2024-2025 SUSTAINABLE MARITIME CONNECTIVITY REPORT IN ASIA AND THE PACIFIC :

Connecting the Pacific, A Voyage towards Sustainable Development

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Economic and Social Commission for Asia and the Pacific

Ministry of Oceans and Fisheries

KMI KOREA MARITIME INSTITUTE

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FOREWORD

By Armida Salsiah Alisjahbana, ESCAP

Maritime transport is the backbone of international trade and economic growth, with the Asia-Pacific region accounting for more than half of global maritime trade. However, this connectivity is not evenly distributed. While major economies in East and South-East Asia continue to strengthen their maritime infrastructure, many small island developing States (SIDS) in the Pacific remain at the periphery of global shipping networks, facing high transport costs, limited trade opportunities and vulnerability to external shocks.

The 2024-2025 Asia-Pacific Sustainable Maritime Connectivity Report marks the first jointly published annual report dedicated to assessing regional maritime transport connectivity, with a special focus on the Pacific region, where connectivity gaps are among the most severe in the world. The report provides an in-depth analysis of shipping network trends, port infrastructure development, regulatory frameworks and digitalization efforts, highlighting the disparities between well-connected regions and those that struggle to integrate into global supply chains.

The findings reveal that Pacific SIDS collectively account for less than 0.1 per cent of global container throughput, with many islands receiving only infrequent and costly shipping services. The Liner Shipping Connectivity Index (LSCI) scores for Pacific nations remain among the lowest globally, underscoring the urgent need for investment in maritime infrastructure and policy innovation. Moreover, climate change is adding another layer of complexity, threatening the long-term viability of many ports and shipping routes.

To address these challenges, ESCAP is committed to supporting sustainable and resilient maritime connectivity through regional cooperation, investment in green and digital port development and the promotion of low- and zero-emission shipping solutions. This report serves as both a benchmark and a roadmap, offering policymakers and industry stakeholders data-driven insights and strategic recommendations to enhance maritime connectivity in the most vulnerable regions.

I extend my deepest appreciation to all contributors and partners who have made this publication possible. Together, we can build a more inclusive, resilient, and sustainable maritime transport system that leaves no country behind.

Armida Salsiah Alisjahbana
Under-Secretary-General of the United Nations and
Executive Secretary of the United Nations Economic and Social Commission for Asia and the Pacific

FOREWORD

By Kang Do-Hyung, MOF

As the hub of over half of the world's maritime trade, the Asia-Pacific region is shaping the future of the global economy. However, many parts of the region, particularly the Pacific Island countries, continue to face significant maritime transport challenges. Gaps in maritime connectivity, elevated transport costs, and limited infrastructure highlight the urgent need for inclusive and sustainable development strategies.

With an unwavering commitment to maritime cooperation in the region, the Republic of Korea is firmly dedicated to supporting regional efforts aligned with the Sustainable Development Goals (SDGs) and the implementation of the Regional Action Programme for Sustainable Transport Development(2022–2026). In this spirit, Korea is pleased to jointly publish *the 2024-2025 Asia-Pacific Sustainable Maritime Connectivity Report*, in collaboration with the Economic and Social Commission for Asia and the Pacific (ESCAP) and the Korea Maritime Institute (KMI).

This report sheds light on the persistent structural barriers faced by Pacific Island countries—ranging from limited port accessibility to disproportionately high shipping costs—within one of the most disconnected regions in the global shipping network. It is my sincere hope that the insights and policy recommendations presented in this report will serve as practical guidance for policymakers, maritime industries, and international development partners alike.

The Ministry of Oceans and Fisheries (MOF) has been working in close partnership with ESCAP to strengthen maritime connectivity across the region through a range of initiatives, including the Asia-Pacific Sustainable Maritime Connectivity Dialogue and Capacity Building Workshop for Port Experts. Moving forward, MOF will continue to spare no effort to achieve net-zero in maritime transport by promoting green shipping corridors and expanding low-carbon maritime fuel supply chains. I hope that this report will provide a concrete foundation for translating these policy goals into action.

I am deeply grateful to the experts and partner institutions, both domestic and international, for their dedication and contributions to this report. I look forward to continued collaboration as we take collective steps toward building a sustainable maritime transport system in the Asia-Pacific.

Kang Do-Hyung
Minister
Ministry of Oceans and Fisheries
Republic of Korea

FOREWORD

By Cho Jung-Hee, KMI

The Asia-Pacific region plays a pivotal role in the global economy. This economic strength is underpinned by a well-integrated and resilient connectivity framework, which forms the foundation for efficient trade and logistics. Handling over 60% of the world's container port throughput, the region is a cornerstone of global maritime trade. However, disparities in connectivity persist, posing challenges for some economies in fully integrating into global trade networks.

The 2024-2025 Asia-Pacific Sustainable Maritime Connectivity Report, a collaborative effort by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), the Ministry of Oceans and Fisheries of the Republic of Korea, and the Korea Maritime Institute (KMI), highlights the importance of equitable maritime connectivity and regional resilience as drivers of sustainable economic growth. While leading economies continue to strengthen their positions as global shipping hubs, Small Island Developing States (SIDS) and other vulnerable economies need strategic investments and enhanced international support. Additionally, challenges such as climate change, supply chain disruptions, and rapid technological transformation demand multilateral cooperation and coordinated policy responses.

This report provides comprehensive analysis and strategic guidance for policymakers and industry leaders to foster a more integrated, efficient, and sustainable maritime sector. It reflects our shared commitment to advancing data-driven analysis and strategic policy recommendations that contribute to a more resilient and interconnected maritime sector.

I extend my profound gratitude to ESCAP, the Ministry of Oceans and Fisheries of the Republic of Korea, and all esteemed contributors whose expertise and dedication have been instrumental in realizing this publication. Through sustained collaboration, we can further strengthen maritime transport systems, making them more inclusive, resilient, and strategically positioned to navigate the evolving dynamics of global trade and economic interdependence.

Cho Jung-Hee
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The preparation of this publication was led by Ms. Azhar Jaimurzina Ducrest, Chief of TCLS, TD, ESCAP, and Mr. Geunsub Kim, Deputy President of KMI. The core team included Mr. Gyuserb Kim and Mr. Sooyeob Kim from ESCAP, as well as Mr. Sewon Kim, Ms. Daye Lee, Ms. Bokyung Kim, Ms. Heeyoung Ryu, Mr. Seonghyun Cho and Ms. Yoonji Kim from KMI. Valuable contributions were also made by Mr. Paul Tae-Woo Lee, Mr. Sang-Ho Oh, Mr. Adrian Maurice Sammons, Ms. Boonyanin Pakvisal, Mr. Bruce Rowse, Ms. Kyeongrim Ahn, Mr. Min-Kyu Lee, and Mr. Henri Sandee, who served as individual consultants for the Transport Division. Additionally, Ms. Frida Youssef and Ms. Hassiba Benamara from the United Nations Conference on Trade and Development (UNCTAD) provided insightful input and constructive feedback to this report.

The team conducted a comprehensive literature review, analysis, and survey to identify key issues and trends in maritime transport and to provide policy recommendations. This work was further supported by regional and national experts specializing in sustainable maritime connectivity across Asia and the Pacific, with a particular focus on Pacific Island countries.

Furthermore, this report incorporates insights gathered during the 2024 Asia-Pacific Dialogue on Sustainable Maritime Connectivity, held on 22–23 July 2024 in Nadi, Fiji, with financial support from the Government of the Republic of Korea.

This final report was prepared by ESCAP and KMI, with both financial support and technical contributions from KMI. Special appreciation is extended to the Government of the Republic of Korea and the Ministry of Oceans and Fisheries for their generous funding of this study.

June 2025

EXPLANATORY NOTES

The term "ESCAP region and Asia-Pacific" refers to the group of countries and territories/areas comprising: Afghanistan; American Samoa; Armenia; Australia; Azerbaijan; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; China; Cook Islands; Democratic People's Republic of Korea; Fiji; French Polynesia; Georgia; Guam; Hong Kong, China; India; Indonesia; Iran (Islamic Republic of); Japan; Kazakhstan; Kiribati; Kyrgyzstan; Lao People's Democratic Republic; Macao, China; Malaysia; Maldives; Marshall Islands; Micronesia (Federated States of); Mongolia; Myanmar; Nauru; Nepal; New Caledonia; New Zealand; Niue; Northern Mariana Islands; Pakistan; Palau; Papua New Guinea; Philippines; Republic of Korea; Russian Federation; Samoa; Singapore; Solomon Islands; Sri Lanka; Tajikistan; Thailand; Timor-Leste; Tonga; Türkiye; Turkmenistan; Tuvalu; Uzbekistan; Vanuatu; and Viet Nam.

The term "Asia" refers to the above group of countries and territories or areas excluding the Pacific.

The term "East and North-East Asia" refers collectively to: China; Hong Kong, China; Democratic People's Republic of Korea; Japan; Macao, China; Mongolia; and Republic of Korea.

The term "North and Central Asia" refers collectively to Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Russian Federation, Tajikistan, Turkmenistan and Uzbekistan.

The term "Pacific" refers collectively to American Samoa, Australia, Cook Islands, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, New Caledonia, New Zealand, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

The term "South and South-West Asia" refers collectively to Afghanistan, Bangladesh, Bhutan, India, the Islamic Republic of Iran, Maldives, Nepal, Pakistan, Sri Lanka and Türkiye.

The term "South-East Asia" refers collectively to Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste and Viet Nam.

2024–2025 SUSTAINABLE MARITIME CONNECTIVITY REPORT IN ASIA AND THE PACIFIC:

Connecting the Pacific, A Voyage towards Sustainable Development

Report Overview

The 2024–2025 Sustainable Maritime Connectivity Report highlights Asia and the Pacific's vital role in global seaborne trade, covering over half of the world's maritime volume. It analyzes trade flows, port performance, and shipping trends across five subregions, with special focus on the Pacific's unique connectivity challenges. The report also tracks progress in maritime decarbonization and presents strategic recommendations to foster a more inclusive, resilient, and sustainable maritime transport system.

Global context of greater volatility

Maritime transport remains the backbone of global trade, carrying around 80% of goods worldwide. Although the global economy grew by 3.3% in 2024, it remains vulnerable to trade uncertainty, geopolitical tensions, and climate change. The shipping industry is undergoing a period of transition, shaped by stricter GHG regulations, a shift toward low- and zero-emission fuels, and the rapid adoption of digital and automated technologies. Meanwhile, freight markets exhibit mixed trends, with container rates under pressure due to vessel oversupply and ongoing volatility in tanker and bulk sectors.

Asia-Pacific Maritime Landscape: Opportunities and Ongoing Challenges

The Asia-Pacific region accounts for 62% of global container throughput and 54% of global maritime trade. Subregions show growing complementarity:

- East and North-East Asia (ENEA) is notable for high-value exports and efficient port operations.
- South-East Asia (SEA) is experiencing steady growth and deeper integration into regional supply chains.
- South and South-West Asia (SSWA), led by India, is diversifying its exports and strengthening its manufacturing base.
- North and Central Asia (NCA) has limited maritime trade, though Russia plays a significant role as an energy exporter.
- Pacific subregion presents a diverse picture—Australia and New Zealand are key exporters, while Small Island Developing States (SIDS) face persistent connectivity challenges.

The region continues to address important issues such as uneven digitalization, the need for climate-resilient and low-emission port infrastructure, and the impacts of evolving global trade dynamics. The report emphasizes the importance of investing in green and smart ports, enhancing regional cooperation and skills development, and promoting more inclusive maritime growth for all economies in the region.

2024 Quick Snapshot – Maritime Transport in Asia-Pacific

- **Seaborne Trade Volume: 6.9B tons (import), 4.9B tons (export)**
- **Container Port Activity: 566 million TEU handled**
- **Widening gaps in maritime connectivity across the region**

Data Source: S&P Global, Drewry and UNCTAD

79% of global merchandise exports shipped by sea

54% of global seaborne trade originated in the Asia-Pacific

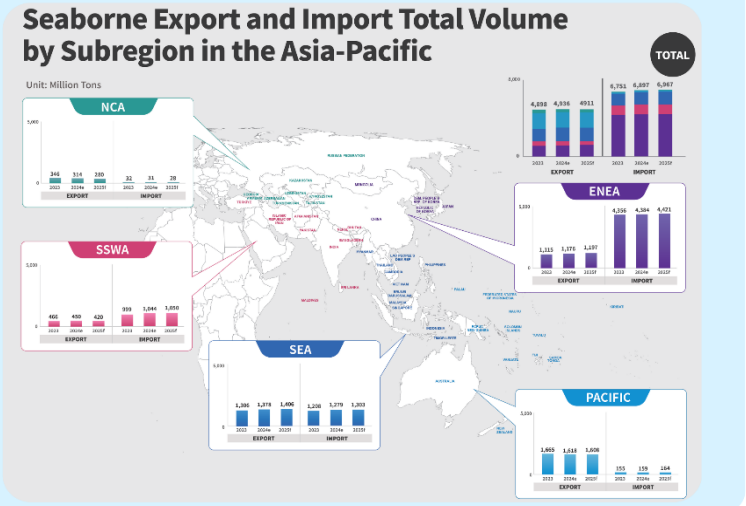
62% of global container throughput handled in the Asia-Pacific

9 of Top 10 Ports in PLSCI : located in the Asia-Pacific

87% of regional seaborne trade from Top 10 countries

0.5% of regional seaborne trade from the 19 Pacific SIDS

Seaborne Export and Import Total Volume by Subregion in the Asia-Pacific



Connectivity at Multiple Speeds: Bridging Maritime Gaps in the Pacific

Pacific Island countries remain significantly under-connected, representing less than 0.1% of global container trade. They face high freight costs, limited port infrastructure, and rank among the lowest LSCI scores globally. Key challenges include aging domestic fleets, shallow ports, limited digitalization, and high climate vulnerability.

To address these gaps, the report calls for climate-resilient infrastructure upgrades, expanded shipping routes with financial support, and investment in digital tools like AIS. Strengthening regional institutions and securing climate finance are also vital to support green port development and workforce capacity, especially for women.

Way Forward

While leading economies are advancing green and digital port initiatives, vulnerable regions—particularly Pacific SIDS—require urgent support. To bridge these gaps, the report calls for enhanced international cooperation, targeted infrastructure investments, technology transfer, and capacity building, along with better alignment of climate and trade policies. With coordinated action, Asia and the Pacific can achieve a resilient and equitable maritime future that leaves no economy behind.

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EXECUTIVE SUMMARY

Overview

Maritime transport continues to serve as a critical enabler of international trade and regional development in Asia and the Pacific, a region responsible for over half of the world's maritime trade. The 2024–2025 edition of the Sustainable Maritime Connectivity Report presents **a comprehensive analysis of seaborne trade flows, port performance, and shipping market outlooks across five subregions of Asia and the Pacific**: East and North-East Asia (ENEA), South-East Asia (SEA), South and South-West Asia (SSWA), North and Central Asia (NCA), and the Pacific. It also analyses the regional progress toward the decarbonization of shipping, as part of the wider shift toward greater sustainability. In response to the region's ambitious regional connectivity agenda, this year's report especially emphasizes the Pacific subregion, where small island economies face the most acute connectivity challenges. Through detailed data analyses and policy review, the report identifies both the structural disparities and the shared opportunities that define the region's maritime landscape. It also outlines **strategic recommendations to build a more inclusive, resilient, and sustainable maritime transport system**.

Seaborne Trade Flows by Subregion in the Asia-Pacific Region

Maritime trade patterns in Asia and the Pacific reflect **a high degree of economic complementarity among subregions,** with shipping flows shaped by industrial specialization, resource distribution, and infrastructure development.

- **ENEA** has firmly established itself as **the logistics and manufacturing hub of the region**. China, Japan, and the Republic of Korea are at the forefront, leveraging their technological advantages and large-scale industrial bases to lead in high-value exports. Their trade structure is characterized by imports of raw materials and exports of refined and high-tech goods, making the subregion a critical anchor of global and regional supply chains.
- **SEA** plays **a pivotal connecting role** in regional trade. With its strategic maritime position and growing manufacturing capacity, the subregion is deeply integrated into intra-regional trade networks. Indonesia's raw material exports, Viet Nam's rapid emergence as a manufacturing powerhouse, and Singapore's dominance as a global transshipment hub all contribute to the subregion's growing trade significance. SEA's close ties with ENEA in the production and supply of intermediate goods are accelerating due to shifts in global value chains.
- **The Pacific subregion**, while home to small island developing states, holds **strategic importance as a resource base**. Australia is a key supplier of minerals—including rare earth elements and lithium—that support the green and digital economies. New Zealand's agricultural exports and Papua New Guinea's natural resources also play significant roles. However, the smaller island nations struggle with limited shipping frequency, high transport costs, and minimal trade volumes, reflecting their **economic vulnerability and infrastructural constraints.**
- **SSWA** is emerging as **a new manufacturing center**. Spearheaded by India, the subregion is diversifying beyond traditional agriculture and textile exports toward higher-value goods, including refined petroleum and chemicals. India's growth in IT and electronics, coupled with its large labor force and domestic market, positions SSWA as a key driver of future trade expansion in the region.
- **NCA** remains largely **limited in seaborne trade** due to its landlocked geography. However, the Russian Federation plays an important role through its growing energy exports to Asian markets. As geopolitical shifts realign trade flows, Russian Federation's reliance on maritime routes in the Pacific is intensifying, although overall seaborne trade volumes remain relatively modest.

While a handful of countries dominate maritime trade today, rising investment in port infrastructure and improved logistics systems in developing economies—especially in SEA and SSWA—will gradually balance trade dynamics. Overcoming geographical and developmental barriers through technological innovation and infrastructure development will be key to fostering more inclusive trade growth.

Outlook for Shipping and Ports in the Asia-Pacific Region

The global economy expanded by 3.3 percent in 2024, and the Asia-Pacific region maintained a higher growth rate of 4.0 percent, reaffirming its central role in global trade. The region accounted for 40.7 percent of global merchandise exports, and approximately 54 percent of global maritime trade volume. This dominant position is underpinned by robust manufacturing output and well-integrated logistics chains. However, new uncertainties are emerging from global protectionist trade policies, geopolitical tensions, and environmental constraints.

From a subregional perspective:

- ENEA continues to lead in trade volume and port efficiency, driven by strong industrial output and advanced digital technologies.
- SEA is on a trajectory of rapid economic growth and trade expansion.
- SSWA, led by India, is leveraging its scale and labor advantages to attract manufacturing investments.
- NCA remains reliant on energy exports, with limited shipping volumes.
- The Pacific faces unique vulnerabilities due to small economic size and isolation.

In 2024, ports in six Asia-Pacific countries—China, the Republic of Korea, Singapore, Malaysia, Japan, and Viet Nam—ranked among the global top 10 in the Liner Shipping Connectivity Index (LSCI). These nations collectively handled over 62 percent of the world's container throughput, totaling 566 million TEUs. Yet, stark contrasts persist: Pacific Island countries have among the world's lowest LSCI scores, underlining severe connectivity gaps.

By 2025, the maritime shipping market is expected to face a complex mix of growth and disruption:

- Container shipping may see a drop in freight rates due to vessel oversupply, as well as trade uncertainties and trade tensions.
- Dry bulk markets will be shaped by global economic recovery efforts and environmental regulations driving fleet renewal; however, there are concerns about declining demand due to trade uncertainties.
- Tanker markets are likely to be volatile, with energy policy shifts, oil demand recovery, and geopolitical risks all influencing trade patterns.

Transforming Maritime Transport in Asia-Pacific: Decarbonization and other sustainability challenges

The maritime transport sector is undergoing a period of transformation shaped by global regulatory changes, climate pressures, technological advancement, and geopolitical uncertainties. The Asia-Pacific region, as a key player in global maritime trade, is experiencing these challenges acutely.

Environmental sustainability is a core challenge. Stricter international regulations on greenhouse gas emissions, such as those from the International Maritime Organization (IMO), are pushing shipping companies toward cleaner fuels and technologies. Transitioning to low- or zero-emission vessels and investing in green port infrastructure are increasingly necessary but capital-intensive.

Digital transformation is accelerating. Automation, artificial intelligence, and smart port systems are being adopted in leading economies, improving operational efficiency and transparency. However, this trend is widening the technological gap between advanced and developing economies, particularly in the Pacific and parts of South Asia.

Supply chain vulnerabilities exposed by geopolitical events and trade conflicts continue to disrupt trade. These disruptions highlight the need for regional resilience through diversified logistics networks and improved crisis response mechanisms.

Meanwhile, **growing inequality** in port and shipping infrastructure across the region threatens to entrench trade imbalances. Addressing these challenges requires coordinated policy efforts, multilateral cooperation, and targeted investment to ensure all economies can participate equitably in the benefits of maritime trade.

Closing Maritime Connectivity Gaps: The Case of the Pacific Small Island Developing States

Pacific Island countries face a unique set of maritime transport challenges due to **their geographic isolation, small market sizes, and vulnerability to climate change**. Most small island developing states (SIDS) have limited shipping options, resulting in high freight costs and unreliable services. Their Liner Shipping Connectivity Index (LSCI) scores remain among the lowest globally.

- Infrastructure limitations—such as shallow harbors, limited cargo handling equipment, and inadequate inter-island transport—compound the issue. Many domestic fleets are aged and inefficient, further increasing transport costs.
- Climate change is an existential threat. Rising sea levels, frequent cyclones, and coastal erosion are already damaging port infrastructure. While some Pacific countries are piloting solar-powered ports and exploring wind-assisted vessels, the scale of transformation needed is far greater.
- Digitalization remains low. Paper-based systems and limited IT infrastructure hinder efficiency, transparency, and trade facilitation. Additionally, the maritime workforce often lacks access to training opportunities and career development, especially for women.

Addressing these challenges requires not only infrastructure investment but also long-term capacity building, technological transfer, and stronger regional coordination mechanisms such as the Central Pacific Shipping Commission.

Analysis by Key Topics for Enhancing Maritime Connectivity in the Pacific subregion

Regional Cooperation for Maritime Decarbonization: Pacific Island countries are advancing maritime decarbonization through regional cooperation like 6PAC+, focusing on shared policies, green port development, and renewable energy adoption. These efforts, supported by international partners, strengthen the region's voice in global climate forums and improve access to climate finance and technical capacity.

Estimating Port Traffic Using AIS Data: Due to limited trade statistics in Pacific Island countries, AIS (Automatic Identification System) data is used to estimate port traffic. Analysis of major ports such as Suva, Apia, and Nuku'alofa revealed vessel patterns and seasonal trends. This data-driven approach supports infrastructure planning and highlights the need to build national capacity for maritime data analysis.

Strengthening the Central Pacific Shipping Commission (CPSC): The CPSC has played a role in coordinating regional shipping but faces structural limitations, including weak authority, funding shortages, and limited coordination. The report recommends enhancing CPSC's mandate and resources to enable better oversight of services and improve bargaining power with shipping operators.

Energy Transition in Ports through Solar Power: High electricity costs and climate vulnerabilities make energy transition a priority. A case study in Kiribati showed that solar-battery systems could meet port energy needs efficiently. However, successful deployment requires technical expertise, maintenance plans, and initial investment support.

Policy Recommendations for Asia-Pacific Countries

To foster sustainable and inclusive maritime development in the Asia-Pacific, the following policy actions are recommended:

1. Strengthen regional cooperation to reduce trade-related uncertainties, harmonize trade and shipping policies, enhance logistics resilience, and facilitate emergency response.
2. Expand investment in port infrastructure, especially in underserved regions, through public-private partnerships and international funding mechanisms.
3. Promote digital innovation by supporting smart port development, electronic trade documentation, and AI-powered logistics systems.
4. Accelerate the green transition by incentivizing low-carbon fuels, investing in renewable energy-based port infrastructure, and supporting emission reduction technologies.
5. Support workforce development with a focus on upskilling port and shipping personnel and advancing gender equality initiatives.
6. Encourage knowledge sharing and technology transfer to close the gap between advanced and developing maritime economies.

Specific policy Recommendations for Pacific Island Countries

Given their specific vulnerabilities, Pacific Island countries require targeted interventions to improve maritime connectivity and resilience through:

1. Upgrading maritime infrastructure, including ports and domestic fleets, with climate-resilient design and green technologies.
2. Expanding inter-island and international shipping routes through regional alliances and subsidy mechanisms to reduce freight costs.
3. Developing human capital by investing in maritime education, training, and career development—especially for women and youth.
4. Promoting digital adoption in port and customs operations through capacity-building programs and international technical assistance.
5. Strengthening institutions such as the Central Pacific Shipping Commission to improve policy coordination and shipping service oversight.
6. Leveraging regional and international cooperation platforms to secure investment and align national policies with global sustainable development goals.

Conclusion and Future Outlook

The 2024-2025 Asia-Pacific Maritime Connectivity Report calls for investment, policy innovation, and collaboration to boost maritime connectivity, trade efficiency, and sustainability. While some economies advance in smart ports and green shipping, others need support and regional cooperation. Strengthening infrastructure, digital innovation, and climate resilience can create a more inclusive, efficient maritime system, promoting trade and long-term stability.

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ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
AIS	Automatic Identification System
APA	ASEAN Port Association
APEC	Asia-Pacific Economic Cooperation
APSN	APEC Port Service Network
APTN	Asia-Pacific Transport Network
ASEAN	Association of Southeast Asian Nations
ASSM	ASEAN Single Shipping Market
BDI	Baltic Dry Index
BDS	Basin Development Strategy
BINCO	Baltic and International Maritime Council
CII	Carbon Intensity Indicator
CPSC	Central Pacific Shipping Commission
ESI	Environmental Ship Index
EU ETS	European Union Emissions Trading System
ESCAP	Economic and Social Commission for Asia and the Pacific
EEXI	Energy Efficiency Existing Ship Index
GHG	Greenhouse Gas
GPAS	Green Port Award System
GSC	Green Shipping Corridor
GVCs	Global Value Chains

IMO	International Maritime Organization
ITF	International Transport Forum
IWT	Inland Waterway Transport
KMI	Korea Maritime Institute
LSCI	Liner Shipping Connectivity Index
MRC	Mekong River Commission
MASS	Maritime Autonomous Surface Ships
MEPC	Marine Environment Protection Committee
ODA	Official Development Assistance
OPEC	Organization of the Petroleum Exporting Countries
PacWIMA	Pacific Women in Maritime Association
PBSP	Pacific Blue Shipping Partnership
PLSCI	Port Liner Shipping Connectivity Index
RAP	Regional Action Programme
SCFI	Shanghai Containerized Freight Index
SDGs	Sustainable Development Goals
SIDS	Small Island Developing States
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
TEU	Twenty-foot Equivalent Unit
TtW	Tank-to-Wake
UNCTAD	United Nations Conference on Trade and Development
VLCC	Very Large Crude Carrier
WMU	World Maritime University
WtW	Well-to-Wake

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CHAPTER 1

INTRODUCTION

1. INTRODUCTION

1.1. Background

Shipping and port activities are vital to both regional and national economic development, serving as essential components for sustainable growth and international trade. This significance is especially evident in the Asia-Pacific region, home to numerous coastal states and small island nations. Despite diverse conditions and levels of infrastructure development across the region, common challenges persist in aligning maritime policies with global objectives such as the carbon reduction targets of the United Nations Sustainable Development Goals (SDGs) and the Paris Agreement. Additionally, fostering innovation, ensuring environmental sustainability and strengthening collaboration with the private sector remain priorities for enhancing the maritime sector's overall performance.

To address these challenges and promote sustainable maritime connectivity, [1]the Economic and Social Commission for Asia and the Pacific (ESCAP), in collaboration with the Ministry of Oceans and Fisheries (MOF) of the Republic of Korea and the Korea Maritime Institute (KMI), launched the "Sustainable Maritime Connectivity" series in 2024. This report aims to analyse the current state of development in the shipping and ports sector, identify key policy issues and provide insights for advancing regional connectivity while effectively implementing the SDGs and the ESCAP Regional Action Programme for Sustainable Transport Development in Asia and the Pacific (2022–2026).

The Sustainable Maritime Connectivity report segments the diverse Asia-Pacific region into subregions, each possessing distinct geopolitical characteristics, to adopt a strategic approach. To facilitate in-depth analyses, the report centres its annual assessments on one specific subregion, with the delineation of subregions based on the classifications outlined in ESCAP Economic and Social Survey of Asia and the Pacific Report.

- East and North-East Asia (ENEA): China; Hong Kong, China; Japan; Macao, China; Democratic People's Republic of Korea (DPR Korea); Mongolia; Republic of Korea
- South-East Asia (SEA): Brunei Darussalam; Cambodia; Indonesia; Lao People's Democratic Republic (Lao PDR); Malaysia; Myanmar; Philippines; Singapore; Thailand; Timor-Leste; Viet Nam
- South and South-West Asia (SSWA): Afghanistan; Bangladesh; Bhutan; India; Iran (Islamic Republic of); Maldives; Nepal; Pakistan; Sri Lanka; Türkiye
- North and Central Asia (NCA): Armenia; Azerbaijan; Georgia; Kazakhstan; Kyrgyzstan; Russian Federation; Tajikistan; Turkmenistan; Uzbekistan
- Pacific: American Samoa; Australia; Cook Islands; Fiji; French Polynesia; Guam; Kiribati; Marshall Islands; Micronesia (Federated States of); Nauru; New Caledonia; New Zealand; Niue; Northern Mariana Islands; Palau; Papua New Guinea; Samoa; Solomon Islands; Tonga; Tuvalu; Vanuatu

[1] Sustainable Maritime Connectivity can be interpreted in various ways. In this report, Maritime Connectivity refers to "the degree to which a country, port, or region is integrated into global and regional shipping networks, in terms of service frequency, port calls, network coverage, and efficiency." Sustainable Maritime Connectivity is used to mean "the development and strengthening of maritime and port connectivity in ways that are environmentally sustainable, economically efficient, socially inclusive, and resilient to disruptions."

Last year's report focused on the South-East Asia subregion, addressing key challenges and opportunities specific to the region. This year, the report shifts its focus to the Pacific subregion, delving into the unique maritime challenges and opportunities faced by this area. Subsequent editions will continue to examine other subregions within the Asia-Pacific, offering tailored insights based on their distinct geopolitical and economic contexts.

1.2. Overview of ESCAP Regional Action Programme (2022-2026)

The fourth Ministerial Conference on Transport, held in Bangkok in December 2021, adopted the Regional Action Programme (RAP) for Sustainable Transport Development in Asia and the Pacific (2022-2026). The RAP was developed based on the UN's SDGs and balances the three dimensions of sustainable development.

Figure 1-1: Ministerial Declaration and Regional Action

The RAP is structured around three overarching goals and seven thematic areas. The goals are:

- Efficient and Resilient Transport Logistics Networks and Mobility for Economic Growth
- Environmentally Sustainable Transport Systems and Services
- Safe and Inclusive Transport and Mobility

Figure 1-2: Matrix of the Regional Action Programme

The seven thematic areas encompass a comprehensive range of focus points:

- Regional Land Transportation Connectivity and Logistics
- Maritime and Interregional Transportation Connectivity
- Digital Transportation
- Low Carbon Mobility and Logistics
- Urban Transportation
- Road Safety
- Inclusive Transportation and Mobility

Notably, the RAP introduces "Maritime and Inter-regional Transport Connectivity" as a new thematic area. This thematic area includes:

- Strengthening port and hinterland transport connectivity and deployment of logistics facilities
- Enhancing efficient intermodal operations
- Supporting the transition to sustainable and resilient port development
- Contributing to sustainable shipping and port operations, including reducing emissions and pollution from shipping and port operations and developing green port infrastructure
- Addressing connectivity challenges faced by small island states

Additionally, several other thematic areas within the RAP, including 'Regional Land Transportation Connectivity and Logistics', 'Digital Transportation', and 'Low Carbon Mobility and Logistics', encompass various activities related to shipping and ports, reflecting a holistic approach to sustainable transport development in the region.

Table 1-1: Shipping and port-related activities by topic area in the RAP (2022-2026)

Topic areas	RAP (2022-2026)
Maritime and interregional transportation connectivity	- In close partnership with global and regional actors and the shipping industry, support a structured regional dialogue on sustainable and resilient shipping connectivity, including promoting the development of low-carbon and carbon-neutral green shipping for the Asia-Pacific region. - Helping small island developing states (SIDS) address transportation challenges and build resilience to future shocks
Digital Transportation	- Streamline port activities by enhancing the application of new technologies and digitalization - Improve the resilience, sustainability, and interconnectivity of maritime transportation systems
Low-carbon mobility and logistics	- Share best practices for greening and decarbonizing the transportation value chain, including building green port infrastructure - Ability to facilitate the implementation of international best practices that support sustainable shipping connectivity - Expand your deployment program

1.3. Direction and Scope of the Report

This report examines shipping and port-related targets and priorities in ESCAP's Regional Action Programme (RAP) for Sustainable Transport Development in Asia and the Pacific (2022–2026). It analyzes global and regional trends in shipping and port development using relevant data and indicators.

To provide actionable insights, the report reviews strategies from international organizations and national governments, offering recommendations for sustainable and inclusive shipping and port development.

The report also explores digitalization and the green transition in the transport sector, focusing on shipping and ports, to support the ESCAP RAP goals of "Efficient and Resilient Transport Logistics Networks and Mobility for Economic Growth" and "Environmentally Sustainable Transport Systems and Services". Additionally, it assesses human resource development strategies at international and regional levels, aligning with the RAP goal of "Safe and Inclusive Transport and Mobility". This year's edition highlights the Pacific subregion, addressing connectivity, port development and regional cooperation to promote resilient maritime practices.

The scope of this report encompasses ESCAP members and associate members, including all countries within the subregions defined in ESCAP Economic and Social Survey of Asia and the Pacific Report, as mentioned above. While France, the United Kingdom of Great Britain and Northern Ireland, the United States of America and the Netherlands are ESCAP member states and have territories in the Asia-Pacific region, only these territories are considered in this report, considering their geographical context. This approach ensures a more focused analysis of the core geopolitical and economic entities in the Asia-Pacific and Pacific subregions.

CHAPTER 2

ASIA-PACIFIC IN THE GLOBAL MARITIME TRANSPORT: Trends and Outlook

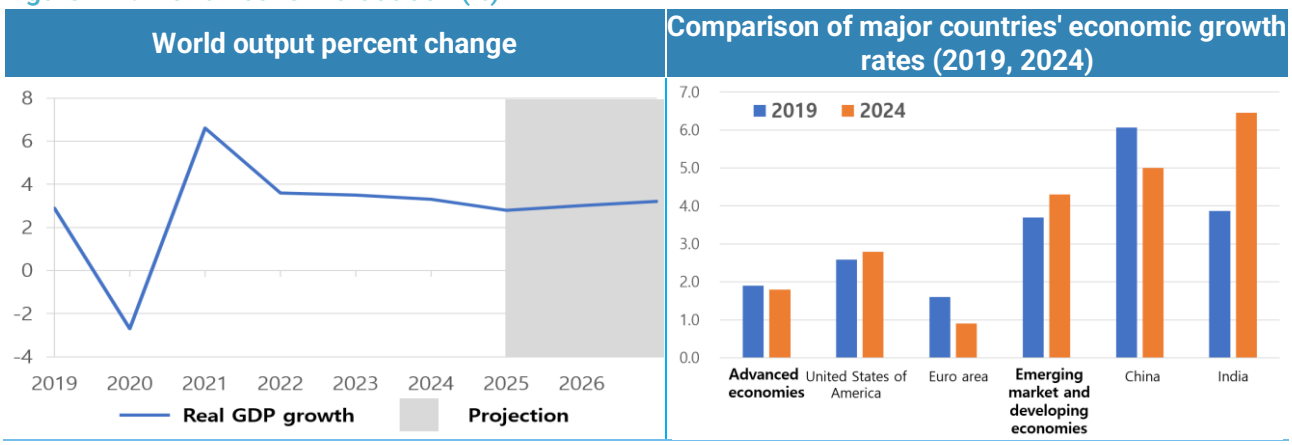
2. ASIA-PACIFIC IN THE GLOBAL MARITIME TRANSPORT: Trends and Outlook

2.1. Economic Development and Trade

2.1.1. Global Economic Trends and Outlook

The global economy maintained a growth rate of 3.3 percent in 2024 as it continued recovering from the COVID-19 pandemic, though it has not yet returned to its pre-pandemic trajectory. According to the IMF's April 2025 World Economic Outlook, global growth is projected to decline to 2.8 percent in 2025 and 3.0 percent in 2026 — down from the earlier projections of 3.3 percent for both years in the January 2025 update. This cumulative downgrade of 0.8 percentage point reflects heightened trade tensions and increased policy uncertainty, placing projected growth well below the historical average of 3.7 percent (2000–2019) (IMF, 2025).

Figure 2-1: World Economic Outlook (%)



Source: Compiled and analyzed by KMI based on (IMF, 2025)

Among major economies, the United States recorded growth of 2.8 percent in 2024 but is projected to slow to 1.8 percent in 2025 and further decline to 1.7 percent in 2026, reflecting increased trade policy uncertainty and tighter financial conditions. China recorded growth of 5.0 percent in 2024, with growth expected to moderate gradually to 4.0 percent in both 2025 and 2026 amid external demand pressures and structural adjustments. The euro area, affected by the prolonged war in Ukraine and elevated energy prices, grew by just 0.4 percent in 2023, but recovered to 0.9 percent in 2024. Growth is expected to remain at a similar level in 2025, at 0.8 percent, before slightly increasing to 1.2 percent in 2026.

Advanced economies grew by 1.8 percent in 2024, with growth projected to slightly moderate to 1.4 percent in 2025, before improving marginally to 1.5 percent in 2026. In contrast, emerging markets and developing economies posted relatively strong growth of 4.3 percent in 2024 but are expected to slow somewhat to 3.7 percent in 2025 and 3.9 percent in 2026. Emerging and developing Asia remains the fastest-growing region, expanding by 5.3 percent in 2024, though growth is projected to moderate to 4.5 percent in 2025 and 4.6 percent in 2026. Within the region, India is expected to maintain steady growth, expanding by 6.5 percent in 2024 and sustaining stable growth rates of 6.2 percent in 2025 and 6.3 percent in 2026.

Table 2-1: Overview of the World Economic Outlook Projections (%)

Year	2023	2024	2025(f)	2026(f)
World Output	3.5	3.3	2.8	3.0
Advanced Economies	1.7	1.8	1.4	1.5
United States	2.9	2.8	1.8	1.7
Euro Area	0.4	0.9	0.8	1.2
Emerging Market and Developing Economies	4.7	4.3	3.7	3.9
Emerging and Developing Asia	6.1	5.3	4.5	4.6
China	5.4	5.0	4.0	4.0
India	9.2	6.5	6.2	6.3

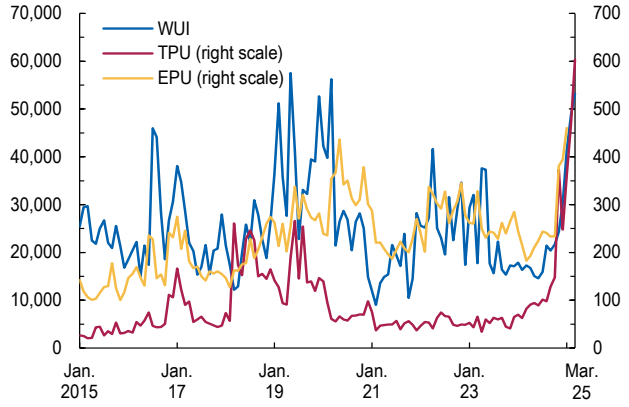
Source: Compiled by KMI based on (IMF, 2025)

Global economic uncertainties appear to be deepening amid escalating trade tensions and evolving policy priorities. Trade tensions are likely to contribute to increased volatility in trade flows and policy uncertainty. These developments may lead firms to delay investment decisions and could prompt financial institutions to adopt more cautious lending practices. Inflation, although generally declining, is still expected to remain above pre-pandemic levels in several regions, particularly in advanced economies, due to lingering supply-side constraints, energy price fluctuations, and elevated services sector inflation. Emerging markets and developing economies, with their relatively limited fiscal and monetary space, could be particularly exposed to the adverse effects of these compounded risks (IMF, 2025).

In this context, strengthened international cooperation is expected to play a critical role in maintaining global economic stability and preserving the resilience of maritime supply chains. Restoring a stable and predictable trade policy environment, avoiding escalation of protectionist responses, and rebuilding macroeconomic buffers would help mitigate the negative spillovers. Tariff-induced disruptions may continue to ripple through global value chains, including key maritime logistics hubs, potentially affecting trade efficiency and investment sentiment. Coordinated policy responses aimed at balancing inflation control with growth, reinforcing financial stability, and promoting transparent, rules-based trade frameworks could help sustain the reliability of maritime transport systems in an increasingly fragmented global landscape.

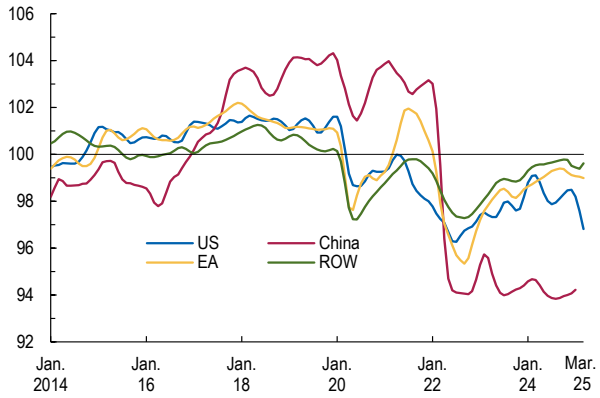
Figure 2-2: Economic Uncertainty (IMF, 2025)

Overall Uncertainty, EPU and TPU



Sources: Ahir, Bloom, and Furceri 2022; Caldara and others 2020; Davis 2016; and IMF staff calculations.
Note: The uncertainty measures are news- and media-outlets-based indices that quantify media attention to global news related to overall uncertainty (WUI), economic policy uncertainty (EPU), and trade policy uncertainty (TPU).

Consumer Confidence



Sources: OECD; and IMF staff calculations.
Note: The rest of world (ROW) represents the average value for data across 22 countries. EA = euro area; OECD = Organisation for Economic Co-operation and Development.

2.1.2. Asia-Pacific Economic Trends and Outlook

As of 2024, the Asia-Pacific region accounts for approximately 37.4 percent of global GDP. Among subregions, ENEA dominates with 62.6 percent of the region's GDP, followed by SSWA at 16.0 percent, SEA at 9.6 percent, NCA at 6.8 percent, and the Pacific at 5.1 percent. While share of ENEA has been gradually declining from 67.3 percent in 2021, that of SSWA has been increasing from 13.2 percent in 2021.

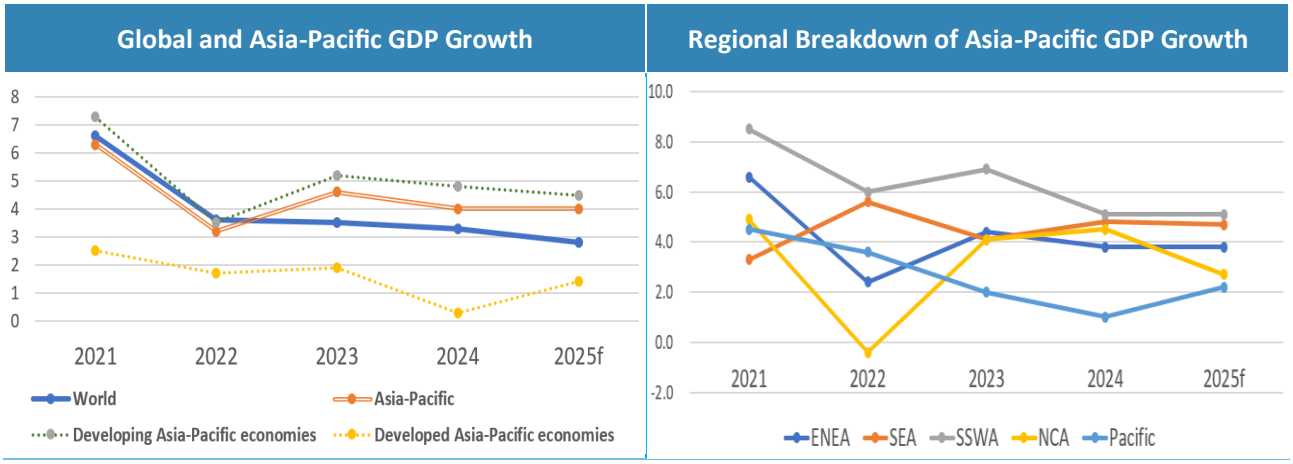
Table 2-2: Asia-Pacific Region's Share of Global GDP (2021-2025) (billion USD, %)

Year	2021		2022		2023		2024		2025(f)	
Total World	97,844		101,948		106,432		110,549		113,796	
Asia-Pacific (Share %)	39,185 (40.0)		39,701 (38.9)		40,136 (37.7)		41,376 (37.4)		41,969 (36.9)	
ENEA	26,381	(67.3)	25,551	(64.4)	25,544	(63.6)	25,907	(62.6)	26,517	(63.2)
SEA	3,398	(8.7)	3,683	(9.3)	3,799	(9.5)	3,953	(9.6)	4,123	(9.8)
SSWA	5,177	(13.2)	5,603	(14.1)	6,082	(15.2)	6,610	(16.0)	6,490	(15.5)
NCA	2,270	(5.8)	2,835	(7.1)	2,656	(6.6)	2,808	(6.8)	2,774	(6.6)
Pacific	1,958	(5.0)	2,029	(5.1)	2,055	(5.1)	2,098	(5.1)	2,066	(4.9)

Source: 1) Total World GDP is based on IMF World Economic Outlook data. 2) The GDP of the Asia-Pacific region is the sum of 57 countries' GDPs. Data for American Samoa, Guam and the Northern Mariana Islands are sourced from the World Bank; data for DPR Korea, French Polynesia, Cook Islands and New Caledonia are from UNCTAD; and the rest are from the IMF. 3) Data for Niue are not available. 4) Data for DPR. Korea, French Polynesia, and New Caledonia are not available after 2024. 5) "Data for American Samoa, Guam, and the Northern Mariana Islands are not available after 2023. 6) Data for the Cook Islands are only available for the year 2023.

Despite global economic shifts, the Asia-Pacific region is expected to maintain stable growth. The region grew by 4.0 percent in 2024, exceeding the global average of 3.3 percent. This growth was largely driven by strong domestic demand in India and robust export performance, especially in electronics manufacturing, in Southeast Asia (SEA). In 2025, the region is projected to grow again by 4.0 percent, significantly outpacing the global GDP growth rate of 2.8 percent. In particular, developing economies in the Asia-Pacific are expected to expand by 4.5 percent in 2025. The region's average inflation stood at 4.6 percent in 2024 and is projected to ease to 4.1 percent in 2025 (ESCAP, 2025).

Figure 2-3: Asia-Pacific GDP Growth (%)



Source: Compiled and analyzed by KMI based on the (IMF, 2025), (ESCAP, 2025), (ESCAP, 2024), and (ESCAP, 2023)

In 2025, a range of downside risks is likely to continue weighing on the region's economic outlook. The escalation of trade tensions is expected to amplify financial market volatility and disrupt regional trade flows. Fluctuating global interest rates could further constrain capital access, particularly in economies with limited fiscal and monetary buffers. China's ongoing economic restructuring and persistent weakness in the real estate sector may continue to generate spillover effects, dampening regional demand and investor confidence. Geopolitical tensions, including those related to the Middle East and Ukraine, add to global uncertainty and may affect key maritime and overland supply routes. Meanwhile, digital transformation, climate change adaptation, and the transition toward a green economy remain both opportunities and policy challenges. As the Asia-Pacific region remains a major driver of global growth, sustaining long-term stability and resilience will likely require renewed international coordination, targeted structural reforms, and strengthened domestic policy frameworks.

2.1.3. Global Trade Structure and Patterns

Global merchandise trade has maintained long-term growth, establishing itself as a key pillar of the global economy. According to UNCTAD data, global merchandise trade (measured by exports) increased from approximately $6.7 trillion in 2000 to around $23.8 trillion in 2023, a 3.6-fold increase (UNCTAD, Merchandise: Total trade and share, annual, 2024). This growth has been driven by accelerated globalization, technological innovation, the expansion of global value chains (GVCs), and the rise of emerging economies. In 2024, global merchandise trade was estimated to grow by 2 percent YoY, reaching approximately $24.3 trillion (UNCTAD, 2024). Continued trade growth was expected in 2025, but global economic recovery and shifts in trade policies may influence future trends (ESCAP, 2024).

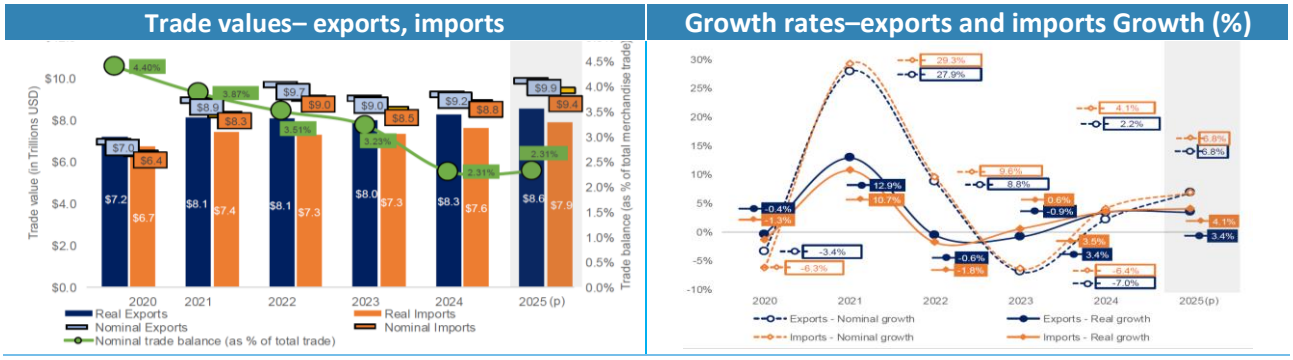
Merchandise trade has evolved based on interdependence between advanced and developing economies. Advanced economies remain export hubs for high-value goods, with the United States of America and Europe maintaining competitiveness in pharmaceuticals, aerospace, and high-tech industries. Meanwhile, developing economies, traditionally key players in manufacturing and raw material exports, are now also emerging as major importers of manufactured goods, consumer products, and intermediate inputs such as parts and components used in production. A significant trend is the rise of South-South trade, which has become a major driver of global trade growth. Between 2007 and 2023, trade between developing countries (excluding China) grew by 150 percent, and when including China, it more than doubled, highlighting China's role as a central trade hub.

Another notable trend is the accelerated digitalization and technological transformation in trade following the COVID-19 pandemic, which is expected to lead to a structural shift toward digital economies and the SDGs by 2025. Digital services, including technical and AI-driven solutions, along with e-commerce, are projected to become key growth drivers, reshaping global trade structures. In particular, the rise of services trade—already playing a larger role since the pandemic—is contributing significantly to the growth of global merchandise trade and is expected to have an even greater impact in the future.

2.1.4. Trade Structure and Patterns in the Asia-Pacific

From 2000 to 2023, the Asia-Pacific region played a pivotal role in global merchandise trade, significantly expanding its share. According to the 2024 ESCAP report, the region's merchandise exports in 2024 are estimated to increase by 2.2 percent YoY, reaching $9.2 trillion, while imports are projected to grow by 4.1 percent, totalling $8.8 trillion. These growth rates exceed the global average, with the region accounting for 38.9 percent of global merchandise trade in terms of exports.

Figure 2-4: Merchandise trade in Asia Pacific, 2020-2025 (trillions USD, %)



Source: (UNESCAP, 2024).

As of 2024, approximately 54.5 percent of total trade in the Asia-Pacific region consists of intra-regional trade, highlighting the region's strong internal trade ties. Notably, China plays a crucial role, as it accounts for 23.0 percent of the total trade of Asia-Pacific countries (excluding China), underscoring China's significance in regional trade dynamics.

Table 2-3: Trade partners of Asia and the Pacific in 2024 (%)

Trade Partner	Asia-Pacific (excluding China)			Asia-Pacific		
	Exports(to)	Imports(from)	Trade(with)	Exports(to)	Imports(from)	Trade(with)
Intra-Asia-Pacific	57.8	60.1	59.0	53.4	55.6	54.5
China	20.2	25.6	23.0	12.6	18.1	15.3
Other Asia-Pacific	37.6	34.5	36.0	40.8	37.5	39.2
European Union	11.9	9.8	10.8	13.6	10.2	11.9
United States of America	14.3	7.4	10.7	13.7	7.2	10.5
Rest of the World	16.1	22.6	19.5	19.3	27.0	23.1

Source: Compiled and analyzed by KMI based on (UNESCAP, 2024).

In 2024, trade patterns in ENEA continue to shift, with a growing emphasis on intra-regional trade within Asia-Pacific. ENEA economies have strengthened trade ties with Asia-Pacific partners outside their subregion, while slightly reducing exports to the United States of America, with their export share to the latter at 14.7 percent. Meanwhile, trade between ENEA and SEA has strengthened, with the former's export share to the latter reaching 15.3 percent. This trend highlights the increasing importance of regional economic cooperation, particularly between China and the Association of South-East Asian Nations (ASEAN), as trade reconfiguration continues amid geopolitical shifts (ESCAP, 2024).

Table 2-4: Subregional merchandise export share by export destination in 2024 (%)

Export dest. / Exporter	ENEA	NCA	Pacific	SEA	SSWA	Asia-Pacific	EU (27)	US	Rest of the World
ENEA	25.4	3.5	2.4	15.3	5.4	52.0	12.5	14.7	20.8
NCA	27.0	13.3	0.0	2.1	23.2	65.6	14.9	0.7	18.9
Pacific	57.0	0.0	5.1	12.8	4.9	79.9	3.8	5.3	11.1
SEA	30.7	0.4	3.7	22.8	5.6	63.3	8.7	15.9	12.1
SSWA	6.3	4.0	1.5	6.3	6.9	25.0	27.1	14.2	33.7
Asia-Pacific	26.9	2.5	2.7	14.9	6.4	53.4	14.7	13.6	18.4

Source: Compiled and analyzed by KMI based on (UNESCAP, 2024).

The NCA region has reduced exports to Europe owing to geopolitical conflicts and sanctions, shifting its trade focus to Asia-Pacific countries instead. Notably, the Russian Federation has expanded its exports to South and East Asian nations, contributing to enhanced regional economic cooperation.

In the SEA region, countries such as Viet Nam, Thailand and Indonesia have emerged as global manufacturing hubs owing to several key factors. First, these countries have strengthened their manufacturing base with relatively low labour costs and an abundant workforce. Second, as global companies seek supply chain diversification, they have relocated production facilities to this region, expanding the electronics, automotive and textile industries. Viet Nam has become a key hub for smartphone and computer component production, while Thailand has emerged as a major centre for automotive and parts manufacturing. Third, South-East Asian nations have successfully centre multiple free trade agreements, reducing trade barriers and attracting foreign investment. Viet Nam plays a significant role in electronics and textile manufacturing, while Thailand stands out in the automotive industry.

As shown in Table 2-5, trade patterns changed significantly between 2019 and 2024 owing to geopolitical shocks and ongoing structural shifts. The most notable shift is NCA exports shifting from the European Union to the Asia-Pacific region, mainly owing to Western sanctions on the Russian Federation, leading to increased exports by the Russian Federation to India and China. Beyond NCA, dependency on specific markets within other subregions has slightly declined, reflecting efforts by countries to diversify supply chains and ensure trade stability.

Table 2-5: Change in merchandise trade partners of Asia and Pacific, 2019-2024 (%)

Export dest. / Exporter	ENEA	NCA	Pacific	SEA	SSWA	Asia-Pacific	EU (27)	US	Rest of the World
ENEA	-4.7	1.1	0.2	1.2	0.7	-1.6	0.3	-0.9	2.2
NCA	6.4	4.8	-0.1	0.5	15.0	26.6	-25.4	-2.0	0.8
Pacific	-1.5	-0.2	-1.1	2.1	1.0	0.3	0.2	0.8	-1.3
SEA	-2.0	-0.1	0.3	-0.6	0.4	-2.0	-0.8	2.9	-0.1
SSWA	-4.6	1.1	0.5	-0.2	-1.9	-5.1	2.3	1.6	1.2
Asia-Pacific	-3.3	1.0	0.1	0.8	1.3	0.8	-1.4	-0.7	1.3

Source: Compiled and analyzed by KMI based on (ESCAP, 2024).

Asia-Pacific merchandise trade is expected to maintain its recovery momentum in 2025[2], export volume projected to grow by 3.5 percent and import volume by 4.1 percent. Developing economies in the region are expected to sustain their growth momentum, with Viet Nam emerging as a key driver. As it continues to consolidate its position as a global manufacturing hub, Viet Nam's export volume is projected to grow significantly by 16.1 percent. Japan's import volume is also expected to rise by 11.0 percent, supported by a recovery in domestic demand. In contrast, China's trade growth in volume terms is anticipated to slow, with export and import volumes forecast to increase by 2.9 percent and 2.6 percent, respectively.

Table 2-6: Merchandise exports and imports growth for selected Asia-Pacific economies

	Exports						Imports					
	2024			2025(p)			2024			2025(p)		
	Value	Price	Vol.	Value	Price	Vol.	Value	Price	Vol.	Value	Price	Vol.
Australia	-6.6	-4.1	-2.5	1.3	-0.1	1.4	5.2	-1.8	7.0	3.2	2.0	1.2
Bangladesh	1.2	-5.1	6.3	5.4	-3.2	8.6	13.0	-6.9	19.9	5.3	-4.2	9.5
China	-2.0	-5.1	3.1	7.5	4.6	2.9	3.7	0.8	2.9	5.7	3.1	2.6
Hong Kong, China	11.5	4.3	7.2	6.2	4.1	2.1	8.5	3.6	4.9	6.3	3.4	2.9
India	7.0	1.9	5.1	6.2	3.6	2.6	7.6	4.9	2.7	5.6	3.0	2.6

[2] These projections were based on conditions at the end of 2024. However, as of April 2025, amid rising trade uncertainties in the first half of the year, the WTO projected a contraction in global trade volume (-0.2%) and a slowdown in trade growth in the Asia region (1.6%) for 2025 (WTO, 2025).

Iran (Islamic Rep. of)	5.1	-2.6	7.7	-0.7	-3.6	2.9	7.0	2.9	4.1	2.0	-1.0	3.0
Japan	0.4	0.3	0.1	16.0	7.0	9.0	1.0	0.2	0.8	18.1	7.1	11.0
Kazakhstan	2.7	-0.6	3.3	0.3	-0.6	0.9	-0.1	0.7	-0.8	3.6	2.7	0.9
Malaysia	9.4	1.5	7.9	6.6	5.0	1.6	5.5	-2.9	8.4	8.5	3.2	5.3
Myanmar	0.4	0.1	0.3	1.1	-1.5	2.6	-2.0	1.0	-3.0	1.6	0.5	1.1
New Zealand	-1.4	-2.1	0.7	5.8	-2.2	8.0	-5.5	0.3	-5.8	-0.1	1.0	-1.1
Papua New Guinea	2.6	6.0	-3.4	3.1	-2.8	5.9	-2.0	-12.7	10.7	0.5	-10.3	10.8
Philippines	4.1	1.2	2.9	8.4	0.5	7.9	11.6	3.3	8.3	5.3	3.0	2.3
Republic of Korea	6.0	1.6	4.4	5.7	5.6	0.1	-1.6	2.1	-3.7	6.3	3.3	2.8
Russian Federation	0.0	-0.5	0.5	0.3	-1.2	1.5	-2.8	0.8	-3.6	3.8	3.4	0.4
Singapore	3.4	1.4	2.0	4.9	2.0	2.9	3.2	-0.4	3.6	4.2	1.3	2.9
Sri Lanka	0.8	-2.7	3.5	5.7	0.0	5.7	20.8	1.2	19.6	11.7	1.2	10.5
Thailand	4.2	4.0	0.2	6.6	4.2	2.4	5.4	0.4	5.0	6.3	2.1	4.2
Türkiye	3.7	4.6	-0.9	2.7	10.7	-8.0	-5.5	-3.3	-2.2	2.9	-2.3	5.2
Viet Nam	16.6	2.5	14.1	9.9	-6.2	16.1	21.0	-4.7	25.7	10.0	-0.1	10.1
Asia-Pacific	2.2	-1.3	3.4	6.8	3.4	3.5	4.1	0.5	3.6	6.8	2.7	4.1
Asia-Pacific developed	0.9	-0.4	1.3	8.9	4.5	4.5	0.6	0.6	0.0	10.8	4.7	6.0
Asia-Pacific developing	2.5	-1.5	4.0	6.3	3.1	3.2	5.1	0.5	4.6	5.7	2.2	3.5
Asia-Pacific developing excl. China	6.6	1.7	4.9	5.2	1.7	3.5	6.1	0.3	5.8	5.7	1.6	4.2

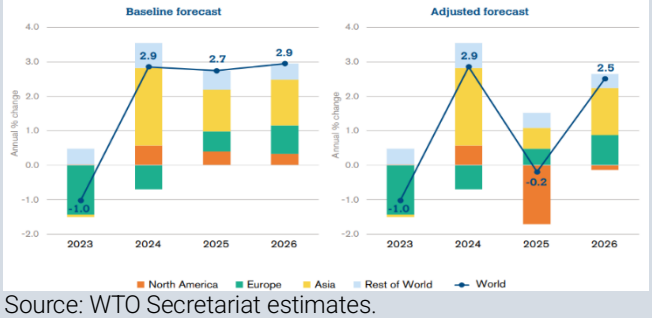
Source: Compiled and analyzed by KMI based on (ESCAP, 2024).

The Asia-Pacific region's merchandise trade continues to grow but faces several challenges. The trade conflict has significantly impacted trade policies and supply chains, increasing uncertainty for exports from China and SEA countries. Additionally, geopolitical risks are accelerating trade flow shifts and restructuring, which could strongly influence future trade growth in the region. Climate change presents another major challenge: The 2023 El Niño phenomenon severely impacted rice production in SEA, causing over a 10 percent decline in rice exports from the Philippines and Thailand. Such extreme weather events negatively affect maritime logistics stability, while environmental regulations, such as carbon border taxes, impose additional costs on manufacturing-based economies.

The WTO's *Global Trade Outlook and Statistics 2025*

In its outlook as of April 2025, the WTO significantly downgraded the 2025 global trade forecast, citing heightened trade policy uncertainty. After an expected expansion of 2.9 percent in 2024, world merchandise trade is now projected to contract by 0.2 percent in 2025, with a moderate recovery of 2.5 percent in 2026. Major downside risks include the potential reactivation of suspended U.S. reciprocal tariffs and the broader spread of trade policy uncertainty, which together could deepen the contraction in merchandise trade to -1.5 percent. Regionally, Asia's contribution to global trade growth has been halved from 1.2 to 0.6 percentage points, while North America is expected to exert a negative impact, further weighing on global trade momentum.

Figure 2-5: Contributions to world merchandise trade volume growth by region, 2023-2026 (%)



Source: WTO Secretariat estimates.
Note: Trade refers to sum of exports and imports. Figures for 2025 and 2026 are projections.

2.2. Seaborne Trade Trend and Shipping Market

2.2.1. International Seaborne Trade Trend

According to S&P Global data, global trade volume (exports) has declined consecutively, falling from 14,381 million tons in 2021 to 14,125 million tons in 2022 and 13,757 million tons in 2023. Seaborne trade volume (exports) also decreased from 11,025 million tons to 10,822 million tons over the same period.

However, starting in 2024, global trade is expected to recover in terms of weight. Total export volume is projected to increase by 0.77 percent YoY, reaching 13,862 million tons, while seaborne exports are expected to rise by 1.26 percent, reaching 10,959 million tons (S&P Global, 2024).

Table 2-7: Global Merchandise and Seaborne Trade (Exports) Trends, 2021-2025 (million Tons, %)

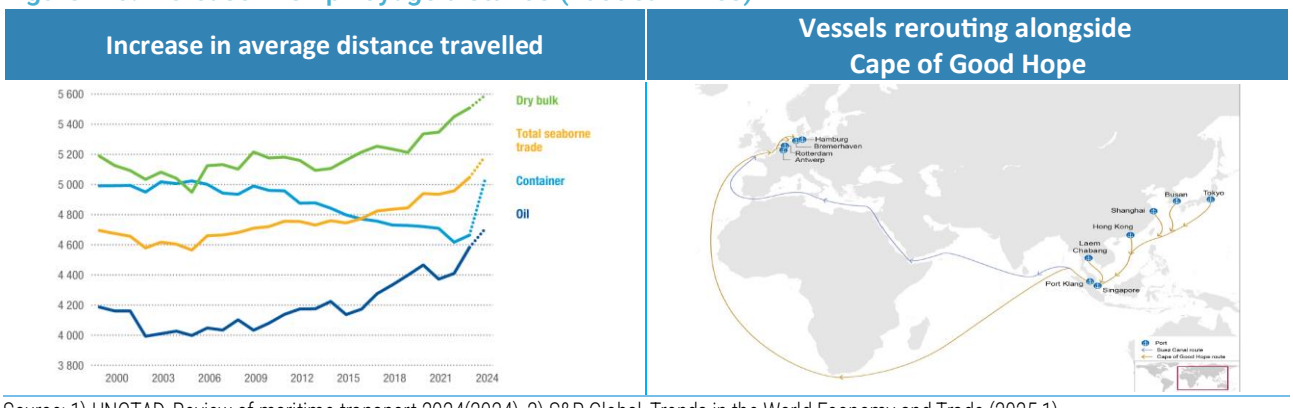
Year	Global Trade Volume	Seaborne Trade Volume	Seaborne Trade Share
2021	14,381	11,025	76.64%
2022	14,125	10,967	77.64%
2023	13,757	10,822	78.65%
2024(e)	13,862	10,959	79.02%
2025(f)	14,022	11,054	78.85%

Source: Compiled and analyzed by KMI based on S&P Global data

From a transportation perspective, seaborne trade remains the largest component of global trade. The share of seaborne trade in total global trade has shown a steady increase, rising from 76.64 percent in 2021 to 79.02 percent in 2024. This trend underscores the growing significance of maritime transport in the global trade structure. Comparing the compound annual growth rate of global trade and seaborne trade between 2021 and 2024, the decline in seaborne trade (-0.2 percent) was relatively smaller than the overall trade decline (-1.2 percent). This indicates that maritime transport demonstrates greater resilience even during economic downturns (S&P Global, 2024).

A notable recent trend in seaborne trade is the notable increase in shipping distances on major trade routes owing to geopolitical tensions and environmental factors in 2023–2024. Instability in the Middle East has disrupted shipping through the Suez Canal and the Red Sea, leading to a rise in vessels rerouting via the Cape of Good Hope around Africa. As shown in Figure 2-5, this has resulted in increased voyage distances for all cargo types, including containers, petroleum and dry bulk cargo, causing longer transit times and higher freight costs.

Figure 2-6: Increase in ship voyage distance (nautical miles)



Source: 1) UNCTAD, Review of maritime transport 2024(2024), 2) S&P Global, Trends in the World Economy and Trade (2025.1)
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

2.2.2. Asia-Pacific Seaborne Trade Trend

2.2.2.1. Trends in Seaborne trade[3] volume in the Asia-Pacific

According to S&P Global [4]data, the Asia-Pacific region's seaborne import volume in 2023 totaled 6,751 million tons, while its seaborne export volume reached 4,898 million tons. This accounted for 62.4 percent of global seaborne imports and 45.3 percent of global seaborne exports, indicating a structural trade surplus in imports over exports.

In 2024, the Asia-Pacific seaborne trade volume is estimated to increase to 6,897 million tons in imports (a 2.2 percent increase YoY) and 4,936 million tons in exports (a 0.8 percent increase YoY). The region's share of global seaborne trade (exports and imports) is projected to rise slightly to 54 percent, reaffirming its position as the core hub of global maritime logistics, handling more than half of global seaborne trade. This dominance is largely attributed to the geographical distribution of both manufacturing powerhouses and resource-rich countries within the region.

At the country level, emerging economies such as China, India and Viet Nam are experiencing notable growth, while developed nations such as Japan and the Republic of Korea are maintaining a steady, moderate growth trajectory. From a market concentration perspective, the top 10 countries in 2024 are expected to handle a combined seaborne trade volume of 10,276 million tons, accounting for approximately 86.8 percent of the total Asia-Pacific trade volume (11,833 million tons). China dominates with 3,758 million tons (31.7 percent) and Australia follows with 1,659 million tons (14.2 percent). Together, these two countries contribute 45.8 percent of the total trade volume, highlighting their dominant influence in the market.

In contrast, island nations and landlocked countries at the lower end of the rankings account for less than 1 percent of the total trade volume, indicating their marginal participation in seaborne trade. This reveals a stark polarization between the leading economies and countries in special situations in the Asia-Pacific region.

Table 2-8: Ranking of Seaborne Trade Volume by Country in the Asia-Pacific Region (Total Exports and Imports Combined) (thousand Tons)

No.	Country	Sub Region	SEABORNE TRADE TOTAL		
			2023	2024(e)	2025(f)
1	China	ENEA	3,650,879	3,757,946	3,833,957
2	Australia	PACIFIC	1,696,240	1,658,579	1,663,092
3	India	SSWA	938,693	975,019	999,708
4	Indonesia	SEA	881,321	944,819	957,827
5	Japan	ENEA	749,897	740,502	741,249
6	Republic of Korea	ENEA	727,736	732,994	735,106

[3] The seaborne trade volume data provided by S&P Global refers to the volume of cargo transported by sea. The total seaborne export and import volumes for each of the 253 countries and regions are equal. This data excludes transshipment cargo, transit cargo, and empty containers. As a result, it differs significantly from port throughput, which represents the total volume of cargo handled at ports, including transshipment.

[4] The data used in this report is based on S&P Global's dataset as of December 2024 and does not take into the surge in trade uncertainties that occurred in the early of 2025.

