

Environmental Policy in International Shipping: An Analysis on Current Policy and its Effects

LORI KATELYN WAREHAM¹, *Memorial University of Newfoundland*

Abstract. Shipping is a main method of transportation for goods internationally, and is also a sizeable contributor towards global emissions produced annually. The International Maritime Organization (IMO) which is a specialized agency within the United Nations with responsibility for the safety and security of shipping, and for the prevention of marine pollution by ships, has amended the International Convention for the Prevention of Pollution on Ships (MARPOL) in 2013 to include more energy-efficient regulations on new-build vessels, and stricter regulations on existing vessels. With this implementation, IMO is the first and only organization to have adopted energy-efficient measures that are legally binding across a whole global industry, and apply to all countries. Discussion of the intention of this policy, as well as its effect on industry and innovation in the field is considered in the following paper.

Introduction

While shipping, upon consideration of the ratio of average product weight to overall emissions produced, is one of the best ways to transport bulk goods in the earth's increasingly international trade-based economy, it is correspondingly a significant contributor to the overall emissions produced globally (International Maritime Organization, 2016). The International Maritime Organization (IMO), a specialized agency within the United Nations responsible for overseeing the safety and security of shipping, and for the prevention of marine pollution, has amended the International Convention for the Prevention of Pollution on Ships (MARPOL) in 2013 to include more energy-efficient regulations on new-build vessels, and stricter regulations on existing vessels (MEPC, 2013). With this implementation, the IMO is the first and only organization to have adopted energy-efficient measures that are legally binding across a global industry, and whose measures apply to all countries (IMO, 2016). There are global limits set on what types of pollutants vessel are permitted to emit, with certain zones and seaways having heavier restrictions than others. The United Nations Conference on Trade and Development (UNCTAD) estimates that over 70 per cent of global trade by value is transported by sea and handled by ports, by any of the 90,000 vessels registered in over 150 ports, and handled by any of the more than one million seafarers of virtually every nationality (UNCTAD, 2015). Given the direct and influential tie that shipping has on the global economy, policy changes to vessels that perform transportation carry a possibility of greatly changing the way global trade occurs. The following article will analyze the successes and

¹ Lori Katelyn Wareham is a Bachelor of Engineering in Ocean and Naval Architectural Engineering with a focus stream in Political Science, graduating spring 2017 and pursuing a Master of Public Policy at the University of Saskatchewan in fall 2017.

failure of the regulations brought forward by the IMO and other classifications, as well as analyze if indicting environmental regulations is the best policy instrument in the case of producing more energy-efficient shipping vessels, using a political economy approach. The political economy approach will consider the overarching, and high-level effects on the economy due to the influences of policy change. The objective of evaluation, and the framework of the paper, is considering if the level and scale of the policies being set by the IMO are effective conductors of change within the marine industry, as well as the global economy. Furthermore, is this policy necessary for innovation, is it producing actual change that would not be natural within the industry, if they were not mandated to do so?

The Energy Efficiency Design Index (EEDI) as an International Environmental Policy Model

The IMO regulations are thought to be a model for future international climate change co-operation for other global sectors (Intergovernmental Panel on Climate Change, 2014). The Energy Efficiency Design Index (EEDI) was phased in during 2013, and by 2025 it is expected that all new ships will be over 30 per cent more efficient than when the EEDI was first implemented (IMO, 2016). The EEDI sets a minimum energy efficiency level, per mile, specific to the ships type and size- this level is to be continually restricted every five years. This standard is modeled to stimulate further technological advancements and innovation in order to meet the continually stricter requirements. The emission standards for EEDI are set in grams of carbon dioxide emissions as per a vessel's capacity-mile, as can be seen in Equation 1 below. The EEDI policy is inclusive to almost all types of vessels, and as part of being a requirement and regulation of IMO, it is subsequently a requirement to having a ship classified under all major classification societies, including Lloyd's Register and DNV-GL (IPPC, 2014). This specific policy follows well under the theoretical framework of the political economy approach, in that it focuses on the awareness of how a policy functions in the world. This approach understands that through the development of policy, new industries could flourish due to the competition to meet the increasing demands of the EEDI, in turn expanding and developing facets of the economy. There would be no unified incentive to reduce emissions in the shipping industry to the extent that the EEDI requires strictly within the shipping industry itself, so to introduce policy forcing new ships to fit emissions standards, there is a creation of a new normal.

