Evaluating the Impact of Climate Hazards, Adaptations and Decarbonization to Shipping Risks and Oil Spill Preparedness and Response Systems

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Introduction

Human activities are causing unprecedented change to the global climate, with wide-ranging implications to human populations, ecosystems, and infrastructure. Climate hazards may alter the nature and severity of shipping-related oil spill risks, while changing the efficacy of spill response systems. Climate adaptation and decarbonization strategies may influence shipping risks and subsequently to require changes to oil spill preparedness and response systems.

The IMO aims to decrease greenhouse gas emissions from shipping by 50% by 2050, and to decarbonize shipping as soon as possible within this century.[1] The adoption and proliferation of new technologies and low-carbon fuels, including hydrogen, ammonia, biofuels, and LNG, are likely to change the risk profile for the shipping sector, and may require a reconsideration of spill response systems and technologies.

Climate Change and Oil Spills

Climate hazards, adaptations, and decarbonization may impact both the threat of oil spills and the efficacy of response systems. The interactions between climate change and oil spill threats have not been widely explored in the published literature; however, there has been extensive analysis of "Natech" events, a term used to describe technological disasters that result from natural disasters. The literature is more focused on impacts to infrastructure, but some work has also been done to examine how Natech incidents impact systems and services, such as oil spill preparedness and response.

Case studies from past oil spills triggered by specific hazard events inform the potential for climate hazards to influence future oil spill risks. Yet, there are very few studies that evaluate the likely and potential future implications of climate hazards and adaptation to oil spill preparedness and response, and even fewer that consider how decarbonization targets may influence future shipping risks and spill response.

Shipping Decarbonization and Oil Spills

As a result of IMO commitments to decarbonize shipping, industry groups are emerging to explore technological and regulatory options to comply.[2, 3] While only a few years ago many industry leaders viewed alternative fuels, such as hydrogen, as a very far off possibility, today efforts are underway to invest in new shipping technologies and research to incorporate climate mitigation. Research and pilot initiatives are currently underway to determine the viability of a range of fuels for commercial shipping, including but not limited to hydrogen, ammonia, natural gas, and biofuels.[4]

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[1] "Decarbonization in shipping," (DNV, June 2021), accessed July 2021, https://www.dnv.com/maritime/insights/topics/decarbonization-in-shipping/index.html.
[2] "New Research Center Will Lead the Way for Decarbonizing Shipping," (Maersk, June 25, 2020), https://www.maersk.com/news/articles/2020/06/25/new-research-center-will-lead-the-way-for-decarbonizing-shipping.
[3] "About Us," Vancouver Maritime Centre for Climate, accessed 2021, https://vmcclimate.ca/about-us.
[4] Erik Nyhus, "What did we learn about CII and SEEMP at MEPC 76?" *Impact: A DNV Podcast*, Podcast audio, July 5, 2021, https://www.dnv.com/expert-story/maritime-impact/What-did-we-learn-about-CII-and-SEEMP-at-MEPC-76.html.

This decarbonization effort requires mass investment and adoption of new technologies and supporting government policy at costs estimated by industry analysts of $1.65 trillion by 2050.[5] Assuming that industry collaboration, financial investment and government policy will continue to drive decarbonization efforts, experts estimate that the first "net-zero vessels" could enter the commercial fleet by the year 2030. Liquified Natural Gas (LNG), hydrogen, ammonia and biofuels are the most commonly referenced alternatives to fuel oil in the literature. LNG use in ships is currently increasing, in part because burning LNG results in relatively low emissions.[6] However, industry analysts observe that the viability of LNG as a long-term solution is problematic, given the high upstream GHG emissions associated with production.[7] Hydrogen and ammonia are perceived to be the most "promising alternatives" to oil; however, technology and infrastructure are not yet in place globally.[8] [9] [10]

Ammonia is perceived by some industry experts to be a viable alternative fuel in part because the shipping industry has experience handling ammonia over the last several decades.[11] Hydrogen technology is also being developed both to enable vessels to transport and meet global demand for hydrogen,[12] and as a fuel for commercial vessels. Following a successful pilot project in 2019, Kawasaki Heavy Industries recently announced approval to develop a hydrogen carrier with capacity "on par with LNG carriers."[13] Starting in 2021, hydrogen is being used to power ferries and cruise ships including in Norway[14] and the US.[15]