7	Viet Nam	SEA	468,483	508,900	521,603
8	Malaysia	SEA	348,702	360,952	373,957
9	Singapore	SEA	310,777	314,991	314,515
10	Türkiye	SSWA	278,180	281,413	279,766
11	Thailand	SEA	246,814	250,118	256,373
12	Russian Federation	NCA	277,468	246,683	216,926
13	Philippine	SEA	200,382	215,726	225,795
14	Bangladesh	SSWA	79,957	80,937	81,214
15	Iran	SSWA	97,851	80,486	34,193
16	Kazakhstan	NCA	57,459	59,517	58,357
17	New Zealand	PACIFIC	55,229	57,093	57,974
18	Pakistan	SSWA	45,168	50,082	49,681
19	Hong Kong, China	ENEA	48,589	48,633	46,720
20	Papua New Guinea	PACIFIC	34,627	29,454	17,728
21	Azerbaijan	NCA	25,315	22,500	21,174
22	Brunei Darussalam	SEA	20,010	21,632	20,160
23	Sri Lanka	SSWA	18,232	20,632	21,486
24	Cambodia	SEA	18,760	20,497	20,906
25	Myanmar	SEA	16,681	17,166	15,929
26	Marshall Islands	PACIFIC	15,166	15,429	15,649
27	DPR Korea	ENEA	14,520	9,999	615
28	New Caledonia	PACIFIC	10,738	7,782	7,987
29	Uzbekistan	NCA	5,280	5,239	3,261
30	Georgia	NCA	4,683	5,087	5,101
31	Fiji	PACIFIC	2,740	2,782	2,841
32	Maldives	PACIFIC	2,800	2,760	2,956
33	Afghanistan	SSWA	3,393	2,647	548
34	Turkmenistan	NCA	4,014	2,599	1,307
35	Solomon Islands	PACIFIC	1,910	2,505	2,595
36	Macao, China	ENEA	2,205	1,838	1,690
37	Kyrgyzstan	NCA	1,353	1,327	1,254
38	Armenia	NCA	1,653	1,207	525
39	Guam	PACIFIC	1,200	1,027	890
40	Laos	SEA	1,127	1,013	785
41	Timor-Leste	SEA	1,030	939	853
42	French Polynesia	PACIFIC	637	631	601
43	Mongolia	ENEA	433	497	502

44	Nepal	SSWA	490	491	480
45	Tajikistan	NCA	475	445	242
46	Vanuatu	PACIFIC	321	385	377
47	Western Samoa	PACIFIC	315	355	356
48	Nauru	PACIFIC	303	302	271
49	Micronesia	PACIFIC	198	290	295
50	American Samoa	PACIFIC	161	214	195
51	Northern Mariana Islands	PACIFIC	153	160	161
52	Kiribati	PACIFIC	129	156	156
53	Cook Islands	PACIFIC	87	138	139
54	Tuvalu	PACIFIC	158	134	135
55	Tonga	PACIFIC	116	131	130
56	Palau	PACIFIC	110	122	124
57	Bhutan	SSWA	23	20	18
58	Niue	PACIFIC	32	14	10
ENEA			5,471,643	5,559,735	5,618,800
SEA			2,514,087	2,656,753	2,708,703
PACIFIC			1,823,370	1,780,443	1,774,062
SSWA			1,467,987	1,491,277	1,467,094
NCA			377,700	344,604	308,147
Total			11,648,786	11,833,261	11,877,410

Note: The seaborne trade volume of landlocked countries is generated through various means, including multimodal transportation (land-sea combined transport) and connections to maritime logistics networks via inland waterways such as rivers, lakes, and canals.
Source: Compiled and analyzed by KMI based on S&P Global data

The key characteristics of global seaborne trade in the Asia-Pacific region are as follows:

- First, resource-exporting countries demonstrate strong performance. Resource-rich nations such as Australia, Indonesia, and the Russian Federation rank among the top, reflecting the increasing demand for raw materials driven by global industrial development.
- Second, manufacturing powerhouses maintain stable performance. Countries with high technological capabilities and industrial competitiveness, such as China, the Republic of Korea, and Japan, consistently achieve strong export performance.
- Third, significant disparities exist due to geographical conditions. Landlocked countries exhibit low trade volumes due to limited access to seaborne trade, while small island nations also show restricted trade scales.

These characteristics suggest that seaborne trade in the Asia-Pacific region is driven by a range of factors, including resource availability, industrial competitiveness, and geographic accessibility. In addition, it is strongly shaped by demographic trends, particularly rising import demand fueled by growing purchasing power and an expanding middle class—as well as by national policies and broader development strategies.

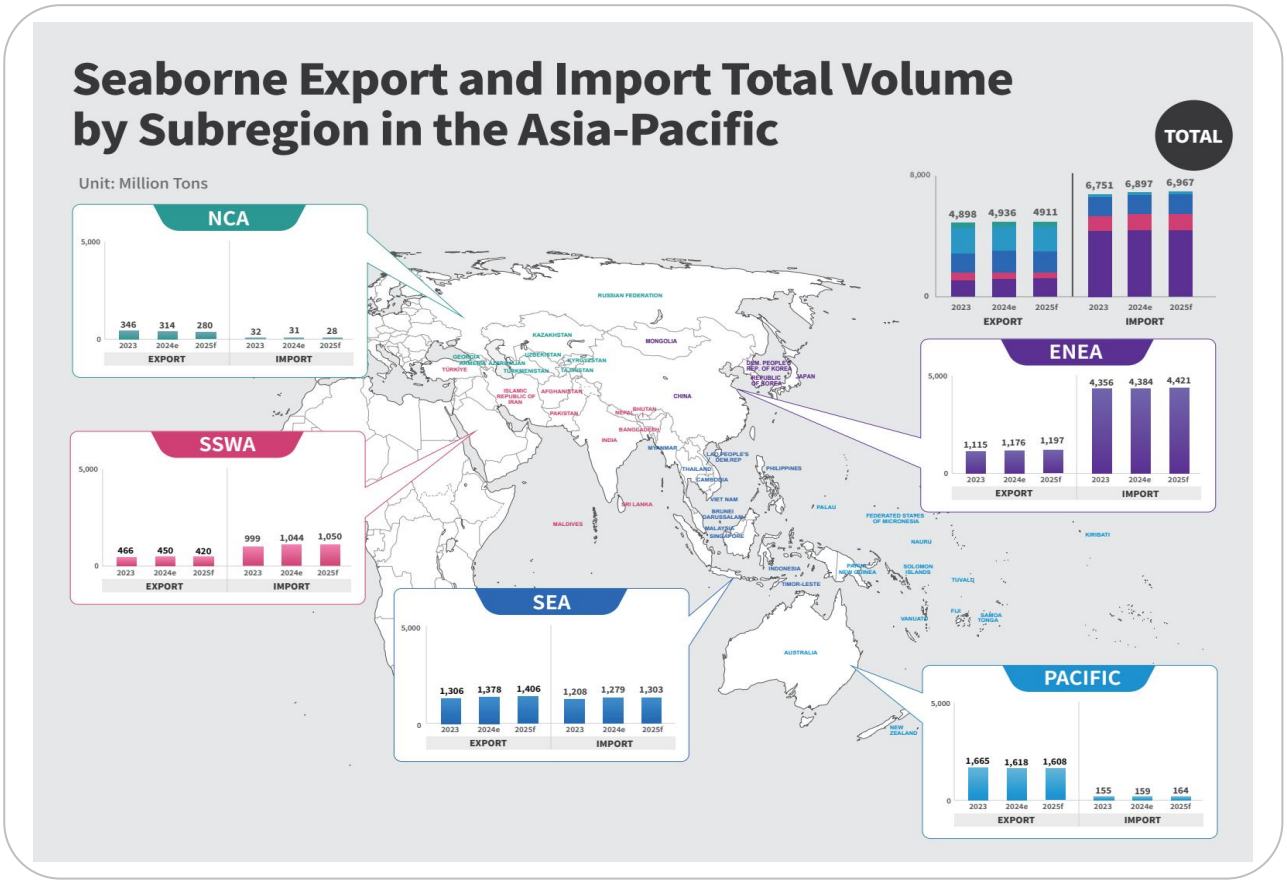
Seaborne trade among sub-regions exhibits distinct patterns that reflect each area's industrial structure and geographical characteristics. ENEA is centered around manufacturing industries, while the Pacific, especially Australia, serves as a key supplier of raw materials. Additionally, SEA, with its strategic seaborne trade routes, plays a crucial role in facilitating active intra-regional trade.

Table 2-9: Seaborne Export and Import Volume by Subregion in the Asia-Pacific (million Tons)

Region	EXPORT SEABORNE TRADE			IMPORT SEABORNE TRADE		
	2023	2024(e)	2025(f)	2023	2024(e)	2025(f)
ENEA	1,115	1,176	1,197	4,356	4,384	4,421
SSWA	466	450	420	999	1,044	1,050
SEA	1,306	1,378	1,406	1,208	1,279	1,303
PACIFIC	1,665	1,618	1,608	155	159	164
NCA	346	314	280	32	31	28
Total	4,898	4,936	4,911	6,751	6,897	6,967

Source: Compiled and analyzed by KMI based on S&P Global data

Figure 2-7: Asia Pacific Seaborne Trade Volume by subregion



Source: Compiled and visualized by KMI based on S&P Global data and the United Nations map, *Map of the World*, Map No. 4651 Re V.3 Mar 2025 (www.un.org/geospatial/content/map-world-1)
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Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.

2.2.2.2. Status and flows of seaborne trade in ENEA

In 2024, ENEA recorded a total seaborne trade volume of 5,560 million tons, accounting for 47.0 percent of the total trade volume in the Asia-Pacific region, solidifying its role as the region's maritime logistics hub. This concentration trend is expected to continue for the foreseeable future. Among this volume, imports amounted to 4,384 million tons, while exports totaled 1,176 million tons, resulting in a clear import-oriented structure, where imports are approximately 3.7 times greater than exports.

China continues to hold the position of the largest trading nation within the region with a well-balanced trade structure between raw material imports and finished goods exports. Japan focuses on specialized high-tech products, maintaining its market position through quality competitiveness and the Republic of Korea maintains stable trade, driven by key industries such as semiconductors, automobiles and shipbuilding.

Trade between ENEA and SEA exhibits a clear complementary relationship. SEA exports 626 million tons to ENEA, primarily consisting of energy and mineral resources, wood and paper-related products, and metals and metal products. This trade structure reflects the abundant natural resources of SEA and the manufacturing base of ENEA. In contrast, ENEA exports 265 million tons to SEA, mainly comprising energy and mineral resources, metals and metal products, and chemical products. This highlights the advanced manufacturing capabilities of ENEA and the mutually complementary industrial structures of both regions.

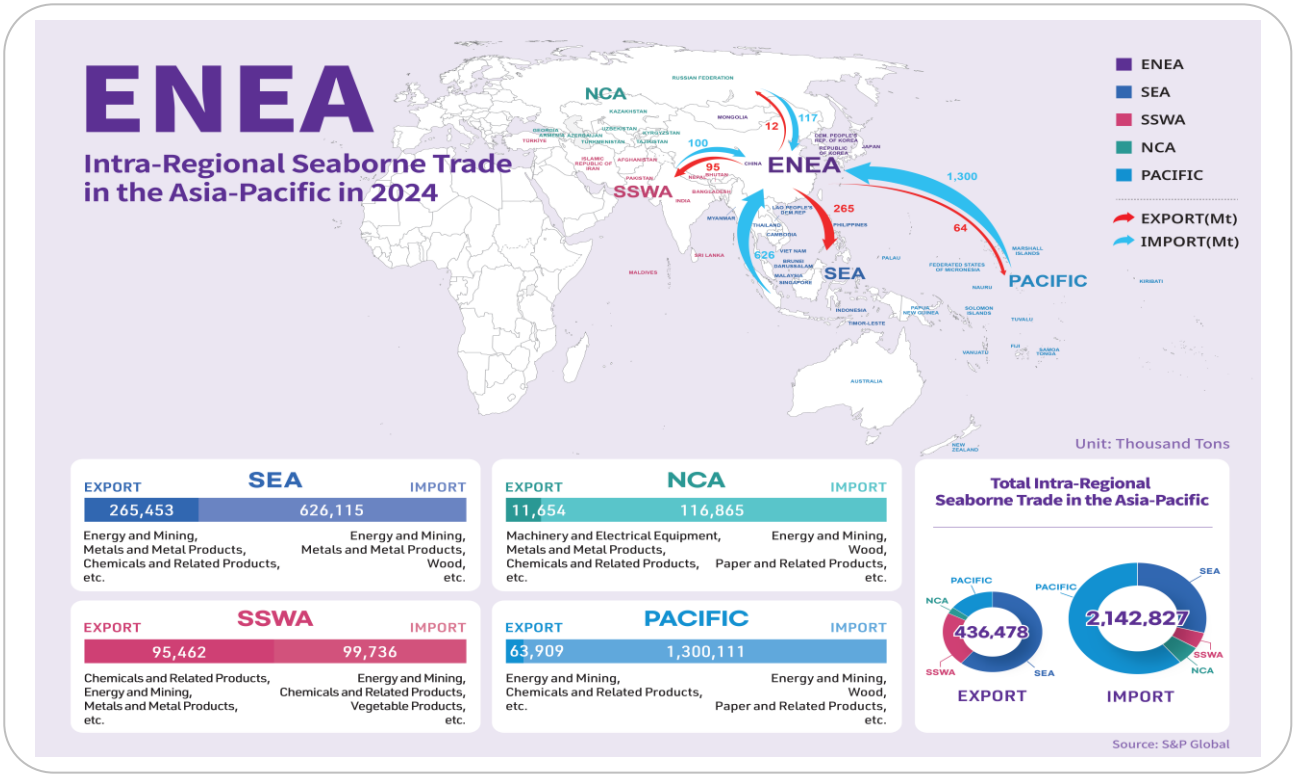
Trade between ENEA and SSWA is relatively balanced, with ENEA exporting 95.5 million tons and importing 99.7 million tons. SSWA primarily exports energy and mineral resources, chemical products and agricultural products to ENEA, reflecting the resource endowment and agricultural productivity of the SSWA region. Conversely, ENEA exports chemical products, energy resources and metal products to SSWA, demonstrating sectoral specialization and a complementary trade relationship between the two regions.

Table 2-10: Intra-Asia Pacific Seaborne Trade Volume and Key Trade Items in ENEA (thousand tons)

Region	EXPORT SEABORNE TRADE			IMPORT SEABORNE TRADE		
	Region	Volume	Main	Region	Volume	Main
ENEA	SEA	265,453	Chemicals and Related Products, Energy and Mining, Metals and Metal Products.	SEA	626,115	Energy and Mining, Metals and Metal Products, Wood, Paper and Related Products.
	SSWA	95,462	Chemicals and Related Products, Energy and Mining, Metals and Metal Products.	SSWA	99,736	Energy and Mining, Chemicals and Related Products, Vegetable Products.
	NCA	11,654	Machinery and Electrical Equipment, Metals and Metal Products, Chemicals and Related Products.	NCA	116,865	Energy and Mining, Wood, Paper and Related Products, Chemicals and Related Products.
	PACIFIC	63,909	Energy and Mining, Chemicals and Related Products.	PACIFIC	1,300,111	Energy and Mining, Wood, Paper and Related Products, Vegetable Products.
Total	436,478			2,142,827		

Source: Compiled and analyzed by KMI based on S&P Global data

Figure 2-8: Intra-Asia Pacific Seaborne Trade Volume and Key Trade Items in ENEA



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Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.

Largest Seaborn Trade Country in ENEA region: China

China is the largest economy and the country with the highest seaborne trade volume within ENEA and the Asia-Pacific region. In intra-regional exports, metals and metal products, chemicals, steel, machinery, and electronic equipment are the key export items, primarily supporting the manufacturing and construction industries of the Republic of Korea, Viet Nam, and Indonesia. Additionally, China exports chemical products and energy resources to Japan and India, while trade with the Russian Federation is centered around metals and wood products.

On the import side, China has a high dependence on energy and raw materials, importing large volumes of coal, iron ore, and natural gas from Australia and Indonesia, while also strengthening energy cooperation with the Russian Federation. Furthermore, agricultural products and chemicals are imported from India and the Philippines, continuously expanding domestic consumption and industrial raw material supply. This trade structure reflects China's manufacturing-driven economic model and its strong demand for raw materials.

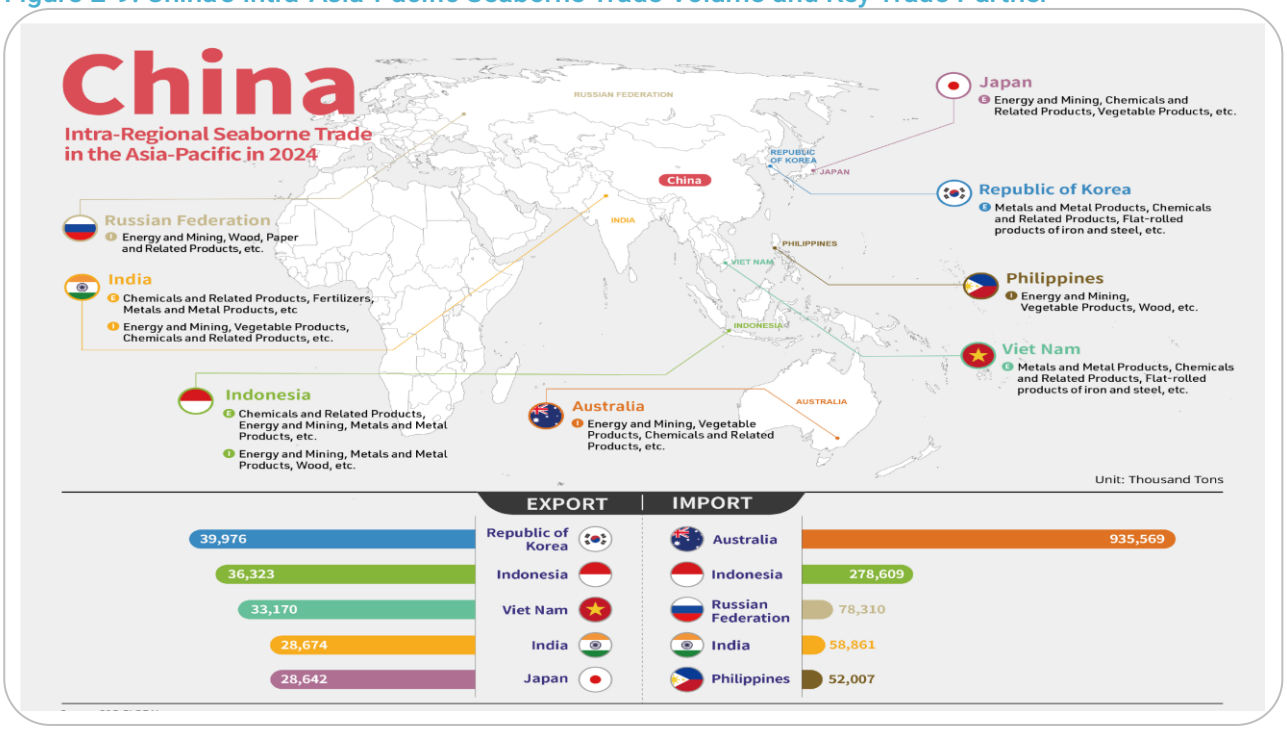
China's seaborne trade is characterized by the export of intermediate goods and industrial raw materials based on its manufacturing foundation, alongside the import of energy and mineral resources. Key trading partners include the Republic of Korea, Viet Nam, Indonesia, India, Japan, the Russian Federation, Australia, and the Philippines, with each country forming a mutually complementary trade structure. This trade configuration demonstrates China's role as a core manufacturing hub and the central node of industrial supply chains in the Asia-Pacific region. Looking ahead, factors such as trade conflicts, the expansion of protectionism, raw material price volatility, and the strengthening of eco-friendly policies may impact trade flows, making strategies for supply chain stabilization and trade diversification even more critical.

Table 2-11: China's Intra-Asia-Pacific Seaborne Cargo Volume and Key Trade Item (thousand tons)

Country	EXPORT SEABORNE TRADE			IMPORT SEABORNE TRADE		
	Country	Volume	Main Commodity	Country	Volume	Main Commodity
China	Republic of Korea	39,976	Metals and Metal Products, Chemicals and Related Products, Flat-rolled products of iron and steel.	Australia	935,569	Energy and Mining, Vegetable Products, Chemicals and Related Products.
	Indonesia	36,323	Chemicals and Related Products, Energy and Mining, Metals and Metal Products.	Indonesia	278,609	Energy and Mining, Metals and Metal Products, Wood, Paper and Related Products.
	Viet Nam	33,170	Metals and Metal Products, Chemicals and Related Products, Flat-rolled products of iron and steel.	Russian Federation	78,310	Energy and Mining, Wood, Paper and Related Products, Metals and Metal Products.
	India	28,674	Chemicals and Related Products, Fertilizers, Metals and Metal Products, Organic chemicals.	India	58,861	Energy and Mining, Vegetable Products, Chemicals and Related Products.
	Japan	28,642	Energy and Mining, Chemicals and Related Products, Vegetable Products.	Philippines	52,007	Energy and Mining, Vegetable Products, Wood, Paper and Related Products.

Source: Compiled and analyzed by KMI based on S&P Global data

Figure 2-9: China's Intra-Asia-Pacific Seaborne Trade Volume and Key Trade Partner



Source: Visualized by KMI based on the United Nations map, *Map of the World*, Map No. 4651 Re V.3 Mar 2025 (www.un.org/geospatial/content/map-world-1)

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Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.

2.2.2.3. Status and flows of seaborne trade in SEA

In 2024, SEA recorded a total seaborne trade volume of 2,657 million tons, accounting for 22.5 percent of the Asia-Pacific total. With imports of 1,279 million tons and exports of 1,378 million tons, SEA maintains a relatively balanced trade structure. Trade volumes continue to rise steadily, benefiting from global supply chain restructuring, with manufacturing expansion and increased intra-regional trade.

SEA's trade network is anchored by Indonesia, along with Malaysia, Viet Nam and Singapore. Indonesia, the region's largest trading nation, has rich natural resources and a large domestic market. Coal and palm oil exports dominate its seaborne trade. Singapore serves as a transshipment hub, leveraging its strategic location, world-class port infrastructure and advanced logistics systems, making it the centre of regional maritime logistics. Viet Nam, emerging as a manufacturing hub, is experiencing consistent growth in seaborne trade, creating new opportunities amid global supply chain shifts.

SEA's exports to ENEA total 626 million tons, while imports from ENEA reach 265 million tons, making it the highest trade volume among sub-regions. Exports include energy and mineral resources, metal products and wood-related products, while imports mainly consist of energy and minerals, metals and chemicals. This highlights the resource wealth of SEA and the strong manufacturing base of ENEA, forming a complementary trade relationship.

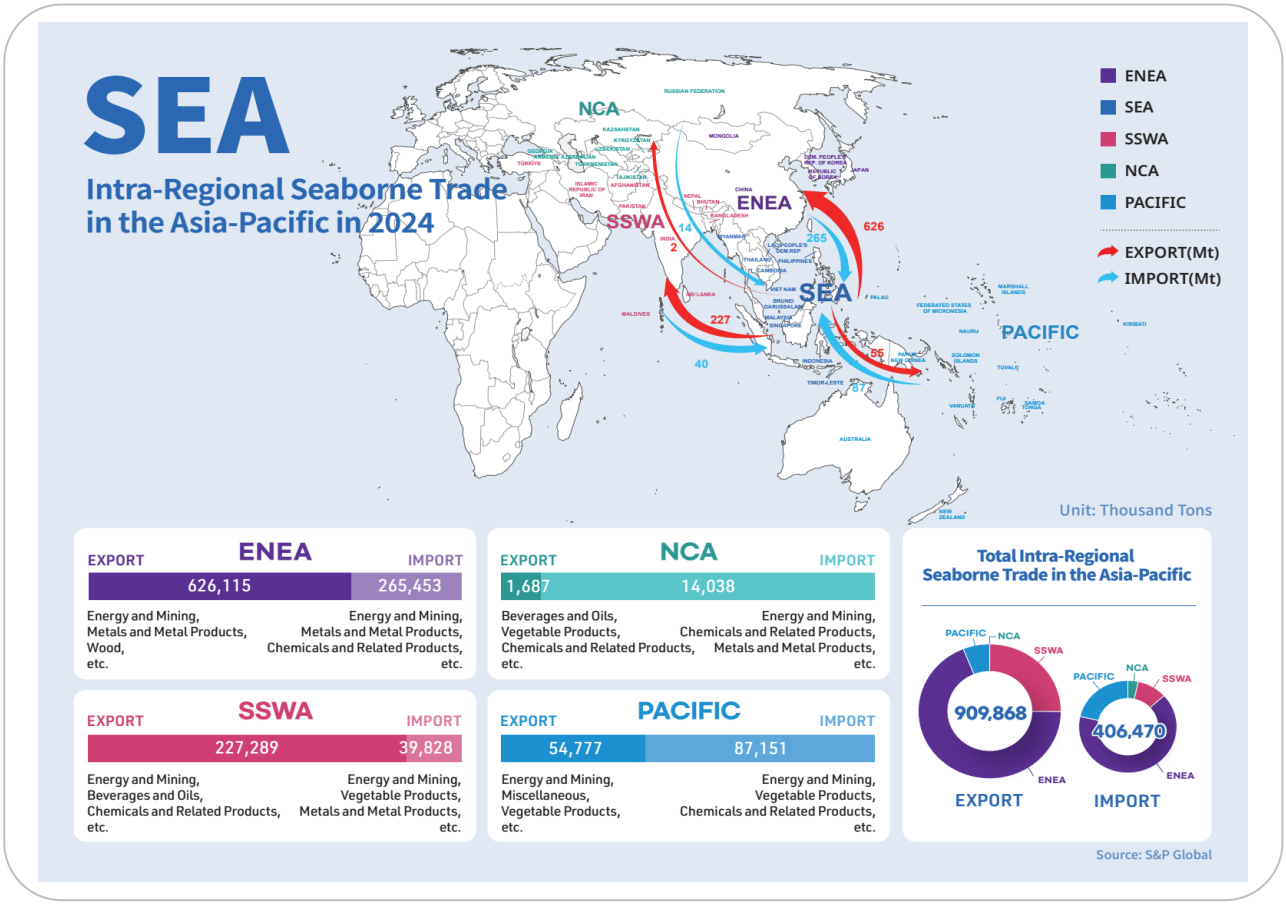
SEA exports 227 million tons to SSWA, primarily energy and mineral resources, beverages and oils, and chemicals. Conversely, SEA imports 39.8 million tons from SSWA, consisting mainly of energy and minerals, agricultural products and metal products. This trade imbalance reflects differences in industrial development and economic structures between the two regions.

Table 2-12: Intra-Asia Pacific Seaborne Trade Volume and Key Trade Items in SEA (thousand tons)

SUB REGION	EXPORT SEABORNE TRADE			IMPORT SEABORNE TRADE		
	SUB REGION	Volume	Main Commodity	SUB REGION	Volume	Main Commodity
SEA	ENEA	626,115	Energy and Mining, Metals and Metal Products, Wood, Paper and Related Products.	ENEA	265,453	Energy and Mining, Metals and Metal Products, Chemicals and Related Products.
	SSWA	227,289	Energy and Mining, Beverages and Oils, Chemicals and Related Products.	SSWA	39,828	Energy and Mining, Vegetable Products, Metals and Metal Products, Glass and Non-Metallic Products.
	NCA	1,687	Beverages and Oils, Vegetable Products, Chemicals and Related Products.	NCA	14,038	Energy and Mining, Chemicals and Related Products, Metals and Metal Products.
	PACIFIC	54,777	Energy and Mining, Miscellaneous, Vegetable Products.	PACIFIC	87,151	Energy and Mining, Vegetable Products, Chemicals and Related Products, Metals and Metal Products.
Total	909,868			406,470		

Source: Compiled and analyzed by KMI based on S&P Global data

Figure 2-10: Intra-Asia Pacific Seaborne Trade Volume and Key Trade Items in SEA



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Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.

Largest Seaborn Trade Country in SEA region: Indonesia

Indonesia has the highest seaborne trade volume among SEA countries. An analysis of Indonesia's top five export destinations globally and within the Asia-Pacific region reveals that the two categories are identical, indicating that Indonesia's exports are heavily concentrated within the Asia-Pacific region.

An analysis of Indonesia's key export items reveals that energy and mineral resources hold a significant share across all top five export destinations. This underscores Indonesia's abundant natural resources and its role as a key supplier to neighboring countries. Additionally, agricultural products and chemicals are also major export items, reflecting the diversity of Indonesia's economy.

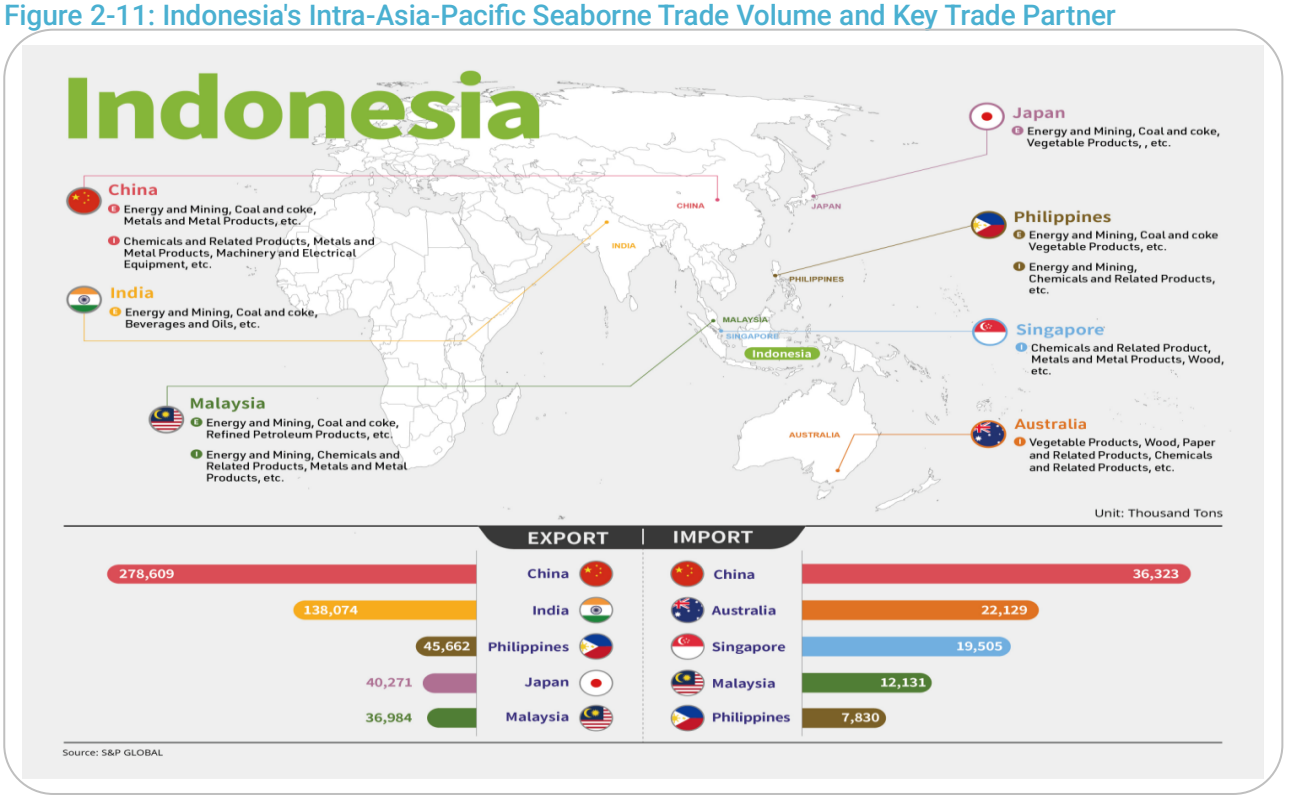
Indonesia's seaborne trade exports are primarily composed of primary industry products centered on energy and mineral resources, with a particularly high dependency on China and India—two major markets. This reliance reflects the economic scale and industrial development of these countries. This export structure solidifies Indonesia's position as a major resource supplier in Asia while also highlighting the need for market and product diversification. The findings indicate that Indonesia's exports are shaped by geographical proximity, its resource-based industries, and close economic ties with the region. Furthermore, they reaffirm Indonesia's strategic economic position within the Asia-Pacific region and its potential to play a crucial role in regional economic integration and cooperation in the future.

Table 2-13: Indonesia's Intra-Asia-Pacific Seaborne Trade Volume and Key Trade Item (thousand tons)

Country	EXPORT SEABORNE TRADE			IMPORT SEABORNE TRADE		
	Country	Volume	Main Commodity	Country	Volume	Main Commodity
Indonesia	China	278,609	Energy and Mining, Coal and coke, Metals and Metal Products.	China	36,323	Chemicals and Related Products, Metals and Metal Products, Machinery and Electrical Equipment.
	India	138,074	Energy and Mining, Coal and coke, Beverages and Oils.	Australia	22,129	Vegetable Products, Wood, Paper and Related Products, Chemicals and Related Products.
	Philippines	45,662	Energy and Mining, Coal and coke, Vegetable Products.	Singapore	19,505	Chemicals and Related Product Metals and Metal Products, Wood, Paper and Related Products.
	Japan	40,271	Energy and Mining, Coal and coke, Vegetable Products.	Malaysia	12,131	Energy and Mining Chemicals and Related Products, Metals and Metal Products.
	Malaysia	36,984	Energy and Mining, Coal and coke, Refined Petroleum Products.	Philippines	7,830	Energy and Mining, Chemicals and Related Products.

Source: Compiled and analyzed by KMI based on S&P Global data

Figure 2-11: Indonesia's Intra-Asia-Pacific Seaborne Trade Volume and Key Trade Partner



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2.2.2.4. Status and flows of seaborne trade in the Pacific

In 2024, the Pacific sub-region recorded a total seaborne trade volume of 1,777 million tons, accounting for 15.0 percent of the Asia-Pacific total. With exports of 1,618 million tons and imports of 159 million tons, the region exhibits a strong export-oriented trade structure, where exports exceed imports by more than tenfold.

This imbalance is driven by the raw material export structure of Australia and New Zealand, and limited trade volumes of Pacific Islands nations. Australia plays a key role in the global supply chain, exporting not only traditional minerals and energy resources but also strategic minerals such as rare earth elements and lithium, which are essential for the Fourth Industrial Revolution. Meanwhile, New Zealand maintains its position as a major agricultural and livestock exporter, and Papua New Guinea continues to grow through natural resource exports. The Pacific region also includes many small island nations with limited economies and industrial bases, resulting in minimal seaborne trade volumes.

The Pacific exports 1,300 million tons to ENEA while importing 63.9 million tons. Major exports include energy and mineral resources, wood and paper products, and agricultural goods, while imports mainly consist of energy, minerals, chemicals and metal products. This trade structure is largely driven by Australian mineral exports, where iron ore is supplied to the Chinese steel industry, and coal is used in the power generation and steel production of Republic of Korea and Japan. The Pacific maintains stable trade with SEA and SSWA, reinforcing its role as a key resource supplier for the Asia-Pacific region.

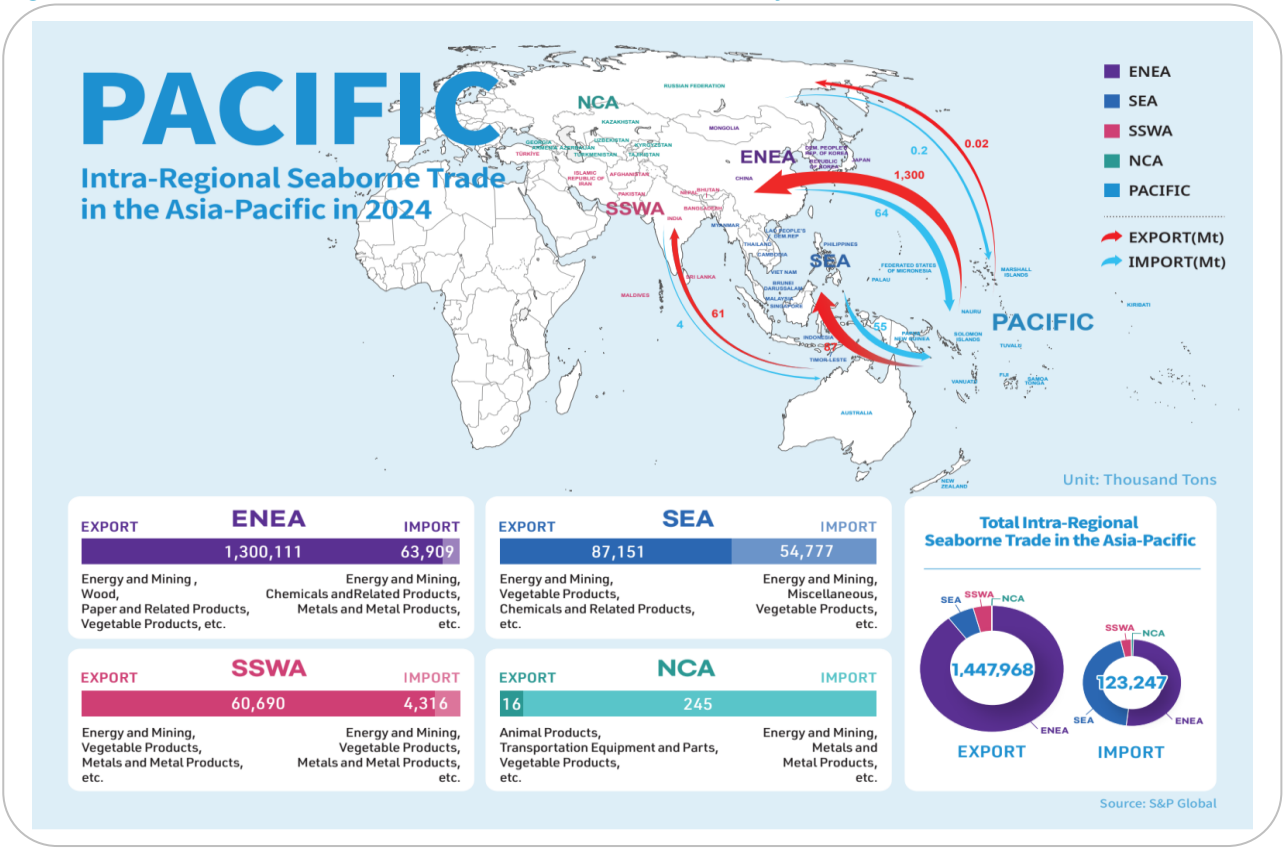
Across the region, resource exports led by Australia continue to dominate trade patterns, and this structure is expected to persist in the foreseeable future.

Table 2-14: Intra-Asia Pacific Seaborne Trade Volume and Key Trade Items in Pacific (thousand tons)

SUB REGION	EXPORT SEABORNE TRADE			IMPORT SEABORNE TRADE		
	SUB REGION	Volume	Main Commodity	SUB REGION	Volume	Main Commodity
PACIFIC	ENEA	1,300,111	Energy and Mining, Wood, Paper and Related Products, Vegetable Products.	ENEA	63,909	Energy and Mining, Chemicals and Related Products, Metals and Metal Products.
	SEA	87,151	Energy and Mining, Vegetable Products, Chemicals and Related Products.	SEA	54,777	Energy and Mining, Miscellaneous, Vegetable Products, Chemicals and Related Products.
	SSWA	60,690	Energy and Mining, Vegetable Products, Metals and Metal Products.	SSWA	4,316	Energy and Mining, Vegetable Products, Metals and Metal Products.
	NCA	16	Animal Products, Transportation Equipment and Parts, Vegetable Products.	NCA	245	Energy and Mining, Metals and Metal Products.
Total	1,447,968			123,247		

Source: Compiled and analyzed by KMI based on S&P Global data

Figure 2-12: Intra-Asia Pacific Seaborne Trade Volume and Key Trade Items in the PACIFIC



Source: Visualized by KMI based on the United Nations map, *Map of the World*, Map No. 4651 Re V.3 Mar 2025 (www.un.org/geospatial/content/map-world-1)
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Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.

Largest Seaborn Trade Country in the Pacific region: Australia

Australia serves as a key resource supplier to Asia while importing industrial and consumer goods, forming a two-way trade structure. Its exports are dominated by energy and mineral resources, particularly coal, natural gas and iron ore, supporting the industrial and energy sectors of China, Japan and the Republic of Korea. Meanwhile, imports consist mainly of chemicals, metals, machinery and transport equipment, sourced from China, the Republic of Korea, Malaysia, Singapore and Japan.

China remains Australia's largest trading partner, importing raw materials, agricultural products and chemicals, while also being its largest supplier of industrial inputs. This trade pattern reflects Australia's strong economic dependence on Asia, particularly on China, Japan and the Republic of Korea.

However, global decarbonization, energy transitions and shifting trade policies pose challenges to Australia's resource export model, especially coal. To adapt, Australia must diversify exports by focusing on renewable energy, critical minerals such as lithium and rare earth elements, and high-value-added processed good.

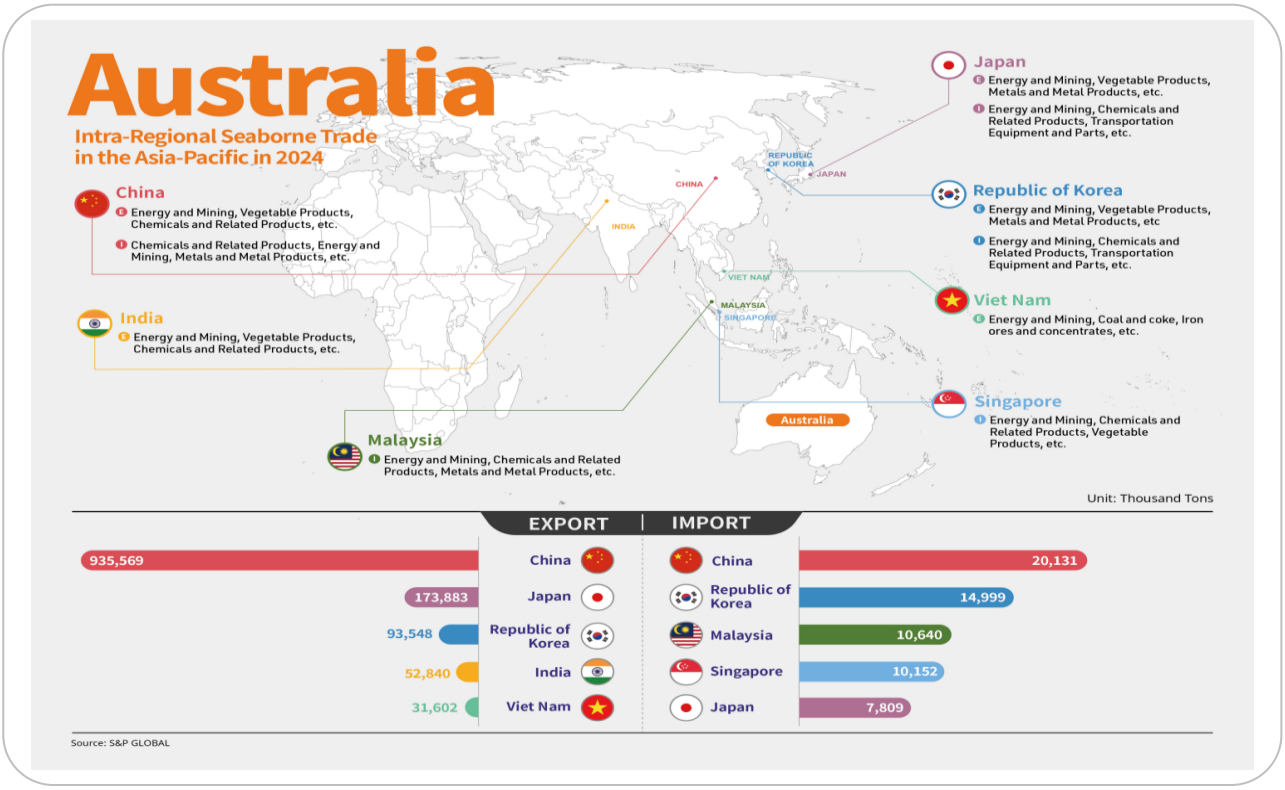
While Australia remains a major resource hub, its ability to adjust to global energy shifts and trade diversification will be key to ensuring long-term economic stability.

Table 2-15: Australia's Intra-Asia-Pacific Seaborne Trade Volume and Key Trade Item (thousand tons)

Country	EXPORT SEABORNE TRADE			IMPORT SEABORNE TRADE		
	Country	Volume	Main Commodity	Country	Volume	Main Commodity
Australia	China	935,569	Energy and Mining, Vegetable Products, Chemicals and Related Products.	China	20,131	Chemicals and Related Products, Energy and Mining, Metals and Metal Products.
	Japan	173,883	Energy and Mining, Vegetable Products, Metals and Metal Products, Chemicals and Related Products, Animal Products.	Republic of Korea	14,999	Energy and Mining, Chemicals and Related Products, Transportation Equipment and Parts.
	Republic of Korea	93,548	Energy and Mining, Vegetable Products, Metals and Metal Products.	Malaysia	10,640	Energy and Mining, Chemicals and Related Products, Metals and Metal Products.
	India	52,840	Energy and Mining, Vegetable Products, Chemicals and Related Products.	Singapore	10,152	Energy and Mining, Chemicals and Related Products, Vegetable Products.
	Viet Nam	31,602	Energy and Mining, Coal and coke, Iron ores and concentrates.	Japan	7,809	Energy and Mining, Chemicals and Related Products, Transportation Equipment and Parts.

Source: Compiled and analyzed by KMI based on S&P Global data

Figure 2-13: Australia's Intra-Asia-Pacific Seaborne Trade Volume and Key Trade Partner



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Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.

2.2.2.5. Status and flows of seaborne trade in SSWA

SSWA plays a significant role in Asia-Pacific maritime trade, with a total trade volume of 1,494 million tons, accounting for 12.6 percent of the regional total. The region exhibits a strong import-oriented structure, with imports (1,044 million tons) more than doubling exports (450 million tons). This trend is primarily driven by India's expanding manufacturing sector and growing raw material exports, particularly in chemicals and agricultural products, which serve as key economic drivers. As India strengthens its IT and manufacturing industries, trade continues to grow, while supply chain diversification presents new opportunities. Other countries, such as Iran and Türkiye, contribute to the region's trade network, though geopolitical risks introduce significant volatility.

SSWA's strongest trade relationship is with ENEA, with exports reaching 99.7 million tons and imports at 95.4 million tons, creating a relatively balanced trade structure. The region's exports mainly consist of energy, minerals, chemicals and agricultural goods, while imports include chemicals, metals and other industrial materials. Notably, the chemical sector has seen increasing trade flows in both directions, reinforcing industrial linkages between SSWA and ENEA.

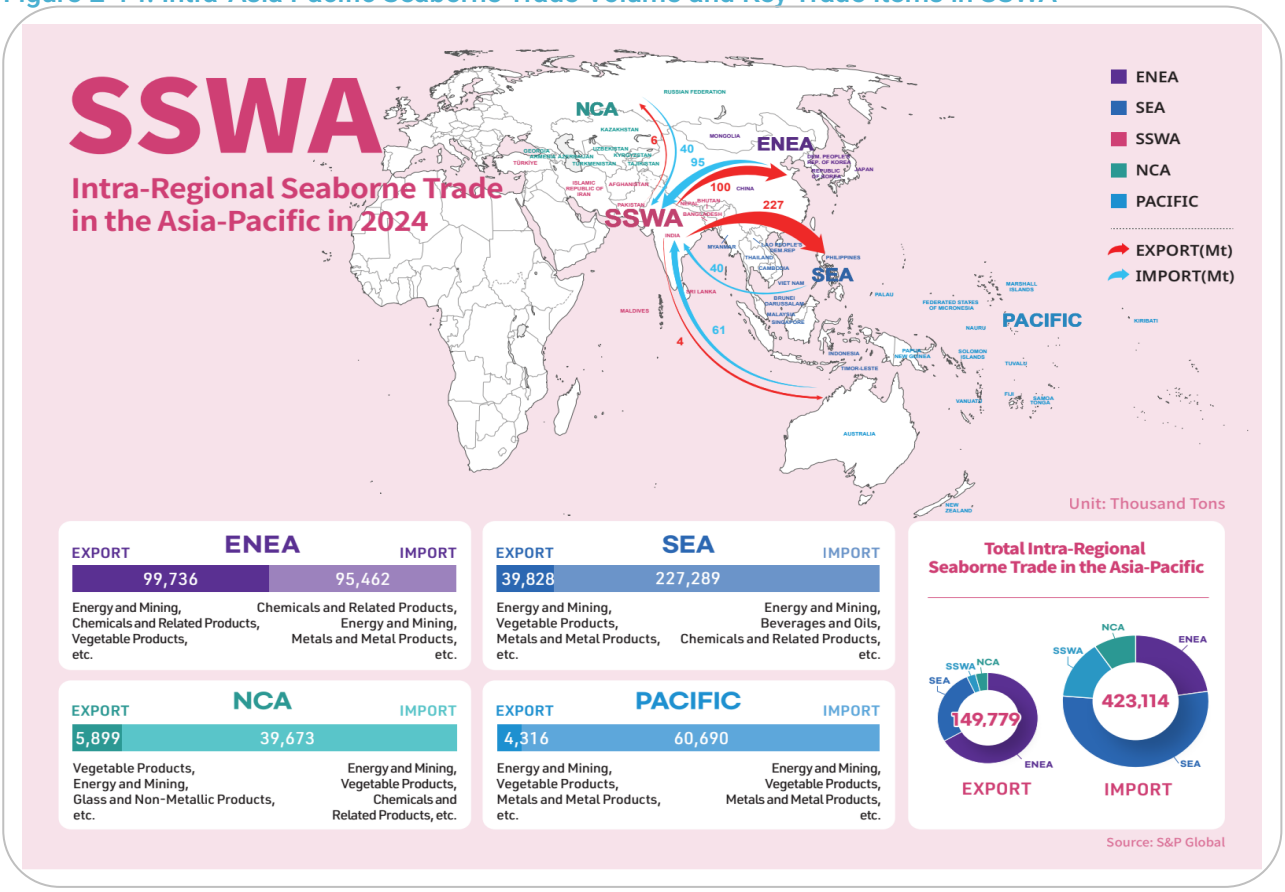
Moving forward, India's industrial growth and shifts in global supply chains are expected to further strengthen SSWA's trade position, enhancing its role as an emerging hub in Asia-Pacific trade.

Table 2-16: Intra-Asia Pacific Seaborne Trade Volume and Key Trade Items in SSWA (thousand tons)

SUB REGION	EXPORT SEABORNE TRADE			IMPORT SEABORNE TRADE		
	SUB REGION	Volume	Main Commodity	SUB REGION	Volume	Main Commodity
SSWA	ENEA	99,736	Energy and Mining, Chemicals and Related Products, Vegetable Products.	ENEA	95,462	Chemicals and Related Products, Energy and Mining, Metals and Metal Products.
	SEA	39,828	Energy and Mining, Vegetable Products, Metals and Metal Products.	SEA	227,289	Energy and Mining, Beverages and Oils, Chemicals and Related Products.
	NCA	5,899	Vegetable Products, Energy and Mining, Glass and Non-Metallic Products.	NCA	39,673	Energy and Mining, Vegetable Products, Chemicals and Related Products.
	PACIFIC	4,316	Energy and Mining, Vegetable Products, Metals and Metal Products.	PACIFIC	60,690	Energy and Mining, Vegetable Products, Metals and Metal Products.
Total	149,779			423,114		

Source: Compiled and analyzed by KMI based on S&P Global data

Figure 2-14: Intra-Asia Pacific Seaborne Trade Volume and Key Trade Items in SSWA



Source: Visualized by KMI based on the United Nations map, *Map of the World*, Map No. 4651 Re V.3 Mar 2025 (www.un.org/geospatial/content/map-world-1)
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Largest Seaborn Trade Country in SSWA region: India

India, the largest seaborne trade nation in SSWA, follows a trade pattern typical of emerging markets, with raw material imports and manufactured goods exports. Its seaborne trade is heavily dependent on energy and raw materials, while exports focus on refined petroleum, iron ore, and chemical products.

India's key trading partners—China, Indonesia, Singapore, Australia, the Republic of Korea, and Malaysia—reflect a complementary trade relationship driven by industrial and energy demand. The country imports coal, palm oil, and chemicals from Indonesia, coal, natural gas, and minerals from Australia, and chemicals, machinery, and metals from China, Singapore, and the Republic of Korea. Meanwhile, it exports refined petroleum, iron ore, and chemicals to China, Singapore, the Republic of Korea, Malaysia, and Indonesia.

This trade structure positions India as both a major importer of resources and a key supplier of industrial goods within the Asia-Pacific region. As economic growth and infrastructure expansion continue, India's demand for energy and raw materials is set to rise, requiring further trade diversification.

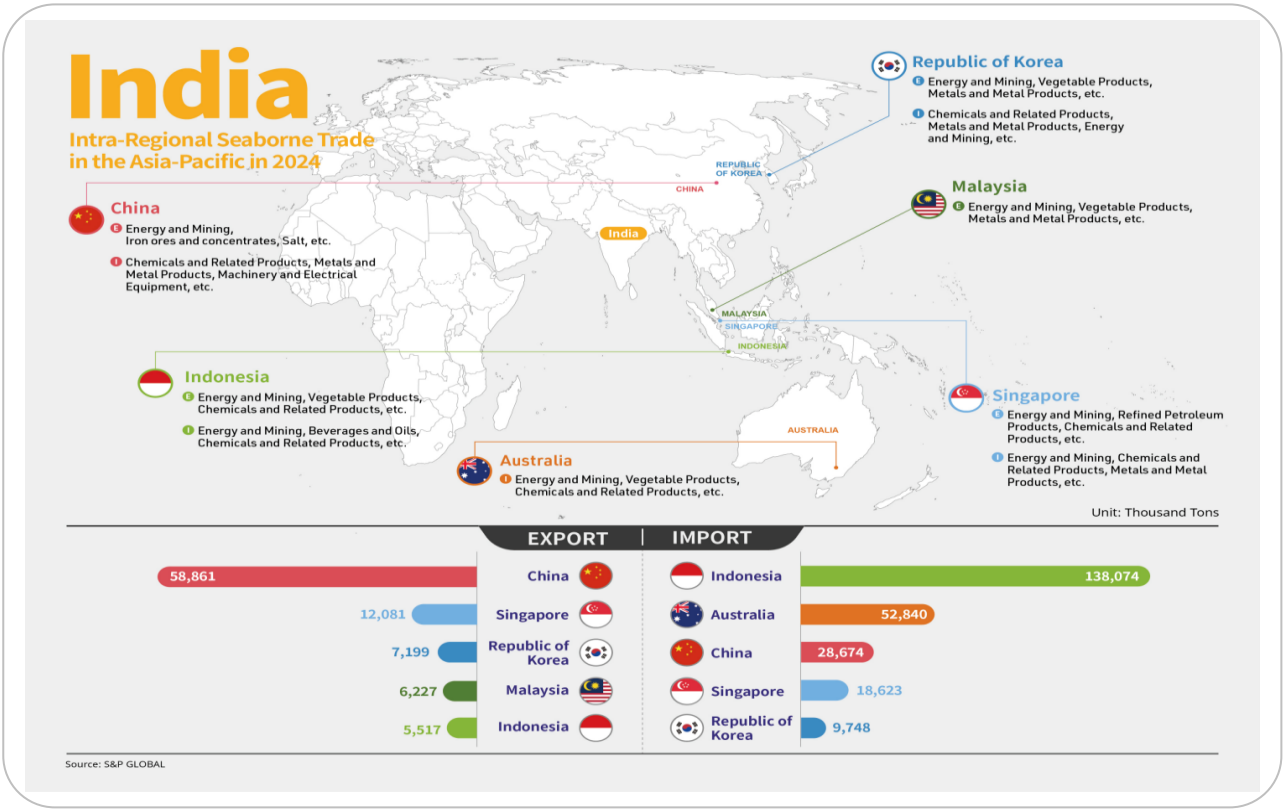
The transition to renewable energy and stricter carbon regulations may reshape India's trade dynamics. To remain competitive, India must broaden its export focus on renewable energy resources and sustainable industrial materials, aligning with global environmental policies and shifting trade demands.

Table 2-17: India's Intra-Asia-Pacific Seaborne Trade Volume and Key Trade Item (Thousand tons)

Country	EXPORT SEABORNE TRADE			IMPORT SEABORNE TRADE		
	Country	Volume	Main Commodity	Country	Volume	Main Commodity
India	China	58,861	Energy and Mining, Iron ores and concentrates, Salt, Sulphur, earths, plastering materials, lime and cement.	Indonesia	138,074	Energy and Mining, Beverages and Oils, Chemicals and Related Products.
	Singapore	12,081	Energy and Mining, Refined Petroleum Products, Chemicals and Related Products.	Australia	52,840	Energy and Mining, Vegetable Products, Chemicals and Related Products.
	Republic of Korea	7,199	Energy and Mining, Vegetable Products, Metals and Metal Products.	China	28,674	Chemicals and Related Products. Metals and Metal Products, Machinery and Electrical Equipment.
	Malaysia	6,227	Energy and Mining, Vegetable Products, Metals and Metal Products.	Singapore	18,623	Energy and Mining, Chemicals and Related Products, Metals and Metal Products.
	Indonesia	5,517	Vegetable Products, Energy and Mining, Glass and Non-Metallic Products.	Republic of Korea	9,748	Chemicals and Related Products, Metals and Metal Products, Energy and Mining.

Source: Compiled and analyzed by KMI based on S&P Global data

Figure 2-15: India's Intra-Asia-Pacific Seaborne Trade Volume and Key Trade Partner



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2.2.2.6. Status and flows of seaborne trade in NCA

In 2024, NCA (North and Central Asia) recorded a total seaborne trade volume of 345 million tons, accounting for just 2.9 percent of Asia's total trade, making it the smallest contributor in the region. The trade structure exhibits severe imbalance, with exports (314 million tons) nearly ten times higher than imports (31 million tons). This disparity is largely due to NCA's landlocked geography and limited domestic consumption base, which results in strong reliance on raw material exports and minimal import volumes.

One of NCA's defining trade characteristics is its heavy reliance on the Russian Federation, which dominates the region's trade flows. The Russian Federation primarily exports energy resources, and its trade share with Asian markets has been increasing due to recent geopolitical shifts.

NCA's trade is highly concentrated on ENEA, exporting 116.9 million tons while importing only 11.7 million tons, resulting in a large trade surplus with the region. Trade with other sub-regions remains limited, mainly due to logistical and infrastructure constraints. Key exports include energy, minerals, chemicals, and agricultural products, while imports are focused on machinery, electrical equipment, metals, and chemicals.

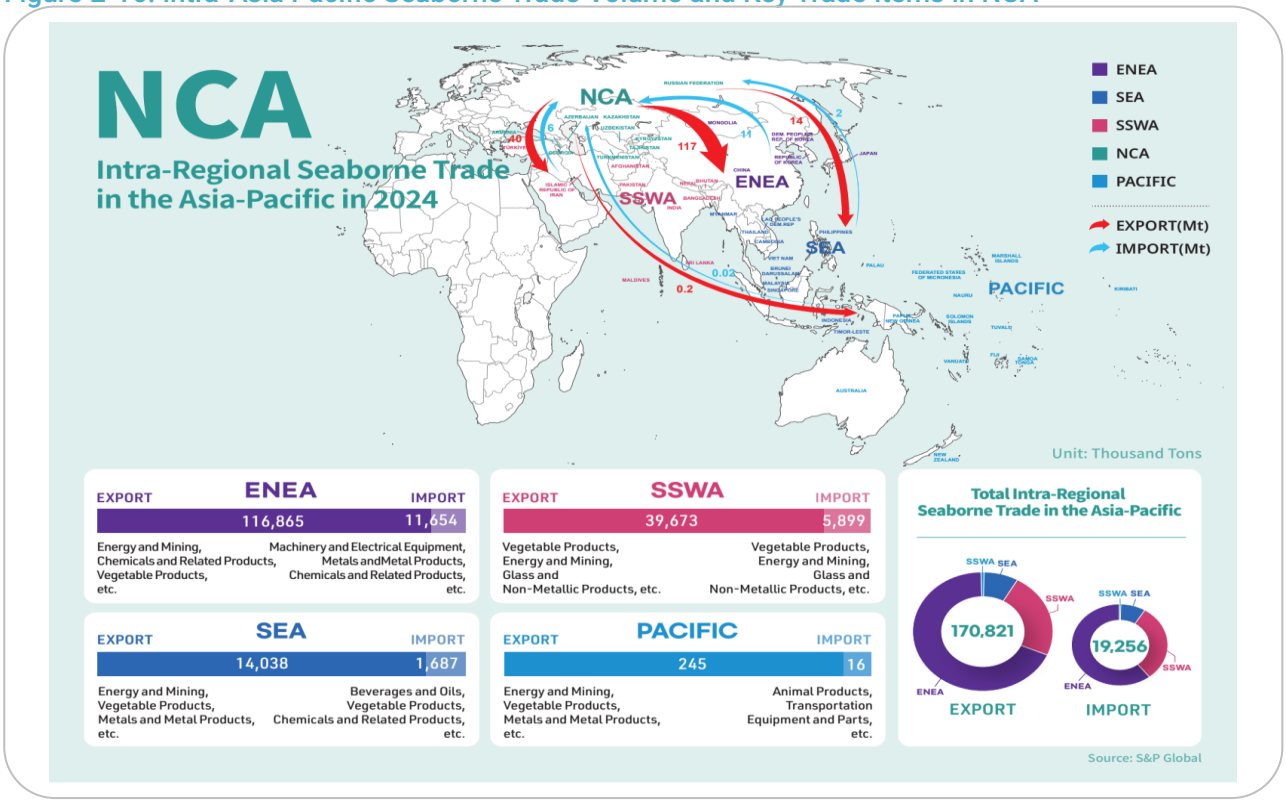
This trade structure reflects NCA's resource wealth and its manufacturing sector's relative weakness, reinforcing its role as a resource supplier rather than an industrial hub. Moving forward, improvements in logistics infrastructure and industrial capacity will be crucial for enhancing trade diversification and economic resilience.

Table 2-18: Intra-Asia Pacific Seaborne Trade Volume and Key Trade Items in NCA (thousand tons)

SUB REGION	EXPORT SEABORNE TRADE			IMPORT SEABORNE TRADE		
	SUB REGION	Volume	Main Commodity	SUB REGION	Volume	Main Commodity
NCA	ENEA	116,865	Energy and Mining, Wood, Paper and Related Products, Chemicals and Related Products.	ENEA	11,654	Machinery and Electrical Equipment, Metals and Metal Products, Chemicals and Related Products.
	SEA	14,038	Energy and Mining, Wood, Chemicals and Related Products, Metals and Metal Products.	SEA	1,687	Beverages and Oils, Vegetable Products, Chemicals and Related Products.
	SSWA	39,673	Energy and Mining, Vegetable Products, Chemicals and Related Products.	SSWA	5,899	Vegetable Products, Energy and Mining, Glass and Non-Metallic Products.
	PACIFIC	245	Energy and Mining, Metals and Metal Products, Vegetable Products.	PACIFIC	16	Animal Products, Transportation Equipment and Parts, Vegetable Products, etc.
Total	170,821			19,256		

Source: Compiled and analyzed by KMI based on S&P Global data

Figure 2-16: Intra-Asia Pacific Seaborne Trade Volume and Key Trade Items in NCA



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Largest Seaborn Trade Country in NCA region: Russian Federation

The Russian Federation, the largest seaborne trade nation within NCA, maintains an export-driven trade structure dominated by energy and mineral resources. Its key trading partners include China, Türkiye and the Republic of Korea, reflecting a strong dependency on the Asia-Pacific region.

China is the largest trading partner of the Russian Federation, importing coal, crude oil, iron ore and liquefied natural gas (LNG), while Türkiye primarily imports energy and wheat, benefiting from Black Sea trade routes. The Republic of Korea relies on Russian energy but also imports wood, paper and metals, with LNG playing a key role in the former's energy diversification strategy.

On the import side, the Russian Federation sources industrial goods from China, the Republic of Korea and Japan, including machinery, chemicals and metal products, supporting the modernization of its manufacturing sector.

The Russian Federation's trade structure is characterized by heavy reliance on energy exports; geographic proximity driving trade with China, the Republic of Korea and Japan; and gradual export diversification into chemicals, wood and agriculture. Additionally, the Russian Federation's dependence on Asia has intensified owing to Western sanctions.

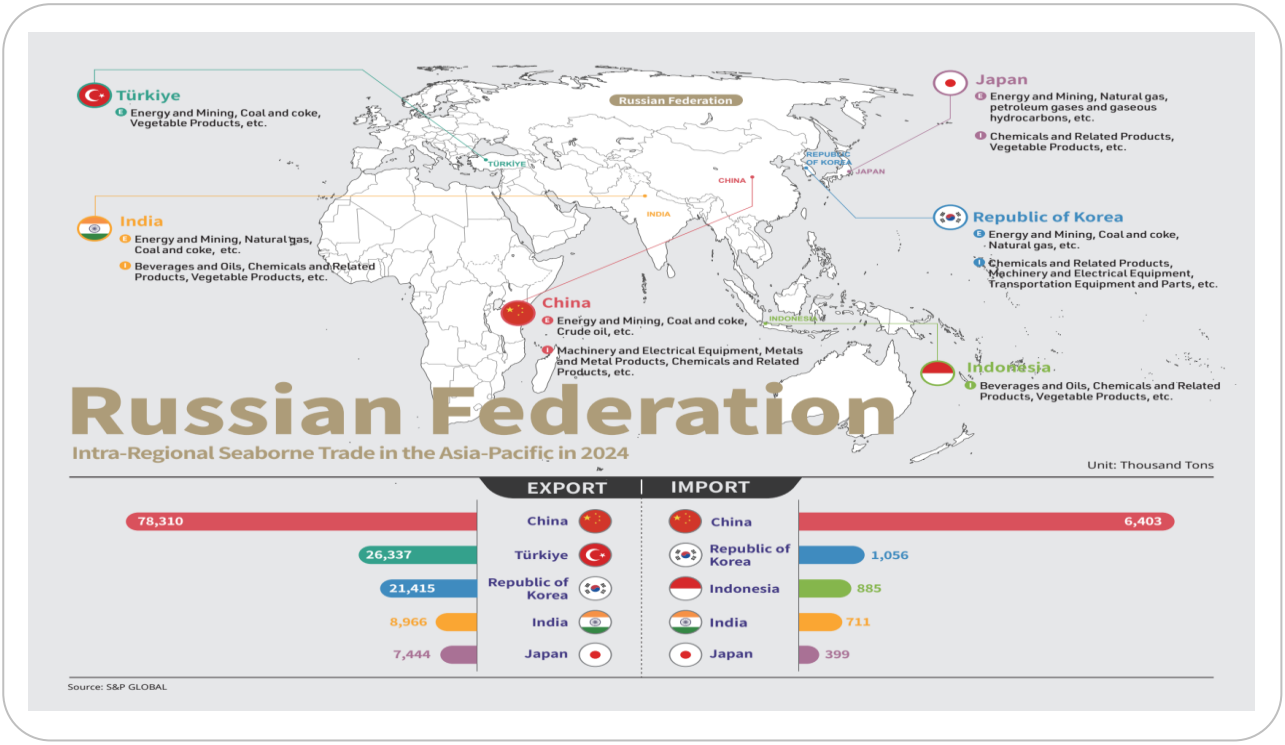
Looking ahead, the Russian Federation's trade ties with Asia-Pacific markets will continue to grow, but its reliance on fossil fuel exports poses risks amid global energy transitions. To adapt, the Russian Federation must diversify its exports and strengthen its industrial base, further integrating into the regional supply chain.

Table 2-19: The Russian Federation's Intra-Asia-Pacific Seaborne Trade Volume and Key Trade Item (thousand tons)

Country	EXPORT SEABORNE TRADE			IMPORT SEABORNE TRADE		
	Country	Volume	Main Commodity	Country	Volume	Main Commodity
Russian Federation	China	78,310	Energy and Mining, Coal and coke, Crude oil, Iron ores and concentrates.	China	6,403	Machinery and Electrical Equipment, Metals and Metal Products, Chemicals and Related Products.
	Türkiye	26,337	Energy and Mining, Coal and coke, Vegetable Products, Refined Petroleum Products, Wheat.	Republic of Korea	1,056	Chemicals and Related Products, Machinery and Electrical Equipment, Transportation Equipment and Parts.
	Republic of Korea	21,415	Energy and Mining, Coal and coke, Natural gas, petroleum gases and gaseous hydrocarbons.	Indonesia	885	Beverages and Oils, Chemicals and Related Products, Vegetable Products.
	India	8,966	Energy and Mining, Natural gas, Coal and coke, Chemicals and Related Products, Fertilizers.	India	711	Beverages and Oils, Chemicals and Related Products, Vegetable Products.
	Japan	7,444	Energy and Mining, Natural gas, petroleum gases and gaseous hydrocarbons, Coal and coke.	Japan	399	Chemicals and Related Products, Vegetable Products.

Source: Compiled and analyzed by KMI based on S&P Global data

Figure 2-17: The Russian Federation's Intra-Asia-Pacific Seaborne Trade Volume and Key Trade Partner



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2.2.2.7. Summary and Synthesis of Seaborne Trade Flows by Subregion

ENEA as the regional trade hub: ENEA has strengthened its role as the region's logistics hub, maintaining significant trade flows with all other sub-regions. China, Japan and the Republic of Korea lead exports, especially in high-tech and high-value-added goods, with a balanced structure between raw material imports and finished goods exports. Their export-driven growth, backed by technological strength, makes ENEA a key supply chain hub.

SEA as the key connector in regional trade: SEA plays a crucial role in intra-regional trade, benefiting from strategic maritime routes and a strong manufacturing base. Key contributions include Indonesia's raw material exports, Viet Nam's manufacturing growth and Singapore's role as a transshipment hub. Trade volumes are increasing owing to global supply chain restructuring, and SEA is deeply integrated with ENEA's manufacturing supply chain, particularly in raw material exports and intermediate goods imports.

The Pacific as a strategic resource base: The Pacific region, led by Australia, serves as a major supplier of mineral resources, tightly linked to ENEA's manufacturing needs. Critical minerals such as rare earths and lithium, which are essential for the Fourth Industrial Revolution, are becoming increasingly significant. Additionally, New Zealand's agricultural exports and Papua New Guinea's natural resources are key trade components. However, small island economies have limited trade volumes owing to their small economic scale.

SSWA as an emerging manufacturing hub: SSWA is evolving into a new manufacturing hub, with India leading growth in IT services and manufacturing. As global supply chains diversify, SSWA is exploring new opportunities. Chemical and agricultural exports are key growth drivers, and India is shifting toward high-value-added industries, such as refined petroleum product exports.

NCA's limited seaborne trade: Owing to its landlocked geography, NCA has limited seaborne trade, except for the Russian Federation, which is increasing its energy exports to Asia. Geopolitical shifts have intensified the Russian Federation's dependence on Asian markets, though overall trade volume remains constrained by structural limitations.

Key trends and future outlook: The region's trade patterns demonstrate that economic complementarity outweighs geographical distance in determining trade intensity. Advancements in maritime transport and logistics efficiency are helping overcome geographical constraints, facilitating increased intra-regional trade. Differences in industrial structures and development stages continue to foster complementary trade relationships, driving overall trade growth in the Asia-Pacific.

Looking ahead, the concentrated trade structure, dominated by a few key countries, is expected to persist. However, the economic growth of developing nations and improvements in logistics infrastructure will gradually balance regional trade dynamics. The growth potential of SEA is particularly noteworthy, as its expanding role may reshape regional seaborne trade patterns.

