

Research on governance of HFO use and carriage on ships in accordance with the Polar Code

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Abstract In this paper, we discuss the environmental damages caused by the use and carriage of Heavy Fuel Oil (HFO) by ships in Arctic waters. We also review efforts made by major international and regional organizations in governing the use and carriage of HFO by ships in Arctic waters after implementation of the Polar Code, and analyze the obstacles and difficulties that lie ahead. By illustrating the features of the Arctic Council and the International Maritime Organization (IMO), which govern Arctic waters, we examine measures taken by these two organizations in tackling HFO issues. These include: assessing indigenous and local community's reliance on HFO transportation in the Arctic, developing risk prevention measures for ships operating in Arctic waters, seeking economic alternatives to HFO that contribute to a greener economy, developing a package of HFO governance measures, strengthening cooperation between relevant international and regional organizations that govern HFO to provide suggestions for follow-up discussions on HFOs, and optimize governance by relevant organizations and determine a better global solution to governing the use and carriage of HFO by ships. In addition, we discuss the feasibility of an IMO-imposed HFO ban from the perspective of the Arctic governance to clearly grasp the path of its future development.

Keywords Heavy Fuel Oil (HFO), Arctic Council, International Maritime Organization (IMO), governance measures

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1 Introduction

The International Code for Ships Operating in Polar Waters (referred to in this paper as “the Polar Code”) was adopted by the International Maritime Organization (IMO) in 2014 and implemented on January 1, 2017. The Polar Code covers all aspects of ships operating in Polar waters, such as design, construction, equipment, operation, search and rescue, and environment protection, and has far-reaching significance for the maintenance of maritime management in Polar Regions. The Polar Code is still far from perfect and does not address the issue of the use and carriage of heavy fuel oil (HFO) by ships. As black carbon emissions from HFO combustion and accidental oil spills can severely

affect the Arctic environment, reducing the risk to the Arctic by banning the use and carriage of HFO has become an important aspect of Arctic environmental governance. IMO and the Arctic Council play an important role in governing the use and carriage of HFO in Arctic shipping. Both the IMO Marine Environment Protection Committee (Canada, et al., 2017; Libenson et al., 2017; CCU, 2016) and the Protection of the Arctic Marine Environment (PAME Secretariat, 2017) have discussed the issue of use or carriage of HFO by ships in Arctic waters.

As two non-state organizations, the effectiveness of Arctic Council and IMO governance can vary. Therefore, the governing advantages of the two organizations can be combined to explore a more effective solution to the use and carriage of HFO by ships operating in Arctic waters, thus finally achieving the aim of protecting the Arctic marine environment.

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2 Risks of use and carriage of HFO by ships in Arctic waters

HFO, a fuel used throughout the shipping industry, is a viscous and tar-like residue of the crude oil refining process that breaks down extremely slowly in cold waters, and is close to impossible to clean up in the event of a spill. HFO is also the source of harmful black carbon, which contributes to the warming of the Arctic region.

According to International Council on Clean Transportation (ICCT), HFO is the most commonly used marine fuel in the Arctic, representing 57% of fuel use and more than 75% of the volume of bunker fuel carried on board ships in the Arctic in 2015 (Comer et al., 2017).

The risks associated with HFOs in Arctic waters are the environmental damage caused by oil spill accidents and emissions from burning HFO. As the Arctic Region is remote, Arctic-alpine, and high-latitude, the ecological environment is very fragile. Additionally, the emergency mechanism is incomplete and the environmental rehabilitation capability is poor in Arctic waters. Taking into account the aforementioned factors, environmental damages caused by HFO are disastrous (Deere-Jones, 2016).

When a ship using or carrying HFO suffers from an oil spill accident in Arctic waters, marine life and marine resources will be subsequently endangered, which will exert negative effects on the ecology and economy of the Arctic. Meanwhile, a research report has been submitted to the European Climate Foundation (ECF) in which ecological, economic, and social losses caused by oil spill accidents in Arctic waters were examined. Parameter Characterization Method has demonstrated that the clean-up costs of oil spill accidents in the Arctic are much higher than those in other non-remote and non-polar regions (Deere-Jones, 2016).

