Experiences and key learnings in demonstrating fuel cells in shipping

Jyrki Mikkola
Senior Scientist, Hydrogen Applications, VTT Technical Research Centre of Finland

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VTT in numbers
Creating impact over 80 years

284 M€
operating income

2,355
employees

450
patent families

50+
start-ups*

45%
of the net turnover from abroad

1,135
customers

488
scientific articles

75
Net promoter score (NPS)

VTT Group (2023). *) Rolling data

VTT Marine portfolio

Funded by the European Union

VTT

MARANDA

H2+PEMFC based hybrid powertrain system is developed and validated for marine applications

SHIP·AH2OY

Demonstrate safe and scalable solution for zero-emission shipping using LOHC and FC technology.

2017 — 2026

Clean Hydrogen Partnership

Co-funded by the European Union

FLAGSHIPS

Development and deployment of two comer-cially operated hydrogen fuel cell vessels.

RH2IWER

Deployment of six commercially operated hydrogen fuel cell vessels. Standardization of H2&FC containers

To Be Announced !

Plus many more…

e·SHyIPS ON THE WAVE OF HYDROGEN

AEGIR

FuelSOME

H2MARINE

FLAGSHIPS

The **FLAGSHIPS** project demonstrates zero-emission waterborne transport with two commercially operated hydrogen fuel cell vessels.

VTT · COMPAGNIE FLUVIALE DE TRANSPORT (SOGESTRAN GROUP) · SOGESTRAN GROUP · FPS · ABB · BALLARD · maritime cleantech (Norwegian Centre of Expertise) · Persee · NORLED · LMG MARIN · SEAM

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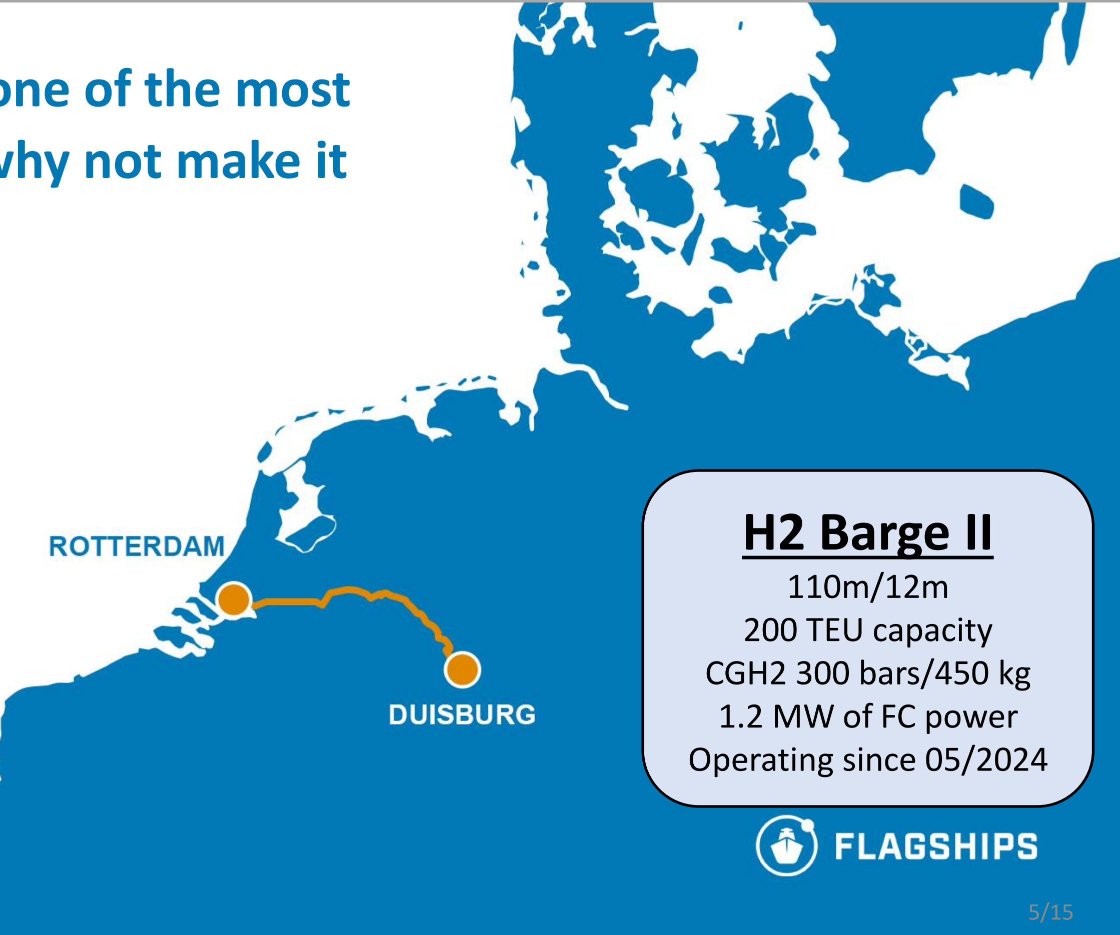
Inland waterway transport is one of the most efficient transport modes → why not make it zero emission?



