THE KEY ROLE OF SEAFARERS IN NATIONAL ECONOMIES IN A NET-ZERO WORLD

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Shaping the Future of Shipping
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A report commissioned by the International Chamber of Shipping, prepared and written by graduate student researchers and staff at the Institute of the Americas at the University of California San Diego

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As the collective voice of the international shipping industry, ICS articulates and advocates shipowner positions to international regulators International Maritime Organization and International Labour Organization as well as to other government regulators and relevant stakeholders. ICS aims to positively influence regulatory changes while maintaining high standards of quality, safety, and environmental protection.

ICS is an international, independent, not-for-profit London-based trade association. It is managed by its secretariat for the benefit of national shipowner associations and their members.

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EXECUTIVE SUMMARY

In the Philippines, seafarer remittances accounted for 1.8% of the nation's GDP (2022). In 2010, the maritime sector was responsible for 1.8% of total UK employment, 1.9% of UK GDP, and 1.6% of total government revenue. In the U.S, the sector contributed US$ 432 billion to the national economy, or around 2% of its GDP (2022).

Seafarers and the maritime industry in general clearly play a vital role in national and global economies. And as the global economy continues to rebound from the Covid pandemic, the industry will grow. By 2050:

32,500
new vessels will be needed

875,000
new jobs will be created

5,500 mt
of goods will be moved

To meet only the needs for trade up to 2050, the maritime sector must add more than 1,000 new vessels to the global fleet, and more than 30,000 new seafarers to the labor market. These adjustments will require almost US$ 12.5 billion in direct investment, and another US$ 20 billion in indirect and induced investments. They will also generate up to 84,500 indirect jobs each year. Those numbers imply an additional 0.5% of GDP per year to the UK, U.S., or Philippine economies.

Meanwhile, the shipping sector is actively seeking to reduce its environmental footprint. It needs to up those efforts significantly. The sector needs a zero-emissions business model that addresses the "function of travel demand, travel mode, transport technology, GHG intensity of fuels, and energy efficiency." And it must work in tandem with governments to design a framework that:

- **Creates** supply and demand incentives to optimize travel
- **Sets** targets to phase out fossil fuel usage
- **Implements** standards to improve efficiency and reduce carbon content
- **Promotes** research and development of low carbon technologies

Given the expected growth in trade by 2050, and the need to add another half of the current labor force just to match the associated work, stable, consistent labor demand is here to stay. The outlook for the seafarer labor force under a zero-emissions business model is vibrant. The sector has never experienced a change of this scale and speed, with so many forces creating positive feedback loops.

Yet seafarers face significant challenges. Job security and continuity, health concerns, and a lack of career development opportunities are creating a dearth of potential workers.

Technological advances and environmental demands will also challenge countries, governments, and the overall industry to invest in seafarer development and skill building to keep up.

Labor market conditions under a zero-emissions business model will require permanent certification and training, a flexible scheme that balances land and sea activities, longer term contractual arrangements to provide job security, and competitive compensation packages.

This report examines seafarer impact on nations' GDP, job creation, linkages with other sectors, maritime clusters, labor conditions, just transition challenges, and the importance of seafarer training and competence.

Lastly, it offers a set of recommendations to address the challenges and opportunities the maritime sector faces, including:

- **Strengthen international collaboration.** Develop a baseline and a roadmap to a zero-emissions business model that attracts public and private sector stakeholders from shipping and other sectors, including energy, technology, and finance.

- **Promote a global carbon market** that creates the conditions to assign efforts and investments in the most efficient way according to intensity and cost. The carbon market should be combined with progressive limits on carbon, as well as energy efficiency and renewable energy standards. Develop a globally accepted monitoring, reporting, and verification system that provides certainty for the certification and labeling of products.

- **Promote mission-driven work** to help address the challenges the shipping industry manages, including infrastructure (ships and ports), operations (engines and materials), and energy (sources, use, conservation, and storage). The alignment of the research community with private sector needs, in addition to seed funding from the public sector, can accelerate and scale up the technologies needed for zero emissions shipping.

- **Develop financial mechanisms** to de-risk the uptake of new technologies and materials and allow the leveraging of public and private resources.

Each industry stakeholder has a role to play—from government officials to shipping companies, to seafarers themselves. With proper steps and integrated efforts, seafarers will continue to powerfully contribute to national and global economies in a net zero world.

LIST OF ACRONYMS

- **Baltic and International Maritime Council (BIMCO)**
- **Bangko Sentral ng Pilipinas (BSP)**
- **Bureau of Economic Analysis (BEA)**
- **Certificate of Recognition (COR)**
- **Greenhouse Gas Emissions (GHG)**
- **International Chamber of Shipping (ICS)**
- **International Convention for the Prevention of Pollution from Ships (MARPOL)**
- **International Maritime Organization (IMO)**
- **International Labor Organization (ILO)**
- **Liquefied natural gas (LNG)**
- **Liquefied petroleum gas (LPG)**
- **Malaysia Shipowners Association (MASA)**
- **Marine Department of Malaysia (MARDEPT)**
- **Maritime Economy Satellite Account (MESA)**
- **Organization for Economic Cooperation and Development (OECD)**
- **Offshore service vessels (OSV)**
- **Sulfur emission control areas (SECA)**
- **Standards of Training, Certification and Watchkeeping for Seafarers (STCW)**
- **World Trade Organization (WTO)**

CHAPTER 1
INTRODUCTION

1.1 Background and Significance

The maritime sector transports approximately 90% of the world's goods. Seafarers help ensure the smooth passage of those goods. Without them, the global trade system would break down—economies would suffer.

There are nearly two million seafarers in the workforce. They support a variety of maritime activities, including the operation of cargo vessels, container ships, and tankers. Seafaring offers broad employment opportunities that contribute not only to individual livelihoods but also to local economies, particularly in regions with thriving maritime industries.

Seafarers also play an integral role in keeping global supply chains efficient. Their expertise in navigating waterways and ports ensures that goods reach their intended destination in a timely manner. These workers enable businesses and industries worldwide to access the resources they need to meet consumer demands.

Seafarers help generate substantial revenue for countries and economies. A variety of stakeholders, including shipping companies, port operators, and logistics providers, participate in the business of transportation of goods by sea. Each of these stakeholders helps generate revenue beyond seafaring itself. The economic activities associated with the maritime sector, which seafarers drive, power revenue streams through freight charges, port fees, and other related services. These revenue streams contribute to the overall economic growth and stability of nations that depend heavily on international trade.

Thus, seafarers' contributions reach far beyond what is visible at a casual glance. They support employment generation, supply chain efficiency, and revenue generation. One must understand the breadth of seafarers' economic contributions to grasp their overall importance.

1.2 Report Objectives

This report aims to assess the economic value of seafarers and their contribution to international trade and global maritime transportation. It examines the impact of seafarers on national economies by analyzing revenue generation and job creation within the maritime sector. The report also highlights the significance of seafarers in maintaining supply chain efficiency and supporting industries associated with maritime trade.

Finally, this report offers a set of policy recommendations to address the challenges and opportunities the maritime sector faces. These recommendations are based on data analysis, literature review, and expert opinions. The recommendations consider potential impact, feasibility, and stakeholder perspectives, and aim to support seafarers, promote talent development, ensure a just transition, and improve access to reliable industry information.

1.3 Methodology

Official reports, publications, and International Maritime Organization (IMO) documents provided the data on IMO energy efficiency regulations and emissions reduction targets.

The Seafarer Workforce Report by BIMCO and ICS provided information on the factors that affect seafarers and an outlook for the Zero Emissions Business Model.

Scientific articles, industry reports, and technological studies supplied data on technology requirements and adoption in the shipping industry, including energy-saving technologies, renewable energy sources, and alternative fuels.

Research papers, policy documents, and industry reports set the foundation for understanding current policies and regulation for decarbonizing the shipping sector.

An extensive literature review helped identify key concepts, theories, and best practices for the shipping sector New Zero transition, including impact on business models, labor, technology, and policy.

Scholarly articles, industry reports, and policy papers offered insights into the challenges, opportunities, and potential solutions for achieving zero emissions in the shipping industry.

Studies and reports on talent development, just transition, seafarer welfare, and successful policies in the maritime sector informed the policy recommendations.

Inputs and insights from subject matter experts, including industry professionals and researchers, validated findings, provided a framework to assess the feasibility of recommendations, and understand the current state of the shipping sector's Net Zero transition and future prospects.

CHAPTER 2

THE ROLE OF SEAFARERS IN THE NATIONAL ECONOMY

2.1 Maritime Sector Overview

The maritime sector is undergoing significant change. The IMO is pressuring shipping businesses to develop new regulations to reduce greenhouse gas emissions, having adopted mandatory energy efficiency regulations for ships with progressive carbon intensity reductions (10% drop in intensity for new ships by 2015, 20% by 2018, 30% by 2025) in 2012. It has targeted a 40% reduction in CO_2 emissions from 2008 levels by 2030, and a 50% reduction of greenhouse gas emissions from 2008 levels by 2050[1].

But technical and political challenges inhibit such a shift. The decarbonization of shipping is one of the maritime industry's biggest challenges. Finding sustainable fuels and making them available at ports is just part of it[2].

As the maritime sector decarbonizes, the IMO will likely increase environmental and labor regulations. The maritime sector is not known for complying with such regulations, and maritime sector professionals indicate that the 2030 and 2050 goals for renewable energy source regulations are too ambitious. Meanwhile, the WTO anticipates that trade will increase over the coming decades. This means demands on the sector will increase, and decarbonization will have to take a back burner.