The use of HFO by ships emits a large amount of nitrogen oxides, sulfur oxides, and black carbon, which cause severe damage to the local environment and ecology. In particular, the subsidence of black carbon on the surface of Arctic ice reduces the reflection of snow and ice, leading to the extensive melting of ice and snow due to heat absorption. The aforementioned factors have exerted adverse impacts on the Arctic climate and even the local lifestyle and physical health (Azzara et al, 2015).

As the Arctic route is increasingly becoming economically viable, traffic volume in this area will continue to increase and so will the carriage capacity and use of HFO. Accordingly, the probability of oil spill accidents and air pollution incidents will also increase significantly. Therefore, starting with the existing measures promulgated by international and regional organizations involved in Arctic shipping affairs, it is important to explore a comprehensive solution to the problem and create an inter-organizational synergy that can effectively reduce the environmental risks caused by the use and carriage of HFO

by ships within the shipping industry in Arctic waters.

3 Obstacles and difficulties lying ahead for addressing the HFO issue

Revising the Polar Code by implementing an HFO requirement is no easy task, and requires the agreement between various stakeholders. For example, there is conflict between coastal states and user states in the Arctic shipping routes, as well as the competition between different alternatives to HFO.

3.1 Interest conflicts between the coastal states and user states

Article 234 of the United Nations Convention on the Law of the Sea, 1982 (UNCLOS 1982) endows coastal states with the rights to adopt and enforce non-discriminatory laws and regulations in ice-covered areas within the limits of the exclusive economic zone, which shall give due regard to the navigation as well as the protection and preservation of the marine environment. As for developing measures that address the HFO issue from shipping, coastal states have proposed specific measures to restrict or eliminate the HFO use in the Arctic and they have taken the lead in showing how the user states can comply with the requirements of the coastal states through a wider platform.

Meanwhile, the user states of the Arctic Shipping routes are mainly large shipping nations as defined by the IMO (especially those council members of IMO), who seek economic profits by using sea transportation through this shortcut. The restriction or elimination of comparatively cheap HFO would lead to additional economic costs for those who depend heavily on HFO. Therefore, an international solution on this matter needs to reflect and consider the interests of the user states, especially those flag states whose vessels might be affected by HFO ban.

3.2 Interest conflicts among the coastal states

Even among coastal states, opinions on how to deal with the HFO vary. According to the measure, opinions can be divided by two kinds: HFO ban and mitigation measures, which are represented by the US and Russia, respectively. HFO ban features drastic measures developed under IMO's time table and impose a mandatory ban on the vessels operating in the Arctic water as defined by IMO. In contrast, those who favor the mitigation measures propose to control the HFO use in a mild way by determining risk mitigation measures.

3.3 Rivalry among different alternatives

The current feasible alternatives are distillate oil or liquefied natural gas (LNG) (FOEI et al., 2017). Distillate oil is either a desulfurized oil residual or a mixture of oil and residual that temporarily meets the requirements and

whose cost pressure is relatively low. However, LNG has proved to be the most cost-effective alternative to reduce sulfur oxide emission, especially in the context of not exceeding the fuel sulfur limit of 0.5% by 2020.

Therefore, competition between distillate oil and LNG, or other alternatives, will be considered before implementation of specific roadmap regarding HFO ban by IMO.

4 Efforts made by International Maritime Organization and related agencies of the Arctic Council in the governance of HFO in the Arctic

With regard to the governance of HFO within the shipping industry in the Arctic, there is a need to take into account the interests of stakeholders representing the coastal states, user states, and major international shipping nations. In this paper, we selected existing measures adopted by the Arctic Council, which primarily represent coastal states, as well as the existing measures published by IMO, which represent Arctic coastal states. Arctic coastal states are the user states of the Arctic shipping route and the major international shipping nations and are the focus for enabling a comprehensive and effective solution to the HFO issue.