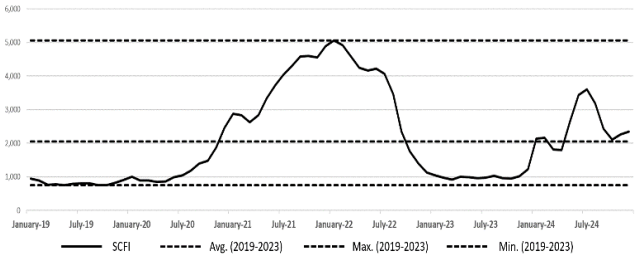
To ensure sustainable seaborne trade growth, stronger cooperation among Asia-Pacific nations is essential. Investment in infrastructure and technology transfer will be critical in enhancing developing countries' maritime logistics capacity. Additionally, digitalization and environmental sustainability must be collectively addressed to align with global trade trends.

2.2.3. Current Status and Outlook of the Global Shipping Market

2.2.3.1. Container Shipping Market

In 2024, the Shanghai Containerized Freight Index (SCFI) surged 2.5 times compared with 2023 (1,006 points), reaching 2,507 points. This sharp increase was driven by both supply reductions owing to geopolitical risks and a surge in early shipments following tariff announcements by major economies.

Figure 2-18: Trend of SCFI



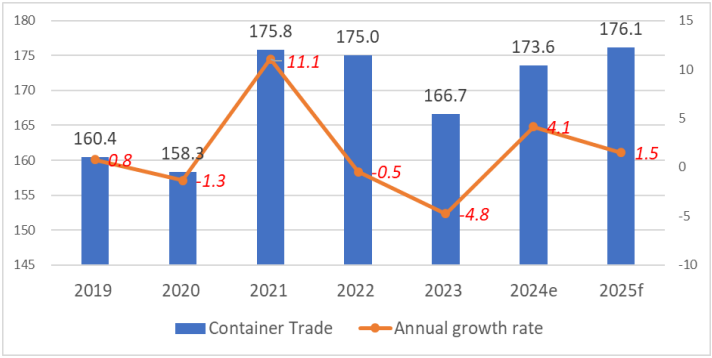
Source: Compiled and analyzed by KMI based on Clarksons data as of end-2024

Key factors contributing to the rise in freight rates in 2024 include:

- Geopolitical risks in the Middle East, making vessel rerouting unavoidable.
- Transit restrictions in the Panama Canal owing to drought, effectively reducing vessel supply.
- Disruptions in supply, leading to a decrease in available shipping capacity, thereby placing an upward pressure on freight rates
- A surge in early shipments following tariff announcements on Chinese exports, further contributing to higher freight rates

From a demand perspective, in 2024, seaborne container trade is estimated to reach 174 million TEUs, reflecting a 4.1 percent increase compared with 2023 (S&P, 2025). This growth has been driven by global economic recovery, which has boosted consumer demand and manufacturing activity across major economies.

Figure 2-19: Seaborne container trade (million TEU, %)



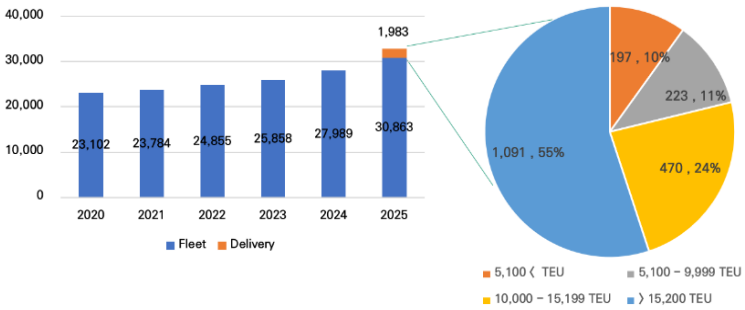
Source: Compiled and analyzed by KMI based on S&P Global data

Key factors contributing to the increase in container trade volume include:

- Rising exports from emerging economies, particularly China, alongside the expansion of Southeast Asia and India as key manufacturing hubs.
- Supply chain diversification by global companies due to trade tensions and geopolitical risks, leading to increased demand for maritime transport.
- The continued expansion of the e-commerce market, driving higher shipping volumes due to rising online shopping demand.

From a supply perspective, in 2024, the total container ship fleet capacity reached 27,989 thousand TEUs, and the container fleet growth rate in 2025 is expected to be around 5–6 percent. The ongoing geopolitical risks in the Middle East, IMO environmental regulations, and limited shipyard capacity causing delivery delays are expected to help mitigate supply shocks in the market.

Figure 2-20: Container Fleet and Delivery by Vessel Size (thousand TEU)



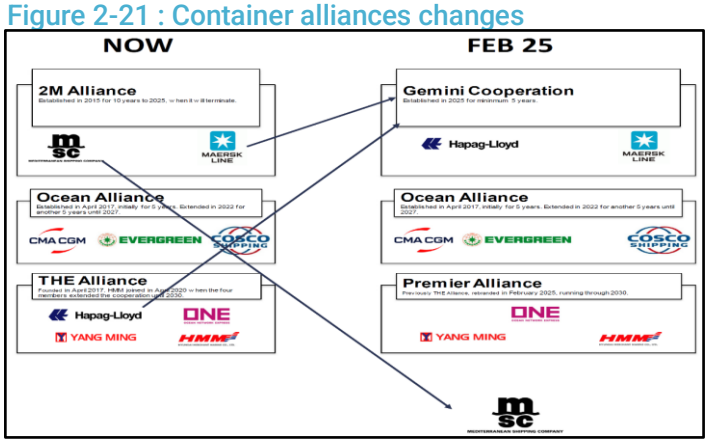
Source: Compiled and analyzed by KMI based on Drewry and Clarksons data

In 2025, the new vessel deliveries are projected to total approximately 1.98 million TEUs (221 ships), while ship scrapping is expected to range between 200,000 and 300,000 TEUs. Among the newly delivered vessels, ships of 5,100 TEUs or larger will account for about 90 percent of total deliveries, totaling 124 vessels (approximately 1.78 million TEUs). In contrast, ships of 3,000 TEUs or smaller will constitute only around 30 percent (68 vessels) of new deliveries, a significant decrease compared with the current level of 54 percent (3,428 vessels) (Drewry, 2024; KMI, 2025).

One of the key recent issues in the container shipping market is the restructuring of shipping alliances. As of 2024, there are three major alliances in operation: 2M Alliance, Ocean Alliance and THE Alliance. Among them, 2M Alliance, a partnership between Maersk Line and MSC, established in 2015, is set to terminate in February 2025.

From February 2025, the alliance structure will be reorganized into Ocean Alliance, Gemini Cooperation (Maersk, Hapag-Lloyd), Premier Alliance, and MSC's independent network. Gemini Cooperation, a formed alliance between Maersk and Hapag-Lloyd, will operate 26 main liner services, covering major routes such as Asia-Europe, Asia-Mediterranean, and Europe-North America East Coast. Gemini will have the largest presence on transatlantic routes and the second-largest footprint on Asia-Europe, Asia-Mediterranean, and Europe-North America East Coast routes.

Figure 2-21 : Container alliances changes



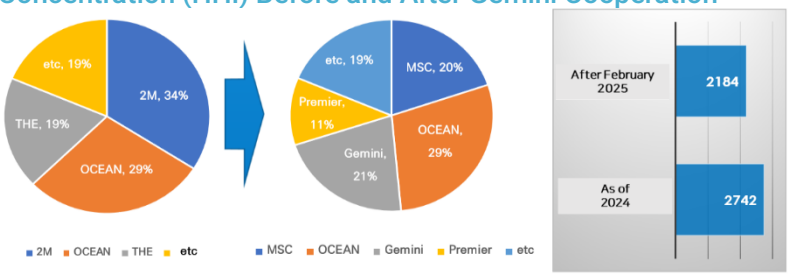
Source: (Drewry, 2024)

THE Alliance will be restructured into a new Premier Alliance, consisting of HMM, ONE and Yang Ming, following Hapag-Lloyd's withdrawal. From February 2025, this alliance will operate 30 routes, including 12 trans-Pacific West Coast routes, 4 trans-Pacific East Coast routes, 6 North European routes, 5 Mediterranean routes and 3 Middle East routes, with a five-year cooperation agreement in place (Drewry, 2024).

Meanwhile, MSC, formerly part of 2M Alliance, is expected to collaborate with Premier Alliance, engaging in a four-year vessel-sharing agreement on the Asia–Europe route. Additionally, MSC is anticipated to establish a long-term operational cooperation agreement with ZIM Line for services on the Asia–U.S. East Coast Service and Gulf Coast routes.

Following the alliance restructuring in February 2025, an analysis of the Herfindahl-Hirschman Index (HHI) for market concentration in the container shipping sector indicates a decline from 2,741 to 2,184, reflecting a reduction in market concentration (KMI, 2025).

Figure 2-22: Container Shipping Market Share and Concentration (HHI) Before and After Gemini Cooperation



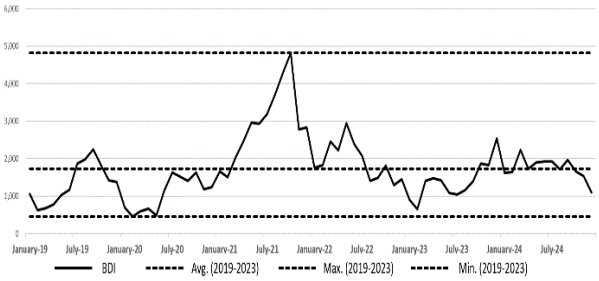
Source: Compiled and analyzed by KMI based on Alphaliner data

The container shipping market in 2025 is expected to face continued downward pressure due to vessel oversupply driven by a surge in new ship deliveries (FitchRatings, 2024). This structural imbalance is being compounded by weaker-than-expected global trade volumes. Although some geopolitical tensions in the Middle East have shown signs of easing, broader trade policy uncertainty and disruptions are likely to sustain volatility across supply chains. While the alliance restructuring that took effect in February 2025 appears to have had a limited direct market impact so far, close monitoring is warranted as carriers increasingly pursue differentiation strategies, which could influence freight rates and service patterns in an oversupplied environment.

2.2.3.2. Dry Bulk Shipping Market

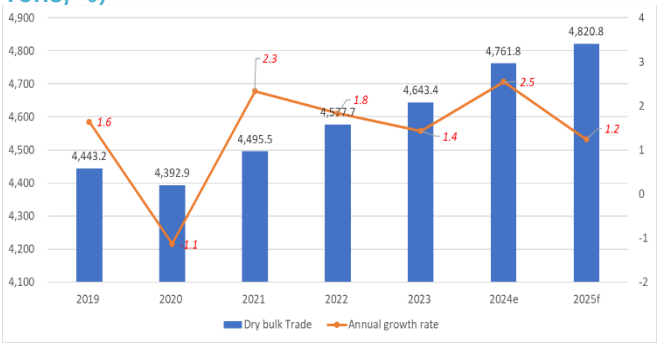
In 2024, the Baltic Dry Index (BDI) recorded 1,758, marking a 27.5 percent increase compared with 2023. This surge was driven by a combination of geopolitical tensions in the Middle East, reduced vessel supplies due to IMO environmental regulations, increased demand for raw materials and grain shipments, and seasonal factors.

Figure 2-23: Trend of the Baltic Dry Index (BDI)



Source: Compiled and analyzed by KMI based on Clarksons data

Figure 2-24: Dry Bulk Seaborne Trade (million Tons, %)



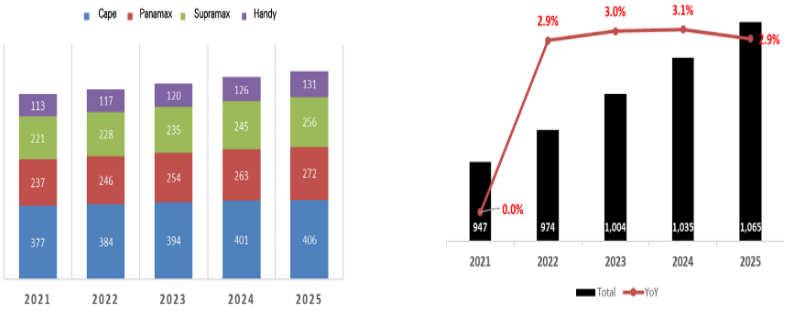
Source: Compiled and analyzed by KMI based on S&P Global data

In 2024, dry bulk seaborne trade volume is estimated to have increased by 2.5 percent YoY, reaching 4,762 million tons. This growth was driven by economic stimulus policies in China and emerging markets, leading to higher raw material shipments, particularly for iron ore, coal, grain and non-ferrous metals. Additionally, rising demand for heating coal and seasonal factors, such as South America's grain harvest season, further contributed to the increase in seaborne trade volumes.

In 2025, global dry bulk shipping volumes are expected to grow by 1.2 percent, with China's stimulus measures playing a key role in market dynamics. For grain shipments, growth in the soybean market is expected to be a key driver, while weather-related factors, such as excessive rainfall in Europe affecting wheat production and Australia returning to normal output levels, are expected to significantly impact grain trade flows.

From the vessel supply perspective, the dry bulk fleet capacity is expected to increase by 2.9 percent in 2025. This is due to a decline in new vessel deliveries caused by a drop in new orders since 2022, while ship scrapping is expected to rise following the tightening of IMO environmental regulations.

Figure 2-25: Dry Bulk Fleet Capacity (ships, %)



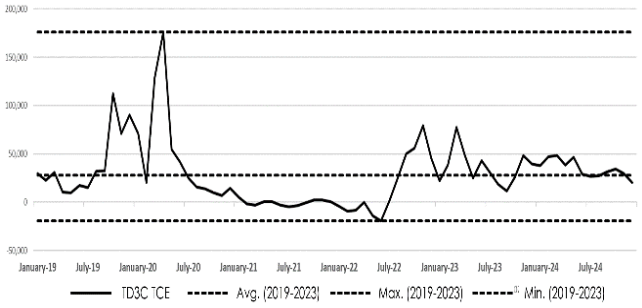
Source: Compiled and analyzed by KMI based on Clarksons data

Freight rates in the dry bulk shipping market remained weak through Q1 2025, and while a recovery is anticipated from Q2 onward, the outlook remains uncertain due to a combination of complex factors. These include weaker-than-expected global trade performance and concerns over a slowing global economy. The scale and sustainability of China's economic stimulus measures—particularly in reviving the real estate sector—will be a key determinant of demand. Ongoing geopolitical tensions in the Middle East also continue to pose risks to trade routes and market stability. Meanwhile, stricter environmental regulations are expected to reduce vessel speeds and prompt operational adjustments, effectively limiting fleet capacity and helping to balance market conditions despite sluggish demand.

2.2.3.3. Tanker Shipping Market

In 2024, the tanker market maintained generally strong freight rates. The ongoing impact of the war in Ukraine and heightened instability in the Middle East led to longer shipping distances, as vessels bypassed the Suez Canal. In particular, the reconfiguration of Europe's crude oil supply chains, shifting from African, U.S., and Russian crude export routes to India and China, resulted in increased voyage distances and tight vessel supply, supporting market improvement.

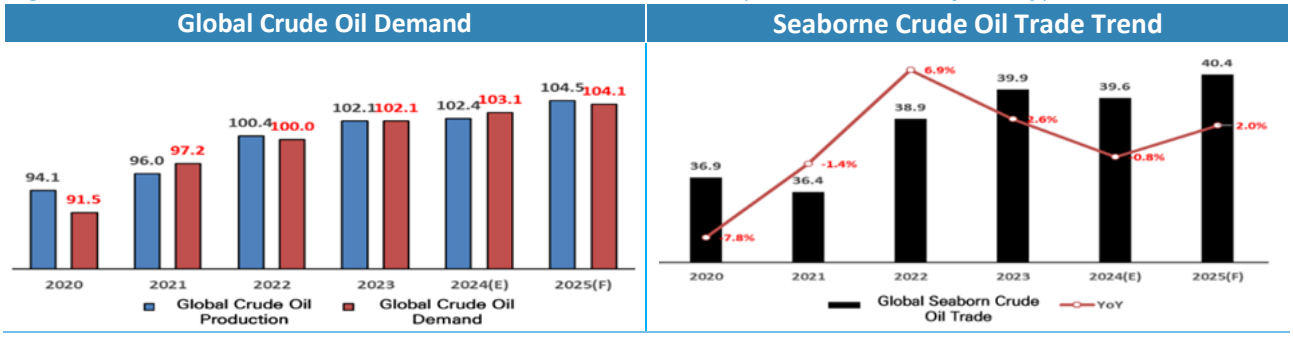
Figure 2-26: Freight Rates Trend of VLCC



Source: Compiled and analyzed by KMI based on Clarksons data

According to the International Energy Agency (IEA), the 2024 global crude oil market is expected to undergo a structural shift toward oversupply. Non-OPEC+ production, led by the the United States of America, is rising, and even if OPEC+ cuts production in response, such reductions are likely to be offset by increased output from non-OPEC+ nations. Global seaborne crude oil trade volumes in 2024 declined by 0.8 percent year-on-year but are expected to increase by 2.0 percent in 2025 (IEA, 2024)

Figure 2-27: Global Crude Oil Demand and Seaborne Trade (million barrels / per day)

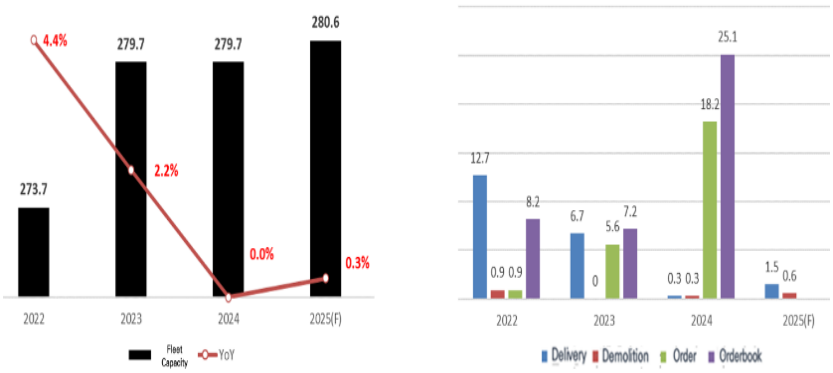


Source: Compiled and analyzed by KMI based on Clarksons data

The growing role of non-OPEC+ producers may further reduce OPEC+'s market share. Additionally, factors such as rebounding crude oil consumption in China and the United States of America, declining inventories, and rising non-OPEC+ production are expected to drive a modest increase in crude oil trade in 2025. However, global Electric vehicle (EV) adoption may slow oil demand growth, while an escalation of Middle East conflicts could threaten the stability of the Strait of Hormuz, which handles 27 percent of global seaborne crude oil trade, increasing market volatility.

On the supply side, the VLCC (Very Large Crude Carrier) fleet capacity remained at 2.797 million DWT in 2024, unchanged from the previous year. In 2025, the VLCC fleet is expected to grow by 0.3 percent. This was influenced by limited new vessel deliveries, increased scrapping, delayed orders, oil price volatility, and global economic uncertainty, leading to a cautious fleet management strategy among shipowners.

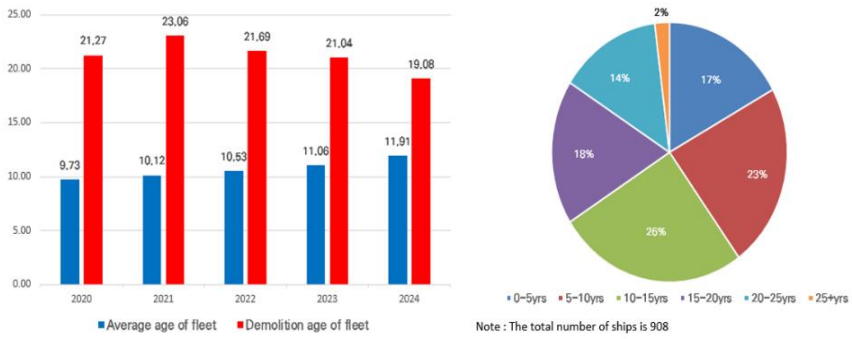
Figure 2-28: Fleet Capacity Trend of VLCC



Source: Compiled and analyzed by KMI based on Clarksons data

Currently, about 34 percent of the VLCC fleet consists of vessels over 15 years old, and higher scrapping activity is expected due to IMO environmental regulations. However, if demand for older vessels remains strong in the grey market, scrapping may be delayed.

Figure 2-29 Age Trend of VLCC



Source: Compiled and analyzed by KMI based on Clarksons data

Freight rates in the 2025 tanker market are projected to increase compared with 2024, driven by slower fleet expansion and increased long-haul trade resulting from shifting crude oil trade patterns. Interest rate cuts in major economies such as the United States of America and Europe, along with inventory declines, are positive factors supporting oil demand. Additionally, rising production from non-OPEC+ countries, particularly in the United States of America, is expected to stimulate trade and boost seaborne crude oil volumes.

However, surging trade-related uncertainties, concerns over an economic slowdown, continued geopolitical tensions in the Middle East, adjustments to OPEC+ production policies, and evolving demand trends in China will be key factors shaping the overall market environment. Conversely, the United States may shift toward more pro-fossil fuel policies—such as increasing domestic oil production and expanding crude oil exports—which could further boost seaborne trade volumes.

Table 2-20: 2024 Trend and 2025 Outlook of the Global Shipping Market

Category	Container Shipping Market	Dry Bulk Market	VLCC Market
2024 Trends	· SCFI recorded 2,507 (2.5 times increase year-on-year) - Influenced by geopolitical risks, increased early shipment demand, and supply chain disruptions - Growth in the global economy, rising exports from emerging markets, and e-commerce expansion driving Seaborne trade volume	· BDI recorded 1,758 (27.5 percent increase year-on-year) - Impact of Middle East geopolitical crisis, IMO environmental regulations, and rising demand for raw materials and grains - Increased Seaborne trade volume due to China's economic stimulus, higher demand for iron ore, coal, grains, and non-ferrous metals	· VLCC freight rates remained at a stable level (2.7 percent decline year-on-year) - Longer shipping distances due to the war in Ukraine and Red Sea tanker attacks - Decline in OPEC+ market share due to increased non-OPEC+ production, expansion of EV adoption, and slowdown in oil consumption leading to lower Seaborne trade volume
2025 Outlook	· Market decline expected - (↓) Oversupply of vessels and growing trade uncertainties - (↑) Geopolitical risks and increased protectionism may offset some impacts	· Market growth expected - (↑) Implementation of China's economic stimulus, rising demand for raw materials - (↓) Slowdown in coal demand growth, growing trade uncertainties and adverse weather conditions as variables	· Market growth expected - (↑) Recovery in oil demand, increased non-OPEC+ production, interest rate cuts, and rising fossil fuel demand in the United States of America - (↓) Growing demand-side uncertainties, continued oil production cuts by major oil-producing countries and lingering uncertainty in the oil market due to delayed global economic recovery
Key Market Issues	· End of 2M alliance, launch of Gemini Cooperation – restructuring of shipping alliances · Ongoing supply chain uncertainties	· Sustainability of China's economic stimulus and ongoing geopolitical risks in the Middle East · Impact of environmental regulations leading to slow steaming and increased scrapping of vessels	· Continuation of OPEC+ production cuts and Middle East conflicts · Energy policy shifts under the second Trump administration in the United States of America

2.2.3. Linear Shipping Connectivity Index (LSCI) analysis

2.2.3.1. Overview of the Liner Shipping Connectivity Index (LSCI)

The Liner Shipping Connectivity Index (LSCI), published quarterly by UNCTAD, measures the extent to which each country is connected to the global liner shipping network for international trade. The index is intuitive and objective, allowing for both year-over-year trend analysis and cross-country comparisons. As such, it serves as a highly valuable indicator for assessing a country's maritime transport competitiveness and connectivity.

Since its introduction in 2004 and its revision in 2016, the LSCI has been calculated based on six core components. In 2024, the index underwent another revision, not in its fundamental methodology but in the calculation approach. This update aimed to better reflect the evolving landscape of the shipping and port industry over the past two decades and to strengthen the correlation between maritime connectivity and trade (or freight rates). The normalization method for data was modified: instead of dividing each country's value by the maximum value of each component in the first quarter of 2006, it is now divided by the average value of each component. This adjustment resolves the issue of vessel size being overly weighted in the index, resulting in a more balanced and representative distribution.

Table 2-21: LSCI Components and Key Revisions in 2024

6 Components of LSCI methodology	
1	The number of scheduled ships calls per week in the country
2	Deployed annual capacity in TEU: total deployed capacity offered at the country
3	The number or regular liner shipping services from and to the country
4	The number of liner shipping companies that provide services from and to the country
5	The size in TEU of the largest ship deployed on services from and to the country
6	The number of other countries that are connected to the country through direct liner shipping services (Note: a direct service is defined as a regular service between two countries; it may include other stops in between, but the transport of a container does not require transshipment)

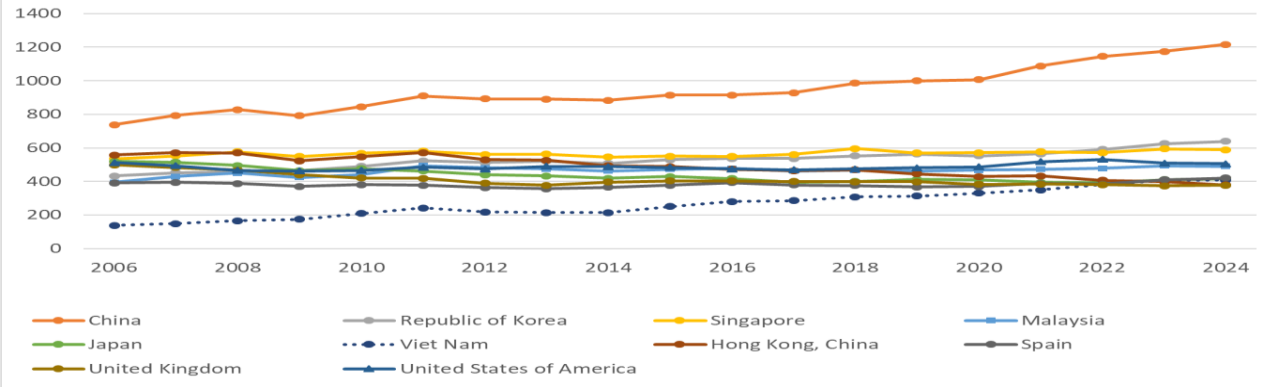
Source: Compiled and analyzed by KMI based on UNCTAD data

2.2.3.2. Global and Asia-Pacific LSCI Trends

Since the COVID-19 pandemic, the global liner shipping network has largely recovered. In particular, the port stay duration for all types of vessels has decreased to pre-pandemic levels. As a result, the connectivity index, which had been declining or stagnating in most countries during the pandemic, has now turned into a clear upward trend. However, continuous attention should be given to factors that could directly hinder maritime connectivity, such as geopolitical risks in the Red Sea and the Panama Canal.

In the LSCI, countries in the Asia-Pacific region generally achieve high scores. As of 2024, seven of the world's top ten ranked countries and regions include China, the Republic of Korea, Singapore, Malaysia, Japan, and Viet Nam. Notably, China has maintained its position as the top-ranked country since 2006.

Figure 2-30: Global Top 10 Countries in LSCI(UNCTAD)



Source: Compiled and analyzed by KMI based on UNCTAD data

Looking at the changes in major Asia-Pacific countries over the past decade (2015–2024), Viet Nam recorded the highest average annual growth rate at 5 percent, followed by India and China. In contrast, Hong Kong, China and Japan experienced negative growth rates. In terms of year-on-year (YoY) growth compared to 2023, India recorded the highest increase at 3.8 percent, followed by China.

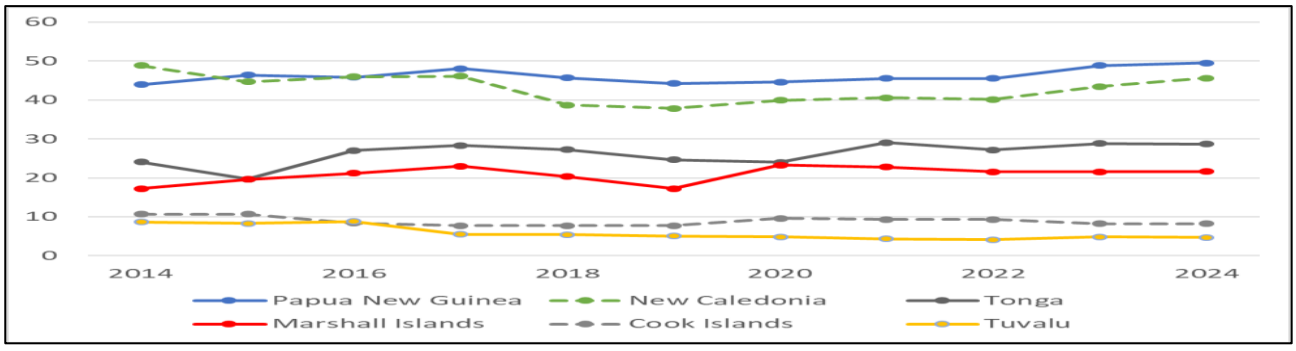
Table 2-22: LSCI Changes of the Top 10 Asia-Pacific Countries (2015–2024)

Rank	Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	CAGR
1	China	915.5	914.0	929.1	985.7	999.7	1,007.1	1,088.8	1,144.6	1,173.9	1,215.6	2.9%
2	Republic of Korea	530.0	536.4	537.5	552.5	562.3	551.8	564.4	591.2	625.2	640.0	1.9%
3	Singapore	550.3	549.1	561.4	596.1	570.8	571.1	576.4	571.1	594.8	588.4	0.7%
4	Malaysia	473.3	478.2	463.0	467.1	460.5	468.6	473.3	477.8	494.6	491.0	0.4%
5	Japan	429.4	416.8	396.7	400.3	412.4	411.3	394.2	391.1	411.0	417.5	-0.3%
6	Viet Nam	251.0	280.8	285.6	307.8	314.1	330.1	350.7	382.5	407.2	408.4	5.0%
7	Hong Kong, China	488.8	473.0	464.9	469.4	444.4	429.6	432.7	406.7	399.2	379.2	-2.5%
8	India	245.3	262.7	253.9	256.7	245.6	251.1	270.5	295.3	330.8	343.4	3.4%
9	Türkiye	221.0	220.4	231.0	236.2	229.9	227.5	231.5	251.9	279.0	280.3	2.4%
10	Thailand	207.8	215.6	210.1	217.5	221.7	225.8	239.0	252.1	264.3	263.6	2.4%

Source: Compiled and analyzed by KMI based on UNCTAD data

Despite having the goal of enhancing maritime connectivity, most Small Island Developing States (SIDS) face challenges such as low trade volumes and trade imbalances. As a result, they remain at the bottom of the LSCI. Non-main hub ports in regions like the Pacific often follow a double hub-and-spoke model. This leads to higher freight costs due to the inefficiencies in liner shipping routes, operators, and economies of scale. Consequently, this creates a vicious cycle where reduced trade volumes lead to weakened trade competitiveness and further declines in connectivity.

Figure 2-31: Some Pacific Island Countries' LSCI Index



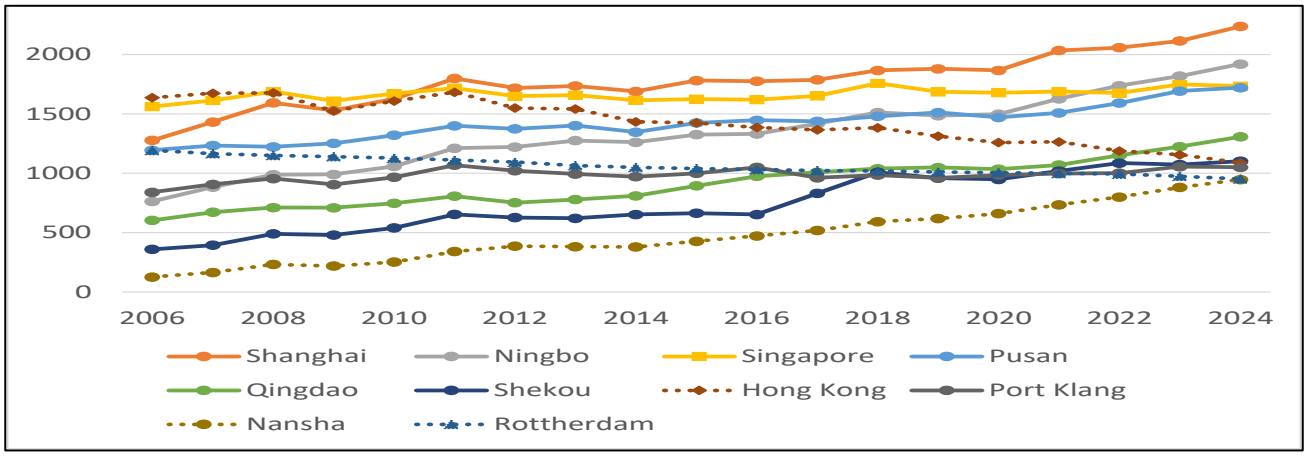
Source: Compiled and analyzed by KMI based on UNCTAD data

2.2.3.3. Global and Asia-Pacific PLSCI Trends

In the Port Liner Shipping Connectivity Index (PLSCI), which measures liner shipping connectivity at the port level, Asia-Pacific ports continue to achieve high scores. As of 2024, all but one of the world's top 10 PLSCI-ranked ports—Rotterdam—were located in the Asia-Pacific region, with six of them being Chinese ports (including Hong Kong Port).

In terms of connectivity growth, Ningbo, Shekou (Shenzhen), and Qingdao, which have been strategically developed along the South and East China Sea coastline, have shown rapid increases. Conversely, Hong Kong Port's connectivity has declined sharply due to increasing competition from neighboring South China ports, such as Shekou and Nansha.

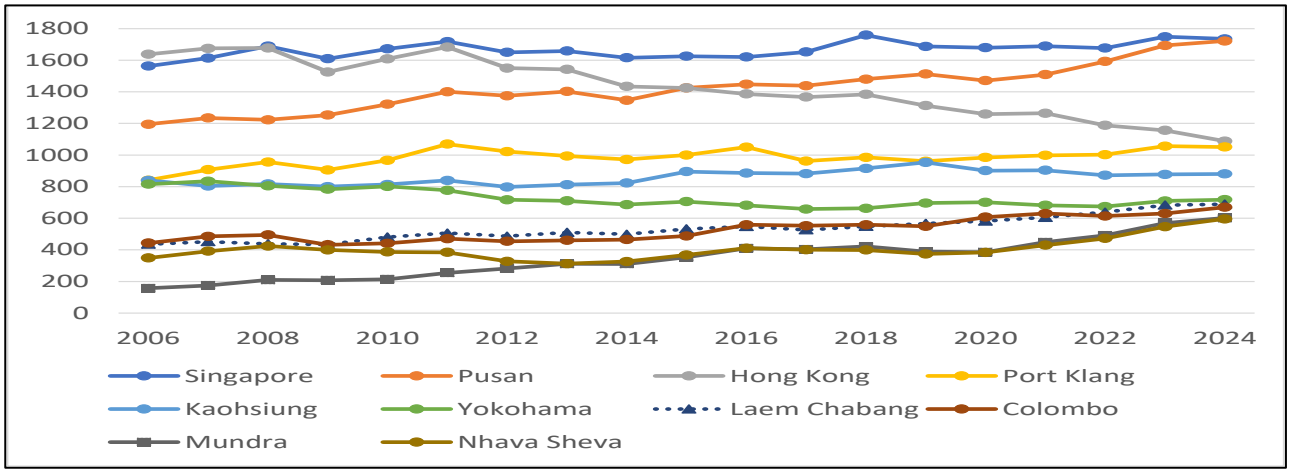
Figure 2-32: Global Top 10 Ports in PLSCI



Source: Compiled and analyzed by KMI based on UNCTAD data

Among Asia-Pacific ports excluding Chinese ports, Busan, in the Republic of Korea, and Singapore recorded the highest connectivity scores, followed by Port Klang in Malaysia, Yokohama in Japan, and Laem Chabang in Thailand. The average annual growth rate of India's Mundra and Nhava Sheva ports, over the past five years (2019–2024), has exceeded 9 percent, demonstrating significant improvements in India's port network.

Figure 2-33: Asia-Pacific Top 10 Ports in PLSCI (Excluding China)



Source: Compiled and analyzed by KMI based on UNCTAD data

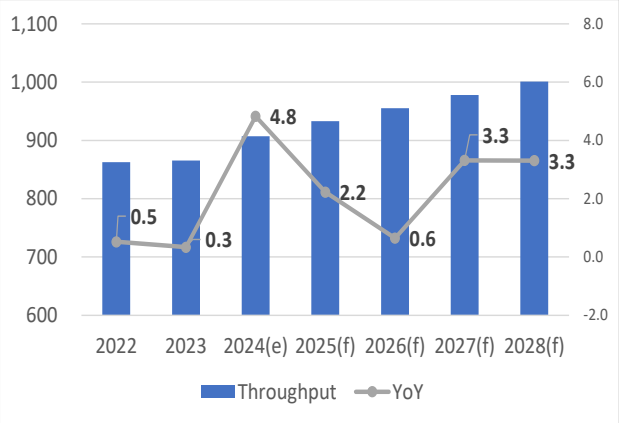
2.3. Container Port traffic and port services

2.3.1. Container Port Throughput

2.3.1.1. Trends in Container Port Throughput[5] by Country in the Asia-Pacific

Global container port throughput declined due to COVID-19 but rebounded in 2021 and has since maintained steady growth. From 857,622 thousand TEU in 2021 to 865,464 thousand TEU in 2023, global container port throughput has shown a modest growth rate of less than 1 percent. However, in 2024, it is expected to increase by 4.8 percent YoY to 907,345 thousand TEU, driven by economic improvements in major economies, particularly the United States of America and China. Additionally, from 2024 to 2028, the annual average growth rate is projected to be 2.5 percent, with container port throughput surpassing 1 billion TEU by 2028 (Drewry, 2024).

Figure 2-34: Global container port throughput (million tons, %)



Source: Compiled and analyzed by KMI based on Drewry Data

Container throughput in the Asia-Pacific region increased from 494,156 thousand TEU in 2020 to 549,701 thousand TEU in 2023 and is expected to reach 566,159 thousand TEU in 2024. The region consistently accounted for over 61 percent of global container port throughput from 2020 to 2024. However, due to the expansion of global trade wars and protectionism, its share is projected to decline slightly to 62.4 percent in 2024.

Table 2-23: Global and Asia-Pacific Country Container Port Throughput and Share (thousand TEU)

Classification	2020	2021	2022	2023	2024e
World	801,293	857,622	862,626	865,464	907,345
Asia-Pacific	494,156	525,987	532,816	549,701(E)	566,159
Asia-Pacific Share among the World	61.7%	61.3%	61.8%	63.5%	62.4%

Source: 1) Global container port throughput: Drewry, Container Forecaster Single Issue Q3 2024, 2024. 2)Asia-Pacific container port throughput: Based on UNCTAD statistics up to 2022, with 2023–2024 figures estimated (e) by KMI.

As of 2024, China ranked first in port container throughput in the Asia-Pacific region, recording a 4.2 percent YoY increase and maintaining an average annual growth rate of 5.0 percent since 2020. Singapore and the Republic of Korea ranked second and third, respectively, followed by Malaysia in fourth place and Viet Nam in fifth.

By region, ENEA countries, led by China, continue to dominate, while SEA is also experiencing steady growth, driven by Singapore, Malaysia, and Viet Nam. Notably, Viet Nam recorded a significant 47.2 percent growth compared to 2020, ranking fifth, while India followed in seventh place.

[5] Container port throughput refers to the total volume handled at ports, including exports, imports, transshipment, and empty containers. It is distinct from seaborne trade volume and is generally much larger than seaborne container trade volume.

In 2024, the top 10 countries accounted for nearly 90 percent of the total container throughput in the Asia-Pacific region, highlighting a significant imbalance with lower-ranking countries. Some Southeast Asian nations, such as Myanmar and Cambodia, as well as Pacific Islands countries, still handle less than 1 million TEU annually.

Table 2-24: Top 10 Asia-Pacific countries by container port throughput (thousand TEU)

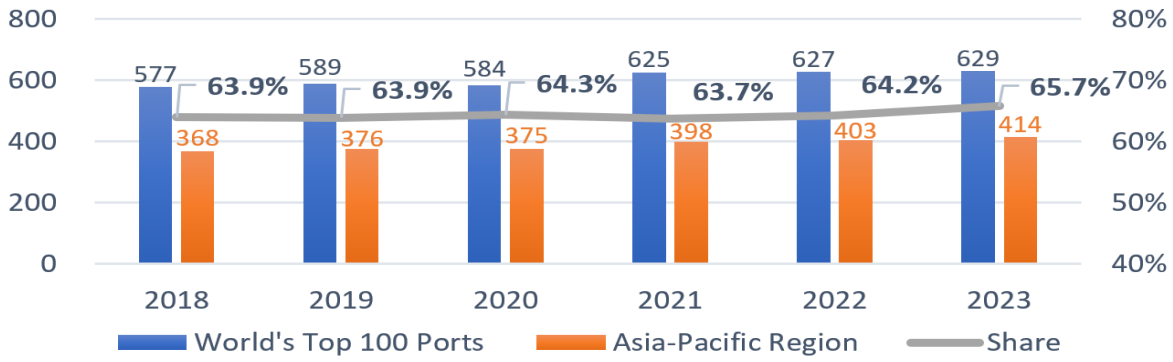
Rank		Country and Sub-Region		Year				
'24	'23	Country	Sub-Region	2020	2021	2022	2023e	2024e
1	(1)	China	ENEA	240,480	256,946	268,990	280,179	291,833
2	(2)	Singapore	SEA	36,871	37,571	37,290	37,735	38,186
3	(3)	Republic of Korea	ENEA	28,834	29,787	28,502	29,141	29,794
4	(4)	Malaysia	SEA	26,669	28,262	27,294	28,104	28,938
5	(6)	Viet Nam	SEA	16,395	19,821	20,519	22,256	24,141
6	(5)	Japan	ENEA	21,569	22,354	22,516	22,594	22,673
7	(7)	India	SSWA	17,597	19,562	19,717	20,561	21,442
8	(8)	Hong Kong, China	ENEA	17,953	17,772	16,573	16,357	16,143
9	(10)	Indonesia	SEA	11,674	12,911	12,381	12,615	12,854
10	(9)	Türkiye	SSWA	11,627	12,591	12,366	12,796	11,917

Source: Container port throughput for 2023 and 2024 is based on UNCTAD statistics, with both years' figures estimated (e) by KMI.

2.3.1.2. Current Status of Container Throughput at Major Ports in the Asia-Pacific[6]

The total container throughput of the world's top 100 container ports increased from 576,567 thousand TEU in 2018 to 629,476 thousand TEU in 2023. Among them, ports in the Asia-Pacific region saw an increase in throughput from 368,368 thousand TEU in 2018 to 413,678 thousand TEU in 2023.

Figure 2-35: Container Port Cargo Volume in the World's Top 100 Ports (million TEU)



Source: Compiled and analyzed by KMI based on (ISL, 2024)

[6] Based on the 2023 container port throughput statistics published by the institute of shipping economics and logistics (ISL), figures may differ from those reported by individual port authorities.

The share of Asia-Pacific ports in the total throughput of the top 100 ports rose from 63.9 percent in 2018 to 65.7 percent in 2023, an increase of 1.8 percentage points. Notably, even during the COVID-19 pandemic, in 2020, the region maintained a high share of 64.3 percent. Although it slightly declined to 63.7 percent in 2021, it has been on a steady upward trend, reaching 65.7 percent in 2023, the highest in the last six years. This trend highlights the growing importance of major Asia-Pacific ports in the global supply chain.

As of 2023, the Asia-Pacific region included a total of 41 ports across 16 countries among the world's top 100 container ports. In terms of rankings, Shanghai Port recorded 49,158 thousand TEU, securing first place, followed by Singapore Port with 39,013 thousand TEU in second place and Ningbo-Zhoushan Port with 35,180 thousand TEU in third place. Shenzhen Port and Qingdao Port ranked fourth and fifth, handling 30,120 thousand TEU and 28,430 thousand TEU, respectively.

Among the top 10 ports, seven were in China, one in the Republic of Korea and one in Singapore, highlighting North-East Asia's dominance. Significantly, Viet Nam's Saigon New Port, jumped from 40th place in the previous year to 26th. The Republic of Korea's Incheon Port moved up from 50th to 43rd place, and Türkiye's Ambarli Port rose from 57th to 48th place. In contrast, Hong Kong Port experienced a decrease in throughput, falling from 9th to 10th place.

By region, North-East Asia accounted for 65.7 percent of the total, holding the highest share, driven by the strong performance of the Shanghai, Ningbo-Zhoushan and Shenzhen ports in China, along with the stable throughput of the Republic of Korea and Japan. SEA accounted for 25.7 percent, led by Singapore Port, Port Klang and Tanjung Pelepas, with continuous growth in Vietnamese ports being particularly notable. SSWA, including India's Jawaharlal Nehru Port and Chennai Port, and major Turkish ports, contributed 6.8 percent, while the Pacific region, led by Melbourne, Sydney and Brisbane, accounted for 1.8 percent.

Analyzing the characteristics of each region:

- North-East Asia increased from 258.7 million TEU in 2022 to 266.1 million TEU in 2023, marking a 2.9 percent increase, driven by the growth of major Chinese ports. Tianjin Port recorded a high growth rate of 11.9 percent, while Hong Kong Port saw a 13.7 percent decrease, showing a significant decline.

- SEA increased from 99.66 million TEU in 2022 to 104 million TEU in 2023, a 4.4 percent increase, attributed to the steady growth of Singapore and Malaysia, and the continuous increase in Viet Nam's throughput.

- SSWA grew from 26.8 million TEU in 2022 to 27.5 million TEU in 2023, a 2.6 percent increase, the highest growth rate among the regions, driven by the expansion of Indian and Sri Lankan ports.

- The Pacific region declined from 7.5 million TEU in 2022 to 7.2 million TEU in 2023, marking a 3.6 percent decrease. While Sydney and Brisbane Ports have maintained stable trends over the last five years, Melbourne Port saw a significant 8.9 percent decline.

Table 2-25: Asia-Pacific Container Ports in the World's Top 100 Ports (thousand TEU)

Rank		Port, Country and Sub-Region			Year				
'23	'22	Port	Country	Sub-Region	2019	2020	2021	2022	2023
1	(1)	Shanghai	China	ENEA	43,308	43,503	47,033	47,303	49,158
2	(2)	Singapore	Singapore	SEA	37,196	36,871	37,468	37,290	39,013
3	(3)	Ningbo-Zhoushan	China	ENEA	27,451	28,709	31,077	33,350	35,180
4	(4)	Shenzhen	China	ENEA	25,548	26,548	28,770	30,040	30,120
5	(5)	Qingdao	China	ENEA	21,010	22,010	23,700	25,670	28,430
6	(6)	Guangzhou	China	ENEA	22,747	23,186	24,180	24,590	25,090
7	(7)	Busan	Republic of Korea	ENEA	21,992	21,824	22,706	22,078	22,550
8	(8)	Tianjin	China	ENEA	17,264	18,351	20,200	19,830	22,180
10	(9)	Hong Kong	Hong Kong, China	ENEA	18,303	17,969	17,798	16,685	14,401
11	(13)	Port Kelang	Malaysia	SEA	13,581	13,244	13,724	13,224	14,061
13	(14)	Xiamen	China	ENEA	11,081	11,463	12,028	12,430	12,600
15	(15)	Tanjung Pelepas	Malaysia	SEA	9,077	9,846	11,200	10,513	10,481
16	(20)	Laem Chabang	Thailand	SEA	7,981	7,598	8,335	8,730	8,866
20	(21)	Saigon Port	Viet Nam	SEA	7,554	7,906	7,952	8,397	8,314
24	(24)	Tanjung Priok	Indonesia	SEA	5,560	6,205	6,750	6,417	6,616
25	(25)	Jawaharlal Nehru	India	SSWA	5,031	4,677	5,685	6,051	6,465
26	(40)	Saigon New Port	Viet Nam	SEA	3,743	4,410	4,794	3,966	5,483
27	(27)	Manila	Philippines	SEA	5,316	4,434	4,976	5,467	5,202
35	(36)	Dalian	China	ENEA	8,760	5,110	3,670	4,460	4,620
36	(31)	Tokyo	Japan	ENEA	4,682	4,262	4,863	4,932	4,571
37	(37)	Hai Phong	Viet Nam	SEA	3,484	3,739	3,759	4,341	4,517
43	(50)	Inchon	Republic of Korea	ENEA	3,085	3,249	3,354	3,192	3,459
48	(57)	Ambarli	Türkiye	SSWA	3,105	2,888	2,943	2,867	3,170
51	(54)	Yokohama	Japan	ENEA	2,994	2,662	2,861	2,980	3,021
52	(49)	Chittagong	Bangladesh	SSWA	3,038	2,840	3,097	3,255	3,007
54	(51)	Melbourne	Australia	The Pacific	2,700	3,104	3,233	3,188	2,903
55	(55)	Kobe	Japan	ENEA	2,872	2,647	2,824	2,891	2,835
59	(61)	Sydney Ports	Australia	The Pacific	2,471	2,704	2,797	2,726	2,724
60	(62)	Nagoya	Japan	ENEA	2,844	2,471	2,726	2,680	2,698
68	(70)	Izmit (Kocaeli)	Türkiye	SSWA	1,715	1,801	1,968	2,059	2,159
71	(69)	Karachi	Pakistan	SSWA	2,237	1,992	2,335	2,086	2,047
73	(68)	Osaka	Japan	ENEA	2,130	2,060	2,128	2,130	2,010
74	(79)	Chennai	India	SSWA	1,384	1,387	1,602	1,852	1,996
75	(74)	Icel (Mersin)	Türkiye	SSWA	1,854	1,949	2,107	1,990	1,942
79	(78)	Gwangyang	Republic of Korea	ENEA	2,378	2,151	2,125	1,864	1,832
81	(92)	Colombo	Sri Lanka	SSWA	1,982	1,613	1,643	1,499	1,765
83	(82)	Tekirdag	Türkiye	SSWA	1,414	1,444	1,812	1,773	1,701
85	(77)	Bandar Abbas	Iran	SSWA	1,382	1,010	1,687	1,910	1,691
88	(93)	Aliaga	Türkiye	SSWA	1,132	1,276	1,389	1,494	1,586
90	(89)	Brisbane	Australia	The Pacific	1,342	1,304	1,470	1,557	1,578
98	(100)	Penang	Malaysia	SEA	1,493	1,388	1,248	1,319	1,444
99	(88)	Qinhuangdao	China	ENEA	1,166	1,345	1,495	1,599	1,385

Source: Compiled and analyzed by KMI based on (ISL, 2024)

2.3.2. Port service indicators: Berth productivity

2.3.2.1. Berth Productivity Overview

Minimizing berth congestion time and ensuring swift cargo handling operations are crucial factors in enhancing port competitiveness and improving service quality. With the recent increase in the size of vessels and growing influence of shipping companies, the importance of port services has been further emphasized. Consequently, the need for objective indicators to assess port service levels has emerged.

The KMI has developed six key indicators to measure port service levels, which are average waiting time, port connectivity index, berth productivity, net berth productivity, average container throughput and average vessel size index. These indicators are published on a quarterly and annual basis. Chapter 2 analyses berth productivity in major countries and ports in the Asia-Pacific region for the year 2023.

(times/hour)

Berth productivity refers to the number of container loading and unloading operations performed per unit of berth time. It is calculated by dividing the total number of loading and unloading operations by the total berth time. A higher berth productivity index indicates faster container cargo handling, making it a key metric for assessing the efficiency of port operations.

$$BP(k) = \frac{\sum_{i=1}^{n} \frac{CM_i}{ST_i}}{n}$$

$BP(k)$ = Berth Productivity in Port k
i = Number of Container Ships ($i = 1,2,3,\cdots,n$)
ST_i = Loading and Unloading Times for Container Ship i
CM_i = Total Container Workload Handled on Container Ship i (Moves)
k = Container Ports ($k = 1,2,3,\cdots,m$)

2.3.2.2. Berth Productivity by region

In 2023, global berth productivity reached 64.2 moves per hour, marking a 2.1 percent increase compared with the previous year. A detailed regional analysis revealed that North Asia recorded 82.7 moves per hour, reflecting an 8.2 percent YoY growth, the highest growth rate among all regions, securing the top position. North Asia maintained its leading position for five consecutive years from 2019 to 2023, consistently demonstrating high productivity. This trend can be attributed to the introduction of automated terminals and the establishment of specialized handling systems for large vessels at major ports such as Tianjin Port and Qingdao Port. Following North Asia, South Asia/SEA ranked second with 68.0 moves per hour, while the Middle East/Africa region ranked third with 59.0 moves per hour.

2.3.2.3. Berth Productivity by Country

Among the top 100 countries in berth productivity by vessel type in 2023, 23 countries from the Asia-Pacific region were included. China recorded the highest productivity among Asia-Pacific countries, with 94.9 moves per hour, marking a 10.4 percent YoY increase, the largest growth among all countries. Notably, China moved up from fourth place in the previous year to third place, while India, with 83.6 moves per hour, dropped from third to fourth place. Singapore improved its ranking from seventh to fifth place, achieving 82.2 moves per hour, continuing to compete among the top-performing ports.

Below is a summary of countries with notable ranking changes:

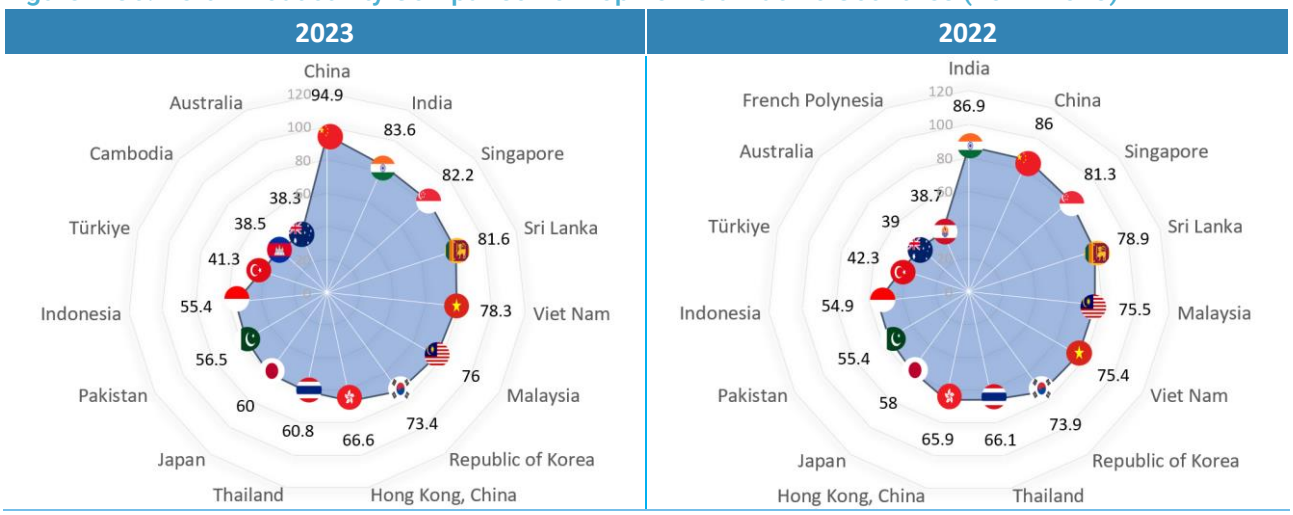
- Thailand fell from 14th to 21st place, recording 60.8 moves per hour.
- The Russian Federation saw a significant decline, with productivity dropping 15.6 percent YoY to 26.3 moves per hour, causing its rank to plummet from 77th to 92nd place.
- Newly entering the rankings this year were Cambodia (55th, 38.5 moves per hour), New Caledonia (83rd, 28.7 moves per hour), and Myanmar (90th, 26.5 moves per hour).

Table 2-26 Asia-Pacific Countries in the Top 100 Countries for Berth Productivity (times/hour)

Rank		Country and Sub-Region		Year				
'23	'22	Country	Sub-Region	2019	2020	2021	2022	2023
3	(4)	China	ENEA	96.0	87.6	89.0	86.0	94.9
4	(3)	India	SSWA	83.5	80.8	87.0	86.9	83.6
5	(7)	Singapore	SEA	87.0	85.7	77.9	81.3	82.2
7	(8)	Sri Lanka	SSWA	87.1	80.8	79.4	78.9	81.6
10	(10)	Viet Nam	SEA	66.4	73.9	74.4	75.4	78.3
11	(9)	Malaysia	SEA	78.2	76.7	72.1	75.5	76.0
12	(11)	Republic of Korea	ENEA	86.5	77.5	71.8	73.9	73.4
15	(16)	Hong Kong, China	ENEA	73.4	74.4	65.9	65.9	66.6
21	(14)	Thailand	SEA	70.8	64.3	61.0	66.1	60.8
23	(25)	Japan	ENEA	69.0	66.9	61.5	58.0	60.0
30	(28)	Pakistan	SSWA	67.9	63.1	60.9	55.4	56.5
32	(30)	Indonesia	SEA	54.8	56.1	55.3	54.9	55.4
50	(50)	Türkiye	SSWA	51.2	49.1	45.0	42.3	41.3
55	-	Cambodia	SEA	-	-	-	-	38.5
56	(55)	Australia	The Pacific	43.5	42.2	40.6	39.0	38.3
60	(62)	Philippines	SEA	54.3	42.5	35.1	37.2	38.1
66	(58)	French Polynesia	The Pacific	-	-	-	38.7	36.8
72	(59)	New Zealand	The Pacific	50.8	42.7	35.7	37.7	35.0
83	-	New Caledonia	The Pacific	-	-	38.1	-	28.7
89	(92)	Georgia	NCA	25.8	28.0	28.3	25.2	26.6
90	-	Myanmar	SEA	-	-	-	-	26.5
91	(94)	Bangladesh	SSWA	23.3	24.5	25.1	24.3	26.3
92	(77)	Russian Federation	NCA	29.8	32.7	32.6	31.1	26.3

Source: Compiled and analyzed by KMI based on S&P Global data

Figure 2-36: Berth Productivity Comparison of Top 15 Asia-Pacific Countries (2022-2023)



Source: Visualized by KMI

2.3.2.4. Berth Productivity by Port

Among the top 100 ports globally in berth productivity by vessel type in 2023, 46 ports from the Asia-Pacific region were included.

Qingdao Port in China recorded the highest productivity among Asia-Pacific ports, with 113.6 moves per hour, making a significant jump from tenth place last year to second place. Tianjin Port (112.4 moves per hour) and Shanghai Port (110.5 moves per hour) ranked third and fourth, respectively, leading the top-tier ports.

Cai Mep Port in Viet Nam, the country's leading port, achieved 109.1 moves per hour, reflecting a 4.5 percent YoY increase. Despite its strong performance, its ranking dropped from second place last year to fifth, owing to the sharp increase in productivity at major Chinese ports.

From a growth perspective:

- Chiwan ort in China saw the largest improvement, with a 38.4 percent year-on-year increase, jumping from 123rd to 57th place.
- Dachan Bay Port also experienced a significant rise, increasing 35.1 percent, moving from 65th to 23rd place.
- Fuzhou Port (28.9 percent) and Dalian Port (28.3 percent) also recorded high growth rates.

Conversely:

- Hazira Port in India saw a 16.5 percent decline, recording 69.7 moves per hour, dropping significantly from 17th to 41st place.
- Karachi Port in Pakistan experienced an 8.6 percent decrease, falling from 51st to 76th place.
- Among the Republic of Korea's key ports, Busan Port recorded 74.9 moves per hour, a slight 0.8 percent decline from the previous year. Gwangyang Port increased by 8.1 percent, reaching 69.1 moves per hour.

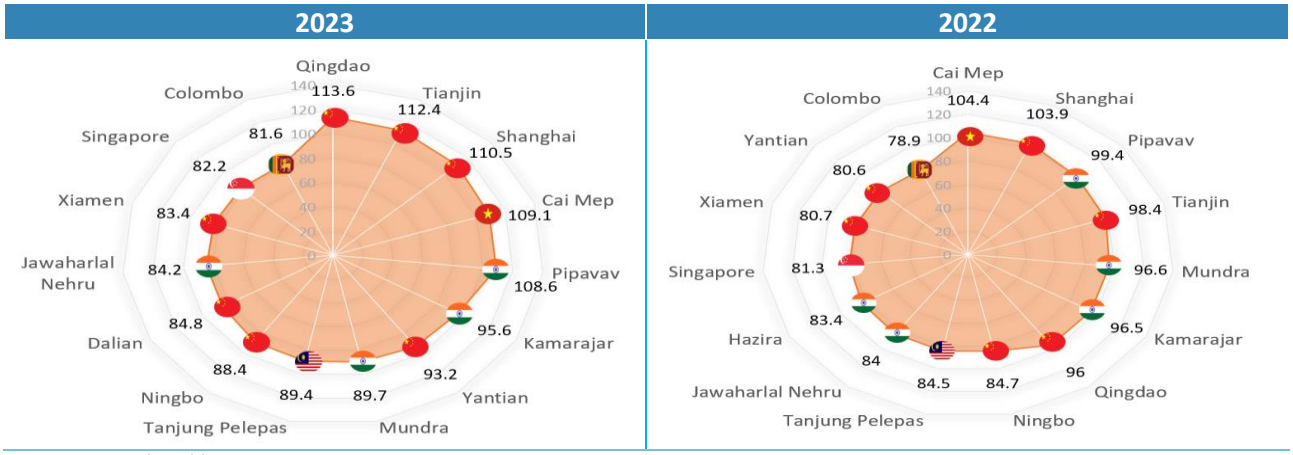
Table 2-27: Asia-Pacific Ports in the Top 100 Countries for Berth Productivity (times/hour)

Rank		Port, Country and Sub-Region			Year				
'23	'22	Port	Country	Sub-Region	2019	2020	2021	2022	2023
2	(10)	Qingdao	China	ENEA	107.3	108.2	97.6	96.0	113.6
3	(7)	Tianjin	China	ENEA	110.3	111.6	100.4	98.4	112.4
4	(3)	Shanghai	China	ENEA	107.3	96.7	108.2	103.9	110.5
5	(2)	Cai Mep	Viet Nam	SEA	92.8	94.2	99.9	104.4	109.1
6	(5)	Pipavav	India	SSWA	-	-	103.2	99.4	108.6
9	(9)	Kamarajar	India	SSWA	-	-	80.6	96.5	95.6
11	(21)	Yantian	China	ENEA	91.1	79.8	78.6	80.6	93.2
12	(8)	Mundra	India	SSWA	-	107.1	95.8	96.6	89.7
13	(14)	Tanjung Pelepas	Malaysia	SEA	89.4	85.1	79.3	84.5	89.4
14	(13)	Ningbo	China	ENEA	92.0	87.2	93.1	84.7	88.4
17	(38)	Dalian	China	ENEA	76.3	75.3	62.6	66.1	84.8
18	(15)	Jawaharlal Nehru	India	SSWA	87.8	80.1	87.1	84.0	84.2
19	(20)	Xiamen	China	ENEA	87.9	79.5	75.0	80.7	83.4
20	(19)	Singapore	Singapore	SEA	87.0	85.7	77.9	81.3	82.2
22	(22)	Colombo	Sri Lanka	SSWA	87.1	80.8	79.4	78.9	81.6
23	(65)	Dachan Bay	China	ENEA	-	-	43.5	59.4	80.3
24	(35)	Mawan	China	ENEA	103.8	79.9	73.8	69.9	80.2

29	(36)	Guangzhou	China	ENEA	97.7	82.1	76.9	69.9	77.9
30	(25)	Cat Lai	Viet Nam	SEA	67.4	68.1	69.2	76.1	77.1
32	(26)	Busan	Republic of Korea	ENEA	89.6	79.4	72.9	75.5	74.9
34	(34)	Visakhapatnam	India	SSWA	-	-	-	70.2	72.0
35	(59)	Zhoushan	China	ENEA	67.9	63.0	60.9	60.7	71.9
36	(79)	Fuzhou	China	ENEA	71.3	63.6	60.7	55.3	71.2
39	(40)	Yokohama	Japan	ENEA	95.0	85.6	69.0	66.0	70.1
41	(17)	Hazira	India	SSWA	-	-	-	83.4	69.7
42	(33)	Chennai	India	SSWA	72.6	-	70.9	71.3	69.5
43	(29)	Laem Chabang	Thailand	SEA	76.3	73.9	69.4	73.1	69.2
44	(47)	Gwangyang	Republic of Korea	ENEA	76.2	72.4	65.8	63.9	69.1
47	(42)	Hong Kong	Hong Kong, China	ENEA	73.4	74.4	65.9	65.9	66.6
49	(46)	Kattupalli	India	SSWA	-	-	-	64.0	66.5
56	(58)	Port Kelang	Malaysia	SEA	56.3	60.8	60.2	60.7	64.0
57	(123)	Chiwan	China	ENEA	66.1	63.1	48.8	46.2	63.9
58	(52)	Tajung Priok	Indonesia	SEA	62.9	61.4	61.3	61.8	63.8
60	(56)	Kobe	Japan	ENEA	64.5	65.7	64.2	60.8	63.4
61	(80)	Shekou	China	ENEA	54.8	63.5	59.2	55.0	62.0
67	(84)	Hakata	Japan	ENEA	57.4	53.9	58.3	54.4	59.8
69	(68)	Inchon	Republic of Korea	ENEA	58.4	59.1	61.3	57.8	59.3
76	(51)	Karachi	Pakistan	SSWA	75.5	71.7	66.5	62.7	57.4
78	(111)	Tanjung Perak	Indonesia	SEA	50.7	52.3	51.9	48.7	57.2
83	(73)	Tokyo	Japan	ENEA	66.5	66.6	60.7	56.6	56.2
84	(83)	Nagoya	Japan	ENEA	59.6	60.1	59.8	54.4	56.2
86	(69)	Diliskelesi	Türkiye	SSWA	65.3	67.0	59.2	57.7	56.1
87	(95)	Muhammad bin Qasim	Pakistan	SSWA	-	48.9	55.6	51.2	56.0
95	(110)	Hai Phong	Viet Nam	SEA	35.9	44.4	43.3	48.9	53.0
98	(113)	Gemlik	Türkiye	SSWA	58.7	56.8	45.5	48.1	52.8
100	(124)	Saigon Port	Viet Nam	SEA	42.9	-	-	46.1	52.0

Source: Compiled and analyzed by KMI based on S&P Global data

Figure 2-37: Berth Productivity Comparison of Top 15 Asia-Pacific Ports (2022-2023)



Source: Visualized by KMI

2.4. Outlook Summary for shipping and ports in the Asia-Pacific region

In 2024, the global economy recorded a growth rate of 3.3 percent, while the Asia-Pacific region is expected to maintain a solid growth rate of 4.0 percent, playing a pivotal role in driving the global economy. From a trade perspective, the Asia-Pacific region accounted for 40.7 percent of global merchandise trade (in terms of exports), further solidifying its position as a key pillar of the global supply chain. However, the intensification of protectionist trade policies and the restructuring of global supply chains have added uncertainties to the region's trade environment.

Within the Asia-Pacific region, different subregions exhibit distinct economic characteristics:

- ENEA, which includes economic powerhouses such as China, Japan, and the Republic of Korea, is characterized by high trade volumes and advanced technology industries.
- SEA consists of rapidly growing emerging economies.
- SSWA, centered around India, boasts a large market and abundant labor force.
- NCA is distinguished by its rich natural resources.
- PACIFIC, composed of small island nations, faces unique economic challenges and opportunities.

The global maritime trade volume is expected to recover in 2024 and continue its growth trend into 2025.

- However, in the container market, an oversupply of new vessels is anticipated to drive freight rates downward in 2025. Geopolitical uncertainties and strengthening protectionist policies may partially offset these effects. Additionally, ongoing alliance restructuring in the container shipping sector requires close monitoring.
- The dry bulk market in 2025 is likely to be influenced by the scale and direction of economic stimulus measures implemented by major economies. Key factors affecting this sector include: An increase in vessel scrapping due to stricter environmental regulations, A slowdown in raw material demand, The tightening of trade barriers in certain industries.
- In the tanker market, fluctuations are expected based on: Policy shifts among major oil-producing countries, A recovery in oil consumption, The impact of environmental regulations, geopolitical risks, and financial market changes.

As a result, the 2025 maritime market is expected to develop through a complex interplay of factors, including container vessel oversupply, the potential recovery of raw material demand for dry bulk carriers and shifts in trade patterns for tankers. Geopolitical risks, protectionist trade policies and environmental regulations will continue to be key drivers of market volatility. This underscores the importance of strategic responses by shipping companies and related industries in adapting to market changes across different vessel segments.

In 2024, the export and import maritime trade volume of Asia-Pacific countries accounted for approximately 54 percent of the total global maritime trade. An analysis of maritime trade flows in the region reveals significant disparities based on economic power. These differences stem from various factors, including economic size, industrial structure, trade policies and geographical location.

- ENEA countries, such as China, Japan, and the Republic of Korea, exhibit high maritime trade volumes, supported by large-scale manufacturing and advanced technology industries.
- In contrast, small island nations in the Pacific region show relatively low trade volumes, reflecting regional economic imbalances and underscoring the need for greater regional cooperation.
- Economically powerful countries benefit from advanced port infrastructure and efficient logistics systems, securing a strong position in global trade.
- However, smaller economies often face challenges in maritime trade due to infrastructure deficits and geographical constraints.

Ports in the Asia-Pacific region maintain high competitiveness in container handling and port services. As of 2024, six countries in the Asia-Pacific region – China, the Republic of Korea, Singapore, Malaysia, Japan and Viet Nam – are among the world's top 10 in the LSCI, demonstrating excellence in container shipping networks. In container port throughput, Asia-Pacific ports handled a total of 566 million TEUs, accounting for over 62 percent of global container port throughput. China, Singapore and Malaysia have notably enhanced their productivity.

Despite these strengths, several structural challenges are emerging in the maritime and port industries:

- Growing regional disparities: North-East and South-East Asia dominate maritime trade volumes, whereas Pacific Islands countries and South Asia exhibit relatively low trade volumes and weak maritime connectivity. This disparity goes beyond trade volumes, potentially leading to broader economic development imbalances across the region.

- Environmental regulations and climate change: Stricter environmental regulations are demanding structural changes in the shipping and port sectors. Ports must strengthen resilience against natural disasters linked to climate change.

- Accelerated digital transformation: Automation, smart ports and digital shipping technologies offer new opportunities but also pose risks. The technology gap between ports and regions is widening, requiring policy support for small and medium-sized ports to remain competitive. Workforce challenges in the maritime and port industries are also emerging owing to digitalization.

Addressing these challenges requires close cooperation between governments, port authorities, shipping companies and international organizations. International organizations such must take the lead in coordinating and facilitating regional cooperation. In the long term, the Asia-Pacific shipping and port industries should aim for qualitative growth through sustainability and digitalization while promoting balanced regional development and resilience enhancement to establish a foundation for sustainable growth.

The next chapter will explore various strategies at international and regional levels to tackle these challenges.

