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ARTICLE

Green Financing for Shipping Industry: Results of a Marine Professionals' Survey

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ABSTRACT

The global shipping industry, like many others, is under growing pressure to be more sustainable. Regulation, renewable energy advances and customer demand have created a golden opportunity to make shipping more environmentally sustainable, which, however, entails significant funding. Traditional ship financing has been done largely on a secured basis, with relatively few considerations around sustainability and environmental protection. This approach is ripe for innovation, given the industry's significant environmental footprint. Evidence from other industries suggests that borrowers could benefit in pricing and structure from sustainable borrowing mechanisms, such as green bonds (where proceeds are dedicated to environmental and social investment). The trend is also increasing for sustainable loans, which can help to meet the growing demand for retrofit financing within existing vessels to meet CO_2 emission targets. This paper aims to explore the attitudes of shipping industry participants, through the use of a survey, to green financing, that is, issuing unsecured and covered green, social, and sustainable bonds and other related financing instruments. These could effectively advance the environmental and social agenda in the industry, strengthening environmental, social, and governance (ESG) structures at the same time. Preliminary results suggest that there is considerable scope for improving knowledge and awareness among marine professionals to bridge the sustainability gap.

Keywords: Shipping; Sustainability; Green Finance

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1. Introduction

International shipping accounted for around 2% of global energy-related CO_2 emissions in 2019. While shipping is the most energy-efficient way to carry cargo, the transportation industry in general, and shipping in particular, has not historically kept pace with other sectors in terms of decarbonisation. Given ever-rising cargo volumes, shipping-related CO_2 emissions have changed little since 2000 [1].

Solutions that are currently being explored encompass alternative fuels (to replace the overwhelming proportion of polluting hydrocarbons currently being used). These include low sulphur fuels, biodiesel, natural gas and hydrogen [2]. Alongside these proposals are various other technical and operational measures such as improved hull performance and design, waste heat recovery, vessel speed reduction, improved fleet management, scheduling and routing, as well as abatement technologies (e.g., scrubbers), cold ironing (using onshore power supply), selective catalytic and non-catalytic reduction, and exhaust gas recirculation [3].

The regulations governing shipping emissions have become more stringent over the years. The International Maritime Organisation (IMO) has established Emissions Control Areas (ECAs) under the International Convention for the Prevention of Pollution from Ships (MARPOL), in order to limit emissions [3]. Also, MARPOL has established an Energy Efficiency Design Index (EEDI) which defines a minimum energy performance threshold per potential mile (tonne mile), on a progressively stricter basis [4].

While external regulation provides some incentivization, industry self-regulation is seen as an additional and important impetus to lowering emissions. The Poseidon Principles [5] were established in June 2019 by a group of leading global banks in collaboration with maritime industry stakeholders. The primary focus of these is to integrate climate considerations into lending decisions in the maritime industry, and to align shipping industry investments with the International Maritime Organization's (IMO) greenhouse gas (GHG) reduction targets, which are, namely, to reduce shipping's total annual GHG emissions by at least 50% by the year 2050 relative to 2008. By integrating climate considerations into lending decisions, the principles aim to encourage the industry to a successful transition towards a more sustainable and low-carbon future.

The Poseidon Principles provide a framework for assessing and disclosing the carbon intensity of ship finance portfolios. Financial institutions that adopt these principles commit to assessing the carbon performance of their shipping portfolios and to work with clients to improve their environmental performance over time. In addition to regulation and technology, an increasing driver for environmental improvement, related to the Poseidon Principles, is green financing. In entering into green bonds and loans, borrowers provide a set of sustainable criteria and commit that borrowed capital to projects meeting those criteria. Lenders require regular reporting and set strict criteria to ensure compliance with the green financing terms.

