Inclusion of Maritime into the EU ETS: Implications from the Aviation EU ETS and Aviation Sector

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***Abstract*—The EU Emissions Trading System (EU ETS) has proven to be an effective tool in helping drive down emissions within the EU. To regulate the rising environmental impact of shipping, the EU proposed to further include maritime into the EU ETS starting from 2024. Despite the efforts of industry stakeholders, the most effective pathway to maritime EU ETS compliance remains unclear. Both belong to the transportation industry, the aviation sector has been included into the EU ETS for over a decade, the high correlation between aviation and maritime sectors enables the aviation sector capable to provided knowledge to the maritime sector in terms of policy developments and compliance. This study aims to predict potential policy iterations to the maritime EU ETS and provide shipping companies with methodologies to alleviate economic pressure resulting from EU ETS compliance by reviewing the policy development of the aviation EU ETS and resulting responses at governmental, organizational and industry levels.**

***Keywords*—EU Emissions Trading System (EU ETS), EU ETS aviation, EU ETS maritime, policy development, maritime sustainability**

I. Introduction

Characterized by shifting in global temperatures and weather patterns, Climate change is amongst the most pressing challenges of human history, with far-reaching implications for ecosystems, economies, and societies worldwide. The first international conferences that raised the awareness of climate change could be dated back to 1972 when the United Nations Conference on the Human Environment was held in Stockholm (United Nations. n.d.). Later in 1992, Climate change and its effects elevated significant attention after the inception of the United Nations Framework Convention on Climate Change (UNFCCC). Since then, concerted international efforts have been underway to address this existential threat. Landmark agreements such as the Kyoto Protocol and the Paris Agreement have underscored the urgency of mitigating greenhouse gas emissions and adapting to the impacts of climate change. Subsequently, governments and governing bodies worldwide set ambitious goals for their emissions reduction scheme and introduced Market-Based Mechanisms (MBMs) such as Emission Trading System (ETS) to ensure their climate goals can be achieved.

MBMs are regulatory instruments that use the market to achieve policy objectives such as environmental protection or resource conservation. Instead of overriding the free market with central planning, MBM aims to create economic incentives that encourage market participants to reduce their impact on the environment and utilize resources more efficiently (Stewart, 1991). ETS is a specific type of MBM used to reduce GHGs. An ETS sets a cap on the total amount of emissions allowed within a certain jurisdiction or sector, emission permits representing the right to emit emissions are then distributed or auctioned to participants within the system. By adopting ETS, an emissions market is created with price of permits determined by the market, allowing authorities to achieve environmental goals while providing flexibility for the business to find the most cost-effective ways to reduce their emissions either by trading or by investing in cleaner technologies.

Both the aviation and maritime sectors play a key role in securing supply chain safety and facilitating global trade while representing significant contributions to global greenhouse gas emissions (European Parliamentary Research Service, 2023). The mobile source emissions nature of aircraft and ship makes emissions reduction thorny to achieve without technological advances. Hence, both sectors face common challenges in mitigating carbon footprints and complying with evolving ETS regulatory frameworks. The inclusion of aviation into the EU Emissions Trading System (EU ETS) has witnessed rising operational costs for industries and prompted experiments on cost alleviation strategies, giving valuable knowledge to the maritime sector.

This paper will first introduce the development of the EU ETS before focusing on examining the EU ETS on aviation sector comprehensively. For over 12 years, the development of the aviation EU ETS policies and resulting strategies taken by industry stakeholders, governmental and organizational bodies provide valuable knowledge to the maritime industry. By analysing the evolution of the aviation sector EU ETS and compare with the existing policy content of the EU ETS on maritime sector, this paper aims to predict potential policy iterations to the maritime EU ETS and contribute to informed industry practices based on the maritime industry status quo.

