# Global Port Development Report

# （2022）



上海国际航运研究中心
Shanghai International Shipping Institute

# Global Port Development Report (2022)



Shanghai International Shipping Institute (SISI)

June 2023

# Preface

In 2022, the global epidemic has been brought under control, but countries have ended huge fiscal and tax stimulus policies, coupled with frequent international incidents such as geopolitical conflicts and international trade sanctions, the momentum of global economic growth has weakened, and the growth rate of global trade volume has narrowed sharply, Therefore, the growth rate of global seaborne trade demand and port throughput has also shown a sharply narrowing trend. The recovery of the global economy and trade in 2023 still faces a series of risks such as new epidemics, deflation, international trade wars, and supply chain disruptions. In view of this, we must keep an eye on the developments of global ports, analyze the new features and trends in the global port industry, and summarize and promote new concepts, technologies, methodologies and models emerging during port development to support sustainable advancement of the port industry.

This report contains nine chapters. Chapter 1 introduces the macro environments of global ports from the perspective of world economy and trade as well as shipping industry development; Chapter 2 analyzes and summarizes production statuses of global ports in 2021 based on the throughput data; Chapter 3 summarizes new trends of port operation and management; Chapter 4 focuses on analyzing the business performance and investment trend of global terminal operators; Chapter 5 summaries the construction of global terminals and their development trends in 2021; Chapter 6 mainly introduces the latest port intelligence technologies and information technologies as well as green technologies employed by ports; Chapter 7 describes the current developments of global green and ecological ports; Chapter 8 assesses the comprehensive services efficiency of Global container ports; and Chapter 9 forecasts global ports' development focuses and trends in 2022. There are also special topics in various chapters to give thematic analyses and comments on current hotspot issues. Necessary detailed data for the analysis in this report is listed at the end of this report for readers' reference.

The preparation of the *Global Port Development Report (2022)* was supported by Shanghai Maritime University and relevant personnel in the port industry. The report has drawn reference from a large number of relevant literatures at home and abroad, and quoted the points of view of some experts and some data from these literatures. The authors would like to express their appreciation.

Please don't hesitate to inform the authors, if there are any deficiencies or errors in this report. The report is prepared in the hope that it can have referential values for promoting communication and exchange in the global port industry, understanding other ports' development status and formulating ports' development strategy.

Zhao Nan

Deputy Secretary General of SISI

June 2023

# CATALOG

# Chapter 1 Overview of Global Port Development Environment in 2022

## 1.1 Overview of Global Economic Development

### 1.1.1 Global economy resumed slow development

**The year 2022 witnessed frequent international events, and the global economic growth rate fell slightly.** Countries worldwide ended the huge fiscal and tax stimulus policies one after another in 2022, and pressure from the high inflation in developed economies hindered the global economy pickup pace. Furthermore, as the COVID-19 pandemic was put under control with the popularization of vaccines, the contracting labor force and decreasing consumer confidence in the market still produced a lasting impact. In addition, geopolitical conflicts and international trade sanctions continued to alter the energy trade pattern and restrained the development of the European economy, weakening the global economic growth momentum. According to the World Economic Outlook report released by the International Monetary Fund (IMF) in January 2023, the global economic growth rate in 2022 was 3.4%, recording a significant drop compared with the 6.2% high growth rate in 2021 when the accommodative monetary policy played a supporting role. Specifically, the growth rates of advanced economies, and emerging markets and developing economies were 2.7% and 3.9%, respectively.

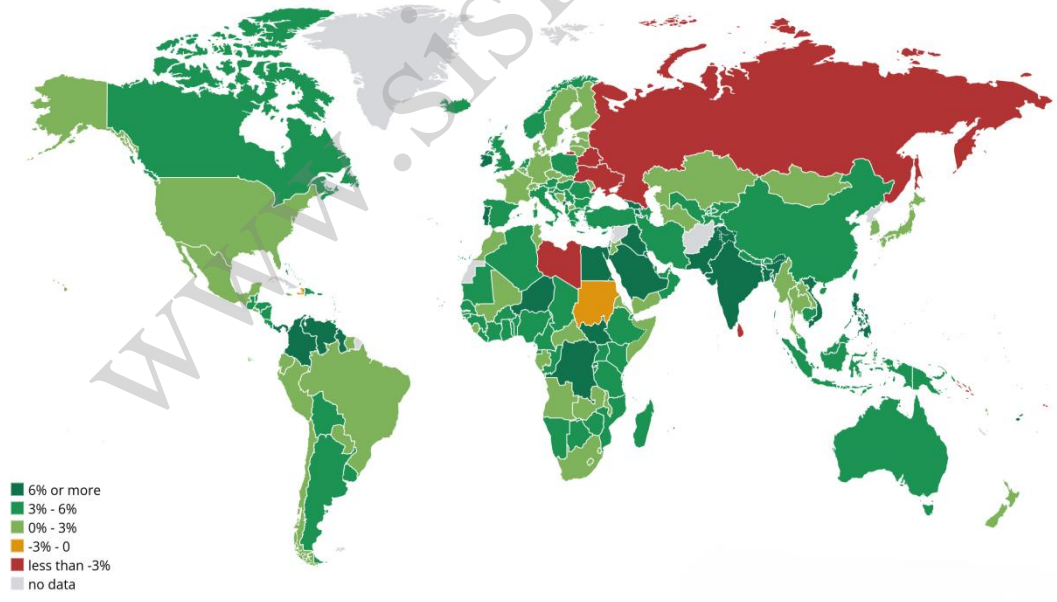
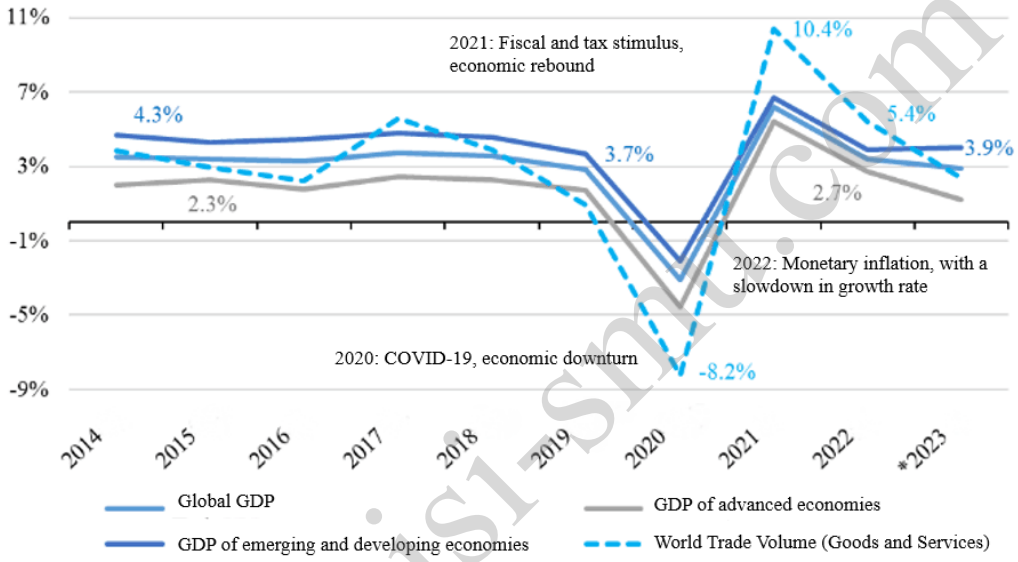



Chart source: International Monetary Fund (IMF), The World Economic Outlook (January 2023)

**Figure 1-1 GDP Growth Rates of Major Global Economies in 2022**

Except Russia, Ukraine, and other Eastern European regions, as well as some African countries such as Libya and Sudan, major economies in the world continued their

economic growth, but the momentum was weakened due to the high inflation and monetary tightening policies. As a result, industrial manufacturing and consumption demand in the market fell sharply. In particular, advanced economies such as Europe and the United States were challenged by labor and energy shortages, with economic growth rates more than halved, significantly undermining global economic growth. In contrast, countries in South Asia and the Middle East, such as India and Saudi Arabia, maintained an economic growth rate of higher than 5%, relying on infrastructure and energy trade. In addition, countries in East Asia and Latin America, such as China, Brazil, and Mexico, also recorded steady growth. Emerging economies have played a positive role in stabilizing the global economy.




Note: * indicates estimates. Source: International Monetary Fund (IMF).

**Figure 1-2 Economic and Trade Volume Growth Rates of Global Major Economies in 2014–2023**

## 1.2 Overview of Global Trade Development

The year 2022 closely followed the global trade pickup, and the growth rate in the year was expected to be stabilized, given the larger base. However, factors such as price hikes which reduced commodity trade, high inflation and tightening policies which dampened consumer demand, and occasional strikes, which interrupted the supply chain, profoundly impacted the trade volume growth slowdown. As a result, according to WTO estimates, the global trade volume increased by 3.5% in 2022, and the growth rate marked a drop of 6.2 percentage points compared with 2021.

**Table 1-1 Global Cargo Trade Volume Growth in 2018–2022**

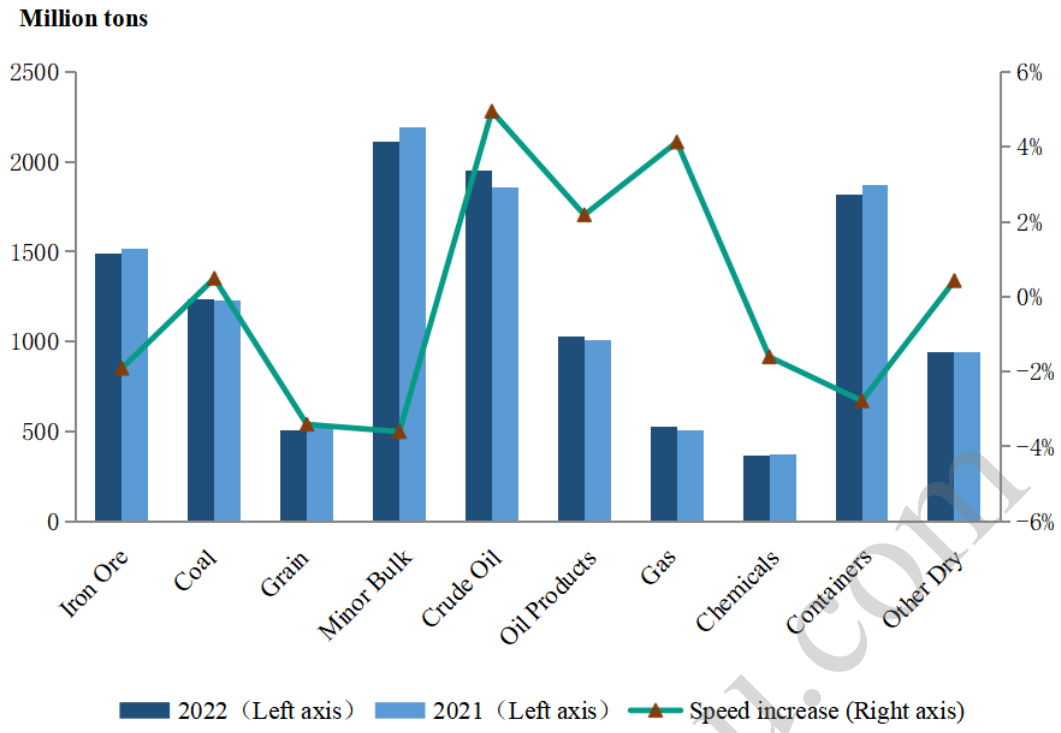
| Area | 2018 | 2019 | 2020 | 2021 | 2022 | Change in percentage points |
|---|---|---|---|---|---|---|
| **World trade volume of goods** | **3.2%** | **0.5%** | **-5.2%** | **9.7%** | **3.5%** | **-6.2** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **export** | North America | 3.9% | 0.4% | -8.9% | 6.5% | 3.4% | -3.1 |
| | Central/South America | 0.6% | -1.3% | -4.9% | 5.6% | 1.6% | -4.0 |
| | Europe | 1.8% | 0.6% | -7.8% | 7.9% | 1.8% | -6.1 |
| | CIS | 4.1% | -0.1% | -1.7% | 0.5% | -5.8% | -6.3 |
| | Africa | 3.2% | -0.4% | -8.1% | 5.2% | 6.0% | 0.8 |
| | the Middle East | 4.8% | -1.3% | -8.9% | 1.4% | 14.6% | 13.2 |
| | Asia | 3.7% | 0.9% | 0.5% | 13.3% | 2.9% | -10.4 |
| **import** | North America | 5.1% | -0.6% | -5.9% | 12.3% | 8.5% | -3.8 |
| | Central/South America | 4.6% | -1.8% | -10.7% | 25.4% | 5.9% | -19.5 |
| | Europe | 1.9% | 0.3% | -7.3% | 8.3% | 5.4% | -2.9 |
| | CIS | 4.0% | 8.3% | -5.5% | 9.1% | -24.7% | -33.8 |
| | Africa | 5.5% | 3.1% | -14.7% | 7.7% | 7.2% | -0.5 |
| | the Middle East | -4.4% | 11.2% | 10.1% | 8.4% | 11.1% | 2.7 |
| | Asia | 5.0% | -0.4% | -1.0% | 11.1% | 0.9% | -10.2 |

Source: World Trade Organization (WTO).

## 1.3 Overview of International Shipping Market Development

In 2022, geopolitical conflicts and surging international commodity prices caused the seaborne trade volume throughout the year to edge down by 0.7% to 11.88 billion tons. Specifically, boosted by the supply tension in the natural gas market and the increased natural gas use in various countries against the rising prices at the beginning of the year, the seaborne trade volume of coal presented a growing trend starting from the second quarter. Meanwhile, under the impacts of deflation in advanced economies and high energy prices, the manufacturing, real estate, and infrastructure demands in various countries weakened, and the iron ore trade tumbled again. The grain trade also declined significantly due to the impeded export from grain-producing countries such as Ukraine. Energy cargoes such as liquefied natural gas and oil products boosted the demand in the international seaborne trade market due to the decreased trade volume through the Russian pipelines.

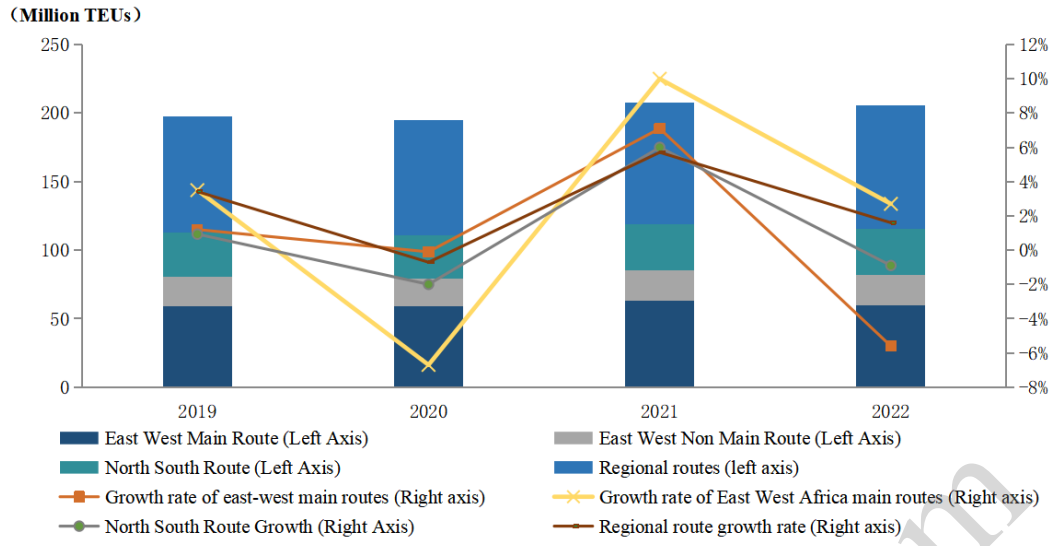



Source: Clarksons, Seaborne Trade Monitor (February 2023).

**Figure 1-3 Global Growth Rates of Seaborne Cargo Shipping Volumes in 2021–2022**

### 1.3.1 Global seaborne container shipping volume shrank slightly

Although the impact of the COVID-19 pandemic on the container supply chain subsided to some extent, and port congestion was greatly alleviated, the international commodity trade demand slowed quarter by quarter. In the second half of the year in particular, European countries saw their energy cost surge, dampening the market consumption demand, and the container trade volume dropped rapidly. In addition, the inflation levels in South America and Africa stayed at a historically high level, which greatly weakened the purchasing power of international commodities. In contrast, the Middle East and India benefited from the huge trade surplus from energy trade, which boosted the commodity consumption and container trade scale. In general, the global seaborne container shipping volume approximated 200 million TEUs, a year-on-year decrease of 3.8%.

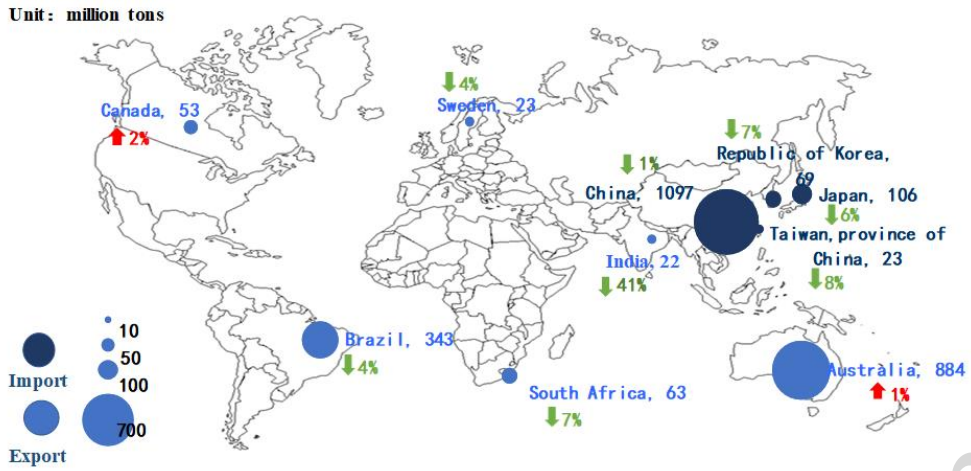



Source: Clarksons, Container Intelligence Quarterly (January 2023).

**Figure 1-4 Global Container Shipping Volumes and Growth Rates on Various Routes in 2019–2022**

## 1.3.2 Global major bulks trade declined to varied degress

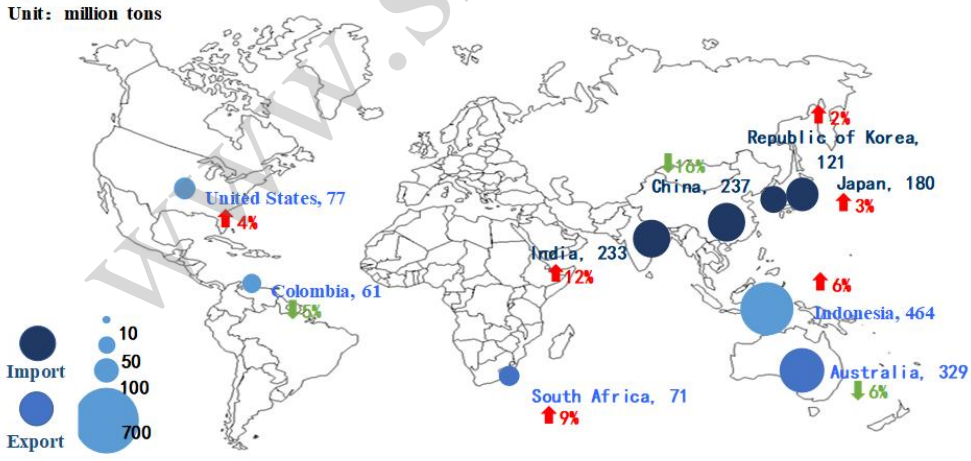
**The decline of the global iron ore trade volume widened.** In 2022, global economic growth slowed, the manufacturing industry prosperity continued to fall, and the overall performance of the seaborne iron ore trade was poor. In terms of demand, the ore demand from manufacturing bases such as China, Japan, and Korea declined significantly. In terms of supply, Australian mining giant Fortescue Metals Group (FMG) increased production at the Eliwana Mine in Pilbara, and the mine projects of "Rio Tinto" and "BHP Billiton" were updated, increasing the Australian iron ore shipments. However, the iron ore production fell below expectations due to the mine labor shortage in Brazil and other countries and the significantly prolonged rainy season compared with previous years. Meanwhile, as the ore demand growth generally slowed, the ore shipments dropped dramatically due to the year-end production surge of Australian mines.




Source: Clarksons.

**Figure 1-5 Global Seaborne Iron Ore Shipping Volumes for Import/Export in 2022**

**The global coal trade volume stayed high.** The global seaborne coal shipping volume in 2022 remained at a high level of 1.22 billion tons. In terms of demand, Europe expanded its coal imports, and Asia augmented the development and use of domestic coal. In contrast, India expanded its imports of coal and other fossil energy sources, with its seaborne shipping volume increasing by more than 12% year-on-year. In terms of supply, South Africa, Indonesia, and the United States all augmented their mining and export efforts. The main coal-producing areas of Australia produced a certain impact on the coal trade due to rainfall, floods, trading partners, and other factors.



