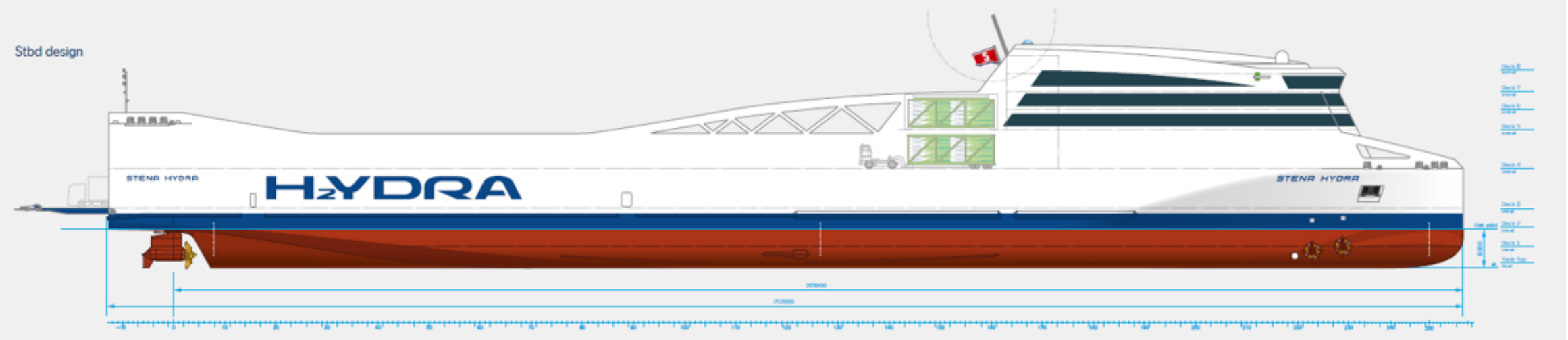
Julia Hansson and Karl Jiven
Swedish Environmental Research Institute

The HOPE project



HOPE - Hydrogen fuel cells solutions in shipping in relation to other low carbon options – a Nordic perspective

Julia Hansson and Karl Jivén, IVL

ivl SVENSKA MILJÖINSTITUTET

HOPE - analyzing the potential role of marine hydrogen fuel cells solutions for regional shipping in the Nordic region

HOPE outlines and evaluates a concept design for a short sea shipping vessel using hydrogen and fuel cells for propulsion…

…including technical and cost aspects, barriers/drivers for and environmental impact of realization in the Nordics.

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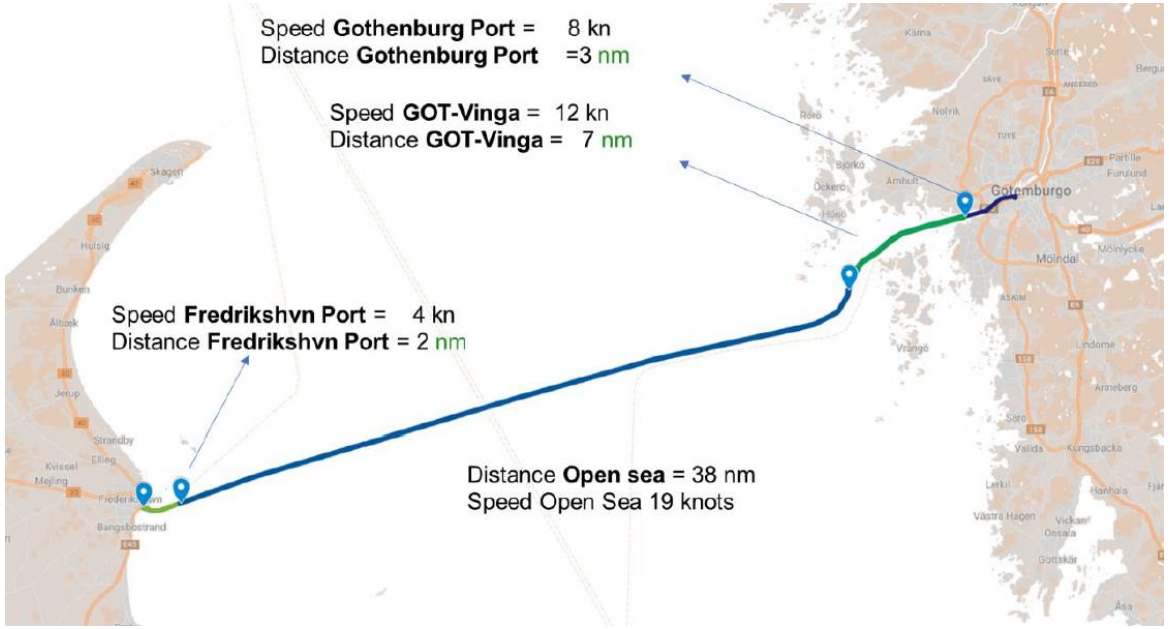
Funded by Nordic Energy Research, Danish EUDP, Business Finland, Swedish Transport Administration, Norwegian Research Council, Icelandic Research Center and in-kind from participating companies

