

Developments In Maritime Finance & Maritime Financial Centres



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Foreword

In this era of rapid transformation, digitalization and the net-zero transition are presenting both significant challenges and opportunities across all industrial sectors, including the financial industry. Advanced digital technologies such as AI, machine learning, and blockchain are not only enabling new financial models but are also contributing to considerable efficiency gains. Concurrently, the sustainability transition is profoundly reshaping financial and business practices. This is evident in the adoption of the IFRS Sustainability Disclosure Standards and the EU's Corporate Sustainability Reporting Directive, compelling firms, including financial institutions, to rigorously assess climate-related risks and measure their carbon footprints.

The maritime finance centres are at the forefront of these changes. Technological advancements have catalysed new opportunities in the maritime industry. Fintech companies are leveraging the potential of blockchain technologies to fill the gaps created by the diminishing role of commercial banks. In the global maritime sector, there is intense competition to develop and commercialise AI-driven autonomous shipping. However, this advancement is countered by the challenges of sourcing sustainable fuels and maintaining eco-friendly fleets, which are imposing significant costs on maritime firms.

The intersection of sustainability, digitalisation, and the unique characteristics of the maritime industry could lead to the rise and fall of various maritime financial centres, potentially leading to diverse exogenous changes. This phenomenon mirrors the historical shift of the maritime finance centre from Amsterdam to London in the 18th century, influenced by factors such as financial innovations, trade expansion, and geopolitical stability.

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At this critical juncture, this Z/Yen Group's report aptly addresses the impact of the net-zero transition and digital technology on the future of the maritime industry. It explores how these changes might influence the dynamic, competitive, and cooperative relationships between different finance centres. Readers will gain insights into the principles of maritime finance and understand the recent innovations and changes brought about by digitalization and sustainability. The report also provides concrete examples from various financial centres, including Busan, London, and Tokyo, offering a comprehensive view of the latest developments in maritime finance.

I extend my heartfelt gratitude to the Right Honourable Lord Mayor of the City of London, Professor Michael Mainelli, for his profound concern for the future of the global maritime finance industry, which has been a primary motivation for this research project. Additionally, my sincere appreciation goes to Mike Wardle and Simon Mills for their unwavering dedication and efforts in completing this report.

Myongho Rhee

President, Busan Finance Center

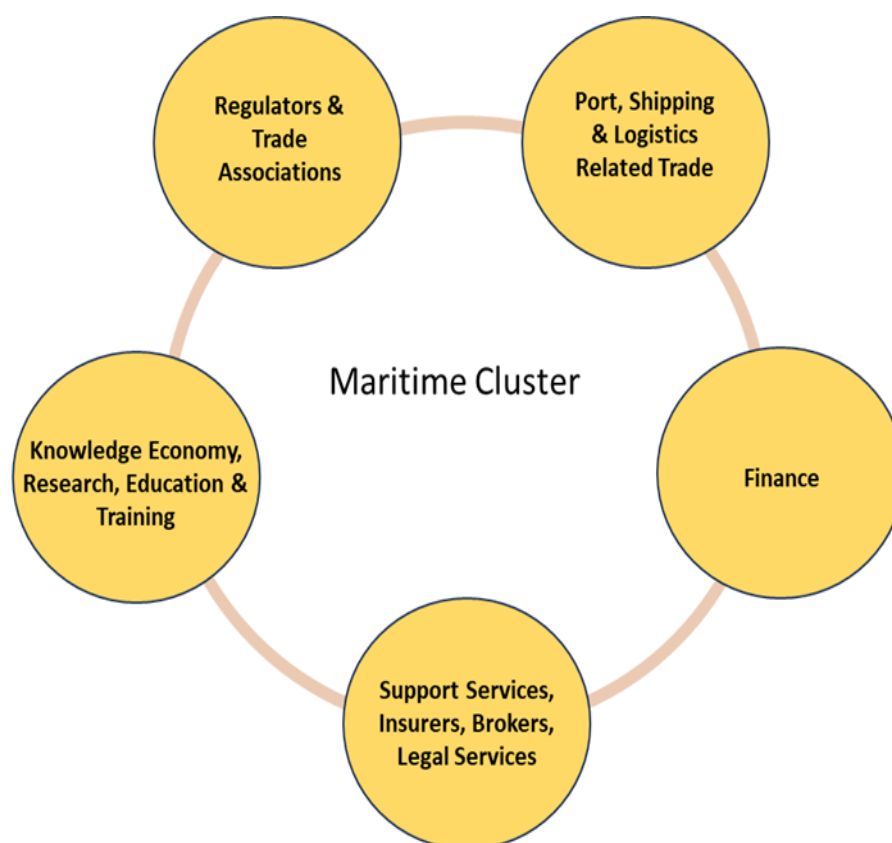


Executive Summary

Maritime Centres

The maritime sector is a critical, but hidden part of the global economy, as it facilitates up to 90% of global trade. Maritime financial centres – the clusters of interlinked businesses, organisations, and agencies that coagulate around maritime activity are extremely important for national and regional economies and can contribute significant fractions of GDP, driving growth and employment throughout the supply chain.

Maritime Clusters



Banks have become risk averse since the 2008 financial crisis and ship owners face significant challenges in financing new vessels. Global fleet size and composition changes as demand shifts, and the need to fund these changing requirements has led to the development of alternative financing models which present a major opportunity for maritime finance centres, who, by specialising in maritime finance, can outcompete larger centres and draw in new business and investment.

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However, with respect to competitiveness, past performance is no guarantee of future success. The development of effective supporting infrastructure - both physical and systemic - is crucial to maintain performance, as is communication and collaboration between government agencies, port authorities, academic institutions, and businesses. Connectivity – the diversity of other centres that a maritime centre does business with, is also important – as it enhances reputation and draws in more business. And finally, there is a great disruptive potential held by centres which embrace the (as yet unrealised) promise held by marine finance-focussed Fintech.

Fundamentally, successful maritime centres are complex ecosystems and require careful management. Because of the complexities and dynamic nature of changes, the locus of maritime centres may continue to shift, indicating the ever-increasing tensions and cooperative opportunities among maritime finance centres.

Developments In Maritime Finance

Maritime derivatives are becoming an increasingly important product in maritime finance as they can be used to hedge against risk. Although the Baltic Exchange in London pioneered the development of this type of product, other centres are developing their own markets, with Forward Freight Agreements emerging as a particularly important market segment.

The maritime sector has been relatively slow to embrace developments in Fintech, but the challenge of ship finance has created some notable emergent technologies, notably the tokenisation of marine assets which allows fractionised ownership and the spreading of risk for investors.

ESG issues are significantly influencing outcomes in the maritime sectors and are becoming a major issue for both ship owners and port authorities. However, this has opened up new financing opportunities in green bonds, sustainability linked bonds and sustainability linked loans, which maritime financial centres can leverage to gain further advantage.

Challenges For Maritime Financial Centres

Maritime financial centres face significant risks with respect to decarbonisation and the sustainability transition - national and international policy and regulation is driving short term risks with respect to fleet valuations, with knock on effects on financing for fleet operators.

In the medium term, as pressure builds to retire older, less efficient ships, the lead time required for shipbuilding may result in a reduction in global fleet capacity that pushes up charter rates and increases volatility in futures markets.

Blockchain applications hold significant promise for streamlining the maritime sector and creating significant efficiencies and cost savings, though the sector has proved resistant to digitalisation, possibly because of the current importance of intermediaries. This area holds significant opportunities for centres which innovate.

Conversely, the sector has embraced automation and AI for portside operations, and fleet operators are embracing opportunities to enhance fuel efficiency and improve safety. International law has yet to catch up with the implications of fully autonomous vessels and, as increased automation increases the risk of hostile actors causing disruption and damage, cyber security remains a concern.

Outlooks & New Opportunities For Maritime Financial Centres

There are three key challenges which will determine the success of maritime financial centres over the next few decades:

- **Embracing the challenge of financing the maritime industry** – whilst investment in docks and shoreside infrastructure has not been an issue for most maritime financial centres, ship owners are facing an increasingly tight fiscal environment, as banks and equity funds redirect capital to lower risk sectors. Maritime financial centres should consider working with stakeholders in the financial services sector to identify the obstacles and opportunities associated with developing new financial products for ship owners.
- **Embracing the challenge of net zero** – Achieving International Maritime Organisation (IMO) net zero targets will have a seismic impact on the commercial shipping fleet over the next twenty years. This will send waves throughout the industry, affecting shipbuilding, technological development, insurance, the freight futures market, and finance. Maritime financial centres should collaborate to navigate an effective course through this undertaking, whilst competing to find new products and services which will enhance their reputations and attract new business.

- **Embracing technology advancements** – Maritime financial centres have been slow to adopt developments in fintech. Many processes are still paper based and require the involvement of intermediaries for processing, adding to costs for both ship owners and clients. Digitisation holds significant promise to streamline processes and reduce costs, and new developments in blockchain technology hold promise for both ship financing and freight handling. However, the international nature of the maritime sector means that the benefits of digitalisation cannot be monopolised – a single maritime centre cannot effectively implement digital solutions (particularly with respect to freight handling) without the participation of its trading partners. Maritime financial centres should work together to develop commonly agreed standards in fintech and digitalisation which will allow the roll out of this technology globally.

To maximise the opportunities presented by these challenges leading maritime financial centres could collaborate and demonstrate leadership by:

- Leading multi-stakeholder groups to develop industry-wide strategies.
- Developing regulatory roadmaps.
- Raising awareness of key issues affecting the industry.
- Supporting the development of new financial instruments (such as SSLBs and Green loans) to assist the flow of finance into the sector.
- Encouraging the exchange of technical knowledge and collaborative research.
- Supporting the development of international standards and benchmarks.
- Contributing to international and national policy development.

In conclusion our research has found that current leading maritime finance centres need to continue innovating to maintain their positions to help manage the continuing challenge of technological and sustainability related risks. Emerging financial centres with a strong maritime tradition, such as Busan Finance Center, hold significant potential for sectoral growth because of their advanced maritime technology and active pursuit of new financial instruments.

Finally, while conducting this research, two key areas were identified that, while they did not fall within the remit of this report, may become significant issues in the medium to long term (5 to 15 years).

The first is the issue of fleet bifurcation - The US and Europe have, over the last decade, made increasing use of sanctions as a means of projecting foreign policy. These sanctions cover a range of trading nations (particularly Russia and Iran) and affect vessels docking at ports, making inter-ship transfers, or carrying goods from affected countries. Vessels breaking these sanctions violate the terms of their insurance and are unable to dock at European or US ports.

However, a “grey fleet” is emerging, which, although primarily involving older, smaller vessels may be as large as 18% of the global fleet. These vessels flout IMO regulations by disabling their automatic identification systems, employing location-hiding technologies, and engaging in location falsification to break sanctions. Analysis of the implications of this trend and recommendations on how to counter it may be a useful area for further investigation.

The second is the issue of carbon efficiency - There has been a great deal of attention paid to the carbon emissions of the global merchant fleet. However, the geographical location of certain forms of manufacturing industry (near natural and manufactured resources or drawing on low carbon energy sources) may result in carbon efficiency savings that outweigh the carbon emissions of sea transportation. Although this flies in the face of the trend for deglobalisation, further research could examine whether there is a carbon accounting case to be made for maritime finance beyond scope 1 and 2 emissions.

The Maritime Sector & Maritime Financial Centres

Introduction

The maritime sector forms the backbone of global trade, facilitating between 80% and 90% of global commodity trade¹ (by volume) and contributing around USD 380 billion a year via freight rates alone, to the global economy (see figure 1). Every year the shipping industry transports nearly 2 billion tons of crude oil, 1 billion tons of iron ore (the raw material needed to create steel), and 350 million tons of grain².

When additional segments are added, such as the construction and maintenance of ships, passenger and leisure transport, the use of ports and terminals, and financial services, including financing, insurance, and broking, the sector is worth more than USD 14 trillion³ to the global economy, and shipping and ports link global value chains and underpin global economic interconnectedness.

As a result, ports are global strategic assets which have evolved to become complex, multifunctional centres, creating a cluster effect (the concentration of complementary industries in a specific location which synergises their strengths and influences governmental, academic, and regulatory services), which acts as a critical driver of social and economic progress in cities, regions, and countries worldwide.

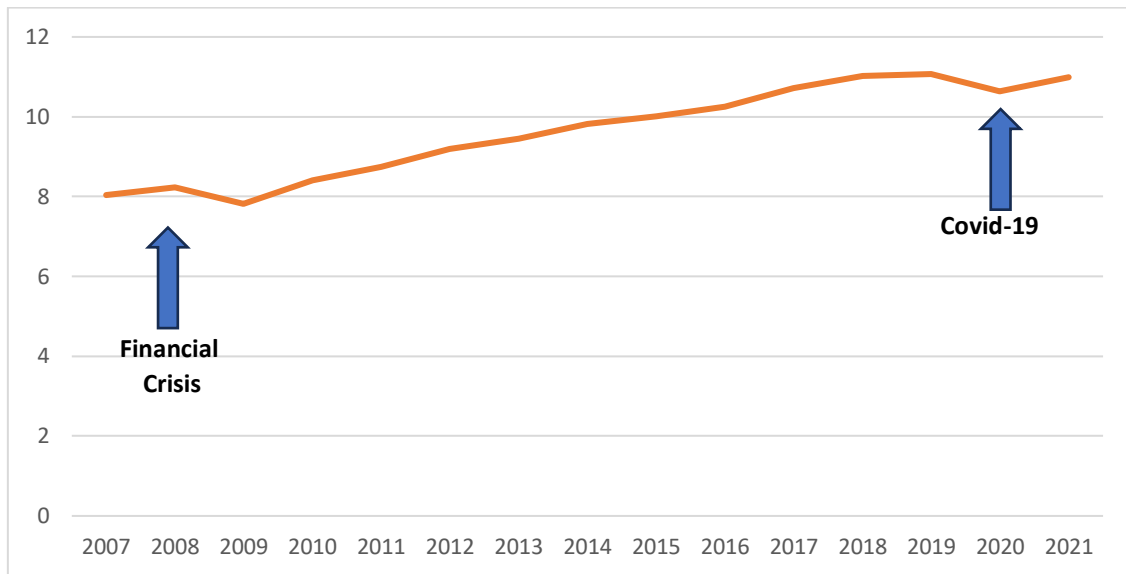
Most of the world's financial capitals, such as London, New York, Shanghai, Frankfurt, Singapore, and Busan, grew from the exchanges that were nurtured by the international connections associated with the maritime sector.

¹ OECD (accessed 1 10 23) *Ocean Shipping And Shipbuilding* <https://www.oecd.org/ocean/topics/ocean-shipping/>

² UNCTAD 2023 *Review Of Maritime Transport 2023* <https://unctad.org/publication/review-maritime-transport-2023>

³ International Chamber Of Shipping (accessed 1 November 2023) *Shipping And World Trade: Driving Prosperity* <https://www.ics-shipping.org/shipping-fact/shipping-and-world-trade-driving-prosperity/>

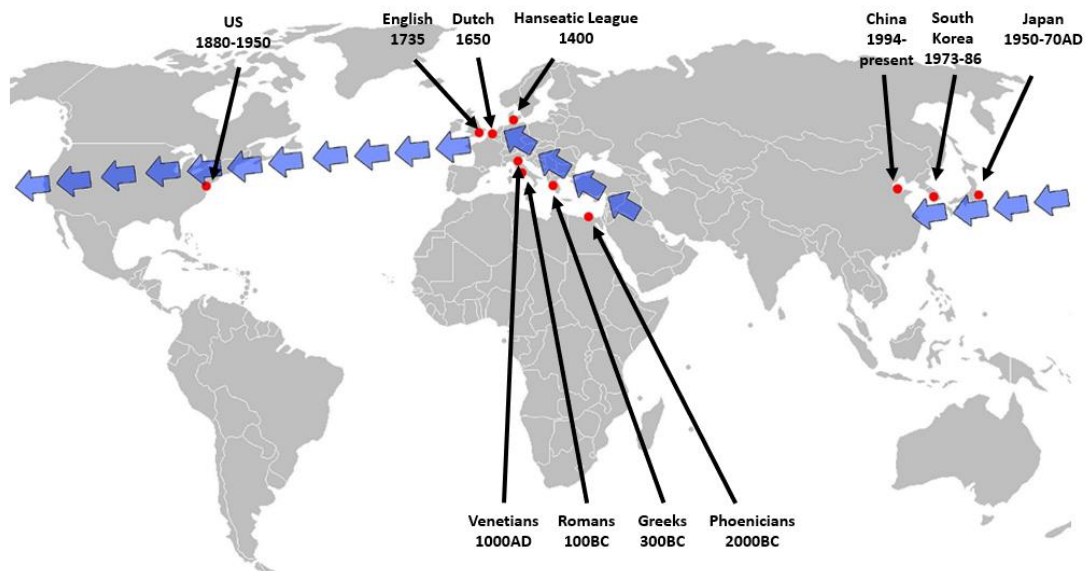
Figure 1 | Maritime Transport – Goods Loaded World-Wide (Billions Of Tonnes)



Current Size And Shape Of Maritime Markets

The locus of maritime trade has, in a well-documented phenomenon named “The Westline”⁴, gradually drifted westward over the last 5,000 years, although the causes of this drift remain a matter of speculation (see figure 2).

Figure 2 | The Westline



Adapted From Stopford 2008

⁴ Stopford, M 2008 *Maritime Economics 3rd Edition*, Routledge ISBN-13. 978-0415275583

By the 1990s, four-fifths (81%) of ship traffic was conducted in the northern hemisphere and today more than 60% of the traffic is in the Indian and Pacific Oceans⁵.

Although the locus of trade has moved, in the late twentieth and twenty-first centuries the maritime finance sector has displayed both inertia and diffusion, as Athens, London, Amsterdam, New York, Singapore, and Busan remain important centres for the provision of capital for the construction of vessels, as well as brokerage, arbitration and insurance.

In part, this is because maritime finance encompasses a diverse range of financial instruments, activities, and services that support the construction, acquisition, operation, and maintenance of vessels; and in part it is because the maritime sector by its very nature involves operating across regulatory boundaries, and maritime finance follows the nexus of trade.

The Modern Merchant Fleet

Commercial ship sizes vary enormously - dry bulk carriers can start at 20,000 dead weight tonnes (dwt) for a Handysize carrier to over 220,000 dwt for a very large ore carrier (also known as Capesize, as this class of vessel cannot fit through the Panama Canal and must travel around the Cape of Good Hope and Cape Horn).

Tankers and container vessels vary likewise - with the latter being measured in TEU (Twenty-foot Equivalent Units – the size of a standard shipping container).