CHAPTER 3

TRANSFORMING MARITIME TRANSPORT IN ASIA-PACIFIC: Decarbonization and sustainability challenges

3. TRANSFORMING MARITIME TRANSPORT IN ASIA-PACIFIC: Decarbonization and sustainability challenges

3.1. Sustainability: Maritime Decarbonization

3.1.1. Global Regulations and Cooperation Trends in Maritime Decarbonization

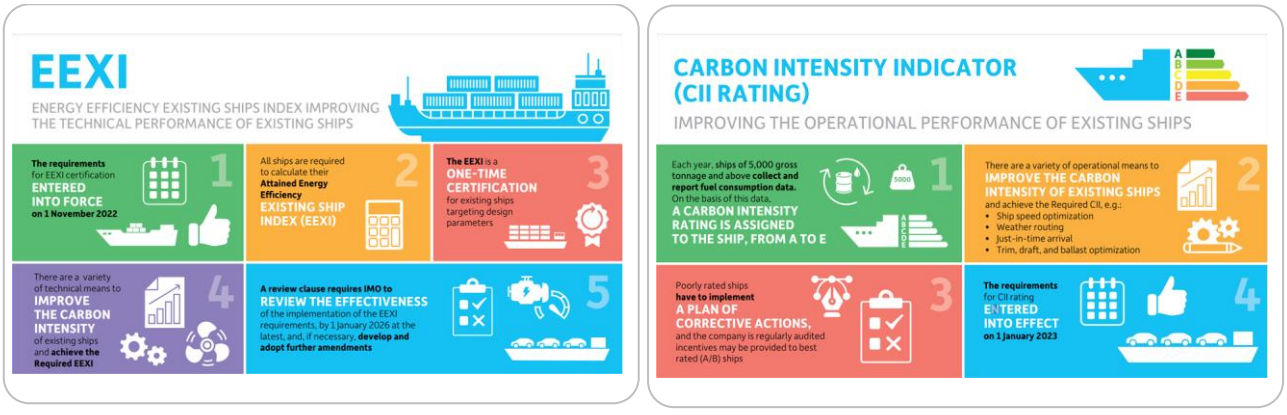
3.1.1.1. IMO's Regulatory and Response Trends on Maritime Decarbonization

The International Maritime Organization (IMO) is leading greenhouse gas (GHG) reduction efforts in the shipping sector. In 2018, the IMO adopted the Initial IMO GHG Strategy and later amended MARPOL Annex VI at the 76th Marine Environment Protection Committee (MEPC 76) to introduce short-term GHG reduction measures aimed at lowering the carbon intensity of international shipping. As a result, from 1 January 2023, ships are required to comply with measures aimed at reducing GHG emissions through improved energy efficiency, specifically through the Energy Efficiency Existing Ship Index (EEXI) and the Carbon Intensity Indicator (CII).

The EEXI applies to ships of 400 GT or more and affected vessels must comply with EEXI by their first survey after 1 January 2023. Compliance includes obtaining an International Energy Efficiency Certificate (IEEC), which must be kept onboard. The EEXI benchmark is based on the average energy efficiency of ships built between 1999 and 2009, with a 20 percent reduction target by 2024 and a 30 percent reduction from 2025 onwards.

The CII applies to ships of 5,000 GT or more and categorizes ships into five ratings, from A (Excellent) to E (Poor). Vessels rated D for three consecutive years or E for one year must submit a corrective action plan to achieve at least a C rating.

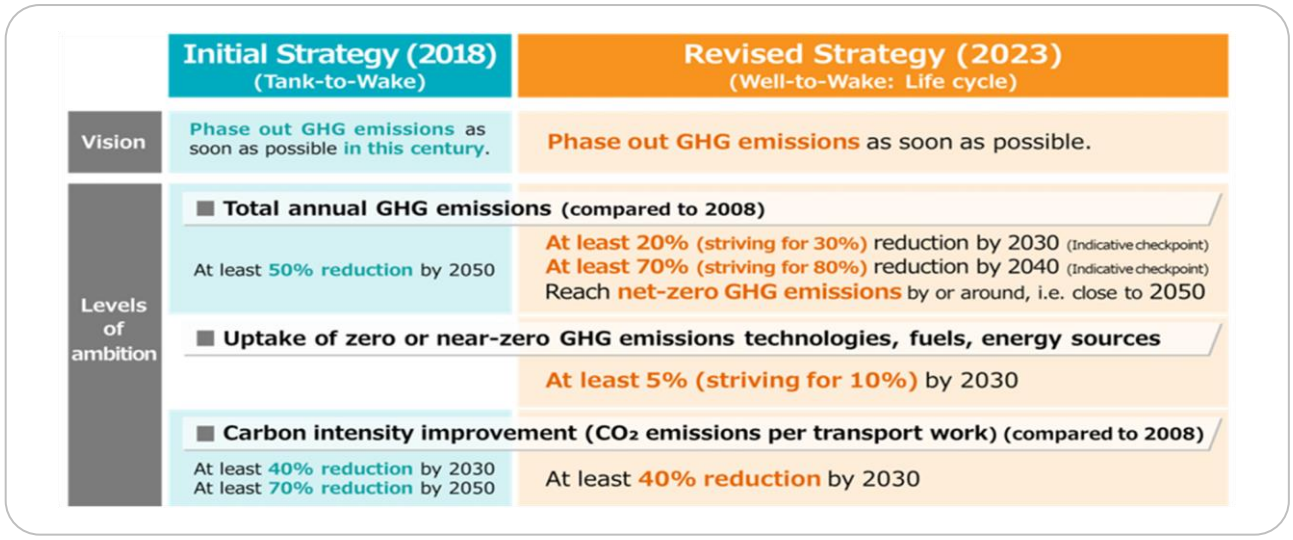
Figure 3-1: IMO Strategy on Reduction of GHG Emissions from Ships-EEXI and CII



Source: (IMO)

At MEPC 80 in 2023, the IMO adopted the 2023 IMO GHG Strategy, increasing the 2050 emission reduction target from the previous 50 percent cut (compared to 2008 levels) to a net-zero goal.

Figure 3-2: Comparison of Initial and Revises IMO GHG Strategy



Source: (ClassNK, 2023)

As part of its mid-term GHG reduction strategy, IMO decided to develop a combined approach, consisting of a goal-based fuel standard (technical measure) and a GHG pricing mechanism (economic measure).

The Green Fuel Standard (GFS) aims to establish fuel-based emission reduction targets, encouraging the adoption of alternative and low-carbon fuels in the maritime sector.

Meanwhile, the GHG Levy would introduce a carbon pricing mechanism for ships of 5,000 GT or more, applying fees on CO_2, CH_4, and N_2O emissions to incentivize emission reductions.

Both measures are designed to support IMO's net-zero emissions target by 2050, with finalization expected by 2025 and enforcement by 2027, aiming to accelerate the energy transition in global shipping, ensure an equitable transition, and provide necessary incentives. A special committee will assess the comprehensive effects and potential impacts of these measures while considering the diverse situations of IMO member states.

Table 3-1: GHG Regulations of IMO

Regulation	Applied to	WtW or TtW	GHG covered	Impacts
EEDI	>=400 GT from 2013	TtW	CO2	Pass or Fail
EEXI	>=400 GT in 2023	TtW	CO2	Pass or Fail
DCS	>=5,000 GT from 2019	TtW	CO2	Monitoring
CII	>=5,000 GT from 2023	TtW	CO2	Corrective Actions
GHG LEVY (Proposed)	>=5,000 GT from 2027	WtW or TtW	CO2, CH4, N2O	Financial
GFS (Proposed)	>=5,000 GT from 2027	WtW or TtW	CO2, CH4, N2O	Financial

Source: Korean Register (KR)

3.1.1.2. Integration of International Shipping into the EU ETS and FuelEU Maritime Initiative

From 2024, the European Union Emissions Trading System (EU ETS) will expand to include the international shipping sector, requiring 5,000 GT vessels or more calling at EU and EEA member state ports to monitor, report, and submit allowances for their greenhouse gas (GHG) emissions annually. This requirement applies regardless of a ship's flag state, making it a significant regulatory step toward decarbonizing global maritime transport (EU, 2024).

The first monitoring period will cover January 1 to December 31, 2024, with companies required to submit emissions reports by March 31, 2025, and surrender emission allowances by September 30, 2025. The scope of emissions covered under EU ETS depends on voyage type:

- 100 percent of emissions from voyages between an EU/EEA ports or within an EU/EEA port fall under the system.
- 50 percent of emissions from voyages between an EU/EEA port and a non-EU/EEA port are also covered.

The regulation will gradually expand in both GHG coverage and allowance submission requirements. Initially, only carbon dioxide (CO_2) emissions will be regulated, but from 2026, methane (CH_4) and nitrous oxide (N_2O) will also be included. Additionally, the percentage of required allowances will increase over time:

- 40 percent of CO_2 emissions in 2024
- 70 percent of CO_2 emissions in 2025
- 100 percent of all GHG emissions from 2026 onward

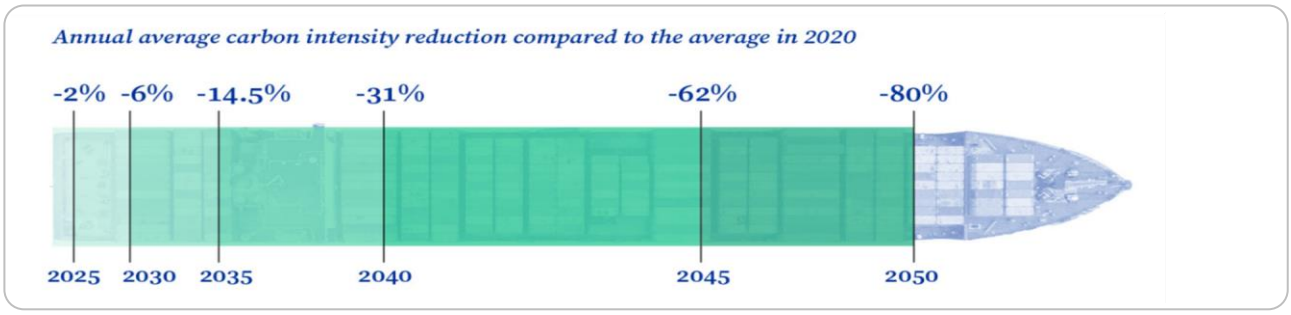
Figure 3-3: EU ETS Extension to Maritime Transport - Introduction Timeline

Source: (EU, 2024)

In 2023, the European Union also adopted the FuelEU Maritime Initiative to accelerate decarbonization in the shipping sector by promoting the use of low-carbon fuels and clean energy.

This regulation applies to all vessels of 5,000 GT or more calling at EU ports, regardless of flag state, and sets maximum limits on the annual average GHG intensity of the energy used by ships. The GHG reduction targets begin with a 2 percent reduction by 2025 compared to 2020 levels, increasing every five years to reach an 80 percent reduction by 2050 (EU, 2023).

Figure 3-4: Annual average carbon intensity reduction goal of FuelEU Maritime Initiative



Source: (EU, 2023).

To further reduce air pollution in ports, passenger ships and container vessels over 5,000 GT must use Onshore Power Supply (OPS) or zero-emission alternatives while at berth in designated ports from 2030 and in all EU ports with OPS infrastructure from 2035. The EU has established compliance mechanisms to ensure effective implementation. Shipowners must obtain a FuelEU Certificate and comply with annual GHG emissions monitoring and reporting requirements. Non-compliance will result in financial penalties, while companies that exceed reduction targets will receive incentives. This system is designed to encourage voluntary participation from the shipping industry while ensuring regulatory effectiveness in achieving decarbonization goals.

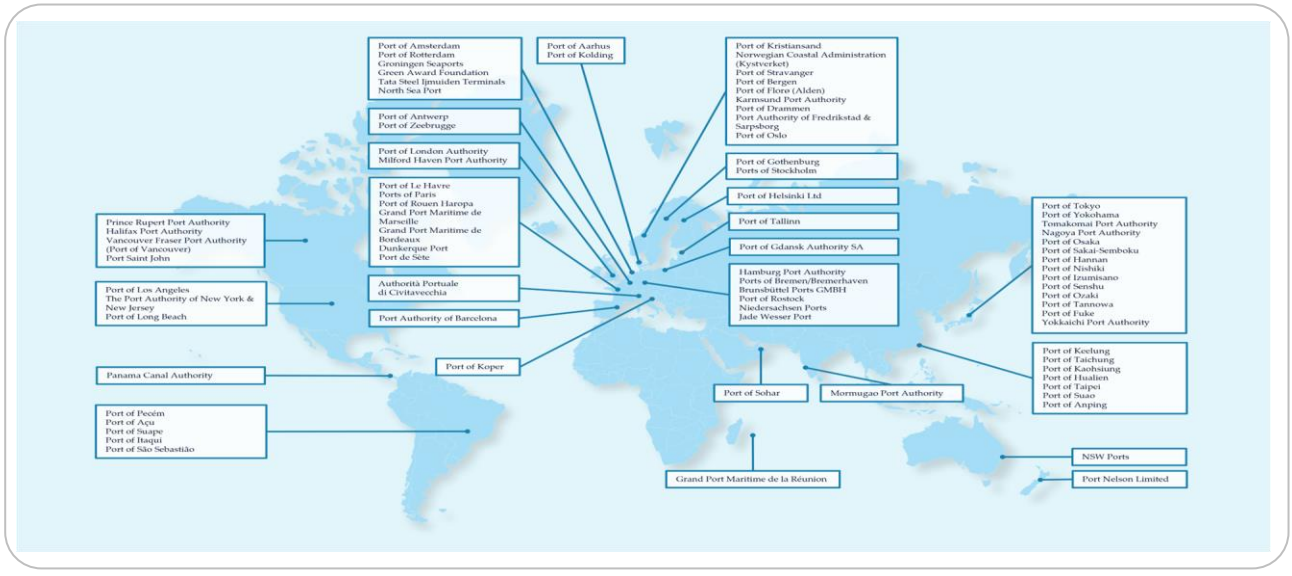
3.1.1.3. IAPH's Environmental Ship Index (ESI) and Its Role in Decarbonization (IAPH, 2024)

The International Association of Ports and Harbors (IAPH) has developed and implemented the Environmental Ship Index (ESI) as a tool to measure carbon emissions from ships and provide incentives for vessels contributing to emission reduction. The ESI scores ships on a scale from 0 to 100, based on their carbon emissions, allowing participating ports to offer incentives to eco-friendly vessels, thereby promoting voluntary decarbonization.

The initiative has seen continuous expansion, with over 6,000 ships worldwide now registered under ESI, and more than 80 ports actively offering incentives to encourage greener shipping practices.

In support of the 2023 IMO GHG Strategy, IAPH is currently developing a new ESI module to enhance its effectiveness in measuring ship emissions. Following a transition period in 2024–2025, the revised ESI module will be implemented from 2026. The new system will go beyond GHG emissions to include air pollutants such as SOx and NOx, as well as noise emissions, providing a more comprehensive assessment of a ship's environmental performance.

Figure 3-5: Participating Incentive Providers of ESI



Source: Environmental Ship Index accessed January 2025, available at: https://environmentalshipindex.org/
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

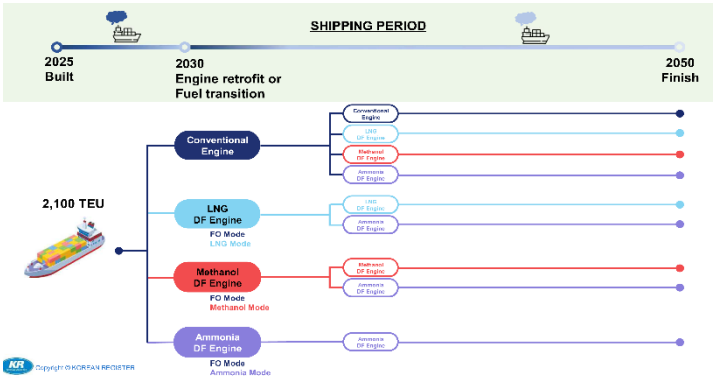
3.1.1.4. Economic Uncertainty Related to Maritime Decarbonization

While the direction of maritime decarbonization and corresponding regulatory frameworks are being internationally defined and discussed, the responses from shipping companies to comply with these regulations vary widely. Due to high economic uncertainty, most shipping companies are not yet taking proactive measures. Instead, they are focusing on risk minimization by constructing dual-fuel vessels. Furthermore, the range of available fuel options for these ships—such as ammonia, LNG, biodiesel, and methanol—is quite broad, leaving shipping companies with a wide array of choices.

Shipping companies must consider multiple factors when responding to environmental regulations. These include high initial investment costs for shipbuilding, rapid technological advancements, differing environmental regulations across countries and regions, and uncertainties regarding the price and availability of various alternative marine fuels. Among these, the high volatility in the relative prices of ship fuels makes it particularly difficult for companies to justify aggressive investment based on economic feasibility analyses.

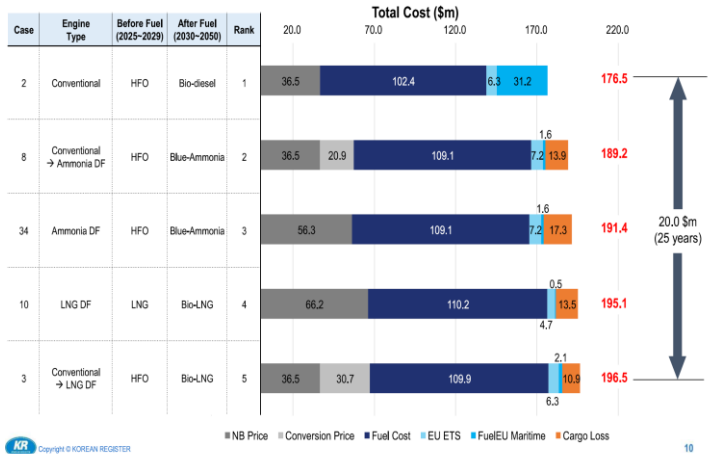
As shown in Figure 3-6, the choices available to shipping companies when constructing new vessels are highly diverse. A more concerning issue is that the economic viability rankings of these choices shift depending on various conditions. According to an economic analysis conducted by the Korean Register (KR), under certain conditions, continuing to use conventional HFO while paying related penalties until 2030—and switching to biodiesel with existing engines thereafter—ranked highest in terms of economic viability.

Figure 3-6: Shipbuilding Strategies for Meeting Decarbonization Requirements



Source: Korean Register (2024)

Figure 3-7: Ranking of Economic Feasibility by Vessel Construction Scenario



Source: Korean Register (2024)

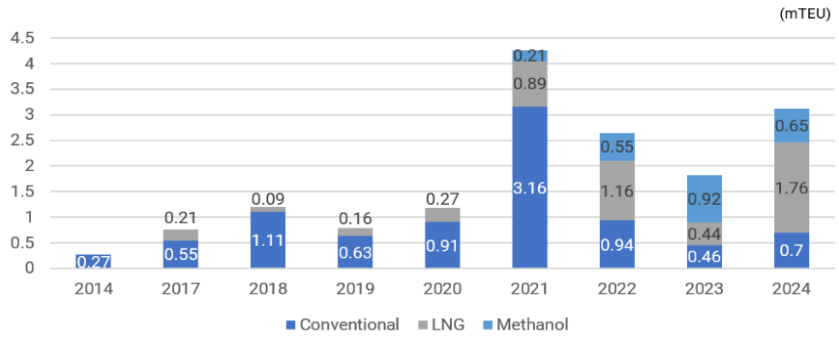
Unlike the aviation sector, where sustainable aviation fuels (SAF) are becoming mainstream due to the physical and technical limitations of aircraft, and unlike the land transport sector, where electric vehicles are expanding rapidly due to national-level policies and support, the maritime sector faces significant uncertainties. Overcoming these uncertainties through international cooperation remains one of the most critical challenges for maritime decarbonization.

3.1.1.5. Decarbonization Strategies of Container Shipping Companies

Container shipping companies are aligning their strategies with the IMO and national decarbonization roadmaps to achieve net-zero emissions between 2040 and 2060. Among them, Maersk has set the most ambitious target, aiming for net-zero emissions by 2040. Other major carriers, including Hapag-Lloyd, have set targets for 2045, while most shipping lines, except COSCO, have committed to reaching net-zero by 2050 (ChoiGun Woo, HwangSoo-jin, RyuHee-Young, KimByeong-Ju, 2024).

In relation to this, orders for alternative fuel-powered container ships have been increasing. LNG-powered ships have been ordered since 2017, and from 2022 onwards, the order volume for eco-friendly fuel vessels (LNG and methanol) has surpassed that of fossil fuel-powered ships.

Figure 3-8: Annual Container Ship Orders by Fuel Type

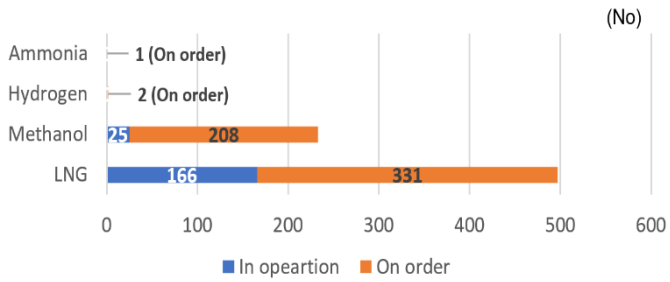


Source: Compiled and analyzed by KMI based on (Alphaliner, 2024)

Before 2021, most container carriers relied on LNG-fuelled vessels in compliance with carbon emission regulations. However, with the IMO adoption of the Well-to-Wake (WTW) emissions assessment method, which accounts for emissions from fuel production to final usage, the relative advantage of using LNG has weakened. Despite this, LNG remains attractive owing to its established bunkering infrastructure, whereas methanol availability is still limited. Reflecting this challenge, CMA CGM converted a methanol-fuelled vessel order to LNG propulsion in September 2023 owing to concerns regarding the availability and cost of green methanol.

As of March 2025, in terms of the number of vessels, only 0.92 percent of the world's fleet was alternative-fueled, but 16.81 percent of the ships on order alternative-fueled. In case of container fleet, 166 LNG-fueled vessels are in operation and 331 are on order, 25 methanol-fueled vessels are in operation and 208 are on order. In addition, two Hydrogen-fueled vessels and one Ammonia-fueled vessel are on order (DNV, 2025).

Figure 3-9: The global fleet of alternative fuel-powered container ships



Source: Compiled and analyzed by KMI based on (DNV, 2025)

Maersk has taken a leading role in the transition to methanol and currently operates three methanol-powered container ships. The company has placed orders for 23 new methanol-fuelled ships and plans to retrofit 11 additional vessels. Similarly, CMA CGM has ordered 32 methanol-powered container ships, while most top 10 global container carriers have also placed methanol vessel orders. Hapag-Lloyd, for instance, will convert 15 chartered vessels from Seaspan to methanol propulsion.

3.1.2. Advancing Green Shipping Corridors

3.1.2.1. Overview and History of Green Shipping Corridors

Green shipping corridors (GSCs) are not merely related to fuel transitions or port infrastructure upgrades; they represent a comprehensive initiative to address the maritime industry's decarbonization challenges. By fostering collaboration among governments, shipping companies, fuel suppliers and ports, GSCs introduce a new paradigm and alternative vision for achieving net-zero emissions in the sector.

The Clydebank Declaration, launched at COP26 (2021), in Glasgow, marked the first global commitment to GSCs, with participating nations pledging to establish at least six corridors by 2025 and expand them by 2030.

At COP27 (2022) in Egypt, the United States of America and Norway introduced the Green Shipping Challenge to accelerate GSC implementation and link efforts to climate compensation mechanisms. This momentum continued at COP28 (2023) in Dubai, where seven Pacific nations launched the Pacific Blue Shipping Partnership (PBSP) to support regional maritime decarbonization.

At COP29 (2024) in Baku, focus shifted to the Pacific Islands and SIDS, with Secretariat of the Pacific Regional Environment Programme and Alliance of Small Island States driving regional emission reduction strategies. The IMO reinforced the need to decarbonize regional shipping fleets, particularly in the Pacific. A key outcome was the increase in climate financing from US$ 100 billion to US$ 300 billion annually by 2035, securing long-term support for maritime decarbonization.

3.1.2.2. Global Trends in Green Shipping Corridor Initiatives (KimGa-Hyun, KimEun-Woo, JungYea-Jin, ShinJung-Hoon, KimChan-ho, 2024) (GMF, 2024)

1) Diverse Policy Approaches for Green Shipping Corridors

Countries are advancing Green Shipping Corridors (GSCs) through four key strategies: (1) clean energy-based ship technology, (2) green port infrastructure, (3) international cooperation, and (4) regulatory adjustments. These policies, tailored to national priorities, are accelerating maritime decarbonization.

The United States of America targets net-zero shipping emissions by 2050 under the Green Shipping Corridors Framework (2022). In 2023, it strengthened legal support through the Clean Shipping Act and the International Maritime Pollution Accountability Act, while leading the Green Shipping Corridors Initiation Project to assist developing nations.

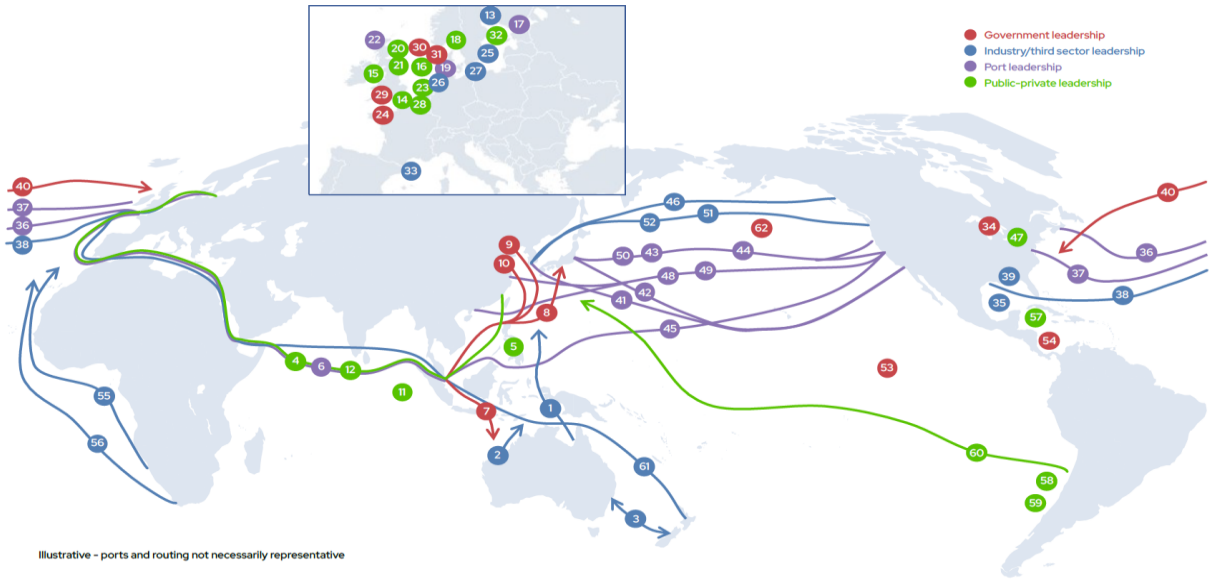
Europe has integrated GSC efforts into the European Union Green Deal. The UK leads the Clydebank Declaration, expanding corridors with France, Singapore and Belgium. Germany has a National Action Plan for Zero-Emission Shipping, while Norway has aimed for 55 percent emissions cut by 2030 via carbon pricing. Denmark has pledged zero-emission shipping by 2050, France has earmarked a €1.5 billion fund for vessel innovation and the Netherlands plans to launch 30 climate-neutral ships by 2033.

In Asia, Japan is implementing its Carbon Neutral Port Initiative, aiming for ammonia-fuelled ships by 2026 and hydrogen-powered vessels by 2027. China is developing the Yangtze River Green Corridor and leading green shipbuilding technology under its 2024–2030 plan. The Republic of Korea has set a 69.9 percent emissions reduction target by 2050, focusing on eco-friendly fleet transitions, shipping support and global cooperation.

2) Expansion of Green Shipping Initiatives and Stakeholders

Since the Clydebank Declaration (2021), interest in green shipping corridors has surged, resulting in a rapid increase in related initiatives. As of October 2024, 62 GSC initiatives had been launched. This represents an increase of 18 from 44 corridors at the end of 2023 (GMF, 2024).

Figure 3-10: Global Green Shipping Corridor Initiative Map (62 Corridors, as of 2024)



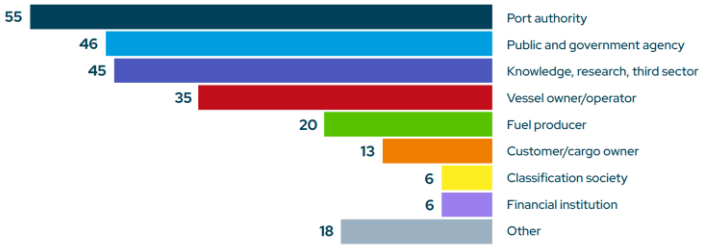
1. Australia Bauxite
2. Australia-East Asia Iron Ore
3. Australia-New Zealand
4. Hamburg-Shanghai
5. Philippines Corridors
6. Rotterdam-Singapore GDSC
7. Singapore-Australia GDSC
8. Singapore-Japan GDSC
9. Singapore-Shandong
10. Singapore-Tianjin GDSC
11. The Silk Alliance
12. UK-Singapore-ASEAN
13. Åland Mega Green Port
14. Dover-Calais/Dunkirk Ferry
15. Dublin-Holyhead
16. Esbjerg-Immingham
17. FIN-EST
18. Gothenburg-Frederikshavn Pilot Study
19. Gothenburg-Rotterdam
20. Larne-Liverpool
21. Liverpool – Belfast
22. Northwestern England-Ireland
23. Oslo-Rotterdam Pilot Study
24. St Helier-St Malo
25. Stockholm-Åbo
26. Sweden–Belgium
27. Trelleborg-Lübeck
28. Tyne-Ijmuiden
29. UK-Belgium
30. UK-Denmark
31. UK-Norway
32. Vaasa-Umea
33. West Mediterranean Cruise
34. Great Lakes Iron Ore
35. Gulf of Mexico Green Shipping Corridor
36. Halifax-Hamburg
37. Ireland-to-Indiana container
38. Port of Houston-Port of Antwerp-Bruges
39. US Green Bulk
40. US-UK Green Shipping Corridors Taskforce
41. Hueneme-Pyeongtaek Green Automotive
42. Hueneme-Yokohama Green Automotive
43. LA-Nagoya
44. LA-Yokohama
45. Los Angeles/Long Beach-Singapore GDSC
46. North Pacific Green Corridor Consortium
47. Pacific Northwest to Alaska Green Corridor
48. LA-Guangzhou
49. Port of Los Angeles-Port of Long Beach-Port of Shanghai
50. Port of Oakland-Yokohama
51. Seattle and Tacoma-Busan
52. Seattle and Tacoma-Korea PCTC
53. US and Pacific Blue Shipping Partnership Green Corridors
54. US and Panama Green Corridors
55. Namibia Corridors
56. South Africa-Europe Iron Ore Corridor
57. The Caribbean Green Shipping Corridor Initiative
58. Chile Piscicultura
59. Chile Sulfuric Acid
60. Chile-Japan/Korea copper concentrate
61. Taurange-Zeebrugge
62. West Green Shipping Corridor

Map source: Global Maritime Forum, 2024

Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Stakeholder participation has also grown significantly. Between 2022 and 2023, the number of participating entities increased from 171 in 2023 to 240 in 2024, with notable contributions from shipping companies, ports, and maritime regulators.

Figure 3-11: Number of stakeholders represented in the green corridor movement by



Source: (GMF, 2024)

However, participation from key supply chain stakeholders—cargo owners, fuel producers, and financial institutions—remains limited. In 2024, only 13 cargo owners, 20 fuel producers, and 6 financial institutions were actively engaged in GSC initiatives.

The bulk shipping sector sees major mining firms and their customers leading green shipping efforts owing to their concentrated cargo flows. Meanwhile, the container shipping sector, with its fragmented customer base, is exploring alternative engagement models such as demand aggregation platforms and reservation-based solutions.

While the rapid growth of GSC initiatives signals strong industry momentum toward decarbonization, efforts must be made to broaden participation among key stakeholders. Increasing cargo owner engagement is particularly critical to creating market demand for green shipping services and ensuring the economic viability of sustainable investments.

3) Geographic Expansion of Green Shipping Corridors

Originally concentrated in Europe and North America, GSC initiatives are now expanding globally. In 2023 and 2024, multiple trans-Pacific routes were launched, reflecting growing awareness of shipping's environmental impact in Asia. Additionally, South America and Africa have begun developing green corridors, with increasing activity in the South Pacific and South Atlantic regions.

In Europe, the number of short-sea green corridors has increased, demonstrating a shift from long-haul routes to coastal and regional shipping initiatives.

Figure 3-12: Regional Distribution of Global GSC

Source: Global Maritime Forum, 2004 on the United Nations Carto Tile Map (https://www.un.org/geospatial/mapsgeo/webservices)
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.
Final boundary between the Republic of Sudan and the Republic of South Sudan has not vet been determined.

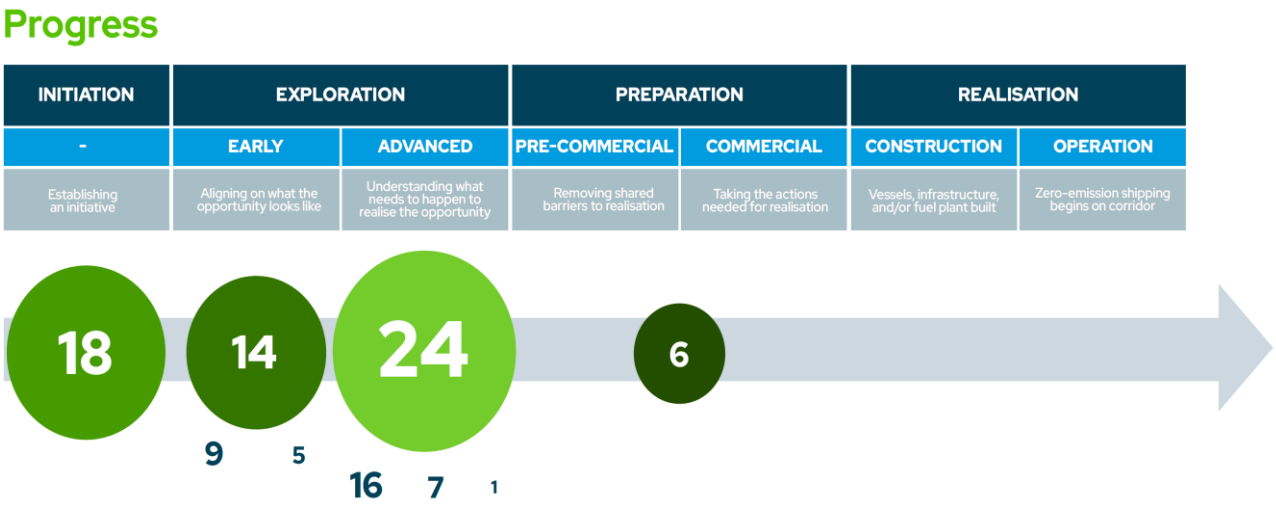
This geographic expansion highlights that maritime decarbonization is a worldwide priority. However, regional variations in shipping industry structures and economic conditions necessitate localized strategies. Meanwhile, global cooperation in knowledge-sharing and best practices will play a crucial role in ensuring effective implementation of GSCs worldwide.

4) Maturity of Green Shipping Initiatives

The green corridor portfolio has made steady progress, with 17 initiatives completing key activities or advancing to a new phase since 2023, which accounts for two-fifths of those recorded last year. There is strong evidence that early-stage initiatives are becoming more concrete, as nine initiatives in the Initiation or Early Exploration phases in 2023 have shown measurable progress.

While "Initiation" was the most common progress phase last year, this year has seen the greatest advancement in the "Advanced Exploration" phase. Additionally, government framework agreements established at the Sharm El-Sheikh and Dubai COPs are moving forward, supported by funding studies and third-party collaborations (GMF, 2024).

Figure 3-13: Number of GSC initiatives at each progress stage



Source: (GMF, 2024)

At least six initiatives have advanced from the Advanced Exploration phase to Preparation, with others close behind. These initiatives aim to introduce zero-emission vessels, supported by clear action plans (GMF, 2024).

In 2024, the focus shifted from planning to action. Feasibility studies were completed, and working groups tackled key challenges, leading to publications, meetings, and stakeholder collaborations.

Figure 3-14: Initiatives known to have progressed to the Preparation stage (as of October 2024)

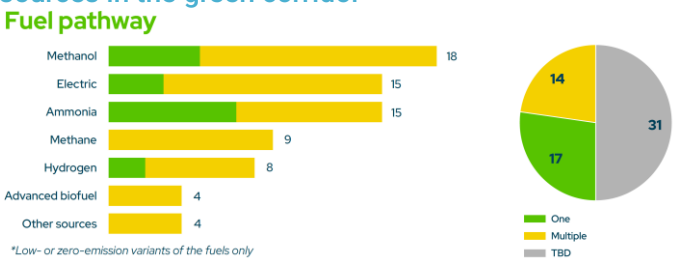
Map source: Global Maritime Forum, 2024
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Despite this progress, achieving tangible results will require continued technological innovation, infrastructure investment, policy support and industry collaboration.

5) Growing Focus on Alternative Fuels

A key trend in the evolution of GSCs is the slow but steady increase in focus on specific alternative fuels. As of 2024, 31 GSCs have designated specific fuels, reflecting the industry's growing consensus on the role of clean fuels in maritime decarbonization. Methanol and ammonia have emerged as leading options owing to their technological readiness, economic feasibility and suitability for large vessels. .

Figure 3-15: Representation of different fuels/energy sources in the green corridor



Source: (GMF, 2024)

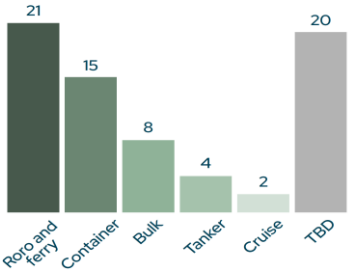
However, remaining 31 initiatives have yet to commit to a specific fuel pathway. Since many of these initiatives are led by governments and ports, this hesitation may stem from challenges in securing key stakeholders or a lack of authority to make fuel-related decisions.

By vessel type, the container shipping sector was the most active in GSC participation in 2023. However, in 2024, the roll-on/roll-off (ro-ro) and ferry segments have taken the lead. While interest and involvement in bulk carriers are growing, participation remains limited. Meanwhile, engagement from the cruise and tanker sectors remains limited.

Ports play a crucial role in this transition – not only as shipping hubs but also as energy supply centers. Developing multi-fuel infrastructure will provide shipping companies with greater flexibility in fuel selection.

In the short term, biofuels and transitional fuel options may serve as practical solutions while the industry moves toward fully green energy sources.

Figure 3-16: Vessel types in green shipping corridors



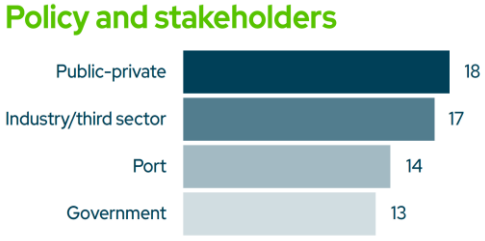
Source: (GMF, 2024)

6) The Emergence of Diverse Governance Models

As GSC initiatives mature, various governance models have emerged, reflecting the global significance of shipping decarbonization. Public, private and hybrid governance structures are now coexisting, with public–private partnerships proving particularly effective in securing funding and managing project timelines.

However, key challenges remain, particularly regarding the cost gap between alternative and fossil fuels. Governments must adopt stronger financial incentives and policy measures to support the transition. Strengthening global regulatory frameworks through organizations such as the IMO, alongside domestic policy adjustments, will be crucial.

Figure 3-17: Number of green corridor initiatives by leadership type



Source: (GMF, 2024)

Additionally, coordinating diverse industry stakeholders and fostering transparent collaboration will be essential for the successful deployment of GSCs and the long-term sustainability of green shipping initiatives.

3.1.2.3. Major Green Shipping Corridors in the Asia-Pacific Region

Singapore-Rotterdam Green Digital and Shipping Corridor

The Singapore–Rotterdam Green & Digital Shipping Corridor (GDSC) is a joint initiative between the Maritime and Port Authority of Singapore and the Port of Rotterdam Authority, established in August 2022. It aims to accelerate decarbonization and digitalization in maritime transport along the key Asia–Europe trade route, which connects two of the world's largest bunkering ports. The initiative has gathered 26 global value-chain partners, including shipping companies, fuel suppliers, financial institutions, research organizations and industry coalitions.

GDSC's primary focus is to reduce barriers for early adopters of alternative fuels by ensuring their availability, acceptability and affordability. It supports first-mover pilot projects to test and implement zero- and near-zero emission fuels, such as bio-methane, green methanol, ammonia and hydrogen. Several working groups, including Bio-methane, Methanol, Ammonia and Hydrogen Working Groups, have been formed to address fuel adoption challenges, standardization and supply chain optimization. Additionally, a Commercial Structures Working Group is exploring financial mechanisms to lower the cost of green fuel.

On the digital front, Singapore and Rotterdam have successfully trialed real-time data exchange for vessel arrival and departure times, improving port call optimization. The corridor also facilitates the monitoring, reporting, and verification (MRV) of GHG emissions, aligning with international standards such as European Union MRV and IMO Data Collection System. To further enhance digitalization, a call-for-proposal has been issued for secure ship-shore data exchange solutions.

The Singapore–Rotterdam GDSC represents a significant step toward maritime sustainability, demonstrating how public–private collaboration can drive transformation in the shipping industry. The corridor serves as a testbed for innovation, supporting the operational deployment of low-carbon fuels and digital solutions on one of the world's busiest trade routes (MPA, Port of Rotterdam, 2024).

Singapore-Japan Green Digital and Shipping Corridor

Signed on December 16, 2023, this initiative involves MPA and six Japanese ports (Tokyo, Yokohama, Kawasaki, Osaka, Kobe, and Nagoya). It focuses on decarbonization and digitalization, emphasizing ammonia and hydrogen as alternative fuels and developing supporting bunkering infrastructure. Stakeholders from Singapore, Japan, the United States of America, and Australia collaborate to streamline port clearance and enhance maritime cybersecurity.

Singapore-Australia Green Digital and Shipping Corridor

Singapore and Australia signed a Memorandum of Understanding (MoU) on March 5, 2024, to develop supply chains for low- and zero-carbon fuels and improve digital information exchange in port operations. The initiative aligns with the Singapore-Australia Green Economy Agreement and involves collaboration between government agencies, port operators, and energy sector stakeholders to optimize cargo flows and advance maritime decarbonization.

The Los Angeles – Long Beach – Shanghai Green Shipping Corridor Partnership

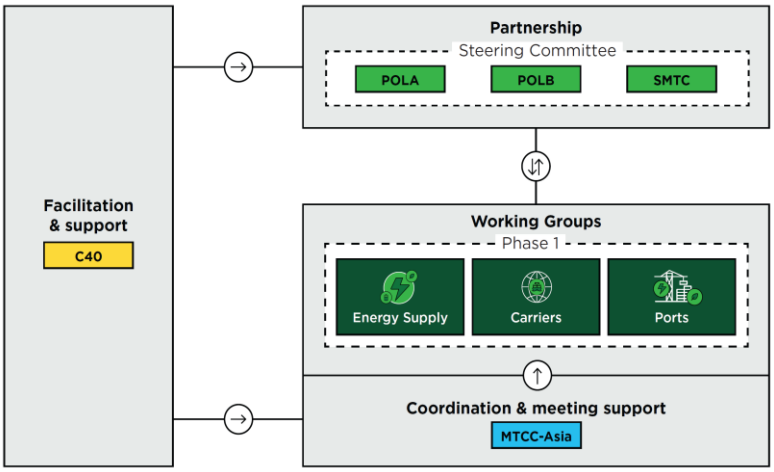
The Los Angeles – Long Beach – Shanghai Green Shipping Corridor (GSC) Partnership was launched in January 2022 as a voluntary collaboration among major maritime stakeholders. This initiative, led by the Port of Los Angeles (POLA), the Port of Long Beach (POLB), and the Shanghai Municipal Transportation Commission (SMTC), aims to decarbonize one of the world's busiest container shipping routes. Supported by C40 Cities Climate Leadership Group, key partners include major carriers such as Maersk, CMA CGM, COSCO, ONE, and Evergreen, as well as research and classification organizations like China Classification Society (CCS) and the Maritime Technology Cooperation Centre (MTCC-Asia).

In September 2023, the Green Shipping Corridor Implementation Plan (GSCIP) was introduced, outlining key objectives. The plan commits carrier partners to deploy reduced or zero lifecycle carbon emission vessels by 2025 and aims to launch the world's first fully zero-carbon container ship by 2030. The initiative also promotes shore power usage, clean marine fuel infrastructure development, and emission tracking metrics to support decarbonization efforts.

The 2024 progress included the first in-person partnership meeting in Shanghai, strengthening collaboration among stakeholders. To implement its goals effectively, the GSC Partnership operates through three working groups:

1. Energy Supply Working Group – Focuses on developing fuel supply infrastructure and establishing low-carbon fuel standards.
2. Carriers Working Group – Works on deploying green vessels and creating a roadmap for fleet transition.
3. Ports Working Group – Supports investment in clean marine fueling infrastructure, expands shore power availability, and aligns port incentive programs with the corridor's objectives.

Figure 3-18: High-level overview of the Corridor Partnership Structure



Source: (GMF, 2024)

Challenges ahead include fuel availability and cost, regulatory consistency, and stakeholder engagement. Future plans involve refining fuel supply frameworks, improving vessel deployment strategies, and enhancing port sustainability initiatives. The Los Angeles – Long Beach – Shanghai Green Shipping Corridor is a key step toward maritime decarbonization, setting a precedent for global green corridor initiatives (POLA, POLB, SMTC, 2024).

Silk Alliance Green Shipping Corridor Initiative

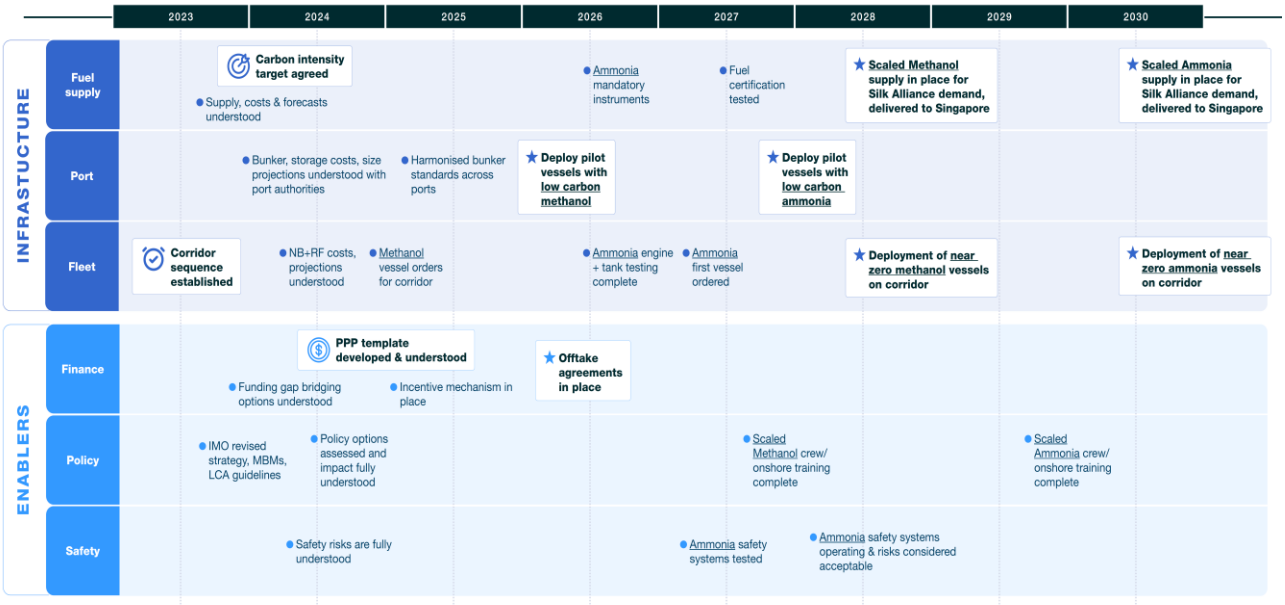
The Silk Alliance was launched in May 2022 to establish a green shipping corridor network. This initiative brings together major industry players, including shipping companies, fuel suppliers, financial institutions, and research organizations, to support decarbonization efforts across the Indian and Pacific Oceans.

The Silk Alliance is led by the Lloyd's Register Maritime Decarbonization Hub and joined by key stakeholders, including the Maritime and Port Authority of Singapore (MPA), PSA International, Keppel Offshore & Marine, Wan Hai Lines, and X-Press Feeders, alongside alternative fuel providers such as Yara Clean Ammonia ASA and the Methanol Institute. Additionally, research institutions like the NUS Centre for Maritime Studies and technology firms such as Wärtsilä contribute to developing sustainable fuel solutions and operational efficiencies.

The Silk Alliance aims to connect East Africa, Shanghai, and Western Australia through a dedicated green corridor for container shipping. A pilot project using low-carbon methanol and ammonia-fueled vessels is set to begin in early 2025, with a long-term plan to expand alternative fuel supply infrastructure between 2028 and 2030.

The Silk Alliance Implementation Plan outlines several key milestones. By 2030, the initiative aims to standardize bunkering infrastructure across ports, expand alternative fuel supply chains for methanol and ammonia, and deploy near-zero-emission vessels along its key routes. Through ongoing collaboration among shipowners, fuel suppliers, financial institutions, and regulators, the Silk Alliance seeks to accelerate the transition to sustainable maritime transport while addressing economic and operational challenges.

Figure 3-19: Implementation plan for the Silk Alliance Green Corridor Cluster



All the milestones outlined in this implementation plan represent milestones that need to be delivered, led by a combination of actions from the Members and from wider industry efforts, to support the ultimate implementation of this Green Corridor Cluster. This is a live implementation plan that the Members will continue to detail further and refine as the initiative progresses.

Source: (Lloyd's Register Maritime Decarbonisation Hub, 2023)

Republic of Korea (ROK)-U.S. Green Shipping Corridor

The Republic of Korea – U.S Green Shipping Corridor Initiative was first announced at COP27 in 2022 as a collaborative effort between the two governments to promote maritime decarbonization. In 2023, a pre-feasibility study was conducted with the participation of key stakeholders, including the Busan Port Authority, Ulsan Port Authority, the Maersk Mc-Kinney Moller Center for Decarbonizing Shipping, and the Northwest Seaport Alliance.

Following the study's findings and input from shipping companies and port operators, two preliminary green corridors were selected:

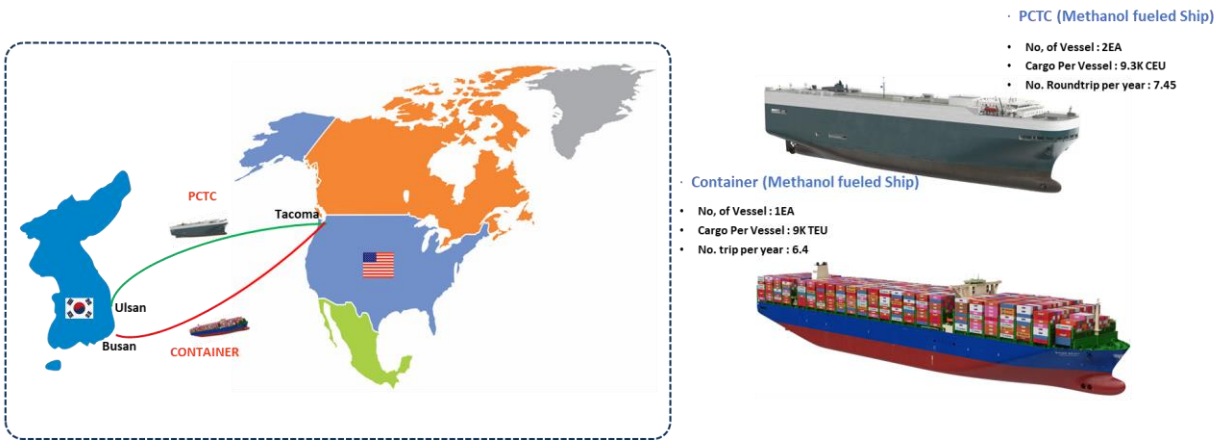
1. A methanol-fueled container shipping route between Busan Port and the Ports of Seattle and Tacoma.
2. A methanol-fueled car carrier route between Ulsan Port and the Ports of Seattle and Tacoma.

In 2024, a detailed feasibility study was conducted to evaluate the economic, technical and regulatory aspects of these corridors. Led by the Maersk Mc-Kinney Moller Center, this study began in early 2024, with preliminary findings expected by the end of the year.

The next phase involves the development of a roadmap for green corridor implementation. Once completed, a consortium of stakeholders, including shipping companies, port authorities and fuel suppliers, will be formed to launch pilot operations in 2027. The initiative aims to accelerate the transition to low-emission shipping by fostering collaboration across the public and private sectors, improving alternative fuel infrastructure and ensuring regulatory alignment for sustainable maritime transport.

These GSCs represent significant progress in global maritime decarbonization, with governments, industry leaders and research institutions working together to drive sustainability in shipping operations (JeonSeoyeon & RyuHeeyoung, 2024).

Figure 3-20: The route under consideration and the vessels to be applied in the feasibility study



Map source: R&D Center in Korean Register (2024)
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

3.1.2.4. Key Strategies for Advancing Green Shipping Corridors in the Asia-Pacific Region

1) Public-Private Partnership in Green Shipping Corridors (GSC)

Encouraging collaboration between governments and private sector stakeholders is essential to turning green shipping commitments into tangible actions. Drawing insights from COP29 and the Green Shipping Corridor Partnership (GSCP), this approach ensures that GSC initiatives receive the necessary support for implementation, financing, and scaling.

2) National Adaptation Policy (NAP)

To align GSC initiatives with broader national sustainability goals, National Adaptation Policies (NAPs) should incorporate GSC projects into national greenhouse gas (GHG) emission reduction targets. This integration reinforces the role of maritime decarbonization in achieving climate objectives.

3) Benchmarking with Green Digital and Shipping Corridor (GDSC)

The Singapore–Rotterdam GDSC serves as a best practice model for integrating green shipping corridors with smart port development. By benchmarking against this initiative, GSC projects can adopt digitalization strategies, port efficiency improvements, and alternative fuel infrastructure development to enhance sustainability efforts.

4) Launching Regional Green Shipping Corridors (GSCs)

Expanding regional green shipping corridors by connecting feeder ports with major container hub ports across the Asia-Pacific region is a critical step. This initiative aims to strengthen maritime connectivity, enhance low-carbon supply chain networks, and support the broader adoption of alternative fuel infrastructure.

5) Incentivization Policy for Zero-Emission Ships

A well-defined incentive policy is needed to encourage shipping carriers to transition towards zero-emission vessels within a set time frame. This could include financial subsidies, tax benefits, or priority berthing for carriers committed to deploying low-carbon and zero-carbon ships in the Pacific region.

6) A Two-Stage Decarbonization Model

A structured, phased approach to maritime decarbonization can help facilitate a smooth transition. The first stage focuses on establishing logistics distribution centers and feeder networks to optimize cargo movement and reduce emissions. The second stage advances full-scale maritime decarbonization by incorporating alternative fuels, digital solutions, and enhanced port infrastructure to support a sustainable and resilient shipping ecosystem in the Asia-Pacific region.

3.1.3. Regional Initiatives and Collaborative Efforts for Maritime Decarbonization

3.1.3.1. ESCAP's Efforts to Promote Sustainable Maritime Connectivity in the Asia-Pacific

The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) has been actively fostering regional cooperation in sustainable maritime connectivity by hosting the Annual Dialogue on Sustainable Maritime Connectivity in collaboration with the Ministry of Oceans and Fisheries of the Republic of Korea, the Korea Maritime Institute (KMI), and other key stakeholders. These dialogues serve as a platform to share best practices and experiences, discuss emerging issues and priorities, and promote sustainable development in maritime transport and ports across the Asia-Pacific region.

In 2023, the dialogue was held in Bangkok, Thailand, focusing on Southeast Asia, while in 2024, discussions centered on the Pacific region in Nadi, Fiji. The key topics included global and regional issues related to sustainable maritime connectivity, port decarbonization, and adaptation of climate change in the Pacific. The dialogue resulted in several recommendations to strengthen sustainable maritime connectivity in the Asia-Pacific and Pacific regions:

- Developing mid- and long-term national policies addressing decarbonization trends, digital advancements, and climate change
- Enhancing regional cooperation through technology sharing and capacity-building activities to support developing countries
- Promoting stakeholder engagement, including shipping companies, port operators, and local communities
- Facilitating smart port infrastructure development to support digital and green transitions
- Expanding collaborative research, capacity-building, and training initiatives with international and regional organizations to address challenges and opportunities faced by Asia-Pacific countries

In November 2024, ESCAP, in collaboration with Busan Port Authority (BPA), Korea Maritime Institute (KMI), and the Ministry of Oceans and Fisheries of Korea, hosted a side event titled "Advancing a Sustainable Port Network for Asia and the Pacific" at the 8th Transport Committee. The event provided a platform for regional cooperation to achieve maritime decarbonization by 2050, emphasizing collaboration among Asia-Pacific ports to build a sustainable port network.

Participants shared policy case studies on port and shipping decarbonization and discussed key areas such as green shipping corridors, alternative fuel supply chains, and regional cooperation for developing countries.

A key outcome of the event was the signing of a Memorandum of Agreement (MoA) between ESCAP and Busan Port Authority, reaffirming their commitment to port decarbonization. Moving forward, ESCAP will continue to provide a platform for regular dialogues and strengthen its collaborative network to support sustainable development in the maritime and port sectors across the Asia-Pacific region.

3.1.3.2. APSN's Green Port Award System and Its Role in Sustainable Port Development (APSN, 2024)

The Asia-Pacific Economic Cooperation (APEC) Port Services Network (APSN) launched the Green Port Award System (GPAS) in 2016 to promote sustainable port development. This program encourages environmentally friendly practices and knowledge sharing across the region. GPAS assesses ports based on commitment, implementation, and effectiveness.

Since its launch, 80 port terminals have received the award, with China, Malaysia, the Philippines, Thailand, and Singapore leading green initiatives. Awarded ports have adopted cleaner energy, renewable sources, and onshore power supply systems, along with rainwater harvesting and plastic reuse.

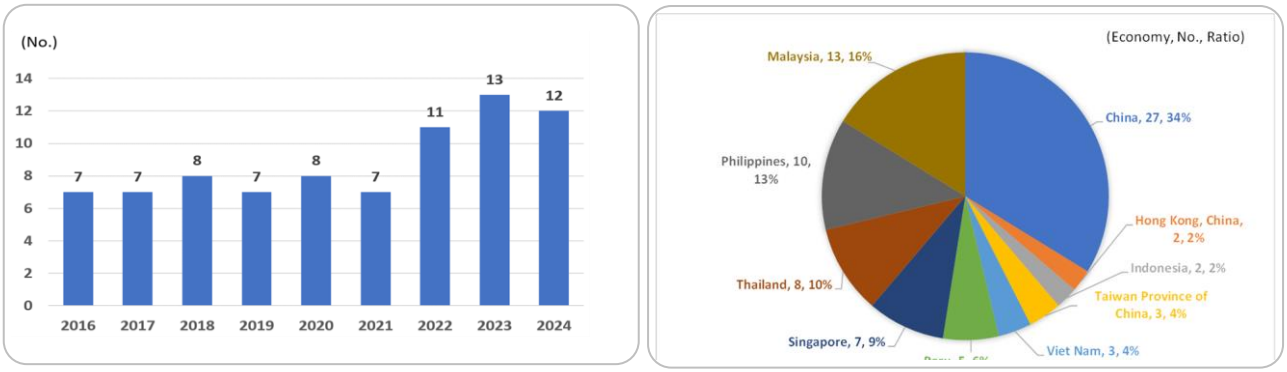
APSN continues to support sustainable port operations and decarbonization, with GPAS serving as a model for future green port development.

Table 3-2: The GPAS Indicator System

Primary Indicator	Secondary Indicator	Reference Standard
Commitment and Willingness (25%)	Green Port Awareness and Willingness (60%)	(1) Green strategy or development plans (2) Green support funding (3) Green annual reports (4) Others
	Green Port Promotion (40%)	(1) Green training programs (2) Green promotion campaigns (3) Others
Action and Implementation (50%)	Clean Energy (15%)	(1) Using renewable energy sources (2) Using od LNG (3) Using cold ironing (shore power) (4) Others
	Energy Saving (30%)	(1) Using energy-saving devices & technologies (2) Optimizing power supply system (3) Others
	Environmental Protection (40%)	(1) Air pollution prevention (2) Noise control (3) Waste treatment (liquid and solid) (4) Others
	Green Management (15%)	(1) Green environment management system (2) Green performance assessment (3) Others
Efficiency and Effectiveness (25%)	Energy Saving (40%)	(1) Energy consumption reduction (2) Renewable energy increment (3) Others
	Environmental Protection (60%)	(1) Air quality improvement (2) Noise control result (3) Liquid & solid pollution control (4) Others

Source: APSN, GPAS

Figure 3-21: GPAS Award winners during 2016-2024



Source: Compiled and analyzed by KMI based on APSN and GPAS data
Note: Includes multiple award-winning cases

3.1.3.3. ADB's Maritime Decarbonization Initiative and Funding Efforts in the Asia-Pacific (ADB, 2024)

Despite the variety of funding and financing initiatives in the Asia-Pacific region, few specifically target port and maritime decarbonization. Recognizing this gap, the Asian Development Bank (ADB), in collaboration with Royal HaskoningDHV, conducted a financial landscape assessment in 2023 to support decarbonization investments in developing countries' ports and maritime sectors. The study surveyed major ports and stakeholders across the region, highlighting the need for a Green Ports and Maritime Decarbonization Fund and identifying potential projects that could benefit from such funding.

Building on this effort, ADB launched the Maritime Decarbonization Initiative (MDI) at COP29 in November 2024, introducing a newly developed fund alongside existing Pacific project. The MDI provides a structured support framework divided into three key phases—Upstream, Midstream, and Downstream:

- Upstream: Supports policy and strategy development at the national and port levels to establish a regulatory foundation for green port initiatives.
- Midstream: Focuses on feasibility studies and project design for energy efficiency improvements, clean energy adoption, and climate resilience, ensuring the identification of viable projects.
- Downstream: Facilitates infrastructure investments in smart energy management systems, port equipment efficiency upgrades, LED lighting conversion, onshore power supply (OPS) installation, renewable energy generation, energy storage systems, and zero-emission equipment deployment, driving port decarbonization.

Moving forward, ADB aims to establish itself as a leading multilateral development bank supporting maritime decarbonization in the Asia-Pacific region. Through this initiative, ADB seeks to actively promote sustainable shipping and port development, particularly in developing countries, ensuring a low-carbon transition in the regional maritime sector.

Table 3-3: Potential GPMDF (Green Ports and Maritime Decarbonization Fund) Project Types

Financial support level	Green port topic	Intervention
Upstream	Governance	• Support for development of a national level gre en port policy • Support for development of a port / terminal le vel green port policy and strategy
Midstream	Energy Efficiency, Clean energy and fuels and climate resilience	• Feasibility studies and design for energy efficien cy, climate resilience and clean energy and fuels related project
Downstream	Energy Efficiency	• Smart energy management • Retrofit and energy-efficient equipment • LED lighting conversion
	Clean energy and fuels	• Shore power • Solar and wind • Battery-Energy Storage Systems • Zero-emission equipment and vehicles • Alternative fuel bunkering
	Climate Resilience	• Adaptation (Structural and non-structural)

Source: (ADB, 2024)

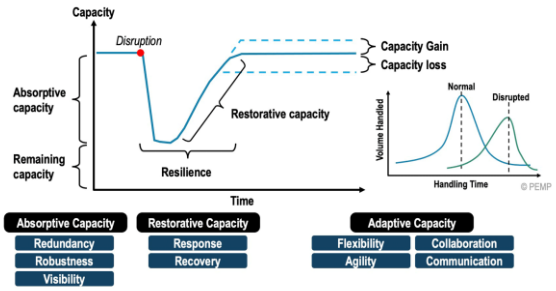
3.2. Adaptability: Climate Change and Resilience

3.2.1. Climate Change and Port Resilience

Climate change presents a major challenge for ports, which serve as critical hubs for global trade and transportation. Rising sea levels, extreme weather events and shifting weather patterns pose significant threats to port infrastructure and operations, making resilience a key priority. Ports in coastal and riverine areas are particularly vulnerable to flooding, saltwater intrusion and structural damage, which can disrupt operations and lead to costly repairs. Additionally, climate-related disruptions can create bottlenecks in global supply chains, delaying shipments and increasing logistical complexity.

To address these challenges, port resilience involves the ability to anticipate risks, adapt to changing conditions and recover quickly from disruptions. This includes strengthening infrastructure, improving drainage systems and implementing early warning mechanisms to mitigate the impact of storms and flooding. Mitigation strategies such as reducing GHG emissions, transitioning to renewable energy and adopting green shipping technologies are also essential for long-term sustainability.

Figure 3-22 Resilience of maritime transportation systems



Source: Notteboom T., PallisA., RodrigueJ., 2022

3.2.2. Current Status of Climate Change Affecting Ports

3.2.2.1. Sea level rise

Global mean sea levels will continue to rise throughout the 21st century and beyond. The rate of sea level rise has been accelerating in recent decades as ocean temperatures warm and ice sheets melt at an increasing pace. Projections indicate a potential rise of between 30 cm and 2 m by 2100 compared with the levels in 2000, depending on GHG emission scenarios (IPCC, 2021). Sea levels will continue to rise for centuries even if GHG emissions are significantly reduced owing to the long response time of the climate system.

Figure 3-24: Projected global mean sea level rise (IPCC, 2021)

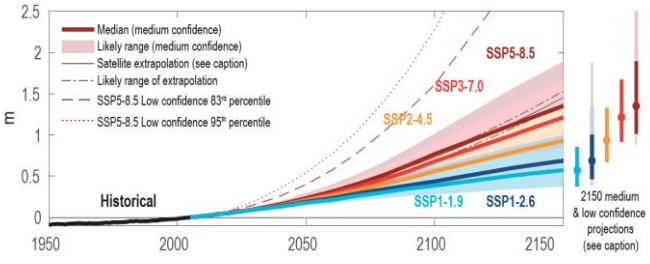
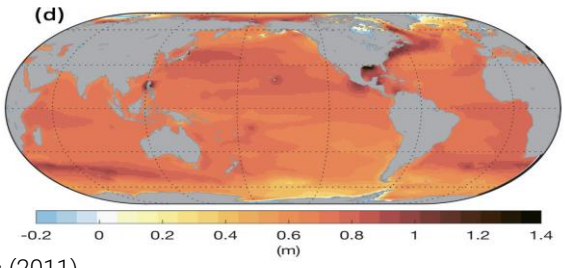


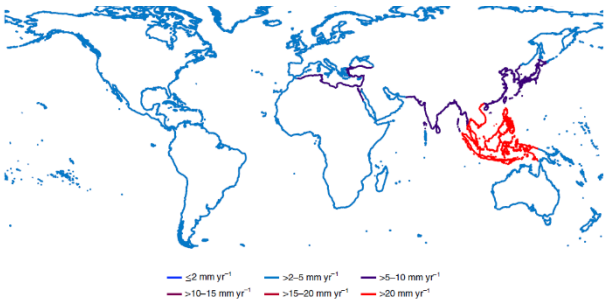
Figure 3-23: Regional sea level change at 2100 for SS3-7.0 scenario (with respect to 1995–2014



Source: IPCC, Climate Change 2021: The Physical Science Basis (2011)
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

The Asia-Pacific region is particularly vulnerable to sea level rise owing to its extensive coastlines, high population density in coastal areas and low-lying island nations. In particular, certain areas within the Asia-Pacific are experiencing particularly rapid sea level rise. Low-lying delta regions in countries such as Bangladesh, Viet Nam and Indonesia are highly vulnerable to sea level rise. Small island nations in the Pacific continue to face existential threats, with some projections suggesting significant portions of their landmass could be submerged by the end of the century (UN, 2024).

Figure 3-25: Average relative sea level rise rate for 23 coastal world regions (Nicholls et al., 2021)

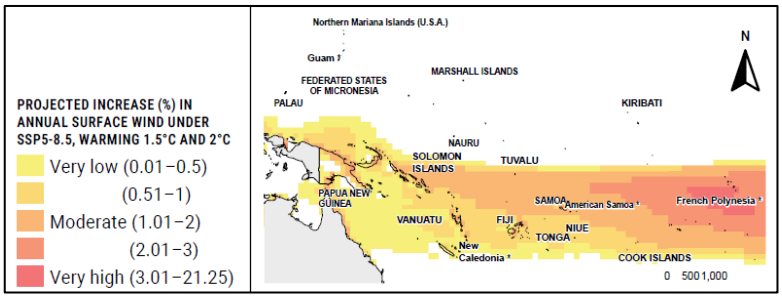


Map source: Nicholls et al., 2021
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United

3.2.2.2. Tropical storms

Climate change is expected to significantly alter global storm patterns, with a notable increase in storm intensity. Warmer ocean temperatures will likely fuel stronger hurricanes, raising the proportion of Category 4 and 5 storms. Additionally, a warmer atmosphere will hold more moisture, leading to heavier rainfall and increased flood risks.

Figure 3-26: Projected increase in annual surface winds under SSP 5–8.5 scenario (UNESCAP, 2022)



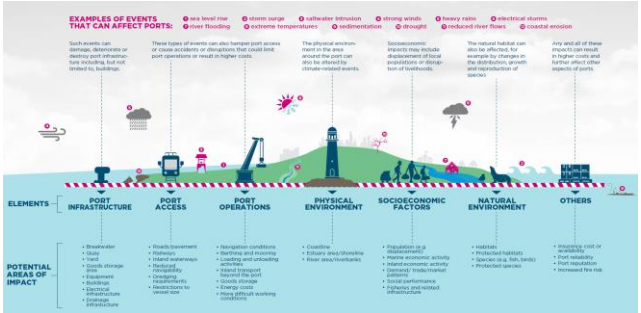
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. * Non-Self-Governing Territory

Storm distribution is also projected to shift, with storm tracks moving poleward, exposing new regions to higher risks. Rising sea levels will amplify storm surge impacts, causing greater coastal flooding and erosion. While uncertainty remains in predicting regional storm changes, some areas will face heightened risks. Furthermore, storms often coincide with other hazards like flooding and wildfires, creating compound events with severe cascading consequences.

3.2.3. Impact of Climate Change on Port Operations

Climate change has profound and far-reaching impacts on port operations globally, transforming how ports function, maintain infrastructure, and ensure safety and efficiency. These impacts arise from a variety of interconnected climate phenomena, such as rising sea levels, extreme weather events, and changing marine conditions. Each poses unique challenges, affecting ports of all sizes and functions.