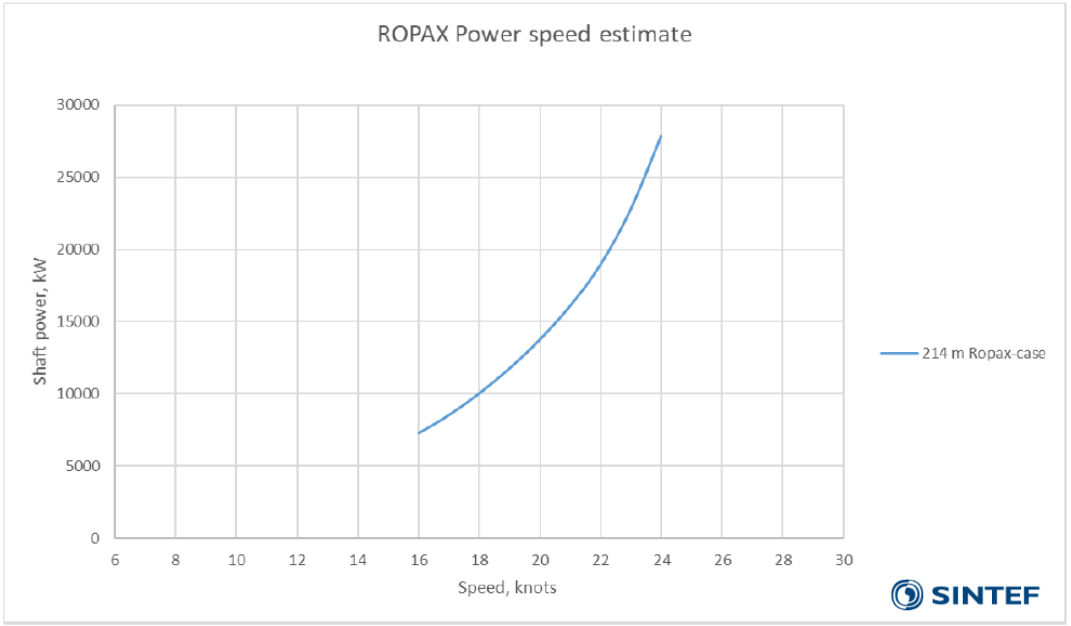
What we have done:

- Technology options
- Concept design
- Models and assessment of concept design/strategy
- Scenario and impact analysis
  (Scenarios for and assessment of emission impact from potential uptake in Nordic fleet, cost-effectiveness of fuels)
- Policy and drivers/barriers for change in the Nordic maritime sector

Find our publications and more info at:
https://www.nordicenergy.org/project/hope/

Gothenburg (SE)-Fredrikshavn (DK) route





- Route data based on present RoPax service
- Route modeling by SINTEF
- Initial vessel design by Stena Teknik