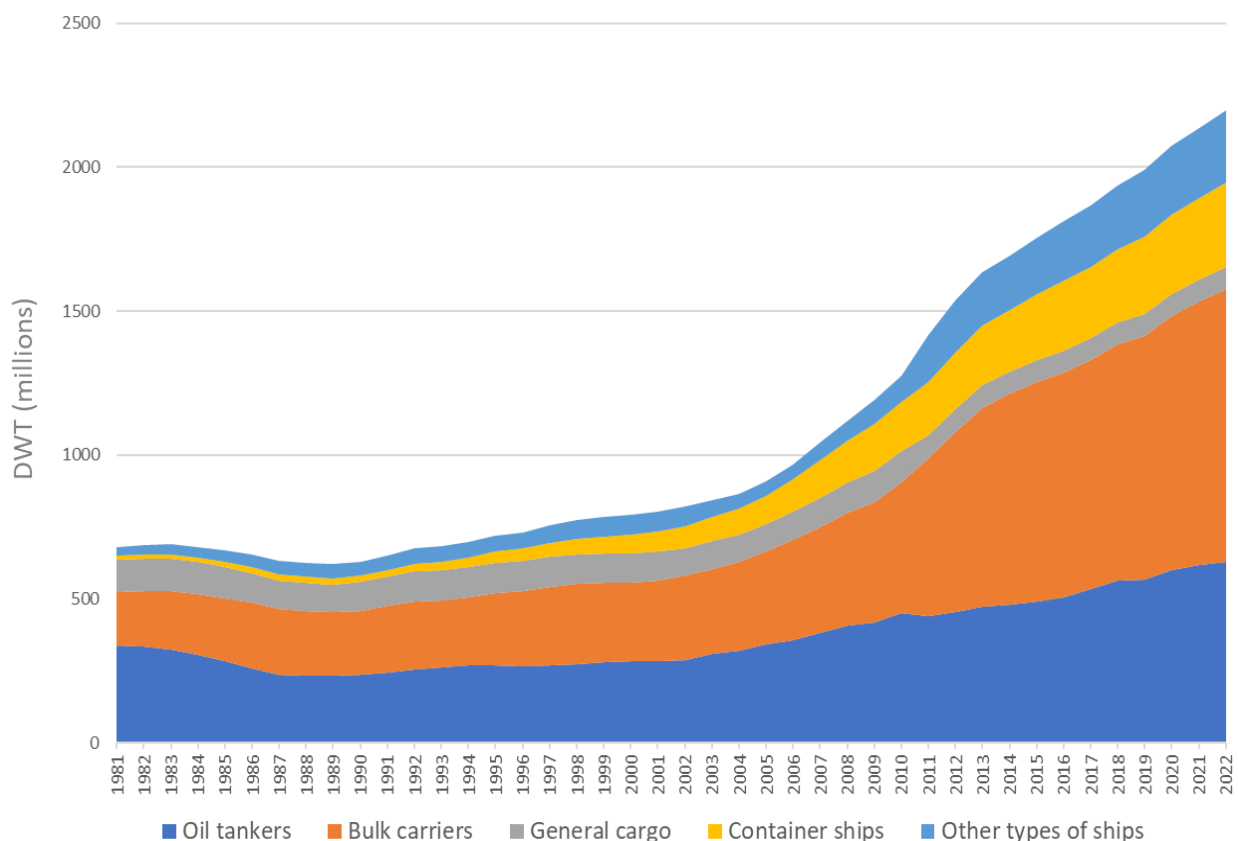
Tanker size ranges from general purpose, refined product tankers of around 10,000 dwt to ultra large crude carriers of over 500,000 dwt, and container vessel run from 1,000 to 20,000 TEU.

Build costs vary according to the size of the vessel - a small container ship can cost around USD 30 million, while a bulk carrier can cost more than USD 50 million. Swiss-based private shipping firm MSC took delivery of the Ultra Large Container Vessel, the MSC Tessa, in March

⁵ Demirel, E. 2019 *World Economy, Seaborne Trade And Posture Of Maritime Sector In The Next Decade* International Social Sciences Studies Journal, 5(46): 5389-5407

2023, built at the Changxing Shipbuilding Base in Shanghai. This vessel is part of a four-ship leasing deal which is estimated to have cost more than USD 600 million⁶.

Figure 3 | Total Size Of World Merchant Fleet (All Vessels)



Source: UNCTAD

Demand for new hulls is determined by the age of the existing fleet (with ships typically having a lifespan of 25 years), combined with other issues, such as the economic and policy environments, fuel costs, freight rates, new-building and second-hand prices, and demolition prices⁷.

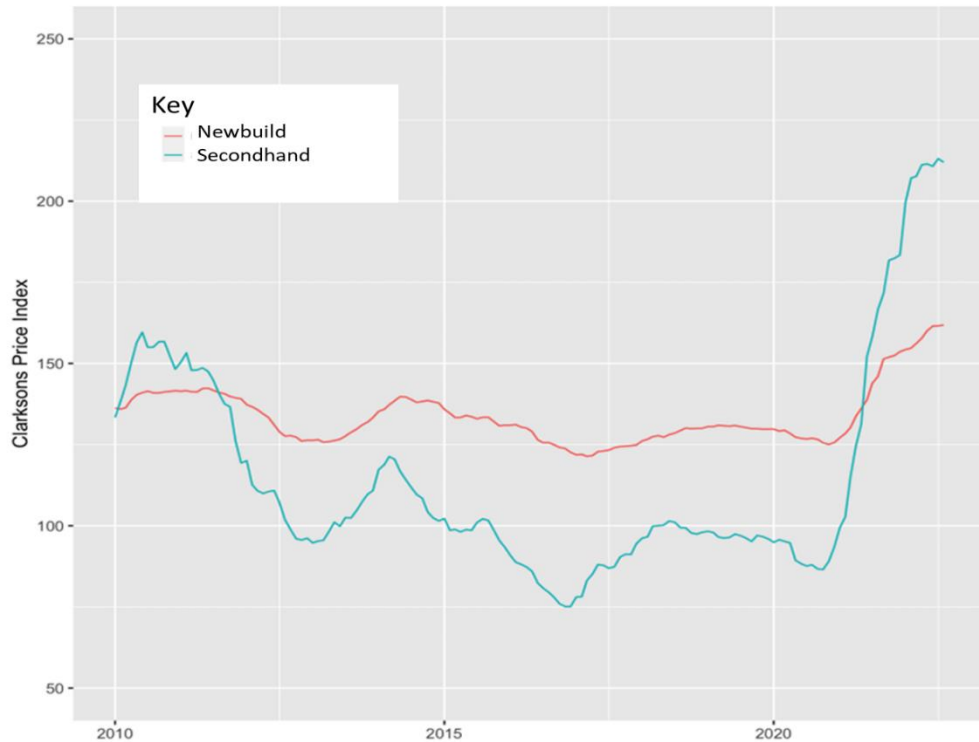
Figure 4 illustrates how the costs of new and second-hand vessels have changed over the last fifteen years, with significant price increases after the 2020 pandemic. In part this illustrates

⁶ Interesting Engineering *World's Largest Container Ship MSC Tessa Delivered, Made In China*
<https://interestingengineering.com/transportation/ultra-large-container-msc-tessa-delivered>

⁷ Knapp, S., Kumar, S. N., & Remijn, A. B. (2008), *Econometric analysis of the ship demolition market*, Marine Policy, 32(6), 1023-1036

a rise in ship building costs driven by increased raw material and labour costs, but it is also a good demonstration of how the post-pandemic rise in demand for freight (combined with a shortage of hulls) inflated second hand ship prices.

Figure 4 | Hull Costs



Source: Clarksons

Freight Rates

High freight rates are essential for ship owners to turn a profit, service debts, and purchase new vessels. At a broad level freight rates reflect:

- Customer demand – this is affected by the global economy.
- The availability of shipping – this is a factor of the total size of the merchant fleet.
- Fuel costs – A Panamax container vessel can carry around 8,000 Tonnes of bunker fuel and sailing at between 20 and 25 knots will consume about 225 tons of bunker fuel per day⁸. Fuel prices can vary between ports (see figure 5).

⁸ Notteboom, T. and P. Carriou (2009) *Fuel surcharge practices of container shipping lines: Is it about cost recovery or revenue making?* Proceedings of the 2009 International Association of Maritime Economists (IAME) Conference, June, Copenhagen, Denmark.

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- The cost of servicing debt interest on ship mortgages reflects the base rates of the jurisdiction in which the finance was raised.
- Port service charges and terminal fees - Depending on the destination, these may include freight duties, pilotage, berth, canal, anchorage, lighthouse, and sanitation fees, customs duties, tugboat, and dock fees.

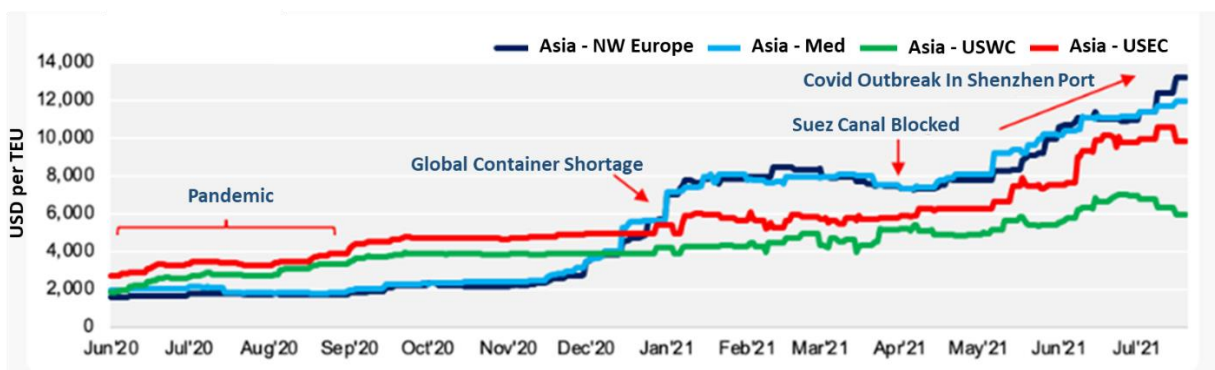
Figure 5 | World Bunker Prices 13/11/23 (prices in USD/Tonne)



Source: <https://shipandbunker.com/prices>

Between mid-2020 and early 2023 other factors, such as the global economy rebounding after the pandemic, a global shortage of shipping containers, and interruptions to major shipping routes served to push shipping rates to record highs (see figure 6)

Figure 6 | Global Freight Rates June 2020 - June 2021



Source: [czarnikow.com](https://www.czarnikow.com)⁹

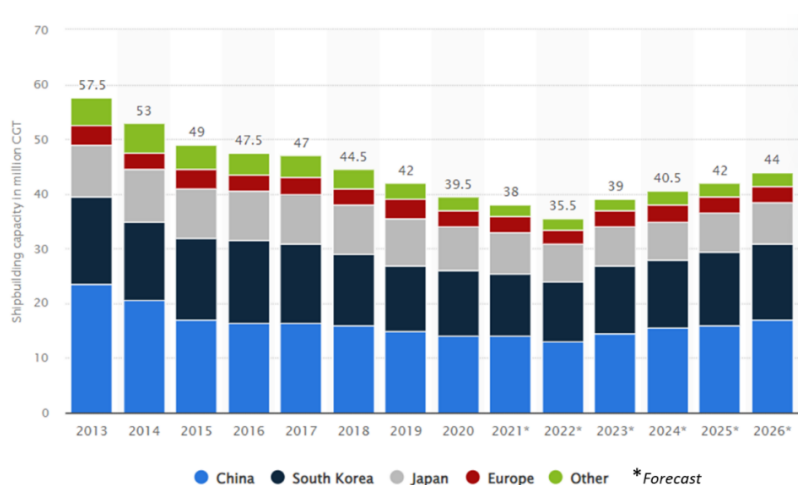
⁹ Czarnikow (accessed 12 Nov 2023) **High Freight Rates Until 2023?** <https://www.czarnikow.com/blog/high-freight-rates-until-2023>

However, by the start of 2023, freight rates began to soften as global demand declined and shipping routes cleared, and commentators¹⁰ are predicting turbulent times for freight markets over the next couple of years as global economic forecasts continue to darken.

Location Of Ship Building Activity

The People’s Republic of China’s (China) is currently the world’s largest shipbuilding economy, representing 47% of all compensated gross tonnes (CGT) delivered worldwide in 2022, closely followed by South Korea, accounting for about 38%¹¹ (with a significant fraction of this taking place at Dae Sun Shipbuilding Engineering and STX Offshore & Shipbuilding in Busan¹²). Japan came in third at 17%¹³. According to Clarksons, ordering in 2022 was dominated by LNG carriers (a record 182 vessels, 36% CGT), container vessels (350 vessels, 29% CGT: down 50% on 2021 but still the third largest on record) and car carriers (69 vessels, 2.4% CGT). The increase in LNG carriers is a direct result of the war in Ukraine. Figure 7 Illustrates the global distribution of ship building activity for the last decade.

Figure 7 | Global distribution of shipbuilding Capacity 2013-2026



Source: Statista

¹⁰ The Loadstar (accessed 12 November 2023) **Gloomy outlook for container shipping – and not just for 2024** <https://theloadstar.com/gloomy-outlook-for-container-shipping-and-not-just-for-2024/#:~:text=Drewry's%20senior%20manager%20container%20research,drop%20of%2033%25%20in%202024.>

¹¹ OECD 2023 **Council Working Party On Shipbuilding C/WP6(2023)3/FINAL** [https://one.oecd.org/document/C/WP6\(2023\)3/FINAL/en/pdf](https://one.oecd.org/document/C/WP6(2023)3/FINAL/en/pdf)

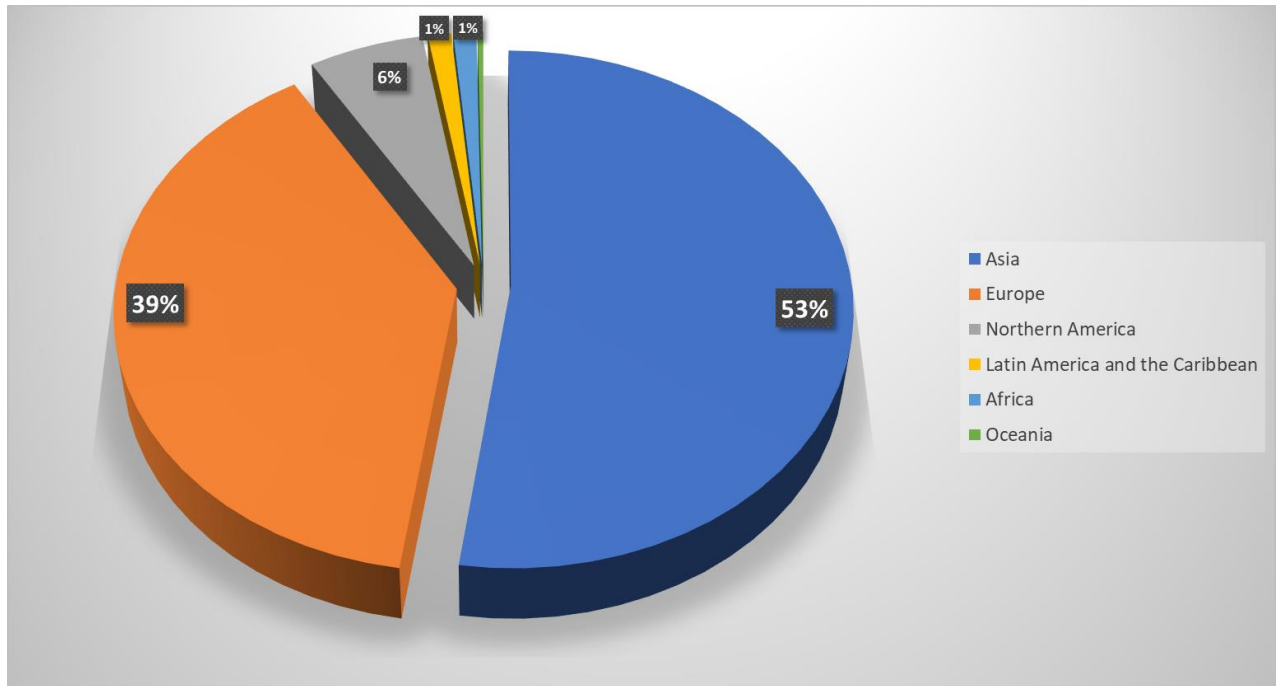
¹² OECD 2015 **Peer Review Of The Korean Shipbuilding Industry And Related Government Policies** <https://www.oecd.org/sti/ind/peerreviewofthekoreanshipbuildingindustryandrelatedgovernmentpolicies.htm>

¹³ Clarksons (accessed 4 November 2023) <https://insights.clarksons.net/2022-shipbuilding-review/>

Vessel Ownership

Between January 2021 and January 2022, the world's commercial fleet grew by 63 million dwt, to reach 2.2 billion dwt¹⁴. The geographical distribution of the beneficial ownership of vessels is illustrated in figure 8.

Figure 8 | Beneficial Ownership By Region



Source: UNCTAD Handbook Of Statistics 2023



¹⁴ EMASoH 2023 *Information Bulletin EMASoH April* <https://www.linkedin.com/pulse/information-bulletin-emasoh-april-emasoh/>

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Details of the ten largest merchant vessel companies are contained in table 1.

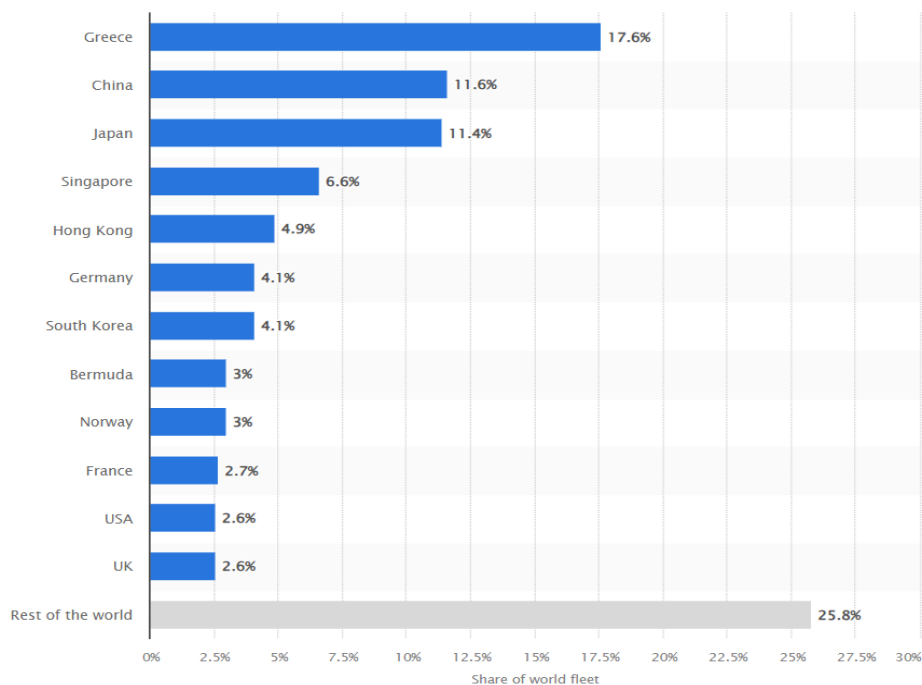
Table 1 | The Ten Largest Shipping Companies

Company	Headquarters	Details
Mediterranean Shipping Company S.A. (MSC)	Geneva, Switzerland	MSC was founded in 1970 in Italy. It is a privately owned company and has a fleet of over 500 container vessels that offer a capacity of over 4 million TEU. MSC operates out of 500 ports on 200 trade routes and employs over 70,000.
AP Moller-Maersk Group	Copenhagen, Denmark	This Danish company has been in operation since 1904. They are the largest vessel and container ship operation in the world, and have several subsidiaries providing transport and logistics operations
CMA CGM Group	Marseille, France	Founded in 1978 the CMA CGM Group offers a variety of services including vessel and container fleet management, cargo cruises, logistics, and freight delivery... Employing 110,000 people, it operates through 160 companies, 755 agencies and 750 warehouses
China Cosco Group	Shanghai, China	Founded in 1961 Cosco is a government-owned shipping and logistics company, which owns several subsidiaries including OOCL, New Golden Sea, and Shanghai Pan Asian Shipping. It operates more than 10,000 ships and 360 dry bulk vessels and employs over 130,000 people.
Hapag-Lloyd	Hamburg, Germany	Founded in 1970, Hapag-Lloyd stops at 600 ports in 130 countries. Employing around 14,000, its fleet has a capacity of 1,801,738 TEU and offers 118 liner services worldwide.
Evergreen Marine Corporation	Taipei City, Taiwan	Founded in 1968, Evergreen employs over 10,000 and has a fleet of over 200 container ships with a capacity of 1,668,555 total TEU that travel to 240 global ports.
ONE (Ocean Network Express)	Singapore	ONE began trading in 2018 and is a joint venture between K-Line, Nippon Yusen Kaisha, and Mitsui OSK Line. It employs around 14,000 people and its fleet has a capacity of 1,534,426 TEU.
Hyundai Merchant Marine	Seoul, South Korea	Established in 1976, Hyundai Merchant Marine specializes in refrigerated and dry cargo, employing around 5000 people and operating a fleet of over 160 vessels with a capacity of 816,365 TEU.
Yang Ming Marine Transport Corporation	Keelung City, Taiwan	Founded in 1972 the Yang Ming Marine Transport Corporation employs 10,000 has a fleet with a capacity of 7.74 million dwt and 705,614 TEU, which serves over 70 countries at 170 ports.
Zim Integrated Shipping Services	Haifa, Israel	Zim employs around 4,500 and operates a fleet of over 90 vessels, with a total capacity of approximately 700,000 TEUs serving more than 180 ports in 100 countries

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It is notable that Greek shipping firms are not included in table 1. Greek shipowners control more than one-fifth of the world's entire merchant fleet¹⁵ (5,514 vessels, or 21% of the global fleet in deadweight ton (dwt) terms), and the total capacity of the Greek-owned fleet has grown by 7.4% since the COVID-19 pandemic. The Greek-owned fleet represents 59% of the European Union (EU)-controlled fleet. Most Greek shipping companies are family-owned businesses which have been in shipping for many decades (some for over a century). Most have small fleets of under five vessels. These companies have survived and prospered, have repaid all their loans, and have very good credit ratings within the Greek shipping industry¹⁶.

