Cost Effect of EU's Carbon Levy by Container Ship Capacities

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Abstract: The increase in global GHG emissions has revealed the concept of sustainability in transportation and to prevent this increase worldwide, regulations or laws are required. In the literature, the use of fossil fuels is shown as the primary cause of GHG emissions, and it is stated that the share of the transportation industry in this use is quite high. Aiming to reduce GHG emissions, IMO has committed to reducing carbon emissions from the shipping industry by at least 50 percent below 2008 levels by 2050. The levy to be charged for international marine fuel has emerged as an important component of this strategy. This study aims to determine the cost effect of EU carbon levy for container ship owners and freights. Within the scope of the study, the data on the X shipping line's container ships that called at EU ports between April 2021 and April 2022, obtained from the ShipsGo Global Container Shipping Platform have been analyzed. Results demonstrate that The X shipping line should pay 336.784 €, 757.765 €, 1.178.745 €, 1.683.922 € consecutively in 2023, 2024, 2025 and 2026 as carbon levy.

Keywords: carbon levy, GHG emissions, container ships

1. Introduction

Although maritime transport is the greenest type of transport, causing the lowest carbon dioxide emissions per unit load carried within the scope of economies of scale, it accounts for 3.3% of global (CO2) carbon dioxide emissions, 2% of nitrogen oxide (NOx) emissions, %11 of sulfur oxide (SOx) emissions and 4% of global greenhouse gas emissions (Tokuşlu and Burak, 2021). Considering that nearly 3% of the world's annual carbon emissions are generated by the global shipping industry, the pressure to reach the international goal of zero carbon level by 2050 is increasing day by day. Since, IMO has committed to reducing carbon emissions from the shipping industry by at least 50 percent below 2008 levels by 2050, the levy to be charged for international marine GHG emissions has emerged as an important component of IMO's this strategy (Parry, et al., 2022). Since approximately 90% of the world's tradable cargo is transported by sea, it is estimated that the global tax of approximately US$ 40 per ton of CO2 will reduce CO2 emissions by 7.65% (Mundaca, et. al., 2021). In this line with the aim to determine the cost effect of EU carbon levy for container ship owners and freights, levy calculations have been made with the datum gathered from ShipsGo Global Container Shipping Platform, EMSA (European Maritime Safety Agency) and EMBER (EU Carbon Permit Index).

2. Shipping Emissions

As the dominant mode of transport for international cargo, maritime transportation plays and will continue to play an essential role in global trade and economy. Considering that almost 90% of world merchandise trade is transported by ocean going vessels, in general sense maritime transport is responsible for almost one-tenth of CO2 (carbon dioxide) emissions and is an important source of air pollution (Stevenson, 2022:41). As in all other modes of transport that burn hydrocarbon fuels for energy use, ships also create air pollution, which deteriorates air quality, negatively affects human health and climate change. While merchant ships consume fuel for energy, on the other hand they emit particles creating air pollution. Ship sourced pollutants that adversely affect climate change and public health include carbon dioxide (CO2), nitrogen oxides (NOx), sulfur oxides (SOx) and particulate matter (World Health Organization, 2018). Globally, the marine shipping industry's annual emission contribution from human sources is calculated as 2.2% CO2, 15 % NOx and 13 % SOx (IMO, 2015: 1 – 2). Pollution types from the shipping industry are classified and defined in Table 1.

Table 1. Pollution types from marine shipping.

Pollution Types	Definitions
Carbon Dioxide (CO2)	A major greenhouse gas (GHG) contributing to climate change and ocean acidification (WHO, 2018)
Nitrogen Oxides (NOx)	A collection of gases of various combinations of nitrogen and oxygen (United States Environmental Protection Agency, 1999).
Sulphur Oxides (SOx)	A collection of gases of various combinations of sulphur and oxygen (Landrigan et al., 2018)
Methane (CH4)	A colorless, odorless gas is the atmosphere that is considered to play a major role in what is called the ''greenhouse effect'' (European Maritime Transport Environmental Report, 2021)
Particulate Matter	A collection of solid and liquid particles formed during fuel combustion (Cho, 2016)

Source: Adopted by author

When it is compared with the other modes of transportation, shipping can be considered as one of the modes of transport with the lowest carbon dioxide (CO2) emissions per distance and weight carried. However, pollution from shipping activities has serious adverse effects on air and water quality, as well as on marine and estuarine biodiversity. Ships are quite complex systems with various features such as having different types, operational profiles, control systems, types of cargo carried, fuels consumed, and materials used. To ensure sustainability, it is necessary to consider the effects of ships on both water and air as they move on the surface (Comer et. al, 2020: 15; EEA, 2020: 30).