The maritime sector can be divided into two parts, both of which bring extreme value to national economies:

- **Shipping sector:** The OECD states that the shipping sector accounts for about 90% of global goods[3]. It includes vessels like cargo ships, tankers, container ships, cruise liners, and ferries, which move goods and passengers via sea routes.
- **Maritime cluster sector:** This sector focuses on managing and operating ports, terminals, and harbors.

The shipping sector and the maritime cluster are closely linked. Maritime cluster services play a critical role in facilitating the movement of goods, optimizing supply chains, and ensuring efficient cargo flow for logistics and supply chain services. In turn, shipping sector activities generate demand for logistics and supply chains, fostering the growth and development of these industries.

Together, these interconnected sectors impact global supply chains significantly. World merchandise trade was valued at US$ 25.3 trillion in 2022[4].

[1]Un body adopts climate change strategy for shipping. International Maritime Organization. (n.d.). https://www.imo.org/en/MediaCentre/PressBriefings/Pages/06GHGinitialstrategy.aspx

[2]Fourth Greenhouse Gas Study 2020. International Maritime Organization. (2020). https://www.imo.org/en/OurWork/Environment/Pages/Fourth-IMO-Greenhouse-Gas-Study-2020.aspx

[3]Ocean Shipping and Shipbuilding-OECD. Available at: https://www.oecd.org/ocean/topics/ocean-shipping/

[4]Global Trade Outlook-World Trade Organization. Available at: https://www.wto.org/english/rese/bookspe/tradeoutlook23e.pdf

2.2 Seafarer Contribution to National GDP

Seafarers contribute to trade facilitation, job creation, economic growth, and technological advancement. Most international trade is conducted through maritime transportation, and seafarers help ensure the smooth passage of goods and commodities between countries. By operating cargo vessels, container ships, and tankers, seafarers contribute to importing and exporting goods, enabling countries to access global markets and participate in international trade.

In fact, world trade depends on maritime transport to function. The March 2021 incident involving megaship Ever Given, which ran aground in the Suez Canal and blocked the passageway for nearly one week, tells the story:

- **About 12%** of global trade, including around one million barrels of oil and roughly 8% of liquified natural gas, traverse the Suez Canal each day[5] and the significant amount of trade that uses the Suez Canal, made the traffic jam felt worldwide[6].
- **Nearly US$ 10 billion** in trade was frozen for each of the six days the vessel was stuck[7].
- **More than 400 ships** were delayed, jamming the global supply chain.

2.3 Employment, Job Creation, and Gender

Although seafarers execute some of the world's most important jobs, their numbers are dwindling. Their work is demanding, and involves challenging conditions, including extended periods away from families and loved ones. Additionally, the appeal of adventure the industry once held has evaporated. Stops at ports are brief, typically lasting only a few hours to, at most, slightly more than a day. Depending on the type of ship, route, and contract, a seafarer can spend weeks or even months without touching land. They no longer enjoy the benefits of travel that once drew them to the field.

Seafarer hiring practices also discourage individuals from joining a workforce that is in high demand. Seafarer contracts typically last only a few months to protect worker health and well-being. There is also a limit on time spent at sea for the same reason. In such an environment, individuals often fail to complete training, or even focus on their current projects. They have no sense of job security as they jump from contract to contract. The lack of incentives has deeply reduced the labor force, particularly that portion made up of women. On top of the work-life imbalance and the physically demanding nature of the job, isolation, loneliness, and the limited social interaction associated with being at sea for extended periods impacts many seafarers' well-being.

[5]Russon, M.-A. (2021) The cost of the Suez Canal blockage, BBC News. Available at: https://www.bbc.com/news/business-56559073
[6]Brochures SCA-Brochures. Available at: https://www.suezcanal.gov.eg/English/MediaCenter/Pages/Brochures.aspx
[7]Yee, V. and Glanz, J. (2021) How one of the world's biggest ships jammed the Suez Canal, The New York Times

Gender diversity in the maritime sector is extremely fragmented. The IMO 2021 Women in Maritime survey found that women make up just 2% of the seafarer workforce. They are predominantly found in the cruise sector[8]. There is a slight increase in women in the seafaring workforce; 75.6% of women seafarers are between the ages of 21-30, 25.4% are over the age of 35[9].

With increased regulatory development, the maritime industry has had to adopt cost-effective solutions to help existing and new ships comply with new regulations. This adjustment has led to an increase in demand for natural gas-fueled ships. And qualified seafarers are needed to work on them[10]. While demand for this job sector has grown, supply has not kept pace. Additionally, seafarers require specialized training and certifications to perform their roles effectively and safely. Frequently, a seafarer trained for one type of vessel cannot simply be transferred to another type.

[8]Women in maritime survey 2021

[9]Seafarer workforce report, 2021 edition(2023) International Chamber of Shipping. Available at: https://www.ics-shipping.org/publication/seafarer-workforce-report-2021-edition/

[10]Ibd

2.3.1 Case Study – United Kingdom

The UK maritime sector illustrates the training challenges faced by multiple stakeholders and across the sector.

The UK maritime sector is in decline due to a shrinking workforce. But this sector contributes significantly to the UK's economic growth. Oxford Economics (OE), a leading independent economic advisory firm states that the UK maritime sector employs more people than the country's general medical practice industry and contributes more to its GDP than the civil engineering sector[11]. The sector is responsible for 1.8% of total UK employment, 1.9% of UK GDP, and 1.6% of total government revenue.

Seafarers require specialized training and certification to perform their roles effectively and safely. In the UK, this training has traditionally followed an informal system of apprenticeships whereby trainees shadow a master mariner to acquire the skills and experience to perform everyday duties[12]. However, after the 1978 International Convention on Standards of Training, Certification, and Watchkeeping (STCW) for seafarers adopted by the IMO all professional seafarers worldwide had to earn STCW-compliant certificates. The job now requires more than hands-on training and education, as was the case for many decades.

2.4 Linkages with the Energy Sector

Environmentally motivated policy changes in one sector can have a ripple effect and impact others. The shipping sector is no exception. It relies heavily on oil and gas for fuel, and seafarers are also responsible for transporting oil and gas products across the seas. The implementation of environmental and safety standards in the shipping industry and the oil and gas sectors has led to stricter regulations and demand for compliance. These shifts have had economic implications for both sectors.

[11]The economic impact of the UK's Maritime Services Sector' Oxford Economics' May 2011
[12]An independent review of the economic requirement for trained seafarers in the UK

CHAPTER 3

MARITIME CLUSTERS AND ECONOMIC IMPACT

3.1 Definition and Characteristics of Maritime Clusters

Maritime clusters are geographical concentrations of maritime-related activities and industries that form ecosystems of collaboration and innovation. These clusters convene a variety of stakeholders, including shipping companies, port operators, shipbuilders, marine services providers, logistics firms, research institutions, and supporting industries. They leverage proximity and interconnections between these entities to foster collaboration, knowledge exchange, and economic growth within the maritime sector.

Clusters often emerge in areas with strategic advantages like access to major shipping routes, deep-water ports, skilled labor, and supportive infrastructure. They benefit from well-developed infrastructure, a wide range of supporting services, efficient terminal operations, shipyards, maritime research institutions, and maritime training centers. These facilities and services enhance the cluster's efficiency and competitiveness.

Maritime clusters foster innovation and knowledge exchange through collaboration between industry players, research institutions, and academia. The proximity of various stakeholders encourages the sharing of best practices, technological advancements, and research findings. Such exchanges lead to the development and adoption of innovative solutions, driving industry growth and competitiveness.

Deep sea shipping refers to the transportation of goods and cargo across long distances by sea, typically involving the movement of vessels between continents. It involves maritime trade routes connecting major ports worldwide. Deep sea shipping plays a crucial role in international trade and globalization.

In this chapter we provide an economic analysis and comparison of some major maritime clusters such as Manila, Philippines and the United States.

3.1.1 Case Study: Maritime Economy – The United States

The Maritime Economy Satellite Account (MESA) provides valuable insight into the U.S. maritime industry by measuring the contributions of activities related to the nation's oceans, seaports, and Great Lakes to the nation's economy.

In 2021, the U.S. maritime economy experienced growth, with an increase in its share of GDP compared to the previous year. It generated US$ 432 billion, to contribute nearly 2% of the nation's US$ 23.32 trillion GDP that year. The maritime economy's real gross output, which measures inflation-adjusted sales and receipts, also saw a positive trend. This growth was primarily driven by sectors like tourism and recreation, transportation and warehousing, and living resources.

MESA real gross output—principally a measure of the marine economy's sales and receipts, including sales to final users in the economy (GDP) and sales to other industries (intermediate inputs), adjusted for inflation increased 10.5%, or US$ 63.9 billion in 2021.

Marine-related economic activity highlights for 2021 include the following:

- **Coastal and offshore tourism and recreation** increased **27.3%**, or US$ 49.8 billion, to reach US$ 231.8 billion, making the sector the largest contributor to growth in MESA real gross output for 2021.

- **Marine transportation and warehousing** increased **16.8%**, or US$ 8.2 billion, to reach US$ 57.1 billion, making the sector the second-largest contributor to overall growth.

- **Marine living resources** increased **13.5%**, or US$ 3.7 billion, to reach US$ 31.0 billion.

- **Offshore minerals** decreased **2.5%**, or US$ 2.5 billion, to US$ 96.6 billion, making the sector the largest offset to overall growth in MESA real gross output for 2021.