Equation 1 Fundamental Formula for EEDI

$$EEDI = \frac{P \cdot SFC \cdot C_f}{DWT \cdot V_{ref}}$$

where: P = 75% of installed shaft power

SFC = specific fuel consumption

C_f = a form factor for CO₂ emission rate based on fuel type

DWT = ship's deadweight in tonnes

V_{ref} = the vessel speed at design load

The EEDI framework, at a quick glance is one that forces an equilateral restriction of emissions in a global field, forging opportunity for new technology and innovation to replace antiquated methods of design. It would be limiting for a singular vessel or fleet to be energy efficient, if the competition were profiting at a lower standard. The challenge with global climate

change and policy is the unknown timeline and lag between action and effect (Kontovas et al., 2011). There is an argument among policy-makers as to the best way to utilize policy to reduce emissions, and force environmental consciousness among consumers and industry. Many resulting policies are classified as incentive policies, either consisting of charges and subsidies or transferable emission permits (Field and Field, 2009). The EEDI framework utilizes the Command and Control (CAC) approach- wherein the regulator (in this case IMO) mandates a desired behavior into binding law (Field and Field, 2009). These standards tend to be either ambient, technological, or emissions based, and are heavily favored politically, as the CAC approach is significantly easier to implement than market-based policy (Hanley et al., 2006). However, the drawbacks for the CAC approach are such that it has been debated that the industry has no incentive to go above and beyond any minimum standards, and there are often conflicting expert recommendations as to the actual threshold (Kontovas et al., 2011). The lack of incentive could plausibly have a negative impact upon consideration of a political economy approach, as ultimately, the result would be adding financial restraint on the global trading industry, without seeing any immediately positive response. However, considering EEDI with the employment of the CAC approach in a dynamic manner, such that the actual standards and regulations behave in a reactive and equitable manner to industry, has produced an example of global environmental policy that is not only reactive, but also proactive.

The Marine Industry: Technological Implementations of Policy

It may seem intuitive that a vessel would be built to the most efficient standard to begin with, as the more inefficient a vessel design is, the more fuel it requires for its journey and thus the more money it costs the company to fuel the vessel (Papanikolaou, 2014). However, in the design of vessels, the naval architect must decide where to make cut-backs in the design, depending on the trade-off between technical work required, the time it would take to build the vessel, and the cost of upkeep and refits; thus, a more fuel efficient design may not balance the overall cost reduction on fuel in the ship's lifetime. For example, a smooth, hydro-dynamically designed bow form on a ship, with minimal edges or flat surfaces in the steel is usually less resistant and thus more efficient than a bow with harsh edges and flat steel. However, the skill of the welder to bend the steel and form the required shape can be timely and costly for the company, "the ship hull (steel part) represents approximately 20% of the cost of the ship and the cost of labour represents about 60% of the cost of the ship hull," (Caprace, 2006). Additionally, this process will slow down work for the entire construction of the vessel, which may often cost more long-term than just engineering a less-efficient hull form (Okumoto et al., 2009). By forcing a continually stricter standard for all vessels to be in compliance with, the industry practice changes, and designers are forced to re-evaluate the cost trade-off from a new minimum. This shows the strength in using environmental regulations as an instrument to influence policy change. The effect of reduction of fuel projected until 2030, and the cost effect due to reduced required fuel can be seen below in Figure 1.

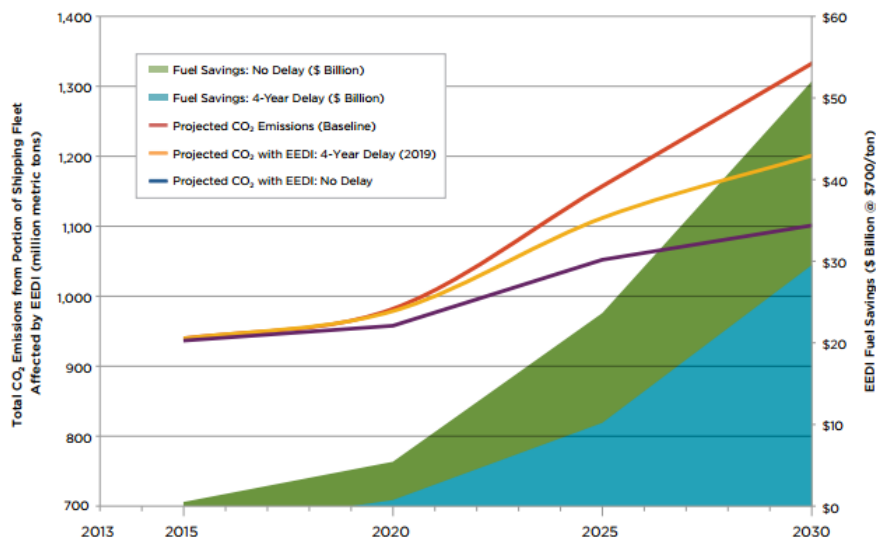


Figure 1 Projected CO2 Emissions and cost savings through 2030 - considered without delay to EEDI implementation (ICCT, 2011)

The Economic Advantages: An International, Industry, and Environmentally Balanced Approach

