ON THE SUSTAINABILITY OF LIQUEFIED NATURAL GAS (LNG) AS A MARINE FUEL IN A POST-IMO 0.5% SULFUR CAP ENVIRONMENT

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ABSTRACT

The International Maritime Organization (IMO), the leading regulatory body for the shipping industry, recently finalized its decision to decrease the global sulfur cap for marine bunker fuels from 3.5% to 0.5% effective January 2020 to reduce the shipping community's environmental impact. This decision will have significant impacts on shipowners, forcing them to choose among a suite of options to comply with the new emissions limit, options with substantial capital expenditure (CAPEX) or operational expenditure (OPEX) implications. Among these options is using liquefied natural gas (LNG) as an alternative to low-sulfur fuel oil or distillates and exhaust gas cleaning systems (ECGS). While LNG has been used in a limited capacity as a marine fuel, mostly in passenger vessels (ferries) and LNG carriers from the boil-off gas (BOG) in storage tanks, there are currently only 119 LNG-capable ships operating globally (out of a merchant fleet of over 50,000). LNG fuel can effectively eliminate nearly 100% of sulfur oxide (SO_x) and particulate matter (PM) emissions, while reducing nitrogen oxide (NO_x) emissions up to 80% and greenhouse gas (GHG) emissions by up to 30%. LNG is also price competitive with other bunker fuel, making it an attractive alternative both environmentally and economically.

This thesis examines the business case for LNG-capable ships as a viable option to meet the IMO's sulfur cap. Specifically, the thesis compares the choice to invest in an LNG-capable ship to investing in ECGS (enabling continued use of high-sulfur fuel oil) or using compliant low-sulfur fuel oil or distillates (which still requires selective catalytic reduction (SCR) or exhaust gas recirculation (EGR) systems to comply with NO_x limits). The thesis analyzes eight different vessel types across the three investment options and subject to three different fuel price scenarios, accounting for variation in CAPEX, OPEX, engine types, ship utilization, and charter rates, for a total of 96 scenarios. Each scenario uses a discounted cash flow (DCF) model to yield unique NPV, IRR, and payback for the investment. The thesis demonstrates that LNG-capable vessels are competitive investments and, in some cases, outperform other options to achieve compliance with SO_x and NO_x emissions limits.

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