The Nordic Hydrogen Valleys Conference

Hubs, Harbours and Marine Use of Hydrogen (Workshop)

Nordic Energy Research

Workshop

The Nordic Hydrogen Valleys Conference

Jon Bjorn Skúlason

Moderator

HYCELAND

The Icelandic Hydrogen Valley
Co-funded by the Clean H_2 Partnership

Jón Björn Skúlason, CEO Icelandic New Energy


HYCELAND
Heavy-duty transport
Fish transport - Westfjords
Heavy-duty transport
Reykjavík – Akureyri
Mosfellsbær
Knowledge transfer and dissemination activities with impact throughout the country
Hydrogen production
Landsvirkjun
Skills and training
Technical College
Research and education
University of Iceland
Co-located dispensing
Olís - Korpa
Reykjavík
Plaster production
BM Vallá
European added value through cooperation with other Hydrogen Valleys, European Innovation projects and international consortium members
Existing dispensing
Capital area
Kópavogur
Observer group members prepare scale-up activities in various parts of Iceland
Garðabær
Hafnarfjörður
100% renewable electricity supply
Landsvirkjun
Asphalt production
Colas
Heavy-duty transport
Southland road
Geothermal energy
Hydropower
Wind power

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Establishing a scalable, sustainable hydrogen energy ecosystem in Iceland

100% renewable electricity supply

Landsvirkjun

Hydrogen production

Landsvirkjun

Snerpa PWR

Hydrogen compression, storage, distribution and dispensing

Olís

Hydrogen use

Industrial

Colas

BM Vallá

Mobility

Kraftur

Colas

Samskip

BM Vallá

Project coordination and local management

ERM

Icelandic New Energy

Data collection, analysis, and studies

Cenex

University of Iceland

Communication,dissemination, and exploitation

Blámi

Technical College

University of Iceland

ERM

Icelandic New Energy

Observer group

Isavia

City of Reykjavík

Icelandair

Verkís

Olíudreifing

MS Iceland Dairies

Iceland Post

IRCA

The overall original Hyceland project goals

At the end of the day 500 tons of H_2 must be used per annum, this is between 4-5 MW H_2 production

In Iceland

- Trucks
- A few smaller vehicles vans etc.
  - This could change as we are in dialogue with Toyota for Hilux H_2 vehicles
- 25-50 tons of H_2 for plaster production
- 100-200 tons of H_2 for asphalt production
- Other end use being evaluated
  - Offtake is the most complex part of the project.

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Nordic Hydrogen Valleys as Energy Hubs

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Adaptions will be made..

Currently the project is re-organising a bit

- Some partners decided to leave
- Economics are worse in the truck industry than when the proposal was written
- Battery vehicle development….
- However, new opportunities have been identified
- Offtake of H_2 is more complex than most of you think
    - Governments are confused
    - Current oil crisis might stimulate demand

This was the feeling when we go the grant

But this guy keeps surfacing and is continously building a new one!

We will make it…..

Thank you

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Co-funded by the European Union

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Nordic Roadmap
Future Fuels
for Shipping

Nordic Council of Ministers

Nordic Roadmap for the introduction of sustainable zero-carbon fuels in shipping

Phase 1 and 2: Implementation and realization 2025-2027

Julia Hansson, IVL Swedish Environmental Research Institute

The Nordic roadmap project 1 (2022-2025)

Nordic Council of Ministers

Nordic collaboration with **70 partners** coordinated by DNV and **funded by the Nordic Council of Ministers**

Objectives:

- Gain **technical knowledge** and regulatory development
- Establish a **Nordic collaboration platform** and **green shipping corridor pilot studies**
- Develop a **Nordic fuel transition roadmap**

- Fuels in focus: **ammonia, hydrogen and methanol**
- 10+ technical deliverables
- 3 green shipping corridor pilot studies

For more information visit the project website:

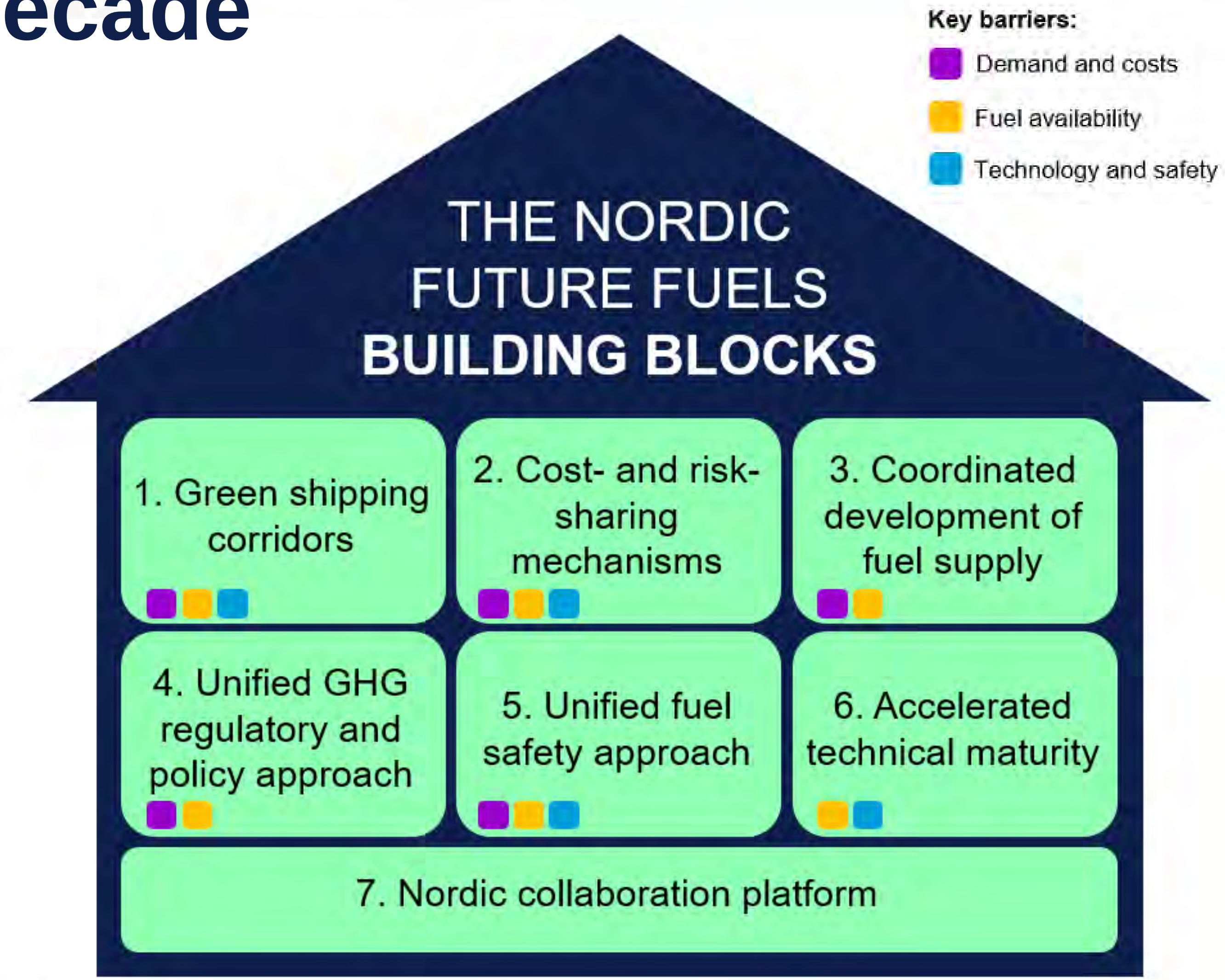
futurefuelsnordic.com/

ivl Swedish Environmental Research Institute

The Roadmap lays foundation for upscaling in the next decade

7 strategic building blocks with 20 specific actions towards 2030

- Actions to overcome **key barriers**
- Creating a **Nordic playground** – with a unified approach
- **Targeted collaboration** between stakeholders and Nordic governments
- Focus on first mover segments, operating in **green shipping corridors**



