



## Work Group #4: Sustainable Marine Fuels

### Deliverable 3.1 Report Review Template

1. Report title	<b>Ammonia as Marine Fuel</b>
2. Publication date	1-11-2018
3. Author	<p>The slides are related to a panel discussion with the following panelists:  Emile Herben (Yara)  René Sejer Laursen (MAN Diesel &amp; Turbo)  Niels de Vries (C-Job)</p> <p>Yara is a large fertilizer producing company  MAN is a producer of marine engines  C-Job is a naval architect engineering firm</p> <p>Agustin Valera-Medina from Cardiff University was the moderator of the panel discussion.</p>
4. Client (organization and type of organization, specifying private/commercial/public; research institute/interest group etc.)	<p>The conference had been organized by the NH3 Fuel Association.</p> <p>NH3 Fuel Association (now: Ammonia Energy Association) is an industry association that promotes the adoption and use of ammonia in a sustainable energy economy</p>
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)	The slides are related to a panel discussion held at the NH3 Fuel Conference in November 2018.



6. Length (pages)	18
7. Link (or where to get if not available online)	<a href="https://sustainableworldports.org/wp-content/uploads/NH3-Fuel-Conference_2018_Ammonia-as-marine-fuel-report.pdf">https://sustainableworldports.org/wp-content/uploads/NH3-Fuel-Conference_2018_Ammonia-as-marine-fuel-report.pdf</a>
8. Sector coverage	Maritime shipping
9. Main aim of the study	The presentation is set up in the form of a set of questions to be discussed with the audience. The aim is to discuss with the audience the current state of, and perspectives and prerequisites for, the use of ammonia as a marine fuel.
10. Methodology	None. The presentation supported a panel discussion in the NH3 Fuel Conference in November 2018.
11. Topic(s) and indication of the level of detail For example: <ul style="list-style-type: none"> <li>• System Description - <i>A description of the full marine energy system.</i></li> <li>• System Components - <i>A description of all the components.</i></li> <li>• Infrastructure requirements for new fuels</li> <li>• Applicability - <i>which of the new fuels are expected to replace existing fuels?</i></li> </ul>	Brief slides with mostly questions for the panel discussion deal with the following topics: <ul style="list-style-type: none"> <li>• Marine power generation</li> <li>• Ammonia power generation</li> <li>• Safety rules and regulation on the transport and use of fuels by ships</li> <li>• Ammonia distribution infrastructure</li> <li>• Comparison of ammonia with other renewable fuels (properties, economics)</li> <li>• Technical, economic and regulatory prerequisites for the uptake of ammonia</li> <li>• Public perception</li> </ul>
12. What are the main conclusions from the report?	There are no conclusions in this presentation.
13. What fuel/energy type(s) are discussed in the report and in what level of detail? For example:	The presentation is about ammonia as a marine fuel, but does not include a discussion.  Safety rules and regulations for ammonia transport and use by ships are compared with those for natural gas, methanol and ethanol. Properties of liquid ammonia (energy density, renewable synthetic production cost, storage pressure and temperature) are compared with those of liquid methane, ethanol, methanol, liquid hydrogen, and compressed hydrogen.

<ul style="list-style-type: none"> <li>Fuel description e.g. type, energy density, specific energy density, flash point, boiling point, fire point, flammability limits, hazards</li> </ul>	
<p>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)</p>	<p>NO<sub>x</sub> emissions.</p>
<p>15. Does the report consider exhaust emissions only, or life-cycle, or both (or some other range of emissions)?</p>	<p>Only exhaust emissions are considered.</p>
<p>16. If determined in the report, what are the emission rates/factors by pollutant? NO<sub>x</sub>, SO<sub>x</sub>, PM<sub>10</sub>, PM<sub>2.5</sub>, ultra fine PM, VOC, NH<sub>3</sub>, GHGs, Black carbon, and any others e.g. that may be unique to the fuel/energy.</p>	<p>These are not determined.</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>There are no discussions in the presentation. The graphs on slide 10 (from other reports) show that the current use of non-fossil fuels in the shipping industry is negligible.</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>There are no discussions in the presentation. The raised questions bring up possible barriers of missing rules and regulations, undeveloped distribution infrastructure, current technological shortcomings, and high costs.</p>



	The maturity level of the fuel with respect to provision by ports is not discussed. Two long ammonia pipelines (one in the U.S. and one in Eastern Europe) are described, but not in the context of ports.
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: <ul style="list-style-type: none"> <li>• Technology Readiness Level of the system - <i>Estimated maturity of the system technology</i></li> <li>• On Board Safety Readiness Level of the system - <i>Estimated maturity of the risk mitigations on board (on a scale of 1-9)</i></li> <li>• External Safety Readiness Level of the system - <i>Estimated maturity of the risk mitigations for bunker operations (on a scale of 1-9)</i></li> </ul>	This is not described.
21. Are the fuels suitable for short and/or long (trans-oceanic) voyages?	This is not described.
22. Does the report identify/discuss potential issues around community acceptance for this fuel, or potential social/community impacts associated with the system?	The presentation asks the question how important the perception of the general public is on the use of ammonia as a maritime fuel.