When the emission rates from ships on a global and regional basis are evaluated based on numbers, 2018 data presents those ships calling at EU and European Economic Area have released 140 million tons of CO2. This constitutes 18% of the total global CO2 emissions from international shipping activities. The ships that are thought to be responsible for 90% of the emissions are those that are over 5000 gross tons and carry out commercial activities (European Maritime Transport Environmental Report, 202: 37). On the global scale, it has been observed that CO2 emission rates in international maritime transport increased by 4.9% in 2021 compared to 2020, despite the slowing effect of the pandemic. Figure 1 summarizes global maritime transport emission rates relative to 2019 by ship types.

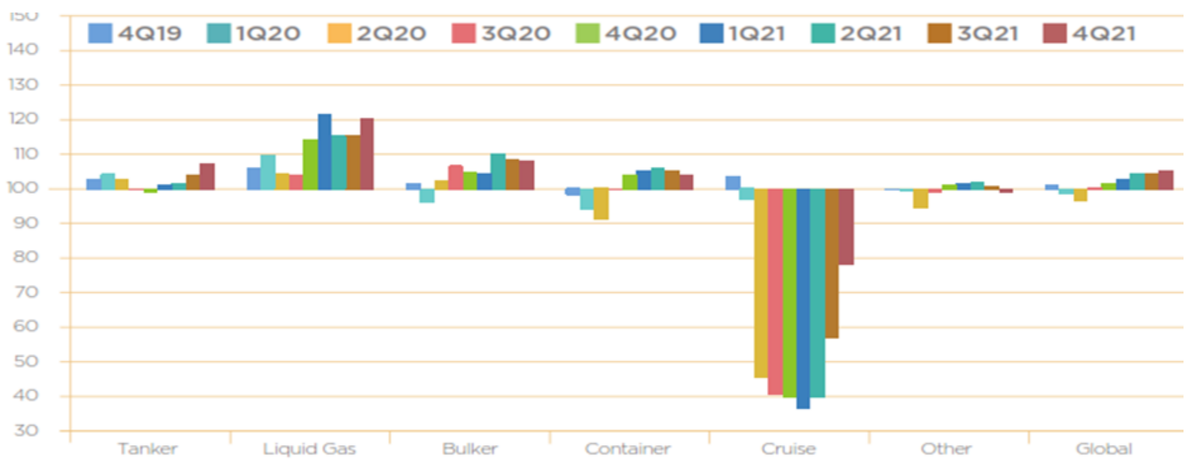

Figure 1. Quarterly international shipping CO2 emissions trends (index: 2019=100).
Source: Stevenson, 2022: 44.

The most striking point in the figure is the emission reductions in cruise ships, whose operations have slowed down due to the global lockdowns. Liquid bulk carriers, on the other hand, are among the parties that dominate emission consumption due to reasons such as additional gas capacities, strong demand structure and longer routes with high volumes. Due to the stable demand for durable goods, longer routes requirements and congestion at ports, the emission rates of container and bulk carriers, which constitute the two largest segments, continued to increase. Lastly, tanker ships started to mobilize in second the half of 2021 as the quarantine process begin to improve, contributing again to emissions consumption (Stevenson, 2022: 44 - 45).

3. Regulations Related GHG Emissions in Maritime Industry

As reducing emissions from ships is a complex issue that falls under the responsibility of different institutions and covers different policy areas (e.g. maritime transport, marine environment, climate change, air pollution, energy, transport, trade, infrastructure and human health), (Miola, et al., 2010), to date, the international shipping sector within the International Maritime Organization (IMO) appears to lag behind other sectors in reducing overall emissions.