In addition to utilizing tools that the marine industry is familiar with in order to reduce emissions, the planned implementation of continuously stricter guidelines to be put forward by the IMO forces the industry in its entirety to come up with new technology to meet the demanding standard. This continuous momentum also forces new technology, and thus new parts of the economy, to expand and competition to be created. A simulated system of competition within an industry can expand its economic potential and allow for new pockets of innovation to become industries (Hahn, 2000). Such innovations include, harnessing different kinds of wind energy for modifying the propulsion systems, as well as, traditional ideas, such as sails and windmills, as they are simple and inexpensive additions that can even marginally cut down on emissions. For larger craft, air cavity systems have been created and patented in more detail in recent years. This system pressurizes air into an air cavity below the waterline, it then creates a thin layer of air over the flat, bottom part of the hull, and this is called micro-bubble air lubrication. The effect of this is a reduction in resistance for the overall vessel. Furthermore, an interesting effect of some of these innovations is the connection of industries outside of pure hull design or machinery (CMTI, 2011). For example, companies involved with manufacturing materials, or those researching material properties, have become increasingly involved with innovating technologies due to EEDI as one of the effects of the air cavity system (a method originally designed to reduce a vessel's emission rate) is an amplified rate of erosion on the bottom of the hull due to the creation of air bubbles (i.e. cavitation)- requiring different sorts of steel to be considered. On a large scale this means there are further opportunities for regions that don't have or aren't strongly connected to the marine industry, to also benefit from the EEPI implementation. These unilateral results, from a singular type of environmental policy, and its obvious effects on the economies of multiple countries, show the strength of the policy under a political economy approach. The use of environmental regulations as an instrument for policy change can be clearly observed, as well.

An interesting element within the policy network for EEPI is the understanding of the complexities of economies and access to technology. While the IMO is an international body whose jurisdiction allows for forced compliance to all internationally bound vessels, as well as any vessels being classed by a recognized classification society, the implemented policy attempts to consider various political and economic considerations in implementation. One such clause ensures that information on technology is transferred, and assistance is offered which would help ensure that all countries have access to new technologies and processes that may be needed to meet EEDI standards (International Council on Clean Transportation, 2011). The intent of this stipulation was to ensure there was not monopolization on the advancements being made internationally, and that all markets would have fair access to the same technology. While, as previously mentioned, this forced innovation to meet continually stricter regulations was meant to foster competition within the industry, the overall benefit (from a political economy approach standpoint) is moot if there are entire countries or sectors that are left outside the technology bubble due to lack of fair access or financial constraints. By forcing this policy addition into immediate consideration within EEDI, the private market is thereby required to consider the advancements as not only the response of individual investments and opportunity, but as a global duty to ensure credible competition across all markets.

In addition to pure emission reduction requirements introduced in EEDI, the IMO has also implemented the Ship Energy Efficiency Management Plan (SEEMP) during the 62nd session of the Marine Environmental Protection Committee (MEPC62), (Johnson et Al., 2013). The SEEMP is a regulation, which requires all ships (or shipping companies) to create, develop, and manage a plan that maximizes the efficiency of their vessels through ship operations. This task involves developing routes that correctly balance time and expended emissions, as well as minimizing downtime at ports, and improving logistical operations. It was suggested that with an optimization of operational strategies alone, it was possible to see a 10-15 per cent reduction in fleet wide emissions, proving that the benefits of SEEMP could be similar to those of EEDI over the next 20-30 years (Corbett et al., 2009).

Conclusion

The EEDI regulations implemented by the IMO have already shown success in an international environmental policy capacity, even as the first of their kind. Forcing entire industries to fall under environmental regulations uniformly in a global marketplace has made compulsory equal change and development both within these industries, and at local levels, proving it successful under consideration of the political economy theory. While the IMO is in a unique position, and the maritime industry itself has always been fairly self-governing and separate from exclusively national interests, the implementation of EEDI and SEEMP have proved the positive effect environmental regulations can have as an instrument for international environmental policy change. While the long-term benefits and effects of these policy implementations cannot be known for some time, the positive effect thus far, as discussed in this paper, is without question. Not only is the policy reactive, it is proactive and adaptive as well as industry leading in creating a fascinating new frontier in environmental policy.

