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Life Cycle Assessment of
Present and Future Marine Fuels

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ABSTRACT

Interest in new fuels for marine propulsion is growing, mainly as a result of stricter environmental regulations but also due to increased attention to air pollution, greenhouse gas emissions and the uncertainty of future oil supply. Several different fuels and exhaust abatement technologies are proposed for marine transportation, all of which have different advantages and disadvantages in relation to the environment and human health. It is interesting to assess the upstream environmental impact of a fuel change in order to avoid problem shifting from one phase in the life cycle to another.

Life Cycle Assessment (LCA) is a common tool for environmental assessments of products and services and it addresses the potential environmental impact of a product or service from a cradle-to-grave perspective. LCA is already well established for evaluating alternative fuels for road transportation. It is therefore considered an appropriate tool for assessing the environmental performance of marine fuels. Here, LCA has been used in two different studies for assessing the environmental impact of marine fuels.

In the first study, Paper I, the life cycle environmental impact of changing fuel and/or installing abatement techniques in order to comply with upcoming environmental regulations is explored. The alternatives investigated were heavy fuel oil with and without scrubber, marine gas oil with and without selective catalytic reduction, liquefied natural gas and synthetic diesel with and without selective catalytic reduction. This study thus only involved fossil fuels and indicated that the global warming potential of the investigated fuels are of the same order of magnitude. The best overall environmental performance was reached, not surprisingly, for the fuels that fulfil the most stringent upcoming environmental regulations: liquefied natural gas and marine gas oil with SCR. Synthetic diesel was ruled out as being too energy intensive.

In the second study, Paper II, two routes, a diesel route and a gas route, towards the use of renewable fuels in the shipping industry were investigated. The study started from the traditional fuel used today: heavy fuel oil. For 2015, two possible paths were assessed: marine gas oil and liquefied natural gas. For 2020, these fuels were blended with a small proportion of a first-generation biofuel of the same type, and for 2025 they were fully replaced with a second-generation biofuel. This study indicated that the gas route has better overall environmental performance than the diesel route. The study also illustrated that biofuels are one possible measure to decrease the global warming impact from shipping but that it can be at the expense of greater environmental impact from other impact categories.

Keywords: marine fuels, environmental impact, Life Cycle Assessment, LCA, heavy fuel oil, marine gas oil, liquefied natural gas, LNG, biofuels