4.1 Efforts made by the Arctic Council Working Group on the Protection of the Arctic Marine Environment (PAME)

In 2009, PAME began assessing the potential risks of using HFO, which proved that the most severe damage caused by ships to Arctic waters was the result of accidents or illegal discharge (AMSA, 2009). In 2011, PAME released a report stating that replacing HFO with distillate oil is an effective way to reduce environmental risks (DNV, 2011). In February 2016, PAME invited members of Arctic Council, permanent participants and observers to submit proposals for reducing risks caused by the use and carriage of HFO by ships in the Arctic. In September 2017, PAME held a substantive discussion of HFOs in the Arctic and launched several projects related to HFO. Initially, PAME required Member States to submit not only information on the number of ships that used HFO as fuel, types of ships, and routes within the past three years, but also the quality and grade of fuel oil. This information on the quantity of HFO carried by ships and the port of destination, lays a foundation for future discussion. Assessment of indigenous and the local community's reliance on HFO should be carried out. To determine the extent to which indigenous people and local communities rely on ships that use HFO to deliver supplies and provisions, the United States and other stakeholders suggested collecting, reporting, and reviewing the information about on-shore use by indigenous peoples and local communities. Finally, PAME agreed to submit information on projects relevant to HFO use and carriage in

the Arctic to IMO (PAME Secretariat, 2017).

4.2 Efforts made by Marine Environment Protection Committee (MEPC) of the IMO

As early as 10 years ago, a legal document prohibiting the use of HFO in the Antarctic was adopted by the parties according to the Antarctic Treaty. Subsequently, a resolution adopted by IMO in 2010 prohibited the use of HFO by ships in the Antarctic to the annex I of the International Convention for the Prevention of Pollution from Ships (MARPOL) (MEPC.189 (60)).

This document serves as a reference for future discussion on the issue of prohibiting the use and carriage of HFO by ships in Arctic waters. At the MEPC70, IMO held a discussion on the use of HFO in the Arctic, where risks posed by HFO use in Arctic ships were highlighted by non-governmental organizations such as Friends of the Earth International (FOEI), World Wildlife Fund (WWF), and Clean Shipping Coalition (CSC). These non-governmental organizations also hoped to provide the IMO with more focus towards the recent achievements made by stakeholders in mitigating the use of HFO in the Arctic, and expected that IMO and the Arctic Council could strengthen cooperative efforts on addressing the HFO in Arctic waters and increase information sharing.

Moreover, at the MEPC70, the IMO set a cap on sulfur in fuel oil at a global scale, with sulfur content not to exceed 0.5% in 2020. These caps will significantly restrict the use of HFO by ships in the Arctic (IMO Secretariat, 2016). The recent IMO MEPC71 included "measures reducing risks caused by the use and carriage of HFO by ships in Arctic waters" as a new output, which will be included in the 2018–2019 biennial agenda and is scheduled to be completed in the following two sessions. IMO MEPC71 included an invitation to member states to submit specific suggestions that address the aforementioned issue and adopt mandatory or recommended measures (IMO Secretariat, 2017).

5 Ways to address HFO in Arctic waters

With respect to governing the use and carriage of HFO by ships in the Arctic within the industry, efforts can be described as follows: assessing indigenous and local community reliance on HFO-fueled transportation in the Arctic, developing risk prevention measures for ships operating in Arctic waters, seeking economic alternatives to HFO that contribute to a greener economy, developing a package of HFO governance measures, and strengthening cooperation between relevant international and regional organizations in the governance of HFO.

5.1 Assessment of indigenous and local community reliance on HFO-fueled transportation in the Arctic

The starting point for addressing HFO begins with assessing

the reliance of indigenous and local community on HFO in the Arctic. Only when we understand the extent to which indigenous people and the local community rely on ships that rely on HFO to deliver supplies and provisions, can we seek solutions to the problem objectively and soundly. Thus, the perception and traditional knowledge of indigenous people in the Arctic on use and carriage of HFO by ships is highly significant.

Examining the reliance of Arctic residents on HFO for household heating and cargo delivery can provide more ideas and approaches to address the HFO issue in Arctic waters from the perspective of local communities. Within the PAME framework, the role of Permanent Participants (PPs) should be emphasized, relevant projects should be conducted in line with the traditional understanding of the role of PPs in the local community, and good communication with local residents should be maintained. With traditional and local knowledge (TLK), PPs can better understand the specific needs of local residents for HFO and the methods of using other alternatives to replace HFO. The contribution and knowledge of PPs can help in developing a more practical policy.

Currently, the members of PAME conducted an assessment of the Arctic's reliance on HFO, with a goal of obtaining relevant information from national maritime administrations, the shipping industry, and indigenous peoples (USA et al., 2017). The results of the assessment can be shared with the IMO through Arctic Council Member States participating in the IMO meeting, thus providing beneficial inputs to relevant decisions.