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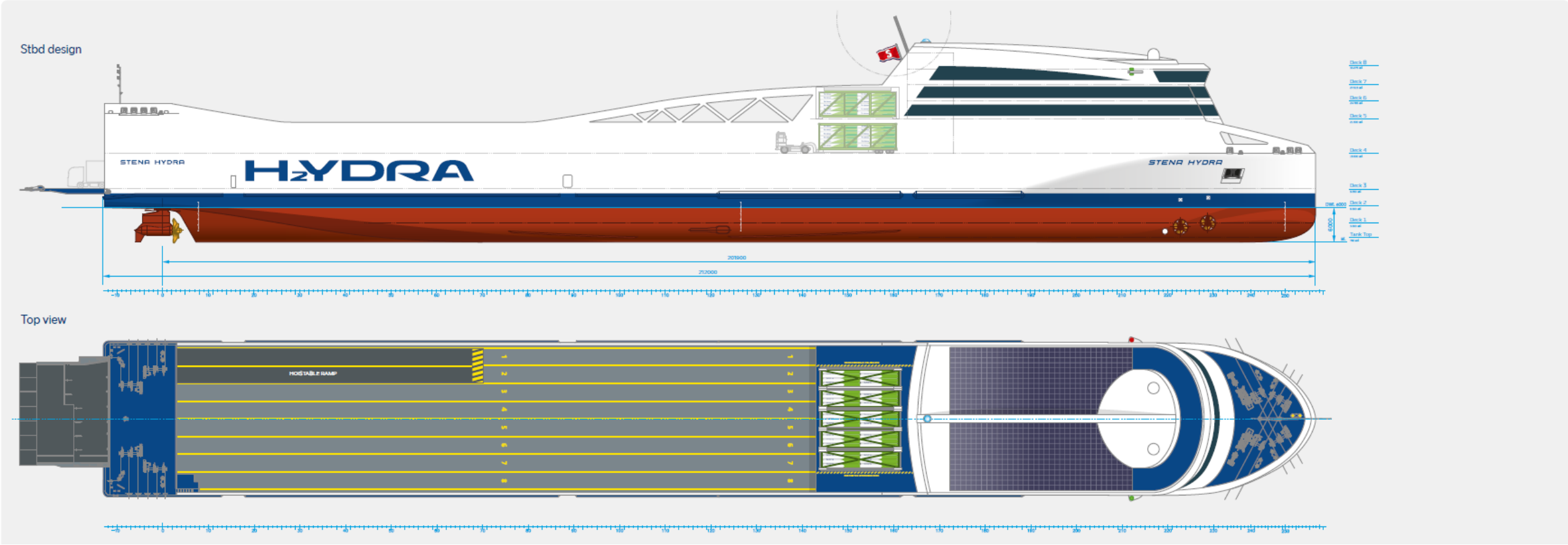
General Arrengement (GA) - Stena Hydra

PROPOSAL



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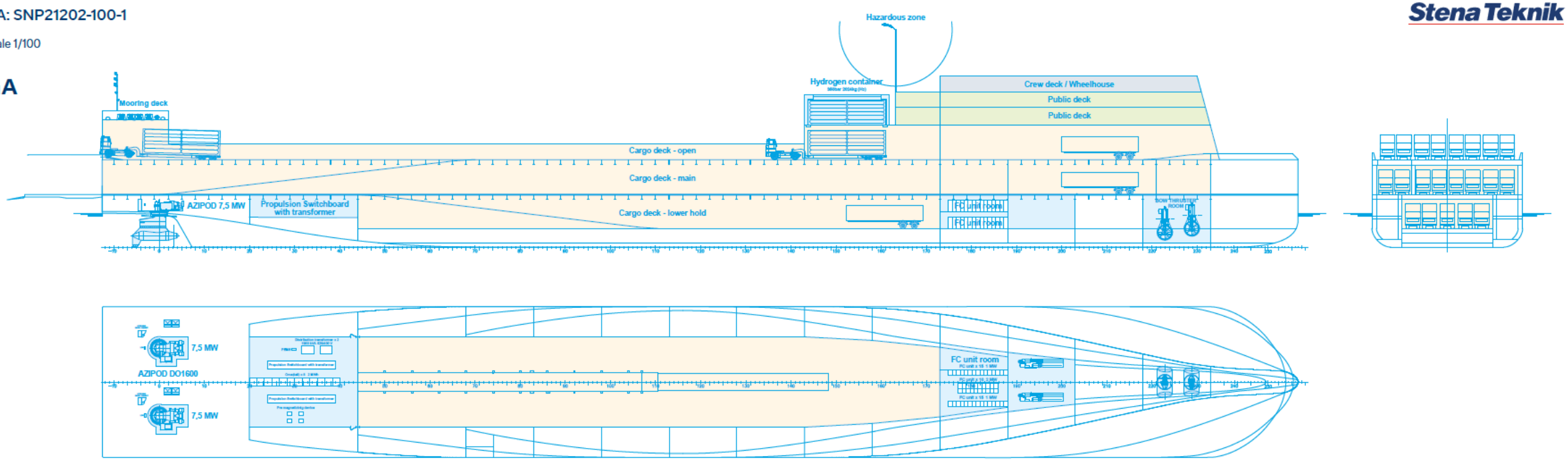
STENA HYDRA - COMPRESSED HYDROGEN CONCEPT