The main regulations regarding air pollution from ships can be classified as; International Convention for the Prevention of Pollution from Ships (MARPOL) (International Maritime Organization, 2022a), United Nations Convention on the Law of the Sea (UNCLOS) (International Union for Conservation of Nature, 2022) and Kyoto Protocol (United Nations Framework Convention on Climate Change, 2022).

The main international convention, MARPOL, covering the prevention of operational or accidental pollution of the marine environment by ships, accepted by the International Maritime Organization (IMO) in 1973 and later amended by the 1978 and 1997 protocols (International Maritime Organization, 2022b). With the Air Pollution Conference held in 1997, IMO brought the issue of air pollution from ships to the agenda and added a protocol to MARPOL 73/78 and adopted the regulations on "ANNEX VI: Prevention of Air Pollution from Ships". MARPOL Annex VI, which entered into force in 2005, revised in 2008 with significantly tightened emission limits and entered into force in 2010 (IMO, 2022c). A part of MARPOL Annex VI, which consists of 33 regulations, adopted in 2011, also covers mandatory technical and operational energy efficiency measures aimed at reducing greenhouse gas emissions from ships. Applicable to approximately 99% of world trade tonnage, MARPOL has contributed greatly to the significant reduction of pollution from international shipping (International Maritime Organization, 2022b).

The United Nations Convention on the Law of the Sea (UNCLOS), (1982) defines the rights and responsibilities of nations regarding their use of the world's oceans and provides the legal framework for the conservation and sustainable use of the oceans and their resources (Miola, et al., 2010). In addition, the Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change, and the parties set and commit to internationally binding emission reduction targets for GHGs. The protocol was adopted in Kyoto, Japan on 11 December 1997 and entered into force on 16 February 2005 (Poulopoulos, 2016).

While the whole world strives to ensure fair welfare for all living things on the planet, another step that is expected to have permanent and sustainable results was announced in 2019 as the European Union's climate action plan, as the “Green Deal”. The European Union aims to zero its greenhouse gas emissions by 2050 with the changes and regulations it will implement in many sectors with the European Green Deal (Ecer, et. al., 2021). Under the Green Deal, the shipping sector will have to play a central role in tackling climate change by easing the multiple demands on the EU's land resources and improving the use of water and marine resources (Adamczak-Retecka, 2021). Within the scope of the Green Deal, the EU has created the “Fit for 55” package, which revises the climate, energy and transport legislation, in order to reach the target of reducing emissions by at least 55 percent by 2030. The reforms proposed by the "Fit for 55" package include a range of maritime measures, from a sustainable fuel mandate within the EU to the inclusion of marine emissions in the bloc's emissions trading scheme (ETS) (Council of the European Union, 2022). Suggestions that will directly affect the maritime industry are classified as follows.

- EU Emissions Trading System (ETS): Extended to include maritime transport.
- Fuel EU Maritime Initiative: It includes the maximum limit on the greenhouse gas intensity of the energy used on board and certain obligations for using land power source or zero emission technology.
- Energy Taxation Directive (ETD): It includes the introduction of a minimum tax rate for certain fuels / ships (Council of the European Union, 2022).

The current Energy Taxation Directive (ETD) sets the structural rules and minimum consumption tax rates for the taxation of energy products and electricity used as motor fuel and heating fuel. The updates introduce a new tax rate structure based on the energy content and environmental performance of fuels and electricity, and broaden the tax base by including more products in coverage and removing some of the existing exemptions and deductions. The proposal, introduced on 14 July 2021, introduces a minimum tax rate on the relevant fuels used for intra-EU ferries, fishing and cargo vessels. Sustainable and alternative fuels, on the other hand, will be subject to a minimum zero tax rate for a transitional period of 10 years when used for maritime transportation (Business and Human Rights, 2021).

4. Methodology

This study aims to determine the cost effect of EU carbon levy for container ship owners. To reach this aim the 356 voyages of X shipping line between 22.04.2021-17.04.2022 gathered from ShipsGo Global Container Shipping Platform used as a sample. EU Carbon permit index datum has been used as CO2 price in calculations which is obtained from ember-climate.org website. And The EMSA (European Maritime Safety Agency) website is used as the main source to obtain the amount of CO2 emitted by each ship. The port time of ships has been neglected as CO2 emissions amount in berths can not be reached by the authors.

