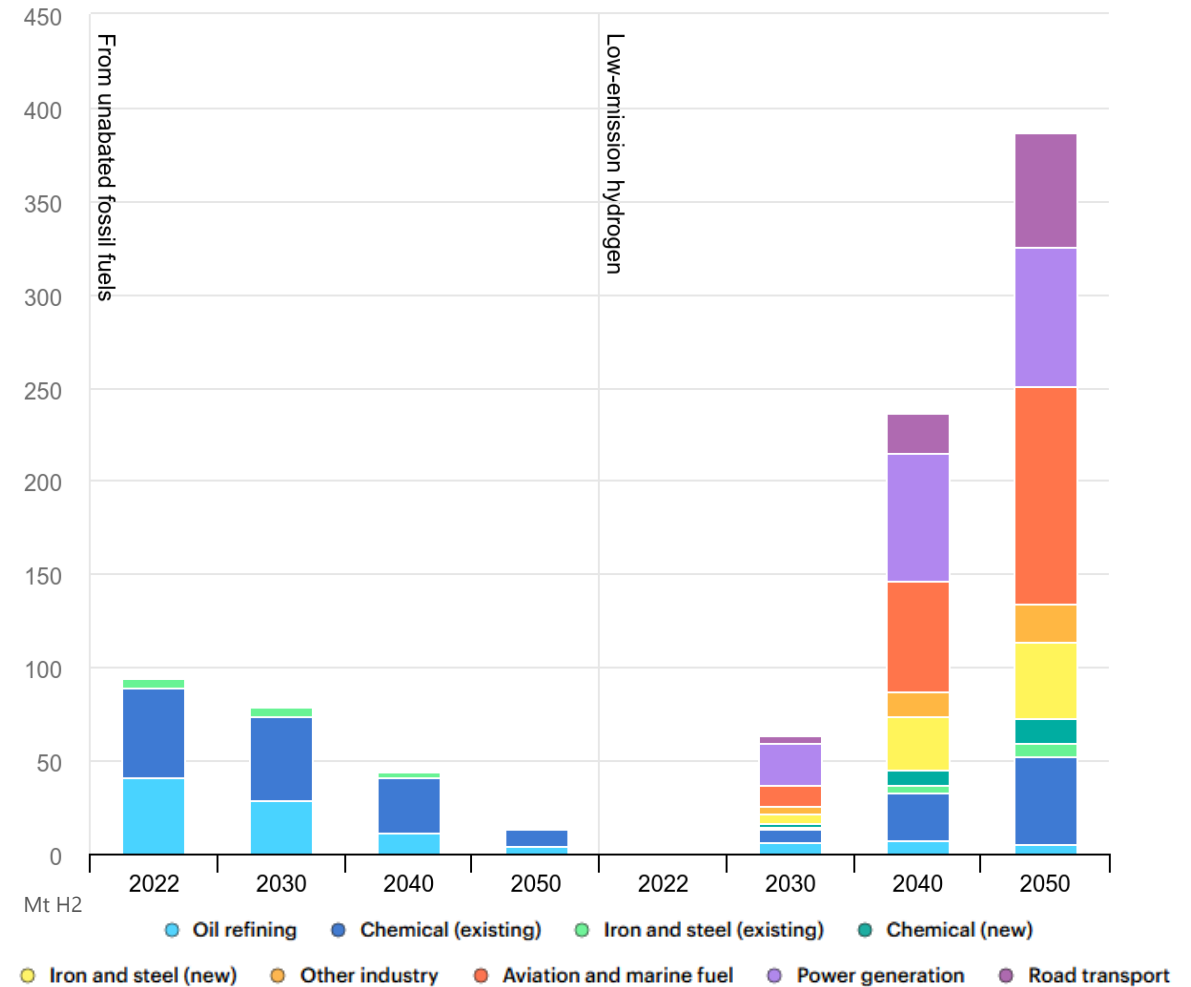
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Demand for green hydrogen could grow strongly by 2050

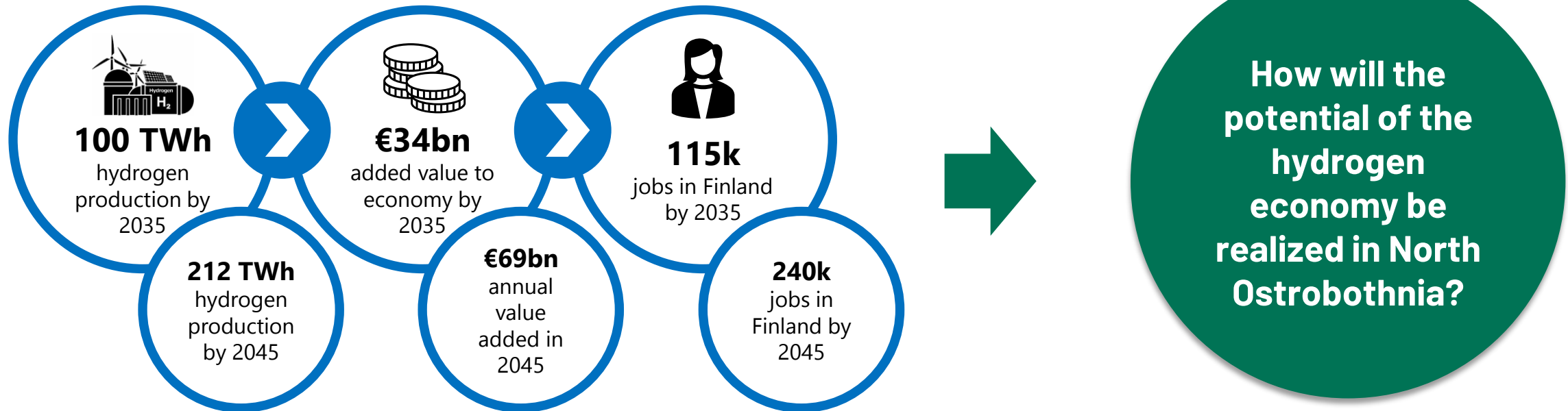
- **IEA Net Zero scenario:** increasing demand for low-emission hydrogen
 - 2030 ~60 Mt
 - 2040 ~240 Mt
 - 2050 ~390 Mt
- **In particular, the increase will be directed at:**
 - synthetic fuels for aviation and maritime transport
 - production processes in the steel industry
 - energy storage
- **In addition to hydrogen, the production of hydrogen-based fuels requires significant biogenic CO₂ flows**
- **The market for hydrogen technologies is growing by more than 10% per year, and the global market size is estimated to be ~USD 600 billion by 2035** ([Precedence Research](#))