References

- Barros, Vincente. R., & Field, Chris. B. (2014). *Climate change 2014: to the fifth assessment report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge Univ. Pr. 5.
- Caprace, Jean D. (2006). *An Analytical Cost Assessment Module for the Detailed Design Stage*. ANAST, University of Liege.
- Chapman, Lee (2007). *Transport and Climate Change: A Review*. *Journal of Transport Geography*, 15(5), 354-367.
- Centre for Maritime Technology and Innovation. (2011). *Analysis of the effect of the new EEDI requirements on Dutch build and flagged ships*. Ministry of Infrastructure and the Environment, 1-46.
- Corbett, James J., Wang, Haifeng, & Winebrake, James J. (2009). *The effectiveness and costs of speed reductions on emissions from international shipping*. *Transportation Research Part D: Transport and Environment*, 14(8), 593-598. doi:10.1016/j.trd.2009.08.005
- Darby, Megan (2016, September 13). *Emerging economies don't want to talk about shipping emissions*. *Climate Home*. Retrieved January 21, 2017, from <http://www.climatechangenews.com/2016/09/13/emerging-economies-dont-want-to-talk-aboutshipping-emissions/>
- Field, Martha, & Field, Barry (2008). *Environmental Economics* (5th ed.). McGraw-Hill.
- Hahn, Robert W. (2000). *The Impact of Economics On Environmental Policy*. *Journal of Environmental Economics and Management*, 39(3). doi:10.2139/ssrn.167028
- Intentional oil pollution at sea. *Environmental policy and treaty compliance*. (1995). *Environment International*, 21(3), 346. doi:10.1016/0160-4120(95)90070-5
- Intergovernmental Panel on Climate Change. (2014). *Summary for Policymakers. Climate Change 2014 Mitigation of Climate Change, 2014th ser.*, 1-30. doi:10.1017/cbo9781107415416.005
- International Chamber of Shipping, & International Shipping Federation. (2007). *Shipping Industry Guidance on Environmental Compliance*. Maritime International Secretariat. Retrieved January 21, 2017, from <http://www.ics-shipping.org/docs/default-source/resources/environmentalprotection/shipping-industry-guidance-on-environmental-compliance.pdf?sfvrsn=8>
- International Council on Clean Transportation. (2011). *The Energy Efficiency Design Index (EEDI) for New Ships. Policy Update*, 15, 1-9.
- International Maritime Organization. (2016, April 6). *"Shipping: Indispensable to the world" Selected as World Maritime Day theme for 2016*. *IMO News Magazine*, (1), 7-8.
- International Maritime Organization. (2016). *Module 2 – Ship Energy Efficiency Regulations and Related Guidelines*. IMO Train the Trainer (TTT) Course on Energy Efficient Ship Operation.
- International Maritime Organization. (2016, October 28). *New requirements for international shipping as UN body continues to address greenhouse gas emissions [Press release]*. Retrieved from <http://www.imo.org/en/MediaCentre/PressBriefings/Pages/28-MEPC-datacollection--.aspx>
- International Panel on Change. (2014). *Integrated Risk and Uncertainty Assessment of Climate Change Response Policies*. *Climate Change 2014 Mitigation of Climate Change*, 151-206. doi:10.1017/cbo9781107415416.008

- International Maritime Organization. (2013). Resolution MEPC. 231(65) . 2013 Guidelines for Calculation Of Reference Lines For Use With The Energy Efficiency Design Index (EEDI) (Annex 14).
- Johansson, Mikael., Andersson, Karin., & Södahl, Bjorn. (2013). Will the ship energy efficiency management plan reduce CO2 emissions? A comparison with ISO 50001 and the ISM code. *Maritime Policy & Management*, 40(2), 177-190. doi:10.1080/03088839.2012.757373
- Kontovas, Christos A., & Psaraftis, Harilaos N. (2011). Climate Change Policy in Shipping Focusing on Emission Standards and Technology Measures. *Environmental Engineering and Management Journal*, 10(10).
- Millerd, Frank (2010). The potential impact of climate change on Great Lakes international shipping. *Climatic Change*, 104(3-4), 629-652. doi:10.1007/s10584-010-9872-z
- Niese, Nathan D., Kana, Austin A., & Singer, David J. (2015). Ship design evaluation subject to carbon emission policymaking using a Markov decision process framework. *Ocean Engineering*, 106, 371-385. doi:10.1016/j.oceaneng.2015.06.042
- Okumoto, Yasuhisa, Mano, Masaki, Okada, Tetsuo, & Takeda, Yu (2009). *Design of Ship Hull Structures: a Practical Guide for Engineers*. Berlin, Heidelberg: Springer Berlin Heidelberg.
- Papanikolaou, Apostolos (2014). *Ship Design: Methodologies of Preliminary Design*. Springer.
- Tupper, Eric C. (2013). *Introduction to naval architecture*. Amsterdam: Elsevier/Butterworth Heinemann.
- Upton, John (2016, October 28). Shipping Industry Postpones Climate Plan Until 2023. *Climate Central*. Retrieved January 21, 2017, from <http://www.climatecentral.org/news/shipping-industry-postponesclimate-plan-until-2023-20831>
- Wilson, Katherine, J. (2004). Shipping in the Canadian arctic other possible climate change scenarios. *IEEE International Geoscience and Remote Sensing Symposium*. doi:10.1109/igarss.2004.1370699.