Source: DNV (2024), *The Fuel Transition Roadmap for Nordic shipping*

ivl Swedish Environmental Research Institute

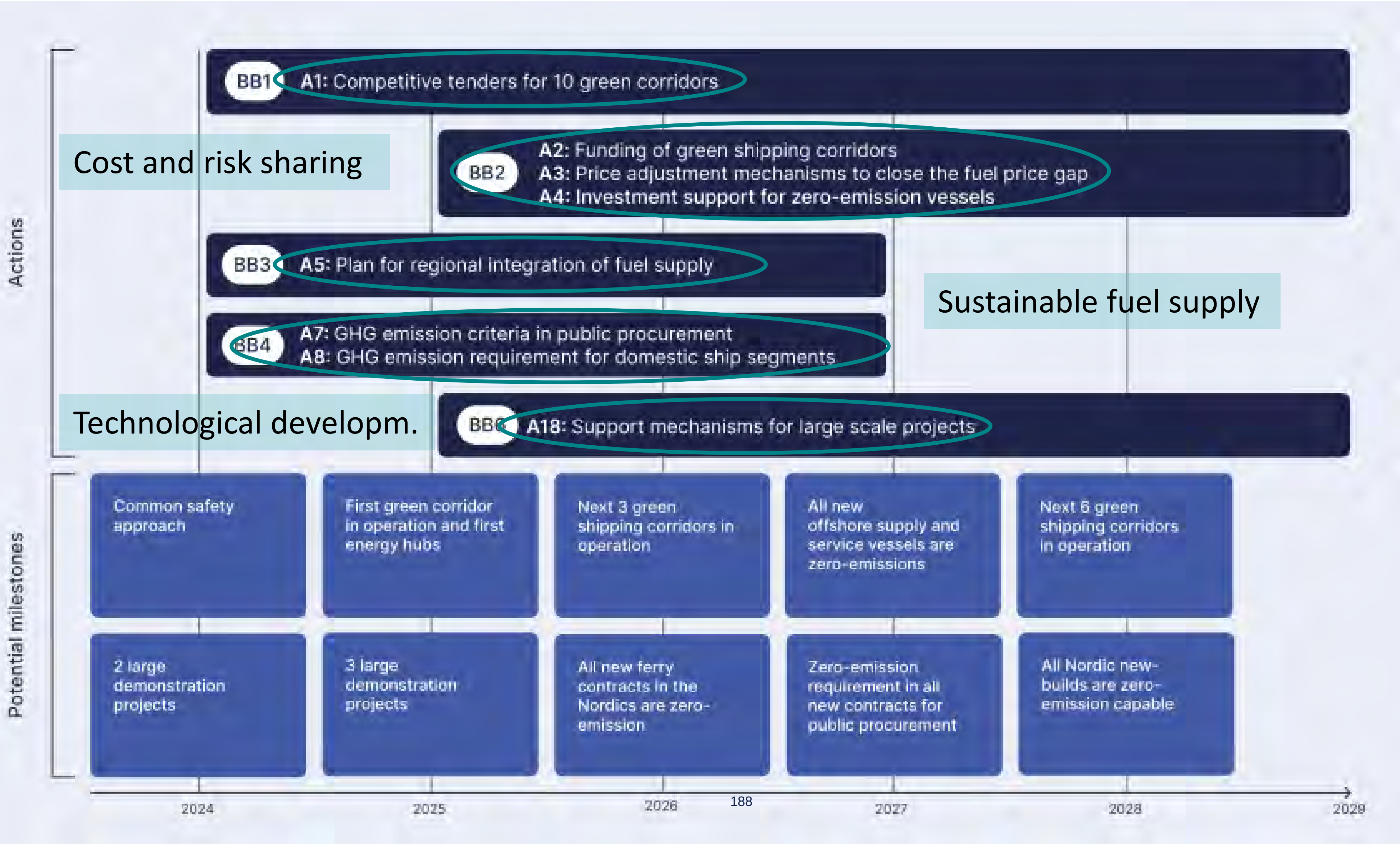
DNV

Critical actions and potential milestones towards 2030 – highlighting 8 of 20 actions (A)

Nordic vision: “to become the most sustainable and integrated shipping region in the world”

Goal: Zero-emission shipping by 2050

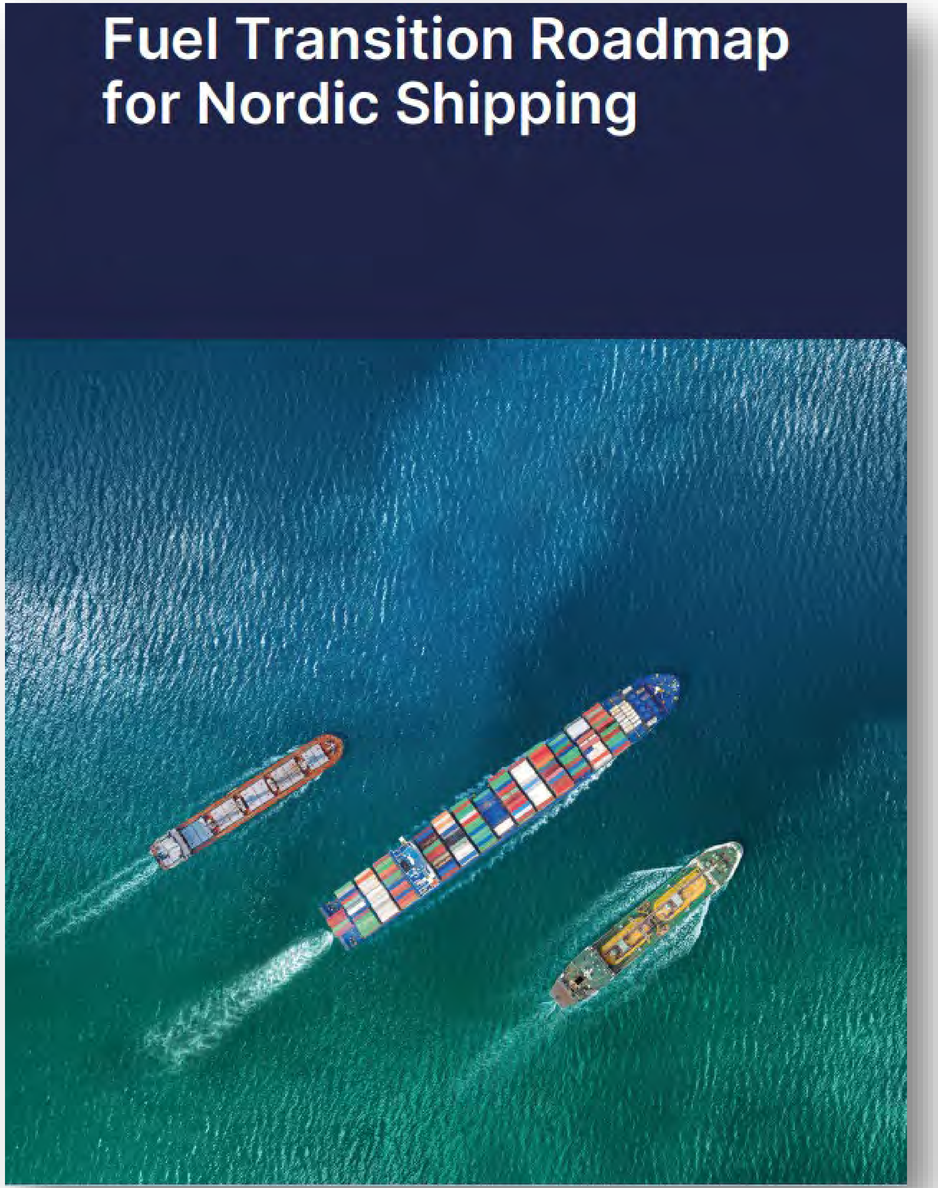
Starting mechanism: **Nordic Green shipping corridors**



Next step: Implementation

- We urge Nordic governments to **implement the actions** identified, including:
  – Contribute to closing the cost gap
  – Set up competitive tenders for green corridors
- The actions will **provide confidence** for the industry to invest in zero-emission vessels, and the needed fuel infrastructure

futurefuelsnordic.com/the-fuel-transition-roadmap-for-nordic-shipping/



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Nordic Roadmap Phase 2: Implementation and realization

Key facts:

- Duration: 2026-2027
- Programme coordinator: DNV
- Partners: Everllence, Icelandic New Energy, IVL, SINTEF, VTT
- Consist of four projects:

- Project 1: Moving Green Shipping Corridors into realization
- Project 2: Ensure safe port- and bunkering operations for sustainable zero carbon fuels
- Project 3: Continue and Strengthen the Nordic Collaboration Platform
- Project 4: Develop a Nordic green transition barometer for shipping

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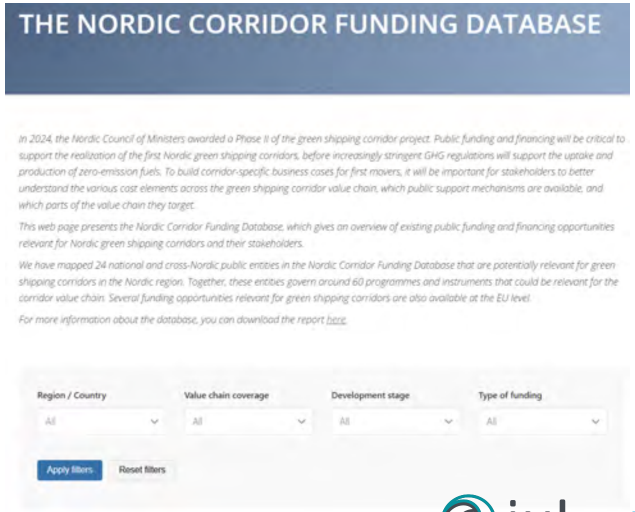
1: Moving Green Shipping Corridors into realization

- ✓ Support **progress** towards final investment decisions and/or **address remaining barriers** to uptake of alternative fuels, to **enable** establishment of **green shipping corridors** in Nordics.
- ✓ E.g., providing **support** such as technical and safety analyses, assessment of logistical and organizational barriers, and/or financial/funding aspects for **2-3 green shipping corridors**.
- ✓ **Identify/map financing options**, through expansion of Nordic Corridor Funding Database



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2: Ensure safe port- and bunkering operations for sustainable zero carbon fuels

- ✓ **To support safe port operations and a harmonized approach to safe bunkering**
  - Risk assessment related to safe port and bunkering operations for relevant fuel(s)
  - General safety guidance for bunkering operations in ports
  - Best practices for onshore power supply

- ✓ **To support ports in assessing their feasibility and readiness for specific fuels**

3: Sustain and develop the collaboration platform

More partners welcome!

