

Session 1: Role of hydrogen in a low-carbon economy – long-term perspective

Views from industry ; Maritime. .

**International Energy Agency
Technical Collaboration Programme**

Task 39: Hydrogen in Maritime Transport, 2017-2019

Operating Agent:

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Workshop on hydrogen production with CCS

CAMPUS EDF CHATOU

November 6, 2019

Jacques Saint-Just

H2 Plus Ltd, ask member

Why Hydrogen in Maritime transport?

Because hydrogen could be an option for maritime transport, which is a major contributor to:

- GHG emissions
 - 2.8 % of annual global emissions
- Pollutant emissions
 - SO_x
 - NO_x
 - VOCs
 - Particles
 - ODS, ROGs...



Regulated by IMO (Emission Controlled Area, ...) + Kyoto protocol



Golden Gate « Water-go-round »

- passenger capacity of 84
- hydrogen tank capacity for two full days of operation.



Why an IEA task?

The current deployment of H2 technologies in maritime transport is poor

Objective of the task

<http://ieahydrogen.org/Activities/Task-in-Definition-Hydrogen-in-Marine-Applicatio.aspx>

- provide know-how on the use of hydrogen and fuel cells in the maritime
 - ship propulsion, shore-side electrical power, cargo handling
- evaluate concepts
- initiate research and demonstration projects

This is achieved by creating an exclusive network of

- suppliers of hydrogen and fuel cells
- shipping companies
- advisory and research institutions

How it is done

- Bi-annual meetings of the members of the task and invited stakeholders
- Production of a “white paper” with the conclusions of the group and time horizons

White paper

1. Logistics, H2 supply and port development

- H2 vs other clean fuels, for propulsion & auxiliary power
- Compressed or LH2, Green or Clean (CCS) H2
- On-shore power (cold ironing)
- Fuel cell port handling devices (cranes, trucks)

2. Safety (mainly on-board safety) and RCS

- Safety issues for H2 storage options (above or below deck)
- Global regulatory framework

3. On-board technology – fuel cell development/hybrid solutions/energy management and ship design; retrofitting.

Task members (39) and invited stakeholders



- Industry: *Fincantieri, Wartsila, Nedstack, Hydrogenics, Ballard, ITM, PowerCell, Engie, ...*
- Port Authorities, shipyards: *Eastern Adriatic Sea, Damen, Holland, ...*
- Registrar and classification: *Lloyd's Register, DNV GL*
- Government: *European Commission, California Hydrogen Business Council*
- Institutes: *VTT, SINTEF, INTA, ...*
- Academia: *NTNU, U. Southampton, Delft, Tokyo, Trieste, Madrid, Lausanne, Genoa, ...*

Hydrogen demonstrations in the ports of Los Angeles & Long Beach

CALIFORNIA HYDROGEN BUSINESS COUNCIL

FuelCell Energy and Toyota Biogas-to-Hydrogen Station

TOYOTA
Let's Go Places

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fuelcellenergy

CALIFORNIA HYDROGEN BUSINESS COUNCIL

Fuel Cell Yard Tractor Demonstration at Port of Long Beach

Commercialization of Off-Road Technology Demonstration Project (C-PORT)

- Partners: Long Beach Container Terminal, Port of Long Beach, Loop Energy
- \$5.3 million grant from CARB
- 3 battery electric "top handlers"
- 1 fuel cell yard tractor vs. 1 battery yard tractor

Long Beach Container Terminal

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Fuel Cell Trucks Project Port of Los Angeles

Zero-Emission and Near Zero-Emission Freight Facilities (ZANZEFF) project

- Partners: Toyota, Shell, Kenworth, Port of Los Angeles
- \$41 million award from CARB
- Project cost: \$82.5 million
- 10 Hydrogen fuel cell trucks operated by 4 companies
- 2 heavy duty hydrogen stations

TOYOTA **THE PORT OF LOS ANGELES** **Shell**

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CALIFORNIA HYDROGEN BUSINESS COUNCIL

Top Loader Project Port of Los Angeles

Fuel Cell Powered Top Loader

- Partners: CTE, Nuvera, Hyster-Yale, Port of Los Angeles
- \$6.5 million grant from CARB
- Project cost: \$8.8 million
- Inductive charging capability

NUVERA **HYSTER-YALE GROUP** **THE PORT OF LOS ANGELES**

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CALIFORNIA HYDROGEN BUSINESS COUNCIL

Recently Announced Project Port of Angeles

Zero Emissions for California Ports (ZECAP) Project

- Partners: TraPac Container Terminal, Port of Long Beach, Ballard Power Systems, BAE Systems
- \$5.7 million grant from CARB
- 2 fuel cell yard tractors
- Delivery: March 2020; 12 months

THE PORT OF LOS ANGELES **TraPac** **BALLARD** **BAE SYSTEMS**

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CALIFORNIA HYDROGEN BUSINESS COUNCIL

Vehicles Zero Emission Cargo Transport II

KENWORTH **A PACCAR COMPANY** **US Hybrid** **HYDROGENICS**

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Fuel Cell Ferry Project San Francisco: The Water-Go-Round

