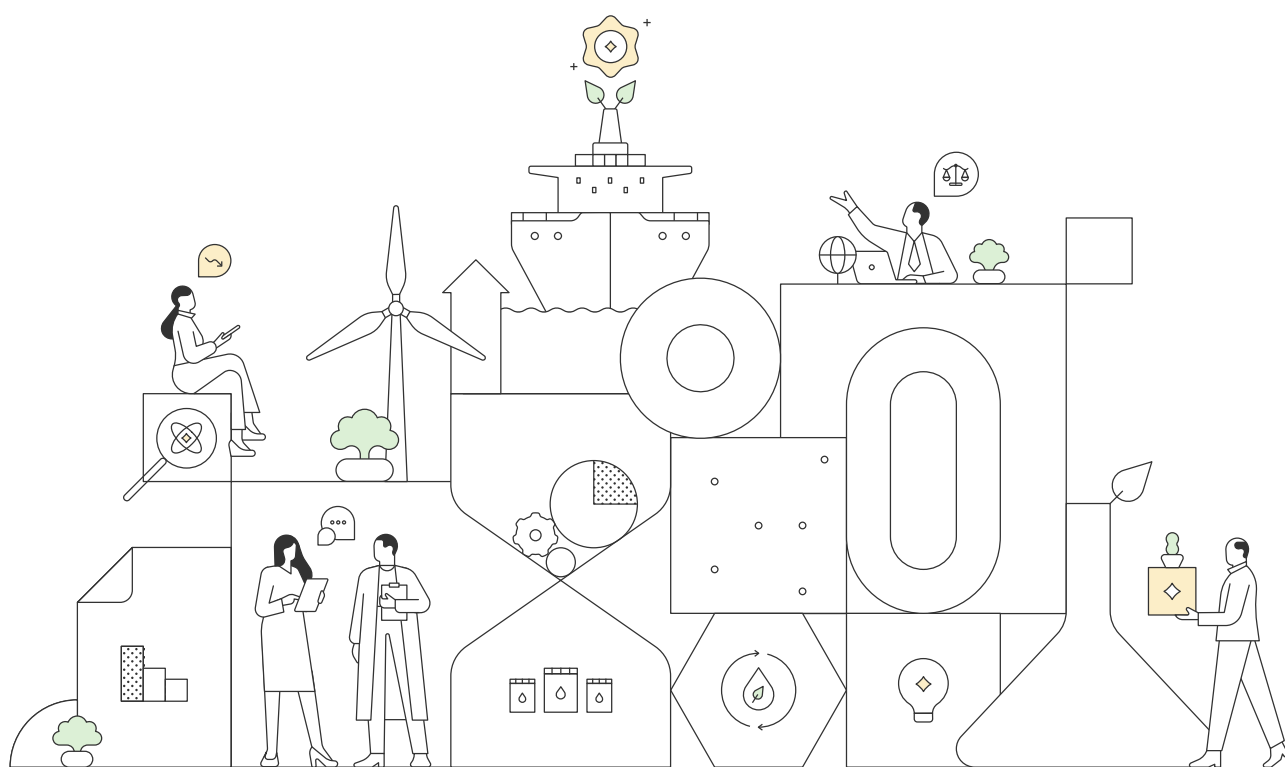


Ready, set, decarbonize!

Are shipowners committed to a net zero future?

Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping



01 Executive Summary4

02 Setting the Scene: Decarbonization in the Maritime Sector4

 Shipping and the Global Effort to Achieve Net Zero 4

 Emissions Regulations at the International Maritime Organization (IMO) 5

 A New Resolve to Decarbonize the Maritime Sector at COP26 5

 Decarbonization Reporting in the Maritime Industry 6

03 Data and Methods: Measuring Maritime Decarbonization.....8

 Data 8

 Methodology 9

04 Results: 2022 Industry Decarbonization Assessment Pledges 10

 Disclosures 12

 Strategies 14

 Actions 16

05 Conclusions and Recommendations 17

06 References 19

Appendix A.1 - Top 30 Tanker Shipowners..... 21

Appendix A.2 - Top 30 Bulk Shipowners..... 22

Appendix A.3 - Top 30 Container Shipowners..... 23

Appendix A.3 - Top 30 RORO and Car Carrier Shipowners..... 24

Appendix B – Highlighted Actions of Eight Shipowners 25



List of Abbreviations

CAPEX	Capital Expenditure
CCS	Carbon Capture and Storage
CDP	Climate Disclosure Project
CRSD	The European Union's Corporate Sustainability Reporting Directive
DCS	International Maritime Organization's Data Collection System
DWT	Deadweight tonnage
ESG	Environmental, social, and governance
EU ETS	European Union Emissions Trading System
EU MRV	European Union regulation for the monitoring, reporting and verification of CO2 emissions from maritime transport
GHG	Greenhouse gas
GHGP	Greenhouse Gas Protocol
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
ITS	Industry Transition Strategy report from the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping
LNG	Liquefied natural gas
NRFD	Non-Financial Reporting Directive
RORO	Roll-on / roll-off ships are designed to carry wheeled cargo (e.g., cars, trucks, trailers)
TCFD	Task Force on Climate-Related Financial Disclosures
UN	United Nations
USD	United States Dollar



01 Executive Summary

As global ambitions to reduce emissions and avoid the worst impacts of climate change intensify, pressure is mounting to achieve meaningful emissions reductions in the global maritime sector. A series of commitments, declarations, and pledges aimed at decarbonizing the maritime industry have been made in recent years by public and private actors. However, the true test of progress will be within shipping companies themselves.

This study examines top shipowner's commitment to decarbonization to understand:

- the prevalence of emissions reduction pledges;
- the transparency of climate impacts and decarbonization measures;
- if pledges are consistent with reported strategies and actions.

The assessment draws on published decarbonization ambitions and actions of the largest companies by owned capacity in tanker, bulk, container, and RORO / car segments. Through a desktop study conducted in February 2022 of data in the public domain, we assess decarbonization pledges, disclosures, strategies, and actions for 94 companies as a representation of the industry and find the following key takeaways.

- Of all companies assessed, only 35% have a clearly expressed emissions target to be net zero by 2050 or sooner and/or have committed to IMO targets.
- The container segment shows the highest levels of ambition with 16 of the 30 largest firms in the segment having set emissions targets (53%). This translates to 69% of the total container maritime fleet capacity (in owned deadweight tonnage).
- Of firms with net zero 2050 pledges, the division between publicly traded and private/state-owned shipping companies is roughly equal, which points to factors beyond shareholder pressure and mandatory reporting driving pledges.
- Only 36% of assessed firms have a sustainability report. Four companies without pledges have a sustainability report while almost all with pledges have a sustainability report. However, even many pledging companies lack emissions data from previous years as well as Scope 2 and 3 data.
- Of all firms, 31% identified a fuel strategy, largely overlapping with pledges. LNG is the most often mentioned fuel overall and ammonia is the most often mentioned alternative fuel. Many opt for a fuel strategy that includes both LNG and alternative fuels.
- Offsets (carbon reduction is the process of directly reducing emissions while offsets employ credits that fund external projects such as forestry to reduce emissions) are used by a low number of firms (4%) as a strategy to lower carbon emissions.
- For eight companies with net zero 2050 ambitions and a standardized disclosure to CDP, an average of 9 million USD was invested in the previous year on

decarbonization, representing an average of 2% of capital expenditures and 8% reduction in emissions.

Companies in the study with decarbonization pledges were largely found to have higher levels of reported emissions disclosure, decarbonization strategies, and related actions. Firms that implement comprehensive reporting can gain greater visibility into climate-related risks and opportunities, distinguish true climate action from green washing, and attract capital from a growing number of investors interested in the green transition. Based on our findings we make recommendations for firms and regulators to achieve a higher bar for decarbonization reporting:

Key Recommendation: Companies should set emissions reductions targets, preferably aligned with a net zero ambitions for 2050 or sooner, and back up pledges with comprehensive sustainability reporting including: strategies, GHG emissions reporting, and progress through actions.

Key Recommendation for Regulators: Government regulators should implement (or strengthen) mandatory reporting requirements of climate-related impacts subject to third party auditing. Requirements should rely on global standards to increase comparability and avoid creating additional reporting burdens.

The state of decarbonization in the maritime industry shows that while real progress has been made, there is a long way to go for the industry to reach net zero within the limited time left to transition. Accessible reporting with detailed emissions data observed among leaders within the industry, must become commonplace to set an industry-wide trajectory towards net zero by 2050 or sooner.

02 Setting the Scene: Decarbonization in the Maritime Sector

Shipping and the Global Effort to Achieve Net Zero

In 2015, 192 countries adopted the Paris Agreement and together committed to avoid the worst impacts of climate change by limiting global warming to well below 2°C, with further efforts to limit global temperature rise to 1.5°C. Driven by a recognition of the scale of potential economic, political, and social damages, governments at all levels have committed to reduce greenhouse gas (GHG) emissions. In 2021 pledges to



achieve net zero¹ by 2050 or sooner reached 70% of the global economy in GDP².

While on a per-good basis shipping is a more fuel-efficient means of transport than road or aviation, 80% of global trade by volume occurs on maritime vessels³. Therefore, the sector accounts for ~3% of global emissions⁴, similar to aviation, and roughly equivalent to the combined oil demand of France, Germany, and the UK combined⁵. The sector's share of global emissions could grow to between 5% and 8% of global emissions by 2050 as other sectors such as road transport decarbonize at a faster pace⁶.

High costs and lack of availability have thus far made alternative fuel sources out of reach for most companies⁷. Bringing down costs will require active coordination between public and private sectors. In 2018 the International Maritime Organization (IMO)⁸ took the first steps in regulating emissions in the shipping sector.

Emissions Regulations at the International Maritime Organization (IMO)

Shipping was not mentioned within the text of the 2016 Paris Agreement. To fill the need for an international climate goal for the shipping sector, the IMO adopted a strategy designed to reduce emissions from the shipping sector and phase out GHGs, "as soon as possible"⁹. The 2018 Initial IMO GHG Strategy sets the following targets for international shipping.

1. **The IMO Intensity Target:** to reduce carbon emissions intensity (per transport work), across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008 levels.
2. **The IMO Absolute Target:** to start to reduce GHG emissions from international shipping as soon as possible and reduce total annual GHG emissions by at least 50% by 2050 compared to 2008, whilst pursuing efforts towards phasing them out.

Many in the industry have called for higher ambition, particularly around the 2030 intensity target¹⁰. For example, the baseline year, which dictates the pace and magnitude of progress, was set for 2008 when GHG intensity was 22% higher than in 2018 when the strategy was adopted, giving greater latitude to shipping companies¹¹. Furthermore, a low intensity target aimed at lowering vessel emissions per unit and distance, has the potential to reward vessels that travel longer distances without a full load of cargo, incentivizing more voyages and possibly

increasing total GHG emissions¹². Introducing more ambitious intensity targets can lower onboard fuel consumption and, therefore, lower the total cost of ownership between conventional and alternative fuel vessels. However, intensity targets will not address the cost gap between conventional and alternative fuels.

There is progress within the IMO on technical capacity to support higher efficiency through various work programs that aid member states to implement knowledge transfers to shipping companies¹³. Efforts are also underway to improve lifecycle analysis for various alternative fuels, including emissions calculations that include the full fuel production chain, known as 'well-to-wake'. This can ensure IMO regulations don't punish alternative carbon containing fuels such as methane or methanol¹⁴. However, despite the efforts of a coalition of 14 countries to strengthen IMO targets¹⁵, a net zero 2050 target or market-based measures such as a global carbon tax are unlikely in the near-term due to consensus voting requirements at the IMO. More work will need to be done to build the implementation plan for such measures and to lay out a safe and just transition that also addresses concerns of developing nations.

