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ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

ΣΧΟΛΗ ΔΙΟΙΚΗΣΗΣ ΕΠΙΧΕΙΡΗΣΕΩΝ
SCHOOL OF BUSINESS

ΣΧΟΛΗ ΟΙΚΟΝΟΜΙΚΩΝ ΕΠΙΣΤΗΜΩΝ
SCHOOL OF ECONOMIC SCIENCES

ΔΙΑΤΜΗΜΑΤΙΚΟ ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ ΣΕ **ΔΙΕΘΝΗ ΝΑΥΤΙΛΙΑ, ΧΡΗΜΑΤΟΟΙΚΟΝΟΜΙΚΗ & ΔΙΟΙΚΗΣΗ**
MASTER OF SCIENCE (MSc) IN **INTERNATIONAL SHIPPING, FINANCE & MANAGEMENT**

ESG and Firm Performance: The Case of NYSE Listed Shipping Companies

by

DIMOPOULOS ARGYRIOS

STATHI ATHINA-LYDIA

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Ευελπίδων 47Α & Λευκάδος, 113 62 Αθήνα. Τηλ.: 210 8203696
47 Evelpidon & Lefkados Street, Athens 113 62 Greece. Tel.: (+30) 210 8203696
E-mail: MSc.ISFM@aueb.gr / www.aueb.gr

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We approve the Thesis of

DIMOPOULOS ARGYRIOS & STATHI ATHINA-LYDIA

[NAME OF ACADEMIC SUPERVISOR] **[SIGNATURE]**

SPYRIDON SPYROU

[NAME OF CO EXAMINER] **[SIGNATURE]**

DIMITRIOS TSOUKNIDIS

[NAME OF CO EXAMINER] **[SIGNATURE]**

THOMAS MOUTOS

https://doi.org/10.26219/heal.aueb.9746

[31/10/2025]

CERTIFICATION OF THESIS PREPARATION

"I hereby declare that this thesis has been written by me, in order to obtain the Postgraduate Degree in International Shipping, Finance and Management, and has not been submitted to or approved by any other postgraduate or undergraduate program in Greece or abroad. This thesis presents my personal views on the subject. All the sources I have used for the preparation of this thesis are mentioned explicitly with references being made either to their authors, or to the URL's (if found on the internet)."

[STUDENTS' FULL NAMES] **[SIGNATURE]**

DIMOPOULOS ARGYRIOS

[STUDENTS' FULL NAMES] **[SIGNATURE]**

STATHI ATHINA-LYDIA

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Abstract

The purpose of this study is to examine the relationship between Environmental, Social and Governance (ESG) Scores and the financial performance of New York Stock Exchange (NYSE)-listed shipping companies. The relationship was analyzed using Ordinary Least Squares (OLS) regression models and panel regression models with both fixed and random effects. The Hausman (1978) specification test was also used to determine which effects tailored better in the analysis. The data sample was extracted by London Stock Exchange Group (LSEG) Datastream platform and spans from 2014 to 2024. The findings suggest that there is a significant positive correlation between ESG Scores and financial performance in OLS and panel regression models, although some differences appear when control variables are added in panel regression models, as more factors are taken into consideration. Specifically, when ESG scores increase, financial performance tends to increase, as better sustainability strategies improve business operations. As for controversies, there is a significant negative correlation with financial performance, as negative events affect the reputation and the performance of the firms. The results are completely in line with the international literature, indicating the reliability of the research.

Keywords: ESG, Financial Performance, Sustainability, Shipping, Regression, NYSE

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List of Abbreviations

Abbreviation	Definition
CII	Carbon Intensity Index
COP	Conference of the Parties
CFP	Corporate Financial Performance
CSR	Corporate Social Responsibility
CSRD	Corporate Sustainability Reporting Directive
ECA	Emissions Control Area
EEA	European Economic Area
EEXI	Energy Efficiency Existing Ship Index
ESG	Environmental, Social, Governance
ETS	Emissions Trading System
GHG	Greenhouse Gas
GT	Gross Tonnage
IMO	International Maritime Organization
LNG	Liquefied Natural Gas
LSEG	London Stock Exchange Group
MARPOL	International Convention for the Prevention of Pollution from Ships
MEPC	Marine Environment Protection Committee
MSCI	Morgan Stanley Capital International
NYSE	New York Stock Exchange
SDGs	Sustainable Development Goals
UNFCCC	United Nations Framework Convention on Climate Change

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Introduction

In recent years, the discussion around ESG has taken an exceptional dimension in the business and finance sectors. Investors, regulatory authorities, and institutions understand that the financial performance of a company cannot be examined without being connected to its sustainability strategies. ESG indexes are not just an indicator of good corporate behavior, but are directly connected to access to capital, market valuation and the long-term resilience of the company (Friede et al., 2015; Ioannou and Serafeim, 2015).

The shipping industry stands as a certainly attractive sector to study the relationship between ESG and financial performance, as almost 80% of global trade is transported by sea, marking the industry as unique for the global economy. However, due to its scale, shipping is responsible for 3% of total annual anthropogenic greenhouse gas (GHG) emissions (UNCTAD, 2022). Although environmental issues have received much attention, the shipping industry also faces important social and governance challenges, such as crew safety and transparency.

Existing literature is mainly focused on several other industries, like manufacturing, financial services, or general multi-industry samples. Despite the sector's importance, there are some studies on the connection between ESG and firm performance, but its unique characteristics such as, intense volatility, large capital structures, and high regulatory exposure, call for more specialized research. This research aims to cover part of this gap, proceeding with an empirical analysis on how ESG scores are related to financial performance of shipping companies listed on the NYSE.

The main purpose of the study is to examine if higher ESG scores can be translated to measurable higher profitability and valuation ratios, such as ROA, ROE, Net Profit Margin and Market Value, as well as to examine the differentiated effects of individual pillars (Environmental, Social, Governance) and controversies. The methodology combines multiple approaches to ensure the reliability of the findings using data from the past decade. First, simple linear regressions (OLS) were used to get an overall view of the relationship. Then, panel regression models with fixed (FE) and random effects (RE) were applied, and the Hausman (1978) test was used to choose the best model. The data were obtained from LSEG Datastream, and after filtering, the final sample included 26 shipping companies.

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This research contributes on both theoretical and practical levels. Theoretically, it adds to the existing literature by applying stakeholder theory and the resource-based view to a sector that has received limited attention (Barney, 2001; Porter and Kramer, 2011). Practically, the study provides useful insights for investors looking to include ESG criteria in their portfolios and for shipping companies that need to respond to sustainability pressures in order to remain competitive.

Chapter 1: Definition of Sustainability

The idea of sustainability first gained significant international recognition at the 1972 United Nations Conference on the Human Environment (UNHE) in Stockholm, Sweden, shaped by the slogan "Only One Earth" (Joos, 2023). This event was the first global summit to address humanity's impact on the environment and the initial significant effort to align economic development with environmental protection (United Nations, 1972). One significant outcome of the conference was the creation of the United Nations Environment Programme (UNEP), the leading global authority on the Environment. One of the first formal references to the term "sustainable development" as a global priority was the 1980 World Conservation Strategy by the International Union for Conservation of Nature (IUCN), the UNEP and the World Wildlife Fund (WWF), which focused on protecting ecosystems and genetic diversity while connecting environmental issues to poverty and development (IUCN, UNEP, & WWF, 1980; Tilbury et al., 2003).

However, it was not until the late 1980s that the term received wider recognition and was more clearly defined, mainly due to the work of the World Commission on Environment and Development (WCED), led by Norwegian Prime Minister Gro Harlem Brundtland. The Commission's influential report (1987), "Our Common Future", commonly called the Brundtland Report, offered the well-known and most quoted definition of sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". This definition has since become a key reference in sustainability discussions across many fields, including academia, policy and business.

The Brundtland Commission's report laid the foundations for the first Earth Summit in 1992 in Rio de Janeiro, Brazil, which emphasized the need to integrate environmental protection, social equity, and economic development into national and local policies through the historical agreement, Agenda 21. Agenda 21 is considered a blueprint for action for the world and is a non binding document. (United Nations, 1992; Tilbury et al., 2003).

A decade later, the 2002 World Summit on Sustainable Development -informally nicknamed "Rio+10"- in Johannesburg, South Africa, introduced the notion of the three pillars of sustainable development, that is the environmental, the social and the economic, considered as

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"interdependent and mutually reinforcing" (UNESCO, n.d). The summit's Johannesburg Declaration on Sustainable Development explicitly stated: "*We assume a collective responsibility to advance and strengthen the interdependent and mutually reinforcing pillars of sustainable development -economic development, social development, and environmental protection-at the local, national, regional, and global levels*" (United Nations, 2002).

Overall, even though there is not a universally accepted definition in literature, sustainability is generally understood as a long-term goal of creating a more sustainable world, while sustainable development refers to the various processes and pathways that societies use to achieve this goal. According to UNESCO (2015), "*sustainability, or a more sustainable world, is the long-term goal. Sustainable development focuses on inter- and intragenerational equity bound to the distinct but interconnected pillars of the environment, economy, and society*".

1.1 The Sustainable Development Goals (SDGs)

Sustainability began as a focus on environmental protection but has since grown to include social, economic, and governance issues. The United Nations Sustainable Development Goals (SDGs) reflect this broader approach, translating sustainability principles into clear, global objectives that guide countries and companies can pursue.

The SDGs include 17 interconnected global objectives that the United Nations adopted in 2015 as part of the 2030 Agenda for Sustainable Development. These goals represent a universal call to action to end poverty, protect the planet, and ensure peace and prosperity for all by 2030 (United Nations, 2015). The SDGs build on the Millennium Development Goals (MDGs), which guided global development from 2000 to 2015, however the SDGs have a wider scope and are more inclusive. They address systemic issues, including inequality, climate change, economic growth, and peacebuilding (UNDP, n.d.).

The SDGs represent a comprehensive approach to development that combines economic growth, social well-being, and environmental protection. They include 169 associated targets and more than 230 indicators to monitor progress (United Nations, 2015). For example, Goal 8 (Decent Work and Economic Growth) supports economic sustainability, Goal 13 (Climate Action) advances environmental sustainability, and Goals 10 (Reduced Inequality) and 5 (Gender Equality) address social sustainability.

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Figure 1: The 17 Sustainable Development Goals

Source: United Nations Department of Public Information, 2019

The SDGs are interconnected and indivisible so progress towards one goal influences the achievement of others. The SDGs promote collaboration among governments, businesses, civil society and individuals to reach common objectives. Many companies align their Corporate Social Responsibility (CSR) strategies with the SDGs to enhance transparency and meet the expectations of socially conscious consumers and investors.

Furthermore, although the SDGs are not legally binding, member states are encouraged to incorporate the goals into their national policies and strategies. Progress is monitored through Voluntary National Reviews (VNRs), which countries submit to the United Nations High-Level Political Forum (HLPF) on Sustainable Development for accountability and learning (UNGC, 2023).

Overall, the SDGs offer an international framework that integrates economic, social, and environmental goals, guiding nations to work together in addressing the world's most pressing issues (UN, 2015).

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Chapter 2: Conceptualizing ESG

The adoption of ESG factors in investment and corporate decisions has increased significantly in global markets. The investment community has shifted its attention from pure financial metrics to ESG factors, recognizing that non-financial performance can impact stocks, company value and risk profiles (Friede et al., 2015; Khan et al., 2016). This chapter focuses on the conceptual foundations of the ESG, defines each pillar and discusses issues that are important for the shipping industry. Section 2.1 presents the evolution of ESG from CSR. Section 2.2 analyzes the term in three directions and finally Section 2.3 highlights the most important issues for shipping companies.

2.1 Origins & Evolution of ESG

ESG is closely tied to older concepts of CSR. While CSR focused on the voluntary nature of adopting new standards based on values, ESG emerged as a measurable framework geared towards investors.

As discussed in previous sections of this study, sustainability reflects broader social goals balancing environmental protection, economic growth and social equity. CSR represents the corporate concept of these responsibilities. On the other hand, ESG can be understood as a more formal, data-driven evolution of CSR, specifically designed to meet the needs of investors and capital markets (Kotsantonis et al., 2016). Therefore, CSR is the conceptual and historical bridge between sustainability and ESG (Eccles et al., 2014).

In order to understand this development, the first step is to examine the past. CSR is not a modern model for businesses, as references to the term corporate responsibility have existed for more than 60 years. In fact, Howard Bowen is considered one of the first to introduce the term CSR in the early 1950s (Passas, 2024). Bowen defined CSR as the obligation of entrepreneurs to follow common policies, actions, and initiatives with the broader aim of achieving the values and goals of society (Bowen, 2013). As the policies of the time were changing, more and more companies and board members adopted the view that profits were not everything for organizations and that a decentralized approach should now be followed, focusing not only on profits but also on the employees and customers of each organization (Farcane and Bureana, 2015).

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The 2000s were a key period for the development of CSR. More investors were putting pressure on organizations to be socially responsible. The relationship between CSR and financial performance began to strengthen. Until then, CSR reporting had been largely voluntary, with companies often publishing reports with gaps (Farcane and Bureana, 2015). At the beginning of the decade, major scandals such as Enron and the 2008 crisis led stakeholders to demand greater awareness of business ethics, leaving social responsibility behind in most economies, with the exception of Europe, which continued to develop more comprehensive models and standards incorporating all the necessary criteria (Carroll, 2008; Matten and Moon, 2008).

During the same period, there was a growing need for more quantifiable and measurable results, as more investors used the results to make their investment and business decisions. In this way, the UN created the Principles for Responsible Investment, an independent organization with the primary purpose of promoting environmental and social responsibility among investors (Sullivan and Mackenzie, 2017). In fact, according to the latest information, the organization has 5,345 members, including investment managers, asset owners, and service providers (Principles for Responsible Investment, 2025). In terms of sustainable development, the mid-decade saw the emergence of the SDGs, essentially an agenda with a 2030 horizon, under the umbrella of the UN, to be adopted by all its member states. The SDGs were a driving force for companies to take a long-term view on sustainable development issues, while at the same time creating new investment standards and new business opportunities (Pedersen, 2018).

