

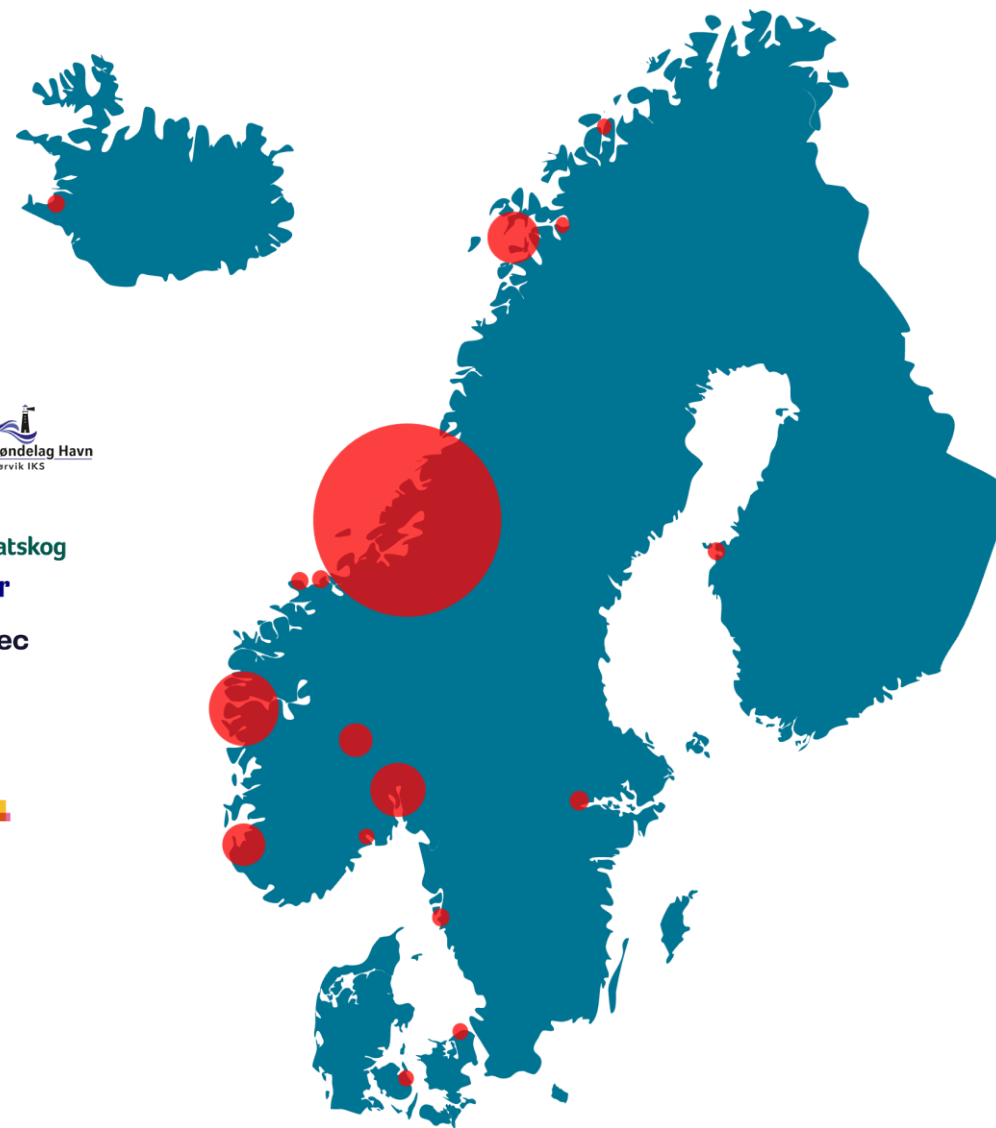


RENERGY
Norwegian Renewable Energy Cluster

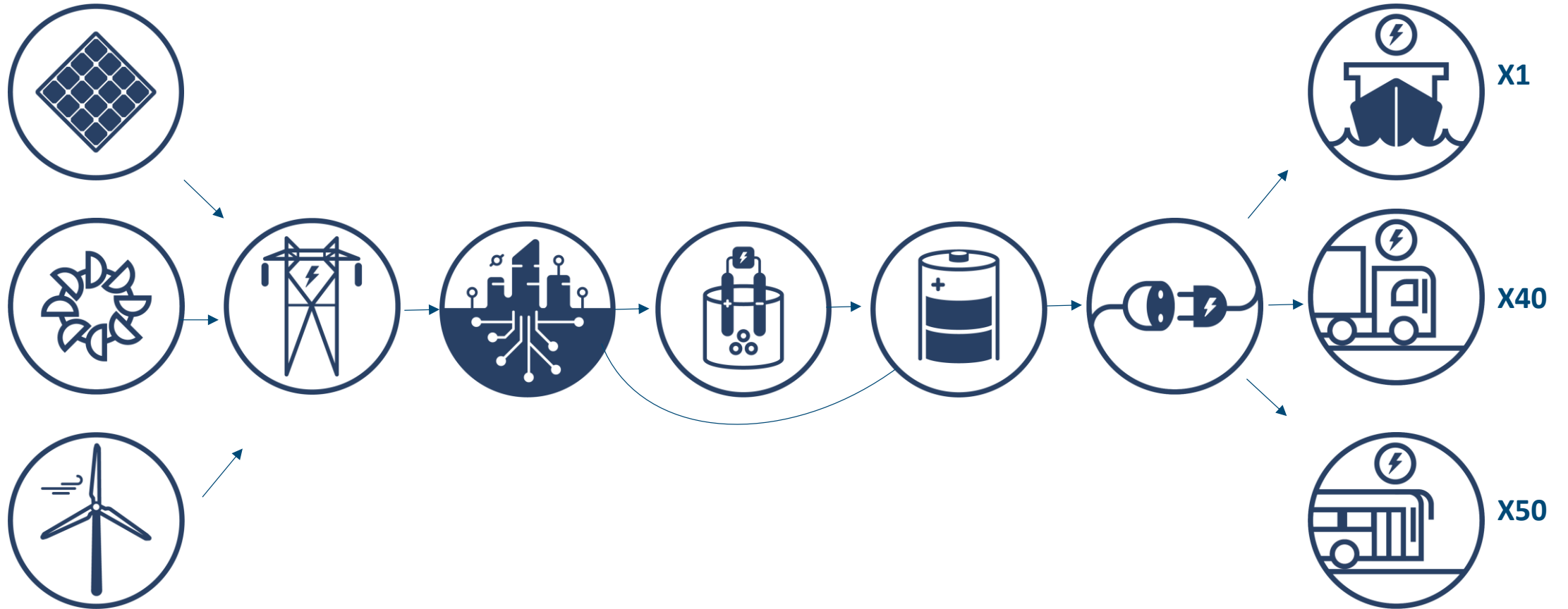