A New Resolve to Decarbonize the Maritime Sector at COP26

As the pivotal meeting for global action on climate change, the 26th Conference of Parties (COP26) was successful in reaffirming the legitimacy of the Paris Agreement and setting a course for higher global ambitions. Within the maritime industry, it can further be argued that COP26 was a significant step forward with a greater sense of urgency and shared responsibility than has been seen before. An important shift occurred through multiple government-led maritime declarations announced in the weeks before and during the conference, pointing to a growing alignment between regulation, climate science, and industry. Declarations included:

- the **Declaration on Zero Emission Shipping by 2050**, where signatories pledge to work at the IMO to establish a zero-emission target for international shipping;
- the **Dhaka-Glasgow Declaration** in which 55 governments called for the IMO to establish a mandatory GHG levy on international shipping;
- the **Clydebank Declaration**, in which 22 governments from six continents committed to working together to establish green shipping corridors; and

1 The term 'net zero' is defined by the IPCC as a balance between emissions and removals from human activity.

2 IEA 2021.

3 UN Conference on Trade and Development 2019.

4 IMO 2021.

5 Victor, Geels, and Sharpe 2019.

6 Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping 2021.

7 IRENA 2021.

8 The IMO is a UN agency that sets global standards related to safety, security, and environmental performance for international shipping.

9 IMO 2022a.

10 Carlsen 2020.

11 Rutherford 2020.

12 Wang, Psarafis, and Qi 2021.

13 IMO 2022b.

14 Unlike alternative fuels such as ammonia where combustion does not produce CO₂, methanol has positive emissions in combustion that are balanced by negative emissions in the growth of biomass feedstocks.

15 Abnett, Saul, and Filks 2021.



- the **First Movers Coalition** for hard-to-abate sectors with cargo owners committing to shipping 10% of their cargo using zero-emission fuels by 2030, and shipowners and charterers committing that 5% of fuel use will be zero emissions by 2030.

In the last few years decarbonization has become a top priority for shipping companies. A 2020 survey by the Global Maritime Forum found that shipping companies consistently rank decarbonization as one of the top issues that will impact the industry in the next ten years¹⁶. The maritime industry's commitment to net zero GHG emissions could catalyze system-wide change, including large-scale investment in new fuels and improved energy efficiency. Bold commitments to decarbonize the sector can in-turn significantly impact most firms' Scope 3 emissions and put into motion a ripple effect that resonates across global supply chains.

Ambitions set by coalitions of public and private actors are an important first step to initiate policy changes and guide corporate transitions. However, ambitions must be followed by immediate action to achieve global climate goals. The ultimate test of the impact of global pledges is how they play out within shipping companies themselves.

Decarbonization Reporting in the Maritime Industry

Setting time-bound pledges is the first step toward achieving decarbonization. Accountability toward meeting abatement targets requires companies to disclose progress on emissions as well as near-term strategies, and actions. At present, decarbonization reporting in the maritime industry is guided by several mandatory and voluntary frameworks, some of which are publicly available while others have only limited accessibility.

Fuel Consumption and Emissions Reporting

The IMO Data Collection System (DCS) and the EU's monitoring, reporting and verification (MRV) regulation are mandatory measures for fuel and emissions reporting. Both systems have been mandatory since 2017 (MRV) and 2019 (DCS) and are sited as some of the most consequential initial steps toward decarbonization in the maritime industry¹⁷. The MRV data is publicly accessible while focusing on CO₂ emissions to, from and within the EU. The DCS establishes the same for global voyages but lacks the same level of transparency as data is anonymized and aggregated across the industry before shown to the public. There are also questions surrounding the use of emissions calculations and potential underestimation¹⁸.

Further strengthening and transparency of individual fuel consumption and emissions from public disclosures such as IMO and EU could potentially become powerful tools to increase abatement target setting and accountability across the maritime value chain¹⁹.

Government Mandated Sustainability Reporting

Governments are increasingly implementing mandated reporting requirements for publicly traded companies. The Non-Financial Reporting Directive (NFRD) in EU law²⁰ requires publicly traded companies with more than 500 employees to disclose information on sustainability. A proposed amendment to the NFRD, the Corporate Sustainability Reporting Directive (CSRD), would extend requirements to all companies listed on regulated markets (over 49,000 firms)²¹. Current proposals include audited GHG emissions disclosures and life cycle calculations²².

Outside the EU, mandatory GHG reporting schemes have been in place for several governments where shipping companies are headquartered including Korea, the UK, Japan, and the US²³. The number of governments with mandates and the scope of regulation is growing. Publicly traded US companies may soon be required to prepare auditable ESG reports including GHG emissions by the Securities and Exchange Commission in a federal rule under consideration²⁴. New mandatory disclosure requirements are expected in Japan²⁵ and South Korea²⁶. In addition to governments, stock exchanges are also a driver of emissions reporting including the Singapore stock exchange²⁷, and the Shanghai (SSE) and Shenzhen (SZSE) stock exchanges in China²⁸.

In summary, government mandated reporting requirements have not fully solved the problem of needed transparency in the maritime industry. Auditing mechanisms are largely underdeveloped and could benefit from globalized assurance standards for third-party auditing to guarantee the relevance, consistency, and credibility of reports²⁹. Further, mandated reporting is typically only required for publicly traded companies. This excludes a large share of the maritime fleet which is private or state-owned.

Voluntary Reporting Standards and Frameworks

Where reporting is not required, the maritime industry is increasingly undertaking voluntary sustainability reporting in response to growing pressure from stakeholders³⁰. In the absence of globally regulated standards for emissions reporting,

16 GMF 2020.

17 Panagakos et al. 2019.

18 New requirements expected to go into effect in November 2022 include a carbon intensity indicator based on a ship's designed capacity instead of the actual tonnage shipped. Using designed capacity typically underestimates emissions as ships do not always sail with their full designed capacity.

19 Deane, Huggins, and Karim 2019.

20 European Parliament 2014, vol. 330.

21 European Commission 2021a.

22 European Commission 2021b.

23 OECD 2022.

24 MacMillan and Joselow 2022.

25 ESG Investor 2021.

26 Regulation Asia 2021.

27 SGX 2022.

28 OECD 2022.

29 He 2021.

30 Papandreou, Koundouri, and Papadaki 2021.



companies have turned to private standards³¹. The most widely accepted being the Greenhouse Gas Protocol (GHGP), built on the Kyoto Protocol’s definition of GHGs, it specifies calculation methods for Scope 1, 2, and 3 emissions³². While widely used private standards, like the GHGP, provide a degree of comparability, self-imposed reporting without a third-party regulator can be unsystematic and can lead to gaps in reported emissions³³.

In addition to reporting standards that provide methods for calculating emissions, privately developed frameworks guide companies on how to structure and present information. In response to growing pressure from investors, two commonly frameworks have been developed to standardize reported information on environmental risks including impacts and opportunities due to climate change (Table 1).

Publicly Available Reporting as a Measure of Maritime Decarbonization

As the industry transitions, true accounting of maritime decarbonization will require uniform and accurate measurement of emissions made available for public scrutiny. In addition, accountability requires companies to set targets backed by strategies and investment initiatives.

To assess the current state of the decarbonization transition in the absence of streamlined mandatory reporting requirements, we therefore turn to reporting by shipowners themselves. Public reporting can provide a snapshot of the industry and establish a baseline understanding of what is being promised.

In the following sections we outline the data collected, methodology for evaluation, and the results of the assessment as a measure of maritime decarbonization.

Table 1. Commonly Used Frameworks for Environmental Risk Reporting

Framework	Description
Carbon Disclosure Project (CDP)	<ul style="list-style-type: none"> - Widely used environmental disclosure platform, geared primarily toward investors, the database includes over 13,000 companies and 1,100 local and regional governments. The data is publicly available and was used to assess actions in this study. - The platform collects information through a standardized questionnaire on climate change, forests, and water security. Disclosures are assigned a letter grade by CDP based on quality and timeliness of the responses³⁴.
Task Force on Climate-Related Financial Disclosures (TCFD)	<ul style="list-style-type: none"> - Guidelines created following recommendations from G20 finance ministers and central bank governors to standardize reporting on climate-related risks. In 2021 over 2,600 companies “expressed support” for the TCFD. - The framework recommends disclosure on material risks and opportunities to which companies are exposed due to climate change. The recommendations cover four areas: governance, strategy, risk management, and metrics including emissions consistent with GHGP methodology³⁵.

31 Green 2010.

32 Scope 1 emissions are those that occur directly within the company’s operation; Scope 2 emissions are associated with the consumption of electric power; and Scope 3 emissions are those that occur from inputs or in the downstream use of the product.

33 Klaaßen and Stoll 2021.

34 CDP 2022.

35 TCFD 2021.



03 Data and Methods: Measuring Maritime Decarbonization

Data

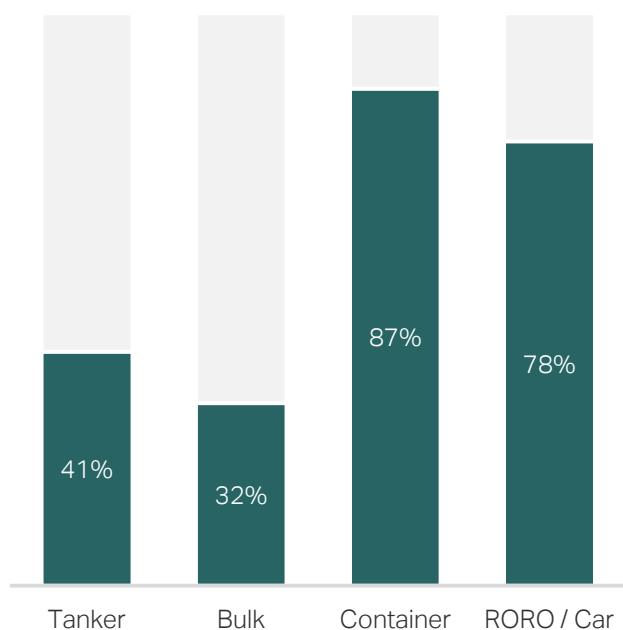
Top-30 in Four Segments

With 99,800 commercial ships of 100 gross tons and above spread across a large number of companies³⁶, it is beyond the scope of this report to evaluate all players. Hence, we zoom in on the 30 largest owners in each of four segments as a representation of the industry. The following segments were chosen for the assessment:

- the three largest emitters by tonnage sailed – tanker, container, and bulk; and
- a segment expected to be highly impacted by the transition in the auto industry – RORO and Car Carriers (hereafter, RORO / car).

Together the four segments³⁷ account for over 90% of the industry by ton-miles sailed and over 70% of international maritime CO₂-eq emissions³⁸.

Figure 1. Market Share of the 30 Largest Owners within each Segment (% of DWT)



The study focuses on the top-30 companies by owned fleet capacity in deadweight tonnage (DWT). The 30 largest shipowners make up significant majorities of total segment DWT in container (87%) and RORO / car (78%) and smaller shares of tanker (41%) and bulk (32%) segments (Figure 1).

Data Collection Period

Company information, including DWT, was collected from the Clarkson's Research Services³⁹ between November and December 2021⁴⁰. Data on pledges, emissions, strategies, and actions was collected from publicly available sources during the month of February⁴¹. These included sustainability reports, annual reports, press releases, and web pages. Therefore, if a firm published a report in 2021 which was updated with a press release in before the end of February 2022, the data from the press release was used.