Amidst this evolution and diversification of needs, in 2004, the UN and the Swiss Federal Department of Foreign Affairs published the report Who Cares Wins, in which the term ESG was mentioned for the first time on the international economic scene ("Who Cares Wins," 2004). Gradually, ESG began to become mainstream and gain its role in the market as a measurable and more comprehensive tool than CSR. ESG also included the aspect of good corporate governance, which after 2008 became a major concern for stakeholders, and in general there was great interest in how businesses operated (Passas, 2024).

During the 2020s, ESG entered a new phase, often referred to as ESG 2.0 (Passas, 2024). Whereas companies previously viewed it primarily as a tool for compliance or improving their public image, ESG now tends to be integrated into the core of business strategy. Significant global challenges

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such as climate change and social inequalities have made it clear that a compliance-only approach is not enough.

The COVID-19 pandemic has further highlighted the interrelation of social, environmental and economic systems, bringing to the forefront the need for resilience and sustainable development (2022). Companies that strategically adopt ESG, such as Microsoft or Patagonia, demonstrate that meaningful integration of sustainable principles can enhance innovation, stakeholder trust and competitiveness (Liang et al., 2022).

This progress also reflects the transition from CSR, which was mainly voluntary, to ESG as a structural framework connecting financial performance with risk management and social responsibility (Eccles et al., 2014). Thus, ESG 2.0 is not only about the "right" way of operating but also marks a new way of thinking in business, where profitability and sustainability co-exist and support each other.

2.2 ESG Pillars Defined: Environment, Social, Governance

The theory of ESG factors has become established in latest years as a central framework for evaluating companies beyond traditional financial measures. ESG offers investors and stakeholders a more complete view of companies' performance, taking into account issues related to sustainability, social responsibility and corporate governance. Contrasting CSR, which has often been more voluntary and qualitative, ESG focuses on measurable data and standardized indicators enabling the quantitative integration of non-financial criteria into investment and strategic decisions (Infante et al., 2025; Kotsantonis et al., 2016).

ESG is divided into three main pillars, Environmental, Social, and Governance. Although each pillar examines different aspects of corporate activity. The value of ESG lies in its holistic nature, as the interconnection of the three areas creates an overall picture of sustainability and long-term business risk (Friede et al., 2015; Khan et al., 2016).

2.2.1 Environmental Pillar

The environmental pillar refers on how businesses interact with the environment and manage the ecological risks and opportunities arising from their activities. Key issues include greenhouse gas emissions, energy consumption, natural resource use, waste management and climate change

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(Krüger, 2015). In addition, biodiversity management, water resource protection and investment in renewable energy sources are critical aspects which affect both the reputation and operating costs of companies.

The growing attention to environmental issues stems not only from regulatory pressures but also from investor and consumer preferences. Research has shown that companies with better environmental performance enjoy lower capital costs and higher long-term value (Chava, 2014; Clark et al., 2015). At the same time, an effective environmental strategy can reduce exposure to risks such as natural disasters, legal sanctions and supply chain disruptions (Grewal et al., 2020). Thus, the environmental dimension of ESG is not purely a compliance tool but is directly connected to a company's ability to innovate, minimize risks and enhance its long-term profitability.

2.2.2 Social Pillar

The social pillar focuses on the company's relationships with its stakeholders, employees, customers, suppliers and the communities in which it operates. Issues such as labor rights, health and safety in the workplace, diversity and inclusion, gender equality and respect for human rights are at the heart of this dimension (Ioannou and Serafeim, 2015).

Studies indicate that companies with high social performance tend to enjoy a stronger reputation, increased consumer trust and better talent attraction and retention (Servaes and Tamayo, 2012). Social responsibility is also linked to reduced operational risks as companies that ignore social issues are more exposed to strikes, boycotts and legal disputes (Deng et al., 2013).

Also, social practices are becoming particularly important at a time when investors are increasingly incorporating social criteria into their decisions. For example, institutional investors often avoid companies that violate human rights or engage in poor labor practices which directly affect companies' access to capital (Ferrell et al., 2016). Thus, the social dimension of ESG acts as a catalyst for building trust and maintaining sustainable relationships with stakeholders.

2.2.3 Governance Pillar

The corporate governance pillar refers to the mechanisms, processes and structures that determine how a company is managed. Critical issues include the composition and independence of the board of directors, the alignment of executive compensation with the long-term interests of shareholders, transparency in financial reporting, protection of minority shareholders and risk management (Gompers et al., 2001; Larcker and Tayan, 2011).

Good corporate governance is associated with higher company valuations and a lower likelihood of accounting scandals (Brown and Caylor, 2006). At the same time, investors systematically use governance criteria to assess the quality of management and a company's ability to make strategic decisions that create long-term value (Shleifer and Vishny, 1996). Inadequate governance on the other hand can lead to conflicts of interest, destruction of shareholder value and increased capital costs.

2.2.4 Holistic Dimension of ESG

Despite the three-pillar analysis, ESG should be treated as a single framework. In practice, investors and ESG data providers create composite scores that combine the three dimensions, providing an overall picture of a company's non-financial performance (Berg et al., 2022). However, the lack of uniformity in assessment criteria and methods has led to significant discrepancies between different ESG providers, a phenomenon that has been termed “aggregate confusion” (Berg et al., 2022). This highlights the need for standardization and greater transparency in measurement methodology.

There is a growing consensus that ESG has now evolved from a minor issue to a key strategic and investment tool. Companies adopting ESG practices have the opportunity to strengthen their resilience, reduce their exposure to risks and gain competitive advantages through innovation and attract investors (Infante et al., 2025; Fatemi et al., 2018). ESG, therefore, is not just a set of indicators but a holistic framework that links sustainability to financial performance and stakeholder value.

2.3 Materiality in Shipping: Which ESG Issues Matter Most

The idea of materiality in ESG refers to the issues that are most critical to the creation or destruction of a company's value, depending on its industry and business model (Oll et al., 2024). While certain aspects of the three pillars of ESG are of horizontal importance to all sectors (e.g., transparency, diversity, and CO_2 emissions), shipping is particularly relevant due to the nature of its activity, its international character and the strict regulatory frameworks that govern it (Poulsen et al., 2018).

In the environmental pillar, the most important issues concern GHG and pollutant emissions, the transition to alternative fuels and energy efficiency. Regulatory pressure from the International Maritime Organization (IMO), through IMO targets, makes reducing emissions a top priority (Cariou, 2010). Environmental materiality also concerns waste management, ship recycling and the protection of marine ecosystems (Yliskylä-Peuralahti and Gritsenko, 2014).

In the social pillar, the welfare of seafarers is very important. Shipping employs hundreds of thousands of seafarers in demanding conditions, and issues such as health, safety, psychological support, labor rights are particularly material (Kim and Jang, 2018). The COVID-19 pandemic highlighted the social dimension of the industry, as travel restrictions trapped thousands of seafarers, affecting not only the human dimension but also the functioning of the supply chain. Training, diversity and attracting new talent are also issues of growing importance (Lai et al., 2011).

Finally in the governance pillar, materiality is correlated to the structure of ownership and boards of directors. Shipping is characterized by strong family ownership and often low transparency, which increases the risk of conflicts of interest and reduces investor confidence (Tsatsaronis et al., 2024a; Tsatsaronis and Syriopoulos, 2011). The adoption of international corporate governance standards and the strengthening of accountability are material issues, particularly for listed shipping companies.

Overall, materiality in ESG for shipping reflects the uniqueness of the industry. Environmental issues relate mainly to decarbonization, social issues to seafarers' welfare and governance issues to ownership structure and transparency. Properly understanding and integrating these material issues can enhance the sustainability of the industry and improve access to investment, particularly at a time when financiers and charterers are increasingly demanding strong ESG profiles (Boura, 2020; Tsatsaronis et al., 2024b).

Chapter 3: ESG Measurement & Scoring

Having examined the conceptual development and dimensions of ESG, the next step is to analyze how these concepts are empirically reflected through data and rating systems. As ESG is not a financial instrument through measurement and evaluation, its data is either qualitative or quantitative. It is observed that the measurement of this data is a major issue in literature but also a matter of practical application. Investors, regulators and stakeholders are increasingly interested in ESG data, as it serves to assess corporate performance and risks. This fact ranks the reliability, comparability and accuracy of ESG data among the most critical factors (Kotsantonis and Serafeim, 2019). Since they are different from traditional financial measurements, ESG scores are derived from more complex processes that combine available data in any form, public assumptions, questionnaires and third party assessments (Sunarti Halid et al., 2023).

However, it has been observed that there are significant inconsistencies between providers, mainly due to the lack of regulated standards. In international literature, this phenomenon is referred to as "aggregate confusion" which translates into the inability of investors to derive clear and comparable conclusions from ESG ratings (Berg et al., 2022). This situation is reinforced by the different weighting of ESG pillars, the diverse data sources and the emphasis on specific issues by each provider. At the same time, ESG ratings have been criticized for potential biases, limitations in data availability and whether they actually reflect operational risk and economic value (Dorfleitner et al., 2013).

This chapter focuses on the leading ESG rating providers and their methodologies, the process of constructing ESG scores and the parameters that determine their weighting, examines the strengths and weaknesses of the rating system as well as controversial indicators, and finally emphasizes the characteristics of the shipping industry and the adjustments required for effective ESG assessment.

3.1 Major Providers & Methodologies

Over the years, the need for systematic assessment of organizations' ESG performance has become obvious driven by increasing pressure from capital markets for transparency and responsible business conduct. In this context, a new specialized market has been created, where dozens of ESG providers assess and rate companies based on their environmental, social and governance performance. These assessments provide a means of illustrating and evaluating non-financial risks contributing to strategic and investment decisions. However they do not constitute investment advice, although many institutional investors rely on them to identify risks and opportunities that are not reflected in financial data (Kotsantonis and Serafeim, 2019).

In the emerging ESG data market, certain providers stand out due to their extensive use by investors, regulators and analysts, as well as their frequent mention in international literature. Among these, Morgan Stanley Capital International (MSCI) ESG Ratings, Sustainalytics, and LSEG Refinitiv ESG Scores (formerly Refinitiv Eikon) are among the most recognized providers. Each organization applies a different methodology for assessing ESG performance, which often leads to significant differences in ratings for the same company. This phenomenon results in aggregate confusion among stakeholders, as mentioned in Chapter 2, as it makes it challenging to reliably compare ESG performance (Dorfleitner et al., 2013).

3.1.1 MSCI ESG Ratings

MSCI ESG Ratings covers a range of more than 17,000 companies internationally and its methodology is based on assessing companies' exposure to ESG risks and their ability to manage them, comparing them with other companies in the same industry. The final ratings uses a scale from AAA (excellent ESG management) to CCC (inadequate management). The data comes from thousands of sources, including published company reports, government databases, news media and third-party agencies, without relying on self-reported data from companies (MSCI, 2025).

3.1.2 Sustainalytics

Sustainalytics provides ESG Risk Ratings that assess the extent to which non-financial risks may affect a company's economic value. Its methodology is based on two key dimensions. The company's exposure to ESG issues and its ability to manage them. The final assessment is expressed as a quantitative score on scale from 0 to 100, where a lower score indicates lower ESG risk. Companies are classified into five risk categories, where are negligible, low, medium, high and severe. Sustainalytics obtains its data from company reports, questionnaires, regulatory authorities and publicly available databases, while also conducting independent assessments in cases of disagreement or lack of information (Sustainalytics, 2025).

3.1.3 LSEG Refinitiv ESG Scores

The LSEG Refinitiv ESG (formerly Refinitiv Eikon) is an ESG performance assessment platform screening more than 16,000 companies all over the globe. Its methodology is based on the processing of more than 870 ESG metrics, of which a subset of 186 constitute the material ESG indicators per sector and are those considered in the overall rating process for each company. The data is organized into 10 key pillars and results in three main ratings: Environmental, Social, and Governance, as well as an overall ESG Score. The final ratings are expressed on an alphabetical scale from A+ to D-, while the ESG Controversy Score, which reflects recent negative events or violations, is also taken into account. LSEG Refinitiv ESG uses only publicly available data, such as company reports, press releases, search engines, and independent news providers, without relying on self-reports or questionnaire responses (LSEG, 2025).

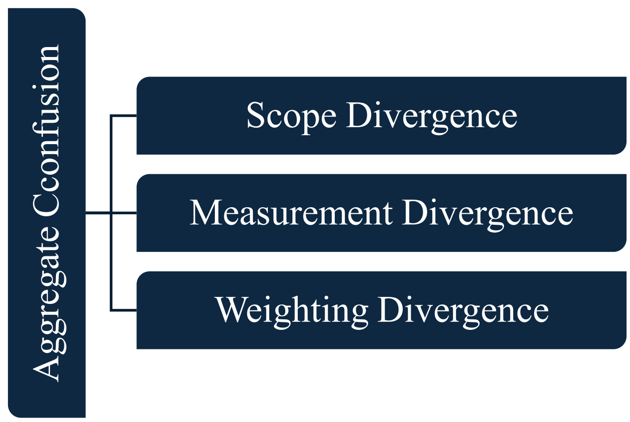
Subsequently, in this study, it has been decided to use data from this particular provider, as it offers broad coverage of listed companies, detailed sub-indices per pillar, and, due to the nature of the information it provides (publicly available information). Furthermore, LSEG Refinitiv ESG is one of the most widely used providers in empirical studies of the shipping industry, which facilitates the comparability of the results of this study with previous research findings (Tsatsaronis et al., 2024a).

Although there are major differences in methodology and rating scales between the providers their assessments have become a critical tool for modern financial practices. They are widely incorporated into sustainability indices, financial risk assessment models, investment portfolios and active management strategies . For institutional investors, ESG scores serve as supplementary non-financial performance indicators, influencing companies' access to capital and their overall market valuation (Friede et al., 2015; Kotsantonis and Serafeim, 2019).

3.2 Score Construction: Weights, Data Sources, Frequency

The construction and modeling of ESG data is a key challenge that scoring providers have to deal with. Both the nature of the data and the different approaches adopted by providers have led to the creation of diverse models for measuring and evaluating performance. It is worth noting that, as there is no single standardized model, this leads to differences in scores between providers. As mentioned above, this is also a description of aggregate confusion phenomenon, which can be explained by three key factors that influence the ESG score. These factors are composed of the type of data examined by each provider (Scope divergence), the method of measurement (Measurement divergence) and the weighting of individual indicators (Weighting divergence) (Berg et al., 2022).