5.2 Developing risk control measures for ships operating in the Arctic

The operation of ships also has a profound impact on the safe use and carriage of HFO in the Arctic. Therefore, a range of options should be considered when developing measures that reduce the risk of use and carriage of HFO by ships in the Arctic. An example has been set by Canada through its submission to IMO, which suggests considering the following factors when developing risk control measures, "types and sizes of ships operating in Arctic waters; existing fuel oil tank protection; the nature of voyage including ships engaged in commercial transportation, mineral extraction and tourism; the duration of voyages; ships engaged exclusively in trade between ports or terminals of a State; ships routinely making voyages between specified ports or locations; the distinction between local or regional shipping and trans-Arctic shipping; the anticipated availability of bunker fuel; operating areas including lower risk voyages." (Canada et al., 2017)

At the same time, risk control measures, which aim to reduce the use and carriage of HFO by ships in Arctic waters, should undergo corresponding evaluation of cost-effectiveness as well as take the potential increase in administrative burden and human factors into consideration.

It is recommended that the IMO should provide expertise on developing risk control measures aimed at reducing the use and carriage of HFO by ships in Arctic waters and fully consult the member states of the Arctic Council and PPs in an attempt to formulate measures that are in line with local conditions.

5.3 Seeking alternatives to HFO to contribute to a greener economy

Addressing the issue of use and carriage of HFO in the shipping industry from the source requires searching for an economic alternative to HFO. Although this move will result in a 4% increase in fuel costs for ships operating in the Arctic (Roy and Comer, 2017), a large cleanup costs from HFO accidents will be saved. At present, a number of Arctic stakeholders and non-governmental organizations have proposed that distillate oil or LNG can be used as an alternative to HFO (FOEI, 2017). Distillate oil means using desulfurized oil residual or a mixture of oil and residual to temporarily meet the requirements, whose cost pressure is relatively low. However, LNG has proved to be the most cost-effective alternative in reducing sulfur oxide emissions.

In addition, the requirement of "the sulfur limit of fuel oil with sulfur content not exceeding 0.5% by 2020" imposed by IMO positions LNG as the most ideal alternative to HFO. However, the cost estimate made by ICCT for distillate oil and LNG demonstrates that use of LNG requires relatively high-quality facilities and incurs higher costs.

Therefore, it has been suggested that a transition period be set before the full conversion to "high quality distillate oil or LNG". During this period, distillate oil could be used to temporarily meet the requirements, which would relieve the cost pressure shouldered by world merchant fleets. Meanwhile, supporting facilities for LNG should be actively constructed and HFO should be gradually replaced by LNG. At the same time, the IMO should put forward relevant strategic goals and a specific roadmap to phase out the use of HFO within the shipping industry.

The member states of Arctic Council should also pioneer the use of alternatives to HFO, collect data on the use of alternatives, and publicize the environmental benefits within the shipping industry through the IMO platform, thus playing an exemplary role in using clean alternatives for the global shipping industry.

5.4 HFO governance package from a legal, technical, and economic perspective

The following aspects could be taken into consideration when the relevant policies are made:

(1) Legitimate support for a ban on HFO

The governances of the Arctic and the Antarctic are always learning from each other (Young, 2016). Similar to HFO policies in the Antarctic, requirements on restrictions

and prohibitions of HFO in the Arctic should be included in the amendments of the Annex of the MARPOL.

Previously, Regulation 43, Chapter 9 of MARPOL Annex I determined that the use and carriage of HFO in Antarctic waters was prohibited. Similarly, the ban on the use or carriage of HFO in Arctic waters has already been proposed by IMO member states to mitigate the damage to the Arctic environment, which will help achieve the goal of the Arctic Council, namely, gradually banning the use and carriage of HFO by ships in the Arctic by 2020. MEPC72 (April 2018) agreed to question whether it was appropriate to, “on a basis of an assessment of the impacts, develop a ban on HFO for use and carriage as fuel by ships in Arctic waters, on an appropriate timescale” during its 6th Session of Pollution Prevention and Response Subcommittee (PPR6), which will be held in February 2019. Meanwhile, MEPC72 tasked PPR with developing a definition for HFO “taking into account regulation 43 of MARPOL Annex I.” Therefore, the Arctic HFO ban may occur in the near future (IMO Secretariat, 2018).