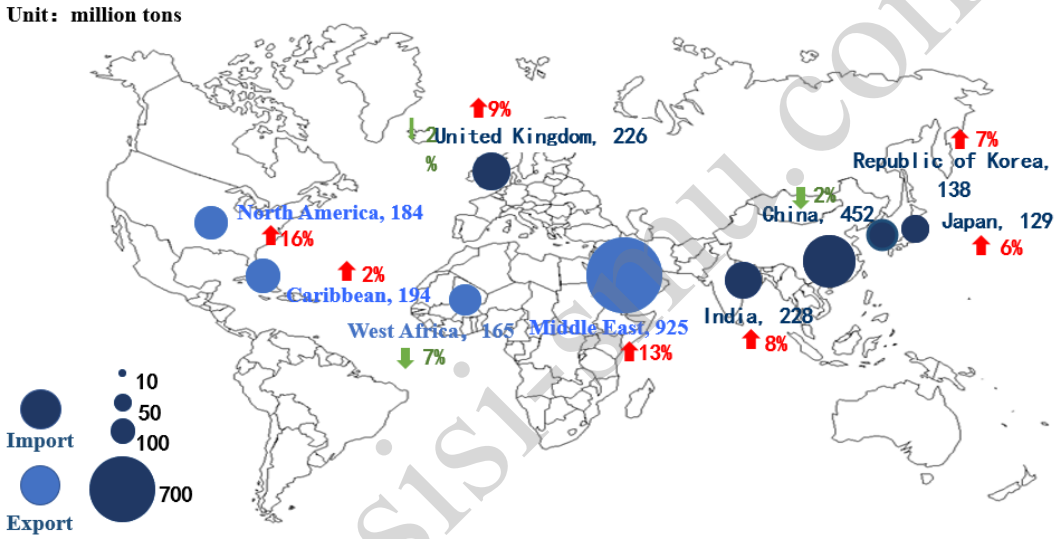

Source: Clarksons.

**Figure 1-6 Global Seaborne Coal Shipping Volumes for Import/Export in 2022**

## 1.3.3 Global liquid bulks market picked up significantly

In 2022, the global oil trade demand picked up quickly. In terms of demand,

international oil prices continued to rise, and the Brent crude oil price once touched USD 128 per barrel at the beginning of the year, which dampened the import demand of emerging market countries. However, Europe actively expanded coal imports, and other countries also used it as a strategic reserve for inventory replenishment. In terms of supply, the geopolitical conflicts caused a slight decline in Russia's oil production. Meanwhile, OPEC+'s production increase plan was poorly implemented, and the new drilling in the United States was slow in entering production, leading to the insufficient supply of international oil in the first half of the year. In the second half of the year, the international oil trade fluctuated upward with the increase in production. Given the favorable trend, OPEC+ announced to tune down the crude oil production quota from November and control the crude oil supply via production trimming, which slightly slowed the oil product trade growth.




Source: Clarksons.

**Figure 1-7 Global Seaborne Crude Oil Shipping Volumes for Import/Export in 2022**

## Special Topic 1: Changes in Global Trade Structure and Seaborne Shipping Network Pattern

The global trade cargo types and flows underwent many changes in the past several decades. In 1980, about 70% of the cargoes in the international trade system were finished products, such as tractors, machine tools, TV sets, and bicycles, primarily transported from the country of origin to the country of consumers. In 2010, about 60% of the global trade value was contributed by intermediate products, primarily raw materials, parts and components, and others, with the remaining 40% being finished products. In 2020, more than 70% of the global trade volume was from raw materials or intermediate products, with the remaining 30% from the service trade. Globally

traded cargoes were no longer independently produced by companies based in one country or region. A single product may relate to multiple countries, dozens of companies, and hundreds of parts and components. For example, the localization rate of China's semiconductor chips in recent years is only 16.7%. Southeast Asia, a North American foundry, had more than 35% of its raw materials and intermediate products from China. Industrial nesting has contributed to the current global commodity trade pattern.

## 1. Trade value increase far higher than cargo volume increase due to the pandemic and inflation

The trade prices of international commodities hiked in 2022 due to the combined effects of the production contraction and currency inflation in the "post-pandemic era" and the energy and food crisis following the geopolitical conflicts. As a result, the global trade value hit a historical high of USD 32 trillion, which also restrained the trade volume growth. According to statistics from the United Nations Conference on Trade and Development (UNCTAD), the global cargo trade value in 2022 rose by more than 30% over 2019, but the actual trade volume rose by less than 10%. The soaring price of energy commodities was a major reason. Specifically, the prices of imported crude oil, natural gas, and coal in Asia rose by as much as 43%, 39%, and 30%, respectively (valued in US dollars). In addition, the prices of natural gas and other energy sources in Europe rose by as high as more than 2.7 times, while the prices of corn, soybeans, wheat, and other grain crops also rose to varying degrees, jointly pushing up the annual trade value.

In terms of cargo volume, Europe's rigid demand for natural gas, crude oil, coal, and other bulk cargoes during the energy crisis fueled the continuous trade volume growth, but the demands for ore, steel, and other infrastructure materials and manufacturing raw materials fell in both cargo volume and price. Despite the fact that a higher energy cost can boost the trade value in the short term, the high cost may dampen the long-term growth trend of trade value. According to the World Trade Organization (WTO) forecast, the global commodity trade growth will slow down significantly in 2023 due to the surging energy costs and interest rates, which weaken household demand, and the import and export trade value may grow by only 1%.

## 2. Higher stickiness of industries in the region expanded trade with neighboring regions

In recent years, global trade has demonstrated an intensified regionalization trend. Especially under the impacts of emergencies such as the COVID-19 pandemic and geopolitical conflicts, the supply chain and industrial chain of the global production network have suffered a breakdown, suspension, and dramatic reduction, dealing a heavy blow to the industries deeply involved in global division of labor, high industrial complexity, long supply chains, and dependence on the global logistics network. As a result, the world is accelerating the establishment of three major regional production network systems in East Asia, Europe, and North America, respectively, bringing a

closer industrial chain and increasing the trade dependence in the region faster. According to the UNCTAD data, about 56% of the foreign trade in the Asian region occurs within the region, while the intra-region trade proportion in Europe reaches 68%.

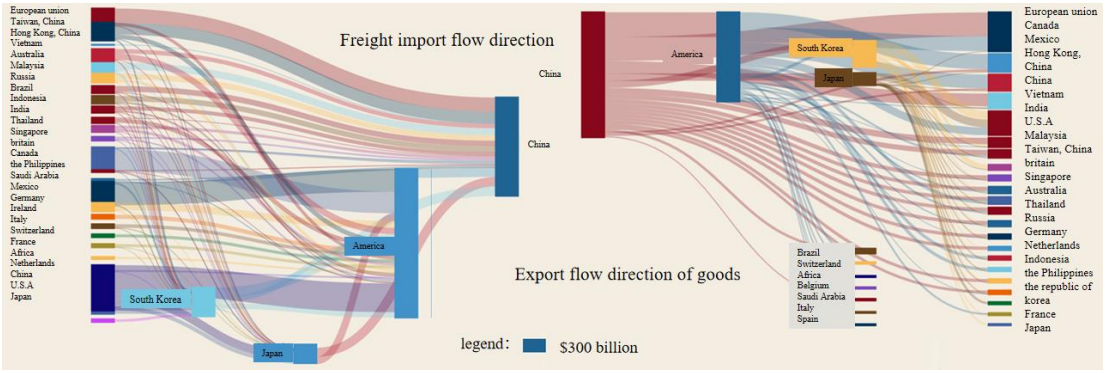
Take the world's largest bilateral commodity trade as an example. Although China remained the largest commodity importer of the United States in 2022, the growth rate was only 6.3%, far lower than that of the U.S. neighboring Mexico and Canada. Meanwhile, the three goals (bringing manufacturing back to the United States, nearshore outsourcing, and diversification in China) that the United States adhered to for reshaping the global industrial chain are gradually changing the global industrial chain division of labor. In terms of the import flow, nearshore outsourcing in the United States is the top choice. Second, more inter-regional trade demands are shifting to Vietnam, Korea, India, and Chinese Taiwan. In terms of the export flow, the United States is strengthening trade with its North American neighbors through the United States–Mexico–Canada Agreement (USMCA) and actively launching the Free Trade Area of the Americas (FTAA) plan to build a new nearshore supply chain relying on Central and South American countries.

**3. Great power politics will have a lasting effect on the trading system**

In addition to economic recession and the trade pressure from neighboring countries, the supply chain shifts brought about by great power politics and geopolitics will also have a lasting effect on global trade flows and directions. The global economic and trade landscape is rapidly changing. With the continued military conflicts in Ukraine and the political and economic frictions between Western countries and China, the low risk premium brought about by the globalization heyday has been completely changed. "Supply chain risk" is becoming a strategic concern of many countries and multinational companies. Their countermeasures include supplier diversification, localization, nearshoring, and "friendly-shore" production. This will entail restructured industrial chains, value chains, and supply chains on a global scale, and the global trade routes and supply chains will be reshaped along geopolitical and political lines.

**4. The international multilateral trade pattern is unassailable in the short term**

Although reverse globalization has restructured the traditional international trade network, transforming international relations from multilateral to bilateral ones, the current multilateral trade landscape cannot be changed over by the neighboring layout and politicized trade in the short term considering the different international industrial divisions of labor and resource reserves. Even though European and American countries are worried about supply chain security, most labor-intensive industries remain in Asia due to cost constraints such as technology, labor, energy, and the environment. Moreover, only part of the industries gained speed in shifting from East Asia to Southeast Asian countries featuring a lower labor cost and a smaller international influence.




Source: Customs of various countries.

**Figure 1 Sankey Diagram of Global Cargo Trade Flows (by amount)**

## 5. The economic transformation of various countries accelerated the global trade pattern transition

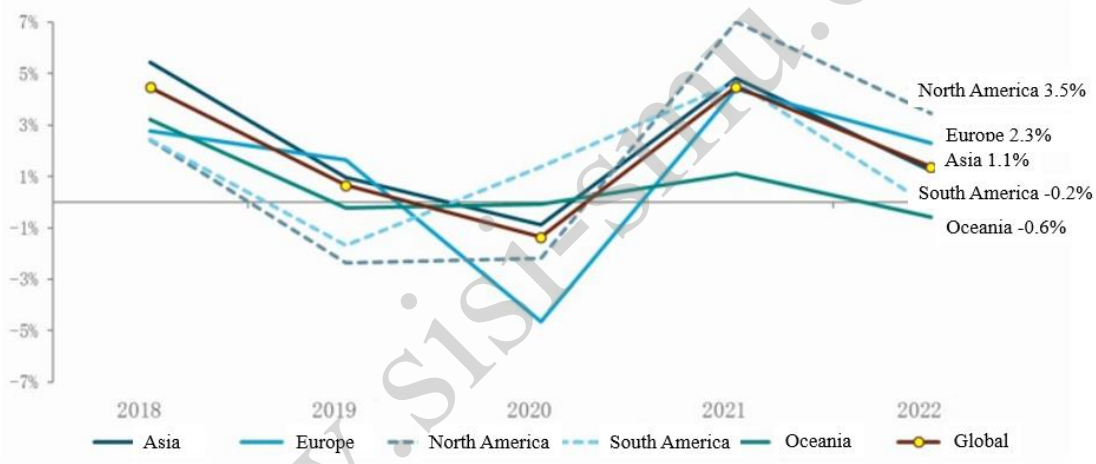
With the escalating requirements for ecological protection and low-carbon development, global economic and trade patterns are changing faster. Currently, 136 countries worldwide have made "carbon neutral" commitments, covering 88% of the world's carbon dioxide emissions, 90% of GDP, and 85% of the population. Specifically, the European Union took the lead in releasing a new growth strategy, "Green New Deal for Europe", in 2019, aiming to decouple economic growth from resource consumption. The Japanese government released the "Green Growth Strategy Through Achieving Carbon Neutrality in 2050" in 2020, investing USD 15 billion to promote eco-friendly business models. The United States released in 2021 the "Long-Term Strategy Towards Net Zero Emissions by 2050" to accelerate investment in clean electricity and promote industrial transformation. Meanwhile, the Chinese government also increased the carbon emission intensity reduction target for 2030 (based on the 2005 level) from the original 60%–65% to more than 65%. As a result, the economic and industrial structures of various countries will quickly transform toward a low-carbon one, with the demands for iron ore, coal, and other cargo types and energy trade slashed.

# Chapter 2 Overview of Global Port Production in 2022

## 2.1 Overview of Global Port Throughputs

### 2.1.1 Overview of global port cargo throughputs

In 2022, the cargo throughput of the world's major ports[1] increased by 1.4% year-on-year, a decrease of 3.1 percentage points compared with 2021, showing a general slowdown trend. Specifically, the international prices of bulk commodities soared in the first half of the year, and the trade scales of coal mines and oil products contracted. In the second half of the year, monetary tightening policies were strengthened, and exchange rates continued to fluctuate, affecting the global seaborne trade demands. Region-specific, except ports in Oceania and South America which recorded declining throughput values, ports in other continents registered narrower growth rates to varying degrees.




Source: Official websites of ports, prepared by SISI.

**Figure 2-1 Cargo Throughput Growth Rates of Major Global and Regional Ports in 2018–2022**

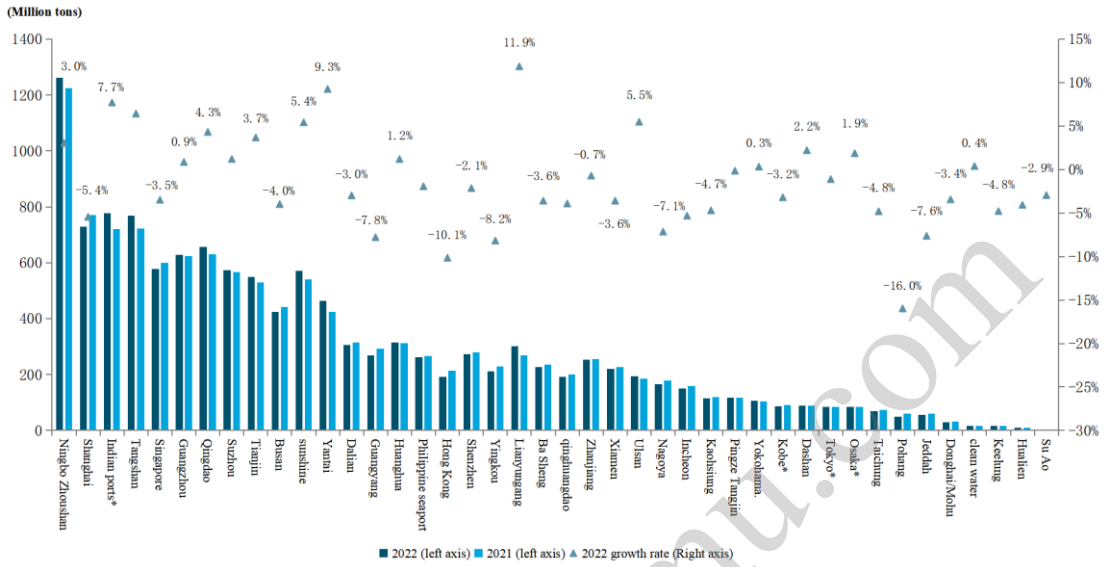
### 2.1.2 Cargo throughput analysis of ports by region

#### (1) Asian ports continued to record slower growth

In 2022, the cargo throughput growth rates of major Asian ports significantly decreased.

[1] Major global ports refer to the ports with statistical data available in the SISI's Global Port Development Report, including major cargo ports in the world. The data can reflect the trade growth trend at global ports. Comparing the statistics by the United Nations and the World Bank and Clarksons analysis of international maritime trade data, the port throughput (totaling about 25.3 billion tons) covered in this report accounted for about 70% of the global total throughput of coastal ports. For more information of specific ports, see the attachment.

Specifically, the manufacturing industry in Southeast Asia is largely dependent on developed countries such as Europe, America, Japan, and Korea. With the declining demands for consumption and OEM in the European and American markets, the cargo throughputs of Southeast Asian ports also fell. Against this backdrop, the throughput of major Asian ports[2] increased by 0.9% in 2022.




Source: Official websites of ports, prepared by SISI. Note: * indicates estimates.

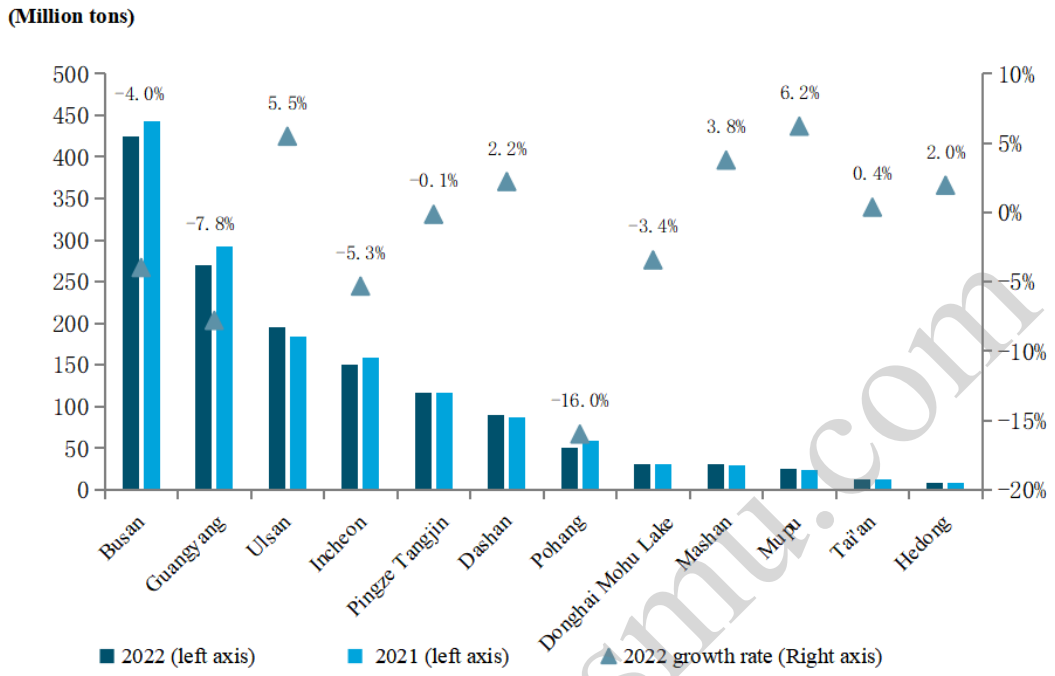
**Figure 2-2 Cargo Throughputs and Growth Rates of Major Asian Ports in 2021–2022**

**More than 30% of ports in Mainland China registered a falling throughput.** In 2022, ports in Mainland China recorded differentiated performance in cargo throughput, and the growth rates of ports in northern China were slightly better than those in southern China. After the outbreak of military conflicts in Ukraine, coal and ore throughputs of ports in northern China, such as the Bohai Bay Rim, increased, while those of most ports in southern China declined due to the foreign trade slump. The government introduced a series of tax cut measures, but the sluggish foreign trade continued to lead to cargo volume declines. Besides, the real estate investment slowdown and lack of confidence in the consumer market adversely affected the port throughput growth.

**Korean port throughputs dropped slightly.** In 2022, Korean ports recorded relatively sluggish performance, with their throughput growth rates turning negative from positive. On the one hand, the higher international raw material prices and the slowed infrastructure demand growth reduced the ore imports. Moreover, the export market for semiconductors and other electronic equipment slumped, further cutting the trade demand. On the other hand, the rising fuel prices and the less-than-expected inflation

[2] Major Asian ports refer to the ports covered in the SISI's Global Port Development Report. For specific ports, see the attached table. The statistical methods of major ports in other regions are the same.

curb and salary increases caused two serious collective strikes by truck drivers at ports in the third quarter, suspending the Port of Busan and the Port of Gwangyang operations. In addition, the logistics supply chain interruptions resulted in a sharp drop in container throughput at Korean ports.




Source: Official websites of ports, prepared by SISI.

**Figure 2-3 Cargo Throughputs and Growth Rates of Major Korean Ports in 2021–2022**

**The throughputs of Southeast Asian ports dropped slightly.** Ukraine is a major exporter of grain, wheat, and related agricultural products to Southeast Asia. However, the outbreak of the military conflicts in Ukraine dramatically cut the wheat exports to Indonesia and the Philippines, and the corn trade with Vietnam was interrupted. Subject to the impact of the decreased trade between China and Europe, Singapore, Kelang, and Tanjung Pelepas, among other international transit hub ports on the Eurasian routes, met with challenges, with port throughput falling to varying degrees. In comparison, Vietnam was impacted by the falling OEM product trade volumes from the European and American markets. However, its port throughput nationwide recorded a higher growth rate of 4.3%, benefiting from the Regional Comprehensive Economic Partnership (RCEP), which strengthened economic and trade cooperation with countries in the region and Vietnam's vigorous efforts in attracting foreign direct investment.