H2 Barge II

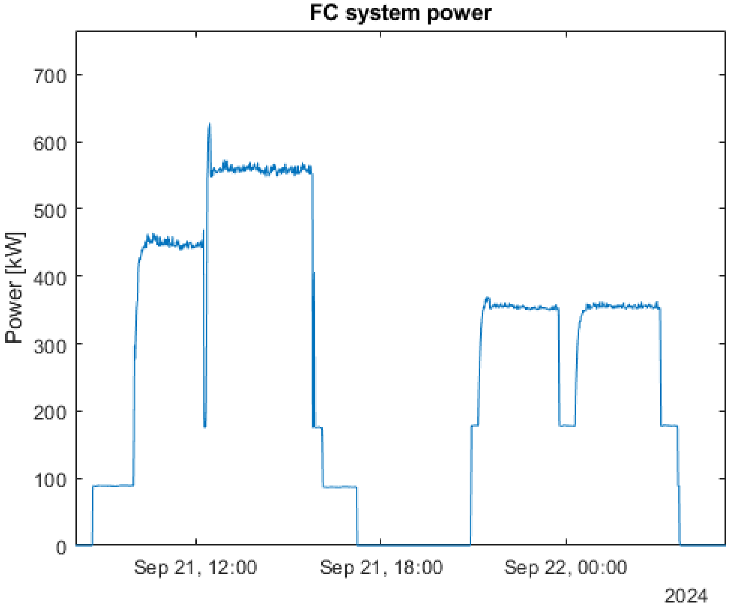
110m/12m
200 TEU capacity
CGH2 300 bars/450 kg
1.2 MW of FC power
Operating since 05/2024

Clean Hydrogen Partnership
Co-funded by the European Union

H2 Barge II - Fuel Cell Data Analysis

- Data from the fuel cell vessel H2 Barge 2 analysed for a 12 month operational period
- FC system efficiency estimated at 50%
- Around 1500 tonnes of CO_2 emissions saved
- Availability estimated at 83%

Example data:

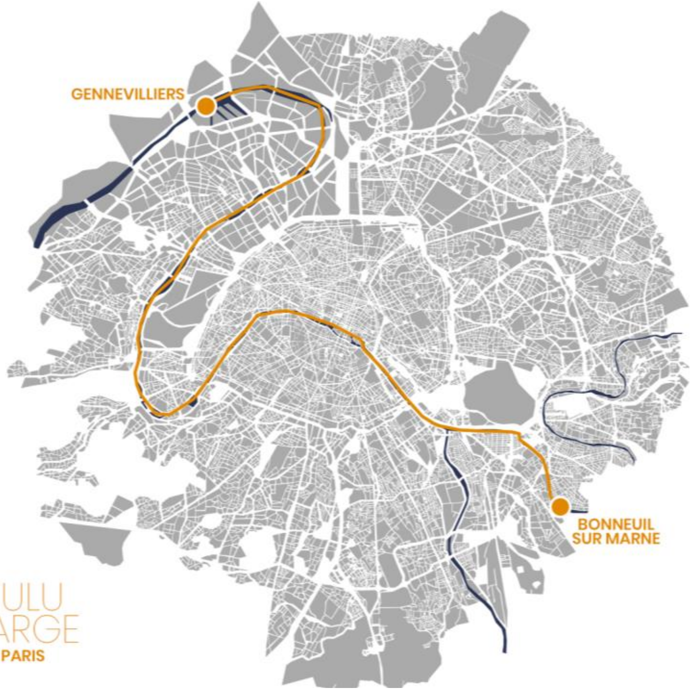


Urban distribution along the river offers an option to roads which are lacking capacity

COMPAGNIE FLUVIALE DE TRANSPORT
SOGESTRAN GROUP

Zulu06

55m/8m
CGH_2 300 bars/300 kg
400 kW of FC power
About to commence operations



ZULU BARGE PARIS

Clean Hydrogen Partnership
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SHIP·AH2OY

Ship-aH2oy

Safe and sustainable power for ships with **fuel cells** and **LOHC**

The goal is to enable **zero-emission operations** in the growing **offshore renewables** sector

In **Ship-aH2oy**, we will develop a first-of-its-kind maritime power unit based on **LOHC** and **fuel cell** technology