Figure 9 | Beneficial Ownership of Vessels By Country



Source: Statista

¹⁵ Union of Greek Shipowners 2022 **Annual Report 2021-22** <https://www.ugs.gr/media/13738/annual-report-21-22.pdf>

¹⁶ Gratsos G 2014 **Greek Shipping And The Maritime Economy** <https://www.eesc.europa.eu/sites/default/files/resources/docs/gratsos.pdf>

Registration

International law requires that merchant ships are registered in a host country. However, many commercial ships are registered under flags that don't match the nationality of the vessel owner. Liberia, Panama, and the Marshall Islands (three countries with a combined population of less than ten million people) have registered nearly half of the world's merchant vessels¹⁷.

At the beginning of 2022, 49% of all ships owned by Japanese entities were registered in Panama; 25% of Greek-owned vessels were registered in Liberia and 23% in the Marshall Islands¹⁸.

Flying a 'flag of convenience' regards the registration of a ship in a different state to that of the ship's owners. Vessels registered under flags of convenience can cut operating costs and avoid regulations and taxes. Nations with open registries often make it easier to register a foreign owned vessel, some even allow companies to register vessels online¹⁹.

The top five flag states with the largest number of registered vessels are Panama, Liberia, The Marshall Islands, Hong Kong, and Singapore.

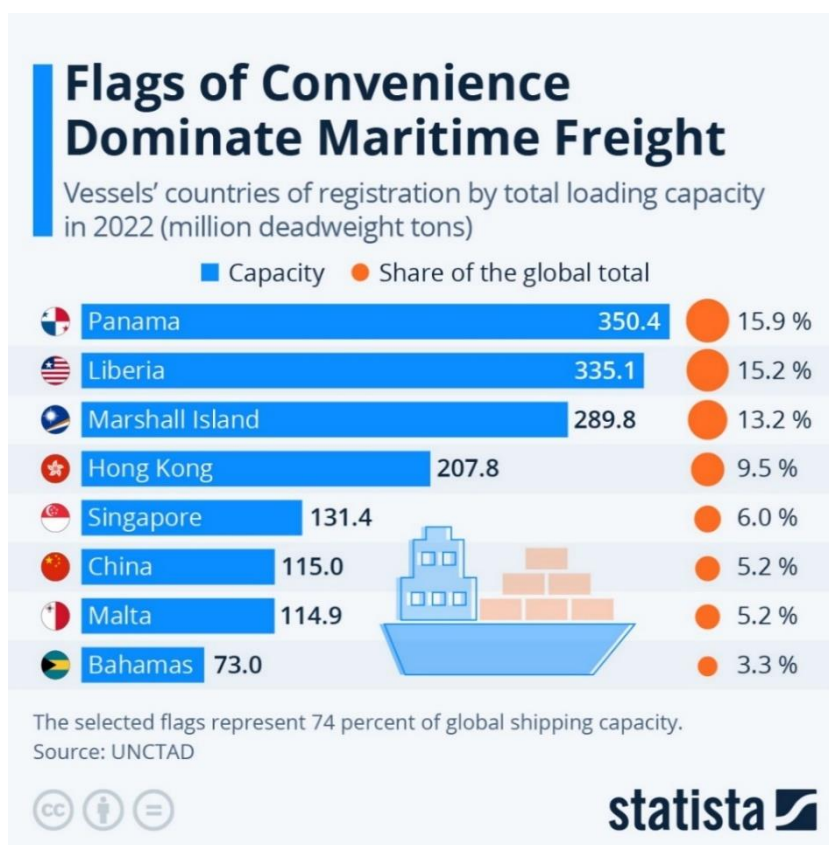
These five nations control 77% of the total number of vessels registered under flags of convenience.

¹⁷ Dickinson M 2023 *Tackle 'Flags of Convenience' and protect domestic shipping* <https://www.nautilusint.org/en/news-insight/news/tackle-flags-of-convenience-and-protect-domestic-shipping/#:~:text=Liberia%2C%20Panama%20and%20the%20Marshall,flags%20favoured%20by%20P%26O%20Ferries>.

¹⁸ Safety4sea 2019 *Why do ships choose flags of convenience?* <https://safety4sea.com/watch-why-do-ships-choose-flags-of-convenience/>

¹⁹ DieselShip.com (Accessed 20 December 2023) *Ship registration and Flag of Convenience System* <https://dieselship.com/management/ship-registration-and-flag-state-duties/>

Figure 10 | Ships Registered Under Flags of Convenience States



Source: Statista

Maritime Finance

Maritime finance is an umbrella term used to refer to the financial services associated with the commercial marine industry. This includes the purchase or lease of vessels (either new or second-hand), the refitting of ships, the hiring of vessels to transport goods, marine insurance, and all associated legal services.

Purchasing And Refitting Vessels

Acquiring a vessel is a capital-intensive endeavour, requiring significant financial investment. Ship financing typically involves a mix of equity and debt. Equity financing involves investors contributing capital to acquire ownership stakes in vessels, while debt financing involves loans secured by the vessels themselves. Shipowners carefully balance these two components to optimise their capital structure.

Shipping finance transactions are a form of asset finance, and generally involves a lender providing funding to a borrower for the purchase of a vessel- either a brand-new vessel, built under contract with a shipyard, or an existing second-hand vessel, which may have to undergo a refit. A borrower may also be seeking to refinance an existing debt on more favourable terms.

Today's ship mortgages originate from the ancient practice of 'bottomry'²⁰, which was when a shipowner, to borrow money, had to pledge his ship as security for the loan. The lender was entitled to take possession of the vessel, and sell it, if the borrower was in default.

A simplified debt financing arrangement is illustrated in figure 10. Typically, a lender will take collateral on a loan in the form of mortgage and may seek initial deposit on between 10 and 40% of the loan value (the size of the deposit will depend on the perceived risk of the loan and the length of the relationship the lender has had with the borrower).

Due to the considerable size of finances required to purchase ships, shipping loans have traditionally been arranged as syndicated loans. Syndicated loans are where a group of financial institutions collaborate to offer ship owners loans whilst spreading risk and allowing individual members of the syndicate take part in financial opportunities that may be too large for their individual capital base. Syndicated loans are becoming increasingly popular in Asian markets. European and American banks have yet to catch up, however BIMCO (The world's largest direct-membership organisation for shipowners, charterers, shipbrokers, and agents.) has developed a standard term sheet²¹ for syndicated ship financing allowing ship owners to more easily compare between loan offers. Currently, more than 60% of shipping finance consistently comprises syndicated loans²²

The maritime sector is heavily exposed to market volatility. Changes in freight rates (a function of demand in the global economy, the number of vessels available for hire, and port capacity) as well as factors such as fuel costs and regulatory changes can all impact on profitability, which is why fleet owners tend to diversify their portfolio of vessels.

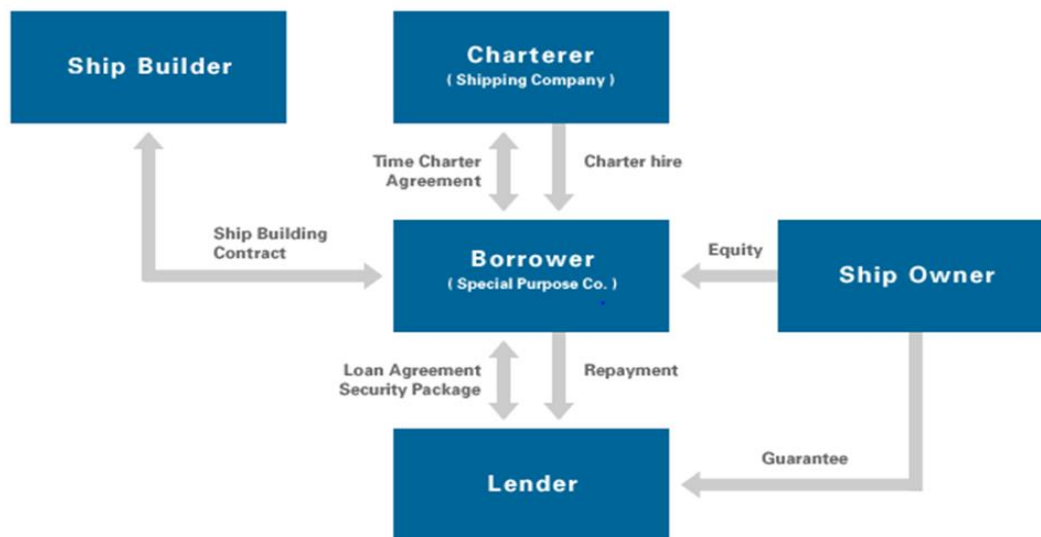
²⁰ <https://legal-dictionary.thefreedictionary.com/Bottomry>

²¹ <https://www.bimco.org/contracts-and-clauses/bimco-contracts/shipterm-s>

²² Lee, K.R. and Pak, M.S., 2018. *Multi-criteria analysis of decision-making by international commercial banks for providing shipping loans*. Maritime Policy & Management, 45(7), pp.850-862.

The aftermath of the 2008 financial crisis saw an exodus of banks from the maritime finance sector, a trend that continued within both European and US markets until early 2021 (although European banks still hold a 49% share of the global market, and Asian and Australian banks' share has increased to 44%).

Figure 11 | A Simplified Ship Financing Model

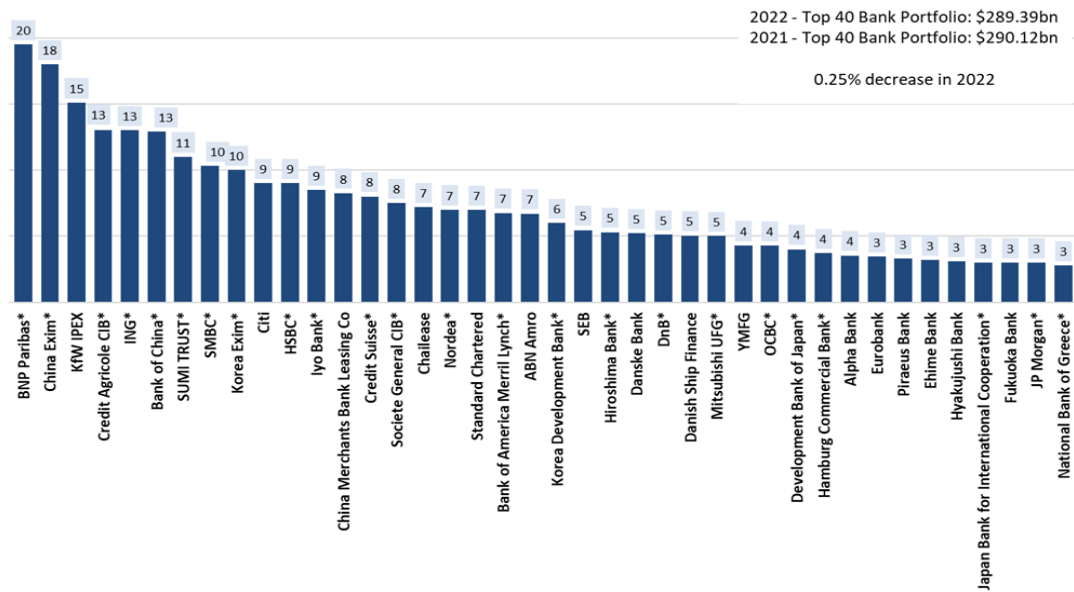


Rapidly expanding demand, post-pandemic, saw ship owners' profits rising rapidly, and as a result debt funds, and lessors have "showered" shipowners with relatively inexpensive capital over the past 24 months²³. However, in 2022 the top 40 banks' total lending to shipping was USD 289.39 billion, a fall on the 2021 level of USD 290.12 billion²⁴.

²³ Hellenic Shipping News 2023 *Changing seas of ship finance*
<https://www.hellenicshippingnews.com/changing-seas-of-ship-finance/#:~:text=The%20challenge%20for%20owners%20seeking,which%20have%20limited%20financing%20volumes>

²⁴ Petropoulos P 2023 *Key Developments and Growth in Global Ship Finance* Petrofin Research

Figure 12 | The Top 40 Global Ship Finance Banks Ranked (USD billion)



Source: Petrofin

Alternative Sources Of Finance

In the years since the global financial crisis, maritime finance has seen significant changes. As banks have scaled back exposure or withdrawn completely from ship finance, traditional financing has been replaced by convertible debt, private equity, bonds, and sale-and-leaseback arrangements.

This trend has increased over the past year caused by, in part, the volatility in the sector because of the COVID-19 pandemic, and certain banks, most notably many European banks, exiting the sector and selling their shipping portfolios or not taking on new business while existing loans are paid off.

Equity

Equity finance comes in four varieties for the shipping industry - owner equity, private equity, limited partnerships, and public offerings.

- Owner Equity - Most shipping companies finance a part of their investments with equity that comes from retained earnings or the owner's private resources.
- Private Equity - There are several ways in which private equity funds can make investments within the shipping sector, including entering into joint ventures with ship owners, taking direct ownership stakes in vessels, acting as mezzanine lenders,

or purchasing existing debt from banks. Despite a buoyant market, in the last eighteen months, institutional investors have been moving money out of shipping and into less risky investments, driven by the rise in base rates which has made equity positions in shipping assets less appealing. Significant players in the sector include J.P. Morgan Asset Management (JPM), Oaktree Capital Management, Carlyle Group, Blackstone Group LP, Apollo Global Management LLC, and WL Ross & Co. LLC.

- Limited partnerships – see One-Ship KGs and JOLCOs (below).
- Public offering - A public offering takes the form of flotation on one of the world's stock exchanges. London, New York, Oslo, Singapore, Hong Kong, and Stockholm all have stock exchanges used by the shipping industry, with Oslo being particularly favoured, hosting around 40 maritime companies with a combined market capitalisation of close to USD 20 billion²⁵. However, raising equity through public offering has a mixed history due to the high volatility of the shipping market.

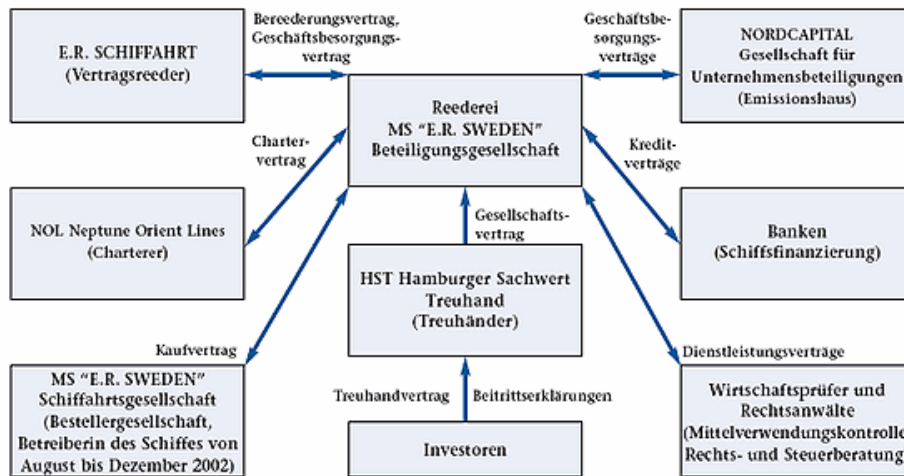
One-Ship KGs

An early experiment in alternative funding can be seen in the ill-fated German "one ship KG" financing model. In 2004, the establishment of single ship *Kommanditgesellschaften*, or limited partnerships, combined with a favourable tax regime, saw a flood of private investors pour into this market²⁶. The hallmark of this model is that investors can gain benefits from both shipping performance and flat tax rates. Since taxes are levied according to shipping capacities and not the actual generated revenues, investors can expect positive returns from their shipping investments.

²⁵ Nor Shipping.com (accessed 08 November 2023) *Oslo tops chart for shipping listings* <https://nor-shipping.com/oslo-tops-chart-for-shipping-listings/>

²⁶ Kravets & Kravets (accessed 08 11 2023) *The rise and fall of the German "one ship KG" financing model* [https://www.kravets.de/kk-report/2014/10/14/rise-and-fall-of-one-ship-kg-financing-in-germany#:~:text=2007\)%2C%2026%25%20of%20global,been%20removed%20from%20the%20market.](https://www.kravets.de/kk-report/2014/10/14/rise-and-fall-of-one-ship-kg-financing-in-germany#:~:text=2007)%2C%2026%25%20of%20global,been%20removed%20from%20the%20market.)

Figure 13 | The In One Ship KG and Surrounding Management Company, Banks And Investors



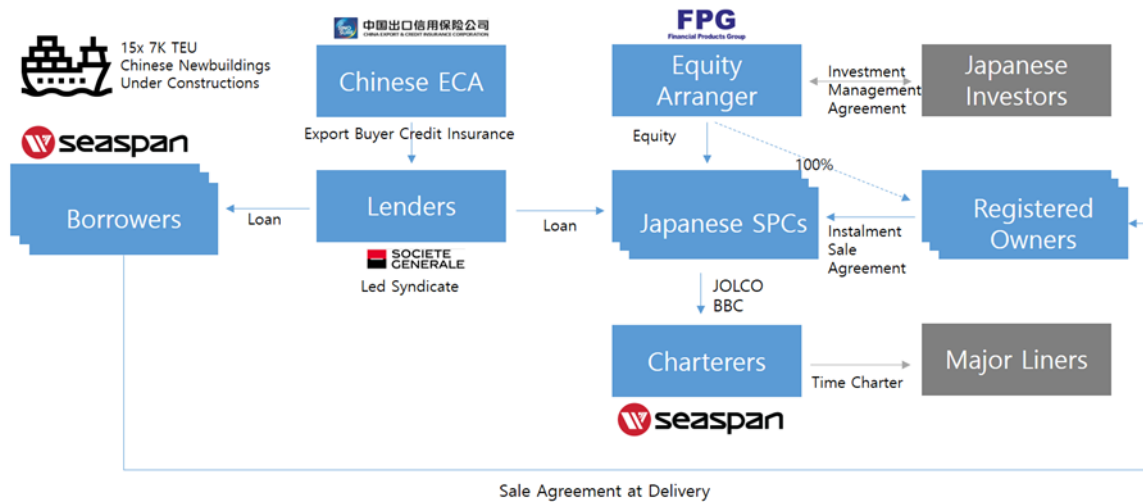
Source: Kravets.de

Initially, the high charter rate saw significant profits, and in 2007, 26% of global order book tonnage came from German one ship KGs. However, the financial crisis saw the bottom drop out of demand in the shipping sector, a significant number of investors had their fingers burned, and today that figure is less than 2%.

JOLCOs

Widely used in the aviation sector, the Japanese Operating Lease with Call Option or JOLCO has become an increasingly popular source of financing in shipping over recent years. JOLCO finance is a sale and leaseback arrangement that benefits from the tax advantages available to Japanese investors that allow the ship owner to reduce the cost of financing. The JOLCO model's advantage lies in the special depreciation allowance permitted by the Japanese government for asset lessors. This allows for accelerated depreciation of assets such as ships, resulting in significant tax benefits for the lessors. These benefits can indirectly favour ship owners or operators, as they often translate into reduced leasing costs.

Figure 14 | An example of Japanese Operating Leases



Source: Busan Finance Center

As banks become more regulated and risk averse, ship owners are seeking alternative structures that give them cash liquidity, flexibility and returns. The fundamental structure of a leasing arrangement is for a ship owner to give a lessee full possession and operational control of the ship for an agreed period in return for an agreed rent/hire charge. The most common types of leasing structures are the operating lease, and the finance lease.

Operating leases or full-service leases are used for short to mid-term charter of the ship (for a single voyage or a series of voyages) and at the end of the term, the ship is returned to the owner. Operating leases can be terminated by the lessee at short notice, with minimal compensation to the lessor.

Finance leases are used for the long-term finance of ships, with the lessor acting as the de facto financier. The lessor is not involved in the operation of the ship (other than owning it) and the lessee enjoys the benefits (and the risks) of ownership of a vessel without the up-front capital costs. Finance leases contain a clause meaning the lessee cannot in any circumstances terminate the lease or be excused from paying hire. If the lease is terminated early, the lessee must compensate the lessor.