II. The EU ETS

Under the European Climate Law, EU Member States will work collectively to become climate-neutral by 2050 (European Commission, n.d.a). The "Fit for 55" scheme is the first milestone which aims to reduce net emissions by at least 55% by 2030 compared to 1990. Set up in 2005, the EU ETS first covers Greenhouse Gases (GHGs) of Carbon Dioxide (CO_2) and expands to Nitrous Oxide (N_2O) and Perfluorocarbons (PFCs). The EU ETS has proven to be an effective tool in helping drive emissions reductions cost-effectively by the EU where industries covered by the ETS witnessed a reduction of emissions by about 35% between 2005 and 2021 (European Commission, n.d.b). The

EU ETS is an MBM which introduced a 'cap and trade' system by setting a cap on the total amount of greenhouse gases that can be emitted within the system on a yearly basis and allowing participants to receive, buy or trade emissions allowances with one another (European Commission, n.d.c). The cap is reduced over time so that total emissions fall. By 2030, the cap on emissions from all sectors covered by the EU ETS is estimated to decrease by 62% compared to 2005 levels (European Commission, 2023).

The EU ETS scheme has been divided into four "Trading Periods" where geography, sectors and greenhouse gases are gradually expanding (Northern Ireland Assembly Research and Information Service, 2020; European Commission, 2022). Starting from 2021, phase 4 of the EU ETS covers EEA countries and electricity generating installations in Northern Ireland. Starting from phase 3, GHG emissions of Carbon Dioxide (CO_2), Nitrous Oxide (N_2O) and Perfluorocarbons (PFCs) from power generation, manufacturing as well as aviation are included in subsequent trading periods, with maritime sector included starting from 2024 (European Commission, n.d.e; European Commission, n.d.d). Besides, phase 4 also plans to reduce further the number of overall emissions allowances by speeding up linear reduction and continuing the phase-out of free allocation of emission allowances by 2027.

III. EU ETS on Aviation Sector

The aviation sector accounts for 3.7% of total carbon emissions in the EU and is expected to be the fastest-growing greenhouse gas emission sources (European Parliamentary Research Service, 2023). The attempt to include the aviation sector into the EU ETS can be dated back to 2008 when Directive 2008/101/EC stated that airlines operating in the EEA are required to adhere to Monitor Report Verification (MRV) and surrender their emissions since 2012 (European Commission, 2008). It is proposed that CO_2 emissions from all domestic flights as well as international flights arriving at or departing from EEA countries are to be included into the EU ETS. Fuel consumption by land based Auxiliary Power Units used to power the aircraft will also be accounted. The Directive follows the "cap and trade" principle, which specifies that total aviation allowances will be determined using historical emissions data and cut down proportionally each year starting from 2012. Among them, no less than 15% of allowances are planned to be auctioned with 3% of the total quantity of allowances planned to be set aside in a special reserve for special aircraft operators. Carbon credits including Certified Emission Reductions (CERs) and Emission Reduction Units (ERUs) can be used to surrender up to 15% of total emissions.

Different to those of stationary installations, Aircraft operators are responsible for complying with obligations, the owner of the aircraft will only be regarded as responsible when the identity of the aircraft operator is not known (European Commission, n.d.f). Aircraft operators based in the EU are assigned to the Member State that issued their license, while aircraft operators from outside the EU are assigned to the Member State to which it attributes its greatest amount of emissions. Although the aviation sector shares its own emission cap, which is independent from the general emission cap, the aircraft operators can choose to either surrender aviation allowances (EUAA) or general EU emission allowances (EUA) to comply with the EU ETS. Moreover, the EU claims that a route-based approach will be introduced to ensure that airlines operating flights on the same routes are treated equally, regardless of nationality (European Commission, n.d.g).

The Directive received fierce opposition from aviation carriers and governments, including the US, China and India (Mai and Yan, 2023). Airlines in China and India refused to submit emissions data with US lawmakers readying a law that could make it illegal to pay the tariff. The Chinese government was amongst the most vocal opponents against the EU policy and claimed the ignorance of "common but differentiated responsibilities" agreed in the Kyoto Protocol. Furthermore, the MRV and surrender requirements on extra-EEA flights make the jurisdiction of the Directive substantially step out of EU ETS participating countries. Nevertheless, the EU ETS on international aviation is a unilateral policy that is pushed out without mutual government agreements and differs from the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) established by the International Civil Aviation Organization (ICAO). Hence, the aviation EU ETS was also criticized by ICAO as destabilizing the international consensus for aviation carbon reductions (Schvartzman, 2023).