IEA: Global hydrogen demand in the Net Zero Scenario, 2022-2050 (2023)

Finland aims to play a significant role in Europe's hydrogen economy

- The Government Programme "A strong and committed Finland" outlines Finland's role as a key player in the hydrogen economy and aims for a 10% share of the EU's clean hydrogen production and use in 2030 → **1 Mt of green hydrogen per year (~33 TWh)**



[H2Cluster Suomen vetytalousstrategia: Suomi: Johtava vetytalouden ekosysteemi Euroopassa vuonna 2035](#)



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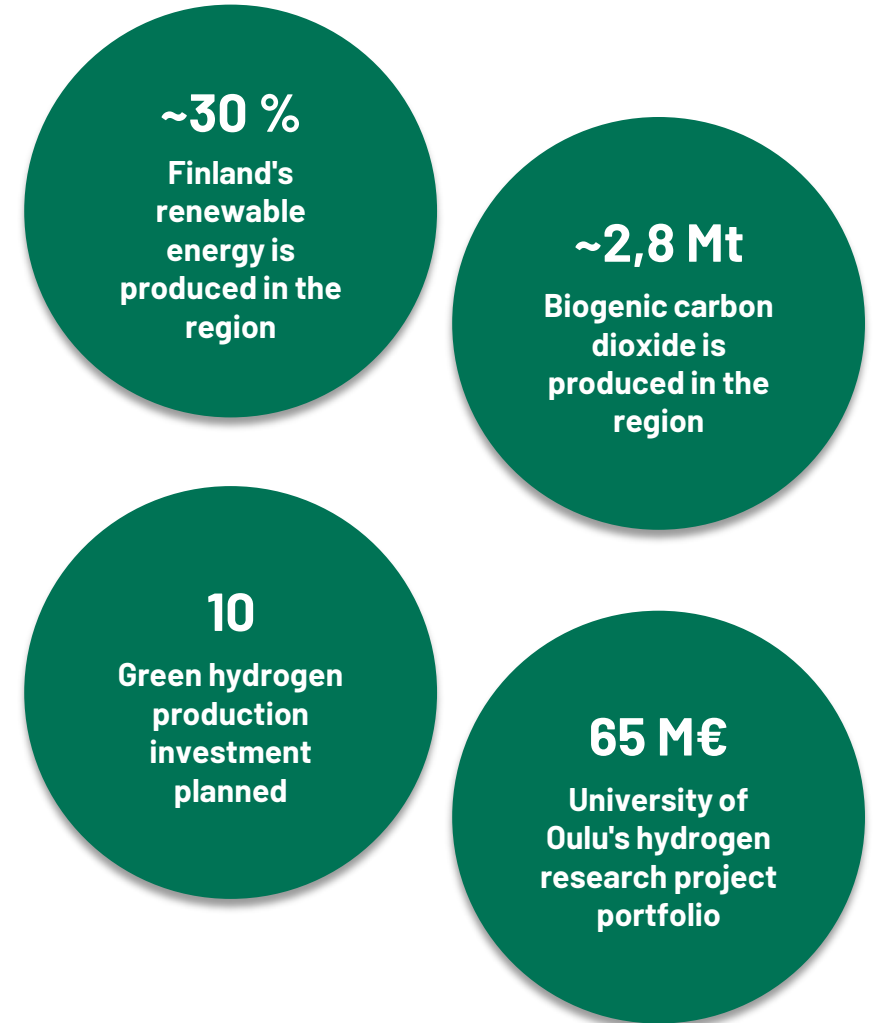
The current state and potential of the hydrogen economy in North Ostrobothnia

Strengths, capabilities and bottlenecks in the green hydrogen value chain



Northern Ostrobothnia's prerequisites for the development of the hydrogen economy

- **Significant renewable energy potential** and investments in the electricity grid create good conditions for the production of green hydrogen
- **Biogenic CO₂ available**, enabling the production of hydrogen-based fuels and chemicals
- **Strategically located at the junction of the electricity grid and the planned hydrogen backbone network**, the Nordic Hydrogen Route connects the west coast of Finland via Northern Finland to Sweden (Tornio–Kokkola).
- **Several industrial areas suitable for hydrogen production have been zoned in different parts of the region**, supported by the Port of Oulu and logistical connections
- **A strong research and innovation environment and industrial base** that supports the development of the entire hydrogen value chain