For most firms, information was found within sustainability and/or annual reports. Most published reports were from 2021 with disclosures and strategies from the previous year. Shipping experienced a sharp decline during 2020 and 2021 due to the COVID-19 pandemic, therefore it should be noted that this may have impacted reported plans and actions⁴².

Companies are continuously making announcements and publishing new reports. Therefore, there is no clear cut-off date that can be used as a standard for assessing industry change and development. For this and future studies we therefore document the time of data collection and choose a cut-off date for comparison.

Characteristics of the Top-30 Companies

Of the Top-30 companies, 14 are represented in multiple segments (Figure 2). For the purposes of this study, when looking within segments, shipowners with fleets in multiple segments are considered distinct entities for each segment. When looking industry-wide, companies are counted only once for a total of 94⁴³.

36 UNCTAD / RMT 2021.

37 To provide a sense of the relative emissions for each segment, in 2020 the four segments had the following GtCO₂-eq: 0.28 (tanker), 0.24 (bulk), 0.29 (container), 0.06 (RORO / car)

38 Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping 2021.

39 Clarksons Research 2022. <https://www.clarksons.net/>

40 The top 30 shipowners by capacity from the November to December data collection period may not reflect the top 30 when pledge data was collected or at the time of publication














41 See Appendix A.1 – A.4 for collected data

42 UNCTAD / RMT 2021.

43 The data in DWT is specific to each segment, not a total across all segments.



Figure 1. Top-30 Shipping Companies Represented in Multiple Segments

Four Segments	Three Segments	Two Segments
 Mitsui O.S.K. Lines	 <ul style="list-style-type: none"> • Tanker • Bulk • Container 	 <ul style="list-style-type: none"> • Tanker • Bulk
	 <ul style="list-style-type: none"> • Tanker • Bulk • Container 	 <ul style="list-style-type: none"> • Tanker • RORO / Car
Fredriksen Group	 <ul style="list-style-type: none"> • Tanker • Container • RORO / Car 	 <ul style="list-style-type: none"> • Bulk • Container
	 <ul style="list-style-type: none"> • Bulk • Container • RORO / Car 	 <ul style="list-style-type: none"> • Bulk • RORO / Car
	 <ul style="list-style-type: none"> • Tanker • Bulk • Container 	 <ul style="list-style-type: none"> • Bulk • Container
	 <ul style="list-style-type: none"> • Bulk • Container • RORO / Car 	

The headquarters of the 94 companies is roughly equally distributed between Asia and Europe (Figure 3). Within Europe, Greece is home to the greatest number of top-30 companies (15), followed by Germany (7), and Norway (5). In Asia, Japan has the most shipping companies (15), followed by South Korea (7), and China (5). The seven shipowners in the group labeled as "Other", are in Canada (2), Bermuda (2), Saudi Arabia (1), USA (1), and Iran (1). Looking at ownership, there is a greater share of private companies (56 vs 38) but with no clear region that dominates either type (Figure 4). In this assessment state-owned enterprises are grouped together with private companies as they are both largely shielded from shareholder pressure and mandated reporting requirements.

Figure 3. Regional Distribution of Company HQs

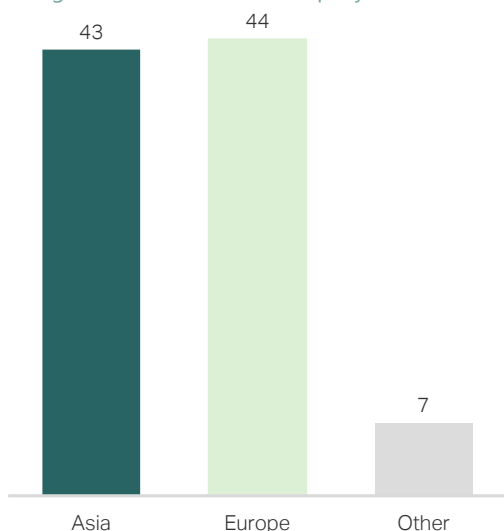
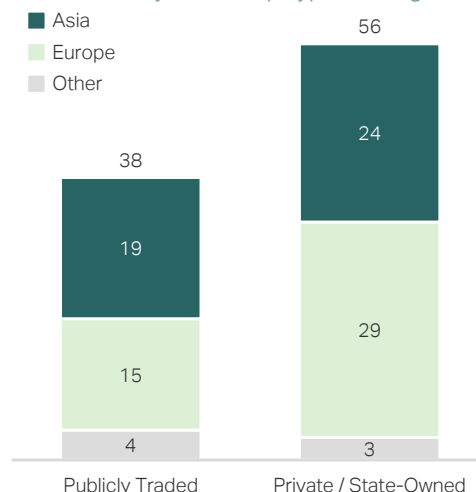


Figure 4. Distribution by Ownership Type and Region



Methodology

Decarbonization is assessed within four measures: pledges, disclosures, strategies, and actions (Figure 5). Within each measure there is a wide spectrum of implementation. Therefore, where possible, qualitative assessments are made as to the degree that measures are transparent, detailed, and have potential meaningful impact on decarbonization.

The data was collected from publicly available sources, primarily through reports published on company websites. If the information is kept internal, it is not reflected in the results. Further, the assessment does not attempt to verify emissions disclosures nor ensure that reported measures set a realistic path to achieve pledges. Instead, the data collected from available sources provides a snapshot of decarbonization in the industry. The results of this report can be used as a jumping off point for more critical analysis of reported decarbonization claims.

Figure 5. Data Collected to Assess Four Decarbonization Measures

Decarbonization Measures Evaluated	Data collected
Pledges: commitment to decarbonization	- Zero-emissions and IMO targets - Other short-, medium-, long-term targets - Unspecified decarbonization aim
Disclosures: accessible information on GHG emissions and climate-related risks	- Sustainability and emissions reporting - Environmental risk reporting
Strategies: methods to achieve decarbonization	- Alternative and low-carbon fuels - Offsets
Actions: investments and organizational transformations	- Green, environmental or sustainably-linked bonds/investments - Deep dive on eight companies with data from CDP



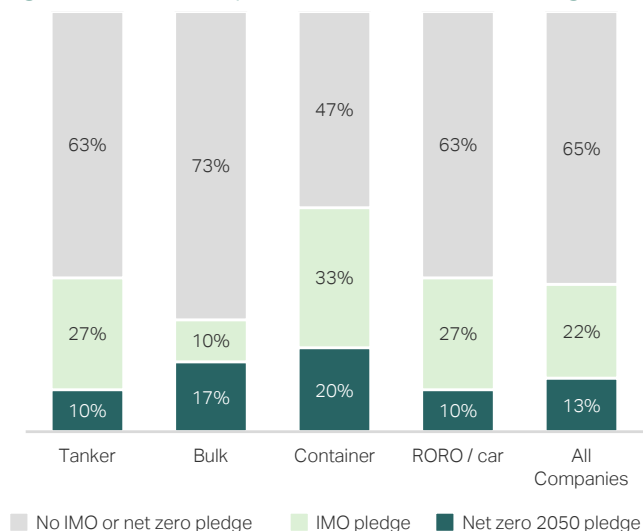
04 Results: 2022 Industry Decarbonization Assessment Pledges

Net zero 2050 and IMO decarbonization pledges

Shipping companies make a wide range of pledges at various levels of ambition and detail. Here, a firm's explicit commitment to the highest pledge is accounted for. Therefore, firms that expressed both a net zero 2050 as well as an IMO target are included once for the highest ambition pledge – net zero 2050.

Looking across the total 94 top-30 companies (firms in multiple segments are counted once), 33 companies (35%) made an IMO or net zero 2050 decarbonization pledge (Figure 6). Of those with a pledge, 12 firms' highest ambition was net zero by 2050 or sooner, and 21 additional firms committed to the Initial IMO GHG Strategy 2030 and 2050 targets. The remaining 61 companies (65%) did not publish time-bound pledges in line with the IMO or net zero 2050.

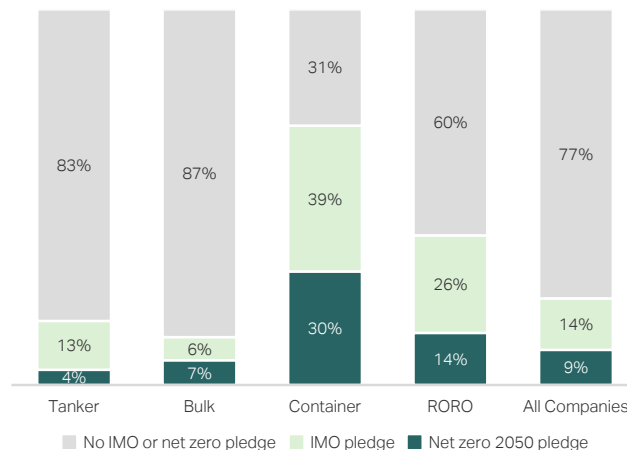
Figure 6. Share of Companies with Decarbonization Pledges



Note: The 'IMO target' indicates the company's highest ambition is to achieve the Initial IMO GHG Strategy for 2030 and 2050. The 'net zero 2050' pledge indicates a public commitment to achieve net zero emissions by 2050 or sooner.

Looking across segments (Figure 6), the container segment has the highest level of ambition, with 53% of companies setting IMO or net zero 2050 targets. Container also has the highest share of net zero pledges (20%). Bulk has the lowest percentage with pledges (27%), however, of the firms with pledges, most have net zero 2050 commitments. In contrast, only 10% of both tanker and RORO / car companies have net zero 2050 pledges.

Figure 7. Pledging Companies Share of total Segment Capacity



Translated to shares of total segment capacity in DWT (Figure 7), the 16 container companies with pledges account for 69% of the full segment fleet. The relative size of pledging container companies and their share of the overall segment fleet implies that the 16 companies with pledges can have high impact on overall container segment emissions. This is also true for RORO / car where eight companies with pledges make up 40% of total segment capacity.

In contrast the 37% of tanker and 30% of bulk companies with pledges represent only 17% (tanker) and 13% (bulk) of segment capacity. For tanker and bulk, action across a greater number of companies will be needed for a significant impact on emissions within each segment.

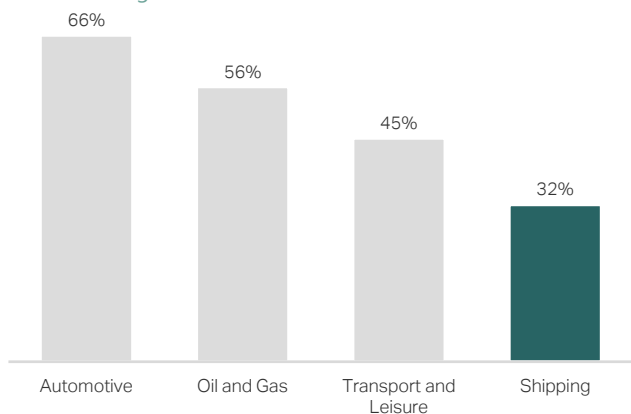
A comparison with other industries suggests that 35% of shipping companies with IMO or net zero 2050 pledges is low⁴⁴. A 2020 KPMG report looking at top-100 companies by revenue in 52 countries across industries, found that 66% of automotive, 56% of oil and gas, and 45% of transport and leisure companies had sustainability reports with carbon reduction targets⁴⁵ (Figure 8). In comparison, only 32% of companies in this study had both a decarbonization pledge and sustainability report. The maritime industry, it would seem, is behind. However, among those with pledges, there are those with high ambitions to achieve net zero before 2050⁴⁶.