Meanwhile, the Polar Code should be revised accordingly. Since the Polar Code is far from being perfect, revisions are ready to make their way into the text with MEPC initiating the revision process. The current version of the Polar Code does not set requirements on the use or carriage of HFO in Arctic waters and Part II-A of Chapter I of the Polar Code can be revised to include regulations on prohibiting the use or carriage of HFO on board ships operating in Arctic waters. PAME can draft relevant guidelines for phasing out the use and carriage of HFO in the Arctic, while IMO revises the Polar Code.

With legitimate support for the aforementioned responses, the HFO ban should be phased in rather than an all-at-once method, which is much like what IMO has done with the mitigation of CO₂ emission from the shipping industry, different control volume of different timing. The phase-in method should be based on the economy, society and culture impact analyses, after which a phase-in method could be introduced to avoid negative impacts on the sea-borne trade.

(2) Technical support by the existing IMO measures

The technical measures, such as Emission Control Area (ECA) and routing measures, can serve as the technical support needed to regulate the emission and navigation method in the Arctic waters. Establishing an Arctic Sulfur ECA in the Arctic (as defined by the IMO's in the Polar Code instead of the Geographic Arctic (at or above 58.95°N)), would be a positive step toward eliminating the use of HFO and could reduce black carbon emissions, which would cause vessels to switch to distillate fuels and emit less black carbon relative to residual fuels. However, ECA did not prohibit the use of HFO in the Arctic, and vessels may comply with ECA fuel sulfur limits by using scrubbers that may yield modest black carbon reductions and less particulate matter. Establishing an ECA in Arctic waters will provide for more stringent rules on the

emission of sulfur oxides, nitrogen oxides, and particulates, but it cannot address pollution in the case of an HFO spill. To prevent accidental discharge of HFO, Particularly Sensitive Sea Areas (PSSA) were developed to address oil spills and their ecological and biological impacts as well as their impacts on the food safety of local community/indigenous residents.

Accordingly, recommendations have been made to establish routing measures in Arctic waters and demarcate the areas to be avoided (ATBA) in ecologically sensitive sea areas. This will reduce the risks brought by the use and carriage of HFO by ships in Arctic waters.

Routes can be delineated through the establishment of a traffic separation scheme, recommended routes, or two-way routes, which effectively avoids ship groundings and collisions. “These measures decrease incidents such as groundings and collisions with other vessels and are of great significance for reducing the potential hazards in high-risk areas in Arctic waters, such as in 53-miles wide Bering Strait” (FOEI, 2016).

With considerable expertise on Arctic ecological and environmental issues, PAME has the ability to develop voyage planning criteria, including the “low impact corridors” to help seafarers avoid hazards and sensitive sea areas.

(3) Economic considerations toward a cleaner industry

Environmentally friendly shipping in the Arctic relies on the use of clean energy, which will, in turn, bring economic benefits to the industry in the long run.

As for the economic benefits of using the alternative energy, the following scenarios may be taken into consideration when the policies concerning the green energy are initiated.

Against the backdrop of a forced 0.5% fuel sulfur cap in 2020, ships that currently operate on HFO will be required to use desulfurized residual fuel or residual fuel blends that comply with the standard instead of switching to more expensive distillate fuel or installing scrubbers. Some ships will continue to use HFO with an exhaust gas cleaning system until 2020 and beyond.

If the vessels operating in the Arctic switch from HFO to distillate oil in 2020 or 2025, the fleet-wide fuel cost will increase by nearly \$9 million to \$11 million per year, which is less than a 4% increase in fleet-wide fuel costs (Roy et al., 2017).

It is estimated that, if vessels operating in the Arctic switch from HFO to LNG in 2020 or 2025, provided that LNG remains low relative to other bunker fuels and that shipowners accept the payback period, more Arctic ships may operate on LNG in the future (Knizhnikov, 2017).

If an HFO spill occurs, the clean-up costs will outweigh the fuel savings by continuing to operate on these fuels in a given year. Moreover, the cost of cleaning up an HFO or residual fuel blend spill has exceeded \$100 million per incident in recent decades, which exceeds the expected increased fuel costs associated with prohibiting HFO and

desulfurized fuel (Roy et al., 2017).

A comprehensive assessment of the net economic benefits associated with shipping shows the economic gains achieved by using the Northern Sea routes (NSR) might be offset by the underlying costs of climate change globally until 2200 (Yumashev et al., 2017).