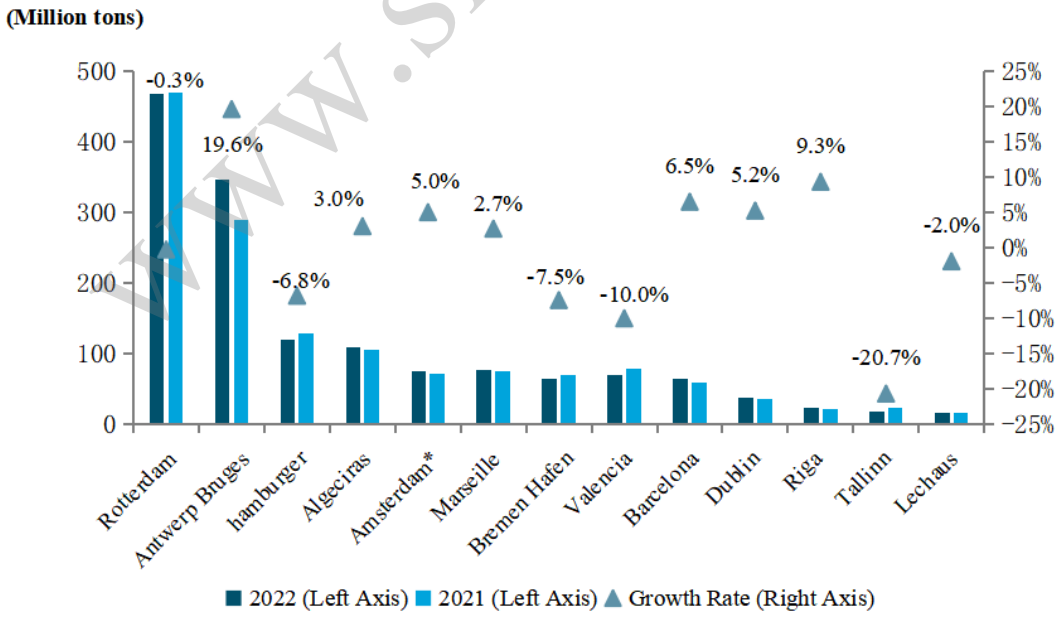
**Table 2-1 Cargo Throughputs and Growth Rates of Major Southeast Asian Countries in 2019–2022 (Unit: 10,000 tons)**

| Country | 2019 | 2020 | 2021 | 2022 | 2021 growth rate | 2022 growth rate |
|---|---|---|---|---|---|---|
| the Philippines | 26642 | 24399 | 26676 | 26162 | 9.3% | -1.9% |
| Malaysia | 59524 | 56584 | 59034 | 56677 | 4.3% | -4.0% |
| Vietnam | 72503 | 75523 | 76695 | 79983 | 1.6% | 4.3% |
| Singapore | 62652 | 59074 | 59964 | 57819 | 1.5% | -3.6% |

Source: Official websites of ports, prepared by SISI.

### (2) Growth of European ports fell slightly

The high inflation and energy crisis pushed the European economy to the brink of a "moderate recession" in 2022. Large northern European ports such as the Port of Rotterdam, the Port of Bruges in Antwerp, the Port of Hamburg, and the Port of Amsterdam, and southern European ports such as the Port of Valencia and the Port of Barcelona all recorded negative growth. Specifically, the Port of Antwerp and the Port of Bruges merged to maintain a throughput growth rate of about 20%. The European economic and trade downturn has caused a huge impact on the port industry. In addition, after "Brexit", short-distance feeder trade volume in the European Union decreased, and more routes became concentrated in large and medium-sized hub ports. Small and medium-sized ports such as the Port of Leixoes, the Port of Tallinn, and the Port of Klaipėda posted even poorer performance, with a weak trade demand for construction materials and other products and the commodity import trade tending to stagnate. As a result, most ports were experiencing widened declines.

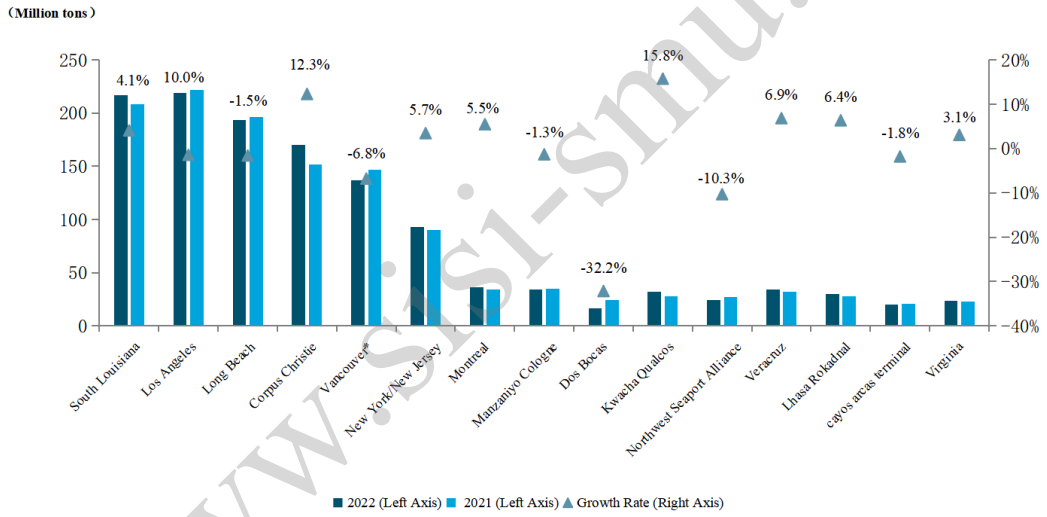



Source: Official websites of ports, prepared by SISI. Note: * indicates estimates.

**Figure 2-4 Cargo Throughputs and Growth Rates of Major European Ports in 2021–2022**

### (3) North American ports recorded significant growth

Based on the data in recent years, the throughput growth rates of North American ports continued to shrink but remained favorable. Port-specific, the US East ports and the Gulf of Mexico that support trade with Europe developed fast. Ports such as the Port of New York-New Jersey, Port of Savannah, and Port of Virginia all presented growth, while ports serving grain and energy trade such as Port of Houston, Port of South Louisiana, and Port of Corpus Christi posted even more significant growth, with some ports growing by more than 10% in throughput. The Port of South Louisiana purchased the logistics facilities (covering 254 acres) of the former shipbuilding site on its east, and the warehouses can now be directly connected to rivers, highways, and railways, further improving the logistic efficiency of the port. Meanwhile, the Port of Halifax in Canada also leveraged the joint operations center to carry out the container freight business and introduced post-Panamax lifting equipment to enhance trade logistics efficiency with neighboring regions. The Port of Montreal earmarked about CAD 335 million for port infrastructure construction and set up a green shipping corridor, which increased the cargo volume of inland river shipping by 5.5% year-on-year.



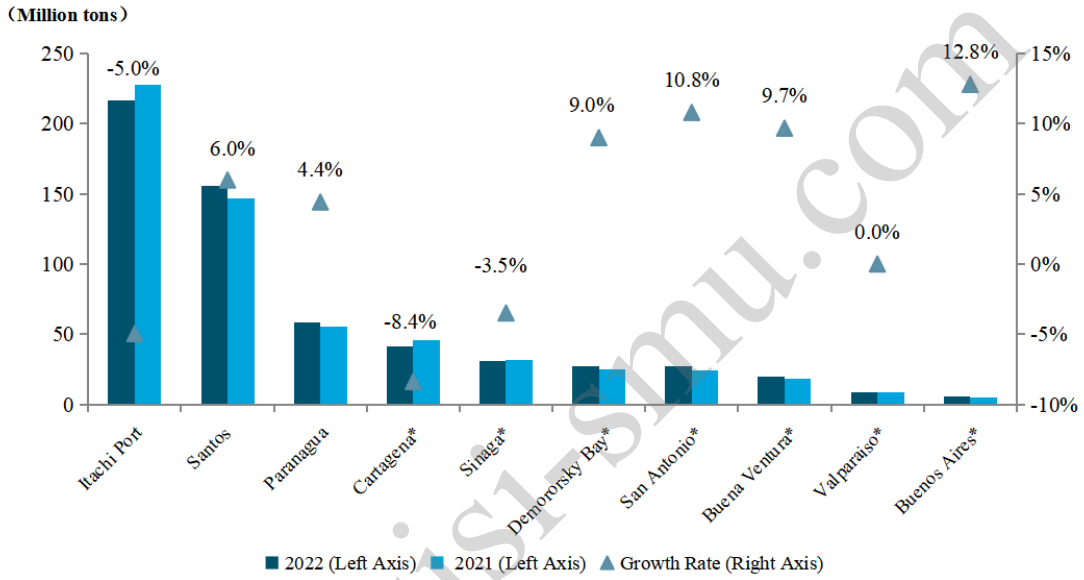

Source: Official websites of ports, prepared by SISI. Note: * indicates estimates.

**Figure 2-5 Cargo Throughputs and Growth Rates of Major North American Ports in 2021–2022**

### (4) Cargo volume growth at South American ports at a standstill

With the high inflation increasing in 2022, South American countries faced intensified economic risks, and their trade demand shrank sharply. As a result, according to the WTO statistics, the import trade volume growth dropped from 25.4% in 2021 to 5.9%. Moreover, after implementing the monetary tightening policy, South American countries witnessed a sluggish consumer market and international commodity import demand. Meanwhile, the relatively backward conditions, the impact of the COVID-19 pandemic, and the severe weather, such as hurricanes and droughts in some areas, jointly led to a strong imbalance among South American ports.

Specifically, Brazil's iron ore export volume plummeted due to the surging international bulk commodity prices and the crude steel production trimming plans in China, Japan, Korea, and other countries. The throughput of the Port of Itaqui, its main trading port, dropped by as much as 5%. The Port of Buenos Aires in Argentina recorded a throughput growth rate of 12.8%, driven by exports of primary products, agricultural products, and industrial manufacturing which amounted to more than USD 100 billion. The Port of Cienaga and the Port of Cartagena in Colombia recorded declined throughput due to a shortage of labor and transport vehicles. DP World continued to strengthen investment in port infrastructure, such as Port of Santos in Brazil, striving to expand the business size on the left bank to maintain stable port throughput growth.




Source: Official websites of ports, prepared by SISI. Note: * indicates estimates.

**Figure 2-6 Cargo Throughputs and Growth Rates of Major South American Ports in 2021–2022**

## 2.2 Overview of Container Shipping Throughput of Global Ports

### 2.2.1 Overview of global port container throughputs

With the COVID-pandemic effect weakened and the supply chain interruption alleviated, various countries withdrew consumption stimulus policies in 2022, and the global commodity trade demand was satisfied to a large extent. However, the deflationary policies to balance the economy and the anti-globalization trade pattern produced a lasting effect on the container throughput growth of global ports.

### 2.2.2 Container throughput analysis of ports by region

The container throughput of most intercontinental ports suffered dismal growth or negative growth in 2022. Specifically, the container volume at ports in Europe, Africa, and Latin America dropped by more than 2%. Based on a larger base of Chinese ports,

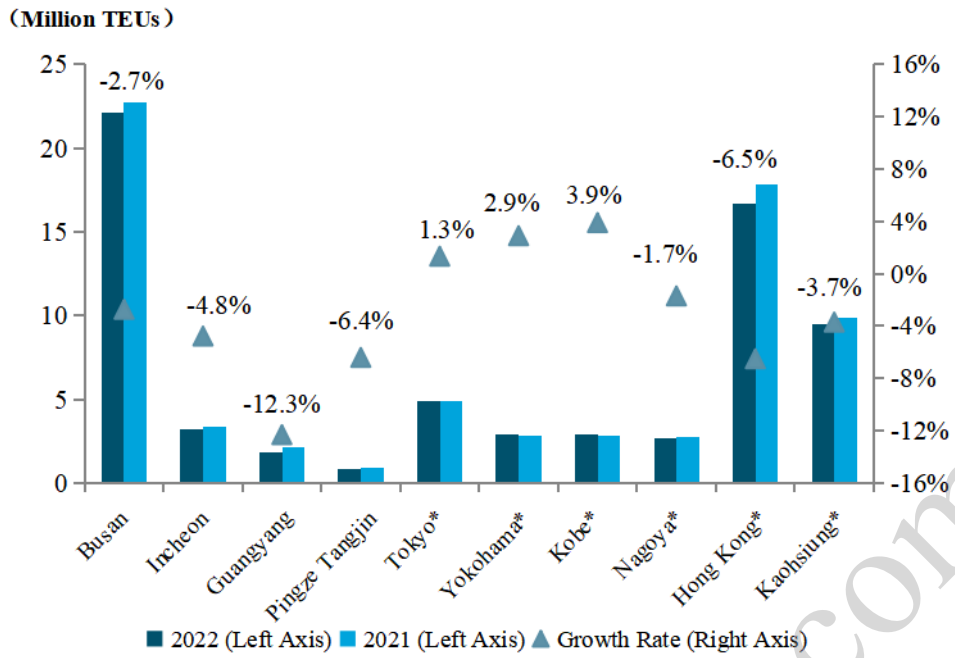
the Asian region maintained a stable growth rate of 1.7% overall, followed by North American ports with a growth rate of about 0.9%, while European and Latin American ports all registered negative growth in container throughput.

**(1) Container throughput of Asian ports grew steadily**

Asian ports recorded a cumulative container throughput of 464.47 million TEUs in 2022, a year-on-year increase of 0.2% only. Specifically, the sluggish demand in European and American consumer markets affected the East Asian container trade represented by China, Japan, and Korea and produced an adverse effect on Southeast Asian processing and manufacturing industries, such as in Vietnam. In particular, the cargo shipping demand on Eurasian routes fell, reducing the container volumes at international transhipment hubs such as the Port of Singapore and Port of Kelang.

**The container throughput growth of Mainland China ports edged down.** Ports in Mainland China recorded a total container throughput of 296 million TEUs in 2022, a year-on-year increase of 4.7%, a slight drop compared with the 7.0% growth rate in the previous year. As free trade agreements such as RCEP entered into effect, container trade between ports in China and other areas in the region became more frequent. Meanwhile, China vigorously promoted the "bulks-to-container coal transport" from northern to southern areas and container transport for domestic trade, ensuring the continued positive growth of container throughput at Chinese ports.

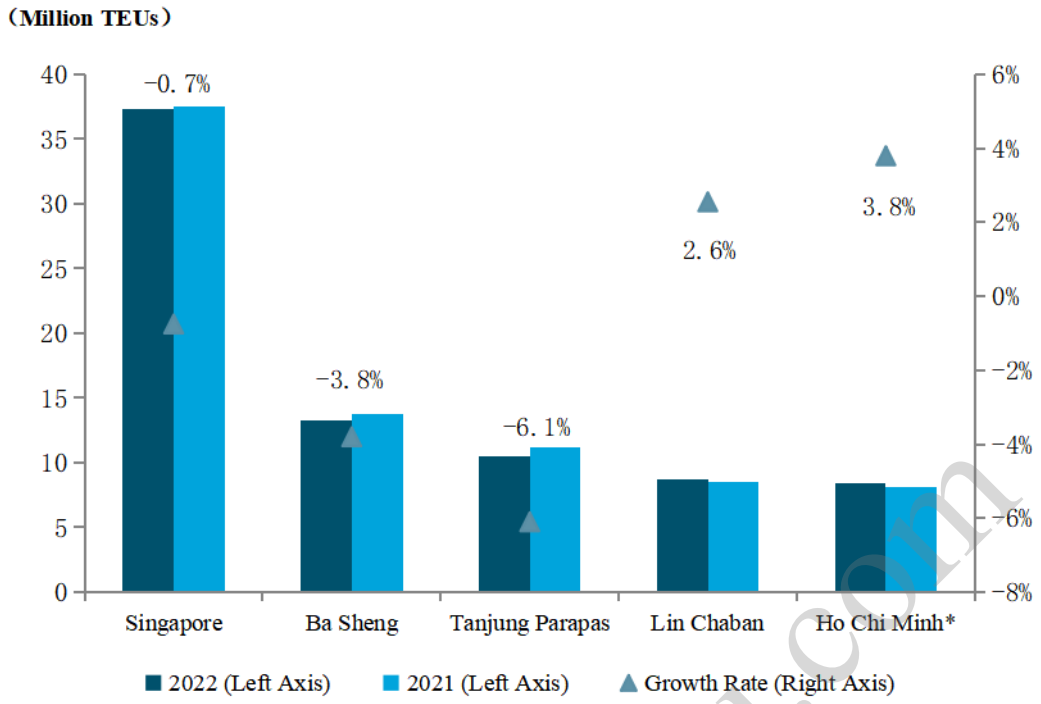
**Most other ports in East Asia posted a declining container throughput.** Korean ports had reduced cargo sources for import and export due to the reduced trade demand for commodities such as auto parts, fossil products, and semiconductors. Ports such as the Port of Busan were also impacted by the shrinking trade between China and the United States in the second half of the year, as shown in their transhipment throughputs. The Port of Tokyo, Port of Yokohama, Port of Kobe, and other ports in Japan posted steady performance due to the local import and export trade growth. Besides, the Japanese government well controlled its domestic inflation, preventing large fluctuations in economic and trade performance.




Source: Official websites of ports, prepared by SISI. Note: * indicates estimates.

**Table 2-7 Container Throughputs and Growth Rates of Other Major East Asian Ports in 2021–2022**

**Container throughput of Southeast Asian ports dipped again.** Due to the diminishing consumption power of European and American sales companies and the resulting weak consumer market, Southeast Asian ports posted negative growth again in 2022. In terms of industrial structure, China, Japan, Korea, and other countries couldn't fully take in the excess production capacity and products in Southeast Asia in the short to medium term, and regional container trade still needed to grow. Port-specific, the Port of Kelang and the Port of Tanjung Pelepas in Malaysia recorded a growth rate of -3.8% and -6.1%, respectively, due to insufficient supply of transhipment cargoes on Eurasian routes. The container throughput of the Port of Tanjung Priok in Indonesia fell by more than 14% due to the lower domestic trade demand. The tourism industry in Thailand came to a standstill. The country also actively introduced policies to address the insufficient container supply and encouraged trade of medical products, maintaining a steady container throughput growth rate of the Port of Laem Chabang at 2.6%. Relying on the scale effect of industrial bases, Vietnam gathered similar industries in its surrounding areas to its domestic market and maintained stable trade exchanges with European and American countries. Its hub ports, such as the Port of Hochiminh and Port of Haiphong, maintained slight growth, with the overall growth rate of Vietnam's seaports at about 3%.

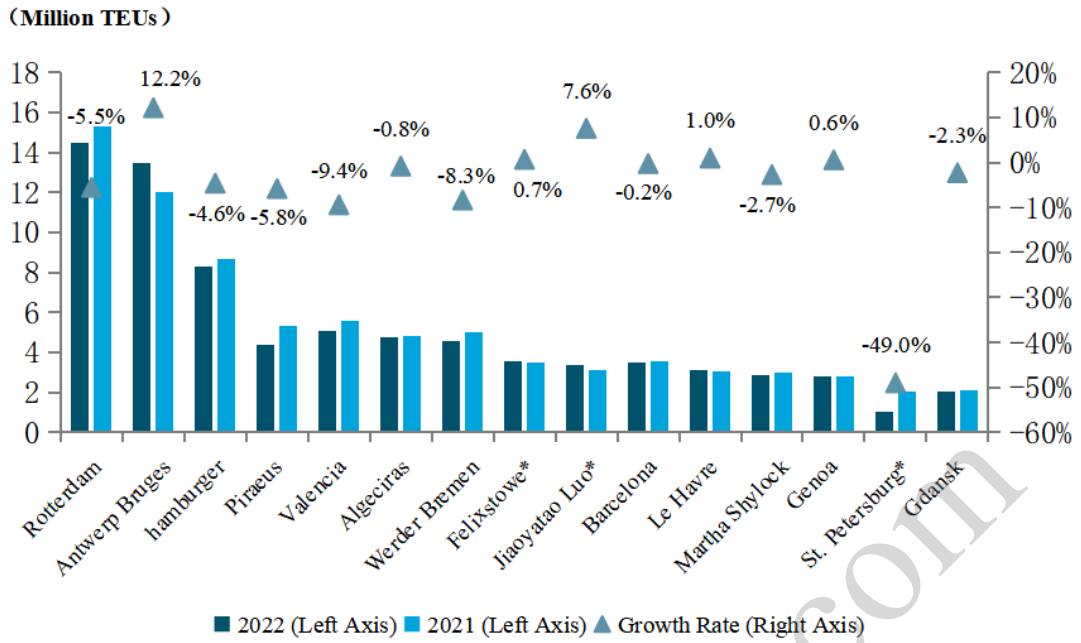



Source: Official websites of ports, prepared by SISI. Note: * indicates estimates.

**Table 2-8 Container Throughputs and Growth Rates of Major Southeast Asian Ports in 2021–2022**

### (2) European ports experienced a bigger slump in container throughput

The manufacturing industry in Europe came to a standstill due to the surging energy costs, and the trade demand for raw materials and finished products fell as a result at European ports. Furthermore, under high inflation, the European consumer market was sluggish, traders had high inventories, and residents had fewer expenditures in other areas due to rising living costs. All these factors curbed the overall demand for merchandise trade in the region, and the container volumes at ports also slumped.



