Work Group #4: Sustainable Marine Fuels

Deliverable 3.1 Report Review Template

1. Report title	**Addendum: Life Cycle GHG Emission Study on the Use of LNG as Marine Fuel**
2. Publication date	September 2019
3. Author	thinkstep AG thinkstep is a software company with focus on software for environmental modelling purposes
4. Client (organization and type of organization, specifying private/commercial/public; research institute/interest group etc.)	SEA\LNG Ltd and Society for Gas as a Marine Fuel Limited (SGMF) SEA\LNG Ltd is a 'multi-sector industry coalition whose members work together to demonstrate the benefits of LNG as a marine fuel throughout the entire value chain'. SGMF 'is an NGO established to promote safety and industry best practice in the use of gas as a marine fuel'.
5. Context of study (e.g. project in the context of which report is published or titles of other reports if part of a series)	This note is a reply to the following commenting paper: Lindstad E. (2019), Increased use of LNG might not reduce maritime GHG emissions at all which commented the following study: thinkstep (2019), Life Cycle GHG Emission Study on the Use of LNG as Marine Fuel
6. Length (pages)	6
7. Link (or where to get if not available online)	https://sustainableworldports.org/wp-content/uploads/thinkstep_2019_Addendum-life-cycle-GHG-emission-study-report.pdf
8. Sector coverage	Maritime shipping

9. Main aim of the study	To respond to the issues raised by Lindstad from SINTEF regarding the 2019 study from thinkstep on the life cycle GHG emissions of LNG compared to HFO/MGO/MDO.
10. Methodology	None. This is a response on points, for which no methodology was applied.
11. Topic(s) and indication of the level of detail For example: • System Description - *A description of the full marine energy system.* • System Components - *A description of all the components.* • Infrastructure requirements for new fuels • Applicability - *which of the new fuels are expected to replace existing fuels?*	• Introduction – *Short description of first reply to the raised issues.* • Response to critique on well-to-tank calculations of heavy fuel oil (HFO) – *elaborate response* • Response to critique on engine efficiencies – *response, including explanation of the conversion method used in the Thinkstep report* • Response to critique on methane emissions and engine load points – *elaborate response*
12. What are the main conclusions from the report?	• The authors believe that, as long as HFO is considered a product with a positive market value, HFO should be accountable for certain refinery emissions. • The authors conclude that the fuel conversion method used in the Thinkstep study to calculate GHG emissions of marine fuels is suitable given the scope of the study. The consideration of specific engine efficiencies, pilot fuel and the urea solution are best practice. • The IMO E2/E3 cycle is an accepted, standardized methodology, which is repeatable and reproducible, and therefore is an appropriate approach to quantify the GHG emissions of vessel engines. All of these conclusions oppose the statements made in SINTEF (2019).
13. What fuel/energy type(s) are discussed in the report and in what level of detail? For example:	The calculation of CO_2 and CH_4 emissions of LNG, MGO and HFO as marine fuels is discussed. As part of the (qualitative) response, a few fuel consumption and GHG emission values are given as an example of the calculation method used. Furthermore, the optimal load point ranges of HFO/MGO/LNG-fuelled engines are given.

• Fuel description e.g. type, energy density, specific energy density, flash point, boiling point, fire point, flammability limits, hazardsT	
14. What environmental aspects does the report consider? E.g. Air quality emissions, climate change emissions (GHG + BC), other (for example terrestrial or underwater noise, water quality, emergency releases, fugitive emissions, odour, water resources, mining)	Greenhouse gas emissions (CO_2 and CH_4).
15. Does the report consider exhaust emissions only, or life-cycle, or both (or some other range of emissions)?	Both exhaust emissions and life-cycle emissions are considered.
16. If determined in the report, what are the emission rates/factors by pollutant? NOx, SOx, PM10, PM2.5, ultra fine PM, VOC, NH3, GHGs, Black carbon, and any others e.g. that may be unique to the fuel/energy.	No emission factors are determined in this document.
17. Does the report discuss barriers and opportunities for ships to use the fuel(s)/energy? Does the report identify the maturity level of the fuel on a regional or global scale with respect to use by vessels?	No.
18. Does the report discuss barriers and opportunities for ports to provide the fuel(s)/energy? Does the report identify the maturity level of the fuel on a regional or global scale with respect to provision by ports?	No.

19. Does the report include capital and operating cost estimates for the ship and/or land-side?	No.
20. When are the fuel(s)/energy expected to be at a demonstration stage vs. commercialization? For example: • Technology Readiness Level of the system - *Estimated maturity of the system technology* • On Board Safety Readiness Level of the system - *Estimated maturity of the risk mitigations on board (on a scale of 1-9)* • External Safety Readiness Level of the system - *Estimated maturity of the risk mitigations for bunker operations (on a scale of 1-9)*	This is not discussed.
21. Are the fuels suitable for short and/or long (trans-oceanic) voyages?	This is not discussed.
22. Does the report identify/discuss potential issues around community acceptance for this fuel, or potential social/community impacts associated with the system?	This is not discussed.
23. Other?	The report counters some of the statements/arguments by Dr. Lindstad (SINTEF, 2019): those on the attribution of well-to-tank emissions to HFO, the suitability of the calculation method applied in Thinkstep (2019) (including specific engine efficiencies), and the use of the IMO E2/E3 cycle to estimate methane emissions across the different engine load points.