FreeCO$_2$ast
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Havyard Group ASA

Havyard Group ASA is a knowledge-based marine and maritime technological company, which deliver innovative and sustainable technology offshore and onshore to customers within seafood, energy and transport.

“Change our industry”
Business segments

Ship Design & Solutions

Power & Control

Shipbuilding technology
The road towards zero-emission

2011

“Havila Charisma”
Equinor
Low speed hull lines
Efficiency and engines for operational speed

2012

“Polarsyssel”
Sysselmannen
New bow shape
New stern shapes

2013

“Esvagt Faraday”
Simens
New bow & stern
Variable RPM engines
Fuel commitment

2014

“Giskøy”
Vegvesenet
Energy & emission commitment
Batteries

2015

“Havila Kystruten”
Samferdsels-departementet
Energy & emission commitment
Batteries
Energy recovery

2016

2017

2018

2019

Future
The road towards zero-emission

- **IMO**: Baltic/North Sea NECA
- **IMO**: EEDI Phase 3
- **Nasjonal transportplan**: All new private cars, city buses, and light trucks to be zero emission
- **Norwegian cruise harbor collaboration**: Shore-power supply requirements
- **Parliament resolution**: 2026: Zero emission from ferries and cruise ships in World heritage fjords
- **Nasjonal transportplan**: Reduce greenhouse gas emissions from Norwegian shipping with at least 50% compared to 2008
- **IMO**: 0.5% Global Sulphur cap EEDI phase 2
- **IMO**: Reduce greenhouse gas emissions from international shipping with at least 50% compared to 2008

- 2020
- 2025
- 2030
- 2035
- 2040
- 2045
- 2050
FreeCO₂ast Consortium

- Havyard Group ASA
- Havyard Design & Solutions AS
- Havyard Ship Technology AS
- SINTEF
- cmr Prototech
- Kystruten
- norwegian electric systems
Pilot-E awarded the project 104 MNOK in 2018.

“The FreeCO$_2$ast project shall develop a high-capacity hydrogen powertrain approved for zero-emission operation with higher speed and over longer distances.”
FreeCO2ast targets

- Develop and approve **Pilot system** for Havila Kystruten
- Expand toolbox for **simulation driven ship design** including hydrogen and total system energy.
- Develop deep knowledge in fuel cell, tank and control system applications. “**X in the loop**” philosophy.
- Explore hydrogen solutions for other vessel segments with **Virtual lab**.
- **Market analysis** for maritime zero emission solutions
Approval in principal case

- 3,2 MW Fuelcell
- 3,5 t LH2 Tank
Simulation-Driven Design
Simulation-Driven Design
Simulation-Driven Design
Virtual lab
Fuel cell supply
Heat Recovery
Batteries
Thruster
Virtual lab
FreeCO2ast realization roadmap

Start FreeCO2ast

- Preliminary Design
- Suppliers

- Approval in Principal

- Commercial Contract

- Final Approval

GOAL

Final Installation

- Governmental Conditions
- Incentives
- Passenger preferences

- CO2 taxes
- Tender bonuses
- Emission Control Areas
Market Analysis

Research questions

• Passenger desire to use zero emission transport?
• Passenger will to pay extra for zero-emission transport 3 years from now?
• Potential passenger fear of being close to hydrogen installations?
• Regulations development?
Installation strategy

Challenges:
• Timeline require retrofit solution
• Need technology verification
• Extensive commissioning and tuning
• Ongoing tender demands very short yard stay
Installation strategy

Tank supplier

Fuel cell supplier
Installation strategy

Production LH2 module
Factory Acceptance Test

Production FC module
Factory Acceptance Test
Installation strategy

Transportation to test site
Installation strategy

H2 TEST CENTER

LH2

FC
Installation strategy

- Onshore Commissioning
- Testing towards simulated environment and other components (Virtual lab, X-in the loop)
Installation strategy

Complete H2 solution prepared for onboard installation.
Installation strategy
Installation strategy

H2 TEST CENTER

Quick installation onboard

FC
LH2
Installation strategy

- Support and tuning during sailing enabled by data exchange from ship to shore
- The ships existing hybrid solution (LNG/battery) takes away risk of downtime
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