Figure 3-27: Potential climate change events and impacts



Source: IDB, Climate risk and ports: a practical guide on strengthening resilience (2021)

3.2.4. Climate Change Response in Ports

Climate change threatens port facilities and operations, potentially disrupting the stability of the entire global logistics system. In response to these threats, major ports around the world are implementing a variety of policies to actively address climate change. The various mitigation and adaptation measures to prepare for the impacts of climate change are shortlisted as follows.

Table 3-4: Climate change adaptation measures in port sectors.

Category	Technology	Description
Infrastructure upgrade	Raising infrastructure	Increasing the height of quays and wharves
	Strengthening structures	Using resilient materials for breakwaters, seawalls
	Flood protection	Constructing flood barriers, improving drainage
Nature-Based Solutions	Mangrove restoration	Protecting and restoring mangrove forests
	Wetland creation	Creating/restoring wetlands
	Living shorelines	Combining natural and engineered elements
Technological Innovations	Early warning systems	Advanced weather forecasting
	Data analytics	Using AI and data analysis
	Smart technologies	Sensors and remote monitoring
Sustainability Initiatives	Renewable energy	Use of solar and wind power
	Electrification	Electric equipment and vehicles
	Shore power	Providing shore power connections for ships
Collaboration & Knowledge Sharing	Industry partnerships	Collaborating with other organizations
	International networks	Participating in global initiatives

THE CASE OF SINGAPORE PORT

Singapore port recognizes the growing threat of climate change and is proactively implementing adaptation strategies to safeguard its port infrastructure. A key element of this strategy is raising reclamation levels. Since 2011, Singapore has mandated that newly reclaimed land be elevated to at least 4 meters above mean sea level, a significant increase from the previous 3 meters. Furthermore, critical infrastructure projects, such as the Tuas Mega Port and Changi Airport Terminal 5, will be built even higher, at 5 meters or more above current mean sea level, demonstrating a commitment to long-term resilience.

Beyond raising land levels, Singapore is actively pursuing comprehensive coastal protection measures. Recognizing that different coastal segments have unique vulnerabilities, the nation is conducting detailed site-specific studies. These studies inform the design and implementation of tailored engineering solutions, including the construction of seawalls, earth mounds, and tidal gates to provide robust defense against rising sea levels and storm surges. Importantly, Singapore is also exploring hybrid solutions that integrate engineering with nature-based elements. The use of mangroves or strategically placed vegetation in front of coastal dikes is being investigated to naturally dissipate wave energy and provide additional protection.

Singapore's approach to climate adaptation is characterized by flexibility. Acknowledging the inherent uncertainties in climate projections, the nation is investing in "no-regret" measures in the short-term actions that provide immediate benefits while also laying the groundwork for more extensive, long-term adaptation strategies as needed. This dynamic approach allows Singapore to respond effectively to evolving climate data and ensure that adaptation measures remain relevant and effective.

3.3. Innovation: Maritime Digitalization and Smart Port

3.3.1. Digital Transformation in Maritime Transport

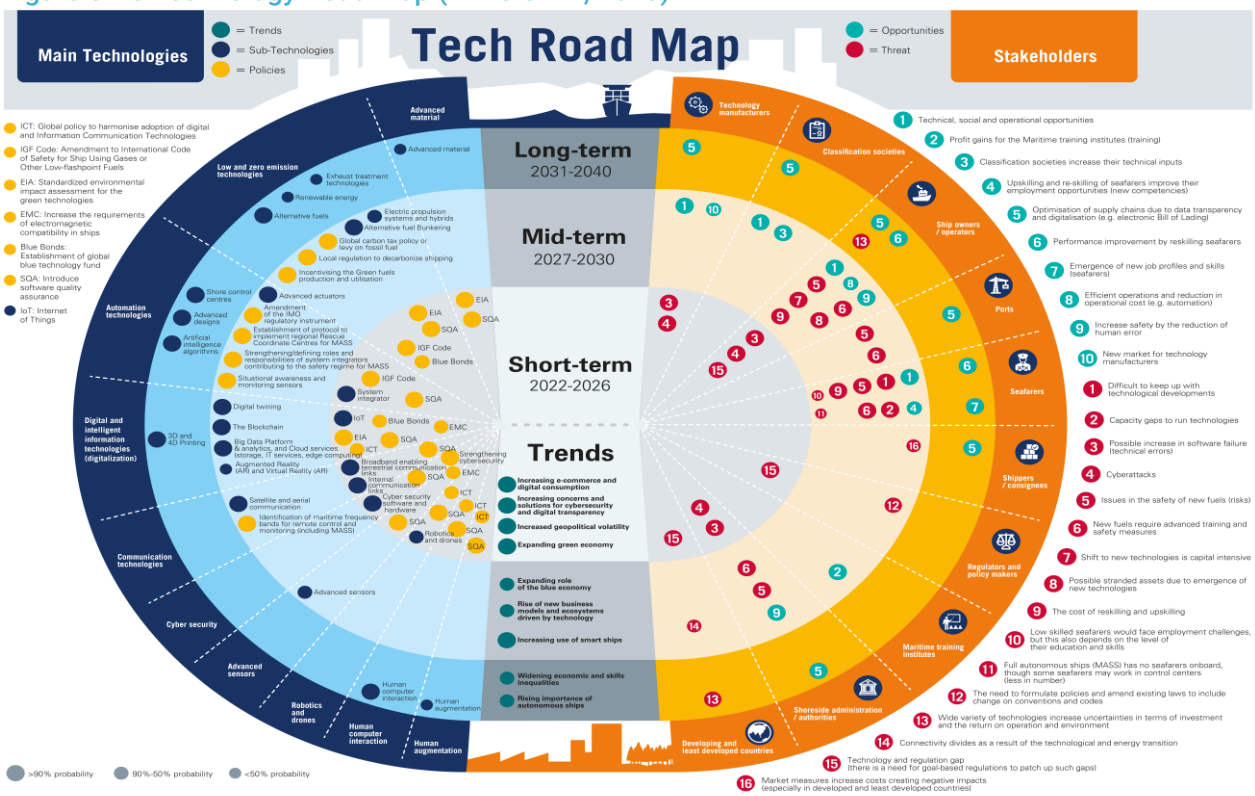
The rapid advancement and integration of digital technologies are revolutionizing industries and daily life worldwide, and the maritime transport sector is no exception. Real-time data collection and sharing are driving greater efficiency in ship operations, port management, and infrastructure maintenance, while digitalization is unlocking new business models in logistics. Technologies such as autonomous ships, automated cranes, and self-driving port vehicles are expected to enhance the reliability, safety, and efficiency of global maritime networks.

To remain competitive, the maritime industry must actively embrace cutting-edge digital solutions. Digitalization also has the potential to bridge technological gaps between nations and regions, fostering a more equitable and interconnected maritime sector.

The Technology Roadmap below for Ships outlines key innovations shaping the future of ship design, construction, and operations (WMU & ITF, 2023). These technologies rely on integration and interoperability, ushering in a new era of smart and connected maritime operations.

However, for successful implementation, global standardization, regulatory alignment, and cross-sector collaboration are crucial. Shipowners, operators, manufacturers, port authorities, policymakers, and investors must work together to drive efficiency, sustainability, and the digital transformation of the maritime industry. The future of maritime technology depends not only on technological innovation but also on strategic cooperation to shape a more resilient and future-ready maritime ecosystem (WMU & ITF, 2023).

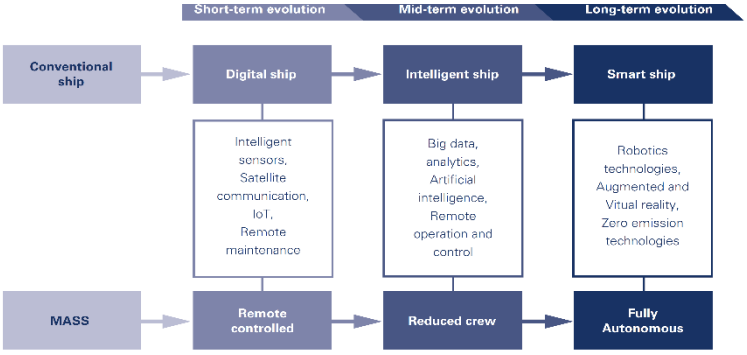
Figure 3-28 Technology Road Map (WMU & ITF, 2023)



3.3.2. Autonomous Ship Technology Development

Innovations in digital technology are transforming ship operations, enhancing efficiency, and enabling the development of smart ships. This transition to smart shipping is expected to improve operational efficiency, promote environmentally friendly maritime transport, and strengthen global maritime connectivity.

Figure 3-29 Future ship evolution



Source: WMU&ITF, Transport 2040

In particular, autonomous navigation technology is being developed and applied to enhance ship operations. The IMO is actively working on establishing regulations for the operation of Maritime Autonomous Surface Ships (MASS) to support their safe and standardized implementation. Autonomous ships utilize artificial intelligence (AI), the Internet of Things (IoT), and advanced sensors to independently perceive and control their surroundings, ensuring safe and cost-effective navigation. These next-generation high-value-added vessels, ultimately capable of unmanned operation, are expected to reduce maritime accidents caused by human error, optimize navigation routes, and improve efficiency in the shipping industry, making them a key factor in shaping the future competitiveness of shipping companies.

The IMO classifies autonomous ship technology into four levels. In 2021, YARA (Norway) successfully demonstrated Level 3 autonomy with a small container vessel carrying minimal crew. In 2022, Japan achieved a milestone by successfully demonstrating fully unmanned departure, navigation, and berthing.

Figure 3-30 Autonomous navigation system sub-technologies

Source: WMU&ITF, Transport 2040

Asia-Pacific countries, with strong shipbuilding capabilities and major hub ports, are actively pursuing the development of autonomous ship technologies, given their crucial role in maritime transport. As industry moves towards international implementation, global cooperation is essential to ensure seamless integration of autonomous vessels into existing maritime operations. In response, ESCAP has been leading international collaboration efforts, launching cooperative projects in 2023 and 2024 to support technological advancements and policy harmonization across the region.

The latest autonomous navigation technology developments in major Asia-Pacific countries are outlined below (UNESCAP, 2023)..

1) China

China is a global leader in the maritime industry, with a strong shipbuilding sector, extensive port infrastructure, and significant investments in autonomous navigation. The government actively supports innovation through policies and funding. Research institutions and companies, such as Wuhan University of Technology and China Classification Society, collaborate on digitalization and automation. China has developed multiple test sites for autonomous vessels, such as Zhuhai, Qingdao, and Dalian. The country's first autonomous cargo ship, *JinDouYun-0*, completed its trial voyage in 2019, and in 2021, the electric container ship *Zhi Fei* was launched with autonomous navigation capabilities. China aims to integrate smart and green shipping technologies, combining automation with electric-powered vessels.

2) Japan

Japan has a long maritime history and remains a key player in global shipping. The government actively supports the sector through policies like the *Ocean Policy* and promotes technological advancements. Major shipbuilding companies, such as Mitsubishi Heavy Industries and Kawasaki Heavy Industries, lead innovation. Japan launched the *MEGURI2040* project to develop fully autonomous ships by 2025, supported by the Nippon Foundation and a consortium of over 30 companies. In 2022, the *Suzaku*, a 749 GT container ship, successfully completed an autonomous navigation trial in Tokyo Bay. Japan focuses on integrating autonomous technologies into ferries and container ships while developing remote control centers for emergency operations.

3) Republic of Korea

The Republic of Korea is a global leader in shipbuilding and shipping, with major companies like HMM. The Korea Autonomous Surface Ship (KASS) Project (2020-2025) aims to develop AI-driven navigation, cybersecurity, and remote-control systems. Leading institutions, including Korea Research Institute of Ships and Ocean engineering (KRISO), Korea Advanced Institute of Science and Technology (KAIST), and Samsung Heavy Industries, are involved. The project plans to launch 250 autonomous ships by 2025. In 2022, Hyundai's Avikus successfully completed an autonomous trans-Pacific voyage of the Liquefied Natural Gas (LNG) carrier Prism Courage, covering 10,800 nautical miles with AI-based navigation, improving fuel efficiency and safety.

4) Russian Federation

The Russian Federation is a pioneer in commercial autonomous navigation. The country conducted the world's largest *Autonomous and Remote Navigation Trial Project (ARNTP)* from 2019 to 2021, leading to commercial operation approvals. Russian ships, such as *Pola Anfisa* and *Mikhail Ulyanov*, use autonomous systems. The Russian Federation's approach follows the *Complete Functional Equivalence* principle, ensuring that autonomous vessels comply with international regulations. The government has integrated AI, remote control, and sensor fusion technologies into its maritime strategy. In 2023, the Russian Federation expected to classify two railway/vehicle carriers with reduced crew as the world's first commercial MASS.

5) Singapore

Singapore is a global maritime hub with advanced port infrastructure. The country benefits from foreign technological developments and government support for autonomous navigation. In 2019, Keppel Offshore & Marine partnered with ABB for an autonomous tug trial at the Port of Singapore, supported by the government and the American Bureau of Shipping (ABS). Singapore's maritime sector prioritizes innovation and digitalization, integrating smart port technologies to enhance efficiency.

3.3.3. Port Digitalization and Smart Port

The future of ports is undeniably moving toward smart ports, marking a transformation driven by automated, intelligent and digitalized systems. The adoption of cutting-edge technologies is continuously expanding, particularly in major port nations, with the aim of enhancing productivity, improving safety, and optimizing port operations.

At the core of smart port development is port digitalization, which has become one of the most crucial and rapidly evolving areas in modern port operations. Port digitalization integrates ICT-based convergence technologies, enhancing traditional port functions with advanced automation, data-driven decision-making, and interconnected systems. This not only improves convenience and efficiency for port users and operators but also drives overall productivity and economic benefits at the national level.

The implementation of digitalization in ports leverages emerging technologies to optimize port operations across all aspects, enhancing safety, connectivity, and collaboration among stakeholders. While port digitalization is a fundamental concept—given the existing use of e-documents, web-based services, and Port Community Systems (PCS)—the COVID-19 pandemic has further accelerated the urgency for digital transformation in the maritime industry.

To fully activate and maximize the benefits of port digitalization, it is essential to establish legal, technical and institutional frameworks that facilitate information sharing and utilization among stakeholders. However, ensuring data security is a critical challenge, as public disclosure of port-related data could risk exposing trade secrets. To mitigate this, anonymous and secure port service platforms should be developed to protect sensitive information while enabling efficient data exchange.

Additionally, specialized workforce training in new port logistics technologies is necessary. Skilled professionals who understand smart port operations, maintenance, and management must be equipped to handle emerging technologies and drive innovation in port logistics and digital infrastructure.

Ultimately, port digitalization aims to streamline operations, enhance efficiency, and improve overall port management by incorporating various advanced technologies. The table below outlines the expected benefits of port digitalization and the corresponding technologies driving these improvements.

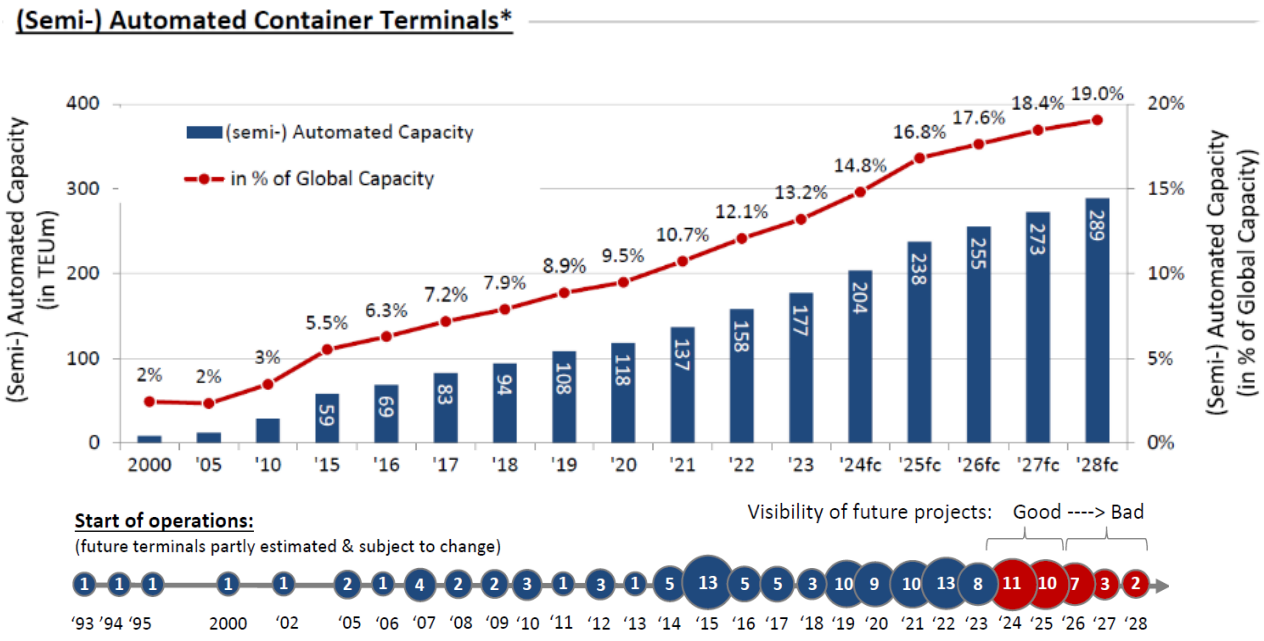
Table 3-5 The expected effects of port digitalization and the corresponding technologies

Effects	Details for effects	Technologies
Effectiveness	◦ Manage all movement and flow of cargo through a state-of-the-art remote-control system ◦ Automate port operations by utilizing automated equipment and facilities ◦ Improve logistics processing speed by reducing ship waiting time and improving the accuracy of unloading operations ◦ Maximize port operation efficiency through analysis and demand forecasting	◦ IOT Sensor ◦ Big data ◦ AI ◦ Cloud ◦ Edge Computing ◦ Automated systems trucks, cranes, etc. ◦ 5G ◦ Digital twin

		◦ Blockchain
Economical	◦ Reducing ship operation costs for ship owners ◦ Solving labour reduction issues through unmanned automation and robotics ◦ Reducing port operation costs with effective port operation processes	◦ Automation ◦ Robotics ◦ Autonomous ships
Safety	◦ Preventing accidents by monitoring workers' safety and work status in real-time ◦ Prevent accidents in advance by deploying unmanned means (drones, robots, etc.) to areas where workers have difficulty accessing	◦ AI, Big data ◦ Drone, Robotics ◦ Autonomous means (ex: ships, cranes, trucks)
Eco-Friendly	◦ Minimize the emission of various pollutants by optimizing the flow and energy use within the port ◦ Minimize carbon emissions by switching to eco-friendly/renewable energy	◦ Electric vehicles and electric ships ◦ Eco-friendly technology ◦ Renewable energy

It is also expected that future port developments will also predominantly adopt automated terminals. As of 2023, 103 automated terminals are in operation worldwide, based on planned global port development projects. By 2028, an additional 33 terminals are expected to adopt automation (with 12 projects currently on hold). If container terminals are automated as planned by 2028, approximately 85 million TEU of new terminal capacity (increasing from 204 million to 289 million TEU) will be introduced compared to 2024, accounting for about 19 percent of the total global container terminal handling capacity. Notably, the adoption of automated terminals is projected to experience significant growth between 2024 and 2026 (DS Research, 2024).

Figure 3-31 Global Automated Container Terminal Capacity Trends



Source: DS Research, Container Terminal Projects 2024

3.3.4. International Cooperation for Maritime Transport Digitalization

3.3.4.1. IMO's Efforts to Establish Regulatory Framework to Promote Digitalization.

The IMO is promoting the digitalization of global shipping and ports. In the shipping sector, it is leading discussions on international standards for Maritime Autonomous Surface Ships (MASS), while in the port sector, it has mandated the implementation of the Maritime Single Window (MSW) to streamline and harmonize port clearance procedures.

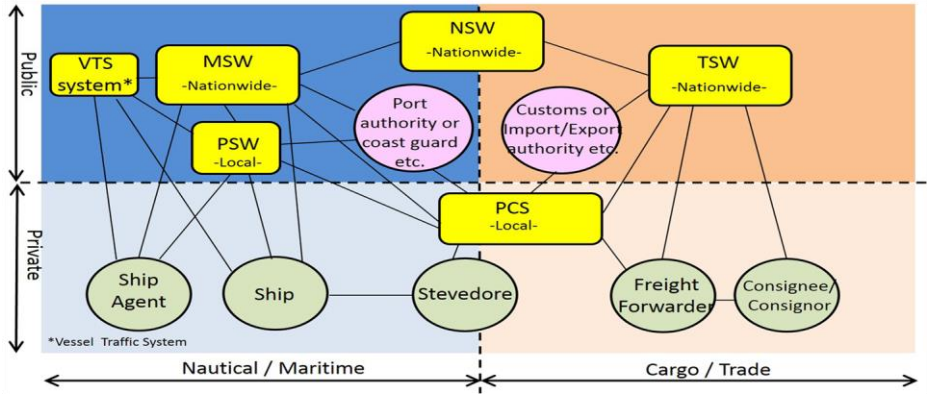
In December 2024, the IMO adopted a revised roadmap for the development of the MASS Code. According to the roadmap, the development of the IMO MASS Code will proceed as follows:

- By 2026: Adoption of a non-mandatory code and development of a framework for the Experience-Building Phase (EBP).
- By 2028: Initiation of the development of a mandatory code based on the non-mandatory code and EBP results.
- By July 1, 2030: Adoption of the mandatory code.
- By January 1, 2032: Entry into force of the mandatory code.

In the port sector, as of January 1, 2024, all IMO member states are required to use MSW. The MSW is a platform designed to simplify port clearance procedures and facilitate the exchange of standardized electronic data. It enables vessels of various nationalities to efficiently complete clearance procedures at foreign ports. Through MSW, the IMO expects to significantly enhance the efficiency of maritime transport by enabling fast and accurate information exchange between ships, ports, and government agencies.

The MSW operates in coordination with other single window systems at the national, trade/cargo, and port levels. It serves as an integrated maritime platform by linking with systems such as the Port Single Window (PSW), which digitalizes information exchange within a single port, and the Vessel Traffic Service (VTS). The National Single Window (NSW), which integrates multiple single window systems within a country, such as the MSW and the Trade Single Window (TSW), provides an environment for collecting, distributing, and exchanging information across various sectors. Depending on national and regional requirements, single window systems may be operated as a unified platform or as interconnected systems.

Figure 3-32: Examples of single window and associated systems relationship



Source: IMO, Guidelines for setting up a maritime single window (2023)

3.3.4.2. Global partnerships for innovation in maritime sector

As digitalization and smart transformation continue to reshape the global shipping and port sectors, international partnerships centered around key stakeholder groups are gaining momentum. Various industry-led initiatives are driving innovation by establishing standardized frameworks and fostering collaboration across the maritime industry.

One of the most significant developments in this transformation is the Digital Container Shipping Association (DCSA), which plays a pivotal role in advancing the digitalization of container shipping. This initiative brings together major global shipping companies to create common standards that streamline operations and improve efficiency. At the same time, terminal operators are focusing on enhancing port automation and smart operations through TIC 4.0 (Technical Industry Committee 4.0), which develops technical standards for terminal digitalization.

Port authorities are also actively engaging in collaborative efforts to accelerate the implementation of smart port solutions. Through the chainPORT initiative, leading global ports are sharing expertise and strategies to enhance digital connectivity. Meanwhile, the International Port Community System Association (IPCSA) is working to standardize Port Community Systems (PCS) and establish global frameworks for seamless information exchange.

These international partnerships, driven by industry stakeholders, are not only fostering innovation within their respective fields but also contributing to the broader digital transformation of the maritime sector. By strengthening interconnectivity and promoting efficiency, they are shaping the future of global trade and logistics.

Table 3-6: Global partnership for maritime digitalization and smart port

Organization	Key Stakeholders	Role
DCSA	Shipping Lines	- Standardizing information and technology in the container shipping sector. - Collaborates with various stakeholders, including shipping companies, freight forwarders, shippers, regulatory bodies, banks, ports and terminals, solution providers, and insurers, to establish a common industry framework.
TIC 4.0	Terminal Operators	- Developing standards to promote the digitalization and automation of the port terminal industry. - Works on creating sensor data collection interfaces for terminal equipment, defining KPIs for equipment performance measurement, and ensuring interoperability of terminal automation systems.
chainPORT	Ports	- A multilateral port partnership aimed at sharing digital transformation solutions and building an intelligent global port network.
IPCSA	Port Community Systems (PCS)	- Facilitating and promoting electronic data exchange related to trade across global Port Community Systems (PCS).

The Role of the Digital Container Shipping Association (DCSA) in Industry Standardization

The Digital Container Shipping Association (DCSA) was established in April 2019 as a neutral, non-profit organization dedicated to promoting the digitalization of the container shipping industry. Founded by major shipping companies—including MSC, Maersk, CMA CGM, Hapag-Lloyd, ONE, Evergreen, Yang Ming, HMM, and ZIM—DCSA aims to develop unified standards that enhance operational efficiency and streamline digital processes across the sector.

Recognizing the complexity of the container shipping ecosystem, DCSA collaborates not only with shipping lines but also with freight forwarders, shippers, regulatory agencies, banks, ports, terminals, solution providers, and insurers. By establishing industry-wide standards, the organization seeks to improve transparency, reduce operational complexity, drive innovation, and facilitate seamless exchange of information.

TIC 4.0: Driving Automation and Smart Terminal Operations

The Terminal Industry Committee 4.0 (TIC 4.0) was established by major terminal operators and port equipment manufacturers to promote the digitalization and automation of port terminals. Recognizing the need for a common technological framework, TIC 4.0 is actively working on developing standardized approaches for data collection, equipment interoperability, and automated terminal operations.

At the core of TIC 4.0's mission is the harmonization of terminal operating equipment standards, ensuring that different technologies and systems can seamlessly integrate. To achieve this goal, the organization focuses on 1) Developing standardized interfaces to collect sensor data from port terminal equipment. 2) Defining Key Performance Indicators (KPIs) to measure efficiency and performance. 3) Establishing technical standards to ensure interoperability between different automation systems.

chainPORT: A Collaborative Initiative for Smart Port Development

As digital transformation becomes a priority for port authorities worldwide, chainPORT has emerged as a key initiative in fostering international collaboration among leading ports. Established in 2016 by the Hamburg Port Authority (HPA) and the Port of Los Angeles, chainPORT provides a platform for ports across Europe, Asia, North America, and Africa to exchange knowledge, develop innovative solutions, and establish a global network of intelligent ports.

Through its annual meetings, member ports engage in discussions on emerging trends, challenges, and technological advancements in the maritime and logistics industries. Additionally, the initiative operates various working groups that focus on different aspects of digital transformation, By facilitating collaboration between some of the world's most advanced ports, chainPORT plays a crucial role in accelerating the digitalization of the port sector, fostering global innovation, and shaping the future of maritime logistics.

IPCSA and the Standardization of Port Community Systems (PCS)

The International Port Community Systems Association (IPCSA) was originally established in 2011 as the European Port Community Systems Association (EPCSA) before expanding into a global organization in 2014. IPCSA plays a crucial role in facilitating the electronic exchange of trade-related data across Port Community Systems (PCS), ensuring seamless integration between different stakeholders in the supply chain.

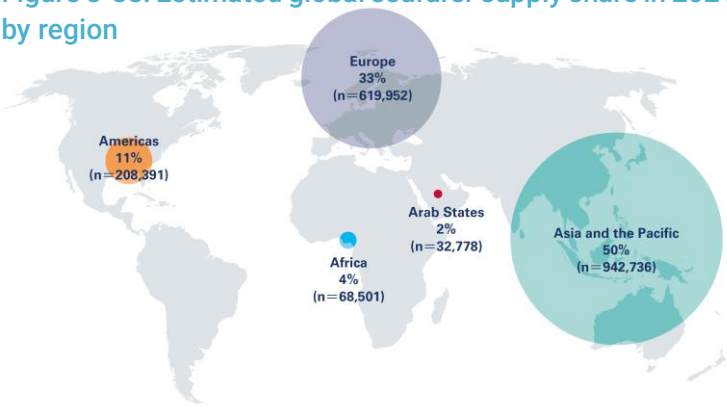
As a key player in global trade facilitation, IPCSA actively collaborates with international organizations, including the World Customs Organization (WCO), the International Maritime Organization (IMO), and the United Nations Conference on Trade and Development (UNCTAD). Through these partnerships, IPCSA is working to accelerate digital transformation in global maritime logistics, improving trade efficiency while ensuring security and regulatory compliance.

3.4. Decent Work: Human Capacity Building & Equality

3.4.1. Global and Asia-Pacific Seafarer Workforce Status and Supply-Demand Trends

As of 2021, the global seafarer workforce was estimated at 1,872,358, with Asia and the Pacific contributing the largest share (50 percent), followed by Europe at 33 percent. Officers were primarily drawn from these two regions, with 45 percent originating from Asia and the Pacific and 40 percent from Europe. Similarly, ratings were most prevalent in Asia and the Pacific, making up 55 percent of the total, while Europe accounted for 27 percent. Overall, Europe supplied 339,121 officers and 280,831 ratings (WMU & ITF, 2023).

Figure 3-33: Estimated global seafarer supply share in 2021 by region



(Source: Adapted from BIMCO & ICS (2021))

Map source: Transport 2040 - Impact of Technology on Seafarers - The Future of Work (WMU & ITF, 2023)
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

In terms of seafarer supply by country, shipping companies report employing officers primarily from the Philippines, China, Ukraine, India, and Russian Federation, while ratings are mainly sourced from the Philippines, China, India, Ukraine, and Indonesia. Notably, four of the top five seafarer-supplying countries are in the Asia-Pacific region.

Figure 3-34: Top 5 seafarer supply countries in 2021 and Top 10 future seafarer supply countries selected by shipping companies

(Source: Adapted from BIMCO & ICS (2021))

Map source: Transport 2040 - Impact of Technology on Seafarers - The Future of Work (WMU & ITF, 2023)
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Looking ahead, future key seafarer supply countries are expected to include Ukraine, Myanmar, the Philippines, India, China, Romania, Greece, Indonesia, Croatia, and the United Kingdom, with these nations continuing to provide crew for conventional ships. However, seafarer supply potential remains largely untapped in other regions, such as Africa, the Americas, and the Pacific/Oceania. These regions could benefit from proactively adapting to industry changes and developing strategies to expand their role in the global seafarer workforce.

On the other hand, the labor market in the shipping and port sectors faces significant challenges in terms of supply and demand. In particular, the shipping industry is experiencing a growing imbalance between the supply and demand of seafarers, driven by factors such as global aging. To ensure the stability and sustainability of the maritime industry, addressing the shortage of seafarers is crucial. According to estimates by BIMCO & ICS (2021), by 2026, there is expected to be a shortfall of approximately 23,000 officers and 26,000 ratings.

Table 3-7: Global Supply and demand balance in Seafarers (persons)

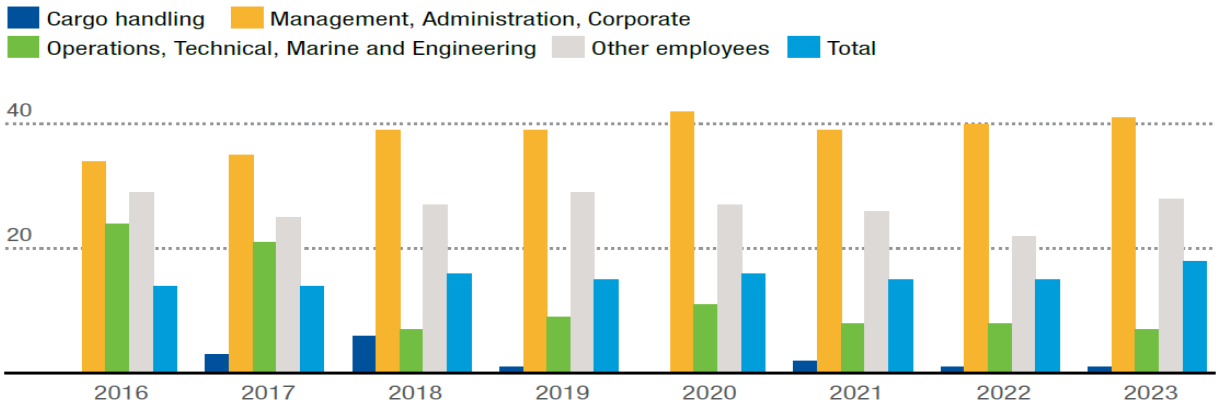
Year	Officers			Ratings		
	Supply	Demand	Balance	Supply	Demand	Balance
2015	790,500	774,000	-16,500	754,500	873,000	118,500
2021	883,780	857,540	-26,240	997,540	1,035,180	37,640
2026(e)	947,050	923,860	-23,190	1,069,500	1,043,320	-26,180

Source: (BIMCO & ICS, 2021)

To address labor shortages in the shipping and port sectors, structural and long-term measures must be established, including the enhancement of seafarer education and training, as well as improvements in working conditions. The maritime industry is currently undergoing rapid transformations driven by decarbonization, digitalization, and automation, highlighting the increasing importance of human capital development. Consequently, education and training must be adapted to meet these evolving industry demands. In response, international organizations such as the IMO and UNCTAD are analyzing the impact of technological innovations on the maritime workforce and developing various training programs to equip seafarers with the necessary skills.

Gender equality remains a significant challenge. As of 2021, the estimated number of female seafarers (both officers and ratings) worldwide was approximately 24,059, reflecting a 45.8 percent increase compared to 2015. However, despite this growth, women still account for only 1.3 percent of the global seafarer workforce (BIMCO & ICS, 2021). In the port sector, the proportion of female employees is relatively higher, with an average employment rate of 18 percent. Nevertheless, this figure indicates that there is still a long way to go in achieving true gender equality in the industry.

Figure 3-35: Women's participation in port workforces, median across all ports (%)



Source: UNCTAD, Review of maritime transport 2024 (2024)

3.4.2. International Initiatives for Strengthening Maritime Transport Workforce Capacity

3.4.2.1. IMO's Initiatives for Seafarer Training and Workforce Development

Existing maritime regulations have yet to fully integrate autonomous and digital technologies, leaving many seafarers without the necessary digital skills to operate smart ships. This skills gap increases the risk of job losses among low-skilled seafarers. On the other hand, the transition to green shipping—such as the adoption of alternative fuels, carbon emission reduction, and energy efficiency improvements—is expected to create new employment opportunities. Sectors like offshore wind energy, electric propulsion ships, and eco-friendly port management are anticipated to see significant job growth.

STCW Convention and Its Revisions

The IMO's Standards of Training, Certification, and Watchkeeping for Seafarers (STCW) Convention establishes uniform competency standards for seafarers worldwide, ensuring they meet consistent qualifications and reducing the risk of human error. The convention has undergone multiple revisions to keep pace with industry changes.

As the maritime industry undergoes rapid transformation—driven by autonomous ships and alternative fuel technologies — there is increasing demand for a comprehensive revision of the STCW Convention. The IMO has set a goal to complete a full revision of the STCW Convention and Code by 2027.

In February 2024, the 10th Human Element, Training and Watchkeeping (HTW) Sub-Committee outlined a review framework addressing technological advancements. This framework was later approved at the 108th session of the Maritime Safety Committee (MSC) in May 2024. Moving forward:

- An Intersessional Working Group Meeting will be held before the 11th HTW Sub-Committee in February 2025 to refine the initial draft.
- Throughout 2026, international consultations and further amendments will take place, along with the development of technical guidelines and training programs.
- In 2027, the final revised STCW Convention will be adopted, and implementation support systems will be established, introducing new certification and training requirements.

The comprehensive review focuses on 22 key areas, reflecting advancements in maritime technology and the evolving needs of seafarers. This comprehensive revision aims to modernize the training framework, strengthen seafarers' competencies in line with emerging technologies, and support the maritime industry's shift towards sustainable operations. By integrating new training standards, the revised STCW Convention will enhance maritime safety, efficiency, and environmental sustainability, while also fostering the growth of green jobs.

Table 3-8: IMO's Comprehensive Review of the STCW Convention

	Specific Areas Identified	Proposed Actions
1	Emerging technologies on ships and ship operations	Review existing standards to address provisions established by IMO and other relevant instruments.
2	Digitalization of documentation, including certificates issued under STCW	Facilitate the utilization of electronic documentation and validate certificates.
3	Emerging technologies in education and training	Incorporate emerging instructional and assessment techniques, such as distance learning.

4	Facilitation, flexibility and quality of onboard, shore-based and workshop skills training, including use of simulators	Improve the quality and flexibility of onboard training, shore-based, and workshop skills training.
5	Flexibility and efficiency in implementation of new training requirements and reduction of administrative burdens	Identify provisions for a viable and efficient amendment process for new training standards.
6	Requirements for sea time or practical experience in relation to new and emerging technologies including the use of simulation	Consider the use of simulation as an alternative to a portion of the sea service requirement.
7	Psychological safety, bullying and harassment, including SASH, gender diversity and gender sensitization	Incorporate psychological safety, bullying and harassment, including SASH, into training requirements.
8	Mental health	Incorporate mental health concepts into seafarer training requirements.
9	Twenty-first century and interpersonal skills	Address digital skills, communication, and adaptability to a changing work environment.
10	Addressing inconsistencies	Address inconsistencies, duplications, and different interpretations in the STCW text.
11	Addressing different interpretations	Clarify issues arising from inconsistent interpretations of various standards.
12	Addressing taxonomy and terminologies	Ensure consistent terminology aligned with modern educational systems.
13	Flexibility in revalidation of certificates and endorsements	Provide flexibility for revalidation of certificates and endorsements under normal and exceptional circumstances.
14	Overview of the implementation of the Convention, in particular the need to update the STCW 'White List'	Clarify provisions related to quality standard systems and compliance with the STCW Convention.
15	Lessons learned	Incorporate lessons learned from previous amendments and extraordinary circumstances like COVID-19.
16	Flexibility	Facilitate seafarer mobility across different ship types and trades.
17	Alternative certification under chapter VII	Utilize alternative certification to accommodate emerging technologies and organizational changes.
18	Watchkeeping arrangements and principles to be observed (chapter VIII)	Support the use of emerging technologies in watchkeeping arrangements.
19	Alignment of STCW with requirements placed on ships, seafarers, and shipowners by other IMO and relevant international instruments	Ensure alignment with IMO and other relevant international instruments.
20	Cybersecurity	Address the need for cybersecurity awareness for seafarers.
21	Implementation and transitional provisions	Ensure efficient implementation of amendments with reasonable transitional provisions.
22	Addressing outdated training requirements	Update outdated competences, KUPs, and training requirements.

Source: (IMO, 2023)

Promoting Gender Diversity in Maritime Workforce

In addition to workforce training, the IMO is actively promoting gender inclusivity in the maritime sector through the Women in Maritime Association (WIMA). WIMA operates across eight global regions, including the Pacific, Asia, Africa, and the Caribbean, offering specialized training and networking opportunities for women in the maritime industry.

Key initiatives include:

- Training programs focused on port operations, digitalization, and sustainability.
- Mentorship programs aimed at experience-sharing and skills development.
- Awareness campaigns to break cultural biases and encourage women's participation in maritime careers.

To further assess and improve gender diversity in the industry, the IMO has partnered with WISTA (Women's International Shipping & Trading Association) to conduct the Women in Maritime Survey. The first survey, conducted in 2021, revealed low female representation in the shipping industry. A second survey, planned for 2025, aims to collect more comprehensive data and drive gender-inclusive policy improvements.

Through these initiatives, the IMO is fostering human capital development in the maritime industry, strengthening workforce sustainability, and enhancing industry competitiveness by expanding female participation and digital skill capabilities.

3.4.2.2. UNCTAD's Port Management Programme (PMP)

The United Nations Conference on Trade and Development (UNCTAD) operates various training and technical assistance programs to enhance the maritime and port management capacities of developing countries. One of its flagship initiatives is the Train For Trade Port Management Programme (PMP), which focuses on equipping port managers and maritime personnel with management skills and knowledge of the latest industry trends to ensure both operational efficiency and environmental sustainability in port operations (UNCTAD, 2025).

UNCTAD's PMP is centered around digitalization, green technology adoption, and sustainability. The program provides tools such as the Port Performance Scorecard (PPS) to help monitor port efficiency and develop strategic improvements. It also offers training in port operations, digital logistics management, and environmental management, providing practical guidance on renewable energy use, carbon emission reduction, and waste management (UNCTAD, 2023).

The PPS serves as a critical tool within the PMP, offering key performance indicators (KPIs) to strengthen the competencies of port managers. It includes comprehensive metrics that assess operational efficiency, financial performance, environmental sustainability, and social impact, enabling benchmarking among ports and data-driven decision-making. To date, over 2,000 port managers have been trained through the PPS, contributing to the resilience of the global maritime logistics network (UNCTAD, 2023).

UNCTAD provides comprehensive information on the PPS through its official website, offering guidelines and case studies to help port managers effectively utilize key performance metrics. These initiatives enhance the technical capacity of ports in developing countries, promote the sustainability of global supply chains, and drive digital transformation and green technology adoption. Additionally, UNCTAD's programs emphasize gender inclusivity, encouraging greater participation of women in the maritime and port industries, thereby fostering diversity and inclusivity in the sector.

3.4.2.3. APEC's Efforts to Promote Gender Equality in the Maritime and Port Industries

The Asia-Pacific Economic Cooperation (APEC) is actively working to enhance gender equality in the transport sector by expanding female workforce participation and strengthening capacity-building programs in the shipping and port industries. To support the development of maritime professionals, APEC established the APEC Seafarers Excellence Network (APEC SEN) in 2017 (APEC, 2024).

APEC SEN consists of 11 member economies and operates through three specialized expert groups:

- Expert Group on Maritime Education and Training
- Expert Group on Seafarers' Better Welfare
- Expert Group on Career Development and Job Transition

APEC is also committed to increasing women's participation in the maritime industry through the Women in Transport (WiT) Program. This initiative aims to facilitate women's entry into the transport sector, support job retention, and develop female leadership. The WiT Program focuses on leadership development and digital transformation training, equipping women in the shipping and port sectors with the necessary skills to strengthen their professional competencies and build sustainable careers. Moreover, APEC provides a platform for member economies to share best practices and implement policies that promote female participation in transport-related fields.

As part of the WiT Program, APEC SEN operates the Executive Certificate Course on Empowering Women in the Global Maritime Industry. This course is conducted in collaboration with WISTA (Women's International Shipping & Trading Association) and WIMA ASIA (Women in Maritime Association Asia), supporting networking and capacity-building for female maritime professionals. The program covers key topics such as the latest maritime industry trends, digitalization, sustainability, and leadership development, helping participants take on significant roles in the global maritime industry.

3.4.2.4. PacWIMA's Empowering Women in the Pacific Maritime Sector

Pacific countries are making significant efforts to increase women's participation in the maritime sector. In 2005, with support from the Pacific Community (SPC) and the International Maritime Organization (IMO), the Pacific Women in Maritime Association (PacWIMA) was established. This was the first official initiative to promote women's involvement in the maritime sector in the Pacific region, leading to the subsequent formation of State Women in Maritime Associations (StateWIMAs) in several Pacific Island nations.

Particularly in capacity building and education support, PacWIMA takes a comprehensive approach by providing specialized training in port operations, maritime safety, and green technologies. It strengthens practical skills through technology-based training and mentoring programs, helping women develop professional expertise. Additionally, PacWIMA expands opportunities for women to participate in international conferences, fostering global networking and encouraging greater involvement in policy decision-making processes.

The impact of these efforts is evident in statistics recorded in SPC's Regional Strategy for Pacific Women in Maritime (2020–2024). Data from 2017 highlights the growing presence of women in port management and operations, as well as in maritime education institutions, where they contribute as professors and trainers in developing the next generation of maritime professionals. Notably, women's participation in environmental management and sustainability projects is particularly significant. Women play key roles in marine ecosystem restoration and carbon emission reduction projects, making substantial contributions to the sustainable development of the maritime industry.

CHAPTER 4

CLOSING MARITIME CONNECTIVITY GAPS: the Case of the Pacific Small Island Developing States

4. CLOSING MARITIME CONNECTIVITY GAPS: the Case of the Pacific Small Island Developing States

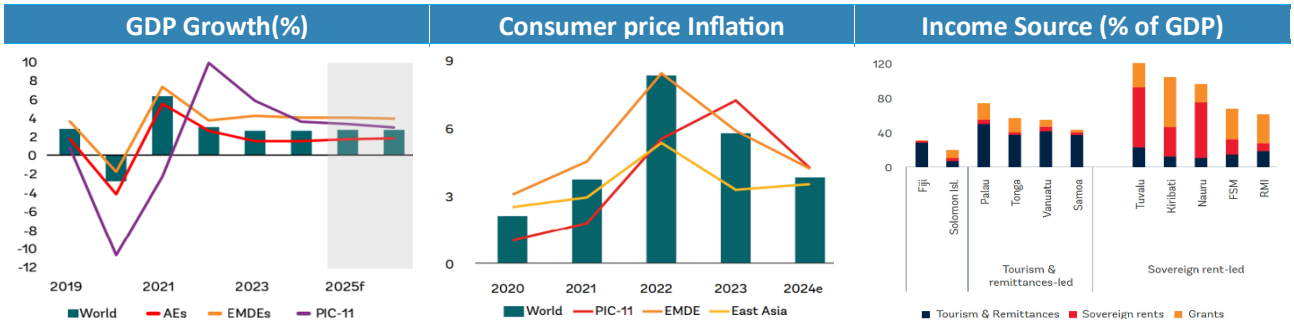
4.1. Status and features of the shipping and port sector

4.1.1. Overview of the Regional Status of Pacific Island Countries

4.1.1.1. Economic status

Pacific island countries, excluding Australia, New Zealand and Papua New Guinea, have very small economies, leading to a persistent trade deficit in their trade structure. Their economies are generally service-oriented, with a heavy reliance on primary industries and tourism. This structure contributes to significantly higher imports compared with exports. Owing to the imbalance in import and export volumes and their remoteness from major global shipping routes, maritime connectivity is weak, resulting in high shipping costs. Consequently, these countries are highly sensitive to changes in the external economic environment, with relatively large fluctuations in economic growth rates, depending on global economic conditions. Additionally, as island nations, they are particularly vulnerable to external factors such as climate change and natural disasters.

Figure 4-1: Economy status of Pacific Island countries



Remark: 1) EMDEs Emerging Market and Developing Economies, 2) PIC11 - - Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Palau, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu
Source: World bank(2024a), World bank(2024b)

Figure 4-2 Trade status of Pacific Island countries (Case of Fiji, Tonga)

Source: Pacific Data Hub

4.1.1.2. Shipping & logistic status

Maritime cargo volumes in Pacific Islands countries vary significantly by country, with most SIDS, except for Fiji and Papua New Guinea, having relatively low cargo volumes compared with other nations. As the Pacific region consists mostly of small island countries[7], they heavily depend on maritime transport for trade. However, owing to structural factors, such as differences in economic scale and external economic conditions, annual fluctuations in maritime cargo volumes tend to be considerable.

Table 4-1: Seaborne trade volume of Pacific countries (thousand Tons)

Countries	2019	2020	2021	2022	2023	2024	CAGR
American Samoa	196	135	166	188	172	214	1.7%
Australia	1,613,172	1,606,195	1,638,678	1,671,700	1,696,204	1,658,579	0.6%
Cook Islands	114	72	78	87	101	138	4.0%
Fiji	3,493	2,953	3,005	3,309	3,221	2,782	-4.5%
French Polynesia	647	600	691	691	639	631	-0.5%
Guam	1,249	1,048	1,167	1,155	1,198	1,027	-3.8%
Kiribati	172	168	156	169	152	156	-1.9%
Marshall Islands	12,467	14,928	15,086	14,389	15,110	15,429	4.4%
Federated States of Micronesia	177	177	204	186	198	290	10.4%
Nauru	194	300	414	373	308	302	9.3%
New Caledonia	10,477	10,990	10,046	12,029	10,607	7,782	-5.8%
New Zealand	63,397	58,369	61,866	56,655	55,181	57,093	-2.1%
Niue	99	107	19	29	33	14	-32.5%
Northern Mariana	120	147	57	117	152	160	5.8%
Palau	63	74	94	96	109	122	14.1%
Papua New Guinea	30,486	39,775	41,683	36,352	31,983	29,454	-0.7%
Samoa	384	333	350	402	348	355	-1.6%
Solomon Islands	3,734	2,980	2,053	1,906	1,908	2,505	-7.7%
Tonga	249	178	184	178	156	131	-12.1%
Tuvalu	109	161	183	161	175	134	4.3%
Vanuatu	247	296	330	366	327	385	9.2%

Note: The unit is '000 M/T, representing the total maritime import and export cargo volume.
Source: Compiled and analyzed by KMI based on S&P Global data

Excluding Australia and New Zealand, Fiji and Papua New Guinea have the highest seaborne trade volumes among Pacific Island countries. Overall cargo volume growth is not expected to be significant by 2030, though Australia, Nauru, and Federated States of Micronesia are projected to experience relatively higher growth rates.

[7] The 12 countries designated by the United Nations as SIDS in the Pacific region include Fiji, Kiribati, the Marshall Islands, the Federated States of Micronesia, Nauru, Palau, Papua New Guinea, Samoa, the Solomon Islands, Tonga, Tuvalu and Vanuatu. In addition, autonomous territories such as American Samoa, the Cook Islands, French Polynesia, Guam, New Caledonia and Niue are also included.

Table 4-2: Seaborne containerized trade volume of Pacific countries (thousand TEU)

Countries	2019	2023	2024(f)	2025(f)	2030(f)	CAGR
American Samoa	13.8	12.9	11.6	9.9	9.7	-3.2%
Australia	4,666.0	5,218.8	5,454.8	5,611.8	6,390.7	2.9%
Cook Islands	11.8	12.1	13.6	13.2	13.4	1.2%
Fiji	146.8	106.8	108.3	107.4	113.8	-2.3%
French Polynesia	59.8	50.5	50.5	50.5	53.1	-1.1%
Guam	18.6	21.0	20.2	18.3	19.0	0.2%
Kiribati	20.0	15.2	16.0	15.3	16.2	-1.9%
Marshall Islands	42.1	37.1	38.6	38.7	44.1	0.4%
Federated States of Micronesia	18.2	18.1	22.1	22.6	25.3	3.0%
Nauru	9.7	17.0	17.7	19.1	20.2	6.9%
New Caledonia	117.1	112.4	138.8	140.7	157.8	2.7%
New Zealand	1,718.6	1,490.2	1,527.0	1,552.8	1,725.6	0.0%
Niue	1.7	5.5	3.4	0.7	0.7	-7.7%
Northern Mariana	7.1	7.3	7.1	5.9	5.9	-1.7%
Palau	8.7	12.4	12.7	12.2	12.8	3.6%
Papua New Guinea	232.0	235.4	213.2	201.1	229.1	-0.1%
Samoa	32.4	26.7	26.4	26.1	27.5	-1.5%
Solomon Islands	79.7	62.6	65.8	66.8	73.3	-0.8%
Tonga	16.7	14.4	14.9	14.7	16.2	-0.3%
Tuvalu	12.8	15.1	16.1	16.4	19.3	3.8%
Vanuatu	30.0	30.4	30.1	29.0	30.5	0.2%

Note: The unit is '000 TEU, with figures from 2024 onward being projections, representing the total maritime import and export container cargo volume.
Source: Compiled and analyzed by KMI based on S&P Global data

Pacific island countries generally have relatively low levels of connectivity in liner shipping services due to their small cargo volumes. Recently, Kiribati, Tonga, the Marshall Islands, and Micronesia have shown a notable increase in maritime connectivity.

Table 4-3: LSCI (Liner Shipping Connectivity Index) of Pacific countries

Countries	2019	2020	2021	2022	2023	2024	CAGR ('19-'24)
American Samoa	26.1	28.6	28.3	28.2	28.4	26.8	0.5%
Australia	145.8	140.4	146.8	149.6	149.8	141.7	-0.6%
Cook Islands	7.7	9.6	9.3	9.3	8.2	8.2	1.4%
Fiji	37.5	37.2	38.0	39.8	40.3	41.9	2.2%
French Polynesia	37.3	40.3	41.5	37.8	39.9	40.7	1.8%
Guam	22.6	22.9	22.8	22.8	22.8	22.9	0.2%
Kiribati	7.6	15.5	15.4	16.0	16.6	16.2	16.3%
Marshall Islands	17.2	23.3	22.8	21.6	21.6	21.6	4.7%
Federated States of Micronesia	12.8	14.4	15.0	15.0	15.0	15.0	3.2%
Nauru	4.5	-	-	-	-	-	-
New Caledonia	37.8	40.0	40.5	40.2	43.5	46.0	4.0%
New Zealand	92.9	90.4	95.7	100.4	105.1	90.1	-0.6%
Niue	-	5.8	5.8	5.8	5.8	5.8	
Northern Mariana Islands	16.5	15.8	15.5	15.1	15.1	15.1	-1.7%
Palau	8.5	7.8	7.4	6.9	6.9	6.9	-4.2%
Papua New Guinea	44.3	44.6	45.5	45.5	48.8	49.5	2.3%
Samoa	29.3	31.0	32.5	32.4	31.4	29.7	0.2%
Solomon Islands	33.5	30.2	30.0	28.4	31.3	30.6	-1.8%
Tonga	24.7	24.0	29.0	27.2	28.8	28.6	3.0%
Tuvalu	5.1	4.8	4.4	4.1	4.8	4.5	-2.3%
Vanuatu	22.5	23.8	24.0	23.3	24.7	25.4	2.5%

Source: Compiled and analyzed by KMI based on UNCTAD data

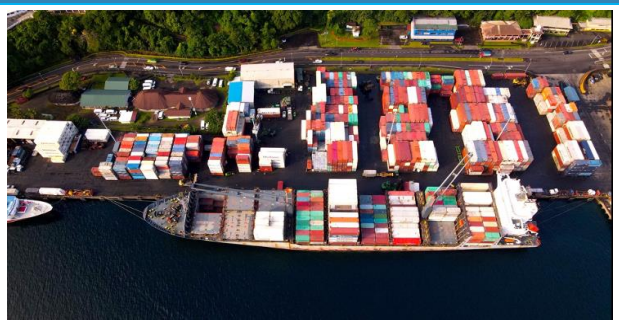
4.1.2. Shipping and ports status by states, non-self-governing-territories and territories

4.1.2.1. American Samoa

The main port of American Samoa is Pago Pago Port, located on Tutuila Island, which serves as the country's only international trade port. Pago Pago Port consists of a container terminal, a multipurpose wharf, a service wharf, and an inter-island terminal. The port primarily exports tuna and tuna products while importing essential goods, construction materials, and petroleum products.

The Department of Port Administration (DPA) is responsible for the management and operation of both airports and ports in American Samoa, while the U.S. Coast Guard (USCG) provides security and safety support for the port. Other ports in the region include Auasi Port, Aunu'u Port, Ofu Port, Ta'u Port, and Faleasao Port, which mainly serve inter-island transportation for local residents and small-scale fishing activities, accommodating small ferries and fishing boats.

Figure 4-3: Major port in American Samoa

Geographical Location of American Samoa	Pago Pago Port
	

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; American Samoa Department of Port Administration, https://portadministration.as.gov/
Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

As of 2023, American Samoa's maritime cargo volume totaled 12,931 TEU, fluctuating around 13,000 TEU over the past five years. The region exhibits a significant trade imbalance, with imports consistently exceeding exports. While imports have remained stable at over 8,000 TEU, exports have declined from 5,602 TEU in 2019 to 4,605 TEU in 2023, reflecting an average annual decrease of -4.8 percent. This trend underscores the economy's high dependence on imports for essential goods and raw materials, as well as the limited export industry, primarily centered on tuna processing.

Table 4-4: Seaborne containerized trade volume of American Samoa (TEU)

	2019	2020	2021	2022	2023	CAGR('19-'23)
Export	5,602	4,446	4,837	4,888	4,605	-4.8%
Import	8,180	8,561	8,732	8,507	8,326	0.4%
Total	13,782	13,007	13,569	13,395	12,931	-1.6%

Source: Compiled and analyzed by KMI based on S&P Global data

The maritime connectivity of Pago Pago Port has improved overall, rising from 42.69 in 2010 to 55.88 in 2024. Regular South Pacific liner services from Australia, New Zealand, and the United States of America are operated by shipping companies such as Matson and Swire Shipping.

Table 4-5: LSCI of major port in American Samoa

Port	2010	2015	2019	2020	2021	2022	2023	2024	Average
Pago Pago	42.69	48.36	54.22	58.74	58.33	55.27	57.84	55.88	53.94

Note: Data for 2024 includes up to the third quarter, with only major ports for each country presented.
Source: Compiled and analyzed by KMI based on S&P Global data

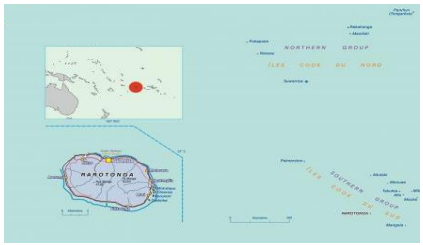
4.1.2.2. Cook Islands

The main port of the Cook Islands is Avatiu Port, located on Rarotonga Island, serving as the country's only international trade port and a key tourism hub. It handles most cargo, including containers, and features a single 260-meter-long wharf, warehouses, and other port facilities.

Arutanga Port also handles some container cargo. However, its vessel accessibility is limited owing to a lack of proper port infrastructure. As a result, cargo is transported to shore via barges outside the port.

The Cook Islands Ports Authority (CIPA), a subsidiary of the Cook Islands Investment Corporation (CIIC), is responsible for the operation and management of the country's major ports. Cargo and passenger transport between the main ports and outer islands is facilitated by nationally operated cargo ships. However, owing to fluctuating demand, regular shipping schedules are not maintained, leading to service variability.

Figure 4-4: Major ports in Cook Islands

Geographical Location of Cook Islands	Avatiu Port	Arutanga Port
		

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members
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The Cook Islands highly depends on Australia and New Zealand, from which it receives economic support. The economy is primarily reliant on tourism, with Avatiu Port serving as the main gateway for imports such as food and fuel, reflecting the country's substantial reliance on imports. As of 2023, total maritime cargo volume stood at 12,134 TEU, with imports accounting for approximately 90 percent of the total.

Table 4-6: Seaborne containerized trade volume of Cook Islands (TEU)

	2019	2020	2021	2022	2023	CAGR('19-'23)
Export	1,417	1,383	1,698	1,385	1,319	-1.8%
Import	10,423	9,191	10,212	10,976	10,815	0.9%
Total	11,840	10,574	11,910	12,361	12,134	0.6%

Source: SPC (https://www.spc.int/our-members); Cook Islands Ports Authority(2024a), Cook Islands Ports Authority(2024b)

The Cook Islands has a relatively low level of maritime connectivity. Regular liner services from Australia and New Zealand are provided by Swire Shipping, Matson, and other operators, serving select Pacific Island nations.

Table 4-7: LSCI of major ports in Cook Islands

Port	2010	2015	2019	2020	2021	2022	2023	2024	Avergage
Arutanga	-	16.49	11.20	14.94	15.38	15.38	11.90	11.94	13.34
Avatiu	12.86	23.61	16.50	19.60	20.05	20.05	16.57	16.61	16.10

Note: Data for 2024 includes up to the third quarter, with only major ports for each country presented.
Source: Compiled and analyzed by KMI based on UNCTAD data

The Cook Islands' maritime and port sector faces several key challenges, including insufficient port infrastructure, difficulties in hiring skilled personnel, high dependence on fossil fuels and the operation of ageing vessels. Major areas requiring capacity building include climate change adaptation, legal and regulatory frameworks, technological advancements and the development of environment-friendly ports.

For long-term development and investment, priorities include promoting renewable energy use, adopting eco-friendly port equipment and ensuring safe navigation through adequate water depth maintenance (Cook Islands Ports Authority, 2024).

Recently, key cargo handling equipment at Avatiu and Arutanga Ports has been replaced. Additionally, under the leadership of CIPA (Cook Islands Ports Authority), several projects are underway at Arutanga Port, including the introduction of cranes, dredging of the port and waterways to improve vessel accessibility, and expansion of berthing facilities. The first phase of dredging has been completed, and the second phase, focusing on port area development, is currently in progress (Cook Islands Ports Authority, 2024).

4.1.2.3. Fiji

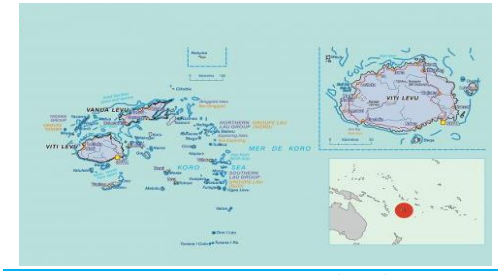
Port and Lautoka Port, serve as international trade hubs, handling over 95 percent of Fiji's cargo.

Suva Port has three berths, accommodating container vessels of up to 3,500 TEU; it handles containers, fuel and general cargo. Lautoka Port processes containers, bulk cargo and general cargo.

Fiji's ports are managed and operated by the state-owned enterprise, Fiji Ports Corporation Limited (FPCL). The five main ports under FPCL include Suva Port, Lautoka Port, Levuka Port, Malau Port and Wairiki Port.

Additionally, 46 jetty-type berthing facilities are installed across the country, primarily serving outer island regions. Most of these facilities are installed and managed by the government or FPCL, except for a few privately owned structures.

Figure 4-5: Major Ports in Fiji

Geographical Location of Fiji	Port of Suva	Port of Lautoka
		

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; FPCL(https://www.fijiportsterminal.com/facilities)

Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

As of 2023, Fiji's container cargo volume totaled 106,798 TEU, showing a gradual decline over the past five years. However, unlike many other Pacific Island countries, Fiji maintains a relatively balanced trade structure between imports and exports.

Suva Port, Fiji's largest port and a regional hub for Pacific Island countries, handles not only domestic cargo but also a significant volume of transshipment cargo. In 2023, Suva Port's total cargo volume reached 106,000 TEU, with transshipment cargo accounting for approximately 22 percent. With the recent increase in transshipment cargo, Lautoka Port has also seen growth in its transshipment handling capacity.

Table 4-8: Seaborne containerized trade volume of Fiji (TEU)

	2019	2020	2021	2022	2023	CAGR('19-'23)
Export	74,706	66,796	73,232	76,026	45,838	-11.5%
Import	72,087	66,195	65,217	71,224	60,960	-4.1%
Total	146,793	132,991	138,449	147,250	106,798	-7.6%

Source: Compiled and analyzed by KMI based on S&P Global data

Table 4-9: Container Throughput in major port of Fiji (TEU, Year of 2023)

Port	Export	Import	Transshipment	Total
Suva	42,810	40,385	23,661	106,856
Lautoka	38,264	41,273	374	79,911

Source: Fiji Ports corporation Limited (2024)

Fiji serves as a key port of call for most regular shipping routes operating in the Pacific Island region. As of 2023, it is connected to 23 shipping routes, giving it a higher level of maritime connectivity compared to other Pacific Island nations. Due to this strong network, both Suva and Lautoka Ports have shown continuous growth in maritime connectivity levels over time.

Table 4-10: LSCI of major ports in Fiji

Port	2010	2015	2019	2020	2021	2022	2023	2024	Average
Lautoka	82. 86	57. 94	68, 49	72, 27	81, 47	78. 82	82. 11	86. 91	74, 23
Suva	73.36	84.95	71.84	77.35	83.43	84.81	86.62	90.86	87.72

Note: Data for 2024 includes up to the third quarter, with only major ports for each country presented.
Source: Compiled and analyzed by KMI based on S&P Global data

Fiji is implementing its "Green Port Master Plan (2019–2023)" under the framework of the National Development Plan, led by FPCL. This plan focuses on enhancing energy efficiency, improving air quality and managing waste. Additionally, Fiji actively participates in various regional initiatives and organizations, including the Secretariat of the Pacific Regional Environment Programme, 6PAC+ Alliance, Maritime Technology Cooperation Centre, Pacific Maritime Transport Alliance and Pacific Community, to advance the maritime and port sector.

However, like many other countries, ageing infrastructure remains a major challenge, requiring significant improvements and investments. Key issues in the maritime transport sector include the need for disaster risk planning for port infrastructure, limited technical capacity for disaster monitoring and restricted access to information. The lack of national plans and strategies addressing these challenges has weakened policy effectiveness, leading to long delays in implementation (Fiji Ports corporation Limited, 2024).

Fiji is currently advancing development projects for Suva Port, Lautoka Port and small pier facilities. Owing to Suva Port's ageing infrastructure, the government is conducting a feasibility study for a new port development to replace it.

Meanwhile, Lautoka Port is undergoing the expansion of its wharf facilities to accommodate rising vessel and cargo demand. The Australian Infrastructure Financing Facility for the Pacific (AIFFP) is conducting a feasibility study for this development. Potential tentative port development sites include Nabouwalu, Natovi and Malau.

Figure 4-6 New Port Development Plan in Fiji

Port of Nabouwalu	Port of Natovi	Port of Malau
		

Source: Fiji Ports corporation Limited (2024)

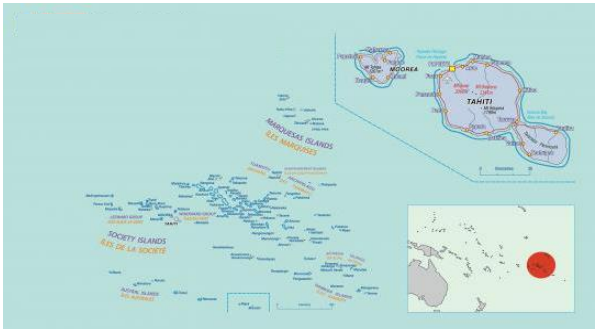
4.1.2.4. French Polynesia

As of 2023, French Polynesia has a population of approximately 280,000, with 76 of its 118 islands being inhabited. The territory operates around 20 vessels, facilitating maritime transportation between islands.

The main port, Papeete Port, is the only international trade port and is located in Papeete, the capital of Tahiti, the largest island in French Polynesia. The port handles 90 percent of the country's imported goods, serving as a central logistics hub for distributing cargo to other islands.

Maritime administration falls under the responsibility of the Direction Polynésienne des Affaires Maritimes (DPAM), while the Port Autonome de Papeete manages and operates Papeete Port. The port is equipped with three berths for container and cargo ships, two berths for oil tankers with a capacity of up to 45,000 tons, and a dedicated unloading facility for butane gas. It provides berthing facilities for large cruise ships and inter-island ferries, supporting both tourism and domestic transportation.

Table 4-11: Major port in French Polynesia

Geographical Location of French Polynesia	Papeete Port
	

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; Port Autonome de Papeete(https://www.portdepapeete.pf/)
Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whats oever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

In 2023, French Polynesia's total maritime cargo volume reached 50,506 TEU, showing a declining trend in recent years. The country's trade structure is highly imbalanced, with imports significantly outweighing exports.

The main industries include tourism, black pearl farming, fisheries and agriculture. Key export products consist of black pearls and pearl-related products, seafood and vanilla. French Polynesia's Imports are heavily reliant on essential goods, including petroleum products, food, machinery and transport equipment and construction materials. Its major trading partners include France, Hong Kong, China, the United States of America and Singapore, with mainland France being the most dominant trade partner (ISPF, 2024).

Table 4-12: Seaborne containerized trade volume of French Polynesia (TEU)

	2019	2020	2021	2022	2023	CAGR('19-'23)
Export	7,626	6,656	6,542	7,785	4,893	-10.5%
Import	52,201	50,793	53,063	54,658	45,613	-3.3%
Total	59,827	57,449	59,605	62,443	50,506	-4.1%

Source: Compiled and analyzed by KMI based on S&P Global data

Papeete Port's regular liner services primarily connect Asia, Oceania, Europe, and North America. Major shipping companies providing these services include Maersk, CMA CGM, Swire Shipping, Pacific Forum Line (PFL), and Marflet.

Table 4-13: LSCI of major port in French Polynesia

Port	2010	2015	2019	2020	2021	2022	2023	2024	Average
Papeete	82.86	81.70	84.70	86.52	89.24	79.61	83.41	84.90	83.50

Note: Data for 2024 includes up to the third quarter, with only major ports for each country presented.
Source: Compiled and analyzed by KMI based on UNCTAD data

In 2015, French Polynesia established a Sustainable Maritime Transport Master Plan, with a key focus on promoting eco-friendly vessels. Through regulatory and institutional reforms in 2016 and 2017, the territory achieved a reduction in the average age of vessels, new ship orders, enhanced maritime connectivity and progress in environmental sustainability.

French Polynesia has also been actively developing and implementing various maritime transport policies, including the expansion of tourism infrastructure, establishment of special marine protected areas (rahui) and the creation of a digital platform (REVATUA).

Future improvement directions include enhancing digital-based information sharing, developing a competitive low-carbon model and strengthening synergies between the agriculture, fisheries and maritime transport sector (MaritimesDirection, 2024)

4.1.2.5. Guam

Guam, an overseas territory of the United States of America in the Western Pacific, has two main ports: Apra Port and Piti Port. Apra Port, functioning as the island's primary international trade port, serves as the logistics and economic hub of Guam, while Piti Port, located nearby, mainly supports fishing and local maritime activities.

Apra Port is a strategic military location, home to a U.S. Navy base. The commercial port area is managed and operated by the Port Authority of Guam, whereas certain military zones fall under U.S. Navy jurisdiction.

To enhance operational efficiency, the port has adopted modern cargo-handling equipment, including rail-mounted gantry cranes, tractors, and forklifts. Out of six berths, four are designated for international trade, supporting fishing vessels, container ships, general cargo ships, and passenger vessels. The port features an 850-meter-long quay with a depth of 11 meters, ensuring safe berthing for various vessel types.

Figure 4-7: Major ports in Guam

Geographical Location of Guam	Apra Port
	 

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; Port Authority of Guam(https://www.portofguam.com/)
Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Guam's total maritime cargo volume increased from 18,643 TEU in 2019 to 20,980 TEU in 2023, with imports accounting for over 90 percent of the total, reflecting a highly import-dependent trade structure. This trend aligns with Guam's island economy and tourism-driven industrial structure. Approximately 60 percent of imports come from the United States of America, while the remainder originates from Japan, the Philippines, other Asia-Pacific countries, Australia, New Zealand, and the Micronesian islands.

Table 4-14: Seaborne containerized trade volume of Guam (TEU)

	2019	2020	2021	2022	2023	CAGR('19-'23)
Export	2,168	1,859	2,721	2,648	1,978	-2.3%
Import	16,475	14,189	15,622	16,249	19,002	3.6%
Total	18,643	16,048	18,343	18,897	20,980	3.0%

Source: Compiled and analyzed by KMI based on S&P Global data

Guam serves as a strategic hub connecting the U.S. mainland, Hawaii, and Asia, with various regular liner services in operation. Major shipping companies such as Matson, APL, Kyowa Shipping, and Marianas Express provide weekly services linking the U.S. West Coast and Guam, as well as regular routes connecting major Asian ports and neighboring island nations. Through these connections, Guam plays a key role as a transshipment hub in the Western Pacific region.