5. Findings

Within the scope of the Green Deal, the Maritime Emissions Trading System is examined under three headings. According to this;

a. 50% of the CO2 emissions on the voyages of the ships to/from the ports of the European Economic Area (EEA),
b. 100% of CO2 emissions from voyages between European Economic Area ports
c. 100% of CO2 emissions in European Economic Area ports must be subject to carbon levy.

A 4-year plan has been made to pay the taxes calculated as specified, and 20% of CO2 emissions in 2023, 45% in 2024, 70% in 2025 and 100% in 2026 will be priced by the EU. The levy responsibilities arising from the voyages of the ships between 22.04.2021 and 17.04.2022 belonging to the company examined within the scope of the study are shown in Table 2.

Table 2. Annual carbon levy of X shipping line

Year	Levy amount of voyages to/from EEA	Levy amount of voyages between EEA	Total
2023	186.760 €	336.784 €	523.544 €
2024	420.210 €	757.765 €	1.177.975 €
2025	653.661 €	1.178.745 €	1.832.406 €
2026	933.802 €	1.683.922 €	2.617.724 €

Accordingly, the amount of carbon levy that X shipping line has to pay in 2023 for a total of 16 ships has been calculated as approximately (the value is considered to be approximate because the calculations were made using the voyages between April 2021 and April 2022, the CO2 emissions of those voyages and the carbon prices of the dates of those voyages) 523.544 € plus the amount due to the time spent in the port.

Table 3. Carbon levy cost of ships per unit mile

Vessel	Capacity (TEU)	kg/CO2 nm	Levy per unit mile (€)			
			2026	2025	2024	2023
M/V 1	1122	199,01	8,87	6,21	3,99	1,77
M/V 2	1139	301,9	7,79	5,45	3,50	1,55
M/V 3	1157	208,16	9,25	6,47	4,16	1,85
M/V 4	1199	241,3	5,70	3,99	2,56	1,14
M/V 5	1208	296,54	7,93	5,55	3,57	1,58
M/V 6	1221	321,13	22,84	15,98	10,27	4,56
M/V 7	1445	232,44	9,70	6,79	4,36	1,94
M/V 8	1445	232,94	9,08	6,35	4,08	1,81
M/V 9	1604	239,15	9,1	6,4	4,1	1,8
M/V 10	1604	390,61	16,91	11,84	7,61	3,38
M/V 11	1604	326,23	18,74	13,12	8,43	3,74
M/V 12	1604	274,6	11,10	7,77	4,99	2,22
M/V 13	2474	363,81	13,12	9,18	5,92	2,62
M/V 14	2478	392,85	19,90	13,93	8,95	3,98
M/V 15	2478	364,72	17,97	12,58	8,09	3,59
M/V 16	2837	354,08	23,4	16,4	10,5	4,7

Table 3 shows that some sister ships produce different amounts of CO2 emissions and levy paid per unit mile varies. The deviation of CO2 emission amongst sister ships may be explained by many reasons including some tolerances in AIS data, redundant capacity on board, performance of main engine, hull fouling or some energy saving applications such as derating of main engine, optimization of propeller, etc.

6. Conclusion

In this study the total amount of carbon levy which should be paid by X shipping line is calculated on a yearly basis, annual levy for each ship of fleet as well. Also the cost as per unit mile for each ship is determined. The X shipping line should pay 336.784 €, 757.765 €, 1.178.745 €, 1.683.922 € consecutively in 2023, 2024, 2025 and 2026. This will cause an additional cost on the freight. The additional cost may be fixed per each container or simply can be calculated as per mile/teu for each single voyage which will be a more fair assessment to the authors' suggestion. To decrease the levy and CO2 emitted as well, all shipping lines should apply new technologies suggested by IMO for energy efficient management which is cost effective and environmentally friendly.

Acknowledgements

This work would not have been possible without the data support of the ShipsGo Global Container Shipping Platform. We would like to express our special thanks of gratitude to the company's valuable and kind owners and employees.

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