Market-Based Measures for International Aviation and Shipping: Lessons Learned from a Cross-Sectoral Analysis of EU ETS

Goran Dominioni[1] and Marina Efthymiou[2(✉)]

[1] School of Law and Government, Dublin City University, Dublin, Ireland
[2] Business School, Dublin City University, Dublin, Ireland
Marina.efthymiou@dcu.ie

Abstract. The reduction of greenhouse gas (GHG) emissions from international aviation and shipping is a key priority for policymakers. The International Maritime Organization (IMO) has adopted its 2023 Greenhouse Gas Strategy and is working on the adoption of a carbon pricing instrument to decarbonize international shipping. Similarly, the European Union (EU) has extended its emission allowance trading scheme (ETS) to international shipping, while the International Civil Aviation Organization (ICAO) has adopted the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). CORSIA runs in parallel to the EU ETS to intra-EEA flights. The paper analyzes the approach taken by EU policymakers for the inclusion of aviation and shipping in the EU ETS. In particular, it discusses the regulated entities, exemptions, allowance types, geographical scope, GHG types, revenue use, fines, Monitoring Reporting and Verification (MRV) and allocation rules. By exploring the policy progress made in the two sectors and the lessons learnt from a cross-sectoral comparison of the market-based measures, this article provides valuable insights for policymakers, industry stakeholders, and other interested parties seeking to promote an effective and equitable energy transition in international aviation and shipping.

Keywords: Market-based measures · international shipping · international aviation · International Civil Aviation Organization · International Maritime Organization · EU Emission Trading System

1 Introduction

The European Union, via the EU Green Deal, envisions becoming climate-neutral by 2050. The plan includes various policy measures aimed at reducing greenhouse gas (GHG) emissions in various sectors, including aviation and shipping. Both shipping and aviation are some of the fastest-growing industries and a contributor to climate change. Thus, their decarbonisation is deemed necessary and the EU Emissions Trading Scheme (EU ETS) and Market Based Measures (MBMs) in general, among other policies, have been seen as useful components of the policy mix to address climate change.

C. McNally et al. (Eds.): TRAconference 2024, LNMOB, pp. 117–124, 2025.
https://doi.org/10.1007/978-3-031-89444-2_16

The EU ETS is a cap-and-trade system. From an economic perspective, it can be seen as cost-effective in theory because it creates a financial incentive for firms to reduce emissions where they are least costly. Under a carbon pricing instrument, regulated entities can choose whether to pay the price or reduce emissions—the expectation is that emissions reductions will occur only when the cost of reducing emissions is lower than the carbon price. If the carbon price is too low, it will not provide sufficient incentive for the regulated entities to have emissions reductions, and if it is too high, it could lead to economic distortions. Carbon leakage can also influence the effectiveness of the scheme. In practice, the EU ETS's actual efficiency, effectiveness, and feasibility can vary depending on its design and implementation [1]. Implementing market-based measures in the two sectors presents similar challenges due to their global nature, relevance for trade, and the existence of dedicated United Nations institutions for regulating GHGs outside the UNFCCC process. Aviation has been gaining more public attention and the altitude of where the GHGs are emitted made its decarbonisation more urgent. Therefore, EU ETS has been applied to aviation before shipping.

The paper critically examines the inclusion of aviation and shipping in the EU ETS from a policy perspective and highlights its shortcoming, but also decarbonisation potential. There is an emerging body of scholars that evaluate EU ETS from various perspectives (e.g., competition, impact on market, trading prices, policy evaluation). The originality of this paper lies in the fact that there are very few papers that examine aviation and shipping in parallel within the context of EU ETS. The lessons learned from aviation for shipping are researched [2], but this work was prior to the inclusion of shipping in EU ETS and does not include the latest developments about the aviation allowances phasing out. Our paper covers the regulated entities, exemptions, allowance types, geographical scope, GHG types, revenue use, fines, and allocation rules. Following the analysis of the EU ETS policy in aviation and shipping, the paper concludes with the key takeaways for policy makers which is also the major contribution of the paper.

