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THE DEVELOPMENT OF THE INCLUSION OF THE SHIPPING INDUSTRY IN EMISSION TRADING SYSTEMS AND ITS IMPACT ON THE SHIPPING SECTOR

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Abstract: With the growing global demand to address climate change, emission trading systems have gradually become a core tool for reducing greenhouse gas emissions in various regions. Shipping is an essential part of global trade, and several regions are either already including or planning to include the sector in their emission trading systems. Given the varying levels of development of ETS across different regions, the management approaches for incorporating shipping into these systems differ significantly. The incorporation of shipping will have widespread implications for shipowners, international cargo owners, ship operators, and the shipbuilding industry. As the shipping sector takes on the responsibility of transporting international goods, its integration into ETS will drive significant changes across various industries. These changes include increased compliance costs, new regulatory requirements, and a shift toward cleaner technologies and fuels. The paper discusses the impacts of these changes, focusing on how shipping's inclusion in ETS is reshaping the sector globally and driving its transition towards sustainability.
Keywords: Emission trading system; Shipping industry; Decarbonization; Energy efficiency; Green shipping corridors

1 INTRODUCTION

As the core way of transport supporting global trade, the shipping industry is responsible for over 90% of international cargo transportation. Its total carbon emissions account for 2.89% of global anthropogenic emissions, being significant negative externality characteristics. Currently, there are three main types of measures being implemented in the shipping industry to reduce carbon emissions: technological measures, operational measures, and market-based measures.

Technological measures primarily involve improving ship energy efficiency, using clean fuels, and replacing old, high-emission ships with newer vessel. Operational measures include reducing ship speed, optimizing routes based on weather conditions, improving logistics management, enhancing loading and unloading efficiency, and maintaining ship hulls. These measures focus on management efficiency and operations to reduce greenhouse gas emissions. Market-based measures refer to incorporating the shipping industry into emission trading system（ETS）and carbon taxes, using market-based regulatory tools to actively engage the shipping industry in emission reduction efforts. Essentially, an ETS is a market-based incentive mechanism that controls the cost of emissions in the shipping industry by adjusting the total emission allowance, allocation methods, and prices. It encourages industries to upgrade their technologies and operational methods to reduce greenhouse gas emissions. Theoretically, there are two types of ETS: the *Cap and Trade* system and the Baseline system. However, discussions and research on ETS typically refer to the *Cap and Trade* system. The key difference between these two mechanisms lies in their approach to setting emission limits. The *Cap and Trade* system sets a fixed upper limit on the total emissions within the system, while the Baseline system establishes a reduction target or carbon debt based on the entity's performance relative to the baseline. Under both mechanisms, emission reductions or surplus allowance can be traded between companies. However, the Baseline system is more complex and typically incurs higher costs for regulators. Baseline system requires setting emission baselines for each covered emission activity or industry, and emissions from each entity are measured against these baselines. In contrast, the *Cap and Trade* system does not require baseline calculations, as the total emissions cap is the key factor driving the emission reduction goals. Some Baseline systems set specific emission targets for different facilities to determine the credit-generating emission baselines.

The emission reduction in the shipping sector reflects a typical multilateral regulatory predicament: On one hand, the shipping industry actively responds to global emission reduction trends, making breakthroughs in technology and operations. However, the potential for technological improvements, such as in fuel consumption, is constrained by the long economic life cycle of ships, making it difficult to achieve emission reductions in a short term. It means that the shipping industry cannot solely rely on incremental technological advancements to meet the goal of net-zero emissions. On the other hand, carbon pricing mechanisms are rapidly developing globally. While the International Maritime Organization (IMO) coordinates global shipping emission reduction efforts, the approaches adopted by different regions are subject to regional limitations. Due to the international nature of shipping, carbon pricing mechanisms implemented by different regions face issues of overlap and conflict during their implementation.

2 CHALLENGES OF INTERNATIONAL SHIPPING EMISSION TRADING SYSTEM

According to the Convention on the International Maritime Organization under the International Convention for the

Prevention of Pollution from Ships (MARPOL), IMO, as a specialized agency of the United Nations responsible for global shipping emissions reduction, has proposed the establishment of a global shipping ETS market. This initiative aims to cover international shipping carbon emissions through a unified system of allowance allocation and trading rules, with the core objective of supporting the maritime industry's commitment to achieving net-zero emissions by 2050[1].