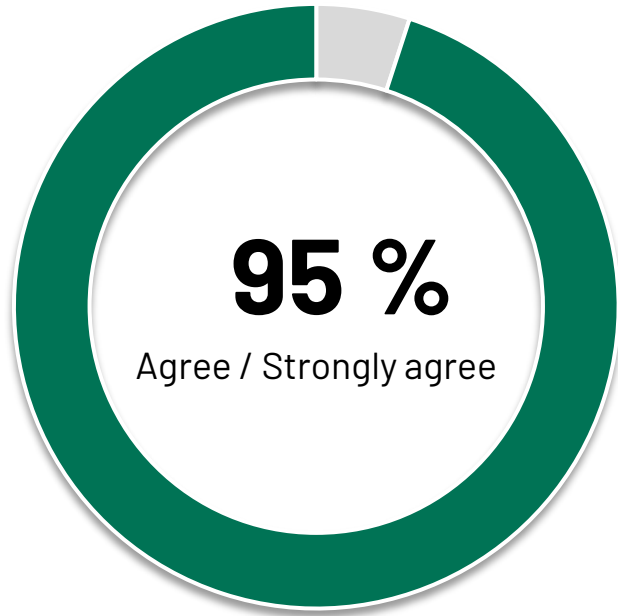


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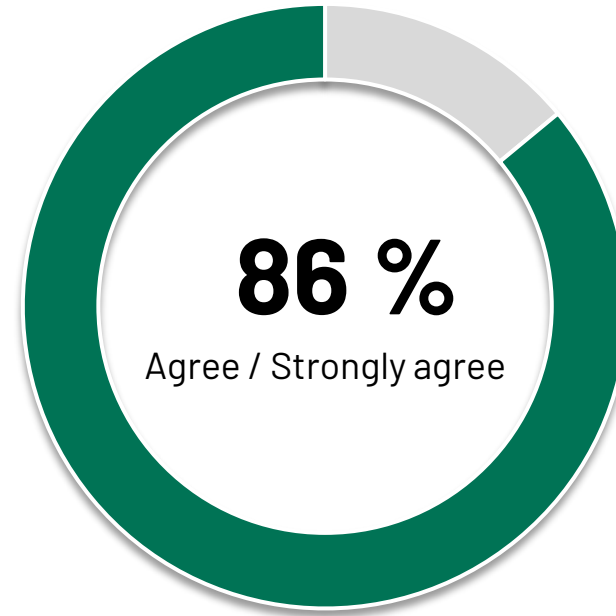


The Oulu region has realistic conditions to act as a leading region in the hydrogen economy...

in Finland



in Northern Europe

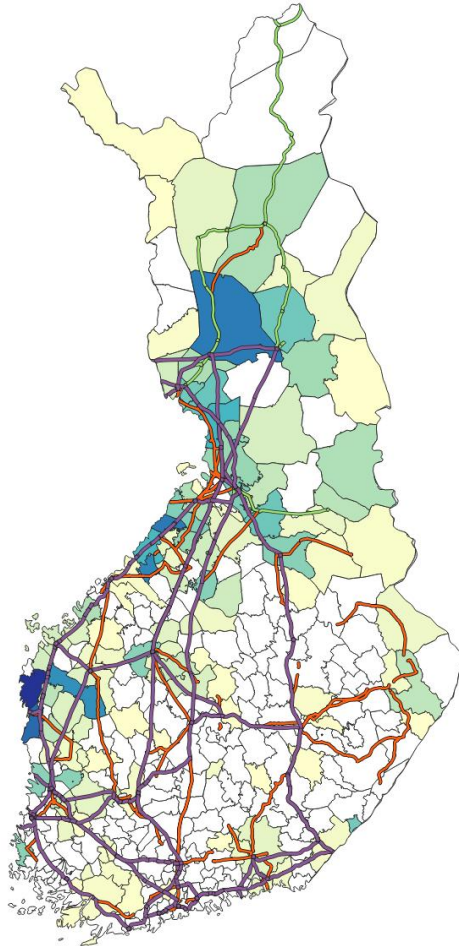


Stakeholders' views on the prerequisites for the hydrogen economy in the Oulu region were surveyed in an expert survey conducted at the Nordic Hydrogen Week 2026 event. 23 hydrogen economy actors from different organizations responded to the survey.

North Ostrobothnia combines the key production resources of the hydrogen economy

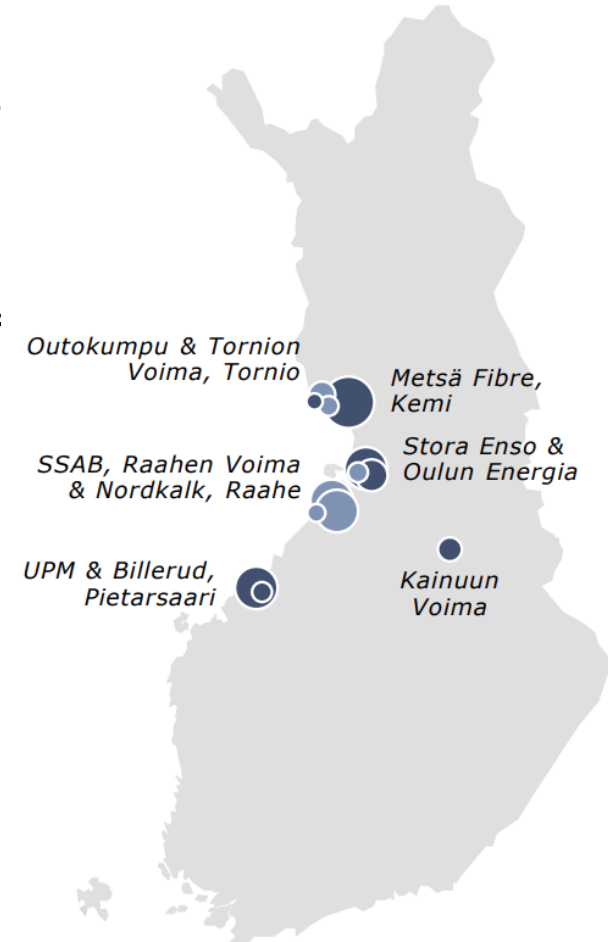
Renewable energy – demand and availability

- The planned hydrogen projects require a significant amount of electrical power:
 - Oulu ~2 000 MW
 - Muhos ~1 000 MW
 - Vaala ~1 000 MW
 - Nivala ~2 × 200 MW
- North Ostrobothnia is one of Finland's leading renewable energy regions, and about **30% of the country's renewable energy is produced in the region**
- **The connection capacity of the electricity network is at a good level** from the perspective of implementing planned projects.



