Asian Transport Observatory

Changing Tides:

Maritime Transport in Asia-Pacific

An Asian Transport Observatory (ATO) Publication

Changing Tides: Maritime Transport in Asia Pacific

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Asian Transport Observatory

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Summary

The world's economic center of gravity has moved. The Asia-Pacific region, home to half the planet's people and economic output, is now the pivot of global trade. What happens on its waters—stagnation or progress—reverberates globally, shaping sustainable development far beyond its shores.

The ocean carries the world's goods. Roughly 80% of all international trade moves by sea; for many developing Asian nations, the share is higher still. In 2023, this trade surpassed 12 billion tons. Asian developing nations alone discharged 47% of this global volume. The region's dominance is absolute. This is where the world's fleet is manufactured. In 2024, Asia built about 98% of the world's large merchant ships. Three nations—the People's Republic of China, the Republic of Korea, and Japan—delivered 93% of all new tonnage in 2022. The ports are here, too. Asia controls half of the world's port capacity and handles two-thirds of global container throughput. Eight of the ten best-connected ports are in Asia.

Yet, this aggregate success conceals deep fault lines. Our assessment reveals that the convergent forces of decarbonization, digitalization, and geopolitics are remaking the architecture of maritime transport. This transformation unfolds on five interconnected fronts.

First, the technological. The International Maritime Organization's mandate for net-zero emissions creates a new pathway for shipping. Yet the domestic sector, a growing source of both carbon and air pollutants, remains overwhelmingly dependent on legacy fuels. The shape of the transition will depend on the interplay of regulation, fleet modernization, and the build-out of new fuel infrastructure. A new asset class is being visualized, from green ammonia production to shore power facilities.

The second front is physical. Asia is warming at nearly double the global average. The region's ports represent a systemic risk to the global economy. Trade losses from a single port failure can be 100 times greater than the cost of the physical damage. The economic case for resilience is a calculation of averted disruption.

Asia-Pacific region, home to half the planet's people and economic output, is now the pivot of global trade

The third front is equity. A divergence is clear. While hyper-connected hubs in East and Southeast Asia automate and expand, the Pacific Small Island Developing States are still isolated. Connectivity suffers. The costs of climate inaction are mounting. Inland waterways, a vast but neglected asset, see passenger services decay from a lack of investment. The geography of investment determines whether hinterlands connect to global markets or fall further behind.

The fourth front is human. This transition rests on the shoulders of the maritime workforce. The global maritime workforce is predominantly Asian. The shift toward automation, green fuels, and resilient infrastructure demands a parallel investment in new skills. A just transition is essential to ensure this workforce is retrained and upskilled, not left behind. This is also an opportunity to address long-standing disparities, such as the fact that women comprise a mere 1.2% of the global seafarer workforce. Managing this human capital is as critical as developing new technologies or securing financial investment.

The fifth front is money. The capital required is not present. Official Development Assistance is a fraction of what is needed. Private sector investment in ports has fallen sharply over the past decade. Without stable, long-term regulatory frameworks, private capital remains on the sidelines. As the United Nations Decade of Sustainable Transport begins, the situation is clear. The transition can be managed with foresight, or it will be managed by the crises that follow. The pathways outlined in this report are not predictions. They are possibilities, contingent on the decisions made now. The destination remains unwritten.

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List of Abbreviations

AIIB	Asia Infrastructure Investment Bank
ADB	Asian Development Bank
ATO	Asian Transport Observatory
CPPI	Container Port Performance Index
DWT	Dead Weight Tonnage
GHG	Greenhouse Gas
GAINS	Greenhouse Gas and Air Pollution Interactions and Synergies
GDP	Gross Domestic Product
GT	Gross Tons
HFO	Heavy Fuel Oil
IMO	International Maritime Organization
ITF	International Transport Forum
LSCI	Liner Shipping Connectivity Index
LNG	Liquefied Natural Gas
LEDS	Long-Term Low Emissions Development Strategy
NW	National Waterways
NDC	Nationally Determined Contribution
NOx	Nitrogen Oxide
ODA	Official Development Assistance
PM2.5	Particulate Matter 2.5
PPP	Public-Private Partnership
RCP	Representative Concentration Pathway
R&D	Research & Development
SOx	Sulfur Oxides
SDG	Sustainable Development Goals
TEUs	twenty-foot equivalent unit
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
VRP	Vehicle Retirement Program

Background

The world's economic and demographic center of gravity has shifted. The Asia–Pacific region is home to over half the world's population and economic output. What happens in the region—whether stagnation or progress—reverberates globally, shaping the pursuit of sustainable development far beyond its shores.

At the heart of this global pivot lies a complex maritime transport ecosystem, the lifeblood of international trade. Yet, this complex system faces a convergence of new challenges and opportunities. Decarbonization, Air Pollution, and digitalization demand new ways of operating. Shifting geopolitical currents are redrawing the old trade routes. The fundamental architecture of maritime transport is being remade.

This transformation unfolds against the backdrop of the United Nations Decade of Sustainable Transport, which begins on January 1, 2026. Established by General Assembly Resolution A/78/1481, this initiative represents a significant global commitment. It calls for enhanced international cooperation, capacity-building, and policy alignment to address the environmental, social, and economic dimensions of transport.

This report maps the currents of this change. It documents a comprehensive analysis of the maritime transport sector's current state and future trajectory. We examine the discussion from several angles: the international fleet, port infrastructure, inland waterways, coastal shipping, and their impacts.

This report is built on a foundation of data. The analysis within these pages is rooted in the Asian Transport Observatory (ATO), a joint initiative by the Asian Development Bank (ADB) and the Asia Infrastructure Investment Bank (AIIB). The ATO is an open resource, created to provide a clear, comprehensive picture of transport across 52 regional economies using more than 450 indicators. It supports the planning and delivery of transport projects, serves as a vital tool for governments, and tracks progress—or the lack thereof—against international commitments, from the 2030 Sustainable Development Goals to the Paris Agreement on Climate Change. This foundation is enriched by data from a range of other sources—from official country statistics and UN data hubs to scholarly journals—to help navigate the waters ahead.

At the heart of the global pivot lies a complex maritime transport ecosystem, the lifeblood of international trade

Trade and Maritime Transport

The ocean carries the world's goods. Roughly 80% of all international trade moves this way (UNCTAD, 2024b). For many developing Asian nations, this share is even higher. In 2023, the total volume of this trade surpassed 12 billion tons. Its dominance is absolute, outshining all other modes in both value and volume (Figure 1 & Figure 2). Within the Asia-Pacific region, it accounts for roughly 60% of the trade by value and 80% by volume (Figure 3) (UNCTAD, 2024b; Verschuur et al., 2022). Therefore, it is the lifeline of the world's economy.

In 2023, the total volume of global maritime trade exceeded 12 billion tons, with shipping distances reaching about 62 trillion ton-miles (UNCTAD, 2024b). However, this growth wasn't uniform. It was stimulated by several factors: a resilient global economy providing a tailwind, but disruptions forced ships onto longer, more distant routes. The war in Ukraine, Red Sea disruptions, and low water levels in the Panama Canal all forced ships onto longer, more distant routes.

For the past decade, global supply chains have been reconfiguring. The latest statistics show the consequences of this shift, with the most visible changes in maritime trade patterns now centered on the People's Republic of China and several other Asian countries (UNCTAD, 2023). In 2023, Asian developing nations alone discharged 47% of the world's total volume while loading 32%. The change is driven by a rising demand for dry bulk cargo—iron ore and coal—and by crude oil shipments, with much of it destined for the People's Republic of China.

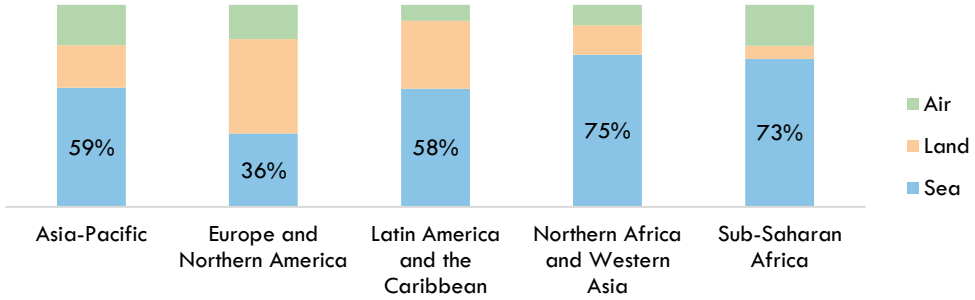

Figure 1: Trade modal share, computed by value (2015)
ATO visualization based on Verschuur et al. (2022)

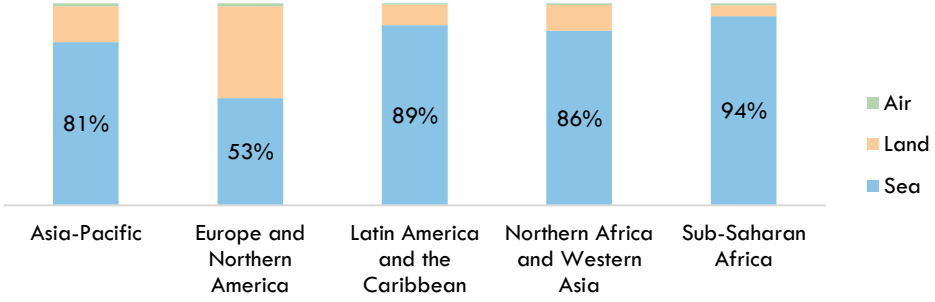

Figure 2: Trade modal share, computed by volume (2015)
ATO visualization based on Verschuur et al. (2022)

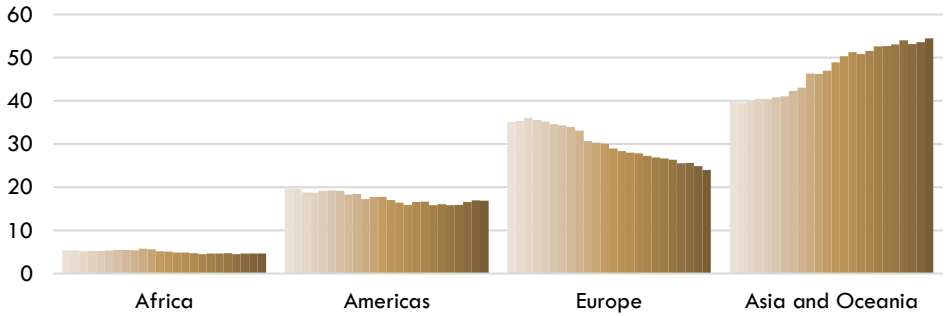

Figure 3: Total maritime trade, percentage shares by region, 2000–2023
ATO visualization based on UNCTAD (2025g)

International Shipping Fleet

Form follows function. As global trade has shifted, so has the composition of the Asian shipping fleet. In international maritime transport, the world merchant fleet is detailed by flag of registration and ship type. Bulk commodities like iron ore, coal, and grain have grown, surpassing fossil oil's share. Consequently, dry bulk carriers have increased their share, outpacing oil tankers. With the rise of containerization, breakbulk cargo is now moved in containers. The container ships and other specialized vessels have continued to overtake the share of general cargo ships.

Around 40% of the global vessels carry flags of Asian economies, in particular, developing Asian economies (Figure 4). A third of the global vessel fleet carried flags from 6 developing Asian countries in 2024 (Indonesia, People's Republic of China, Marshall Islands, Viet Nam, India, Malaysia, Türkiye) (UNCTAD, 2025c).

Over half (54%) of the global vessel fleet is owned by economies in Asia-Pacific. Fifty-eight percent (58%) of the vessels owned by Asian economies carry national flags (Figure 5). A higher percentage of vessels owned by developing Asian economies carry national flags (70%) as opposed to those that are owned by the developed Asian economies (43%).

In 2024, Asia built about 98% of global seagoing propelled merchant ships of 100 gross tons (GT) and above, excluding inland waterway vessels, fishing vessels, military vessels, yachts, and offshore fixed and mobile platforms and barges(UNCTAD, 2025d) (Figure 6). However, within Asia, lower to upper-middle-income nations hold less than a third of Asia's container-registered ship deadweight tonnage (UNCTAD, 2025c). The majority is registered in high-income Asia.

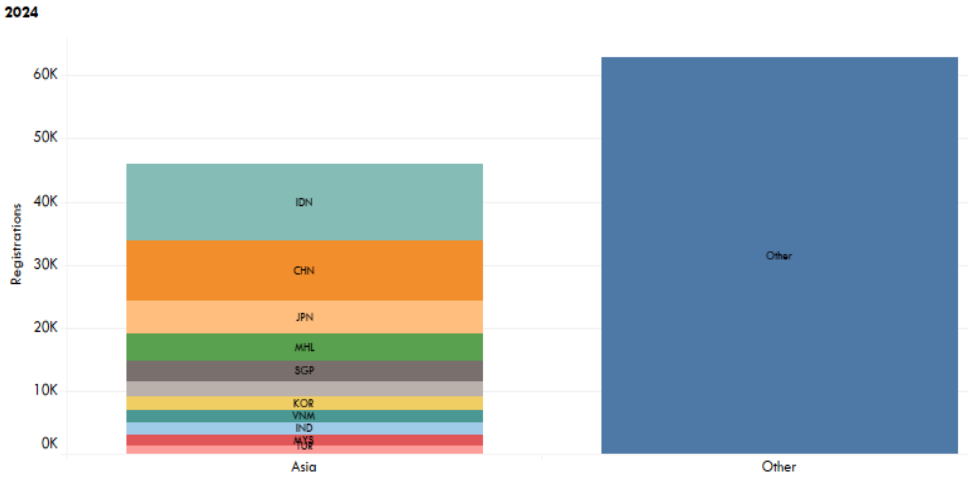

Figure 4: Flags of Registration (Number of Vessels)
ATO visualization based on UNCTAD (2025c)

Figure 5: Number of vessels by flag
ATO visualization based on UNCTAD (2024b)

Asia is the dominant force in the global shipbuilding industry, mainly due to its competitive advantage in materials, power, and labor costs (Allen Brooks, 2025). Three countries dominate global shipbuilding. In 2022, the People's Republic of China, the Republic of Korea, and Japan delivered 93% of all new tonnage, with China alone accounting for a 47% share (UNCTAD, 2025d) (Figure 7). Several Asian countries have actively promoted shipbuilding as a strategic sunrise sector. This support stems from the industry's ability to generate foreign currency, create a significant number of jobs, and stimulate demand for the industrial outputs essential to the construction process.

India's Coastal Shipping Bill, 2024 (Parliament of India, 2024), is an example of using cabotage policy to create a protected, demand-driven market. For Indian ships, it streamlines operations by removing the general trading license, enhancing their competitiveness in home waters. On the other hand, foreign vessels face new regulations; they may engage in coastal trade, but only under a specific license issued by the Director General of Shipping. Importantly, this licensing condition is explicitly designed to bolster Indian shipbuilding and seafarer employment. This protected market is managed through a biennial National Coastal and Inland Shipping Strategic Plan, a dynamic instrument for route planning and integrating coastal trade with inland waterways, ensuring the growth of a domestically built fleet. India aims to achieve the ambitious targets of making India one of the top 10 shipbuilding nations by 2030, and one of the top 5 countries in shipbuilding by 2047 (PIB - Government of India, n.d.).

Viet Nam's "Transport Strategy 2020" (Government of Viet Nam, 2013) echoes similar priority, focusing on building ships up to 100,000 DWT and repairing ships up to 150,000 DWT for both domestic and export markets.