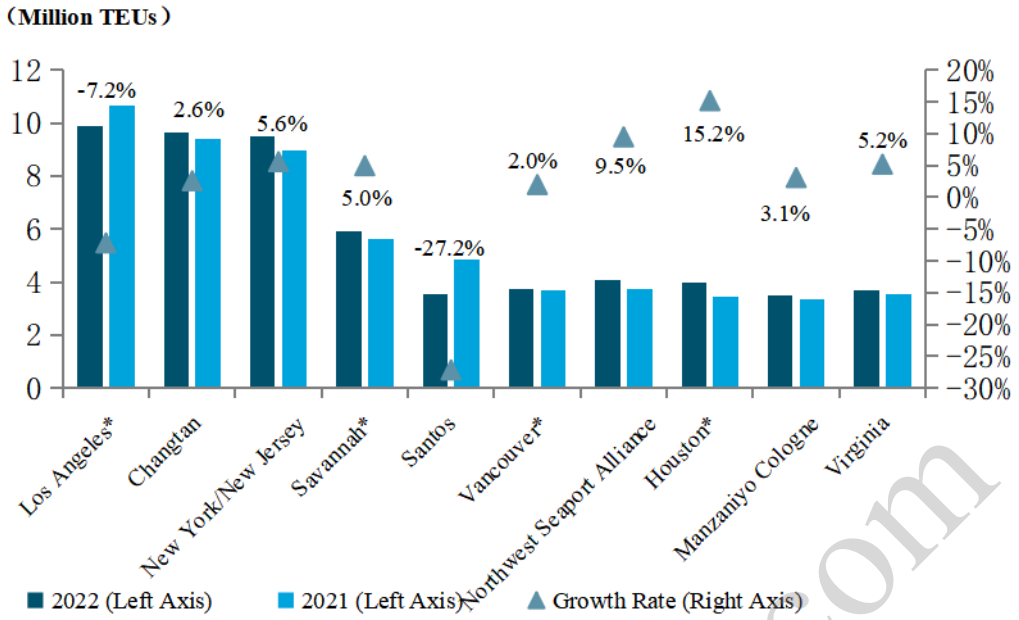

Source: Official websites of ports, prepared by SISI. Note: * indicates estimates.

**Figure 2-9 Container Throughputs and Growth Rates of 15 Major Ports in Europe in 2021–2022**

### (3) American ports stagnated in container throughput

More than 50% of the ports in the Americas recorded a container throughput decline in 2022. The Latin American consumer market had a lower demand, and the economic and trade environment hindered the container throughput growth at ports. As a result, most ports in Brazil, Colombia, Chile, and other countries registered negative growth. In addition, ports experienced congestion due to adverse weather and public security hazards in some areas, with the annual decrease rate exceeding 2.7%.

The container throughputs of the Northwest Seaport Alliance (NWSA), the Port of Los Angeles, the Port of Long Beach, and other ports fell to varying degrees in 2022. Uncertainties remained in labor wage negotiations of ports in the US West, and the growth potential of the US West ports may be compromised in short to medium term. On the other hand, clouded by the trade politicization tendency, the United States may further strengthen its trade exchanges with the European market. Besides, the initiative of trade with neighboring regions also boosted the port development on the eastern coast, while the US East ports were expected to maintain steady growth.




Source: Official websites of ports, prepared by SISI. Note: * indicates estimates.

**Figure 2-10 Container Throughputs and Growth Rates of 10 Major Ports in the Americas in 2021–2022**

### (4) African ports' container throughputs declined slightly

Against the sluggish global economic and trade performance in 2022, the container throughput of African ports declined slightly. Africa features relatively backward infrastructure and sanitation conditions, with low vaccination coverage, and industrial development and logistics capabilities during the pandemic outbreaks were all curbed to a certain extent. Meanwhile, Western countries continued raising interest rates to attract capital backflow, undermining Africa's infrastructure and trade development. In addition, with the ship type changes of liner companies, African port facilities can no longer fully meet the berthing needs of large container ships, resulting in a decline in the container throughputs at African ports. In 2022, the container throughput of African ports dropped by 2.1%, second only to Europe and Latin America. Specifically, the container throughput of the Port of Durban declined by more than 3.3%.

## Special Topic 2: Rankings of the World's Top 100 Container Ports and Top 50 Cargo Ports

The global economy and trade gradually got rid of the impact of the pandemic in 2022. However, the high inflation after the introduction of fiscal and tax stimulus policies in various countries, as well as the subsequent deflation and sluggish consumer market, jointly produced a negative effect on maritime trade. Additionally, geopolitical conflicts

and trade politicization also played a part in further elevating the global energy and grain prices, polarizing the global economic and trade landscape, and slashing the growth potential of the port freight market. According to statistics, the top 100 container ports, which accounted for about 80.5% of the global container market share, recorded a total container throughput of 689 million TEUs in 2022, a year-on-year increase of 1.1% from 7.2% in 2021. The world's 50 largest ports completed a cargo throughput of 16.73 billion tons, with the growth rate also dropping from 4.1% in 2021 to 1.3%.

**Table 1 Rankings of global top 50 ports in terms of cargo throughput in 2022**

| 2021 Ranking | 2022 Ranking | Ranking: 2022 (2021) | | Country of origin | Port | 2020年 (10,000t) | 2021年 (10,000t) | 2022 (10,000t) | 2021 growth rate | 2022 growth rate |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 (1) | 0 | China | Ningbo-Zhoushan | 117240 | 122405 | 126134 | 4.4% | 3.0% |
| 3 | 2 | 2 (3) | 1 | China | Tangshan | 70260 | 72240 | 76887 | 2.8% | 6.4% |
| 2 | 3 | 3 (2) | -1 | China | Shanghai | 71104 | 76970 | 72777 | 8.2% | -5.4% |
| 4 | 4 | 4 (4) | 0 | China | Qingdao | 60459 | 63029 | 65754 | 4.3% | 4.3% |
| 5 | 5 | 5 (5) | 0 | China | Guangzhou | 61239 | 62367 | 65592 | 1.8% | 5.2% |
| 6 | 6 | 6 (6) | 0 | Singapore | Singapore | 59074 | 59964 | 57819 | 1.5% | -3.6% |
| 7 | 7 | 7 (7) | 0 | China | Suzhou | 55408 | 56590 | 57276 | 2.1% | 1.2% |
| 9 | 8 | 8 (9) | 1 | China | Rizhao | 49615 | 54117 | 57057 | 9.1% | 5.4% |
| 8 | 9 | 9 (8) | -1 | Australia | Hedland | 54705 | 55327 | 56621 | 1.1% | 2.3% |
| 10 | 10 | 10 (10) | 0 | China | Tianjin | 50290 | 52954 | 54902 | 5.3% | 3.7% |
| 11 | 11 | 11 (11) | 0 | The Netherlands | Rotterdam | 43681 | 46871 | 46739 | 7.3% | -0.3% |
| 13 | 12 | 12 (13) | 1 | China | Yantai | 39935 | 42337 | 46257 | 6.0% | 9.3% |
| 12 | 13 | 13 (12) | -1 | South Korea | Busan | 41120 | 44280 | 42492 | 7.7% | -4.0% |
| 14 | 14 | 14 (14) | 0 | China | Beibu Gulf | 29567 | 35822 | 37134 | 21.2% | 3.7% |
| 15 | 15 | 15 (15) | 0 | China | Taizhou | 30111 | 35291 | 36444 | 17.2% | 3.3% |
| 16 | 16 | 16 (16) | 0 | China | Jiangyin | 24705 | 33757 | 35062 | 36.6% | 3.9% |
| 18 | 17 | 17 (18) | 1 | China | Huanghua | 30125 | 31134 | 31510 | 3.3% | 1.2% |
| 17 | 18 | 18 (17) | -1 | China | Dalian | 33401 | 31553 | 30613 | -5.5% | -3.0% |
| 22 | 19 | 19 (22) | 3 | China | Fuzhou | 24897 | 27352 | 30164 | 9.9% | 10.3% |
| 23 | 20 | 20 (23) | 3 | China | Lianyungang | 24182 | 26918 | 30111 | 11.3% | 11.9% |
| 25 | 21 | 21 (25) | 4 | United States | Houston * | 25038 | 25789 | 29735 | 3.0% | 15.3% |
| 27 | 22 | 22 (27) | 5 | Belgium | Antwerp Bruges | 23097 | 23978 | 28686 | 3.8% | 19.6% |
| 19 | 23 | 23 (19) | -4 | China | Nantong | 31014 | 30851 | 28508 | -0.5% | -7.6% |
| 21 | 24 | 24 (21) | -3 | China | Shenzhen | 26506 | 27838 | 27243 | 5.0% | -2.1% |
| 24 | 25 | 25 (24) | -1 | China | Nanjing | 25112 | 26855 | 27155 | 6.9% | 1.1% |
| 20 | 26 | 26 (20) | -6 | South Korea | Gwangyang | 27332 | 29206 | 26932 | 6.9% | -7.8% |
| 26 | 27 | 27 (26) | -1 | China | Zhanjiang | 23391 | 25555 | 25376 | 9.3% | -0.7% |
| 28 | 28 | 28 (28) | 0 | Malaysia | Klang | 22302 | 23786 | 22614 | 6.7% | -4.9% |
| 29 | 29 | 29 (29) | 0 | China | Zhenjiang | 35064 | 23706 | 22542 | -32.4% | -4.9% |
| 32 | 30 | 30 (32) | 2 | China | Xiamen | 20750 | 22756 | 21940 | 9.7% | -3.6% |
| 33 | 31 | 31 (33) | 2 | United States | Los Angeles | 18300 | 22200 | 21900 | 21.3% | -1.4% |
| 35 | 32 | 32 (35) | 3 | United States | South Louisiana | 22721 | 20847 | 21705 | -8.2% | 4.1% |
| 31 | 33 | 33 (31) | -2 | Brazil | Itaki | 23189 | 22795 | 21663 | -1.7% | -5.0% |
| 30 | 34 | 34 (30) | -4 | China | Yingkou | 23821 | 22997 | 21118 | -3.5% | -8.2% |
| 39 | 35 | 35 (39) | 4 | South Korea | Ulsan | 18794 | 18472 | 19485 | -1.7% | 5.5% |
| 38 | 36 | 36 (38) | 2 | United States | Long Beach | 17182 | 19639 | 19335 | 14.3% | -1.5% |
| 36 | 37 | 37 (36) | -1 | China | Qinhuangdao | 20061 | 20053 | 19269 | 0.0% | -3.9% |
| 34 | 38 | 38 (34) | -4 | Hong Kong, China | Hong Kong | 24929 | 21373 | 19210 | -14.3% | -10.1% |
| 48 | 39 | 39 (48) | 9 | China | Yancheng | 11622 | 15819 | 18444 | 36.1% | 16.6% |
| 49 | 40 | 40 (49) | 9 | China | Jiujiang | 12047 | 15175 | 18061 | 26.0% | 19.0% |
| 42 | 41 | 41 (42) | 1 | Vietnam | Ho Chi Minh * | 16324 | 16912 | 17081 | 3.6% | 1.0% |
| 50 | 42 | 42 (50) | 8 | United States | Corpus Christi | 14489 | 15173 | 17046 | 4.7% | 12.3% |
| 45 | 43 | 43 (45) | 2 | Australia | Dampier | 16993 | 16521 | 16623 | -2.8% | 0.6% |
| 40 | 44 | 44 (40) | -4 | China | Dongguan | 19070 | 18235 | 16540 | -4.4% | -9.3% |
| 41 | 45 | 45 (41) | -4 | Japan | Nagoya * | 16852 | 17775 | 16506 | 5.5% | -7.1% |
| 51 | 46 | 46 (51) | 5 | Brazil | Santos | 14647 | 14701 | 15581 | 0.4% | 6.0% |
| 43 | 47 | 47 (43) | -4 | Malaysia | Tanjong Parapas | 14463 | 16806 | 15158 | 16.2% | -9.8% |
| 47 | 48 | 48 (47) | -1 | South Korea | Incheon | 15223 | 15828 | 14987 | 4.0% | -5.3% |
| 54 | 49 | 49 (54) | 5 | Russia | Novorossiysk | 14181 | 14280 | 14740 | 0.7% | 3.2% |
| 44 | 50 | 50 (44) | -6 | Australia | Newcastle | 16454 | 16609 | 14517 | 0.9% | -12.6% |

Source: Transport administrations or port authorities of various countries, prepared by SISI.

Note 1: Port name marked by an asterisk (*) indicates estimated data.

Note 2: The Port of Antwerp and the Port of Zeebrugge were merged in 2022, and the 2022 data is the aggregate of the two ports. The Port of Busan, Port of Gwangyang, Port of Ulsan, and Port of Pyeongtaek-Dangjin in Korea, the Port of Vancouver in Canada, the Port of Melbourne in Australia, and the Port of Los Angeles and the Port of Long Beach in the United States adopt the revenue ton for statistics. The Port of Houston, the Port of South Louisiana, and the Port of Corpus Christi in the United States adopt the short ton for statistics, and the data has been converted to the data in metric tons.

**The seaborne container shipping trade volume may reverse the strong growth momentum.** Impacted by fiscal and taxation policies and funding subsidy policies, countries worldwide recorded a large rebound in trade demand against the pandemic in 2021. The surging international seaborne shipping volume resulted in a 6.8% year-on-year throughput increase of global container ports, while the top 100 container ports even recorded an increase of 7.2%. In contrast, as Western developed countries adopted deflationary policies, the European economy experienced a mild recession, and major powers distorted trade with political means in 2022, the growth rate of the world's top 100 container ports plummeted to 1.1%. Specifically, traditionally major ports such as the Port of Singapore, the Port of Busan, the Port of Hong Kong, the Port of Kelang, the Port of Rotterdam, the Port of Los Angeles, and the Port of Hamburg even recorded negative growth. The global economic and trade situation is expected to remain grim in 2023, and the container shipping trade may reverse the strong growth momentum to continue with slow growth.

**Table 2 Rankings of the world's top 100 container ports by throughput in 2022**

| 2021 Ranking | 2022 Ranking | Ranking: 2022 (2021) | | Country of origin | Port | 2020 (10,000 TEU) | 2021 (10,000 TEU) | 2022 (10,000 TEU) | 2021 growth rate | 2022 growth rate |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 (1) | 0 | China | Shanghai | 4350 | 4703 | 4730 | 8.1% | 0.6% |
| 2 | 2 | 2 (2) | 0 | Singapore | Singapore | 3687 | 3757 | 3729 | 1.9% | -0.7% |
| 3 | 3 | 3 (3) | 0 | China | Ningbo-Zhoushan | 2872 | 3108 | 3335 | 8.2% | 7.3% |
| 4 | 4 | 4 (4) | 0 | China | Shenzhen | 2655 | 2877 | 3004 | 8.4% | 4.4% |
| 6 | 5 | 5 (6) | 1 | China | Qingdao | 2201 | 2371 | 2567 | 7.7% | 8.3% |
| 5 | 6 | 6 (5) | -1 | China | Guangzhou | 2317 | 2418 | 2486 | 4.4% | 2.8% |
| 7 | 7 | 7 (7) | 0 | South Korea | Busan | 2181 | 2269 | 2207 | 4.0% | -2.7% |
| 8 | 8 | 8 (8) | 0 | China | Tianjin | 1835 | 2027 | 2102 | 10.5% | 3.7% |
| 9 | 9 | 9 (9) | 0 | Hong Kong, China | Hong Kong | 1797 | 1780 | 1664 | -1.0% | -6.5% |
| 10 | 10 | 10 (10) | 0 | Netherlands | Rotterdam | 1435 | 1530 | 1446 | 6.6% | -5.5% |
| 11 | 11 | 11 (11) | 0 | UAE | Dubai | 1349 | 1374 | 1397 | 1.9% | 1.7% |
| 14 | 12 | 12 (14) | 2 | Belgium | Antwerp Bruges | 1203 | 1202 | 1348 | -0.1% | 12.2% |
| 12 | 13 | 13 (12) | -1 | Malaysia | Klang | 1324 | 1374 | 1322 | 3.7% | -3.8% |
| 13 | 14 | 14 (13) | -1 | China | Xiamen | 1141 | 1205 | 1243 | 5.6% | 3.2% |
| 15 | 15 | 15 (15) | 0 | Malaysia | Tanjong Parapas | 980 | 1120 | 1051 | 14.3% | -6.2% |
| 16 | 16 | 16 (16) | 0 | United States | Los Angeles | 921 | 1068 | 991 | 15.9% | -7.2% |
| 19 | 17 | 17 (19) | 2 | United States | New York/New Jersey | 759 | 899 | 949 | 18.5% | 5.7% |
| 17 | 18 | 18 (17) | -1 | Taiwan, China | Kaohsiung | 962 | 986 | 949 | 2.5% | -3.8% |
| 18 | 19 | 19 (18) | -1 | United States | Long Beach | 811 | 938 | 913 | 15.7% | -2.7% |
| 22 | 20 | 20 (22) | 2 | China | Suzhou | 629 | 811 | 908 | 28.9% | 12.0% |
| 21 | 21 | 21 (21) | 0 | Thailand | Lim Chabang | 755 | 852 | 874 | 12.9% | 2.6% |
| 23 | 22 | 22 (23) | 1 | Vietnam | Ho Chi Minh * | 785 | 809 | 839 | 3.0% | 3.8% |
| 20 | 23 | 23 (20) | -3 | Germany * | Hamburg | 853 | 870 | 830 | 2.0% | -4.6% |
| 26 | 24 | 24 (26) | 2 | Morocco | Tangirmade | 577 | 717 | 760 | 24.3% | 5.9% |
| 28 | 25 | 25 (28) | 3 | China | Beibu Gulf | 505 | 601 | 702 | 19.0% | 16.8% |
| 25 | 26 | 26 (25) | -1 | Sri Lanka | Colombo | 685 | 725 | 686 | 5.8% | -5.4% |
| 27 | 27 | 27 (27) | 0 | India | Mundra * | 566 | 666 | 653 | 17.7% | -2.0% |
| 24 | 28 | 28 (24) | -4 | Indonesia | Tanjung Priok | 687 | 747 | 642 | 8.8% | -14.1% |
| 29 | 29 | 29 (29) | 0 | Vietnam | Haiphong * | 514 | 579 | 600 | 12.6% | 3.6% |
| 30 | 30 | 30 (30) | 0 | India | Nehru | 447 | 563 | 596 | 26.0% | 5.8% |
| 31 | 31 | 31 (31) | 0 | United States | Savannah | 468 | 561 | 589 | 19.9% | 5.0% |
| 35 | 32 | 32 (35) | 3 | China | Rizhao | 486 | 517 | 580 | 6.4% | 12.2% |
| 36 | 33 | 33 (36) | 3 | China | Lianyungang | 480 | 503 | 557 | 4.8% | 10.7% |
| 38 | 34 | 34 (38) | 4 | Philippines | Manila | 443 | 498 | 547 | 12.2% | 10.0% |
| 40 | 35 | 35 (40) | 5 | Panama | Cologne | 445 | 492 | 510 | 10.3% | 3.8% |
| 32 | 36 | 36 (32) | -4 | Spain | Valencia | 543 | 560 | 508 | 3.2% | -9.4% |
| 34 | 38 | 38 (34) | -4 | China | Yingkou | 565 | 521 | 500 | -7.8% | -4.0% |
| 33 | 37 | 37 (33) | -4 | Greece | Piraeus | 544 | 531 | 500 | -2.3% | -5.8% |
| 41 | 39 | 39 (41) | 2 | Japan | Tokyo * | 426 | 486 | 492 | 14.1% | 1.3% |
| 39 | 40 | 40 (39) | -1 | Vietnam | Gemei * | 441 | 494 | 479 | 12.0% | -3.0% |
| 43 | 41 | 41 (43) | 2 | Spain | Algeciras | 511 | 480 | 476 | -6.1% | -0.7% |
| 44 | 42 | 42 (44) | 2 | Saudi Arabia | Jeddah * | 474 | 474 | 463 | 0.0% | -2.4% |
| 37 | 43 | 43 (37) | -6 | Germany | Bremerhaven | 477 | 502 | 460 | 5.3% | -8.3% |
| 45 | 44 | 44 (45) | 1 | Oman | Seralai | 434 | 451 | 450 | 3.9% | -0.2% |
| 50 | 45 | 45 (50) | 5 | China | Dalian | 511 | 367 | 446 | -28.2% | 21.5% |
| 51 | 46 | 46 (51) | 5 | China | Yantai | 330 | 365 | 412 | 10.6% | 12.9% |
| 46 | 47 | 47 (46) | -1 | Egypt | Port Said * | 401 | 407 | 408 | 1.5% | 0.2% |
| 57 | 48 | 48 (57) | 9 | United States | Houston | 300 | 345 | 397 | 15.1% | 15.1% |
| 49 | 49 | 49 (49) | 0 | Canada | Vancouver * | 347 | 368 | 375 | 6.1% | 2.0% |
| 55 | 50 | 50 (55) | 5 | United States | Virginia | 281 | 352 | 370 | 25.2% | 5.1% |
| 52 | 51 | 51 (52) | 1 | Indonesia | Tanjong Pera * | 360 | 360 | 362 | 0.0% | 0.5% |
| 65 | 52 | 52 (65) | 13 | Bangladesh | Chittagong * | 284 | 321 | 354 | 13.2% | 10.0% |
| 56 | 53 | 53 (56) | 3 | Britain | Felixstowe * | 349 | 351 | 354 | 0.6% | 0.6% |
| 54 | 54 | 54 (54) | 0 | Spain | Barcelona | 296 | 353 | 352 | 19.4% | -0.2% |
| 42 | 55 | 55 (42) | -13 | Brazil | Santos | 423 | 483 | 352 | 14.1% | -27.2% |
| 60 | 56 | 56 (60) | 4 | Mexico | Manzanillo Colon | 291 | 337 | 347 | 15.9% | 3.0% |
| 58 | 57 | 57 (58) | 1 | China | Fuzhou | 352 | 345 | 346 | -2.0% | 0.3% |