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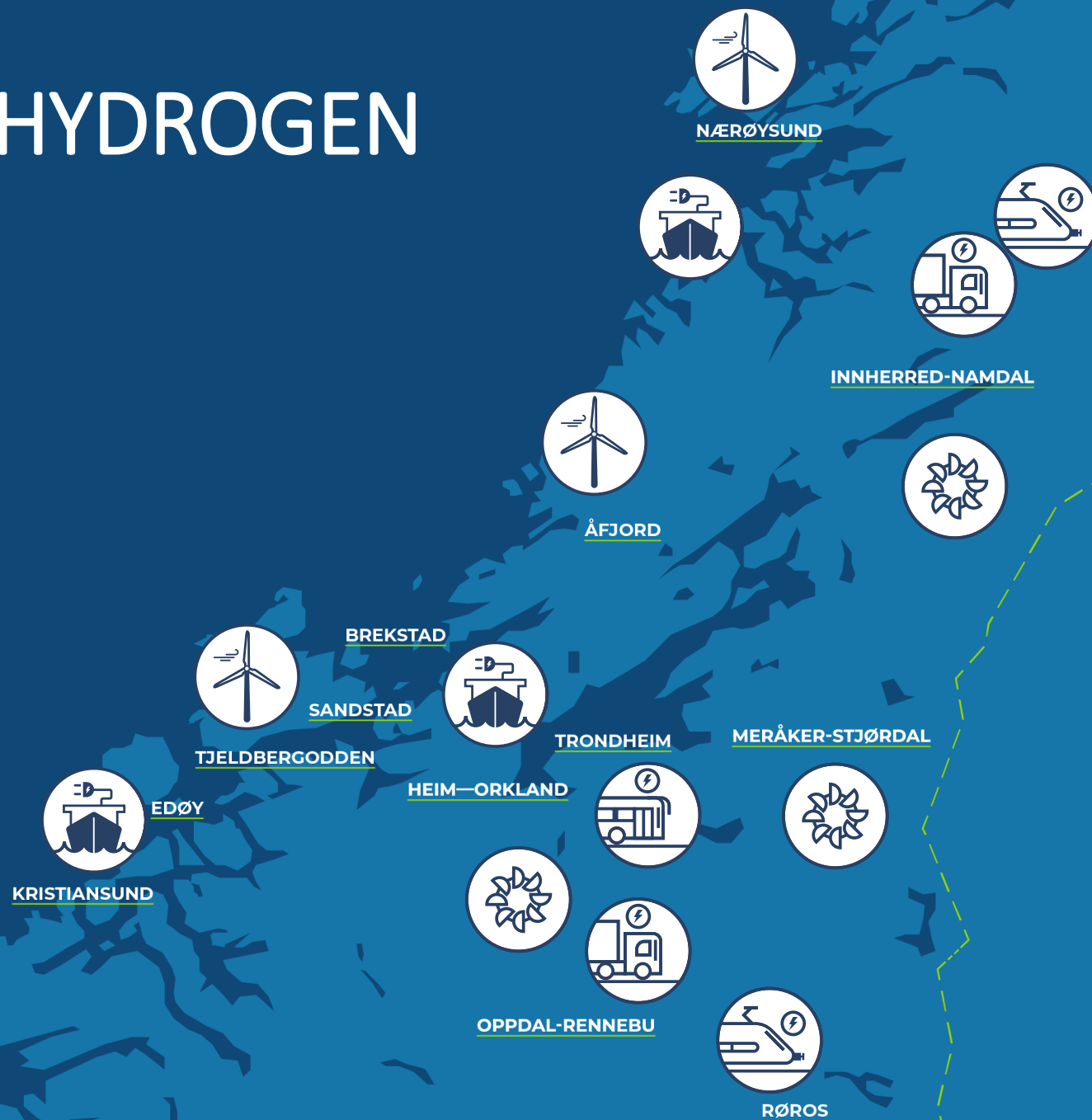
The Norwegian Renewable Energy Cluster RENERGY gathers over 100 businesses and organisations from the entire energy value chain



