Ammonia as a marine fuel in Asia

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Supporting organisations

Presentation documents:
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Page 19: Tsutomu Yokoyama, NYK Line

#asiamaritimeoffshore
Mapping of Zero Emission Pilot and Demonstration Projects
About the Getting to Zero Coalition

- Launched in 2018, >140 companies
- Ambition: to have commercially viable Zero Emission Vessels (ZEVs) operating along deep-sea trade routes by 2030, supported by the necessary infrastructure for scalable net zero-carbon energy sources including production, distribution, storage and bunkering
- Workstreams: **Motivating First Movers**, Fuels, Global Opportunities, Closing the Competitiveness Gap
What is in the mapping?

- Increasing from 66 projects in the first edition, the Mapping of Zero Emission Pilots and Demonstration Projects now includes 106 projects focusing on zero emission pathways for the maritime industry.

- The projects cover the full value chain, focusing on the different elements needed to facilitate shipping’s transition to zero emission fuels. This includes projects focusing on ship technologies, fuel production and bunkering/recharging.

- The projects have been categorized in terms of their geographical focus, project focus, project type, fuel choice, and the existence of public funding.
In terms of **geography**, most projects in the mapping have a significant connection to Europe (71), with Norway, the Netherlands, Denmark and Belgium all having over 10 projects in the mapping.

Since the first edition, the geographical spread of the mapping has become more representative, which is reflected in the increase of Asian projects from 16 in the first edition to 31 in the second.

The mapping has further seen an expansion in terms of new geographies now pursuing zero emission pilot projects.
For large ship projects, one notable trend we are seeing is a post-2020 increase in the uptake of large ammonia vessels, with the mapping receiving 4 additional large ammonia demonstration projects since the first edition.
Emerging trends

For **small ship projects**, there appears to be a continuing preference towards using hydrogen, battery power or a combination of the two onboard small ships.
Emerging trends

For *fuel production projects*, the mapping shows a preference towards Power-to-X fuel production with hydrogen as an input.
Emerging trends

◉ Among projects based in Asia, about 80% are focused on vessel technology and demonstration (compared to 60% in Europe)

◉ Among projects based in Asia, Ammonia is the most common fuel focus, accounting for just under 40% of projects

◉ More than half of Ammonia-centric projects in the mapping were based in Asia.

Fuel focus (Global)
- Hydrogen only
- Ammonia only
- Methanol only
- Biofuel only
- Multi-fuel

Fuel focus (Asia)
- Hydrogen only
- Ammonia only
- Methanol only
- Biofuel only
- Multi-fuel
In the last 6 months, we have seen around 10% of the projects from the first edition announce new phases of development, increases in size or ambition or move from concept study stage to demonstration stage.

Of the 106 projects in the mapping, just over half (54) received some amount of direct public funding to the project. The majority of this funding originates in Europe.

The largest awards of public funding in the mapping continue to go to large scale fuel production projects.
What Next?

◉ The second edition of the mapping is now publicly available, including the full list of projects with links to further information.

◉ It is hoped that by making the second edition publicly available, the mapping can provide support to potential first movers in helping them to draw upon learnings from other projects and improving confidence in undertaking these initiatives.

◉ The mapping will be updated on a continuing basis by the Getting to Zero Coalition, with future reports being released biannually.
Thank you

If you’d like to know more, please contact Jesse Fahnestock at jf@globalmaritimeforum.org
April 14, 2021

Integrated Project for Development of NH3 fuel Ship with Fuel Supply Chain

ITOCHU Corporation Marine Department
1. Introduction

Founded: 1858 (incorporated 1949) as of Apr 1, 2020
Number of employees: 4,319
Number of offices: 94 (oversea) & 9 (domestic)
Website: http://www.itochu.co.jp

Business Activity
- Ship Trading / Finance
- Ship Owning
- Investment of LNGC & Off-shore unit

: Internal partnership for NH3 fuel value chain
2. Integrated Project with partnership

**Shipbuilding**
- ClassNK
- NIHON SHIPYARD
- Engine Supply
  - Mitsui E&S
  - MAN

**Shipping**
- End-User
  - Charter

**Bunkering**
- (Other)
- (Japan)
- (Singapore)

**Fuel**
- ITOCHU
  - Partnership
  - Producer

** IMO**
- ABS
- NTU
- ASTI
- ABS
- VOPAK
- Local Partner
- Shipping Co
- UBE
- UYENO
- ENEX
- ENEX
- Shipping Co

**Local Partner**
- ENEX
- Shipbuilding
- Shipping
- Bunkering
### 3. Target for Pilot Project

<table>
<thead>
<tr>
<th>Item</th>
<th>Target for NH3 Fuel Ship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept</td>
<td>■ Dual Fuel (NH3 &amp; LSFO)</td>
</tr>
<tr>
<td>Pilot Project</td>
<td>■ 10 units of Bulk Carrier and/or Tanker based on Shippers demand</td>
</tr>
<tr>
<td>Delivery</td>
<td>■ 2025 – 2026 for first 10 units (but subject to Rules below)</td>
</tr>
<tr>
<td>NH3 Bunkering</td>
<td>■ Singapore &amp; Japan (under development with partners)</td>
</tr>
<tr>
<td>Rules</td>
<td>■ Alternative Design Approval under SOLAS to be considered</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Target for NH3 Fuel Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH3 specification</td>
<td>■ Current specification (but subject to further study)</td>
</tr>
<tr>
<td>NET CO2 Emission</td>
<td>■ NET CO2 Emission to be less 1-CO2-ton against production of 1-NH3-ton</td>
</tr>
<tr>
<td>Terms</td>
<td>■ Multiple years basis with INDEX link</td>
</tr>
<tr>
<td>Price INDEX</td>
<td>■ To be discussed during development</td>
</tr>
</tbody>
</table>