| 2021 Ranking | 2022 Ranking | Ranking: 2022 (2021) | | Country of origin | Port | 2020 (10,000 TEU) | 2021 (10,000 TEU) | 2022 (10,000 TEU) | 2021 growth rate | 2022 growth rate |
|---|---|---|---|---|---|---|---|---|---|---|
| 59 | 58 | 58 (59) | 1 | China | Dongguan | 342 | 340 | 341 | -0.6% | 0.3% |
| 67 | 59 | 59 (67) | 8 | Italy | Gioia Tauro * | 319 | 315 | 339 | -1.3% | 7.6% |
| 47 | 60 | 60 (47) | -13 | United States | Northwest Seaport Alliance | 332 | 374 | 338 | 12.5% | -9.4% |
| 81 | 61 | 61 (81) | 20 | China | Jiaxing | 227 | 259 | 336 | 14.1% | 29.7% |
| 53 | 62 | 62 (53) | -9 | Panama | Balboa | 316 | 356 | 335 | 12.6% | -5.9% |
| 63 | 63 | 63 (63) | 0 | China | Tangshan | 312 | 329 | 334 | 5.4% | 1.5% |
| 69 | 64 | 64 (69) | 5 | Britain | London * | 277 | 308 | 332 | 11.0% | 8.0% |
| 62 | 65 | 65 (62) | -3 | UAE | Abu Dhabi * | 322 | 329 | 332 | 2.3% | 0.9% |
| 64 | 66 | 66 (64) | -2 | Australia | Melbourne | 300 | 328 | 329 | 9.6% | 0.2% |
| 48 | 67 | 67 (48) | -19 | China | Foshan | 405 | 371 | 322 | -8.4% | -13.2% |
| 68 | 68 | 68 (68) | 0 | China | Nanjing | 302 | 311 | 320 | 3.0% | 2.9% |
| 61 | 69 | 69 (61) | -8 | South Korea | Incheon | 327 | 335 | 319 | 2.4% | -4.8% |
| 70 | 70 | 70 (70) | 0 | France | Port Le Havre | 242 | 307 | 310 | 27.0% | 1.0% |
| 78 | 71 | 71 (78) | 7 | United States | Charleston * | 231 | 275 | 303 | 19.0% | 10.1% |
| 73 | 72 | 72 (73) | 1 | Japan | Yokohama * | 266 | 286 | 295 | 7.5% | 2.9% |
| 75 | 73 | 73 (75) | 2 | Japan | Kobe * | 265 | 280 | 291 | 5.9% | 3.9% |
| 74 | 74 | 74 (74) | 0 | Saudi Arabia | King Abdullah | 215 | 281 | 291 | 30.6% | 3.2% |
| 77 | 75 | 75 (77) | 2 | Australia | Sydney * | 252 | 276 | 290 | 9.5% | 5.1% |
| 71 | 76 | 76 (71) | -5 | Malta | Malthashlok | 244 | 297 | 289 | 21.6% | -2.7% |
| 72 | 77 | 77 (72) | -5 | Turkey | Ambali | 289 | 294 | 287 | 1.9% | -2.6% |
| 76 | 78 | 78 (76) | -2 | Italy | Genoa | 250 | 278 | 280 | 11.3% | 0.6% |
| 84 | 79 | 79 (84) | 5 | China | Wuhan | 196 | 248 | 270 | 26.5% | 8.9% |
| 79 | 80 | 80 (79) | -1 | Japan | Nagoya * | 247 | 273 | 268 | 10.3% | -1.7% |
| 66 | 81 | 81 (66) | -15 | Colombia * | Cartagena * | 313 | 316 | 267 | 1.0% | -15.5% |
| 82 | 82 | 82 (82) | 0 | Peru | Callao | 225 | 254 | 264 | 12.8% | 3.8% |
| 80 | 83 | 83 (80) | -3 | South Africa | Durban | 260 | 266 | 257 | 2.6% | -3.3% |
| 86 | 84 | 84 (86) | 2 | Japan | Osaka * | 235 | 243 | 239 | 3.1% | -1.4% |
| 85 | 85 | 85 (85) | 0 | United States | Oakland | 246 | 245 | 234 | -0.5% | -4.5% |
| 91 | 86 | 86 (91) | 5 | Britain | Southampton * | 176 | 210 | 231 | 19.2% | 10.0% |
| 94 | 87 | 87 (94) | 7 | China | Nantong | 191 | 203 | 224 | 6.2% | 10.3% |
| 95 | 88 | 88 (95) | 7 | China | Haikou | 197 | 201 | 215 | 2.0% | 7.0% |
| 83 | 89 | 89 (83) | -6 | Pakistan | Karachi | 208 | 253 | 209 | 21.7% | -17.6% |
| 99 | 90 | 90 (99) | 9 | China | Quanzhou | 226 | 195 | 208 | -13.7% | 6.7% |
| 89 | 91 | 91 (89) | -2 | Poland | Gdansk | 193 | 212 | 207 | 10.0% | -2.3% |
| 98 | 92 | 92 (98) | 6 | Turkey | Izmit | 180 | 197 | 206 | 9.3% | 4.7% |
| 87 | 93 | 93 (87) | -6 | Ecuador | Guayaquil | 207 | 214 | 205 | 3.4% | -4.2% |
| 109 | 94 | 94 (109) | 15 | Mexico | Lazaro | 106 | 169 | 203 | 58.5% | 20.2% |
| 90 | 95 | 95 (90) | -5 | Turkey | Mersin | 195 | 211 | 199 | 8.1% | -5.6% |
| 106 | 96 | 96 (106) | 10 | Saudi Arabia | Dammam * | 186 | 177 | 195 | -5.0% | 10.3% |
| 102 | 97 | 97 (102) | 5 | China | Jinzhou | 164 | 183 | 188 | 11.4% | 2.7% |
| 88 | 98 | 98 (88) | -10 | South Korea | Gwangyang | 215 | 212 | 186 | -1.2% | -12.3% |
| 96 | 99 | 99 (96) | -3 | Taiwan, China | Taipei | 162 | 201 | 179 | 24.1% | -10.9% |
| 97 | 100 | 100 (97) | -3 | Taiwan, China | Taichung | 182 | 198 | 179 | 8.7% | -9.8% |

Source: Transport administrations or port authorities of various countries, prepared by SISI. Note: * indicates the estimated data.



## 2.3 Overview of Dry Bulks Throughputs of Global Ports

Global dry bulk shipping trade volumes such as ore, coal, grain, and small bulk cargoes fluctuated downward in 2022. In terms of major trade ports, the dry bulk throughput of ports in the Asian region fell to some extent. However, hub ports such as Tangshan and Ningbo-Zhoushan ports in China maintained a stable growth rate. In contrast, the Port of Hedland and the Port of Hay Point in Australia, a coal and ore exporter, and the ports in Colombia and the Port of Santos in Brazil in the South American region mostly recorded a slight decline of less than 5%. India, which actively developed the transhipment trade, and European ports with a high "rigid demand" for fossil energy only registered minor increases. Specifically, after the ports of Antwerp and Zeebrugge

in northern Europe were integrated, their resources, such as the cargo collection, distribution, and transportation network, and warehousing and logistics facilities, were effectively utilized, contributing to a more than 40% total increase in dry bulks throughput within the two years.

**Table 2-2 Dry Bulks Throughputs and Growth Rates of Some Ports in the World in 2022**

| Area | Port name | 2020 | 2021 | 2022(10000 tons) | | | | | Growth rate in 2021 | Growth rate in 2022 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | (10000 tons) | | Q1 | Q2 | Q3 | Q4 | total | | |
| Asia | Tangshan | 58826 | 60909 | 15489 | 15829 | 18119 | 16921 | 66359 | 3.5% | 8.9% |
| | Ningbo-Zhoushan | 57058 | 61450 | 15347 | 17467 | 16990 | 15649 | 65453 | 7.7% | 6.5% |
| | Qinghuangdao | 18125 | 18157 | 4533 | 4701 | 4280 | 4108 | 17621 | 0.2% | -2.9% |
| | Guangyang | 7713 | 8418 | 1889 | 1783 | 1987 | 1936 | 7595 | 9.1% | -9.8% |
| | Pohang | 4564 | 4670 | 907 | 1037 | 913 | 908 | 3765 | 2.3% | -19.4% |
| | Main ports in India | 23177 | 24199 | 6440 | 6959 | 6454 | 7039 | 26892 | 4.4% | 11.1% |
| Europe | Major ports in Spain | 7707 | 8498 | 2241 | 2383 | 2324 | 2469 | 9417 | 10.3% | 10.8% |
| | Rotterdam | 6380 | 7871 | 1791 | 2145 | 2046 | 2024 | 8007 | 23.4% | 1.7% |
| | Antwerp Bruges | 1156 | 1511 | | | — | | 1719 | 30.7% | 13.8% |
| Australia | Hedland | 54074 | 54605 | 13529 | 14451 | 14005 | 13240 | 55226 | 1.0% | 1.1% |
| | High Point | 10104 | 9916 | 2331 | 2514 | 2465 | 2465 | 9776 | -1.9% | -1.4% |
| America | South Louisiana | 12525 | 12279 | 3422 | 3009 | 3009 | 2737 | 12177 | -2.0% | -0.8% |
| | Major ports in Mexico | 10116 | 11068 | 2681 | 2967 | 2822 | 2518 | 10988 | 9.4% | -0.7% |
| | Main ports in Colombia | 7090 | 7700 | 1890 | 1995 | 1544 | 2022 | 7451 | 8.6% | -3.2% |
| | Madrid Cape Pier | 19132 | 18236 | | | — | | 19132 | -4.7% | 4.9% |
| | Santos | 7567 | 7047 | 1955 | 2214 | 1795 | 915 | 6879 | -6.9% | -2.4% |

Note: The 2022 and 2021 data are the total data of the Port of Antwerp and the Port of Zeebrugge after the integration, and the 2020 data is of the Port of Antwerp.

Source: Official websites of ports, prepared by SISI.



## 2.3.1 Analysis of the global iron ore port production

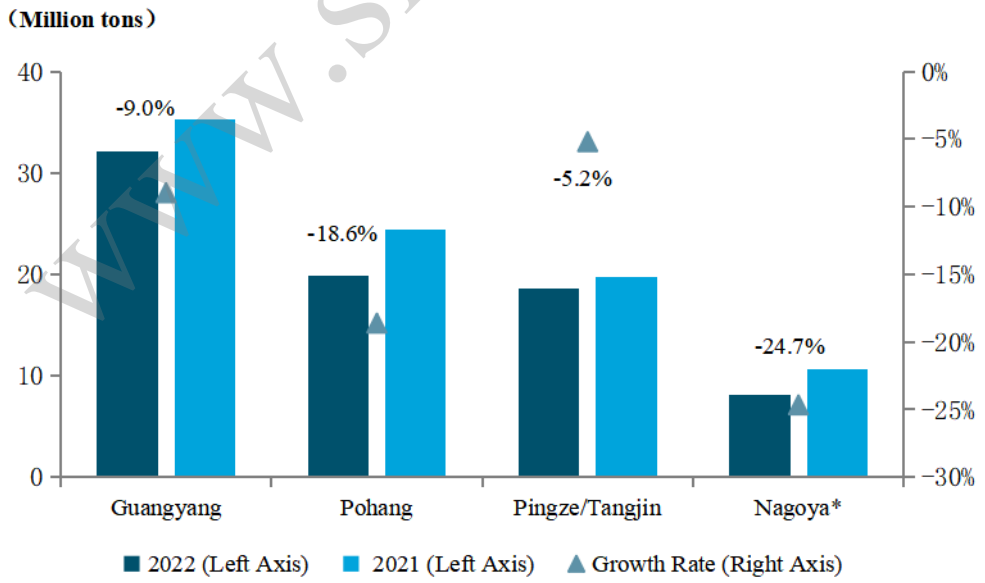
### (1) Global seaborne trade volume of iron ore glided down

The major iron ore handling ports posted differentiated performance in 2022. Specifically, large iron ore handling ports such as Ningbo-Zhoushan and Tangshan ports and the Port of Tubarão maintained growth. Small and medium-sized ore ports faced difficulty in business development. In particular, the ore handling volumes of ports glided down against the trade demand decline of Japanese and Korean ports.

**The iron ore throughputs of Chinese ports fell across the board.** In the first half of 2022, the "COVID-19" pandemic still impaired China's economy and urban development, compromising the manufacturing, infrastructure construction, and

logistics and transportation efficiency in some areas amid depressed ore imports and crude steel production supply and demand. The production and manufacturing capacity gradually recovered in the second half of the year, but the demand for steel and machinery trade in the European and American markets went down, which dampened the demand for ore processing to a certain extent. The Chinese government further strengthened the policies of boosting domestic demand and "supporting the development of the real estate market" in financial and other fields at the end of the year, which drove up the demand for ore imports and steel trade slightly. According to data, China's ports handled 2.13 billion tons of iron ore in 2022, an increase of 3.1% year-on-year. However, its iron ore throughput for foreign trade was only 1.24 billion tons, a year-on-year drop of about 0.5%, the growth rate marking a significant decline from last year.

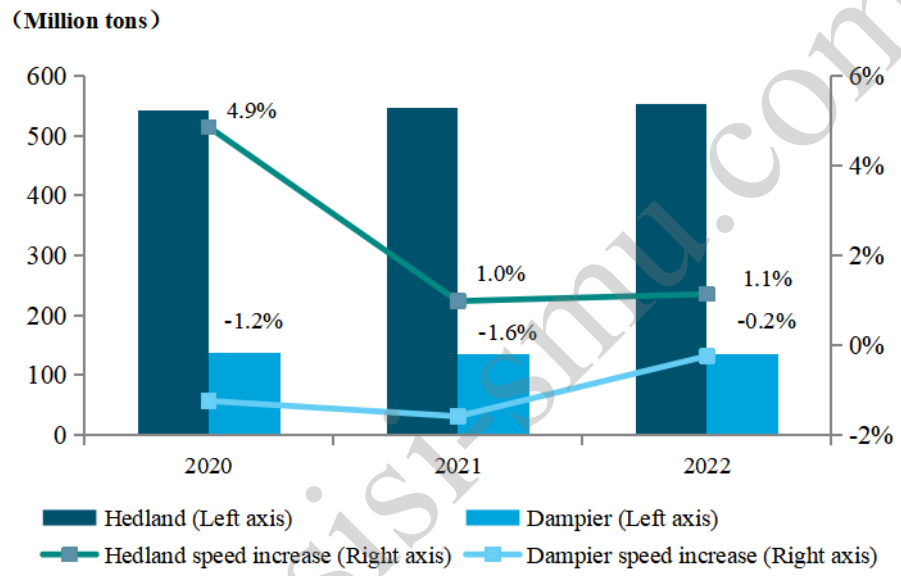
**Iron ore imports to Japan and Korea fluctuated downward.** Japan's ore is primarily used to manufacture mechanical equipment and auto parts. Since the COVID-19 pandemic outbreak, Japan's "craftsman-type" manufacturing industry has been impacted in terms of market sales performance, though not severe enough to cause a business shutdown as in the case of some labor-intensive industries. The auto industry remained stagnant, with the export trade of finished products posting weak growth. The domestic demand also fell, and the inventory was relatively high following the significant expansion of import volume in 2021, while the trade demand gradually shrank. Likewise, although the increased shipbuilding orders in Korea drove up the ore trade demand, the demand from other industries plunged. In addition, the international ore prices fluctuated upward due to the unsmooth logistics, and scrap iron recycling reduced the ore import in Korea.




Source: Official websites of ports, prepared by SISI. Note: * indicates estimates.

**Figure 2-11 Iron Ore Throughputs and Growth Rates of Major Ports in Japan and Korea in 2021–2022**

**Iron ore throughput in Australia increased slightly.** Australia's iron ore output was affected by the increased COVID-19 infected cases, labor shortages, and the accident at the Moranbah mine at the beginning of the year. Meanwhile, the infrastructure investment slowdown in Asian countries reduced the trade demand. Australian port tugboat workers went on strike in the third quarter, and the output of Australia's three major iron ore enterprises remained the same as the previous year, all of which restricted the iron ore throughput growth at ports. Port-specific, the Port of Hedland in Australia shipped 482 million tons of iron ore to China, a year-on-year increase of 6%, and its port throughput also rose by a small margin, making the Chinese market account for 86% of the total iron ore shipment from the Port of Hedland. The shipments from the Dampier Port decreased due to the rainfall in the Pilbara area.

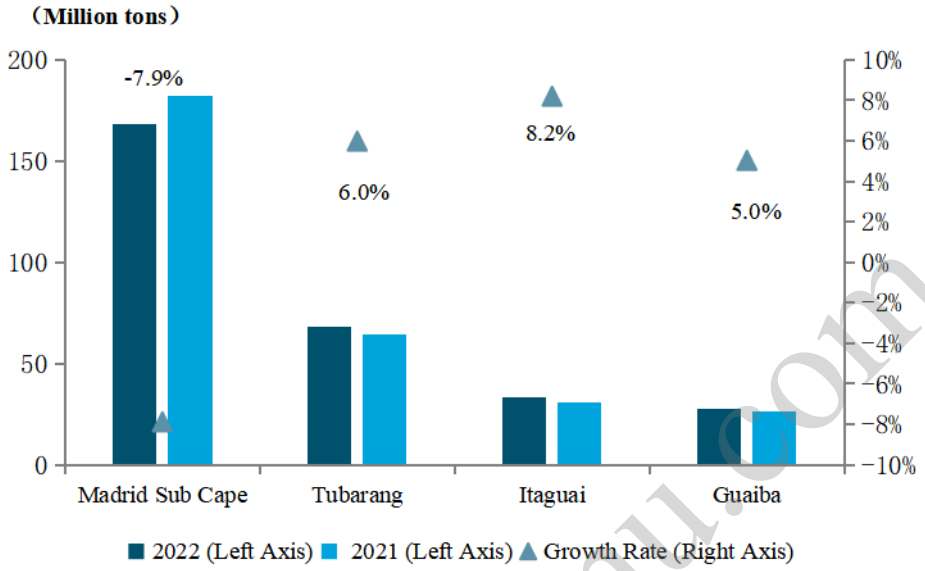



Source: Official websites of ports, prepared by SISI.

**Figure 2-12 Iron Ore Throughputs and Growth Rates of Port of Hedland and Dampier Port in 2021–2022**

**Brazil's iron ore throughput dropped slightly.** Brazilian ports handled 396 million tons of ore in 2022, a year-on-year decrease of 2.6%, in stark contrast to the 2.6% increase in the previous year. Although Brazil has replaced the United States for imported iron ore, the import demand fell due to the weak manufacturing industries in Europe and the United States and failed to effectively secure the steady growth of ore trade in Brazil. Meanwhile, the heavy rainfall at the beginning of the year also forced Vale to suspend the iron ore transportation business in the southeast temporarily. In addition, the output of the Samarlakota mining area restarted after the tailings collapsed was limited. As a result, the iron ore inventories at ports such as the Port of Tubarão were at historic lows. Port-specific, the ore throughput of the Ponta da Madeira Terminal fell by nearly 8% due to the mining progress slowdown of the northern mines, as well as the lack of terminal machinery and equipment, the strike of port workers, and unsmooth logistics. On the other hand, ports such as the Port of Tubarão, the Port of

Itaguaí, and the Port of Guaíba all maintained minor growth as they were not affected by the weather, the logistics and transportation were relatively smooth, and some North American countries didn't cut the ore imports to follow the initiative of trading with neighboring regions.




Source: Official websites of ports, prepared by SISI.

**Figure 2-13 Iron Ore Throughputs and Growth Rates of Major Brazilian Ports in 2021-2022**

## 2.3.2 Analysis of global coal port production

All countries narrowed the usage scope of fossil energy sources such as coal, reducing the global coal trade volume in 2022. As a result, the coal handling volume at Asian ports gradually fell back. Only Indian and European ports made active moves to expand the seaborne trade scale of coal. In particular, the coal throughputs of the Port of Paradeep, the Port of Kamarajar in India, and the Port of Amsterdam in the Netherlands, among other ports, continued growing rapidly.

**The coal throughput growth of Chinese ports decreased significantly.** China's ports handled a total of 2.86 billion tons of coal and products in 2022, an increase of 1.2%, a sharp decline from 10.8% in the previous year. Specifically, the throughput of imported coal for foreign trade stood at 270 million tons, a decrease of 13.6% from the previous increase of 24.2%. Port-specific, the growth of coal throughput for domestic trade slowed but remained high. Specifically, the coal shipments of Tianjin, Rizhao, and other ports in northern China maintained a double-digit growth rate, while Tangshan Port recorded a steady growth rate of only 5% due to its relatively large base. On the other hand, in southern China, ports such as Ningbo-Zhoushan, Shanghai, Guangzhou, and Fuzhou suffered negative growth in coal throughput due to the reduced imported coal for foreign trade.