Sale and leaseback arrangements can be used by shipping firms seeking to increase liquidity or reduce their exposure to volatility in shipping markets. Key players in the leasing market include First Ship Lease Trust (Singapore), Global Ship Lease (London), IFCHOR Galbraiths

(London), CMB Financial Leasing (Shanghai), ICBC Leasing (Beijing), Bank of Communication Financial Leasing (Shanghai), Hamburg Commercial Bank (Hamburg), Minsheng Financial Leasing (Tianjin), Maersk (Copenhagen), and CCB Financial Leasing (Beijing).

Bonds

The Norwegian bond market is seen as particularly favourable for shipping assets, with significant offerings of green bonds. Decarbonisation of fleets is seen by ship owners as a priority as the International Maritime Organisation (IMO) has set a target reduction of 50% in greenhouse gas emissions from the maritime sector by 2050 (see page 33). The sector currently accounts for around 2.9% of global emissions.

Other Segments Of The Maritime Finance Sector

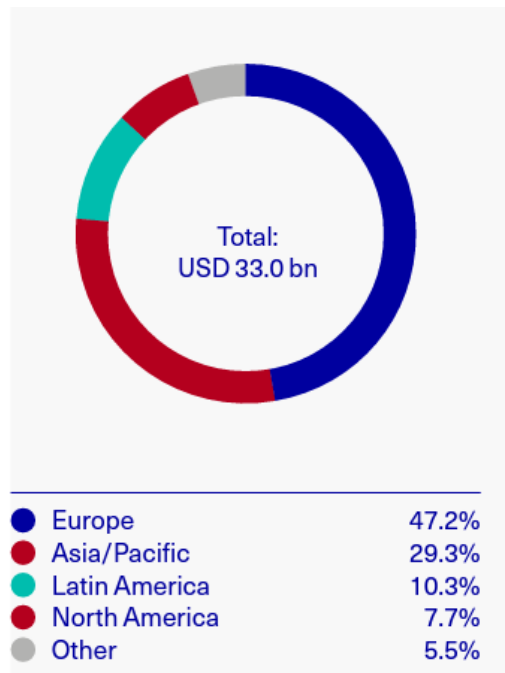
Shipbroking - Shipbrokers are specialist intermediaries/negotiators between ship owners and customers who wish to charter ships to transport cargo, as well as between buyers and sellers of vessels. The shipbroking Market size was valued at USD 1.34 billion in 2021 and is projected to reach USD 1.73 billion by 2030²⁷. This significant growth is being driven by the adoption of new technologies such as artificial intelligence, machine learning, blockchain and Augmented Reality (see page 45). The key global centres for shipbroking are London, New York City, Singapore, and Tokyo, though all maritime centres have some shipbroking expertise.

Insurance - Insurance and ship finance are closely connected as a ship financier will wish to minimise credit risk by having a vessel as collateral security for the loan. This vessel will need to be adequately insured to serve as sufficient security. As a result, marine insurance is a large and profitable sector. The global marine transport insurance market collected premiums more than USD 35 billion in 2022, an increase of 8.3% over the previous year²⁸. European insurers held the bulk of the market share (see figure 14), lifted by a combination of increased global trade volumes, a stronger US dollar, increased offshore activity and higher vessel values.

²⁷ Technavio 2023 *Shipbroking Market by Application, End-user, and Geography - Forecast and Analysis 2023-2027* <https://www.technavio.com/report/shipbroking-market-industry-analysis>

²⁸ IUMI 2022 *Analysis of the global marine insurance market* https://iumi.com/document/view/IUMI_Stats_Report_2022_638778cd10a7a.pdf

Figure 14 | Regional Share Of Marine Insurance



Source: IUMI

Legal Services - Maritime policy and the laws that enforce it can be disaggregated into international, regional, and national policies. The United Nations Convention on the Law of the Sea (UNCLOS) is the international agreement that provides the top level defining the rights and responsibilities of nations in their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources. Each region and nation has absorbed this into their own regulatory frameworks.

Globally the maritime law sector is estimated to be worth more than USD 2 billion. Within the field of maritime law, there are 3 key service segments:

- Litigation & dispute resolution.
- Shipping Finance (including mergers & acquisitions).
- Contractual Work (including charters & insurance).

The United Kingdom is the largest centre for maritime law globally (with around a 25% share of the value of the global market). The UK's strength in this sector is partly due to long-

established legal infrastructure such as Admiralty and Commercial Court judges, but mainly due to the ubiquitous use of English law in the maritime sector²⁹.

Characteristics Of Maritime Financial Centres

Menon Economics and DNV have produced a bi-annual annual report ranking maritime financial centres since 2019. The publication is highly influential and has been credited with prompting China to promote Shenzhen, Shanghai, and other cities to build 'Global Maritime Capital' in its 13th Five-Year Plan for Maritime Economic Development³⁰. In addition, such analyses have paid close attention to emerging financial centres such as Busan for their advanced maritime technology and ecosystem developments. The index measures performance of maritime centres across five pillars – Shipping Centres, Maritime Finance & Law, Maritime Technology, Ports & Logistics, and Attractiveness & Competitiveness. Details of the top 20 maritime centres are contained in table 2.

For the last 16 years, Z/Yen has published two Global Financial Centres Index reports a year which have charted the progress of the world's leading financial centres. The GFCI provides profiles, ratings, and rankings for 111 financial centres, drawing on two separate sources of data – 147 instrumental factors (external indices) and more than 9,000 responses to an online survey.

Comparison between the latest GFCI report and the Menon Economic Index reveals that although there is some consistency in ranking between the two indices (see Figure 13), there are some notable disparities – particularly for Oslo, Hamburg, Copenhagen, Busan, and Athens, which are ranked lower in the GFCI than the Maritime Centres Index – substantially lower in the case of Athens.

²⁹ City Of London 2016 *The UK's Global Maritime Professional Services: Contribution and Trends*
<https://www.cityoflondon.gov.uk/assets/Business/the-uks-global-maritime-professional-services.pdf>

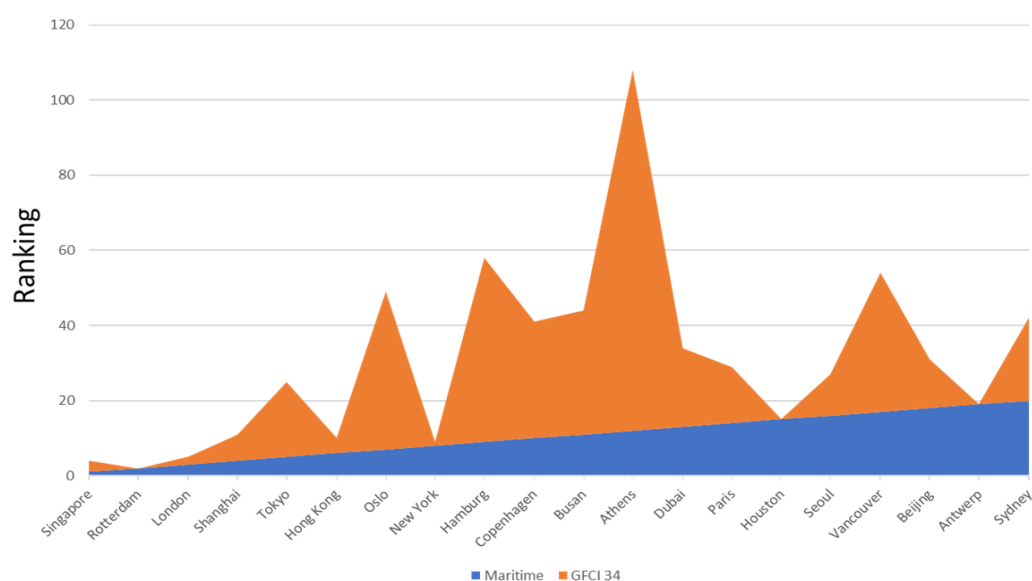
³⁰ Cheng Y et al. 2023 *The construction of Global Maritime Capital - Current development in China Marine Policy*, Volume 151, May 2023 <https://www.sciencedirect.com/science/article/abs/pii/S0308597X23001033>

Developments In Maritime Finance & Maritime Financial Centres

Table 2 | The Top 20 Maritime Centres (Menon Economics and DNV)

	SINGAPORE	ROTTERDAM	LONDON	SHANGHAI	TOKYO	HONG KONG	OSLO	NEW YORK	HAMBURG	COPENHAGEN	BUSAN	ATHENS	DUBAI	PARIS	HOUSTON	SEOUL	VANCOUVER	BEIJING	ANTWERP	SYDNEY
Ease Of Doing Business	Q: Entrepreneur	1	1	6	7	3	10	13	5	4	12	11	9	26	15	16	20	16	26	26
	Q: HQ	1	5	2	3	10	4	10	7	8	12	11	5	36	15	18	19	28	24	36
	Q: Maritime Centre	1	5	3	2	11	4	12	8	9	16	10	6	33	16	23	20	19	27	33
	STRI Index	10	1	6	21	7	x	15	29	2	137	19	36	4	29	19	3	20	16	14
	Entrepreneurship	25	10	8	29	22	11	3	1	14	2	17	40	12	1	17	6	6	29	15
	Transparency/corruption	2	4	6	34	11	6	3	18	5	2	27	32	16	14	20	4	27	34	10
	Ease of doing business	1	37	11	25	22	2	12	4	19	16	4	15	34	4	4	20	24	38	14
Port & Logistics	Q: Ports	1	2	x	3	9	x	16	5	x	9	19	6	x	14	x	27	21	11	23
	LNG available at ports	4	1	x	x	x	x	x	x	45	4	x	x	x	x	x	x	x	7	x
	Line Shipping Connectivity index	2	6	19	1	13	4	23	11	x	x	18	12	x	30	x	33	46	7	37
	Size of Port Operators	3	4	x	2	8	1	x	7	x	x	x	5	14	x	12	x	x	x	x
	TEU in port	3	10	18	2	22	8	20	12	6	6	6	11	x	34	32	30	7	15	36
Maritime Technology	Q: R&D	1	7	3	3	8	2	18	5	4	11	12	10	30	15	17	23	20	26	30
	Q: Digital	1	6	5	3	10	2	11	7	3	13	14	8	26	14	17	11	23	14	26
	Q: Sustainability	2	4	6	7	8	1	14	5	5	4	12	9	26	13	17	11	23	14	17
	Q: Technology	1	8	7	3	6	2	16	3	5	4	15	16	31	13	10	31	26	23	31
	Maritime education institutions	5	2	1	10	3	16	10	3	12	x	31	3	7	15	31	16	15	22	23
	Maritime patents	11	2	6	17	6	3	9	17	4	x	1	39	7	8	1	27	20	22	30
	Market value of ships	8	18	x	2	6	19	10	17	x	1	1	11	x	x	x	x	15	x	x
	Classi-ed eet	16	x	4	18	2	2	1	19	32	7	2	21	6	3	24	x	5	x	x
	Turnover Marine Technology Companies	5	10	8	3	6	35	13	18	x	2	2	25	9	28	4	36	1	24	40
	Shipyards deliveries - eco-friendly ships	11	9	x	2	5	21	15	16	11	1	1	18	x	x	21	21	21	x	x
	Shipyards deliveries	13	9	x	2	8	25	22	17	11	1	1	28	x	x	31	29	21	x	x
Maritime Finance & Law	Q: Finance	2	9	1	6	7	4	3	8	11	25	12	10	5	17	27	27	13	17	20
	IPO/Bonds/Follow ons	3	6	9	8	10	2	1	10	22	5	19	x	x	x	x	x	x	11	x
	Market cap maritime companies	7	x	13	3	6	2	10	22	15	12	4	26	11	x	x	x	x	24	16
	List maritime owner groups	7	x	6	9	4	2	1	21	18	7	16	x	2	x	x	x	x	21	19
	Shipping banks portfolio	13	4	6	x	3	x	5	9	9	9	x	10	4	x	7	x	1	x	12
	Mandated loans	x	5	6	x	3	x	2	x	7	x	x	x	4	x	x	x	x	x	x
	Insurance premiums	3	7	1	16	2	19	9	10	29	29	28	17	4	x	8	x	5	11	13
	Maritime lawyers	8	5	1	15	26	10	16	9	36	5	x	3	10	14	36	21	24	7	20
	Legal experts	7	7	1	x	14	10	14	14	5	16	x	16	12	x	x	6	x	16	2
	Shipping	Q: Operations	1	6	5	2	15	11	21	7	10	19	9	3	34	15	20	24	29	30
Q: Shipping		1	8	2	5	11	4	12	6	9	21	3	10	29	16	26	29	29	19	29
Env. friendly eet size - owner		8	16	4	12	2	15	38	9	7	30	1	24	19	13	6	22	1	20	33
Turnover shipping companies		14	26	5	2	3	21	24	8	4	20	39	10	35	19	40	40	1	23	41
Number of shipping HQ		3	4	14	9	6	18	21	5	26	16	2	10	46	29	7	37	29	20	43
Fleet value - owner		6	11	9	4	3	11	16	3	7	31	1	26	36	17	8	25	19	23	45
Fleet size - owner		2	11	9	2	2	5	19	2	9	31	1	18	45	20	7	43	21	16	45
Fleet size - management		2	9	9	2	3	4	16	2	9	11	1	10	45	17	8	25	37	22	46

Figure 15 | Comparison Between GFCI 34 And The Maritime Centres Index



These disparities illustrate that, whilst the criteria for success for both financial services and maritime financial services are broadly similar (clustering of financial services, an enabling business environment, effective infrastructure, and readily available human capital), maritime finance remains a niche field where smaller, nimble centres have become specialised providers of high value-added services, such as maritime financial, legal, insurance, and brokerage.

These market segments which are critical to the functioning and performance of multinational firms' local and global operations allow smaller financial centres to develop specialisms which dramatically increases their standing as maritime financial centres.

Successful Maritime Centres

Research confirms that maritime centres contribute large amounts of value to national economies - in some cases a significant percentage of total GDP and employment³¹. The value and demand created in the maritime cluster results in investment in supply chains and increases in consumption, which creates further jobs and demand³². There is also some

³¹ DSA 2010 *The Economic Significance of Maritime Clusters - Lessons Learned from European Empirical Research* Working Paper The Danish Shipowners' Association

³² Goodwin A 2016 *The Economic Value Of Shipping And Maritime Activity In Europe* Oxford Economics https://www.oecd.org/sti/ind/Session%201_c%20-%20Andrew%20Goodwin%20-%20Presentation%20for%20Website.pdf

Developments In Maritime Finance & Maritime Financial Centres

evidence that nations with maritime centres have a higher GDP per capita than those which do not.

Table 3 | Global Maritime Centres And Their Rankings In The GFCI Index

City	GFCI Ranking	Maritime Finance Developments
London	1	Known for its rich history and prominence in maritime finance, London is a hub for shipping and insurance. The city is home to a multitude of shipping firms, brokerage houses, and the Baltic Exchange, a pivotal player in the shipping market.
New York	2	As a pivotal maritime finance hub, New York excels in ship financing and maritime insurance. Its famed Wall Street and financial institutions provide substantial backing for maritime investments.
Singapore	3	As a leading global maritime hub, Singapore has rapidly established itself as a central maritime finance city in Asia. It offers an extensive array of financial services to the maritime sector, including banking, insurance, and legal support.
Hong Kong	4	Playing a key role in the Asia-Pacific region, Hong Kong is a major centre for maritime finance. It offers a variety of services like ship financing, maritime insurance, and a strong legal framework for maritime dealings.
Shanghai	7	Emerging swiftly as a leading maritime finance centre, Shanghai is gaining prominence alongside the growth of China's shipping industry.
Tokyo	20	Tokyo plays a vital role in maritime finance, closely linked to Japan's shipping sector and known for its involvement in maritime financing models like JOLCO.
Busan	30	As home to one of the world's busiest and most technologically advanced ports, it plays a crucial role in the shipping industry. Busan's growth as a maritime finance centre is bolstered by South Korea's strong shipbuilding industry and its strategic position in international shipping routes.
Oslo	42	Renowned for its maritime heritage, Oslo is especially recognised for its contributions to shipping finance, insurance, and maritime technological innovations.
Hamburg	49	Hamburg stands out as a crucial maritime centre in Europe, marked by its concentration of shipping companies and financial institutions focused on ship finance.

Clustering is extremely important to maritime centres. Porter³³ gives the following definition for clusters: *“Clusters are geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standard agencies, and trade associations) in particular fields that compete but also cooperate.”*

³³ Porter, M. *On Competition*; Harvard Business School Press: Boston, MA, USA, 1998

Clusters tend to have the following features in common:

- Physical proximity of sector participants.
- A shared focus and strong linkages between sector participants.
- Good information exchange between sector participants.
- Strong institutional infrastructure supporting the activities of the sector.
- A strong cultural identity and common values.

In summary, strong local government, effective maritime associations, forward looking research institutions, and ongoing stakeholder engagement are all essential to ensuring that centres remain attractive locations for maritime business³⁴.

Whilst it is a truism that maritime financial centres owe their success and continued existence to their historic status as regional ports and commercial hubs; a centre's past success is no guarantee of continued relevance. Venice in Italy, Liverpool in England, and New Orleans in the United States all lost their status as maritime centres due to a combination of factors including war, lack of investment in infrastructure and changing technology (notably the development of railways in the case of New Orleans³⁵).

Connectivity

Today's successful maritime centres demonstrate high levels of connectivity with other locations, as they typically have a good physical information and communication infrastructure that facilitates the international transfer of goods, people, and information to national, regional, and international markets. Figures 14i-iii illustrate the connectivity of Singapore, Busan, and Sydney³⁶. These diagrams are created from data collected in the 34th Global Financial Centres Index³⁷, and illustrate that higher ranking centres have high levels of business connectivity with other financial centres, reflecting the international nature of maritime finance.