We will demonstrate the solution onboard an **offshore wind vessel** (CSOV)

SHIP·AH2OY

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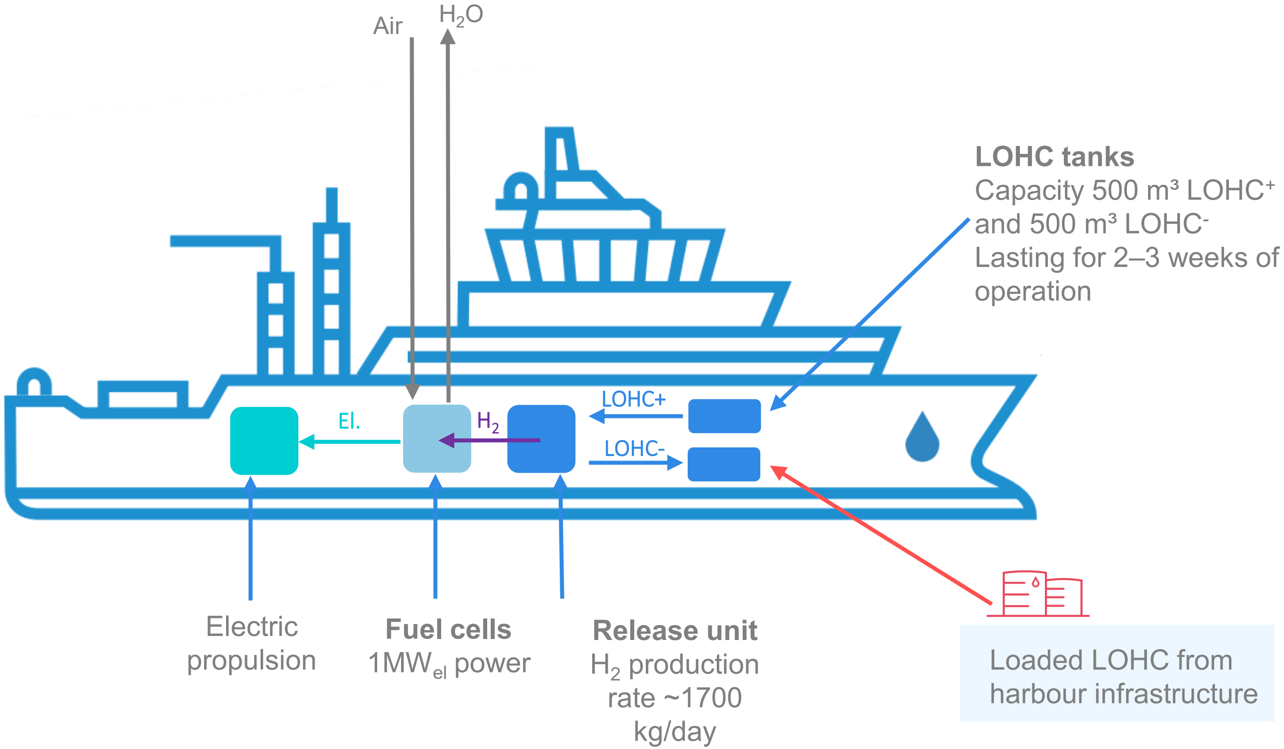
Liquid Organic Hydrogen Carrier or LOHC offers a safe and scalable option for enabling hydrogen as shipping fuel

- H_2 is chemically bound to a carrier (= LOHC)
- LOHC can be stored and transported at ambient conditions within existing fossil fuel infrastructure
- Diesel-like liquid → Fast and familiar bunkering process
- Non-explosive and hardly flammable liquid → Increased safety
- Minimal amount of H_2 molecules onboard



RH2IWER

Clean Hydrogen Partnership

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RH2IWER | Renewable Hydrogen² for Inland Waterway Emission Reduction

Demonstration of 6 inland waterway vessels

- MW-scale, 3 vessel types, 1-2 year demo times

Standardisation of FC and H2 solutions

VTT
VT
FPS
POUW THEO POUW GROEP
CFT COMPAGNIE FLUVIALE DE TRANSPORT SOGESTRAN GROUP
SPB
Air Liquide
h2boat hydrogen to boat
BALLARD
Nedstack PEM FUEL CELLS
UNIVERSITÀ DEGLI STUDI DI GENOVA

The project is supported by the Clean Hydrogen Joint Undertaking and its members Hydrogen Europe and Hydrogen Europe Research. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or Clean Hydrogen Joint Undertaking. Neither the European Union nor the granting authority can be held responsible for them.