Figure 2: Aggregate Confusion



Source: Authors' own elaboration

3.2.1 Weighting Methodologies

The weighting of each indicator holds the main role in determining the final ESG score. The term weighting is used to highlight the importance of each indicator for each sector, industry, or even company. It essentially refers to which data providers rely on in order to produce the most accurate ESG Score, tailored to the particularities of each organization. The ways in which data is selected to be assigned the appropriate weight is another cause of aggregate confusion, as, as in previous cases, methodologies differ between providers (Berg et al., 2022).

Certain providers are implementing hybrid methodologies, utilizing both qualitative and quantitative data, with the ultimate aim of assigning weight to the most material data for each sector. One example of such a provider is MSCI ESG Ratings, whose methodology is based on so-called industry materiality, focusing mainly on issues that either add or detract from the value of companies in relation to their business model (Berg et al., 2022). On the other hand there are providers who prefer fixed weights for all indicators, regardless of sector or geographical location, giving the data consistency but reducing sensitivity to the particularities of each organization (Kotsantonis & Serafeim, 2019). This approach has been criticized as oversimplified, as it can moderate critical risks or opportunities related to specific sectors, such as GHG emissions in the shipping sector (Kotsantonis and Serafeim, 2019). In the case of LSEG Refinitiv ESG, which is of most interest to this study, it is a provider that relies primarily on the importance and frequency of data disclosure.

As each provider applies a different approach to the weighting of indicators, one of the main challenges in terms of the usefulness of ESG Scores arises, which is none other than creating non-comparable scores for the same company. This diversity affects both the interpretation of performance and the effectiveness of scores as a means of risk prediction and strategic planning giving rise to the need for greater transparency and regulation (Infante et al., 2025).

3.2.2 Data Sources

The selection of data sources is a key factor in preparation of ESG scores, as it directly affects the quality, completeness and comparability of assessments. ESG rating providers collect information from a wide range of sources, which differ in origin, validity and availability (Berg et al., 2022).

The main data sources include corporate reports, such as sustainability or annual reports, regulators, databases of governmental and non-governmental organizations, news media and independent monitoring bodies. In many cases, the information used is exclusively publicly available, while in other cases it is supplemented by replies to questionnaires or by estimates by the providers themselves (Christensen et al., 2021). For example, LSEG Refinitiv ESG relies specially on publicly available data, avoiding using self-reports or questionnaires, which enhances transparency and verifiability (LSEG, 2025).

However, the heterogeneity of the sources is accompanied by significant completeness problems. In many cases, companies do not disclose all necessary ESG data or provide incomplete information (Tsatsaronis et al., 2024a). To reduce these gaps, providers apply imputation techniques, which may introduce subjectivity or errors in the final assessments. In addition, self-reported information has been criticized for its lack of independent verification and the risk of greenwashing[1] (Christensen et al., 2021).

[1] Greenwashing is when a company pretends to be more environmentally friendly than it really is.

3.2.3 Frequency

The frequency which ESG scores are updated and revised is a critical parameter,both for the reliability of the ratings and for their usability in investment and strategic perspectives. ESG rating providers vary notably in terms of update frequency, which affects the ability to track changes in companies' ESG performance in real time.

Most providers conduct an annual update of their overall ESG scores, while in between they monitor significant developments or ESG controversies, which they incorporate into a discrete score (LSEG, 2025; MSCI, 2025). Thus, in cases of adverse events (e.g. environmental accidents, labour rights violations or governance problems), the final assessment can be revised before the standard annual update (Kotsantonis and Serafeim, 2019).

Sustainalytics, for its part, has adopted a monthly monitoring model to update ESG Risk Ratings, especially in cases where new information may affect the existing rating. In addition, the frequency also varies at pillar level; for example, governance indicators are updated more frequently, due to the faster availability of relevant data (e.g. board changes, administrative decisions), than environmental or social indicators that are often only included in annual reports (Christensen et al., 2021).

The asymmetry in the frequency of information also affects the analysis of ESG scores by researchers and investors. Low-frequency data may not reflect actual changes in a company's ESG performance in a timely manner, while frequently revised scores create challenges of a statistical nature, especially when used in economic or financial regressions (Chatterji et al., 2016).

Lastly, frequency is also related to reporting lag, as most ESG data is based on information from the previous year. This limits the ability to use ESG scores as predictive tools in the short-term, particularly in dynamic industries such as shipping, where conditions can change rapidly (Christensen et al., 2021).

3.3 Strengths & Weaknesses of ESG Scoring Systems

The ESG scoring systems have been established as a key tool for assessing the non-financial performance of companies, offering structured information to investors, regulators and other stakeholders. The chief strength of these systems is the ability to standardize and benchmark corporate ESG practices, thus facilitating the integration of sustainability criteria into investment decisions (Friede et al., 2015). In addition, ESG scores act as risk proxies, enhancing capital management and strategic planning capabilities, especially in industries with increased exposure to regulatory or operational challenges such as shipping (Infante et al., 2025).

However, the weaknesses of ESG scoring systems are equally significant and have been widely recognized in the literature. Mainly, the lack of regulatory standards has led to significant discrepancies between the ratings provided by different providers for the same company (Berg et al., 2022). This discrepancy reduces the possibility of reliability and comparability, remarkably when scores are used for empirical analysis or portfolio construction.

Finally, limited transparency in calculation methodologies, as well as the use of proprietary models that are not fully accessible to users, reinforces doubts about the reliability of the final scores (Doyle, 2018). This complexity particularly affects smaller companies, which may get lower scores not because of poor performance, but because of limited data disclosure.

3.4 Sector-Specific Adjustments for Shipping

The ESG performance assessment in the shipping industry is accompanied by several methodological and practical particularities that make specific adjustments necessary. ESG rating providers are often required to adjust the weights, data sources and themes of their indicators to reflect the operational reality of the sector.

The strong environmental impact of shipping activities, the multi-ethnicity of crews and idiosyncratic corporate governance structures require a specialized approach. However, in many cases, general ESG methodologies fail to effectively capture these diversifications, leading to a partial or distorted valuation of performance (Tsatsaronis et al., 2024a).

The need for more targeted, sector-sensitive indicators is increasingly recognized by the literature and relevant bodies. Therefore, the next chapter focuses exclusively on the shipping sector examining how ESG assessment is shaped in this context and what are the key challenges and trends fundamental in the industry.

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Chapter 4: ESG in the Shipping Industry

Shipping is a fundamental component of international trade, and it significantly impacts the global economy. According to the United Nations Conference on Trade and Development (UNCTAD, 2022), more than 80% of the volume of international trade in goods is transported by sea. However, shipping is responsible for approximately 3% of total anthropogenic emissions worldwide (IMO, 2020). Despite its operational efficiency, the industry faces increased regulatory pressure to mitigate its environmental impact and promote sustainability across the global supply chain. In this direction, key regulatory bodies such as the IMO and the European Commission have established ambitious targets aimed at reducing the total annual GHG emissions from shipping.

4.1 Regulatory Drivers

Figure 3: Regulations Impacting a Shipping Company's Operations

Source: Authors' own elaboration

4.1.1 The Paris Agreement

Global climate governance developed through three key agreements. The first, the United Nations Framework Convention on Climate Change (UNFCCC) of 1992, created a framework for international cooperation. The second, the Kyoto Protocol of 1997, imposed legal emission reduction obligations on industrialized countries. The third, the Paris Agreement of 2015, was a significant development ,by requiring all nations to contribute to climate mitigation through nationally determined plans (Delbeke et al., 2019).

The UNFCCC aimed to maintain GHG concentrations at safe thresholds and created essential institutions for worldwide climate collaboration, such as the UNFCCC Secretariat and the yearly

Conference of the Parties (COP)[2] . It also established the initial framework for nations to disclose their emissions and exchange the strategies that they implemented to lower them. In 1996, the European Union presented its initial GHG inventory, showcasing its early dedication to global climate efforts. The Convention applied the principle of common but differentiated responsibilities by grouping countries and was made operational through the Annexes of the Convention. Developed countries (Annex I) committed to limiting emissions, while wealthier states (Annex II) were expected to support developing countries financially. The Convention grouped countries based on responsibility and capacity. Developed countries committed to limiting emissions and supporting developing states, while others received flexibility. This approach enabled broad participation in 1992 but left the UNFCCC without legally binding emission targets. (Delbeke et al., 2019).

Prior to 2015, the only international agreement with legally binding commitments to cut greenhouse gas emissions was the Kyoto Protocol of 1997, developed under the UNFCCC (European Commission, n.d.). It required developed countries to reduce their collective GHG emissions by 5% between 2008 and 2012 compared with 1990 levels. Each country had its own target depending on its circumstances and historical emissions. The Protocol also introduced carbon trading and the Clean Development Mechanism, which allowed developed countries to offset emissions by supporting projects in developing nations. A dedicated Compliance Committee monitored adherence and could enforce penalties (Delbeke et al., 2019). The European Union ratified the Kyoto Protocol on May 31, 2002, committing to an overall 8% reduction in GHG emissions for the 2008-2012 period compared to 1990 levels. This target was broken down into legally binding national targets for each member state, known as Quantified Emission Limitation and Reduction Commitments (QELRCs), under the "burden sharing" agreement. The EU's Emissions Trading System (EU ETS), created as part of the European Climate Change Programme, played a key role in helping meet these targets. By 2012, the EU had surpassed its emissions reduction goal, demonstrating the effectiveness of its policies and the EU ETS in reducing emissions (European Commission, n.d.).

[2] The Conference of the Parties (COP) is a yearly UN meeting under the UNFCC where countries review climate progress and agree on new actions to fight climate change.

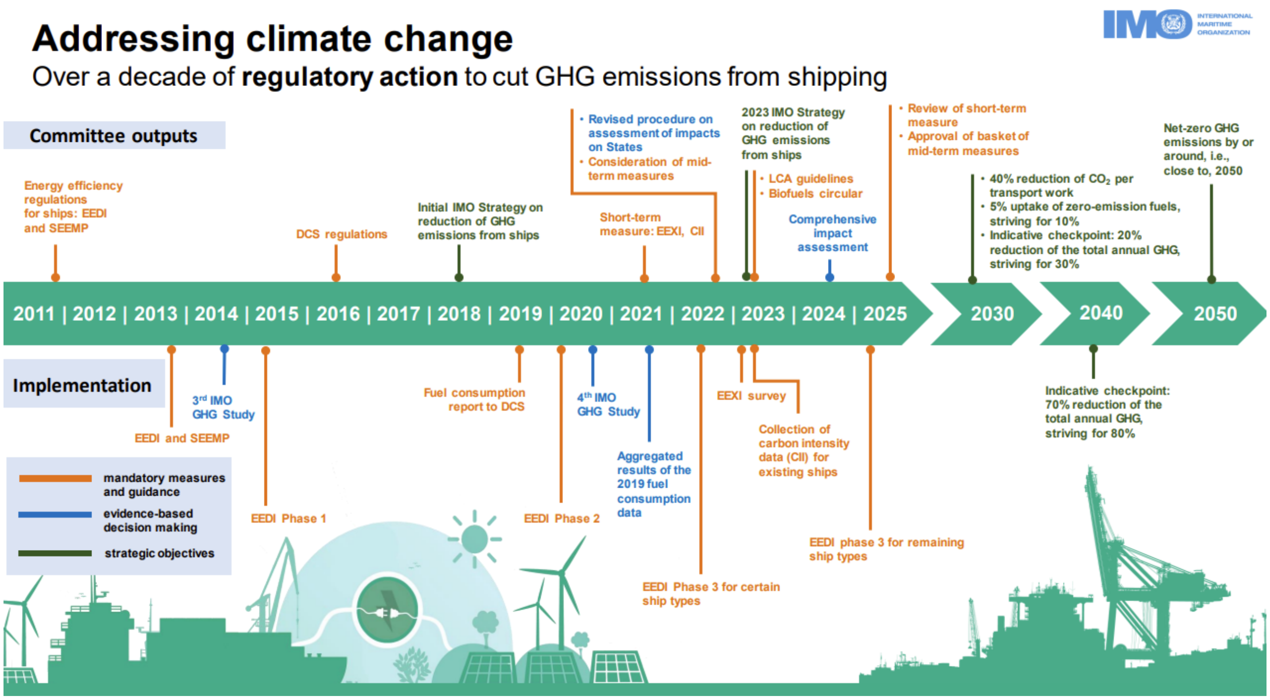
The Paris Agreement, adopted in 2015 at COP21 under the UNFCCC represents an important step forward in the global fight against climate change. Its main goal is to keep global warming well below 2°C above pre-industrial levels, aiming for 1.5°C if possible (UNFCCC, 2015). It was signed by 174 countries and the European Union in New York and came into force on 4 November 2016.

Under the Paris Agreement, every participating country must submit a Nationally Determined Contribution (NDC), which describes how it plans to reduce emissions and adapt to climate impacts. The agreement stresses the importance of worldwide cooperation.and It emphasizes transparency, regular progress checks, and increasing ambition over time. While the focus is mainly on national efforts, the Agreement also highlights the need to address emissions in all sectors, including international shipping, urging organizations like the IMO to develop sector-specific strategies aligned with global climate targets (UNFCCC, 2015). Implementation of the Agreement is also essential for the achievement of the SDGs (UN, n.d).

4.1.2 IMO Strategy on GHG Emissions

Over the past decade, the IMO has taken continuous action to reduce GHG emissions from international shipping. Beginning with the introduction of energy efficiency regulations such as the Energy Efficiency Design Index (EEDI) and SEEMP Ship Energy Efficiency Management Plan (SEEMP) in 2011, the IMO has gradually strengthened its framework through data collection systems, GHG studies, and the adoption of short-, mid-, and long-term measures. Milestones include the 2018 Initial IMO Strategy, the implementation of the Energy Efficiency Existing Ship Index (EEXI) and CII regulations, and the updated 2023 Strategy, which sets ambitious targets, such as achieving net-zero GHG emissions by or around 2050. Figure 4 below shows the IMO's regulatory action to cut GHG emissions from shipping over the years.