Specific focus on engaging also **cargo owners** and **finance sector**

Webinars/website: **Share/discuss results**

Task-force - **innovative collaboration and financing** forms for GSCs

Nordic Collaboration Platform events

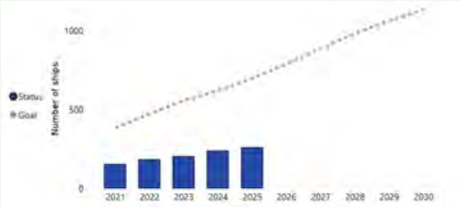
- First Nordic Collaboration Platform event scheduled for **7th May in Gothenburg**
  - ***From Vision to Investment: Realising green shipping corridors in the Nordics*.**
- Events will be planned in relation to the projects with respect to timing of **input to** project work and/or **presentation of deliverables**
- Local/national content

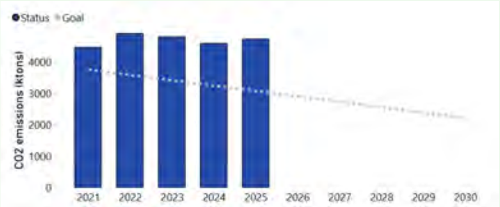
4: Develop a Nordic green shipping transition barometer

- ✓ Monitor the green transition for Nordic shipping by developing a Barometer to assess progress.
- ✓ Updating this barometer annually to track development over time.

Status on the green transition

- Measurements of emissions and uptake of fuels and technologies in the current fleet
- Comparison of these measurements to a pre-defined trajectory towards the 2030 milestone
- Combination of the measurements into a barometer score, indicating the status on the green transition





Effort towards further transition

- Description of status of building blocks in the roadmap
- Qualitative assessment of how well we are on track towards 2030 for each building block

Green shipping corridors

Cost- and risk-sharing mechanisms

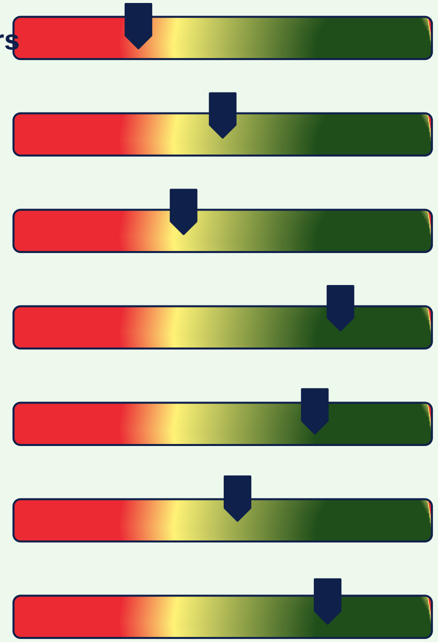
Coordinated development of fuel supply

Unified GHG regulatory policy

Unified fuel safety approach

Accelerated development of technical maturity

Nordic collaboration platform



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Thank you!

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Nordic Hydrogen Valleys as Energy Hubs

NordicH$_2$ubs

WP1- Case studies and sector coupling

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29.04.2026

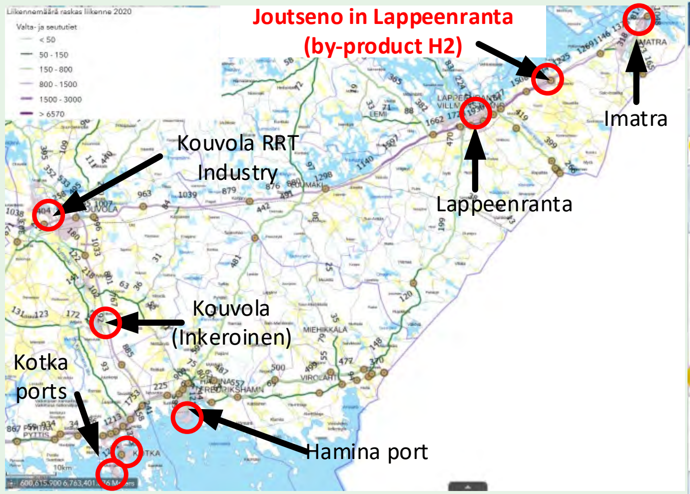
Case study 1: Cross-sectoral H2 value chains in Finland

— Involved: VTT, Kemira, companies providing transport services to Kemira
- VTT – Aleksandra Saarikoski
- Kemira – Logistical personnel

— Analysis of H2 availability for HD transport
- Total volume of Kemira transport needs in Joutseno and Äetsä, Finland. Raw materials and products flows.
- Availability (quality and quantity) of by-product hydrogen (Chlor-Alkali) for heavy duty transport for Kemira and for other industry transport in Southeastern Finland and Western Finland.

— A case study was selected based on the initial traffic data collected in the Next Wave project (D2.5) (see right)

Initial traffic flow analysis the case study is based on



Site / City	External truck visits	Internal	Environmental permit Dnro or other reference
Imatra, Ovako	50 truck visits per day		ESAVI/346/04.08/2013
Imatra Stora Enso	340 truck visits per day		ISY-2004-Y-170
H2 need for external traffic: 10-15 tonnes per day (2 HRS)			
Lappeenranta (Joutseno), Kemira factory	15 long distance truck loads per day and 10 short -> Now 25 long distance truck loads per day	-	ESAVI/11436/2016
Lappeenranta (Joutseno), Metsä Fibre Oy, Metsä Board and Stora Enso Wood products	Total 350-400 for all three factories		ESAVI/2046/2015 ESAVI/2043/2015 ISY-2004-Y-240
H2 need for external traffic: 10-15 tonnes per day (2 HRS)			
Lappeenranta, UPM	250-300 truck visits per day	Reach stackers, trucks	ISY-2004-Y-71 ESAVI/167/04.08/2011
Lappeenranta, Nordkalk	45 truck visits per day	200 loads	ESAVI/3/04.08/2014
Lappeenranta, Fazer makeiset	20 truck visits per day		LPR/365/11.01.00.00/2018
Lappeenranta, Kaukaan voima	50 truck visits per day		ISY-2006-Y-241
H2 need for external traffic: 15-20 tonnes per day (2-4 HRS)			
Kouvola (Inkeroinen), Stora Enso	100 truck visits per day	572 m3 diesel per year	Dnro ESAVI/8648/2016 Dnro ESAVI/2466/2016
H2 need for external traffic: less than 5 tonnes per day			
Kouvola, UPM Kymin tehtaat	100-200 truck visits per day		ESAVI/1834/2016
Kouvola, Solvay Chemicals	20 truck visits per day		ESAVI/9201/2014
Kouvola, Road and railway terminal (RRT)[13]	Not known (total volume 250,000 TEU containers)		
H2 need for external traffic: 5-10 tonnes per day (2-3 HRS)			

Site / City	External truck visits	Internal	Environmental permit Dnro or other reference
Hamina, Hamina port	230 trucks per day		ESAVI/289/04.08/2013
Hamina, Fintoil	15 trucks per day		ESAVI/13144/2020
H2 need for external traffic: 5-10 tonnes per day (1 HRS)			
Kotka smaller ports (Hietanen, Kantasatama, Sunila and ja Halla)	Total 800 trucks per day		ESAVI/290/04.08/2013
Kotka Mussalo ports	1200 trucks per day	TBD	ESAVI/288/04.08/2013
Kotka Kotkamills	280		ESAVI/10733/2015
Kotka Stora Enso	110-140		ESAVI/846/2016
H2 need for external traffic: 40-80 tonnes per day (2-8 HRS)			

https://www.nordicinnovation.org/programs/next-wave-next-nordic-green-transport-wave-large-vehicles

