TALLINN UNIVERSITY OF TECHNOLOGY
SCHOOL OF ENGINEERING
Engineering, Manufacturing and Technology

LIFE CYCLE ASSESSMENT ON VESSEL OPERATIONS THROUGH ONE YEAR OF OPERATIONAL SPAN

LAEVA KÄITAMISE OLELUSRINGI HINDAMINE ÜHE TÖÖAASTA VÄLTEL

MASTER THESIS

Student: Markos Paschalis

Student code: 223603EABM

Supervisor: Viktoria Voronova, Senior Lecturer

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SUMMARY

The shipping industry is expanding annually. With the amalgamation of industrialization and consumerism, modern society demands faster product shipments than ever before. As society transitions towards a more sustainable future, freight shipping companies must contemplate their role in this trajectory and how they can contribute.

This thesis aims to assess the environmental impact of a shipping vessel operation before and after the retro fitment (eco-design) of the various technologies that will help the transformation of the industry to a sustainable future. Furthermore it will provide recommendations, improvements and options for the future.

The EU has set explicit targets for the continent to achieve climate neutrality by the end of 2050. Consequently, new laws and regulations have been established for various sectors, including the shipping industry. The European Parliament initiated the Emissions Trading System by January 2024, along with a myriad of other laws aimed at reducing the environmental impact of shipping.

Two companies, Njord and Seabound, are at the forefront of this transformative endeavor, both striving towards the common goal of reducing emissions from the shipping industry. Njord focuses on retrofitting various technologies onto vessels to diminish the use of fossil fuels, while Seabound is dedicated to introducing Carbon Capture technology to capture CO_2 emissions within the shipping industry.

This report will assess the efforts of these two companies, utilizing Life Cycle Assessment with OpenLCA 2.1.1 software and the Ecoinvent v.3.10 databases as fundamental tools for Impact Assessment. Data pertaining to the operation of one vessel over the span of a year was evaluated before and after the application of these technologies.

The assessment provided analyses of Midpoint and Endpoint level indicators to determine the impact of these technologies on the vessel in question, extending to the entire fleet of 11 vessels. Both Midpoint and Endpoint level indicators showed a clear reduction across the board. Among the Midpoint level categories, such as Marine aquatic ecotoxicity, Global warming, and Human toxicity, the most significant changes were observed, while Acidification, Eutrophication, and Freshwater aquatic ecotoxicology showed the least change. Endpoint level indicators followed the sequence of change from most to least as Resources, Human Health, and Ecosystem quality.

Upon examining the findings and conducting data analysis, a distinct advantage emerged post-application of the technologies. In every category, the new technologies are demonstrating a positive impact on environmental factors. Particularly noteworthy are the subcategories associated with fossil fuels, where the technologies in use exhibit marked improvements over previous performance. Furthermore, if Carbon Capture technology is implemented, the magnitude of these changes will be even greater.

Keywords: Life Cycle Assessment, Shipping Industry, Eco-design, Green House Gass Reduction Technologies.