THE ENERGY VALUE CHAIN

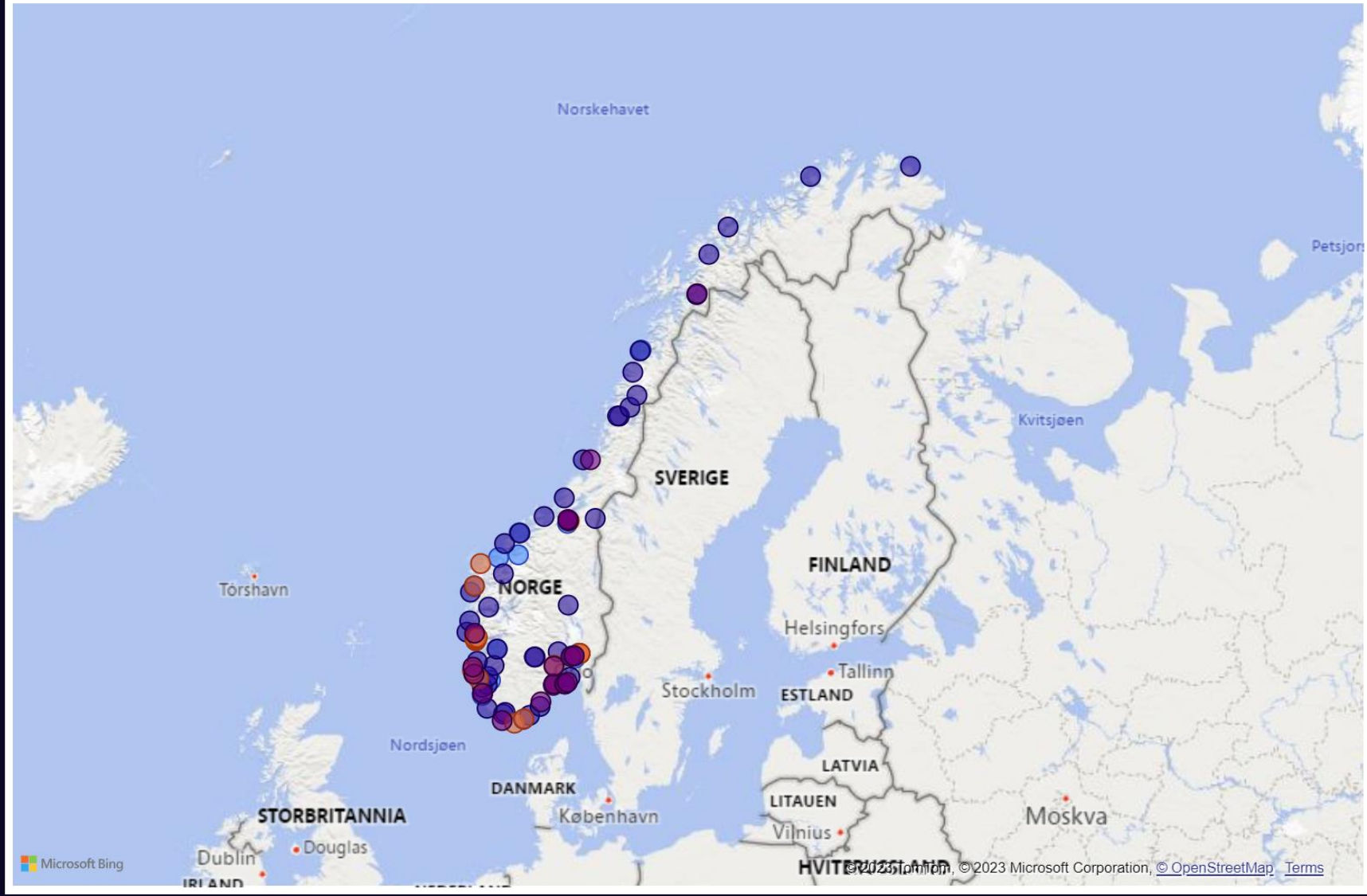


ROADMAP FOR HYDROGEN



The Norwegian Hydrogen Landscape

Project Type ● Consumption ● Production ● R&D ● Technology



Coordinates are only illustrative and do not necessarily reflect the exact location of the project



 1 express boat operative from 2028	 1 service vessel operative from 2023
 2 container ships under planning	 8 service vessels under planning

RØRVIK

H2 PRODUCTION | H2 STORAGE | H2 DISTRIBUTION
 One service vessel and H2 infrastructure for bunkering under construction. Operative from 2023
 Investment: €6 million | **Production: 0,5 T/day**

H2 PRODUCTION | H2 STORAGE | H2 DISTRIBUTION
 Funding approved. Full-scale production, storage and distribution for mobility. Operative from 2025
 Investment: €30+ million | **Production: 8 T/day**

H2 PRODUCTION | H2 DISTRIBUTION
 Four heavy-duty trucks, warehouse forklifts and fuel station. Operative from 2020
 Investment: €9 million | **Production: 0,3 T/day**

H2 R&D FME HYDROGENi and LAB FACILITY (SINTEF & NTNU)
 Research and development
 Norwegian Fuel Cell and Hydrogen Centre

HITRA

 3 bulk carriers under planning	 4 service vessels under planning
 1 express boat operative from 2026	

TRONDHEIM

 1 express boat operative from 2026	 4 trucks operative from 2020
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MERÅKER

H2 PRODUCTION
 Joint initiative
 Ambitions for operation from 2026
 Investment: N/A | **Production: N/A**

H2 PRODUCTION | H2 STORAGE | H2 DISTRIBUTION
 Funding approved. Full-scale production, storage and distribution for mobility. Operative from 2025
 Investment: €30+ million | **Production: 6 T/day**

H2 PRODUCTION | INDUSTRIAL
 Methanol production. H2 use in methanol process 15-30 t/day. Working on a development plan which might facilitate for large export of blue and/or green H2 or H2 derivatives.
 Investment: €x million | **Production: 15-30 T/day ++**