⁴⁴ Companies that pledge to achieve IMO targets and have an unspecified net zero target date or a net zero target later than 2050, have only been counted as having an IMO target.
⁴⁵ KPMG 2020.

⁴⁶ For example, Berge Bulk has committed to net zero by 2025, and A.P. - Moller Maersk has established a net zero 2040 target.



Figure 8. Sectoral Comparison of Sustainability Reporting + GHG Reduction Targets



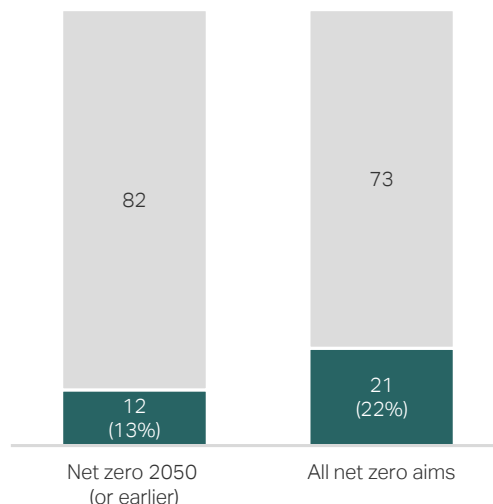
Note: Data on three additional sectors taken from a 2020 KPMG Survey of Sustainability Reporting of 52 top-100 Companies

A 2022 study that scrutinized the sustainability claims of 25 high-profile businesses with net zero targets, found that only three companies clearly demonstrated a path to eliminate 90% of their full value chain emissions⁴⁷. Therefore, even among the 35% of companies with decarbonization pledges, further scrutiny is necessary to ensure that commitments translate into action.

Unspecified net zero aims

This assessment finds that only 13% of the largest firms in the maritime industry have net zero 2050 targets. In contrast, a 2021 report assessing net zero targets in a sample across industries found that 21% of firms have time-bound net zero targets⁴⁸. However, if the 'net zero' definition is expanded in this assessment to shipping companies that state an ambition to fully decarbonize without a target date, the share of net zero companies increases to 23% of companies (Figure 9). While targets that lack timelines are less credible, they could indicate a first step towards a more ambitious decarbonization pledge. Alternatively, the use of terms such as "net zero" or "carbon neutral" in sustainability and annual reports without time-bound commitments, could be an attempt to appear ambitious while avoiding accountability.

Figure 9. Change in Share of Net Zero when Definition Includes Companies with No Target Date



Short-term interim targets

In order to be on track to meet midcentury targets, it is imperative that companies set near-term goals in line with longer-term targets. A delay in planning and implementing technology transitions by shipping companies could add significantly to the costs of decarbonization⁴⁹. In the 2018 Initial IMO GHG Strategy, the IMO defined short-term measures as between 2018 and 2023, mid-term between 2023 and 2030, and long term as 2030 and beyond. Drawing on the IMO definitions and counting a firm's nearest term target, only two firms in this assessment commit to short-term emissions targets (2%), and three additional firms committed to medium-term targets (3%). Looking within the 33 companies with an IMO or net zero pledge, only one firm reports a commitment between now and 2023. The lack of short-term targets may point to low-levels of readiness for alternative fuel types. Even firms with high ambitions in the long-term lack short-term commitments. As corporate ambitions continue to evolve, future assessments should examine if short-term targets increase commensurate with the viability of alternatives.

Variation by region and ownership type

The location of a firm's headquarters does not appear to be strongly connected to the level of decarbonization ambition (Figure 10). While Europe has a slightly higher share of companies with net zero 2050 and IMO targets, no region clearly dominates pledges, suggesting that the incentives driving decarbonization in the maritime industry are global.

Turning to pledges by ownership type, a reasonable argument could be made that publicly traded companies facing higher disclosure requirements and more pressure from shareholders, will have more ambitious decarbonization pledges than both

47 Day et al. 2022.
48 Black et al. 2021.

49 Sanderson and O'Neill 2020.



private and state-owned companies. However, the 12 companies with net zero 2050 pledges are evenly divided between publicly traded and private/state-owned (Figure 11). For those with IMO pledges, there is a higher level of ambition among publicly traded firms (62% vs 38%), which may indicate higher pressure on publicly traded companies to comply with targets set by international regulators.

Figure 10. Share of Company HQ Regions by Decarbonization Pledge

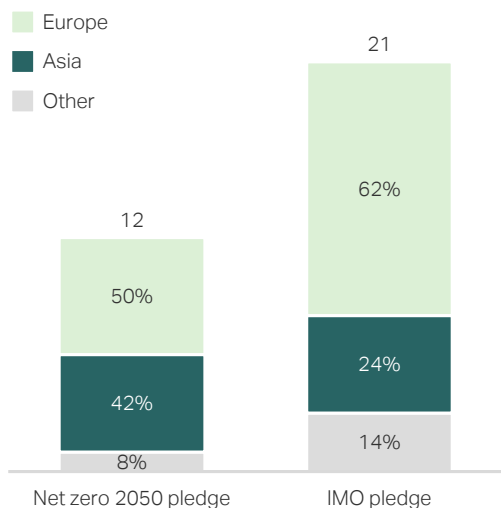
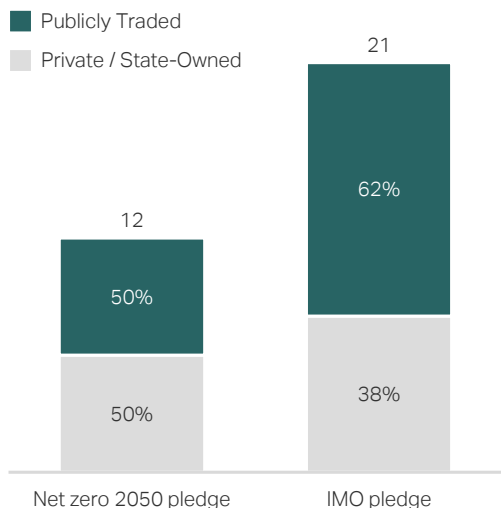


Figure 11. Share of Ownership Type by Decarbonization Pledge



Disclosures

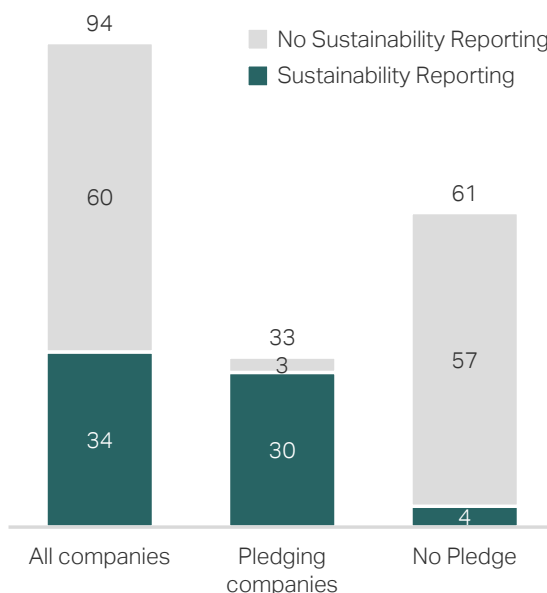
Sustainability and Emissions Reporting

On their own, pledges to decarbonize can be empty objectives that lack credibility unless accompanied by disclosures. The most important disclosure for decarbonization is GHG

emissions. Reporting emissions has the potential to encourage reductions in GHGs, enable firms to track progress over time, and allow for comparison with other firms⁵⁰. A commonly used method for disclosure of emissions as well as risks and opportunities due to climate change is through voluntary sustainability reporting.

Reporting appears to be confined to companies with decarbonization pledges (Figure 12). Of the 33 companies with published net zero or IMO pledges, 30 issued a standalone sustainability report or integrated the information into their annual report. Meanwhile, only 4 of 61 companies without pledges issued a sustainability report.

Figure 12. Sustainability Reporting by Pledge



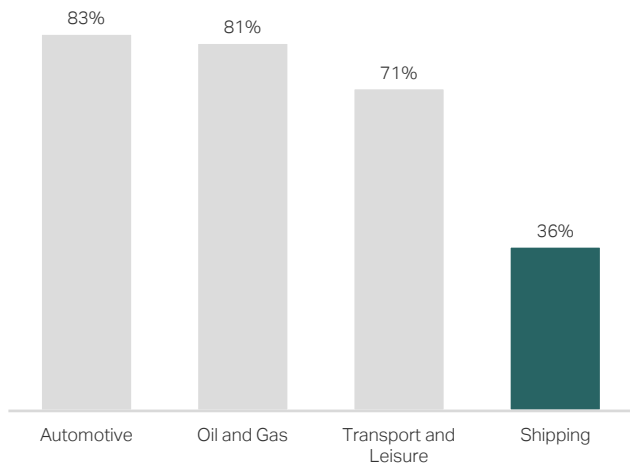
Looking across all companies in the study, only 36% published either a standalone or integrated sustainability report. As a comparison with other industries, a 2020 KPMG study⁵¹ that looked at top-100 companies by revenue in 52 countries, found that in the automotive sector, 83% issued sustainability reports (Figure 13). The share is similarly high for oil and gas (81%), and transport and leisure (71%). Relative to peer industries, the practice of issuing regular sustainability reports is still relatively limited within shipping.

50 LoPucki 2022.

51 KPMG 2020.



Figure 13. Sustainability Reporting Comparison to Study of Industry Peers



While most companies with pledges have sustainability reports, this doesn't translate to high transparency on emissions. Emissions disclosures were found to be limited to Scope 1, with few firms disclosing data on Scope 2 or 3 (Figure 14). Scope 3 emissions are particularly important to understand the full well-to-wake emissions of fuels. For example, upstream methane leakage and emissions from production and liquefaction can significantly increase the emissions profile of LNG⁵². Further, emissions disclosures should include previous years to allow for assessment of change over time. For those pledging to achieve the IMO 2030 and 2050 targets, emissions disclosure for the 2008 IMO reference year is necessary to evaluate a firm's progress. While most reporting companies provide two years of emissions data, very few go further back and only a small percentage (5%) of companies provide data for the IMO reference year (Figure 15). The lack of transparency on full Scope 1, 2, and 3 emissions along with historic emissions for comparison can create barriers, intentional or otherwise, to accountability.