Table 4-15: LSCI of major ports in Guam

Port	2010	2015	2019	2020	2021	2022	2023	2024	Average
Apra	53.10	58.05	45.26	43.13	42.93	42.45	42.45	42.49	50.99
Piti	-	-	14.17	14.17	14.66	15.35	15.35	15.36	14.88

Note: Data for 2024 includes up to the third quarter, with only major ports for each country presented. Blanks indicate missing values, which were excluded from the calculation of the average.
Source: Compiled and analyzed by KMI based on UNCTAD data

In 2023, Guam established a Port Master Plan to expand capacity and modernize port facilities. Key initiatives include enhancing the Terminal Operating System (TOS), expanding berth facilities, upgrading cargo-handling equipment, improving infrastructure to support the fishing and cruise industries, and preparing for increased cargo volumes related to the relocation of U.S. military bases (Ports of Guam, 2024).

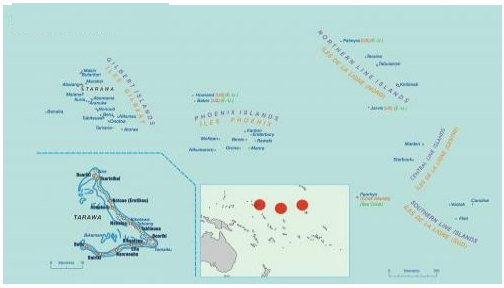
4.1.2.6. Kiribati

Kiribati consists of three island groups, namely Gilbert, Line and Phoenix Islands, which are spread over more than 4,000 km. Owing to their atoll-based geography, the islands are highly vulnerable to climate change. The country's main ports are Betio Port in Tarawa (Gilbert Islands) and Kiritimati Port on Kiritimati Island (Line Islands), both operated by the Kiribati Ports Authority.

Betio Port serves as Kiribati's primary international trade port, handling most of the country's import and export cargo. Imported goods arriving at Tarawa Port are then distributed to other islands. Kiritimati Port facilitates maritime transport between the Line and Phoenix Islands. The main types of cargo handled include containers, general cargo, tankers and seafood products. In 2014, an expansion project for Betio Port was completed with support from Japan International Cooperation Agency. Kiritimati Port is a small jetty-type facility that handles containers and general cargo but lacks cargo-handling equipment and dedicated storage facilities.

As part of a major national project, AIFFP is currently supporting the development of a Master Plan for Betio Port and improvements to Charlie Wharf.

Figure 4-8: Major ports in Kiribati

Geographical Location of Kiribati	Betio Port	Kiritimati Port
		

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; Kiribati Ports Authority, https://kiribatiportsauthority.online/
Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Kiribati is home to one of the world's largest fishing grounds, making seafood a major component of its maritime trade. Like other Pacific Island nations, the country primarily imports manufactured goods and food products. As of 2023, Kiribati's total maritime cargo volume was 15,195 TEU, with a declining trend in recent years.

Table 4-16: Seaborne containerized trade volume of Kiribati (TEU)

	2019	2020	2021	2022	2023	CAGR ('19-'23)
Export	8,580	7,785	7,158	7,170	5,250	-11.6%
Import	11,445	11,706	12,633	11,855	9,946	-3.4%
Total	20,025	19,491	19,791	19,025	15,196	-6.7%

Source: Compiled and analyzed by KMI based on S&P Global data

At Betio Port in Kiribati, regular liner services are provided by Swire Shipping, NPDL, and Kyowa Shipping, but service frequency remains low. As a result, the maritime connectivity of Betio Port, despite being an international trade port, is relatively weak. Similarly, domestic inter-island maritime transport is infrequent and operates on a non-regular basis.

Table 4-17: LSCI of major ports in Kiribati

Port	2010	2015	2019	2020	2021	2022	2023	2024	Average
Betio	16.09	25.19	13.26	25.16	24.37	25.63	26.27	26.17	22.22

Note: Data for 2024 includes up to the third quarter, with only major ports for each country presented.
Source: Compiled and analyzed by KMI based on UNCTAD data

Kiribati's maritime transport sector faces several critical challenges, with nine key areas identified for improvement. Major issues include the deterioration of navigation safety infrastructure owing to rising sea levels, the impact of environmental conditions on ports and vessels, and shortages in skilled personnel, technology, and equipment.

The effects of climate change have led to frequent port facility repairs, while container yard shortages and berth congestion have become serious concerns. Additionally, a lack of glass repairs for port structures and insufficient skilled personnel for equipment operations further complicate port management.

The top priority for the shipping and port sector is the development of sustainable and climate-resilient green ports. To achieve this, key focus areas include:

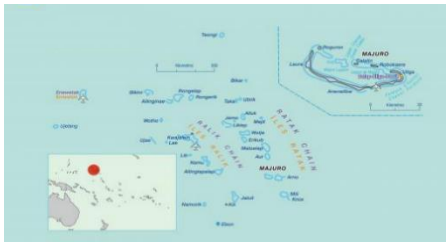
- Utilization of renewable and high-efficiency energy
- Implementation of waste management facilities
- Development of eco-friendly infrastructure
- Promotion of green, low-carbon vessels and efficient shipping routes
- Enforcement of environmental regulations with incentives
- Research and development initiatives.

These measures are being considered as priority actions to ensure a sustainable and resilient maritime transport system (Kiribati Ports Authority, 2024).

4.1.2.7. Marshall Islands

The Marshall Islands is primarily composed of atolls, making it highly vulnerable to climate change. Maritime connectivity and port infrastructure are limited owing to geographical constraints. The country's main ports are Majuro Port and Ebeye Port, both serving as international trade ports. Majuro Port has two terminals, Uliga and Delap, which handle most of the country's import, export and transshipment cargo. Ebeye Port primarily handles coastal cargo, though it also processes some import and export shipments. Marshall Islands Ports Authorityis responsible for the management and operation of these ports.

Figure 4-9: Major ports in Marshall Islands

Geographical Location of Marshall Islands	Majuro Port	Ebeye Port
		

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; Marshall Islands Ports Authority (2024)

Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

In the Marshall Islands, seafood, primarily tuna, constitutes the majority of exported goods, while fishing license fees from tuna operations serve as a major source of national revenue. Like other Pacific Islands nations, the country relies heavily on imports for food and general manufactured goods, resulting in a significantly higher import volume compared with exports. As of 2023, the total maritime cargo volume was 37,084 TEU, with imports accounting for over 80 percent of the total.

Table 4-18: Seaborne containerized trade volume of Marshall Islands (TEU)

	2019	2020	2021	2022	2023	CAGR ('19-'23)
Export	10,924	7,406	6,957	7,364	6,372	-12.6%
Import	31,152	45,689	40,769	42,601	30,712	-0.4%
Total	42,076	53,095	47,726	49,965	37,084	-3.1%

Source: Compiled by the author based on data from S&P GLOBAL (https://connect.ihsmarkit.com).

Table 4-19: LSCI of major ports in Marshall Islands

Port	2010	2015	2019	2020	2021	2022	2023	2024	Average
Kwajalein	-	15.34	19.68	19.68	18.20	13.75	13.75	13.75	14.65
Majuro	16.60	36.43	34 37	44.21	41.95	38.94	38.96	39.07	33.21

Note: Data for 2024 includes up to the third quarter, with only major ports for each country presented. Blanks indicate missing values, which were excluded from the calculation of the average.

Source: Compiled and analyzed by KMI based on UNCTAD data

Both major ports in the Marshall Islands are built on atoll terrain, making them highly vulnerable to climate change. The ports face persistent challenges, including ageing infrastructure and limited space, yet expansion and development are difficult owing to geographical constraints.

The key challenges currently identified include the deterioration of port facilities, requiring upgrades to berthing structures such as fenders and bollards, as well as the urgent need for channel dredging. There is a growing need to update the port master plan. Other critical concerns include port congestion, the transition to environment-friendly operations owing to high fuel costs and the adoption of more efficient port management practices (Marshall islands Ports Authority, 2024).

4.1.2.8. Federated States of Micronesia

The Federated States of Micronesia has one international trade port in each of its four states: Pohnpei Port, Chuuk Port, Yap Port and Kosrae Port. All four ports handle containers and general cargo and are managed and operated by state government agencies and state-owned enterprises, except for a few privately operated facilities.

Pohnpei Port, located on Pohnpei Island, the capital of Federated States of Micronesia, has a single multipurpose berth primarily used for handling imported containerized cargo, while also serving as a base for tuna fishing operations. The port also includes a domestic berth for inter-island vessels. Chuuk Port has two general cargo berths, accommodating vessels of up to 1,300 tons. Yap Port and Kosrae Port each have one berth, handling containers and general cargo. While none of these ports experience major congestion owing to low vessel traffic and cargo volumes, a lack of cargo-handling equipment has been identified as a key challenge. Additionally, infrastructure in the outer islands is underdeveloped, and domestic shipping frequency remains low outside the main ports.

Figure 4-10: Major ports in Federated States of Micronesia

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; Pohnpei Port Authority, Micronesia Drone Videos

Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Like Kiribati, Federated States of Micronesia are located near one of the world's richest fishing grounds, resulting in high seafood production, with marine products accounting for the majority of exports. The country primarily imports manufactured goods and food products, maintaining a relatively balanced trade volume between exports and imports. As of 2023, Micronesia's total maritime cargo volume stood at 18,073 TEU, remaining stable with no significant fluctuations in recent years.

Table 4-20: Seaborne containerized trade volume of Federated States of Micronesia (TEU)

	2019	2020	2021	2022	2023	CAGR ('19-'23)
Export	9,038	9,131	12,489	11,238	9,160	0.3%
Import	9,204	8,718	8,726	8,579	8,913	-0.8%
Total	18,242	17,849	21,215	19,817	18,073	-0.2%

Source: Compiled by the author based on data from S&P GLOBAL (https://connect.ihsmarkit.com).

Micronesia has a very low level of maritime connectivity. Although Kyowa Shipping and Matson operate regular liner services to the four main state ports, service frequency remains limited. Rather than having strong maritime links with New Zealand and Australia, Micronesia's shipping connectivity is primarily tied to Guam and other locations within the Micronesian region.

Table 4-21: LSCI of major ports in Federated States of Micronesia

Port	2010	2015	2019	2020	2021	2022	2023	2024	평균
Kosrae	-	15.34	25.59	24.95	24.95	24.95	24.95	24.98	18.48
Pohnpei	-	15.34	13.75	24.95	24.95	24.95	24.95	24.98	17.22
Yap	14.10	-	-	11.72	11.56	11.09	11.08	11.08	15.25

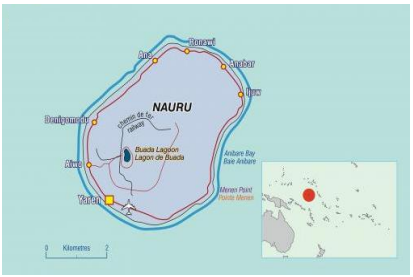
Note: Data for 2024 includes up to the third quarter, with only major ports for each country presented. Blanks indicate missing values, which were excluded from the calculation of the average.
Source: Compiled and analyzed by KMI based on UNCTAD data

4.1.2.9. Nauru

Nauru is a small independent nation in the South Pacific, with Aiwo Port as its only international trade port, managed and operated by the Nauru Maritime and Port Authority. Previously known as Aiwo Boat Harbour, the port relied on cargo handling via barges for unloading operations.

In 2018, the "Sustainable and Climate-Resilient Connectivity Project" was launched, led by the ADB with support from the Australian government and the Green Climate Fund. This project aims to construct Nauru's first modern international port, featuring a new wharf, breakwater and container yard. Construction began in October 2019, with completion targeted for late 2024 (Logistics Cluster(LCA), 2024).

Figure 4-11: Major port in Nauru

Geographical Location of Nauru	(Existing) Aiwo Port	(Planning) Aiwo Port
		

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; ADB(https://www.adb.org/projects/48480-003/main); LCA(https://lca.logcluster.org/21-nauru-port-nauru)

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From 2019 to 2023, Nauru's maritime cargo volume showed a steady increase from 9,696 TEU in 2019 to 19,829 TEU in 2022, before experiencing a slight decline to 17,009 TEU in 2023. A significant shift in trade structure has occurred. Exports surged from 4,199 TEU in 2019 to 12,365 TEU in 2023, reflecting an average annual growth rate of 31 percent. In contrast, imports declined from 5,497 TEU to 4,644 TEU over the same period, marking an average annual decrease of 4.1 percent. As a result, Nauru has transitioned from an import-dominant to an export-driven trade structure.

The country's main industries are phosphate mining and fisheries, with phosphate and seafood as major exports, while imports mainly consist of food, fuel, machinery, construction materials and essential consumer goods. Nauru's key trading partners include Australia, New Zealand, Fiji and Japan

Table 4-22: Seaborne containerized trade volume of Nauru (TEU)

	2019	2020	2021	2022	2023	CAGR ('19-'23)
Export	4,199	8,821	12,583	12,953	12,365	31.0%
Import	5,497	5,561	6,727	6,876	4,644	-4.1%
Total	9,696	14,382	19,310	19,829	17,009	15.1%

Source: Compiled and analyzed by KMI based on S&P Global data

Nauru's national shipping company, Nauru Shipping Line (NSL), provides regular maritime services across the central Pacific region. The company operates a shipping network handling various types of cargo, including containers, refrigerated/frozen goods, and bulk cargo.

Table 4-23: LSCI of major port in Nauru

Port	2010	2015	2019	2020	2021	2022	2023	2024	Average
Nauru	10.5	15.30	8.56	8.56	-	-	-	-	9.97

Note: Data for 2024 includes up to the third quarter, with only major ports for each country presented. Blanks indicate missing values, which were excluded from the calculation of the average.

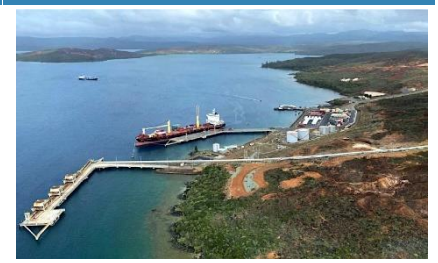
Source: Compiled and analyzed by KMI based on UNCTAD data

4.1.2.10. New Caledonia

New Caledonia's main ports are Noumea Port and Prony Port. Noumea Port, the country's primary international trade port, is managed and operated by the Port Autonome de Nouvelle-Calédonie. Although New Caledonia is an overseas territory of France, the port operates under autonomous administration. As a multi-purpose trade port, Noumea Port features a total quay length of approximately 1 km and berths with a depth of 13 meters, accommodating containers, bulk cargo and cruise ships.

Prony Port is a dedicated port serving the Goro nickel and cobalt mine, handling raw material imports and nickel product exports (ScottJason, 2024).

Figure 4-12: Major ports in New Caledonia

Geographical Location of New Caledonia	Noumea Port	Prony Port
		

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; PANC and New Century Resources (2020)

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As of 2023, New Caledonia's total maritime cargo volume stood at 112,422 TEU, marking a 50 percent decline from the previous year. Over the past five years, exports have shown a steady annual increase of 2.4 percent, whereas imports have declined at an average annual rate of 2.3 percent, with significant fluctuations in import volumes. Noumea Port handles all imported goods consumed by New Caledonia's population, with food accounting for the largest share. Construction materials and manufactured goods hold similar proportions in the country's import structure (PANC, 2024).

Table 4-24: Seaborne containerized trade volume of New Caledonia (TEU)

	2019	2020	2021	2022	2023	CAGR ('19-'23)
Export	29,576	32,429	31,017	32,083	32,578	2.4%
Import	87,517	103,886	67,039	191,254	79,844	-2.3%
Total	117,093	136,315	98,056	223,337	112,422	-1.0%

Source: Compiled and analyzed by KMI based on S&P Global data

Noumea Port in New Caledonia has a relatively high level of maritime connectivity compared to other Pacific Island ports. As a key transshipment hub in the South Pacific region, it is served by major shipping lines, including CMA CGM, Maersk, MSC, and NPDL, which provide regular liner services.

Table 4-25: LSCI of Major ports in New Caledonia

Port	2010	2015	2019	2020	2021	2022	2023	2024	Average
Noumea	99.32	96.83	82.38	89.65	92.23	90.46	95.58	99.95	99.40
Prony	-	-	-	14.93	18.92	15.02	18.81	27.01	19.18

Note: Data for 2024 includes up to the third quarter, with only major ports for each country presented. Blanks indicate missing values, which were excluded from the calculation of the average.

Source: Compiled and analyzed by KMI based on UNCTAD data

Key challenges in New Caledonia's shipping and port sector include upgrading aging port infrastructure, developing an environmentally friendly port, and diversifying the economy, which is highly dependent on the nickel industry. To address these issues, Noumea Port is pursuing a modernization plan through the expansion of its commercial wharf. This includes the construction of Berth No. 8.

4.1.2.11. Niue

Niue is a self-governing state in free association with New Zealand, with defence and foreign affairs delegated to New Zealand. The country remains highly dependent on New Zealand in areas such as economy and trade. Niue's only international trade port, Alofi Port, is located in the capital, Alofi. However, it has limited infrastructure, small-scale wharf facilities and minimal cargo-handling equipment, making it difficult for large vessels to berth. Additionally, port operations are constrained by weather conditions, highlighting the port's infrastructural limitations.

Unlike many other countries, Niue does not have independent port authority. Instead, the Department of Transport under the Niue government directly manages the port. This structure reflects Niue's limited administrative capacity and the practical realities of port operations. The Department of Transport oversees maritime and aviation services, rescue and firefighting operations and international cooperation, while also being responsible for Alofi Port's operations (NMPA, 2024).

Figure 4-13: Major port in Niue

Geographical Location of Niue	Alofi Port
	

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; Niue Department of Transport (2024)
Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Table 4-26: Seaborne containerized trade volume of Niue (TEU)

	2019	2020	2021	2022	2023	CAGR ('19-'23)
Export	1,718	1,005	1,020	1,480	2,727	12.2%
Import	-	-	-	-	2,782	-
Total	-	-	-	-	5,509	-

Source: Compiled and analyzed by KMI based on S&P Global data

Alofi Port's maritime connectivity level has remained steady at 11.32, ranking among the lowest compared with major Pacific Islands ports. Currently, Matson and Swire Shipping operate regular liner services on the New Zealand–South Pacific route, serving as Alofi Port's primary shipping connections.

Table 4-27: LSCI of major port in Niue

Port	2010	2015	2019	2020	2021	2022	2023	2024	Average
Alofi	7.93	-	-	11.32	11.32	11.32	11.32	11.32	9.93

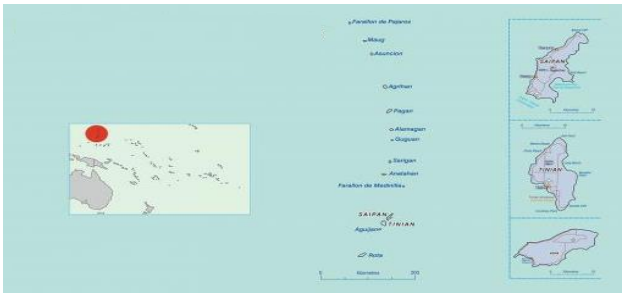
Note: Data for 2024 includes up to the third quarter, with only major ports for each country presented. Blanks indicate missing values, which were excluded from the calculation of the average.
Source: Compiled and analyzed by KMI based on UNCTAD data

Niue's shipping and port sector faces challenges such as high fuel costs, frequent cyclones and a shortage of skilled personnel. To address these issues, the Niue government is enhancing maritime safety through a VHF radio network and a national maritime safety programme, while also strengthening port management capacity. For long-term sustainability, Niue is transitioning away from fossil fuels by promoting marine conservation through the NOW Project and developing a maritime legal framework. These efforts aim to build a more resilient and efficient maritime transport system (NMPA, 2024).

4.1.2.12. Northern Mariana

The Northern Mariana Islands, a United States of America territory in the Western Pacific, has three main ports: Saipan Port, Tinian Port and Rota West Harbour. Among them, Saipan Port serves as the only international trade port. Established in 1981, the Commonwealth Ports Authority manages and operates all airports and seaports across the Northern Mariana Islands. Saipan Port features a 792.5-meter (2,600-foot) berth with a depth of 12.2 meters (40 feet), along with a container yard and cargo-handling facilities. Tinian Port includes fuel supply facilities, small vessel berthing and tourism-related infrastructure, while Rota West Harbour primarily serves small vessels with limited cargo-handling capacity (CPA, 2025).

Figure 4-14: Major port in Northern Mariana

Geographical Location of Northern Mariana	Saipan Port
	

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; CPA (https://cnmiports.com/default.asp)

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As of 2023, the total maritime cargo volume in the Northern Mariana Islands reached 7,348 TEU, surpassing pre-pandemic levels from 2019. With an economy heavily reliant on tourism and services, the region has a weak domestic production base, leading to a high dependency on imports. Approximately 90 percent of total cargo volume consists of imported goods, reflecting the territory's strong reliance on external trade.

Table 4-28: Seaborne containerized trade volume of Northern Mariana (TEU)

	2019	2020	2021	2022	2023	CAGR('19-'23)
Export	739	493	635	632	646	-3.3%
Import	6,335	5,564	5,540	5,555	6,702	1.4%
Total	7,074	6,057	6,175	6,187	7,348	1.0%

Source: Compiled and analyzed by KMI based on S&P Global data

The maritime connectivity index for Saipan Port has remained stable over the past five years. There are two main regular liner services operating in the region. Matson's Guam & Micronesia service connects the U.S. West Coast with Hawaii, Guam, Saipan, and Tinian. Meanwhile, Swire Shipping's Western Pacific service links Busan Port with Guam and Saipan on a weekly basis via transshipment.

Table 4-29: LSCI of major port in Northern Mariana

Port	2010	2015	2019	2020	2021	2022	2023	2024	Average
Saipan	26.08	27.27	33.38	32.69	32.90	33.12	33.12	33.13	30.63

Note: Data for 2024 includes up to the third quarter, and only major ports for each country are presented.
Source: Compiled and analyzed by KMI based on UNCTAD data

The Northern Mariana Islands are advancing port development projects tailored to each port's needs. Saipan Port is improving access roads and security systems, while Tinian Port is installing a seawater firefighting system and planning a hotel construction. Rota West Harbour is undergoing maintenance dredging and wharf upgrades.

4.1.2.13. Palau

Palau's only international trade port, Koror Port, is operated by the private company Belau Transfer and Terminal Company. The port has two berths, each 160 meters in length and 9 meters deep, capable of accommodating vessels up to 500 feet. In terms of cargo handling, the port processes 200–400 TEU of containers and approximately 100 metric tons of bulk cargo per month. Key cargo-handling equipment includes reach stackers, forklifts and container trailers. However, the port lacks a gauntry crane, requiring all cargo handling to rely on shipboard cranes. Additionally, there is no power supply for refrigerated containers, posing operational constraints (LCA, 2025).

Figure 4-15: Major port in Palau

Geographical Location of Palau	Koror Port
	

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; LCA (https://lca.logcluster.org/21-palau-port-koror)
Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Over the past five years, Palau's maritime cargo volume has steadily increased from 8,713 TEU in 2019 to 12,420 TEU in 2023. However, the trade structure shows a significant imbalance. While exports have declined at an average annual rate of 8.4 percent, imports have grown by 10.6 percent per year, highlighting a stark contrast. In 2023, import volumes were approximately 22 times higher than export volumes, underscoring Palau's heavy reliance on imports, a common characteristic of small island economies.

Table 4-30: Seaborne containerized trade volume of Palau (TEU)

	2019	2020	2021	2022	2023	CAGR ('19-'23)
Export	769	517	715	629	541	-8.4%
Import	7,944	8,057	10,916	11,578	11,879	10.6%
Total	8,713	8,574	11,631	12,207	12,420	9.3%

Source: Compiled and analyzed by KMI based on S&P Global data

Palau's maritime connectivity is relatively low among Pacific Island nations and has been steadily declining in recent years.

Kyowa Shipping and Matson operate regular liner services, linking Asia, Guam, Palau, and the Federated States of Micronesia.

Table 4-31: LSCI of major port in Palau

Port	2010	2015	2019	2020	2021	2022	2023	2024	Average
Koror	23.51	16.29	14.01	12.13	11.56	11.09	11.08	11.08	16.35

Note: Data for 2024 includes up to the third quarter, and only major ports for each country are presented.
Source: Compiled and analyzed by KMI based on UNCTAD data

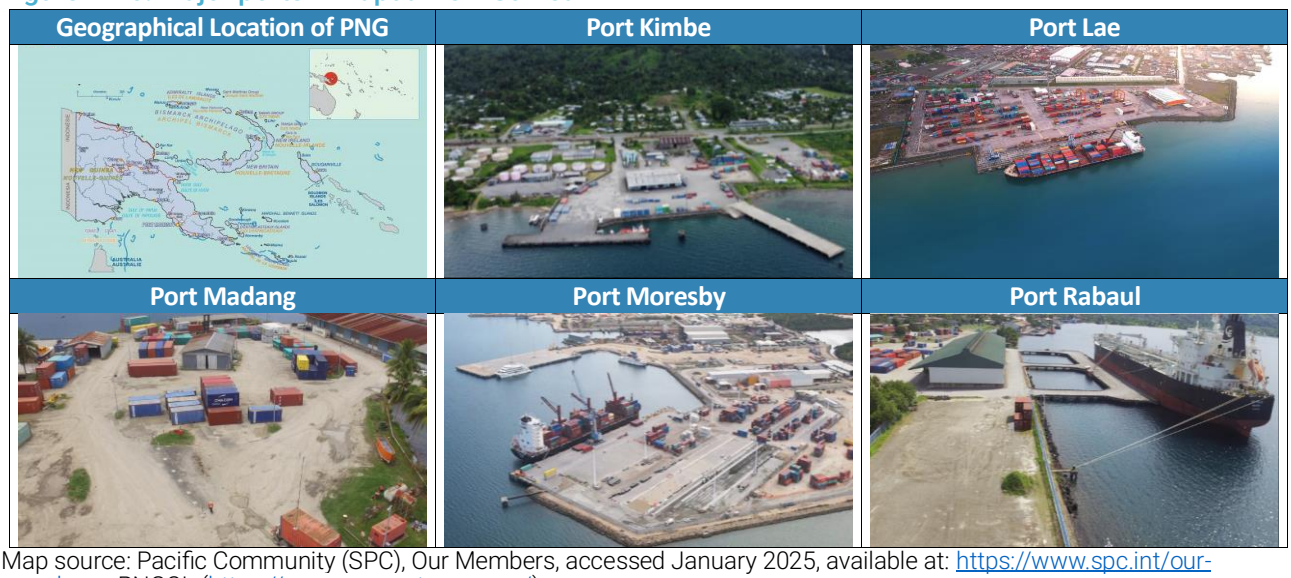
4.1.2.14. Papua New Guinea

Papua New Guinea, a Pacific island nation, has a total of 23 ports, with five major international trade ports: Kimbe, Lae, Madang, Port Moresby (Motukea), and Rabaul. The Papua New Guinea Ports Corporation (PNG Ports Corporation) directly manages 15 ports, including these five key international ports.

Lae Port is the largest container port in the country, while Port Moresby Port, the capital's main port, was relocated to Motukea Island in 2018, featuring modernized facilities. Both Lae and Port Moresby Ports are operated by International Container Terminal Services Inc. (ICTSI) under a 25-year concession.

In 2023, the World Bank's Container Port Performance Index ranked both ports in the top 50 percent among Oceania ports, reflecting their improved operational efficiency (PNG Ports Corporation Limited, 2024).

Figure 4-16: Major ports in Papua New Guinea



Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; PNGCL (https://www.pngports.com.pg/)

Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Papua New Guinea is one of the larger and more economically developed Pacific Islands nations in terms of population and land area. As of 2023, the country's total maritime cargo volume stood at 235,291 TEU, with a balanced trade structure between imports and exports. Key exports include palm oil, coffee, cocoa, coconut oil and timber, while natural resources such as gold, petroleum and copper serve as major sources of export revenue. Papua New Guinea's main trading partners are Australia, China, Japan and Singapore (UNCTAD, 2021).

Table 4-32: Seaborne containerized trade volume of Papua New Guinea (TEU)

	2019	2020	2021	2022	2023	CAGR ('19-'23)
Export	121,505	134,165	138,328	129,807	115,760	-1.2%
Import	110,445	107,953	114,765	128,113	119,631	2.0%
Total	231,950	242,118	253,093	257,920	235,391	0.4%

Source: Compiled and analyzed by KMI based on S&P Global data

Papua New Guinea's major international trade ports maintain strong maritime connectivity, with Lae Port and Port Moresby Port playing particularly significant roles. Maritime transport is divided into international and domestic routes. On international routes, Swire Shipping operates a 14-day service to Australia, Blue Water Shipping runs a 30-day service to North Asia and Kyowa Shipping connects the Republic of Korea and Japan. For domestic coastal shipping, Consort Express Lines provides regular services, linking 15 key ports across the country.

Table 4-33: LSCI of major ports in Papua New Guinea

Port	2010	2015	2019	2020	2021	2022	2023	2024	Average
Kimbe	16.46	18.22	32.16	34.58	28.08	24.69	29.10	31.89	24.95
Lae	63.36	107.11	113.39	113.03	116.96	114.77	125.79	128.27	99.29
Madang	28.01	40.45	44.39	40.90	46.17	46.04	38.09	35.43	39.67
Port Moresby	69.03	109.52	85.08	68.29	73.86	70.47	63.95	62.24	81.42
Rabaul	31.52	49.71	40.64	40.48	41.83	44.65	52.49	48.60	43.34

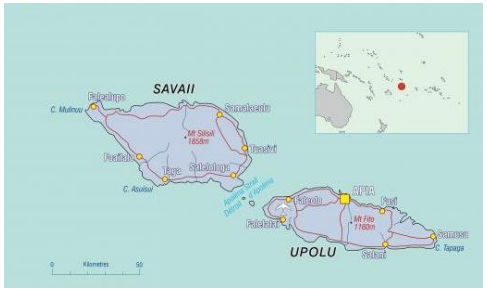
Note: Data for 2024 includes up to the third quarter, and only major ports for each country are presented.
Source: Compiled and analyzed by KMI based on UNCTAD data

Papua New Guinea is implementing a 30-year port infrastructure development plan (2021–2051) to enhance its maritime sector. The Papua New Guinea Ports Corporation is investing approximately 2 billion kinas (PGK) in port infrastructure through the AIFFP. The 30-year master plan outlines short-term strategies focused on facility maintenance and medium- to long-term strategies for asset renewal and modernization. Key development initiatives include port facility upgrades and modernization, establishing an international transshipment hub, supporting resource sector growth, optimizing operations through digital transformation, strengthening inland transport and distribution networks, and formulating government policies to facilitate private sector participation in port development (International Trade Administration, 2022).

4.1.2.15. Samoa

Samoa serves as a key logistics hub in the Polynesian region, making its ports highly significant. The country has one major port, Apia Port, which handles all import and export cargo. The Samoa Port Authority manages Apia Port along with Asau Wharf and Aleipata Port, overseeing their maintenance and operations. Additionally, it serves as a stopover for cruise liners sailing across the Pacific and plays a central role as a fishing port. Apia Port primarily handles import, export and transshipment container cargo but is also used for tankers, bulk cargo and cruise terminals. Besides Apia Port, a regular ferry service operates between Saleologa and Mulifanua islands, transporting vehicles and passengers, with dedicated passenger facilities available.

Table 4-34: Major ports in Samoa

Geographical Location of Samoa	Apia Port and domestic ports
	

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; Samoa Port Authority (2024)
Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Samoa's main exports consist of agricultural and marine products, while imports primarily include food products, fuel and other essentials. Trade is mainly conducted with neighbouring countries within the region. As of 2023, the country handled 26,650 TEUs, with imports accounting for approximately 80 percent of the total volume. Regarding port throughput, Apia Port's container handling capacity has steadily increased, rising from 34,950 TEUs in 2017 to 43,933 TEUs in 2021.

Table 4-35: Seaborne containerized trade volume of Samoa (TEU)

	2019	2020	2021	2022	2023	CAGR ('19-'23)
Export	7,718	5,419	6,963	6,267	5,345	-8.8%
Import	24,705	20,669	21,214	23,117	21,305	-3.6%
Total	32,423	26,088	28,177	29,384	26,650	

Source: Compiled and analyzed by KMI based on S&P Global data

Apia Port has relatively strong network connectivity with regional countries. Multiple regular shipping lines call at the port, connecting Samoa with New Zealand, Australia, Tonga, Tuvalu, the Cook Islands, and other regional nations. The level of maritime transport connectivity has been steadily increasing compared to the past.

Table 4-36: LSCI of major port in Samoa

Port	2010	2015	2019	2020	2021	2022	2023	2024	Average
Apia	49.04	48.87	63.91	65.07	69.64	66.59	65.51	62.35	59.55

Note: Data for 2024 includes up to the third quarter, and only major ports for each country are presented.
Source: Compiled and analyzed by KMI based on UNCTAD data

Apia Port has relatively well-developed facilities; however, congestion owing to increasing demand, insufficient cargo handling facilities and a lack of a digitalized port management system have been identified as key challenges. During the swell season from October to March, strong waves pose a risk, making vessel berthing difficult and affecting port operations. Other coastal ports face persistent issues such as ageing infrastructure, insufficient water depth and a lack of operational and management personnel.

Samoa's major port development project is the Apia Port Improvement Project, which is currently underway with support from the ADB. The project aims to enhance safety and sustainability by reinforcing outer port structures to address climate change impacts, introducing new tugboats, expanding container storage areas to accommodate growing cargo demand and installing container security screening and lighting systems. This initiative also includes the establishment and pilot implementation of Green Port Initiatives. A phased roadmap is currently being developed to identify and implement pilot projects (ADB, 2019) (Samoa Port Authority, 2024).

Figure 4-17: Reconstruction project of Apia Port

Source: Samoa Port Authority (2024)

4.1.2.16. Solomon Islands

Honiara Port and Noro Port are the main ports of Solomon Islands and serve as international trade ports. Honiara Port, the largest port, consists of seven domestic jetties and two international berths, while Noro Port has a shared berth for both domestic and international vessels. Under the State-Owned Enterprises Act, the Solomon Islands Port Authority is responsible for the management and operation of these ports. Additionally, the country has several smaller ports, including Gizo, Ringgi Cove, Tulagi and Yandina, which are not international trade ports but serve inter-island transport and are managed by local authorities (LCA, 2025).

Figure 4-18: Major Ports in Solomon Islands

Geographical Location of Solomon Islands	Honiara Port	Noro Port
		

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; SIPA (https://www.sipa.com.sb/)

Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

In the Solomon Islands, maritime cargo volume has been declining over the past five years. While exports have decreased at an average annual rate of 9.8 percent, imports have grown by 2.4 percent per year. Despite the decline, exports still account for a larger share of trade than imports. The main export products include logs and timber, seafood, palm oil and minerals. The key trading partners are China, Australia, Singapore, Italy, India and Thailand.

Table 4-37: Seaborne containerized trade volume of Solomon Islands (TEU)

	2019	2020	2021	2022	2023	CAGR('19-'23)
Export	57,203	47,013	41,231	37,895	37,824	-9.8%
Import	22,546	22,235	23,292	24,666	24,765	2.4%
Total	79,749	69,248	64,523	62,561	62,589	-5.9%

Source: Compiled and analyzed by KMI based on S&P Global data

Honiara Port has approximately five times higher connectivity than Noro Port and ranks among the top ports in the Pacific Islands region in terms of maritime connectivity. Swire Shipping and Mariana Express Line operate regular liner services to Honiara Port, establishing a shipping network that connects South Pacific nations with Northeast Asian countries.

Table 4-38: LSCI of major ports in Solomon Islands

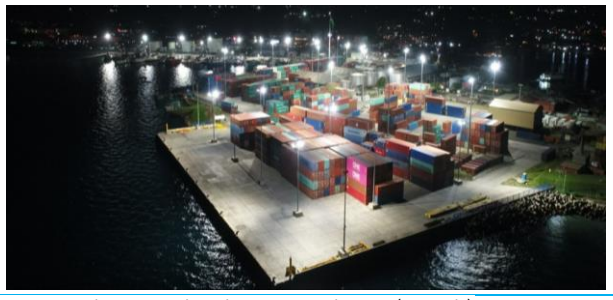
Port	2010	2015	2019	2020	2021	2022	2023	2024	Average
Honiara	45.97	75.80	72.68	63.34	63.05	59.38	63.57	61.34	62.40
Noro	8.47	21.66	23.15	20.07	12.77	12.28	12.02	12.35	18.70

Note: Data for 2024 includes up to the third quarter, and only major ports for each country are presented.
Source: Compiled and analyzed by KMI based on UNCTAD data

The Solomon Islands Port Authority has implemented Octopi, a Terminal Operating System, to improve port efficiency, customer information sharing and vessel monitoring. It has also adopted Pronto, a financial software system, to digitalize port administration. However, challenges remain in digitalization and climate change, particularly rising sea levels. Key digitalization issues include a lack of standardized systems, data-sharing difficulties, integration limitations and cybersecurity risks.

Climate change threatens port infrastructure with flooding, operational disruptions, safety hazards and corrosion. Coastal erosion and road flooding further impact logistics. To mitigate these risks, the port authority is adjusting quay heights, using corrosion-resistant materials, and reinforcing structures. It has also introduced LED lighting, solar power and WatchKeeper™ Buoys to enhance vessel navigation safety (SIPA, 2024).

Figure 4-19: Cases for preparedness for climate change in port of Solomon Islands

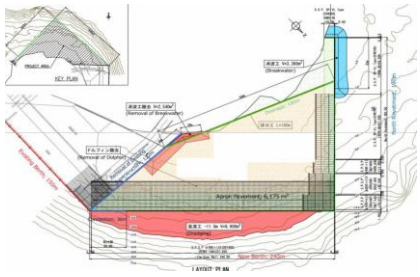
LED lighting systems	Watch Keeper Buoys
	

Source: Solomon Islands Port Authority(2024b)

The Solomon Islands' shipping and port sector faces limited maritime connectivity, excessive public intervention and low investment in maintenance. To address this, efforts focus on policy reforms, operational efficiency, workforce training, and governance. Pilot projects aim to boost port energy efficiency, train workers for new vessels and enforce international maritime regulations (SIMP, 2024).

The Solomon Islands Port Development Roadmap outlines major infrastructure expansion and modernization across key ports. Honiara Port, supported by the ADB, is upgrading Berth No. 1, expanding port areas, developing a cold-chain logistics facility and building a bulk terminal. Noro Port will undergo facility upgrades, while a new logistics hub in Ranadi will feature a container terminal linked to the Honiara–Ranadi logistics corridor for improved cargo flow (SIPA, 2024).

Figure 4-20: Cases for port development in major ports of Solomon Islands

Honiara Port Bulk Terminal Development		Noro Port facility upgrade	
			

Source: Solomon Islands Port Authority(2024a)

4.1.2.17. Tonga

Tonga has two international trade ports and five domestic coastal ports. The main international ports are Nukualofa Port in Tongatapu and Neiafu Port in Vava'u. Nukualofa Port handles over 98 percent of Tonga's trade and serves as the domestic passenger transport hub. It includes Vanu Wharf (320 m) for cruise ships, Funa Wharf (two 90 m berths) for inter-island transport and Queen Salote Wharf for international cargo, with berths of 93 m, 110 m, 100 m, and 50 m. Neiafu Port is growing rapidly in export cargo and partially functions as an international port. It features a 65 m multipurpose wharf and a marina for tourist yachts, reinforcing its role as a tourism hub.

Figure 4-21: Major ports in Tonga

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; Tonga, Timeless Tonga
Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whats oever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Like other Pacific Islands nations, Tonga relies heavily on imports, which far exceed exports. In 2023, total maritime cargo volume reached 14,410 TEUs. Exports mainly consist of agricultural products, while imports are primarily fuel and food supplies. Kyowa, Swire and Matson provide regular shipping services to Nukualofa Port, ensuring strong maritime connectivity, which has been rising. However, international transport connectivity remains limited beyond Nukualofa Port.

Table 4-39: Seaborne containerized trade volume of Tonga (TEU)

	2019	2020	2021	2022	2023	CAGR (19-'23)
Export	2,463	2,243	2,670	2,211	2,290	-1.8%
Import	14,234	13,333	13,992	13,947	12,120	-3.9%
Total	16,697	15,576	16,662	16,158	14,410	-3.6%

Source: Compiled and analyzed by KMI based on S&P Global data

Tonga's key priority areas for support include port infrastructure improvements, environmental compliance, and enhanced safety measures. In the long term, there is a need for the integration of renewable energy,

Table 4-40: LSCI of major ports in Tonga

Port	2010	2015	2019	2020	2021	2022	2023	2024	Average
Neiafu(Vavau)	16.22	8.03	11.20	11.32	11.32	11.32	17.77	17.78	13.12
Nukualofa	39.67	41.10	47.87	49.95	60.28	54.42	60.08	60.89	51.78

Note: Data for 2024 includes up to the third quarter, and only major ports for each country are presented.
Source: Compiled and analyzed by KMI based on UNCTAD data

Tonga's key support priorities include port infrastructure upgrades, environmental compliance and safety improvements. Long-term goals focus on renewable energy integration, green port development and sustainable operations, in alignment with the Tonga Strategic Development Framework 2015–2025, which emphasizes climate resilience, safety and capacity building. Several eco-friendly projects, backed by ADB and Japan International Cooperation Agency, target port infrastructure, cargo inspection and transport facility upgrades. The Nukualofa Port Improvement Project (2022–2025), funded by ADB, aims to enhance disaster resilience, introduce renewable energy and upgrade drainage systems. It also includes berth expansion for cargo efficiency, Berth 1 restoration at Queen Salote Wharf, additional container storage, a 50 m extension of Berth 2 and new navigational aids (AIFFP, 2025).

4.1.2.18. Tuvalu

Tuvalu faces challenges in port development and operations owing to its coral atoll geography. The country's primary `port is Funafuti Port, located on the main island, serving as the hub for international trade and passenger transport. The port features two L-shaped jetties, one of which was constructed in 2009 with Japanese official development assistance. It is equipped with a logistics centre, water tanks, forklifts and trailers. Cargo and passenger transport between Funafuti Port and the outer islands is conducted using government-owned vessels.

Figure 4-22: Major port in Tuvalu

Geographical Location of Tuvalu	Funafuti Port	
		

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; Ministry of Transport, Energy and Tourism, Tuvalu (2024)
Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Tuvalu has a small economy and population, with most of its people engaged in subsistence agriculture and fishing. As a result, the country relies heavily on imports of food and manufactured goods. Maritime cargo volume has been increasing, reaching 15,123 TEUs in 2023. Although Swire Shipping provides regular liner services, Tuvalu has one of the lowest levels of maritime connectivity among Pacific Islands nations.

Table 4-41: Seaborne containerized trade volume of Tuvalu (TEU)

	2019	2020	2021	2022	2023	CAGR (19-'23)
Export	1,769	1,736	2,574	4,318	3,303	16.9%
Import	11,069	16,402	16,082	14,192	11,820	1.7%
Total	12,838	18,138	18,656	18,510	15,123	4.2%

Source: Compiled and analyzed by KMI based on S&P Global data

Table 4-42: LSCI of major port in Tuvalu

Port	2010	2015	2019	2020	2021	2022	2023	2024	Avereage
Port Funafuti	9.89	13.93	9.43	9.17	8.71	8.29	8.67	8.80	9.61

Note: Data for 2024 includes up to the third quarter, and only major ports for each country are presented.
Source: Compiled and analyzed by KMI based on UNCTAD data

Key challenges in Tuvalu's shipping and port sector include limited storage and damaged infrastructure, requiring urgent berth construction and port expansion. There is also a need for GHG reduction, private sector collaboration, digitalization, and sustainable development. The ongoing projects include Funafuti Port upgrades, the eco-friendly vessel MV MARU SINA, and solar lighting installation. With AIFFP and ADB support, berthing and navigation improvements are underway for Nui and Niutao Islands (AIFFP, 2025).

Figure 4-23: Cases for preparedness of climate change and port reconstruction in port of Tuvalu

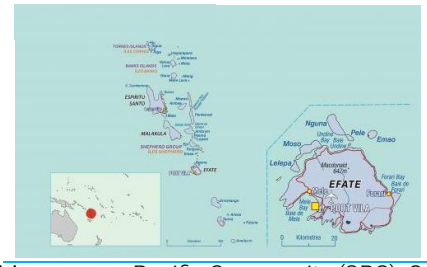
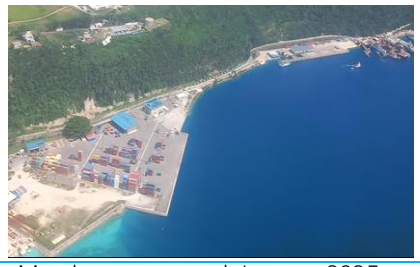
Funafuti Port improvement works	New eco-friendly vessel MV MARU SINA	Nui harbour improvement
		

Source: Ministry of Transport, Energy and Tourism, Tuvalu (2024), AIFFP

4.1.2.19. Vanuatu

Vanuatu's major ports include Port Vila and Luganville (Santo) Ports, with both serving as international trade ports. Port Vila Port features a multipurpose wharf that accommodates cruise ships and tankers, as well as the Lapetasi Wharf, dedicated to international cargo vessels. Luganville Port, located on Santo Island, handles dry and liquid cargo and has facilities for cruise ships and tankers. The country primarily imports general goods and petroleum, while exports consist of fish, beef, and copra. The Department of Ports and Marine, under the Ministry of Infrastructure and Public Utilities, is responsible for managing and operating Vanuatu's ports.

Figure 4-24: Major ports in Vanuatu

Geographical Location of Vanuatu	Port Vila	Luganville Port
		

Map source: Pacific Community (SPC), Our Members, accessed January 2025, available at: https://www.spc.int/our-members; LCA (https://lca.logcluster.org/vanuatu-21-port-assessment)
Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

In 2023, Vanuatu's total maritime cargo volume reached 30,445 TEUs, marking a 13.2 percent decrease compared to the previous year. Due to its import-dependent economy, imports account for approximately 70 percent of total cargo volume. The country's key industries are agriculture and tourism, with exports mainly consisting of agricultural and marine products, while a weak manufacturing sector results in heavy reliance on imports for most industrial goods.

Table 4-43: Seaborne containerized trade volume of Vanuatu (TEU)

	2019	2020	2021	2022	2023	CAGR (19-'23)
Export	7,237	9,741	8,924	10,724	8,715	4.8%
Import	22,759	20,358	22,415	24,363	21,730	-1.2%
Total	29,996	30,099	31,339	35,087	30,445	

Source: Compiled and analyzed by KMI based on S&P Global data

Among Vanuatu's major ports, Port Vila Port has the strongest maritime connectivity, while Luganville/Santo Port, though smaller, is experiencing growth. Regular shipping services are provided by Neptune Pacific Direct Line (NPDL), Swire Shipping, and CMA CGM, while Pacific Energy operates tanker calls for fuel imports (Pacific Energy, 2025).

Table 4-44:LSCI of major ports in Vanuatu

Port	2010	2015	2019	2020	2021	2022	2023	2024	Average
Luganville	-	-	-	8.47	8.47	-	10.37	10.37	9.42
Port Vila	27.29	48.80	49.53	50.62	52.02	48.06	51.38	52.41	47.51
Santo	14.12	25.37	27.18	31.16	22.98	25.04	33.67	37.43	27.12

Note: Data for 2024 includes up to the third quarter, and only major ports for each country are presented.
Source: Compiled and analyzed by KMI based on UNCTAD data

4.2. Key Challenges in Achieving Sustainable Shipping and Port Development in Pacific Island Countries

Many Pacific Islands countries recognize that climate change poses significant challenges to shipping and port infrastructure and operations, particularly owing to their vulnerable geographic conditions. As a result, there is a growing emphasis on the need for climate-resilient infrastructure. However, a lack of skilled professionals and technical capacity remains a key issue.

Additionally, the transition to eco-friendly energy has become a major priority, reflecting global environmental concerns. Based on the previously analyzed shipping and port conditions, challenges, and trends in each country, the key issues can be categorized as follows:

Table 4-45: Main challenges of maritime transportation sector in Pacific Islands countries

Categories	Issues	Countries
Infrastructure / Technology	•Aging port facilities, need for infrastructure upgrades to address climate change •Need for infrastructure development to ensure maritime safety and connectivity	Cook Islands, Solomon Islands, Tuvalu, Tonga, Kiribati, etc.
Capacity building	•Lack of port operations and technical personnel, insufficient workforce capacity	Cook Islands, Kiribati, Niue, etc.
Green	•Need for eco-friendly practices across the maritime and port sectors	Cook Islands, Marshall Islands, Tuvalu, Tonga, Kiribati, Samoa, New Caledonia, etc.
Safety	•Urgent need to enhance safety in port and ship operations	Cook Islands, Niue, Tonga, etc.
climate change	•Severe nationwide impacts of climate change •Increasing need for climate adaptation to ensure efficient port operations and safety	Most countries
International regulation/ Cooperation	•Need to implement initiatives from international and regional organizations and comply with international regulations	Fiji, Samoa, etc.

Source: Compiled with reference to the *2024 Asia-Pacific Regional Dialogue on Sustainable Maritime Connectivity* (July 22-23, 2024).

Efforts to address key challenges in the maritime and port sector are hindered by several factors, with policy integration being one of the most significant obstacles. Many countries struggle to align their national development strategies with specific policies for the maritime and port sectors. For instance, while Kiribati prioritizes digitalization and climate-resilient infrastructure, its national port development policies remain in the early stages. This misalignment complicates the integration of maritime policies within broader national development frameworks. Similarly, Fiji faces difficulties in inter-agency coordination and lengthy decision-making processes, which further delay the implementation of government policies.

Another critical challenge is the lack of financial resources, as most countries rely heavily on foreign aid (official development assistance) for port infrastructure development, capacity-building programmes and operational improvements. Limited domestic funding makes it difficult to independently address pressing maritime sector challenges, leading to delays in port expansion, technological investments and regulatory framework development.

One notable example is the digitalization of the maritime and port sector, which has gained global importance, including in Pacific nations. While some countries have adopted foreign digital systems, others struggle with implementation owing to policy gaps, insufficient digital infrastructure, limited technical investment and a shortage of trained personnel. Successful digital transformation requires a comprehensive approach, including policy and strategic planning, infrastructure investments, workforce training and regulatory development.

Given these challenges, a multifaceted support system is essential, covering capacity-building, financial assistance and technology transfer. Strengthening these areas will be crucial to facilitate the modernization, efficiency and climate resilience of port operations.

4.2.1. Maritime Transport Infrastructure

The most pressing issue is the development of new infrastructure and improvement of ageing facilities. Infrastructure upgrades are essential in order to adapt to climate change, environmental sustainability, maritime connectivity and safety. Most countries prioritize these improvements to address challenges and enhance maritime transport capacity.

The demand for port infrastructure development in Pacific nations falls into three main areas: expanding capacity for growing cargo volumes, upgrading ageing facilities to withstand natural disasters and rising sea levels, and constructing small berthing facilities on outer islands to improve connectivity.

Many Pacific ports are expanding to meet increasing maritime demand, but efforts mostly focus on yard expansion and equipment procurement. No Pacific Islands ports have fixed quay cranes; instead, they rely on mobile cranes, which extend vessel handling times and limit berthing options.

Ageing infrastructure and natural disasters further challenge port operations. Facility improvements are in higher demand than new port developments. Ports located on open coastlines are highly vulnerable to rising sea levels, cyclones, extreme heat, high winds, storm surges, tsunamis and flooding, which damage infrastructure, equipment and access roads. However, financial constraints hinder maintenance and upgrades, making many Pacific nations reliant on international aid.

Table 4-46: Maritime asset damages and losses from disasters in the Pacific (2009–2018) (million USD, %)

Country	Year	Natural Disaster Event	Maritime asset Damages	Maritime asset Losses	Total Combined Damages/Losses	Maritime Damages as Proportion of GDP
Samoa	2009	Earthquake	6.73	2.4	9.13	1.57
Fiji	2012	Tropical Cyclone	0.18	0.06	0.24	0.01
Samoa	2012	Tropical Cyclone	26.0	9.2	35.2	4.63
Vanuatu	2015	Tropical Cyclone	0.37	10.8	10.45	1.36
Fiji	2016	Tropical Cyclone	8.34	0.02	8.36	0.17
Tonga	2018	Tropical Cyclone	0.57	0.21	0.78	0.16

Source: World Bank, Blue Transformation of Pacific Maritime Transport (2023)

Many outer islands, despite being inhabited, lack proper docking facilities, or have deteriorated or damaged structures, making vessel berthing difficult. In many cases, there are no suitable piers for cargo unloading or passenger disembarkation, and access is often restricted to small boats.

In some instances, passengers and cargo must be transferred using small boats or rafts, which is highly risky, especially under adverse weather conditions. This method poses significant safety concerns and is inaccessible for the elderly and individuals with disabilities, emphasizing the urgent need for improved berthing infrastructure on these islands.

Table 4-47: Age of domestic ships in Pacific Islands countries

Country	Total domestic vessels	Average age	Maximum age
Vanuatu	243	38	57
Solomon Island	304	29	75
Marshall	34	30	55
Kiribati	44	23	41

Source: World Bank, Blue Transformation of Pacific Maritime Transport (2023)

The challenges outlined above significantly hinder the development of maritime transport networks at both national and regional levels. As a result, governments tend to prioritize the operation and construction of major ports, while development plans for outer islands receive less attention and policy support.

The existing berthing infrastructure on outer islands varies widely and can generally be categorized into four types: small jetties, temporarily installed pontoons or barges, ramps designed for landing craft-type vessels and direct beach landings without docking facilities. Many outer islands lack adequate berthing infrastructure, making vessel docking and cargo handling difficult and unsafe (World Bank, 2023).

The development and improvement of berthing infrastructure on these islands are essential not only for ensuring the safety of vessels and passengers but also for enhancing the quality of life for local communities. Improved maritime access contributes to better social and economic integration, enabling more reliable transportation of goods and services, while strengthening overall regional connectivity

4.2.2. Logistics Competitiveness (Connectivity level)

Most Pacific nations are small island states with limited economies and low trade volumes, and they are geographically distant from major trading partners. As they rely on imports for essential goods such as food, fuel, vehicles and machinery, these countries have a high dependency on foreign trade. Therefore, they have the lowest maritime transport connectivity in the world but among the highest logistics costs, including shipping rates.

Many Pacific ports lack adequate infrastructure, handling equipment and deep-draft channels, limiting access to only small and medium-sized vessels with onboard cargo-handling equipment. Additionally, ports in the region are highly vulnerable to natural disasters, often facing disruptions in operations, infrastructure damage and extended recovery periods, further complicating maritime transport.

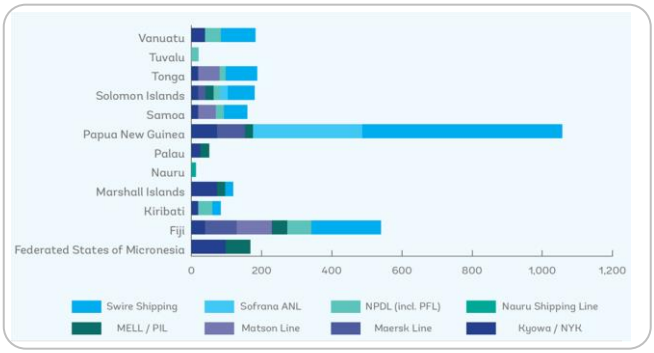
Papua New Guinea and Fiji have relatively higher maritime connectivity levels compared with other Pacific nations, aside from Australia and New Zealand. These countries play a regional transshipment role, benefiting from larger economies and higher cargo volumes. However, other Pacific nations struggle with low maritime connectivity owing to their geographic and economic limitations.

The Pacific region's regular shipping routes can be categorized into three main types:

- Continental shipping connections – Services originating from the U.S., China, and Europe, with stops at various Pacific islands. Some vessels serve multiple island ports along their entire route.
- International Pacific Islands connections – Services operating from Australia, New Zealand, Japan, and the Republic of Korea, typically using multipurpose vessels on scheduled routes.
- Intra-Pacific Islands connections – Dedicated services linking Pacific Island ports, such as Fiji's Suva Port acting as a hub for smaller ports in Tuvalu (Funafuti Port) and Nauru.

As illustrated in the figure below, the frequency of regular shipping services varies by country, reflecting trade volumes, transshipment cargo, and overall market demand.

Figure 4-25: Annual Number of Port Calls by shipping line



Source: World Bank, Blue Transformation of Pacific Maritime Transport (2023)

As mentioned earlier, Pacific Islands have low trade volumes and limited export-import goods, meaning that the current maritime connectivity levels – measured by vessel frequency and capacity – do not pose a significant barrier to handling national trade volumes. However, port efficiency and operational stability in each country can impact the reliability and overall connectivity of maritime transport in the region.

One of the key issues in maritime connectivity is the extremely low transport links for small island states such as Tuvalu and Nauru, as well as outer islands such as Kiritimati in Kiribati. These areas not only have infrequent shipping services but also face frequent delays or cancellations owing to unfavourable sailing conditions. To address this issue, the Nauru government launched the Nauru Shipping Line in 2020, providing a regular shipping service between Fiji and Nauru. However, it was later discontinued owing to economic feasibility concerns and route duplication with existing services.

In terms of domestic shipping services, most Pacific Islands countries have established routes, but operations are generally irregular and informal. In countries with domestic maritime transport demand, private shipping companies dominate and manage their own vessels and crews. Meanwhile, some nations, including Samoa, Tuvalu, the Marshall Islands, Kiribati and Tonga, operate government-run shipping services.

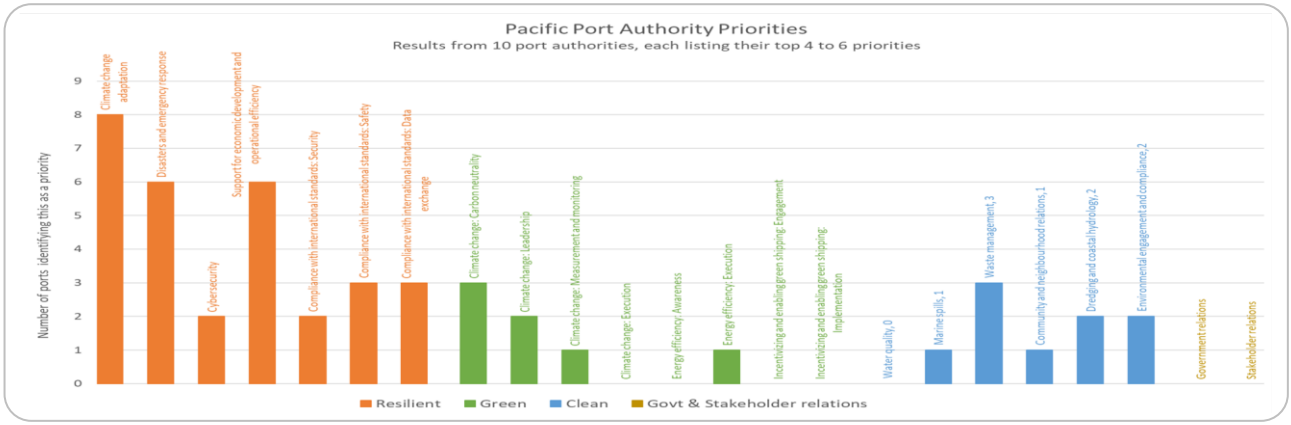
Domestic maritime transport faces several challenges, including low cargo volumes, ageing vessels and a lack of port infrastructure, making it difficult to establish regular, commercially viable shipping networks. Unprofitable routes often operate on a monthly or yearly schedule, and many receive government subsidies. However, these services are not only infrequent and irregular but also prone to delays and cancellations, further limiting reliable domestic shipping connections.

4.2.3. Green Shipping & Resilience

The importance of resilience and green initiatives in Pacific ports is particularly high. According to UNESCAP (2023), when countries identified priority areas in the maritime and port sector, resilience and environmental sustainability (green initiatives) emerged as the most critical.

Enhancing resilience is essential for adapting to climate change, responding swiftly to disasters and emergencies, and improving port efficiency and economic development. Key measures include strengthening disaster and climate change response capabilities, adopting international standards for safety and security, and establishing systems for climate change awareness, assessment, and monitoring.

Figure 4-26: Priorities of Pacific Port Authority

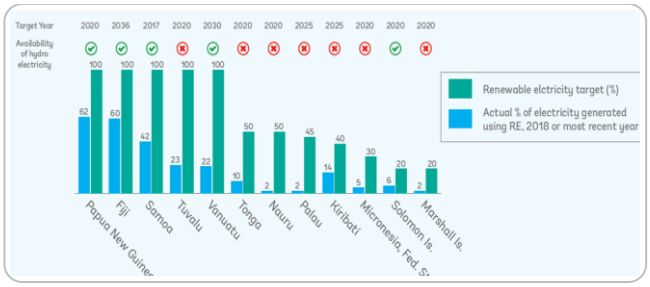


Note: Port authority officials were asked to select the top 5-6 priority areas based on the *Pacific Ports Vision 2030-2050*.
Source: UNESCAP, Sustainable and resilient Pacific Ports States Report (2023)

In the green sector, the need to transition to renewable energy is particularly important to address high fuel costs and climate change adaptation. Most Pacific nations rely on fossil fuels for over 90% of their energy supply, which is entirely import-dependent. Shifting to alternative energy sources would reduce fossil fuel dependency, align with global decarbonization trends, and ultimately enhance the sustainability and resilience of the maritime transport sector.

However, the use of electricity remains low in many Pacific nations. Except for Fiji, Samoa, Papua New Guinea, and New Caledonia, most Pacific Island Countries (PICs) face high electricity costs relative to fuel prices. Given the current cost structure, supplying ports and transport systems with electricity is considered economically unviable compared to fossil fuels.

Figure 4-27: Actual renewable energy share vs Targets in Pacific countries



Source: World Bank, Blue Transformation of Pacific Maritime Transport (2023)

According to the World Bank (2023), fossil fuel import dependency is expected to remain high for at least the next 20 years. Therefore, rather than an immediate full transition to electric-powered equipment, a gradual shift is needed. This includes expanding electricity production capacity and progressively integrating electric energy sources into port operations and maritime transport.

From another perspective, the need for environmental compliance in maritime transport is increasing owing to international regulations set by organizations such as the IMO, particularly regarding decarbonization and marine pollution prevention. Pacific nations seek to ensure that ports are economically resilient while also contributing to national decarbonization goals by reducing GHG emissions. However, many Pacific Islands countries have no clear guidelines or plans for port decarbonization.

To address this gap, international cooperation is essential for setting common goals and aligning with global standards. Collaborative efforts focus on capacity building, financial support and technology transfer in key areas. Many Pacific Islands countries actively engage with international organizations and regional partnerships, either by initiating cooperative projects or participating as partner nations in existing initiatives.

A significant number of these collaborative projects focus on decarbonization, carbon reduction, marine waste management and climate change adaptation. These efforts are often implemented through regional cooperation platforms or international initiatives led by organizations such as the IMO. In particular, Pacific Island countries have adopted the "Pacific Ports Vision 2030 to 2050", which prioritizes resilient and eco-friendly ports. In line with this vision, countries are also increasing their focus on sustainable energy solutions and actively working to reduce greenhouse gas emissions in the maritime sector (SPC, 2024).

Table 4-48: Projects and cooperation initiatives for green

Program	Country	Contents
Pacific Ports Vision 2030-2050 (SPC)	All regional countries	• Green port initiatives, including GHG emission reduction cooperation projects, technology collaboration projects with major donors and partner countries, and regional green port projects. • Planning of related international cooperation projects.
IMO Technical Cooperation Partnerships	Specific countries (varies by project)	• Participation as a partner country in "GloFouling", a project addressing biofouling issues and GHG emission reduction (Fiji, Tonga, Tuvalu). • Participation as a partner country in "GloLitter", a project for marine litter reduction and prevention (Solomon Islands, Tonga, Vanuatu). • Engagement in "TEST Biofouling", a pilot initiative based on the GloFouling network and expertise (Fiji, Tonga, Tuvalu).
Pacific Regional Environment Programme	21 island countries	• Development of the "Waste Management and Pollution Control Programme (2016-2025)" to prevent and manage waste in the Pacific region.
PBSP (Pacific Blue Shipping Partnership)	6PAC+ (Fiji, Kiribati, Marshall Islands, Solomon Islands, Tonga, Tuvalu)	• Intergovernmental agreement setting common goals, prioritizing policies and projects for member states, optimizing financial investments, and promoting long-term capacity building and institutional development. • Goal of zero carbon emissions in the transport sector by 2050, with a 40 percent GHG reduction target by 2030.
POMF (Pacific One Maritime Framework)	All regional countries	• A unified framework to define sustainable maritime transport strategies and serve as a platform for implementation. • Incorporates financial support, infrastructure, technology, and capacity-building measures, including the "2050 Strategy Implementation Plan 2023-2030 (Phase 1)", established in May 2023.
CIS-PAC5	5 countries (Cook Islands, Niue, Palau, Marshall Islands, Tuvalu)	• Promotion of early warning systems for climate change and oceanic information services to enhance monitoring and predictive response capabilities for island nations. • Funding support from GCF (2022-2026).

Note: Extracted based on recently developed or ongoing initiatives.
Source: Compiled with reference to the *2024 Asia-Pacific Sustainable Maritime Connectivity Forum presentations* and the SPC website, among other sources.

4.2.4. Human Capacity

Another notable issue is the shortage of skilled personnel with expertise in port operations. This problem is particularly evident in small-scale ports, such as the Cook Islands, Kiribati and Niue. These nations face a lack of workforce with comprehensive operational expertise, including port cargo handling, equipment and facility operation and maintenance. Such human resource deficiencies hinder efficient port operations, compromise maritime transport safety and undermine the sustainability of the maritime sector. Addressing this issue requires long-term efforts in capacity building and knowledge transfer rather than a short-term solution.

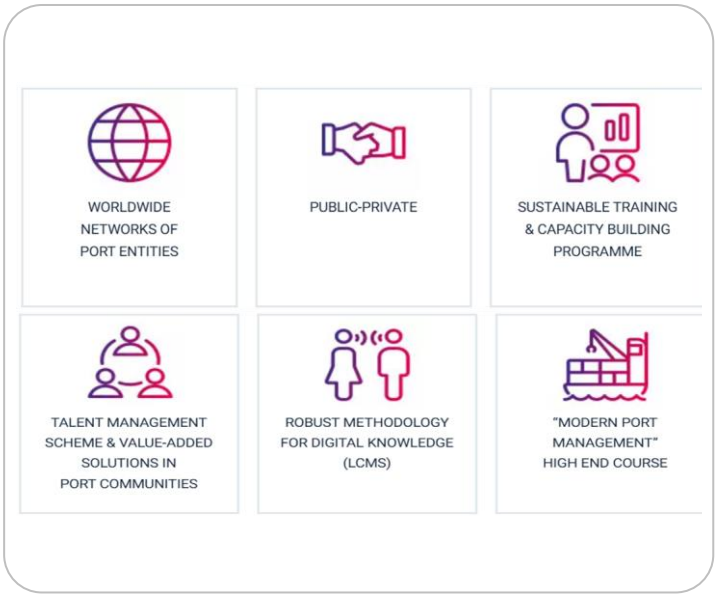
The shortage of maritime professionals is a major obstacle to the sustainable development of the shipping and port industry in Pacific Islands countries.

First, regarding lack of expertise and capacity, most ports in the Pacific region are small-scale, characterized by a shortage of skilled personnel in cargo handling, equipment operation and maintenance. The Cook Islands, Kiribati and Niue are particularly affected, experiencing a severe lack of technical staff, which negatively impacts port operational efficiency. This workforce shortage makes it difficult to ensure safe maritime transport and undermines the sector's long-term sustainability (World Bank, 2023) (UNESCAP, 2023)

Second, regarding low participation of women in the maritime workforce, organizations such as PacWIMA are working to promote female participation in the maritime industry. However, women's representation in leadership and technical roles remains low. In some Pacific Islands countries, the percentage of female maritime professionals is below 10 percent, and institutional and social barriers hinder women from entering port operations and ship management fields.

Third, lack of digital and green technology expertise. Maritime education and training programs (MET) in Pacific Island countries have not sufficiently adapted to emerging trends such as digitalization and green technologies. While programs like UNCTAD's TrainForTrade Port Management Programme aim to enhance port operation and management capabilities, the participation and benefits for Pacific Island countries remain limited. Without adequate education on digital technologies and eco-friendly ship operations, these nations risk losing competitiveness in the global maritime industry (ILO, 2017) (UNCTAD, 2023).

Figure 4-28: TrainForTrade's Port Management Programme Core features (UNCTAD)



4.3. Key Strategies in Achieving Sustainable Shipping and Port Development in Pacific Island Countries

4.3.1. Developing Maritime Transport Infrastructure

Over the past decade, many ports have received subsidies or loans for quay infrastructure; a growing trend of ongoing or newly initiated projects, aimed at improving quay infrastructure, has emerged. Most of these quay projects are designed with a 50-year timeframe to account for rising sea levels. Their primary objectives are meant to enhance port operational efficiency as well as expand and improve infrastructure resilience against extreme weather conditions and sea level rise.

Table 4-49: Projects and initiatives being implemented to improve infrastructure

Country	Project and initiatives
Federated States of Micronesia	- **FSM Maritime Investment Project:** $40 million from the World Bank to improve safety, efficiency, climate resilience, and emergency response at four ports (Kosrae, Pohnpei, Chuuk, and Yap) - Ongoing construction aims to reduce vessel handling time, improve container yard productivity, meet ISPS requirements, enhance climate resilience, strengthen disaster response, upgrade yard infrastructure, improve drainage, and enhance port security.
Marshall	- **Marshall Islands Maritime Investment Project:** $33 million from the World Bank to improve safety, efficiency, climate resilience, and emergency response. - Includes upgrades to Delap and Uliga wharves in Majuro and outer island facilities, improvements in maritime safety and security, technical support for port planning and project management, and enhanced emergency response.
Nauru	- Construction of a new international port that eliminates the need for barges when transferring goods from ships. - Includes reconstruction of Aiwo Port's wharf, breakwater, berths, port buildings, and container storage areas. - Funded by an $80 million investment from Australia and the Asian Development Bank (ADB).
Papua New Guinea	- Development of a **30-year master plan (2021)** for port infrastructure redevelopment covering multiple ports. - A $365 million program to repair and upgrade seven ports, including Lae Tidal Basin development to accommodate vessels up to 9,000 TEU, funded by Australia. - Target ports: Oro, Kavieng, Kimbe, Lae, Manus, Wewak, and Vanimo.- Infrastructure improvements include raising wharf heights by 0.5–1m, incorporating earthquake-resistant designs, and ensuring continuous port operations. - In Daru Port, cargo handling efficiency has been improved by allowing containers to be transferred via barges instead of direct unloading from ships.
Samoa	- **$75 million Apia Port upgrade**, funded by ADB and Samoa, launched in 2022 to enhance port safety, security, and sustainability. - The project aims to reconstruct and upgrade Apia Port to withstand a **100-year storm** and a **50-year sea level rise**, expand the container terminal area, and install a new container X-ray scanner.
Tonga	- **Queen Salote International Wharf redevelopment** with a **$50 million ADB-funded project**. - Raising the low wharf level for storm surge resilience (forecasted for 2070), expanding port capacity, and improving management and operations.
Tuvalu	- **Upgrades to Funafuti Port**, including wharf surface improvements and warehouse replacement. - Construction of three workboat wharves in outer islands. - The World Bank provided **$22.5 million**, with an additional **$35 million** to address funding shortages in the initial project and enhance maritime transport capacity, with a focus on women's involvement.