**Korean ports recorded across-the-board declines in coal throughput.** As Korea

continued to advance its energy transformation move, its fossil energy trade kept falling. As a country with relatively poor energy resources, Korea attaches great importance to energy security and vigorously develops alternative energy industries. Given the higher carbon emission requirements, it has sped up investment in energy production and manufacturing sectors. On the other hand, Korea's demand for energy use was insufficient, and most of its fossil energy depends on the international market, which led to a significant drop in port imports.

**Indian ports posted strong growth in coal throughput.** India's coal throughput at ports nationwide hit a record high of 186 million tons in 2022, an increase of more than 30%. India vigorously developed international energy transit trade to earn a large trade surplus, supporting domestic energy procurement. Meanwhile, India's domestic manufacturing industry and infrastructure demand rebounded rapidly, significantly elevating the coal import demand in the nation. As a result, various ports in India maintained high growth in coal throughput. Specifically, the coal throughput growth of the Port of Kolkata, the Port of Paradeep, the Port of Visakhapatnam, the Port of Tuticorin, and other ports exceeded 30% (mostly from domestic trade transportation), continuing the rapid growth of the previous year.

**Australia's major coal ports posted a steep fall.** Asian countries, the main destination of Australia's exported coal, reduced their coal use and import scale. In addition, the international bilateral/multilateral relations affected the coal trade demand, and Australia's coal exports also faced competition from Indonesia and South Africa. As a result, Australia's annual coal export volume totalled about 347 million tons, a year-on-year drop of 5.1%. The throughputs of major coal export ports such as the Port of Newcastle, the Port of Hay Point, and the Port of Gladstone fell across the board.

## 2.4 Overview of Liquid Bulks Throughputs of Global Ports

The liquid bulk throughputs of global ports generally presented a pattern featuring "brisk shipping activities in Europe and the United States and leisure in Asia" in 2022. Driven by the "solid demand", the oil products imports at European ports kept climbing while the United States and the Middle East took advantage to augment exports, pushing up the liquid bulk throughput. On the contrary, some countries moderately reduced the import volume due to the high international oil prices without affecting energy use and strategic reserves. As a result, the liquid bulk throughputs of the Port of Singapore, Qingdao Port, Dalian Port, and the Port of Gwangyang, among others, fell.

### 2.4.1 Throughputs of Asian ports stopped growth

Asian countries still had a huge trade demand for liquid bulks such as oil products in 2022. Country-specific, liquid bulks such as oil products in Chinese ports were affected by the COVID-19 pandemic and the oil trade with Russia was transported by pipeline. As a result, the throughput declined from a positive growth rate, down by 1.4% year-on-year to 1.30 billion tons. Most ports suffered less satisfactory performance in liquid bulk production. In addition, the liquid bulks throughput of Korean ports increased slightly by 0.7% year-on-year to 470 million tons in 2022, marking a wide decline from

the previous year. Meanwhile, India's oil products import volume grew steadily due to the large energy gap to support its economic and industrial development. Ports such as the Port of Kandla, the Port of Paradip, and the Port of Mumbai recorded an increase of about 5%.

### 2.4.2 Throughputs of European ports returned to the growth track

The use of fossil energy, such as oil and coal, in Europe gradually declined in 2022. Taking crude oil as an example, the European seaborne trade volume fell from 527 million tons in 2019 to 461 million tons and then returned to 516 million tons in 2022. Meanwhile, European ports were active in boosting liquid bulk production. Specifically, northern European ports such as the Port of Rotterdam and the Port of Antwerp-Bruges (using the same standard after integration), as well as southern European ports such as the Port of Marseille and ports in Spain, all registered significant increases. The international crude oil prices rose, the inflation in EU countries continued to raise energy costs, and European residents had high living expenses. However, the insufficient savings made it difficult to sustain the imports of high-priced crude oil for a long time. Therefore, the European oil product trade may gradually ease in the future. The Organization of the Petroleum Exporting Countries (OPCE) will also stabilize oil prices by trimming production and other means, slowing the growth of liquid bulk trade in European ports.

### 2.4.3 Throughputs of American ports showed varied performance

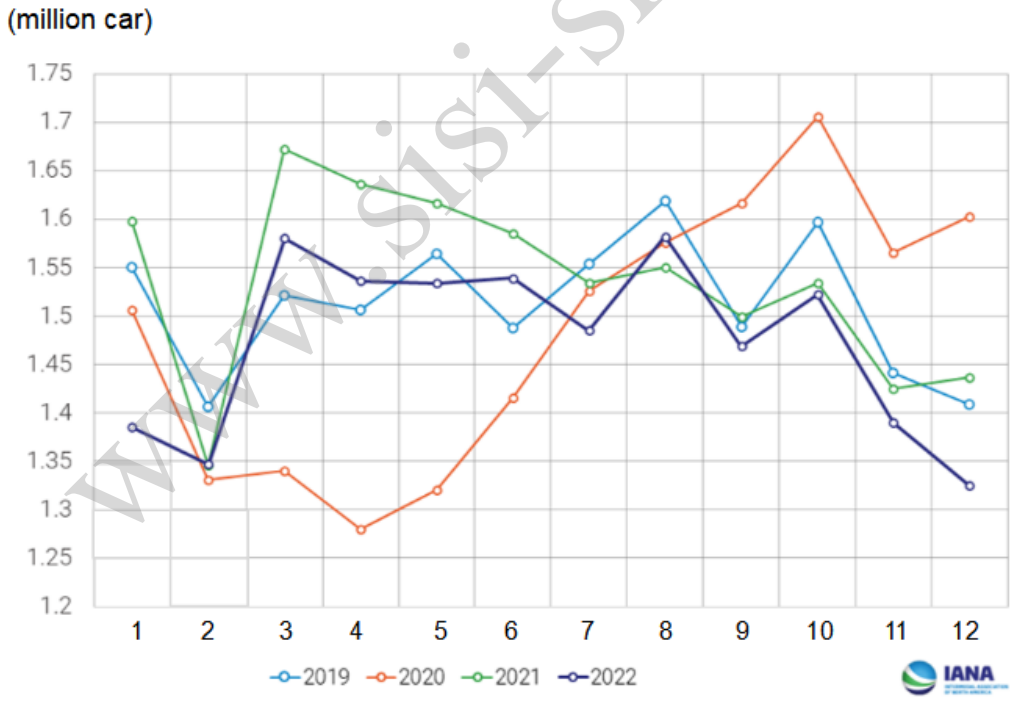
American countries have relatively abundant natural resources. South America is rich in coal resources, and North America is also becoming a major energy exporter in the world with the emergence of new energy sources such as shale gas. After many countries, including the European Union, announced the cancellation of imports of crude oil and its products from Russia, the United States was actively expanding the supply of crude oil exports. Its crude oil export in 2022 increased by 640,000 barrels per day to 3.6 million barrels per day, and its LNG export volume also exceeded that of Qatar and Australia, reaching 22% of the global market share, with the price up from USD 7/MMBtu to USD 13/MMBtu, an increase of more than 76%. As a result, the liquid bulk throughputs of ports such as the Port of Houston, the Port of Corpus Christi, and the Port of South Louisiana in the United States achieved substantial growth. That benefited the business at the ports in Mexico, Colombia, Brazil, and other countries where the liquid bulk throughput steadily increased.

# Chapter 3 Overview of Global Port Operations and Management in 2022

## 3.1 Port Logistics Development

### 3.1.1 Sea-railway intermodal transport development in North America

North American ports continued the congestion in the first half of 2022. The strikes on the railway system and the shortage of container pallet equipment continued to undermine the production operations of railways and ports. Coupled with the sharp decline in exports from eastern China, the North American sea-railway intermodal transport business was in a downturn. However, as port congestion eased starting from the second half of the year, the incentive measures and infrastructure investment launched by the government and the port authorities started to show, and the sea-railway intermodal transport volume rebounded briefly but then fell sharply in the fourth quarter. As a result, North America's sea-railway intermodal transport volume reached 17.72 million vehicles (including containers and trailers) in 2022, a year-on-year decrease of 3.9%.




Source: Intermodal Association of North America (IANA)

**Figure 3-1 Monthly Business Volumes of Sea-railway Intermodal Transport in North America (including Containers and Trailers) in 2019–2022**

**The US West ports expanded the construction of sea-railway intermodal transport**

**facilities to attract cargoes to the US East ports.** As a result, the sea-rail intermodal transport volume in the United States and the throughput of the US West ports fell in the second half of 2022. The US ports are the major sea-railway intermodal transport carriers in the United States. However, the Pacific Maritime Association (PMA) and the International Longshore and Warehouse Union (ILWU) didn't reach a consensus in the wage negotiations, and the carriers turned to ports on the east coast of the United States for their shipping activities instead. In addition, the port authorities of the US West ports accelerated the construction of the sea-railway intermodal transport facilities to attract the return of cargoes from Mexico, Canada, and the US East ports. The Port of Long Beach promoted the construction of the Pier B railway project and the "Pier G-J" double-track project in the southern basin area. The fourth track project of Ocean Avenue was also advanced simultaneously. The U.S. BNSF Railway planned to build a new sea-rail intermodal facility, the Barstow International Gateway (BIG), where containers can be transferred directly from ships at the ports of Los Angeles and Long Beach to the rail, then through the Alameda Railway Freight Corridor and finally to Barstow.

**Canada sped up the transformation of old facilities for sea-railway intermodal transport.** Due to the declined consumer demand, Canada's annual sea-railway intermodal transport volume in 2022 dropped by 0.6% year-on-year to 36.81 million tons. However, Canadian National Railway (CN), the most important sea-rail intermodal operator, and Canadian Pacific Railway (CP) still adopted an aggressive expansion strategy. Canadian National Railway (CN) planned to launch a new sea-rail intermodal transhipment project in Calgary. Under the project, the sea-rail intermodal facilities handle the shipped containers destined for the Port of Vancouver and the Port of Prince Rupert, British Columbia, reducing the number of trucks travelling to and from the coast and reducing transportation costs. Furthermore, the CP company planned to merge with the Kansas City Southern Railway Company to expand its business territory from Canada to the United States and Mexico. In addition, the Port of Vancouver actively promoted the renovation of the Burnaby rail corridor, reducing the trains' passage time through the tunnel by upgrading the Thornton tunnel ventilation system and building a new rail track from Willingdon Avenue to Piper Avenue. This has made the trade through the sea-rail transport at the Vancouver Port more efficient.

### 3.1.2 Geopolitical factors changed the Asia-Europe sea-railway intermodal transport pattern

**The European Union's sanctions against Russia promoted the sea-railway intermodal transport at the ports along the International North–South Transport Corridor (INSTC).** As the EU intensified sanctions on Russia, Russia has shifted the shipping focus to the International North–South Transport Corridor (INSTC), and launched cooperation with Iran, India, Kazakhstan, Azerbaijan, and other countries to actively invest in transportation and trade industries in Central Asia and other regions. For example, Russia invested USD 4 billion in Iranian oil fields and built the Rasht-Astara railway and the "Russia-Iran-India" sea-railway intermodal transport route. In

addition, Russia also promoted the construction of the Trans-Afghan railway in Uzbekistan, which can greatly reduce the time and cost of cargo transportation.

**The sea-railway intermodal transport through the middle corridor became an alternative option for the EU to go around Russia.** After the EU sanctions officially kicked start, some cargo owners gave up the plan to go through Russia and actively sought alternative routes. For Eastern and Central Europe and Central Asia, constructing intermediate corridors can attract cargo flows, which is of great significance to regional development. Therefore, Azerbaijan, Turkey, and other countries actively promoted the construction of intermediate corridors. Port groups were also actively building intermediate corridors. A.P. Moller - Maersk operated a terminal in Georgia and actively built the sea-railway intermodal transport infrastructure. DP World established two regular freight routes from the Port of Constanta to the European interior. Diamond Line, a subsidiary of COSCO Group, launched the TBX1 service express line to Batumi, Georgia, in the Black Sea, providing a new option for cargo transfers between the Far East and Europe.

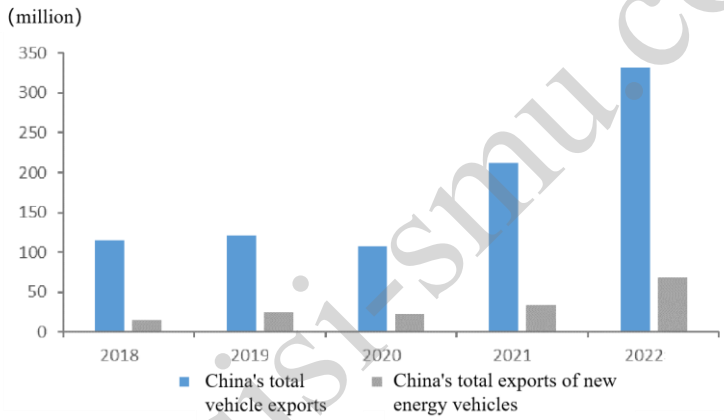
**The sea-railway intermodal transport volume between Russia and China increased due to reduced trade with the EU.** The cargo volume between Russia and Europe plummeted in 2022, and the cargoes shipped via sea and rail by way of Russia were also greatly affected. As a third party, China attracted the trade cargo flows between Europe and Russia. As a result, China's seaborne cargo volume exported to Russian Far East ports in 2022 more than doubled, and the Sino-Russian trade volume reached USD 190.2 billion, a year-on-year increase of 29%. The surging cargo volume even caused congestion at ports in the Far East, with a waiting time for unloading as long as 30 days. Against this backdrop, China and Russia actively built railways and developed sea-railway intermodal transport to promote simultaneous railway and waterway transport. As a result, the freight turnover between Russian railways and China in 2022 increased by 28%.

## Special Topic 3: Vehicle Export Ushered in Rapid Growth at China's Ports

### 1. Energy reform drove the growth of vehicle exports at ports

Vehicle export at ports is closely related to the trade performance of the automobile industry. Meanwhile, vehicle energy is the biggest factor impacting the automobile industry and market. The change in vehicle energy determines the increase and decrease in the automobile trade volume. With the fossil energy price rising in the 1970s, the low-fuel-consuming engine technology of Japanese cars was widely praised. Japanese car corporations quickly expanded their production scale and leapt to the top league of the automotive industry, which led to a substantial increase in vehicle export at Japanese ports. The export volume of automobiles at Japanese ports reached more than 2.5

million in 1976 alone. With the global environmental protection process speeding up and energy prices rising from favorable geopolitical factors after 2020, new energy electric vehicles are gaining popularity in the automotive industry. After the impact of the pandemic faded, the global auto trade volume posted a strong rebound. China is a major manufacturer of new energy vehicles. Tesla is building a super factory in Shanghai, and top Chinese vehicle brands such as BYD and Chery demonstrate a strong growth momentum. The booming new energy vehicle industry led to a surge in China's auto exports. According to data from the China Association of Automobile Manufacturers (CAAM), China exported 3.11 million vehicles in 2022, a year-on-year increase of 54.4%, surpassing Germany to become the world's second-largest passenger vehicle exporter next only to Japan. Meanwhile, the total export of new energy vehicles stood at 679,000, about twice the export volume 340,000 in 2021. Waterway transport is the primary means of vehicle export, and Chinese ports have ushered in a boom period.



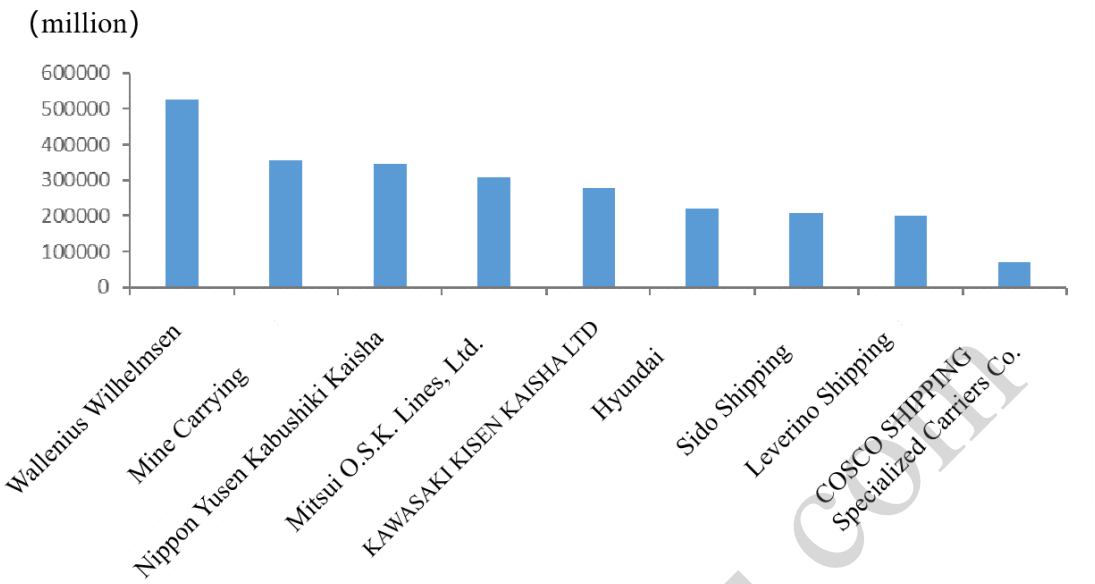

Source: National Bureau of Statistics, China Association of Automobile Manufacturers (CAAM), prepared by SISI.

**Figure 1 China's Total Vehicle Export Volume and New Energy Vehicle Export Volume**

## 2. Automobile companies actively participated in vehicle exports at ports

**The supply-demand imbalance in the automobile transportation market increased the ro-ro ship rent.** As the global automotive semiconductor supply chain challenge was alleviated, China's new energy vehicle production capacity increased. Meanwhile, the import demand for new energy vehicles in Europe went up. These factors contributed to a substantial increase in China's vehicle exports. However, the international ro-ro vehicle shipping capacity is dominated by shipowners from Japan, Korea, and some European countries, with Chinese shipowners taking less than 5% of the market share. Besides, Japanese and Korean shipowners' ro-ro ships were mostly tied to their domestic vehicle manufacturers. As a result, the number of free ro-ro ships in China was difficult to meet the demand of the vehicle shipping market. The intensified supply-demand imbalance of ro-ro ships pushed up the ship rent. According to the Clarksons data, the one-year rent of a car carrier with 6,500 parking spaces in

early 2023 reached USD 110,000 per day, triple that of the same period in 2022 and 7 times that of the same period in 2021.




Source: Clarksons, prepared by SISI

**Figure 2 Ro-Ro Capacity of Some Ship Enterprises**

**Given the growing demand for automobile waterway transport for exports, Chinese auto companies actively expanded their waterway transport business and partnered with port and shipping enterprises.** For port and shipping enterprises, the container freight rate fell back to the historical norm, and reviving the booming market in the short term was not easy. The port and shipping enterprises also held a large amount of funds earned in the last boom, and the waterway automobile transport market was a strong impetus. Port, shipping, and vehicle enterprises have engaged in frequent cooperation since 2022. COSCO Shipping, Shanghai International Port Group, and SAIC Motor Corp., Ltd. jointly established Guangzhou Ocean Shipping Company and furthered their partnerships through equity swaps. Chery established Anhui Hangrui International Ro-Ro Transportation Company with Anhui Provincial Port and Shipping Group and JAC Motors. Apart from expanding the seaborne shipping business through cooperation, some **automobile companies ordered ships as cargo owners and set up waterway transport departments to develop the vehicle shipping export business.** After BYD ordered two 7,000-space dual-fuel vehicle ro-ro ships with China State Shipbuilding Corporation, it signed an order with China Merchants Industry Holding Co., Ltd. for four 9,400-space dual-fuel vehicle ro-ro ships. According to China's Ministry of Commerce, BYD's business scope has expanded to ship management. Meanwhile, the Chery Group is also actively building free car carriers. Chery Group and its subsidiary Wuhu Shipyard Co., Ltd. built a car carrier ship construction base in Weihai and will start building the first batch of three LNG dual-fuel car carriers with 7,000 parking spaces in 2023. With the increasing presence of Chinese automobile brands, especially new energy vehicles, in the overseas market, the demand for China-

exported vehicles and shipping capacity will also increase. As companies expand their automobile production and transportation businesses via partnerships and independent development, the vehicle export scale at Chinese ports will also grow further.

3. **Automobile exports at ports boosted the loading technology development**

**The loading technology of container trucks at ports keeps progressing, but container trucks also face safety and efficiency challenges.** The shipping mode has evolved from two car spaces per container to three spaces per container. Four cars can be accommodated in one container for small and lightweight cars. The MR30 container double-decker car developed by PANASIA Shipping applies to various vehicles, making a technical breakthrough by supporting four cars in one container. On the other hand, the wheel hub is usually tied to the container to fix the vehicle in the container's safety or an inflated airbag is placed between the vehicle and the container to provide a buffer. Both methods require a large amount of labor and time, while transporting vehicles into and out of containers is also a challenge, leading to overall low efficiency and high difficulty of container loading. Vehicle safety is also an issue not to be underestimated. The containers make it more difficult to monitor the vehicles in them. Currently, the new energy vehicles mostly use lithium batteries, which harbor fire hazards. Due to the high monitoring difficulty, safety problems are more likely to occur for car enterprises. Out of safety considerations, new energy vehicles may be transported in refrigerated containers. However, the technical difficulties, economic costs, and loading and unloading efficiency issues with the refrigerated shipping mode deter carriers from using it.