The impact of the Poseidon Principles, a commitment to invest in assets that comply with shipping's long-term environmental goals, is set to drive sustainability-linked ship finance further. The 29 signatory banks represent around US$185 billion in investments, well over half of the total global ship finance portfolio. Although many have yet to fulfil the principles across their portfolios, the direction is clear.

In order to evaluate the impact of these initiatives on the shipping sector, a survey of 187 maritime professionals was conducted in the third quarter of 2023, to assess their attitudes towards green financing, in an effort to determine decision points to guide future initiatives.

This introduction is followed by the theoretical background, which precedes the methodology, the empirical results, a discussion, and lastly conclusions and recommendations.

2. Background

Global warming and industrial development have caused significant climate change and contributed to gradual temperature rise. These developments have very negative outcomes for society, especially for the environment [6].

Nations are attempting to move towards more sustainable and climate-healthy economies. Climate change is also well recognized as a severe challenge to financial stability and to the global economy by international organisations, such as the G20 and the Financial Stability Board. The financial industry has a key role to play in addressing this challenge. This transition entails huge costs, and financial institutions are providing finance under the general name

"green finance" in order to mitigate global climate change.

Financial institutions can significantly contribute to promoting more sustainable economies through various strategies and initiatives. By providing loans and investment options specifically for green projects, such as renewable energy, sustainable agriculture, and eco-friendly infrastructure, financial institutions can directly support the transition to a greener economy.

Incorporating Environmental, Social, and Governance (ESG) criteria into their investment decisions helps financial institutions ensure that their portfolios are aligned with sustainability goals. This not only mitigates risks but also attracts investors who prioritize ethical and sustainable practices.

Developing and offering financial products like green bonds, sustainability-linked loans, and eco-friendly credit cards encourages both businesses and consumers to adopt more sustainable practices. Financial institutions can lead by example by adopting sustainable practices within their operations. This includes reducing their carbon footprint, implementing energy-efficient technologies, and promoting a culture of sustainability among employees.

Collaborating with stakeholders, including governments, NGOs, and the private sector, to promote and implement sustainable finance initiatives can amplify the impact of their efforts. Financial institutions can play a crucial role in raising awareness about the importance of sustainability and educating their clients and the public on how to make more sustainable financial decisions.

By integrating these strategies, financial institutions can not only contribute to a more sustainable economy but also enhance their brand reputation, attract more customers, and improve their overall competitive advantage.

Offering green loans and sustainability-linked loans specifically for the shipping industry can help finance the transition to cleaner vessels and technologies. This includes funding for retrofitting existing ships with energy-efficient technologies and supporting the development of new ships that use alternative fuels.

As of 2023, the global green bond market has seen substantial growth. The total issuance of green bonds reached approximately $872 billion in that year. This is part of a broader trend in sustainable finance, with the cumulative issuance of green, social, sustainability, and sustainability-linked bonds surpassing $4 trillion since 2018[7].

The market for green bonds continues to be a key instrument for financing projects aimed at environmental sustainability, including renewable energy, clean transportation, and sustainable water management. In this respect, transparency and disclosure are fundamental to align investors' incentives properly[8].

Investors generally view green financing positively, recognizing its potential to drive sustainable development and address climate change. Many investors are increasingly prioritizing green financing as part of their investment strategies. The transition to net zero and decarbonization are central to their decision-making processes. Investors see significant opportunities in green financing, particularly in renewable energy and sustainable projects. However, there are concerns about potential market bubbles due to high demand outstripping supply[9–13].

Moreover, there is a risk of greenwashing, where companies may exaggerate or misrepresent their environmental efforts. Investors are becoming more vigilant about ensuring the authenticity of green projects. To effectively contribute to a green recovery, investors are focusing on long-term strategies that manage risks and address gaps in credible ESG (Environmental, Social, and Governance) data.

Overall, while investors are enthusiastic about green financing, they are also cautious about the challenges and are working towards more robust and transparent investment practices.