³⁴ Robins D 2012 *Clustering in the Marine Industry* Channel Arc Manche Integrated Strategy Technical Report

³⁵ Kaufman B 1973 *New Orleans and the Panama Canal, 1900-1914* Louisiana History: The Journal of the Louisiana Historical Association Vol. 14, No. 4 (Autumn,) pp. 333-346

³⁶ Z/Yen 2023 *GFCI 34 Connectivity Tool* <https://www.longfinance.net/programmes/financial-centre-futures/global-financial-centres-index/gfci-34-explore-the-data/gfci-34-connectivity-chart/>

³⁷ Z/Yen 2023 Global Financial Centres Index 34, Z/Yen Group <https://www.longfinance.net/publications/long-finance-reports/the-global-financial-centres-index-34/>

Figure 16i | Singapore Connectivity Chart

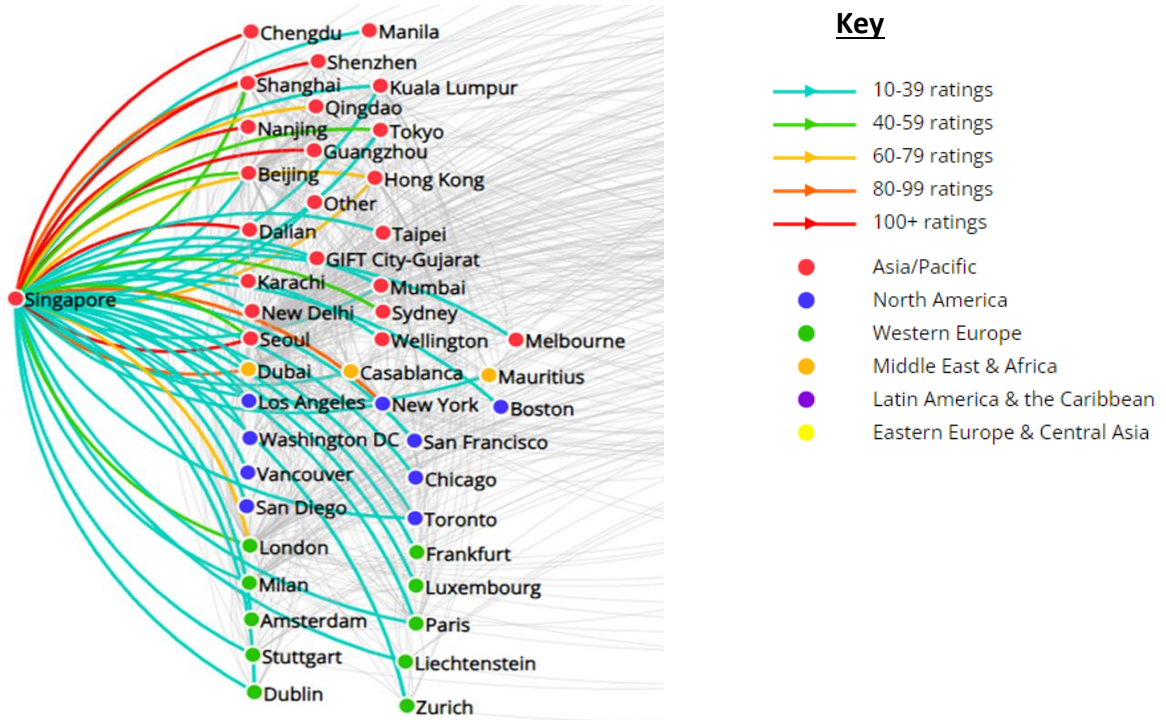


Figure 16ii | Busan Connectivity Chart

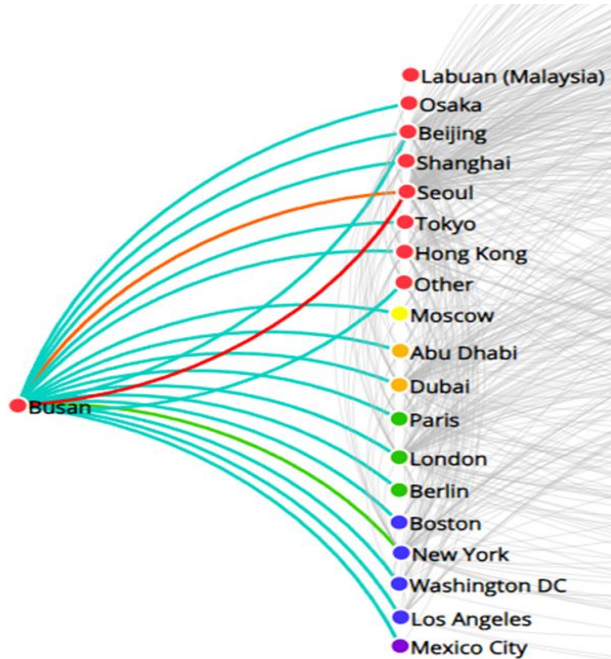
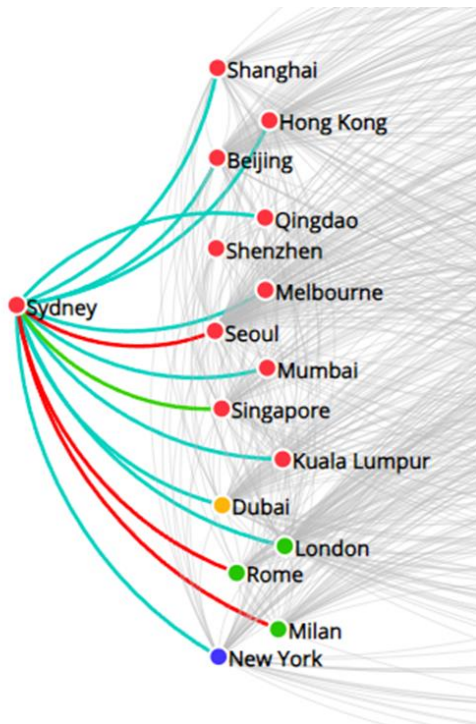


Figure 16iii | Sydney Connectivity Chart



The Knowledge Economy

A strong knowledge-based economy is also essential. Shipping requires very large amounts of capital investment, and the maritime sector faces several significant technical challenges around decarbonisation.

The maritime sector was quick to embrace the advantages that information technology brought to the logistics sector notably the use of digital platforms for ship and cargo tracking, as well as the implementation of digital communication and collaboration tools. Amongst the current advances in maritime technology are:

- Robotics technology and the internet of things has applications in port terminals, where automated cargo handling systems can contribute to fast and efficient operations, track shipments, lower risk of human errors and accidents, and, most importantly minimized waiting times at anchor or at the quay for ships.
- Big data and analytics can be used to forecast demand and optimize sailing routes to reduce fuel consumption.
- Space-based monitoring system can be used to provide real time data on weather conditions and vessel traffic.

- Artificial and Augmented Intelligence can be used to create smart ports and enhance efficiency, transparency, and sustainability, as well as potentially creating autonomous cargo vessels which could improve safety, reduce fuel consumption, and optimise scheduling and routing to reduce delivery times.

Figure 17 | AI Driverless Trucks Transporting Cargo From Busan To Incheon



Source: Mars Auto

Knowledge-based industries tend to centralize in key city regions – San Francisco for ICT; London for finance; and Busan for maritime technology. Universities act as incubators for start-ups and exert a powerful clustering influence on industry³⁸. It is no coincidence that all the world’s great cities are also renowned centres of learning.

³⁸Parilla J & Haskins G 2023 *How research universities are evolving to strengthen regional economies: Case studies from the Build Back Better Regional Challenge* <https://www.brookings.edu/articles/how-research-universities-are-evolving-to-strengthen-regional-economies/>

Figure 18 | The Korean Maritime & Ocean University Campus, Busan



Source: KMOU

An Enabling Environment

A diverse collection of non-commercial organisations, including ship registries & classification societies, training bodies, trade associations, and governmental agencies, acts as both glue and catalyst to hold marine finance clusters together and allows them to nurture future talent. These organisations allow firms to connect, build relationships and transfer knowledge, enhancing economic development and improving a centre's competitiveness³⁹. Amongst the agencies responsible for providing an enabling environment for marine finance clusters are:

Classification Societies – These are organisations which develop and apply technical standards for the design, construction, and survey of ships and which carry out surveys and inspections on board ships. The original role of classification societies was to supply information about the condition of ships for the insurance sector that wanted to reduce uncertainty and manage marine risk⁴⁰. Today this role has extended to inspection and regulation.

³⁹ Porter J. 2010 **Best practices in local development. LEED Programme of the Organisation for Economic Co-operation and Development** https://www.oecd-ilibrary.org/urban-rural-and-regional-development/best-practices-in-local-development_9789264193369-en#:~:text=This%20book%20identifies%20the%20strong,and%20actions%20that%20underpin%20restructuring

⁴⁰ Furger F 1997 **Accountability and systems of self-governance: The case of the maritime industry** Law & Policy 445 University of Denver <https://onlinelibrary.wiley.com/doi/abs/10.1111/1467-9930.t01-1-00035>

Flag states can authorise classification societies to act on their behalf to carry out statutory survey and certification work of their ships. Worldwide there are more than 50 classification societies but only 11 are presently recognised by the European Union. This recognition allows them to act as recognised organisations on behalf of EU member States. Amongst them is the Korean Register, headquartered in Busan, which in 2022 classed more than 80 million gross tonnage of shipping⁴¹.

Merchant Marine Colleges – There are more than 350 merchant marine colleges around the world⁴² offering training for individuals seeking a career in merchant shipping. Some nations with a particularly strong maritime tradition have multiple colleges, the most prestigious of which are affiliated with universities and offer training beyond basic seamanship to encompass marine technology and engineering, financial services, insurance, and law.

Trade Associations – Effective trade association enhance connectivity and promote the exchange of ideas and talent. They also empower industry to lobby local and national government and promote the industry nationally and internationally. Some trade associations are closely aligned with regulators and may be given “self-regulatory” status. A self-regulatory organization (SRO) is an entity such as a non-governmental organisation, which has the power to create and enforce stand-alone industry and professional regulations and standards. These standards may cover training, professional exams, registration, and professional development, and form a licence to operate for industry practitioners. For example, the Institute of Chartered Shipbrokers is the SRO for shipbroking in the United Kingdom and offers accreditation for shipbrokers⁴³.

⁴¹ Korean Register (accessed 14 November 2023)

https://www.krs.co.kr/eng/Content/CF_View.aspx?MRID=347&URID=85#

⁴² https://en.wikipedia.org/wiki/List_of_maritime_colleges

⁴³ UK Government *List of regulated professions* (accessed 14 November 2023) <https://www.regulated-professions.service.gov.uk/>

Local, National and Regional Government Agencies - Port authorities are public or semi-public organisations which are responsible for the governance, management, and development of ports. They take responsibility for:

- **Governance** – Port Authorities are responsible for applying and enforcing regulations set by other policymakers. These regulations cover a broad swathe of areas including health and safety, labour laws, and environmental protection, and are handed down by both national administrators and international organizations, such as the International Maritime Organisation. For specific regulations such as navigation, and law and order, they are assisted by the Harbour Master, dedicated police forces, customs and excise, and the coastguard. The way in which these regulations are applied and enforced can impact on a port’s competitiveness⁴⁴ – consultation with stakeholders and pragmatism in their application rather than short-notice enforcement by diktat, can do much to ease the burden of regulation on ports.
- **Management** – Port Authorities commission, construct and maintain infrastructure, as well as leasing or giving concessions on this infrastructure to private companies and ensuring the development and competitiveness of the port cluster. Revenue raised from leasing and concessions can be redirected into further investment in infrastructure and maintenance, although local and regional government may demand a proportion of the income.
- **Inward Investment** - Maintaining a port is a capital-intensive activity and the development of ports is largely driven by investment by multinational companies in industrial logistics⁴⁵. Competition for this investment can be fierce and port authorities aim to provide the most competitive environment for this type of inward investment, often maintaining permanent regional representative offices abroad and participating in trade missions or trade fairs organized by either national or regional foreign trade offices or trade associations. For a port authority to effectively enhance the benefits

⁴⁴ Notteboom T *et al* 2022 **Port Economics, Management and Policy**

<https://porteconomicsmanagement.org/pemp/contents/part4/port-reform-and-governance/>

⁴⁵ Wang J & Olivier D (2004). Port governance in China: A review of policies in an era of internationalizing port management practices. *Transport Policy*, 11, 237–250. <https://ideas.repec.org/a/eee/trapol/v11y2004i3p237-250.html#download>

of maritime cluster development, it should be self-sustaining, and have the autonomy to set prices and make investment decisions.

- **Legal infrastructure** - Arbitration clauses are standard in most maritime contracts. Maritime arbitration is particularly suited to resolve international disputes, which usually involve multiple jurisdictions. Flexible procedures and accelerated decisions and enforcement, via the New York Convention, make arbitration an attractive option compared to court proceedings. Historically, London and New York have been the traditional centres of maritime arbitration, however in recent years, organisations such as The Asia-Pacific Maritime Arbitration Center, based in Busan, have encouraged the maritime community to use their venues for the resolution of maritime disputes.

Figure 19 | The Asia-Pacific Maritime Arbitration Center, Busan International Finance Center



Source: Busan International Finance Centre

2 Developments In Maritime Finance

The maritime sector is an industry characterised by capital intensiveness, highly price volatility, strong business cycles, seasonality, and cyclicity. In recent years, these extant risks have been joined by new challenges around the management of air pollution, climate change and environmental, social and governance issues.

Risk management is extremely important for both ship owners and their customers, who face high volatility in freight rates and vessel prices as well as in operating and capital costs. Which is why the maritime finance sector has developed a suite of tools to address risk.

Derivatives

Derivatives are a type of financial contract, the value of which is dependent on an underlying asset group or class. Prices for derivatives are sensitive to fluctuations in the underlying asset and may be traded to hedge against risk.

The four main types of derivative contracts are options, futures, forwards, and swaps.

- **Options** are derivative contracts that give the buyer the right (but not the obligation) to buy or sell the underlying asset at a specified price at a certain time. The specified price is known as the strike price.
- **Futures** are standardised contracts that allow the holder to buy or sell an asset at an agreed price at the specified date. The parties to the contract are obligated to perform the contract.

Both futures and options are traded on stock exchanges. The value of futures and options is adjusted according to market movements until their expiration date.

- **Forwards** are similar to futures (the parties are obligated to perform the contract) however, forwards are not a standardised product and are generally not traded on stock exchanges.
- **Swaps** are contracts where two parties exchange their financial obligations; swaps are primarily used to hedge against volatility in interest rates. Swaps are not traded on

stock exchanges and are over-the-counter contracts between businesses or financial institutions.

Freight Derivatives

Maritime derivatives have been developed specifically for protecting (hedging) against risks in shipping⁴⁶, both for owners and those chartering cargo haulers. Freight derivatives are financial instruments whose value is derived from the future levels of freight rates, such as TEUs, dry bulk carrying rates and oil, LPG, or LNG tanker rates.

Freight derivatives are used by end-users, ship owners, commodity exporters, and suppliers to hedge against price volatility in freight rates. Freight derivatives can include exchange-traded freight futures, swap futures, forward freight agreements (FFAs), and container freight swap agreements. Derivatives give companies the ability to manage risk as they provide a way to mitigate exposure to price fluctuations in shipping⁴⁷. They are an important element of shipping markets, and, as with any derivative they can be bought or sold by hedge funds and retail traders allowing liquidity into the marketplace.

- **Freight Futures** - These derivatives are exchange traded contracts and are guaranteed by clearing houses, which act as counterparties and guarantee the underlying contracts. These are standardised products with respect to the underlying asset, maturity etc.
- **Forward Freight Agreements** – These are Cash Settled Contracts for Difference (CFD) bought and sold at an agreed rate per tonne or daily time-charter rate. An FFA fixes a price today for settlement against an agreed future period and the position settled against an index or assessment of spot market over the agreed future period. FFAs can be either an Over The Counter (OTC) or Exchange Cleared Contract and are tailored to meet the needs of the participants.

For many years the Baltic Exchange in London was the world centre for freight derivatives trading. In addition, over the last decade other centres have drawn increasing traffic including

⁴⁶ Kavussanos M.& Nomikos N 1999. *The forward pricing function of the shipping freight futures market.* Journal of Futures Markets 19, 3, 353-376. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1435269

⁴⁷ Kavussanos M & Visvikis I 2006. *Derivatives and risk management in shipping*, 1st Edition June 2006 Witherbys Publishing Limited & Seamanship International, ISBN 10: ISBN 1 85609 310 7 ISBN 13: ISBN 978 1 85609 310 1

Developments In Maritime Finance & Maritime Financial Centres

the Cleartrade Exchange (CLTX) in Singapore and the Maritime Exchange Information Center (MEIC) in Busan.

The MEIC, located in the Busan Finance Centre, was first designated as the Korean centre for promoting Marine derivative finance in 2012 when Busan City, Korea Exchange (KRX), and Busan Development Institute (BDI) signed a memorandum of understanding on developing shipping derivatives.

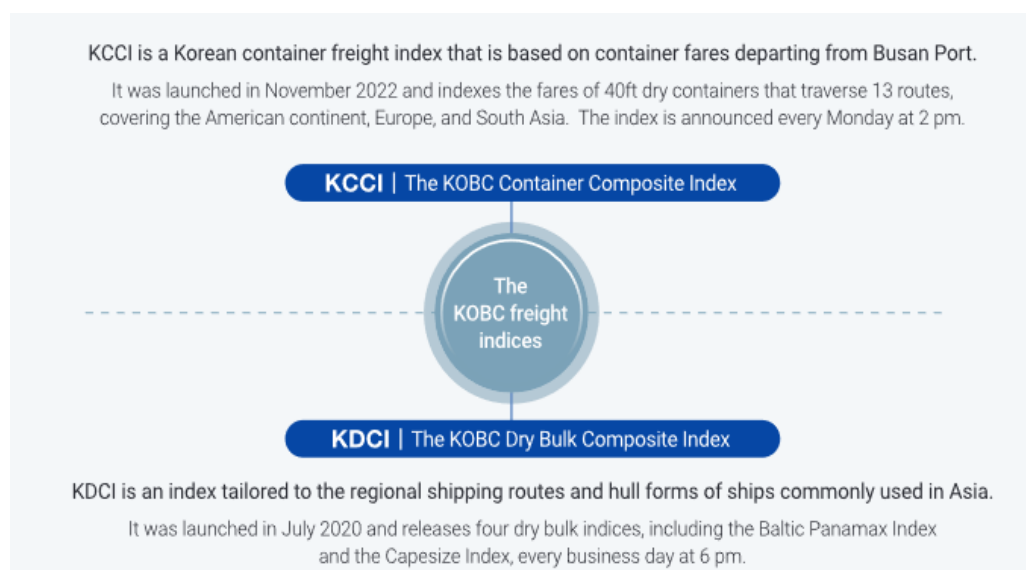
Busan is one of the busiest ports in the world⁴⁸ and the MEIC has grown significantly to become a leading regional maritime finance information provider, helped by the development of local expertise through the development, by Korea Maritime and Ocean University and Pusan National University, of a master's degree program specializing in maritime finance and derivatives.

The MEIC was later incorporated into the Korean Ocean Business Corporation (KOBIC) in 2018. Since its establishment, KOBIC has been periodically publishing maritime market reports and developing freight indexes for containers departing from Busan port. Indexes including the KCCI (KOBIC Container Composite Index) and KDCI (KOBIC Dry Bulk Composite Index) have become useful references for global maritime businesses, which primarily use Busan port for transportation.⁴⁹

⁴⁸ Baltic Exchange 2023 **Xinhua-Baltic International Shipping Centre Development Index Report**
<https://www.balticexchange.com/content/dam/balticexchange/consumer/documents/Xinhua-Baltic%20ISCDI%20Report%202023.pdf>

⁴⁹ *Busan Port, in South Korea, one of the largest and busiest ports in the world, handles a significant volume of transshipment cargo. It has recorded the second-largest transshipment volumes in the world, following Shanghai Port*

Figure 20 | KOBC Freight Indices Categorized By Ship Type



Source: KOBC, 2023

The derivatives market for tankers saw increased traded volumes in 2022. Tanker Forward Freight Agreement (FFA) volumes hit 734,972 lots, up 33% on 2021 (tanker market volatility has largely been caused by Russia's invasion of Ukraine). Whereas dry Forward Freight Agreement (FFA) volumes reached 2,218,249 lots, down 12% on 2021, reflecting strengthening headwinds for the global economy⁵⁰.

Fintech

Financial technology (known as FinTech) is a term used to describe technology that improves and automates the delivery and use of financial services. FinTech uses specialised software and algorithms, accessed through computers or smartphones, that enable end to end business to business (B2B) or business to customer (B2C) transactions, allowing streamlined processing that can access new markets, enhance outcomes, and reduce both costs and risk.

⁵⁰ Baltic Exchange 2023 **Market Information** <https://www.balticexchange.com/en/news-and-events/market-information/dry/2023/2022-record-year-for-tanker-derivative-volumes.html#:~:text=The%20derivatives%20market%20for%20clean,%2C%20down%2012%25%20on%202021.>

Developments In Maritime Finance & Maritime Financial Centres

Following the 2008 global financial crisis, the introduction of capital adequacy requirements for maritime loans led to banks moving away from competitive lending, particularly for small and medium sized fleet operators⁵¹.

Despite an explosion in the use of FinTech in the financial services sector - McKinsey research shows that revenues in the FinTech industry are expected to grow almost three times faster than those in the traditional banking sector between 2023 and 2028⁵² - the maritime sector has been relatively slow to grasp the opportunities that this technology presents, but several platforms have sprung up over the last five years.

⁵¹ Kalgora B & Christian M 2016 *The Financial and Economic Crisis, Its Impacts on the Shipping Industry, Lessons to Learn: The Container-Ships Market Analysis* Open Journal of Social Sciences, Vol.4 No.1, 2016 <https://www.scirp.org/journal/paperinformation.aspx?paperid=62786>

⁵² McKinsey & Company 2023 *Fintechs: A new paradigm of growth* <https://www.mckinsey.com/industries/financial-services/our-insights/fintechs-a-new-paradigm-of-growth>

Currently, the main players in this field include **eshipfinance.com**, **oceanis.io** and **Infinity Maritime**. All These platforms offer rapid assessment of loans, and high transparency and bring together both large and small borrowers and investors to streamline the ship financing process.

FinTech platforms tend to suit smaller ship owners – large shipping firms can find cheaper money through listing or bonds - but smaller players are facing an increasingly tight lending market - bank exposure to shipping is now at just 63% of where it stood in 2008, even though the world fleet is some 40% larger. For small companies (which make up the bulk of the global fleet) FinTech platforms can offer both speed and the potential to reach a wider lender base.