2 Policy Analysis of EU Emissions Trading Scheme in Aviation

Emissions Trading Scheme (ETS) is one of the main instruments used in Europe to control GHG emissions. The inclusion of aviation in the EU ETS in 2012 (Directive 2008/101/EC) was a highly debated topic. Initially, aircraft emissions occurring within the European airspace were included in the EU ETS proposal, but after significant resistance from the international aviation community and in consideration of the International Civil Aviation Organization (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), the EU decided to 'stop the clock' (Decision No. 377/2013/EU) and include only flights to and from airports located in the European Economic Area (EEA). The 'stop-the-clock' has been extended until 2026. The regulated entities, i.e. aircraft operators, are required to monitor, report and verify their emissions and to surrender allowances, i.e. permits to emit, against those emissions. When an aircraft operator does not surrender sufficient allowances to cover its emissions in the previous calendar year, an excess emissions penalty (EEP) automatically applies. The penalty is based on a price of €100/tonne of CO2 adjusted for increases in the Harmonised Index of Consumer Prices (HICP) since 2012.

While intra-EEA aviation emissions kept increasing, the inclusion of aviation in the EU ETS delivered 100 million tonnes of CO2 reductions/offsets between 2012 and 2018. There are two main types of allowances under the EU ETS, EU Al-lowances (EUAs) and European Aviation Allowances (EUAAs). Aircraft operators were entitled to use certified emission reduction credits (CERs) up to a maximum of 1.5% of their verified emissions. CERs use has been discontinued from 2020 on-wards. Every year a number of allowances is issued. The original cap on aviation allowances was 95% of the 2004–2006 emission levels and is set at 210,349,264 allowances per year [3]. Up to 82% of these al-lowances are granted for free, while the remaining 15% and 3% are auctioned and given to fast-growing airlines and new entrants, respectively and cross-sectoral trading of allowances and banking of allowances for future use is allowed. The regulation, though, does not sufficiently consider new entrants after 2015, and those operators have to purchase all the allowances and therefore are considerably disadvantaged against longer-running airlines, causing a fair competition discourse.

The overallocation of free allowances affected the carbon prices and did not allow EU ETS to realise its full potential [3]. Since then, the EU established a Market Stability Reserve to reduce the surplus of allowances. From 2021 onwards, the cap will decrease annually through the application of a linear reduction factor (LRF), which will increase from 2.2% to 4.3% for the years 2024 to 2027, and to 4.4% starting in 2028. Additionally, a linear reduction factor of 2.2% annually is applied to the aircraft operators' allowance allocations (Directive 2018/410/EC). Moreover, the free allowances will be gradually phased out by 2026. This is particularly important considering the increase of air traffic post-COVID 19 [4–6]. Carbon leakage has not been observed as the choice of routes is driven by demand, and the environmental cost for the aircraft operators is not significant enough to make them change their origin-destination routes [7].

The EU ETS acknowledges the need for aviation decarbonisation efforts to go beyond CO_2. Two-thirds of aviation's climate impacts is attributed to non-CO_2 factors [8]. These non-CO2 emissions' climate effects vary based on altitude and meteorological conditions and are not related to the fuel consumption in a linear way. Therefore, addressing the fuel consumption does not resolve the non-CO_2 effects and they require policy control. From 2025, aircraft operators will also have to monitor, report, and verify non-CO_2 emissions. These actions will facilitate better implementation of EU ETS in aviation in terms of measuring effectiveness and align better with the Green Deal commitments.

Another important element identified is the linking of EU ETS with other policies, and the policy complementarity [3, 9]. ReFuelEU, a Sustainable Aviation Fuels (SAF) blending mandate to be implemented by 2025, is interconnected to EU ETS. While free allowances are withdrawn, EU ETS will reserve 20 million allowances worth €1.6 billion from 2024–2030 to cover the price difference between SAF and Fossil Fuel and make the transition to non-free allowances easier as aircraft operators that use SAF are not required to surrender allowances for that fuel combustion. Airlines can use SAF as offsets to fulfil their ETS (and CORSIA) obligations [10]. Moreover, 5 million allowances will be transferred to an Innovation Fund to support the commercial deployment of breakthrough innovation across the economy. EU Member States have reported using more than €46 billion or 77% of their ETS revenues for climate action over the last 8 years.