Figure 14. Scope 1, 2, and 3 Emissions Reporting

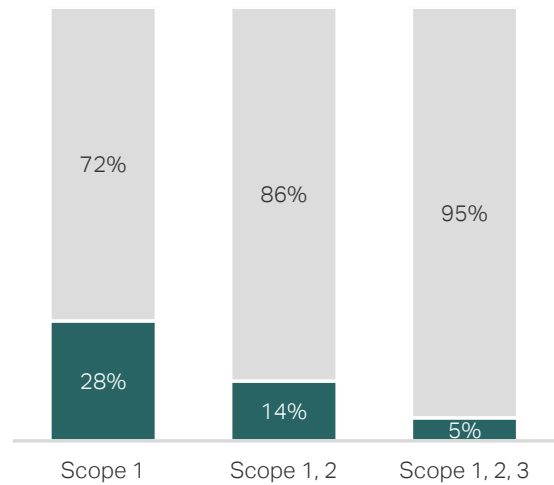
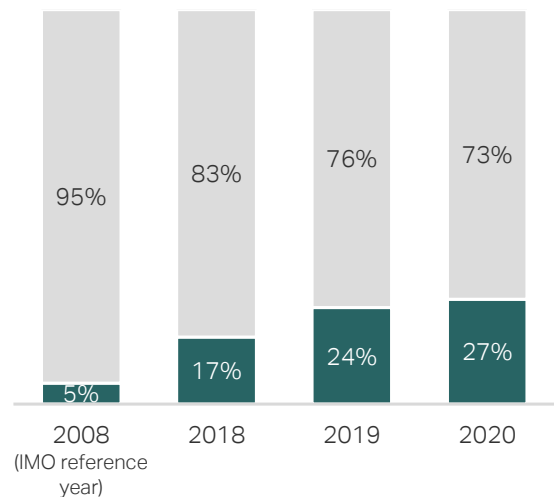


Figure 15. Emissions Reported for Previous Years



Environmental Risk Reporting

A new strand of public policies and private initiatives aimed at sustainable development is escalating pressure on companies to publish risks due to climate change. Investors are increasingly concerned about financial losses from climate change and firms that do not provide this information face higher costs of capital and investor skepticism⁵³. In this assessment two standardized, but voluntary, frameworks of environmental risk reporting are tracked – CDP and TCFD to understand the level of risk disclosure in the maritime industry. Across all companies only 15 implemented guidance from the TCFD framework and/or submitted CDP disclosures (Figure 16). The disclosures primarily occurred within companies with decarbonization pledges. Only one company without an IMO or net zero pledge conducted a CDP and TCFD disclosure.

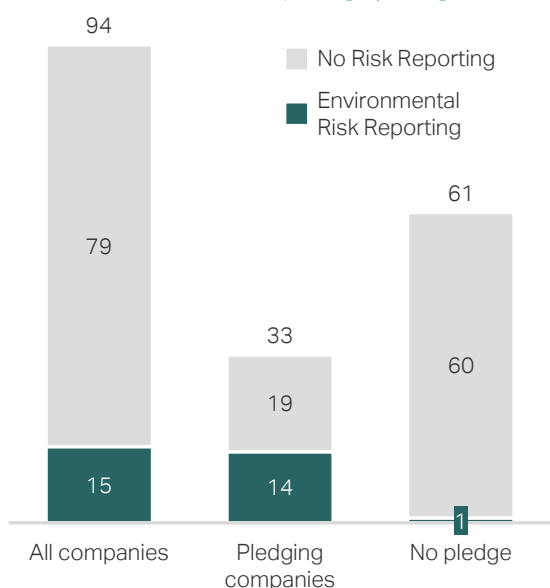
52 Jaramillo, Griffin, and Matthews 2007.

53 Bos and Gupta 2019; Fink 2020.



The low levels of risk reporting among top-30 companies indicates a lack of comprehension of the nature and underlying problems of climate-related risks. Within the few companies that report climate risks, guidelines are applied at varying degrees of precision and depth, making cross company comparisons a challenging task for investors. The low level of environmental risk reporting suggests that firms may face higher cost of capital and forego opportunities for green investment. For those that disclose environmental risks, efforts are likely to support cost savings and future growth opportunities⁵⁴.

Figure 16. Environmental Risk Reporting by Pledge



Strategies

Fuel strategies

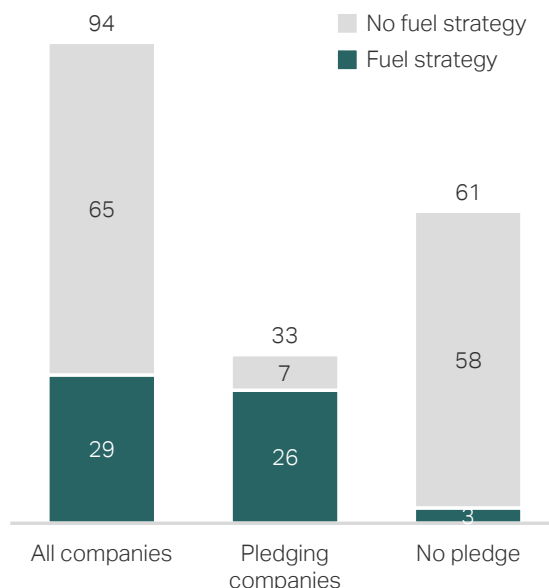
Transitioning a fleet of vessels and securing alternative fuels is a complex and expensive process that requires an enormous amount of time and resources dedicated to strategy. Vessels typically have 25-year lifetimes⁵⁵, therefore today's strategies will have far reaching consequences on the pace and scale of decarbonization. An assessment of strategies can provide a glimpse into the level of investments and a sense of the direction within the industry.

In an analysis of fuel strategies, mentions of fuels were tracked if found within publicly reported decarbonization strategies. Of all companies analyzed, 29 firms (31%) outline some level of a fuel strategy to reduce future emissions (Figure 17). Most firms cite LNG and/or biofuels in combination with alternative fuels in their decarbonization strategy. This confirms assertions from industry players that shipowners will hold off on exclusively investing in alternatives until there is greater convergence on one or multiple

fuel pathways⁵⁶. In future assessments, as alternative fuels come down in cost, the number of companies that focus only on alternatives should increase.

There is significant overlap between pledging companies and those with fuel strategies, indicating a recognition by firms that strategies increase the credibility of pledges. However, the low reporting of strategies across the industry may point to a general lack of decarbonization planning or an unwillingness to disclose the information.

Figure 17. Cited Fuel Strategies



Fuel pathways in the industry

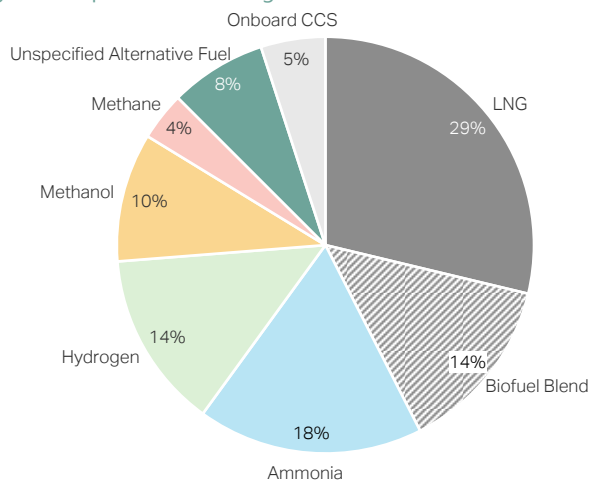
The outlook of the techno-economic model NavigaTE from the 2021 *Industry Transition Strategy*⁵⁷, showed that the industry's path to net zero is likely to involve multiple alternative fuels⁵⁸. Counting each time fuels, grouped by molecule, were mentioned in sustainability or integrated reports, the result shows a diverse set of fuel strategies (Figure 18).

54 Baresic et al. 2022.
55 Dinu and Ilie 2015.
56 GMF 2020.

57 Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping 2021.
58 See 2021 ITS Report: <https://www.zerocarbonshipping.com/>



Figure 18. Split of Fuel Strategies



All alternative fuel types in the 2021 ITS Report were mentioned by the 21 firms with fuel strategies, validating the multiple fuel path finding. Firms frequently mentioned multiple alternative fuel strategies, and often in combination with LNG, which was the most often mentioned strategy. Ammonia (including green and blue) was mentioned more than any other alternative fuel, followed by hydrogen, and methanol. Hydrogen is not considered a suitable fuel for deep sea shipping; however, it is an essential input to produce ammonia and methanol, therefore, the mentions of hydrogen can be interpreted as signs of an early-stage strategy for alternative fuels. Methane was mentioned by only three companies (7% of fuels mentioned) and always in the context of plans to transition LNG to a form of net zero methane.

In addition to fuels, six firms referenced an interest in alternative fuels without identifying a type ('unspecified alternative fuel'), and four mentioned onboard carbon capture and storage (CCS). While onboard CCS is not a fuel, the effect is a significant reduction of emissions⁵⁹. It represents a small but meaningful share (5%) and one that will be important to watch as the technology develops. The mentions of 'unspecified alternative fuels' represent 8% of all strategies mentioned, pointing to an early stage of strategy development for the six firms.

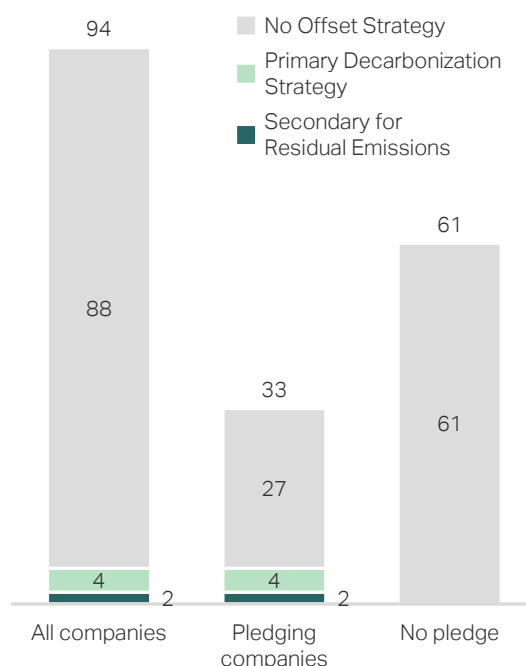
Offsets

Another strategy to reduce emissions is through a voluntary carbon offset market. The voluntary carbon offset market differs from compliance, or cap-and-trade schemes, enshrined in law, such as the EU ETS, which set a finite carbon budget and allow emitters to trade allowances. In this study, the voluntary offset strategies were tracked and further broken down into 1) offsets as a primary decarbonization strategy and 2) offsets as a secondary strategy reserved for residual emissions and to "bridge the gap". The first strategy is common in the airline⁶⁰, and

tourism industries⁶¹, and employs carbon credits as a direct means of reducing a company's carbon emissions. While the second strategy is one in which companies largely participate in offset programs reserved for emissions that cannot be eliminated with available technologies or for which the cost to abate is prohibitively high.

Carbon offsets are a popular tool for decarbonization given their ease of use and economic value as a commodity that has historically not been priced. Theoretically, the number of offset credits can grow as new projects are added to the market. But carbon offsets are not a panacea and there is a risk of companies being viewed as 'indulging' in polluting behavior and using offsets as a cover. The Science-Based-Target Initiatives (SBTi) does not allow offsets to count towards Scope 2 targets, and only permits the use of offsets once operational changes are implemented for Scope 1 emissions. Therefore, companies are increasingly encouraged to meet Paris Agreement targets without the use of carbon offsets.

Figure 19. Offset Strategies



To date, the maritime industry shows a relatively lower appetite for offsets as a strategy, supporting the view of the SBTi methodology. Only six companies (six percent) of all companies assessed mentioned any use of offsets, of which two stated that offsets would be used exclusively for residual emissions, in line with SBTi (Figure 19). Offsets were not mentioned by any company without a pledge⁶².

59 Luo and Wang 2017.
60 Guix, Ollé, and Font 2022.
61 Eijgelaar 2011.

62 Put in perspective, about 50% of the commercial airlines offset programs, See Dichter et al. 2020.



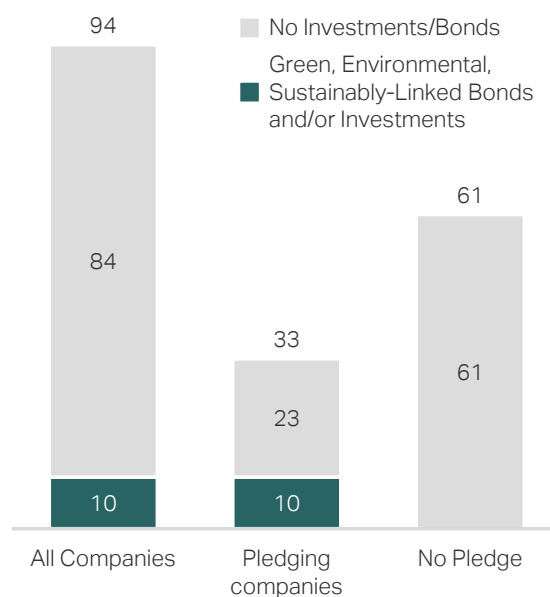
As pressure on shipping companies to decarbonize increases, it will be important to continue to track maritime offset behavior and the motivation behind decisions to purchase, or avoid, carbon credits. It is recommended that carbon offsets are not used as a primary tool for emissions reduction within the industry to achieve net zero.

