

May 13, 2022

Fleet Management Limited

Keppel Offshore & Marine

Maersk Mc-Kinney Moller Center for Zero Carbon Shipping

Sumitomo Corporation

American Bureau of Shipping

Kawasaki Kisen Kaisha, Ltd.

Acceleration of Study on establishing ammonia supply chain for bunkering in Singapore and Receipt of Approval in Principle for Ammonia bunkering vessel

The Consortium, consisting of A.P. Moller - Maersk A/S, Fleet Management Limited, Keppel Offshore & Marine, Maersk Mc-Kinney Moller Center for Zero Carbon Shipping, Sumitomo Corporation and American Bureau of Shipping ("ABS") (collectively the "**Consortium**"), is pleased to announce the addition of Kawasaki Kisen Kaisha, Ltd. ("K"LINE) and Maritime and Port Authority of Singapore ("MPA") to the Consortium, and the receipt of Approval in Principle ("AiP") from ABS for the design of an ammonia bunkering vessel.

During the Singapore Maritime Week on 6 April, a memorandum of understanding ("**MOU**") was signed by the Consortium with "K" LINE and MPA to develop the ammonia bunkering ecosystem at the Port of Singapore, the largest bunkering port in the world.

This follows a feasibility study jointly launched by the Consortium in March 2021 to develop an ammonia bunker supply chain in Singapore. In the past year, the Consortium identified potential ammonia supply sources and indicative costs, as well as undertook the preliminary design and cost estimation for critical infrastructure, such as ammonia storage tanks and bunkering vessels, leading to the AiP from ABS for the bunker vessel design.

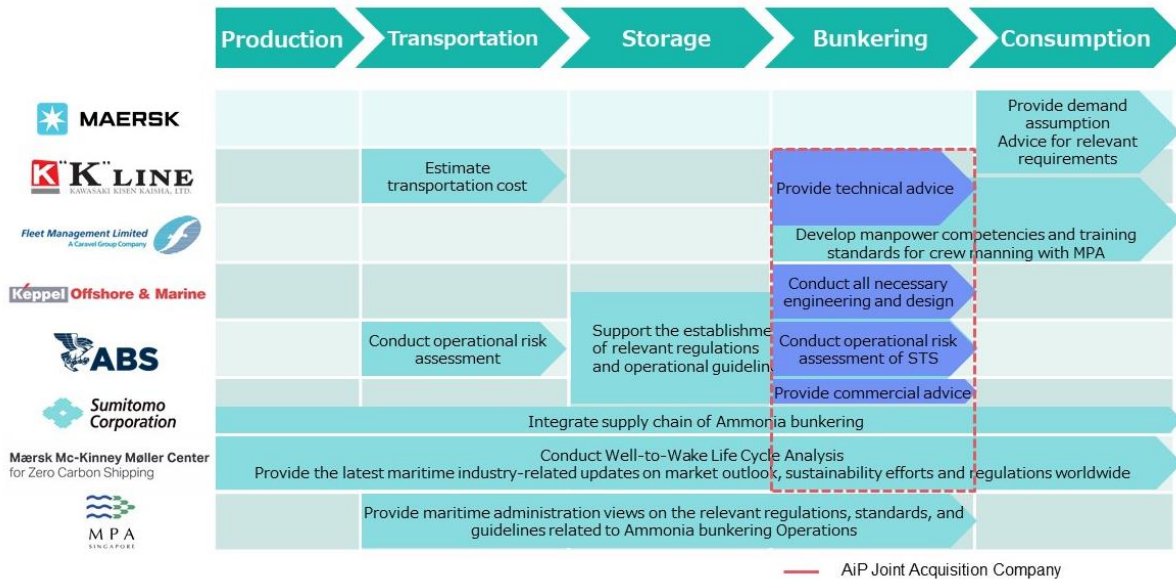
With the addition of "K" LINE and MPA as new members, the parties will build on the current findings and begin development works to establish an integrated supply chain, with the goal to commence ammonia bunkering by 2030.

The parties will continue to seek cooperation with various stakeholders of the maritime industry and relevant Singaporean ministries and agencies to realize the world's first ammonia fuel supply chain.

These developments are in line with the International Maritime Organization's (IMO) initial strategy to halve greenhouse gas (GHG) emissions within the shipping industry by 2050 compared to 2008 levels. Ammonia, which does not emit CO₂ when burned, is expected to be one of the most promising alternative marine fuel that has the potential to make significant contributions to reducing GHG emissions in the shipping industry.

<Reference>

■Key roles of each member



■Executive Summary of Phase 1

(Attached) *NH3 Bunkering in Singapore Joint Feasibility Study Summary of Phase 1*

■Image of Ammonia Bunkering Vessel



■ Signing Ceremony



■ Comment

(a) FML

Mr. Kishore Rajvanshy, Managing Director of Fleet Management Limited

"It has been great collaborating with our partners over the past year. We're very excited for this next phase where the focus is on the development of ammonia bunkering, including the design of the vessel and the processes and procedures that will make the use of ammonia as a marine fuel a reality."

(b) Keppel Offshore & Marine

Mr. Chris Ong, CEO of Keppel Offshore & Marine

"We are pleased to partner the consortium and pioneer the development of green infrastructure such as ammonia bunkering vessels. Leveraging our in-depth engineering and shipbuilding experience as well as LNG bunkering expertise, we are able to contribute to a holistic range of low carbon solutions, such as ammonia as a marine fuel, that will reduce carbon emission and drive the industry's energy transition."