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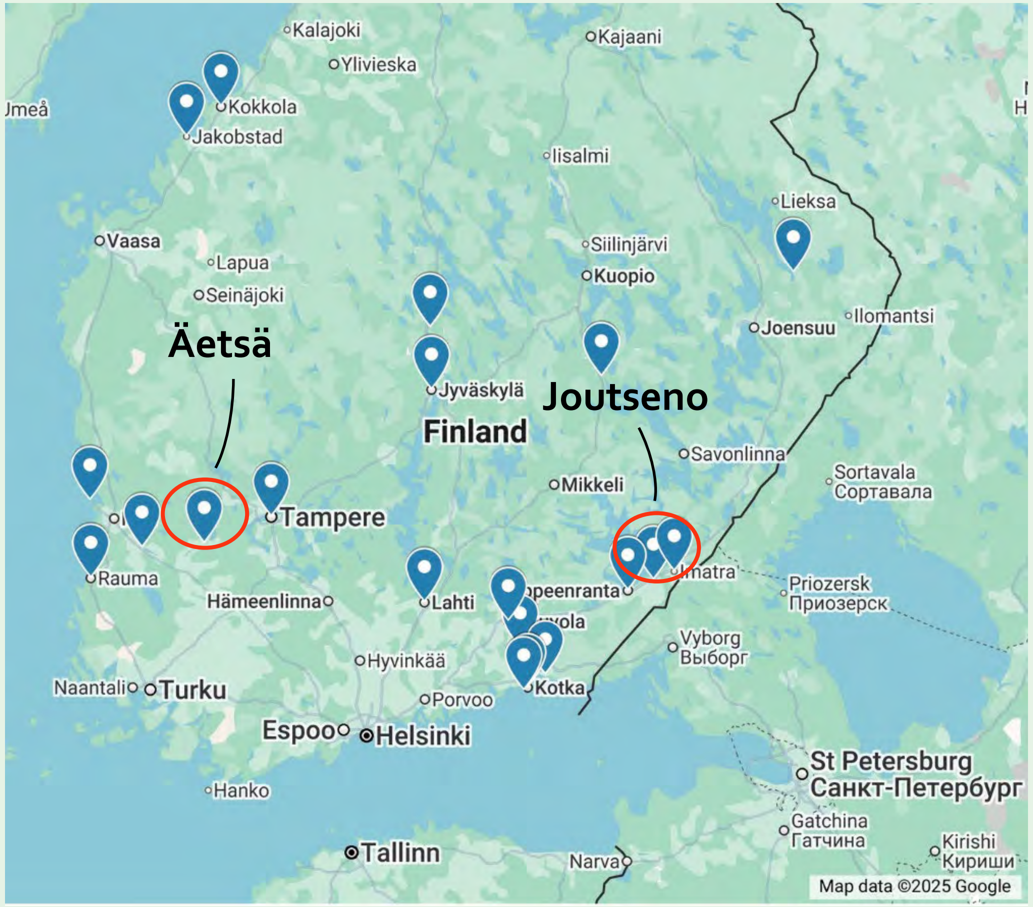
Nordic Hydrogen Valleys as Energy Hubs

Background of Case study 1

— By-product hydrogen in Finland (~20 000 t/a) is mostly vented or used in heat production[1]

- By-product H2 from chlor-alkali and sodium chlorate production
- Case study 1 focuses on two locations with available by-product hydrogen: Äetsä and Joutseno

— The synergies with heavy duty transport and industrial hot spots with available by-product hydrogen could allow cost-efficient utilisation of hydrogen in transport



Methods

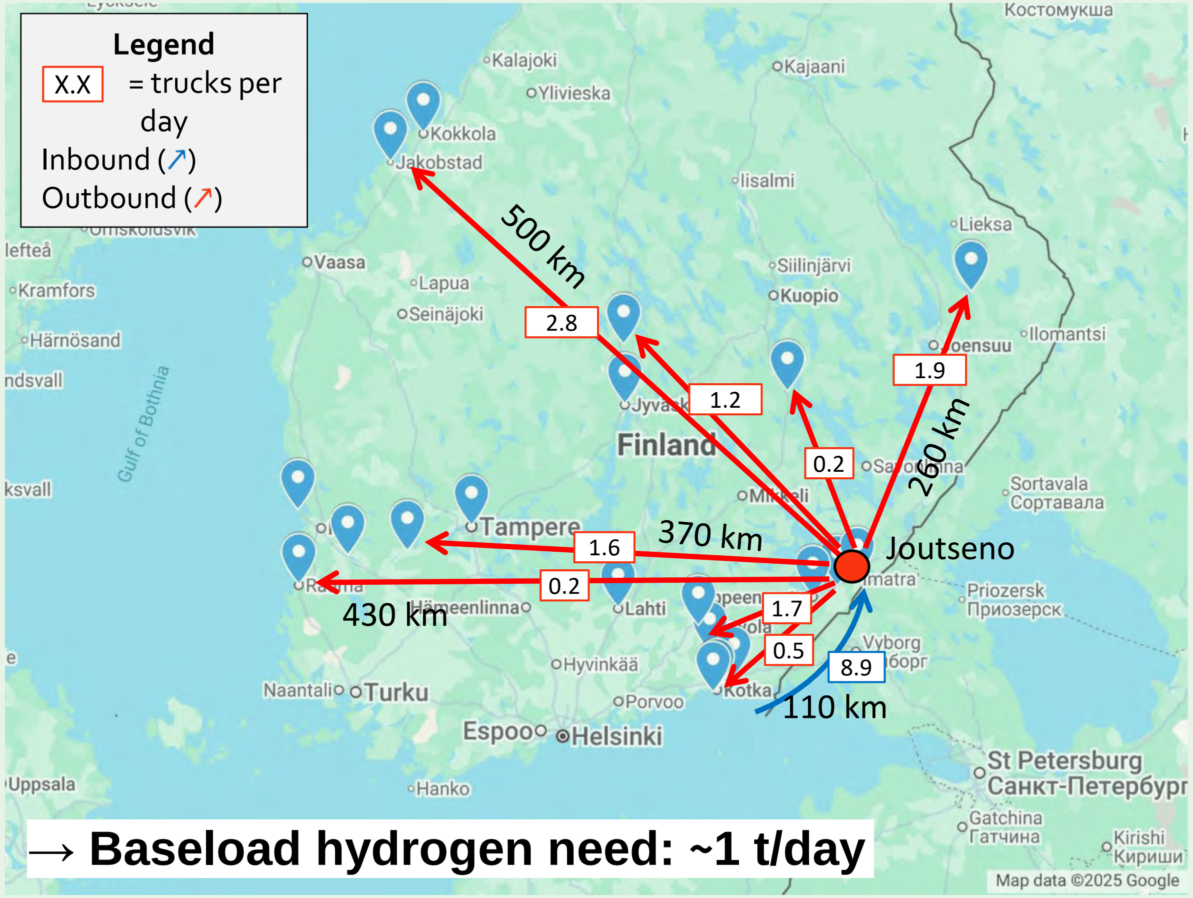
— Analysis of heavy duty transport data from two Kemira locations with by-product hydrogen production: Äetsä and Joutseno. Estimate of H2 baseload for trucks.

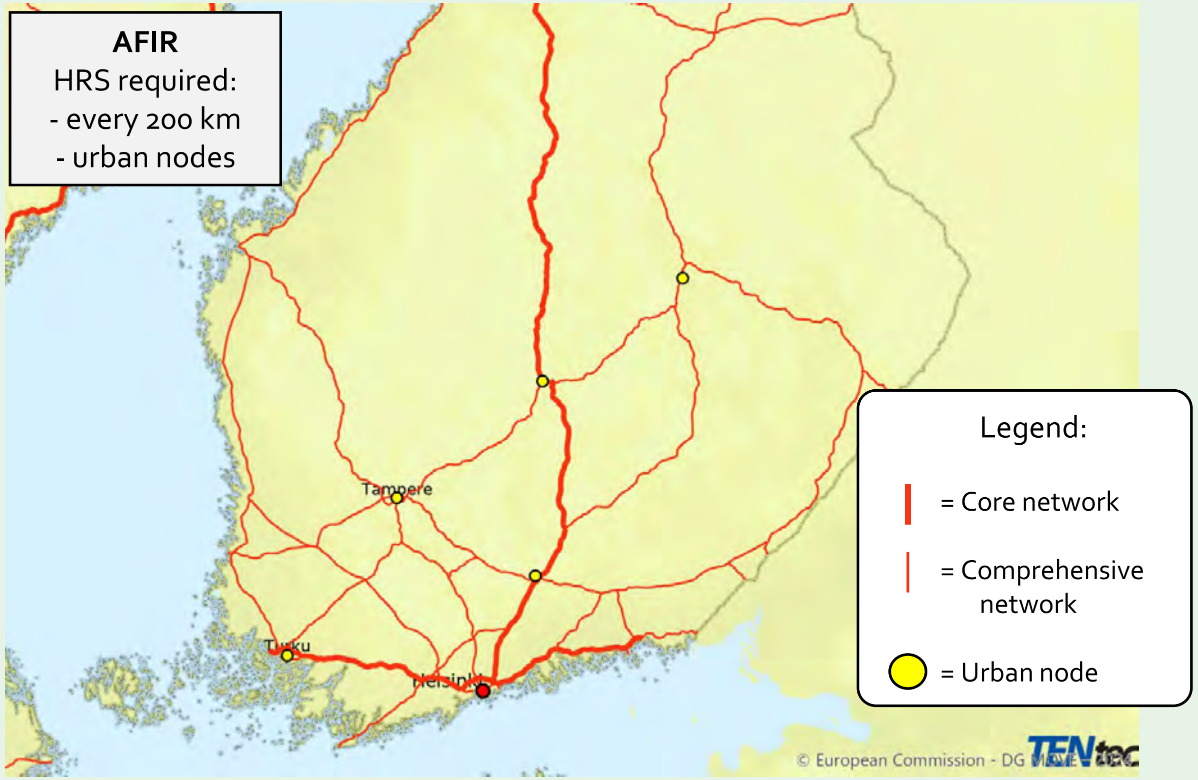
— Identification of hot spots and synergies incl. hydrogen production & consumption sites, industrial hubs and ports, and AFIR HRS locations and routes.