CO₂ – demand and availability

- Planned Power-to-X projects require significant amounts of carbon dioxide:
 - Oulu ~1,4 Mt CO₂ per year
 - Muhos / Utajärvi / Vaala ~0,7 Mt CO₂ per facility
- There are significant sources of biogenic CO₂ in the region:
 - Oulu ~2,8 Mt
 - Kemi ~4,3 Mt
 - Pietarsaari ~2,2 Mt
- In addition, the **Port of Oulu will enable the import of CO₂** and the development of a potential CO₂ terminal



Source: AFRY (2025) Preliminary study of the CO₂ hub in the Oulu region

Regions' ability to participate in global value chains

In global value chains, **production and value creation are divided into different regions**. Different parts of the value chain produce different amounts of added value. **The role of regions in value chains is determined by their characteristics and capabilities.**

COMPETENT WORKFORCE

The different stages of value chains require expertise that meets the needs of technology and industry. Continuous competence development and the ability of the education system to respond to change are key to attracting investments.



INFRASTRUCTURE

High-quality infrastructure enables the movement of resources, services and information and connects the different stages of production in the value chain. It supports business activities and strengthens the attractiveness of the area as an investment destination.



RESOURCES

Local resources, such as energy, raw materials and land, often determine which parts of the value chain a region can participate in. Their availability and efficient utilization affect companies' location decisions.



MARKET ACCESS

Good connections to national and international markets improve the region's opportunities to participate in value chains. Market accessibility supports competitiveness and enables value growth over time.



INNOVATION CAPABILITY AND POLICIES

Technological expertise, cooperation networks, and regional strategies and policy measures support participation in high-value added activities in value chains.



Stakeholders' views on the hydrogen economy capabilities of North Ostrobothnia were surveyed in a survey conducted during Nordic Hydrogen Week 2026 (n=23) – green depicts strengths and orange areas that need development.



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Hydrogen hotspots and the potential of municipalities

The potential of the hydrogen economy is concentrated in the industrial centers of the region, while some municipalities participate in the value chain, especially through the production of renewable energy.

REGIONAL ANCHOR

Industrial and knowledge-intensive centers where hydrogen economy investments, refining and RDI are most likely to be concentrated. CO₂ availability.

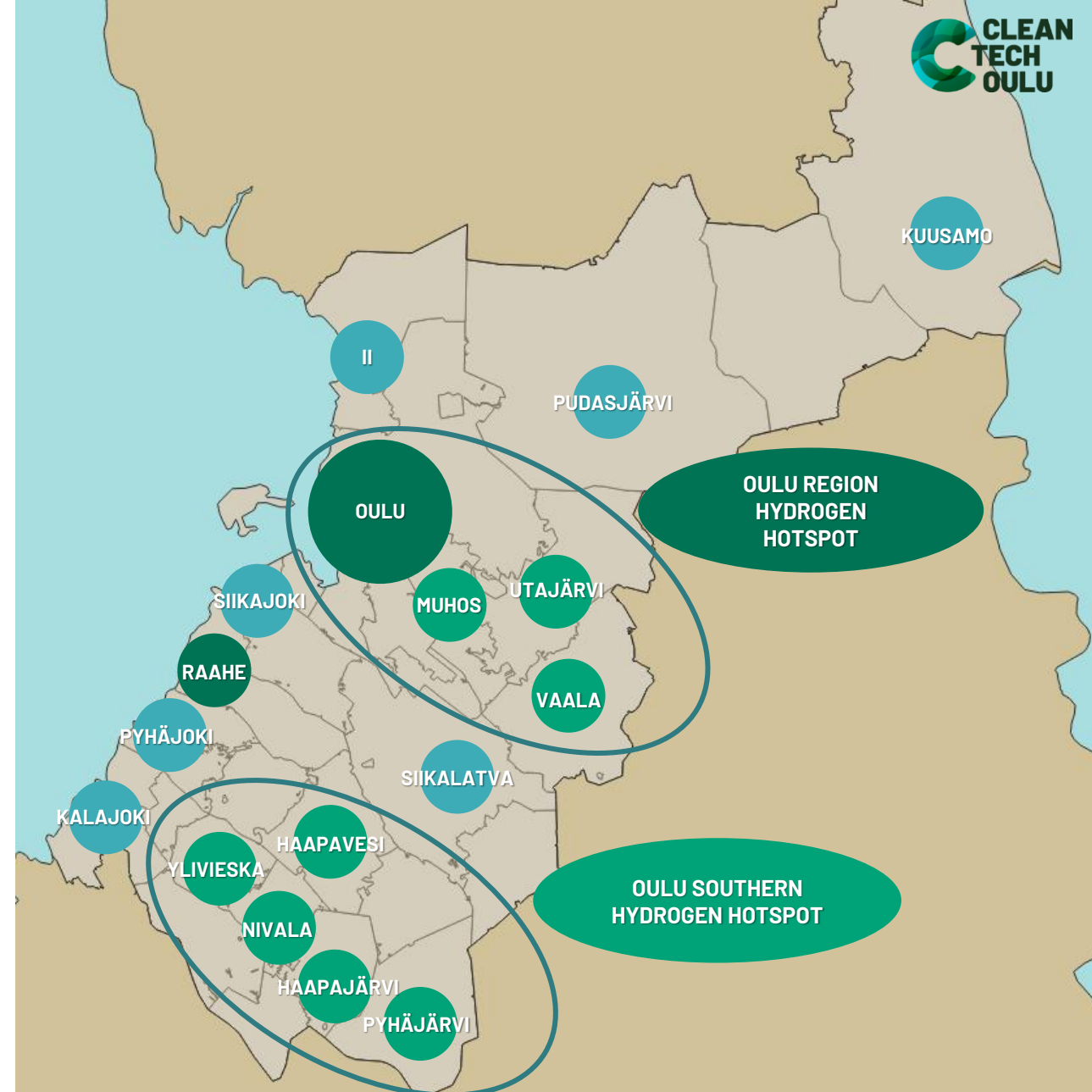
SUPPORT NODES

Municipalities with growing energy and industrial potential that integrate into the value chain in cooperation with anchor cities.