The motivation to invest with low environmental impact is linked to return expectations[14], or lower risk[15]. Much work has suggested that firms with good environmental performance enjoy a lower cost of capital. This negative yield differential is generally attributed to intangible asset creation[16] , along with superior risk management and mitigation[17] .

Many more recent studies have shown growing interest in green bonds as a means to benefit shareholders, issuing companies, and the environments where they are located. Glomsrød and Wei[18] reinforce the role of green bonds in reducing the use of coal, increasing non-fossil electricity, and minimizing CO_2 emissions. Febi et al.[19] studied liquidity risk on green bond yield spreads, finding a positive connection to yield spreads, suggesting that green bonds aid in lowering CO_2 emissions. Tang and Zhang[20] examined

returns and effects of green bond issuance from 2007 to 2017, showing that when green bonds are issued, stock values rise, and green bond issuance also helps to lower CO_2 emissions. Bachelet et al.[21] showed that green bonds significantly contribute to higher yields, lower volatility, and greater liquidity. Moreover, Lebelle et al.[22] explored potential repercussions on issuers using a sample of green bond issuances. This study revealed that investors treat green bonds in the same way they do conventional or convertible bonds. Kanamura[23] investigated the greenness of green bonds and their performance in connection to energy, showing a favourable relationship between energy and environmental values. Tolliver et al.[24]), on the other hand, examined the influence of policies on green bonds for renewable energy assets, based on the Paris Agreement's Nationally Determined Contributions (NDCs). They determined that NDCs have a strongly significant impact on renewable energy green bonds. Wang and Zhi[25] analyze the stock market reaction to green bonds in China, the largest home country for green bonds. They emphasize the importance of issuers, underwriters, and investors in establishing the price premium for green bonds.

For financial institutions, the green debt market often means engaging also in green lending, rather than investing directly in environmentally friendly projects. In all cases, disclosure and reporting requirements associated with green bonds involve added costs for borrowers, which could be compensated by the "greenium", that is, the market premium to the price of the green bond. Activity in the green debt market forms part of an environmental strategy where banks reduce lending to more polluting sectors. Such greening does not automatically change banks' riskiness. Nonetheless, as the commitment to finance green projects following green bond issuance translates into a meaningful reduction in lending to high-polluting sectors, it may contribute to the reduction of environmental and climate-related risks on the asset side of banks' balance sheets[26]). By contributing to the reduction of emissions, such a shift in lending may also lower physical risks and losses associated with negative effects in the overall financial system[27]).

Green bond markets also require appropriate government regulation and promotion. Governments in some countries have failed to give guidelines or relevant rules to support green bond market growth. Local green bond practice should represent the country's specific environmental issues where possible, while remaining compatible with international rules and standards. They should also be simple enough to be understood by market participants who are not environmental experts and boost the confidence of market participants by reinforcing the credibility of information in project monitoring[28]). Some argue that governments should also play a role in developing incentive-based policies and climate-related regulations, such as credit enhancement, fiscal and tax incentives, or capital requirements, to encourage green bond issuance and increase financial contributions to low-carbon transition[29]). Using green bonds can help lower greenhouse gases as environmentally friendly projects are introduced as a result. Based on the negative relationship between green bonds and CO_2 emissions, governments should enable a financial system to promote green projects and industries to adopt processes with low carbon emissions. Policymakers should lower the cost of green bond issuance so that more environmental projects can be implemented.

Transparency in the project evaluation and selection process is critical to green bond market integrity. There is an urgent need to define clear eligibility criteria and selection processes. There is a crucial need to give transparency for sustainability linked bonds which condition coupon payments on reaching specific sustainable targets. Greater transparency should also encourage greater investor demand if investors can obtain access to all the information needed for them to make decisions on which bonds to purchase.

Economic incentivization of improved sustainability performance includes margin ratchets linking sustainability performance to loan interest margins. The margin increases or decreases depending on a firm's environmental, social and governance performance[30]. Environmental, social and governance (ESG) criteria may curtail financing if firms do not adopt them. As more investors adopt ESG, firms are embracing ESG strategies so as not to risk losing investors[31].

