FreeCO$_2$ast
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Content

Havyard and the road to zero emission
FreeCO2ast Project
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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

- Shipbuilding technology
- Ship Design & Solutions
- Power & Control
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
The road towards zero-emission

- **IMO**: Baltic/North Sea NECA
- **IMO**: EEDI Phase 3
- **IMO**: 0.5% Global Sulphur cap EEDI phase 2
- **Nasjonal transportplan**: All new private cars, city busses 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 green house gas emissions from Norwegian shipping with at least 50%
- **IMO**: Reduce green house gas emissions from international shipping with at least 50% compared to 2008
FreeCO\textsubscript{2}ast 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
FreeCO2ast realization roadmap

- Start FreeCO2ast
  - Preliminary Design
  - Suppliers
  - Approval in Principal
  - Commercial Contract
  - Final Approval

- GOAL

- Final Installation
  - CO2 taxes
  - Tender bonuses
  - Emission Control Areas

- Governmental Conditions
- Incentives
- Passenger preferences
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

Production LH2 module
Factory Acceptance Test

Production FC module
Factory Acceptance Test
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

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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