INTERSESSIONAL MEETING OF THE WORKING GROUP ON REDUCTION OF GHG EMISSIONS FROM SHIPS
6th session
Agenda item 5

ISWG-GHG 6/5/3
27 September 2019
ENGLISH ONLY

FURTHER CONSIDERATION OF CONCRETE PROPOSALS TO ENCOURAGE THE UPTAKE OF ALTERNATIVE LOW-CARBON AND ZERO-CARBON FUELS, INCLUDING THE DEVELOPMENT OF LIFECYCLE GHG/CARBON INTENSITY GUIDELINES FOR ALL RELEVANT TYPES OF FUELS AND INCENTIVE SCHEMES, AS APPROPRIATE

The climate impact of Liquefied Natural Gas as a fuel for shipping taking into account methane slip from marine engines and from the supply chain

Submitted by CSC

SUMMARY

Executive summary:	This document provides input to discussion on the suitability of LNG as alternative fuel to decarbonize shipping and concludes that LNG is not a climate solution for shipping
Strategic direction, if applicable:	3
Output:	3.2
Action to be taken:	Paragraph 19
Related document:	MEPC 74/18

Introduction

1 MEPC 74 instructed ISWG-GHG 6 to further consider concrete proposals to encourage the uptake of alternative low-carbon and zero-carbon fuels, including the development of lifecycle GHG/carbon intensity guidelines for all relevant types of fuels and incentive schemes, as appropriate. With this submission, CSC presents elements of available scientific evidence on the GHG impact of one such alternative marine fuels, namely liquefied natural gas (LNG).

Climate footprint of Liquefied Natural Gas

2 LNG has become a fuel of interest for the maritime sector due to the forthcoming tighter air pollution standards for ships. As such, LNG is free of sulphur and its combustion may reduce, depending on the engine technology, nitrogen oxides (NO_x), making ships compatible with the Tier III standard.

3 In light of this, there has also been interest shown in the potential climate benefits of LNG. In theory the lower carbon content of LNG reduces on-board emissions of CO_2 when compared to conventional marine fuel. Using this simple chemical fact, some have suggested that switching from HFO/MGO to LNG would, in addition to providing air quality benefits, also reduce shipping's climate impact. However, evidence increasingly shows that the reality is more complex than that.

4 LNG, as a temporarily liquefied but naturally gaseous fossil fuel, is mostly made of methane (CH_4). Methane is not only a fuel, but also a potent greenhouse gas in its own right. Despite a shorter lifespan (about 10 to 12 years), the direct climate impact of fossil methane is 30 times greater per gram emitted than that of CO_2 in a one hundred year perspective (IPCC, 2013). In other words, in 10 to 12 years methane warms the planet 30 times more than the equivalent amount of CO_2 would warm it in 100 years. Over a shorter timeframe of 20 years, the warming impact of methane is 85 times larger per gram than CO_2 (IPCC, 2013). For this reason, avoiding even relatively small emissions of methane can help preserve the remaining GHG budget and our ability to meet the temperature goals of the Paris Agreement.

Methane slip from marine engines

5 LNG related methane release into the atmosphere can happen during the production, transportation, storage and bunkering, as well as during the on-board combustion of the fuel by ships. All such releases have direct consequences for the GHG balance of LNG compared to HFO/MGO.

6 Numerous studies (Ricardo, 2016; UMAS; 2018; Imperial College SGI, 2019) show LNG's GHG footprint is either comparable to that of MGO (the cleanest oil-based marine fuel) or worse. Other studies (e.g., Thinkstep, 2019) (funded by the natural gas industry) have claimed up to 21% GHG savings from the switch to LNG. The Thinkstep study in its analysis specifically refers to laboratory measurements of methane slip in marine engines undertaken by SINTEF, but in doing so, Thinkstep have made unrealistic and incorrect assumptions about the LNG supply chain as well as the methane slip in engines. This has led SINTEF to issue a public rebuttal of the analysis[*].

7 Marine engines capable of burning LNG as fuel can be divided into 2 categories: low and high-pressure engines. Both types of engine release un-combusted methane during operation, with low pressure engines releasing more than high pressure engines (Lindstad 2018; Ushakov 2018). The Thinkstep (2019) study investigating methane slip from marine engines used the testbed data from the NO_x testing cycle for their estimate of un-combusted methane. The use of the NO_x test cycle assumes that the engine operates at 75-100% power, 70% of the total time, but this is not representative of how engines in the real-world fleet are operated today. Most ships are operating around 50% of the time and use around 50% of installed power to operate at speeds 2 to 4 knots or more below the design speed (Smith et al., 2014; Fairplay, 2018).

8 Results calculated by Lindstad (2019) indicate that the only LNG option that may contribute to reducing GHG emissions, is the two–stroke high pressure dual-fuel option (HP-DF-LNG). For all other LNG options, the GHG emissions are larger or equal to emissions from the combustion of MGO or HFO. This stands in stark contrast to the Thinkstep findings.

[*] https://www.transportenvironment.org/publications/dr-elizabeth-lindstad-why-increased-use-lng-might-not-reduce-maritime-ghg-emissions-all

9 To illustrate the implications of engine methane slip on the GHG balance of an LNG ship, CSC decided to use **AidaNOVA**, a dualfuel LNG capable cruise ship, as a practical example. Using **AidaNOVA** engine specifications and SINTEF's rebuttal to the Thinkstep study, CSC estimated the most likely GHG footprint of **AidaNOVA** compared to its hypothetical equivalent running on MGO (see figure 1 below). This shows that with the engine technology chosen by **AidaNOVA** (a four-stroke low-pressure dual-fuel engine popular with cruise ships) using LNG results in more GHG emissions than using MGO. SINTEF expects that similar methane slip would be observed in two-stroke low-pressure dual-fuel marine engines as well.

