Transition pathways to zero emissions shipping: Wind and H2 with the MATISSE-SHIP model

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H2 fuel cells in shipping

World’s first fuel-cell ship “FCS ALSTERWASSER” proves its reliability (Maritime Propulsion, 2012)

“Ballard PEM (proton exchange membrane) fuel cells are modular. They can be used in various combinations in parallel to provide the power and redundancy needed by a vessel, from 100kW to 1MW or more.”

blog.ballard.com/fuel-cells-marine-vessels, 2019
Changes in Preferences, Practices

Effectiveness in developing and selling the technology

SUPPORT

MACRO

LANDSCAPE

REGIME

MESO

Technology agents

NICHES

MICRO

SHIPOWNERS

User Agents

Structure of the MATISSE-SHIP model
Technology/Operations niches

- Biofuels: which are sustainable, how much?
- Wind
- Wind assistance (windassist)
- Hydrogen Fuel cells
  (Batteries as auxiliary power source)
- Liquid Natural Gas including dual and triple fuel engines (LNGDF)
- Low flashpoint Liquid fuels e.g. Methanol, ammonia, dimethyl ether (LfL)
- Synthetic fuels (so-called power-to-liquid PtL)

- Slow steaming as a practice rather than a technology
Practices

• GHG intensity - CO2 emissions/tonne km or passenger km;
• fuel cost Euro/tonne;
• operational speed (adoption of slow steaming);
• local air emissions /tonne km or passenger km (NOx, SOx, particles);
• capital cost/MW;
• perceived technological and operational change (reduced operational speed and weather optimised routing, even if this involves extended transit times compared to diesel propulsion at the operational speeds of 2012);
• requirement for new bunker infrastructure.
Markets/Trades

- cruise/ferry
- ferry LNG
- bulk (tanker and dry bulk)
- bulk-wind
- container
- psv/service
- psv/service LNG
Wind combined with H2, biofuels by 2050