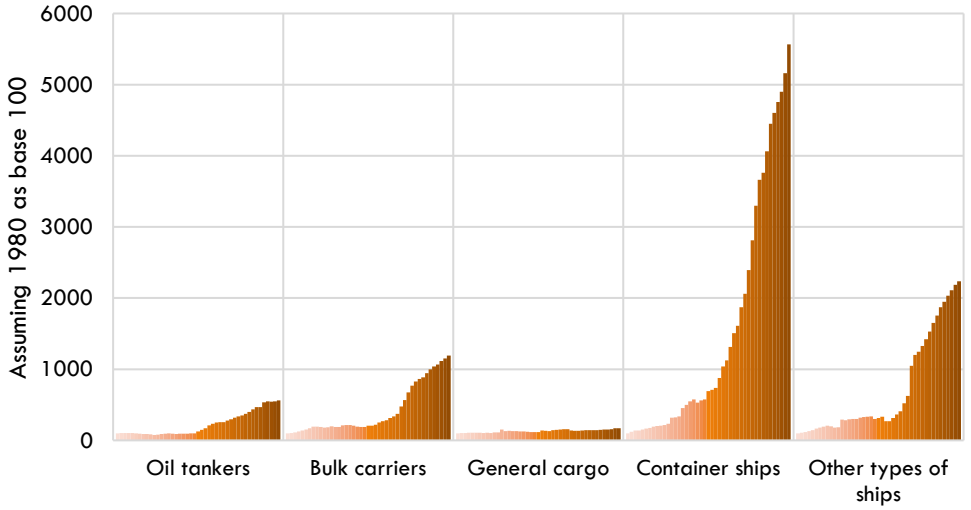

Figure 6: Merchant fleet (dead weight tonnage) in Asia-Pacific, per ship type 1980-2024
ATO visualization based on UNCTAD (2025c)

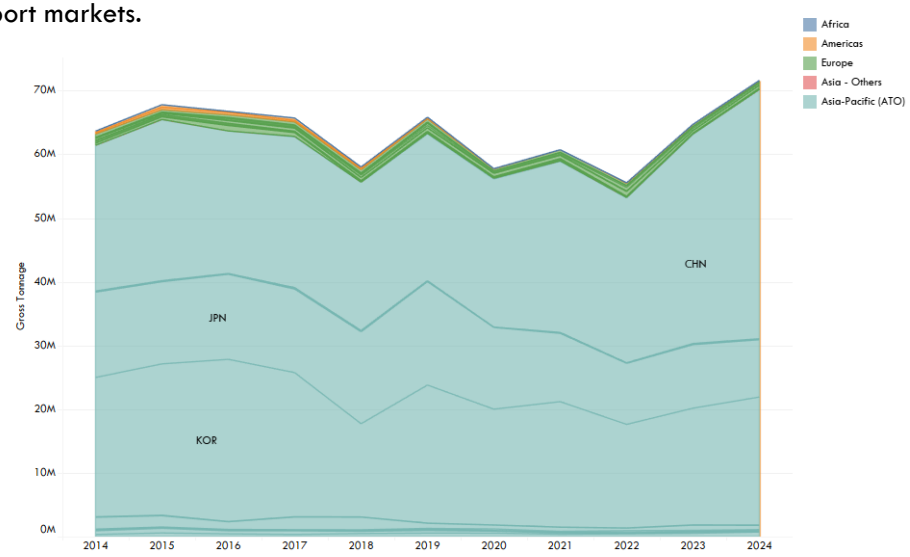

Figure 7: Ships built by country of building, annual (gross tonnage)
ATO visualization based on UNCTAD (2025d)

Ports of Call: Connecting the World's Maritime Trade

In recent decades, ports, the arteries of the global economy, have undergone a massive expansion. Asia, the epicenter of this activity, holds half of global port infrastructure. Asia clearly serves as the central hub of this shift, controlling half of the world's port capacity and handling two-thirds of the global container throughput twenty-foot equivalent unit/ TEUs (Figure 9). In terms of the trade, Asia handles 63% of global container trade. The absolute numbers are overwhelming. Yet, a deeper analysis reveals a developmental lag. When normalized by population, Asia's infrastructure deficit becomes apparent, trailing OECD economies by a significant margin. The Asia-Pacific's port infrastructure amounts to only 210 square meters per thousand people, one-third of the 630 square meters available in OECD economies. The absolute dominance in volume has not yet translated to equivalent infrastructure for its population (Hanson & Nicholls, 2020).

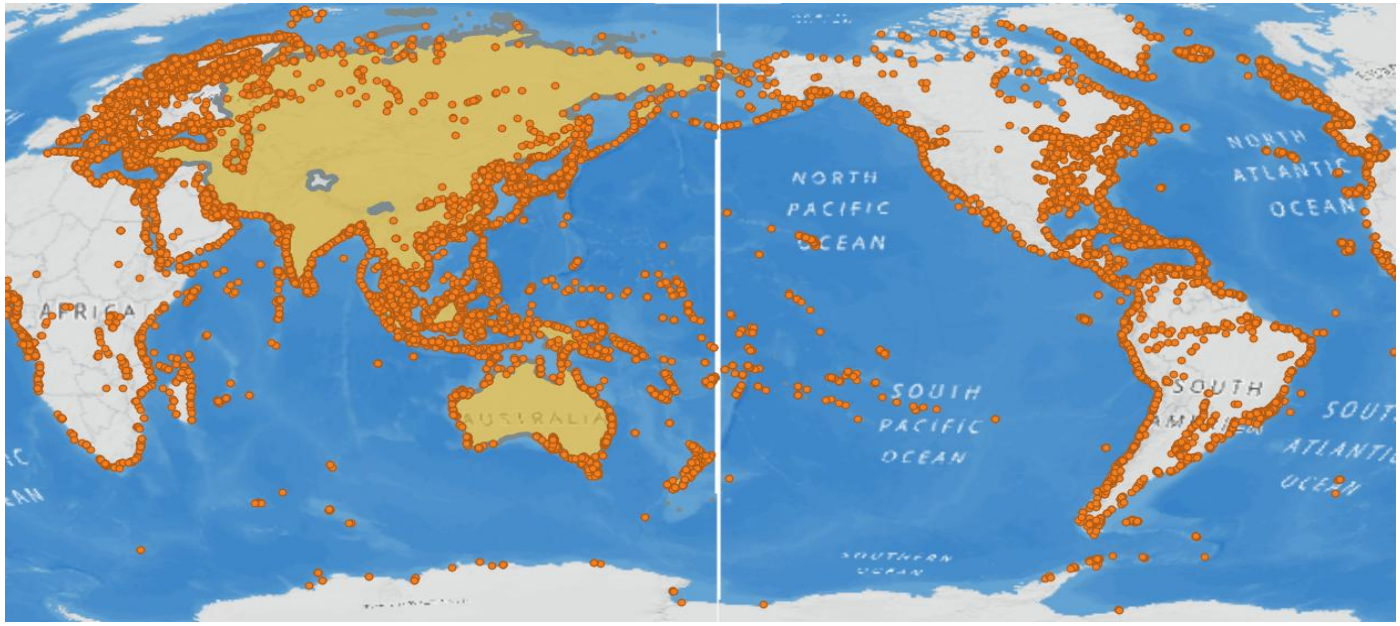

Figure 8: Global Ports Locations
ATO visualization based on (Upply, 2025)

To close the gap, Asia has also pioneered the widespread use of dry ports—inland hubs that function as extensions of their coastal counterparts. These facilities manage cargo, storage, and inspections away from the crowded seaports, offering a vital lifeline to landlocked countries. Today, Asia is home to some 275 dry ports (UNESCAP, 2024), a network that redefines the flow of goods and connects people far from the coast to the global maritime trade.

Efficient container ports are essential for export-driven growth, supporting investments and job creation. Inefficiencies create obstacles. Delays at a single port can ripple through an entire supply chain, raising costs and undermining competitiveness, with landlocked and small island developing states hit hardest. In this competitive landscape, Asian ports in upper-middle-income and high-income economies lead the global Container Port Performance Index (CPPI) rankings (Figure 10). Six out of the top 10 ports based on the CPPI rankings are in Asia- Pacific (The World Bank, 2024).

Countries are moving to enhance port efficiency. Türkiye is focusing on improving its standing in the global logistics arena while also modernizing its maritime sector. The Twelfth Development Plan (2024-2028) (Presidency of the Republic of Türkiye, 2023) outlines goals to boost the country's ranking in the Logistics Performance Index to 25 and increase its total container handling to 17.4 million TEUs. The Mobility Vehicles and

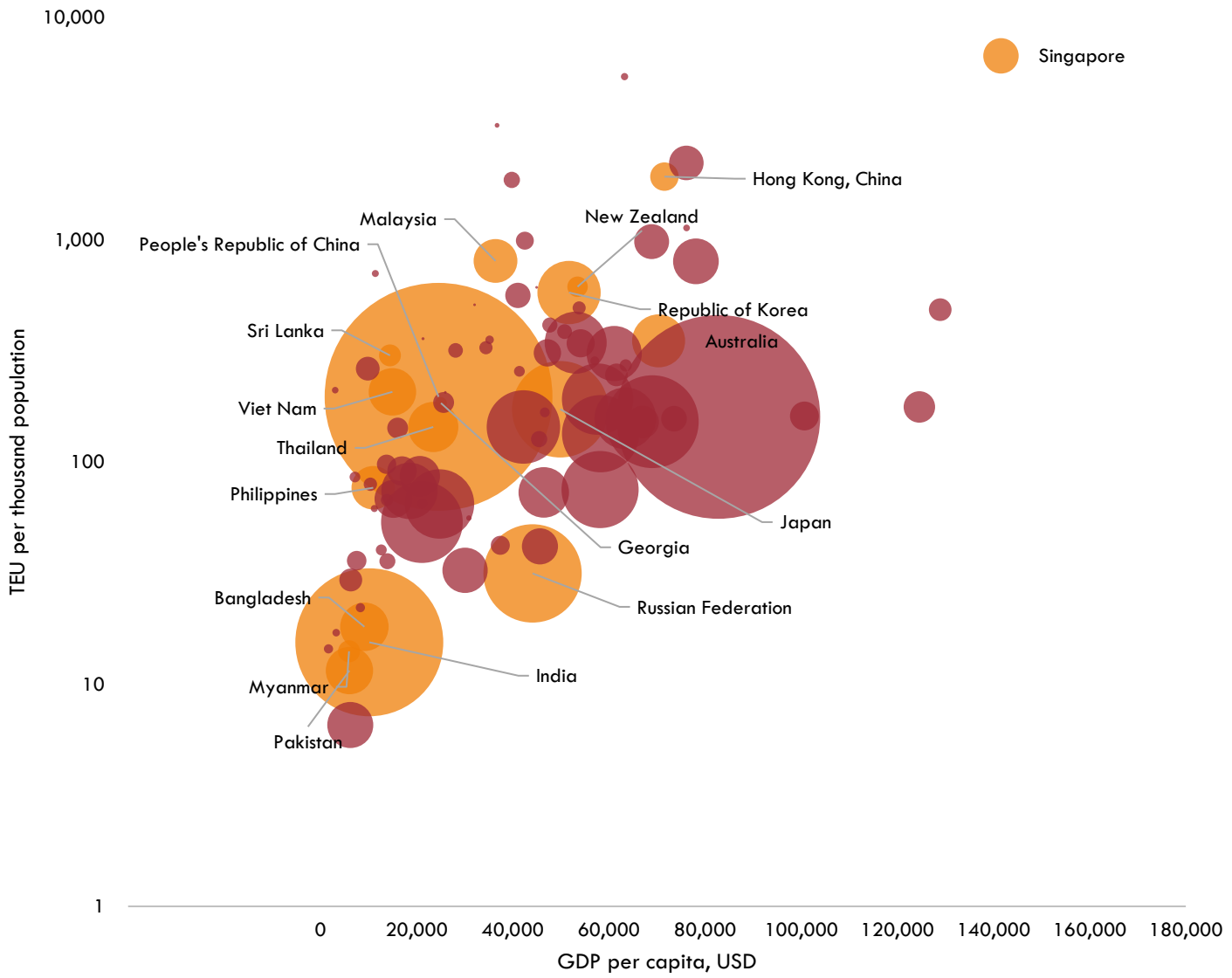

Figure 9: Container port throughput
ATO visualization based on UNCTAD (2025a)

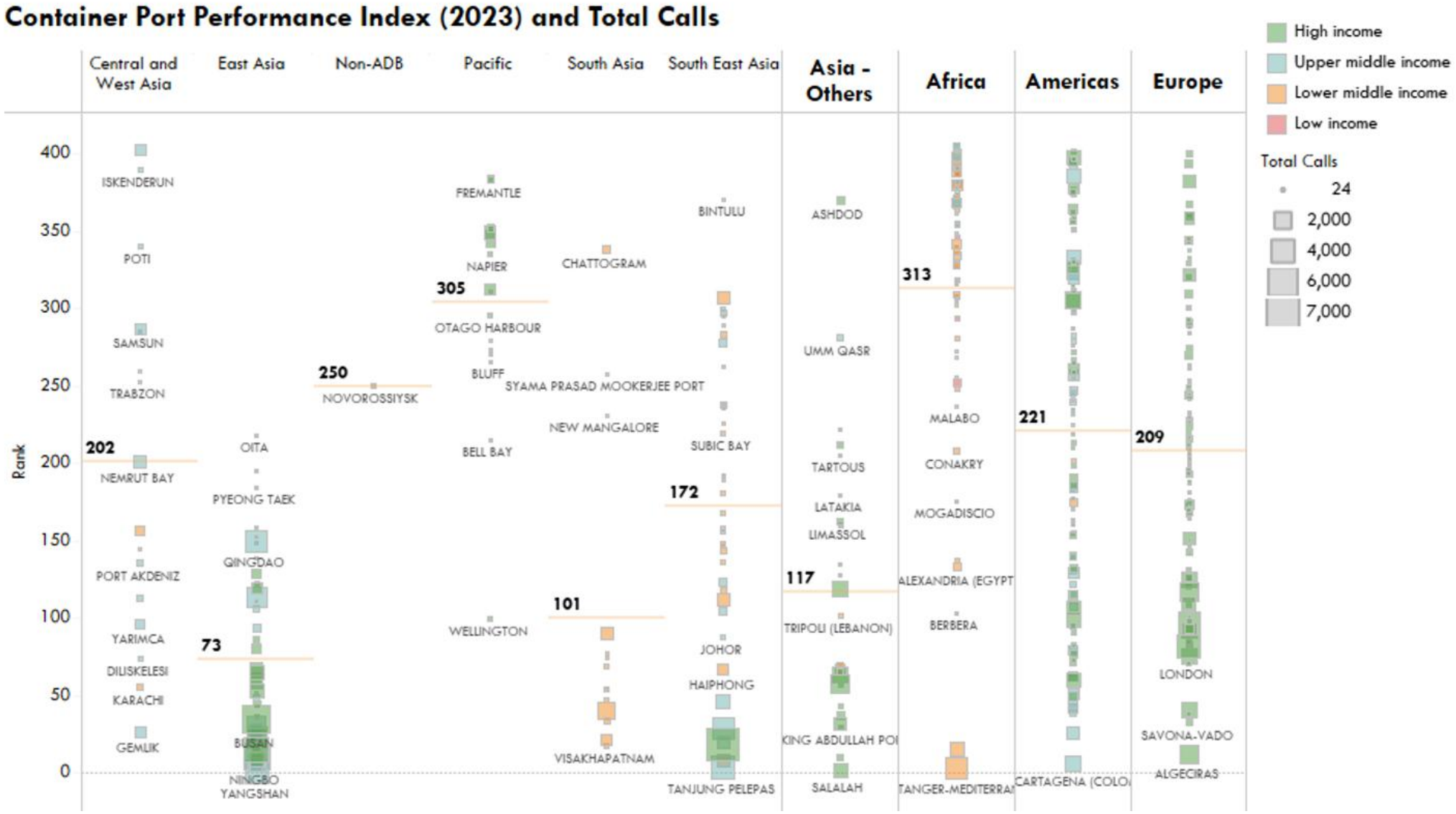

Figure 10: Container port performance index (2023) and total calls
ATO visualization based on The World Bank (2024)

Technologies Roadmap (Government of Republic of Türkiye, 2022) further specifies targets for its shipping industry, including increasing the capacity utilization of its top 10 container ports to 75% and raising the localization rate for ship orders to 35%. This dual focus on efficiency and domestic production shows a country positioning itself for future growth and self-sufficiency in the maritime space.

In the People's Republic of China, port connectivity and automation are major policy priorities. The goal is to elevate the railway access rate to major coastal ports to over 90% by 2025, a target found in the 14th Five-Year Development Plan for Water Transport. The Five-Year Action Plan to Accelerate the Construction of a Strong Transportation Nation (2023-2027) (Government of the People's Republic of China, 2023b) advances this by aiming to build at least five automated container terminals.

In Viet Nam, the development of "green ports" is a critical component. The policies aim to establish and apply green port criteria, with a vision for 100% of newly built inland waterway ports and all seaports to apply these standards. This includes converting all loading and unloading machinery from fossil fuels to electricity and green energy and planning the infrastructure to supply green energy to transport vehicles in urban areas.

In Indonesia, the "National Medium Term Development Plan 2020-2024" (Government of Indonesia, 2020) provides concrete targets for infrastructure improvement, including the construction of "36 new ferry ports" and ensuring that seven main ports meet international standards. The plan also prioritizes the development of major ports, such as the Integrated Main Port Networks, and the expansion of ports that support sea tolls and are located in priority areas, including those catering to cruise tourism. The goal is to improve inter-island trade and the overall supply chain. To ensure the safety and security of these assets, the "Indonesia Blue Economy Roadmap" (Government of Indonesia, 2023) mandates the "Implementation of port audit and 'port risk assessment' and related facilities according to internationally recognized safety standards and rules".