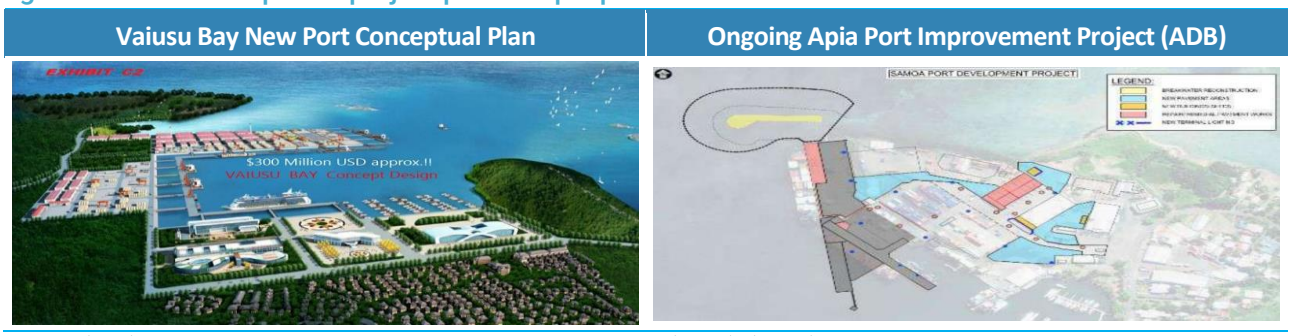
Source: UNESCAP, Sustainable and resilient Pacific Ports States Report (2023)

The infrastructure sector in Pacific Islands countries primarily focuses on improving port facilities to prepare for climate change-related disasters and rising sea levels, as well as developing small docking facilities on outer islands to enhance maritime connectivity. Addressing climate change is the top priority for maritime transport in the Pacific region, as it forms the foundation for efficient port operations and safety.

To achieve this, several factors must be considered. First, the development of major national ports in the Pacific region should be appropriately scaled to meet expected demand over their construction lifespan. Excessive infrastructure development can lead to financial burdens, such as increased debt and maintenance challenges (World Bank, 2023).

For example, Samoa initially planned to construct a new port at Vaiusu Bay to address disaster-related damages at Apia Port and alleviate cargo congestion. The project was designated as a top government priority. However, a feasibility study concluded that the project was not viable owing to significant funding requirements and potential environmental and social impacts (ADB, 2019). Instead, the current approach focuses on improving Apia Port's outer facilities to enhance climate resilience and disaster recovery, as well as redeveloping the existing port area to improve operational efficiency.

Figure 4-29 Redevelopment project plan of Apia port in Samoa



Source: (Left) ADB, Environmental and Social Monitoring Report (2023), (Right) Global security, Samoa Port

Secondly, resilient design improvements are essential for climate change adaptation. This includes elevated decks, breakwaters, floating quays, and heat-resistant materials for rising sea levels. Ecosystem-based measures, like protecting mangroves, help absorb storm surges. Port deck layouts should also allow unstacking containers to prevent toppling during storms (UNESCAP, 2022).

For example, the Solomon Islands have implemented measures to address sea level rise. The Solomon Islands Ports Authority integrated resilience strategies into Honiara Port's design, including protective coatings on piles, enhanced concrete mix to prevent corrosion from rising sea temperatures, and higher quay walls to withstand increased wave heights.

Figure 4-30 Infrastructure construction for preparedness of climate change in port of Solomon Islands

Source: Solomon Islands Port Authority, Charting a Sustainable Course: Pioneering Green Practices for Pacific Ports and Trade (2024)

4.3.2. Strengthening Maritime Connectivity

The first strategy to enhance maritime connectivity in the Pacific region is the development of centralized regional hub ports (UNESCAP, 2022). In other words, the hub-and-spoke concept should be operated more efficiently. According to the World Bank (2023), while parts of the Pacific region, particularly around Fiji, already function as a hub-and-spoke network, there is a need to further consolidate cargo through one or two main hub ports. This approach would replace the traditional multi-calling system, where large vessels make multiple stops, with feeder vessels directly calling at individual countries' international trade ports. By deploying larger vessels at regional hub ports, economies of scale and lower freight costs associated with large container ships can be leveraged, leading to cost reductions and improved service levels. Additionally, connecting hub ports with fewer, smaller feeder vessels to individual international trade ports can reduce transportation time and operational costs.

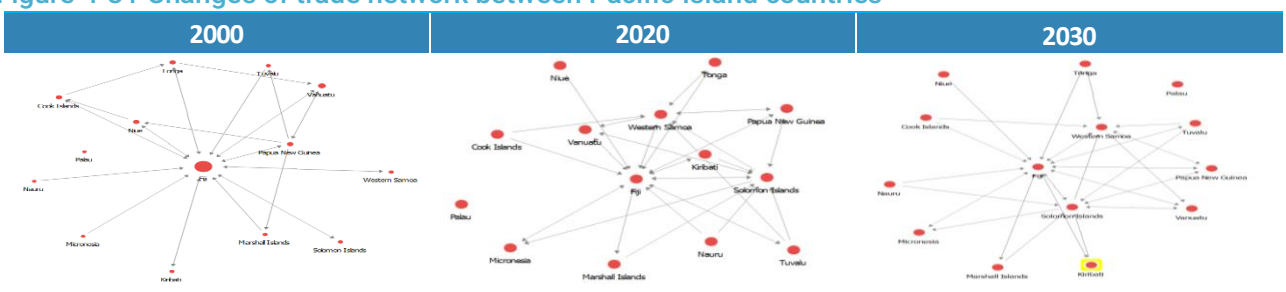
However, preliminary modelling conducted by the World Bank (2023) suggests that, for low cargo volumes, the costs of diverting large container ships to the nearest hub port may outweigh the potential benefits. Nonetheless, the above service model could still be applicable in addressing the connectivity challenges of SIDS and outer islands. Given that improving maritime connectivity under the current system may not be economically viable, simply increasing connectivity levels without considering cost-effectiveness may not be the right approach.

Not all ports can function as transshipment hubs, as the concept relies on increased throughput and revenue for the host port authority. By definition, hub ports require other ports to operate in a dependent relationship. Three key requirements for a functional hub port in the Pacific region are (UNESCAP, 2022):

1. Geographic proximity to trade flows and the establishment of a feeder network to serve smaller regional ports.
2. Sufficient infrastructure, including adequate yard space, equipment, deep water access, and easy port accessibility.
3. Efficient cargo handling, with competitive pricing, fast vessel turnaround times, and the use of advanced technology.

From this perspective, Fiji remains the most suitable hub port in the Pacific region. Additionally, Apia Port in Samoa, which already performs some transshipment functions, could be considered a regional hub port. Apia is centrally located in the Pacific and serves as a secondary hub for nearby island nations such as American Samoa, the Cook Islands, and Niue. While its current cargo volume is not as high as Fiji's, if Samoa develops its hub functions, it could handle more cargo, attract additional transshipment calls, and ultimately improve regional connectivity.

Figure 4-31 Changes of trade network between Pacific Island countries



Source: Analyzed by KMI

The current international shipping network has been established by and for the benefit of international liner shipping companies that form alliances and consortia. As a result, this network may not always provide the most optimal connectivity services for Pacific Island countries. Therefore, a purely market-driven approach may not be suitable.

While private shipping companies need to maintain fair pricing to ensure profitability, there is also a need to develop and operate more efficient maritime transport routes. This requires a regionally coordinated strategic approach to network planning. Additionally, various measures should be explored, such as providing incentives for unprofitable routes and ensuring the fairness and appropriateness of surcharges imposed on the Pacific region.

4.3.3. Promoting Green Shipping & Resilience

4.3.3.1. Energy Transition

The Pacific Islands countries primarily rely on fossil fuels for its energy supply, and the high cost of these fuels makes energy conservation essential. Recognizing the value of minimizing fuel and electricity consumption to achieve both environmental sustainability and cost reduction, many countries and ports are actively implementing policies to reduce energy usage.

Table 4-50: Projects and initiatives being implemented to be green port

Country	Project and initiatives
Cook Island	- Since 2018, an annual assessment of the carbon footprint of Avatiu Port has been conducted. - Installed solar-powered lighting in the port and replaced all building lights with LEDs. - Implemented procedures to minimize fuel consumption in port operations.
Fiji	- Since 2016, tracking electricity consumption and related greenhouse gas emissions. - Developed a **Green Port Master Plan (2019-2023)** as part of the port strategic plan. - Installed solar power systems on two buildings at Suva's domestic wharf, with a third system under installation. - Suva Terminal features LED lighting with a dimming system to reduce energy use during non-operational hours.
Kiribati	- Conducted energy audits for Betio Port in 2018 and 2021, tracking electricity and fuel consumption along with related greenhouse gas emissions. - Installed solar-powered lighting in the port.
Papua New Guinea	- **Daru Port upgrades** include solar lighting installation, rainwater collection, and wastewater treatment, establishing it as a pilot port for green initiatives. - Gradually replacing inefficient lighting with LED across all national ports.
Samoa	- Conducted an **energy audit for Apia Port in 2017**. - Implemented rainwater recycling and upgraded lighting to LED.
Solomon Island	- Upgraded terminal lighting to LED at all ports and installed solar lighting at some ports. - Tracking electricity and fuel consumption along with greenhouse gas emissions since 2017. - Plans to install a **solar power plant in Noro Port** to supply electricity for refrigerated containers.
Tonga	- Conducted an **energy audit for Nuku'alofa Port in 2018**. - Installed **solar panels and energy-efficient lighting** at Taufa'ahau Tupou IV Domestic Wharf.

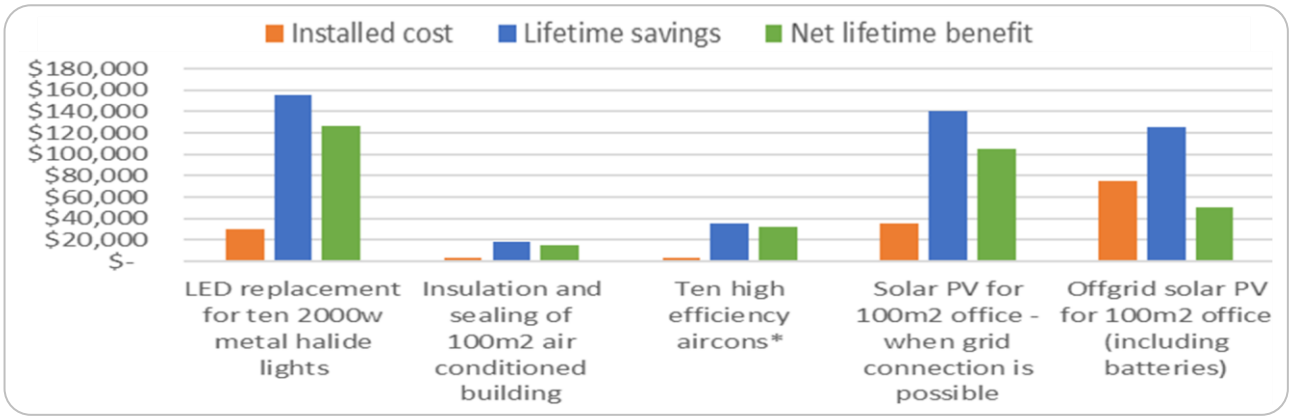
Source: UNESCAP, Sustainable and resilient Pacific Ports States Report (2023)

Various cost-effective energy efficiency measures are commonly applied to ports in Pacific region countries. These include:

1. Upgrading lighting systems – Implementing dimming control for operational lighting and replacing all indoor and outdoor lights with high-efficiency LEDs.
2. Installing rooftop solar photovoltaic (PV) systems – Harnessing renewable energy to reduce dependency on fossil fuels.
3. Improving insulation and sealing of air-conditioned spaces – Enhancing energy efficiency in port facilities.

Additionally, replacing conventional cargo-handling equipment with eco-friendly alternatives, minimizing lighting usage, and promoting awareness among port operators to reduce energy consumption are also necessary behavioral changes. By reducing electricity consumption, ports can lower fuel usage and electricity costs, ultimately contributing to improved financial performance while simultaneously achieving long-term benefits by reducing their carbon footprint.

Figure 4-32: Benefit of various energy efficiency measures for a small port



Source: UNESCAP, Sustainable and resilient Pacific Ports States Report (2023)

While a separate chapter will provide further details on energy transition in the Pacific region, solar power presents itself as a key alternative when considering operational and maintenance aspects, as well as cost factors. Rooftop solar photovoltaic systems are well-suited for most Pacific port areas. However, the size, configuration and the necessity of battery storage should be evaluated on a country-specific basis. Many countries have already implemented solar panel installations to generate electricity, coupled with LED lighting replacements to reduce overall power consumption.

Other simple and cost-effective green port measures include improving energy efficiency in air conditioning and lighting, promoting energy conservation behaviours and water-saving initiatives. These require minimal investment and offer a short payback period while delivering effective results.

However, cargo-handling equipment and vehicles in ports still predominantly rely on fossil fuels, necessitating a transition toward eco-friendly alternatives. As previously mentioned, acquiring and maintaining LNG-powered equipment is challenging and costly, making it necessary to explore renewable energy-based alternatives, such as solar-powered port equipment.

4.3.3.2. Eco-friendly ships and equipment

Some island nations in the Pacific face challenges in port and berthing facility development owing to atoll and coral reef environments, which result in shallow waters. Operating vessels suited to these conditions can help reduce dependence on fossil fuels while improving maritime connectivity between outer islands and nations for both cargo and passenger transport.

For instance, in the Marshall Islands, canoe-style vessels have been developed and deployed for operations in lagoon areas. Alongside this, efforts are being made to train personnel for vessel operation and maintenance. Additionally, the SV Kwai, a 36-meter, 180-ton sailing vessel, has played a role in international trade in the Pacific region. From 2006 onward, it operated on a commercial trade route between the Cook Islands and Hawaii. In 2021, the vessel was sold to the Marshall Islands government and repurposed for domestic shipping services. It primarily transports cargo to outer islands and carries domestically produced copra to the international trade port of Majuro.

The SV Kwai has notable advantages, as it requires a relatively small crew of about eight people and incurs no fuel costs, significantly reducing operational expenses. Moreover, it is equipped with a diesel engine, ensuring greater operational safety compared to a pure sailing vessel.

Figure 4-33: Cases of green ship in Pacific Island countries

Source: Marshall Islands Ports Authority, Marshall Islands Country Report (204)

4.3.3.3. Establishing Green Initiatives

To achieve environmental sustainability and enhance resilience, it is essential to improve operational efficiency, establish monitoring systems, and implement capacity-building measures. These projects are primarily being implemented in major ports, such as those in Fiji and Papua New Guinea. In smaller ports, the focus is on infrastructure improvements to prepare for rising sea levels and minimizing disruptions to port operations. However, in the future, a structured and phased approach to green initiatives will be necessary across all Pacific nations.

A key example is the Green Port Master Plan developed by the Fiji Ports Corporation. Fiji has established frameworks and published policy reports while actively participating in various regional initiatives such as SPREP, 6PAC, MTCC, PMTA, and SPC to promote sustainable practices in the maritime and port sectors.

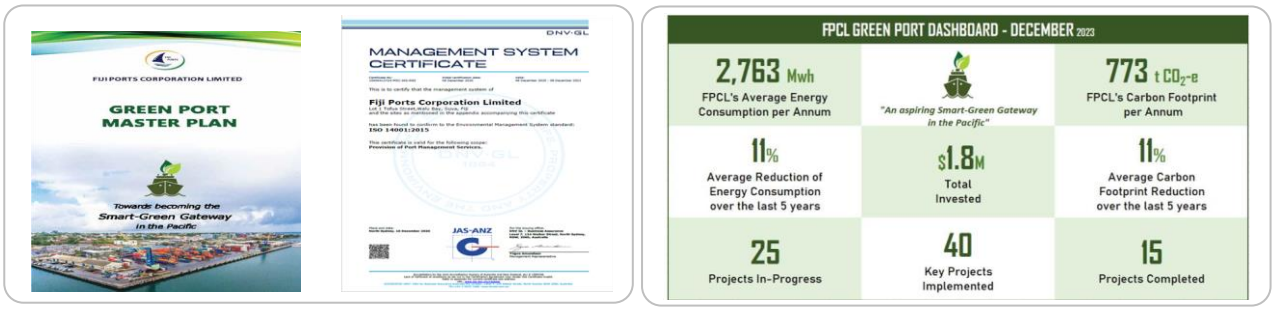
Key Priority Areas:

- Green Shipping Corridor Development / Maritime Insurance Policy Formulation
- Feasibility Studies (on hub ports, seafarer employment centers, and ship recycling)
- Revitalization of the Shipbuilding and Repair Industry /Development of Energy-Efficient Technologies

Sustainable maritime connectivity is being pursued in accordance with various guideline frameworks, with regional and national-level projects actively underway. Among these initiatives, Green Port development is a key focus area with dedicated planning.

As part of its five-year plan (2019–2023), Fiji has integrated a Sustainable Environmental Strategy into the Green Port Master Plan 2019, which provides a roadmap and guidelines for implementation. To further enhance sustainability, four key focus areas have been identified, and strategic investments are being made in lighting upgrades, solar panel installations, and the transition to eco-friendly vessels. Additionally, training programs for capacity building and the adoption of new technologies are in progress (Fiji Ports corporation Limited, 2024). Various projects are monitored using a dashboard system, which tracks implementation progress and evaluates results to ensure the effective execution of green port initiatives. Further details on regional cooperation in green shipping and the development of green shipping routes will be provided in a separate section.

Figure 4-34: Green port initiatives in Fiji Port Authority



Source: Fiji Ports corporation Limited, Green Port Development, The sustainability journey at Fiji Port, Sustainable maritime transport (2024)

4.3.4. Developing Human Capacity

First, it is essential to provide tailored training programmes through cooperation with international organizations. The UNCTAD TrainForTrade Port Management Programme can be utilized to strengthen port management capabilities, while the IMO Women in Maritime Association network can be leveraged to offer training on digital technologies and eco-friendly ship operations.

Second, expanding networks and programmes to foster female maritime professionals is necessary. Networks such as PacWIMA can enhance women's leadership capabilities by providing mentoring programmes and opportunities to participate in international conferences, supporting the formation of a global network. This initiative will help lower barriers to women's entry into technical roles and contribute to greater diversity in the maritime workforce.

Third, establishing a sustainable education infrastructure is crucial. Collaboration with regional development banks (e.g. ADB) and the World Bank should be pursued to secure long-term financial support and develop modern maritime education and training programmes. Such initiatives can enhance port management capacities, facilitate digital transformation and promote the adoption of green technologies.

Professional workforce development is essential for the sustainable growth of the maritime and port sector in Pacific Islands countries. Strengthening cooperation with international organizations, developing region-specific training programmes and increasing women's participation will contribute to the economic and social sustainability of the Pacific region.

4.4. Analysis by Key Topics for Enhancing Maritime Connectivity in the Pacific Region

4.4.1. Regional Cooperation for Maritime Decarbonization in the Pacific region

4.4.1.1. The 6PAC+ Initiative

The 6PAC+ Alliance was established to drive ambitious climate action in the international shipping sector, particularly in six Pacific Islands countries. These nations have taken a proactive approach by setting bold GHG reduction targets, devising practical strategies and strengthening support mechanisms for developing countries. Through 6PAC+ Alliance, they are fostering collaboration among SIDS to present a united voice in global maritime decarbonization efforts.

Recognizing the critical role of shipping in their economies, the six core members, namely Fiji, Vanuatu, the Marshall Islands, the Solomon Islands, Kiribati and Tonga, are leading the charge in the integration of renewable energy, alternative fuels and energy-efficient technologies into their maritime sectors. The "+" in 6PAC+ Alliance represents broader partnerships with United Nations agencies, regional organizations, industry stakeholders and research institutions, ensuring that Pacific nations receive essential technical and financial support for their transition to sustainable shipping.

The initiative's four key focus areas include

- Policy Development & Regulatory Frameworks – Strengthening national maritime decarbonization policies and aligning them with global climate commitments.
- Green Maritime Infrastructure – Developing low-carbon ports, green shipping corridors, and hybrid vessel technologies utilizing solar, wind, and biofuels.
- Capacity Building & Knowledge Sharing – Enhancing expertise through training programs, research initiatives, and regional cooperation.
- Financial Mechanisms & Partnerships – Securing funding from climate finance sources such as the Green Climate Fund, World Bank, and Asian Development Bank, while engaging private sector stakeholders for long-term investment.

A pivotal moment for 6 PAC+ came during the 82nd session of the International Maritime Organization's (IMO) Marine Environment Protection Committee (MEPC 82) in October 2024 in London. The alliance stood united and unwavering in advocating for the adoption of a mandatory universal levy on emissions from international shipping. Their leadership and persistence were instrumental in amplifying the voice of SIDS and Least Developed Countries (LDCs), reinforcing the call for an equitable transition to maritime decarbonization (MCST, 2024).

By fostering innovation and collaboration, 6 PAC+ aims to position Pacific nations as global leaders in sustainable maritime transport, despite their geographical and economic challenges. As the momentum for net-zero shipping accelerates, 6 PAC+ serves as a model for other small island states, demonstrating how collective action can drive meaningful progress toward green and resilient maritime transport.

Additionally, 6 PAC+ collaborates with Caribbean and African island nations to form the 6 PAC+ Alliance, fostering continuous cooperation to promote decarbonization in the maritime transport sector.

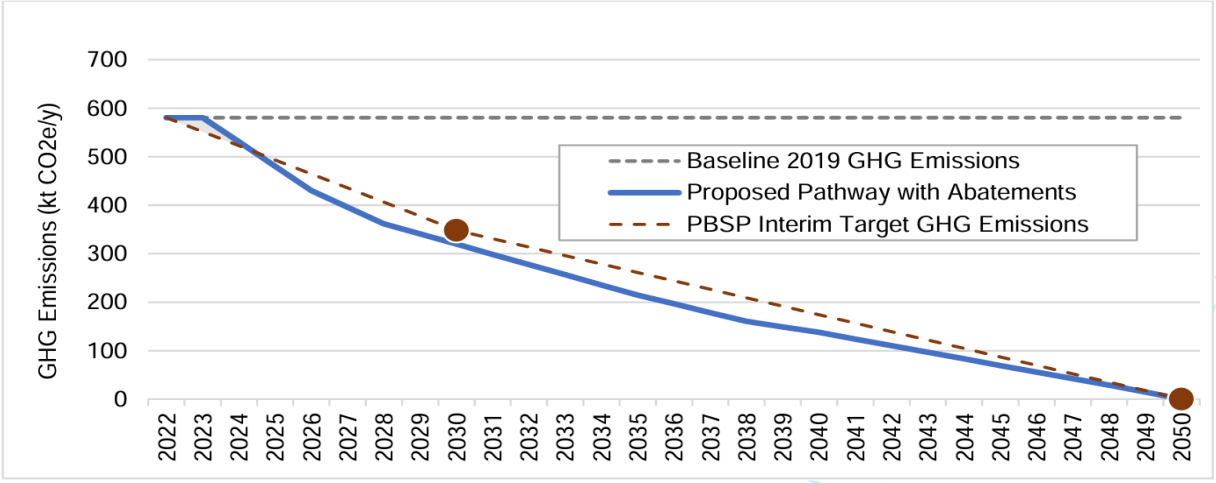
4.4.1.2. The Pacific Blue Shipping Partnership

The PBSP is a coalition of Pacific Islands countries committed to decarbonizing the maritime transport sector in the region.

The PBSP was first launched in September 2019 during the United Nations Climate Action Summit by the governments of Fiji, the Marshall Islands, Solomon Islands, Tuvalu and Vanuatu. Since then, more Pacific Islands countries, including Tonga and Kiribati, have joined the partnership, expanding its regional reach.

Through the PBSP, the governments of Fiji, Kiribati, the Marshall Islands, Solomon Islands, Tonga and Tuvalu have committed to reducing GHG emissions in domestic shipping by 40 percent in 2030 and 100 percent in 2050, coupled with a large-scale transformation of their domestic maritime sectors, in line with regional and international commitments concerning sustainable development (World Bank, 2023)

Figure 4-35: Greenhouse Gas Emissions under The Zero-Carbon Transition Plan (World Bank, 2023)



Source: World Bank, Strengthening the Pacific Blue Shipping Partnership (2023)

By working together, the Pacific Blue Shipping Partnership aims to lead the global transition towards sustainable maritime transport, ensuring that small island developing states (SIDS) can enhance their shipping resilience while addressing climate change challenges.

PBSP member countries seek to achieve the following Common (Strategic) Priorities through their participation in the Partnership (World Bank, 2023):

- Accelerate progress towards the country-driven zero-carbon transformation of their interdependent domestic maritime transport sectors (including all relevant supporting sectors and services), aligned with the 2050 Strategy for the Blue Pacific Continent and the 2030 Agenda for Sustainable Development.
- Reduce total GHG emissions attributable to their respective domestic maritime transport sectors by 40 percent by 2030.
- Decarbonize their respective domestic maritime transport sectors by 2050.

4.4.1.3. Promoting the Green Shipping Corridors in the Pacific region

The Pacific region faces significant challenges in establishing green shipping corridors, including a reliance on second-hand vessels, a lack of green fuel supply chains, and inadequate port infrastructure. However, considering the strong commitment of Pacific nations, the region's limited economic market, and the presence of regional commissions, there is potential for a pilot project-based implementation of green corridors, provided that international cooperation and support are sufficient.

Below is a proposed roadmap for advancing green shipping corridors in the Pacific:

Table 4-51: GSC roadmap for the Pacific region

Phase	Milestone	Key Activities with Policy Design	Key Performance Indicators
Phase 1	- Feasibility study	- Identify GSC stakeholder's capability, cargo flow forecast, and ship type. - Evaluate potential GSC route options to achieve decarbonization targets. - Estimate GHG emissions reduction by each GSC route. - Propose incentivization measures for decarbonization. - Identify funding opportunities from international initiatives and donors. - Analyze the best practices from early GSC adopters.	- Publish and announce the feasibility study report.
Phase 2	- Establish working groups from stakeholders. - Collaborate with international climate initiatives and donors.	- Form three working groups comprising carriers, ports, and green energy suppliers. - Set target goals for each working group aligned with the PBSB targets. - Select three GSC routes connecting the Pacific with key trading partners (Japan, China, Republic of Korea, United States of America, Australia, and New Zealand). - Introduce an incentivization policy to encourage private-sector investment in decarbonization efforts.	- Establish three GSC corridors with ports at origin and destination locations. - Secure participation of three major shipping lines in the GSC routes. - Ensure five major ports in the Pacific join the GSC initiative.
Phase 3	- Scale-up GSC implementation	- Expand GSC corridors. - Deploy near-zero or zero-emission ships on the GSC routes. - Facilitate alternative energy at ports to reduce GHG emissions in the ports. - Deploy hybrid or fully electric vessels within the ports or the Pacific region routes.	- Deploy three zero-emission ships by major carriers on the GSC routes. - Upgrade 50 percent of the ports in the region with renewable energy and alternative fuels bunkering facilities
Phase 4	- Full deployment	- Achieve the PBSB's initial decarbonization target for 2030	- Realize a 40 percent GHG emissions reduction from domestic shipping as committed by the PBSB.

The Pacific region roadmap could align with the PBSP's decarbonization targets, which are (1) achieving a 100 percent carbon-free maritime transport sector in the Pacific by 2050, (2) reducing GHG emissions from domestic shipping by 40 percent by 2030 and (3) reducing GHG emissions from domestic shipping by 80 percent by 2040.

In addition, Central Pacific Shipping Commission (CPSC) can play a critical role in implementing GSCs, as it is a sub-regional intergovernmental body responsible for maritime connectivity in the Central Pacific. To drive decarbonization, the CPSC can design incentivization policies, such as encouraging zero-emission vessel adoption; leverage controlled competition by regulating market entry for green shipping operators; and develop a strategic roadmap, by establishing clear timelines for ship retrofitting and zero-emission fleet development.

Developing and implementing a GSC roadmap for the Pacific region would necessitate addressing specific regional challenges such as limited port infrastructure, dispersed islands, underdeveloped digitalization and heavy reliance on maritime transportation for international trade, which are all compounded further by low connectivity in the region.

4.4.2. Port traffic estimating in the Pacific Island countries using AIS data

4.4.2.1. Background

Efficient and effective port development requires accurate traffic data and investment analysis, but data collection remains challenging in some countries. To address this, research has adopted Automatic Identification System (AIS) data, which tracks vessel movements and maritime traffic. This section presents a method for estimating port throughput using AIS data, particularly for ports with limited statistics.

To validate accuracy, a comparative analysis was conducted on ports with available cargo data, such as Nuku'alofa, Apia, and Malakal, confirming AIS-based estimates' reliability. The method was then applied to Neiafu Port to supplement missing data and used to estimate cargo volumes at Suva and Lautoka Ports in Fiji, where only national-level data was available.

This approach shows promise for estimating cargo volumes in data-limited ports. With continued refinement, it can enhance long-term port throughput estimations, supporting strategic port development.

4.4.2.2. Methodology Overview

To identify berths and anchorage zones for each port, the analysis utilized a combination of IHS Markit's 'Ports & Terminal Guide', Google Satellite imagery, and AIS data. By cross-referencing these data sources, the precise layout of port facilities and operational zones was mapped. This process ensured the accurate delineation of port boundaries and activity zones, forming the basis for further analyses of maritime traffic.

Using unique vessel identifiers such as MMSI (Maritime Mobile Service Identity), ship voyages were classified to extract data specific to vessels engaged in cargo operations. Only ships that docked at port berths were considered as performing loading or unloading operations and were included in the analysis. By this measure, vessels that merely passed through port areas without engaging in cargo operations were excluded from the dataset.

4.4.2.3. Port Volume Estimating Results using AIS data

To evaluate its accuracy and usefulness, six ports (Nuku'alofa, Apia, Malakal, Neiafu, Suva, Lautoka) with approximate cargo volume data available from their annual reports or official websites were selected for analysis When the cargo volume estimation method was applied to ports in the South Pacific region using AIS data, a comparison with actual port or maritime cargo volumes revealed some discrepancies in absolute values and deviations. These differences may be attributed to several factors, including the analysis being limited to vessels with IMO numbers, assumptions about average vessel load factors, the presence or absence of terminal-specific equipment and its varying size and performance, as well as errors inherent in the AIS data itself. To mitigate these issues, the estimated cargo volumes were approximated by scaling based on the mean and standard deviation of actual data. The model that most accurately explained the cargo performance of each port was selected, and the estimated cargo volumes were presented based on the outcomes derived from the chosen model.

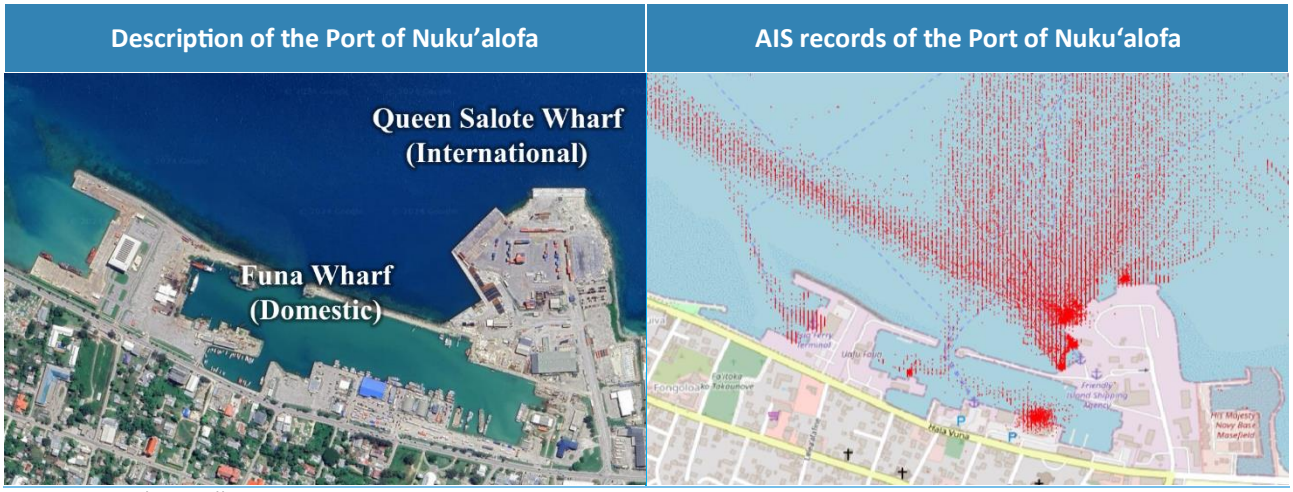
1) Port of Nuku'alofa, Tonga

Nuku'alofa Port is the primary international trade port of Tonga, located in the capital city, Nuku'alofa. Tonga's maritime trade is mainly conducted through Nuku'alofa Port in Tongatapu and Neiafu Port in Vava'u, with approximately 98 percent of the country's import and export cargo handled through Nuku'alofa Port as of 2019. The port consists of three main wharves:

- Queen Salote Wharf (QSW) – Primarily used as the international terminal
- Funa Wharf – Dedicated to domestic inter-island transport
- Vanu Wharf – A berth exclusively for cruise ships

The analysis focuses on QSW and Funa Wharf for cargo volume estimation. AIS records from Funa Wharf show that the rightmost cluster mainly consists of fishing vessels and tugboats. In comparison, a significantly higher number of ship records are concentrated at QSW, indicating its dominant role in cargo operations. Furthermore, ships with IMO numbers were primarily using QSW, reinforcing its importance as the key international terminal for Tonga's maritime trade.

Figure 4-36: Nuku'alofa Port Pier Facilities and AIS Records of Calling Vessels



Source: Google Satellite, OpenStreetMap

The data for Nuku'alofa Port was provided by the Port of Tonga Authority, covering monthly cargo volumes from 2019 to 2023, categorized by cargo type. The Total Cargo Volume was the sum of Liquid Bulk Cargo and Dry Cargo, with additional breakdowns for General Cargo (a subset of Dry Cargo) and container throughput in TEUs. Overall, cargo volume across all categories peaked in 2019, followed by a decline from 2020 to 2022. However, in 2023, cargo volumes showed a recovery trend, approaching 2019 levels.

Table 4-52: Nuku'alofa Port Throughput

Year	Total (tons)	Liquid bulk (tons)	Dry Cargo (tons)	General cargo (tons)	Container (TEU)
2019	461,685	65,371	396,315	196,905	26,643
2020	409,629	56,898	352,731	169,269	22,362
2021	422,898	50,785	372,113	173,149	22,957
2022	411,427	57,452	353,975	203,131	22,236
2023	436,063	63,051	373,012	195,466	26,221

Source: Port of Tonga Authority
Note: The amount of General Cargo is included in that of Dry Cargo.

Figure 4-37: Port Container Throughput Estimate Based on the DWT Model (Nuku'alofa) (TEU)

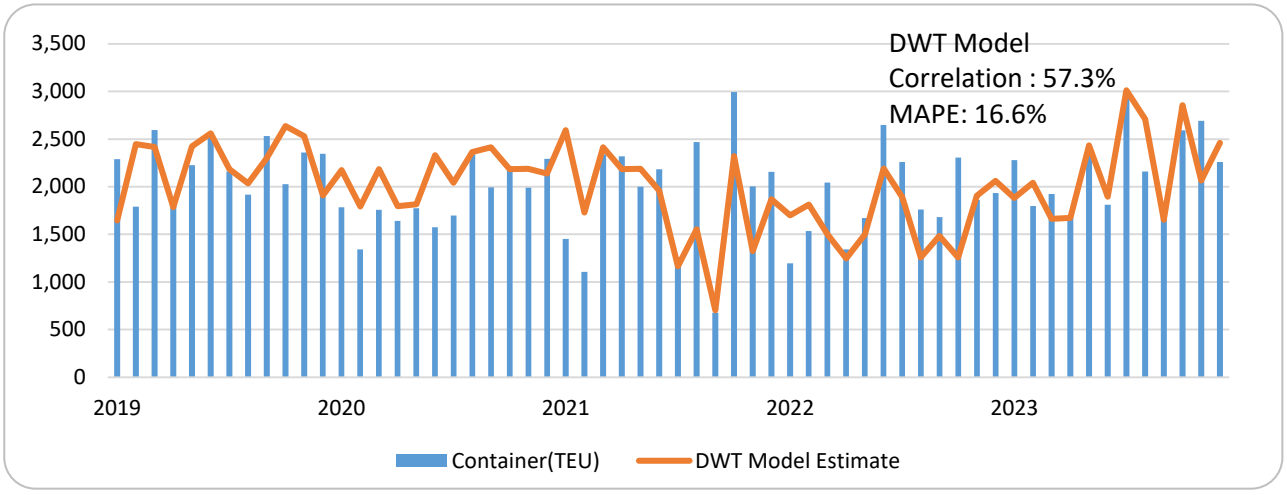
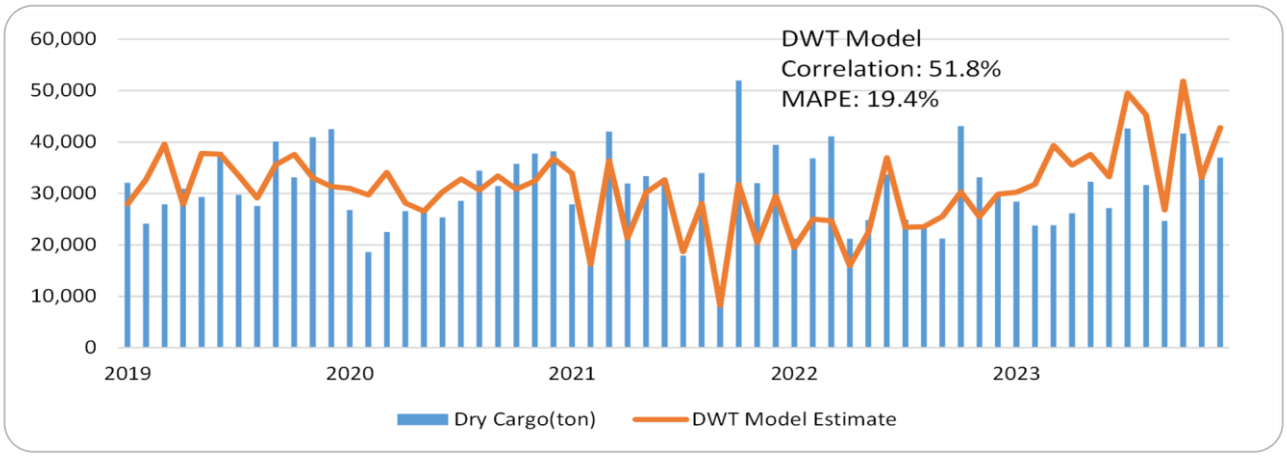


Figure 4-38: Port Dry Cargo Throughput Estimate Based on the DWT Model (Nuku'alofa) (tons)



2) Port of Apia, Samoa

Apia Port is Samoa's primary international trade port, handling over 95 percent of the country's international cargo volume. Apia Port's terminal facilities are categorized into three main sections:

- Main Berth – The primary docking area for cargo vessels and container ships
- Ferry Facility – Dedicated to inter-island passenger and cargo ferries
- Marina Facility – Servicing small recreational and fishing vessels

In satellite imagery, the Main Berth can be identified as the area where large container ships equipped with cranes are docked. AIS records indicate a dense and elongated distribution of vessel activity along this berth, confirming its primary role in cargo handling. Additionally, smaller cargo vessels also dock between the Main Berth and the Ferry Facility, sharing space with fishing vessels for cargo operations. To estimate Apia Port's cargo volume, analytical modeling was applied based on vessels berthed at the Main Berth.

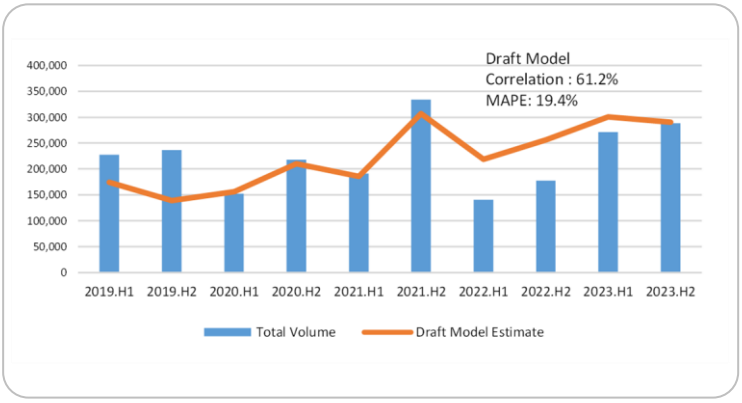
Figure 4-39: Apia Port Pier Facilities and AIS Records of Calling Vessels

Description of the Port of Apia	AIS records of the Port of Apia
	

Source: Google Satellite, OpenStreetMap

Apia Port's cargo volume data can be obtained from the Samoa Bureau of Statistics' Cargo Shipping reports, which are published on a semi-annual and annual basis. To estimate the cargo volume at Apia Port, arrival records of all cargo ships were utilized. A comparison of the estimated cargo volume across different models against actual cargo data showed that the Draft model, which calculates cargo volume based on the difference in draft between arrival and departure, had the lowest error rate.

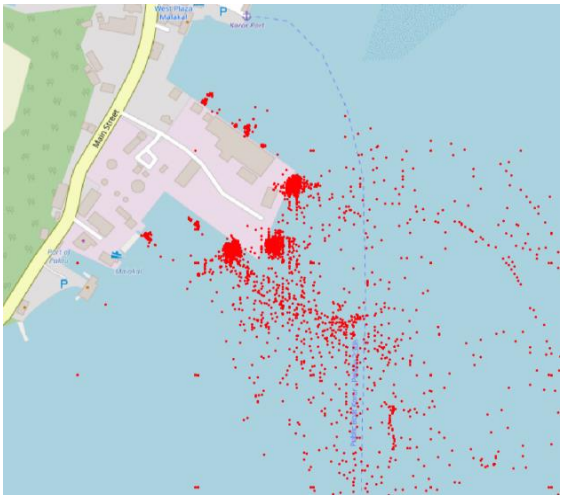
Figure 4-40: Port Cargo Throughput Estimate Based on the Draft Model (Apia) (tons)



3) Port of Malakal, Palau

Malakal Port is Palau's only international trade port, equipped with basic facilities necessary for cargo handling, port operations, and logistics. The port processes approximately 6 to 8 cargo vessels per month. Geographically, Malakal Port is located on the southern side of Malakal Island, an area with relatively fewer coral reefs within Palau's waters. As observed in satellite images, the northern side of the port is dedicated to fishing vessels, leaving two berths on the east and south sides for cargo operations. These two berths, the Main Dock and Secondary Dock, facilitate domestic coastal shipping and international trade, accommodating regular cargo vessel arrivals.

Figure 4-41: Malakal Port Pier Facilities and AIS Records of Calling Vessels

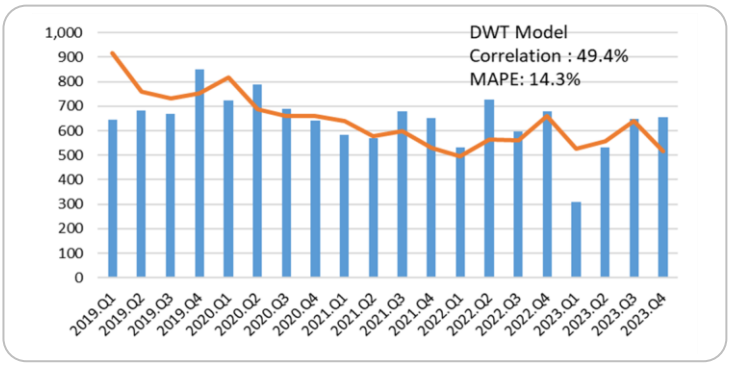
Description of the Port of Malakal	AIS records
	

Source: Google Satellite, OpenStreetMap

Information on Malakal Port's cargo volume can be referenced from the Republic of Palau National Government website, specifically in the ROP Statistical Yearbook under the table "Ocean Cargo Carrier's Containers In-bound Statistics by Quarter." The in-bound cargo volume was relatively high in 2019 and 2020, but it gradually declined through 2023, reaching its lowest point in the first quarter of 2023.

Since the only available actual cargo volume data for comparison was container throughput, the validation was conducted exclusively for container cargo. Additionally, the scope of data usage was examined alongside the model comparison to determine the most appropriate approach. The estimated quarterly in-bound port throughput based on this model is visualized in the graph right.

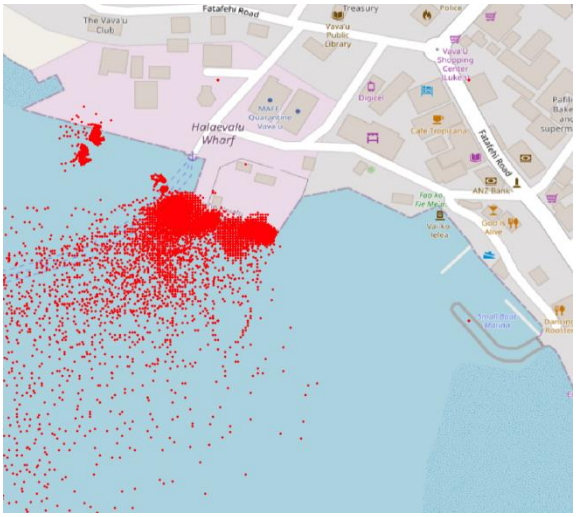
Figure 4-42: Port Container Throughput Estimate Based on the DWT Model (Malakal) (TEU)



4) Port of Neiafu, Tonga

Neiafu Port, located on the southern coast of Vava'u Island in Tonga, serves as both an international trade port and a tourism hub. The port consists of the multipurpose Halaevalu Wharf and a Marina Facility. This analysis focused on estimating cargo volume based on vessels berthed at Halaevalu Wharf.

Figure 4-43: Neiafu Port Pier Facilities and AIS Records of Calling Vessels

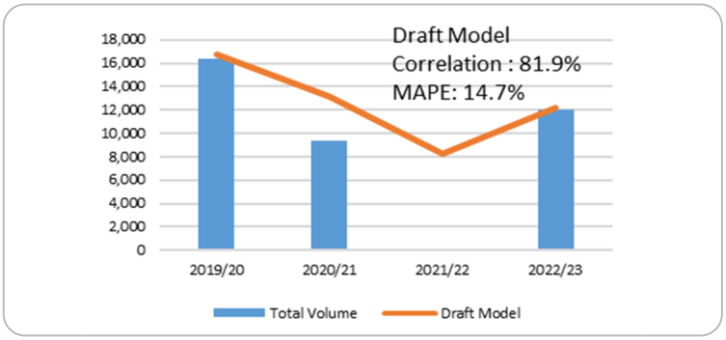
Description of the Port of Neiafu	AIS records of the Port of Neiafu
	

Source: Google Satellite, OpenStreetMap

Cargo volume data for Neiafu Port is not available through official websites or reports but was obtained with the cooperation of the Port of Tonga Authority. The port compiles cargo volume statistics based on the Fiscal Year, recording throughput from the second half of one calendar year to the first half of the next.

For Neiafu Port, port cargo volume was estimated by extracting all vessels classified as Cargo Vessels and comparing different models. The analysis showed that the Draft model, which estimates cargo volume based on the difference in draft between arrival and departure, had the lowest Mean Absolute Percentage Error (MAPE) at 14.7 percent, making it the most accurate model. The correlation coefficient between the estimated and actual values was 81.9 percent, indicating a strong relationship. Additionally, for the 2021/22 period, where official cargo volume data was unavailable, the Draft model was used to estimate the missing values. This demonstrates that for ports where annual cargo statistics are incomplete, this approach can help fill data gaps and construct a more comprehensive time series dataset. The estimated port throughput based on this model is visualized in the graph right.

Figure 4-44: Port Cargo Throughput Estimate Based on the Draft Model (Neiafu) (tons)



5) Port of Suva and Lautoka, Fiji

The berthing facilities at Suva Port are divided into four main areas:

- Kings Wharf – The primary terminal for international shipping, handling fully cellular container ships, general cargo vessels, and other large ships. It is located at the center of Suva Port and serves as the main unloading point.
- Princess Wharf – Located adjacent to Kings Wharf, mainly for fishing vessels.
- Walu Bay – Functions as a secondary cargo handling terminal, primarily for smaller cargo vessels.
- Muaiwalu – Located north of Suva Port, it contains fuel tanks and a small storage yard and is mainly used for coastal cargo unloading, fishing vessel berthing, and passenger ferry operations.

Figure 4-45: Suva Port Pier Facilities and AIS Records of Calling Vessels

Description of the Port of Suva	AIS records of the Port of Suva
	

Source: Google Satellite, OpenStreetMap

The berthing facilities at Lautoka Port are categorized into four main areas:

- Queen's Wharf – The main multipurpose terminal, accommodating various cargo types, including containers, reefers, breakbulk, Ro-Ro/Lo-Lo, chemicals, LPG, and cruise ships. Container ships and large vessels typically berth at Old West and New West for unloading.
- FSC Wharf – Operated by Fiji Sugar Corporation Terminal, primarily handling sugar and wood chips.
- Iron Sand Berth – Home to the Lautoka Iron Sand Export Terminal,
- Tanker Terminal – Located separately on the western side of the island for LPG and chemicals.

Figure 4-46: Lautoka Port Pier Facilities and AIS Records of Calling Vessels

Description of the Port of Lautoka	AIS records of the Port of Lautoka
	

Source: Google Satellite, OpenStreetMap

The cargo volume performance of Suva Port and Lautoka Port in Fiji is not publicly available through official data. However, the 2021 Fiji Ports Corporation Limited Annual Report provides the total cargo volumes for all ports in Fiji, including Suva, Lautoka, Waiqele, Malau, Muaiwalu and Levuka, for the years 2019 to 2021.

Table 4-53: Fiji Port Throughput

Year	Total (Ton)	Liquid bulk (Ton)	Dry Bulk (Ton)	Breakbulk cargo (Ton)	Container (TEU)
2019	2,684,540	951,043	896,419	41,825	167,439
2020	1,880,004	783,480	743,882	29,583	148,488
2021	1,956,555	713,377	833,504	32,793	167,327
2022	Not Available	Not Available	Not Available	Not Available	Not Available
2023	Not Available	Not Available	Not Available	Not Available	Not Available

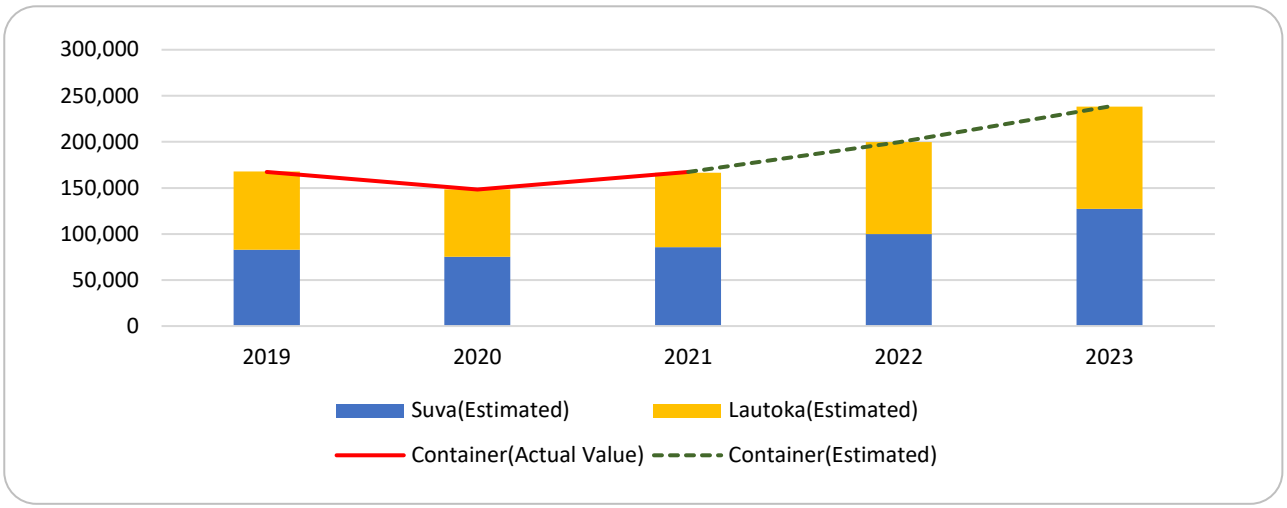
Source: Fiji Ports Corporation Limited. Annual Report 2021

Since container cargo is predominantly handled at Suva Port and Lautoka Port, it was selected as the target cargo type for estimation. Using the optimal model, container cargo volumes for 2022 and 2023, which were not publicly available, were estimated. The analysis suggests that Fiji's container cargo volumes continued to grow steadily in 2022 and 2023.

Additionally, since AIS data allow for distinguishing vessel activity at Suva and Lautoka Ports, the estimated total container cargo volume for Fiji can be distributed between these ports based on their respective vessel traffic shares. By applying this approach, container cargo volumes processed at Suva and Lautoka can be estimated, even when only nationwide cargo volumes are publicly available.

The methodology proposed in this chapter demonstrates that AIS data can be leveraged to disaggregate total cargo volumes, fill in missing data and provide updated estimates for ports where official statistics are either incomplete or unavailable. This makes it a valuable tool for analysing ports lacking comprehensive statistical records.

Figure 4-47: Port Container Throughput Estimate (Suva and Lautoka) (TEU)



4.4.3. Assessing and improving the Central Pacific Shipping Commission (CPSC) System

4.4.3.1. Overview of the Central Pacific Shipping Commission (CPSC)

The Central Pacific Shipping Commission (CPSC) was established to ensure stable, reliable, and competitive maritime transport for small island nations in the Central Pacific. The member countries—Kiribati, Marshall Islands, Nauru, Tuvalu, and Wallis & Futuna—are geographically isolated, heavily dependent on imports, and have small economies, making maritime connectivity a critical component of their economic sustainability.

Figure 4-48: Pacific Region Shipping Commission Location

Map source: The role of shipping commissions in improving service delivery in the Pacific in improving service delivery in the Pacific (SPC, 2009)
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Given the unique geographical and economic challenges of these nations, CPSC was designed to regulate competition among shipping carriers, ensuring that no single company gains an unfair monopoly while preventing excessive competition that could make operations unsustainable. However, the current CPSC system faces several challenges, including port inefficiencies, regulatory weaknesses and limited engagement with shipping operators.

4.4.3.2. Maritime Connectivity and Ports in The CPSC Region

The remoteness and scale of economies of the Central Pacific Shipping Commission (CPSC) countries has hindered economic development in the world economy. The remote location of the Pacific Island countries from the international markets results in high transportation costs for exports, and high distribution and marketing costs. This results in CPSC exporters becoming mainly price takers in the international markets, (UNCTAD, 2013) and heavily reliant upon foodstuffs, and manufactured goods imports (Baker & Sammons, 2022).

The CPSC shipping routes are typified by narrow economic bases that translate to low trade volumes, are long distances to major trade partners and global markets, have a dependency upon on imports for basic merchandise including fuels, construction materials, motor vehicles and foodstuffs.

These factors – small population, isolated and dispersed, with a narrow and vulnerable economies (ADB, 2021), and their heavy reliance on imports – create the fundamental character of CPSC ports and maritime connectivity which includes:

- Low trade volumes – cargo in Oceania is less than 0.2 percent of the total global shipping cargo (UNCTAD, 2021).
- Very long distances between trade partners and global markets – e.g., Majuro to Singapore is 4,150 nautical miles (nm), Suva to Nauru is 1,300 nm and Auckland to Tarawa is 2,300 nm (Netpas Distance, 2024).

- Low export volumes resulting in high rates of empty container returns – e.g., the ratio of full container imports and full container exports is 25:2 for the Port of Tarawa, Kiribati (Prince & Mackeen, 2017).
- Smaller, multi-purpose vessels with ship mounted cranes – scaled according to the volume and type of cargo, and smaller facilities with no shore cranage at most Pacific ports (PRIF, 2021).
- Widely varying port facilities with inadequate funding for operation and maintenance (ADB, 2007).
- Lower frequency of shipping services –e.g., at the lower range, Funafuti port, Tuvalu received 20 direct calls of international container ships in 2023 (NPDL - CPSC, 2024).
- Lack of redundancy of both shipping services and port facilities – in many Pacific Island ports there is only one international port with sufficient capacity (wharf length, depth of water in channels and alongside berth) to allow international ships to direct call (PRIF, 2021).
- High cost of transport relative to the goods sold (ADB, 2007).
- Vulnerable network easily affected by disruption – PIC ports and shipping can be severely affected by a range of issues including natural disasters, a pandemic, or macroeconomic or supply chain shocks including fuel prices.
- Natural monopolies in most ports' services, and in many cases, in shipping services – a condition of the smaller scale of available cargo volumes that do not support, in many cases, more than a single supplier of services.

International shipping networks serving the CPSC countries are dominated by a small number of shipping lines and ship operators. Those shipping operators engaged in dedicated shipping networks are corporations being held by private interests or public listed entities or single aligned governments. These shipping firms operate with ships that are under long term charter or as owned assets that they have been purpose built or selected from the second hand or charter market for the CPSC trade routes. The typical attributes of these shipping lines are that they are part of a larger corporate entity and have other direct or indirect commercial interests in the Pacific. Many shipping organizations are part of larger corporate entities. Shipping routes that connect CPSC countries are concentrated with four (4) main shipping lines/consortia that provide most of the shipping frequency and capacity. Description of vessels deployed capacity and services are shown in Table 4-54.

Table 4-54: Description of CPSC Vessels Deployed

Line	Frequency	Calls per year	Ships	Ship size
SWIRE (PNA)	30 days	12	MELANESIAN CHIEF	185m LOA, 25,000 DWT MPV LoLo 1118 TEU
NPDL (INTRAPAC)	21 days	21	CAPT. KUPE	175m LOA, 23,314 DWT LoLo 770 TEU
NSL	22 days	16	MICRONESIAN PRIDE	100m LOA, 5118 DWT LoLo 364 TEU
KYOWA (MICRO)	14 days	26	KYOWA EAGLE, STORK, FALCON	143m LOA, 12,000 DWT RoLo 650 TEU
KYOWA (SPAC)	40 days	9	TROPICAL ISLANDER CORAL ISLANDER II	160m LOA, 18,000 DWT RoLo 950 TEU

4.4.3.3. PSC Shipping Lines Reporting

The CPSC Protocol and Regulations both state that CPSC-licensed carriers are to provide quarterly reports of their shipping performance, including the number and frequency of ship calls, volume of cargo discharged and loaded, and tariffs, and communicate, to the Secretariat, any changes to the above information. Research and interviews conducted for this study reveal that only annual reports are submitted.

Feedback from CPSC-licensed carriers is that, once they submit annual reports, there is little or no feedback received from the CPSC technical committee or commissioners. A review of the annual reports submitted by licensed carriers demonstrates that the template is provided as Annex 5 in the "CPSC Regulations – Annual Performance Report and Renewal". There are several enhancements to the reporting template which would allow improved visibility of ocean freight pricing and vessel performance, and freight volumes handled. It is noted that some shipping lines provide their own supplementary reports on performance levels and pricing.

An analysis of licensed shipping carriers' most recent annual reports reveals a combined total of 249 direct port calls for February 2023 to June 2024. There was a minor discrepancy for the reported number of direct calls by line, leading to a total of 257 combined port calls.

Figure 4-50: Number of Direct Ship Calls per Port Feb 23 – June 24

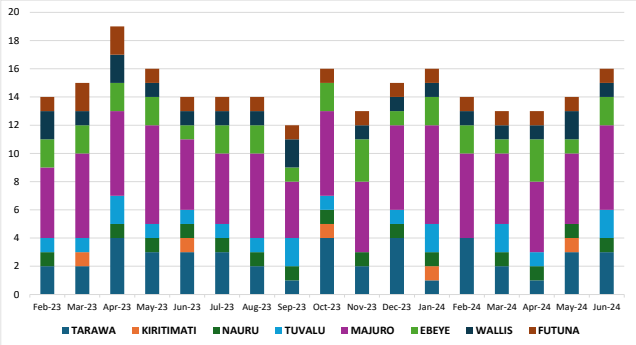
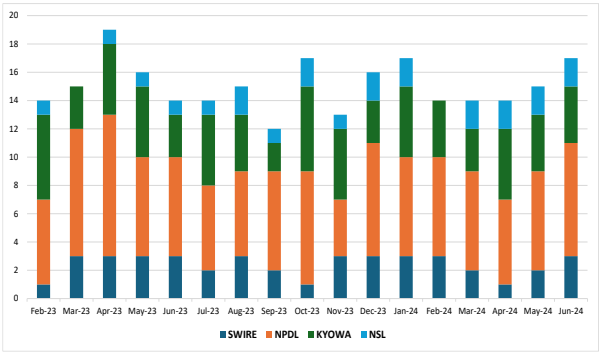


Figure 4-49: Number of Direct Port Calls by Line Feb 23 – June 24



The spread of direct calls by shipping line reveals that NPDL provides the greatest number of direct port calls spread across Kiribati, Tuvalu, Wallis and Futuna. Kyowa is second placed as most frequent provider of direct calls spread across Kiribati and RMI ports. Swire Shipping reported a total of 41 direct port calls spread across Kiribati and RMI ports for the reporting period. It is noted that Swire Shipping service has fundamentally changed effectively in August 2024. This will likely result in a monthly service that produces 12 voyages per year, a reduction of 29 direct calls. The annual report from Swire Shipping dated February 2023 stated 'the frequency service to Majuro and Tarawa remains the same, we do not anticipate any changes for 2023'.

4.4.3.4. CPSC's Controlled-Competition Model and Its Challenges

The CPSC is a unique regulatory model as its protocol includes limiting licensed shipping capacity to crea te "fair competition". Per the CPSC protocol policy, it will limit the number of carriers permitted to operate on an approved route by the anticipated volume of cargo, and exercise regulatory control over adjustments in ocean tariff rates. The mechanisms to achieve this outcome are limited to annual reports and meetings, where the commissioners, technical committee and secretariat exchange views and cooperate to encourage and promote economical, reliable, safe and coordinated commercial shipping services that meet Members' needs for international shipping services.

CPSC operates under a controlled-competition model, licensing two types of shipping service providers: Vessel Owning Common Carriers and Non-Vessel Owning Common Carriers. The goal is to prevent monopolies while ensuring that excess competition does not drive shipping services out of the market. However, the current licensing and reporting system has several weaknesses.

Shipping lines have expressed concerns that CPSC's regulatory approach is too rigid and unresponsive to industry needs. There is little feedback provided to licensed carriers, and annual reporting does not adequately track performance or market trends. In particular, there are no mechanisms for auditing vessel frequency, freight rates or service reliability, making it difficult to assess the true impact of CPSC regulations. Additionally, CPSC authority overlaps with the Micronesian Shipping Commissionin some areas, creating inconsistencies in enforcement and market regulation.

The analysis of the fundamental operations of the CPSC reveals the following gaps:

- Weak Secretariat Capacity – The Secretariat has functioned as an interim body for 14 years, with limited resources to oversee regulatory functions effectively.
- Absence of National Shipping Councils (NSCs) – Some member countries have not established NSCs, weakening regulatory coordination.
- Regulatory Overlaps – Conflicts between CPSC and the Micronesian Shipping Commission (MSC) create unclear jurisdiction over certain shipping routes.
- Government Interference in Licensing – Some VOCC licenses may have been granted without proper policy review, potentially disrupting market balance.
- Port and Stevedore Inefficiencies – Poor port management and low productivity result in long vessel waiting times, higher costs, and shipping delays.
- Lack of Essential Port Services – The absence of pilotage, towage, and navigation aids causes safety risks and operational delays.
- Limited Transparency – Licensed carriers receive minimal feedback on regulatory decisions, performance reviews, and market conditions.
- Inadequate Monitoring of Freight Rates and Service Levels – No clear mechanisms exist to track competition levels, freight pricing, or service reliability.
- Autocratic Approach – The CPSC operates in a rigid, non-consultative manner, limiting industry engagement.
- Unfair Licensing Fee Structure – Flat licensing fees fail to account for service frequency, fleet size, or ports served, leading to inequities among carriers.

4.4.3.5. Recommendations for Improving the CPSC System

To address these issues, several policy and operational improvements for CPSC can be considered and implemented

1. Enhanced Regulation of Competition and Licensing

- Establish a clearer framework for determining how many carriers should be allowed on each route.
- Introduce minimum service level (MSL) agreements for licensed carriers to ensure reliability.
- Develop a penalty system for carriers that fail to meet service commitments.

2. Strengthened Oversight and Reporting Mechanisms

- Implement quarterly performance reporting instead of annual reports to provide more real-time insights.
- Conduct regular audits on freight rates and service frequency to ensure compliance with agreed terms.
- Increase engagement with shipping operators by providing feedback and addressing industry concerns.

3. Port Infrastructure and Efficiency Improvements

- Allocate more funding for port modernization and maintenance to improve handling capacity.
- Establish harbor towage and pilotage services to enhance port safety and vessel turnaround times.
- Encourage regional cooperation to develop shared port facilities and reduce costs.

4. Harmonization with Other Shipping Commissions

- Address regulatory overlaps with the Micronesian Shipping Commission (MSC) to create a more consistent and efficient shipping regulation framework.
- Encourage cooperation with regional maritime organizations to align policies and share best practices.

5. Fairer and More Transparent Freight Pricing

- Introduce tariff audits to prevent excessive pricing and ensure that ocean freight charges are justified.
- Improve market monitoring to prevent predatory pricing practices and ensure stability in shipping rates.
- Facilitate open discussions between CPSC and licensed carriers to establish pricing benchmarks.

The CPSC plays a critical role in maintaining maritime connectivity for its member countries, but the system requires significant reforms to improve its effectiveness. By adopting a more structured regulatory approach, improving port infrastructure, and ensuring fair competition, CPSC can enhance the reliability, affordability, and sustainability of shipping services in the Central Pacific. Strengthening cooperation with industry stakeholders and harmonizing policies with other regional shipping commissions will further contribute to a more resilient and efficient maritime transport system for these island nations.

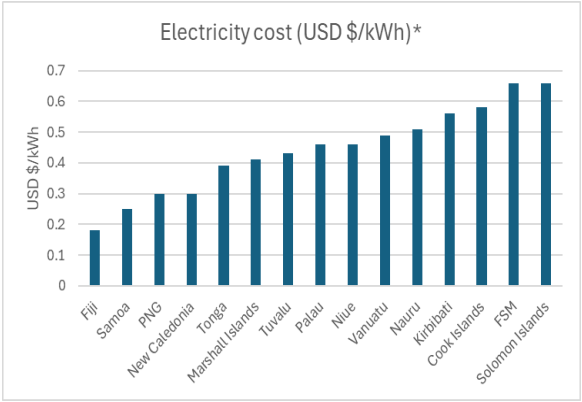
4.4.4. Energy Transition in Pacific Ports: A Focus on Solar Power

4.4.4.1. Energy Challenges and the Need for Sustainable Transition

Pacific Islands country ports face significant energy challenges, primarily owing to their heavy reliance on fossil fuels, high electricity costs and limited access to renewable energy infrastructure. As these ports play a crucial role in trade, connectivity and economic activity, transitioning to sustainable energy sources is essential for reducing operational costs, lowering emissions and improving energy security.

One of the main reasons for shifting to sustainable energy in PIC ports is the high cost of electricity and fossil fuels, which significantly increases the financial burden on port authorities and shipping operators. Unlike many other regions where electricity is cheaper than diesel, most PICs face the opposite situation, making the electrification of transport and port operations less economically attractive. Electricity costs (Government of Vanuatu, 2023) are shown in the right graph below for PICs. These high costs mean that Pacific ports have proportionally higher energy costs than similar ports where electricity is much cheaper

Figure 4-51: Electricity costs in PICs



Additionally, regulatory barriers make it difficult for ports to integrate solar photovoltaic systems into their infrastructure. Many electricity utilities in Pacific ports impose restrictions on grid-connected rooftop solar, limiting renewable energy deployment in key facilities such as port terminals, warehouses and administrative buildings. This regulatory landscape delays investment in clean energy projects, making ports continue to rely on costly and polluting energy sources.

Therefore, it is necessary to examine the opportunities and barriers for Pacific ports in adopting renewable energy and energy-efficient solutions, analysing existing energy consumption patterns, regulatory frameworks and potential pathways for decarbonization.

4.4.4.2. Opportunities for Sustainable Energy in PIC Ports

Despite these challenges, several factors are driving the shift towards renewable energy and energy efficiency in PIC ports:

- Declining costs of solar PV and battery storage make renewables more financially viable than before.
- Energy efficiency improvements, such as LED lighting, high-efficiency air conditioning, and optimized cargo-handling operations, can reduce overall energy consumption.
- Electrification of port equipment, including cranes, forklifts, and yard tractors, can help reduce emissions, especially when powered by renewable energy sources.
- Shore power infrastructure, which allows berthed vessels to connect to the electricity grid instead of running diesel generators, presents a significant opportunity to cut emissions from port operations.

By investing in these solutions, PIC ports can lower operating costs, improve energy resilience, and reduce their carbon footprint, contributing to national decarbonization goals.

4.4.4.3. Key Stakeholders in Energy Transition

The success of sustainable energy adoption in PIC ports depends on collaboration among multiple stakeholders, each playing a critical role:

- Governments – Set national renewable energy targets, develop policies, and allocate funding for port energy projects.
- Port Authorities – Oversee port operations and have the ability to invest in on-site solar PV, energy efficiency upgrades, and green infrastructure.
- Electricity Utilities – Regulate energy generation and distribution, often imposing restrictions on renewable energy adoption, which can either facilitate or hinder progress.
- Shipping Companies and Terminal Operators – While these stakeholders are not currently required to transition to sustainable energy, they may adopt cleaner technologies if cost savings or regulatory incentives are introduced.

Cooperation among these groups is essential for overcoming financial, regulatory and technical barriers, ensuring a smooth transition to sustainable energy in Pacific ports.

4.4.4.4. Recommended Policy Actions

To accelerate the shift toward sustainable energy, following several key policy recommendations can be considered.

Use Ports as Renewable Energy Demonstration Projects

- Ports should be national solar PV deployment sites, showcasing how renewable energy can power large-scale infrastructure.
- Hybrid solar-battery systems should be tested in locations where the grid is unreliable.

Reform Electricity Regulations to Allow Solar PV Deployment

- Many PICs still limit grid-connected solar systems, preventing ports from using rooftop solar PV efficiently.
- Governments should introduce policies that allow decentralized solar energy generation.

Develop Shore Power Infrastructure for Vessels

- Some ports, such as Suva (Fiji) are well-positioned to introduce shore power pilot projects.
- Donor organizations should fund feasibility studies and infrastructure upgrades to support shore power development.