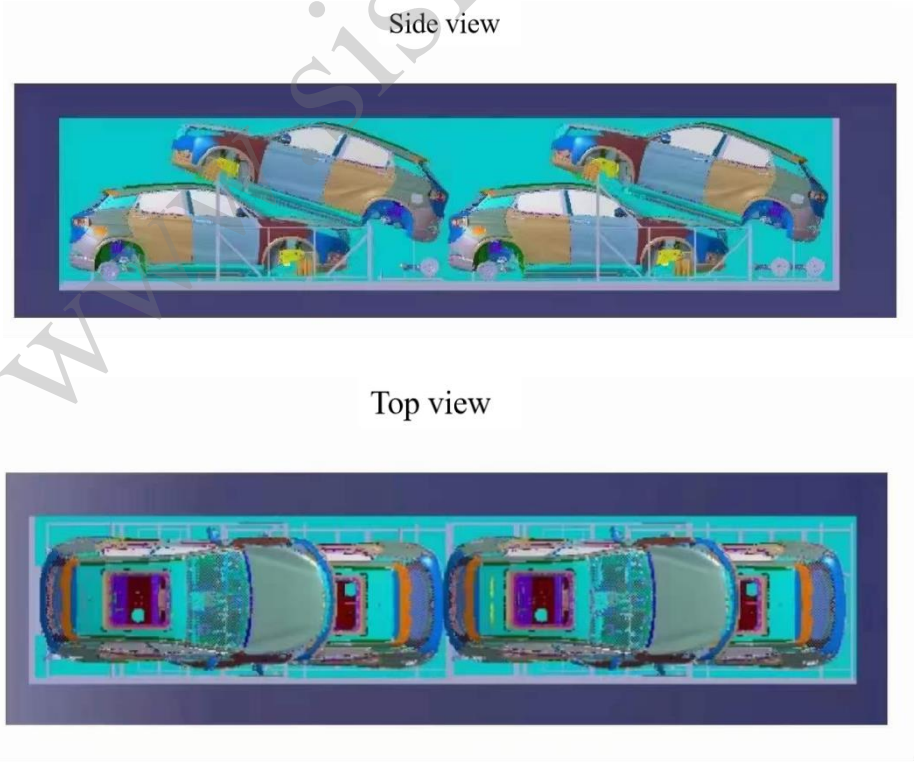



**Figure 3 Side View and Top View of Loading Containers with "Four Cars per Container"**

**In addition to ro-ro and containerized shipping, ports tried to upgrade their carrying and loading equipment and use wood-pulp carriers to export vehicles.** The multi-purpose wood-pulp ships can carry cars using COSCO Shipping Specialized Carriers Co., Ltd.'s 48-foot "foldable frame for commercial vehicles". One frame can flatly hold three vehicles, stacked eight layers high in the ship's cargo hold, with a single ship capable of carrying about 2,600 commercial cars per voyage, which is equivalent to the capacity of a small and medium-sized professional car ship. In addition, China has a large demand for paper imports every year, primarily from the Americas and Europe. In COSCO Shipping Specialized Carriers Co., Ltd.'s route design, the multi-purpose wood-pulp ship first uses the "foldable frame for commercial vehicles" to transport vehicles to regions with a high demand for automobile imports such as Europe, and then directly from Europe or empty ships to the Americas to load pulp for transport back to China, realizing fully-loaded round-trip voyages. Since the "foldable frames for commercial vehicles" occupy a small area after being folded, they can be placed on the deck when the ship transports pulp back to China. According to COSCO Shipping Specialized Carriers Co., Ltd.'s data, seven flat rack containers stacked are roughly equivalent to the size of a 40-foot container.


Chart source: COSCO Shipping Specialized Carriers Co., Ltd.

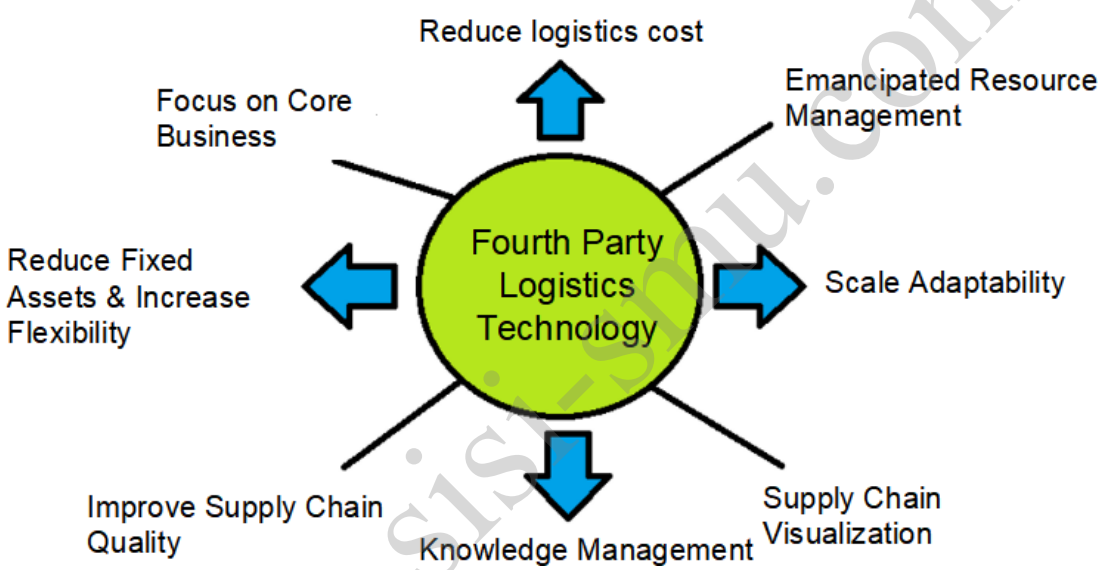
**Figure 4 "Foldable frame for commercial vehicles" used by COSCO Shipping Specialized Carriers Co., Ltd.'s multi-purpose wood-pulp ships**

## 3.2 Port Operations and Development

### 3.2.1 Fourth-party logistics solutions improved supply chain resilience of ports

**The fourth-party logistics solution further integrates modern technology based on**

**third-party logistics to enable digitalized and visualized supply chains and a higher turnover rate of port logistics.** The fourth-party logistics technology provides comprehensive supply chain solutions from strategic planning and design to implementation through integrating logistics resources, facilities, and technology and using modern information technology. Maersk Group and PSA Singapore are the first port companies to propose fourth-party logistics solutions. The fourth-party logistics solutions enable them to master supply chain information throughout the process and adjust cargo volume and cargo entry and exit time to increase the logistics performance while cutting port warehousing costs, flexibly controlling the intensity of operations, and speeding up the turnover rate of port containers. The solutions also elevate the supply chain capacity and provide customers with more transparent and efficient end-to-end logistics services, enhancing port competitiveness.



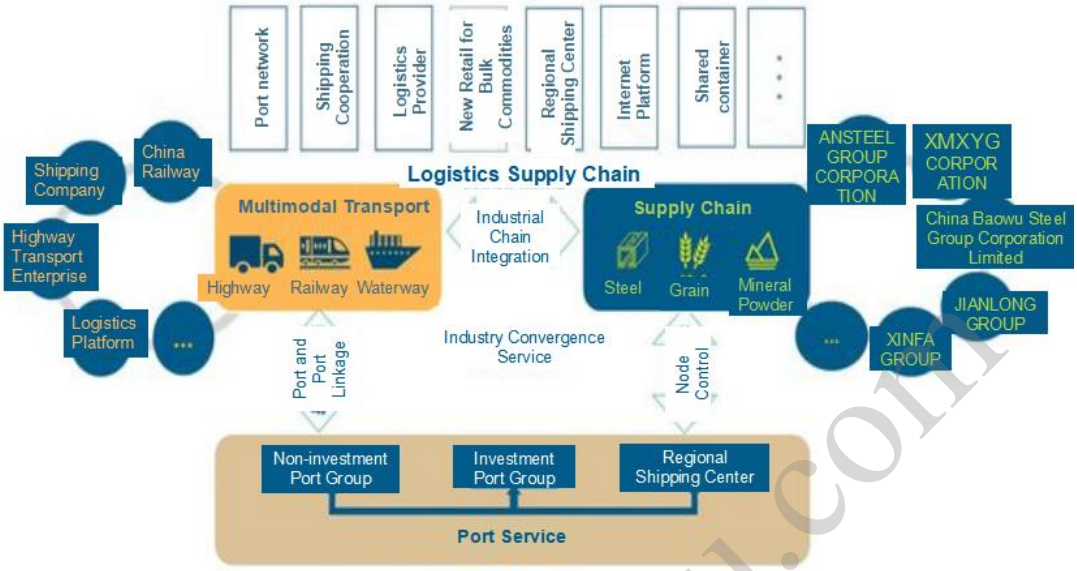

Source: Prepared by SISI.

**Figure 3-2 The Fourth-Party Logistics Technology**

### 3.2.2 Ports actively invested in and developed diversified businesses to mitigate risks

**Port enterprises augmented investment in waterway transport and actively launched joint-stock cooperation to reduce the risk rate.** After ports reached a certain size, most port enterprises looked to investment projects with stable returns. Port waterway investment is one of the most suitable methods. Port and shipping enterprises shared technology through equity swaps to reduce homogeneous competition for win-win cooperation. Taking domestic port and shipping companies as an example, Lianyungang and SIPG realized equity swaps for further capital and technical cooperation and joint construction of logistics channels. China Merchants Port signed an RMB 10 billion share subscription plan with Ningbo-Zhoushan Port Co., Ltd., and the two parties became each other's second-largest shareholder, holding 23% of the shares. Internationally, COSCO Shipping further expanded its shareholding ratio

in the Zeebrugge Terminal based on its shares in the Port of Rotterdam and Port of Antwerp. It also reached an agreement with Germany to take a 25% stake in the Port of Hamburg.




Source: China Merchants Port, prepared by SISI.

**Figure 3-3 Business Development of China Merchants Port**

**The port actively developed diversified types of business cooperated with various enterprises, and expanded the global business.** In 2022, DP World cooperated with Americold to invest in building a global food supply chain. In addition, the group also launched the World Logistics Passport program to provide cost-effective market access and fast cargo tracking. COSCO Shipping runs a global port network. As of 2022, it operated and managed 357 terminals at 36 ports worldwide. Its port portfolio extended from Southeast Asia to the Middle East, Europe, and the Mediterranean Sea. China Merchants Group also acquired equity in eight high-quality ports in Europe, the Middle East, and the Caribbean area, expanding the Group's global business. SIPG focused on multiple assets and set foot in real estate, cruises, and finance sectors. Specifically, its financial investment income accounted for more than half of its total profit and real estate income exceeded 25% of the total revenue.

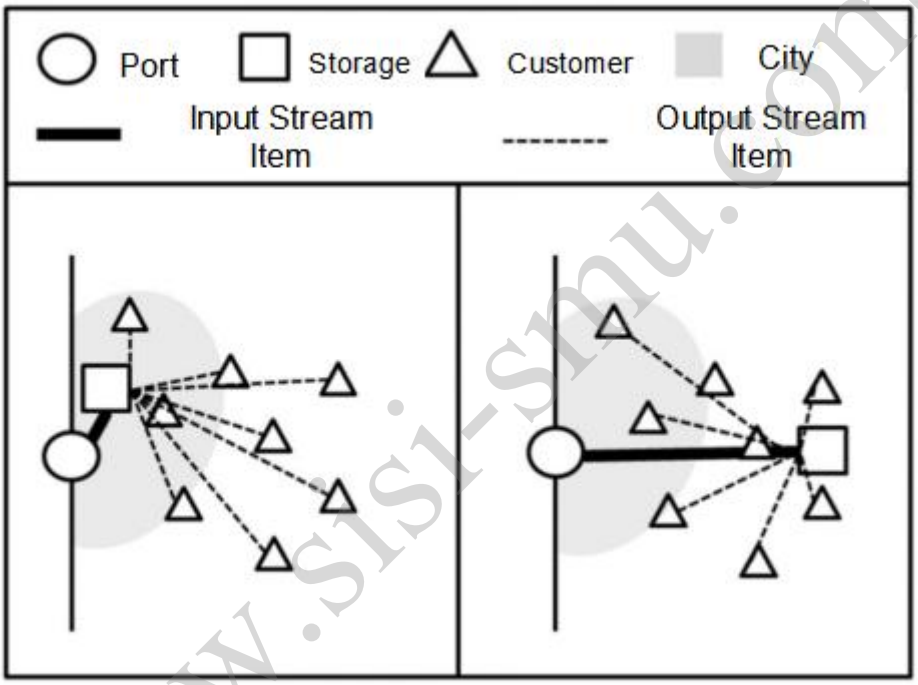
## 3.3 Port Management Development

### 3.3.1 Rise of the port-centric logistics (PCL) model

The port-centric logistics (PCL) model means that the logistics and distribution services are based in the port. Therefore, cargoes can be delivered to the customers directly from the warehouses at the port, which can significantly shorten the delivery time. Meanwhile, the ports can offer derivative services to enhance the port's competitiveness.

**The rise of the PCL model was closely related to high-quality logistics services and set higher requirements for logistics chain technology**. The growth of e-commerce

orders and seaborne cargo volume fueled this model development at the ports, as the former could ensure full-process visualization of the logistics chain data. Port of Liverpool received the highest score for applying the PCL model in the United Kingdom. As a result, its maximum delivery cycle for e-commerce cargoes was shortened by 40%, from an average of 140 days to 100 days. In addition, the port of Liverpool cooperated with the British retailer B&M starting from 2011. The flexible port logistics model enabled B&M to transport and warehouse 85,000 TEUs of cargoes during the peak Christmas season, saving up to 4 million logistics miles per year. In addition, DP World invested GBP 350 million in London in 2022 to establish a port-centric logistics park, combining intelligent logistics technology with the port logistics model.



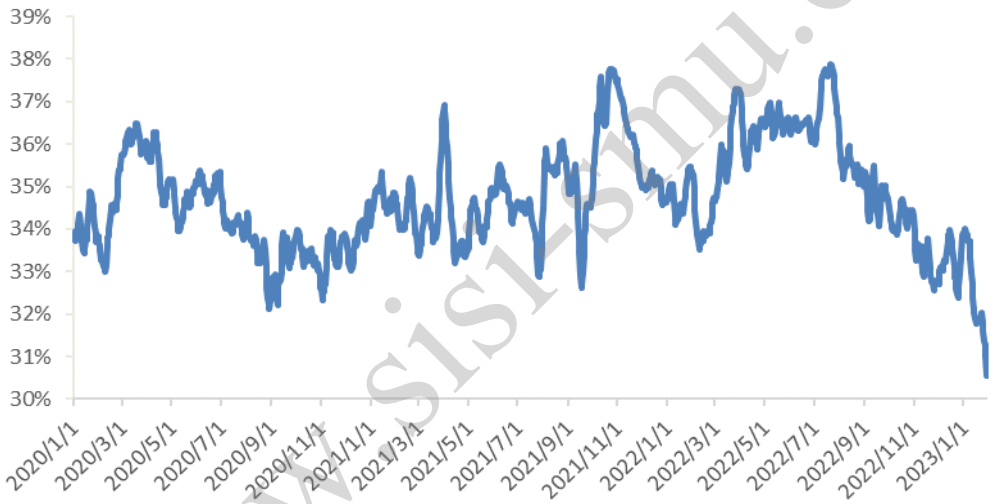

Source: Journal of Transport Geography.

**Figure 3-4 Port-centric logistics model (left) and traditional logistics model (right)**

**The port-centric logistics model features higher requirements on warehousing and derivative services, which must be integrated with modern technology**. Enterprises needed to store cargoes at ports. In addition to traditional technologies, automation technologies are also needed, such as collaborative robots, warehouse management systems (WMS), or automated storage systems. With the PCL mode, the Port of Hull in the United Kingdom split a traditional distribution center of 500,000 square feet into two warehousing points of 250,000 square feet each, saving rent by 1.72% per year, totalling GBP 2 million throughout the 20-year lease period. With warehousing services, retailers can keep greater control over the entire supply chain, using port import centers as "buffer zones" to improve supply chain stability.

### 3.3.2 Implications continued after port congestion eased

**As port congestion was alleviated faster, the shipping capacity became oversupplied, and ship enterprises and cargo owners cut their shipping capacity input.** As freight rates dipped, ship enterprises withdrew part of their shipping capacity and increased the freight charge by cancelling routes and leases, suspending voyages, or idling ships to control the costs. As a result, many ships were withdrawn from the U.S. routes and put into other routes, and the capacity layout gradually returned to normal. China United Lines (CULines), planning to go listed, terminated the ship charter and container lease contracts with An Tong Holdings Limited at the beginning of November 2022. In December of the same year, Wan Hai Lines sold and dismantled ten old ships. In addition, cargo owners who entered the shipping market by buying or chartering ships at the high market level also began to exit. Costco Wholesale Corporation, the largest membership-only supermarket chain in the United States, was cutting its investment in container ship leasing. IKEA also announced its plan to exit the shipping market, selling containers it bought last year.




Source: Clarksons, prepared by SISI.

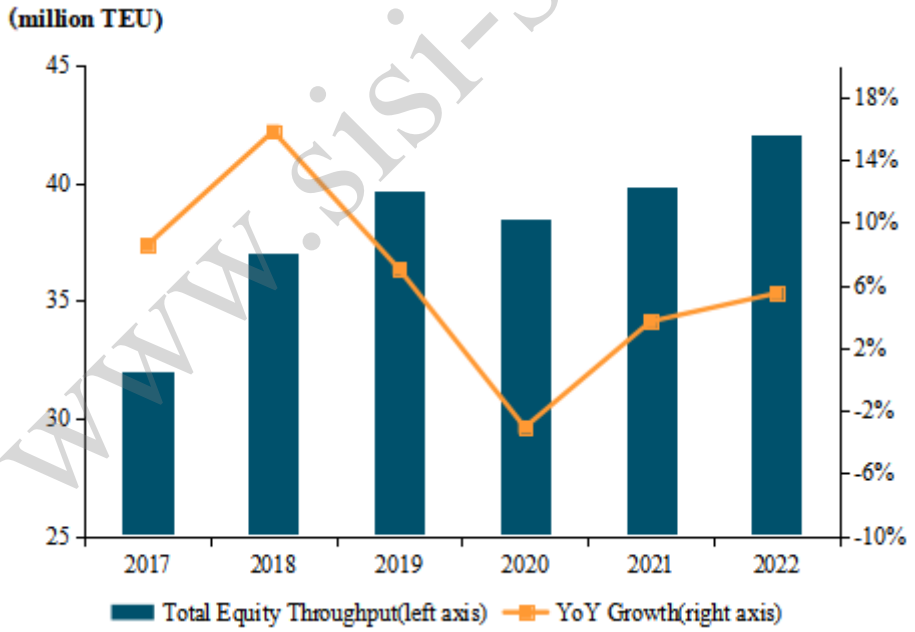
**Figure 3-5 Global Port Congestion Index - Percentage of Congested Container Fleets in Capacity**

# Chapter 4 Comment on Global Terminal Operator Development in 2022

Geopolitical issues continued influencing the global supply chain in 2022, driving up food and energy prices. Meanwhile, inflation reached a high level in recent years. The weakness of the consumer side caused a gradual decline in the seaborne trade demand. Global terminal operators became aware of the importance of risk reduction. While continuing to invest in global ports, they diversified their business types to spread risks and actively utilized information technology to expand the logistics industry chain and transform into integrated logistics providers.

## 4.1 COSCO Shipping Ports' Business Grew by a Small Margin

The container shipping market fluctuated greatly in 2022 due to repeated pandemic outbreaks, high inflation, and economic downturn. As a result, COSCO Shipping Ports actively invested in terminal construction at home and abroad. As a result, supported by positive factors such as the increased investment in overseas terminals, the group's annual equity throughput increased by 5.5% to 42.07 million TEUs, with the total container throughput up by 0.6% year-on-year, reaching 130.11 million TEUs.




Source: COSCO Shipping Ports website, prepared by SISI.

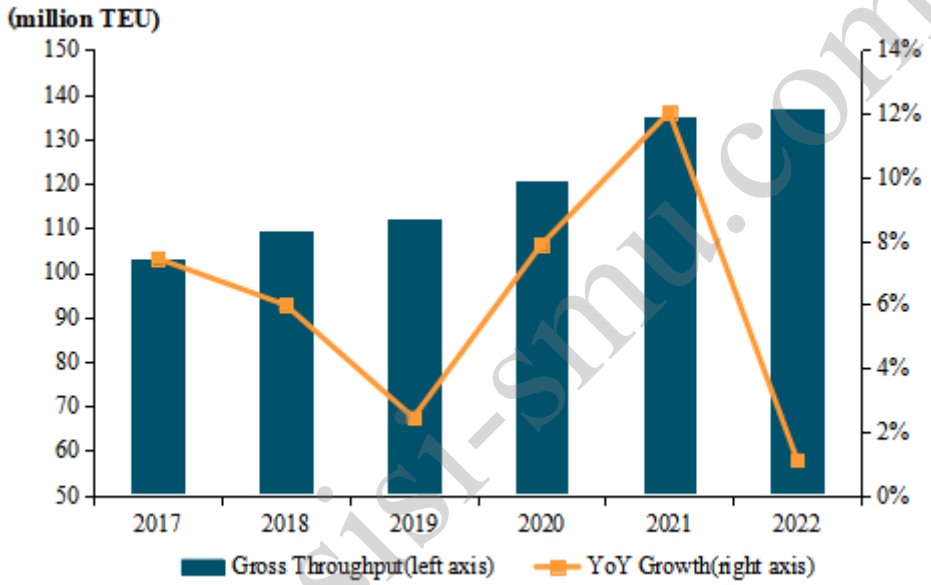
**Figure 4-1 Total Container Throughputs and Growth Rates of COSCO Shipping Ports in 2017–2022**

According to the profit data, COSCO Shipping Ports actively adjusted its equity structure and expanded its overseas business in 2022. It also cooperated with alliance

members, increasing its annual operating income by 19.3% to USD 1.44 billion. As a result, its net profit ran flat with that in the same period last year, while gross profit rose sharply by 32.1% to USD 430 million.