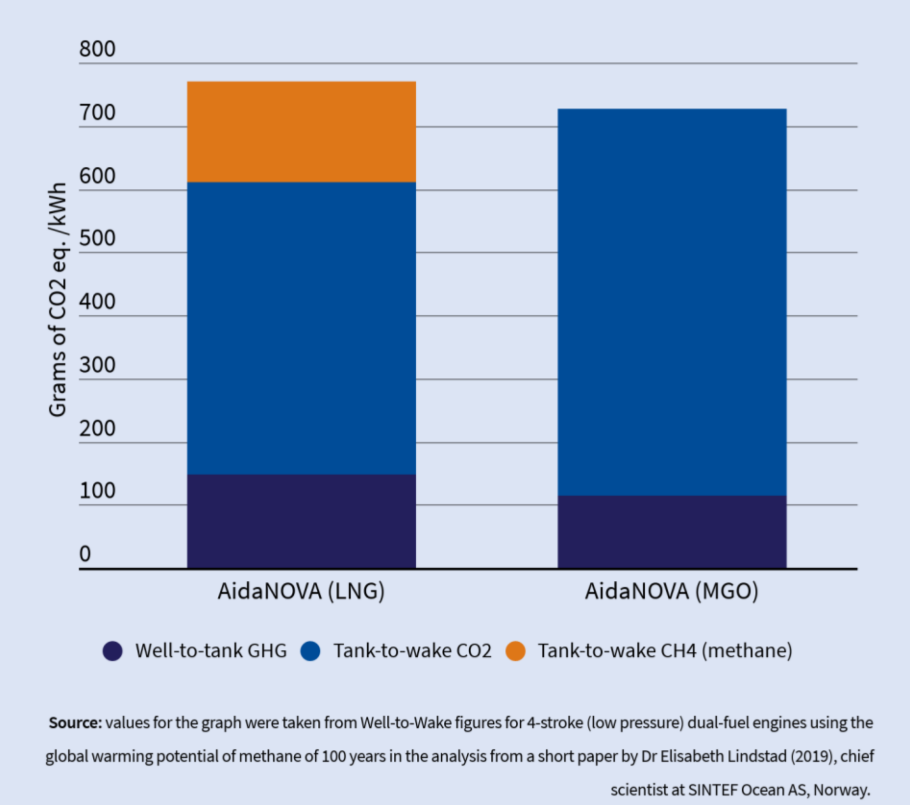

Figure 1: Comparison of CO_2 equivalent emissions of dual fuel cruise ship AidaNova running on either LNG or MGO

Methane slip from the supply chain

10 In addition to onboard methane slip, methane leaks along the supply chain remain a huge concern. Recent studies show that methane has been increasing in the atmosphere with rises attributed to the exploitation of unconventional sources of gas (Howarth, 2019). A study by Winebrake et. al., (2019) assessing emissions factors from new research also indicates that fugitive methane emissions in natural gas extraction, processing, and distribution activities are much higher than previously calculated, further weakening the environmental case for LNG.

11 Available evidence suggests that different LNG production sources have different upstream emissions (Ricardo, 2016). Even though current data can inform emissions modelling and policymaking on this subject, there is evidence showing that upstream methane emissions have been grossly underestimated (EDF, 2018). This means that any analytical effort to depict a complete picture of LNG's impact on climate will fall short of the objective.

12 Last but not least, LNG is a globally traded commodity. Once in the market, it will be difficult, if not impossible to track its origins. Even if one could identify the upstream methane footprint of different LNG sources, from a public policy viewpoint it would be impossible to enforce reduction measures that take account of it.

Impact of methane emissions on carbon budget in short term

13 LNG is still a fossil fuel and as such has no long-term future if the Paris Agreement goals, which assume emissions go to zero, are to be met.

14 In the shorter-term LNG is still a problem because only in the best-case scenario (HP-DF-LNG) may it result in lower emissions than MGO/HFO, and even in that case by only a small margin.

15 Additionally if we take into account the global warming potential of methane over a 20-year timeframe in place of the 100-year time frame the results assessing LNG for climate impact are much worse. This is due to the fact that un-combusted methane has the highest global warming impact in the first years after it has been emitted.

16 Even if LNG's methane leakage and slip issues were to be resolved, the widespread adoption of methane as a marine fuel would result in extensive stranded assets as shipping decarbonizes and other zero-emission fuels take over.

Conclusion

17 LNG has substantial methane emissions throughout the supply chain (well-to-wake), which means that even with the use of high-pressure engines, with lower methane slip, the overall life cycle analysis would show little or no carbon savings and, in many cases, worse performance compared to HFO/MGO.

18 Instead of engaging in a complicated and ultimately unproductive shift from one fossil fuel to another, activities under the IMO GHG Strategy should focus on delivering short-term emission reductions in the existing fleet and speeding up the development of genuine low carbon fuels and the roll out of zero emission vessels.

Action requested of the Working Group

19 The Group is invited to consider this information when further developing actions under the IMO GHG Strategy and to take action as appropriate.

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