Figure 4: Over a Decade of Regulatory Action of IMO to Cut GHG Emissions from Shipping



Source: International Maritime Organization (IMO), n.d.

IMO 2018 Initial Strategy

In April 2018, during its 72nd session in London, the IMO approved its Initial Strategy for reducing GHG emissions from ships at the Marine Environment Protection Committee[3] (MEPC). This strategy was the first global effort to formally address carbon emissions from international shipping with the aim to support the goals of the Paris Agreement and the UNFCCC (IMO, 2018) (IMO, 2018). The strategy includes a specific reference to "*a pathway of CO2 emissions reduction consistent with the Paris Agreement temperature goals*". IMO is committed to supporting UN SDG 13 to "Take urgent action to combat climate change and its impacts " and the Paris Agreement by reducing GHG emissions from shipping (IMO, 2023).

The Initial Strategy sets both short-term and long-term ambitious targets, including:

- A reduction of carbon intensity of international shipping by at least 40% by 2030, pursuing efforts towards 70% by 2050, relative to 2008 levels[4].

[3] The MEPC is the IMO's main environmental policymaking body. It usually meets twice a year at the IMO headquarters in London. Each meeting lasts about a week and gathers representatives from IMO Member States, industry groups, and observer organizations.
[4] The IMO chose 2008 as the reference year because it was the last year of steady global shipping before the financial

- A reduction in total annual GHG emissions by at least 50% by 2050 compared to 2008, while aiming for full decarbonization "as soon as possible" in the second half of the century.
- Encouragement for the development and uptake of zero-emission technologies and alternative fuels (IMO, 2018).

With regards to the third target, the Initial Strategy goes beyond numerical targets by promoting innovation and operational improvements in shipping. It supports the research and development of zero-emission ships, alternative fuels like green ammonia and hydrogen, and efficiency-enhancing measures like optimized hull designs, energy-saving devices (ESDs), and improved operational practices. The strategy also gives emphasis to the importance of collecting and reporting data to monitor progress and provides the option for market-based measures or regulations in the future to further reduce emissions (IMO, 2018).

Even though the Initial Strategy is not legaly binding, it represents an important first step towards creating a global framework for reducing shipping emissions. The strategy recognizes that countries have different responsibilities and capabilities, so their contributions to reducing emissions in the maritime sector may vary (IMO, 2018).

crisis and has reliable data on fuel use and emissions. This helps track progress towards the IMO's carbon intensity reduction goals.

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Figure 5: Candidate Measures Included in IMO's Initial GHG Strategy

Type	Years	Measure	Target	Current status
Short-term	2018-2023	New Energy Efficiency Design Index (EEDI) phases	New vessels	-10% in 2015 -20% in 2020 -30% in 2025
		Operational efficiency measures (e.g. SEEMP, operational efficiency standard)	In-service vessels	SEEMP planning required
		Existing fleet improvement program	In-service vessels	–
		Speed reduction	In-service vessels	–
		Measures to address methane and VOC emissions	Engines and fugitive emissions	–
Mid-term	2023-2030	Alternative low-carbon and zero-carbon fuels implementation program	Fuels/new and in-service vessels	–
		Further operational efficiency measures (e.g. SEEMP, operational efficiency standard)	In-service vessels	SEEMP planning required
		Market-based Measures (MBMs)	In-service vessels/fuels	–
Long-term	2030+	Development and provision of zero-carbon or fossil-free fuels	Fuels/new and in-service vessels	–

Source: ICCT, 2018

IMO 2023 Revised GHG Strategy

In July 2023, during the MEPC 80, the IMO adopted the 2023 Strategy on Reduction of GHG Emissions from Ships. This revised strategy builds on the initial 2018 framework, increasing the ambition and specificity of targets to align with global climate goals (IMO, 2023). While this revised strategy is not legally binding as well, the measures used to implement it can be (Comer and Carvalho, 2023).

The strategy outlines a plan to phase out GHG emissions from international shipping as soon as possible, emphasizing a just and equitable transition (IMO, 2023). It sets the following levels of ambition:

- Carbon Intensity Reduction: Achieve a reduction in CO_2 emissions per transport work, as an average across international shipping, by at least 40% by 2030, compared to 2008 levels.

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- Alternative Fuels Uptake: Ensure that zero or near-zero GHG emission technologies, fuels, and/or energy sources represent at least 5%, striving for 10% of the energy used by international shipping by 2030.

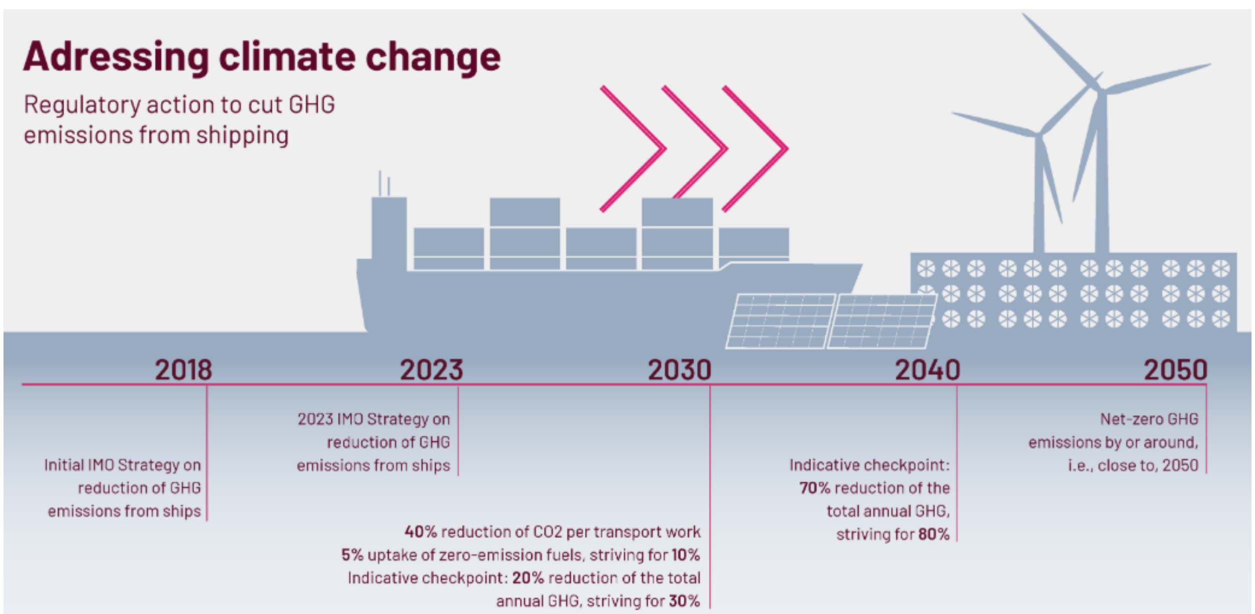
- Net-Zero Emissions: Peak GHG emissions from international shipping as soon as possible and reach net-zero GHG emissions by or around 2050, taking into account different national circumstances (IMO, 2023).

To monitor progress, the strategy introduces indicative checkpoints:

- 2030: Reduction of total GHG emissions from international shipping by 20%, striving for 30%, compared to 2008 levels.

- 2040: Reduction of total GHG emissions from international shipping by 70%, striving for 80%, compared to 2008 levels (IMO, 2023).

Figure 6: IMO's Regulatory Action to Cut GHG Emissions from Shipping



Source: Dan-Bunkering, 2024

The strategy outlines a "basket of measures" to achieve these targets, including:

- Technical Measures: Strengthening energy efficiency design requirements for ships and promoting the development and uptake of zero or near-zero GHG emission technologies.

- Economic Measures: Implementing a maritime GHG emissions pricing mechanism to incentivize emission reductions (IMO, 2023).

The IMO Net Zero Framework (NZF)

In parallel to the revised GHG Strategy, the IMO has been developing the IMO Net-Zero Framework (NZF). This framework is an important step in regulation. It aims to turn the goals of the 2023 IMO GHG Strategy into binding and enforceable rules under international law. It is expected to be incorporated as a new Chapter 5 of the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI, thereby giving the framework full legal effect once adopted (IMO, 2025a).

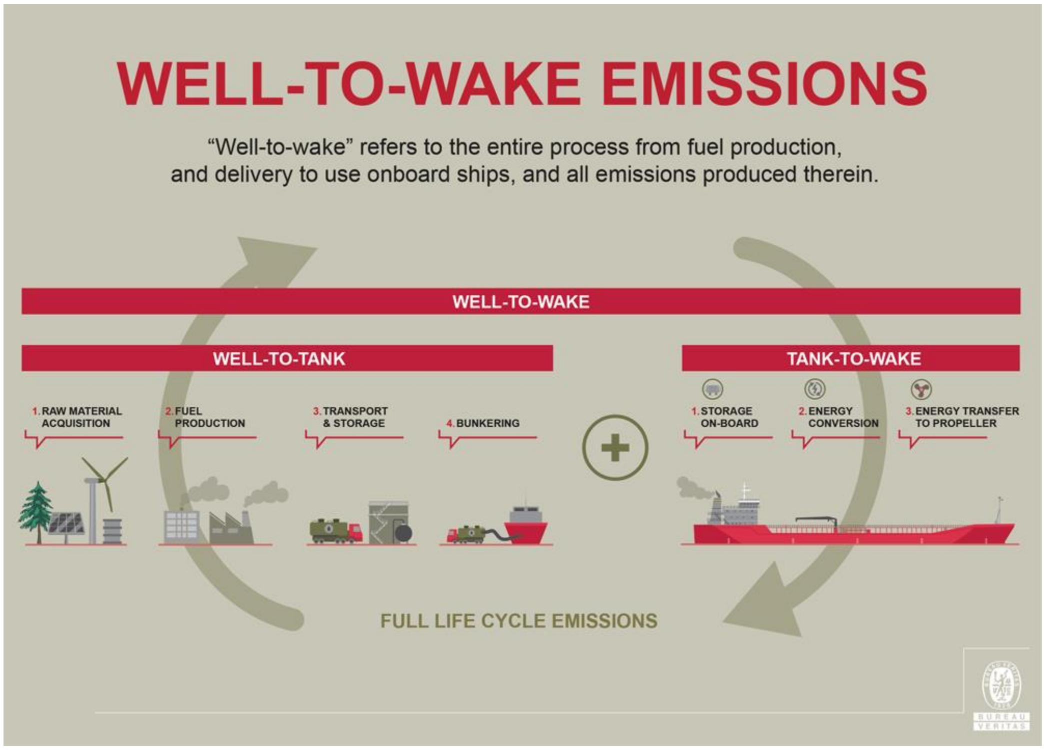
The framework has two main parts:

1. A global fuel standard (GFS), which requires ships to gradually lower the GHG intensity of their fuels over time, based on a full life cycle ("well-to-wake") assessment. Figure 7 below illustrates the well-to-wake concept which covers all stages of a fuel's journey from production and delivery to onboard use and the emissions produced at each stage.

2. A GHG pricing mechanism, which sets prices on emissions to encourage cleaner operations and help fund the transition to low- and zero-emission shipping. This economic measure is intended to create a market-based system in which vessels that underperform in meeting emission requirements would be required to purchase "remedial units," while ships exceeding performance targets could earn "surplus units."

Together, these mechanisms are expected to incentivize investment in cleaner technologies, low- and zero-carbon fuels and more efficient operational practices.

Figure 7: Well-to-wake Shipping Emissions



Source: Bureau Veritas, n.d.

The draft amendments for the IMO's Net-Zero Framework were approved in principle at MEPC 83 in April 2025 (IMO, 2025b). However, the final adoption vote was postponed to allow more discussion, especially on the economic measure and its impact on developing countries and small island states (SIDS). The IMO planned to revisit and potentially adopt the framework at a special MEPC session in October 2025. If adopted at that time, the framework could enter into force between 2027 and 2028, following the usual MARPOL amendment procedures. However, at the extraordinary session held 14-17 October 2025 (MEPC/ES.2), the Committee did not adopt the Framework. Instead it adjourned discussions for one year, to revisit in 2026 after intense negotiations and political disagreements, with the proposal opposed by the US (IMO, 2025b). Analysts suggest that if the IMO fails to achieve a global agreement, countries and regions may introduce their own regulations. This could fragment the dry bulk market, where the modern and alternative-fuel ships could concentrate on trades in Europe and other regulated areas to avoid penalties, while older ships may face higher costs in regions without regulations.

Overall, by combining regulatory standards with economic incentives, the framework is a critical step towards achieving the IMO's goal of net-zero GHG emissions from international shipping by or around 2050, while aligning with other global climate objectives under the Paris Agreement. Economic incentives, in particular, provide a strong motivation for shipowners to invest in cleaner technologies and fuels as they help bridge the cost gap between conventional and low-carbon fuels, making alternative options more economically viable and accelerating the transition to greener shipping (ITF, 2022). However, achieving this goal involves significant challenges, which are discussed in the next chapter on the implementation of the strategy.

Implementation Challenges of the 2023 IMO GHG Strategy

The implementation of the IMO 2023 strategy for maritime decarbonization faces many challenges, including technical, safety, economic, and environmental issues (Zhang et al., 2025). A major challenge is adopting alternative fuels to reach carbon neutrality in shipping by 2050, such as LNG, methanol, ammonia, biofuels, and hydrogen, each with different properties and limitations. Technical issues include retrofitting existing ships or building new vessels with engines and storage systems that can safely use these fuels. Dual-fuel engines can run on alternative fuels alongside diesel but need considerable modifications, while fuel cells are cleaner and more efficient but are more complex and costly to maintain. Storing and handling these fuels is also difficult. LNG and hydrogen need cryogenic tanks, ammonia requires pressurized tanks because it is toxic, and methanol must be stored in corrosion resistant tanks. Hydrogen's low volumetric density makes storage even more challenging. Economic factors add more obstacles. New ships using alternative fuels are expensive, especially hydrogen vessels, and retrofitting still costs a lot. Operating costs are affected by limited fuel supply, price swings, and incomplete bunkering infrastructure. Also, safety and environmental risks vary by fuel, ammonia and methanol are toxic, hydrogen and LNG are flammable, and methane leaks from LNG or emissions from blue fuels can reduce climate benefits. Overcoming these challenges will require coordinated efforts in technology, infrastructure, regulations, and crew training to ensure that alternative fuels can be used safely and efficiently (Zhang et al., 2025).