1. https://www.nordicinnovation.org/2021/next-wave-available-product-hydrogen-nordic-countries

Joutseno: Material flow + TEN-T network

Inbound (↗)+ outbound (↗) trucks TEN-T network





https://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/map/maps.html

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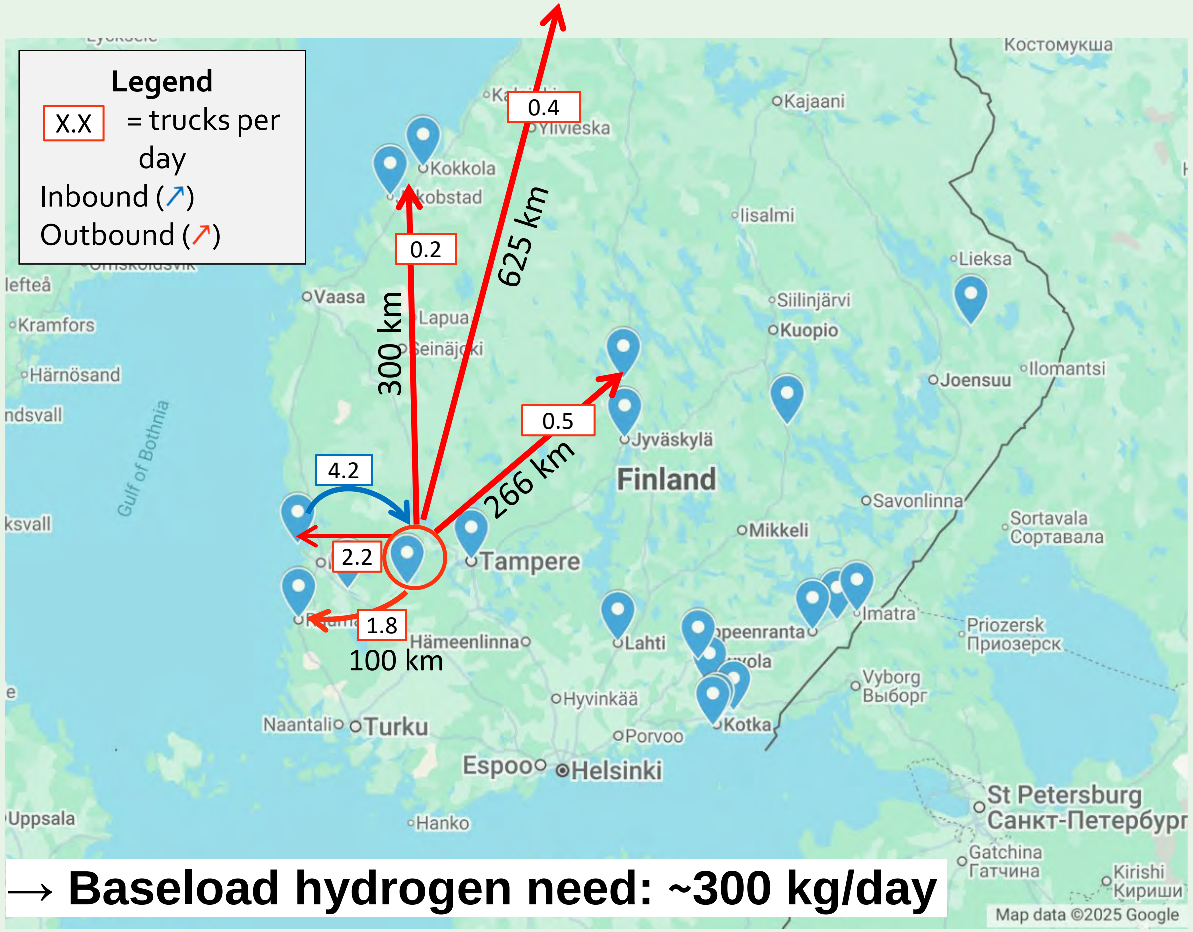
Nordic Hydrogen Valleys as Energy Hubs