The Bureau of Economic Analysis (BEA) examines specific portions of the economy, such as outdoor recreation, health care, and marine-related activities. BEA statistics show that the marine economy accounted for 1.9%, or US$ 432.4 billion, of 2021 U.S. GDP. That number represents an increase from 1.7%, or US$ 363.2 billion, of 2020. In 2021, the marine economy accounted for 1.8%, or US$ 730.0 billion, of the country's GDP.

Analyzing the marine economy by industry sheds light on the breadth of its importance. The government sector emerged as the largest industry group, followed by finance, insurance, real estate, rental, and leasing. Transportation, warehousing, accommodation, and food services also significantly contributed to the marine economy. These industries demonstrate the diverse range of sectors benefiting from maritime activities.

Marine economy industry highlights for 2021 include the following:

- **Government**—as a share of marine economy current-dollar value added—was the largest industry group and accounted for **34.9%**, or US$ 150.8 billion value added and was the largest industry group for compensation (US$ 92.2 billion) and employment (about 717,000 full and part time jobs).

- **Finance, insurance, real estate, rental, and leasing** was the second-largest industry group as a share of the marine economy and accounted for **13.7%**, or US$ 59.1 billion, of value added.

- **Transportation and warehousing** accounted for **8.6%**, or US$ 37.2 billion, of marine economy value added, with the second-largest level of compensation (US$ 23.6 billion).

- **Accommodation and food services** accounted for **6.6%**, or US$ 28.6 billion, of value added and was the second-largest industry group for employment (about 394,000 full and part time jobs) in 2021.

Overall, the maritime economy's positive impact on the United States is evident through its substantial contribution to GDP and employment. The growth in various sectors highlights the economic significance of maritime activities, while the industry breakdown showcases the wide-reaching benefits it brings to the country.

3.2 Economic Impact of Maritime Clusters

A variety of factors influence the economic impact of a maritime cluster. As a baseline, the impact varies by country. The size of the country's economy, its specific characteristics, and the global economy's prevailing conditions all play a role.

But beyond that baseline, there are other factors at play. For example, freight rates (fees for transporting goods or cargo). These rates can be determined by cargo type, shipping distance, supply and demand, market conditions, vessel type and size, and seasonal variations. Additionally, transport costs are directly linked to trade flows and balances. Trade imbalances lead to higher transport costs in high demand regions, which impacts freight rates[13]. For example, between 2018 and 2020, freight rates from Asia to Europe were twice as high as those from Europe to Asia. Rates from Asia to North America were twice as high as those going the other direction. Shipping lines often prioritize larger, well-established shippers, leaving smaller ones unable to negotiate[14].

Confidential contract rates between shippers and shipping lines govern containerized trade. Market conditions influence those contracts: high spot rates lead to high contract rates. Container freight rates have risen consistently since the COVID pandemic. Consequently, costs have increased along global supply chains, and consumer prices have reflected that increase. Small island developing states and lower income countries suffer the greatest economic impact from these increases.

In early 2020, when trade began to shut down, carriers restricted capacity to sustain freight rates. However, as demand later increased, port congestion (e.g., along the west coast of North America) and equipment shortages constrained supply. Shipping containers for goods and products are usually exported full and returned empty, facilitating the efficient and secure movement of cargo. But as Asia transitioned into a recovery phase after COVID, many countries were still in lockdown. They could not return their empty containers. Some containers had also been left behind and failed to be repositioned, in essence they had simply been abandoned, exacerbating the issue. High demand and short supply sent prices skyrocketing.

High freight rates have meant increased profits for global container shipping companies. But if shipping costs continue to climb, not only will exports, imports, production, and consumer prices feel the pinch, short- and medium-term economic recovery will, as well.

The impact of higher freight rates on consumer prices varies by product type. Highly integrated products in global supply chains, like computers, electronic devices, and optical products, are more affected. Low value-added items like furniture, textiles, apparel, and leather products are also impacted. The production of these goods is often dispersed across low-wage economies located far from major consumer markets. Intermediate products, like raw materials, parts, components, and services for production processes (e.g., banking and consulting), are also susceptible to significant price increases as they are integral to global supply chains.

[13]United Nations. (2021). Review of Maritime Transport 2021
[14]Ibd

3.2.1 Case Study: Maritime Clusters – The Philippines

The selection of the Philippines as a case study holds great significance for several compelling reasons. First, as the capital of the Philippines, Manila serves as the hub for numerous maritime activities within the country. Its strategic location and extensive port infrastructure make it a vital gateway for international trade and shipping routes. The Port of Manila, including the renowned Manila International Container Terminal (MICT), plays a pivotal role in facilitating the country's import and export operations.

Additionally, Manila boasts a vibrant maritime ecosystem, housing prominent maritime institutions, shipyards, and a wide range of maritime service providers. This unique combination of factors positions the Philippines, and specifically Manila, as an ideal setting for exploring and understanding the dynamics of the maritime sector and its impact on the national economy.

The Philippines maritime cluster is an interconnected ecosystem that drives economic activity, trade, employment, and expertise in various maritime-related sectors. The cluster leverages the country's strategic geographical location, abundant maritime resources, skilled workforce, and supportive policies to contribute to the national economy and the global maritime industry.

The Philippines has been the leading provider of sea-based workers since 1987. The country currently accounts for approximately 30% of the world's The presence of Filipinos in the Manila cluster is essential due to their significant contributions to economic activity, trade, employment, and expertise in various maritime-related sectors. The cluster leverages the country's strategic geographical location, abundant maritime resources, skilled workforce, and supportive policies to drive growth and development in the national economy and the global maritime industry.

One crucial aspect of the Filipino contribution to the maritime cluster is their role as seafarers. Since 1987, the Philippines has emerged as the leading provider of sea-based workers globally. In fact, the country currently accounts for approximately 30% of the world's seafarers[15]. This extensive presence is reflected in the composition of international vessel crews, where approximately one in every five crew members is Filipino

Filipino seafarers are highly sought after. They work as officers, engineers, and ratings (seafarers without a certificate of competence[16]), among other things, on a variety of vessel types. Remittances play a substantial role in the Philippine economy.

The Philippines is widely recognized as the country with the largest remittances from seafarers. The Bangko Sentral ng Pilipinas (BSP) (the Philippines Central Bank) states that, in 2022, seafarer remittances accounted for at least 22% of all U.S. dollar remittances from Filipino workers overseas (OFWs)[17]. In February 2022, the BSP reported a record-breaking $34 billion in remittances (from all overseas Filipino workers) accounting for 8.9% of the country's GDP[18].

[15]Marine Charts. (2022, February 17). Filipinos: Major Source of Seafarers for Global Maritime Sector.

[16]Ratings in the maritime industry refer to the non-officer crew members who perform various tasks on a vessel, such as deckhands, able seamen, or oilers.

[17]Bangko Sentral ng Pilipinas. Overseas Filipinos' Cash Remittances.

[18]Caraballo, M. U. (2022, February 15). OFW remittances hit record-breaking $34B in 2021– BSP. Manila Times.

Remittances from the sea-based sector of the Filipino seafaring industry have fluctuated in recent years and as seen in the following table.[19]

YEAR	2017	2018	2019	2020	2021	2022
Total Sea-based Remisttances (in USD)	6,870,827,000	6,139,512,000	6,539,246,000	6,353,522,000	6,545,002,000	6,715,880,000

This chart illustrates data from the Bangko Sentral ng Pilipinas (BSP). Remittances experienced a significant increase of US$ 731,315,000 in 2018, followed by a smaller increase of US$ 399,734,000 in 2019. However, there was a decrease in 2020, amounting to US$ 185,724,000. The trend then reversed again in 2021, with an increase of US$ 191,480,000, and continued to rise with another increase of US$ 170,878,000 in 2022[20].

The Philippines stands as a shining example of the key role seafarers can play to a nation's economy.

CHAPTER 4

COMPARATIVE ANALYSIS OF SEAFARER EMPLOYMENT AND WORKING CONDITIONS

Many of the risks and hazards, gender and diversity challenges, and required training for offshore oil workers are analogous to those of global seafarers. As such, a comparison of the two industries provides perspective. Indeed, despite similar challenges and value-added, seafarers earn significantly less than offshore oil and gas workers

4.1 The Offshore Oil & Gas Industry – an Overview

The offshore oil and gas industry has long been a highly desired employer. It has also driven economic development for many countries. The push into increasingly deep waters for offshore projects over the last 30 years has augmented economic opportunities, as well as risks and challenges, for workers.

Employment in the offshore oil and gas sector can generally be split into four areas:

EXPLORATION **CONSTRUCTION** **OPERATIONS** **MANAGEMENT**

[19]Bangko Sentral ng Pilipinas. (Year). Overseas Filipinos' Cash Remittances.
[20]Ibid

Offshore oil workers can perform a range of duties, including drilling, surveying, diving, and health and safety checks[21].

Offshore oil sector employment has generally been considered a rewarding, lucrative career choice. But the industry faces significant challenges. Employee wellbeing remains an issue because of the physical risks associated with the work. In addition, the major structural change in the global energy sector is beginning to cast doubt over the next generation of opportunities for offshore workers.

4.2 Wages and Schedules

Perhaps the most important and, many argue, attractive element of employment in the offshore oil and gas industry is the pay. Historically, offshore worker salaries have exceeded national salary averages; specialist roles can be even more lucrative.