Further liquidity may be injected into the maritime finance using blockchain applications. The blockchain tokenisation of real-world assets can transform a marine asset into a digital asset which can be traded on public platforms, enabling fractional ownership, and enhancing access to marine finance markets. Decentralised, trustless transactions significantly reduce transaction costs, enhance price discovery, and hold the potential to revolutionise shipping finance. Currently **Shipfinex.com** based in London is pioneering developments in this field and TMC Shipping has become the first company to tokenise its assets on the Shipfinex ship financing platform⁵³.

Other players are now entering this potentially game-changing field. Recently, in collaboration with Korea Maritime & Ocean University, the Busan Finance Center published a research article which explored the creation of a blockchain-based STO (Security Token Offering) platform that enables fractional ownership of vessels. Building on this, Korea Maritime & Ocean University has further collaborated with the fintech startup Buysell Standards Co. (*buysellstandards.com*) for the commercialization of the STO platform.

Buysell Standards Co. (*buysellstandards.com*) is preparing a service to issue ship loan bonds and security interest trust beneficiary certificates via a blockchain-enabled platform. The aim is to create a private shipping finance market for small investors, targeting eco-friendly ships of small and medium size. The cost savings achieved through digitisation will allow the

⁵³ Lepic B 2023 TMC *Shipping teams with Shipfinex to tokenise assets* <https://splash247.com/tmc-shipping-teams-with-shipfinex-to-tokenise-assets/>

issuance of atypical securities and the securitization for financing these ships, which were previously difficult to finance through existing large financial companies.

Figure 21 | Buysell Standards Co. Shipping Finance STO Platform, 'Piece'



Source: Buysell Standards Co

This field offers significant opportunities for the maritime finance sector but is not without problems. Financial services institutions operate within a framework of policy, regulation, and standards (some imposed by governments, some by self-regulation) which can be termed financial systems. Although the financial services sector has pioneered the adoption of smart ledger solutions - in clearing and settlement, insurance, and regulatory compliance (particularly for anti-money laundering and know your customer applications), regulation, designed to protect consumers and institutions can act as a constraint on innovation.

One way that financial centres have sought to encourage the growth of the Fintech sector is through the establishment of “sandboxes” - formal regulatory programs that allow businesses to test new financial services or business models with customers, subject to certain safeguards and oversight. For instance, the Busan International Finance Centre has hosted a vast number of blockchain startups based on the regulatory sandbox named the 'Blockchain Regulation-Free Zone.' Since 2019, the South Korean government has designated Busan Metropolitan City as a blockchain regulation-free zone. By utilizing the sandbox program, numerous blockchain ventures have been able to commercialize innovative fintech businesses.

Figure 22 | Sandbox Exemplar – Busan’s Block Chain Regulation Free Zone



Busan Blockchain Regulation Free Special Zone

- **Purpose of designation:** To lead new business markets by supporting blockchain-applied industry related regulatory exceptions and demonstration
- **Designation period:** Aug. 9, 2019 - Dec. 31, 2024
- **Size:** Four businesses (logistics, tourism, public safety and finance)
- **Location:** 17 areas including Munhyun Innovation City and Centum Innovation City (124.83km²)
- **Regulation exceptions:** 11 cases of Regulatory Sandbox (4 proven exceptions) → 11 conditional acceptances
- **Executing organizations:** (institution) Korea Internet & Security Agency, Busan Techno Park, (company) BPN Solution, ESP, Quest X, Marine Flat, Hyundai Pay, Korea Tour Pass, Coinplug, and Busan Bank

Source: Busan Metropolitan City

Although sandboxes seek to provide a controlled environment for testing, reduced time-to-market, consumer protection safeguards and better access to finance, there is a view that they can be anti-competitive, particularly as firms outside the sandbox funnel may be less likely to get regulatory approval.

Regardless of whether financial centres choose to establish sandboxes, there are some useful, progressive regulatory interventions that can be made which can encourage open, competitive markets. These include:

- providing open industry data test sets, e.g., anti-money laundering, or consumer activity, that allow firms to test that their prototype systems can hand real, though anonymised, data.
- working on consistent standards for connecting firms together, more for inputs and output than processes.
- promoting open data wherever possible, for example, European regulators could go much further with GDPR to push for consumer-ownership of data and firms just 'leasing it back'.

Finally, as digitised assets can be traded internationally, the development of international standards will require collaboration between policymakers, financial services providers, and financial centres on regulation, standards, and benchmarking.

ESG

Environmental, Social, and Governance Issues (ESG) refers to a framework used to the active management of the risks and opportunities associated with an organisation's performance on various sustainability and ethical issues, including board governance, remuneration and moral hazards. ESG is increasingly used by large investors to evaluate company performance.

Within the maritime sector, the Poseidon Principles⁵⁴ establish a framework for assessing and disclosing the climate alignment of ship finance portfolios. They set a benchmark for what it means to be a responsible bank in the maritime sector and provide actionable guidance on how to achieve this.

A recent report by Deloitte⁵⁵ found that *“There is a belief in the maritime industry that shipping companies which are improving in ESG areas, amongst other things, gain significantly easier access to capital and sources of finance.”*

Currently, the most significant ESG issue of concern to the maritime sector is that of carbon emissions. In 2018, global shipping emissions represented 1,076 million tonnes of CO₂, and were responsible for around 2.9% of global emissions caused by human activities, this is projected to rise significantly by 2050, in line with the growth of the global fleet⁵⁶.

Greenhouse gas emissions have a triple relevance to shipping company risk:

1. **Bunker fuel price volatility** - the cost of bunker fuel is tied to global oil prices. Reducing emissions through fuel efficiency, reduces costs and exposure to price shocks - see figure 16.
2. **Emissions trading** - In January 2024, the EU's Emissions Trading System (EU ETS) will be extended to cover CO₂ emissions from all large ships (of 5,000 gross tonnage and above) entering EU ports, regardless of the flag they fly. The system covers:

⁵⁴ **The Poseidon Principles** https://www.poseidonprinciples.org/finance/wp-content/uploads/2019/07/Poseidon_Principles.pdf

⁵⁵ Deloitte 2021 **ESG in the Shipping sector The role of ESG in the evaluation of shipping companies** https://www2.deloitte.com/content/dam/Deloitte/gr/Documents/consumer-business/gr_esg_in_the_shipping_sector_noexp.pdf

⁵⁶ IMO 2020 **Fourth Greenhouse Gas Study 2020** <https://www.imo.org/en/OurWork/Environment/Pages/Fourth-IMO-Greenhouse-Gas-Study-2020.aspx>

- 50% of emissions from voyages starting or ending outside of the EU (allowing the third country to decide on appropriate action for the remaining share of emissions).
- 100% of emissions that occur between two EU ports and when ships are within EU ports.

To ensure a smooth transition, shipping companies only have to surrender allowances for a portion of their emissions during an initial phase-in period:

- 2025: for 40% of their emissions reported in 2024.
- 2026: for 70% of their emissions reported in 2025.
- From 2027 ship owners will be required to hold sufficient EU Allowances (EUAs) to cover all their emissions (EUA are currently trading at around eighty euros per tonne).

3. **IMO Net Zero Targets** - In July 2023, IMO Member States adopted the 2023 IMO Strategy on Reduction of GHG Emissions from Ships, this includes an enhanced common ambition to reach net-zero GHG emissions from international shipping by 2050, a commitment to ensure an uptake of alternative zero and near-zero GHG fuels by 2030, as well as indicative checkpoints for international shipping (a 20% reduction by 2030 and 70% by 2040).

It is worth adding that climate change is no longer a theoretical risk to the maritime sector as a recent report by CNBC testifies:

“The Panama Canal Authority is implementing additional vessel reductions in an effort to conserve water as a drought exacerbated by a severe El Nino weather system continues to plague water levels in the locks of the key global trade conduit.

According to Panama Canal authorities, the drought requires them to reduce the number of daily transits from 29 to 25 ships and in the proceeding weeks, they will reduce vessels transits even more until it declines to 18 ships a day in February. That represents between 40%-50% of full capacity. Under normal conditions, between 34-36 vessels traversed the canal daily. The drought and vessel reductions are having a major impact on the flow of trade, according to data from CNBC Supply Chain providers⁵⁷.”

⁵⁷ CNBC 2023 *Panama Canal drought hits new crisis level with nearly half of vessel traffic targeted for cuts*
<https://www.cnbc.com/2023/11/03/panama-canal-drought-hits-new-crisis-level-amid-severe-el-nino.html>

Disruption to the Panama canal will mean either delays in shipping, or owners having to re-route around the cape, a longer, more fuel intensive and more hazardous voyage.

Figure 23 | Average Price of Low Sulphur Bunker Fuel Oil 2019-2023



Source: Statista

When this is coupled with requirements to reduce sulphur, nitrogen and black carbon emissions, ship owners need to invest significant amounts in propulsion technology and other pollution mitigation measures.

Air pollution - The MARPOL treaty Annex VI requires abatement technology to be fitted to ship exhausts, and the IMO imposed new limits on the sulphur content of marine fuel oils to reduce harmful emissions of atmospheric pollutants. However, there is some concern that the scrubber systems designed to reduce atmospheric discharges of sulphur oxides and nitrogen oxides (thus allowing ship owners to burn more sulphur rich fuels) are resulting in the discharge of acidified wastewater which is affecting marine biodiversity⁵⁸. Solving this problem will require more innovation and investment in new technology by ship owners.

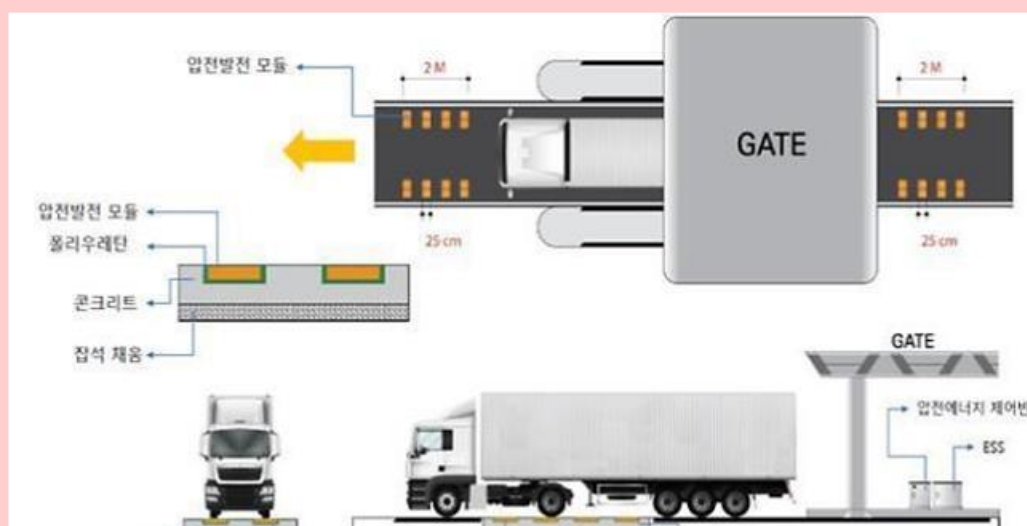
Sustainable Ports - Ports themselves are facing greater pressures to comply with regulatory and societal requirements for operational sustainability and are increasingly taking action in

⁵⁸ Chambers S 2023 *Scrubbers have saved container shipping \$12bn*: Sea-Intelligence
<https://splash247.com/scrubbers-have-saved-container-shipping-12bn-sea-intelligence/>

this area as it has become a consideration when shipping companies are determining which port to use⁵⁹. A port which is operating at a high level of sustainability is more likely to attract support from the government, communities, and the public, as well as potential investors in the maritime industry⁶⁰ (see box 1). In 2017, the International Association of Ports and Harbors established the World Ports Sustainability Program (<https://sustainableworldports.org/>) which is guided by the UN SDGs. The program aims to enhance and coordinate the sustainability efforts of ports worldwide and foster international cooperation with partners in the supply chain.

Box 1 Sustainable Innovation In Ports

Busan Port Authority and the Korean Ministry of SMEs and Startups have installed a piezoelectric power generation system which harvests energy from the pressure and vibrational loads of trucks passing through the gates of the container terminal. The prototype system was installed at one gate in 2022 and produces 45 MWh/a year. The intention is to instal the system at all 47 terminal gates in the Busan New Port, to generate 2,115 MW/h a year, reducing annual emissions by around 936t CO₂eq annually. The system will supply electricity to port lighting, unloading equipment, and electric vehicle charging stations.



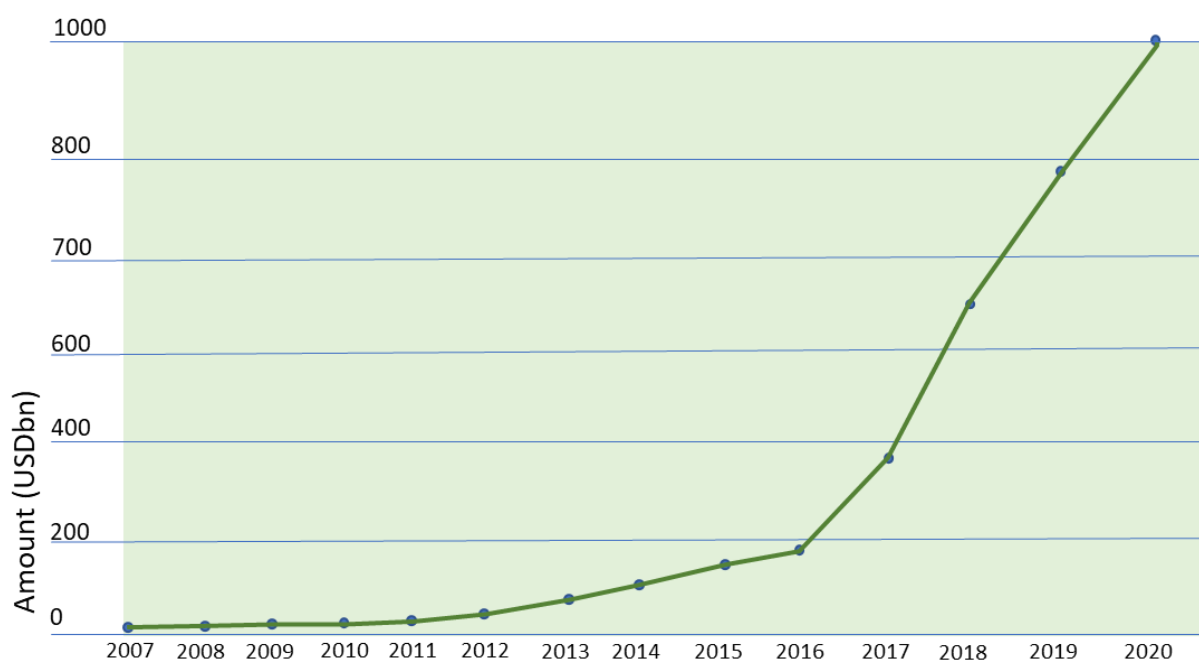
⁵⁹ Alamoush A. et al 2021. *Revisiting port sustainability as a foundation for the implementation of the United Nations Sustainable Development Goals* Journal of Shipping and Trade volume 6, Article number: 19 <https://jshippingandtrade.springeropen.com/articles/10.1186/s41072-021-00101-6#citeas>

⁶⁰ UNCTAD 2015 *Review of Maritime Transport 2015* <https://unctad.org/publication/review-maritime-transport-2015>

Green Finance

Green bonds are financial instruments that allow issuers to borrow money for investments that have positive environmental impacts. Ever since their debut in 2007 with the AAA-rated issuance from the European Investment Bank (EIB), the green bond market has seen exponential growth (see figure 24).

Figure 24 | The Exponential Growth Of The Green Bonds Market



Source: Carbon Bonds Initiative

Green bonds are debt issuances where the proceeds must be applied exclusively to finance (in part or in full) projects that promote progress on environmentally sustainable activities, such as reducing waste, enhancing biodiversity, or reducing emissions (through renewables generation, green transport, or energy efficiency programmes). Like green bonds, but focused on beneficial societal outcomes are social bonds, with a further subset, sustainability bonds, combining elements of both social and environmentally beneficial outcomes.

Initially, green bond issuance was the exclusive purview of supranational financial institutions - after the EIB issued its equity index-linked bond in 2007⁶¹, the World Bank issued a labelled

⁶¹ Kreivi E 2017 *Green Bond Market Development and EIB* <https://www.eib.org/attachments/green-bond-market-development-and-eib.pdf>

‘green bond’ in 2008⁶², and in 2010 the International Finance Corporation issued its first bond.

In 2013, the first corporate green bond was issued by Vasakronan, a Swedish real estate company, and the flood gates were opened. December 2020 saw the cumulative issuance of green bonds, worldwide, reach USD 1 trillion and it is forecast that green bond investment in a single year is set to double and reach USD 1 trillion for the first time by the end of Q4 2022.

Within the maritime sector although uptake was initially slow, the issuance of green bonds has accelerated rapidly in recent years. Issuances have been made by the world’s second-largest container line, Maersk Seaspans Corporation — a division of Atlas Corp, which leases vessels to container lines — as well as Hapag-Lloyd, a container line that owns and operates 230 ships. Maersk launched a EUR 500 million (USD 496.3 million) green bond in November 2021 to partially finance its USD 3.7 billion order for methanol-fuelled vessels, and in September 2023 it issued a second bond for USD 750 million to further finance its decarbonisation efforts⁶³.

Small and medium-sized shipping companies have also begun to focus on green bonds for financing. Medium-sized shipping companies in South Korea, such as Pan Ocean and SK Shipping Co., issued green bonds in 2021. The value of the issuances was approximately \$44 million for Pan Ocean and \$34 million for SK Shipping, respectively. Pan Ocean intended to use the proceeds for the purchase of eco-friendly LNG ships, while SK Shipping focused on installing scrubbers and ballast water treatment systems on its ships. To qualify for green bond finance, vessels need to meet specific criteria outlined by organizations or standards like the Climate Bonds Initiative, the EU Taxonomy, or the Green Shipping Programme. That typically means that the AER (Annual Efficiency Ratio) or the EEOI (Energy Efficiency Operational Index) need to be below defined decarbonization trajectories. The EU Taxonomy, however, also allows use of the EEDI (Energy Efficiency Design Index) and defines specific requirements for vessels retrofitting.

⁶² World Bank 2022 *The World's First Green Bond* <https://youtu.be/i3gIJrABLSc>

⁶³ ESG News 2023 *Shipping Giant Maersk taps \$750M Investment for First Dollar Green Bond* <https://esgnews.com/shipping-giant-maersk-taps-750m-investment-for-first-dollar-green-bond/>

Developments In Maritime Finance & Maritime Financial Centres

Table 4 | The Issuance Of Green Bond By Global Maritime Companies

Maritime Companies	Transaction date	USD Million	Details
NYK line	May 24, 2018	91.48	Refinancing LNG-fuelled ships, LNG bunkering vessels, ballast water treatment systems, and exhaust gas scrubbers
Teekay Shuttle Tankers	Oct 10, 2019	125	Refinance intercompany debt relating to 4x LNG-fuelled suezmax DP2 shuttle tanker new buildings
Altera Shuttle Tankers LLC	Aug 21, 2020	75	Refinance intercompany debt relating to 4x LNG-fuelled suezmax (related to the above Teekay deals)
Bonheur ASA	Sep 9, 2020	77.65	Low-carbon and climate resilient development
Sembcorp Industries Ltd	Jun 2, 2021	302.43	Refinance projects under the company's Green Financing Framework that meet Climate Bonds Initiative sector-specific technical criteria
Bonheur ASA	Jun 30, 2021	81.31	refinancing existing intercompany debt.
A.P. Moller - Maersk A/S	Nov 19, 2021	565	construction of a feeder vessel and 8x large container vessels capable of operating on carbon neutral methanol
Hyundai Heavy Industries	Mar 24, 2022	300	finance the construction of eco-friendly vessels and establish a system of sustainable growth based on ESG management
A.P. Moller - Maersk A/S	Sep 15, 2023	750	finance the construction of eight methanol-powered vessels

Source: Marine money

Green bonds cannot finance ships that carry fossil fuel, yet the tanker and gas carrier sectors are possibly in most in need of capital. The tanker market has only just ended an 18-month period of pandemic-induced loss-making, while orders for LNG carriers have surged in the past 12 months due to the war in Ukraine.