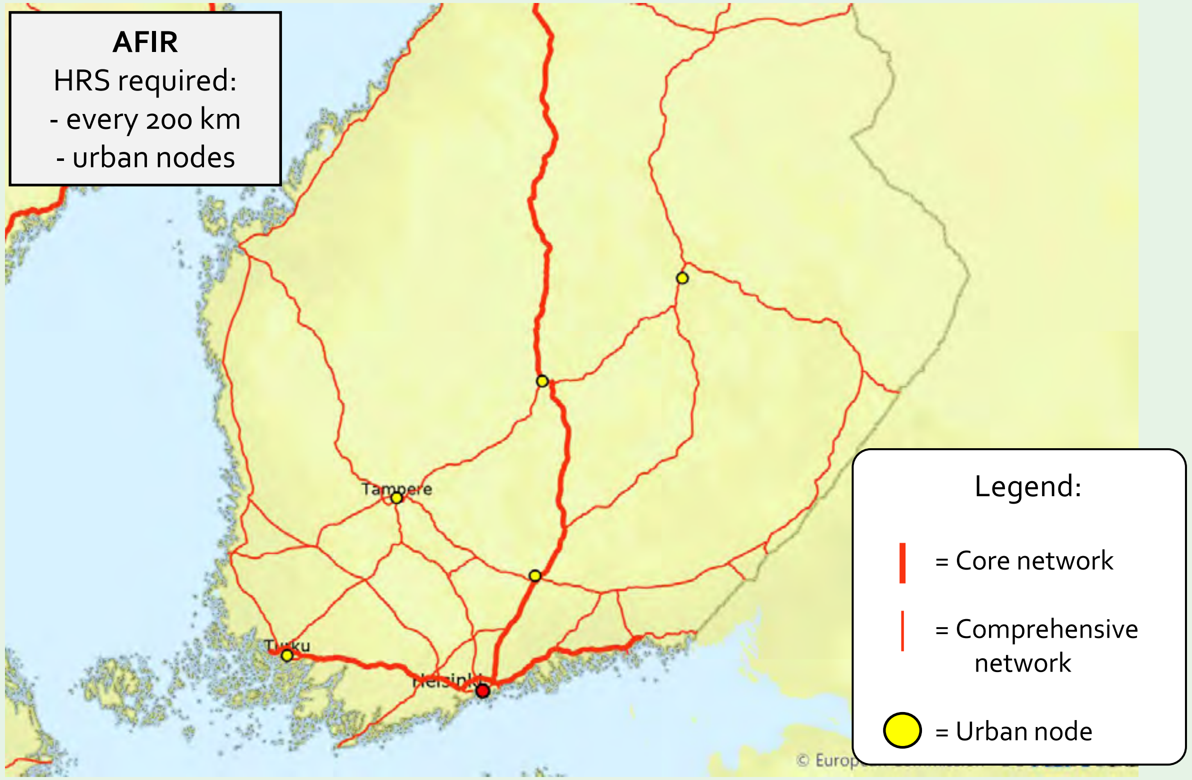
Äetsä: Material flow + TEN-T network

Inbound (↗)+ outbound (↗) trucks



→ Baseload hydrogen need: ~300 kg/day

TEN-T network



https://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/map/maps.html

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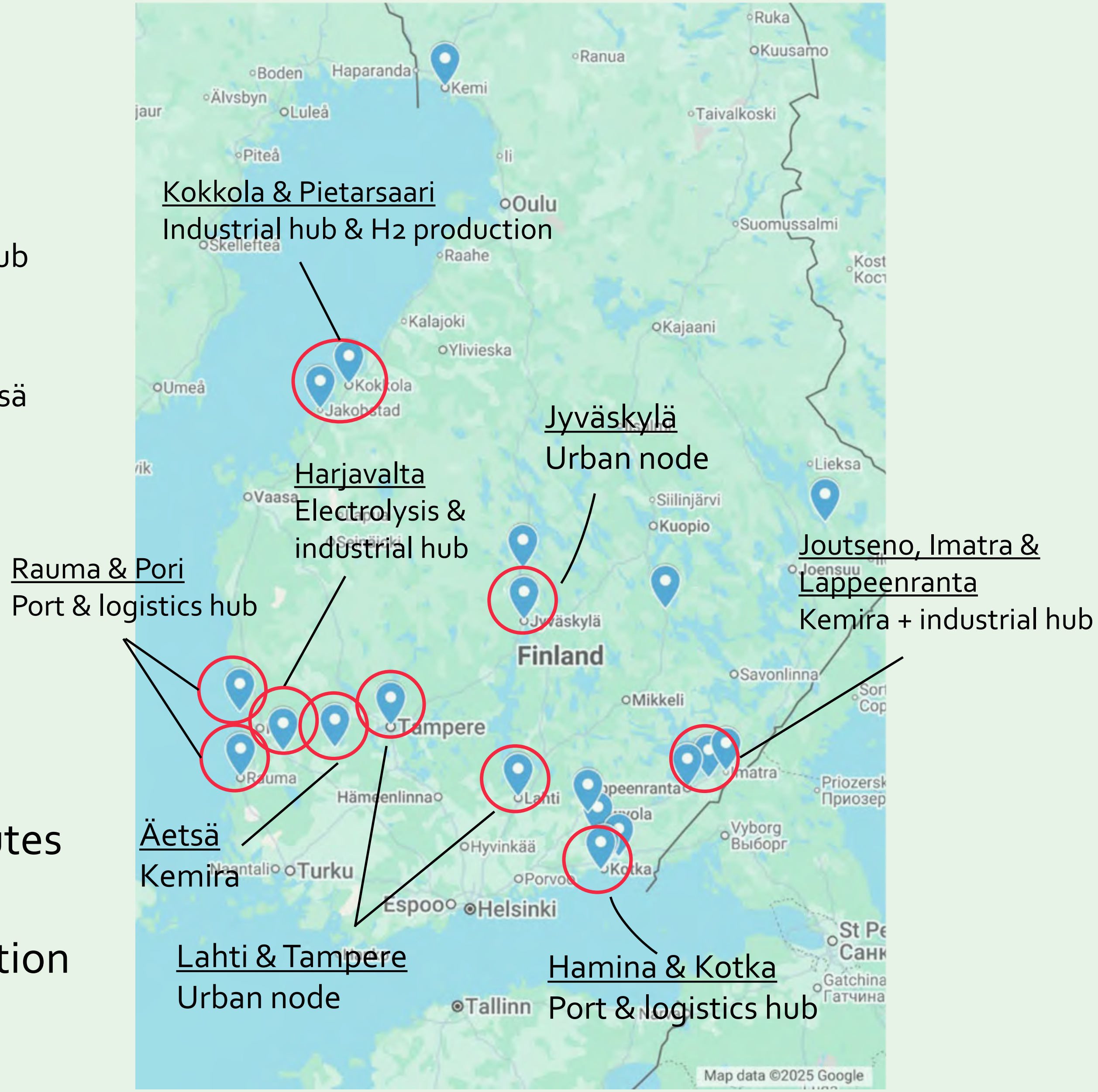
Nordic Hydrogen Valleys as Energy Hubs

Results of Case study 1

Identified hot spots

- Lappeenranta-area
  - Kemira location in Joutseno (by-product H_2) & industrial hub
- Hamina/Kotka & Rauma/Pori
  - Port & logistics hub
  - A large material flow coming from ports to Joutseno & Äetsä
- Lahti, Jyväskylä & Tampere
  - Urban nodes – HRS required because of AFIR
  - Ideal locations for a refuelling stop
- Harjavalta & Kokkola/Pietarsaari
  - H_2 production – ideal locations for HRS



Main takeaways

— Synergies identified between industrial and logistics hubs, H_2 production, and trucking routes

— The work has provided a good base for future collaborations and understanding of H_2 utilisation within the transport sector in Finland

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Nordic Hydrogen Valleys as Energy Hubs

Case study 2: Mid-Sweden Hydrogen Valley

- Regional case focusing on hydrogen as a system solution, not a single technology

- Covers industry, transport and infrastructure in Central Sweden

Why Mid-Sweden is an interesting hydrogen case

- Strong presence of energy-intensive industry
- Long transport distances and heavy-duty transport needs
- Both near-term hydrogen users and long-term hydrogen ambitions
- Active regional collaboration under the Mid-Sweden Hydrogen Valley initiative

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Nordic Hydrogen Valleys as Energy Hubs

1. https://www.nordicinnovation.org/2021/next-wave-available-product-hydrogen-nordic-countries

Case study 2: Mid-Sweden Hydrogen Valley

What does the case illustrate?

- Hydrogen can already be used in **industrial processes today**
- Transport applications are emerging, but depend on:
  - Vehicle availability
  - Refueling infrastructure
  - Hydrogen supply and cost
- Different actors operate on different time horizons
  - Industry: near-term
  - Transport: early scaling
  - Infrastructure: medium to long-term

Key lessons from the Mid-Sweden case

- Hydrogen valleys are primarily coordination challenges, not technical ones
- Early industrial anchors are critical to build experience and confidence
- Front-running transport operators can move faster than vehicle manufacturers
- Local availability of hydrogen strongly affects feasibility

Overall message:

Hydrogen works best when industry, transport and infrastructure develop together.

1. https://www.nordicinnovation.org/2021/next-wave-available-product-hydrogen-nordic-countries

Case study 2: Mid-Sweden Hydrogen Valley

Why this case matters beyond Mid-Sweden

- Challenges observed are common across the Nordics:
  - high costs
  - evolving infrastructure
  - coordination across sectors

The case highlights that hydrogen deployment depends on:
timing, actor readiness, and local conditions, not only technology

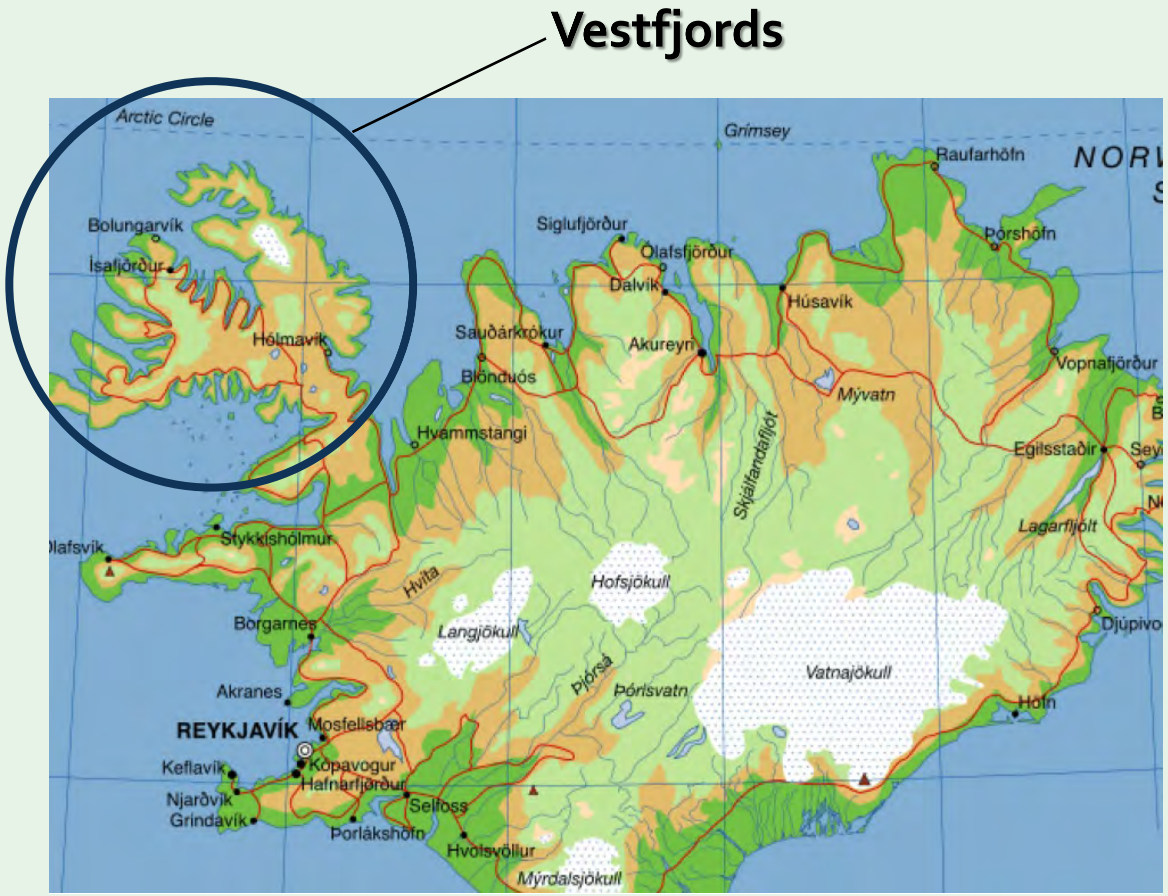
Similar conditions exist in many regions with:
Energy-intensive industry
- Long transport distances
- Constraints on electrification

Key takeaway
Mid-Sweden illustrates system-level challenges relevant for hydrogen valleys throughout the Nordics.