Hseih and Felby (2017) conducted an analysis funded by the IAE on the feasibility of biofuels for the marine sector and identified both challenges and opportunities for the adoption of biofuels.[16] Similar to hydrogen and ammonia, the widespread adoption of biofuels in the shipping sector is dependent on

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[5] "Decarbonising Shipping: All Hands on Deck," (Shell & Deloitte, 2020), accessed July 2021, https://www.shell.com/promos/energy-and-innovation/decarbonising-shipping-all-hands-on-deck/_jcr_content.stream/1594141914406/b4878c899602611f78d36655ebff06307e49d0f8/decarbonising-shipping-report.pdf.

[6] "Decarbonising Shipping," (Shell and Deloitte, 2020).

[7] Nikita Pavlenko et al., "The climate implications of using LNG as a marine fuel," (The International Council on Clean Transportation, 2020), accessed July 2021, https://theicct.org/sites/default/files/publications/LNG%20as%20marine%20fuel%2C%20working%20paper-02_FINAL_20200416.pdf.

[8] "Decarbonising Shipping," (Shell and Deloitte, 2020).

[9] CJ McKinlay, SR Turnock, and DA Hudson, "A Comparison of Hydrogen and Ammonia for Future Long Distance Shipping Fuels," (The Royal Institute of Naval Architects, 2020), accessed July 2021, https://www.researchgate.net/publication/339106527_A_Comparison_of_hydrogen_and_ammonia_for_future_long_distance_shipping_fuels.

[10] "Assessment of selected alternative fuels and technologies in shipping," (DNV, June 2019).

[11] "Decarbonising Shipping," (Shell and Deloitte, 2020).

[12] Jorg Aarnes, Marcel Ejgelaar and Erik A. Hektor, "Hydrogen as an Energy Carrier," (DNV, 2018).

[13] "Kawasaki Develops Cargo Containment System for Large Liquified Hydrogen Carrier with World's Highest Carrying Capacity – AiP Obtained from Class NK," (Kawasaki Heavy Industries, May 6, 2021), https://global.kawasaki.com/en/corp/newsroom/news/detail/?f=20210506_9983.

[14] Bernd Radowitz, "World's first hyudrogen-powered ferry in Norway to run on green gas from Germany," (Recharge, March 9, 2021), accessed April 2021, https://www.rechargenews.com/technology/worlds-first-hydrogen-powered-ferry-in-norway-to-run-on-green-gas-from-germany/2-1-976939.

[15] Joanna Sampson, "Cummins fuel cells to power North America's first commercial hydrogen-powered ferry," (H2View, Feb 10, 2021), accessed April 2021, https://www.h2-view.com/story/cummins-fuel-cells-to-power-north-americas-first-commercial-hydrogen-powered-ferry/.

[16] Chia-Wen Carmen Hseih and Claus Felby, "Biofuels for the marine shipping sector: An overview and analysis of sector infrastructure, fuel technologies and regulations," (IAE Bioenergy, 2017).

production capacity and infrastructure. Several sources note that reliability of supply and competition for biofuels from other sectors may be an impediment to the adoption of biofuels.[17] [18] While biofuels blends may play a role as an in interim low-carbon fuel, in the near term they are more likely to be adopted by smaller commercial and recreational vessels than by the commercial shipping sector.[19]

With a broad range of low-carbon shipping fuels and technologies under development, Shell and Deloitte (2020) highlight the need for global coordination to align efforts and recommend the establishment of Port Coalitions to enable infrastructure investment required to achieve IMO and government low-carbon shipping targets.

Summary

Decarbonization of the shipping industry implies that the threat of oil spills will decrease over time; however, there may be transient risks as alternative fuels emerge and change bunkering practices and infrastructure. Alternative fuels may require adaptations to existing spill preparedness and response systems, which are focused primarily on petroleum fuel oils. Updated risk assessments may be required to assess the threats from non-petroleum fuel spills to ecological systems and human health.

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[17] Ismay et al., "MA 2050 Decarbonization Roadmap."
[18] “Decarbonizing Shipping,” (Shell and Deloitte, 2020).
[19] Hsieh and Felby, "Biofuels for Marine Shipping," (IEA Bioenergy, 2017).