RENEWABLE ENERGY PRODUCTION

Regions where renewable energy production and storage enable hydrogen production and support the development of the hydrogen economy.

The roles of the regions emphasize the importance of cooperation in the regional hydrogen economy ecosystem.



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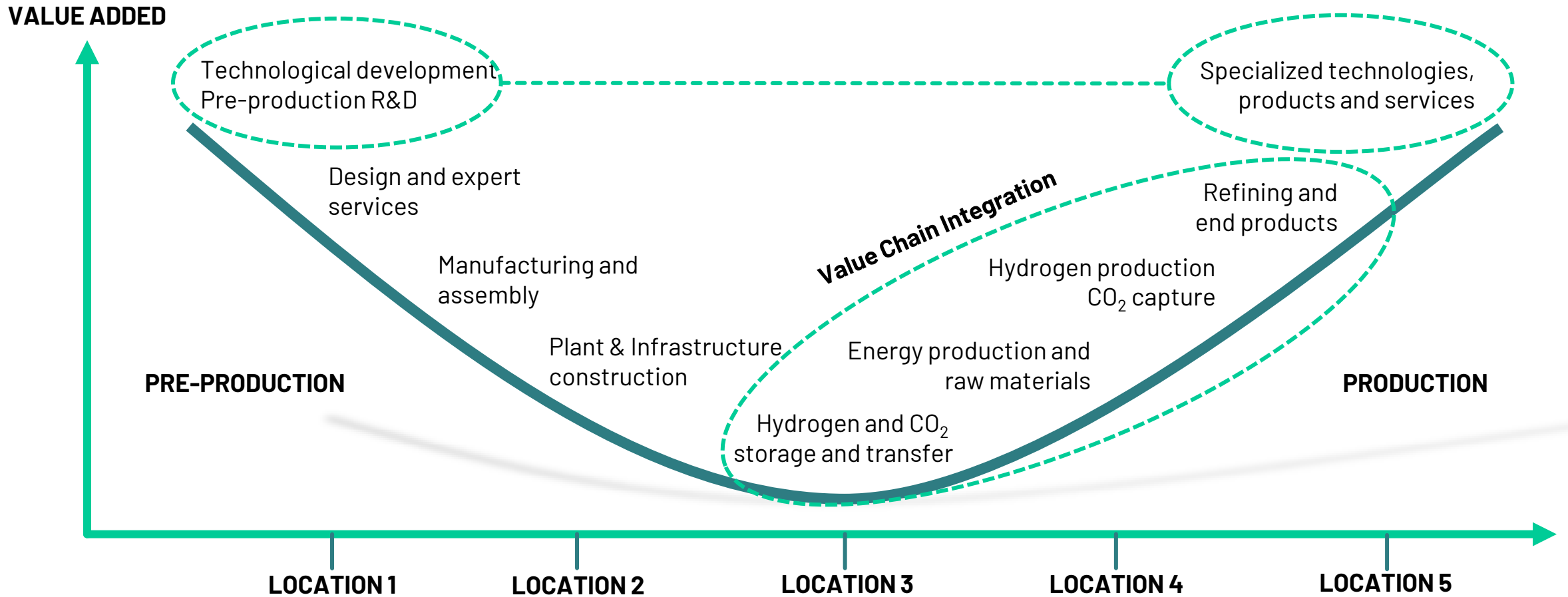
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Green hydrogen value chain and value added

Leading regions in emerging value chains should aim for strong value chain integration and high value-added phases based on strengths



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Roadmap for the hydrogen economy in North Ostrobothnia

Step-by-step approach, investments and coordinated implementation



Planned investments in North Ostrobothnia

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2028

2029

2030

2031

2032

2033

2034-

LAANILA, Oulun Energia, P2X Solutions

Planning

100 MW, e-fuels

ORITKARI, Verso Energy

Planning

350 MW, e-SAF

PYYRYVÄINEN, P2X Solutions

Planning

400 MW, e-fuels

PYYRYVÄINEN, Energiequelle

Planning (on hold)

100–500 MW, H₂ heavy vehicles

PYYRYVÄINEN, ABO Energy

Planning

600 MW, e-fuels

VIHREÄSAARI, Hy2Gen

Planning, 200 MW, e-fuels

MUHOS

MUHOS

Planning, 1 000 MW, e-fuels

UTAJÄRVI

MUSTIKKAKANGAS, Vetyalfa

Planning

1 000 MW, e-fuels

VAALA

LIMINKANGAS, Vetyalfa

Planning

1 000 MW, e-fuels

NIVALA

KURUNPUHTO, ABO Energy

Planning

200 MW + 200 MW, H₂

GASGRID

NORDIC HYDROGEN ROUTE

Planning

Operational



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Roadmap for the development of the hydrogen economy

2026 – 2030

2030 – 2035

2035 –

STEP 1: LOCAL PRODUCTION HUBS

- The first investment decisions will launch the hydrogen economy value chain in the **Oulu region's production and refining hub**.
- **The hydrogen projects in southern Oulu are progressing** and forming the second developing production hotspot in the region.
- **Launching CO₂ capture and exploiting local biogenic CO₂ sources**, as part of building a regional refining strategy.

STEP 2: INTEGRATION OF THE ARC OF BOTHNIA

- **The hydrogen pipeline infrastructure connects** Oulu and other municipalities in the region to the **industrial centers of the Bothnian Arc** (Kemi-Tornio and Kokkola).
- The Oulu region is **developing a local CO₂ infrastructure** that enables refining and the expansion of Power-to-X production. The operators in the region will initially be connected by road transport, and later also by rails and pipeline networks.

STEP 3: INTERNATIONAL INTEGRATION

- The Nordic Hydrogen Route will connect Northern Finland to the **Nordic hydrogen network**.
- The hydrogen economy will be integrated into the **Nordic and European markets**.
- **Production and refining are scaled** to meet growing international demand.