Asia serves as the central hub of this shift, controlling half of the world's port capacity and handling two-thirds of the global container throughput twenty-foot equivalent unit/ TEUs

Inland Waterways & Coastal Shipping

Globally, the network of navigable waterways spans approximately 623,000 kilometers (Beyer, 2018) (Figure 11). Asia holds nearly half of this network. Asia is endowed with extensive river systems, including the Yangtze, Pearl River, Mekong, Ganges-Brahmaputra, and Indus. These rivers and their deltas, such as Vietnam's Red River and Mekong Deltas, serve as natural conduits for trade and connectivity. The extensive system of navigable waterways across Asia offers a significant, though underutilized, infrastructural advantage.

Historically, domestic shipping has served as the primary conduit for the movement of bulk commodities- low-value, non-perishable goods, including building materials, coal, ores, steel, mineral oil products, chemicals, and agricultural products.

From 1950 to 1990, a period of policy-induced underdevelopment saw domestic shipping decline as governments prioritized other transport modes. However, in the recent two decades, Asian economies have turned a corner. Since 2000, the domestic shipping freight traffic has increased from 2 billion tons in 2000 to over 12 billion tons in 2022 (Figure 12). The increase in freight traffic at an annual rate of 8.5% is significantly higher than the annual growth in population (0.97%) and GDP (7.5%). In comparison, railways have only increased freight traffic by 4.5% (in tons) (ATO, 2025b; International Union of Railways, 2024; United Nations Department of Economic and Social Affairs Population Division, 2022; World Bank, 2023).

A notable trend towards containerization is emerging, signifying a maturation and diversification of the sector. Container traffic is experiencing growth in Viet Nam and has seen significant increases in the People's Republic of China, with the Yangtze River handling millions of TEUs annually, and the Pearl River also demonstrating substantial container throughput. This shift enables the mode to serve higher-value manufactured goods and integrate more effectively into modern logistics chains, particularly for supplying highly populated urban centers.

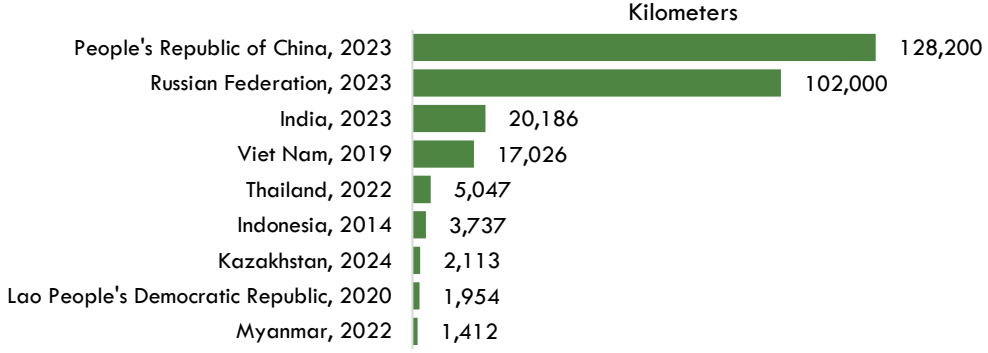

Figure 11: Inland waterways
Country official statistics as compiled in ATO (2025b)

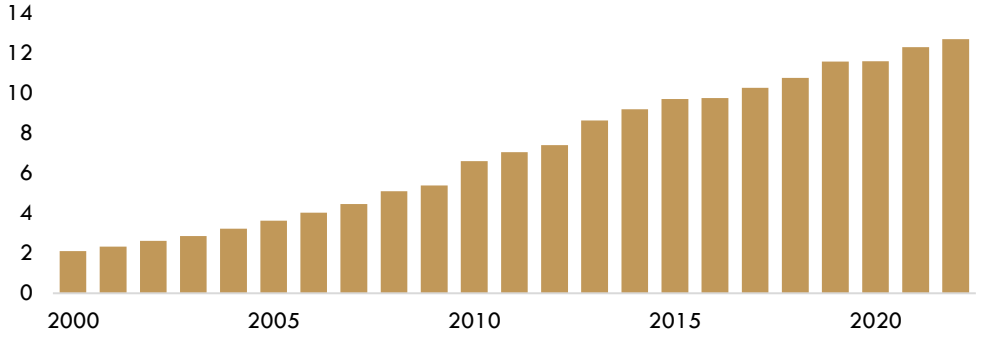

Figure 12: Coastal shipping and inland waterways traffic (Billion Tons)
Country official statistics as compiled in ATO (2025b)

The People's Republic of China overwhelmingly dominates Asia's waterborne freight, handling two-thirds of the cargo volume (tons) but a massive 94% of the freight movement (ton-kilometers), highlighting the overall dominance and significantly longer distances its cargo travels. . Some countries, like Viet Nam, exhibit a shorter average length of shipping haul. Inland waterways attract about 48% of tonnage compared to roads' 45%, yet their share of ton-kilometers falls to 30%, trailing roads' 36%. This translates to an average inland waterways haul of 112 kilometers, significantly shorter than the 143-kilometer average for road transport[1].

Passenger transport, however, tells a story of stagnation and decay (Table 1). Across several countries, traffic has fallen, a sign of deep structural faults: old vessels, poor terminals, and silted-upriver channels born from chronic under-investment.

The policy interest in domestic shipping has been rekindled by necessity. Escalating road congestion, climate concerns, and rising freight costs have forced a correction. Linking domestic shipping to "green growth" agendas and decarbonization targets marks a strategic shift.

For example, India has set ambitious targets to increase its inland waterways modal share from 2% to 5% by 2030, with a further aim of reaching 7% by 2047 (PIB - Government of India, 2025). To achieve the ambitious targets of transporting 200 million MT by 2030 and 500 million MT by 2047, a multi-pronged policy strategy has been put into motion. These measures are designed to create a conducive ecosystem for both public and private players, fostering a significant modal shift towards inland water transport.

- Cargo Diversion Scheme: A pivotal scheme offers a 35% incentive to cargo owners to promote the use of inland waterways. This initiative aims to establish scheduled cargo services on NW-1, NW-2, and NW-16 via the Indo-Bangladesh Protocol route, with an expected diversion of 800 million ton-kilometers of cargo.
- Tonnage Tax Scheme Extension: In a significant fiscal move, the tonnage tax scheme is being extended to inland vessels registered under the Indian Vessels Act, 2021. This provides a stable, predictable, and lower taxation regime for vessel owners, thereby reducing their financial burden and enhancing the competitiveness of the sector.
- Attracting Private Investment: The notification of the National Waterways (Construction of Jetties/Terminals) Regulations 2025 has created a clear and transparent regulatory framework. This is a crucial step to attract private sector investment in the construction and operation of inland waterways infrastructure, a key component for accelerated growth.

Table 1: Passengers transported - Waterways/shipping (in thousands)

ECONOMY	FROM	TO
Viet Nam (2010-2022)	157,500	346,600
People's Republic of China (2010-2023)	223,920	257,710
India (2018-2023)	156,901	58,548
Japan (2010-2021)	85,000	49,000
Philippines (2012-2022)	49,998	59,193
Republic of Korea (2010-2022)	14,308	13,991
Russian Federation (2010-2023)	16,000	11,000
New Zealand (2013-2023)	5,288	4,794
Myanmar (2011-2023)	27,565	6,438
Lao People's Democratic Republic (2010-2023)	2,026	2,091
Kazakhstan (2010-2023)	108	121
Mongolia (2018-2023)	10	60
Azerbaijan (2010-2023)	10	24

Country official statistics as compiled in ATO (2025b)

[1] Analysis based on country official statistics as contained in ATO (2025).

Thailand's Strategies for the Development of Thailand's Transport System (2018-2036) (Government of Thailand, 2019)aims to increase the share of freight volume carried by rail to 10% and by water to 19% by 2036. This is a significant rebalancing from the 2015 baseline of 1.4% for rail and 11.44% for water. It is a long-term plan to move cargo more efficiently. The Philippines' Development Plan 2023-2028 (PHL - National Economic and Development Authority, 2023) has clear targets for freight and passenger traffic. The plan is to increase passenger numbers via air and sea to 202.34 million and cargo to 1850 million metric tons by 2028.

The physical and digital architecture of the People's Republic of China's waterways and ports is undergoing a monumental expansion. The long-term vision, articulated in the Planning Outline of National Comprehensive Three-dimensional Transportation Network (2021-2035) (Government of the People's Republic of China, 2021), projects a total physical network of about 700,000 kilometers by 2035, including 25,000 kilometers of high-grade waterways. This build-out is supported by intermediate goals, such as reaching 18,500 kilometers of inland high-grade waterways by 2025, as stated in the 14th Five-Year Plan Modern Comprehensive Transportation System Development Plan (Government of the People's Republic of China, 2022a). The Action Plan for Energy Conservation and Carbon Reduction 2024-2025 (Government of the People's Republic of China, 2024) aims for national railway and water freight volumes to climb by 10% and 12%, respectively, compared to 2020 levels.

In the People's Republic of China, the physical expansion of inland waterways is paralleled by a drive towards digitalization. The government aims to digitally transform approximately 70% of key national high-grade waterways by 2027, aiming to improve traffic efficiency on demonstration channels by about 20%. This digital frontier is further advanced by the goal to achieve 85% coverage of electronic waterway charts for high-level waterways by 2030, a key objective within the Opinions on promoting high-quality development of inland waterway transportation. These interconnected targets illustrate a comprehensive strategy to construct a modern, integrated, and intelligent maritime and waterway network poised to meet future economic and environmental challenges.

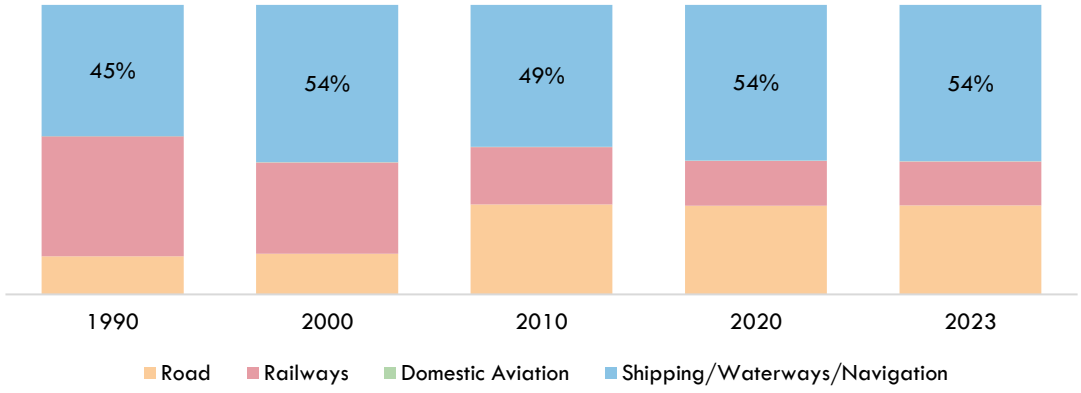

Figure 13: People's Republic of China - freight Ton-kilometers
Country official statistics as compiled in ATO (2025b)

Demand Outlook

The future is freight. The International Transport Forum's 2023 Outlook (Figure 14) projects a doubling of global freight demand by 2050 under its Current Ambition scenario (ITF, 2023). Growth on land and in the air is forecast to be faster. The consequence is a strategic erosion of market share: shipping's portion of global freight activity is expected to decline, falling from 69% in 2022 to 62% by mid-century.

The demand for domestic shipping is set to grow, as shown by our analysis based on the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model (IIASA, 2025) (Figure 15). The projection suggests that between 2020 and 2035, the demand for the domestic fleet is forecast to expand at twice the rate of population growth.

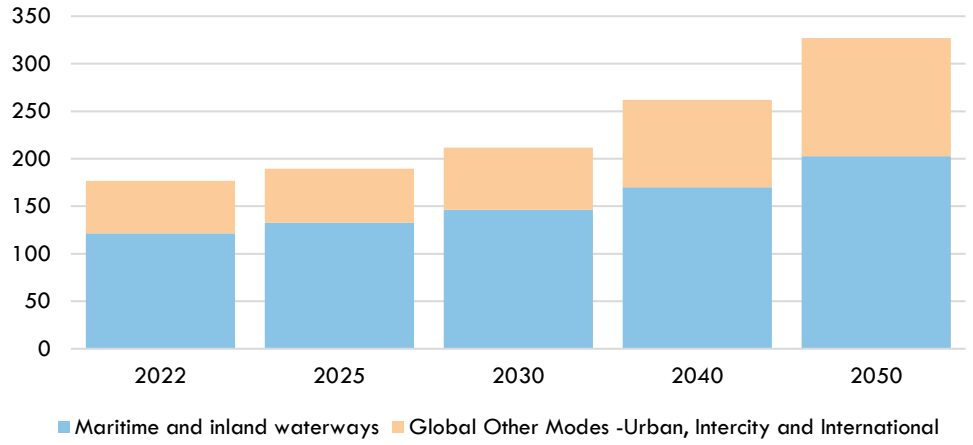

Figure 14: Freight demand, trillion Ton-kilometers
International Transport Forum's 2023 Outlook

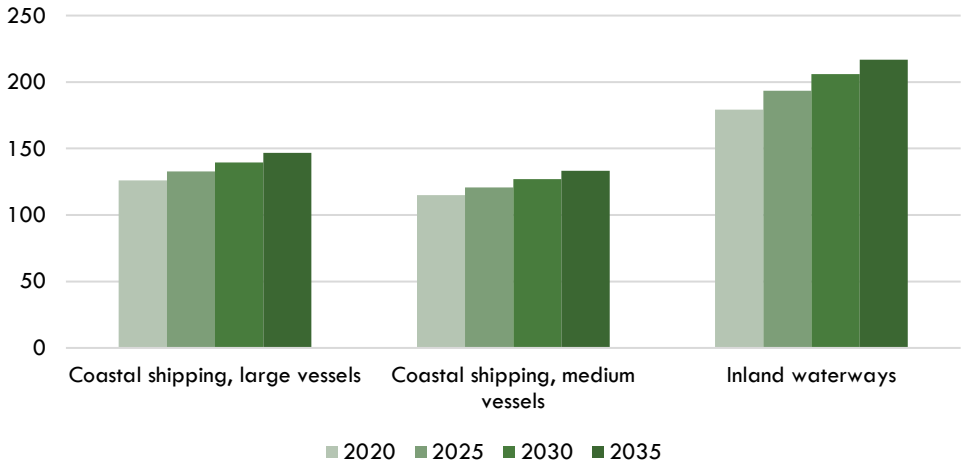

Figure 15: Fleet Demand (thousands of vehicles) - domestic shipping in Asia Pacific
ATO visualization based on: (IIASA, 2025)

Shipping Connectivity

Maritime connectivity is measured by the Liner Shipping Connectivity Index (LSCI) (UNCTAD, 2025b). It combines several parameters: how often ships call, their size, their reach, and the whole network. The results show that the Asia-Pacific region stands apart. Its average LSCI in 2023 was 185. The rest of the world averaged 83. Nine countries in Asia scored above 300. The region has been on a positive, steady climb since 2015, with a sustained increase. A third of the region's nations improved their scores by 20% or more. The Federated States of Micronesia and Viet Nam saw gains of over 50%. Yet, this narrative of aggregate success conceals a deep internal fracture. The Pacific Small Island Developing States tell a different story. Their LSCI values languish between 4 and 50, showing no meaningful improvement over time (Figure 16).

The world's most connected nations reflect this contrast. Seven Asian countries make the list, along with the U.S. and two from Europe. The People's Republic of China leads the way with an LSCI of 1,191 (UNCTAD, 2025b). South Korea and Singapore follow, and then the U.S. For the People's Republic of China and South Korea, the two most connected countries in the world, LSCI growth has been in the double digits over the last five years. While East Asia's giants dominate in absolute terms, other Asian subregions demonstrate faster relative improvement; since 2006, Central and West Asia (2.2% per year), Southeast Asia (1.9% per year), and South Asia (1.7% per year) have all outpaced East Asia's own growth rate of 0.8% per year.

This national-level story is mirrored at the Ports. Three of the top five are in the People's Republic of China: Shanghai, Ningbo, and Qingdao. Busan in Republic of Korea and the port of Singapore round out the top five. The top ten list includes eight ports from Southern or Southeastern Asia, with only Rotterdam and Antwerp from Europe. Of the thirty best-connected ports, twenty are in Asia (UNCTAD, 2025f). Yet, this top-tier performance masks a widespread connectivity gap. A 2023 survey of over 300 Asian ports reveals the connectivity gap with 74% falling below the global average for connectivity (The World Bank, 2024).