Actions

Green investments and bonds

The true measure of a company’s progress on decarbonization is action, including a strategic approach to decarbonizing investments. However, at this early stage in the industry’s decarbonization transition, it proves challenging to assess at the industry level due to the low level of reporting and wide range of measures reported. Firms mentioned everything from the ordering of alternative fueled ships, to recycling efforts in corporate headquarters. As a first attempt to capture a snapshot of decarbonization action, data was collected on “green”, “sustainability-linked”, or “environmental” investments and bonds (Figure 20). Across all companies, only ten published information on such investments and/or bond types. All ten are within pledging companies but represent a small share of those with ambitions (30%). It would appear from this high-level analysis that actions on decarbonization remain low, alternatively, companies are not forthcoming about investments or bonds in public reports.

Figure 20. Investments and Bonds



Highlighted actions of shipowners

A true assessment of decarbonization investments and organizational transformations requires greater transparency than is possible from most sustainability reports. Further, in the absence of global reporting standards, disclosures cannot be compared across companies. However, public data from the standardized disclosure platform, CDP⁶³, allows for insights into decarbonization initiatives for shipowners with submitted disclosures. Of all 94 companies assessed, eight shipowners had both 1) a target of net zero by 2050 or sooner, and 2) a submitted CDP report for the years 2020 and/or 2021 (Figure 21)⁶⁴. The container segment is strongly represented with six out of eight companies included. Together these owners represent over one thousand ships and 89 million DWT, representing approximately 30% of the container market.

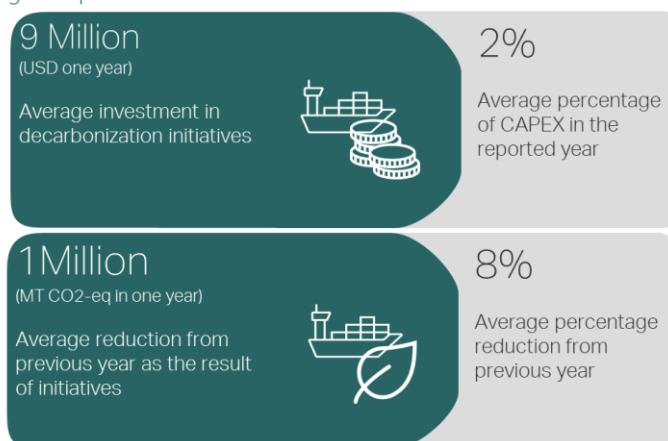
The eight companies reported an average investment in decarbonization initiatives of USD 9 million, representing an average of 2% of CAPEX⁶⁵ in the CDP reporting year (2021 for all but one company). The average effect from these reported initiatives was ~ 1 million MT CO₂-eq, which in turn is equal to an average abatement effect of 8% reduction of total Scope 1 and 2 emissions compared to the previous year.

63 Access CDP data here: <https://www.cdp.net/en/search>
 64 See collected data from CDP in Appendix B

65 The IPCC recommends investment between 5% and 15% of global capital will be necessary to reach temperature targets, see IPCC 2019. Investments range between 2-20 USD across the eight companies assessed.



Figure 21. Average Decarbonization Investment Disclosures for Eight Shipowners with Net Zero 2050 Ambitions



Note: Average investments and emission reductions for eight shipowners with a target of net zero by 2050 or sooner, and a submitted CDP disclosure for 2021 (or 2020). Initiatives source: CDP disclosures; CAPEX source: financial reports

Taking a closer look at the initiatives reported to CDP, it becomes clear that increased understanding of shipowners' strategies will be important for investors, shareholders, and consumers concerned with the green transition. Of the USD 65 million invested in decarbonization initiatives in the previous year by eight companies, USD 34 million was spent on investments related to the use of LNG fuel and no investments were reported in low carbon fuels. While under certain price scenarios there is a business case for LNG⁶⁶, it has limited climate benefits and like conventional fuels, requires a pathway to net zero emissions. It is debated if the climate impact of LNG is better or worse than LSFO, largely depending on upstream and onboard methane emissions and the timeframe considered⁶⁷.

The remaining USD 31 million was invested in energy efficiency initiatives (e.g., route optimization, reduced speeds, hull and propeller improvements, shore power, waste heat recovery). Compared to LNG investments, efficiency initiatives result in unambiguous abatement. As vessels with higher efficiency require less fuel to cover a given distance, it is important that all firms continue – and increase – investments in energy efficiency to achieve net zero goals. It will also be necessary for firms to begin to invest in low carbon fuels as part of the pathway to reach net zero by 2050⁶⁸. While real emissions reduction was observed among companies with ambitious decarbonization commitments and a CDP disclosure, actions are not yet in line with what is needed to transition to net zero by 2050.

05 Conclusions and Recommendations

In the years since the Paris Agreement, the public and private sectors have raised ambitions for decarbonizing global shipping. However, the UN Intergovernmental Panel on Climate Change (IPCC) makes clear that the world is currently not on track to limit warming to below 1.5°C or even 2°C of temperature increases⁶⁹. In response to the growing crisis, a higher level of urgency was evident in several groundbreaking declarations at COP26 that could trigger an acceleration in the transition to net zero. While declarations are an important signal, the true test of an industry transition are measures taken within firms to achieve credible emissions reductions in line with global temperature targets.

In this assessment of the state of decarbonization within the maritime industry, we analyze if and how shipping companies pledge to achieve decarbonization targets accompanied by credible disclosures, strategies, and actions. Drawing on publicly available information in February 2022 of the 94 companies assessed, 12 companies (13%) pledged to be net zero by 2050 or earlier and another 21 companies (22%) committed to achieving targets set in the Initial IMO GHG Strategy. While pledges by themselves do not guarantee decarbonization, companies with specified targets in this assessment were largely found to have higher levels of emissions disclosures, decarbonization strategies, and carbon reduction initiatives. However, within pledging companies more needs to be done especially on emissions data and initiatives to truly align with climate ambitions. While pledges appear to represent an important first step for many in the industry, further scrutiny and tracking over time will be required to ensure commitments translate into action.

When comparing the level of pledges and reporting to cross-industry assessments, the maritime industry continues to lag. However, there are reasons to believe that the outlook will improve in coming years. An additional ten companies have made tentative pledges to net zero; there appears to be low substitution of emissions reduction with offset strategies; and ambitions are spread evenly across regions and between private/state-owned and publicly traded companies pointing to global incentives beyond shareholder pressure. In coming years, increasing pressure from customers seeking to reduce their Scope 3 emissions which includes transportation of products may be reflected in higher ambitions among a larger group of shipping companies. This can be seen by the fact that in the time since the data was collected new, more ambitious, sustainability reports have emerged⁷⁰.

The latest report from the IPCC recommends disclosures, and particularly climate-risk disclosures, as an effective tool for

66 Adachi et al. 2014.
67 Pavlenko et al. 2020.

68 Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping 2021.

69 IPCC 2022.

70 NYK released new targets and strategies in March 2022; COSCO released a new sustainability report with a net zero 2060 target in April 2022



climate impact. Ambitious emissions targets with transparent disclosures accompanied by robust strategies and actions can not only lower emissions but can attract investors looking to take part in the green transition. Integrating decarbonization within internal company practices can also provide firms with greater visibility on the risks they face due to climate change as well as business opportunities in the green transition. Below we provide a list of recommendations for firms and regulators looking to strengthen reporting on decarbonization. While reporting on its own cannot reduce emissions, it can lead to more accountability and help differentiate gestures at sustainability from true climate action.

Recommendations for Firms

Key Recommendation: Companies should set emissions reductions targets, preferably aligned with a net zero ambitions for 2050 or sooner, and back up pledges with comprehensive sustainability reports including: strategies, GHG emissions reporting, and progress through actions.

Further Recommendations:

- All pledges should be time-bound with interim reduction targets.
- Along with longer-term pledges, companies should identify feasible, but ambitious, short-term pledges to kick-start decarbonization efforts.
- All companies should publish detailed emissions data including Scope 1, 2, and 3 following GHGP methodology.
- All fuel emissions should, as a minimum, take a well-to-wake approach that includes extraction, transportation, and bunkering.
- Companies should submit disclosures to CDP or other centralized disclosure platforms.
- When taking a mixed fuel approach that includes LNG, companies should also indicate how they plan to transition to alternative fuels.

Recommendations for Regulators

Key Recommendation: Government regulators should implement (or strengthen) mandatory reporting requirements of climate-related impacts subject to third party auditing. Requirements should rely on global standards to increase comparability and avoid creating additional reporting burdens.

Further Recommendations:

- To the extent possible governments should work together to align reporting requirements and develop global assurance standards to enable more credible third-party auditing.
- Just as IMO programs work to transfer technical knowledge to member states, the IMO should seek to

promote greater awareness and understanding of decarbonization strategies.

- As environmental risk reporting in the maritime sector is still in its infancy, regulators should provide guidance to improve comprehension of climate-related risks and support standardization to avoid additional reporting burdens and to increase comparability.