CORSIA is essentially a carbon-offsetting scheme, which allows emissions from the aviation sector to continue increasing above the baseline (2019 emissions) and foresees offsetting with credits from reductions in other sectors worldwide. CORSIA is quite different from EU ETS [11] and far less ambitious. Common rules are critical in linking MBM Schemes, and so are the relative stringency and intensity of targets [7]. CORSIA puts a lot of emphasis on carbon offsetting, a practice not significantly encouraged by EU ETS as carbon offsets are not as credible and effective in reducing emissions.

Airlines are concerned about the impact these schemes will have on their costs. According to Airlines for Europe [1], in 2019, airlines spent €950 million on ETS compliance (carbon price €25/ton). Airlines for Europe argue that the cost of compliance for the EU ETS will increase five times in size by 2025 to over €5 billion annually (carbon price €80/ton), and when CORSIA is added, the cost will be €7.6 billion in 2030 and €9 billion in 2035. This will inevitably result in an increase in airline fares but will at the same time address the incorrect pricing of not including the environmental externalities and better align with the 'polluter pays' principle and therefore make the system more efficient and effective. Another element that needs to be considered further is that the price difference of EUA prices to the excess emissions penalty is very small and the EEP should be reconsidered.

3 The Extension of the EU ETS to International Shipping

In 2023, the EU extended the EU ETS to international maritime transport as part of a reform of EU ETS undertook under the EU Green Deal framework (Directive 2023/959/EU). The revised ETS Directive provides that the EUS will cover 50% of GHG emissions released in voyages between an EU port and a third country port and 100% of emissions released between two EU ports and within EU port waters (Directive 2003/87/EC, Art 3ga.1). The obligation to surrender allowances falls onto the ship owner or the entity that has adopted the responsibility to operate the vessel instead of the ship owner, including the compliance with the Management Code for the Safe Operation of Ships and for Pollution Prevention, these could be, for instance, the ship manager or the bareboat charterer (Directive 2003/87/EC, Art. 3 and Art. 3gc). The non-compliance penalty is the same as in aviation.

The instrument is phased in between 2024 and 2026. In 2024, the obligation to surrender allowances will apply to 40% of verified emissions. This will be extended to 70% in 2025 and 100% in 2026 (Directive 2003/87/EC). The types of GHGs covered will also increase over time. Initially, the ETS will apply exclusively to CO2 emissions from shipping – which alone account for about 3–4% of EU emissions. From 2026, coverage will be extended to methane and nitrous oxide. Relatedly, MRV requirements for methane and nitrous oxide will apply from 2024 onwards (Regulation (EU) 2023/957). Including methane is important to disincentivize the uptake of LNG-fueled vessels, thereby reducing risks of carbon lock-in [12]. However, these incentives are limited because the ETS will apply exclusively to GHG emissions released in using fuels on vessels, and a significant share of GHG emissions from LNG occur upstream in the production and distribution of this fuel [13].

Addressing potential risks of carbon leakage has been one of the main concerns in expanding the EU ETS to shipping, as there are several strategies that vessels could

put in place to avoid or evade the carbon price [14]. Empirical simulations indicate that such strategies could become profitable for shipping companies at ETS allowances price levels well below current ETS prices [15]. Historically, carbon leakage risks under the EU ETS have been addressed primarily through the distribution of free allowances, but EU institutions are moving away from this practice. Consistently, no free allowances will be available to shipping companies, but— as mentioned above— the instrument is phased in between 2024 and 2026. In addition, to reduce avoidance risks, calls to container transshipment ports located in third countries within 300 nautical miles from an EU port are not considered ports of call in the directive – thus, the carbon price will also apply to GHG released before and after such calls (Directive 2003/87/EC, Art. 3ga). Moreover, part of the revenues raised through the extension of the EU ETS will support the decarbonization of the shipping sector. Revenues collected through the sale of 20 million allowances will be distributed to help decarbonize the sector via the Innovation Fund. The remaining revenues will be channeled to EU Member States to support climate action domestically or abroad [16].