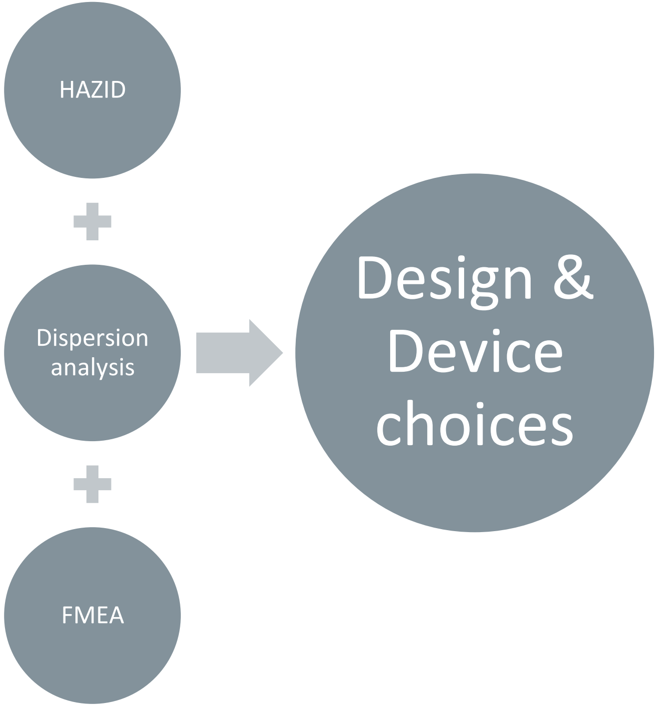
Lessons learnt

Fuel Cell Shipping: Navigating a Turbulent Global Environment

- Global Energy Market Volatility
  - Rising energy prices and uncertainty in energy supply chains.
  - Geopolitical tensions.
- Infrastructure Bottlenecks
  - Slow progress on global hydrogen hubs and bunkering facilities.
- Regulatory & Safety Constraints
  - Unclear rule base for new technologies - alternative design process needed.
  - Compliance costs and delays in certification.
- Economic Pressure
  - High capital expenditure for hydrogen shipping projects.
  - Uncertain demand outlook due to global economic slowdown.

Risk based design as priority in hydrogen system integration

- Iterative process in collaboration with approving authorities



Early engagement of approving authorities is extremely important for successful deployment of these technologies

Maritime: IMO MSC.1 Circ 1455

Project descriptio n → Pre-Hazid → Design docume n-tation → HAZID → GAP-analysis → Risk Assess-ment → Final design

Inland waterway: Derogation process

Technical committee → Local authority → National authority → CESNI EU committee → Approval

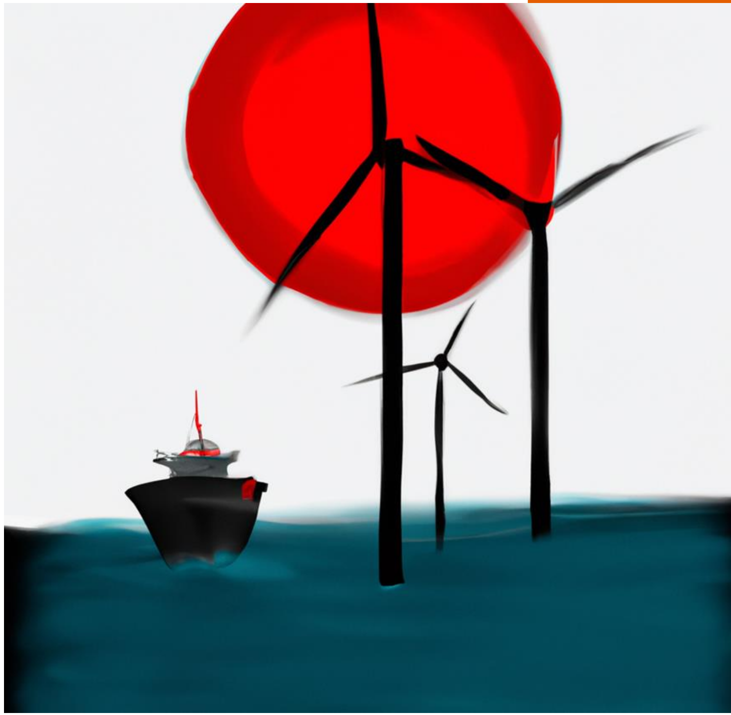
Ecosystems around the hydrogen infrastructure are needed!

Public support and incentives are needed to speed up the deployment of zero emission solutions in waterborne application

- CAPEX
- OPEX

Key takeaways

- H2 and Fuel Cells are ready to go
- Ecosystems around H2
- Engagement of stakeholders from early on
- Public support and incentives still needed



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