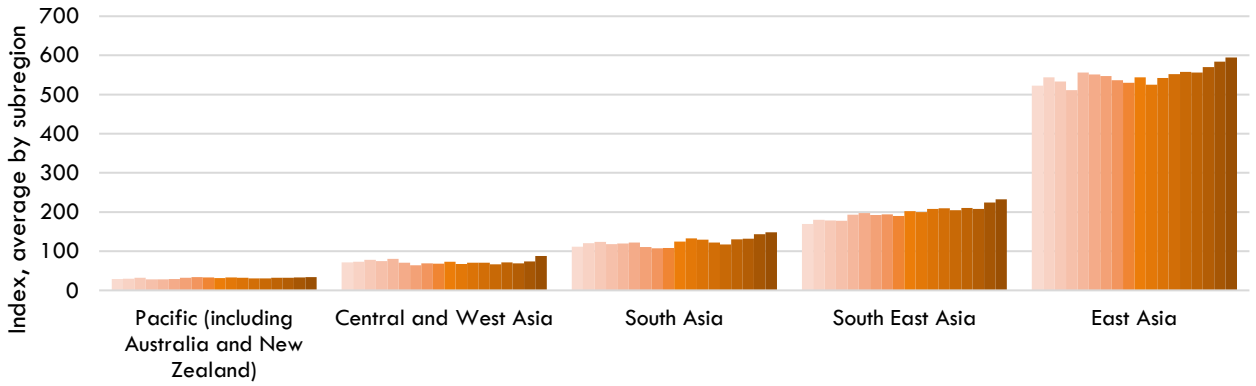

Figure 16: Liner shipping connectivity index (2006-2023)
ATO visualization based on (2025b)

Countries are actively working to bridge the connectivity gap. For example, Papua New Guinea's Development Strategic Plan 2010-2030 (Government of Papua New Guinea, 2010) focuses on port and waterway development. The plan aims to triple the capacity and number of routes serviced for inland waterways by 2030. Simultaneously, it seeks to reduce handling times at its two principal ports, Port Moresby and Lae, to just one day. This is a direct approach to improving trade efficiency and domestic connectivity. The Second Biennial Update Report (Government of Papua New Guinea, 2022) adds another layer, targeting a significant value of transport infrastructure to be built or rehabilitated according to climate-resilient standards by 2030.

The Maldives' Strategic Action Plan 19-23 (Government of Maldives, 2019b) objectives are about safety and accessibility. By 2023, the country aimed to reduce maritime incidents by at least 60% compared to 2018 levels. The plan also aimed for 90% of the population to have access to air connectivity within a 30-minute speedboat ride.

The Kiribati's KV20 Vision (Government of Kiribati, 2017) document sets a goal to increase the number of shipping voyages per month. From a baseline not specified, the target is 30 by 2019 and 50 by 2036. This is about transforming connectivity and access.

The "Visi Indonesia 2045" (Government of Indonesia, 2017) aims to enhance sea connectivity by establishing a comprehensive main port system with sea highways, seven international hubs, short sea-shipping options, and modern port management practices. Details are outlined in the "Indonesia Blue Economy Roadmap," (Government of Indonesia, 2023) focusing on enhancing marine infrastructure and logistics to facilitate increased trade, accommodate larger vessels, and improve cargo handling and transportation. Major initiatives involve establishing 48 port cities and developing new port facilities at strategic points to align with changing trade routes and market needs.

In terms of international processes, the Antigua and Barbuda Agenda for SIDS (ABAS) recognizes the unique vulnerabilities of small island developing states. It is a ten-year agenda that calls for a reformed international financial architecture and easier access to concessional finance. The plan targets enhanced inter-island connectivity. It aims to integrate island economies into regional and global supply chains. The agenda focuses on ocean-based economies, a vital lifeline, and the need for new opportunities in sustainable shipping and port development. It calls for resilient infrastructure and safer transport systems, as well as investments (UN, 2024).

Adhia Huza

Shipping Energy Consumption

In 2022, while the transport sector in Asia consumed a substantial share of energy, accounting for roughly 18% of the region's total final energy consumption, the share of domestic navigation in total energy consumption was negligible (Figure 17) (United Nations Statistics Division, 2024). This small share belies rapid growth. Between 2000 and 2015, energy demand in domestic shipping grew at 3.2% annually, faster than other sectors. The adoption of the SDGs marked an inflection point, moderating this growth to 2% per year. But this deceleration has not catalyzed a meaningful energy transition. The domestic shipping energy landscape remains largely unchanged with the renewable energy in domestic shipping remaining below 1%.

Within Asia, one nation overwhelmingly defines domestic shipping. The People's Republic of China accounts for two-thirds of the region's coastal freight demand by tons and 94% of its inland waterway traffic when measured in ton-kilometers. In terms of energy consumption, its share is nearly three-fourths, indicating higher efficiencies when compared to regional averages (ATO, 2025b; United Nations Statistics Division, 2024).

For international shipping, the International Maritime Organization (IMO) has set a new course. Its revised GHG strategy calls for an end to fossil fuel use, targeting net-zero emissions "by or around, i.e., close to, 2050" (IMO, 2023). An interim target aims for at least 5-10% of energy to come from zero or near-zero emission sources by 2030. Projections suggest Asia's transition could be slow and costly, relying on hydrogen-based fuels like ammonia, e-methanol, and biofuels, with electrification confined to ports and short routes.

Recent projections (Figure 18) by DNV indicate that the shift in Asia could proceed slowly and incur high costs related to fuel changes, making the pathways quite uncertain (DNV, 2024). The fuel composition might mainly include hydrogen-based fuels like ammonia and e-fuels, probably methanol, along with biofuels. Additionally, electrification may be confined to port stays and short routes. The high cost of alternative fuel transition puts the spotlight on energy efficiency and could, in some cases, affect freight volumes.

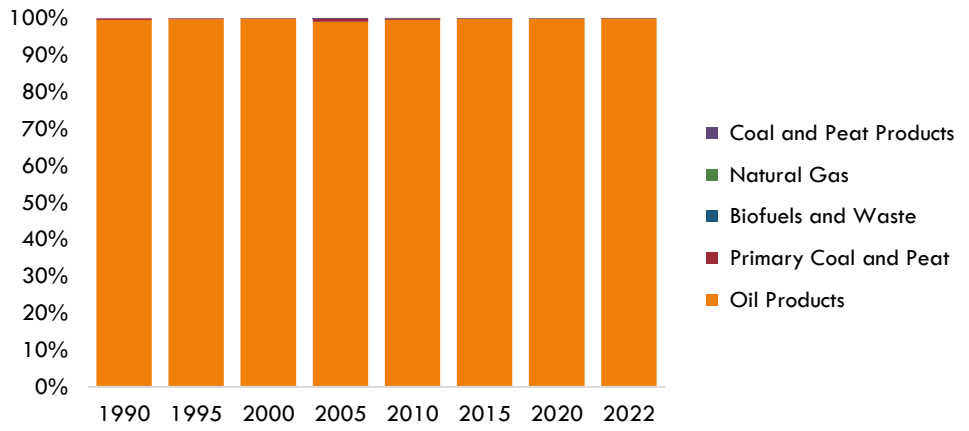

Figure 17: Domestic navigation energy consumption, by source
Visualization based on UN Statistics Division (2024)

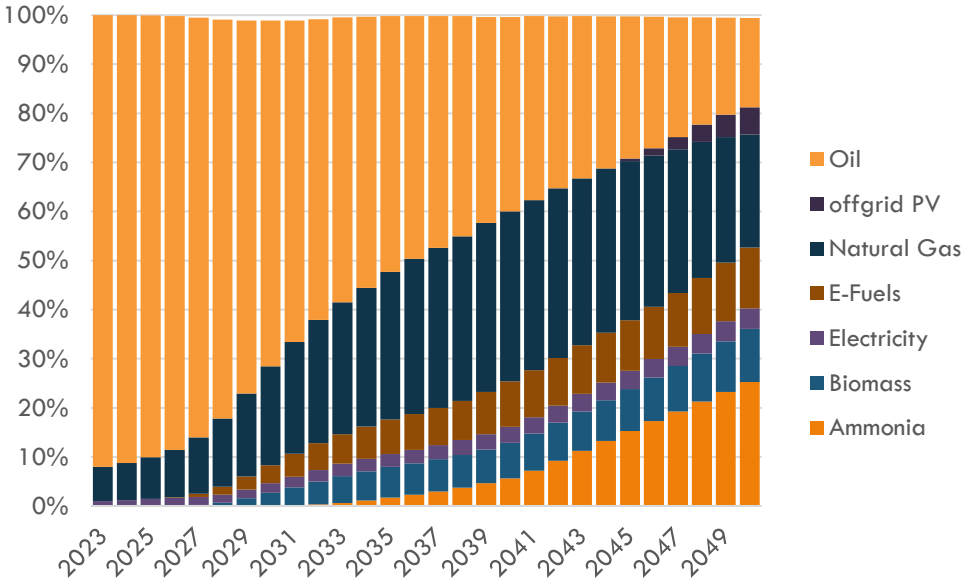

Figure 18: maritime energy transition in Asia Pacific
ATO visualization based on DNV (2024)

Several Asian countries are setting policy frameworks to transform the shipping energy landscape. For example, Viet Nam is undertaking a deliberate, phased transition toward green energy in its transport sector. The Action Program for Transition to Green Energy (Government of Viet Nam, 2022) specifies a clear timeline for inland waterway vessels. By 2040, 100% of newly built inland waterway vessels and equipment at inland ports are to use electricity and green energy. The ambition intensifies further; by 2050, this transition is to be complete for all inland waterway ships currently in operation. The program also states that new or converted marine ships built or imported after 2035 must use green energy.

Malaysia's National Energy Policy 2022-2040 (Government of Malaysia, 2022) includes a specific and future-oriented target for the marine sector. By 2040, the policy aims for Liquefied Natural Gas (LNG) to account for 25% of alternative fuel used for marine transport, up from a baseline of zero in 2018. This is a clear signal of intent to transition the maritime sector towards alternative fuels.

Vanuatu's climate strategy, outlined in its NDC Implementation Roadmap (Government of Vanuatu, 2020) and Vanuatu Updated NDC (Government of Vanuatu, 2022), focuses on energy efficiency, with a 10% improvement targeted for both land and marine transport by 2030. The Kiribati NDC Investment Plan (Government of Kiribati, 2021a) proposes to replace two-stroke outboard motors with more efficient four-stroke or electric alternatives.

Several Asian countries are setting policy frameworks to transform the shipping energy landscape.

Shipping Carbon Emissions

Since 2000, carbon emissions from Asia's domestic shipping have doubled, rising from 75 million tons to 149 million tons in 2023 (EC JRC & IEA, 2024; United Nations Department of Economic and Social Affairs Population Division, 2022; World Bank, 2023). The annual increase of 3% outpaces population growth but lags GDP growth. In the past year alone, the sector's emissions grew by 21%, one of the fastest rates of any transport sub-sector (Figure 19). The People's Republic of China, with 94% of the region's domestic freight movement, accounts for nearly three-fourths of these emissions, indicating a higher carbon efficiency than the regional average.

The international shipping industry is a crucial part of the global economy, but it is also a significant source of CO2 emissions. International shipping accounted for roughly 2% of the world's energy-related CO2 emissions in 2022 (EC JRC & IEA, 2024).

Asia's share of these emissions, based on bunker fuel sales, has grown from 30% in 2000 to 47% today, totaling 308 million tons. By another measure, using Automatic Identification System (AIS) data, the Asia-Pacific now accounts for 45% of global maritime CO2 emissions, with growth of 2.3% per year since 2019, faster than the global average (Figure 20 & Figure 21). Within Asia, a significant portion of total shipping carbon emissions, about 36%, comes from domestic shipping, which contributed about 148 million tons of CO2 in 2023 (OECD, 2023).

The IMO has set a clear direction with its Net-Zero Framework (IMO, 2025a). . The new framework combines mandatory emissions limits with a pricing mechanism for the entire sector. The goal is simple and final: net-zero emissions by or around 2050. The measures were approved in April 2025 and are slated for formal adoption in October, with a 2027 entry-into-force date. The framework, which will apply to large ocean-going ships, calls for a global fuel standard—a gradual reduction of greenhouse gas fuel intensity. Ships that emit above the set threshold must acquire units to balance their emissions. The new IMO Net-Zero Fund will collect these contributions, and the money will be used to reward low-emission ships and to support innovation, research, and a just transition for developing countries.

A significant gap remains between current trajectory and the IMO's revised targets, which are now aligned with the Paris Agreement. To meet a Net Zero Emissions by 2050 scenario, the sector must cut emissions by nearly 15% before 2030 (IEA, n.d.).

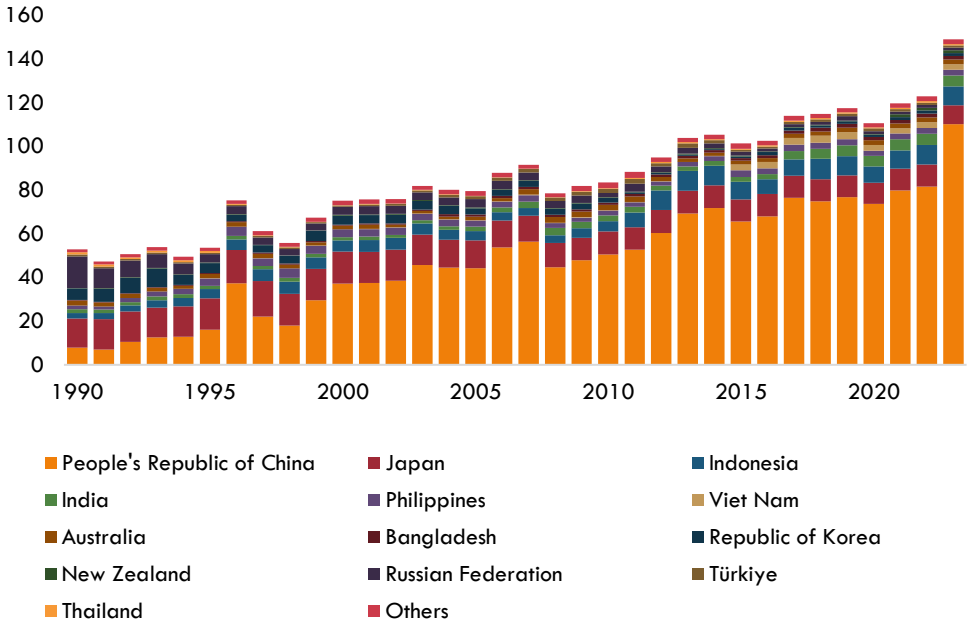

Figure 19: Domestic Shipping, CO2 emissions, Million Tons
ATO visualization based on EC JRC & IEA (2024)

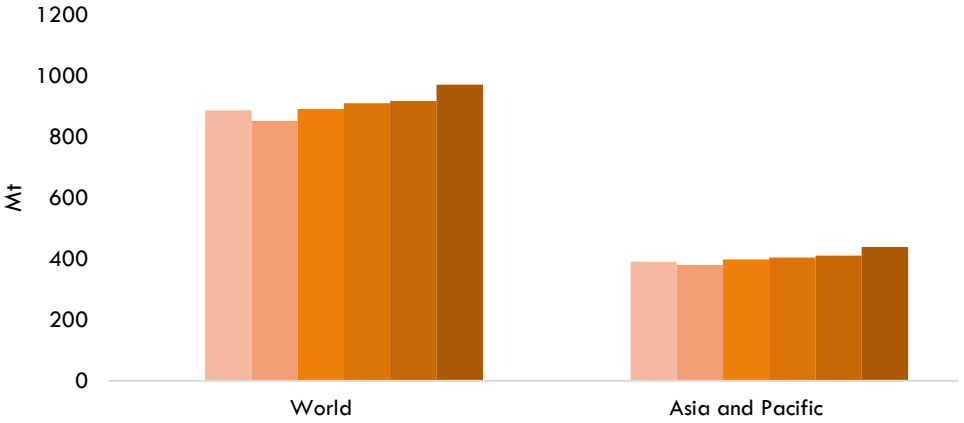

Figure 20: Maritime transport CO2 emissions using AIS (international + domestic), 2019-2024
ATO visualization based on OECD (2023)

Several Asian economies are enacting decarbonization policies. The People's Republic of China's Green Transportation "14th Five-Year" Development Plan (Government of the People's Republic of China, 2022b) sets clear benchmarks for 2025, demanding a reduction in CO_2 emissions per unit of transport turnover by 5% for operating vehicles and 3.5% for operating ships compared to 2020. Furthermore, it targets a 7% reduction in total nitrogen oxide (NOx) emissions from operating ships. A pivotal element of this green transition is the accelerated adoption of shore power. The Action Plan on demonstrating and Promoting the Use of Shore Power (2023-2025) (Government of the People's Republic of China, 2023a) sets a rapid timeline:

- By the end of 2024, 100% coverage of high-voltage shore power facilities at terminals berthing cruise ships is expected.
- By the end of 2025, this coverage is mandated to reach 90% for terminals used by international container ships at hub seaports.
- Simultaneously, 40% of international container ships calling at these ports must be equipped with power-receiving facilities.