4.1.3 European Commission

The European Union's journey towards stronger environmental regulation began with the launch of the European Green Deal in December 2019. This set of policy initiatives outlined the EU's long-term vision of becoming the world's first climate-neutral continent by 2050, aiming to cut emissions, accelerate clean energy investment, foster sustainable industries, and protect biodiversity (European Commission, 2019). Europe is now recognized as a leader in decarbonization, driven by forward looking policies with people and the economy at their heart, guided by the principle of "a green transition that leaves no one behind" (Directorate General for Energy, 2024; European Commission, 2023a).

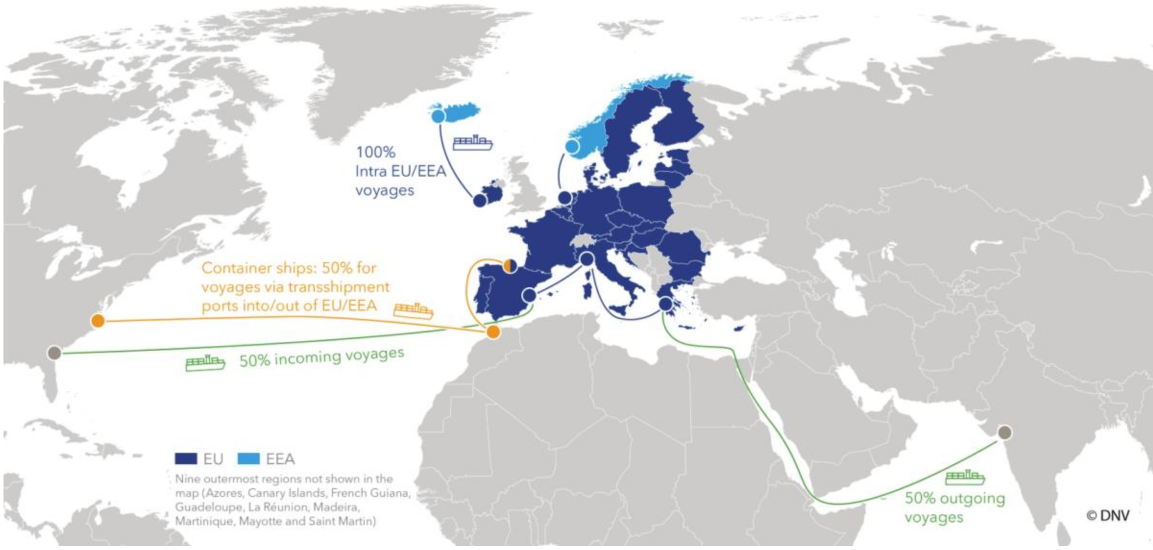
Building on the Green Deal's vision, the European Commission introduced the Fit for 55 package in 2021 aiming to reduce net GHG emissions by at least 55% by 2030 compared to 1990 levels[5]. This legislative package included dozens of interlinked policies covering energy, transport, taxation, and emissions trading, all aimed at speeding up the EU's climate goals and helping different sectors reduce their emissions (European Commission, 2021). The Fit for 55 package is considered among the most comprehensive climate policy frameworks globally.

European Union Emissions Trading System (EU ETS)

A big change for the shipping industry came with the inclusion of maritime transport in the EU, (EU ETS) strarting in 2024. The EU ETS, launched in 2005, is the world's largest carbon market and was originally limited to power generation and heavy industry. Over time, however, policymakers recognized that shipping needed to be part of this framework in order to drive meaningful emission reductions. Under the revised rules vessels over 5,000 gross tonnage (GT), regardless of their flag, are required to monitor, report, and purchase allowances for their CO_2 emissions. This applies to 100% of voyages within the European Economic Area (EEA) and 50% of voyages between EU and non-EU ports, as shown in Figure 8 below.

[5] The 1990 baseline is also used by the UNFCCC and Paris Agreement and represents emissions levels before the rapid economic and industrial growth after that year.

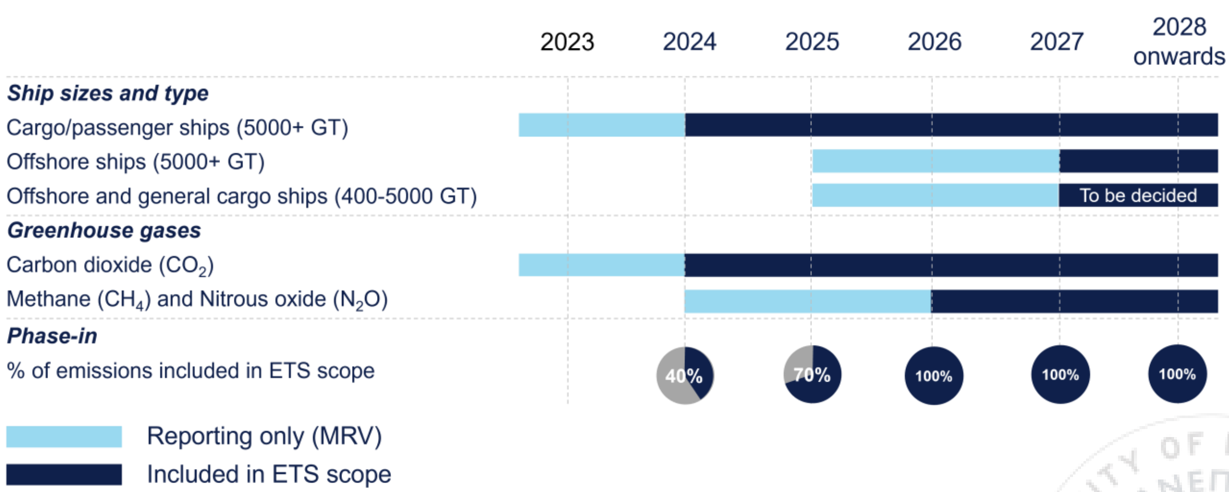
Figure 8: EU ETS based on Percentage of Emissions on Voyages



Source: DNV, n.d.

To give the sector time to adapt, the system is being phased in gradually. Shipping companies needed to surrender allowances for 40% of their verified 2024 emissions in 2025, rising to 70% in 2026 and reaching full coverage from 2027 (DNV, 2025a). From 2026, the scope will expand to include methane (CH_4) and nitrous oxide (N_2O), calculated on a CO_2-equivalent basis, as illustrated in the EU ETS timeline in Figure 9.

Figure 9: EU ETS Introduction Timeline



Source: DNV, n.d

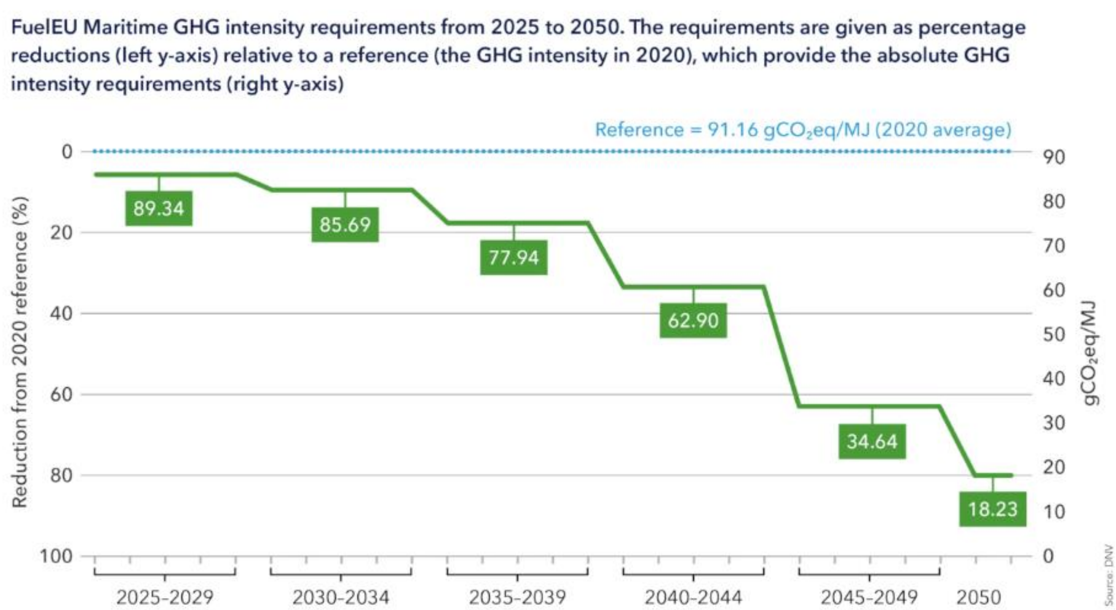
Early assessments by the European Commission suggest that, so far, there is little evidence of major evasion or unintended effects, such as ships rerouting to avoid the system or carbon leakage[6], however continued monitoring remains essential (European Commission, 2025).

Although the EU ETS is expected to increase compliance costs and operational expenses for shipowners, it also provides strong financial incentives for change and a step forward.

FuelEU Maritime Regulation

Another important regulation to reduce GHG emissions from shipping is the FuelEU Maritime Regulation, which came into effect on January 1, 2025. It is a key element of the European Union's Fit for 55 package. It sets progressively stricter limits on the carbon intensity of marine fuels, applying to vessels over 5,000 GT calling at EU ports. The regulation aims for an 80% reduction in GHG intensity by 2050 compared to 2020 levels, with interim milestones set for 2025, 2030, 2035, and beyond (European Commission, 2025), as illustrated in Figure 10 below.

Figure 10: FuelEU Maritime GHG Intensity Limit



Source: DNV, 2025a

[6] Carbon leakage happens when cutting GHG emissions in one region causes emissions to rise elsewhere, usually because companies move production, shipping, or activities to places with less stringent climate rules.

Overall, FuelEU Maritime has faced strong criticism. Some stakeholders worry that it could encourage the use of transitional fuels like LNG, which can release methane and slow progress towards long-term climate targets (Transport & Environment, 2024). Others express their concerns about the availability of sustainable fuels, the potential impact on the competitiveness of EU shipping, and the challenges of ensuring fair enforcement between EU and non-EU operators. These issues highlight how challenging it is to balance ambitious climate goals with the realities of global shipping.

Corporate Sustainability Reporting Directive (CSRD)

The Corporate Sustainability Reporting Directive (CSRD), which came into effect on January 5, 2023, brings important changes to how companies report on sustainability. The directive is part of the EU's broader sustainability agenda. It goes further than the previous Non-Financial Reporting Directive by requiring more detailed information on environmental, social, and employee matters, as well as human rights, anti-corruption, and anti-bribery policies[7] (Samak, 2024). The Directive applies to approximately 50,000 companies across Europe (PwC, n.d.). It applies to a wide range of companies that generally meet at least two of the following criteria:

1. €50 million in net turnover,
2. €25 million in total assets, or
3. 250 or more employees. This includes large, listed corporations, banks, and insurance companies already subject to the NFRD, other listed EU companies not previously covered by the NFRD, listed European SMEs that can report using simplified standards, and large private European companies (PwC, n.d.).

Additionally, non-European companies with significant business in the EU specifically those generating over €150 million in annual turnover in the EU are also required to comply. Large companies already subject to the NFRD must comply for financial years starting 1 January 2024, while other large EU companies not previously under the NFRD will follow for financial years starting 1 January 2025 (Taschner, M., 2023).

[7] The CSRD replaced and expanded the NFRD in 2023, due to lack of standardization.

According to EU Commission (2023), "*this helps investors, civil society organisations, consumers and other stakeholders to evaluate the sustainability performance of companies, as part of the European green deal*".

Companies falling under the CSRD are required to report in line with the European Sustainability Reporting Standards (ESRS), adopted in July 2023 to provide companies with a tool for understanding exactly what they should report[8]. These standards are initially drafted by European Financial Reporting Advisory Group (EFRAG)an independent multistakeholder body (European Commission, 2023b).

Double Materiality

At the core of the directive is the concept of double materiality. Double materiality includes two aspects: financial materiality and impact materiality. Impact materiality requires companies to report on how their activities affect the environment and society, while financial materiality concerns how sustainability issues affect their financial performance. Initially, limited third-party assurance is required, with plans to move towards reasonable assurance in the future (PwC, n.d.).

4.2 Operational Impacts

As highlighted in the introduction of this chapter, although the shipping industry accounts for approximately 80% of global trade it contributes about 3% of global GHG emissions. As a response, the IMO has introduced new performance-based regulations under MARPOL Annex VI. Effective January 1, 2023, all vessels ≥400 GT are required to compute an Energy Efficiency Existing Ship Index (EEXI) and submit an annual Carbon Intensity Indicator (CII) rating (IMO, 2023) (IMO, 2023). These measures support the IMO's 2018 GHG strategy, which aims to cut carbon intensity by 40% by 2030 compared to 2008 (IMO, 2023). To comply, shipowners are optimizing engine settings, retrofitting energy-saving technologies such as advanced hull coatings and propeller upgrades, and using digital voyage planning to reduce fuel consumption. Also, they adopt routine practices like slow steaming and more direct routing to improve CII scores. A good CII rating can bring financial benefits. Top-rated ships (A or B) attract more charterers and better

[8] The ESRS fulfills the standards set by the EU Taxonomy Regulation, the SFDR, NFRD, IFRS, and more.

rates, while vessels with low ratings must take corrective action or they may struggle to obtain charter contracts (Wärtsilä, 2024).

Furthermore, regulations place stricter limits on traditional air pollutants. Since January 1, 2020, ships worldwide have had to use fuel containing no more than 0.50% sulfur (DNV, 2020). As a result, many vessels have switched to very low-sulfur fuels or installed exhaust gas cleaning systems, known as scrubbers, to remove sulfur oxides from engine exhaust (DNV, 2020).