In summary, green financing can offer several benefits to ship owners and operators. Green financing can attract a wider range of investors and lenders who are interested in supporting environmentally friendly initiatives. Green financing options can offer better conditions, such as lower interest rates or more flexible repayment terms.

Green financing moreover promotes a positive public perception. Companies that secure green financing can benefit from a positive public image, as they are seen as

contributing to environmental sustainability.

Importantly, green financing provides support for green projects. It provides capital for projects that enhance energy efficiency, reduce emissions, and adopt green technologies. This supports the transition towards more sustainable shipping operations. In addition, green financing provides incentives for sustainability. Forms of green financing, such as sustainability-linked finance, incentivize improvements in the borrower's sustainability profile by aligning the loan terms to the borrower's achievement of pre-determined sustainability performance indicators. In this way, green finance provides support for transition strategies. Transition finance can support companies with credible corporate decarbonization strategies that align with the Paris Agreement and aim for net zero emissions by 2050.

In summary, green financing can provide ship owners and operators with the financial resources and incentives they need to transition towards more sustainable operations. It's a win-win situation for both the environment and the maritime industry.

3. Survey

This section presents the results of the survey conducted in the third quarter of 2023 to gather the views of the maritime industry. Participants were chosen based on their educational involvement in the industry, in which they all occupy professional positions, and hence are regarded as informed practitioners suitable for this study, which attempts to gauge awareness and explore gaps in knowledge and education. An online survey was found to be more suitable for the purpose of this study, due to its greater accessibility, convenience for the participants, dissemination capabilities and response time. The questions were designed using Likert scales with five qualitative scales of perspectives (for example, positive or somewhat positive), complemented by open-ended questions on the impacts of green and sustainable finance on employment, profitability and income generation in the shipping industry. The Momentive software was employed to carry out the online survey, due to its compatibility with smartphones, its user-friendly environment and the automatic statistics and visualisation of the results once the participant completes the survey. The questionnaire was disseminated to a wide spectrum of participants in the maritime profession. The response rate was 14.4%, that is, 27 responded out of 187 invited participants.

3.1. Analysis of Demographics

Figure 1 shows that the vast majority of respondents are professional seafarers (33.33%), owners or operators (19.05%), along with regulators (19.05%), and technical advisors (14.29%). A smaller number did not provide their job descriptor (9.52%), and a smaller fraction of respondents were in the ship designer/builder category (4.76%).

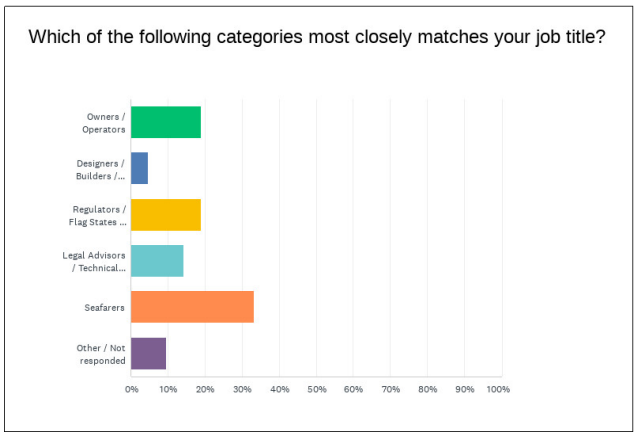

Figure 1. Occupations of the respondents.