IMO suggests that regional carbon trading mechanisms that incorporate shipping into carbon trading systems have a negative impact on global emissions reduction efforts. Therefore, IMO prefers to lead the establishment of a global carbon trading market for shipping. However, the *no more favorable treatment* principle established under the MARPOL Convention requires equal application of technical standards to all ships, which creates a normative conflict with the *common but differentiated responsibilities* principle under the UNFCCC framework. This is especially apparent in the allocation of carbon emission allowance, where developing countries advocate for differentiated management based on *per capita emission equivalents*, while developed countries emphasize that the *stateless emissions* nature of shipping should apply a uniform standard. As a result, it is difficult to reach a consensus on a unified plan.

Currently, countries and regions such as China, the European Union, New Zealand, South Korea, and the United States have established carbon emissions trading systems. However, most carbon emissions trading systems remain limited to sectors like energy, electricity, and road transportation. Only China (Shanghai), the EU, the UK, and South Korea have already included or plan to include shipping within the scope of carbon emissions trading.

3 PROGRESS OF EMISSION TRADING SYSTEMS IN AREAS INCORPORATING SHIPPING

3.1 The Korean Emissions Trading Scheme (K-ETS)

As the first Asian country to commit to carbon neutrality, South Korea has a detailed and proactive plan for establishing a carbon trading system. South Korea's carbon market, commonly referred to as K-ETS, was launched in 2015 with a government-operated carbon credit market that allocates emission allowances for businesses. Through policies and regulations such as the *Framework Act on Carbon Neutrality and Green Growth to Address the Climate Crisis* and the Greenhouse Gas Emissions Trading Act, the government has set carbon reduction targets and strategies for the country.

The carbon trading mechanism has had a significant impact on South Korea's industries, as it requires high-emission companies to purchase allowances or reduce emissions. This has increased operational costs for energy-intensive sectors such as steel, chemicals, and shipbuilding. It may lead to a decrease in profit margins and drive companies to seek energy-saving and emission-reduction technologies. South Korea's export-oriented industries may also face risks of reduced international competitiveness, particularly in cases where global carbon prices vary significantly.

Overall, the development of South Korea's carbon market can be divided into three stages: the first stage (2015–2017), the second stage (2018–2020), and the third stage (2021–2025)[2]. Each stage involves adjustments and upgrades in areas such as the market's coverage, allowance allocation, and offset mechanisms. As the market evolved from the first to the third stage, the sectors covered by the carbon market gradually expanded. In December 2014, the South Korean government officially included the shipping sector in the national carbon allowance allocation plan for the third phase of the K-ETS.

In principle, South Korea allocates different amounts of carbon allowances depending on the industry. However, for industries or businesses with special greenhouse gas emission characteristics (such as transition industries), separate industry-specific allowances may be calculated. The shipping industry is one such exception, and it receives fully free carbon emission allowances. South Korea's shipping industry is heavily supported by its shipbuilding sector. The three major conglomerates—Hyundai Heavy Industries, Samsung Heavy Industries, and Hanwha Ocean—account for 80% of global LNG carrier orders and 60% of orders for ultra-large container ships, with the growth rate for eco-friendly ship orders reaching 17% annually. The shipping industry contributes more than 7% of South Korea's domestic manufacturing output, and its upstream and downstream industries cover over 15 sectors, including steel, electronics, and new energy materials.

3.2 The UK ETS after Brexit

Before Brexit, the UK's carbon emissions were regulated under the EU Emissions Trading System (EU ETS). As a member of the EU, the UK participated in the EU ETS from its launch in 2005 until January 31, 2020, when it officially left the EU. Subsequently, the UK established an independent carbon trading system, which replaced the EU ETS framework on January 1, 2021.

According to a 2022 UK government survey, the UK Emissions Trading Scheme (UK ETS) covers about 25% of the UK's territorial carbon emissions. The UK ETS covers the electricity sector, energy-intensive industries, and domestic flights, as well as flights between the UK and the European Economic Area (EEA), Switzerland, and flights between the UK and the Strait of Gibraltar. The main program of the UK ETS involves 678 fixed installations and 369 aviation operators. Additionally, the scheme includes 250 facilities that participate through the *Hospital and Small Emitters Opt-out Mechanism*, and 110 *Ultra-small Emitters*[3]. Under the terms of the Windsor Framework, five power generation facilities in Northern Ireland continue to participate in the EU ETS.

The UK plans to include shipping in the carbon trading market starting in 2026, and the UK ETS management is actively exploring the possibility of extending the scheme to the maritime industry. Public consultations have already been launched regarding this policy. Shipping is one of the pillar industries in the UK, a nation with a long maritime

history, and 95% of the UK's imported goods are transported by sea. The shipping industry also creates numerous jobs in the UK, including in shipbuilding and port operations.