Therefore, the shipping sector must aim high and constantly strive to be a cleaner industry by taking the economic benefits into consideration in the long run.

5.5 Strengthening the cooperation between relevant international and regional organizations in the HFO governance in shipping

The Arctic Council represents the interests of the coastal states in the Arctic. Some coastal states have formulated national laws on environmental protection in the Arctic, according to Article 234 of UNCLOS 1982. Therefore, the Arctic Council has attached great importance to the interests of the Arctic coastal states in the use and carriage of HFO, and the issued documents are simply regional solutions.

While focusing on the demands of relevant coastal states, the IMO platform also needs to take into account the interests of user states or major international shipping nations and unveil solutions on a global scale. Therefore, the specific solutions also involve competition between coastal states and user states.

The Arctic Council and the IMO have common concerns in developing solutions to Arctic environmental issues. Therefore, the influence of the Arctic Council member states, IMO's legislative development, and its performance monitoring mechanism can be used to improve the Arctic governance mechanism and put the member states of the Arctic Council and non-member observer states into global context. This would allow for effective communication in issuing relevant policies between the two organizations.

It is encouraging that IMO is now seeking observer status with the Arctic Council and has authorized the Secretary-General to take appropriate action for the IMO to obtain such status with the Arctic Council, which will increase communication between the two organizations when making policies concerning the Arctic governance.

6 Discussion on feasibility of implementing HFO ban under the framework of the Arctic governance

MEPC72, held in April 2018, considered the proposals submitted by Member States on Development of Measures to Reduce Risks of Use and Carriage of Heavy Fuel Oil as Fuel by Ships in Arctic Waters. The proposals fall into two categories: one represented by pioneering NGOs, the United States and other Arctic States (except Russia) who favor the HFO ban and the other represented by Russia who favors

the "mitigation measures".

IMO provides a platform for the governance of HFO in the Arctic. Within the Arctic waters, Member States of the Arctic Council play a major role in governance, whether to conduct governance, and how to govern is their decision. Therefore, examining the Arctic governance mechanism will provide insights when it comes to determining whether the HFO ban can finally reach an agreement under the IMO platform. The author will discuss the feasibility of imposing a ban on the use and carriage of HFO in the Arctic from the perspective of mutual learning in governing the Antarctic and Arctic waters, involvement of industry governance, the boost given by permanent participants and observers, and the leading role of Arctic Council Member States in governance.

6.1 Mutual emulation in the governance of the Antarctic and Arctic waters

Mutual emulation in the governance of the Antarctic and the Arctic are always practiced in many cases and there is no exception to the governance of shipping-related issues in those two areas. Since the Polar Code is applicable to both waters, the previously promulgated international legal documents on environment protection in Antarctic waters by the IMO can be quoted and referred for future implementation of similar provisions in Arctic waters. As early as 2005, the parties associated with the Antarctic Treaty adopted a legal document prohibiting the use and carriage of HFO in the Antarctic. Subsequently, in a resolution adopted by the IMO in 2010, the MARPOL Annex I (MEPC189. (60)) prohibited the use and carriage of HFO by ships in the Antarctic. Served as a precedent, this document will provide a reference for the prohibition of ships using or carrying HFO in Arctic waters. MEPC72's discussion on the ban on the use and carriage of HFO in Arctic waters is based on the preceding practice in Antarctic waters. In that sense, there is precedent for the introduction of a ban on HFO in the Arctic, so those who favor prohibiting the use and carriage of HFO in the Arctic will have more impact on the governance of HFO.

6.2 Participation of industry governance

As the main channel and the core platform within the Arctic governance mechanism, the role of the Arctic Council is rooted in consultation, coordination, concepts, recommendations, and norms, while specific and strong actions are rarely seen. It is a fragmented multi-layered forum with few mandatory instruments to regulate the behavior and actions of its members. Therefore, it is necessary to communicate with other international organizations with complete legal mechanisms and have a strong capacity for compliance monitoring, conduct interactive discussions on specific environmental issues, and establish an effective compliance mechanism to solve specific problems more effectively. This highlights the need

for industry governance. As the international regulatory body of the shipping industry, IMO is tasked with carrying out HFO governance within the shipping industry through legislation and supervision. In the governance of HFO in the Arctic, while focusing on the demands of Member States in the Arctic Council, the IMO also needs to take into account the interests of user states or major international shipping nations. It is necessary to use the IMO platform to make a decision on imposing a ban or choosing mitigation measures, and, in the end, must also consider the economic impacts of the ban. The major trading countries that rely on the Arctic waterway are unwilling to accept the increased costs caused by the ban, which will deal a heavy blow to the upstream and downstream enterprises of the entire shipping industry chain. Therefore, whether the HFO ban can be implemented smoothly depends on IMO's comprehensive consideration of the economic situation of the entire industry before making a rational decision.