Figure 2 shows that the vast majority are between 30 and 49 years old (68.42%), followed by 50−59 (26.32%), and a very small minority is older than 60 years old (5.26%). The age is an indicator of how the person feels in relation to sustainability and environmental issues in general. There is evidence showing that younger people are more sensitive to green issues than older people[32]. Common stereotypes reflected in the media and popular press indicate that older individuals are purportedly less environmentally concerned than younger ones. Older workers are also often characterized as inflexible, unwilling to adopt new habits, and unable to learn new skills[33]. However, recent empirical academic research has shown that younger generations tend to be less civic-minded than previous generations at the same age. Twenge et al.[34], for instance, found that people born between 1962 and 1981 (Generation X) and born after 1982 (Millennials) considered goals related to money, image, or fame more important than those related to affiliation, community and belonging.

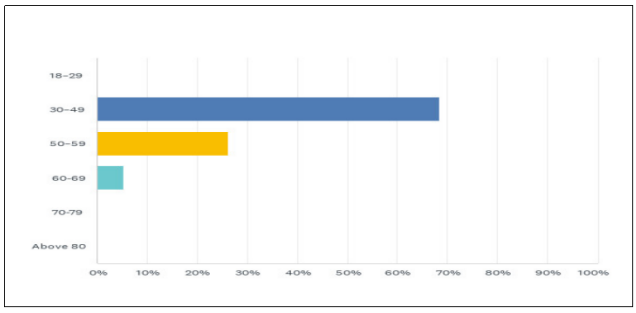

Figure 2. Age groups of the respondents.

Figure 3 shows that the vast majority of respondents believe that the government should promote sustainable and green shipping (90.48%). This is interesting in light of the responses to the question on the Poseidon Principles.

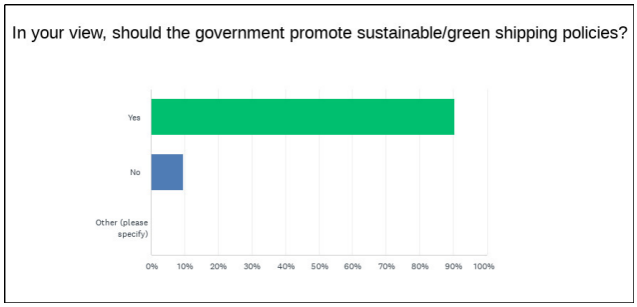

Figure 3. Promotion of sustainable/green policies.

In addition, Wiernik et al. [35] and Dikken et al. [32] show that workers above the age of 40 and people above 65 were somewhat more likely to show positive relationships with pro-environmental behaviours.

Figure 4 shows that the vast majority of respondents believe that there should be sustainable and green finance available in shipping (85.71%). Less than 5% do not know whether there is a need for green finance in shipping, and less than 10% do not believe it is necessary.

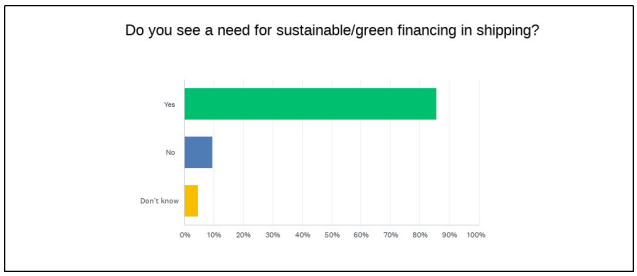

Figure 4. Sustainable/green policies in shipping.

The responses concerning green bonds are much more diverse (**Figure 5**). Again, there is a strong majority (47.62%) who believe that green bonds are an effective way to raise finance in shipping, but it is less than the majority. Nearly a quarter of the respondents do not think that green bonds are effective (23.81%), and the same percentage do not know (3.81%). Less than 5% have a different opinion (4.76%) (**Figure 6**).