Sustainability-linked bonds (SLBs) are a subset of green bonds however, they differ from green bonds in several crucial ways:

Firstly, and most importantly the funds raised are not tied to a specific project, but a corporate (or national) objective – for example absolute reductions in carbon emissions (scope 1 2, or 3). Liberating the proceeds from a specific project, frees the issuer to deliver sustainability improvements using a wide range of means – this may include education and training, the recruitment of specialist staff, and the reorganisation of procurement systems as well as more traditional avenues such as the purchase of plant, machinery, intellectual property, or land.

Secondly, SLBs are issued with specific sustainability performance targets (SPTs), which contain key performance indicators (KPIs), for example: *“A 40% reduction in CO2 emissions from fleet wide activities by 2030”*.

Thirdly if the SPT is missed, the bond is subject to a “step-up” clause, meaning the bond interest increases. Equally if a SPT is surpassed by an agreed amount a “step down clause” can decrease interest.

Khazanah Nasional Berhad, the sovereign wealth fund of Malaysia was the first entity to issue a policy performance bond in 2017 when it raised RM 100 million from the issuance, but the first true SLB was issued by Eni in 2019 with Schneider Electric following in 2020. These bonds are designed to pay up to 0.5% of their nominal value if they fail to meet their sustainability performance targets.

Since their initial issuances SLBs have become a small, but rapidly growing sector of the Green, Social, Sustainability, Sustainability-linked and transition bonds (GSS+) market which despite a rocky road for fix income instruments has held its market share. In January 2021, Norwegian tanker operator Odfjell SE became the first shipping company to issue a Sustainability-Linked Bond⁶⁴. The company linked their NOK 850 million bond to a target of reducing the carbon intensity for their controlled fleet by a minimum of 50% by 2030

⁶⁴ Odfjell 2021 ***Odfjell SE successfully places shipping’s first Sustainability-Linked Bond***
<https://www.odfjell.com/about/our-stories/odfjell-se-successfully-places-shippings-first-sustainability-linked-bond/>

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compared to 2008⁶⁵. They were rapidly followed by bond offerings from Hapag-Lloyd and Wallenius Wilhelmsen.

Listed tanker owners — including Hafnia, Ardmore Shipping Corporation, International Seaways, d'Amico and Euronav — all announced sustainability-linked deals in 2022⁶⁶.

With respect to the Green Bond and SLB sector, the Oslo stock exchange has developed a specialism in this niche market⁶⁷ and has been successful in attracting a great deal of business and other financial centres with green bond specialisms are beginning to view this lucrative area with interest.



⁶⁵ Nordea 2022 *Sustainable finance propels shipping's green transition*

<https://www.nordea.com/en/news/sustainable-finance-propels-shippings-green-transition>

⁶⁶ Bockmann M 2022 *Green goes mainstream in shipping finance* <https://lloydslist.com/LL1142032/Green-goes-mainstream-in-shipping-finance#:~:text=Listed%20tanker%20owners%20%E2%80%94%20including%20Hafnia,sustainability%2Dlinked%20deals%20this%20year.&text=D'Amico%20chief%20executive%20Paulo,%2C%20as%20%E2%80%9Cvery%20limited%E2%80%9D>

⁶⁷ Dixon G 2023 *Oslo bond market hot as Ocean Yield, Kistefos and KCC seeking \$234m combined*

<https://www.tradewindsnews.com/finance/oslo-bond-market-hot-as-ocean-yield-kistefos-and-kcc-seeking-234m-combined/2-1-1509829>

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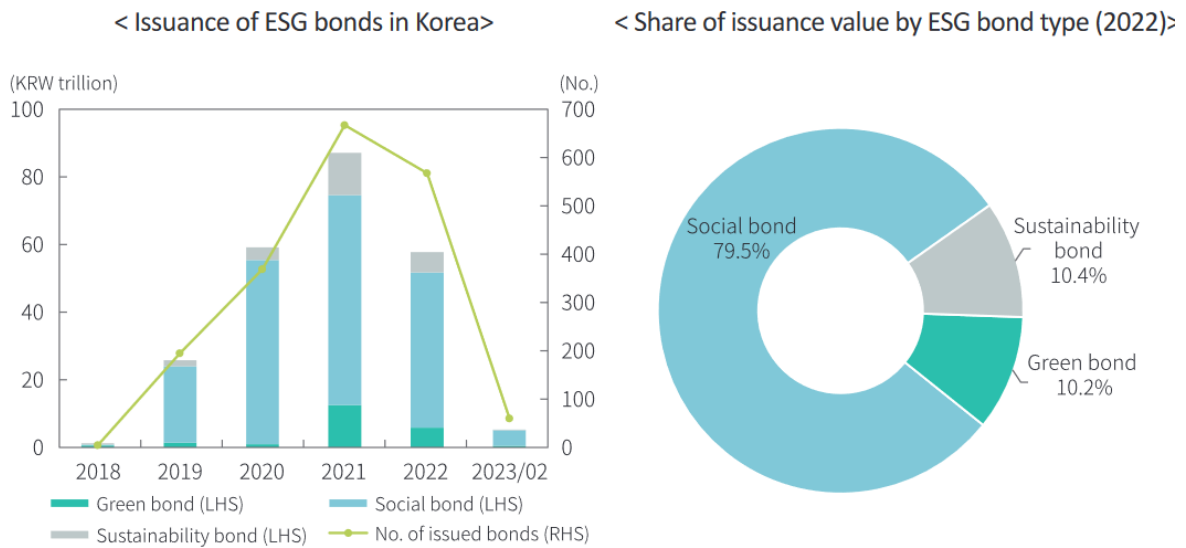
Table 5 | The Issuances Of SLBs By Global Maritime Companies

Maritime Companies	Transaction date	USD Million	Details
SFL Corporation Ltd.	Jan 19, 2023	150	Refinance existing bonds and general corporate purposes
Seaspan	May 18, 2022	500	To pay down existing debt, fund capital expenditures, and other general corporate purposes.
Wallenius Wilhelmsen ASA	Apr 6, 2022	134.89	Refinance existing debt and other general corporate purpose
Seaspan	May 24, 2021	450	1.) the alignment of the collateral vessels' carbon intensity with the IMO 2050 decarbonization trajectory and 2.) fostering cooperation with charterers, including sustainability-linked provisions in charter contracts
Seaspan	Jan 21, 2021	200	Acquisition, newbuilding, or retrofit of vessels which can be powered by alternative fuels.
Odfjell SE	Jan 14, 2021	100.36	Reducing the carbon intensity of its controlled fleet to 50% of its 2008 levels by 2030

Source: Marine Money

In terms of global growth in Green Bonds, Sustainability Bonds, and Sustainability-Linked Bonds (SLBs), the rapid rise of ESG (Environmental, Social, and Governance) bonds governed by the Korea Exchange at the Busan International Finance Centre clearly demonstrates such trends. South Korea's ESG bond issuances have exceeded KRW 100 trillion (approximately USD 76.92 billion).

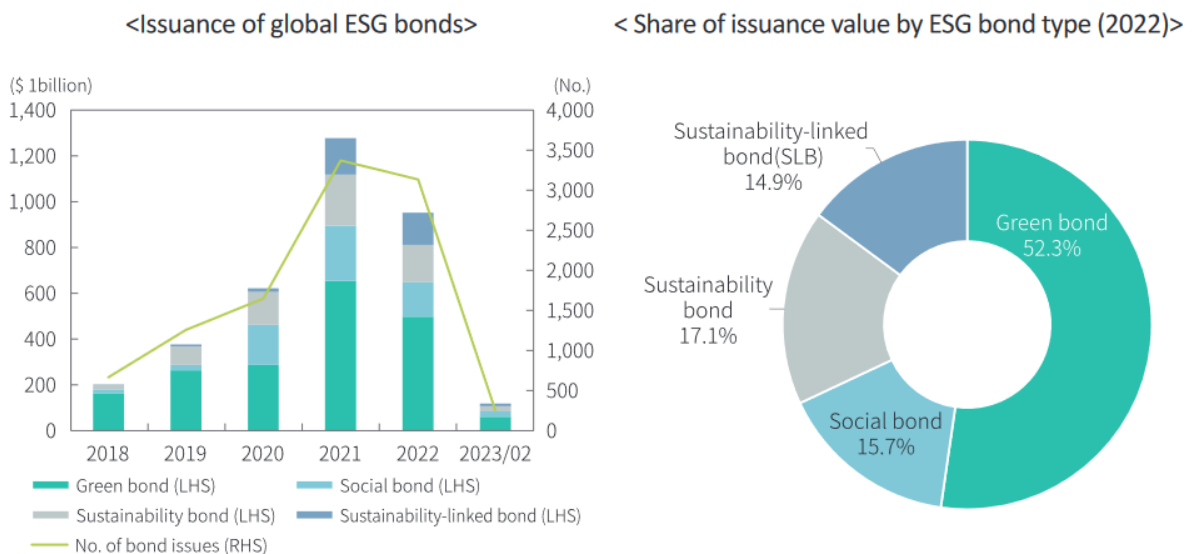
Figure 25 | The Issuance Of ESG Bonds In South Korea, Governed By The Korea Exchange At The Busan International Finance Centre (SRI Bonds Market)



Source: KRX

Globally, the issuance of ESG bonds surpassed USD 1,000 billion by 2022. However, surging energy and raw material costs, brought about by the Russia-Ukraine war, have had adverse effects on sustainable finance.

Figure 26 | The Issuances Of ESG Bonds globally.



Source: KRX

Green & Sustainability-Linked Loans (GSLL) - Green loans offer a lower rate of interest, as much as 10% of the cost of capital if the borrower reduces their impact on the environment and are distinct from green bonds in that lenders do not tie the loan to a specific use but link the cost of capital to overall company performance on sustainability⁶⁸.

Driven by a wish to support low emissions targets, an increasing number of banks have joined the Poseidon Principles, a framework for assessing and disclosing the climate alignment of ship finance portfolios, which set a benchmark for responsible bank in the maritime sector. Currently 35 banks are members, representing around USD 300bn in lending⁶⁹.

Typically, lenders track sustainability metrics against third party benchmarks, such as the Carbon Disclosure Project, or Sustainalytics and re-calculate rates depending on the borrower's sustainability performance.

Although the original concept of GSLL was developed by Dutch banks, once again it is Nordic banks, such as Nordea Bank and Skandinaviska Endkilda Banken, that have led the charge with shipping focussed GSLL facilities, although ABN AMRO Bank and Credit Agricole have also developed offerings in this area.

In April 2023, Malaysian shipping company MISC Berhad (MISC) entered into a USD 527 million sustainability-linked loan for the financing of six very large ethane carriers (VLECs). The Korea Development Bank, Sumitomo Mitsui Banking Corporation, Labuan Branch, DBS Bank, Export-Import Bank of Malaysia Berhad and MUFG Bank Singapore Branch were part of the consortium that arranged the loan⁷⁰.

⁶⁸ ICMA 2019 *Sustainability Linked Loans Principles*

<https://www.icmagroup.org/assets/documents/Regulatory/Green-Bonds/LMASustainabilityLinkedLoanPrinciples-270919.pdf>

⁶⁹ <https://www.poseidonprinciples.org/finance/signatories/>

⁷⁰ Mandra J 2023 *MISC inks half a billion dollar sustainability-linked loan* <https://www.offshore-energy.biz/misc-inks-half-a-billion-dollar-sustainability-linked-loan/>

3. New Challenges For Maritime Financial Centres

There are currently two key areas where developments hold significant implications for marine financial centres – the net zero transition and information technology (including blockchain, AI, IoT and the metaverse/Augmented Reality).

The Net Zero Transition

As discussed in section two, the maritime sector is under pressure to reduce its carbon emissions. In practical terms the impact of net zero policies on the global fleets has two aspects - direct emissions, and cargo.

Direct Emissions

With respect to direct emissions from vessels, the IMO has brought in a series of regulations. These include:

- **The Energy Efficiency Design Index (EEDI)** – this was introduced by the IMO in 2011, (through amendments to MARPOL Annex VI)⁷¹. The EEDI mandates technical and operational energy efficiency measures to reduce the amount of CO2 emissions from international shipping.
- **The Ship Energy Efficiency Management Plan (SEEMP)** – this entered into force on 1 January 2013⁷². A SEEMP is a ship-specific plan to improve the energy efficiency of a ship. SEEMPS are mandatory for all ships above 400 Gross Tonnes (GT) which are engaged in international voyages, forms part of the ship's safety management system and is subject to audit and verification.
- **The Data Collection System (DCS)** – this was applied by the IMO in October 2016 and requires ships to record and report their fuel oil consumption to have the necessary data to make decisions on further measures to improve the energy efficiency of ships.

⁷¹ IMO (Accessed 24 November 2023) *EEDI - rational, safe, and effective*
<https://www.imo.org/fr/MediaCentre/HotTopics/Pages/EEDI.aspx>

⁷² AMSA (Accessed 24 November 2023) *Ship Energy Efficiency Management Plan (SEEMP)*
<https://www.amsa.gov.au/marine-environment/air-pollution/ship-energy-efficiency-management-plan-seemp#:~:text=A%20Ship%20Energy%20Efficiency%20Management,energy%20efficiency%20of%20a%20ship.>

- **The Energy Efficiency Existing Ship Index (EEXI) and Carbon Intensity Indicator (CII)** – these regulations came into force in January 2023. The EEXI indicates the energy efficiency of a ship compared to a baseline, and the CII determines the annual reduction factor needed to ensure continuous improvement of a ship's operational carbon intensity within a specific rating level. Both of these regulations are mandatory for all vessels above 400 GT and although EEXI compliance does not necessarily require technical modifications to a ship, in practice this is likely to be required for many vessels to achieve the minimum required EEXI rating of “C” or above.

The maritime finance implications of this regulatory regime are wide ranging:

Market access – Some ports may restrict access to allow only A, B or C ships, or they may charge higher port fees for D and E ships, pushing up costs for owners of older vessels and reducing available fleet capacity.

Conversely, the CII does not attribute fuel consumption to specific stages of a voyage or operations, including anchoring. Consumption during anchoring (e.g., for generation of auxiliary power) is simply considered as consumption without distance travelled, and hence has an adverse impact on the ship’s CII rating⁷³. As a result, long waiting times to enter the port, and long port stays (which are often outside of the control of the ship operator) will negatively impact the CII rating, resulting in some operators avoiding ports with a reputation for congestion or inefficient operations.

Customers seeking to enhance their ESG ratings may seek high CII scores from the vessels they charter. From a charterer’s perspective, whilst CII is an operational measure and can be managed through trading patterns, the CII performance of a ship is linked to other factors, such as design, maintenance and warranted fuel consumption. If any of these factors is not as described in the charter party, then disputes are likely to arise.

⁷³ IMO 2022 *Carbon Intensity Indicator (CII) – A port and terminal perspective*
<https://greenvoyage2050.imo.org/wp-content/uploads/2023/01/Carbon-Intensity-Indicator-A-port-and-terminal-perspective.pdf>

One way for a vessel to achieve its CII score is to reduce its speed⁷⁴. Although relatively cheap to implement (for example through the addition of an Engine Power Limitation system (EPL)), reducing speed by up to 25% could result in a concomitant increase in voyage time.

All these factors could cause a potential shortfall of available vessels and push up charter prices, adding volatility to the futures market.

Vessel value – According to recent research⁷⁵, CII is becoming increasingly influential in the sale and purchase market. At present, this is primarily manifesting in the liquidity of vessels. This is consistent with the expectation that vessels in band E will carry capital requirements or will see their earnings potential reduce. This may result in a markdown of the corporate valuation of shipping companies with older fleets.

Finance – As discussed in sections one and two, accessing finance has become increasingly difficult for shipowners. Given that CII ratings will impact on both the utility and lifespan of vessels (particularly second-hand vessels), lenders are likely to impose additional conditions on lending to reduce risk⁷⁶.

Fleet renewal – The requirements of CII are likely to result in more rapid turnover of vessels as older ships are retired and new ones commissioned, and given the lead time required for shipbuilding, this may result in a vacuum that pushes up charter rates. Shipyards are also likely to see a brisk trade in retrofitting energy improvements in existing vessels, such as EPLs, photo-voltaic panels to power crew accommodation, and other measures. Owners also face issues in retiring and disposing of obsolete, non-compliant vessels, which will lose most of their market value.

Public finance, bolstered by active government support, can play a significant role in addressing fleet renewal challenges. As previously discussed, several factors, including the

⁷⁴ MIS Marine.com (Accessed 14 November 2023) *The cost of going green – what do the EEXI and CII regulations mean from a chartering perspective?* <https://mismarine.com/the-cost-of-going-green/>

⁷⁵ The Maritime Executive 2023 *Secondhand Vessel Pricing Shows Impact of the New CII Regulation* <https://maritime-executive.com/article/secondhand-vessel-pricing-shows-impact-of-the-new-cii-regulation#:~:text=According%20to%20the%20Vessels%20Value,vessels%20operating%20in%20other%20bands>.

⁷⁶ Raza R 2022 *Carbon Intensity Indicator (CII) and Its Impact on the Global Shipping Industry* <https://blog.fleetmon.com/2022/03/01/carbon-intensity-indicator-cii-and-its-impact-on-the-global-shipping-industry/#:~:text=With%20CII%2C%20the%20problems%20for,scrap%20even%20relatively%20young%20vessels>

rising cost burdens associated with fleet replacement and the diminishing financial support from commercial banks, pose challenges for shipping businesses lacking adequate resources for fleet upgrades. This is especially crucial during transitions towards sustainability. Public financial institutions, offering transitional finance, are vital for facilitating the shift to sustainable maritime shipping. A prime example of such support is the initiatives undertaken by the Korean Ocean Business Corporation (KOBC) at the Busan International Finance Centre.

KOBC's policies for promoting sustainable maritime shipping through transitional finance and support include:

- **Providing Special Guarantees for Retrofitting Facilities to be Eco-Friendly:** This involves offering subsidies for the adoption of eco-friendly facilities at 2% interest rates. Approximately USD 410 million (KRW 553 billion) was allocated to retrofit 277 facilities across 43 shipping companies.
- **Financial Support for the Introduction of Eco-Friendly Ships:** Around USD 65.51 million (KRW 82.2 billion) was provided to 20 shipping companies for this purpose.

Technology – Primary propulsion technology has been the subject of a great deal of research and development over the last decade, and this is accelerating in the wake of CII. Breakthroughs include the development of a new class of ultra-long stroke diesel engine, enhanced propeller design, LNG gas turbines, biofuels, and fuel cells. Each of these technologies comes with its own advantages and disadvantages – and with the latter three, considerable requirements for port-side investment.

In 2020, the Korean government announced a USD 870 million initiative to encourage the development of eco-friendly shipping to reduce pollution caused by the country's marine sector⁷⁷. The 2030 Green Ship-K Promotion Strategy, a central part of South Korea's plans to achieve carbon-neutrality by 2050, specifically targets the advancement and wider use of low-carbon ship technology, including hydrogen fuel cells and propulsion systems. The initiative has set a goal of reducing the country's shipping greenhouse gas emissions by 40% in the next 25 years and 70% by 2050.

⁷⁷ The Maritime Executive 2022 *South Korea to Invest \$870 Million Developing Eco-Friendly Shipping*
<https://maritime-executive.com/article/south-korea-to-invest-870-million-developing-eco-friendly-shipping>

Figure 27 | Sky Sails



Source: <https://albis-mp.com>

As part of this programme, Hyundai Heavy Industries recently commissioned South Korea's first large next-generation electric propulsion ship which incorporates smart technology. The 1,400 gross ton vessel is dual-powered with the ability to operate either fully from its battery or an LNG-fuelled engine or in hybrid mode with the battery supplementing the engines.

A great deal of effort is also being put into secondary propulsion systems such as skysails (see figure 28), Flettner rotors (Figure 29), and wing sails (Figure 30).

Figure 28 | Flettner Rotors



Source: www.stormgeo.com

Figure 29 | Wing Sails



Source: www.newatlas.com/marine/oceanbird-wallenius-wing-sail-cargo-ship/

All of these new technologies present particular challenges to the marine insurance sector who will have to model the risk associated with this new technology and adjust premiums accordingly.

Fleet Composition

A stranded asset can be defined as *“an asset which loses economic value well ahead of its anticipated useful life”*⁷⁸. Stranding risk arises from two areas:

- Supply-side stranding risks associated with the ship’s specification.
- Demand-side stranding risks associated with the demand for ships of a certain specification.

The factors contributing to supply side stranding, which affect all ship classes, have been described in the preceding paragraphs.