Figures vary across regions and jurisdictions, but in many cases entry level positions can offer between US$ 50,000 - US$ 80,000. More skilled and qualified management positions may offer over US$ 100,000 per year, highly specialized roles can reach US$ 300,000 per year.[22]

Additionally, the offshore oil and gas sector has an unusual (attractive for some) schedule that includes 3/5 of the year off per average employee. A typical schedule may offer 14/21 shifts, which means 14 consecutive days of work followed by 21 days off.[23]

4.3 Employment Security and Contracts

Wages often garner a great deal of attention in a cursory discussion of the sector. However, job security and stability are also key. In the U.S., many workers are contractors. Only about 5% are union members. Union membership can foster greater work continuity and employment permanence. Worker surveys routinely note that "job security" is of top concern, with many employees consistently worried about job loss.[24]

[21]Brunel, "What do offshore workers do? And how much do they make?", October 2020, https://www.brunel.net/en/blog/oil-and-gas/offshore-workers

[22]Ibid

[23]Ibid

[24]Sneath, Sara, "Oil and gas worker survey sheds light on unstable, unsafe working conditions," Louisiana Illuminator, April 6, 2023 https://lailluminator.com/2023/04/06/oil-and-gas-worker-survey-sheds-light-on-unstable-unsafe-working-conditions/

4.4 Challenges – Risks and Training

U.S. Occupational Safety & Health Administration (OSHA) data indicate that offshore oil and gas workers in the United States suffer some of the highest injury and fatality rates. That data further notes that the number of these workers killed between 2003 and 2010 was seven times higher than that of all other U.S. industries.[25] Fatigue is also a concern due the intense schedules and grueling work.[26]

Being at sea makes it difficult to access proper medical care and attention. While rigs and offshore companies have medical staff and teams, some health issues can be difficult to treat, and, in some cases, delayed treatment can exacerbate an offshore injury or even lead to death.

In order to operate under the conditions deepwater efforts present, workers must have extensive technical knowledge and experience (e.g., technological capabilities to manage drilling). These workers must also possess a knowledge of earth sciences, with an emphasis on deepwater exploration, as well as an ability to assess feasibility of deepwater operations from the environmental point of view. Because project technology and processing methods can significantly impact the environment, workers must be aware of a project's implications.

4.5 For Consideration

Major structural changes in the international energy arena, including decarbonization and Net Zero goals, will demand reskilling in the offshore oil and gas industry. This demand will require an integrated plan to develop capacity building and training, which will enable oil and gas workers to shift to renewable energy projects.

For example, geology and geophysics skills can be enhanced to transition to work on platforms for offshore wind, and/or plug and clean abandoned oil wells, and/or develop carbon capture projects, among other possibilities.

Perhaps the offshore oil and gas industry's existing, well-regarded apprenticeship model could be translated to other areas of employment.

But Mexican government data on employment opportunities in the offshore sector[27] and U.S.-based industry surveys indicate that wages in the renewable energy sector are not yet high enough to lure workers from the fossil fuel industry.

[25]Ibid

[26]Ibid

[27]Prospectiva del Talento del Sector Energía, Volumen: 1 Análisis de las Cadenas de Valor del Subsector Hidrocarburos, Secretaría de Energía de México, 2016

CHAPTER 5

ECONOMIC VALUE OF SEAFARER TRAINING AND COMPETENCE

World trade depends heavily on seafarer competencies and skills, as the shipping industry contributes to over 90% of the world's economy.[28] As economic liberalization spreads across the globe and shipping becomes increasingly efficient, the industry's growth prospects are strong. The world merchant fleet is registered in over 150 nations and there are over 50,000 merchant ships trading internationally[29].

In 2021, the number of STCW certified seafarers stood at approximately 1,892,720; 857,540 of those workers were officers, 1,035,180 were ratings[30]. Within the five countries that provide the most seafarers for the world merchant fleet (Philippines, Russian Federation, Indonesia, China, and India) there are more seafarers certified for oil and chemical tanker operations than for liquefied gas tanker operations despite the expected growth in use of liquified natural gas (LNG) and liquified petroleum gas (LPG) powered tankers in the coming years[31].

5.1 Importance of Seafarer Training

Seafarer training is crucial to international trade. Well-trained seafarers possess the necessary skills and knowledge to navigate complex trade routes, handle various cargo types, and comply with international trade regulations. Seafarer competence is essential to safe, efficient maritime operations.

Because shipping is a global endeavor, a global regime to standardize competence and certification requirements for seafarers is key. The IMO STCW serves as a global framework for regulating the competence standards and certification requirements for seafarers[32]. It establishes minimum international standards of competence and governs the issuance of certificates that validate seafarer qualifications. A seafarer who holds STCW certification and works in the international merchant fleet is granted an STCW certificate known as a Certificate of Competency (CoC)[33]. The competencies necessary to earn the certificate are broad, and may include navigation and watchkeeping; proficiency in modern technologies like electronic charts and information systems (ECDIS); teamwork and leadership skills; and security and emergency response procedures[34].

The STCW certificate allows seafarers to serve on ships engaged in international trade and on vessels registered under a flag state other than the country that issued their STCW certificate[35]. Under STCW regulations, governments must maintain a register of all STCW certificates they issue to seafarers trained in their system. They must also share information on the status of these certificates with other countries and shipping companies upon request[36]. Under these regulations, shipping companies and other relevant parties can easily verify the authenticity and validity of seafarer certificates.

[32]Seafarer Workforce Report. The global supply and demand for seafarers in 2021, 11.
[33]Seafarer Workforce Report. The global supply and demand for seafarers in 2021, 3.
[34]International Convention on Standards of Training, certification and Watchkeeping for Seafarers (STCW). International Maritime Organization.
[35]Seafarer Workforce Report. The global supply and demand for seafarers in 2021, 1.
[36]Seafarer Workforce Report. The global supply and demand for seafarers in 2021, 1.

There have been great technological advances since the SCTW was adopted. For instance, in 2008, the International Convention for the Prevention of Pollution from Ships (MARPOL), set January 1, 2020 as the effective date for a reduction from **3.50%** to **0.50%** for the global sulfur cap and limit[37]. For vessels operating in MARPOL designated sulfur emission control areas (SECA), the limit – which will remain unchanged for the foreseeable future – has been 0.10% since January 1, 2015[38]. Since 2015, the maritime industry has had to seek economically viable ways to ensure compliance for both existing and new vessels. As a result, demand for natural gas-powered ships has surged.

The natural gas-powered fleet currently stands at 562 vessels worldwide[39]. There are another 192 ships in various stages of construction and an additional 208 ships on order, illustrating the growing interest in natural gas propulsion[40]. There are also 224 ships classified as "gas ready," meaning they are currently not utilizing gas but could transition to this fuel option when required[41].

The growing number of these ships will lead to a higher demand for seafarers to operate them. They will need to be trained. STCW Chapter V-3 "Mandatory minimum requirements for the training and qualifications of masters, officers, ratings and other personnel on ships subject to the International Code of Safety for Ships using Gasses or other Low-flashpoint Fuels" (IGF Code) regulates such training[42].

5.2 Impact of Training on Shipping Performance

Training has a profound impact on shipping performance, as it directly affects shipping operations and crew efficacy.

The technological changes associated with transitioning to a zero carbon economy will require training for seafarers and shipping companies. The increase in ships with electrical and electronic systems means personnel must be highly trained and specialized . If ships are to be electrically powered, seafarers will have to be trained to ensure optimal performance.

Although the STCW already offers training for ships with electrical systems, the impact on the shipping industry's demand has been quite limited. The STCW 2010 Manila Amendments introduced new certified positions of Electro-Technical Officer (ETO) and Electro-Technical Rating (ETR), which took effect in 2012 . Nevertheless, companies reported the highest levels of difficulty when attempting to recruit engineering officers and electro-technical officers among STCW certified seafarers . The supply for this growing demand may be limited.

[37]Seafarer Workforce Report. The global supply and demand for seafarers in 2021, 5.
[38]Global sulphur cap 2020. DNV.
[39]Seafarer Workforce Report. The global supply and demand for seafarers in 2021, 5-6.
[40]Seafarer Workforce Report. The global supply and demand for seafarers in 2021, 6.
[41]Seafarer Workforce Report. The global supply and demand for seafarers in 2021, 6.
[42]Seafarer Workforce Report. The global supply and demand for seafarers in 2021, 6.

5.2.1 Case Study: The Importance of Training – Malaysia

Malaysia is a coastal country with the potential to develop a strong maritime industry. While the country engages in domestic and international shipping, the industry has recently suffered an overall revenue decline. The Malaysian Shipowners Association (MASA) attributes this decline to the weak global shipping market. But as the nation's fiscal deficit continues to worsen, the number of qualified Malaysian seafarers serving on merchant ships has significantly decreased. This shift has led Malaysian shipowners to rely on multinational crews for their maritime operations as demonstrated by the increased issuance of Certificate of Recognition (COR) by the Marine Department of Malaysia (MARDEPT). Because ships must meet a minimum manning requirement to engage in sea trade, shipowners hire non-nationals despite the negative economic impact on the local Malaysian seafarers, who have begun to pursue other, better job opportunities outside of the maritime sector - and in many cases jobs that do not require training - in neighboring countries like Singapore.

This dynamic is progressively damaging Malaysia's overall maritime sector, as the ship building and repair industry, maritime legal services, and ports operation rely on the shipping industry's well-being . For instance, the increased presence of foreign-owned offshore support vessels (OSVs) in Malaysian waters—largely driven by the demand for higher technical specifications from oil companies—has negatively impacted the country's economy.