H₂ INFRASTRUCTURE

H₂ core network design and construction
Regional H₂ networks designing and construction

H₂ core network operational

H₂ integration into northern Sweden

CO₂ INFRASTRUCTURE

Oulu CO₂ network design and construction
Launching CO₂ capture

Oulu CO₂ network operational
CO₂ logistics to the rest of the region

CO₂ network expansion



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Hydrogen hotspot in the Oulu Region

**SEA
LAPLAND**



NUOTTASAARI

Access to
biogenic CO₂



OULUN SATAMA

Oritkari: 350 MW
Verso Energy
Vihreäsaari: 200 MW
HY2GEN

LAANILA

100 MW
Oulun Energia
P2X Solutions.

HANGASKANGAS

New
industrial zone

MUHOS

**UTA-
JÄRVI**

VAALA

**OULU
SOUTHERN
HOTSPOT**

PYYRYVÄINEN

1400 ha

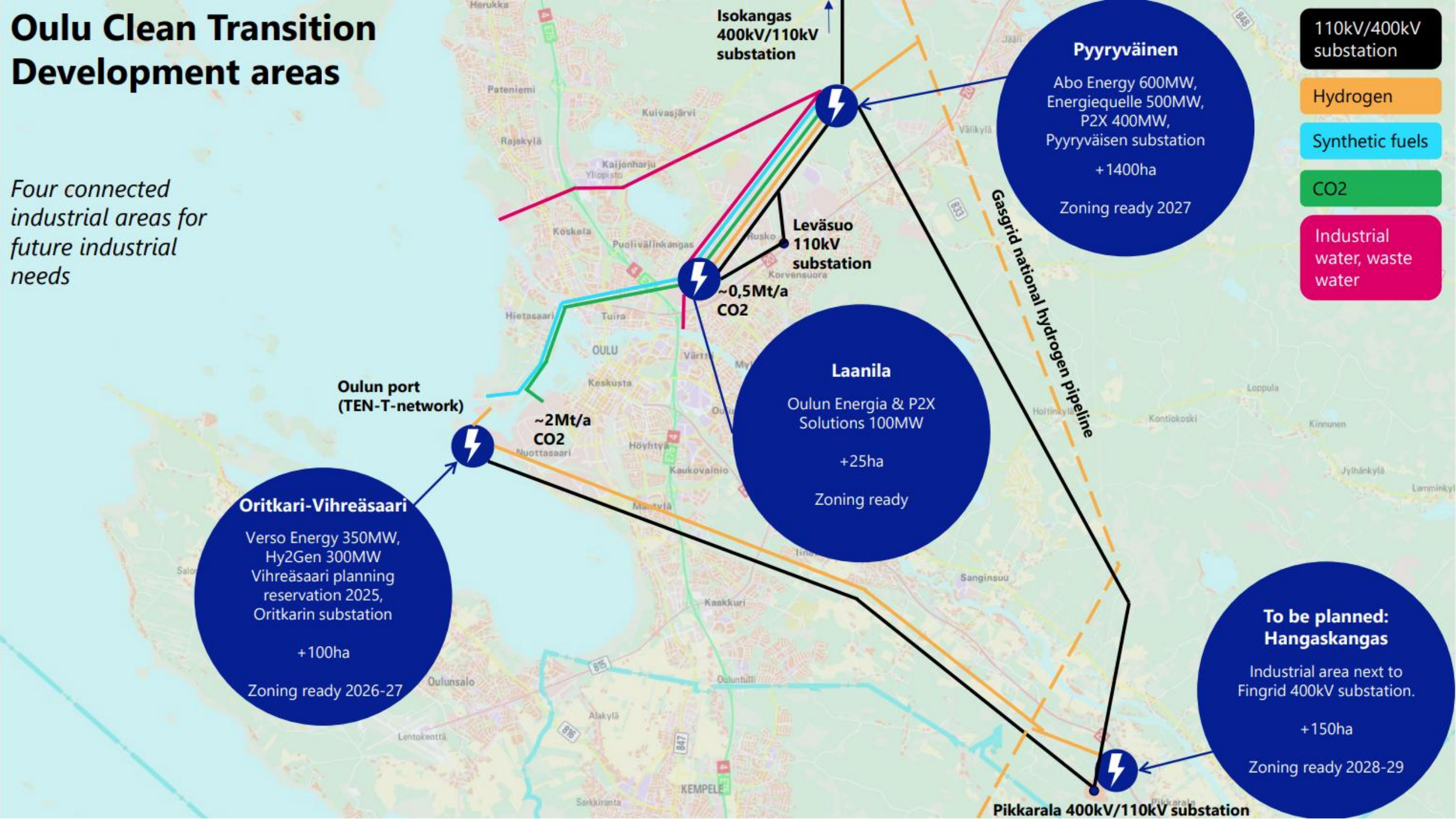
1500 MW
Energiequelle,
ABO Energy
P2X Solutions

