



Work Group #4: Sustainable Marine Fuels

Deliverable 3.1 Report Review Template

1. Report title	Methanol as marine fuel: environmental benefits, technology readiness, and economic feasibility
2. Publication date	20-1-2016
3. Author	IMO
4. Client (organization and type of organization, specifying private/commercial/public; research institute/interest group etc.)	
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)	n/a
6. Length (pages)	50
7. Link (or where to get if not available online)	https://sustainableworldports.org/wp-content/uploads/IMO-2016-Methanol-as-marine-fuel-report.pdf
8. Sector coverage	Maritime shipping
9. Main aim of the study	Main aim of the study is to -determine the environmental benefits of using methanol as a marine fuel with regards to greenhouse gas, NO _x and SO _x emissions. -identify the technology readiness of the different system elements, including bunkering, storage, handling/processing, combustion.

	-assesses the costs of methanol use from the ship owner perspective
10. Methodology	Study based on a literature review and the author's expertise
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 in detail in the report: <ul style="list-style-type: none"> • Regulations – <i>description of current environmental regulations per region</i> • Environmental benefits of methanol – <i>a detailed discussion of the environmental performance of methanol (compared to conventional fuels)</i> • System description – <i>a complete overview of the processes related to methanol as a marine fuel</i> • Technology readiness – <i>a discussion of the technology readiness of methanol as a marine fuel</i> • Costs of methanol as fuel
12. What are the main conclusions from the report?	When methanol is produced from LNG, the greenhouse gas emissions are higher than for conventional marine fuels. However, if methanol is produced from biomass, the greenhouse gas emissions are significantly lower. The NO _x and SO _x emissions are also lower than for conventional marine fuels. The individual technical components needed for the use of methanol as a marine fuel are mostly well-known and mature. Combining these components along the methanol value chain however is required. Additional safety measures are required in every part of the fuel system too, but these adjustments are assessed to be feasible for ship-owners from a technical point of view, both for newbuild and retrofit systems. From a cost perspective, methanol as a fuel shows potential only within certain circumstances.
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 report focusses on methanol. Other fuels which are discussed are: <ul style="list-style-type: none"> • HFO • MGO For methanol, at least the following specifics are stated in the report: <ul style="list-style-type: none"> • Emission factors (also for HFO and MGO) • Production process

	<ul style="list-style-type: none"> • Molecular formula • Other uses • Technology readiness • Safety aspects • Flash point temperature • Toxicity
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)	The report considers both greenhouse gas and air pollutant emissions.
15. Does the report consider exhaust emissions only, or life-cycle, or both (or some other range of emissions)?	The report considers life-cycle emissions.
16. If determined in the report, what are the emission rates/factors by pollutant? NO _x , SO _x , PM ₁₀ , PM _{2.5} , ultra fine PM, VOC, NH ₃ , GHGs, Black carbon, and any others e.g. that may be unique to the fuel/energy.	The emission factors of greenhouse (in CO ₂ equivalents), NO _x and SO _x emissions are presented in the various figures and tables in Chapter 4 of the report.
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?	<p>The report discusses barriers and opportunities for ships to use methanol with respect to safety, technological readiness, greenhouse gas emissions and costs.</p> <p>The report does identify the maturity level of methanol on a global scale.</p>
18. Does the report discuss barriers and opportunities for ports to provide the fuel(s)/energy? Does the report	The report discusses barriers and opportunities for ports to provide methanol with respect to technological readiness, safety and costs.



<p>identify the maturity level of the fuel on a regional or global scale with respect to provision by ports?</p>	<p>The report identifies the maturity level of methanol on a global scale with respect to provision by ports.</p>
<p>19. Does the report include capital and operating cost estimates for the ship and/or land-side?</p>	<p>The study reports capital costs for methanol-fuelled newbuilds and retrofits (see section 5.4) and analyses the pay-back time accounting for different operation times in ECAs.</p>
<p>20. When are the fuel(s)/energy expected to be at a demonstration stage vs. commercialization? 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>The different separate technologies are assessed to be mature and to have been used extensively, however the combination of these components for a methanol-fuelled ship is assessed to be relatively new - at the time of the publication of the study, a single ship had so far been retrofitted to run on methanol. New safety measures are needed, but the report identifies that these are achievable for ship-owners from a technical perspective.</p>
<p>21. Are the fuels suitable for short and/or long (trans-oceanic) voyages?</p>	<p>This is not explicitly specified in the report.</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 explicitly specified in the report.</p>