The number of qualified Malaysian OSVs available to participate in the highly profitable oil and gas extraction activities within Malaysian waters has dropped and are increasingly replaced by foreign OSVs.This situation has not only led to a decrease in employment opportunities for Malaysian seafarers, it also threatens to slash the number of experienced Malaysian seafarers in the long term. Consequently, Malaysia's desire to become a nation that can supply shipping and maritime services to select markets and regions may be derailed by the significant loss of human capacity needed to support the industry.

Thus, the Malaysian government must invest time and capital in human resource development. The development and expansion of the shipping industry depends on it. To produce more seafarers with a valid Certificate of Competency under the STCW, the government must create economic incentives to lure workers and promote training and education for the maritime sector while taking into consideration the current transition to the use of digital technologies.

5.3 Talent Development

Malaysia is not the only country experiencing a declining maritime workforce. The 2021 Seafarer Workforce Report predicts that the seafarer industry already suffers a deficit in STCW-certified officers and a surplus of STCW certified ratings.

The report estimates that by 2026 the industry will need 947,050 officers. To meet that demand, 17,902 officers will have to join the workforce every year[47]. Maritime education, training, and career development must be promoted globally, and seafarer recruitment and retention must be closely monitored to inform the industry and policymakers of the current supply and demand of trained seafarers.

5.3.1 Gender

The maritime industry is male-dominated. Women are underrepresented in several positions, particularly leadership roles. The 2021 Seafarer Workforce Report indicates a significant rise in the number of female STCW certified ratings in comparison to the number of female STCW certified officers. The estimated global supply of female STCW certified seafarers stands at 24,059, an increase of **45.8%** from 2015 estimates, which anticipated approximately 7,289 female officers and 16,770 STCW certified ratings[48].

The report highlights active steps maritime education and training (MET) institutions are taking to entice women to join. In a MET questionnaire, **31%** of the institutions reported the design and implementation of specific policies aimed at attracting female students[49]. For instance, one institution reported a **10%** discount for female students[50]. An increase in training could meaningfully impact the level of female seafarer employment by shipping companies, as only **2.32%** of current officer cadets employed in ships are women[51].

The maritime sector should incentivize gender diversity and inclusiveness, as such diversity could drive not only operational advantages but also empower communities through investment and increased opportunities, ultimately benefiting national economies.

[47]Seafarer Workforce Report. The global supply and demand for seafarers in 2021, 66.
[48]Seafarer Workforce Report. The global supply and demand for seafarers in 2021, 30.
[49]Seafarer Workforce Report. The global supply and demand for seafarers in 2021, 31.
[50]Seafarer Workforce Report. The global supply and demand for seafarers in 2021, 31.
[51]Seafarer Workforce Report. The global supply and demand for seafarers in 2021, 31.

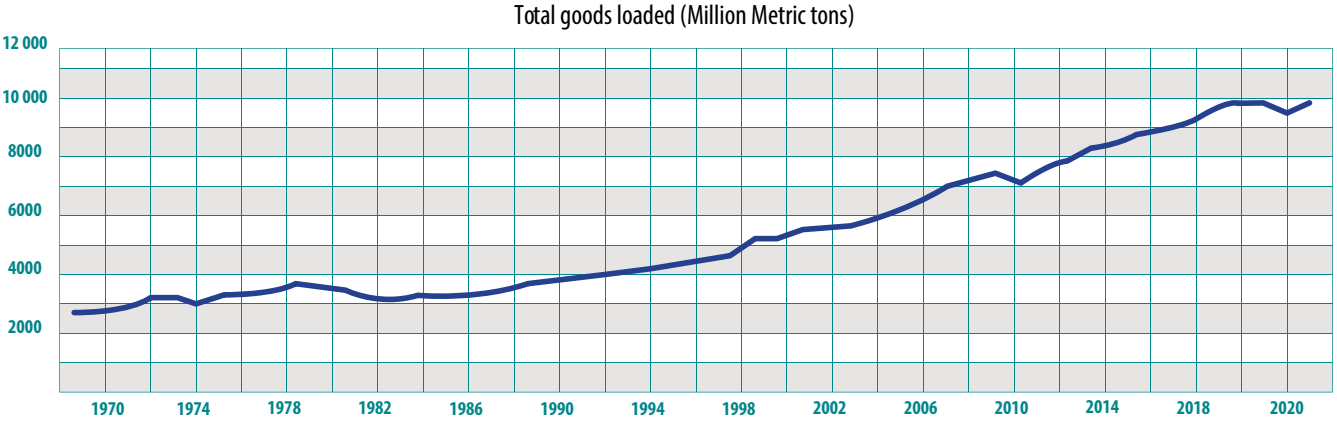
CHAPTER 6

GLOBAL PERSPECTIVE AND OUTLOOK

6.1 Global Seaborne Trade

Global seaborne trade has more than tripled during the last five decades, it went from 2,605 million metric tons (mt) in 1970 to 10,985 mt in 2021 (see graph A).

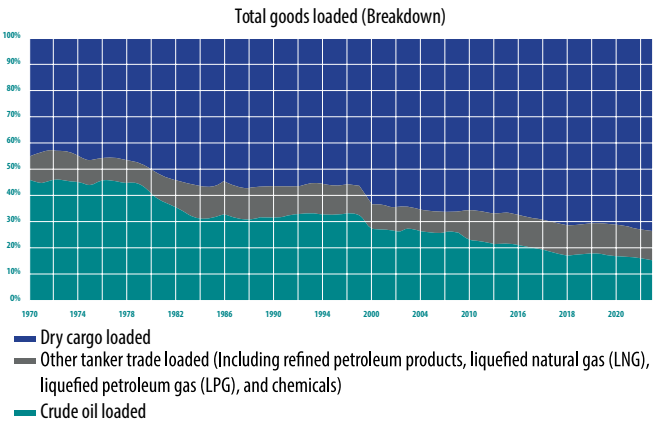
GRAPH A



Source: elaborated with data from UNCTADstat

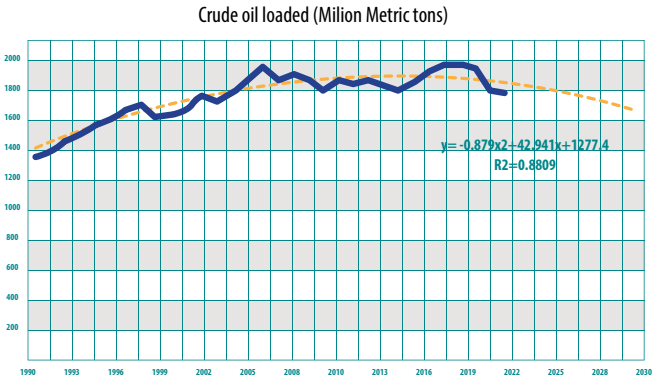
Despite a decrease in share of crude oil loaded (see Graph B1), these shipments in absolute terms grew 40.9% (see Graph B2); while refined petroleum products, liquefied natural gas (LNG), liquefied petroleum gas (LPG), and chemicals increased more than four times (see Graph B3), and dry cargo augmented fivefold (see Graph B4).

GRAPH B1



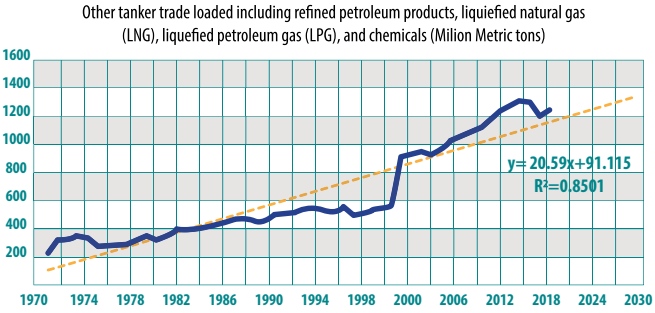
Source: elaborated with data from UNCTADstat

GRAPH B2



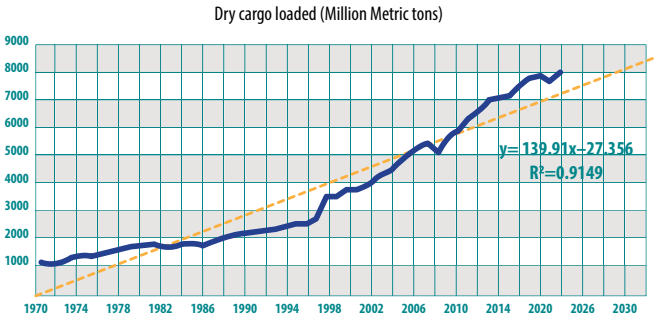
Source: elaborated with data from UNCTADstat

GRAPH B3



Source: elaborated with data from UNCTADstat

GRAPH B4

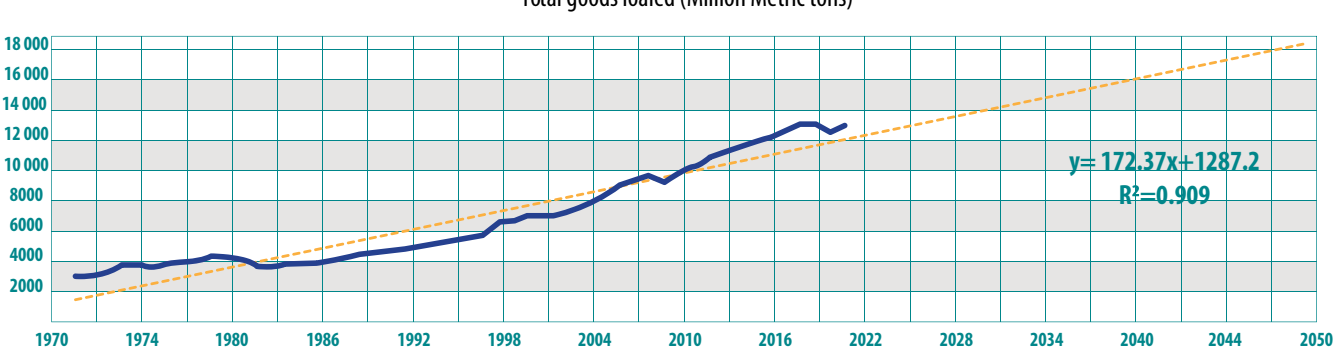


Historically, Asia has benefitted the most from increased trade. In 2006, the continent was responsible for **47.9%** of global seaborne commerce. That volume climbed to **64.3%** in 2021, to account for almost two thirds of global seaborne commerce (7,054 mt). Africa has also improved its share, though marginally, from 4.4% in 2006 to 5% in 2021 (553 mt).