06 References

- Abnett, Kate, Jonathan Saul, and Ilze Filks. 2021. Denmark, U.S. and 12 other nations back tougher climate goal for shipping. *Reuters*, sec. Sustainable Business. Available at <<https://www.reuters.com/business/sustainable-business/denmark-us-12-other-nations-back-tougher-climate-goal-shipping-2021-11-01/>>. Accessed 22 March 2022.
- Adachi, Masaki, Hiroyuki Kosaka, Tetsugo Fukuda, Shota Ohashi, and Kazuyoshi Harumi. 2014. Economic analysis of trans-ocean LNG-fueled container ship. *Journal of Marine Science and Technology* 19 (4): 470–478.
- Baresic, Domagoj, Isabelle Rojon, Allison Shaw, and Nishatabbas Rehmatulla. 2022. *Closing the Gap: An Overview of the Policy Options to Close the Competitiveness Gap and Enable an Equitable Zero-Emission Fuel Transition in Shipping*. London: UMAS. Available at <<https://www.globalmaritimeforum.org/publications/closing-the-gap>>. Accessed 4 March 2022.
- Black, Richard, Kate Cullen, Byron Fay, Thomas Hale, John Lang, Saba Mahmood, and Steve Smith. 2021. *Taking stock: A global assessment of net zero targets*. Energy & Climate Intelligence Unit and Oxford Net Zero. Available at <<https://eciu.net/analysis/reports/2021/taking-stock-assessment-net-zero-targets>>. Accessed 28 March 2022.
- Bos, Kyra, and Joyeeta Gupta. 2019. Stranded assets and stranded resources: Implications for climate change mitigation and global sustainable development. *Energy Research & Social Science* 56: 101215.
- Carlsen, Christian. 2020. Fierce criticism of IMO meeting: 'Financial interests beat out green ambitions'. Shipping Watch. Available at <<https://shippingwatch.com/regulation/article12512564.ece>>. Accessed 2 March 2022.
- CDP. 2022. FAQs for companies. Available at <<https://www.cdp.net/en/companies-discloser/how-to-disclose-as-a-company/faqs-for-companies>>. Accessed 3 March 2022.
- Clarksons Research. 2022. Clarksons Research Portal. Available at <<https://www.clarksons.net/n/#/portal>>. Accessed 4 March 2022.
- Day, Thomas, Silke Mooldijk, Sybrig Smit, Eduardo Posada, Frederic Hans, Harry Fearnough, Aki Kachi, Carsten Warnecke, Takeshi Kuramochi, and Niklas Hone. 2022. *Corporate Climate Responsibility Monitor 2022*. Next Climate and Carbon Market Watch. Available at <<https://newclimate.org/2022/02/07/corporate-climate-responsibility-monitor-2022/>>. Accessed 4 March 2022.
- Deane, Felicity, Anna Huggins, and Md Saiful Karim. 2019. Measuring, monitoring, reporting and verification of shipping emissions: Evaluating transparency and answerability. *Review of European, Comparative & International Environmental Law* 28 (3): 258–267.
- Dichter, Alex, Kimberly Henderson, Robin Riedel, and Daniel Riefer. 2020. *How airlines can chart a path to zero-carbon flying* | McKinsey. McKinsey and Co. Available at <<https://www.mckinsey.com/industries/travel-logistics-and-infrastructure/our-insights/how-airlines-can-chart-a-path-to-zero-carbon-flying>>. Accessed 11 March 2022.
- Dinu, O., and A. M. Ilie. 2015. Maritime vessel obsolescence, life cycle cost and design service life. *IOP Conference Series: Materials Science and Engineering* 95. IOP Publishing: 012067.
- Eijgelaar, Eke. 2011. Voluntary Carbon Offsets a Solution for Reducing Tourism Emissions? Assessment of Communication Aspects and Mitigation Potential. *European Journal of Transport and Infrastructure Research* 11 (3). Available at <<https://journals.open.tudelft.nl/ejtir/article/view/2933>>. Accessed 11 March 2022.
- ESG Investor. 2021. Japan Proposes Mandatory Climate Risk Disclosures. *Regulation Asia*. Available at <<https://www.regulationasia.com/japan-proposes-mandatory-climate-risk-disclosures/>>. Accessed 3 March 2022.
- European Commission. 2021a. Corporate sustainability reporting. Text. *European Commission*. Available at <https://ec.europa.eu/info/business-economy-euro/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en>. Accessed 3 March 2022.
- European Commission. 2021b. Sustainable finance package. Text. *European Commission*. Available at <https://ec.europa.eu/info/publications/210421-sustainable-finance-communication_en>. Accessed 3 March 2022.
- European Parliament. 2014. *Directive 2014/95/EU of the European Parliament and of the Council of 22 October 2014 amending Directive 2013/34/EU as regards disclosure of non-financial and diversity information by certain large undertakings and groups Text with EEA relevance*. OJ L. Vol. 330. Available at <<http://data.europa.eu/eli/dir/2014/95/oj/eng>>. Accessed 3 March 2022.
- Fink, Larry. 2020. BlackRock Letter to CEOs. BlackRock. Available at <<https://www.blackrock.com/corporate/investor-relations/2020-larry-fink-ceo-letter>>. Accessed 22 March 2022.
- GMF. 2020. *Global Maritime Issues Monitor*. Global Maritime Forum.
- Green, Jessica F. 2010. Private Standards in the Climate Regime: The Greenhouse Gas Protocol. *Business and Politics* 12 (3). Cambridge University Press: 1–37.
- Guix, Mireia, Claudia Ollé, and Xavier Font. 2022. Trustworthy or misleading communication of voluntary carbon offsets in the aviation industry. *Tourism Management* 88: 104430.
- He, Xinwu. 2021. Sustainability Assurance: A Call for Specialist Standards. *Social and Environmental Accountability Journal* 41 (1–2). Routledge: 127–129.
- IEA. 2021. Net Zero by 2050 - A Roadmap for the Global Energy Sector: 224.
- IMO. 2021. *Fourth Greenhouse Gas Study 2020*. London: International Maritime Organization. Available at <<https://www.imo.org/en/OurWork/Environment/Pages/Fourth-IMO-Greenhouse-Gas-Study-2020.aspx>>. Accessed 3 March 2022.
- IMO. 2022a. IMO and the Sustainable Development Goals. Available at <<https://www.imo.org/en/MediaCentre/HotTopics/Pages/SustainableDevelopmentGoals.aspx>>. Accessed 2 March 2022.
- IMO. 2022b. Technical co-operation and transfer of technology. Available at <<https://www.imo.org/en/OurWork/Environment/Pages/Technical-Co-operation.aspx>>. Accessed 22 March 2022.



- IPCC. 2019. *Chapter 4: Strengthening and implementing the global response — IPCC*. Intergovernmental Panel on Climate Change. Available at <<https://www.ipcc.ch/report/sr15/chapter-4-strengthening-and-implementing-the-global-response/>>. Accessed 25 April 2022.
- IPCC. 2022. *Climate Change 2022: Mitigation of Climate Change*. Available at <<https://www.ipcc.ch/report/ar6/wg3/>>. Accessed 6 April 2022.
- IRENA. 2021. *A pathway to decarbonise the shipping sector by 2050*.
- Jaramillo, Paulina, W. Michael Griffin, and H. Scott Matthews. 2007. Comparative Life-Cycle Air Emissions of Coal, Domestic Natural Gas, LNG, and SNG for Electricity Generation. *Environmental Science & Technology* 41 (17). American Chemical Society: 6290–6296.
- Klaaßen, Lena, and Christian Stoll. 2021. Harmonizing corporate carbon footprints. *Nature Communications* 12 (1). Nature Publishing Group: 6149.
- KPMG. 2020. *The Time Has Come: The KPMG Survey of Sustainability Reporting 2020*.
- LoPucki, Lynn M. 2022. *Corporate Greenhouse Gas Disclosures*. SSRN Scholarly Paper. Rochester, NY: Social Science Research Network. Available at <<https://papers.ssrn.com/abstract=4051948>>. Accessed 24 March 2022.
- Luo, Xiaobo, and Meihong Wang. 2017. Study of solvent-based carbon capture for cargo ships through process modelling and simulation. *Applied Energy* 195: 402–413.
- MacMillan, Douglas, and Maxine Joselow. 2022. SEC plans to force public companies to disclose greenhouse gas emissions. *Washington Post*. Available at <<https://www.washingtonpost.com/business/2022/03/15/sec-climate-emissions-rule/>>. Accessed 19 April 2022.
- Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping. 2021. *Industry Transition Strategy*. Copenhagen. Available at <<https://www.zeroarbonshipping.com/>>. Accessed 3 March 2022.
- OECD. 2022. *Trends in ESG Investing and Quality Infrastructure Investment in Asia-Pacific*. Paris. Available at <<https://www.oecd.org/finance/Trends-in-ESG-Investing-and-Quality-Infrastructure-Investment-in-Asia-Pacific.htm>>. Accessed 17 March 2022.
- Panagakos, George, Thiago de Sousa Pessôa, Nick Dessypris, Michael Bruhn Barfod, and Harilaos N. Psaraftis. 2019. Monitoring the Carbon Footprint of Dry Bulk Shipping in the EU: An Early Assessment of the MRV Regulation. *Sustainability* 11 (18). Multidisciplinary Digital Publishing Institute: 5133.
- Papandreou, Andreas, Phoebe Koundouri, and Lydia Papadaki. 2021. Sustainable Shipping: Levers of Change. In *The Ocean of Tomorrow: The Transition to Sustainability – Volume 2*, edited by Phoebe Koundouri, 153–171. Cham: Springer International Publishing. Available at <https://doi.org/10.1007/978-3-030-56847-4_10>. Accessed 17 March 2022.
- Pavlenko, Nikita, Bryan Comer, Zhou Yuanrong, Nigel Clark, and Dan Rutherford. 2020. *The climate implications of using LNG as a marine fuel*. International Council on Clean Transportation.
- Regulation Asia. 2021. Korea to Require ESG Disclosures from Listed Companies. *Regulation Asia*. Available at <<https://www.regulationasia.com/korea-to-require-esg-disclosures-from-listed-companies/>>. Accessed 3 March 2022.
- Rutherford, Dan. 2020. Potential CO2 reductions under the Energy Efficiency Existing Ship Index: 18.
- Sanderson, Benjamin M., and Brian C. O'Neill. 2020. Assessing the costs of historical inaction on climate change. *Scientific Reports* 10 (1). Nature Publishing Group: 9173.
- SGX. 2022. Sustainability Reporting. Available at <<https://www.sgx.com/regulation/sustainability-reporting>>. Accessed 3 March 2022.
- TCFD. 2021. *Task Force on Climate-related Financial Disclosures 2021 Status Report*. Switzerland.
- UN Conference on Trade and Development. 2019. *Review of Maritime Transport 2018*. United Nations.
- UNCTAD / RMT. 2021. *Review of Maritime Transport*. New York: UN.
- Victor, David G, Frank W Geels, and Simon Sharpe. 2019. *Accelerating the low carbon transition /ETC*. Brookings. Available at <<https://www.energy-transitions.org/publications/accelerating-the-low-carbon-transition/>>. Accessed 3 March 2022.
- Wang, Shuaian, Harilaos N. Psaraftis, and Jingwen Qi. 2021. Paradox of international maritime organization's carbon intensity indicator. *Communications in Transportation Research* 1: 100005.



Appendix A.1 - Top 30 Tanker Shipowners⁷¹

General Information			Fleet Composition		Assessment Data					
			From Clarkson's		From Public Reports					
Company name	HQ Region	Ownership	Owned Fleet	DWT (mil)	IMO Pledge	Net Zero 2050 Pledge	Other GHG Pledge	No Pledge	Sustainability Report	Emissions Reporting
China COSCO Shipping	Asia	Private/ SOE	180	22	✓				✓	✓
China Merchants	Asia	Publicly traded	135	20				✓		
Euronav NV	Europe	Publicly traded	77	20	✓				✓	✓
Bahri	Middle-East	Publicly traded	89	15				✓	✓	✓
Angelicooussis Group	Europe	Private/ SOE	57	15				✓		
Nat Iranian Tanker	Middle-East	Private/ SOE	55	14				✓		
Fredriksen Group	Europe	Private/ SOE	78	13				✓		
Dynacom Tankers Mgmt	Europe	Private/ SOE	70	12				✓		
Mitsui OSK Lines	Asia	Publicly traded	156	12	✓	✓	✓		✓	✓
SCF Group	Europe	Private/ SOE	115	11	✓				✓	✓
Petronas	Asia	Private/ SOE	66	10	✓	✓			✓	
Intl Seaways	N. America	Publicly traded	90	10	✓				✓	✓
Scorpio Group	Europe	Publicly traded	122	8	✓				✓	✓
Thenamaris	Europe	Private/ SOE	62	8				✓		
SK Shipping	Asia	Private/ SOE	37	8				✓		
Tsakos Group	Europe	Publicly traded	75	8				✓		
Sinokor Merchant	Asia	Private/ SOE	80	7				✓		
Teekay Corporation	N. America	Publicly traded	50	7	✓				✓	✓
Minerva Marine	Europe	Private/ SOE	59	7				✓		
Cardiff Marine	Europe	Private/ SOE	46	6				✓		
Alpha Tankers	Europe	Private/ SOE	35	6				✓		
Zodiac Maritime	Europe	Private/ SOE	48	5	✓				✓	✓
TORM A/S	Europe	Publicly traded	85	5	✓	✓			✓	✓
Navios Holdings	Europe	Publicly traded	52	5				✓		
BW Group	Carribbean	Private/ SOE	82	5				✓		
Eastern Pacific Shpg	Asia	Private/ SOE	66	5	✓				✓	✓
Shpg Corp of India	Asia	Publicly traded	34	4				✓		
Pertamina	Asia	Private/ SOE	91	3				✓		
Vardinoyannis Group	Europe	Private/ SOE	37	3				✓		
Union Maritime	Europe	Private/ SOE	43	3				✓		
Totals			2,272	278	11	3	1	19	12	11