With the Directive's legitimacy widely questioned (Lan 2011; Liang and Zhang 2014; Mendes de Leon 2012), the EU suspended its compliance requirements for extra-EEA flights in November 2012, which stated to "give time for the ICAO to set up an international regulation on emissions from aviation and a MBM at global level" (European Commission, 2012). The so-called "stop the clock" decision by the EU was first set to last for 1 year but remained in effective since then (European Parliamentary Research Service, 2023). Following the approval of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) by the 2016 ICAO Assembly, the EU finally decided to apply CORSIA to international flights departing from or arriving at an airport inside the European Economic Area (EEA) in 2023 (Verifavia, 2023). Since then, MBMs for Aviation emissions in EEA started to be governed by 2 mechanisms where the EU ETS applies to intra-EEA flights while CORSIA is applicable to extra-EEA flights.

IV. EU ETS on Maritime Sector

Although shipping is one of the most energy-efficient transportation modes, the Maritime sector still contributes to 3% of the EU's total CO_2 emissions (European Commission, n.d.h). As part of the "fit for 55" package, the EU ETS proposed to further include the maritime sector starting from January 2024. Maritime sector EU ETS covers emissions from ships at berth in an EEA port, 100% of voyages between EEA ports and 50% of emissions on voyages between an EEA port to a non-EEA port. Compliance obligation lies in shipping companies, which is characterized as the ship owner or any other organization or person, such as the manager or the bareboat charterer, who has assumed the responsibility for the operation of the ship including duties and responsibilities imposed by the ISM Code (European Commission, n.d.i; DNV, 2023). The assignment of

Administering Authorities (AA) to shipping companies is based on the country that a shipping company is registered. For non-EEA registered shipping companies, the country with the most port calls during the preceding four monitoring years will be assigned as the AA.

The inclusion of maritime emissions is taken progressively for both allowances covered, vessels and GHGs (CE Delft and DLR, 2021). No allowance will be distributed freely but 40% of reported emissions during 2024 must be surrendered only by emission allowances, followed by 70% of emissions reported for 2025 and 100% of reported emissions starting from 2026. CO_2 emission will first be covered in 2024 and then emissions of CH_4 and N_2O be included starting from 2026. vessel types and sizes are to be phased in by first introducing cargo and passenger ships of or above 5000 Gross Tonnage (GT) in 2024 and then offshore ships of or above 5000 GT in 2027. Moreover, unlike the aviation sector which has its own cap and allowance, emissions from maritime transport are included in the overall EU ETS cap and follow general annual linear declination. This approach is clarified by the European Commission that could incentive low carbon solutions within the industry and contribute to minimizing the gap between alternative and traditional maritime fuels (European Commission, n.d.j).

V. Discussions

Similar to the aviation industry, jurisdiction boundary is the point of dispute when it comes to extra-EEA voyages. As agreed in the Kyoto Protocol, responsibilities for reducing GHG emissions from international aviation and shipping are passed to ICAO and IMO so that intergovernmental efforts could be taken, 'common but differentiated responsibilities' on GHGs emissions reduction between developed and developing countries should also be shared (United Nations, 1997). Although the EU claims ETS on aviation and maritime sectors are country-neutral and route-based so that each stakeholder is treated equally, it still disadvantaged those from developing countries significantly. This unilateral approach by the EU also breaks the fundamental spirit of 'joint international effort' in targeting climate change. While shipping voyages can span over several continents, 50% of emissions of extra-EEA voyages can lead to the route-based jurisdiction boundary exceeding EEA country boundaries, adding to its legitimacy issues. Furthermore, the application of EU-ETS to non-EU flagged ships' emissions from outside the territorial seas of EU member states will deviate from the UN Convention on the Law of the Sea, and has already been questioned by the government of Japan in 2021 (Government of Japan, 2021). Given the EU finally agreed to introduce CORSIA to regulate extra-EEA flights after a series of governmental and industrial efforts, and the high similarity of aviation and maritime industry nature, application of EU ETS might be suspended for extra-EEA voyages if a global MBM can be developed by IMO.

