Managing Operational and Environmental Risks in the Strategic Plan of a Maritime Container Port
(Technical Report)

A Duty Ethics Analysis of the Implementation of Shore Power from Power Grid Electricity
(STS Research Paper)

An Undergraduate Thesis Portfolio

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Socio-Technical Synthesis

My technical work and my STS research both address aspects of the socio-technical problem of how to leverage both technological and human processes to reduce our environmental footprint in ports. My technical work includes a discussion on the feasibility of hydrogen as a fuel source in a port environment, whereas my research explores the broader implications of providing shore power to berthed ships from power grid electricity. Shore power is a technological upgrade which allows vessels to "plug in" to the local electricity grid and turn off their auxiliary diesel engines while docked at berth. So, while my technical work and my STS research paper approach emissions reductions from different angles, the theme of sustainability is consistent across both projects.

My technical work explores the idea of hydrogen as a fuel source in port environments. Using scenario analysis methodology drawn from systems, risk, and resilience analysis, my Capstone team ultimately developed a demonstration ranking of initiatives for a port strategic plan. Ranking towards the top of those initiatives were many sustainability initiatives, particularly investment in hydrogen fuel cell implementation and cold ironing infrastructure. Hydrogen fuel cells use the chemical energy from hydrogen to cleanly and efficiently produce electricity without polluting the atmosphere, whereas cold ironing is another name for shore power. Based on our findings, I further researched the feasibility of hydrogen as a fuel source in port environments, and looked for areas where emissions can be reduced by switching from diesel to hydrogen. The goal of our technical work is to provide recommendations for strategic planning at a port using scenario analysis and stakeholder feedback.

My STS research also explores sustainability, but from a different angle. My research focuses on the notion of providing shore power from local power grid electricity. I employ

Immanuel Kant's theory of duty ethics to show that providing shore power from local power grid electricity is not an ethically sound solution to the port emissions problem. While this solution does indeed reduce emissions in and around the port area, it does not solve the broader goal of global emissions reductions as the electricity generated for the local power grid cannot be obtained completely emissions-free. The goal of my research is to stimulate healthy debate as to how we can reduce emissions in the future, not just in the port area but in local power plants and electricity generation facilities. Shore power is certainly a promising method of emissions reductions, but will only be truly successful when the electricity used is generated emissions-free.

Working on both projects simultaneously greatly added value to both. My technical work gave me a better understanding of the pressing issue of sustainability as well as the benefits of hydrogen as a fuel source. My STS research helped provide a clearer picture of shore power and how its broader goals cannot be reached unless we change our current means of local power grid electricity generation. Working on both projects in tandem made me realize that there is certainly a method to provide shore power from electricity generated emissions-free, and that is through the utilization of hydrogen. A renewable hydrogen generation facility, known as an electrolyzer, could provide the required hydrogen and, through hydrogen fuel cells, the required electricity to provide shore power completely emissions-free. By performing both projects simultaneously, I learned that as a researcher it is not sufficient to simply look at a technical fix to a problem. Instead, I now realize that I have a responsibility as an engineer to look at the broader social implications of such a technical fix, and find solutions that are ethically sound.