Invest in Charging Infrastructure for Electric Port Vehicles

- As electric vehicle (EV) technology becomes more cost-competitive, PIC ports should invest in EV charging infrastructure for port operations.
- Governments should offer incentives for terminal operators to adopt electric cargo-handling equipment.

Support Regional Knowledge Sharing

- A regional sustainable port energy network should be established to share best practices, technology insights, and financing solutions.
- Regular conferences, webinars, and working groups can help port operators learn from each other's experiences.

The transition to sustainable energy at PIC ports is not just a climate necessity but also an economic opportunity. High fuel costs, increasing pressure to decarbonize, and declining renewable energy costs make the shift to solar power, electrification, and energy efficiency upgrades both feasible and beneficial.

However, several barriers—regulatory restrictions, limited infrastructure, and high electricity costs—must be addressed through policy reforms, stakeholder collaboration, and financial investment.

By implementing targeted renewable energy policies, investing in modern port infrastructure, and fostering regional cooperation, Pacific ports can become leaders in sustainable maritime energy, improving both economic resilience and environmental sustainability in the region.

Potential Pilot Project Location: Betio Port, Kiribati

Betio has already implemented a range of energy efficiency measures, including LED lighting, replacement of old-inefficient LEDs, building sealing, and raising of air conditioner set points. These have reduced its electricity consumption by more than 20 percent.

It has sufficient roof space to meet its annual electricity consumption from an off-grid solar system of around 276 kW capacity.

There are two utility electricity meters and supply points to the site. The right image shows where solar panels should be positioned and the approximate capacity of each.

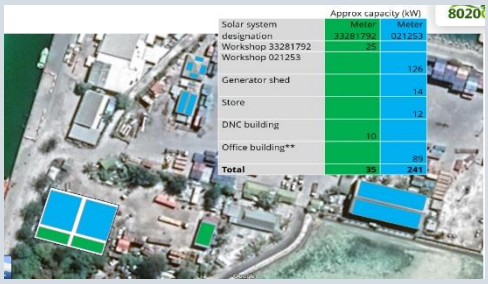
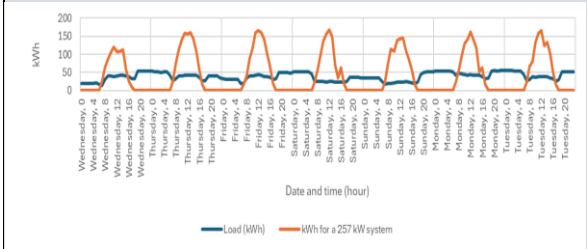


Figure 4-52: PV-system sizing for Betio port

Figure 4-53: Betio simulated electrical load, and solar production, over 7 days, with a solar-battery system sized for off-grid operation



The system's solar production, in relation to the site's demand for electricity, is shown left. Excess electricity produced in the daytime (where the orange line in the graph is above the blue line) is stored for use overnight (where the blue line in the graph is above the orange line).

CHAPTER 5

KEY FINDINGS AND POLICY RECOMMENDATION FOR A MORE SUSTAINABLE MARITIME CONNECTIVITY IN ASIA AND THE PACIFIC REGION

5. KEY FINDINGS AND POLICY RECOMMENDATION FOR A MORE SUSTAINABLE MARITIME CONNECTIVITY IN ASIA AND THE PACIFIC REGION

5.1. Key findings of the Report

The *2024–2025 Sustainable Maritime Connectivity Report in Asia and the Pacific* presents a comprehensive and timely analysis of the evolving maritime transport landscape across the region, with special emphasis on the unique challenges and opportunities facing Pacific Island countries. Drawing from extensive data, stakeholder consultation, and subregional case studies, the report identifies a series of crucial findings that underline the need for targeted policy innovation, regional cooperation, and inclusive development.

1. Growing Uncertainties Shaping Maritime Connectivity

Maritime transport in Asia and the Pacific is increasingly subject to a range of emerging uncertainties that complicate efforts to improve infrastructure, logistics resilience, and sustainability. These uncertainties arise from global political, economic, environmental, and technological dynamics:

Geopolitical Instability and Trade Protectionism

The maritime sector is vulnerable to geopolitical disruptions including the war in Ukraine, tensions in the Middle East and growing trade rivalry between major economies. These tensions contribute to supply chain fragmentation, shipping route realignment and increased freight volatility.

Evolving Environmental Regulations

While international regulations such as the IMO GHG Strategy aim to support decarbonization, their future direction and enforcement levels remain uncertain. This creates planning challenges for fleet renewal, fuel transitions and green port investment.

Energy Market Volatility

The transition toward renewable energy is affecting traditional shipping segments, especially the tanker market. Fluctuating oil prices, shifting energy policies and fuel-related regulatory pressures create uncertainty in vessel deployment and trade flow projections.

Technological Disparities and Automation

The rise of smart ports and autonomous shipping systems in developed economies highlights a widening digital divide. Many developing countries, especially Pacific SIDS, risk being left behind unless supported through technology transfer and skills development.

Macroeconomic and Financial Instability

Global inflation, exchange rate volatility and rising interest rates are dampening investor confidence. These factors particularly affect developing economies' ability to secure financing for port and maritime projects, impeding long-term sustainability planning.

Addressing these uncertainties requires flexible, forward-looking policies and stronger regional cooperation mechanisms to absorb shocks, reduce vulnerability, and ensure inclusive participation in maritime trade development.

2. Persistent Imbalances in Maritime Connectivity

The Asia-Pacific region accounts for over 50 percent of global seaborne trade; yet this connectivity remains deeply uneven. Countries in ENEA, such as China, Japan and the Republic of Korea, lead in trade volume and port performance. They benefit from robust industrial bases, advanced digital infrastructure and efficient logistics networks. In contrast, Pacific Islands SIDS remain at the margins of global trade routes, experiencing low service frequency, high transportation costs and fragile infrastructure. Their LSCI scores are among the lowest globally.

This imbalance has profound implications for economic inclusion and resilience. It not only constrains the growth prospects of small economies but also threatens to deepen developmental disparities in the region unless proactive interventions are made.

3. Diverging Trade Dynamics Across Subregions

Each subregion in Asia and the Pacific plays a distinct role in shaping trade flows:

ENEA is the region's manufacturing and logistics hub. It imports raw materials and exports high-tech and finished goods, anchoring global supply chains.

SEA has emerged as a key intermediary in regional production networks, with strong integration in intra-Asia trade. Countries such as Vie Nam and Indonesia are gaining prominence owing to their growing manufacturing sectors.

SSWA, led by India, is transitioning from a resource-based export structure to higher-value sectors, such as refined petroleum, chemicals and electronics.

NCA remains limited in maritime trade owing to its landlocked geography; however, Russia's growing Pacific energy exports are noteworthy.

The Pacific contributes essential raw materials, particularly from Australia and Papua New Guinea, but smaller island nations face infrastructural and connectivity deficits that hinder trade growth.

4. Shifting Shipping Market Outlook

The regional shipping outlook presents a mixed picture. While economic growth in Asia-Pacific remains relatively strong (3.9 percent in 2024, above the global average), the shipping market is grappling with global protectionism, vessel oversupply and climate-related risks. Container freight rates are expected to decline owing to increased capacity. Dry bulk markets are recovering, buoyed by industrial demand, while tanker markets remain volatile. Ports in six Asia-Pacific countries (China, Republic of Korea, Singapore, Malaysia, Japan and Viet Nam) dominate container throughput, collectively handling 62 percent of global volume. However, this concentration accentuates the exclusion of weaker economies, particularly in the Pacific.

5. Climate Change as an Existential Threat

Climate change presents a growing existential threat to maritime infrastructure, especially for vulnerable island states. Sea-level rise, storm surges and extreme weather events are already damaging port assets and coastal zones. Although some Pacific countries are exploring solar-powered ports and wind-assisted ships, adaptation and mitigation measures are not scaling at the appropriate pace. Most existing port infrastructure lacks climate resilience, and smaller economies often lack access to climate finance or technical expertise to implement green solutions.

6. Maritime Digitalization and Technological Gaps

Digital transformation is reshaping maritime operations. Countries in East and SEA are implementing AI-driven port systems, smart logistics platforms and autonomous vessels. These advancements are boosting efficiency and transparency, while also widening the technological divide. Most Pacific Islands ports still rely on manual and paper-based systems. Limited information and communications technology infrastructure and a lack of digital training for the workforce inhibit the adoption of digital trade facilitation tools. Without external support, the digital gap will further marginalize these economies from global supply chains.

7. Human Capacity Constraints

Human capital remains a critical constraint, particularly in SIDS. Aged maritime fleets, insufficient training and gender disparities in port employment are key challenges. Many Pacific Islands states face shortages of qualified port workers, seafarers and maritime administrators. Moreover, career development and maritime education opportunities are limited. Organizations such as PacWIMA are working to enhance women's participation in the sector, but systemic barriers remain, requiring broader support for education, training and inclusion.

8. The Pacific Region's Maritime Infrastructure Gap

Chapter 4 offers a country-by-country assessment of maritime infrastructure in the Pacific, revealing chronic underinvestment in port facilities. Many ports operate with outdated equipment, shallow berths and inadequate handling capacity. The result is high turnaround times, inefficiencies and elevated shipping costs. Additionally, domestic shipping fleets are often aged and unfit for long-term use. This not only increases operational costs but also limits options for inter-island trade and emergency response.

9. Innovative Approaches to Data and Cooperation

Given limited trade statistics in many Pacific countries, the report highlights the use of AIS data to estimate port traffic. This data-driven approach offers new insights into vessel behaviour, shipping trends and infrastructure planning. Moreover, the CPSC has emerged as a promising but underfunded regional mechanism. The report recommends strengthening CPSC mandate, funding and authority to oversee shipping services and negotiate with shipping lines on behalf of Pacific states.

10. Green Transition and Renewable Energy in Ports

Several case studies, such as the solar-powered port system in Kiribati, demonstrate the potential for renewable energy solutions. Solar-battery systems can reduce costs and improve resilience. However, successful implementation requires external funding, skilled maintenance and long-term planning. Broader green initiatives, including the 6PAC+ Alliance regional decarbonization platform, aim to accelerate the transition to low-carbon maritime operations. International cooperation and climate finance are essential to scale these efforts.

5.2. Summary of Trends and Policy Directions in Maritime Transport in the Asia-Pacific Region

5.2.1. Increasing Importance and Uncertainty

(TRENDS) The significance of maritime transport in the Asia-Pacific region continues to grow, while uncertainties surrounding demand and supply fluctuations are also increasing.

(DIRECTION) There is a need to expand maritime transport networks through long-term port infrastructure development and fleet expansion to support sustainable economic growth. Additionally, the region must strengthen its capacity to respond to short-term shocks such as economic fluctuations and pandemics.

As analysed in Chapter 2, maritime transport in the Asia-Pacific region is expected to continue driving economic growth, with developing countries such as China, India and major ASEAN nations maintaining high growth rates exceeding 5 percent, and advanced economies such as Japan, Australia and the Republic of Korea experiencing steady growth of 2–3 percent. With intra-regional trade expansion, the importance of connectivity and safety in the region's maritime transport network, which accounts for over 90 percent of regional trade and more than 50 percent of global maritime transport, will further increase.

To ensure sustainable economic growth, long-term port infrastructure expansion and fleet supply must be pursued. This requires countries to establish and implement comprehensive long-term plans, build institutional frameworks and develop specialized human resources.

Despite these long-term trends, as analysed in Chapters 2 and 3, increasing complexity in global supply chains, rising interdependence between national and regional economies, potential geopolitical conflicts along major shipping routes and climate change impacts on key maritime gateways are contributing to greater fluctuations and uncertainties in maritime transport demand and supply. To mitigate these uncertainties, the ability to detect risks in advance and minimize negative impacts when disruptions occur is crucial.

5.2.2. Opportunities for Digital Transformation

(TRENDS) The continued development and adoption of digital technologies in maritime transport offer opportunities to enhance operational efficiency in ports, shipping, and logistics.

(Direction) Policies and actions are needed to promote technological advancements and encourage the widespread application of these innovations across the region.

As explained in Chapter 3, the development and application of digital technologies across all industries are expected to continue. Digital transformation also can present a significant opportunity to improve the competitiveness of the maritime transport sector. Examples include improved port efficiency through automation, reduced operational costs and optimized fleet management with autonomous ships, expanded use of electronic bills of lading via blockchain, and enhanced port infrastructure management using digital twin technology. Additionally, real-time data collection and sharing can create new maritime logistics business models.

To ensure an effective and efficient digital transition in maritime transport, continued technological development and application are necessary. It is also crucial to train and develop skilled personnel to support these advancements.

5.2.3. Decarbonization Efforts and Related Uncertainty

(TRENDS) Shipping companies and ports are making continuous efforts to achieve decarbonization in maritime transport. However, uncertainties surrounding regulations and technologies pose challenges, leading to potential delays and trial-and-error in implementation.

(Direction) Stakeholders need to engage in discussions and cooperation to reduce uncertainty and accelerate decarbonization efforts.

As outlined in Chapter 3, regulatory frameworks such as those from the IMO and the European Union are driving carbon reduction initiatives in maritime transport. Shipping companies are investing in environment-friendly vessels, and major ports are transitioning towards carbon-neutral operations through the use of renewable energy. The green shipping corridor initiatives being pursued among various countries and ports are part of these efforts.

However, the absence of a dominant alternative fuel among LNG, methanol and ammonia; lack of established production and supply chains for these fuels; and significant investment required for shipbuilding are slowing the transition to decarbonized maritime transport. To overcome these challenges, stakeholders, including port authorities, shipping companies and terminal operators, must collaborate on expanding alternative fuel supply chains, developing and applying relevant technologies, and reducing uncertainties associated with decarbonization efforts.

5.2.4. Growing Disparities in Maritime Connectivity

(TRENDS) Maritime transport networks continue to be structured based on economic efficiency, leading to increased concentration on major trade routes and hub ports, widening gaps between countries and regions.

(Direction) Efforts are needed to enhance maritime connectivity in underserved areas to ensure sustainable global economic growth and development.

In the Asia-Pacific region, the concentration of cargo volumes and economic activities around top-tier ports is intensifying. As highlighted in Chapter 2, the gap in maritime connectivity between leading and lagging countries is widening. While this trend reflects the autonomous efficiency-driven strategies of ports and shipping lines, growing disparities in maritime connectivity could undermine the sustainability of international trade. Therefore, international efforts and support are necessary to address these connectivity imbalances.

5.2.5. Increasing Risk of Port Infrastructure Damage Due to Climate Change

(TRENDS) Rising sea levels and more frequent natural disasters due to climate change are increasing the risks of damage to port infrastructure and surrounding areas.

(Direction) Measures are needed to assess climate-related risks and mitigate potential impacts, particularly for small island developing states (SIDS).

Climate change is leading to more frequent and intense maritime disasters such as storm surges, which, combined with rising sea levels, pose significant threats to port infrastructure and coastal regions. While large-scale infrastructure investments and continuous monitoring are essential for risk reduction, many ports in the Asia-Pacific region lack sufficient financial and technical capacity.

Small island developing states, in particular, are highly vulnerable to climate-related disasters but have limited resources and capacity to respond. It is crucial for ports in the Asia-Pacific region to collect sufficient data to assess climate risks and develop long-term response strategies. Additionally, international cooperation and discussions are necessary to enhance the resilience of ports in vulnerable island nations.

Table 5-1: Trends and Policy Directions in Maritime Transport in the Asia-Pacific Region

Increasing Importance and Uncertainty	Opportunities for Digital Transformation	Decarbonization Efforts and Related Uncertainty	Growing Disparities in Maritime Connectivity	Increasing Risk of Port Infrastructure Damage Due to Climate Change
Trend: Growing maritime transport with rising demand-supply uncertainties	Trend: The continued development and adoption of digital technologies in maritime transport offer opportunities	Trend: Ongoing decarbonization efforts, regulatory and technological challenges	Trend: Increasing concentration on major trade routes, widening regional gaps in regions.	Trend: Rising sea levels, more frequent natural disasters
Direction: Expand maritime infrastructure and strengthen its resilience	Direction: Promote innovation, encourage adoption	Direction: Enhance stakeholder collaboration, reduce uncertainties.	Direction: Implement policies for inclusive connectivity	Direction: Assess climate risks, implement mitigation measures

5.3. Policy Recommendations for Policymakers in the Asia-Pacific Region

Table 5-2: Policy Recommendations for Sustainable Maritime Connectivity in the Asia-Pacific Region

Focus areas	Policy Recommendations for Policy Makers in the Asia-Pacific Region
Efficient Maritime Connectivity	1) Establishing a Mid-to-Long-Term Port Infrastructure Development Plan
	2) Promoting Digital Transformation in Maritime Transport
	3) Encouraging Active Stakeholder Participation
	4) Strengthening Linkages Between Maritime Transport Policies and Other Sectors
	5) Developing Hinterland Transport Networks and Inland Waterway Systems
Resilient Maritime Connectivity	6) Enhancing Port Crisis Management Capabilities
	7) Developing Climate-Resilient Port Infrastructure
Environmentally Sustainable Maritime Connectivity	8) Advancing Green Shipping Corridors Among Major Trade Partners
	9) Establishing Green Fuel Supply Infrastructure in Ports
	10) Developing Carbon-Neutral Ports Through Renewable Energy Integration
	11) Incentivizing the Adoption of Environmentally Friendly Vessels
	12) Establishing Multilateral Cooperation for Maritime Decarbonization
Inclusive and Safe Maritime Connectivity	13) Strengthening Support for Developing Countries with Limited Maritime Connectivity
	14) Promoting Gender Inclusion in the Maritime Transport Sector
Maritime Connectivity in the Pacific region	15) Strengthening Regional Cooperation to Enhance Maritime Transport Networks
	16) Advocating Pacific Island Interests in Global Maritime Decarbonization Efforts
	17) Leveraging Digital and Innovative Technologies

5.3.1. Efficient Maritime Connectivity

1) Establishing and Implementing a Mid-to-Long-Term Port Infrastructure Development Plan

To systematically and efficiently develop port infrastructure, national governments should establish and implement a national plan for port development, which includes site selection and a comprehensive layout for port infrastructure. This plan must be developed in consultation with relevant ministries and local communities to ensure broad support and feasibility. To prevent fragmented implementation that could threaten the plan's effectiveness, a legal framework should be established to ensure continuity and mandatory periodic updates.

This national plan should be based on objective maritime logistics data and include demand forecasts linked to national industrial policies. The governance structure for port infrastructure development and operation should also be clearly defined. Depending on national circumstances, governments may choose to directly develop and manage port infrastructure, establish a dedicated national agency or create a state-

owned enterprise responsible for infrastructure development and management. In some cases, a combination of these approaches may be applied. Since port expansion requires substantial financial investment and long-term commitments, it is essential to formulate a well-founded national plan based on consensus and objective data, ensuring its phased and consistent implementation.

2) Promoting Digital Transformation in Maritime Transport through the Adoption of Emerging Technologies

Governments and port authorities must adopt digital technologies to enhance port competitiveness and improve maritime connectivity. A comprehensive digitalization strategy should include a diagnostic assessment of the current state of digitalization in the maritime transport sector, followed by the development and implementation of a structured roadmap. To ensure long-term success, digitalization initiatives should not be treated as one-time projects but should be systematically integrated and continuously updated.

For large-scale investments such as port automation, thorough economic feasibility studies should be conducted, and private sector participation should be encouraged. Meanwhile, port authorities should prioritize lower-cost digitalization initiatives that lay the foundation for broader transformation, such as digitalizing administrative procedures, securing and providing relevant data, and establishing high-speed communication networks.

Since many countries and companies worldwide are already developing and applying maritime digitalization technologies, rather than developing new technologies independently, policymakers should focus on identifying and adopting best practices from other ports and industries. International cooperation should also be actively pursued to share knowledge, discuss implementation strategies and enhance maritime transport digitalization efforts.

3) Encouraging Active Stakeholder Participation in Port Development and Operations

Port infrastructure development requires substantial financial resources and workforce investments, and it has wide-ranging geographic and industrial impacts. Therefore, governments and port authorities must ensure active stakeholder participation and consensus-building throughout the planning and implementation phases.

Key stakeholders include government ministries responsible for finance, environment, trade, foreign affairs and fisheries, as well as local governments, residents, shipping companies, port operators, fishery communities and non-governmental organizations. Stakeholder engagement should begin in the early stages of project development, and then institutionalized and regularized to ensure consistent participation and feedback.

4) Strengthening Linkages Between Maritime Transport Policies and Other Sectors

Ports function as essential facilities for handling cargo related to industrial production and consumption activities and are directly linked to national economic policies and global trade dynamics. Therefore, maritime transport policies should be closely integrated with national policies on energy, trade, industry

and the environment. Governments should develop a comprehensive national plan that incorporates maritime transport within broader economic and industrial strategies. Additionally, mechanisms should be put in place to ensure that any updates to policies in other sectors are automatically reflected in port planning and maritime transport policies.

5) Developing Hinterland Transport Networks and Inland Waterway Systems

Efficient port operations require seamless connectivity to inland transport networks, including roads and railways, for effective cargo movement. Port development plans should always include a corresponding hinterland transport plan to ensure integrated development. Since hinterland transport infrastructure is often developed by different agencies, port authorities must collaborate closely with these organizations to align infrastructure planning and investments. For landlocked countries, efficient inland transport connections to neighboring ports, along with expanded logistics hubs, are essential for facilitating international trade. Collaborative efforts with neighboring countries should be pursued to enhance cross-border transport infrastructure.

Additionally, for Asia-Pacific countries with major river systems, the development of inland waterway transport can significantly improve connectivity while promoting environmental sustainability. Despite its potential, inland waterway transport remains underutilized in the region due to challenges such as water level management and insufficient inland port infrastructure. Policymakers should explore inland waterway development as a viable transport option and collaborate with neighboring countries to enhance its utilization.

5.3.2. Resilient Maritime Connectivity

6) Enhancing Port Crisis Management Capabilities for Various Maritime Transport Risks

To mitigate the economic impact of potential global trade disruptions, national governments must strengthen crisis management capabilities for ports and maritime transport operations. Many Asia-Pacific economies depend heavily on global supply chains, making resilience planning essential. Governments should identify key risks such as economic downturns, pandemics, port strikes, vessel incidents, and port infrastructure failures, and conduct impact assessments to develop appropriate countermeasures.

Crisis response capabilities should be periodically updated, and regular simulation drills should be conducted to assess and improve response effectiveness. Additionally, international cooperation should be fostered to share best practices, enhance collective crisis response capabilities, and establish joint response frameworks for maritime emergencies.

7) Developing Climate-Resilient Port Infrastructure

To address increasing climate-related risks, governments and port authorities must assess the impact of climate change on critical port infrastructure and implement adaptive measures. This includes collecting data on sea-level rise and intensifying weather events through research and field monitoring to project long-term impacts.

Based on these assessments, ports should develop phased resilience strategies, which may include reinforcing existing facilities, constructing additional protective structures, and integrating climate monitoring and early warning systems. Given the substantial investment required for infrastructure adaptation, prioritization should be based on thorough risk analysis to maximize cost-effectiveness and long-term resilience.

5.3.3. Environmentally Sustainable Maritime Connectivity

8) Advancing Green Shipping Corridors Among Major Trade Partners

Asia-Pacific nations and port authorities, which play a crucial role in global maritime trade, should expand the establishment of green shipping corridors to accelerate decarbonization. Unlike land transport decarbonization, which is largely driven by domestic policies, maritime transport requires international cooperation. The successful implementation of green corridors will serve as a catalyst for further maritime decarbonization efforts.

Governments and port authorities must continue joint efforts to pilot and scale up green shipping corridors, ensuring measurable outcomes and replicable models for further expansion across the region.

9) Establishing Green Fuel Supply Infrastructure in Ports

Port authorities should proactively develop policies to establish infrastructure for producing and supplying green fuels within ports. While uncertainty around demand has led to hesitancy in fuel infrastructure investment, this inaction could create a bottleneck for green ship deployment. To break this cycle, major hub ports should take a leading role in green fuel supply development, collaborating with shipping companies, bunker fuel suppliers, and energy producers to build fueling infrastructure, establish incentives, and standardize bunkering regulations.

10) Developing Carbon-Neutral Ports Through Renewable Energy Integration

Port authorities should implement strategies to reduce carbon emissions from port operations and improve energy efficiency by transitioning to carbon-neutral port models. This includes deploying renewable energy generation systems such as solar and wind power, upgrading lighting and cargo handling equipment to energy-efficient alternatives, and installing shore power (Alternative Maritime Power (AMP)) systems to enable vessels to use electricity while docked instead of burning fossil fuels.

Collaboration between port operators, shipping companies, and energy providers is essential to implement energy transition measures effectively. Policymakers must also address cost-sharing mechanisms and define the responsibilities of each stakeholder to ensure sustainable implementation.

11) Incentivizing the Adoption of Environmentally Friendly Vessels

To accelerate the adoption of green shipping, governments and port authorities should introduce financial incentives like those used in road transport, such as subsidies for building and operating eco-friendly vessels. Although such support may not be sustainable in the long term, early-stage financial assistance can reduce the burden on shipping companies and drive momentum for maritime decarbonization.

Additionally, port authorities can provide incentives such as discounted port dues or priority berthing for ships that meet higher environmental standards, thereby encouraging fleet renewal with cleaner vessels.

12) Establishing Multilateral Cooperation for Maritime Decarbonization

The successful implementation of initiatives like green shipping corridors, alternative fuel infrastructure, and carbon-neutral ports require multilateral collaboration. Given the transboundary nature of maritime transport, no single country or port can drive these changes independently.

Governments, port authorities, and industry stakeholders should actively engage in regional cooperation frameworks dedicated to maritime decarbonization. While existing forums and conferences have addressed aspects of green shipping, there remains a need for a dedicated regional platform that facilitates regular high-level discussions and coordinated policy actions among Asia-Pacific nations.

5.3.4. Inclusive and Safe Maritime Connectivity

13) Strengthening Support for Developing Countries with Limited Maritime Connectivity

To reduce disparities in maritime connectivity and international trade participation, targeted assistance should be provided to developing countries, particularly Small Island Developing States (SIDS) in the Asia-Pacific region. Cooperation and support mechanisms can be pursued bilaterally or through multilateral institutions, focusing on capacity building, research support, technology transfer, and port infrastructure development.

To ensure long-term impact, development assistance should not be limited to one-time projects. Instead, close coordination with recipient countries is necessary to identify their specific needs, establish clear objectives, and ensure follow-up programs that sustain progress beyond the initial phase.

14) Promoting Gender Inclusion in the Maritime Transport Sector

Encouraging greater participation of women in the maritime industry can help address workforce shortages while promoting gender equality. Traditionally, female representation in the sector—particularly in seafaring roles—has been low. However, ongoing digitalization, labor shortages, and demographic shifts create opportunities for increased female participation.

Governments and port authorities should implement initiatives to support women's entry into the maritime workforce, including training programs, awareness campaigns, workplace environment improvements, and gender equity policies.

5.3.5. Policy Recommendations for Pacific Island Maritime Transport Policymakers

15) Strengthening Regional Cooperation to Enhance Maritime Transport Networks

Pacific island nations should pursue collaborative approaches to improve the stability and frequency of maritime transport services. Given the challenges of geographic isolation, small markets, and trade imbalances, individual countries may struggle to attract and sustain shipping services.

Regional cooperation mechanisms—such as the existing Central Pacific Shipping Commission and Micronesian Shipping Commission—should be expanded or refined to enhance collective bargaining power, promote service reliability, and explore innovative solutions for shared maritime transport infrastructure.

16) Advocating Pacific Island Interests in Global Maritime Decarbonization Efforts

Despite contributing minimally to global emissions, Pacific Island nations are among the most vulnerable to climate change. As such, they must actively participate in international maritime decarbonization discussions to ensure their concerns are considered.

These countries should work collectively to influence global regulatory frameworks and secure targeted financial and technical assistance for their maritime decarbonization efforts. Ensuring that international climate and shipping organizations provide sustained rather than one-off support is crucial for long-term progress.

17) Leveraging Digital and Innovative Technologies for Maritime Transport and Disaster Resilience

Pacific island nations should actively explore cost-effective technological solutions for digital transformation and disaster resilience in maritime transport. While large-scale infrastructure investments may be constrained, smaller-scale innovations—such as digital port management systems, predictive analytics for weather-related disruptions, and cost-efficient infrastructure reinforcement techniques—can yield significant benefits.

Governments should facilitate knowledge-sharing initiatives and collaborations with larger ports and technology providers to ensure the most effective use of new technologies in their unique contexts.

5.4. ESCAP's Short-Term Action Plan for Enhancing Maritime Connectivity in the Asia-Pacific Region (2025–2026)

Figure 5-1: ESCAP's 2025-2026 Action Plan for Enhancing Maritime Connectivity

1) Establishing a Structured Platform for Discussions and Cooperation on Maritime Transport Issues

ESCAP will annually organize the Asia-Pacific Regional Dialogue on Sustainable Maritime Connectivity, providing a structured platform for policymakers, relevant institutions, and stakeholders to share trends and discuss international cooperation on maritime transport issues in the Asia-Pacific region. Additionally, an annual report containing issue analysis and data will be published to support regional policymakers. ESCAP will also explore ways to systematically collect and provide various maritime transport-related data to assist member states in developing their maritime transport policies.

2) Enhancing Port Competitiveness for Small Island Developing States (SIDS) in the Asia-Pacific

To strengthen maritime connectivity for Small Island Developing States (SIDS) in the Asia-Pacific, ESCAP will support the development of National Roadmaps for selected countries, organize National Workshops for capacity building, and convene Regional Workshops to explore regional cooperation strategies. Additionally, a dedicated meeting for SIDS will be held alongside the Asia-Pacific Ministerial Conference on Transport to further discuss collaboration. ESCAP will also organize capacity-building workshops on port digitalization and disaster resilience for small ports and publish relevant research reports.

3) Providing Regional Cooperation Framework for Green Shipping Corridors

To promote green shipping corridors and support decarbonization in maritime transport, ESCAP will provide a regional cooperation framework that facilitates knowledge sharing on best practices, consensus-building on future directions, and discussions on international cooperation. This initiative will be aligned with ESCAP's Regional Dialogue on Ocean-Based Climate Action (OBCA) to ensure a comprehensive and coordinated approach.

4) Strengthening Inland Waterway Transport (IWT) Development in the Asia-Pacific

ESCAP will collaborate with Mekong River Basin member states, international organizations, and academia to discuss inland waterway transport (IWT) development strategies through dedicated workshops. Additionally, ESCAP will conduct joint research with the Permanent International Association of Navigation Congresses (PIANC) to assess future technical assistance needs for developing countries in the inland waterway sector.

5) Integrating Maritime Connectivity Initiatives into the Next Regional Action Programme (RAP) (2027–2031)

The next Regional Action Programme (RAP) for 2027–2031 will serve as the guiding framework for ESCAP's transport-related activities over the five-year period and will be officially adopted at the fifth session of the Asia-Pacific Ministerial Conference on Transport in 2026. ESCAP will ensure that maritime connectivity enhancement initiatives are incorporated into the next RAP through consultations and discussions with member states, shipping companies, port authorities, and other stakeholders.

ANNEX

Annex I. Inland Waterway Transport on the Mekong River

1. Focus Background

In Asia and the Pacific, inland waterways and river ports have the potential to drive sustainable development by providing an environmentally friendly mode of transport and fostering the growth of regional economic corridors. However, the sector remains underutilized, hindered by challenges such as inadequate infrastructure, limited institutional capacity, insufficient human resources, and suboptimal operating conditions.

In particular, the Lower Mekong River Basin has yet to fully capitalize on its vast network of naturally navigable waterways by integrating them into the region's transport system to meet the growing demands for cargo transport and passenger mobility. Inland waterway transport along the Mekong River presents a mix of opportunities and challenges—some uniquely specific to the region, while others are shared universally across inland waterway transport systems worldwide.

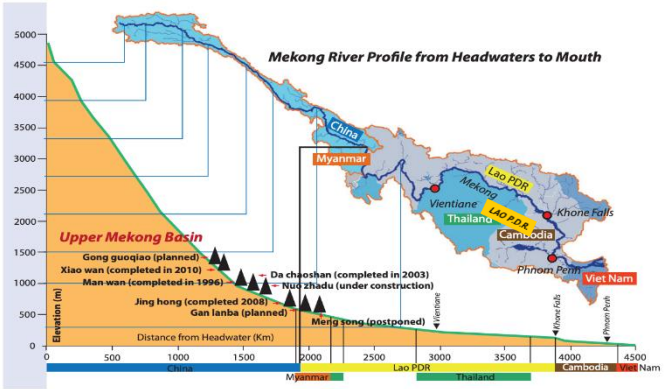
2. Current Status of the Mekong River Logistics Function

(1) Geographic Characteristics

The Mekong River is over 5,000 kilometers long and flows through 6 countries: China, Myanmar, Thailand, Lao PDR, Cambodia and Viet Nam (MRC, 2019). The Mekong River serves as a crucial inland waterway, facilitating both cargo and passenger transport for the numerous riverine communities along its banks. Additionally, it has become an increasingly significant international trade route, linking the six riparian countries and connecting the lower Mekong Basin to the sea and global markets.

In the upper reaches of the Mekong River (above the Khone Falls in Lao PDR), the development of inland waterway transport IWT faces challenges due to narrow, turbulent river sections and significant seasonal fluctuations in water levels.

Figure I-1: Mekong River Profile from Headwaters to Mouth



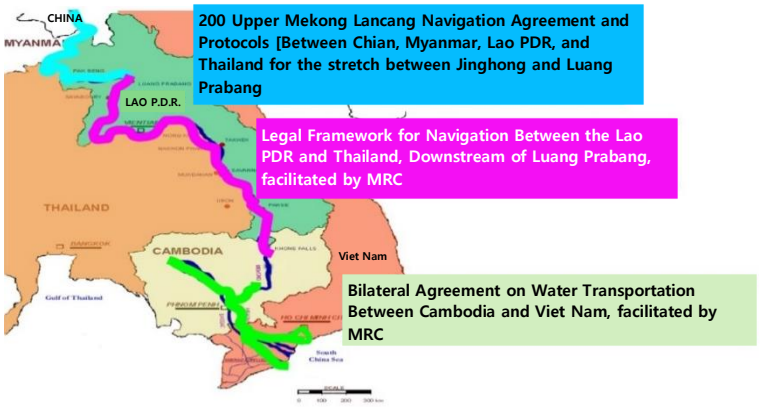
Map source: 1995 Mekong Agreement and Procedures (MRC, 2020)
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Despite these constraints, the river plays a vital role in the transit corridor between Kunming, China, and Bangkok, Thailand. Annually, approximately 800,000 tons of cargo are transported between China, Thailand, Myanmar, and Lao PDR. Across the lower Mekong Basin, cargo volumes grew at an average annual rate of 6.4 per cent between 2007 and 2014, with growth rates of 3.7 per cent in Thailand, 6.2 per cent in Lao PDR, 7 per cent in Cambodia, and 6.5 per cent in Viet Nam (ILO, 2021).

(2) International Agreements Along the Mekong River

As an international river, agreements between countries have been established to enable trade and travel across borders. These agreements address various aspects, including ensuring the rights of navigation for trade and travel and managing the sustainable use of the river's natural resources, such as water for agriculture, fisheries, and hydropower generation.

Figure I-2: International agreements along the Mekong River



Map source: Best Practices for Inland Waterway and Implications (ESCAP, 2024)
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

In addition to multilateral agreements, some Mekong countries have also signed bilateral agreements specifically related to waterborne transport. Cambodia and Viet Nam signed the Agreement on Waterways Transport between Cambodia and Viet Nam in 2009 and came into effect in 2011. The Agreement granted freedom of navigation to vessels of both countries, as well as those of third states, for both maritime and inland waterway transportation, for transit and cross-border transportation, and for the carriage of goods and passengers. Other agreements include the Agreement between China and Lao PDR on Freight and Passenger Transport along the Lancang–Mekong River, adopted in November 1994.

3. Recent History of Inland Waterway Transport Development on the Mekong River

Figure I-3: Timeline of the key characteristics of Mekong's Inland Waterway Development

1990 - 2000: Foundation Building

During this time period, it became essential for countries along the Mekong to establish joint institutions to govern the River collaboratively. The Agreement on Cooperation for the Sustainable Development of the Mekong River for the Lower Mekong Basin was signed, introducing an international framework for navigation and cooperative river management. Under this agreement, the Mekong River Commission (MRC) was established, providing a platform for coordination between LMB countries.

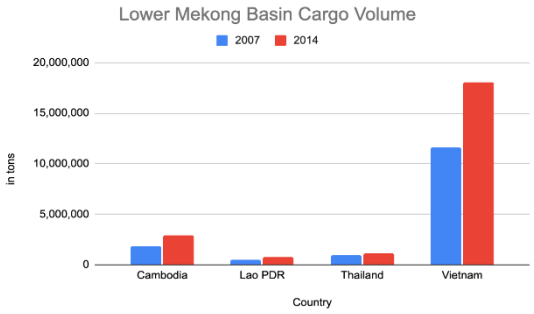
2000 - 2010: Coordination and Exploration

In this decade, countries further developed navigation along the Mekong within their region through means such as port development, waterway dredging, and addition of navigation aids. More bilateral agreements were signed to further strengthen collaboration between countries along the Mekong, especially neighboring countries. In addition to further developing conditions for navigation along the Mekong, there was also trade facilitation that added impetus to the trade along the river. During this period, increased free trade agreements helped to facilitate trade.

2010 - 2020: Increased Facilitation, Investment and Growth

In this time period, there has been a sustained growth in the cargo transport volume along the Mekong River. Between 2007 to 2014, there was an average annual growth of 6.4 per cent between Cambodia, Lao PDR, Thailand, and Viet Nam (Figure 1-4). The cargo volume has almost doubled from 14.8 million tons in 2007 to 22.8 million tons in 2014. Cambodia and Viet Nam saw the highest growth rate, with an average annual growth rate of 7.0 per cent and 6.5 per cent respectively (MRC, 2019).

Figure I-4: Lower Mekong Basin Cargo Volume (MRC, 2019)



In response to the increased trade flow along the river, there was increased investment into infrastructure to support growing trade volumes. For example, the Chiang Saen Port in Chiang Rai, Thailand was upgraded to include the Chiang Saen Commercial Port. Within the same time, Viet Nam also positioned itself as key logistics hub by being the gateway at the Mekong Delta to countries internationally. Cai Cui Port is a recently completed port in the Mekong Delta and is now the largest seaport in the Delta.

2020 - Present: Vested Interests and Competition

As the Mekong River undergoes further development, a growing number of vested interests are emerging along its course. These interests span various sectors, including transport, agriculture, hydropower, fisheries, and tourism, reflecting the river's increasing economic, social, and environmental significance. The competition among these stakeholders underscores the need for careful management and coordination to balance development objectives with the preservation of the river's ecological integrity and the livelihoods of the communities that depend on it.

Figure I-5: Map of Funan Techo Canal (Stimson Center, 2024)

Map source: A Notification of the Inland Waterway Project "Funan-Techo canal" (MRC, 2023)

Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

In 2024, there has been developments to build the Funan Techo Canal from the Cambodian government, a 180-kilometer-long canal under construction in Cambodia. It will connect Phnom Penh with the Gulf of Thailand, bypassing the need to use Vietnamese ports (Figure 1-6).

4. Challenges in the Development of Inland Waterway Transport on the Mekong River

(1) Maintaining Navigational Water Depth in the Mekong River

There are navigational challenges along the Mekong due to variation in water levels and natural obstacles. During the dry season, low water depths restrict the size of vessels that can navigate the Mekong River. Seasonal variations cause significant differences in water levels, ranging by up to 14 meters in Luang Prabang, 13 meters in Vientiane, and 8.5 meters in Phnom Penh between the high-water season (September to November) and the low-water season (February to April) (ESCAP, Guidelines for the Harmonization of Navigation Rules, 2001). There are also stretches of the Mekong where navigation is not possible, such as when the River enters Cambodia at the Khone Falls. Due to variation in water levels, there is correspondingly a great range in the vessel size that can travel through the waterway at a given time in the year.

Table I-1: Navigation Conditions Along the Mekong River (MRC, 2023)[8]

Country	Class at Low Water (Average)	Description	Class at High Water (Average)	Description	Percentage of Total River in the Lower Mekong Basin
Thailand	V	Barge level at 50 DWT	IV	Cargo barge level at 100 DWT	42%
Lao PDR	V	Barge level at 50 DWT	III	Cargo barge level at 300 DWT	71%
Cambodia	VIII	Barge level at 50 DWT	III	Sea-going level at 2,000 DWT	19%
Viet Nam	VIII	Barge level at 50 DWT	II	Sea-going level at 3,000 DWT	10%

(2) Port Infrastructure Development

One of challenges for the Mekong is that the transport facilities are limited and in poor condition in many areas and require investments. However, many of them are small, traditional ports without concrete ramps, creating difficulties for berthing. Recently, there is a positive trend of growing trade volumes in the Lower Mekong Basin that has been growing over the years that have influenced port upgrades.

(3) Harmony with Environmental Conservation and Community Development

The Mekong River, home to one of the world's most diverse fish populations, sustains a thriving fisheries industry that serves as a crucial source of food and income for millions of people living along its banks. There are also concerns about the environmental impacts of inland waterway transport to the River's biodiversity. For inland waterway transport, there is also the need to try to minimize interference with fishing activities due to vessel operation and dredging. Already, there have been fishermen's opposition to the installation and maintenance of navigational aids in Cambodia as well as in Thailand.

(4) Intergovernmental Cooperation and Consensus Building

As an international river, the Mekong River entails intergovernmental cooperation between the countries through which the river flows for effective governance. Political interests and priorities shape each country's stance on inland waterway development, leading to differing levels of commitment and approaches to cooperation. As a result, while the countries share common goals of improving navigation and economic integration, their strategies and outlooks on river development are often influenced by their individual circumstances.

The Mekong River Commission is an intergovernmental body for countries to discuss issues related to the Mekong River, but Inland waterway transport development cannot be considered a high priority.

[8] The Class included in this table is proposed in the MRC report and has not been adopted by each country.

5. Best Practices of Inland Waterway Transport

(1) Case Study: IWT in China

In China, IWT plays a pivotal role in the country's transportation network, leveraging its extensive river systems, such as the Yangtze and Pearl Rivers, to support economic growth and enhance connectivity. The Yangtze River basin accounts for almost 60 per cent of China's total cargo volume and is the world's busiest. In 2018, 52 per cent of the 127,126 kilometers of China's inland waterway network was navigable by the smallest commercial vessels of 50-ton capacity (World Bank, 2022). The success of China's development of its IWT system in the past decades can be instilled to key best practice takeaways.

The development of IWT in China has flourished due to sustained high-level governmental backing, such as through the country's five-year plans. In addition, the central government took charge of coordinating all initiatives related to inland waterway development across the country. The policies were coupled with investments from the government. Standardization of the country's inland waterway was a key first step to propel its development. The classification of waterways established clear standards and dimensions, enabling the development of a vessel classification and standardization program.

(2) Case Study: IWT in Europe

In Europe, inland waterway development plays a vital role in the region's transportation network, offering a sustainable and efficient means of transport that supports economic growth, regional integration, and environmental goals.

The AGN Agreement (European Agreement on Main Inland Waterways of International Importance, 1996) was a key milestone in developing pan-European inland waterway transport by establishing a coordinated network of navigable waterways and ports of international importance.

Initiated by UNECE to address underutilized infrastructure, fragmented networks, and operational challenges, the agreement set specific objectives: Homogeneity (standardized waterway dimensions for vessels), economic suitability (cost-effective international transport), integration (connecting river basins and coastal routes), and cargo accommodation (supporting major cargo flows). It established category E waterways, ensuring compliance with technical standards and promoting national and regional collaboration to address bottlenecks. Additionally, it enhanced awareness of inland waterway potential, supported monitoring systems, and guided strategic infrastructure development across Europe.

The establishment and operation of the Danube Commission (DC) and the Central Commission for the Navigation of the Rhine (CCNR), both international organizations dedicated to the development and management of inland waterway transport on the Danube and Rhine rivers, have played a crucial role in advancing inland navigation in Europe. The CCNR, established in 1815, has binding authority, whereas the DC, created in 1948, operates based on intergovernmental cooperation. Both organizations ensure safe navigation, regulatory harmonization, and infrastructure modernization, while also collaborating on EU transport policies, digitalization, and decarbonization to promote sustainable inland waterway transport in Europe.

6. Policy Recommendations

(1) Common Classification

A common classification system for the Lower Mekong Basin can help to ensure consistency throughout the River and is an important foundation for future development. There are many reasons why it is an important foundation. A common classification system can help to:

- Make the information available as a guarantee for users that minimum dimensions will be respected;
- Inform the shipping and transport industry, determining IWT competitiveness by laying down maximum vessel sizes, affecting navigation costs;
- Ensure the orderly and efficient control and maintenance of waterways;
- Assist the authorities in planning and policy making by showing the missing links and bottlenecks that should be prioritized.

(2) Infrastructure Investment

Infrastructure investment is essential to upgrade the Mekong River's facilities, enabling it to accommodate larger vessels and improve navigability, thereby boosting trade volumes along the river. There is the need for further infrastructure investment to catapult the development of inland waterway transport along the Mekong River. The investment can be divided into 1) infrastructure development for the River's fairways, 2) infrastructure development of port, 3) infrastructure development in vessels.

As swaths of the Mekong River are not navigable, there is the need to develop stretches that are navigable throughout all seasons. This can come in both the form of navigation aids and dredging of waterways. For example, Thailand has once had a project to dredge the stretch of the Mekong with funding from China. However, that was halted due to concerns over the environment and impacts to biodiversity and livelihoods.

Another need for infrastructure investment is in ports. Infrastructure investment is also essential for inland river ports. These ports serve as intermodal terminals, offering expanded facilities that connect various modes of transport. Such investments can help address challenges like road and port congestion, limited storage capacity, and the scarcity of physical space in regions where expanding port facilities is difficult. To facilitate larger volumes of trade and passengers along the Mekong River, there have been upgrades such as the Chiang Saen Commercial Port in Thailand. Another trend is to build a hub, such as in Lao PDR and Viet Nam. This investment into such infrastructure builds multimodal integration and logistics facilities to enhance first / last mile connectivity and consolidation.

(3) Multilateral and Bilateral Cooperation

As the Mekong is an international river, there is need for multilateral and bilateral cooperation to push for development. IWT development requires political interest to reduce uncertainties and establish a set of incentives or subsidies to overcome the resistance to modal shift. The Mekong is a multinational river that demands cooperation across countries in order to successfully have a developed inland waterway system.

Annex II. Decarbonization in Ports: The Importance of Ports, Challenges Faced, and the Role of Cooperation

1. Introduction

As climate change continues to intensify, the transportation sector is under increasing pressure to reduce its carbon footprint. While road transport and aviation have made significant progress toward decarbonization—such as the rapid rise of electric vehicles and the growing use of sustainable aviation fuels—the maritime sector lags behind. Shipping is responsible for nearly 3 percent of global greenhouse gas emissions, and this percentage is likely to rise unless meaningful interventions are made.

In this context, ports occupy a critical position. Not only are they key facilitators of global trade, but they also serve as central nodes in the maritime energy and logistics infrastructure. The role of ports in reducing emissions is often underappreciated, yet without port participation, the maritime sector cannot transition to cleaner fuels or more energy-efficient operations. This is particularly true in the Asia-Pacific region, where a majority of global maritime activity occurs.

This annex explores the central importance of ports in maritime decarbonization, with a focus on current trends, key challenges, and the role of collaborative strategies. It draws from case studies, international initiatives, and interviews with stakeholders to provide a comprehensive narrative on what is being done—and what must be done—to green the ports of the Asia-Pacific region.

2. Why Ports Matter in Maritime Decarbonization

Ports are much more than points of cargo exchange between sea and land. They are gateways to global supply chains, centers of industrial activity, and crucial enablers of energy transition in the maritime sector. Their strategic role in decarbonization can be understood in several dimensions.

First, ports are where ships bunker fuel. If the shipping industry is to transition from traditional fuels to cleaner alternatives—such as green ammonia, hydrogen, or methanol—then ports must be equipped to provide these fuels. Without this infrastructure, green vessels cannot operate efficiently or competitively.

Second, ports are directly responsible for a significant portion of maritime emissions. Port equipment, such as cranes, trucks, and container movers, is often diesel-powered and contributes to local air pollution and global GHG emissions. Electrifying this equipment, combined with the adoption of renewable energy sources, can substantially reduce emissions.

Third, ports play a critical role in ship operations. Efficient, well-managed ports can reduce the time ships spend idling at berth, waiting to load or unload. Providing shore-side electricity, also known as cold ironing, allows ships to turn off their engines while docked, dramatically lowering emissions during port stays.

Finally, ports are where many decisions are made about the flow of cargo and logistics planning. The adoption of smart port technologies—including automation, digital twins, and artificial intelligence—can improve operational efficiency and reduce unnecessary energy use. In short, ports have both a direct and an enabling role in decarbonizing maritime transport.

3. Current Trends and Practices in Asia-Pacific Ports

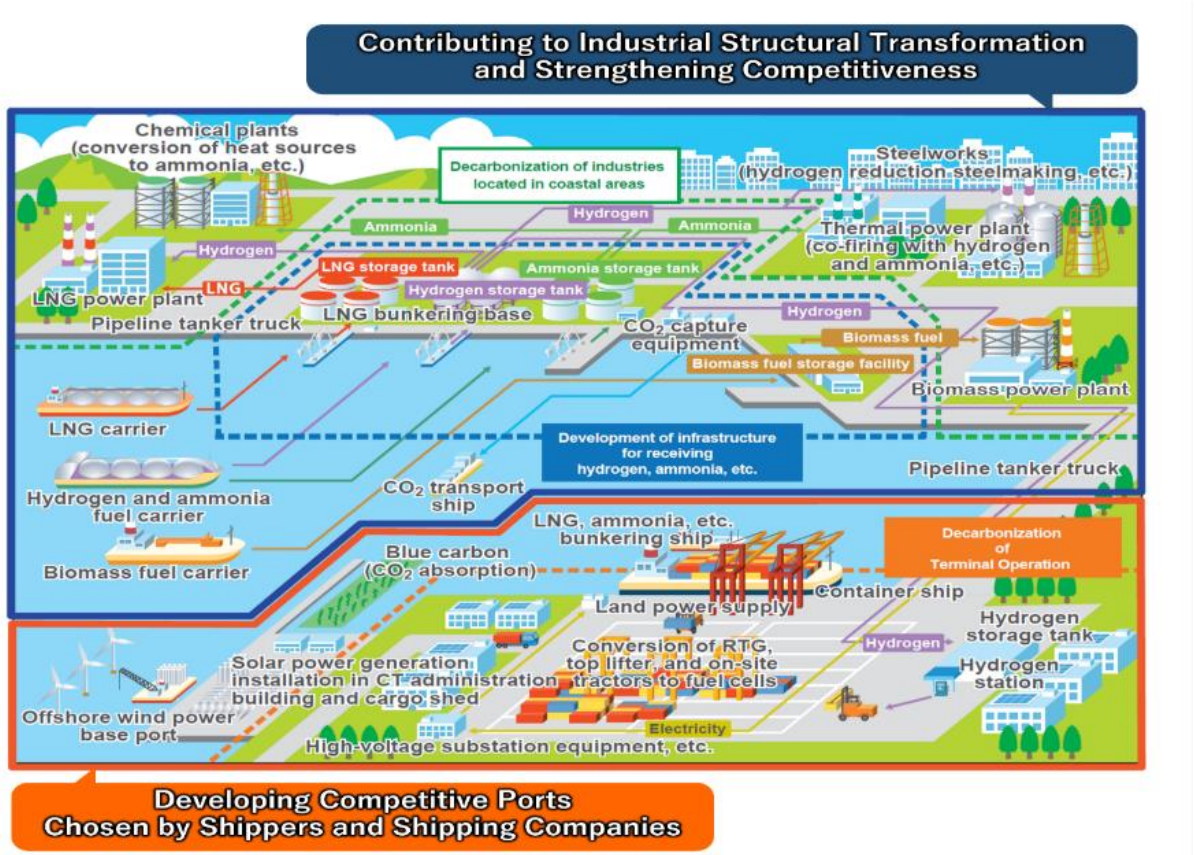
In recent years, a number of ports in the Asia-Pacific have taken important steps toward decarbonization. Singapore stands out as a global leader. The country has adopted a multi-fuel strategy that includes investments in LNG, methanol, and ammonia bunkering infrastructure. Singapore has also promoted electric and automated container terminals, helping reduce operational emissions significantly.

In Japan, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has launched a Carbon Neutral Port certification system to recognize efforts toward sustainability (MLIT, Japan, 2024). In China and the Republic of Korea, major ports are increasingly adopting renewable energy and smart systems.

At the same time, many smaller and medium-sized ports, especially in Southeast Asia and the Pacific islands, are only at the beginning of this journey. In Indonesia, the state-owned port operator Pelindo has carried out energy audits at its largest ports and launched a digitalization strategy to improve port efficiency. However, the use of renewable energy remains minimal, and most port equipment still runs on diesel.

While these trends are promising, they also reveal significant disparities in capacity, investment levels, and strategic direction across the region.

Figure II-1: Image of Carbon Neural Port (CNP)



Source: Ministry of Land, Infrastructure, Transport and Tourism, Japan

4. The Main Challenges to Decarbonization in Ports

The path toward port decarbonization is complex and full of obstacles. One of the first challenges is the lack of awareness or buy-in among many stakeholders. In several interviews conducted during this study, port staff, truck operators, and local logistics companies viewed decarbonization as something external to their business—perhaps even an inconvenience. Sustainability was often considered part of corporate social responsibility, not core operations.

Another major barrier is human resources and technical expertise. Many ports do not have dedicated staff with the knowledge or authority to design and implement decarbonization strategies. Even when sustainability teams exist, they are often small, underfunded, and disconnected from decision-making processes.

Economic factors also play a significant role. The perception that green investment is too expensive is widespread. Electrification of port equipment, installation of solar panels, or development of green fuel infrastructure requires significant upfront capital. In many cases, the payback period is long and uncertain, particularly in the absence of strong regulatory support or customer demand for green services.

Compounding this is the reality that most ports in the region are brownfield. These are older facilities built around fossil fuel-based energy systems. Retrofitting such ports for clean energy use is not only technically challenging but also bureaucratically complex. In some countries, national regulations make it difficult to generate or sell renewable energy, further discouraging investment.

Even in ports that are making progress, technical and infrastructure constraints can slow down implementation. For instance, a port may decide to switch to electric cranes but lack the grid capacity to support large-scale electrification. In addition, the development of onshore power supply systems often requires coordination between port operators, utility companies, and government agencies, something that is not always easily achieved.

5. The Power of Digitalization

Despite these challenges, one area where tangible progress is being made is digitalization. Digital technologies can significantly improve energy efficiency and reduce emissions by optimizing how ports operate. For example, container yard management systems can reduce unnecessary truck movements. Automated berth scheduling can minimize the time ships spend waiting at anchor. Real-time cargo tracking allows for smoother intermodal transfers, reducing congestion and idling.

Indonesia offers a useful case study. Through its digitalization program, Pelindo has reduced port congestion and cut down vessel waiting times. This has had a measurable impact on fuel consumption and emissions, even though renewable energy use remains limited. These early gains show that digital tools can be a cost-effective way to begin the decarbonization process—particularly in brownfield ports.

Still, digitalization is not a substitute for structural change. Unless integrated into a broader energy transition strategy, its benefits will be limited. Nonetheless, it offers a powerful starting point for many ports, especially those with limited resources.

6. Moving Toward Carbon Neutral Ports

The concept of a Carbon Neutral Port (CNP) is becoming more widely accepted. Such ports aim to reduce or offset all emissions from their operations. Achieving this requires a mix of strategies, including:

- Electrifying port equipment
- Installing renewable energy systems
- Providing green bunkering for ships
- Offering shore-side power
- Using digital systems to reduce energy use
- Supporting carbon offset initiatives like blue carbon projects

Several ports—including Rotterdam, Hamburg, Singapore, and Yokohama—are actively pursuing this vision. These ports prove that decarbonization is not only possible but can also be economically viable. In fact, international terminal operators like APM Terminals and DP World have shown that new terminals designed from the ground up with sustainability in mind often result in long-term cost savings.

7. The Need for Cooperation

One of the key lessons from this report is that ports cannot decarbonize alone. Cooperation—both regional and global—is essential.

At the international level, platforms like the IMO Global Industry Alliance, the World Ports Sustainability Program, and the World Port Climate Action Program provide mechanisms for knowledge-sharing, joint pilot projects, and policy coordination. These networks are helping ports align their strategies and avoid duplication of effort.

At the regional level, organizations like UNESCAP are supporting countries and ports in designing decarbonization roadmaps, conducting training, and encouraging cross-border collaboration. This is particularly valuable for small island developing states, which lack the scale and capacity to go it alone.

Meanwhile, green shipping corridors, agreements between ports to provide zero-emission transport routes—are gaining momentum. The corridor between Singapore and Rotterdam is one example. However, the expansion of these corridors will require major infrastructure investment, especially in developing regions. Without shared investment frameworks and international financing, many ports will remain excluded from these global initiatives.

8. Conclusion

The decarbonization of ports in the Asia-Pacific is no longer a question of "if"—but "how fast and how fairly." Ports are at the center of this transition, holding the keys to low-carbon shipping, energy transformation, and sustainable trade. Progress has been made, especially in large ports with access to resources, technology, and political will. Yet many others remain at the starting line, constrained by outdated infrastructure, regulatory hurdles, and financial risk.

To bridge this gap, a combination of national policy support, international cooperation, public-private partnerships, and technological innovation is needed. Decarbonization should no longer be viewed as a cost—but as an investment in long-term resilience, competitiveness, and environmental stewardship.

In a rapidly evolving global economy where climate performance is increasingly tied to trade access and investor confidence, ports that fail to act risk being left behind. But for those that do move forward, the rewards are substantial—not just for themselves, but for the planet.

Annex III. Maritime Transport Database in the Asia-Pacific Region

1. Background: The Need for a Maritime Transport Database in the Asia-Pacific Region

Maritime transport accounts for more than 80 percent of global trade volume, playing a crucial role in economic development, especially in the Asia-Pacific region. A reliable and up-to-date maritime transport database is essential for effective policymaking and investment decisions. The necessity of such a database arises due to several key factors:

- Importance for Individual Countries: Developing an efficient maritime transport network is critical for sustainable economic growth. Reliable data is necessary to formulate and implement effective policies.
- Challenges for Developing Countries: Many developing nations lack the resources to collect and utilize maritime transport data effectively. Access to a centralized international database would support these countries in policymaking and investment planning.
- Data Availability Issues: Given the international nature of maritime transport, many relevant datasets—such as international trade flows and global shipping networks—cannot be compiled by individual countries alone, necessitating access to externally managed international databases.
- Capacity Limitations of Small Island Developing States (SIDS) and Least Developed Countries (LDCs): These nations often struggle with data collection, impacting their ability to develop sound maritime policies. A regionally coordinated database would help bridge this gap.

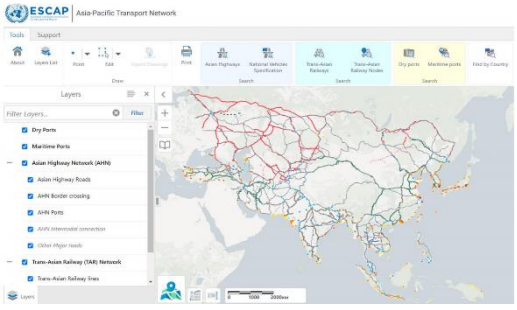
2. Analysis of Existing Maritime Transport Databases

Several international organizations and private institutions provide maritime transport databases, each with its strengths and limitations:

ESCAP's Asia-Pacific Transport Network (APTN):

UNESCAP has databases regarding a wide range of topics in Asia and the Pacific. These databases entail statistical databases, trade databases, sustainability databases and more. Asia-Pacific Transport Network (APTN) database is one database developed by UNECAP. Given that APTN is an interactive online platform of the Asian Highways, Trans-Asian Railways, international dry ports, and selected maritime ports, it shows regional transport connectivity and facilitates the decision-making processes in implementing the Asian Highways, Trans-Asian Railways, and dry ports Agreements.

Figure III-1: An example of a map of APTN database by ESCAP



The maritime infrastructure database employed for display on APTN includes information on the location and parameters of 307 Maritime Ports and 268 Dry Ports. Although APTN provides static information on the location and five kinds of size of maritime ports and dry ports, it does not provide quantitative information regarding port operation such as port throughput, the status of port equipment, the number of berths, and vessel calls. Specifically, annual freight volumes by sea and container throughput can offer quantitative information for evaluating port operation. If annual freight volumes by sea and container throughput is added in APTN, the utilization of APTN database will increase further.

UNCTAD's Maritime Transport Database:

UNCTAD provides reliable and timely data and statistics to help countries better understand trade and development trends and design more effective economic, environmental and social policies. For example, UNCTADstat Data centre includes many kinds of data by six themes such as international trade, economy and finance, maritime transport, environment and related trade, digital economy and technology, and population and inclusiveness.

Figure III-2: An example of port container traffic by UNCTAD (Republic of Korea)

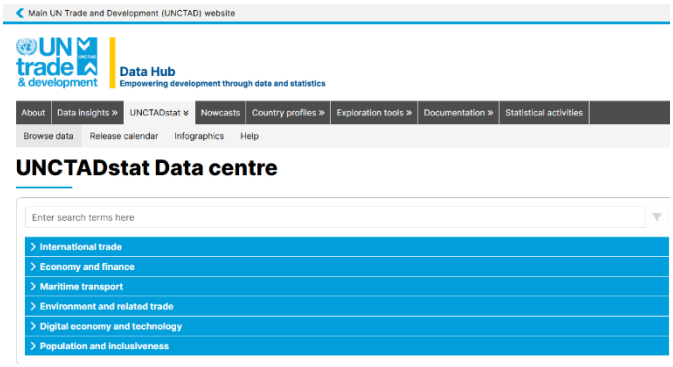


Table III-2 The description of maritime transport data by UNCTAD

Categories	Data	Frequency
Merchant fleet	Share of the world merchant fleet value by country of beneficial ownership	Annual
	Merchant fleet by country of beneficial ownership	Annual
	Share of the world merchant fleet value by flag of registration	Annual
	Merchant fleet by flag of registration and by type of ship	Annual
Freight volumes, by sea	World seaborne trade by types of cargo and by group of economies	Annual
	Container port throughput	Annual
Port calls and performance	Port call and performance statistics: time spent in ports, vessel age and size	Annual Semi-annual
	Port call and performance statistics: number of port calls	Annual Semi-annual
Liner shipping connectivity	Liner shipping connectivity index	Quarterly
	Liner shipping bilateral connectivity index	Quarterly
	Port liner shipping connectivity index	Quarterly
Seafarer supply	Seafarer supply	Quinquennial
Ship building & recycling	Ships built by country of building	Annual
	Ship recycling, by country	Annual

Regarding freight volumes by sea, annual data such as world seaborne trade by types of cargo and by group of economies and container port throughput are provided. World seaborne trade data are given by eight types of cargo. However, it does not include detailed port-level cargo volume data and lacks coverage of small island nations (UNCTAD, 2025).

World Bank's Maritime Transport Database:

World Bank is an international financial institution which provides loans and grants to the governments of low- and middle-income countries for economic development. World Bank operates the DataBank, an analysis and visualization tool that contains collections of time series data on a variety of topics. The DataBank involves many indicators by twenty themes with annual data frequency (World Bank, 2025).

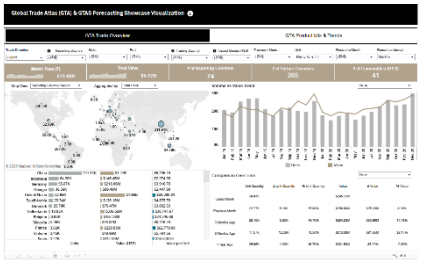
Figure III-3: Container port traffic by World Bank

Among twenty themes, the infrastructure theme includes two indicators related to maritime transport such as container port traffic (TEU) and liner shipping connectivity index (maximum value in 2004 = 100). Container port traffic data are compiled by UNCTAD, which covers the period from 2000 to 2022. The World Bank can provide yearly port container traffic data for each country over the world.

S&P Global's Global Trade Atlas (GTA):

S&P Global is a publicly traded company of which primary areas of business are financial information and analytics. The company provides governments, businesses, and individuals with market data, expertise, and technology solutions for confident decision-making.

Figure III-4: GTA visualization example



Source: Global Trade Atlas (GTA) & GTAS accessed January 2025, available at: https://www.marketplace.spglobal.com/en/datasets?search=Global%20Trade%20Atlas

Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

S&P Global has many databases regarding a wide range of topics. Among maritime-related databases, Global Trade Atlas (GTA) is a dataset for access to a comprehensive view of global trade data in every commodity at the level of Harmonized System (HS) code. This dataset includes monthly bilateral trade data for 144 countries and annual data for close to 200 countries, based on official imports and exports statistics. Moreover, this dataset provides an overview of global trade and transportation trends and outlook on trade demand, supply chain diversification, trade by transportation mode, and containerized trade. GTA is available by subscription only (S&P Global, 2025).

Lloyd's List Intelligence and Drewry Maritime Research

Lloyd's List Intelligence is an interactive online service offering detailed vessel movements, real-time AIS positioning, information on ships, companies, ports and casualties as well as credit reports, industry data and analysis including short-term market outlook reports. Container throughput data of one hundred largest container ports in 2024 are given on Lloyd's List Intelligence's internet site (Lloyd's, 2025).

Figure III-5: One hundred ports analysis

Drewry is a leading international provider of research and consulting services to the maritime and shipping industry. Through Ports & Terminals Insight by Drewry, information on port connectivity index and container throughput by region will be provided with a paid subscription (Drewry, 2025).

But both have limited accessibility and require a paid subscription.

3. Proposed ESCAP Maritime Transport Database

To support sustainable maritime connectivity and policy formulation in the Asia-Pacific region, ESCAP can consider developing a maritime transport database based on the following key principles:

- Integration with Existing Databases: Instead of creating an entirely new database, ESCAP should integrate data from existing sources (e.g., UNCTAD, S&P Global, national port authorities) while filling critical gaps through independent data collection.
- User-Friendly Access: The database should be easily accessible and usable for policymakers, researchers, and industry stakeholders.
- Capacity Building for Member States: Technical assistance should be provided to developing countries to enhance their ability to collect, analyze, and utilize maritime transport data effectively.
- Data Validation Mechanism: A verification process should be established to ensure the accuracy and reliability of submitted data, including cooperation with member states and port authorities.

It is possible to consider establishing a database with the following data:

- Port-Level Data: Cargo throughput (containerized, general, liquid bulk), port calls, berth occupancy, and operational efficiency metrics.
- Trade and Economic Indicators: Maritime trade volume, GDP contribution of maritime sectors, and trade dependencies.
- Shipping Industry Data: Merchant fleet size, seafarer supply and demand, shipbuilding statistics, and vessel registration details.
- Connectivity Metrics: Liner shipping connectivity index, intermodal transport integration, and shipping route efficiency.

4. Implementation Strategy

The development and implementation of the ESCAP maritime transport database should follow a phased approach:

Phase 1: Data Integration and System Development

- Identify key data sources and establish partnerships with international organizations (e.g., UNCTAD, World Bank, S&P Global).
- Develop a web-based database platform with interactive visualization tools.

Phase 2: Data Collection and Expansion

- Conduct targeted surveys to gather missing data, particularly for SIDS and LDCs.
- Pilot test the database with selected member states to refine its usability.

Phase 3: Capacity Building and Promotion

- Conduct workshops and training sessions for national policymakers and port authorities to encourage database usage.
- Promote database adoption through regional maritime forums and policy discussions.

Phase 4: Continuous Improvement and Sustainability

- Establish a monitoring and evaluation framework to assess database effectiveness.
- Regularly update data and enhance system functionalities to meet evolving needs.

5. Expected Benefits

The implementation of an ESCAP maritime transport database will offer the following key benefits:

- Enhanced Policy and Investment Decisions: Reliable and up-to-date data will support evidence-based decision-making for maritime development projects.
- Improved Maritime Connectivity: Analysis of port performance and trade flows will help identify bottlenecks and areas for improvement.
- Capacity Strengthening for Developing Countries: Access to high-quality maritime data will empower policymakers in developing nations to formulate effective transport policies.
- Support for Regional and Global Trade: A harmonized maritime transport database will facilitate efficient trade operations and regional cooperation.

6. Conclusion

The Asia-Pacific region, as a global maritime hub, requires a robust and integrated maritime transport database to enhance regional connectivity, support sustainable development, and facilitate efficient trade. By leveraging existing data sources and providing a user-friendly, accessible platform, ESCAP can play a pivotal role in strengthening the maritime transport sector. The proposed database will not only address existing data gaps but also support evidence-based policymaking, ensuring resilient and efficient maritime connectivity across the Asia-Pacific region.

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2024-2025 Sustainable Maritime Connectivity Report in Asia and the Pacific: Connecting the Pacific, A Voyage towards Sustainable Development

This report aims to analyze the current state of development in the shipping and ports sector, identify key policy issues, and provide insights for advancing regional connectivity while effectively implementing the SDGs and ESCAP's Regional Action Programme for Sustainable Transport Development in Asia and the Pacific (2022–2026). To provide actionable insights, the report reviews strategies from international organizations and national governments, offering recommendations for sustainable and inclusive shipping and port development.

This year's edition highlights the Pacific subregion, addressing connectivity, port development, and regional cooperation to promote resilient maritime practices.

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The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) is the most inclusive intergovernmental platform in the Asia and Pacific region. The commission promotes cooperation among its 53 member states and 9 associate members in pursuit of solutions to sustainable development challenges. ESCAP is one of the five regional commissions of the United Nations.

The ESCAP secretariat supports inclusive, resilient and sustainable development in the region by generating action-oriented knowledge, and by providing technical assistance and capacity-building services in support of national development objectives, regional agreements, and the implementation of the 2030 Agenda for Sustainable Development.

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The Ministry of Oceans and Fisheries (MOF) of the Republic of Korea oversees maritime and fisheries policies, including port development, shipping, and marine environment protection. It aims to enhance Korea's role as a global maritime hub through smart ports and industry support.

MOF collaborates internationally on issues like climate change, marine pollution, and fisheries management. It also invests in research and innovation to advance maritime logistics, shipbuilding, and aquaculture for sustainable development.

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The Korea Maritime Institute is a government-funded research institute established in the Republic of Korea under the auspices of the Prime Minister's Office to contribute to the formulation of national policies in maritime and fisheries affairs to boost the national economy. Established in 1984, it provides research and policy recommendations on port development, shipping trends, marine environment protection, and the blue economy.

KMI collaborates with international organizations and governments to address issues like decarbonization, digital port operations, and maritime security. It supports Korea's maritime competitiveness through research, policy development, and global discussions on sustainable ocean governance.

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