Economic pressure can be alleviated through the appropriate combination of allowance spot, derivatives and international credits to surrender emissions obligations. Aviation operators are allowed to use both EUA and EUAA to surrender their emissions, plus a phase-based limit (max 15% for phase 2, max 1.5% for phase 3) of verified emissions surrendered using international credits, including CERs and EURs. With the comparable price advantage of international credits, aviation operators used a combination of freely distributed EUAA, auctioned EUAA, purchased EUA as well as CERs and EURs to reduce their carbon emission expenditure. Apart from the spot market, exchanges such as the European Energy Exchange (EEX) also provide carbon derivatives exchange, allowing aviation operators to reduce carbon costs through hedging (European Energy Exchange AG, n.d.). Air France KLM group for example, used carbon forwards contracts progressively to hedge its 2019 requirement and a portion of the 2020 requirement (Air France-KLM Group, 2020). Starting from phase 4, the use of CERs and ERUs have been derogated while the new global mechanism under Paris Agreement article 6.4 is still under discussion, which makes international credits temporarily unavailable for EU-ETS (UNFCCC, 2016; European Commission, n.d.k). Moreover, aviation allowances can also be surrendered by other industries starting from 2021 (ISPRA, n.d.). Hence, shipping companies can use a combination of both spot and derivatives of EUA and EUAA to minimize emissions costs while keeping a close eye on the development of the new global mechanism and its credit prices.

Although leading to criticism of potential carbon leakage, costs of the EU ETS compliance can be controlled by route optimization. Recent decades have witnessed an increase in aviation markets especially in Middle East and Asian countries such as Turkey, where carbon cost on goods or passenger transfer inside the EU by air (e.g., Spain to Greece) can be reduced through indirect routings via a stop on these countries (e.g., Turkey) (Air France-KLM Group, 2022). Although resulting in increased travelling length and higher carbon emissions, the reduction of cost on compliance to CORSIA instead of the EU ETS can still make indirect routings profitable. Shipping companies or operators can add a stop on ports near EEA countries so that voyages subject to emission surrender can be cut short. Hence, emissions costs for EU ETS compliance can be controlled by rerouting shipping routes.

The use of alternative fuel can be considered when economically appropriate. Sustainable aviation fuels (SAF) are liquid fuel currently used in commercial aviation which reduces CO_2 emissions by up to 80% (IATA, 2023). Considered as the most promising measure to help the aviation industry target net zero, the EU ETS incentives airlines by attributing SAF zero emissions so that SAF-powered flights are exempt from emissions surrender. However, given that SAF is 2–6 times more expensive than kerosene, SAF consumption is estimated to take only 0.05% of total aviation fuel consumption in 2017 (European Parliamentary Research Service, 2020; EUROCONTROL, 2022). Similarly, voyage emissions that result from the combustion of Renewable Fuels of Non-Biological Origin (RFNBOs) or Recycled Carbon Fuels (RCFs) are remitted in the EU ETS by having an emission factor of zero under EU ETS (European Commission, n.d.i). Hence, shipping operators could consider using alternative fuels for voyages covered by EU ETS when sustainable fuel prices are cost-effective.

VI. Conclusion

The EU ETS has proved to be an effective way to target emissions reduction for the EU. Over the past decades, the inclusion of the aviation sector and its ongoing policy developments provided valuable knowledge to the maritime sector. By referencing the aviation sector, it can be concluded that surrender requirements for extra-EEA voyages are very likely to be suspended after the development and application of a global MBM by the IMO. Expenditures resulted from EU ETS compliance can be cut down by adding a stop on ports near EEA countries, which can be applied to both intra and extra EEA voyages. For shipping companies, disbursements can be further managed by using an appropriate combination of both spot and derivatives positions of EUA and EUAA before international credits are available. The use of alternative fuels such as RFNBOs or RCFs can also be considered if their prices are economically appropriate. Given that the extension of the EU ETS to the maritime sector is currently one of the most thought-provoking issues within the maritime industry, this study provides valuable insights for both policy developments and potential economic alleviation approaches to industry practitioners. Later studies could focus on following the ongoing policy developments to the maritime EU ETS, quantify the effectiveness of each economic alleviation approach and research on hedging strategies.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Zhiqiang Lu supervised this project and contributed ideas for the document's drafting; Shuyue Lu conducted the research and wrote the manuscript; both authors have approved the final version.

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