**KEY for development of Pilot Project**

- Demand from Shippers / End-User for challenge of zero-emission ship
- Economical incentive for Shippers / End-User for such challenge
4. Key for decarbonisation

**International**

- Safety Rules (Ship)
- Emission Control (EEDI / EEXI / CII)
  - Long Term Plan including rules & regulations for Newbuilding / Existing ships
- Linkage with Country’s Responsibility
  - Compliance with the IMO global regulations
  - Reliable and objective standards supported by survey and certification as to ship performance
- Incentive
  - For End-User & Ship-owner
- Carbon Levy
  - To be required if no “Incentive”

**Local**

- Safety Rules (Bunkering)
- Incentive (End-User)
- Incentive (Ship-owner)
- Carbon Pricing

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“COST & REGURATION” is KEY for decarbonisation
THANKS
NYK’s views and project using ammonia for zero-emission ships

April 14th, 2021

Tsutomu Yokoyama
Senior General Manager
Green Business Group
NYK Line
NYK Group Fleet and Facility

**Vessel**
- 58 container ships
- 114 capesize bulkers
- 92 panamax bulkers
- 155 handysize bulkers
- 43 wood chip carriers
- 111 car carriers
- 56 tankers
- 78 LNG carriers
- 41 multi-purpose carriers
- 28 shuttle tankers
- 155 handysize bulkers
- 43 wood chip carriers
- 111 car carriers
- 56 tankers
- 78 LNG carriers
- 41 multi-purpose carriers
- 28 shuttle tankers
- 1 cruise ship
- 3 FPSOs
- 2 FSOs

**Air Freighter**
- 8 aircrafts
- 5,227 flights in 2020

**Terminal**
- Operating at 21 ports in 2020

**Logistics Center**
- 609 locations
- 3.1 million m²

*For the year ended March 31, 2020

*As of March 31, 2020

For Ammonia as a marine fuel in Asia (Apr 14h, 2021)
NYK’s Medium-term Strategy

“Staying Ahead 2022 with Digitalization and Green”

Promoting “Green Business” to Drive Future Growth and Create New Value as a Shipping Company

- Hydrogen/Ammonia
- Offshore wind power
- LNG bunkering

- World’s first LNG-fueled car carrier
- World’s first LNG bunkering vessel
- Japan’s first LNG bunkering vessel

For Ammonia as a marine fuel in Asia (Apr 14h 2021)
Due to engine output size, ammonia combustion is expected to be suitable for ocean-going vessels. NYK predicts that liquefied hydrogen fuel combustion engines (H2 gas turbines, etc.) will be put into practical use and spread after 2040.
NYK would like to contribute to whole NH3 supply chain.

Our Target

- Our target scope will be not only ocean transportation but also other parts of the chain. (e.g. Production / Bunkering etc.)
- We will try to contribute to develop supply chain with partner companies.
NYK started three joint R&D projects from Aug 2020 for use of CO2-free ammonia as an alternative fuel for vessels.

<table>
<thead>
<tr>
<th>Project</th>
<th>Partner</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A-Tug</strong></td>
<td><strong>IHI Power Systems</strong></td>
<td><img src="image1.png" alt="A-Tug Image" /></td>
</tr>
<tr>
<td>(Ammonia-fueled Tug)</td>
<td>ClassNK</td>
<td></td>
</tr>
<tr>
<td><strong>AFAGC</strong></td>
<td><strong>NIHON SHIPYARD</strong></td>
<td><img src="image2.png" alt="AFAGC Image" /></td>
</tr>
<tr>
<td>(Ammonia-fueled Ammonia Gas Carrier)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>A-FSRB</strong></td>
<td><strong>ClassNK</strong></td>
<td><img src="image3.png" alt="A-FSRB Image" /></td>
</tr>
<tr>
<td>(Ammonia Floating Storage Regasification Barge)</td>
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</tbody>
</table>
NYKs plan to scale up NH3 business

NYK plans to scale up NH3 business with steady steps based on cultivated knowledge and experience on maritime field.

**Step 1**

**A-Tug**
(Ammonia Fueled Tug)

- Early realization of ammonia fueled vessel and NH3 bunkering.

**Step 2**

**AFAGC**
(Ammonia Fueled Ammonia Gas Carrier)

- Contribution to early realization of zero emissions oceangoing vessel
- Bunkering function is not required.

**Step 3**

**AFV** (Ammonia Fueled Vessel)
**ABV** (Ammonia Bunkering Vessel)

- Realization of NH3 supply chain with early introduction of ABV and AFV
NYKs transition plan (in Pure Car and Truck Carrier case)

NYK plans to convert PCTC fleet to zero emission vessels in the next decade. *NYKs PCC fleet: 111 vessels as of Mar 2020

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For Ammonia as a marine fuel in Asia (Apr 14th 2021)
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