⁷⁸ Saltzman D 2013 *Stranded Carbon Assets – why and how carbon risks should be incorporated in investment analysis* <http://genfound.org/media/pdf-generation-foundation-stranded-carbon-assets-v1.pdf>

Demand side stranding risks are more complex and primarily affect tankers and carriers. In the short term, the crude tanker fleet is forecast to grow 2.0% in 2023 and 0.4% in 2024, whilst the IMF forecasts that the global economy will grow by 3.0% in both 2023 and 2024. Despite Saudi Arabia's and Russia's crude oil production cuts, oil consumption is expected to hit new recording highs in both 2023 and 2024, 101.2 million barrels per day (MBPD) in 2023 and 102.8 mbpd in 2024 leading to a shortage of tanker supply⁷⁹.

Continued disruption caused by Russia's invasion of Ukraine mean that demand for Liquid Propane Gas and Liquefied Natural Gas carriers is very buoyant. The global LNG Carrier market size was valued at USD 13 billion in 2022 and is expected to expand at a compound annual growth rate of 5.45% during the forecast period, reaching USD 17.8 billion by 2028⁸⁰. Currently the leading shipyard for LNG Carriers is Hyundai Heavy Industries (HHI).

Longer term however, progression to net zero will mean a significant drop in demand for crude oil, LPG and LNG. Hydrogen may become a significant energy source over the next ten to fifteen years – the World Energy Council is forecasting that hydrogen production costs will decrease by around 50% until 2030, and then continue to fall steadily at a slightly slower rate until 2050 by which time production costs in some parts of the Middle East, Africa, Russia, China, the US, and Australia will be in the range of EUR 1 to EUR 1.5/kg⁸¹.

The switch to hydrogen will not necessarily mean a switch to purpose built hydrogen carriers (see figure 22) and cliff edge obsolescence to the existing tanker fleet. Hydrogenious' Liquid Organic Hydrogen Carrier (LOHC) technology, which uses benzyl toluene as a liquid organic hydrogen carrier may mean that existing vessels and infrastructure can be repurposed.

Due to its characteristics as a flame retardant and non-explosive carrier with a high volumetric energy density, benzyl toluene can be handled like a fossil liquid fuel within existing infrastructure. This makes it a natural fit with current port infrastructure, vessels, railcars, and

⁷⁹ Bimco 2023 *Tanker Shipping Market Overview & Outlook Q3 2023*

https://www.bimco.org/news/market_analysis/2023/20230905-smoo-tanker

⁸⁰ IndustryResearch.com (Accessed 28 November 2023) *2023 Global LNG Carrier Market SWOT and Growth Forecast: 2030 Outlook* <https://www.linkedin.com/pulse/2023-global-lng-carrier-market-swot-growth-forecast/>

⁸¹ PWC (Accessed 28 November 2023) *The green hydrogen economy - Predicting the decarbonisation agenda of tomorrow* <https://www.pwc.com/gx/en/industries/energy-utilities-resources/future-energy/green-hydrogen-cost.html#:~:text=Hydrogen%20production%20costs%20will%20decrease,1%20to%20%E2%82%AC1.5%2Fkg.>

tank trucks. After the release of hydrogen (dehydrogenation), the LOHC can be reused to bind hydrogen many hundreds of times⁸².

Korea is already pioneering developments in this field and Elogen, a subsidiary of the French technology company GTT, and Valmax Technology Corporation have signed an agreement to collaborate on the commercialisation of green hydrogen solutions in Korea⁸³. Elogen specialises in the design and manufacture of electrolyzers to produce green hydrogen, and Valmax Technology Corporation, a system integrator for energy solutions for the oil, natural gas and hydrogen sectors, will work to supply electrolyzers in Korea to produce green hydrogen.



⁸² Jallal C 2023 *Could the conventional tanker fleet support hydrogen logistics?*

<https://www.rivieramm.com/news-content-hub/news-content-hub/could-the-conventional-tanker-fleet-support-hydrogen-logistics-74613>

⁸³ Ship Energy 2022 *Elogen and Valmax to work on the production of green hydrogen in Korea*

<https://ship.energy/2022/05/25/elogen-and-valmax-to-work-on-the-production-of-green-hydrogen-in-korea/>

Table 6 | Development of Hydrogen Solutions in Relation to Shipping in South Korea

Hydrogen Solution	Korean Approach
Hydrogen Storage Technology for Ships	South Korea has made significant progress in designing liquid hydrogen fuel tanks for ships. Organizations including the Korea Research Institute of Ships & Ocean Engineering (KRISO), POSCO, and Korea Shipbuilding and Offshore Engineering (KSOE), aims to address the challenges of storing liquid hydrogen at extremely low temperatures. They have obtained two Approval In Principle (AIP) certifications for their tank designs. This is a critical step towards the commercial use of hydrogen in shipping
Green Hydrogen Production and Usage	South Korea is heavily investing in green hydrogen production and infrastructure. This includes constructing a green hydrogen production plant in Ulsan with the capacity to produce 30 tonnes per day, and projects in Jeju City and Samcheok for hydrogen supply in transportation and other sectors.
Hydrogen Ports Development	SK Group has announced plans to invest in the construction of hydrogen ports. By 2040, major ports like Busan, Incheon, and Ulsan are expected to supply over 60% of South Korea's total hydrogen consumption.
Hydrogen Shipping Technology	Korea Shipbuilding & Offshore Engineering (KSOE) is working on the technology to transport hydrogen by ship, with expectations to commercialize it between 2025 and 2027. They have developed a concept ship capable of carrying hydrogen in liquid form, which requires maintaining a temperature of minus 253 degrees Celsius.

Source: *The Maritime Executive, Good News Energy, Hydrogen Central, Gcaptain*

However, a global hydrogen trade is still some way off . Infrastructure needs to be constructed building upon the existing ammonia ports and storage and natural gas pipelines. Regulation including the operation of this new infrastructure needs to be put in place. Cost recovery models, financing and capital mobilisation to build this infrastructure are also needed. A marketplace needs to be created to bring supply and demand together and have a reliable and transparent price index that drives investment.

Figure 30 | A Liquid Hydrogen Tanker



Source: C-Job Naval Architects

Information Technology

Transactions in the maritime sector can be slow and expensive as they often require physical paperwork to pass through several sets of intermediaries. Processing and administration costs have risen to as high as 20% of transportation's overall costs, due to over-reliance on paper transactions. Ship agents and ship brokers constitute a substantial part of the work force in the maritime sector. The Federation of National Associations of Ship Brokers & Agents (FONASBA) has more than 5,000 companies in membership in 63 countries whilst the Baltic Exchange, the international ship broking market, has over 3,000 member companies worldwide, most of which are brokers. It is only a matter of time advances in information technology cause significant disruption to the maritime sector and maritime financial centres should be aware that there may be significant implications for practitioners.

Blockchain

Blockchain, also known as distributed ledger technology, first emerged in 2008 and is intimately associated with cryptocurrencies such as Bitcoin. However, the technology itself is use agnostic and has many applications within the maritime sector.

Current blockchain applications in development include:

Fuel quality traceability and assurance - the use of blockchain-based systems⁸⁴ can offer improved tracking and traceability of fuel origin and quality by recording immutable data collected throughout the bunker fuel supply chain⁸⁵.

Logistics - The shipping industry relies heavily on traditional ways of doing business, including a reliance on hardcopy paperwork and documentation, the use of which involves several different parties in the supply chain. Fraud is a major problem in shipping, including falsification of Bills of Lading, including under-invoicing to avoid taxes; bribes and illicit payments to obtain contracts, influence inspections or enable port operations; and defrauding importers or exporters with illegally purchased letters of credit. The use of distributed ledger technology enables the digital tracking of shipments from origin to destination and has the potential to reduce transaction costs, track hazardous substances, reduce opportunities for fraud and theft, and measure and track the conditions of climate-or temperature-sensitive goods⁸⁶. The adoption of distributed ledger technology for logistics would have a significant beneficial impact on the insurance industry and could reduce premiums.

Bills Of Lading - A Bill of Lading (B/L) is a contract of carriage which serves as a document of ownership and receipt and is required by Maritime Law. B/L essentially gives ownership (or title) of the goods to the person holding the B/L, so the value of the B/L is approximately equal to the goods it describes. Bills of Lading are traditionally paper-based documents, and the transfer of goods from one party to another requires the physical possession of the B/L⁸⁷. Because the B/L must be in physical possession to claim goods at port, and transfer through banks and other intermediaries may be slow, this can lead to delays when cargo arrives at ports ahead of the B/L—adding to system inefficiencies and increased costs. The digitisation

⁸⁴ Bunkertrace.com (Accessed 29 November 2023) <https://bunkertrace.co/whoweare/mission/>

⁸⁵ Gallucci M 2019 *Shipping industry takes a page from bitcoin to clean up its act* <https://grist.org/article/shipping-industry-takes-a-page-from-bitcoin-to-clean-up-its-act/>

⁸⁶ Hampstead J 2018 *Swiss firm brings blockchain to the biopharmaceutical cold chain* <https://www.freightwaves.com/news/blockchain/skycellblockchaincoldchain>

⁸⁷ Maersk 2023 *Bill of lading - what is it and why is it important?* <https://www.maersk.com/logistics-explained/shipping-documentation/2023/10/02/what-is-bill-of-lading>

of B/Ls onto a distributed ledger removes the need for intermediaries and can remove these inefficiencies and reduce costs.

Smart Contracts - The term 'Smart Contract' was coined by Nick Szabo, the father of crypto currency, in 1994. He defined a smart contract as "as a computerized transaction protocol that executes terms of a contract"⁸⁸. In other words, the terms of a real-world legal contract can be compiled into executable computer code, that can run on a network and be made partially or fully self-executing, and self-enforcing. In the case of shipping validation and payments, smart contracts could allow for participants to enter into agreements on the distributed ledger where, for instance, payments would be held in escrow until a shipment delivery is validated, cargo is released, a certain inspection is passed, or any given set of conditions is met. Payments could even be made on the distributed ledger using tokens or a cybercurrency in place of current legacy systems. Tokens or cybercurrencies specific to the maritime sector would allow instant payments as well as instant conversion of currencies and simplify the number and complexity of transactions between companies. However, although there have been several attempts to develop a smart contract ecosystem for the shipping sector (including ShipChain, The Prime Shipping Foundation and 300 Cubits), none have made an impact to date.

Artificial Intelligence

AI has increasingly made its mark on the logistics sector in recent years. Machine learning algorithms are used to maximise the fuel efficiency of routes, optimise their vessel scheduling, automate container configuration to improve space management, and enhance safety through predictive maintenance, forecasting adverse weather conditions and enhancing collision avoidance systems.

Significant advances have also been made with respect to automated cargo handling and even to autonomous vessels. The world's first autonomous, fully electric cargo ship, the Yara Birkeland, 3,200 gwt, completed its maiden voyage in 2022. The vessel was developed through the Norwegian Forum for Autonomous Ships (NFAS), an initiative created by the

⁸⁸ Szabo N 1994 Smart Contracts <http://www.virtualschool.edu/mon/Economics/SmartContracts.html>
(Accessed 30 November 2023)

Norwegian government and industry bodies to promote the concept of unmanned shipping⁸⁹. In addition, the Norwegian government turned the Trondheim Fjord into a test bed for autonomous ship trials.

Other nations are also developing capabilities in this field. Maritime platform developer Orca AI partnered with Nippon Yusen Kabushiki Kaishato run field trials with the Suzaka, a 749 gwt cargo hauler in Tokyo Bay in late 2022. Whilst Korea is currently leading the pack as Samsung Heavy Industries successfully demonstrated autonomous vessel navigation from South Korea to Taiwan, using Samsung's self-developed remote autonomous navigation technology, known as Samsung Autonomous Ship (SAS), and the smart ship system SVESSEL on a 15,000 teu container ship⁹⁰.

Investment in automation represents a significant risk for both ports and ship owners. Ports which fail to invest in automated systems risk seeing trade move elsewhere, whilst owners who invest too soon risk restricting the number of ports compatible with their shipboard systems. Legally, autonomous systems represent a grey area, as both national and international legislation has failed to keep up with developments⁹¹, liability in the case of accidents is not clearly defined, and insurers have not yet developed products with universal coverage.

Cyber security also represents a significant concern as bad actors (sponsored by states, criminals, or terrorist organisations) could cause considerable economic damage to port facilities or international trade by attacking systems or hijacking vessels.

The Metaverse

Although the metaverse received considerable attention in 2021 and 2022, the initial hype it received has receded, with some commentators saying that the bubble has burst⁹². Despite this Virtual Reality and Augmented Reality applications continue to make progress in

⁸⁹ DNV (Accessed 29 November 2023) *Autonomous and remotely operated ships* <https://www.dnv.com/maritime/autonomous-remotely-operated-ships/index.html>

⁹⁰ Splash247 2023 *Autonomous navigation voyage between Korea and Taiwan completed* <https://splash247.com/autonomous-navigation-voyage-between-korea-and-taiwan-completed/>

⁹¹ Rolls Royce 2016 *Autonomous ships The next step* <https://www.rolls-royce.com/~media/Files/R/Rolls-Royce/documents/%20customers/marine/ship-intel/rr-ship-intel-aawa-8pg.pdf>

⁹² Wagner M 2023 *The metaverse hype bubble has popped. What now?* <https://www.fierceelectronics.com/embedded/metaverse-hype-bubble-has-popped-what-now>

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specialist areas such as engineering and training. With respect to the marine sector Augmented Reality and Virtual Reality have applications in remote controlled robot application and testing, Internet of Things integration, and port and cargo management. With respect to the latter, The Korean Register of Shipping (KR) has established an LNG fuel and bunkering simulation centre (KR LSC) at its International Education and Training Centre in Busan, which will be used for operational training on LNG-powered ships and for ship-to-ship bunkering⁹³.



⁹³ Berry R 2020 Korean Register of Shipping opens LNG fuel and bunkering simulation centre
<https://ship.energy/2020/09/15/korean-register-of-shipping-opens-lng-fuel-and-bunkering-simulation-centre/>

4. Outlooks & New Opportunities For Maritime Financial Centres

It is a truism that maritime financial centres are located in proximity to ports. A port city functions as both a port and a city, implying that the port and its host port city are co-dependant⁹⁴. In other words, the port fosters its city's growth and economy, whereas the city's growth drives its port's development and evolution.

Financial and professional service businesses play critical roles in cities and regions by providing investment for businesses, individuals, and infrastructure, and enabling trade, and the cities in which clusters of financial services are located compete to attract businesses by delivering high quality infrastructure, a highly educated and skilled workforce and effective regulation and tax regimes that protect without constraining.

Financial institutions are at the forefront of investing in solutions to the key technological and developmental challenges for the maritime, and they are supported by maritime trade associations. These associations operate both through collaboration and competition, individual organisations aim to offer internationally competitive business services, whilst benefitting from partnerships with other organisations to facilitating trade and knowledge transfer.

With respect to success factors for maritime financial centres, on the supply side, among the principal factors of production are rights of establishment – the ease of establishing a business and the legal constraints (and protections) surrounding it, the availability of skilled personnel, the availability of appropriate premises, access to information technology, and costs of funds relative to other locations. This is as true of the maritime financial sector as it is of any other financial service, which is why successful financial centres are often successful maritime financial centres.

On the demand side, maritime financial firms place a premium on ease of access to customers (so access to thriving ports is important), modified by communications and technology. The tokenisation of physical assets on the blockchain can remove some aspects of geographical

⁹⁴ Shan, J *et al* 2014. *An empirical investigation of the seaport's economic impact: evidence from major ports in China*. Transportation Research Part E: Logistics and Transportation Review, 69, 41–5

constraints, but the cluster effect remains an important determinant particularly maritime knowledge clusters⁹⁵ (which require high degrees of technical expertise due to their engineering and business characteristics).

This ‘co-opetition’ (collaboration and cooperation) element applies at both national and international level, where leading maritime financial centres could collaborate and demonstrate leadership by:

- Leading multi-stakeholder groups to develop industry wide strategies.
- Developing regulatory roadmaps.
- Raising awareness of key issues affecting the industry.
- Supporting the development of new financial instruments (such as SSLBs and Green loans) to assist the flow of finance into the sector.
- Encouraging the exchange of technical knowledge and collaborative research.
- Supporting the development of international standards and benchmarks.
- Contributing to international and national policy development.

This type of collaboration is already beginning to take place. The International Maritime Organization (IMO) and the European Commission (EC) have announced a second phase of the Global Maritime Technology Cooperation Centres Network (GMN) project, to upscale the work of the five regional centres, with a particular emphasis on pilot demonstrations aimed at achieving quantifiable reductions in GHG emissions⁹⁶. However, there is nothing to prevent maritime centres from developing bilateral, or regional partnerships of their own.

⁹⁵ Zhou Y *et al* 2021 *The effect of maritime knowledge clusters on maritime firms’ performance: An organizational learning perspective* Marine Policy Volume 128, June 2021, 104472

⁹⁶ IMO 2023 *Second phase of global Maritime Technology Cooperation Centres Network (GMN) project will upscale work of five regional centres.* <https://www.imo.org/en/MediaCentre/PressBriefings/pages/EU-boosts-Maritime-Technology-Cooperation-Centres-Network-project.aspx>

Figure 31 | Anatomy Of A Maritime Cluster



Moving forward there are three key challenges which will determine the success of maritime financial centres over the next few decades:

- **Embracing the challenge of financing maritime industry** – whilst investment in docks and shoreside infrastructure has not been an issue for most maritime financial centres, ship owners are facing an increasingly tight fiscal environment, as banks and equity funds redirect capital to lower risk sectors. Maritime financial centres should consider working with stakeholders in the financial services sector to identify the obstacles and opportunities associated with developing new financial products for ship owners.
- **Embracing the challenge of net zero** – Achieving IMO net zero targets will have a seismic impact on the commercial shipping fleet over the next twenty years. This will send waves throughout the industry, affecting shipbuilding, technological development, insurance, the freight futures market, and finance. Maritime financial centres should collaborate to navigate and effective course through this undertaking,

whilst competing to find new products and services which will enhance their reputations and attract new business.

- **Embracing technology advancements** – Maritime financial centres have been slow to adopt developments in fintech. Many processes are still paper based and require the involvement of intermediaries for processing, adding to costs for both ship owners and clients. Digitisation holds significant promise to streamline processes and reduce costs, and new developments in blockchain technology hold promise for both ship financing and freight handling. However, the international nature of the maritime sector means that the benefits of digitalisation cannot be monopolised – a single maritime centre cannot effectively implement digital solutions (particularly with respect to freight handling) without the participation of its trading partners. Maritime financial centres should work together to develop commonly agreed standards in fintech and digitalisation which will allow the roll out of this technology globally.

In conclusion, the maritime industry and finance sectors, influenced by dynamics such as sustainability transitions, technological changes, and geopolitical tensions, are likely to witness the rise of emerging cities and the decline of current leaders, as evidenced by the history of global financial centres. Emerging maritime finance centres, including Busan, Qingdao, Oslo, and Osaka, are actively diversifying their maritime ecosystems, thereby challenging the incumbent cities. It remains to be seen whether advantages based on resource acquisitions will continue to be relevant in the future, or if new technology based maritime models will render existing advantages obsolete.

Finally, while conducting this research, two key areas were identified that, while they did not fall within the remit of this report, may become significant issues in the medium to long term (5-15 years).

The first is the issue of fleet bifurcation. The US and Europe have, over the last decade, made increasing use of sanctions as a means of projecting foreign policy. These sanctions cover a range of trading nations (particularly Russia and Iran) and affect vessels docking at ports,

making inter-ship transfers, or carrying goods from affected countries. Vessels breaking these sanctions violate the terms of their insurance and are unable to dock at European or US ports.

However, a “grey fleet” is emerging, which, although primarily involving older, smaller vessels may be as large as 18% of the global fleet . These vessels flout IMO regulations by disabling their automatic identification systems, employing location-hiding technologies, and engaging in location falsification to break sanctions. Analysis of the implications of this trend and recommendations on how to counter it may be a useful area for further investigation.

The second is the issue of carbon efficiency. There has been a great deal of attention paid to the carbon emissions of the global merchant fleet. However, the geographical location of certain forms of manufacturing industry (near natural and manufactured resources or drawing on low carbon energy sources) may result in carbon efficiency savings that outweigh the carbon emissions of sea transportation. Although this flies in the face of the trend for deglobalisation, further research could examine whether there is a carbon accounting case to be made for maritime finance.



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