The EU is expected to review the application of the EU ETS to international shipping in 2028 in light of policy developments undertaken by the International Maritime Organization (IMO). In case the IMO does not adopt a global carbon pricing instrument comparable to the EU ETS and aligned with the aims of the Paris Agreement, the EU will examine the possibility of extending the EU ETS beyond the 50% of emissions released by vessels in trips between an EU port and a third-party port (Directive 2003/87/EC, Art. 3gg).

There is uncertainty on the type of GHG policies that the IMO will implement following the adoption of the *2023 IMO Strategy on Reduction of GHG Emissions from Ships* (2023 IMO GHG Strategy). According to this strategy, GHG policies to be adopted by 2025 will include 'an economic element, on the basis of a maritime GHG emissions pricing scheme'. However, it remains unclear what form and level of ambition such a pricing scheme will take. Currently there are multiple proposals by the IMO Member States and industry stakeholders, with some supporting the implementation of a carbon levy, others a feebate scheme or a reward and penalty scheme [17].

Meeting the climate targets of the 2023 IMO GHG Strategy will likely require implementing stringent GHG policies. In fact, the 2023 IMO GHG Strategy sets a target for the shipping sector to become climate neutral "by or around, i.e., close to 2050", with interim checkpoints to: i) reduce GHG emissions by at least 20% by 2030 over 2008, striving for 30% emissions reductions; ii) reduce GHG emissions by 70% by 2040—striving for 80% over 2008 levels. Large investments in green fuels and related technologies are needed to meet these targets [18] and adequate GHG policies should drive these investments [19]. However, it remains to be seen whether the IMO GHG price will be considered by EU institutions as "comparable" to the EU ETS in the 2028 assessment.

4 Key Takeaways for Policy Makers

The policy analyses above have shown that EU institutions have followed different strategies for including aviation and shipping in the EU ETS despite some similarities between the two approaches. Our analysis has produced three key policy takeaways.

First, there is convergence between the application of the EU ETS to shipping and aviation in relation to some aspects of GHG coverage. Key similarities include the initial focus on CO_2 emissions followed by a gradual expansion to other GHGs and the progressive increase of the share of allowances auctioned over time, which reaches 100% in 2026. Interestingly, however, full coverage is reached differently in the two sectors. While in aviation, this is achieved with a gradual phase-out of exemptions, in shipping, this is done by phasing in the carbon price between 2024 and 2026.

Second, in the application of the EU ETS to shipping, there has been greater attention to the needs of new entrants. As mentioned above, full auctioning of allowances is reached through two different methods in the shipping and aviation sectors. A critical advantage of the approach taken in the shipping sector is that it does not put new entrants at a disadvantage compared to incumbents, since the new entrants have the same compliance measures to the existing regulated entities. Instead, new entrants in aviation will need to purchase all the allowances, while longer-running airlines will still benefit from free allowances between 2024–2026.

Third, the policy environment has changed throughout the years, becoming more favourable for "outward looking" EU GHG policies. A crucial difference between the application of the EU ETS to aviation and shipping is that the latter also covers a share of emissions from voyages from/to outside the EU. The coverage in aviation is instead limited to intra-EEA flights, as the attempt in 2012 to cover flights beyond the EEA encountered stiff resistance. While there are various factors that can explain why the inclusion of GHG emissions from non-EU shipping voyages into the EU ETS was not followed with similar resistance, we think that a critical factor is time. The inclusion of aviation in the EU ETS occurred in a pre-Paris Agreement world, where responsibility to mitigate climate change was still understood as applying exclusively to OECD countries and economies in transition within the framework of the Kyoto Protocol. The inclusion of shipping in the EU ETS occurred a decade later. In the meantime, 195 countries have become parties to the Paris Agreement, and the IMO has adopted its strategy to reduce emissions from international shipping. These are two significant developments. The Paris Agreement states that developed countries shall take the lead in addressing climate change but adds that developing countries should also contribute to addressing it. In this context, it becomes more acceptable that the EU puts a price on GHG emissions beyond its borders. Furthermore, the adoption of the Initial IMO GHG Strategy in 2018 and its revision in 2023 have put the international shipping sector on a clear pathway to decarbonization. In this context, the sub-global climate action of the EU is only an addition to the policy mix that will drive shipping's decarbonization in the coming years.