Under the current proposal, emissions included in the UK ETS mainly pertain to domestic maritime emissions, which cover emissions from voyages that begin and end at the same UK port, voyages between two UK ports, and emissions from anchoring and mooring during these voyages (including offshore facilities). The scope also includes emissions generated at berth in UK ports, including emissions from vessels arriving at or departing for international destinations. The consultation report also suggests that domestic maritime emissions should include emissions generated while vessels are moored at UK ports, even if the ship is leaving the port to travel to a foreign port.

3.3 Regional Emission Trading System and National Emission Trading System of China

China's carbon trading market was initially established through pilot cities. Since 2011, China has launched carbon emission trading pilot programs in seven regions: Beijing, Tianjin, Shanghai, Chongqing, Hubei, Guangdong, and Shenzhen. In December 2016, Fujian Province started its carbon trading market, becoming the eighth pilot region. In 2017, China marked the beginning of establishing a nationwide carbon trading market. On July 16, 2021, the national carbon market officially launched trading, while regional carbon trading markets continued to run. China's carbon trading market primarily focuses on energy-intensive industries, such as electricity and steel.

Due to this development model, the operation of China's carbon trading market varies between cities, with different regulations in place. Reginal government departments are allowed to make the rules for their respective regional carbon trading markets.

According to a document released by the Shanghai Municipal Bureau of Ecology and Environment in 2024, 31 shipping companies have now been included in the carbon emission monitoring and trading market. This is currently the only carbon emission trading market in China that includes shipping. According to the *Shanghai Shipping Industry Greenhouse Gas Emissions Accounting and Reporting Method (Trial)* issued by the Shanghai Development and Reform Commission in 2016, enterprises engaged in waterborne freight and passenger transport in Shanghai are required to monitor, account for, and regularly report the amount of carbon dioxide emissions generated during their operations.

3.4 EU ETS

The *European Climate Law* legally commits the European Union to achieve climate neutrality by 2050, with the first milestone being a reduction in net greenhouse gas emissions to at least 55% below 1990 levels by 2030.

As the most ambitious sustainable roadmap globally, the European Green Deal, proposed in 2019, aims to drive Europe's economic sustainable development through systemic transformation and plans to achieve the world's first carbon-neutral region by 2050[4]. It regulates emissions from power and heat generation, industry, and aviation, which account for about 40% of the EU's total emissions. The EU Emissions Trading System (EU ETS) is a key pillar in implementing *the European Green Deal*.

Since its launch in 2005, the EU ETS has developed into one of the largest carbon trading markets globally. Its coverage has gradually expanded from power and industrial sectors to other energy-intensive industries.

In December 2022, the European Parliament and the EU Council reached a political agreement to revise the EU Emissions Trading System, contributing to achieving more ambitious climate goals for 2030. Compared to 2005 levels, emissions under the EU ETS will be reduced by 62% by 2030. Stricter reduction measures will start taking effect from 2024, and the cumulative reductions over the next seven years will significantly increase. Taking action across the economy to address climate change is crucial. This agreement contributes to achieving this goal by extending the EU ETS to include its fair share of emissions from maritime transport[5].

3.4 New Zealand ETS

New Zealand's carbon trading system, which began in 2008, is the only mandatory carbon emissions trading market in Oceania after the Australian carbon tax was repealed and its national carbon market plan was not implemented. The New Zealand carbon market is the first national carbon pricing system in the world to comprehensively cover agricultural emissions[6]. The system integrates six greenhouse gases, including carbon dioxide, methane, and sulfur hexafluoride, under the *Cap and Trade* principle. By 2023, the covered emissions reached 27.9 $MtCO_2e$, accounting for 38% of the total emissions of New Zealand.

In the early stages of the New Zealand emissions trading system, its broad coverage and low entry thresholds had limited effectiveness, as no emissions cap was initially set. The turning point came with the *2020 Climate Change Response (Emissions Trading Reform) Amendment*, which established an emissions cap for the system and introduced a allowance auction mechanism.

Although domestic aviation and coastal shipping emissions make up a small portion of transportation emissions, accounting for about 8% of total national greenhouse gas emissions, maritime transport and supply chains are key drivers of New Zealand's economy. New Zealand is actively implementing decarbonization strategies in these sectors to better manage supply chain emissions and maintain the competitiveness of upstream and downstream industries in international markets.