In contrast, Europe's trade share plummeted, dropping from **27%** (2,131 mt) of world´s commerce in 2006 to **15.7%** (1,722 mt) in 2021. The Americas experienced a marginal decrease (1,538 mt in 2006 vs. 1,501 mt in 2021), though fifteen years (2006) ago those countries were responsible for one fifth of global trade. In 2021 they held just **13.7%**.

If we extrapolate from this data to project growth in global seaborne trade, such trade could expand another 50% by 2050 (see Graph C). If the regional structure of trade remains consistent, and we assume the International Chamber of Shipping base case scenario detailed in the Seafarer Workforce Report 2021 to estimate labor force and merchant fleet, the expanded trade would imply an additional 5,500 mt of goods, which would require 875,000 new seafarers and 32,500 new ships to ensure the cargo reaches its destination.

GRAPH C



Source: elaborated with data from UNCTADstat

Every year the maritime sector to keep up with the requirements would need to add more than a thousand new vessels to the global fleet, and more than thirty thousand new seafarers to the labor market, with direct investments in the order of USD 12.5 billion. Moreover, if we use the multipliers used by Oxford Economics[52] for the case of Europe and apply them to this scenario, there would be a multiplier effect of up to an additional USD 20 billion in indirect and induced investments, and up to 84.5 thousand additional indirect jobs created per year.

[52]The economic value of shipping and maritime activity in Europe. (n.d.). https://search.oecd.org/sti/ind/Session%201_c%20-%20Andrew%20Goodwin%20-%20Presentation%20for%20Website.pdf

6.2 Environment and Sustainability

In its Fourth Greenhouse Gas Study,[53] the IMO compares trade trends, with emissions and carbon intensity from this study and their three previous Greenhouse Gas Studies (see Graph D).

GRAPH D

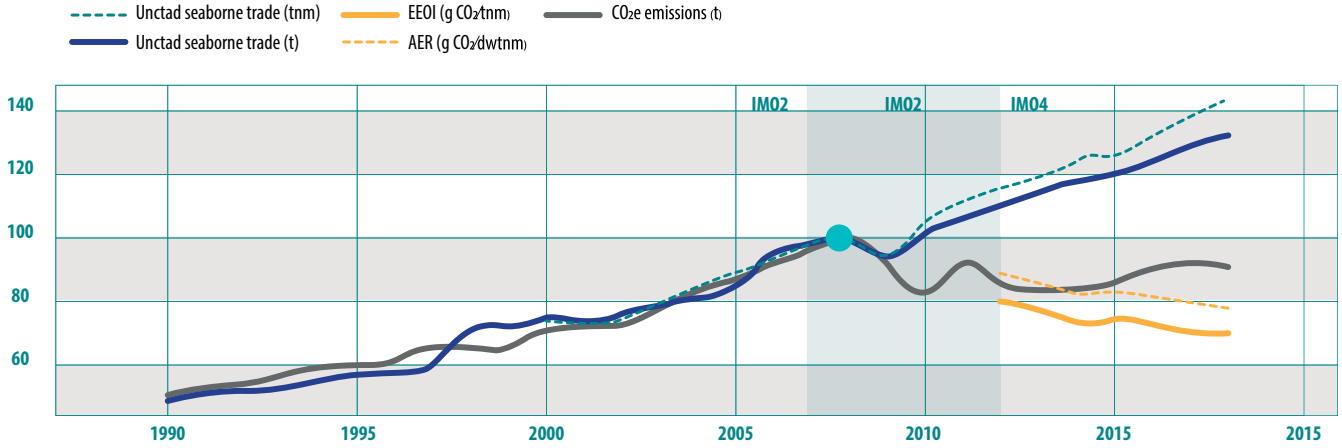


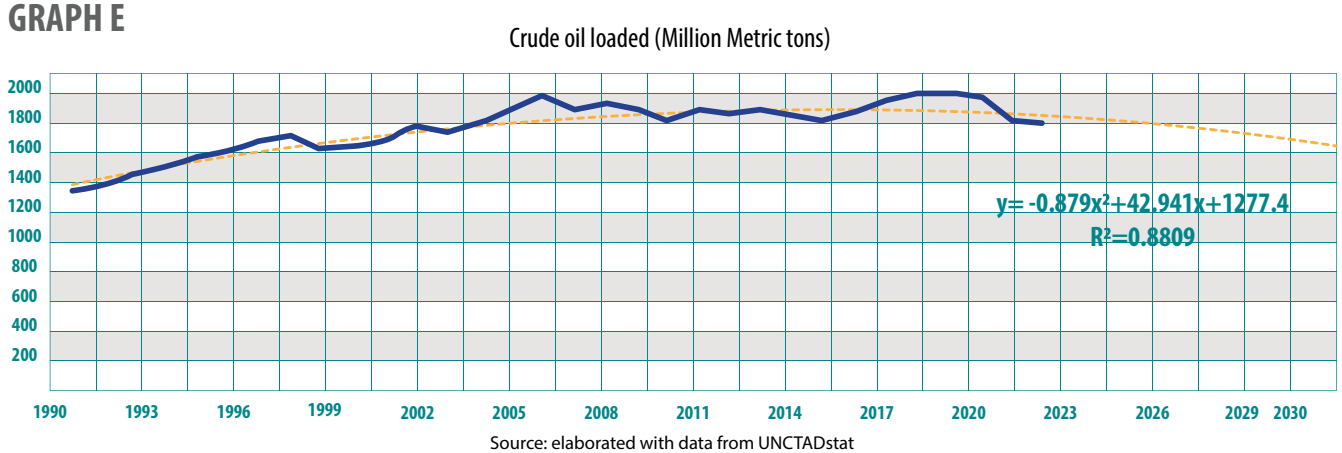
Figure 61. Trends in seaborne trade, carbon, carbon intensity metrics (EEOI and AER) and CO2 -equivalent emissions for international shipping, 1990-2028, indexed to 2008

Source: UMAS

Graph D illustrates two key elements, as follows:

- **Trade and emissions correlate closely from 1990 to 2008.** As trade grew, so did CO2 emissions.
- **Trade and emission decoupled between 2008 and 2014.** This shift coincides with a shift in crude oil trade after the 2008 financial crisis (see Graph E). CO2 emissions declined while seaborne trade increased.

GRAPH E



Source: elaborated with data from UNCTADstat

[53]Fourth Greenhouse Gas Study 2020. International Maritime Organization. (2020). https://www.imo.org/en/OurWork/Environment/Pages/Fourth-IMO-Greenhouse-Gas-Study-2020.aspx

On the other hand, according to the IMO, in the best-case scenario emissions would slightly decrease to **90%** of 2008 emissions by 2050 or alternatively could increase up to **30%** of 2008 emissions by 2050 (see Graph F). However, even though there is a positive trend in lower carbon intensity (as a result of changes in the fleet composition and ship size, regulatory changes in energy efficiency or fuel mix, and market-driven changes in energy efficiency), according to the Inter-Governmental Panel on Climate Change efficiency improvements in these scenarios would be between 20 and **30%**, therefore needed a combination of both regulatory and market mechanisms to push for innovation in existing and new technologies, progressive operational and environmental standards, and incentives to stimulate private investment if the shipping sector is to reach a well below 2˚C scenario (see panel a) scenarios C1-C2 in Graph G).[54, 55] Otherwise the shipping sector would increase its emissions or at best stabilize them (see panel b) of Graph G).

GRAPH F

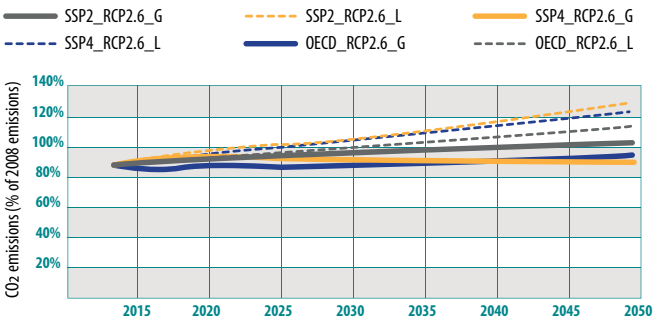


Figure 1 – Projections of maritime ship as a percentage of 2008 amission

GRAPH G

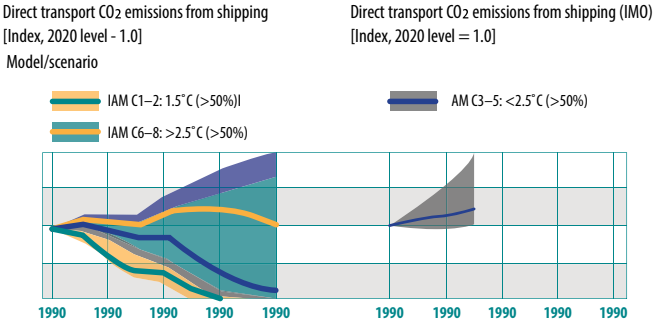


Figure 10.16 | CO2 emissions from shipping acenarios indexed to 2020 modelled year. Panel (a) scenarios from the AR6 database. Panel (b) scenariis from the fourth IMO GHG Study (Faber et al. 2020). Figures show median, 5th and 95 th porcente (shaded area) for each scenario group.