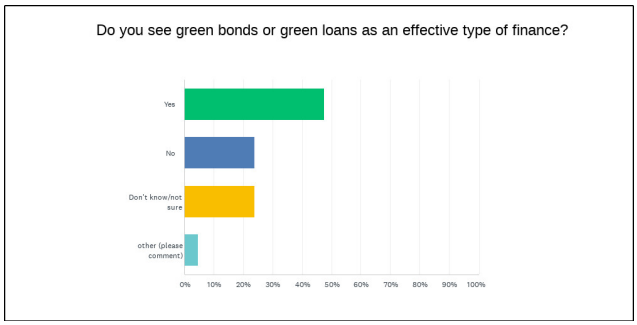

Figure 5. Green bonds as effective finance in shipping.

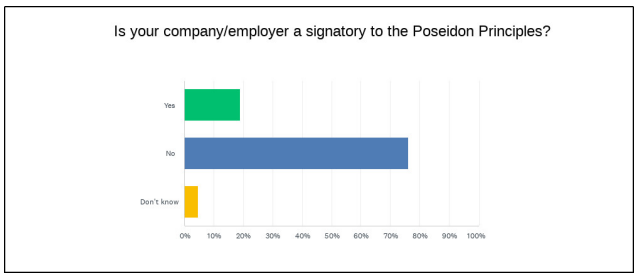

Figure 6. Poseidon Principles [5].

The overwhelming majority of respondents are employed by companies that have not subscribed to the Poseidon Principles (76.19%), which as mentioned are a set of guidelines for responsible ship finance to promote and support environmentally sustainable practices in the maritime industry. Specifically, the key points of the Poseidon Principles include carbon emissions measurement and decarbonization targets, risk assessment and transparency regarding the climate alignment of their shipping portfolios. This transparency is intended to help stakeholders, including investors and the public, to understand the environmental impact of shipping-related financing activities.

The survey shows that nearly one in five employers do subscribe to the Poseidon Principles, and less than 5% do not know. These results are interesting considering that the vast majority of respondents believe that there is a need for green policies in shipping, and even support government-led green policies. However, their employers are not signatories of a set of principles designed to promote green/sustainable practices in the maritime industry.

Figures 7 and **8** relate to access to green finance in shipping. In **Figure 7**, respondents state their perception of the difficulty of obtaining green finance, whilst **Figure 5** shows how many of them have actually attempted to finance green projects. A significant percentage believe that it is difficult (63.16%), with only a minority believing that it is very difficult (5.26%). The majority of respondents believe it is difficult (31.58%), and a quarter believe it is not too difficult (26.32%). In fact, the same percentage of respondents believe that it is neither easy nor difficult (26.32%), which suggests that they are not entirely sure about the actual difficulty in getting green finance. This is corroborated by the results of **Figure 8**, which show that 76.68% have not tried to obtain finance for green projects. The very low percentage of respondents that believe that it is easy (5.26%) or somewhat easy (5.16%) lend more weight to this conclusion.

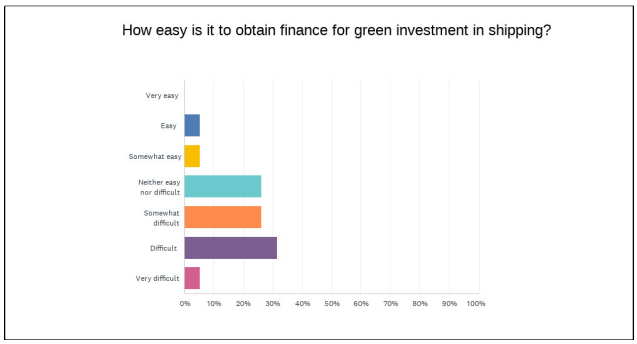

Figure 7. Access to shipping finance.

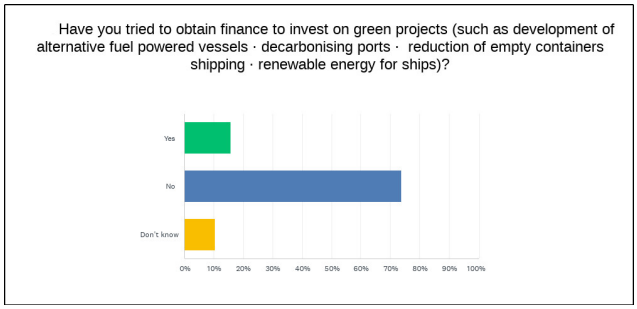

Figure 8. Access to shipping finance for green projects.