Nitrogen oxides (NO_x) are also being controlled. In Emission Control Areas (ECAs), Tier III standards require roughly a 75% reduction compared to older engines. This has encouraged the use of technologies such as selective catalytic reduction (SCR) systems and cleaner engine designs. Particulate matter emissions are also reduced through diesel particulate filters and cleaner-burning fuels (DNV, 2020).

To avoid the cost of penalties in case of non-compliance with the regulations imposed by the IMO and the European Commission, many fleets have adopted alternative fuels. For example, 69% of container ships ordered in 2024 are capable of using LNG or other low-carbon fuels (DNV, 2025b). The infrastructure for bunkering, particularly for LNG, is growing to facilitate this transition (DNV, 2025b).

Therefore, to meet strict environmental regulations, shipping companies are using cleaner fuels, making retrofits, and applying operational strategies such as reducing speed and optimizing routes.

The social aspect of ESG is also getting attention in the industry due to an increased emphasis on labor practices. The COVID-19 “crew change” crisis (2020-2021) revealed significant welfare issues for seafarers (ITWF, 2019) leading to efforts such as the Neptune Declaration and stricter regulations. For instance, new amendments to the Maritime Labour Convention (MLC), which took effect in December 2024, require Member States to facilitate prompt crew repatriation and provide affordable Internet access onboard ships, along with improved medical care provisions (Walton, E., 2024). Shipping companies now regularly audit crew agencies and monitor crew wellbeing. Charterers and investors are paying more attention to labor and human rights standards, and industry leaders highlight that strong social policies help attract talent.

4.3 ESG Leaders and Laggards in the Shipping Sector

Shipping companies are finding that adopting ESG principles is no longer optional if they want to stay competitive and resilient in the long term. Stricter regulations, along with growing expectations from charterers, investors, and other stakeholders are making the gap between ESG leaders and laggards more visible than ever. Recent studies show that ESG factors are now closely linked to both new regulations and financial decision-making. As the IMO pushes forward with its decarbonization efforts, banks and investors are also placing greater weight on sustainability performance when deciding how and where to lend (Tsatsaronis et al., 2024). This chapter examines what distinguishes ESG leaders from laggards in the shipping industry, why these differences arise, and what they mean for the future of the industry.

ESG leaders in shipping are companies that actively integrate sustainability into their strategy, operations, and investment decisions. They usually set clear decarbonization targets, invest in modern and energy-efficient vessels, and report their performance transparently. Their disclosures are often aligned with recognized frameworks such as Global Reporting Initiative (GRI), Sustainability Accounting Standards Board (SASB), and Task Force on Climate-related Financial Disclosures (TCFD) (International Chamber of Shipping, n.d.). In addition, companies subject to the Corporate Sustainability Reporting Directive (CSRD) are now required to report in accordance with the European Sustainability Reporting Standards (ESRS). Using recognized ESG frameworks like GRI, SASB, and TCFD enhances the comparability and credibility of disclosures, reduces information asymmetry, supports investor decision-making, and helps prevent greenwashing (Cunha et al., 2025).

Many companies also participate in industry initiatives such as the Poseidon Principles and the Sea Cargo Charter. Under the Poseidon Principles, banks monitor the carbon emissions of the ships they finance to support climate targets. According to their Annual Disclosure Report 2025, since the launch in 2019, membership has expanded to 36 signatories across 14 countries, which represents almost three-quarters of global ship finance (Poseidon Principles, 2025). The Sea Cargo Charter helps shipping companies track and reduce the climate impact of their cargo (Sea Cargo Charter, n.d.). Furthermore, shipping companies that lead in ESG are engaging with regulators, academic institutions, industry partners through policy forums, sustainability conferences, and multi-stakeholder alliances to share best practices and promote sustainable innovation in the sector and supply chain overall.

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Studies show that companies recognized as ESG leaders see sustainability not just as a compliance requirement, but as a strategic advantage that boosts competitiveness and builds stakeholder trust (Andrikopoulos, 2025).

In contrast, ESG laggards are characterized by limited transparency, older and carbon-intensive fleets, and they seem to follow regulations reactively rather than proactively, which can lead to higher compliance costs, increased reputational risks, and competitive disadvantages over time. Many of these companies have not developed formal sustainability frameworks and disclose little to no ESG information. Their governance structures may be informal, and they may have limited monitoring of environmental or social risks. Studies on ESG reporting quality among maritime firms show that many laggards fail to meet even basic disclosure expectations, despite increasing regulatory and market pressure (Tsatsaronis et al., 2024). Such companies may also perform worse on social indicators, such as crew welfare, safety management, and diversity, which attract increasing attention from regulators and charterers.

There are several reasons why ESG performance varies across shipping companies. One important factor is access to capital, where large, publicly listed companies often have more financing options, allowing them to invest in new technologies and alternative fuels. Smaller, family-owned companies or tramp operators usually operate on tighter margins, which makes it harder to modernize fleets or improve ESG reporting. Regulatory pressures also influences performance. Companies that operate in highly regulated areas, such as container lines under the EU ETS, have stronger incentives to cut emissions. Growing pressure also comes from customers, as international charterers and cargo owners now expect ships to monitor emissions and share environmental data and offer greener transport options (International Chamber of Shipping, n.d.).

Companies that lead on ESG tend to move early. They are the first to explore alternative fuels, invest in digital optimization tools that improve efficiency, and build strong governance structures to guide their sustainability efforts. Many of them order methanol-ready or ammonia-ready vessels, test wind-assisted propulsion technologies, and use advanced route optimization systems to reduce fuel consumption. Their sustainability reports usually include verified emissions data along with clear explanations of their environmental and social initiatives, which helps build trust with stakeholders.

Laggard companies, on the other hand, often operate older vessels and may not systematically track the emissions of their fleets. Instead of acting proactively, they tend to make changes only when new regulations force them to do so. Their limited involvement in industry partnerships and sustainability initiatives can slow their progress even further, widening the gap between them and more forward-looking competitors.

The gap between leaders and laggards has important effects on the industry. ESG leaders gain easier access to green financing, such as sustainability-linked loans and green bonds, which affects ship funding, because lenders increasingly tie financial terms to measurable environmental performance targets (DNV, 2026; ICLG, 2026). They also attract charterers looking for low-carbon shipping which strengthens their market position. Laggards face risks, including higher financing costs, fewer chartering opportunities, and older ships becoming unprofitable. As regulations become more strict and carbon costs rise these companies may find it harder to compete. The industry is moving in a way that could leave companies behind if they do not adapt, as the market seems to favor transparency, innovation, and environmental responsibility.

Chapter 5: Corporate Financial Performance in Shipping

Corporate Financial Performance (CFP) is a core indicator for measuring the resilience and efficiency of a company. In the shipping sector, the importance of CFP is even more noticeable as the industry is characterized by high capital structure, intense cyclicality, increased risks and high exposure to external factors, such as fluctuations in freight rates and international regulations.

The connection between ESG and CFP has been a topic of interest in international literature (Friede et al., 2015; Ioannou and Serafeim, 2015). According to stakeholder theory, companies that incorporate responsible practices are more likely to hold good relationships with investors, customers and employees, which improves their profitability in the short-term. At the same time, the resource-based view argues that companies that invest in non-material resources such as reputation, transparency and sustainable practices, gain a competitive advantage that is difficult to replicate (Barney, 2001).

For shipping, these theoretical approaches are significant. Increasing environmental pressures, such as regulations for CO_2 emissions and low emission fuels make the environmental dimension of ESG critical for long term sustainability. Likewise, social challenges, like crew safety and labour equity are concerns directly related to operational efficiency. Finally, governance remains key as transparency and good management affect access to capital (Porter and Kramer, 2011).

The literature suggests that higher ESG performance can reduce business risk, improve resource efficiency and enhance access to financing (Chava, 2014). In shipping, where financing is a key factor, companies with a strong ESG profile can enjoy better terms or higher market valuation. At the same time, negative events seem to have the opposite effect, hurting reputation and leading to lower returns (Christensen et al., 2021).

Therefore, the theoretical discussion suggests that ESG can act as a mechanism for improving financial performance either through direct improvements in operational practices or through indirect effects such as reducing the cost of capital. This theoretical framework makes it necessary to empirically investigate the relationship between ESG and CFP in the shipping industry.

The next chapter focuses on the methodology and data used to assess whether and to what extent ESG performance affects the financial performance of NYSE-listed shipping companies.

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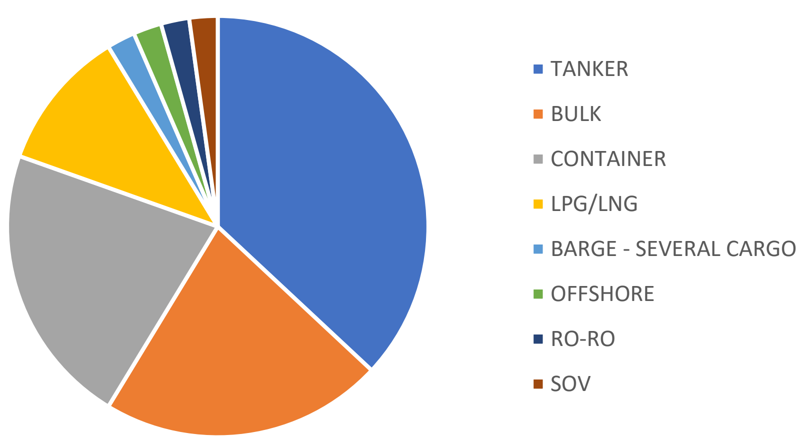
Chapter 6: Data and Methodology

This chapter of the study analyzes the sample data collected and explains the methodology followed for their empirical analysis. More particularly, a quantitative analysis is used to examine the relation between the ESG and financial performance of shipping companies listed on NYSE. The selection of this specific sector was not random, as shipping holds perhaps the largest share of international trade and is also among the most polluting industries. In addition, the pressure for sustainability matters is extremely high (Jia and Azevedo, 2025; Xue and Lai, 2023). For the analysis a wide range of panel data is used in a cross-sectional format.

6.1 Data Selection

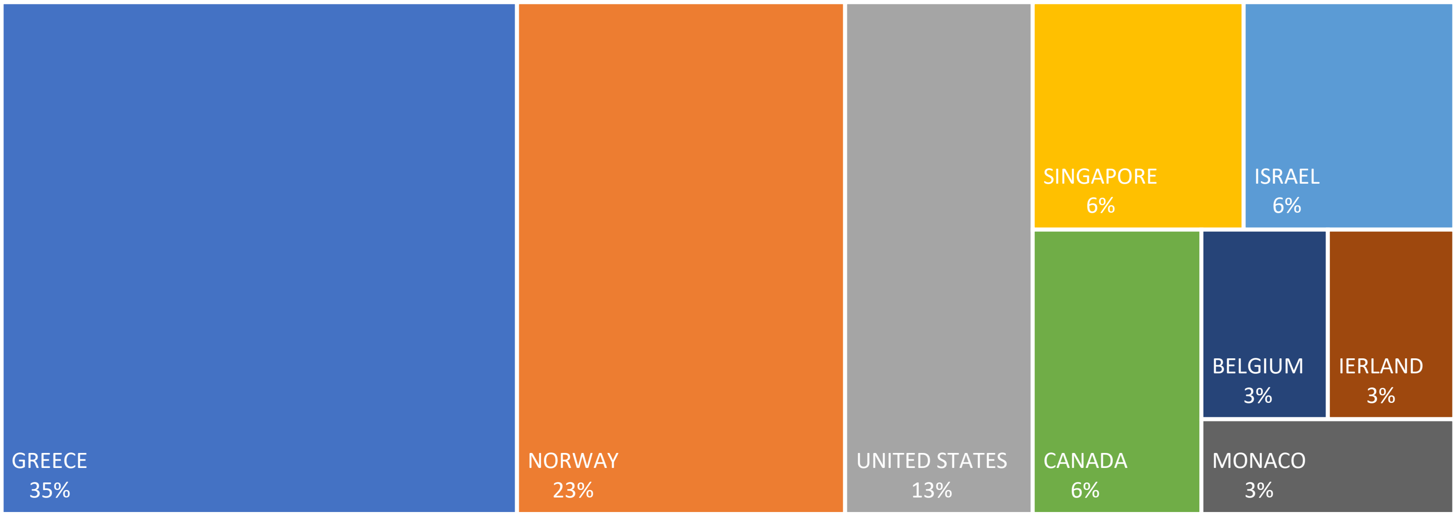
All data collected by the LSEG Datastream platform, considering international literature, to present reliable results. The beginning sample consists of 32 shipping companies listed on NYSE. The range includes companies from several sectors of the shipping industry, such as bulk carriers, tankers, containerships, LNG, Ro-RO, SOV, barge & offshore platforms. Beyond their international activity due to global trade, in terms of ownership these firms come across various geographical areas around the globe, with the highest percentages recorded in Greece, Norway and the USA., while owners from other countries holds a smaller share in the companies of the sample.

Figure 11: Sample Firms per Sector



Source: Author's own elaboration

Figure 12: Firms' Origin



Source: Author's own elaboration

The dataset used includes both financial variables and ESG indicators for all selected shipping companies, covering a ten-year period from 2014 to 2024. The choice of this time frame ensures enough observations for statistical analysis and enables the capture of recent trends in the connection of ESG and financial performance. This selection of variables are consistent with previous studies examining the same relation (Friede et al., 2015; Ioannou and Serafeim, 2015).

The financial variables included in the sample reflect key corporate performance criteria, such as profitability, growth, valuation, financial leverage and risk. Especially, to imprint profitability ROA, ROE and Net Profit Margin indexes are used, which provide additional information on the efficiency of resources, return on equity and operational efficiency accordingly (Agliardi et al., 2023; Aydoğmuş et al., 2022). For companies' growth are initially selected the variables of Net Income and Total Assets, while Market Value are used as valuation indicator (Brown and Caylor, 2006; Chava, 2014). Moreover, the risk and capital structure if reflected through the DS Historical Beta Local Index and the Total Debt to Common Equity Ratio.

As for non-financial variables, the sample consists of the Overall ESG Scores, as well as the scores per individual pillar. The specific variables are ESG Score Overall, Environmental Pillar Score, Social Pillar Score and Governance Pillar Score, which obtain the performance of the companies on environmental, social and governance issues. Additionally, the ESG Controversies Score is used to cover possible negative events that affect the reputation and sustainability of the businesses

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(Berg et al., 2022). Lastly, the ESG Combined Score used also in the analysis in the aim to robust the results.