References

1. Efthymiou, M., Papatheodorou, A.: Environmental considerations in the single European sky: a Delphi approach. Trans. Res. Part A: Policy Pract. **118**, 556–566 (2018)
2. Schinas, O., Bergmann, N.: Emissions trading in the aviation and maritime sector: findings from a revised taxonomy. Cleaner Logistics Supply Chain **1**, 100003 (2021)
3. Efthymiou, M., Papatheodorou, A.: EU emissions trading scheme in aviation: policy analysis and suggestions. J. Clean. Prod. **237**, 117734 (2019)

4. Warnock-Smith, D., Graham, A., O'Connell, J.F., Efthymiou, M.: Impact of COVID-19 on air transport passenger markets: Examining evidence from the Chinese market. J. Air Transp. Manag. **94**, 102085 (2021)
5. Hiney, N., Efthymiou, M., Morgenroth, E.: Impact of Covid-19 on Irish airport stakeholder relationships. Ann. Tour. Res. **102**, 103622 (2023)
6. Graham, A., Warnock-Smith, D., O'Connell, J.F., Efthymiou, M., Zheng, X.: Market Developments on chinese international air passenger markets in light of COVID-19 policy measures. Sustainability **15**(2), 1525 (2023)
7. Efthymiou, M.: Challenges in aviation governance: Implementation of single European sky and EU emissions trading scheme (Doctoral thesis, University of West London) (2016)
8. EASA European Aviation Environmental Report. EASA: Cologne (2022)
9. Efthymiou, M., Papatheodorou, A.: Environmental policies in european aviation: a stakeholder management perspective. Sustainable Aviation: Greening Flight path, 101–125 (2020)
10. Efthymiou, M., Ryley, T.: Governance and policy developments for sustainable aviation fuels. In: Sustainable Alternatives for Aviation Fuels, pp. 201–214. Elsevier (2022)
11. Scheelhaase, J., Maertens, S., Grimme, W., Jung, M.: EU ETS versus CORSIA–A critical assessment of two approaches to limit air transport's CO2 emissions by market-based measures. J. Air Transp. Manag. **67**, 55–62 (2018)
12. Englert, et al.: The Role of LNG in the Transition Toward Low- and Zero-Carbon Shipping (English). Washington, D.C. : World Bank Group (2021)
13. Dominioni, G., Englert, D.: Carbon Revenues From International Shipping: Enabling an Effective and Equitable Energy Transition - Technical Paper. World Bank, Washington, DC (2022)
14. Dominioni, G.: Towards an equitable transition in the decarbonization of international maritime transport: Exemptions or carbon revenues? Policy **154**, 105669 (2023)
15. Lagouvardou, S., Psaraftis, H.N.: Implications of the EU Emissions Trading System (ETS) on European container routes: a carbon leakage case study. Maritime Transport Research **3**, 100059 (2022)
16. European Commission, FAQ – Maritime transport in EU Emissions Trading System (ETS) (2024), https://climate.ec.europa.eu/eu-action/transport/reducing-emissions-shipping-sector/faq-maritime-transport-eu-emissions-trading-system-ets_en (Accessed 14 July 2024)
17. Dominioni, G.: Carbon pricing for international shipping, equity, and WTO law. Rev. European, Comparative Inter. Environ. Law **33**(1), 19–30 (2024)
18. Krantz, R., Søgaard, K., Smith, T.: The scale of investment needed to decarbonize international shipping. Insight brief. Global Maritime Forum (2020)
19. Baresic, D., et al.: Closing the Gap: An Overview of the Policy Options to Close the Competitiveness Gap and Enable an Equitable Zero-Emission Fuel Transition in Shipping. UMAS (2022)