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

Project overview
Project partners

- IVL Swedish Environmental Research Institute (SE)
- SINTEF Ocean AS (NO)
- University of Iceland (IS)
- Stena Rederi AB (SE)
- PowerCell Sweden AB (SE)

Project period:
Start: 2021-02-28, End: 2023-02-27
Aim of project

- to assess the potential role for hydrogen and fuel cell solutions for decarbonizing the Nordic shipping sector in relation to other low or zero carbon fuel solutions by including technology evaluation and impact assessment covering potential, environmental, economic and policy aspects.

Main targets

- Develop and assess a concept design of a ship using hydrogen and fuel cells for propulsion (considering also hybrid solutions) based on a specific case study and compare that with other low-carbon options,
- Perform laboratory tests for evaluating the developed concept design/strategy,
- Assess impact and potential uptake in a Nordic perspective including scenarios, costs and emissions, focusing on short-sea shipping and the infrastructure between the Nordic countries,
- Assess drivers and barriers for increasing uptake of hydrogen and fuel cells in the Nordic maritime sector and assess policy options for enabling the transition.
Overall research objectives (1/2)

● Show a design of a ship operating between the Nordic countries partly powered by hydrogen/fuel cells.

● Identify and describe differences in such design with other low or potential zero fossil carbon marine fuels (e.g. ammonia, NH3) and energy conversion technologies (e.g. internal combustion engines, ICE).

● Demonstrate the concept hydrogen/fuel cells in a series of lab tests.

● Assess what fraction of the fleet operating around the Nordic countries that are suitable for propulsion with hydrogen/fuel cell solutions by 2050 assuming realistic uptake in relation to cost benefit and technical issues and estimate the impact on emissions.
Overall research objectives (2/2)

- Assess the role of shipping and particularly hydrogen based marine solutions in reducing the Nordic GHG emissions based on energy systems modelling.
- Review the potential of renewable hydrogen and ammonia production in the Nordic countries from a shipping perspective.
- To map the drivers and barriers that are expected to affect the energy innovation chain for hydrogen based marine solutions from commercialization to adoption to the Nordic shipping fleet.
- To assess cost effectiveness and identify the policy options needed to accelerate uptake of hydrogen based marine solutions.
Project outline: Overview of WPs

WP1. Project management and dissemination/communication (Lead: IVL)

WP2. Technology options (Lead: SINTEF)

WP3. Concept design (Lead: Stena)

WP4. Laboratory tests and models of concept design/strategy (Lead: SINTEF)

WP5. Scenario and impact analysis (Lead: IVL)

WP6. Policy and drivers/barriers for change in the Nordic maritime sector (Lead: University of Iceland)
WP2 Technology options

- Task 2.1 Low carbon fuels (SINTEF, IVL)
- Task 2.2 Power trains, (SINTEF, Stena, PowerCell)
- Task 2.3 Fuel handling and storage options, (SINTEF, Stena, PowerCell)
- Task 2.4 Fuel production from a Nordic perspective (IVL)
WP3 Concept design

- Task 3.1 Powertrain design (STENA, PowerCell, IVL, SINTEF)
- Task 3.2 Hydrogen storage and handling (STENA, SINTEF)
- Task 3.3 Ship requirements (STENA, SINTEF)
- Task 3.4 Other solutions (STENA, PowerCell, IVL, SINTEF)
WP4 Laboratory tests and models of concept design/strategy

- Task 4.1 System and boundary definitions, (SINTEF, PowerCell, Stena)
- Task 4.2 System Model with Generic Energy Management Strategy, (SINTEF, PowerCell, Stena)
- Task 4.3 Hybrid Testing of the Solutions (SINTEF)
WP5 Scenario and Impact analysis

- Task 5.1 Cost-benefit analysis (IVL, University of Iceland)
- Task 5.2 Assessment of uptake in Nordic fleet (IVL, SINTEF)
- Task 5.3 Emission impacts in scenarios for uptake in Nordic fleet (IVL)
- Task 5.4 Cost-effective fuel and propulsion technologies - Times-Nordic modelling (IVL)
WP6 Policy and drivers/barriers for change in the Nordic maritime sector

- Task 6.1 Drivers and barriers for implementation of hydrogen/fuel cells in Nordic shipping (University of Iceland, SINTEF)
- Task 6.2 Comparative cost effectiveness and policy options for accelerating uptake (University of Iceland, IVL)
WP1 Project management and dissemination

- Task 1.1 Project management (IVL, PowerCell)
- Task 1.2 Strengthen Nordic knowledge sharing (all partners, supported by a consultant: 2030 sekretariatet)
Project management and communication

- Project manager: Julia Hansson, IVL
- External website will be created under the IVL website
- Communication: IVL supported by 2030 sekretariatet - Jakob Lagercrantz (subcontractor)
- Advisory board
- News published by NER and IVL

https://www.nordicenergy.org/project/nordic-maritime-transport-and-energy-research-programme/

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