For the development of the final sample, it was necessary that the data to be carefully filtered to ensure the reliability of the results. Following filtering, some companies were excluded from the evaluation due to lack of relevant data. The purification of the sample resulted in a total of 26 shipping companies providing a sufficient number of observations, which varies depending on the evaluation model used, as listwise deletion is applied to account for missing data.

For the purpose of clarity, Table 1 presents a summary of the variables used, along with a brief explanation of their content and significance.

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Table 1: Variable Definition Table

Variables	Abbreviations	Description	Source
Return on Assets	ROA	Reflects a company's ability to utilize all its assets to generate profits.	LSEG Datastream
Return on Equity	ROE	Expresses the return achieved on equity, showing the benefit shareholders receive from their investment.	LSEG Datastream
Market Value	MV	Represents the market value of the company, as determined by the share price and the number of shares in circulation.	LSEG Datastream
Net Profit Margin	NPM	Expresses the percentage of net profits in relation to total sales, showing the company's net profitability.	LSEG Datastream
ESG Score Overall	ESG	Comprehensive index that aggregates the company's performance in the areas of environment, society, and governance.	LSEG Datastream
Environmental Pillar Score	ENV	Specific index that evaluates the company's environmental practices, such as emissions, resource use, and environmental impact.	LSEG Datastream
Governance Pillar Score	GOV	An index focuses on corporate governance, examining issues such as board structure and transparency.	LSEG Datastream
Social Pillar Score	SOC	Evaluates the social dimension of the company, including employee relations, social responsibility, and human rights.	LSEG Datastream
ESG Controversies Score	ESGCON	Measures the company's exposure to negative events that may create reputational or regulatory risks.	LSEG Datastream
ESG Combined Score	ESGC	Combines the overall ESG index with the negative events index, providing a more comprehensive picture of sustainability.	LSEG Datastream
DS Historical Beta Local Index	BETA	An index that shows the degree of volatility of a stock relative to the domestic market index, reflecting systematic risk.	LSEG Datastream
Total Debt to Common Equity Ratio	DE	Ratio that reveals the degree of financing through borrowing in relation to equity, an indication of the level of leverage	LSEG Datastream
Change in Net Income	ΔNI	Plots the annual change in net profits, showing the trend and momentum of profitability.	LSEG Datastream
Growth in Total Assets	ΔlnTA	An index that measures the growth rate of a company's total assets, reflecting its growth trajectory.	LSEG Datastream

Source: Authors' calculations

6.1.1 Variable Transformation and Optimization

For the aim of the study, it was necessary to examine the stationarity of the timeseries related to Net Income and Total Assets, because the use of non-stationary variables could lead to misleading results and correlation errors. Considering this, the Fisher-Type Augmented Dickey Fuller (ADF), which tests the existence of a unit root. The test results revealed that the variables are non-stationary at their initial levels and thus needed to be adjusted. In order to achieve stationarity for the Net Income variable, the first difference (1) was selected, while for the Total Assets variables the first difference of the natural logarithm (2) was used to reflect the percentage changes.

$$(1)\ \Delta NI_{i,t} = NetIncome_{i,t} - NetIncome_{i,t-1}$$

$$(2)\ \Delta \mathrm{lnTA}_{i,t} = \ln(TotaAssets)_{i,t} - \ln(TotaAssets)_{i,t-1}$$

Upon re-examining stationarity, the new variables were considered stationary. This practice is widely followed in the literature, as logarithmic differences facilitate the percentage change analysis and reduce heteroscedasticity (Bruna et al., 2022).

6.2 Research Methodology

As mentioned earlier, the study examines the impact of ESG scores on the financial efficiency of shipping companies. The research is conducted using quantitative analysis, through OLS and panel regression models between dependent, independent and control variables. During the data collection, the initial sample included both timeseries and panel data and to ensure the homogeneity of the analysis, all data transformed into panel format. The choice of regression models is in line with the existing literature, while empirical analysis performed using STATA software.

6.2.1 Ordinary Least Squares regression (OLS)

The first part of the analysis includes the OLS regression models. In this case, variables are separated into two categories: a) financial performance indexes and b) ESG score related variables. As the research question is to examine whether and which occurs in performance when ESG scores change, financial indexes are stated as dependent variables and ESG score variables as independent. For the examination of the sample, ten basic OLS regression models are derived, which are presented below:

Model 1: $ROA_i = \beta_0 + \beta_1 ESG_i + \epsilon_i$

Model 2: $ROE_i = \beta_0 + \beta_1 ESG_i + \epsilon_i$

Model 3: $MV_i = \beta_0 + \beta_1 ESG_i + \epsilon_i$

Model 4: $NPM_i = \beta_0 + \beta_1 ESG_i + \epsilon_i$

Model 5: $DE_i = \beta_0 + \beta_1 ESG_i + \epsilon_i$

Model 6: $BETA_i = \beta_0 + \beta_1 ESG_i + \epsilon_i$

Model 7: $\Delta NI_i = \beta_0 + \beta_1 ESG_i + \epsilon_i$

Model 8: $\Delta lnTA_i = \beta_0 + \beta_1 ESG_i + \epsilon_i$

In addition to the basic models, the relationship of all dependent variables with the independent variables Environmental Pillar Score, Governance Pillar Score, Social Pillar Score, ESG Controversies Score and ESG Combined Score were also examined, to evaluate further the response of corporate returns to individual dimensions of ESG performance (Robustness Tests). The results will be discussed in the next chapter of the study, however, for the sake of clarity, the tables are presented in the Appendix.

6.2.2 Panel Regressions

For the second part of the analysis, conducted panel regressions, in order to fully examine the relationship between ESG scores and financial indexes. Panel regressions offer significant benefits, as they provide a combination of cross-sectional and time-series dimensions, reducing the possibility of bias and enhancing the accuracy of the estimates (Hsiao, 2014). During the analysis process, two main approaches were followed. The first approach is the Fixed Effects (FE) model, which controls unobservable characteristics that remain constant over time. The second approach is the Random Effects (RE) model, which considers that the observable characteristics are random and uncorrelated with the independent variables. Then, to select the most appropriate model in each case, the Hausman (1978) specification test was applied, which checked whether

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the RE estimates were consistent and in cases where the null hypothesis was rejected, the FE results were retained.

As for the selected variables, The ROE, ROA and Net Profit Margin ratios were used as key dependent variables, as they present different dimensions of profitability such as equity profitability, asset efficiency, operating profitability and market valuation. The ESG Score Overall was used as key independent variable to examine the overall impact of scores on financial performance. Also, control variables, such as the change in total assets (ΔlnTA) indicate growth, the Net Profit Margin (NPM) and ROA ratios to control profitability, the Debt-to-Equity (DE) ratio as a leverage measure, as well as the change in net profit (NI) to dynamically capture profitability, were included to limit the possibility of omitted factors.

According to the above, the following basic panel regression models were designed:

Model 9: $ROE_{i,t} = \beta_0 + \beta_1 ESG_{i,t} + \beta_2 \Delta lnTA_{i,t} + \beta_3 NPM_{i,t} + \epsilon_i$

Model 10: $ROA_{i,t} = \beta_0 + \beta_1 ESG_{i,t} + \beta_2 \Delta lnTA_{i,t} + \beta_3 NPM_{i,t} + \epsilon_i$

Model 11: $NPM_{i,t} = \beta_0 + \beta_1 ESG_{i,t} + \beta_2 \Delta lnTA_{i,t} + \beta_3 ROA_{i,t} + \epsilon_i$

The formulation of the above models is in line with the literature examining the relation between ESG and financial performance (Friede et al., 2015). Results of the models are presented in the next chapter, though detailed tables are included in the Appendix.

The methodology that presented in this chapter combines both simple and multiple regressions with the use of panel dataset, applying stationarity tests and transformations to ensure the reliability of the estimates. The distinction between fixed and random effects and the application of the Hausman test enhanced the accuracy of the model, reducing the possibility of bias. In this way, the analysis offers a solid methodological framework for examining the relationship between ESG and financial performance. In the next chapter, the results are presented in detail and compared to the findings of international literature.

Chapter 7: Results & Analysis

7.1 Descriptive Statistics and Correlation

Table 2 presents the descriptive statistics of the variables used in the study. The ESG indicators are showing a notable spread, indicating the diversification of the sustainable strategy of shipping companies. The ESG Score Overall has a low mean (33.7) and a standard deviation of 17.5, a fact that reflects the important differences between the responsibility practices (Berg et al., 2022). As for the Environmental Pillar displays a lower mean value (26.1), as the sector is vulnerable to challenges of emission and regulation issues. On the other hand, the Governance Pillar presents a higher means as companies are focusing more on management and transparency. The ESG Controversies indicator has an extraordinarily high mean (97.9), explaining that there are not many negative events to affect the firms' reputation (Christensen et al., 2021).

Regarding financial variables, the performance is highly diversified. The means of ROA and ROE amount to low levels (6.5 and 9.9), but with high standard deviations, indicating the cyclicity of the industry. In terms of profitability, Net Profit Margin displays high volatility, thus it is reasonable as the sample contains firms from several shipping sectors. The Market Value variable records a mean of $7.36 billion, while the maximum amount is $159 billion, showing the heterogeneity in the size of the firms. The statistics of the Debt-to-Equity ratio indicate that the capital structure in many cases is particularly burdened. As for Beta, it indicates that on average, term shipping companies reflect almost the same level of risk as the market. Lastly, the difference in Net Income and Total Assets, featuring large fluctuations in terms of income growth per year and stable growth in terms of assets under management. (Chung and Pruitt, 2007).

Table 2: Descriptive Statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
ESG	181	33.684	15.778	1.95	76.1
ENV	181	26.132	17.345	0	67.86
GOV	181	44.295	22.811	4.29	87.82
SOC	181	32.601	19.202	1.08	94.31
ESGCON	181	97.872	10.221	17.65	100
ESGC	181	33.334	15.169	1.95	75.36
ROA	176	6.515	8.922	-15.88	44.69
ROE	175	9.872	19.416	-48.12	88.14
MV	175	7360.431	26094.625	28.21	159000
NPM	164	6.877	32.938	-160.6	152.7
BETA	174	1.032	.658	-.474	2.809
DE	176	120.718	172.428	-1178.54	982.72
ΔNI	152	95099.257	706000	-1872190	7694348
ΔlnTA	152	.041	.214	-1.104	1.251

Source: Authors' calculations

The following Table 3 highlights the significant correlations between ESG indicators and financial performance metrics. The ESG Score Overall displays a moderate positive correlation with ROA (0.308) and ROE (0.373), indicating that shipping companies with higher awareness on sustainable responsibility issues tend to achieve better returns on capital. Similarly, the correlation with Net Profit Margin (0.176) although it is weak, is statistically significant.

In the case of companies' valuation, there is a high positive correlation between Market Value and ESG (0.546). Market Value is also positively correlated with the individual pillars of ESG, advising that capital markets are valuing companies that adopt responsible practices favorably, reinforcing the view that ESG performance can be a key value driver.

As for ESG Controversies, has a negative correlation with both ESG and financial performance variables reflecting the fact that negative events tend to undermine not only corporate sustainability but also firms' profitability and market performance.

In general, the results reliably exhibit a positive correlation between ESG scoring and financial performance, strengthening the argument that responsible and sustainable practices can contribute to improving the profitability and value of shipping companies.

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Table 3: Pairwise Correlation

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) ESG	1.000													
(2) ENV	0.827***	1.000												
	(0.000)													
(3) GOV	0.718***	0.362***	1.000											
	(0.000)	(0.000)												
(4) SOC	0.870***	0.676***	0.384***	1.000										
	(0.000)	(0.000)	(0.000)											
(5) ESGCON	-0.374***	-0.226***	-0.209***	-0.446***	1.000									
	(0.000)	(0.002)	(0.005)	(0.000)										
(6) ESGC	0.986***	0.827***	0.720***	0.838***	-0.240***	1.000								
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)									
(7) ROA	0.308***	0.255***	0.167**	0.315***	-0.042	0.307***	1.000							
	(0.000)	(0.001)	(0.027)	(0.000)	(0.581)	(0.000)								
(8) ROE	0.373***	0.268***	0.212***	0.405***	-0.182**	0.350***	0.925***	1.000						
	(0.000)	(0.000)	(0.005)	(0.000)	(0.016)	(0.000)	(0.000)							
(9) MV	0.546***	0.343***	0.322***	0.631***	-0.641***	0.459***	0.150*	0.340***	1.000					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.051)	(0.000)						
(10) NPM	0.176**	0.150*	0.061	0.207***	-0.077	0.168**	0.314***	0.314***	0.169**	1.000				
	(0.024)	(0.056)	(0.434)	(0.008)	(0.326)	(0.031)	(0.000)	(0.000)	(0.033)					
(11) BETA	-0.070	-0.047	-0.126*	-0.003*	-0.038	-0.073	-0.159**	-0.128*	-0.001	0.062	1.000			
	(0.357)	(0.538)	(0.098)	(0.973)	(0.620)	(0.340)	(0.039)	(0.099)	(0.986)	(0.436)				
(12) DE	0.141*	0.179**	0.006*	0.152**	-0.117	0.137*	-0.057	-0.262***	0.045	-0.040	0.104	1.000		
	(0.063)	(0.017)	(0.932)	(0.044)	(0.124)	(0.070)	(0.451)	(0.000)	(0.563)	(0.614)	(0.177)			
(13) ΔNI	0.024	0.059	-0.059	0.055	-0.025	0.013	0.383***	0.359***	0.029	-0.126	-0.126	-0.044	1.000	
	(0.767)	(0.468)	(0.473)	(0.502)	(0.757)	(0.878)	(0.000)	(0.000)	(0.726)	(0.137)	(0.127)	(0.586)		
(14) ΔlnTA	-0.133	-0.159*	-0.083	-0.084***	0.035	-0.136*	0.212***	0.226***	-0.018	0.042	0.014	-0.006	0.217***	1.000
	(0.102)	(0.050)	(0.310)	(0.301)	(0.671)	(0.094)	(0.009)	(0.005)	(0.829)	(0.618)	(0.865)	(0.940)	(0.007)	

Source: Authors' calculations

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7.2 Linear Regression Results

In this part of the study, the outcomes of the linear regressions are discussed. For reasons of clarity, the main discussion is limited to the models that use the overall ESG score as the explanatory variable and show meaningful links with financial performance. The rest of the models are considered in the text but are presented in detail in the Appendix.