1. https://www.nordicinnovation.org/2021/next-wave-available-product-hydrogen-nordic-countries

Case study 3: Locked-in energy in Iceland

- Investigates on-site hydrogen production via electrolysis using stranded hydropower energy
- Setting is Vestfjords which is the key region for salmon farming, but has weak grid
- Can hydrogen contribute towards the economic feasibility of stranded energy by utilizing it for maritime and/or land transport
- In this case the specific interest is if usage of other resources from H2 production can also be used, i.e. heat and oxygen
- Fish farms need all, i.e. heat, oxygen, truck service, boat service and direct electric connection



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Nordic Hydrogen Valleys as Energy Hubs

1. https://www.nordicinnovation.org/2021/next-wave-available-product-hydrogen-nordic-countries

Case study 3: Key parameters

- The beautiful picture is that if a small hydro potential (5-20 MW) is available near main road and the coast the benefit could be:

- No or little transport cost of electricity
- Very cheap oxygen for the on land fish farm
- No or little transport of H_2 for the main truck route to the Vestfjords
- No or little transport of H_2 for aqua fram service boats
- Very little environmental impact due to electric grid
- Drastic reduction in trucking fuel to the Vestfjords, saving infrastructure, cost and fuel

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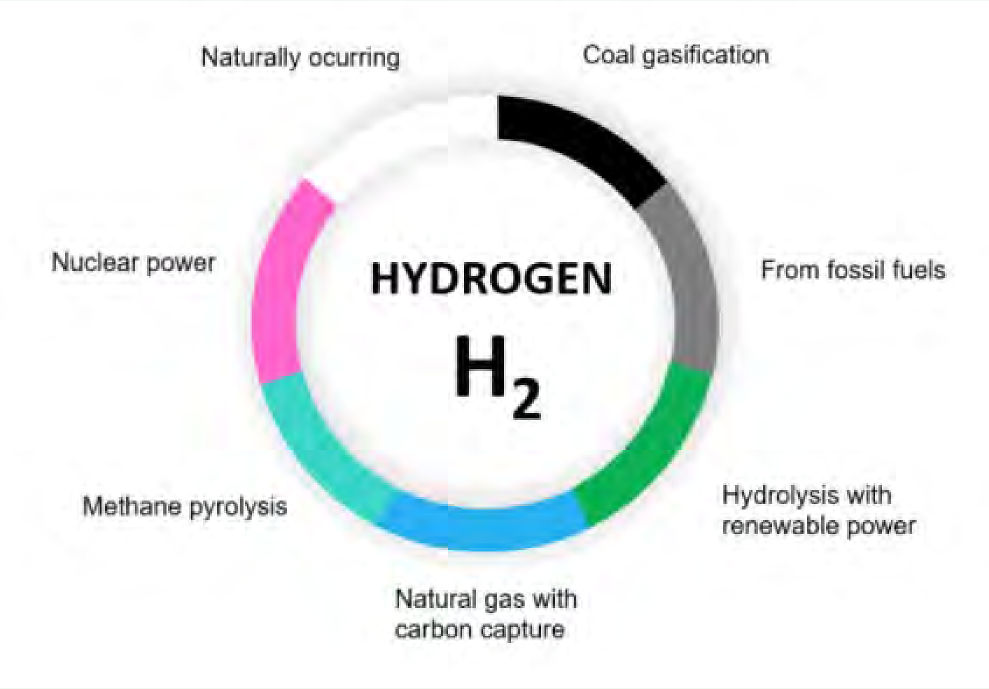
Nordic Hydrogen Valleys as Energy Hubs

1. https://www.nordicinnovation.org/2021/next-wave-available-product-hydrogen-nordic-countries

Case study 3: Main focus

- Investigate on-site hydrogen production via electrolysis using stranded hydropower energy
- Determine optimal electrolyzer system size
- Evaluate Levelized Cost of Hydrogen (LCOH) under local operating conditions
- Assess potential for oxygen and low-grade heat recovery in salmon hatcheries



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Nordic Hydrogen Valleys as Energy Hubs

1. https://www.nordicinnovation.org/2021/next-wave-available-product-hydrogen-nordic-countries

Case study 4: H2 in road transport

Objectives:

Investigate ongoing and necessary H_2 deployment for **HD transport** along the Oslo-Germany stretch of the Scandinavian-Mediterranean TEN-T network corridor:

- H_2 demand
- Infrastructure demand
- Cross-sectorial interactions

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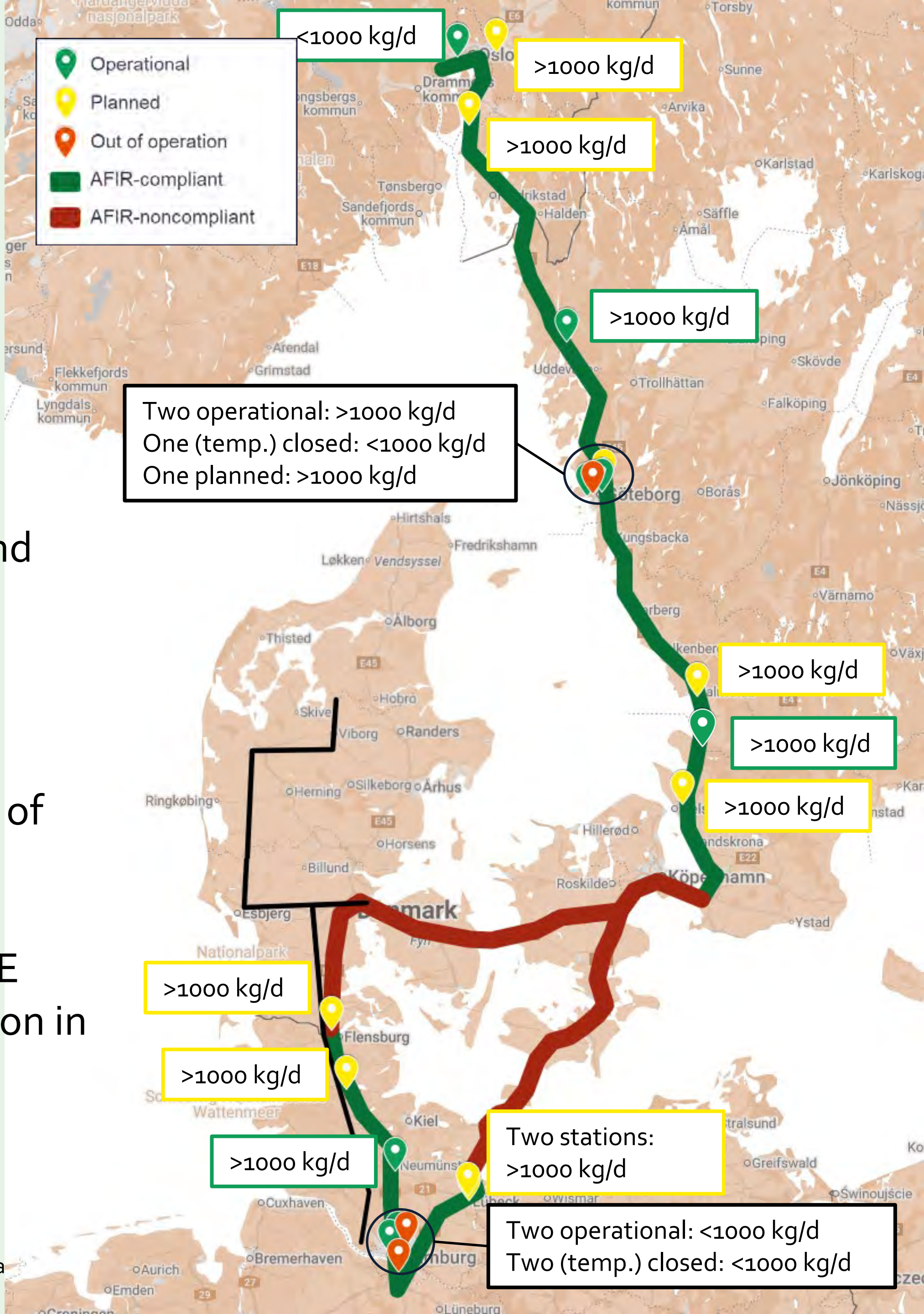
Nordic Hydrogen Valleys as Energy Hubs

1. https://www.nordicinnovation.org/202

Case study 4: H2 in road transport

H2 station roll-out (as of fall 2025)

- 25 existing or planned stations along the studied route
- In NO, SE and GE, existing+planned stations have sufficient capacity and frequency to fulfill AFIR requirements **if** built
- In DK at least two additional 1000 kg/day stations are required
- At 30% capacity utilization, existing+planned stations can cover ca 1 % of the energy demand for transport along the route
- Synergies: Large number of hydrogen production projects in DK and GE could potentially supply hydrogen to stations. More challenging situation in SE, with important production projects cancelled or put on-hold.