Figures 9–11 relate to the perceived impact of the transition to green finance on three main aspects of the shipping industry: employment (**Figure 9**), income generation (**Figure 10**), and profitability (**Figure 11**). A significant percentage of respondents believe that the impact on employment will be positive (31.58%), but the majority have a neutral (47.37%) to negative view (15.79%). Very few believe it will be very positive for employment (5.26%). A neutral to negative perception of the impacts of green shipping on income generation in the maritime industry can also be seen in **Figure 10**. However, these views are less pronounced (negative: 21.05% and neutral: 42.11%). In fact, the respondents are more positive about the implications of green shipping on income generation than they are on the impacts on employment. A proportion of 31.58% believe it will have a positive impact on income generation.

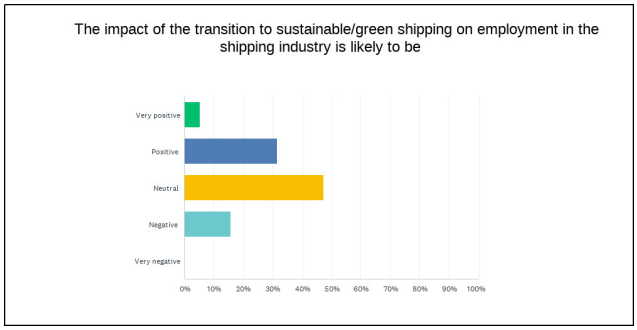

Figure 9. Impact of transition to green/sustainable shipping on employment.

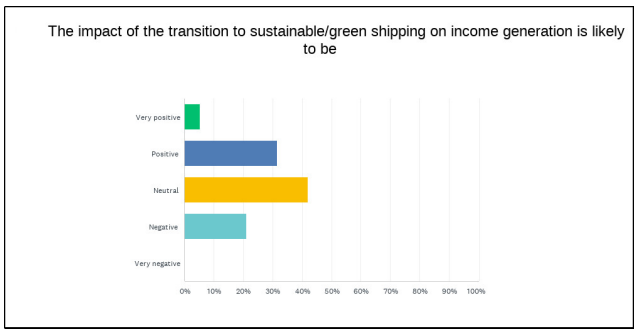

Figure 10. Impact of transition to green/sustainable shipping on income generation.

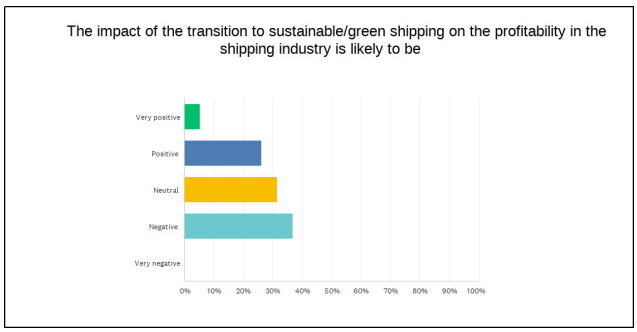

Figure 11. Impact of transition to green/sustainable shipping on profitability.

As shown above, however, the very positive view is very much a minority (5.26%). The final question on the

implications of the adoption of green shipping on profitability suggests that the respondents implicitly assume that the costs of the transition to green shipping will be such that it will reduce profitability (**Figure 11**). Even though a significant number of respondents think that income generation can be positively affected by the transition to green shipping, 36.84% believe green shipping will be negative for the profitability of the industry, whilst 31.58% believe it will be neutral. Around a quarter of the respondents now believe that the impact will be positive, and around 5% believe it will be very positive.