GA: SNP21202-100-1

Scale 1/100

GA



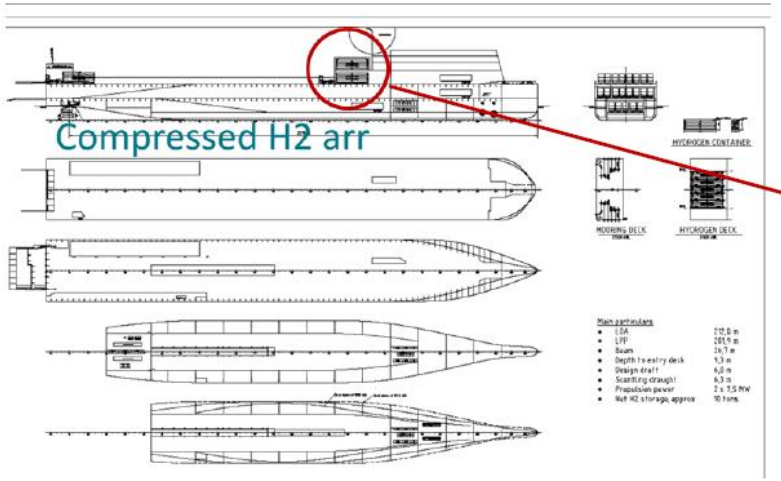
PRINCIPAL PARTICULARS

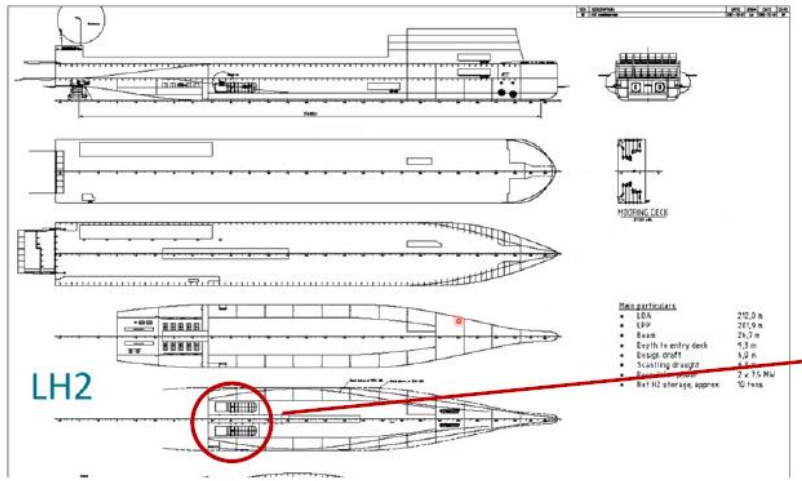
LENGTH O.A.	212.000 M
LENGTH P.P	201.900 M
BEAM	26.700 M
DESIGN DRAFT	6.000 M
SCANTLING DRAUGHT	6.300 M
PROPULSION POWER	2 x 7,5 MW
NET H2 STORAGE, approx	10 tons
OPERATIONAL RANGE	150 NM
SPEED	22 kn