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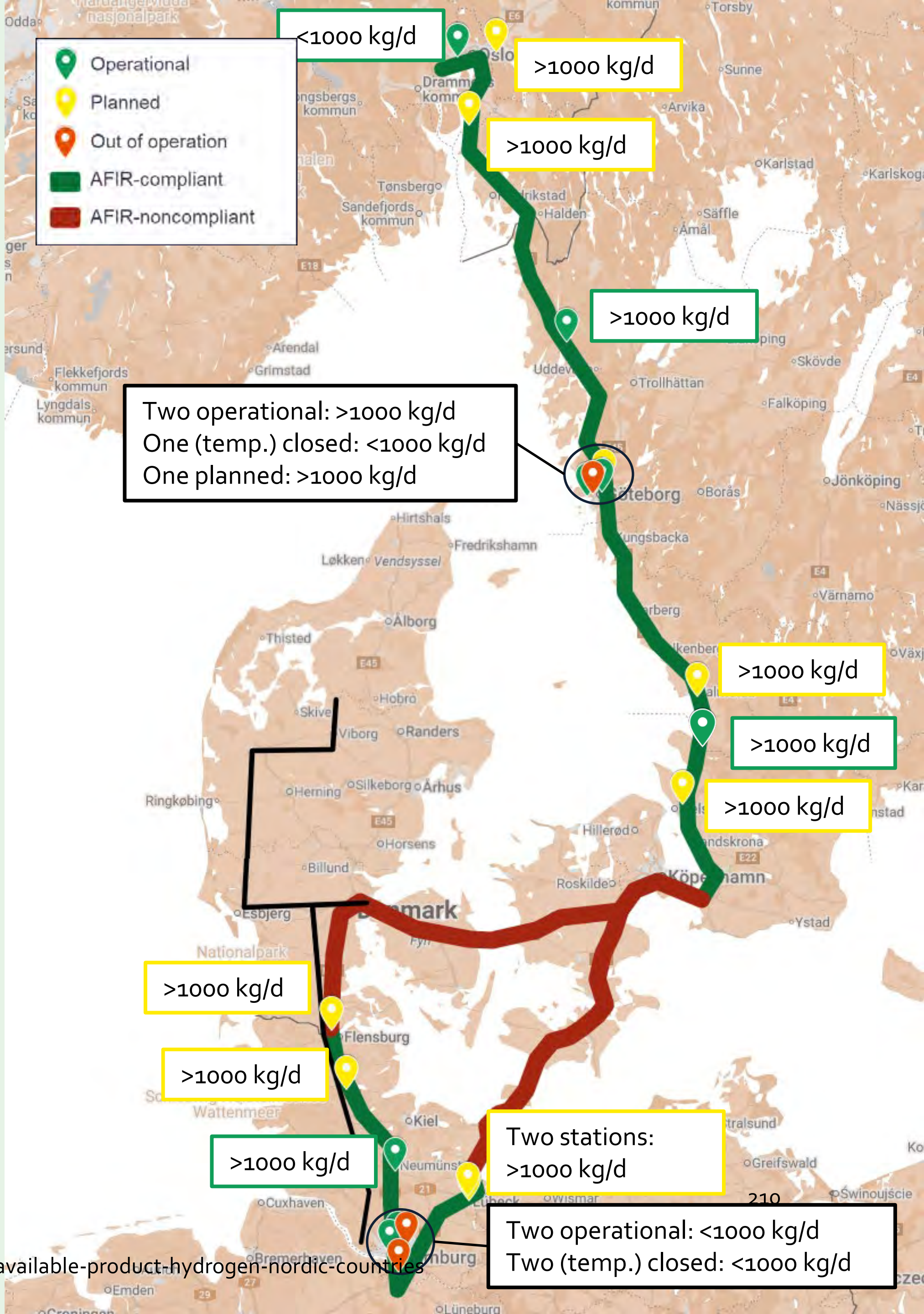
1. https://www.nordicinnovation.org/2021/next-wave-a

Case study 4: H2 in road transport

Important developments since 2023 (start of project)

- Shift from smaller (hundreds kg/day) to larger stations (thousands kg/day) and from passenger cars to heavy-duty transport
- All stations >1000 kg/d were inaugurated in 2023 or later
- Nilsson Energy became "Hydri" in 2024 and is now operating 10 stations in Sweden (11 more in pipeline)
- Vireon was founded by Norwegian Hydrogen in 2023 and has 18 stations under development in Norway, Finland and Denmark
- .



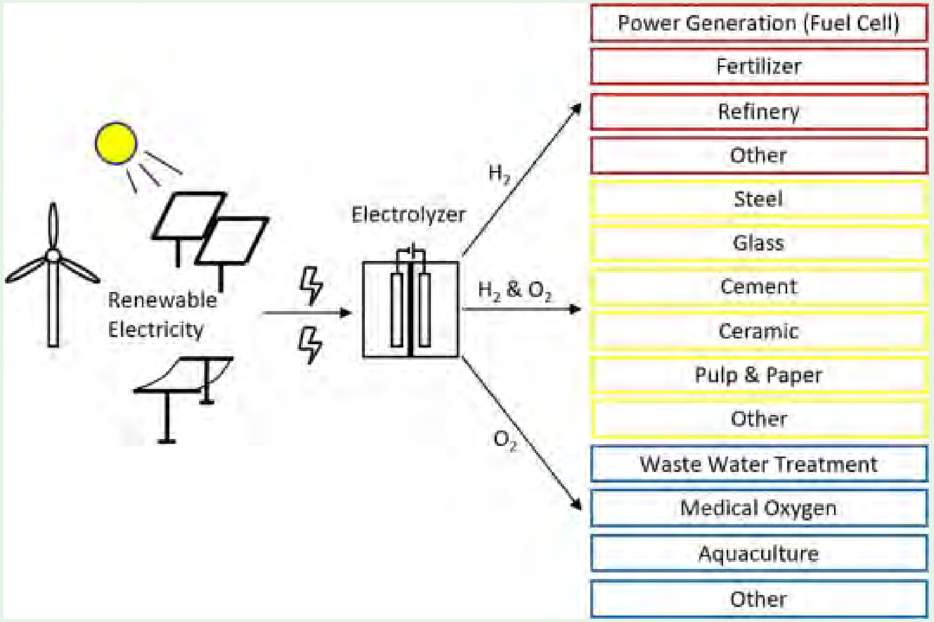
1. https://www.nordicinnovation.org/2021/next-wave-available-product-hydrogen-nordic-countries

Case 5 – Part 1: Oxygen by-product

- **Project partners involved**:
  - SINTEF, Norwegian Hydrogen and Greenstat, (Ovako)

- **Problem statement**:
  - By-product oxygen from electrolysis is typically released to the environment
  - Too expensive to compress, bottle and transport the oxygen -> offtake onsite or close (piping) is often the only feasible solution
  - Output from electrolyser can be too inconsistent to rely on

- **Objective**:
  - *Provide guidance for when the utilization of by-product oxygen from electrolysis is worth it (environmental impact/cost).*
  - Outcome: Report on background/overview, abalysis of one case: why it works/challenges, description of the crucial parameters



F. Eckl, A. Moita, R. Castro, and R. C. Neto, 'Valorization of the by-product oxygen from green hydrogen production', *Applied Energy*, vol. 378, Jan. 2025, doi: 10.1016/j.apenergy.2024.124817

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Nordic Hydrogen Valleys as Energy Hubs

Crucial parameters

- Consider by-products as products during planning
- Distance: Key cutoff parameter
- Technical parameters: liquification, compressors vs movers, piping, existing infrastructure
- Continuous dependency: supplementary vs main source
- Purity and pressure requirements
- Individual from case to case

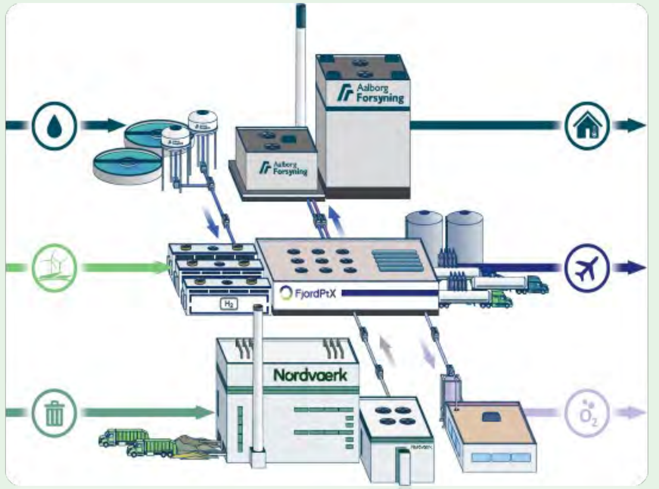
Photos: Ovako

Case Study 5 - Part 2: Heat by-product

- **Project partners involved:** Aalborg Forsyning (Aalborg Varme A/S)
- **Problem Statement:** Hydrogen production generates substantial amounts of by-product heat which, if not adequately utilized, represents a significant lost opportunity for reducing emissions, improving energy efficiency, and lowering system costs; integrating this heat into district heating systems offers a clear pathway for realizing cross-sectoral synergies.
- **Objective:** Assess the techno-economic feasibility of integrating excess heat from large-scale hydrogen production (FjordPtX) into the Aalborg DH system – to increase system efficiency, reduce emissions and costs for the DH utility, and provide an additional revenue stream for the hydrogen producer.

Photo: FjordPtX (Friis og Moltke)

Case Study 5 - Part 2: Heat by-product



- **Method:** Four stepwise parts:
    1. mapping of District Heating system and PtX facility,
    2. identification of integration options (direct use, electric boiler, heat pump)
    3. scenario modelling against a 2030+ baseline,
    4. synthesis of key indicators (excess-heat utilization rate, DH demand share, system COP, annual system cost).
- **Case study results:**
    - Up to ~800,000 MWh/year of excess heat potentially available (≈ 40,000 Danish households)
    - Heat-pump boosting: 49% utilization, 22% of DH demand, ~11% savings, system COP ~8.3
    - Electric-boiler boosting: 23% utilization, 15% of DH demand, ~9% savings, system COP ~2.2
    - Direct shunt only: 6% utilization, 2% of DH demand, ~2% savings
    - Benefits grow significantly with lower supply temperatures
    - Early and joint planning between hydrogen producer and DH utility is essential to realize the potential

This project is part of the

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Nordic Energy Research

Nordic Hydrogen Valleys as Energy Hubs

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