Large process-Industry

Large process-Industry



3 OUT OF 16 SHIPS ON FID

Hydrogen

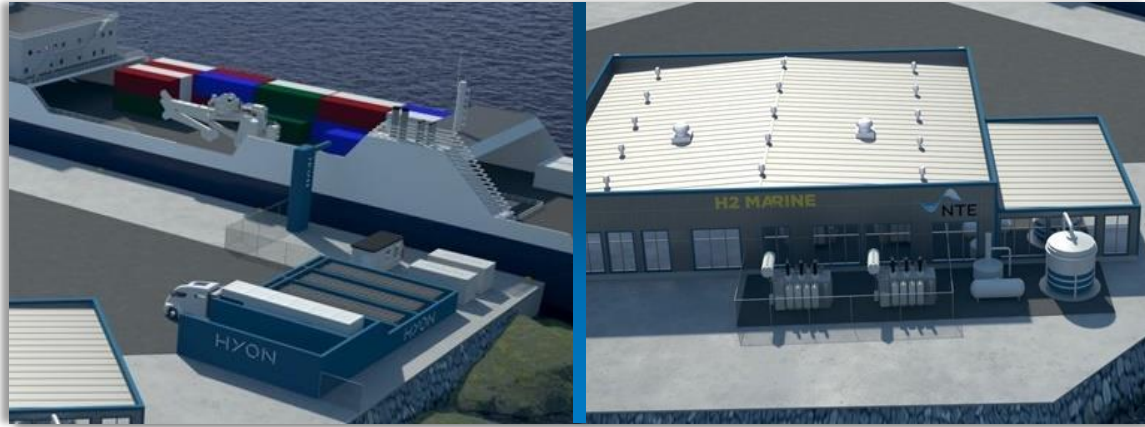
- Loran C – Tråler – stoppet
- Topeka – 2 x RoRo-skip
- Egil Ulvan Rederi – 3 x bulkskip
- Thor Dahl – 1 x bulkskip
- Samskip – 2 x containerskip
- Moen Marin - Salmar – 1 x katamaran


Ammoniakk

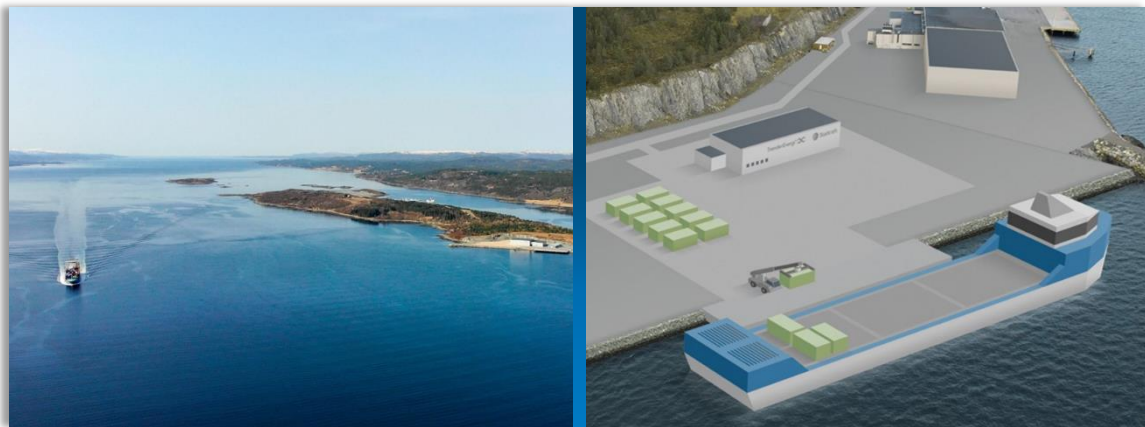
- Færder Tankers – 2 x LR 2 tankskip
- Færder Tankers – 2 x bilskip
- Skarv Shipping Solutions – 3 x bulkskip



NATIONAL HYDROGEN HUBS




NTE
H2 MARINE
ENOVA



ANEO
ENOVA



4 H2 TRUCKS IN OPERATION

Key points:

- Norwegian wholesaler ASKO and Scania have put in operation four hydrogen trucks with electric driveline in Trondheim, Norway.
- Four trucks have been in operation for two years.
- The next (commercial) versions from Scania is ordered.



Hydrogen vessel and bunkering system

Hydrogen infrastructure doesn't have to be expensive!

H2 Marine and NTE's innovative solution includes

- As few components as possible
- Approx. 15–20 % lower CAPEX
- Lower OPEX; approx. 5 % lower power consumption
- Mobile combined storage and bunkering unit
- Flexible and scalable



MORE THAN A POWER POINT

- Pilot vessel under construction



- Pilot innovative bunkering system in operation



Some R&D challenges that must be solved

- We are building a new energy system, and a new market for new fuels
- The carrier of the energycarrier – Storage on land, on board
- Bunkering systems
- Safety, standards and regulations
- Logistics and transport of the fuel
- Public acceptance of the cost of the energy transition

CONTACT



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