To drive this transition, substantial policy support is being provided, including waiving demand electricity fees for shore power operators and ensuring its cost does not exceed that of conventional ship fuel before the end of 2025. The push for cleaner energy also extends to port-side logistics, with a goal for new energy and clean energy container trucks to account for 60% of the fleet at international container hubs.

The Solomon Islands, in its Long-Term Low Emissions Development Strategy (LEDS) (Solomon Islands - Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM), 2023), has set clear and aggressive goals for its domestic shipping sector. The country has committed to a 40% reduction in GHG emissions by 2030 and a 100% reduction by 2050. They are adopting the "Pacific Ports 2030-2050" (Pacific Community, 2025) vision, which aims for resilient, green, and clean ports across the Pacific region. This is a bold statement, demonstrating a small island nation's resolve to lead on climate action.

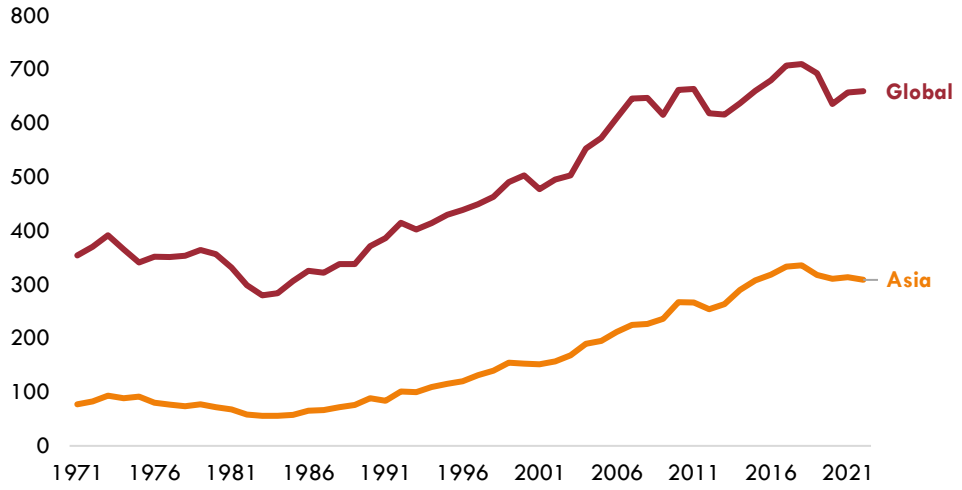

Figure 21: CO2 emissions from international marine bunkers (Mt)
ATO visualization based on IEA (2024)

Fiji's commitment to climate action is visible in its Fiji Technology Needs Assessment Report Mitigation (Government of Fiji, 2020a) and its National Ocean Policy (Government of Fiji, 2020b). The island nation aims for a 40% reduction in domestic maritime shipping emissions by 2030. This aggressive target is a steppingstone to a much larger goal: a 100% carbon-free shipping sector by 2050. Fiji aims to reduce its reliance on imported fossil fuels for transport, aiming to decrease the share from 42% in 2010 to 22% by 2030. This policy integrates environmental goals directly with energy security, a critical issue for small island developing states.

The Maritime Singapore Decarbonization Blueprint (Government of Singapore, 2022a) is a major initiative. It aims for a 15% reduction in emissions from the domestic harbor craft fleet by 2030, followed by a halving of that fleet's emissions by 2050. The blueprint also sets a net-zero target for port terminals by 2050, showing an integrated view. From 2030, all new harbor craft must be fully electric, use B100 biofuels, or be net-zero fuel compatible.

The Pacific Blue Shipping Partnership is an open coalition of Pacific Island nations, co-chaired by Fiji and the Republic of the Marshall Islands. The objective is to accelerate the decarbonization of maritime transport along with a large-scale transformation of their domestic maritime sectors. The Partnership is a first—a multi-country-driven initiative designed to create new opportunities for carbon-free sea transport across the region. The goal is simple: a country-led, large-scale shift to sustainable, resilient, and low-carbon sea transport. The target: a 100% carbon-free domestic maritime sector by 2050, with a clear milestone—a 40% reduction in greenhouse gas emissions from shipping by 2030.

Since 2000, carbon emissions from Asia's domestic shipping have doubled, rising from 75 million tons to 149 million tons in 2023

Maritime Transport – Resilience and Adaptation

Asia is warming at a rate almost double the 1961-1990 average. This fuels a volatile new reality. A disproportionate share of the world's disasters happens in Asia: 77% of flood events, 94% of landslides, and 85% of tropical cyclones. In 2022 alone, 81 major climate-related disasters struck the region, predominantly storms and floods that exacted a $36 billion economic penalty.

The physical damage to the Asia-Pacific's transport infrastructure from climate hazards amounts to about $12 billion to 54 billion annually, about 65% of the global total (CDRI, n.d.b; Verschuur et al., 2023). While roads bear a significant portion of this cost, the vulnerability of seaports presents a unique threat. In Small Island Developing States, ports represent an average of 34% of total transport losses from disasters. In Tuvalu, that figure climbs to 75%.

By 2050, ports in Asia-Pacific are estimated to bear almost a fourth of the trade value (annual USD) at risk due to the potential impacts of climate change under the representative concentration pathway (RCP) 8.5 (Figure 22).

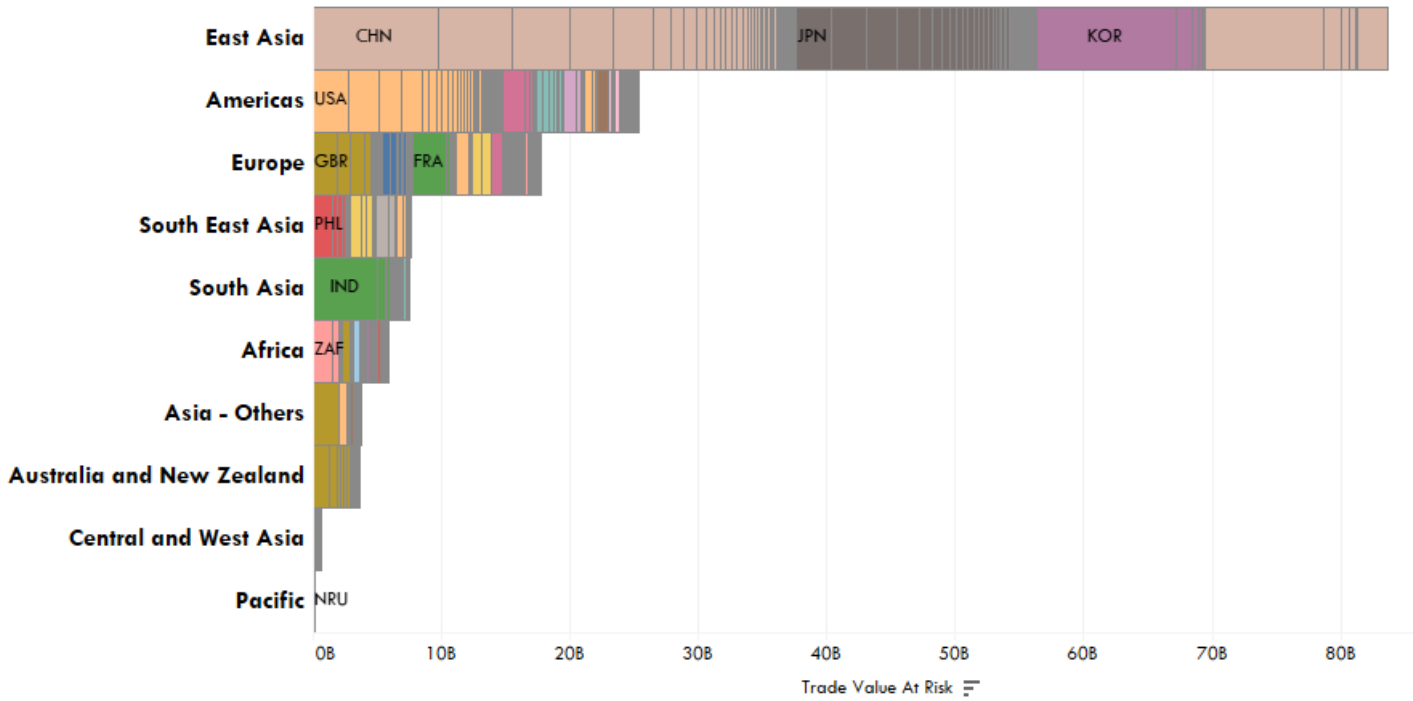

Figure 22: Trade value at risk (billion USD/year)
ATO visualization based on Port Watch IFM & Oxford University (2023)

The failure of a single port is not a localized event; it is a systemic shock, cascading through supply chains. The real price is paid in the disruption that follows. Verschuur et al. (2023) highlight that natural hazards—such as tropical cyclones, earthquakes, river floods, pluvial floods, and coastal floods—threaten global trade, which is valued at least $60 billion. About 70% of this risk is concentrated in Asian countries. These disruptive events could lead to trade losses that are up to 100 times the damages caused at the ports.

Countries are beginning to strengthen their policy frameworks. The Samoa Infrastructure Asset Management Strategy (Government of Samoa, 2022) emphasizes the importance of documenting risk, resilience, and climate adaptation requirements, including any necessary investment. The Samoa National Infrastructure Strategic Plan (Government of Samoa, 2011) also supports investment programs based on the findings of the National Ports Plan and continuous investments in safety and security systems. The Samoa National Disaster Management Plan (Government of Samoa, 2017) also advocates for a disaster risk reduction component in the transport sector budget.

Singapore's Fifth National Communication (Government of Singapore, 2022b) mandates that Tuas Mega Port will rise at least five meters above the current mean sea level. Similarly, the Federated States of Micronesia has set a clear deadline: by 2030, all major ports will be climate-proofed with larger, more resilient docks, as outlined in its updated first NDC (Government of FSM, 2022).

The Fiji in its Technology Needs Assessment Report (Government of Fiji, 2020a) has proposed for river-bank protection that combines ecosystem-based approaches with hard infrastructure. Türkiye in its Twelfth Development Plan (2024–2028) (Presidency of the Republic of Türkiye, 2023), is calling for differentiated design principles for infrastructure projects, tailored to the specific disaster risk of the region where a project is realized. Sri Lanka's National Adaptation Plan for Climate change Impacts (Ministry of Mahaweli Development and Environment, 2016) prioritizes the fundamental work of assessing vulnerable areas and preparing hazard maps for its transport infrastructure.

In Timor-Leste, existing laws, regulations, and standards are proposed for review to enhance the climate resilience of critical infrastructure, a key action in their Nationally Determined Contributions (Government of Timor-Leste, 2022). The Maldives is proposing a similar path, strengthening its national legislative framework to ensure national plans and development activities are built in line with climate resilience, as stated in its Third Nationally Determined Contribution (Government of Maldives, 2025).

Muhamad Guntur

Shipping and Air Pollution

Since 2000, domestic shipping's PM2.5 and black carbon emissions have grown at three percent annually. The growth for NOx and SOx stands at two and a half percent. The increase outpaces the region's population growth. In 2019, surface transport accounted for 6.2% of the ambient PM2.5 pollution in Asia and the Pacific. Domestic shipping's share was 1.5% (European Commission, 2024). However, a closer look reveals the shifting landscape of pollution (Figure 23).

The road sector's share of PM2.5 emissions reduced from 49% in 2000 to just 25% by 2022. During the same period, domestic shipping's contribution increased from 38% to 64%. The trend is clear: shipping is now a significant source of air pollution (European Commission, 2024). Figure 24 provides an overall visualization of the global trends in shipping PM2.5 emissions.

The data for black carbon emissions tells a similar story. The road sector's share dropped from 76% to 49% between 2000 and 2022, while domestic shipping's contribution increased from 22% to 49%. For nitrogen oxides (NOx), the road sector's share decreased from 79% to 72%, and domestic shipping's share grew from 15% to 22%. A starker picture emerges with sulfur oxides (SOx): the road sector's contribution fell from 13% to a mere 1%, while those from domestic shipping jumped from 84% to 97%. These numbers underscore the growing role of domestic shipping in air pollution (European Commission, 2024).

However, a critical caveat remains. Data for transport emission modeling is scarce, especially for the complex network of domestic vessel activity and inland waterways.

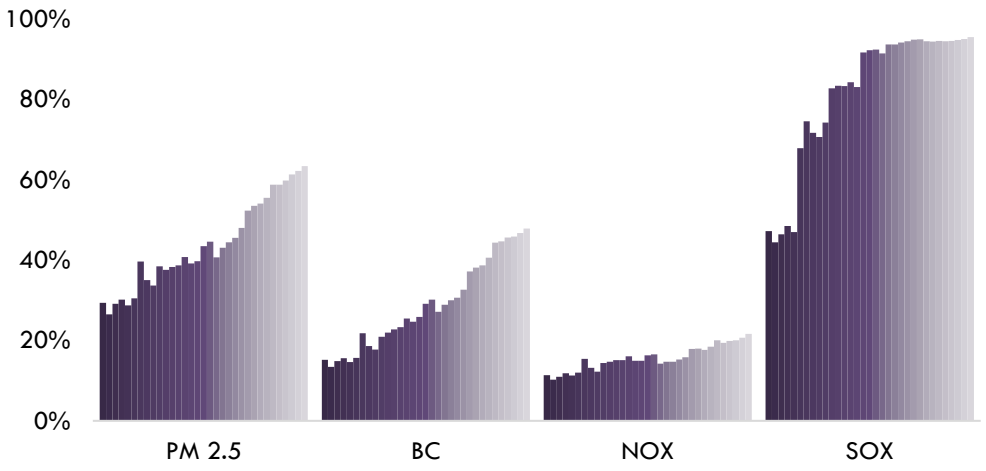

Figure 23: Domestic shipping share in domestic transport air pollutants
ATO visualization based on EDGAR (2024)

International shipping is the primary transport source of SOX emissions and a significant contributor to particulate matter and nitrogen oxides emissions. Before 2020, the global fleet ran predominantly on heavy fuel oil (HFO) —a viscous, residual product of crude oil refining. This fuel was cheap and dirty. It contained sulfur levels orders of magnitude higher than road diesel, along with heavy metals like vanadium and nickel. Unlike road vehicles, ships generally lack exhaust aftertreatment systems like particle filters, meaning these pollutants were released directly into the atmosphere.

The pivotal intervention came in 2020 with the enforcement of the International Maritime Organization's (IMO) global sulfur cap (IMO, 2021). This rule prohibited the use of most HFO, forcing a rapid shift towards cleaner fuels. An alternative path remains: ships can continue to burn HFO, but only if equipped with exhaust gas cleaning systems, or scrubbers, that neutralize sulfur oxides.

The regulation mandates a maximum sulfur content of 0.50% for ships operating outside of designated Emission Control Areas and prohibits the carriage of non-compliant fuel. Within these ECAs, as defined under MARPOL Annex VI, the standard is even more stringent at 0.10%, with regulations that also target NOX emissions. The outcome has been a significant reduction in maritime air pollution. In 2019, just before IMO 2020, heavy-fuel oil accounted for 81% of the industry's fuel. By 2022, the most recent data indicates this share had dropped to 55% (Allen Brooks, 2025). Projections from numerous studies point toward a future with better air quality, saving lives and reducing illness across coastal and port communities worldwide (Arindam, n.d.).

Complementing international regulations and previously discussed clean fuel policies, several countries are implementing supplementary measures to mitigate air pollution. A key strategy is the establishment of emission standards for domestic maritime vessels. The Maldives exemplifies this approach; its National Action Plan on Air Pollutants (Government of Maldives, 2019a) outlines a framework for developing a domestic vessel emission standard, which a national emissions inventory will inform. Türkiye has proposed a vessel scrappage scheme in its nationally determined contribution (Government of Republic of Türkiye, 2023) for the Paris Agreement. The Philippines also prioritizes replacing aged vessels under the Maritime Industry Development Plan (Government of Philippines, 2021).