⁷¹ Tanker list created from Clarkson's Nov 2021; Assessment data collected from public domain Feb 2022

Appendix A.2 - Top 30 Bulk Shipowners⁷²

General Information			Fleet Composition		Assessment Data					
			<i>From Clarkson's</i>		<i>From Publicly traded Reports</i>					
Company name	HQ Region	Ownership	Owned Fleet	DWT (mil)	IMO Pledge	Net Zero 2050 Pledge	Other GHG Pledge	No Pledge	Sustainability Report	Emissions Reporting
China COSCO Shipping	Asia	Private/ SOE	345	38	✓				✓	✓
Fredriksen Group	Europe	Private/ SOE	116	15				✓		
Star Bulk Carriers	Europe	Publicly traded	129	14	✓				✓	✓
Nippon Yusen Kaisha	Asia	Publicly traded	150	14	✓	✓	✓		✓	✓
China Merchants	Asia	Publicly traded	119	14				✓		
K-Line	Asia	Publicly traded	105	13	✓	✓	✓		✓	✓
Berge Bulk	Carribbean	Private/ SOE	66	12	✓	✓	✓		✓	
Oldendorff Carriers	Europe	Private/ SOE	116	12	✓	✓				
ICBC	Asia	Publicly traded	45	12				✓		
China Dev Bank	Asia	Publicly traded	126	11				✓		
Pan Ocean	Asia	Publicly traded	79	11				✓		
Mitsui OSK Lines	Asia	Publicly traded	88	11	✓	✓	✓		✓	✓
H-Line Shipping	Asia	Private/ SOE	47	9				✓		
Angelicoussis Group	Europe	Private/ SOE	51	9				✓		
NS United KK	Asia	Publicly traded	44	8			✓		✓	✓
Navios Holdings	Europe	Publicly traded	69	8				✓		
Imabari Shipbuilding	Asia	Private/ SOE	75	8				✓		
Wisdom Marine Group	Asia	Publicly traded	137	8				✓	✓	✓
Nissen Kaiun	Asia	Private/ SOE	74	7				✓		
Winning Intl	Asia	Private/ SOE	39	7				✓		
Shandong Marine	Asia	Publicly traded	50	7				✓		
BoCom	Asia	Private/ SOE	51	7				✓		
Far Eastern Group	Asia	Private/ SOE	46	6				✓		
Golden Union	Europe	Private/ SOE	46	6				✓		
Nisshin Shipping	Asia	Private/ SOE	97	6				✓		
Zodiac Maritime	Europe	Private/ SOE	38	5	✓				✓	✓
SM Group	Asia	Private/ SOE	41	5				✓		
Laskaridis Shipping	Europe	Private/ SOE	55	5				✓		
Santoku Shipping	Asia	Private/ SOE	61	5				✓		
Doun Kisen	Asia	Private/ SOE	54	5				✓		
Totals			2,559	301	8	5	5	21	9	8

72 Bulk list created from Clarkson's Dec 2021; Assessment data collected from public domain Feb 2022



Appendix A.3 - Top 30 Container Shipowners⁷³

General Information			Fleet Composition		Assessment Data					
			<i>From Clarkson's</i>		<i>From Publicly traded Reports</i>					
Company name	HQ Region	Ownership	Owned Fleet	DWT	IMO Pledge	Net Zero 2050 Pledge	Other GHG Pledge	No Pledge	Sustainability Report	Emissions Reporting
China COSCO Shipping	Asia	Private/ SOE	277	30	✓				✓	✓
A.P. Moller Maersk	Europe	Publicly traded	322	29	✓	✓	✓		✓	✓
MSC	Europe	Private/ SOE	346	26	✓	✓	✓		✓	✓
Atlas Corp (Seaspan)	N. America	Publicly traded	201	22	✓				✓	
CMA CGM	Europe	Private/ SOE	204	19	✓	✓	✓		✓	✓
Hapag-Lloyd	Europe	Publicly traded	123	14	✓		✓		✓	✓
Evergreen Marine	Asia	Publicly traded	174	14	✓		✓		✓	✓
Imabari Shipbuilding	Asia	Private/ SOE	91	10				✓		
HMM	Asia	Publicly traded	56	8	✓	✓	✓		✓	✓
Zodiac Maritime	Europe	Private/ SOE	62	7	✓				✓	✓
Costamare Shipping	Europe	Publicly traded	80	7	✓				✓	✓
Eastern Pacific Shpg	Asia	Private/ SOE	57	7	✓				✓	✓
Wan Hai Lines	Asia	Publicly traded	142	6	✓		✓		✓	✓
BoCom	Asia	Private/ SOE	41	6				✓		
Reederei C-P Offen	Europe	Private/ SOE	52	5				✓		
Danaos Shipping	Europe	Publicly traded	69	5				✓		
Nippon Yusen Kaisha	Asia	Publicly traded	48	4	✓	✓	✓		✓	✓
Global Ship Lease	Europe	Publicly traded	65	4	✓				✓	✓
PIL	Asia	Private/ SOE	90	4				✓		
Fredriksen Group	Europe	Private/ SOE	32	3				✓		
China Merchants	Asia	Publicly traded	46	3				✓		
Mitsui OSK Lines	Asia	Publicly traded	30	3	✓	✓	✓		✓	✓
Navios Holdings	Europe	Publicly traded	45	3				✓		
Yang Ming Marine	Asia	Publicly traded	51	3	✓		✓		✓	✓
Nissen Kaiun	Asia	Private/ SOE	45	3				✓		
SITC	Asia	Publicly traded	111	2				✓		
MPC Group	Europe	Publicly traded	77	2				✓		
Schulte Group	Europe	Private/ SOE	41	2				✓		
Peter Dohle	Europe	Private/ SOE	50	2				✓		
Northern Shipping	Europe	Private/ SOE	33	2				✓		
Totals			3,061	255	16	6	10	14	16	15

73 Container list created from Clarkson's Dec 2021; Assessment data collected from public domain Feb 2022



Appendix A.3 - Top 30 RORO and Car Carrier Shipowners⁷⁴

General Information			Fleet Composition		Assessment Data					
			<i>From Clarkson's</i>		<i>From Public Reports</i>					
Company name	HQ Region	Ownership	Owned Fleet	DWT	IMO Pledge	Net Zero 2050 Pledge	Other GHG Pledge	No Pledge	Sustainability Report	Emissions Reporting
Grimaldi Group	Europe	Private/ SOE	101	2.2	✓				✓	✓
Wallenius Wilhelmsen	Europe	Publicly traded	84	2.1			✓		✓	✓
Nippon Yusen Kaisha	Asia	Publicly traded	65	1.2	✓	✓	✓		✓	✓
Ray Car Carriers	Europe	Private/ SOE	57	1.1				✓		
Mitsui OSK Lines	Asia	Publicly traded	57	1.0	✓	✓	✓		✓	✓
K-Line	Asia	Publicly traded	66	1.0	✓		✓		✓	✓
Leif Hoegh & Co	Europe	Publicly traded	31	0.7	✓					
Hyundai Motor Group	Asia	Publicly traded	31	0.7				✓		
Cido Shipping	Asia	Private/ SOE	37	0.6				✓		
DFDS	Europe	Private/ SOE	38	0.5	✓	✓	✓		✓	✓
CLdN Cobelfret	Europe	Publicly traded	31	0.5				✓		
Ignazio Messina	Europe	Private/ SOE	8	0.4				✓		
Imabari Shipbuilding	Asia	Private/ SOE	16	0.3				✓		
Zodiac Maritime	Europe	Private/ SOE	17	0.3	✓				✓	✓
Hakuyo Shpg	Asia	Private/ SOE	15	0.3				✓		
Eastern Pacific Shpg	Asia	Private/ SOE	16	0.3	✓				✓	✓
P.D. Gram	Europe	Private/ SOE	20	0.2	✓				✓	✓
Spliethoff	Europe	Private/ SOE	17	0.2	✓				✓	
Toyoufuji Shipping	Asia	Publicly traded	21	0.2				✓		
Bahri	Middle-East	Publicly traded	6	0.2				✓	✓	✓
Siem Industries	Europe	Private/ SOE	11	0.2				✓		
Meiji Shipping	Asia	Private/ SOE	8	0.1				✓		
Neptune Shipping	Europe	Private/ SOE	14	0.1				✓		
SAIC Motor	Asia	Private/ SOE	17	0.1				✓		
Fredriksen Group	Europe	Private/ SOE	6	0.1				✓		
UECC	Europe	Private/ SOE	11	0.1	✓					
Singapore Shipping	Asia	Publicly traded	5	0.1				✓		
Eastern Car Liner	Asia	Private/ SOE	7	0.1				✓		
Libera Corporation	Asia	Private/ SOE	6	0.1				✓		
Kansai Steamship Co	Asia	Private/ SOE	5	0.1				✓		
Totals			824	15	11	3	5	18	11	10

74 RORO / Car list created from Clarkson's Dec 2021; Assessment data collected from public domain Feb 2022



Appendix B – Highlighted Actions of Eight Shipowners⁷⁵

Company Information		Information Collected from CDP						
Company	Segment(s)	Disclosed year	CDP grade ⁷⁶	Disclose emissions reduction initiatives?	Total investment in initiatives ⁷⁷	CO2-eq Savings in Reported Year from Initiatives	Change to previous year's CO2-eq due to decarbonization initiatives	Sample initiatives with documented emissions reductions
					<i>million USD</i>	<i>MMT CO2-eq</i>		
Nippon Yusen Kaisha	Bulk, Container, RORO	2020	A	✓	16	2.11	-16%	Combustion improvers, hull improvements; LNG fuel
K-Line	Bulk, RORO	2020	A	✓	2	0.45	-4%	Shore power; waste heat recovery; improved propeller design; additive dozing system; autopilot
A.P. Moller Maersk	Container	2020	B	✓	2	2.30	-6%	Energy efficiency optimization
Mitsui OSK Lines	Tanker, Bulk, Container, RORO	2020	B	✓	8	1.28	-10%	Reduced speed, route optimization, efficiency upgrades
HMM	Container	2020	B	✓	20	0.41	Not Available	"eco-friendly" ships; fuel management; electric power savings
DFDS	RORO	2020	C	✓	2	0.01	Not Available	Hull painting
MSC	Container	2019	Not Available	Not Available	Not Available	0.10	Not Available	Not Available
CMA CGM	Container	2020	Not Available	✓	16	0.86	-4%	Energy saving devices (engine power limit, variable frequency drive, exhaust gas economizer); hull improvements
Averages					9.4	0.9	-8.0%	

75 Collected from CDP website March 2022

76 CDP assigns a grade to disclosures based on the criteria of clarity, specificity, and depth

77 Investments were converted to USD using the US IRS exchange rates for the reported year: <https://www.irs.gov/individuals/international-taxpayers/yearly-average-currency-exchange-rates>