6.3 Role of permanent participants and observers

The Arctic Council is a hierarchical governance body with permanent participants and observers, in addition to Member States. Permanent participants can provide local awareness and knowledge. In HFO governance, putting emphasis on the role of permanent participants helps to understand specific local demands for HFO and how they might shift towards other energy sources. The contribution and knowledge of PPs can allow for a more practical policy.

In addition to sovereign countries, observers also include non-governmental organizations, which have played a pivotal role in the construction of proposals. In terms of HFO governance, NGOs fall into two categories. One category is composed of NGOs that provides data support, such as the ICCT. The ICCT submitted a report entitled "Heavy Fuel Oil Use in the IMO Polar Code Arctic: Summarized by Ship Type", which described the use and carriage of HFO in the Arctic waters in 2015, as well as the black carbon emissions, and provided informative data and decision-making references (Roy and Comer, 2017).

The other category is composed of NGOs with a strong role in mobilization and proposal building capacity, such as WWF and FOEI, who build a bridge between the Arctic Council and IMO, actively seeking legal basis and presenting solutions. At MEPC70, IMO commenced a discussion on the risks of using HFO by ships in Arctic waters. Non-governmental organizations such as WWF asked IMO to pay attention to the recent achievements of stakeholders in reducing the risks of using and carrying HFO in Arctic waters. It is also recommended that the IMO and the Arctic Council should cooperate in HFO governance and improve information sharing. Prior to MEPC72, the above NGOs strongly supported the HFO ban. Their attitude is more determined than the Arctic Council Member States, such as the United States. They push for the sooner application and hesitate in exempting the ships with protective measures.

Therefore, in terms of the introduction of the HFO ban, NGOs were pioneers whose role must be taken seriously.

6.4 The leading role of Member States of the Arctic Council in HFO governance

The Ottawa Declaration of 1996 announced the establishment of the Arctic Council, henceforth its Member States were given the priority in the Arctic governance. As the way forward, HFO ban ushered by the US has gain an upper hand in the IMO, especially those Arctic States except Russia. The seven Arctic States led by the US will gain upper hand in the negotiation on HFO governance.

6.5 Summary

In 2016, MEPC70 adopted the "Sulfur Cap", which means that the Sulphur content of marine fuel oil worldwide shall not exceed 0.5% in 2020, which fundamentally limits the use of HFO use in the Arctic.

MEPC72 finally agreed to instruct its Pollution Prevention and related Subcommittees (PPR) to develop appropriate measures, based on the impact of the use and carriage of HFO on the Arctic waters, and to advance their findings according to an appropriate phase-in manner.

For major shipping nations and user states, future implementation of the HFO ban will definitely affect the economics of the fleet and the upstream and downstream enterprises within the shipping industry chain. Therefore, it is critical that we collect data to support our involvement in the international negotiations on HFO, prepare early, and safeguard the interests of the shipping industry.

7 Conclusion

The shipping industry will move towards "decarbonization" and the use of clean energy. Since the use and carriage of HFO by ships in the Arctic will exert influence on the fragile Arctic environment, the Arctic Council and the IMO have begun to take relevant measures to address this issue.

In the future, the Arctic environmental governance will lay emphasis on the use and carriage of HFO in the Arctic and one of their concerns will be revising the Polar Codes. The shipping industry is one of the HFO users, and the IMO must use its advantages in proposals, construction, and compliance supervision. The Arctic Council must use its influence to mobilize its member states to make comprehensive considerations and balance the interests of the Arctic coastal states and user states. This will allow for the exploration of comprehensive, effective, environmentally friendly and cost-effective solutions for the governance of HFO in shipping. Only then can we address the issue of the use and carriage of HFO by ships in Arctic waters and achieve more effective governance of the Arctic environment.

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