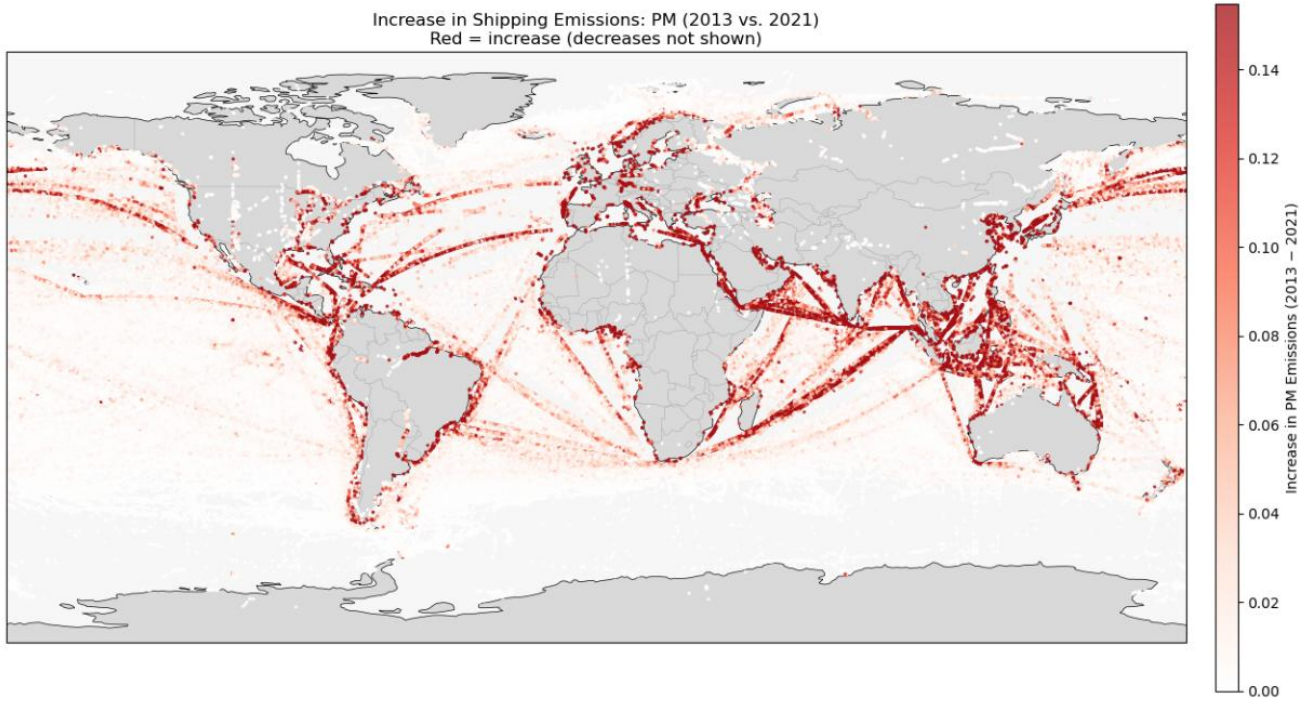

Figure 24: Increase in shipping emissions
ATO analysis and visualization based on (Wen et al., 2024)

Domestic Shipping Emissions Outlook

The future emissions trajectory depends on policy. To project the future emissions outlook, this analysis relies on outputs from the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) (IIASA, 2025) model. The model calculates both current and future emissions by first combining specified activity data with baseline 'uncontrolled' emission factors. Then, it overlays the real-world impact of assuming current legislation for air pollution policy and technology, factoring in both the application rates of emission control measures and their proven removal efficiencies. Without new interventions, the emissions trajectory is one of significant growth. The inland waterways are responsible for the majority, i.e., 80% of domestic shipping emissions; coastal shipping contributes the remaining 20%. This profile is not static. Projections indicate that annual emissions growth is set to lock in at a rate of 2.3% to 2.4% between 2020 and 2035 (Figure 25).

The future emissions trajectory depends on policy.

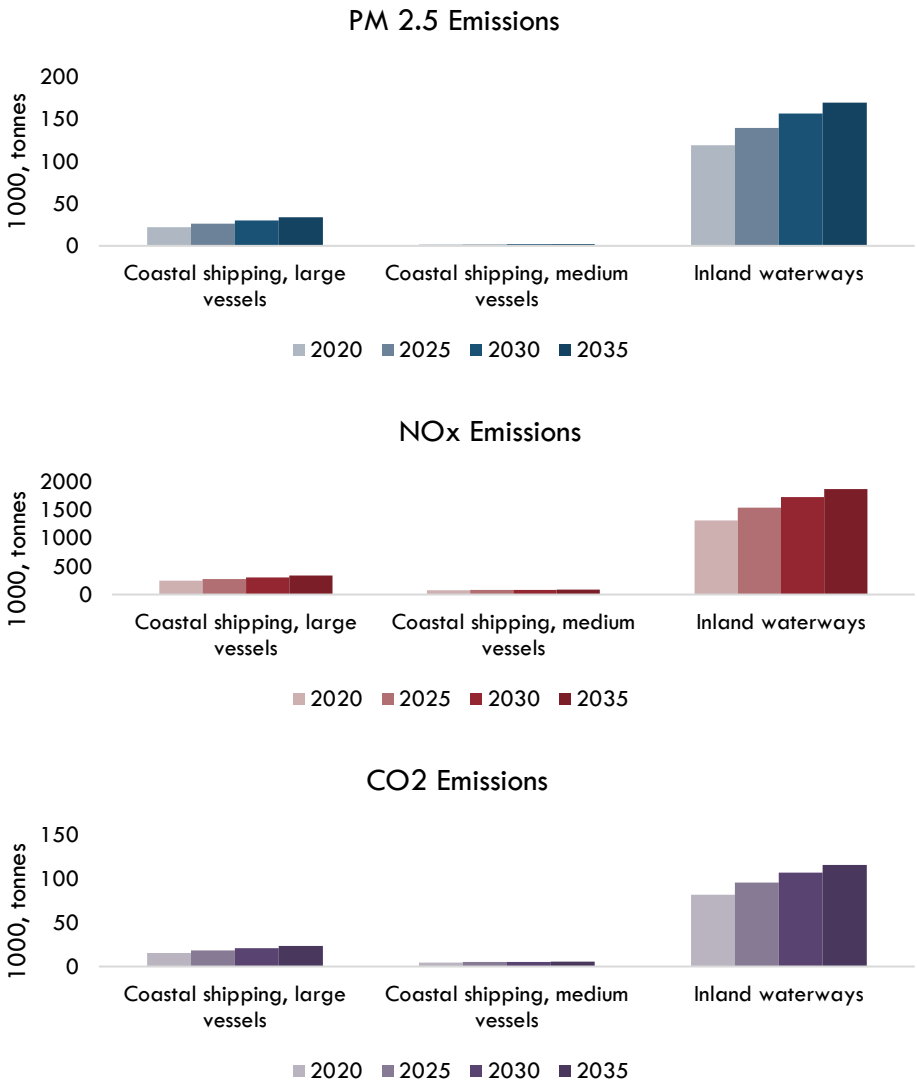

Figure 25: Domestic shipping emissions
ATO visualization based on IIASA (2025)

Shipping Health Impact

Shipping emissions carry a heavy public health toll. Though international shipping contributes the most significant burden, its impact is not uniform. Early studies pegged the annual death toll from shipping emissions at roughly 60,000, primarily from cardiopulmonary illnesses and lung cancer (Corbett et al., 2007). These deaths clustered near coasts in Europe, East Asia, and South Asia. More recently, in 2015, the numbers intensified, revealing 94,200 premature deaths globally (Zhang et al., 2021). Of these, international shipping was responsible for the majority, i.e., 78,000—or 83% of the total—while domestic shipping accounted for the remaining 16,200.

Asia accounts for 52% of the worldwide and domestic shipping-related health burden. Within Asia, domestic shipping makes up approximately 22% of the shipping-related health burden. However, these regional and global overviews mask notable differences between countries, as illustrated in Figure 26.

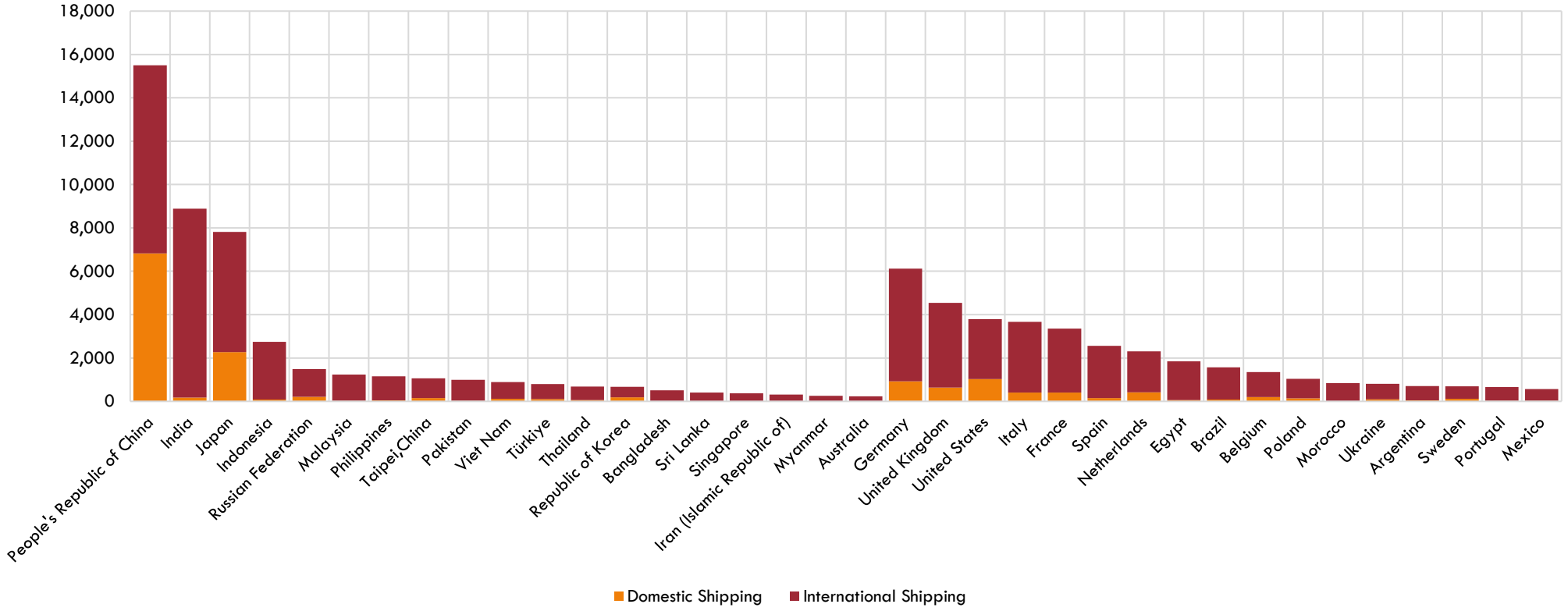

Figure 26: health burden in baseline scenario
ATO Visualization based on Zhang et al. (2021)

Ship Breaking and Recycling

Most ships that have been built will be recycled and repurposed as raw materials. Thus, the average 30-year service life of a ship (Önal, 2023) creates a long shadow of environmental consequence. UNCTAD estimates that the average age of vessels in Asia Pacific is at 18 years. Figure 27 shows the estimated average age (all ships) of ships based on port calls in the specified economies.

South Asia alone, led by Bangladesh, accounts for over 85% of this ship recycling industry by gross tonnage (UNCTAD, 2025e). The global fleet, now at 2.4 billion deadweight tons, has an average lifespan of 22 years (UNCTAD, 2024b) (Figure 28). This suggests that the demand for breaking and recycling could increase significantly over the next decade.

There are international regulations governing the management of toxic and hazardous wastes from ship breaking and recycling. The Hong Kong Convention, which took effect on June 26, 2025 (IMO, 2025b), sets a framework for the safe and environmentally responsible recycling of these ships. It imposes restrictions on hazardous materials like asbestos and ozone-depleting substances, prohibiting or limiting their use on new ships. It also requires a detailed inventory of hazardous materials for each vessel. The Convention further establishes strict requirements for recycling facility operations, including working conditions, and implements strong mechanisms for certification, compliance, and enforcement.

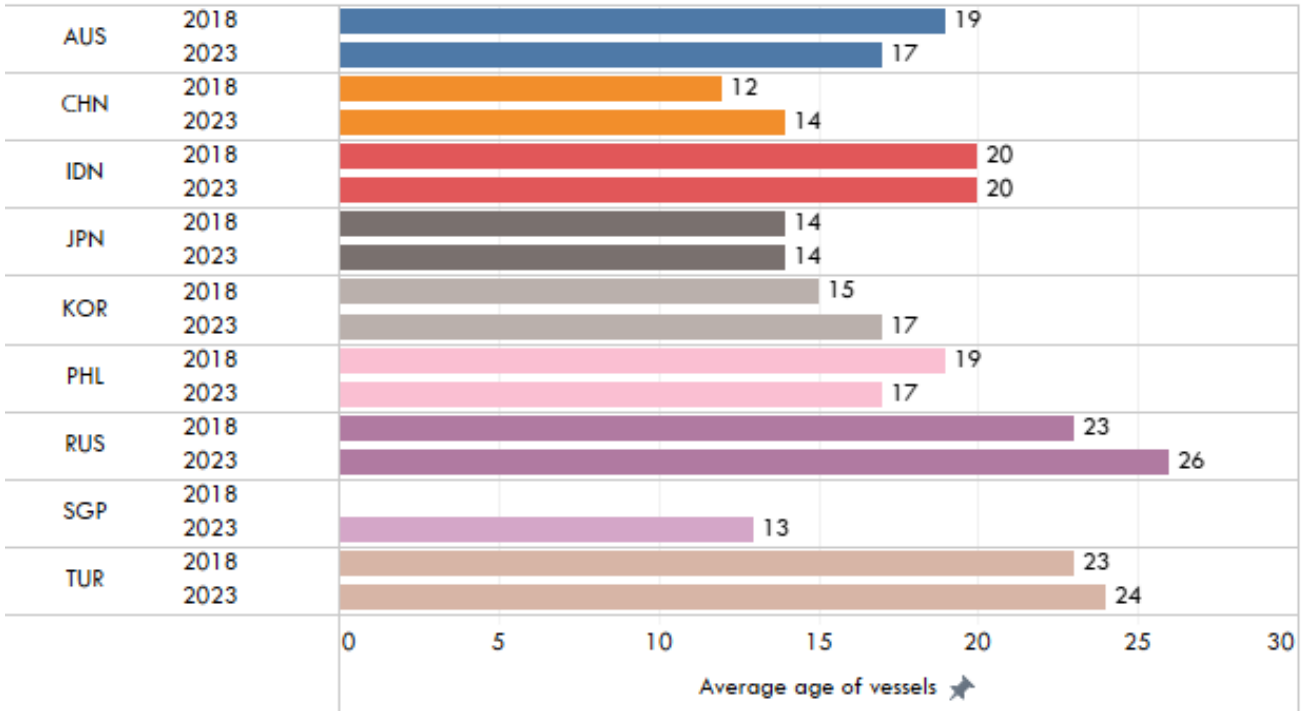

Figure 27: Average age - all ships
ATO visualization based on UNCTAD (2024a)

National policies are catching up. The Philippines, via the Maritime Industry Development Plan (Government of Philippines, 2021), tackles aging fleets by promoting a Vehicle Retirement Program (VRP) for outdated ships and encouraging the modernization and upgrading of domestic ships vessels. The Maritime Transport Act 2008 (Government of the Cook Islands, 2008) for the Cook Islands contains a provision for salvage. This is a specific legal framework, not a broad policy on industrial scrappage. It deals with the end-of-life of vessels in the context of accidents or abandonment. The focus is on legal and operational procedures for recovering vessels.

The Vanuatu's National Ocean Policy (Government of Vanuatu, 2016) promotes the expansion of ship repair and maintenance activities, recognizing that extending a vessel's life is also a key component of sustainable maritime practice. The ship recycling and scrappage industry in Bangladesh is a significant part of its national policy, as detailed in the National Shipping Policy 2000 (Government of the People's Republic of Bangladesh, 2000). The policy acknowledges the challenges of procedural security and environmental impact. The government, through a joint effort of the Ministries of Shipping, Industry, and Labor, is committed to creating a policy to encourage, consolidate, and make the industry environmentally balanced and technology-dependent. The country plans to introduce and apply international conventions to stop pollution from ship-breaking activities and to replace old ships with new, more efficient vessels.