(c) Center**Mr. Bo Cerup-Simonsen, CEO of Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping**

"Close collaboration between public and private sector is crucial in order to decarbonize the maritime industry by 2050. Safe handling of ammonia in ports and onboard vessels is a perfect example of an area that requires effective collaboration between multiple parties as operational, safety, environmental and regulatory issues must be solved in parallel. With MPA onboard we have optimal conditions for a large scale demonstration to support the development guidelines, safety frameworks and standards for the ammonia fuel pathway."

(d) ABS**Mr. Georgios Plevrakis, ABS Vice President of Global Sustainability**

"Ammonia is a fuel with significant potential as a solution for shipping companies looking to decarbonize their operations. ABS is committed to supporting its safe adoption by the industry. We are proud to be able to our industry-leading insight to support our partners with this landmark project."

(e) "K"LINE**Mr. Yukikazu Myochin, President & CEO, Kawasaki Kisen Kaisha, Ltd.**

"We are proud to participate in this innovative project in Singapore as a world class bunkering hub and play a crucial role to cope with common challenge towards decarbonization of global shipping. We believe the collaboration with leaders in maritime industry under this MOU will contribute to develop ammonia bunkering in Singapore and the attainment of Approval in Principle for ammonia bunkering vessel is a remarkable milestone in our journey to decarbonise global shipping."

(f) Sumitomo Corporation**Mr. Koji Endo, General Manager of Energy Division, Sumitomo Corporation**

"We see ammonia as an important future fuel to contribute to the realization of a decarbonized society. Through the close collaboration among like-minded partners in the past year, we have gained not only AiP for the Ammonia Bunkering Vessel but immense insights, both technical and commercial, on the key drivers and challenges to establish an end-to-end supply chain for ammonia bunkering. Leveraging on these insights, and with the addition of strong partners like MPA and "K"LINE to the MOU, we are confident that we can meaningfully progress the development works and target to be among the first to commence ammonia bunkering business in Singapore."

PROJECT SABRE

NH₃ Bunkering in Singapore
Joint Feasibility Study
Summary of Phase 1

06 APR 2022



The SABRE project

On 8 Mar 2021, SABRE partners entered into an MOU to conduct a year long feasibility study to assess the technical, commercial and regulatory viability in establishing an end-to-end supply chain to enable Ammonia Ship-to-Ship (“**StS**”) bunkering in Singapore (“**Study**”).

With the preliminary target to commence Ammonia bunker operation within 2020s, the scope of Study includes identifying potential sources of Ammonia, engaging local authorities to understand the current standing and plan for regulatory establishment, the infrastructure that needs to be put in place, as well as the availability of technology to enable Ammonia bunkering in Singapore.

The Study assumed the development of Ammonia bunkering in two (2) stages, i.e. Pilot stage (“**Pilot**”) before scaling up to Commercial stage (“**Commercial**”), based on a set of Ammonia bunker demand projections.

SABRE Partners



Phase 1 Report - Executive Summary

In recent years, it has been reported that International shipping accounting for 90% of global trade and contributing to approximately 3% of global greenhouse gas (“**GHG**”) emissions. With the International Maritime Organization (“**IMO**”) targeting 50% reduction in GHG emission by 2050, as compared to 2008 emission level, green and blue ammonia (“**Ammonia**”) have been considered by the maritime industry as one of potential alternative marine fuels to decarbonize the maritime trades due to reasons being a) ammonia is an existing industrial commodity, has been stored and transferred globally; b) various potential Ammonia production sites under development globally; c) scalable for other potential downstream uses, e.g. power generation and hydrogen-carrier.

Production

While there are various global Ammonia production projects under planning, none has yet achieved FID at the time of reporting.

The largest capacities of green and blue ammonia production facilities under planning are reported to be up to 2 gigatons annum (“**GTPA**”) in Australia and 5 GTPA in Russia respectively.

Indicative price of Ammonia was obtained from preliminary discussion with potential suppliers as part of the Study. While cost of green ammonia is likely to be CAPEX driven, a significant part of blue ammonia cost is likely to be pegged to grey ammonia pricing. Further, life cycle assessment analysis (“**LCA**”) of selected Ammonia supplier has been conducted and preliminary findings show that the Well-to-Wake GHG emission of selected projects is expected to be lower than that of LNG and LSFO by up to 99%.

Subject to location of Ammonia source and size of carrier to transport from source to Singapore, we could estimate transport cost.

Storage

To date, there is only one existing ammonia storage tank in Singapore (Jurong Island) meant for specialty chemical and other specific downstream applications. Various storage terminal operators with operations in Jurong Island have been engaged. Undeveloped lands in Singapore may be potential sites for Ammonia storage, but subject to various factors, e.g. Qualitative Risk Assessment, land allocation, etc. Subject to Ammonia carrier capacities and operation storage buffer requirements, various storage configurations were considered.

Onboard safety

The parties have studied ideal size of Ammonia bunker vessel (“**ABV**”) for Singapore bunker operation. Preliminary requirements of the ABV has been discussed as part of the Study and hazard identification (“**HAZID**”) workshop has been conducted, with the objective to achieve Approval-in-Principle for the ABV.

In terms of safety standards and regulations on Ammonia bunkering, beside timely engaging with Maritime and Port Authority of Singapore (“**MPA**”), Global Centre for Maritime Decarbonization (“**GCMD**”) has embarked on a study to address technical, procedural and regulatory guidelines for ammonia transfer and bunkering, which is expected to be complemented with pilot trial. The parties are hopeful that such initiatives by the local authorities expedite the enabling of Ammonia bunker supply chain.

Key findings and takeaways

- Well-to-Wake GHG emission of selected Ammonia production projects is expected to be lower than that of LNG and LSFO by up to 99%.
- Various storage terminal operators with operations in Jurong Island have been engaged.