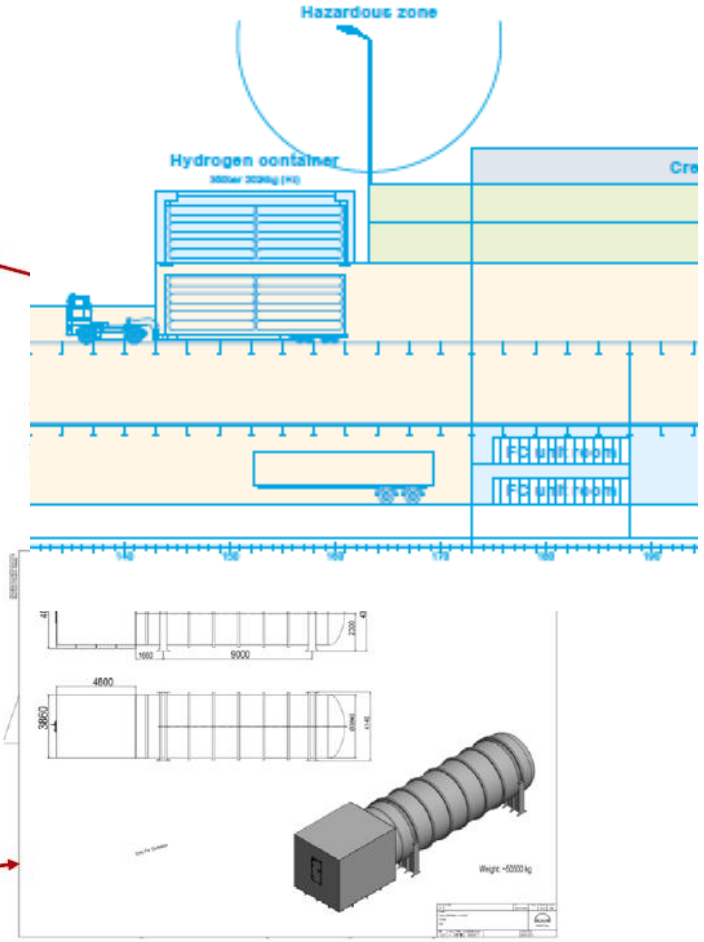
CAPACITIES

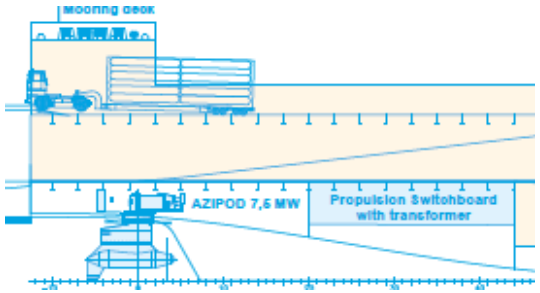
DEADWEIGHT (metric tons)	Abt 6000
PAYLOAD (metric tons)	Abt 4500
LANE METERS	Abt 2500 M
PASSENGER FACILITIES	DAY FERRY
CREW CABINS	50 SINGLE

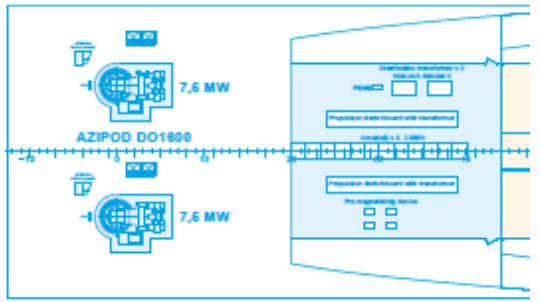
Compressed or liquid hydrogen?