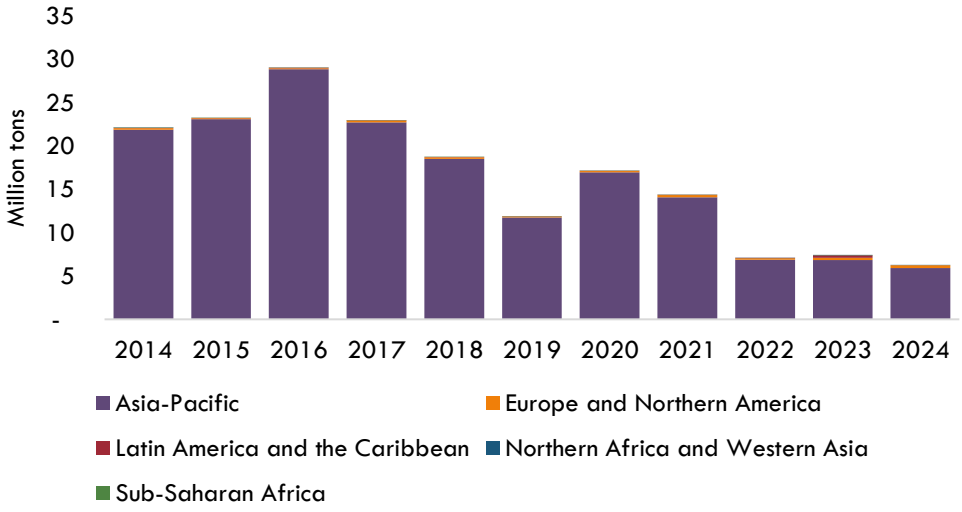

Figure 28: Ship recycling (tons)
ATO visualization based on (UNCTAD, 2025e)

Shipping Employment

For some nations, the sea is the economy. We find that the largest shares of shipping employment are not always found in the largest economies (Figure 29 & Figure 30). In the Philippines, the share reaches 4.5 percent of all jobs, but in small island nations like Kiribati, Maldives, Seychelles, and Tuvalu, it can soar to between 9 and 13 percent (Achkar, 2024). However, the statistics are skewed due to the consideration of the fisheries and aquaculture subsector. If only the maritime transport employment is considered, the shares are lower. However, Asia supplies the world with its seafarers—about 60% of the global total (UNCTAD, 2021).

Three countries —PRC, the Republic of Korea, and Japan—dominate global shipbuilding, and so their shipping related workforces are concentrated there. In contrast, the ship recycling industry has a high share of workforces in Bangladesh, India, and Pakistan.

The sea is not a place for many women. The BIMCO/ICS 2021 Seafarer Workforce Report (IMO, n.d.) found they make up only 1.2% of the global seafarer workforce. While the numbers are better in related onshore sectors, they remain low. Women account for just 12% of the workforce in sea and coastal water transport, 10% in inland water transport, and 9% in shipbuilding.

Figure 29: Share of water transport in total transport sector employment, 2015-2023
ATO visualization based on (International Labour Organization, 2024)

Navigating toward a decarbonized future requires more than just new ships and fuels; it demands a fundamental transformation of the workforce (IMO, n.d.-a). . The shift to alternative fuels, such as hydrogen, ammonia, batteries, and biofuels, introduces new health and safety risks, necessitating a recalibration of training to equip seafarers to operate and handle these volatile fuels. The just transition is challenging. A lack of clear direction on future fuel choices and regulatory frameworks could hinder effective workforce planning and stall crucial investments in new skills programs. This lack of clarity also widens the technology readiness gap between developing and developed economies, impacting skills development in regions that supply a significant portion of the global maritime workforce.

Many countries are implementing policies to enhance maritime just transition through training and capacity building. For example, Bangladesh's National Shipping Policy 2000 (Government of the People's Republic of Bangladesh, 2000) calls for modernizing training centers to meet international standards and encourages private sector investment in training facilities. It aims to ensure a sufficient number of trained seamen are appointed to vessels and to improve the competence of shipping officers. The Perspective Plan of Bangladesh 2021-2041 (Bangladesh - General Economics Division (GED), 2020) also emphasizes strengthening human resource development in this "skill-intensive and competitive line of business."

Cambodia's National Strategic Development Plan 2019-2023 (Royal Government of Cambodia, 2019) also focuses on human resources, with a commitment to strengthening institutions through training and recruiting qualified staff. This includes establishing a training center for crews and providing skills training for port security staff.

The Indonesia Blue Economy Roadmap (Government of Indonesia, 2023) also emphasizes developing competitive, quality maritime human resources, particularly in skills related to research, development, manufacturing, and logistics. The Kiribati NDC Investment Plan (Government of Kiribati, 2021b) and Transport Investment PID (Government of Kiribati, 2020) also detail training and capacity building programs, including for boat operators, mechanics, and even piloting an all-female maintenance team.

The Philippines Maritime Industry Development Plan 2019-2028 (Government of Philippines, 2021) has a strong focus on manpower development, including training programs for maritime tourism crew, boatbuilding, and upgrading the competence of domestic seafarers. The Tuvalu's Programme of Action for Least Development Countries also highlights the need to develop local capacities to understand new technologies for monitoring and reducing ship emissions.

Vanuatu's National Ocean Policy aims to promote Vanuatu as a "crewing nation" by ensuring education and training comply with international standards.

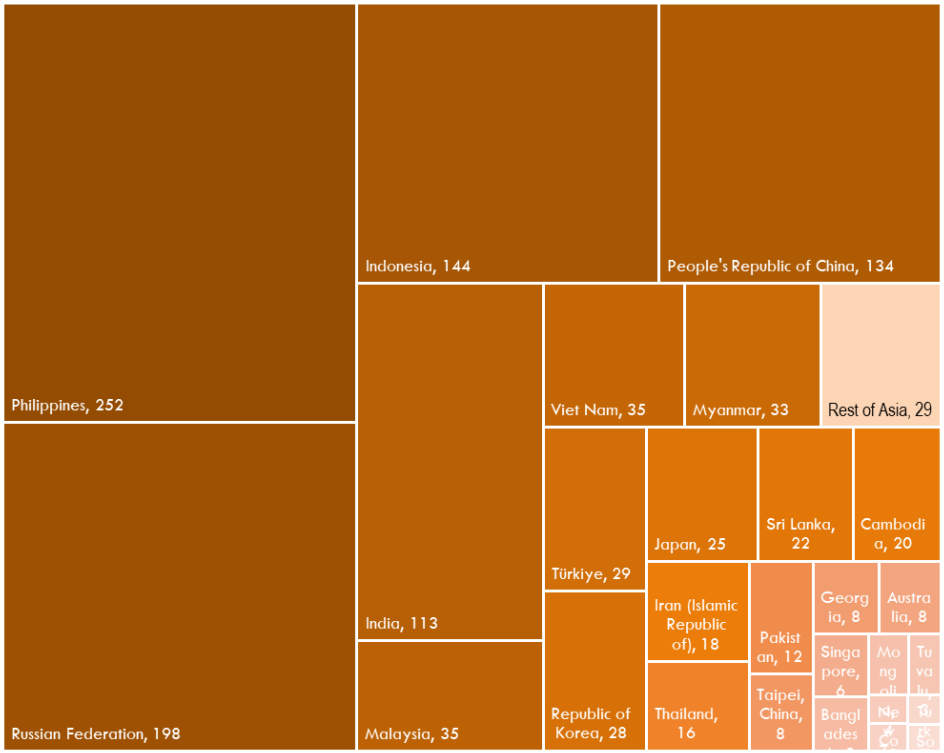

Figure 30: Seafarer supply from Asia in 2021 (thousands)
ATO visualization based on (UNCTAD, 2021)

Investments in Maritime Transport

Official Development Assistance (ODA) provides one of the primary funding channels for developing nations. Traditionally, ODA's mandate focused on economic development and poverty alleviation. That purpose has since expanded. Today, ODA must also serve as a lever for achieving the full scope of Sustainable Development Goals (SDG), including climate change mitigation and adaptation (CONCITO, n.d.).

Since 2000, water transport in the Asia Pacific region has received approximately $6 billion in ODA (Figure 31). This figure, however, represents a share well below its potential within the larger transport segment. From 2000 to 2015, its portion of transport ODA was 4.8%. Following the implementation of the SDG, this share increased to 6.4%. This marginal rise points to greater attention but highlights the persistent gap in investment. Half of all water transport ODA in the Asia-Pacific region from 2002 to 2022 flowed into just two countries: Vietnam (27%) and Indonesia (24%) (OECD, 2025).

A more dramatic shift has occurred in private investment. While ODA flows have been steady, public-private partnership (PPP) investments in ports have fallen sharply (Figure 32). From 2000 to 2010, port projects made up 25% of all transport PPP investments. Between 2011 and 2023, that share collapsed to just 5%. In the region, the People's Republic of China (33%) and India (23%) have the highest PPP port investments (World Bank Group, 2023).

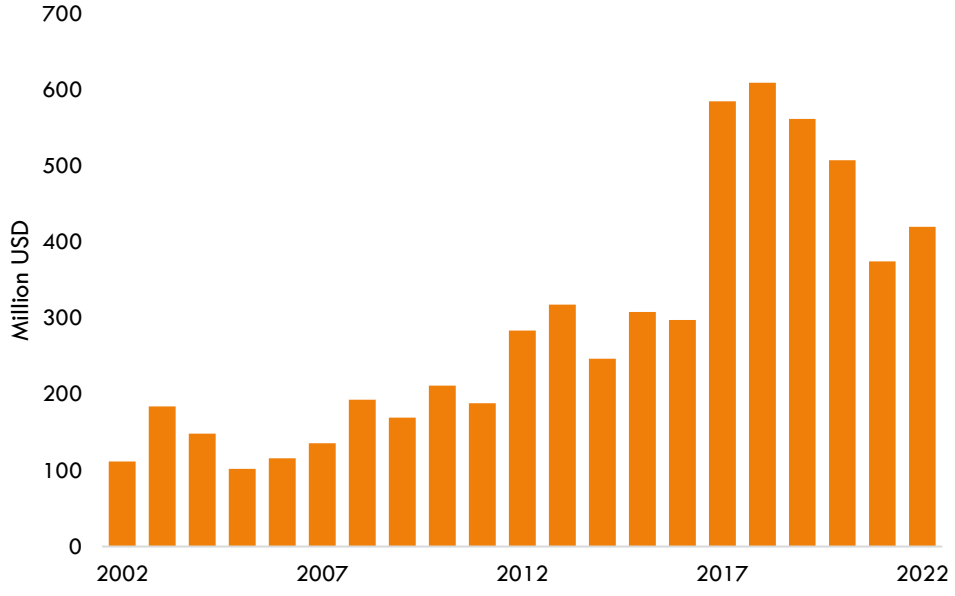

Figure 31: ODA in Water Transport
ATO visualization based on OECD (2025)

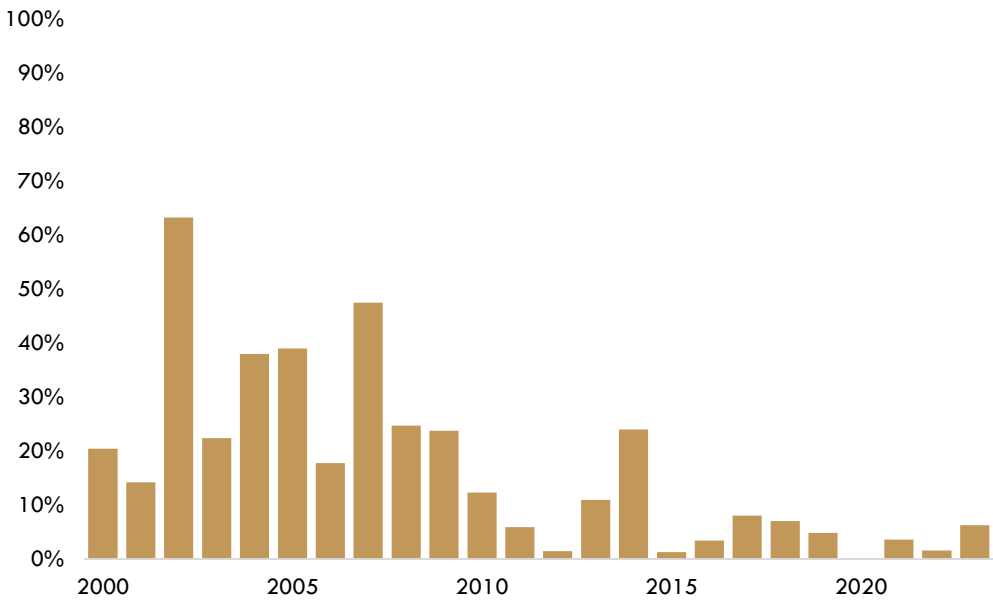

Figure 32: PPP Port share in Transport PPP
ATO visualization based on World Bank (2023)

Port investment in the Asia-Pacific region, as a share of GDP, has outpaced that of Europe and North America, averaging about 0.09% by 2020 (Figure 33). But the figure has remained largely unchanged since 2007. The regional average also masks significant national variations, with investment levels reaching as high as 0.29% in Azerbaijan, 0.26% in Australia, and 0.22% in New Zealand (Global Infrastructure Hub, n.d.).

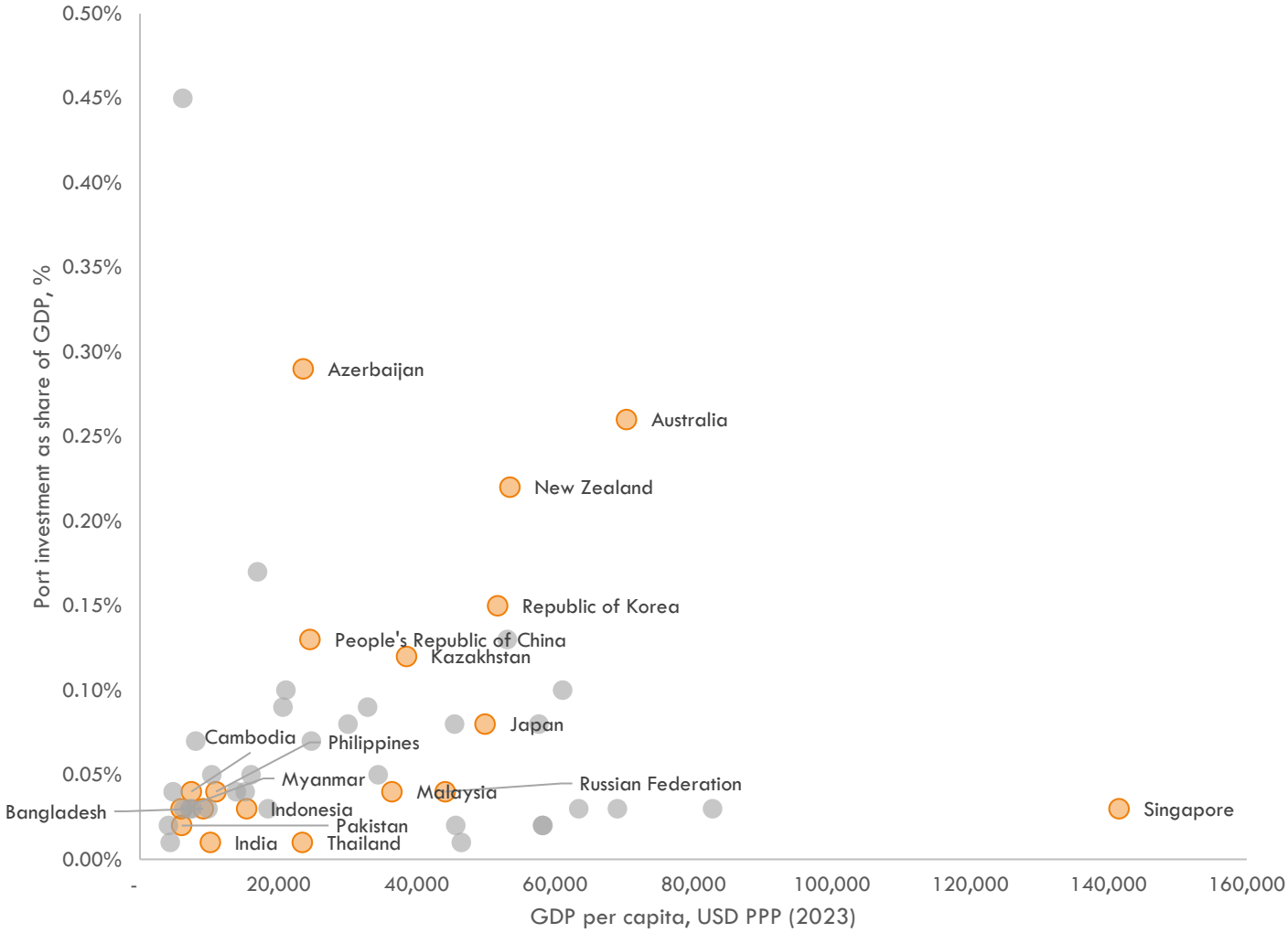

Figure 33: Port investment as a share of GDP
ATO visualization based on Global Infrastructure Hub (n.d.)