From 2008 to 2015, New Zealand's emissions trading system allowed participants to obtain emissions allowances through trading in international emissions markets. However, this provision was later removed, and the New Zealand

emissions trading system became a domestic market with no special connection to other regional trading systems. As one of the most comprehensive trading systems, New Zealand's emissions trading system included the transport sector, including shipping, from the outset, and mandates that the transportation sector report and surrender emissions units.

4 DISCUSSION AND CONCLUSION

4.1 Increasing Management and Operational Costs in the Shipping Industry

Regardless of whether shipping companies obtain emission allowances through free allocation or auction, the ultimate goal of an emissions trading system is to reduce overall emissions through a cap-and-trade mechanism. Under the incentives of market regulation, shipping companies will adopt ways to maximize profits while reducing carbon emissions.

This typically results in increased operational costs for the shipping industry, as companies need to either purchase additional emission allowances to cover their emissions or invest in technologies that reduce emissions[7]. The costs involved include not only the price of allowances but also expenses related to monitoring, reporting, and verifying emissions, as well as additional costs for upgrading equipment and ensuring compliance with emissions reduction targets[8].

4.2 Stricter Emissions Disclosure Requirements and Improved Transparency of Emissions

In June 2024, the Sea Cargo Charter released its 2024 Disclosure Report, highlighting positive progress in reducing the environmental impact of chartered shipping activities and improving the transparency of emissions reporting in the shipping industry. The report also emphasizes the gap between current emissions levels and the IMO 2050 net-zero emissions target. The Sea Cargo Charter is one of the three major environmental initiatives supported by the Global Maritime Forum, along with the Poseidon Principles and the Poseidon Principles for Marine Insurance. These initiatives share the common goal of improving emissions reporting transparency and contributing to the reduction of carbon emissions.

The report targets charterers engaged in bulk cargo transportation. These charterers must have signed time or voyage charter agreements that include mechanisms for allocating ballast voyage emissions. The reported data covers voyages by dry bulk carriers, chemical tankers, oil tankers, liquefied gas carriers, and voyages involving one or more ships in international trade. In April 2024, Sea Cargo Charter expanded its scope to include pure shipowners. In this report, 35 companies engaged in transporting various goods, including agricultural products, aluminum, chemicals, oil and gas, energy, metals, mining, cement, and timber, disclosed their 2023 chartering activities and the alignment of their emissions with the revised IMO greenhouse gas reduction targets. These companies accounted for approximately 20% of the total annual bulk cargo transportation by sea.

After being included in emissions trading systems, shipping companies are required to bear the economic costs associated with emissions. in addition to acquiring carbon allowances through auctions or trading, they also need to cover monitoring costs under the MRV system and ship management expenses. according to estimates, after the inclusion of maritime shipping in the EU ETS, the annual compliance costs for large international shipping companies could increase by millions of euros. Being included in the emissions trading system means that regulated ships must adhere to stringent MRV mechanisms. ships are required to install fuel consumption data collection systems, which increases the costs for technological upgrades as data transparency is emphasized.

4.3 Transformation and Upgrading of the Upstream and Downstream Supply Chains of Shipping

Due to the IMO's requirements for energy efficiency indices such as Energy Efficiency Existing Ship Index（EEXI）, on one hand, large-scale low-carbon retrofitting of ships is underway, leading to a significant increase in demand for components like dual-fuel engines and scrubbers. On the other hand, the ETS accelerates the compliance process for EEXI speeding up the retirement of older ships. As a result, global orders for LNG-powered vessels continue to rise, and LNG bunkering volume is steadily increasing.

4.4 Global Green Shipping Corridors

In November 2021, during the 26th Conference of the Parties to the *United Nations Framework Convention on Climate Change* (COP26), over 20 countries signed the Clydebank Declaration on Green Shipping Corridors. The declaration set the goal of establishing more than six green shipping corridors between two or more ports globally by 2025, with plans to expand the number of green corridors by 2030. This initiative aims to support the global shipping industry in achieving full decarbonization by 2050, marking the formal introduction of the *Green Shipping Corridor* concept.

The declaration specifies that stakeholders across the shipping supply chain, including ports, shipping companies, and fuel suppliers, will collaborate to implement greenhouse gas reductions and even achieve zero emissions on specific routes. These routes will be recognized as green shipping corridors.

By 2023, 44 international green shipping corridor initiatives had been established worldwide. Of these, 22 corridors have specified fuel pathways, with more than half choosing methanol and ammonia as zero-emission fuel options. These fuels are considered the primary scalable choices for medium and large vessels.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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