3.2. Sentiment Analysis

A sentiment analysis of the six open questions of the survey was conducted. Sentiment analysis aims to extract human emotions, opinions, and attitudes expressed in textual data, and although it is usually applied to large amounts of digital content, the responses to the open questions allowed us to gauge the feelings underpinning the responses to questions 4, 8, 9, 13, 15 and 17 of the survey.

Table 1 shows the distribution of responses categorised as positive, neutral, negative, and undetected. Most respondents have negative feelings about the approaches ship managers or operators can take to become greener (78%), and a small percentage have neutral feelings. On the contrary, there is an overwhelming majority of positive responses to the question on ESG measures and monitoring of adherence to sustainability (94%), indicating that respondents believe certain metrics and ESG criteria are appropriate for monitoring sustainability.

Table 1. Sentiment analysis (values in percent).

	Positive	Neutral	Negative	Undetected
Q4: What approaches do you think ship managers/operators can take to become greener?	0	22	78	0
Q8: What metrics are appropriate to monitor adherence to sustainability? What should be the ESG criteria?	94	0	0	6
Q9: From a financing perspective, what are the best ways to incentivise ship managers to be more sustainable/greener?	13	81	6	0
Q13: Any comment on the impact of sustainable/green shipping on employment?	0	54	46	0
Q15: Any comment on the impact of sustainable/green shipping on income generation?	8	58	33	0
Q17: Any comment on the impact of sustainable/green shipping on profitability?	8	69	23	0

Most respondents are neutral regarding the options for incentivising ship managers to become more sustainable or greener (81%), with 13% having a positive outlook. Looking at the impact of green shipping on employment, income generation, and profitability of the industry, the overall sentiment is generally neutral or negative. A proportion of 54% feel that green shipping will have a neutral impact on employment, but 46% feel it will be negative. Significantly, there is no positive sentiment, suggesting concerns about the impact of sustainable shipping on employment. Sentiments are more mixed in relation to the effect of green shipping on income generation, and there is a wider range of attitudes, from 8% having a positive outlook, 58% a neutral outlook, and 33% a negative outlook. This distribution is consistent with the responses to the question on the impact of green shipping on profitability. A low percentage have a positive outlook (8%), more respondents feel that the impact will be neutral (69%), whilst 33% have a negative outlook.

Based on these survey results and the sentiment analysis, it seems clear that further progress needs to be made in spreading awareness and making green finance more accessible and user-friendly. The survey results indicating neutral to negative perception of green financing on profitability suggest that green financing proposals need to be carefully assessed for their impact on profit as well as environmental soundness, as prior evidence supports the argument of cost savings.

4. Conclusions

This paper aimed to explore how shipping industry participants engage with the environmental, social, and gov-

ernance (ESG) agenda in the industry, and how they view the potential impact of green shipping on the sector's income generation, profitability and employment. A survey conducted in the third quarter of 2023 mixed qualitative and open-ended questions and was disseminated to a wide spectrum of participants in the maritime profession. Based on this survey and the sentiment analysis of the open-ended questions, it seems clear that further progress needs to be made in spreading awareness and making green finance more accessible and user-friendly. The survey results indicating neutral to negative perception of green financing on profitability suggest that green financing proposals need to be carefully assessed for their impact on profit as well as environmental soundness, as prior evidence supports the argument of cost savings.

Author Contributions

Conceptualization, E.B. and S.S.; methodology, S.G.; software, S.G.; validation, E.B., S.S. and S.G.; formal analysis, E.B.; investigation, S.G.; resources, E.B..; data curation, S.G.; writing—original draft preparation, E.B.; writing—review and editing, E.B.; visualization, S.G.; supervision, E.B.; project administration, E.B.; funding acquisition, E.B.. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of Middlesex University (March 1, 2023).

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

Data supporting reported results can be found with the corresponding author.

Conflicts of Interest

The authors declare no conflict of interest.

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