6.3 The Net Zero Transition

The transition of the shipping sector to actively reduce its environmental footprint is undergoing. The International Maritime Organization in 2012 adopted mandatory energy efficiency regulations for ships with progressive carbon intensity reductions (**10%** reduction in new ships by 2015, **20%** by 2018, **30%** by 2025), it has set a target of **40%** reduction of CO2 emissions by 2030 compared to 2008, and a **50%** reduction of Green House Gas emissions by 2050 from 2008 levels.[56] However, ambition must be increased to match the level of emissions and action from the sector.

[54]Ibid

[55]Jaramillo, P., S. Kahn Ribeiro, P. Newman, S. Dhar, O.E. Diemuodeke, T. Kajino, D.S. Lee, S.B. Nugroho, X. Ou, A. Hammer Strømman, J. Whitehead, 2022: Transport. In IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.012

[56]Un body adopts climate change strategy for shipping. International Maritime Organization. (n.d.). https://www.imo.org/en/MediaCentre/PressBriefings/Pages/06GHGinitialstrategy.aspx

6.3.1 Business Model

Several efforts are pushing the sector to a Zero-Emissions Business Model. In 2021 it was launched the Zero-Emissions Shipping Mission[57], an effort to demonstrate commercially viable zero-emission ships by 2030; "the "Getting to Zero Coalition's Call to Action for Shipping Decarbonization", urging the adoption of a sector-wide goal of zero emissions by 2050 and the commercial deployment of zero-emission vessels by 2030. At COP26 more than fifty developing countries requested the IMO to work on a mandatory GHG levy on international shipping; and 19 States signed the Clydebank Declaration with the aim to set zero-emission maritime routes between two or more ports."[58]

The Zero-Emissions Business Model is "a function of travel demand, travel mode, transport technology, GHG intensity of fuels, and energy efficiency."[59]

Therefore, there is a need to work in tandem with governments to design both on demand and supply incentives to optimize travel, set targets to phase out fossil fuel usage, implement mandatory standards to improve efficiency and reduce carbon content, and to promote research and development of low carbon technologies.

6.3.2 Labor

In the latest Seafarer Workforce Report [60], BIMCO and ICS focus on the future supply and demand balance for seafarers identifying several factors that have an effect in this market including:

- **The stock, composition, and movement in the world´s shipping fleet**
- **Recruitment**
- **Changes in the crewing levels per ship**
- **Variations in the seafarer–berth ratios**
- **Training**
- **Turnover rates of seafarers**
- **Technical and regulatory developments**

[57]Mission innovation. Mission Innovation. (n.d.). http://mission-innovation.net/missions/shipping/
[58]Review of Maritime Transport 2022. UNCTAD. (2022, November 29). https://unctad.org/publication/review-maritime-transport-2022
[59]Jaramillo, P., S. Kahn Ribeiro, P. Newman, S. Dhar, O.E. Diemuodeke, T. Kajino, D.S. Lee, S.B. Nugroho, X. Ou, A. Hammer Strømman, J. Whitehead, 2022: Transport. In IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.012
[60]Seafarer workforce report, 2021 edition (2023) International Chamber of Shipping. Available at: https://www.ics-shipping.org/publication/seafarer-workforce-report-2021-edition/

Therefore, the outlook of the seafarer labor force in a Zero Emissions Business Model for Shipping is vibrant. The sector has never experienced a change at this scale and that fast, with several forces in play creating positive feedback loops. The expected growth in trade by mid-century would require adding half of the current labor force just to match the work needed to deliver those products to the consumer. Consequently, the perspective for a stable and consistent demand of labor would be present for decades.

The technology needed to meet 2050 targets create incentives both for existing and new labor force. For current seafarers, new energy carriers and a switch to more automated and digitized ships would demand retraining and reskilling to adapt to the requirements of a very sophisticated industrial and regulated sector. For new seafarers, an intellectually rewarding activity with the use of new technologies, and in constant need of innovation to accommodate the needs of a carbon constrained world would attract the best and the brightest. Hence, the conditions of the labor market of the Zero Emissions Business Model would need to have permanent certification and training, a flexible scheme balancing land and sea activities, longer term contractual arrangements to provide job security, and very competitive compensation packages to attract the seafarer of the zero-emissions shipping world.

6.3.3 Technology

The technologies needed in the Zero Emissions Business Model will include three types:

- **energy saving** (autonomous systems, cogeneration, light materials, digitalization)
- **renewable energy** (wind turbines, wind engines, solar panels, low energy lighting)
- **alternative fuels** (LNG, methanol, ethanol, biomass).

The adoption of a particular technology or a combination of them depends on the price of fuels, the lower the cost, the later the adoption of a new technology which in turns reduces the emissions abatement potential (see Graph H). If the price of conventional fuel is **50%** lower the abatement potential starts to have a positive net cost at **7.5%** of CO2 reduction potential.[62]

GRAPH H

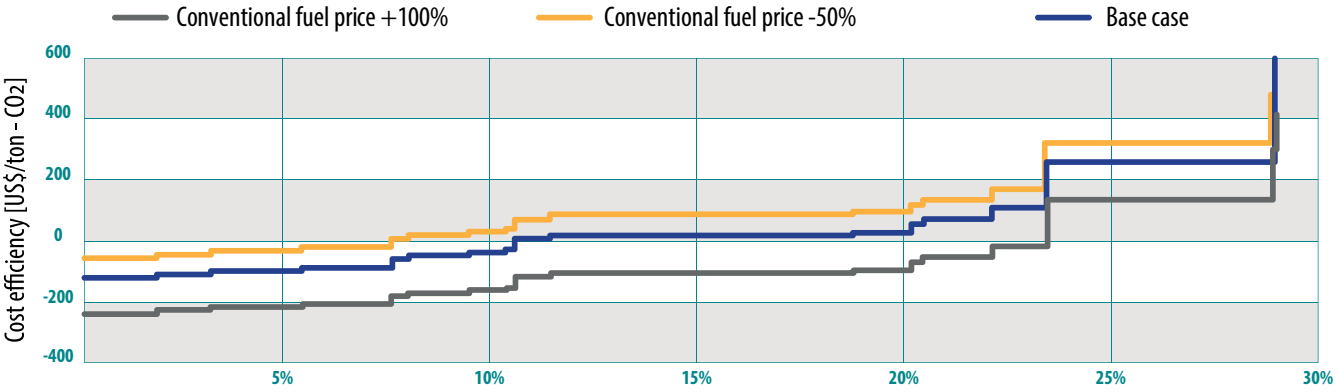


Figure 167 – Sensitivity analysis of conventional fuel price in 2030 (scenario 1)

[62]Ibid

Thus, there are several areas of opportunity for the research community to innovate and contribute to advance different technologies. For example, on biofuels, the focus can be on taking a portfolio of biofuel conversion technologies into commercial phase (see Graph I).[63]

GRAPH I

Table 10.5 | Ranges of efficiency, GHG emissions, and relative cost of selected biofuel conversion technologies for road, marine and aviation biofuels.

MAIN APPLICATION	CONVERSION TECHNOLOGY	ENERGY EFFICIENCY OF CONVERSION	GHG EMISSIONS OF CONVERSION PROCESS (gCO_2-eq per MJ OF FEUL)[b]	RELATIVE COST OF CONVERSION PROCESS
ROAD	Lignocellulosic Ethanol	**35%**[c]	**5**[d]	**MEDIUM**
ROAD/AVIATION	Clasification and Fischer-Tropsch synthesis	**57%**[e]	**<1**[d]	**HIGH**
ROAD	Ethanol from sugar and starch	**60–70%**[f]	**1–31**[d]	**LOW**
ROAD	Biodiesel from oil crops	**95%**[g]	**12–30**[d]	**LOW**
MARINE	Upgraded pyrolysis oil	**30–61%**[h]	**1–4**[h]	**MEDIUM**
AVIATION/MARINE	Hydro-processed esters and fatty acids	**80%**[i]	**3**[i]	**MEDIUM**
AVIATION	Alcohol to jet	**90%**[i]	**<1**[k]	**HIGH**
ROAD/MARINE	Biomethane from residues	**60%**[l]	**n/a**	**LOW**
MARINE/AVIATION	Hydrothermal liquefaction	**35–69%**[h]	**<1**[h]	**HIGH**
AVIATION	Sugars to hydrocarbons	**65%**[m]	**15**[m]	**HIGH**
ROAD	Gasification and syngas fermentation	**40%**[n]	**30–40**[n]	**HIGH**

Notes: [a]Calculated as liquid fuels output divided by energy in feedstock entering the conversion plant; bGHG emissions here refers only to the conversion process. Impact form the difeerent biomass options are not included here as they are addresses in Chapter 7; [c]Olofsson et al. (2017); dKoeble et al. (2017); eSimell at al. (2014); [f]de Souza Dias et al. (2015); [g]Castanheira et al. (2015); [h]Tnezer et al. (2019); [i]Klein et al. (2018); [j]Narula et al (2017); [k]de Jong et al. (2017); [l]Salman et al. (2017); [m]Moreira et al. (2014); Roy et al. (2015); Handler et al. (2016); [n]Salman et al. (2017); Moreira et al. (2014); Roy et al. (2015); Handler et al. (2016).