- \$3 million grant from CARB
- Produced by Gold Gate Zero Emission Marine to be operated by Red & White Fleet
- Keel laying was 8 Nov 2018
- September 2019 delivery
- 3 month demonstration

WATER-GO-ROUND

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Hydrogen for maritime applications projects supported by the European Commission

New projects – started 2019

Call for proposals – 2020 onwards

Maranda



HySeas



FLAGSHIPS



H2020

FCH JU

hydrogen fuelled PEMFC based hybrid powertrain system validated on board the research vessel Aranda

A hydrogen territory in Scotland: hydrogen production, storage, transportation and utilization for heat, power and mobility.

the world's first zero emission, sea-going ferry. Demonstrate a circular economy model for the local production

- Fluvial push-boat, Lyon (FR)
- RO-PAX ferry, Stavanger (NO)

- FC for port/harbor container terminal:
- Reach Stacker
 - Yard Tractor
 - Mobile HRS

- Next Generation Propulsion for Waterborne >5MW on-board power
- Structuring R&I towards zero emission waterborne transport

- Scaling up and demonstration of a multi-MW Fuel Cell system for shipping

2017-2021

2016-2021

2017-2021

2019-2022

2019-2022

H2020 Funding: ~4-8M€

FCH Funding: ~10 M€

FCH Funding: ~3M€

FCH Funding: ~5M€

H2020 Funding: ~9.3M€

FCH Funding: ~5M€

FCH Funding: ~4M€

MoZEEES

Center for environment-friendly energy research focusing on zero-emission transport solutions. The Center is hosted by IFE, Kjeller, Norway, and has a budget of ~ 25 M€ and a duration of 8 years
(Director: Øystein Ulleberg)

Objectives

develop battery and hydrogen materials, components, and technologies for existing and future transport applications on road, rail, and sea.



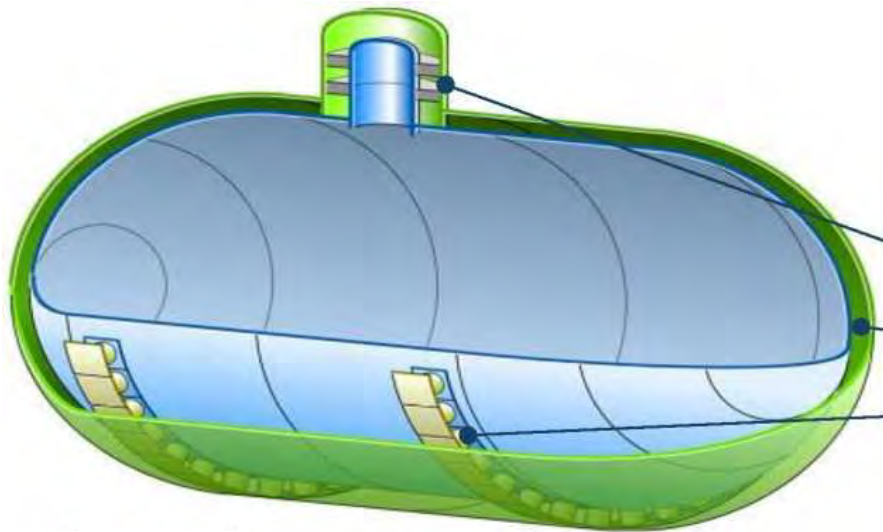
MF Ampere - the first zero-emission ferry in the world

Japan

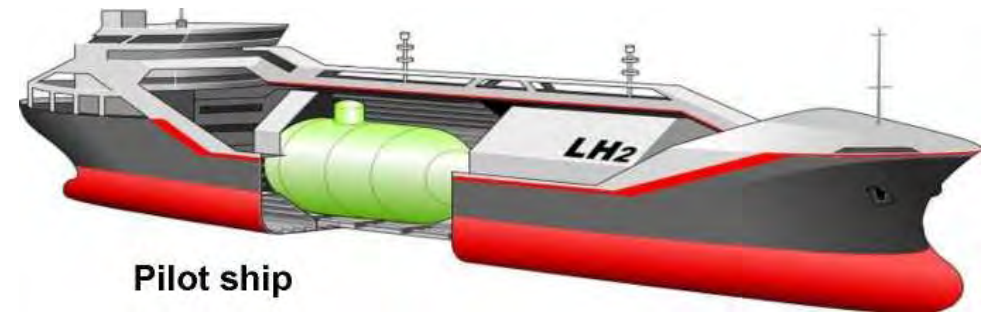


■ Kawasaki

World's first liquefied hydrogen cargo ship



Cargo tank



Pilot ship

- Special dome structure for maintaining vacuum
- Stainless steel vacuum thermal insulation double hull
- High thermal insulation supporting structure

H2 from Australian brown coal + CCS

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Guideline to complement IGC code is being proposed to IMO by both Japan and Australia

Session 1:

Role of hydrogen in a low-carbon economy – long-term perspective.

Views from industry ; Maritime

- Short term: numerous niche opportunities for industry;
Regulatory framework has a critical role
- Long-term perspective: hydrogen will play a major role

Thank you!

Contact for IEA-HIA Task 39



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