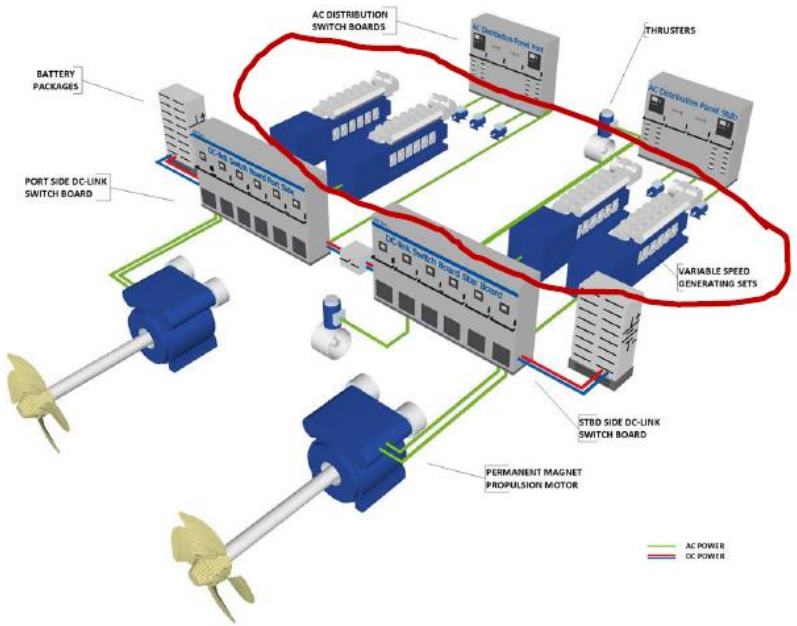
SINTEF

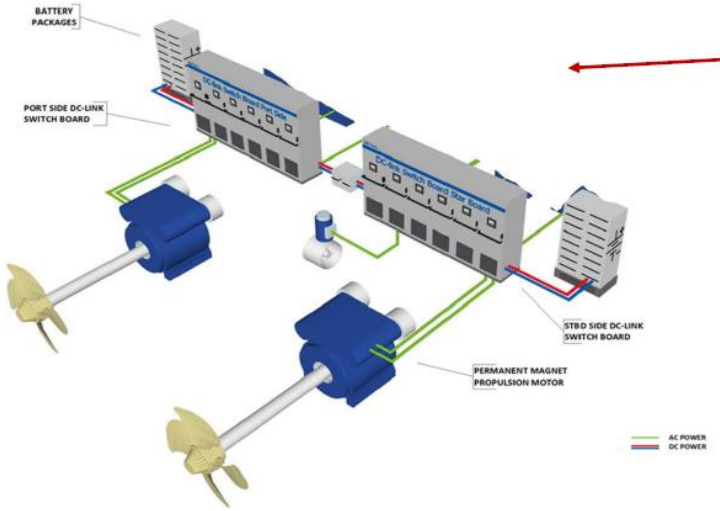
Propulsion systems (fuel cells in focus):

Diesel-electric layout with hydrogen powered ICE

Fuelcells (PEM) running on hydrogen (PowerCell Sweden, 200 kW Modules)

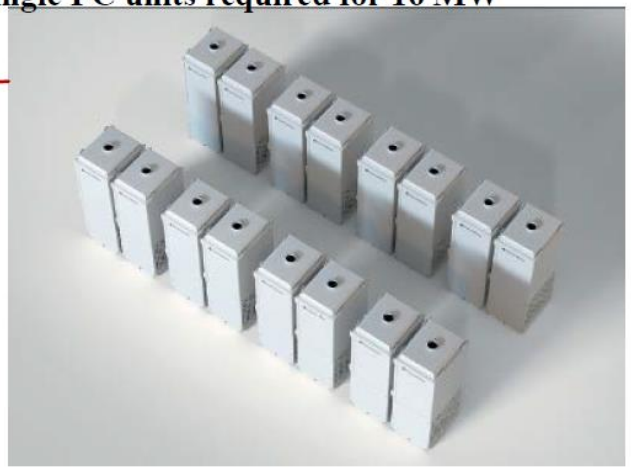
Power trains





Concept design of 3,2 MW Fuel cell block, 16 single FC units arranged in pairs of two units, ref Powercell-

