

SMI Webinar: Alternative Fuels for International Shipping
Answers to Questions posted on Slid.do during the Panel Discussion
16 April 2020

QUESTIONS

No.	Question	Answer
1.	Is Ammonia considered as a potential future fuel?	Yes, ammonia is considered a promising future marine fuel. However, the implementation of ammonia demands a set of clearance such as availability, safety, bunkering and new engine. It is also important to note that source of Ammonia must also be green to meet decarbonisation targets.
2.	If a company is to plan building a new ship in the next 1-2 years with an expected life of 25-30 years. Which is the safest fuel / fuel combination to choose in your opinion?	<p>It is important to watch what is happening around based on own operations.</p> <p>It depends on the type of ships, size, use (fixed route or not), and also considering the safety aspect. It is not easy to give a straight forward answer. MESD centre has been doing a lot of research on harbour craft. In terms of smaller ships, we can consider e.g. bioenergy, electrification or battery, depending on the operating profile of the harbour craft, since they have a more fixed route or on expected route with known traveling distance.</p> <p>LNG can also be a candidate. LNG can reduce GHG emission, and its price is competitive. In future, bio-LNG may kick in also. It is also important to assess the route, the availability and sufficiency of LNG infrastructure.</p> <p>A few tips to make the decision: firstly, to work out the fuel consumption, secondly to assess the engine makers regarding how prepared they are in terms of alternative energy sources. As complexity will increase, ship builders and operators will have to have the means to deal with the complexity, which includes understanding the different operations of the vessels.</p>
3.	A question related to LNG - What are your views on the methane slip? There is a concern that methane levels will increase if LNG is used. This will increase GHG emissions.	<p>Yes, this is a valid concern when low pressure gas engines are used. The leakage from upstream supply chain is also another source of GHG emission, which is less discussed or quantified.</p> <p>Engine manufacturers have been putting continual R&D efforts to minimise methane slip. This has been discussed on page 20 in the report.</p>
4.	Thanks for the informative presentation. Can you please advise the feasibility of batteries or battery powered vessels? As this was not specifically covered in the slides	<p>In the report, electricity is considered as an alternative fuel derived from non-bio renewable energy and sometimes as a secondary energy source. Electricity can go in conjunction with water electrolysis for hydrogen production. So these are versatile and accessible approaches in maritime energy utilisation and we consider the role of electrification to be complementary to future alternative fuels as a secondary energy source.</p> <p>Electrification is being studied separately. A report will be released in due course.</p>
5.	Heard about a company in Singapore developing scrubbers to capture the CO ₂ , NO _x emissions up to 70% sufficient to meet the present IMO targets. How does this fare up against the next Generation Alternate fuels considering the various unknown and economics Commercial viability around the new fuels?	It is challenging to remove CO ₂ and NO _x in one scrubbing process, let alone storing them onboard for safe discharge later. However, the process may complement the main stream alternative fuel development.
6.	I would like to ask about the impact of the government in promoting marine fuel transition, e.g. port authorities to provide financial supports for capacity expansion. Thanks for the nice presentation and all info sharing! :)	When developing policies, there is a need to balance the various tensions and responsibilities of all different sectors. There is political will to do the right thing, not only for Singapore, but humanity at large. The question is the speed and pace that these changes happen. MPA has previously funded a LNG technology project on the tugs. There is financial type of support for capital expenditure where as a whole, the government agencies feel this is the right strategical direction to go.