[63]Jaramillo, P., S. Kahn Ribeiro, P. Newman, S. Dhar, O.E. Diemuodeke, T. Kajino, D.S. Lee, S.B. Nugroho, X. Ou, A. Hammer Strømman, J. Whitehead, 2022: Transport. In IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.012

Take upgraded pyrolysis oil, it **"is promising for its characteristics as combustion fuels used in boiler, engines or gas turbines, however, is corrosive, viscose and thermally unstable."**[64] Therefore, promoting research to work on the energy efficiency conversion or its cost could accelerate an alternative that will have a high potential emissions abatement, and attract the research community into an intellectually challenge and rewarding endeavor.

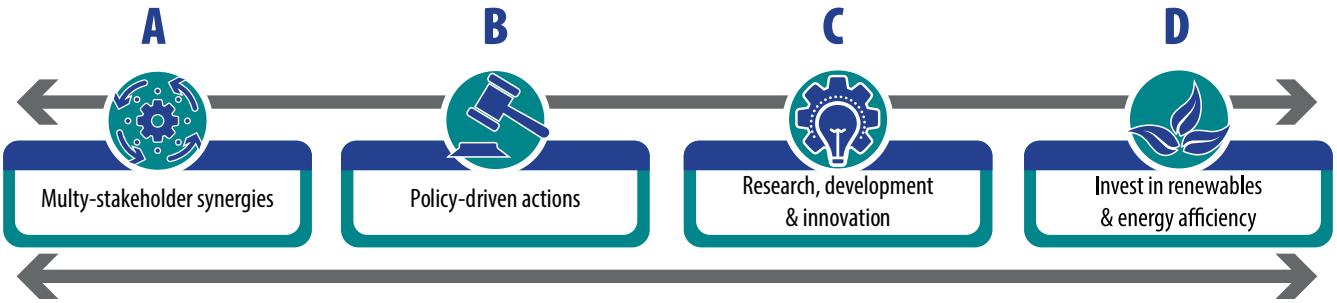
Thus, aligning the research community with private sector needs, in addition to seed funding from the public sector can accelerate and scale up the technologies needed for a Zero Emissions Shipping world.

[64]Huijun Yang, Jingang Yao, Guanyi Chen, Wenchao Ma, Beibei Yan, Yun Qi, Overview of Upgrading of Pyrolysis Oil of Biomass, Energy Procedia, Volume 61, 2014, Pages 1306-1309, ISSN 1876-6102, https://doi.org/10.1016/j.egypro.2014.11.1087 (https://www.sciencedirect.com/science/article/pii/S1876610214029178)

6.3.4 Policy and Regulation

The IMO´s Initial Strategy on the reduction of GHG emissions from ships is a very positive action (**40%** reduction of the carbon intensity of international shipping by 2030 and is striving for a **70%** reduction by 2050)[65], however, the Zero Emissions Business Model would require a new framework to raise the decarbonization ambition. An effort that will require actions in four areas: "Multi-stakeholder Synergies; Policy-driven Actions; Research, Development, and Innovation; Investment in Renewables and Energy Efficiency" (see Graph J).[66]

GRAPH J



Multi-stakeholder synergies: there would be a need to strengthen international collaboration and to develop a baseline and a roadmap to the Zero Emissions Business Model to support a platform that can attract public and private sector stakeholders from shipping, but also from other sectors, including energy, technology, and finance.

Policy-driven actions: it will be required to promote a global carbon market that creates the conditions to assign efforts and investments in the most efficient way according to its intensity and cost. The carbon market should be combined with progressive limits on carbon, and mandatory standards on energy efficiency and renewable energy. In addition, there should be a globally accepted monitoring, reporting, and verification system that provide certainty for the certifications and labeling of the various products.

Research, development, and innovation: promote mission-driven work to help in the challenges of shipping including infrastructure (ships and ports), operations (engines and materials), and energy (sources, use, conservation, and storage).

Invest in Renewables and Energy Efficiency: develop financial mechanisms to de-risk the uptake of new technologies and materials and allow to leverage public and private resources to mobilize the requirements needed for a zero emissions world.

[65] Jaramillo, P., S. Kahn Ribeiro, P. Newman, S. Dhar, O.E. Diemuodeke, T. Kajino, D.S. Lee, S.B. Nugroho, X. Ou, A. Hammer Strømman, J. Whitehead, 2022: Transport. In IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.012

[66] IRENA (2021), A pathway to decarbonise the shipping sector by 2050, International Renewable Energy Agency, Abu Dhabi. ISBN 978-92-9260-330-4

CHAPTER 7

CONCLUSION AND POLICY RECOMMENDATIONS FOR SUPPORTING SEAFARERS AND NATIONAL ECONOMIES

7.1 Conclusion

Seafaring and maritime trade clearly offers plenty of economic opportunity. As the global economy continues to rebound from the Covid pandemic, our assessment of available data indicates 32,500 new vessels will be needed, 875,000 new jobs will be created, and 5,500 mt of goods moved with the associated impact on economies linked to the maritime and seafaring sector.

But these figures are not guaranteed. They are estimates based on our analysis of currently available data. In many cases, that data is uneven and not readily accessible. Indeed, one of our key conclusions from compiling this report is that there is a paucity of publicly available data, and what is available is certainly not consistent and/or accessible for more than a cursory, high-level quantitative analysis.

The sector faces significant hurdles in the form of labor stability and job security. The issues surrounding labor and workforce readiness in many cases are derived from or affected by uneven—and in extreme cases non-existent—training and certification programs.

Indeed, to fully leverage and maximize the economic value and benefits of our projections for the maritime and seafaring industry, our analysis highlights a series of challenges that must be navigated.

There are four broad areas to address:

LABOR AND EMPLOYMENT

TRAINING AND CERTIFICATION

HUMAN CAPITAL AND TRANSITION

DATA AND ACCESS TO RELIABLE INDUSTRY INFORMATION

7.2 Policy Recommendations

In response to these areas and their associated challenges, we have developed a set of recommendations. In many instances, these recommendations require commitments from policymakers, shipping companies, and seafarers alike. Indeed, instead of a so-called "bottom up" or "top down" approach, these recommendations require multiple level engagement. They will require governments to develop policies and legislation. Shipping companies will have to update workplace commitments and support. Seafarers will have to provide input to implement these efforts at an operational level.

7.2.1 Labor and Employment

Invest in a revised employment model to create contract stability for employers and employees. The model should reduce the risk of termination for seafarers and allow shipping companies and vessel operators flexibility. It should incentivize investment in training and certification by reducing the risk of turnover. A revised contract framework might offer new seafarers a twelve-month trial period followed by a three-year contract. To build job security, a curriculum and contractual requirements for safety and security that facilitate those elements as key cultural aspects regardless of type or size of ship and vessel cargo should be developed.

Develop a hybrid employment model that offers on-shore and off-shore experience. A year-long trial period and three-year contract could offer four months at sea followed by eight months inland. This arrangement would provide a healthier work-life balance and more competitive working conditions.

7.2.2 Training and Certification

Invest in training for entry level and mid-career seafarers to ensure more preparedness, which can also be linked to longer and more secure employment contracts. An apprenticeship model like that of the oil and gas offshore industry is one possibility. A more rigorous and international standard for licensing and certification should follow as appropriate training and certification programs are developed. A just transition framework for seafaring should start in the oil and gas offshore industry because of the downward trend in crude traded (see Graph B2) compounded with the need to decarbonize operations in the well below 2°C scenario as indicated by the IPCC (see Section 6.2 Environmental and Sustainability). A natural path would be to retrain this seafaring workforce into operations that could be replicated in a different sector, like offshore wind or clean fuels like hydrogen or methanol.

7.2.3 Data and Access to Reliable Industry Information

Invest in data collection and management with consistent, country-level parameters for key industry indicators. The International Chamber of Shipping or its designee can manage this data in a central repository. Governments need a workforce planning tool to help them develop policies and coordinate with the academic sector for certification and training requirements, and technical and professional curriculum adapted to a Net Zero Business Model. They must also coordinate with the private sector to ensure a qualified stream of talent to tap into for predictable career paths that lead from entry to retirement.

Governments should invest in collecting disaggregated data on seafaring occupation by age group to feed into the workforce planning tool, complemented by a contract and income gauge, to design policies for talent attraction and retention. Additionally, they should conduct surveys on the percentage of income going to remittances by seafaring occupation.

7.2.4 Human Capital and Just Transition

Invest in diversity and gender programs that support a just transition and better leverage entry level and employment possibilities in the sector; increased equity should also support how the industry manages and leverages remittances.

Governments and the private sector should invest in developing talent and technology for the shipping industry's Net-Zero Business Model. A Sustainable Shipping for All fund should be established.

The fund should be endowed by a tax (carbon content of cargo moved and/or of fuel used) with a focus on investing in three areas:

- **Talent development** (certification, training – skilling, retraining, reskilling –professional studies)
- **Research and development** (funding opportunities to develop new materials, cleaner fuels, new technologies)
- **Commercialization and deployment of new technologies**

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