Few funding and financing facilities exist to facilitate access to finance (McIntosh et al., 2025). The box below details these instruments.

Active Green Funding and Financing Initiatives Across Asia and the Pacific

ADB Blue Bonds, ADB Blue Pacific Finance Hub, ADB Blue SEA Finance Hub, ADB Green Climate Fund, ADB Ventures, ASEAN Catalytic Green Finance Facility, Asia Green Fund, Asian Clean Energy Fund, Australian Climate Finance Partnership, Australian Renewable Energy Agency, BIS Asian Green Bond Fund, China Development Bank, Clean Cargo Initiative, Clean Energy Finance Corporation Australia, Clean Energy Financing Partnership Facility, Climate and Clean Air Coalition, Climate Investment Funds, Climate Investor One, ClimateWorks Foundation, EcoPorts Network, EIB Global, Equis Development Pte Ltd, Global Center on Adaptation, Global Climate Action Partnership, Global Energy Efficiency and Renewable Energy Fund, Global Environment Facility, Green Investment Group Asia, Greenko Group, International Finance Corporation, International Renewable Energy Agency, Japan International Cooperation Agency Climate Finance, Japan Renewable Energy Corporation, Korea Green Growth Trust Fund, Lloyd's Register Silk Alliance, Macquarie Asia Infrastructure Fund 3, New Energy Nexus, Ocean Resilience and Coastal Adaptation Financing Partnership Facility, and ORCA Trust Fund, Pacific Blue Shipping Partnership, Pacific Ports Clean Air Collaborative, PROBLUE, Renewable Energy and Energy Efficiency Partnership, Singapore Green Plan 2030, International Cooperation and Development Fund in Taipei,China, The Adaptation Fund, Tropical Asia Forest Fund 2, World Ports Climate Initiative Program, Sustainable and Resilient Maritime Fund (SRMF)

Future trade patterns will shape the ports of tomorrow. Port infrastructure projections by Hanson & Nicholls (2020) examine different climate policy scenarios and their impact on the future of maritime trade in terms of type and volume. The high-emissions consumption scenario estimate suggests that the port area in the Asia-Pacific could potentially grow from 900 sq.km in 2020 to 1,200 sq.km by 2035, a 35% increase, which will be significantly faster than in Europe and North America—where it is projected to increase by 28% from 2020 to 2035. Regionally, the annual investment needed for port expansion is estimated at 0.1% of GDP, or roughly $120 billion (ATO, 2025a). This estimate does not include climate adaptation costs, which could vary widely. Estimates from ADB (ADB, 2017) and Coalition for Disaster Resilient Infrastructure (CDRI) (CDRI, n.d.-a) indicate using an average 7% sketch multiplier to account for mitigation of the average annual losses caused by climate-related damage. Previously, HSBC estimated that protecting and elevating 53 of the region's largest port areas to adapt to climate risks could cost between US$31 billion and US$49 billion (ARE, 2018).

The investment need is not evenly distributed. The Pacific region faces a far more acute challenge, requiring annual port investments equivalent to 0.6% of its GDP—a figure six times the regional average (ATO, 2025a).

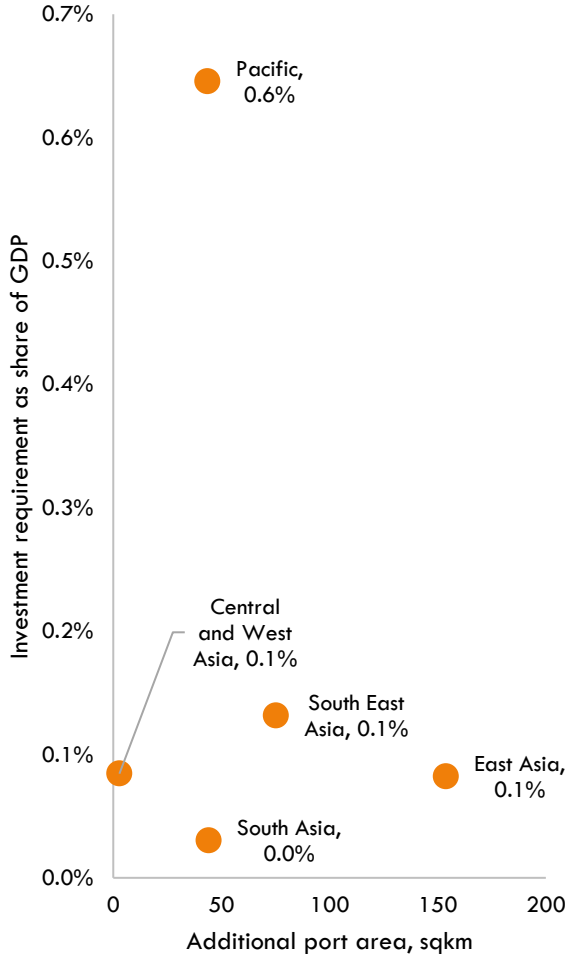

Figure 34: Investment requirement for ports as share of GDP, 2020-2035
Visualization based on ATO (2025a)

Halving global shipping emissions by 2050 alone demands a cumulative investment of $1.0 trillion to $1.4 trillion. That is an average of $50 billion to $70 billion annually, for twenty years (Christensen, 2020). Full decarbonization by mid-century requires even more—an additional $400 billion, raising the total capital needed to between $1.4 and $1.9 trillion.

Countries are trying to create more conducive investment frameworks. Singapore has dedicated an initial funding of S$40 million under the Maritime Green Future Fund (LLYOD's, 2025) to foster R&D in low-carbon technologies, demonstrating a clear commitment to funding innovation. The Fiji 5-Year and 20-Year National Development Plan (Government of Fiji, 2017) commits to high levels of investment to address the backlog in upgrading and maintaining roads, bridges, and jetties. The NDC Implementation Plan 2030 also specifies a fund of US$4-8 million for improved maintenance of sea vessels.

Indonesia's policies are focused on maritime development, a logical priority for an archipelagic nation. The National Medium Term Development Plan 2020-2024 (Ministry of National Development Planning (Bappenas), 2020) sets out to expand its sea toll routes and build 36 new ports. The goal is to improve connectivity and economic contribution. The Visi Indonesia 2045 looks even further ahead, aiming to increase the maritime economic contribution to GDP from 6.4% in 2015 to 12.5% by 2045.

The Maldives' Strategic Action Plan (Government of Maldives, 2019b) articulates key policy reforms for the maritime transport sector. These include establishing a framework to facilitate private sector investment in the operation of ferry services and creating the Aids to Navigation Fund as a financially independent entity managed by the Maldives Transport Authority to ensure dedicated funding for navigational infrastructure.

Om Mishra

Conclusion

The world's economic center has shifted. Asia's maritime ecosystem is at the core of a new global reality. What occurs here does not stay here; it shapes the path of global trade and sustainable development well beyond these shores. This report has outlined the currents driving this change. The structure of maritime transportation is being reshaped by the combined forces of decarbonization, digitalization, and geopolitics. This transformation is happening across five interconnected areas.

The Technological Front - The International Maritime Organization has mandated a net-zero emissions future, creating a new pathway for international shipping. Yet the domestic sector, a growing source of both carbon and air pollutants, remains overwhelmingly dependent on legacy fuels. Since 2000, its carbon emissions have doubled. While the road sector has cleaned up its act, shipping's share of domestic transport PM2.5 emissions has increased from 38% to 64%; for sulfur oxides, its share is now a staggering 97%. The transition requires an entirely new class of assets, from green ammonia production plants to shore power facilities.

The Physical Front - Asia is warming at nearly double the global average. In 2022 alone, 81 major climate disasters struck the region. The region's ports, the critical nodes of the global economy, represent a systemic risk. The physical damage to infrastructure already costs up to $54 billion annually. But this is a rounding error. The real price is disruption. The trade losses from a single port failure can be 100 times greater than the cost of the physical damage itself.

The Equity Front - A story of two Asias is emerging. A deep fracture is opening between the connected and the isolated. One Asia is a network of hyper-connected hubs, where the People's Republic of China's Liner Shipping Connectivity Index scores above 1100. The other is adrift. The Pacific Small Island Developing States have indices ranging from 4 to 50, indicating no significant improvement over time. This divergence is also mirrored inland. Asia holds nearly half the world's navigable waterways, a vast but neglected asset. While freight traffic grows, passenger transport decays, a victim of chronic under-investment. The geography of investment is drawing new lines between those who are connected and those who are left behind.

The Human Front - This entire system runs on people. Asia supplies 60% of the world's seafarers. The shift toward automation, green fuels, and resilient infrastructure is not just a technological challenge; it is a human one. A just transition is essential to ensure this workforce is retrained and upskilled, not abandoned. Managing this human capital is as critical as any technological fix or financial instrument.

The Financial Front - The capital required for this transformation is not present. Official Development Assistance is a fraction of what is needed. More alarmingly, private investment in ports has shrinked. Its share of transport public-private partnerships has reduced from 25% to just 5% over the past decade. Without stable, long-term regulatory frameworks that provide certainty, private capital will remain on the sidelines, a spectator to a transition that cannot happen without it.

As the United Nations Decade of Sustainable Transport begins, the situation is clear. The transition can be managed with foresight, or it will be managed by the crises that follow. The pathways outlined in this report are not predictions. They are possibilities, contingent on the decisions made now. The destination remains unwritten.

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Annex A: Information on port-related projects in the pipeline

Country/Economy	Project Name	Total Amount	Currency	Funding Agency / Structure	Status	Date (Proposed/ Approved)
Bangladesh	Bay Terminal Marine Infrastructure Development Project	350	USD	WB	Active	28/06/2024
Bangladesh	Matarbari Port Development Project (II)		JPY	JICA		29/03/2023
Bangladesh	Matarbari Port Development Project (I)		JPY	JICA		29/05/2019
Bangladesh	Matarbari Port Development Project (E/S)		JPY	JICA		14/06/2018
Brunei Darussalam	Muara Port Expansion & Container Terminal Upgrade	307	USD		Active	24/08/2024
Cambodia	Sihanoukville Port New Container Terminal Development	23502	JPY	JICA	Closed	07/08/2017
Cambodia	Tbong Khmum Inland Port Facility Development		USD		Proposed	
Indonesia	Indonesia Integrated Port Network (Network Nasional Pelabuhan Terpadu)		USD	AIIB	Active	2020
Indonesia	Patimban Port Development Project ()		JPY	JICA		10/01/2025
Indonesia	Patimban Port Development Project (II)		JPY	JICA		20/05/2022
Indonesia	Patimban Port Development Project		JPY	JICA		15/11/2017
Kazakhstan	Aktau Port Modernisation			EBRD	Approved	24/11/2022
Lao People's Democratic Republic	Mekong River Harbour Network – Huay Xai, Luang Prabang, Pakbeng		USD		Proposed	
Lao People's Democratic Republic	Mekong Riverbank Protection & Erosion Control – Upper Mekong		USD	JICA	Active	
Lao People's Democratic Republic	Mekong Harbour Capacity Upgrade – Ban Xai, Xiengkok, Ban Mon, Meuang Kop		USD		Active	2016
Lao People's Democratic Republic	New 500-Ton International Harbour – Xiengkok (Luang Namtha)		USD		Proposed	2016
Lao People's Democratic Republic	New 500-Ton International Harbour – Pakbeng (Oudomxay)		USD		Proposed	2016
Lao People's Democratic Republic	New 500-Ton International Harbour – Kok Jong (Luang Prabang)		USD		Proposed	2016
Maldives	Kulhudhuffushi Harbor Expansion Project	10.94	USD	ADB	Closed	16/08/2016
Nauru	Port Development Project	5.01	USD	ADB	Closed	03/12/2015
Nauru	Sustainable and Climate-Resilient Connectivity Project (formerly Port Development Project)	97.74	USD	ADB	Active	16/12/2015
Niue	Basin Harbour Wharf Expansion		USD		Proposed	2021
Pakistan	Karachi Port and Port Qasim Gate Accessibility Improvement		PKR		Proposed	2020
Palau	Malakal Port Wharf & Harbor Rehabilitation		USD		Proposed	2021
Papua New Guinea	Connect PNG Sea/Water Transport Program – Port Upgrade Package		PGK		Active	2023
Papua New Guinea	MTDP IV Strategic Corridors – New Britain Corridor		PGK		Proposed	2023

Country/Econony	Project Name	Total Amount	Currency	Funding Agency / Structure	Status	Date (Proposed/ Approved)
People's Republic of China	China: Ningbo Green and Low-Carbon Port Development Project			AIIB	Proposed	-
People's Republic of China	Xiaoyangshan North Area Automated Container Terminal	10000	CNY		Active	30/08/2022
People's Republic of China	Ningbo–Zhoushan Port Bulk Cargo & Maritime Facilities Project		CNY		Active	
People's Republic of China	Anhui Province Green Port and Shipping Demonstration Project	0	USD	ADB	Proposed	12/11/2025
People's Republic of China	China: Hunan Inland Waterway Green Port Project			AIIB	Proposed	-
People's Republic of China	Taicang Port Extension	265.6	USD		Proposed	
Samoa	Salelologa Wharf Upgrades				Active	
Samoa	Enhancing Safety, Security, and Sustainability of Apia Port Project	78.03	USD	ADB	Active	26/04/2018
Singapore	Tuas Port – World's Largest Fully Automated Container Terminal		SGD		Active	
Solomon Islands	Ghizo Main Wharf Capacity Upgrade	10	SBD		Active	
Solomon Islands	Kirakira Port Development	30	SBD	ADB	Active	2021
Sri Lanka	East Container Terminal (ECT I & II)	80	USD		Active	2016
Sri Lanka	West Container Terminal (WCT I & II)	700	USD		Active	2021
Sri Lanka	Trincomalee Port & Energy Hub Development		USD		Proposed	05/04/2025
Sri Lanka	Galle Port Yacht Marina & Passenger Terminal Development		LKR		Proposed	2020
Sri Lanka	Kankesanthurai Port Renovation & Passenger Ferry Terminal	61.5	USD		Active	02/05/2017
Thailand	Chiang Khong Port Efficiency Improvement		THB		Active	2015
Thailand	Laem Chabang Port Development Phase 3	114000	THB	PPP	Active	
Thailand	Chiang Saen Commercial Port Upgrade		THB		Active	2015
Thailand	Upper Gulf—Eastern Coast Ferry & Cruise Terminal Development		THB		Planning	2017
Thailand	Map Ta Phut Industrial Port Development Phase 3	55400	THB	PPP	Active	
Timor-Leste	Dili Port Ferry & Operational Upgrade Initiative	150	USD	JICA	Active	2014
Timor-Leste	Timor-Leste Strategic New Seaports Development Program	490	USD	JICA	Active	2011
Tonga	Nuku'alofa Port Upgrade Project	83.5	USD	ADB	Active	03/12/2020
Türkiye	DFF - Altintel Port Expansion			EBRD	Repaying	08/10/2021
Türkiye	Mersin Port bond			EBRD	Complete	21/02/2020
Türkiye	Tekirdag Port Project			EBRD	Repaying	19/06/2019
Türkiye	Tersan Floating Dock			EBRD	Repaying	06/10/2016
Turkmenistan	Turkmenbashi International Sea Port Modernization (until 2020)	1500	USD		Closed	
Tuvalu	Maritime Investment in Climate Resilient Operations	22.5	USD	WB	Closed	18/12/2018
Tuvalu	Maritime Investment in Climate Resilient Operations Additional Financing	2.5	USD	WB	Closed	05/06/2020
Viet Nam	Hai Phong Port Capacity Expansion & Terminal Upgrade	2600	USD		Active	
Viet Nam	Cai Mep–Thi Vai International Gateway Port Development		USD		Active	2022
Viet Nam	Third Harbour – Vung Ang (Vietnam)		USD		Proposed	2016
Viet Nam	Kim Lien Cargo Terminal (Da Nang)		USD		Proposed	
Viet Nam	Lach Huyen Deep-Water Port Expansion	3000	USD		Active	2022
Viet Nam	Lach Huyen Port Infrastructure Construction Project (Port) (III)		JPY	JICA		31/03/2016

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