		<p>Maritime community in Singapore is very cohesive. It is crucial to have the government, R&D communities, industry, and all the stakeholders to work together on the new initiatives. In terms of the role and impact of the government, MPA has been doing a lot including promoting and conducting research and joining efforts with different stakeholders. These new initiatives need further collaboration.</p> <p>This is work in progress recognising the complexity of options on the horizon and its impact on the supply chain.</p>
7.	In the estimation of supply sufficiency of alternative fuels, how much consideration has been given to competing demand, which attracts a higher price. e.g., for biofuels, may have strong competition from aviation sector.	At this stage, we looked into the competing demand by other sectors (including in power generation, automobile, aviation and other industries) in terms of the amount of biofuels. We will further explore on how these competing uses (of biofuel product) and also feedstock of biofuel products will impact prices and affect the shipping industry.
8.	There are parallel researches going on for Ammonia, MCH and other hydrides as H2 carriers. Which of these have achieved maturity for application? And which of these are scalable in terms of safety and availability.	From process point of view, the mentioned hydrogen carriers all achieve certain maturity for application. Perhaps ammonia is the nearest to implement when scalability is concerned. For more information, you can refer to chapter 2.1 in MESD's 2019 report "Project Hafnium: Feasibility Study of Hydrogen as Fuel for PSV Applications" via the following link: https://coe.ntu.edu.sg/MESD_CoE/Publications/Pages/Home.aspx
9.	We can see currently how much a pandemic such as Covid 19 is disrupting economy and changing fuel price landscape. Considering possible periodic occurrence, would this setback the alternative fuel demand?	Taking many countries being affected by COVID-19 as example, the transportation sector is mostly affected, hence the reduced demand of energy or fuel. This is irrespective of fuel type. Furthermore, decarbonisation is not just an economic question, it is about addressing the perils of climate change and as such the momentum to decarbonise should not let up.
10.	Don't we have to see e.g. Ammonia more as an energy carrier? Nuclear as energy source to make Ammonia would then be a zero CO ₂ option as well as solar or wind.	Yes, nuclear as energy to make "green" ammonia is a promising route to explore. Green ammonia produced via this route is shown in the LCA of the GHG emission of Ammonia produced from nuclear sources using Selective Catalytic Reactor (SCR) (refer to page 38, figure 5 of the Alternative Fuels report). There is a need to convert Ammonia from an energy carrier to power via either ICE or fuel cell.
11.	Have you considered the possibility of the fuel mix evolving into different fuels being optimal for different purposes in shipping? e.g. hydrogen being practical for short-sea shipping with frequent bunkering possibilities; and ammonia for deep-sea shipping?	There will not be a dominant fuel in the future. Yes, it will be multi-fuel future tailored for different purposes for shipping and each case. In the long run, large ships of deep-sea shipping may take ammonia as a practical solution. Hydrogen may be practical for short-sea shipping in regions of the world with access to low-carbon generation sources at affordable price. Future innovative technological advances will change the adoptability of potential solutions, so we must keep vigilant on technological scans and prepare for flexible systems that can adapt at minimal cost.
12.	What kind of new fuels are being tried out by the aviation industry?	The aviation sector is looking into "biofuel" for their future clean alternatives. You can refer to page 24 of this attachment .
13.	Regarding Bio-LNG, what would be the difficulties for uptake in SEA? How do you see the uptake roadmap in Singapore?	The availability of production capacity and supply to the marine sector will be key along with OEM approvals. We have not done any specific work for SEA and Singapore.
14.	Can you please advise If we have input or views from the ship owners and managers on how they see feasibility of the various alternatives fuel options and what are they looking into as they are already ordering new ships that will last for 20 to 30 years?	The report has incorporated the inputs from external advisors from SSA, SMI, MPA and industry veterans.
15.	Dr Prapisala, thank you. 2 Qns. (1) For alt. fuel (bio-fuel / Bio-LNG), is the production of these fuels concentrated in 1 geographic area (e.g. S.East Asia)? Or is the production spread across various geographical location? (2) What is the largest life cycle investment required for H ₂ as a fuel?	After coal, oil and natural gas, biomass (i.e. feedstock of biofuels) is the world's fourth largest energy source worldwide. In comparison with fossil fuels, biomass feedstock are distributed more evenly in the world. However, the production of biofuels (especially from feedstock like waste and dry plants) is not realised worldwide and many of them are in the stage of demonstration plants. The life cycle investment is very important for the availability of the alternative fuels. Currently, we are conducting the 2 nd phase of this project to evaluate the life cycle investment for H ₂ and other biofuels.

