



Work Group #4: Sustainable Marine Fuels

Deliverable 3.1 Report Review Template

1. Report title	Why LNG represents a bridge of pragmatism on shipping's road to decarbonisation
2. Publication date	May 2018
3. Author	Sea\LNG Ltd 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'.
4. Client (organization and type of organization, specifying private/commercial/public; research institute/interest group etc.)	n/a
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)	
6. Length (pages)	8
7. Link (or where to get if not available online)	https://sustainableworldports.org/wp-content/uploads/SEA-LNG_2018_Why-LNG-represents-a-bridge-of-pragmatism-report.pdf
8. Sector coverage	Maritime shipping

9. Main aim of the study	Main aim of the paper is to present arguments why an investment in LNG-fuelled ships makes sense although the shipping sector has to decarbonize.
10. Methodology	The paper uses existing literature to argue in favour of LNG as a maritime shipping fuel.
11. Topic(s) and indication of the level of detail For example: <ul style="list-style-type: none"> • System Description - <i>A description of the full marine energy system.</i> • System Components - <i>A description of all the components.</i> • Infrastructure requirements for new fuels • Applicability - <i>which of the new fuels are expected to replace existing fuels?</i> 	The following topics are covered without much detail in the paper: <ul style="list-style-type: none"> • Decarbonisation challenge – <i>a discussion of the challenges for the maritime shipping sector related to decarbonisation</i> • LNG as a shipping fuel – <i>a comparison between LNG and other maritime shipping fuels</i> • Stranded assets – <i>A discussion of stranded assets due to developments in the maritime shipping sector</i>
12. What are the main conclusions from the report?	LNG is available now and scalable, which makes it a good option for decarbonizing shipping today. Alternatives such as batteries and hydrogen will require huge investments and decades of developments before their potential can be realized. Also, the problem of stranded assets is relatively small with LNG. For these reasons, LNG makes sense as a long term, bridging solution for the marine energy transition.
13. What fuel/energy type(s) are discussed in the report and in what level of detail? For example: <ul style="list-style-type: none"> • Fuel description e.g. type, energy density, specific energy density, flash point, boiling point, fire point, flammability limits, hazards 	The paper focusses on LNG and also mentions: <ul style="list-style-type: none"> • Hydrogen • Batteries The characteristics of the fuels are not discussed in detail. They are mainly compared with each other with respect to technological readiness and safety.
14. What environmental aspects does the report consider? E.g. Air quality emissions, climate change emissions (GHG + BC),	The paper considers both greenhouse gas and air pollutant emissions.



<p>other (for example terrestrial or underwater noise, water quality, emergency releases, fugitive emissions, odour, water resources, mining)</p>	
<p>15. Does the report consider exhaust emissions only, or life-cycle, or both (or some other range of emissions)?</p>	<p>For greenhouse gas emissions the stated emission reduction potential of LNG is in terms of well-to-wake emissions whereas for air pollutant emissions the emissions reduction potential of LNG is given in terms of exhaust emissions.</p>
<p>16. If determined in the report, what are the emission rates/factors by pollutant? NO_x, SO_x, PM₁₀, PM_{2.5}, ultra fine PM, VOC, NH₃, GHGs, Black carbon, and any others e.g. that may be unique to the fuel/energy.</p>	<p>This is not specified in the paper.</p>
<p>17. Does the report discuss barriers and opportunities for <u>ships</u> 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?</p>	<p>The paper discusses the barriers to the use of hydrogen and batteries in shipping and the opportunities for the use of LNG in shipping.</p> <p>The paper identifies the maturity level of LNG and hydrogen on a global scale.</p>
<p>18. Does the report discuss barriers and opportunities for <u>ports</u> 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?</p>	<p>The paper discusses the barriers to the supply of hydrogen and argues that the supply of LNG is already advanced and just requires additional upscaling.</p> <p>The paper discusses the maturity level of the supply of hydrogen and LNG on a global scale.</p>
<p>19. Does the report include capital and operating cost estimates for the ship and/or land-side?</p>	<p>The paper gives examples of estimations of capital costs required to scale-up port LNG bunkering infrastructure (page 6). The paper does not give cost estimates for the ship side, but stresses that an LNG-fuelled ship with a dual fuel engine allows ship owners to transition with minimal costs to low emission fuels (e.g. bioLNG and 'power-to-gas' fuel).</p>
<p>20. When are the fuel(s)/energy expected to be at a demonstration stage vs. commercialization?</p>	<p>Fossil LNG is assessed to be commercially available today.</p>



<p>For example:</p> <ul style="list-style-type: none"> • Technology Readiness Level of the system - <i>Estimated maturity of the system technology</i> • On Board Safety Readiness Level of the system - <i>Estimated maturity of the risk mitigations on board (on a scale of 1-9)</i> • External Safety Readiness Level of the system - <i>Estimated maturity of the risk mitigations for bunker operations (on a scale of 1-9)</i> 	<p>In contrast, the production and supply chains of hydrogen are assessed to be currently underdeveloped, the hydrogen storage and propulsion systems to be currently immature and the use of hydrogen as marine fuel is stated to face technical, operational, and commercial challenges. It is expected to take a decade to overcome these challenges. Batteries are stated to have a role in hybrid propulsion systems and to be potentially suitable for short-sea shipping operations in the future.</p>
<p>21. Are the fuels suitable for short and/or long (trans-oceanic) voyages?</p>	<p>The paper argues that LNG is suitable for deep-sea voyages whereas batteries are not.</p>
<p>22. Does the report identify/discuss potential issues around community acceptance for this fuel, or potential social/community impacts associated with the system?</p>	<p>This is not specified in the paper.</p>