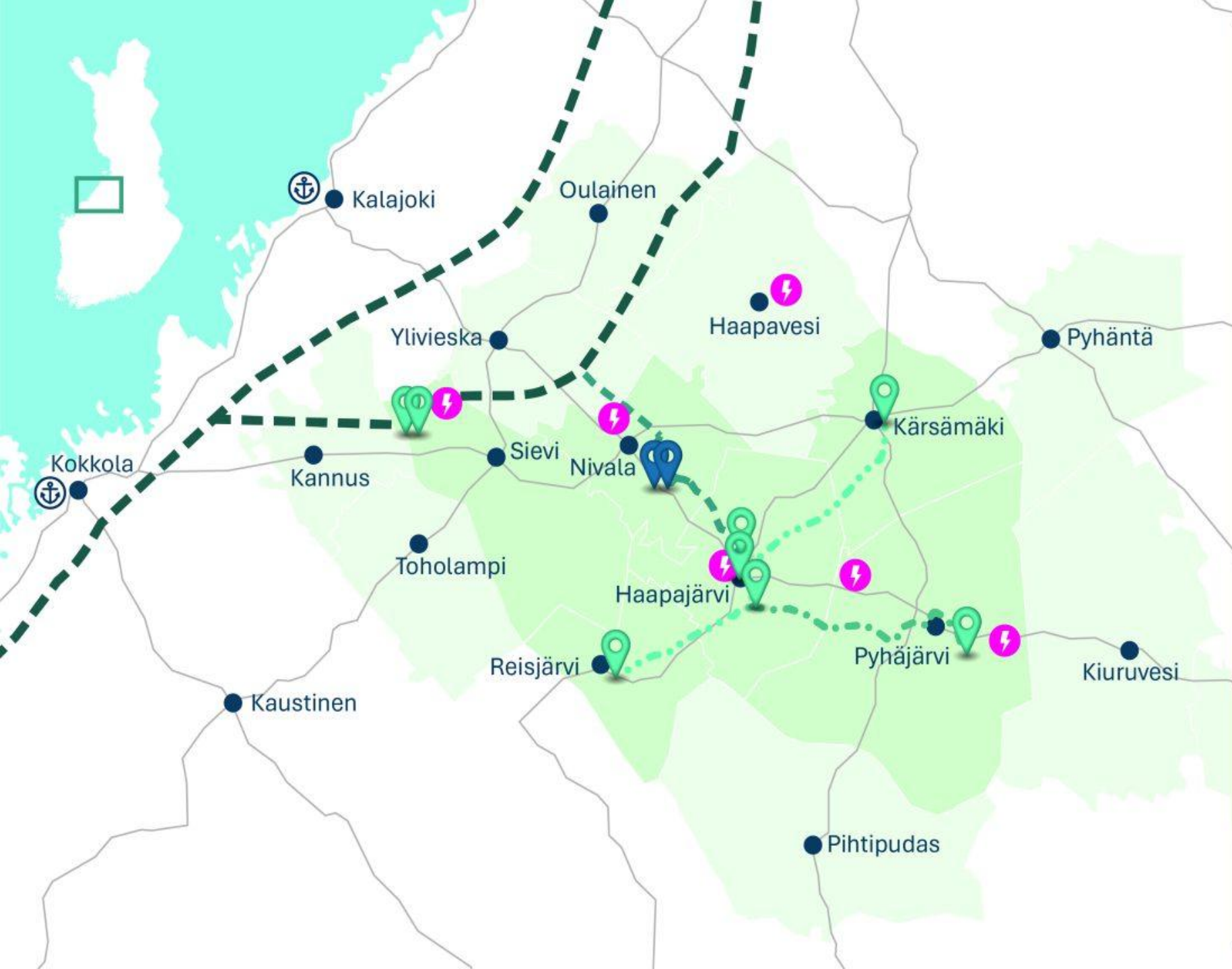
**WHY
OULU
AREA**



Oulu Clean Transition Development areas

Four connected
industrial areas for
future industrial
needs








Hydrogen production suitable locations / industrial areas in the region

-  Planned hydrogen production facility (announced project)
-  Suitable location or zoned area for hydrogen production facility
-  Fingrid substation (existing/planned)
-  Preliminary Gasgrid route options

Planned regional network

-  Route Option 1: Raudaskylä – Nivala – Haapajärvi
-  Route Option 2: Haapajärvi – Pyhäjärvi
-  Route Option 3: Kärämäki – Haapajärvi – Reisjärvi

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HYDROGEN VALLEY**

Powered by  NIHAK

Key theses for the development of the hydrogen economy in North Ostrobothnia

1. Build a strong technology and piloting environment

Build a **technology-focused piloting and development platform**
Turn **technology into commercial hydrogen solutions**

2. Enable investment and business participation

Provide investors with **ready-made conditions: electricity, infrastructure, CO₂ and know-how**
Enable the **low-threshold participation of SMEs**

3. Build a strong ecosystem and national role

Act as **part of the national hydrogen economy**
Network the actors and **productize what the ecosystem offers**

4. Aim for international scalability

Develop **scalable solutions and expertise for export**
Emphasize **concreteness and readiness to act**

Source: Macon Oy (2025) Kauppaa ja kassavirtaa vetytaloudesta –pelikirja (Oulu GH2 -hanke)



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Launching a hydrogen economy value chain in North Ostrobothnia

- **The first investment decisions are critical** for launching the hydrogen economy value chain and creating a market
- In the leading regions of the hydrogen economy, the value chain must be developed as an **integrated entity** that simultaneously takes into account **energy, hydrogen, CO₂, storage, refining and applications**
- In the early stages of development, the main focus is on the **construction of infrastructure, demonstration projects and market access**
- **RDI capabilities must be targeted at the critical stages** of the start of the value chain, making efficient use of the region's research expertise and research infrastructure

The goal is to build an integrated hydrogen economy ecosystem in the region, enabling high-value business operations.