16.	There have now been 4 land-based hydrogen accidents within the past 12 months - one as recently as one week ago. Will safety issues using H2 at sea be properly addressed in time for 2030, to make it safe, as well as cost effective?	The usage of all new alternative fuels will have to be technologically ready and deemed safe by the marine community before large scale usage. In the report, we have projected hydrogen and hydrogen carriers fuel will be more common post 2030.
17.	Kindly advise why H2 solution is not possible between 2020-2030 despite being possible long term solution for 2050. Noticed there are some development for H2 shipbuilding in recent years.	Please refer to section 3.4 in the report for further details.
18.	Will there be a study in which type of ships e.g. bulkers, containers, tankers in using Alternative Fuels?	There is no plan at the moment for further study for specific merchant vessels. We do have alternative fuel study on harbour crafts, which provides a categorized projection and recommendation. The report will be released in a future date.
19.	What are the prospects of using Ammonia as an alternative fuel (not as a carrier for h2)? Taking into consideration an established infrastructure in place as well as developing fuel cells tech that can use ammonia directly.	Technically all the safety issues with ammonia have been well addressed by land based chemical industry. Ammonia as future marine fuel will need to be originated from green resources such as solar and wind. The bunkering facility and engine technology also need to keep up.
20.	Given the drastic fall of crude oil price and the tremendous drop in energy demand, how would this change the scene of efforts in alternative fuel study, given the associated higher cost? Has IMO been responding to this?	The fall in crude oil prices and energy demand is due to various short-term reasons. But efforts in implementing alternative fuels is envisioned to reduce carbon emissions in the long run.
21.	What is the industry's direction towards the fuel costs? Definitely the alternate fuel is not going to be competitive initially compared to conventionally available fossil fuels. Are governments/Flags working on any initiatives to promote first movers?	Decarbonisation is an effort to address an existential threat to humanity, therefore we need to balance economic and environmental sustainability as a responsible business or government. Each country will have to decide on the alternative fuel they can supply to the maritime industry.
22.	In terms of biofuels, and specifically in regards to Indonesian B30 fuel requirement for offshore vessels - is there an enhanced risk of engine breakdown? Do these fuels fit Solas flashpoint requirement?	Engine OEMs should have guidelines that protect their warranty, best to refer to them. The flashpoint of pure biodiesel is considered high (140-160°C) in comparison with that of diesel. One of the research works shows that the flash point of biodiesel blended diesel (such as B10, B20 and B30) is higher than 80°C. Therefore, flash point is unlikely to be the issue for the application of biodiesel. However, there are other technical issues of using biodiesel (including cold flow properties, material compatibility and its degradation. For more information, please refer to Page 23 of the report.
23.	One of the slides mentioned that the TRL for fuel cell technology is 6. To my knowledge, fuel cell technology has been used in a couple of naval submarines. Storage and safety issues related to Hydrogen have been addressed. Can we make reference to that for application on ships?	We are aware of the application of H ₂ -fuel cell for submarine. However, there are still many issues to overcome for commercial vessels (particularly for main propulsion). In fact, the exploration of H ₂ carriers is one of the main topics for H ₂ at moment. Therefore, the topic of ammonia has gained attention from industry now.
24.	If metal hydrides are the most promising carrier for hydrogen, how long do you think it will take to become a viable fuel including the distribution network, production capacity, etc? Will it be in time to meet the 2050 target?	Metal hydride can improve the operability of compressed and liquefied H ₂ for onboard ship operation in term of volumetric energy density and safety. However, there are still major concerns with the weight. With advancement in material science, there are potential approaches to improve. It is hard to see it become the most promising candidate for 2050. It will be post 2050.
25.	From the presentation, Methanol is one of the alternative fuels with much advantages compare with other solutions, in terms of production / consumption technology, as well as cost of handling and storage for marine. Why it is not being highlighted for selection for future fuel for Maritime?	The availability of "green" methanol is still a big challenge. This would require a global effort to set up the renewable energy production and biomass collection/conversion.

COMMENTS

No.	Comment	Answer
1.	I do understand that it's a future fuel seminar but meeting the IMO 2030 and 2050 is not only a job of fuel. The energy efficiency of the ships is very low today. This efficiency improvement itself will contribute significantly towards the emission reduction. it's more of a comment.	Agree, it will be a multipronged effort to reduce maritime carbon emissions, alternative fuels will be one but a significant level to pull.
2.	In response to the earlier question about methane slip, just wanted to share a recent report published by Wärtsilä which could be of interest: https://www.wartsila.com/media/news/06-04-2020-cutting-greenhouse-gas-emissions-from-lng-engines	Thanks for providing the link to the report.
3.	Ammonia usage on ships should not be seen in isolation but should be seen with the development of autonomous shipping when thinking about the toxicity concern. In my opinion, ammonia is the next best available to LNG.	Yes, provided that green ammonia production is keeping up.