Table 4 reports the OLS regressions that test the connection between ESG and six measures of performance: ROA, ROE, Market Value, Net Profit Margin and Debt-to-Equity Ratio. The results point to a positive and statistically significant link between ESG and both ROA and ROE, meaning that firms in shipping with higher ESG scores tend to perform better in terms of returns on assets and equity. A similarly strong relationship is observed between ESG and Market Value, showing that investors reward responsibility. More modest effects appear for Net Profit Margin and Debt-to-Equity, which are still significant but weaker.

Besides the overall ESG score, the three pillars (Environmental, Social and Governance), together with the ESG Combined and ESG Controversies scores, were also tested. The results are mixed as the Social and Governance scores show stronger positive relation with profitability and firm value, while the Environmental pillar shows only selective positive results, mainly for ROE and Market Value. On the other hand, the ESG Controversies score has a clear negative effect, with significant coefficients that confirm how negative events reduce performance and reputation.

Table 4: Linear Regression Result of Financial Performance on ESG

	ROA	**ROE**	**MV**	**NPM**	**DE**
ESG	0.172***	0.454***	894.527***	0.359**	1.517*
	(0.04)	(0.086)	(104.43)	(0.16)	(0.81)
Obs.	176	175	175	164	176
R-squared	0.095	0.139	0.298	0.031	0.02
F-statistic	18.202	27.906	73.371	5.163	3.512

Source: Authors' calculations

7.3 Panel Regression Results

The analysis continues with the panel regressions, which provide a more trustworthy framework than the OLS regressions as they limit bias and consider corporate characteristics that stay constant over time. The choice of fixed or random effects in each case was made using the Hausman test, to ensure a most appropriate assessment. The main results of the analysis are presented in Table 5.

In the results of ROE, ESG has a positive and statistically significant effect. In other words, firms that invest more in sustainability tend to reward their shareholders with higher returns on equity. The Hausman test in this case confirms that the choice of fixed effects, as the unobservable characteristics of companies are important.

Likewise, in ROA, the relationship with ESG is also positive and strong, indicating that the overall efficiency of resources in a company improves as its ESG score increases. In addition, the growth index (ΔlnTA) appears to be significant, which is logical, since the increase in assets is associated with better resource utilization.

In Net Profit Margin, matters are more complex. The ESG variable did not prove statistically significant, which could be explained by the fluctuations in the operating income of the shipping sector. The profitability is strongly affected by external factors, such as freight rates or bunker prices, meaning that the impact of ESG is “covered up”.

In general, the results of the panel regressions reinforce the picture of that also emerged from the OLS. The adoption of ESG practices is associated with higher returns and better valuations, although the strength of the relationship varies depending on the variable used.

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Table 5: Panel Regression Result of Financial Performance on ESG

	Model 9 (ROE)	Model 10 (ROA)	Model 11 (NPM)
Constant	-4.821	1.345	-12.582
	(-0.71)	(0.80)	(-1.10)
ESG	0.4**	0.13***	0.507
	(2.15)	(3.01)	(1.60)
Control variables			
ΔlnTA	22.094**	14.877***	-19.425
	(2.45)	(3.81)	(-1.25)
NPM	0.049	0.07***	
	(0.90)	(3.19)	
ROA			0.423
			(1.37)
DE			
ΔNI			
Obs.	142	142	142
Clustered standard errors	Yes	Yes	Yes
R-squared (Within)	0.082	0.088	0.058
R-squared (Overall)	0.283	0.214	0.100
Model test statistic	3.509	37.621	2.435
Hausaman x2	15.143*** (0.002)	5.35 (0.148)	28.925*** (0)
Fixed/Random Effects	FE	RE	FE

Source: Authors' calculations

7.4 Interpretation & Comparison with Literature

The overall picture that arises from the results reveals stable and positive relations between ESG and financial performance of shipping companies. The findings are consistent with a wide range of literature, which has recorded similar positive correlations in several sectors. For example, the analysis of (Friede et al., 2015), found that the majority of empirical studies demonstrate a positive relation between responsible strategy and financial performance.

The finding that ESG indicators are positively correlated with profitability enhances the opinion that responsible practices are not only a compliance cost but also a driver to improve operational efficiency. This is aligned with the study of Ioannou and Serafeim, (2015), which highlights the importance of non-financial investments for the competitiveness of businesses in the long run.

The results for valuation are also particularly interesting, where positive and statistically

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significant correlations show that capital markets reward companies that adopt sustainable strategies. This is in line with the results of Chava, (2014) and Khan et al., (2016), who indicate that investors conceptualize ESG as an indicator of lower risk and higher prospects.

On the other hand, the weaker and statistically insignificant relationship between ESG and Net Profit Margin reflects a variation that has also been discussed in the literature. Many studies such as that by Auer and Schuhmacher, (2016) have found that in industries with high cost volatility (such as shipping), the effect of ESG on operating performance can be weaker or covered up by other factors.

Eventually, the negative correlation between ESG Controversies and profitability and value of the firms is in complete agreement with the studies by (Christensen et al., 2021; Krüger, 2015), which evidence that negative events affect the reputation and result in immediate economic consequences. In summary, the findings of this study support the view that responsible practices can be used as a source of competitive advantage for shipping companies; however, but with variations depending on the financial indicator under consideration.

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Chapter 8: Discussion & Conclusion

8.1 Key Findings & Implications for Investors & Shipping Companies

The study clearly reveals that ESG indicators have a significant correlation with the financial performance of NYSE-listed shipping companies. The results of both linear and panel regressions highlighted three key findings.

Primarily, the positive and statistically significant relationship between ESG, ROA and ROE indicate that companies that invest in sustainable practices manage to utilize more effectively their assets and achieve higher returns. In a practical point of view, this means that sustainability is not only a regulatory or social obligation but also translated into operational efficiency and improved financial performance.

Next, the positive correlation of ESG with valuation metrics such as Market Value indicates that capital markets value responsible strategies. Investors seem to reward shipping companies that adopt ESG practices, as they happen to be less exposed to risks and better adapted future challenges. In other words, the market "premiums" sustainability not only due to risk minimization but also because of future profit opportunities.

The ESG Controversies record a negative and statistically significant impact suggesting that negative events, such as environmental disasters or compliance failures affect both the reputation and financial performance of shipping businesses. This is a clear warning for the firms that avoidance of serious negative events is equally important as the adoption of ESG initiatives.

As for the investors, these findings have a practical implication. The integration of ESG into investment strategies is not only a moral issue but can also be a lever of performance prediction and risk management. Especially in sectors under high cyclicity -like shipping- selecting companies with high ESG performance can improve the risk-to-return ratio of the portfolios.

For shipping companies, the results show that sustainability can be a driver of competitive advantage. Focusing on environmental, social and governance matters is no longer a choice but a necessary strategy. At a time when regulations (e.g., EU ETS, CSRD) are becoming stricter and investors demand more, firms that respond in a timely manner are more able to secure financing under better terms and enhance their reputation in the global markets.

8.2 Theoretical & Practical Contributions

While the study contributes both in a theoretical and a practical manner, considering the theoretical view, the results support that ESG performance can be explained through the lens of stakeholder theory, where businesses respond to the needs of their stakeholders benefit from better long-term results. At the same time, findings are connected to the Resource-based view, which indicates that ESG planning can become a resource that drives a strong competitive advantage. Thus, the study confirms that the shipping sector follows the trends, despite its particularities.

On the practical front, the contribution is double. On one hand, offering to shipping managers empirical evidence that sustainability can increase the performance and the value of the companies. As a result, firms are encouraged to invest more in projects like emission reduction, transparency and social responsibility. On the other hand, it provides analysts and investors with a clear basis for ESG metrics as part of firm screening.

Furthermore, the study offers evidence that could also be used by regulatory authorities. Thus, the improvement of transparency and ESG reporting is not only a compliance issue but also a mechanism of value creation. For industries like shipping, that effected by external factors these findings have social dimensions as better corporate behavior leads to fewer social and environmental impacts.

8.3 Limitations of the Study

Even though the study provides useful evidence, there are some limitations that must be considered. To begin with, the data sample includes only shipping companies listed on NYSE. This means that the results reflect this specific part of the market and could not be completely in line with other geographical regions or non-listed companies. Additionally, the data was collected exclusively using the LSEG Datastream platform and despite its reliability, differences could appear in several calculation methods of ESG scoring between providers, leading to possible discrepancies. The use of specific regression models can also be a limitation, because if more complex models were used, the results could be different. Finally, the study evaluates data for a specific period of time. A shorter or longer period could also lead to different results.

8.4 Future Research Directions

Considering the previous discussion, there is ample scope for future research. One possible extension would be the expansion of the analysis to other markets or geographical regions, as well as comparisons across different ESG score providers, in order to further assess the robustness of the results. In addition, the use of more advanced econometric techniques could help capture deeper and potentially non-linear relationships. A qualitative dimension, through case studies of pioneering firms, could also provide valuable insights into how ESG strategies are implemented in practice. Furthermore, future research could explicitly address potential reverse causality between ESG performance and financial outcomes, by examining whether firms with lower profitability or tighter margins are less inclined to invest in ESG initiatives. Finally, the timing of ESG disclosure deserves closer attention. Analyzing when firms begin ESG reporting, as well as how the length of their reporting history affects performance, could shed light on learning effects, signaling mechanisms, and reputational dynamics over time

To conclude, this research demonstrates that ESG performance is not a minor indicator but is closely related to the profitability, effectiveness and valuation of shipping companies. In an industry that is at the forefront of global environmental and regulatory pressures, sustainability is not only an obligation but an opportunity. The findings suggest that responsible strategies can be used as driver of competitiveness, while opening the way for further study and implementation of practices that bridge sustainability with financial performance.

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Appendices

Table A1: Linear Regression Non-Statistically Significant Result of Financial Performance on ESG

	ΔNI	ΔlnTA	BETA
ESG	1088.902	-0.002	-0.003
	(0.3)	(-1.64)	(-0.92)
Obs.	152	152	174
R-Squared	0.001	0.018	0.005
F-statistic	0.088	2.701	0.852

Notes: t-statistics in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.

Table A2: Linear Regression Non-Statistically Significant Result of Financial Performance on ESG Pillars

	ROA	ROE	ΔNI	ΔlnTA	MV	NPM	BETA	DE
ENV	0.129***	0.298***	2439	-0.002	516.928***	0.279*	-0.002	1.759**
	(3.47)	(3.67)	(0.73)	(-1.98)	(4.81)	(1.93)	(-0.62)	(2.4)
Obs.	176	175	152	152	175	164	174	176
R-Squared	0.065	0.072	0.004	0.025	0.118	0.022	0.002	0.032
F-statistic	12.058	13.441	0.530	3.914	23.121	3.706	0.381	5.777
GOV	0.065**	0.179***	-1783.06	-0.001	365.043***	0.087	-0.004*	0.048
	(2.23)	(2.86)	(-0.72)	(-1.02)	(4.47)	(0.78)	(-1.66)	(0.09)
Obs.	176	175	152	152	175	164	174	176
R-Squared	0.028	0.045	0.003	0.007	0.104	0.004	0.016	0.000
F-statistic	4.975	8.175	0.519	1.038	20.011	0.615	2.771	0.007
SOC	0.144***	0.404***	1993.85	-0.001	852.982***	0.345	0	1.351**
	(4.37)	(5.82)	(0.67)	(-1.04)	(2.69)	(2.69)	(-0.03)	(2.03)
Obs.	176	175	152	152	175	164	174	176
R-Squared	0.099	0.164	0.003	0.007	0.398	0.043	0.000	0.023
F-statistic	19.115	33.849	0.453	1.076	114.333	7.261	0.001	4.133
ESGCON	-0.036	-0.341**	-1732.7	0.001	-1609.655***	-0.237	-0.002	-1.939
	(-0.55)	(-2.44)	(-0.31)	(0.43)	(-10.98)	(-0.99)	(-0.5)	(-1.55)
Obs.	176	175	152	152	175	164	174	176
R-Squared	0.002	0.033	0.001	0.001	0.411	0.006	0.001	0.014
F-statistic	0.305	5.938	0.096	0.181	120.508	0.971	0.247	2.395
ESGC	0.178***	0.443***	585.943	-0.002*	782.515***	0.358**	-0.003	1.536*
	(4.25)	(4.91)	(0.15)	(-1.68)	(6.79)	(2.17)	(-0.96)	(1.82)
Obs.	176	175	152	152	175	164	174	176

R-Squared	0.094	0.122	0.000	0.019	0.211	0.028	0.005	0.019
F-statistic	18.102	24.074	0.024	2.839	46.135	4.715	0.917	3.322

Notes: t-statistics in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.

Table A3: Panel Regression Result of Financial Performance on ESG (Non-used effects models)

	Model 10 (ROE)	**Model 11 (ROA)**	**Model 12 (NPM)**
Constant	-6.375	-1.101	-5.661
	(-1.81)	(-0.33)	(-0.87)
ESG	0.413**	.208**	0.21
	-4.55	2.24	1.22
Control variables			
ΔlnTA	35.756**	11.864***	-6.97
	(-4.37)	(2.64)	(-0.46)
NPM	0.144	0.037	
	(3.11)	(1.37)	
ROA			0.935***
			(3.08)
DE			
ΔNI			
Obs.	142	142	142
Clustered standard errors	Yes	Yes	Yes
R-squared (Within)	0.074	0.099	0.033
R-squared (Overall)	0.283	0.214	0.1
Model test statistic	54.402	4.342	14.225
Hausaman x2	15.143***	5.35	28.925***
	(-0.002)	(-0.148)	(0)
Fixed/Random Effects	RE	FE	RE

Notes: Robust standard errors are clustered at the firm level. t–statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.