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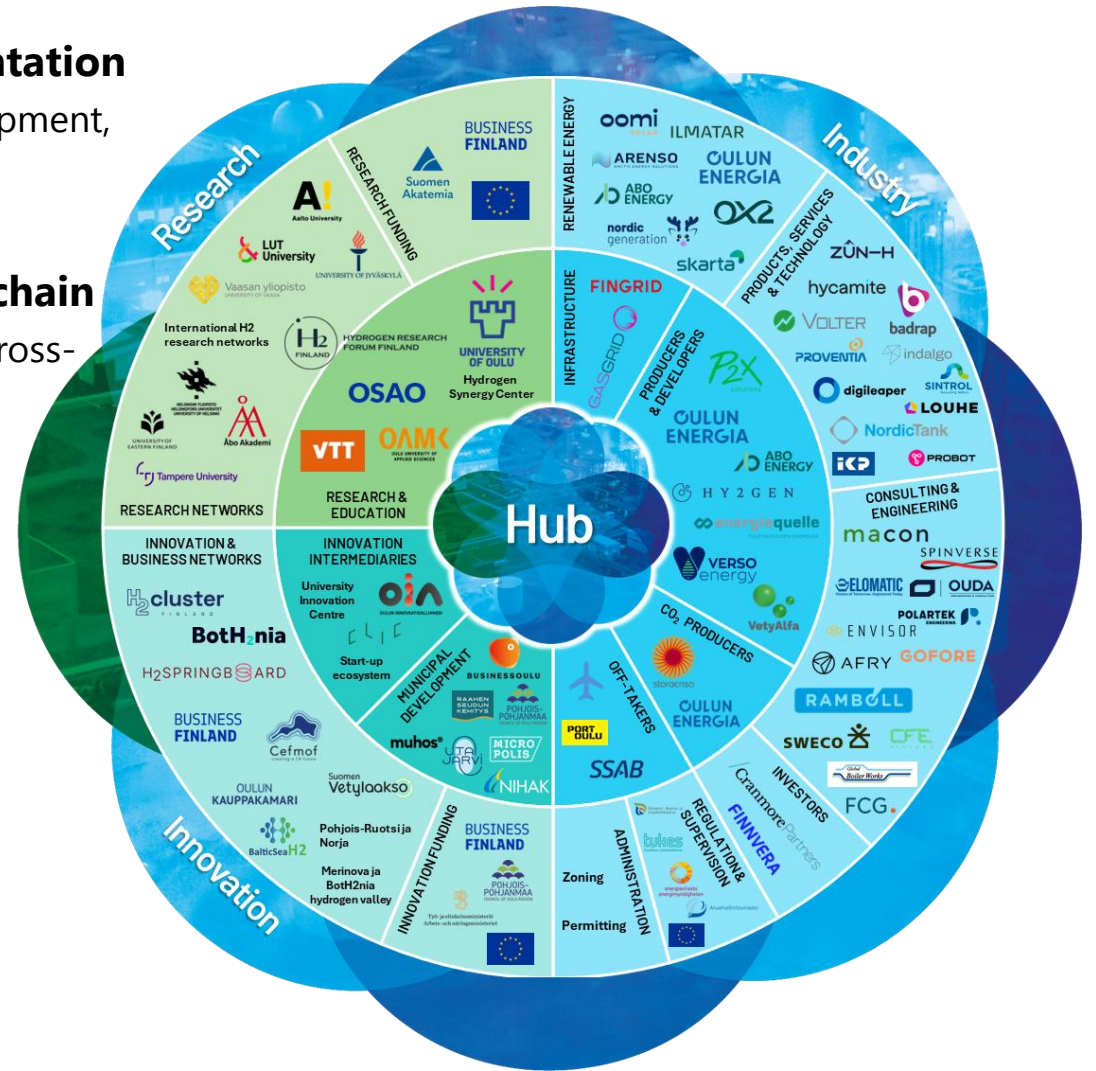
From roadmap to implementation

How do we go from here?



Implementation requires a coordinated ecosystem

- **The ecosystem creates the structure – the Hub enables implementation**
 - The hydrogen economy roadmap defines the direction and stages of development, but its implementation requires an extensive, coordinated network of actors
- **The ecosystem brings together the different stages of the value chain**
 - Actors cover the entire value chain from renewable energy to end-use and cross-cutting solutions
 - Companies, research and the public sector are involved
- **The Hub operating model acts as an engine for ecosystem development**
 - Cooperation between actors is actively managed
 - Knowledge, resources and development activities are interconnected
 - Cooperation is materialized into projects and investments
- **Critical tasks of the near future**
 - Active facilitation and leadership
 - Simultaneous launch of investments, infrastructure and market



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Spearhead projects for the development of the hydrogen economy

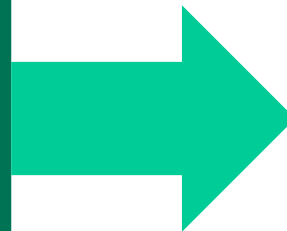
Project	Strategic importance	Feasibility	Time span	Path	Budget range	Facilitator type	Key partners
Ramp-up and leading the Hydrogen Economy Hub	Critical	Easy	Short	Coordination	S/M	Public	RDI actors, leading companies, SMEs
CO ₂ availability, capture and distribution regionally	Critical	Challenging	Long	Study → Pilot → Investment	XL	Public-business consortium	CO ₂ producers, municipalities, leading companies, development companies, research
Development of the hydrogen transmission and distribution network, including sharing the burden of investments	Critical	Challenging	Medium	Study → Pilot → Investment	XL	Public-business consortium	Municipalities, development companies, leading companies, Gasgrid, research
Piloting and ramp-up of hydrogen pipeline construction	Important	Moderate	Medium	Pilot	L	Public	Gasgrid, SMEs, development companies, education
Arctic Non-border Hydrogen Valley	Important	Moderate	Short	Coordination	L	Public	Development companies, innovation actors, research, leading companies
The role of hydrogen in the security of supply and defence sector and other applications	Sturdy	Easy	Short	Survey	M	Public	Finnish Defence Forces, development companies, research
Standardization and safety requirements	Sturdy	Easy	Short	Survey	S	Research / Authorities	Authorities, standardization bodies, research, SME and leading companies, education

The next phase of the hydrogen economy in North Ostrobothnia

North Ostrobothnia has **exceptionally strong prerequisites** for becoming a leading region in the hydrogen economy – but this requires rapid and coordinated implementation

What has already been done?

- The development of the hydrogen economy has exceeded expectations and strengthened the region's position as a key hotspot for hydrogen production in the future
- The region has a strong situational picture of the hydrogen economy and a roadmap
- Investment potential and key development targets have been identified
- The actors are committed to joint development
- The structure of the ecosystem and the hub operating model have been defined



What's next?

- Launching and resourcing the ecosystem and hub activities
- Promoting critical investments and market creation
- Engaging actors and concretizing cooperation into projects
- Continuous updating of the roadmap and reacting to changes in the operating environment

The prerequisites and plans are in place – now they must be turned into implementation

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