Total 80 single FC units required for 16 MW



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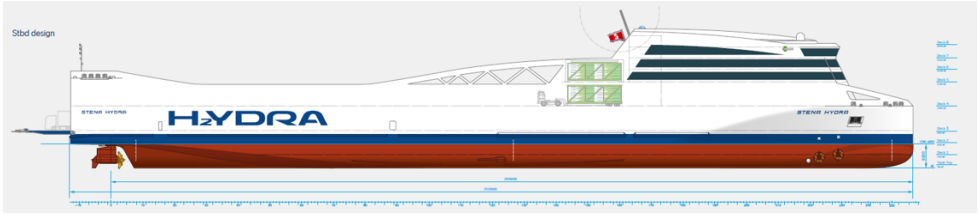
Some findings (1/3)

- Hydrogen appears to be a cost-effective solution for reducing ship's GHG emissions, in some form *(liquified, compressed, ammonia or electrofuels)*, from a global long-term perspective.
- Limited introduction of hydrogen and associated fuels in the short term. *Some initiatives to introduce hydrogen for shipping, mainly in Norway*.
- It seems *possible from a technical perspective* to use *hydrogen for a regional RORO-ROPAX vessel*, between the Nordic countries, even if electrification has advantages on certain routes.
- A concept design for the case study ship in HOPE is being developed focusing on fuel cells as propulsion solutions and discussing two different storage possibilities *(compressed and liquified hydrogen).*



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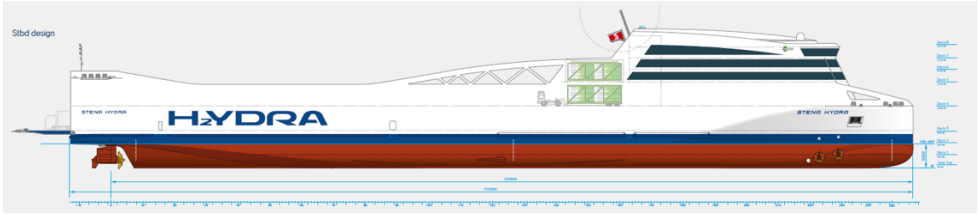
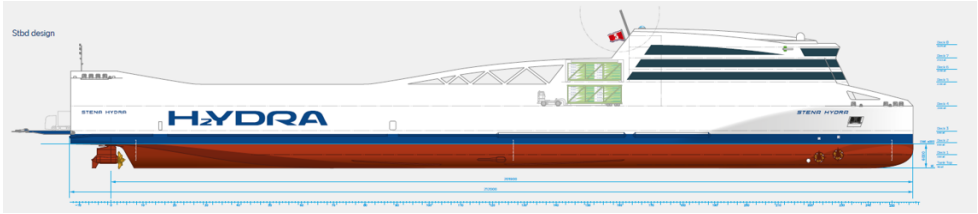
Some findings (2/3)

- Hydrogen-based solutions for shipping is *not the lowest cost option for regional shipping*. Problems also for other options.
- A *range of different barriers & drivers* for hydrogen in shipping. Companies face economic, organizational, behavioral, technological barriers.
- *Primarily economic barriers* e.g., high costs, lack of infrastructure, green hydrogen supply, and regulations/standards, uncertainty and high risk.
- Supply of hydrogen? Significant plans for hydrogen production in Nordics, but *availability of hydrogen for shipping uncertain*. Relatively few of Nordic hydrogen/ammonia production projects clearly address possible use in shipping.



Some findings (3/3)

- Guidelines and regulations are under development. Expansion of bunkering infrastructure for hydrogen in different forms is needed. *Hydrogen based solutions must be tested in parallel*.
- It is possible to substantially reduce the GHG emission/climate impact by introducing hydrogen-based options by 2030 (2050 even more). Other emissions will decrease too.
- ***Policies are crucial*.** Details in the policy design can be crucial for the prerequisites for different options not the least hydrogen solutions.



Thank you!

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HOPE project is part of Nordic Maritime Transport and Energy Research Programme

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