## 4.2 China Merchants Port's Business Showed Stable Performance

China Merchants Port fully utilized the advantages of its global port network layout and secured the stable development of business in 2022. Its cumulative container throughput for the year was 136.53 million TEUs, a year-on-year increase of 1.1%, and the container equity throughput was 51.37 million TEUs, an increase of 0.6% year-on-year.




Source: China Merchants Port website, prepared by SISI.

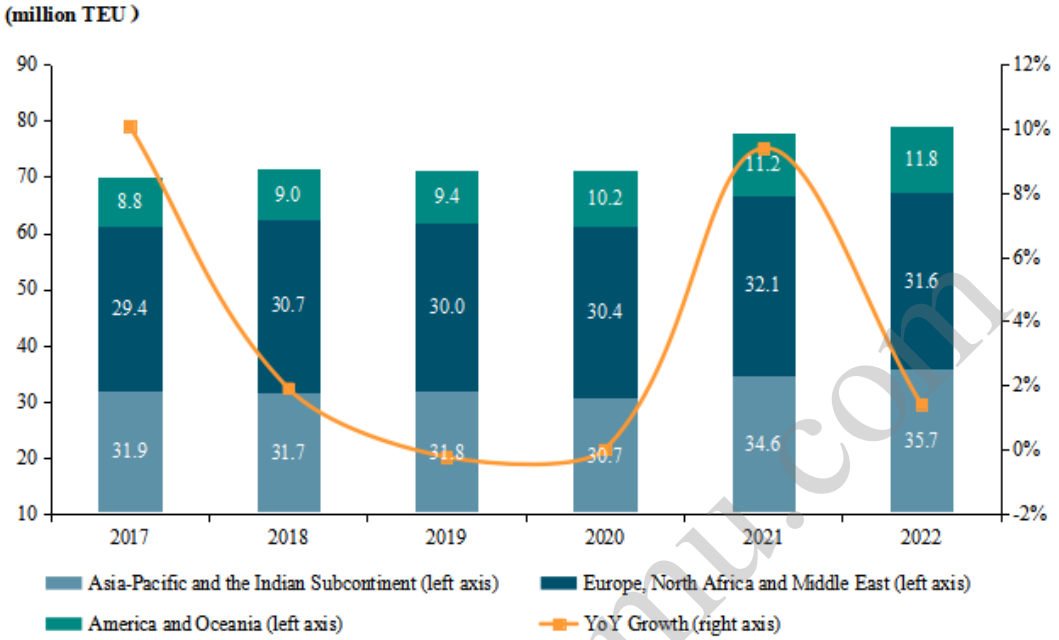
**Figure 4-2 Container Throughputs of China Merchants Group in 2017–2022**

In terms of profitability, factors such as the repeated COVID-19 outbreaks, geopolitical tensions, and inflation in 2022 caused a serious impact on the global economic outlook, bringing more uncertainties to global economic and trade development. Given the complex and ever-changing international situation and surrounding environment, China Merchants Port took advantage of its global port layout and recorded an annual operating income of HKD 12.55 billion, a year-on-year increase of 5.9%. However, the profit attributable to the company's equity holders was HKD 7.781 billion, a year-on-year decrease of 4.5%.

## 4.3 DP World's Business Growth Slowed Down

DP World expanded its business types in 2022 and actively cooperated with government departments and enterprises to resist the economic downturn. As a result, its total container throughput increased slightly, but the growth rate of throughput dropped

significantly. The group continued to invest in building new terminals, renovating old terminals, and promoting modern logistics technology in the United Kingdom, Korea, and other places. As a result, the container throughput of DP World in 2022 increased by 1.4% year-on-year, with the equity throughput increased by 1.5%.




Source: DP World annual report, prepared by SISI.

**Figure 4-3 Total Container Throughputs and Growth Rates of DP World by Region in 2017–2022**

In terms of profitability, DP World recorded a record-breaking operating income in 2022 by focusing on high-end logistics and providing customized supply chain solutions, a year-on-year increase of 58.9% to USD 17.13 billion. The group's adjusted earnings before interest, tax, depreciation, and amortization (EBITDA) were as high as USD 5.01 billion. Under the large operating income base, the adjusted EBITDA profit margin was still as high as 31%. DP World strove to transform itself into an integrated logistics provider, providing customized end-to-end services while accelerating the pace of acquisitions of logistics companies and other industries.

## 4.4 APM Terminals' Business Growth Slowed Down

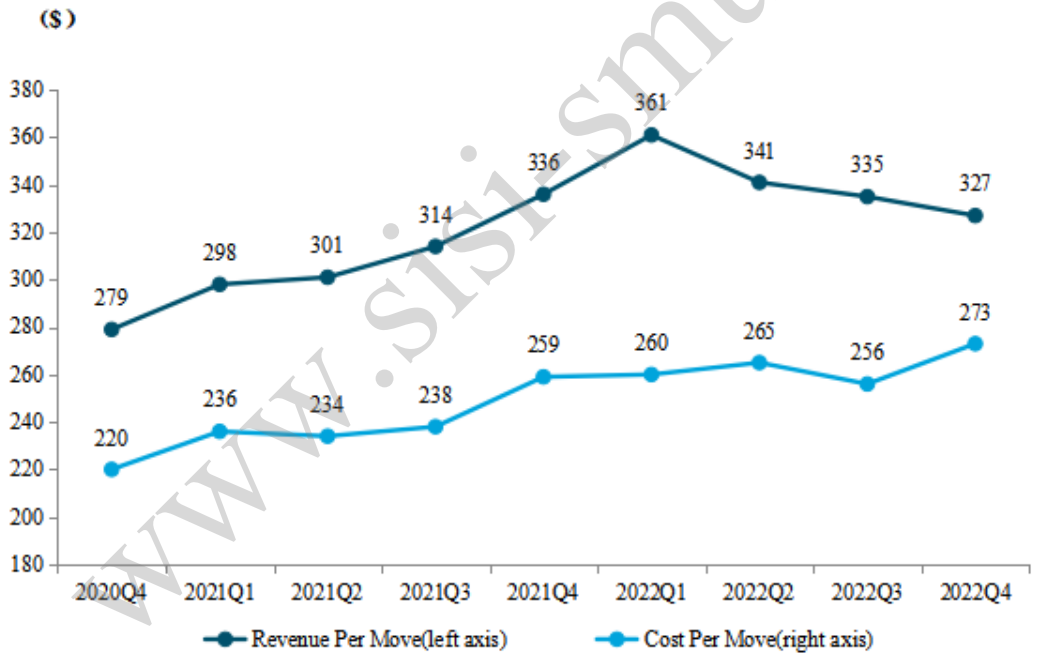
APM Terminals' global container business continued stable performance in 2022. The group's terminal performance in Asia increased significantly compared with other regions, while that in the Americas rose slightly. Its business volume in other regions declined to a certain extent. Specifically, the year-on-year throughput increase in the Asian region was largely driven by the Port of Yokohama in Japan and the Port of Pipavav in India. The group's throughput in the Latin America region fell by 5.4% due to delays in the privatization of the Port of Itajaí in Brazil, whose concession contract expired in 2022, and the divestiture of a terminal at the Port of Cartagena, Colombia.

In Europe, the regional container volume fell by 0.5% due to the short-term business interruptions caused by a terminal operating system upgrade at the Port of Valencia in Spain. Throughputs of Port of Onne, Nigeria, and Port of Cotonou, Benin, fell, leading to a 3.1% drop in port throughput in Africa and the Middle East.

**Table 4-1 Throughputs on Consolidated Statements of APM Terminals by Region in 2022 (Unit: million moves)**

Source: APM Terminals annual report, prepared by SISI.

| Area | 2022 | 2021 | Year-on-year growth |
|---|---|---|---|
| **North America** | 3.3 | 3.2 | 1.6% |
| **Latin America** | 2.4 | 2.5 | -5.4% |
| **Europe, Russia and the Baltic Sea** | 2.6 | 2.6 | -0.5% |
| **Asia** | 2.6 | 2.5 | 5.2% |
| **Africa and the Middle East** | 1.9 | 2.0 | -3.1% |
| **Total** | 12.8 | 12.8 | 0.2% |




Source: APM Terminals annual report, prepared by SISI.

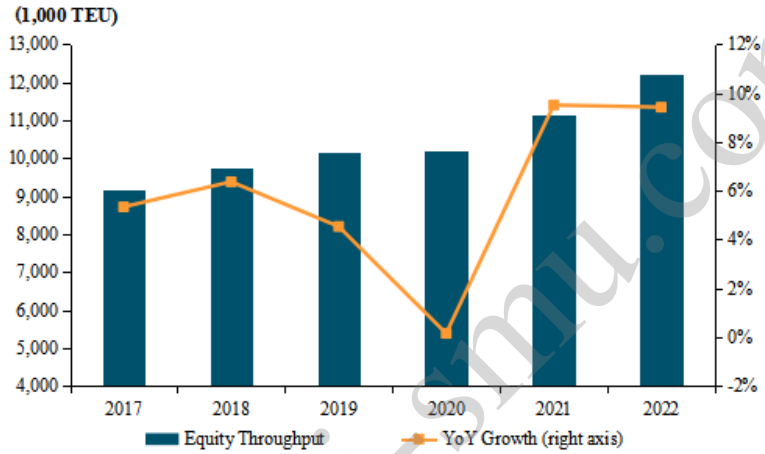
**Figure 4-4 APM Terminals' Cost Per Move and Revenue Per Move in 20Q4–22Q4**

In terms of profitability, despite the container shipping market downturn in 2022, the annual throughput maintained growth. Given this momentum, APM Terminals actively invested in logistics and services. Its terminal warehousing revenue increased, and its financial performance in 2022 was excellent, recording a 32% increase in operating revenue. Specifically, the cost per move in the American region rose by 4.1%, lower than the average inflation rate, as the product increase offset the increases in labor costs, operating costs, and energy prices. Revenues in Europe, Africa, and the Middle East

rose due to higher CPI growth and warehousing earnings. The shipping volume in the Latin America region declined slightly, but the different cargo mix improved the overall revenue to a certain extent.

## 4.5 ICTSI Continued Business Growth

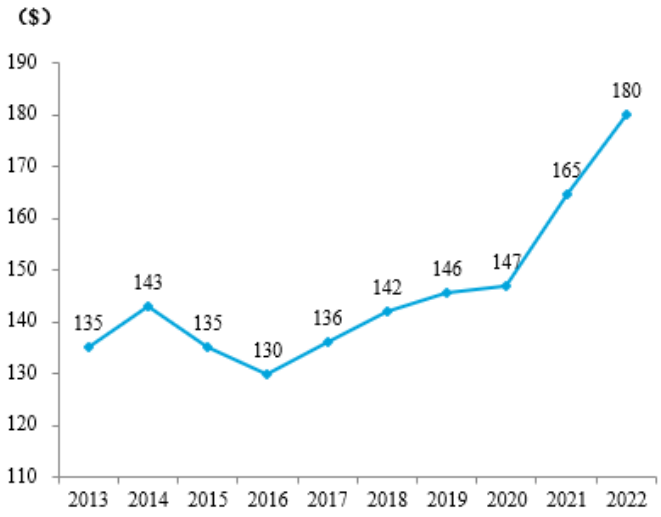
ICTSI benefited from the excellent performance of its Southeast Asian and African terminals in 2022 and posted strong growth in equity throughput and operating revenue. The group completed a container equity throughput of 12.22 million TEUs in 2022, a year-on-year surge of 9.4%. Its port segment revenue also soared by 20.3% year-on-year.




Source: ICTSI website, prepared by SISI.

**Figure 4-5 Container Throughputs of ICTSI in 2017-2022**

The ICTSI's operating revenue in 2022 hit USD 2.24 billion, continuing the growth in 2021, and its revenue per container hit a record high at USD 180 per container. The ICTSI's earnings before interest, taxes, depreciation and amortization (EBITDA) in 2021 was USD 1.41 billion, a year-on-year increase of 24%. Its capital expenditure was largely used for terminal expansion and upgrading, approximating USD 200 million. Its consolidated operating expenditure in cash was about USD 610 million, an increase of 17%.

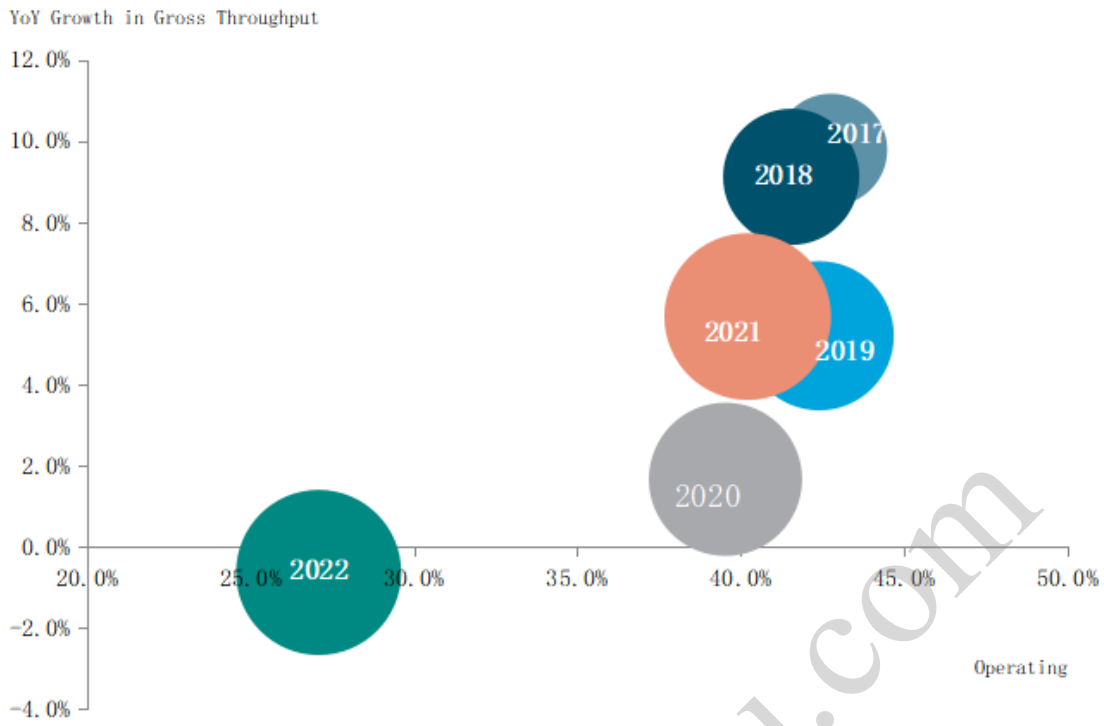



Source: ICTSI website, prepared by SISI.

**Figure 4-6 Revenue Per Container of ICTSI in 2013–2022**

## 4.6 PSA International's Business Dropped Slightly

The geopolitical factors in 2022 led to macroeconomic instability, high inflation, rising fuel and grain costs, supply chain disruptions, and climate pressure, which further caused a downturn in port service and production operations. As a result, PSA Singapore completed a throughput of 90.9 million TEUs in 2022, a year-on-year decrease of 0.6%. However, due to business diversification, especially the acquisition of the business and high revenue from financial investment, PSA Singapore's annual operating revenue increased by 71.2%, with its operating profit margin reaching 27.1%.



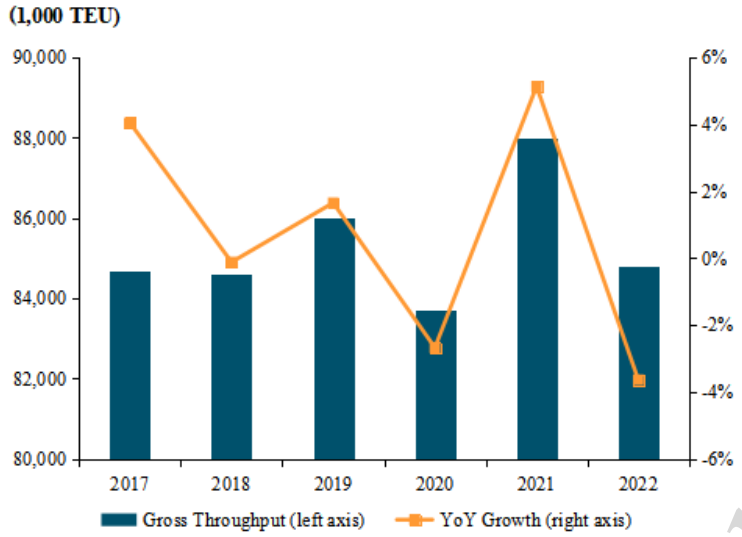

Note: Bubble size in the bubble chart indicates the total throughput scale.

Source: PSA International annual report, prepared by SISI.

**Figure 4-7 Total Container Throughput Growth Rates and Operating Margins of PSA International in 2016–2021**

## 4.7 CK Hutchison's Business Performance Dipped

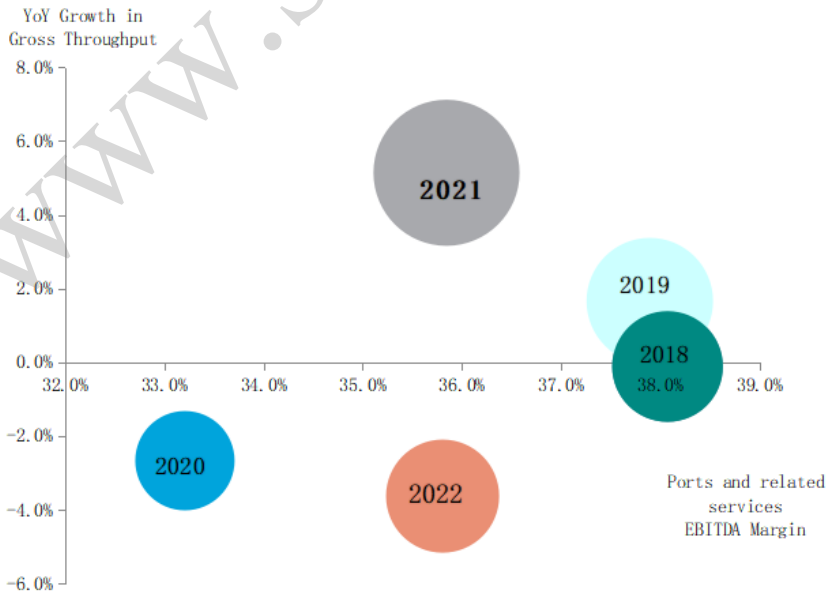
Impacted by the reduced cargo export to the United States and Europe and the prolonged pandemic prevention measures, CK Hutchison's container throughput fell by 3.6%, with all sectors experiencing a decline to a certain extent, especially in the throughputs of Hutchison Port Holdings and the mainland China business segments.




Source: CK Hutchison Holdings Limited, prepared by SISI.

**Figure 4-8 Container Throughputs of CK Hutchison and Related Service Sectors in 2017–2022**

In terms of profitability, despite the container throughput decline, Hutchison Whampoa Limited's total revenue for 2022 increased by 4.4%. The profit was largely driven by the strong performance of throughput and warehousing earnings in Mexico. Meanwhile, the warehousing business of ports such as the Port of Barcelona in Spain, the Port of Rotterdam in the Netherlands, and the Port of Alexandria in Egypt recorded substantial profits. As a result, CK Hutchison's operating revenue in the port and related services sectors in 2022 recorded HKD 44.14 billion, with an EBITDA of HKD 15.81 billion.




Source: CK Hutchison Holdings Limited, prepared by SISI.

**Figure 4-9 Container Throughputs and EBITDA Variations of CK Hutchison in 2018–2022**

# Chapter 5 Overview of Global Terminal Investment and Construction in 2022

Port congestion continued for more than half a year in 2022. Coupled with the impact of events such as the military conflicts in Ukraine on the international landscape, supply chain stability remained a top concern, and port investment and construction were still relatively high. Specifically, the investment and construction of container terminals expanded. Asia continued to steadily advance the construction of container ports. American and European countries continued to expand investment in trafficability and efficiency enhancement. Ports in African regions absorbed much foreign capital to improve port infrastructure. Global container terminal construction exhibited an obvious trend toward larger size and automation. The military conflicts in Ukraine that broke out in early 2022 reshaped the global natural gas supply and demand pattern and trade flows. Many countries started to look at alternatives to pipelined natural gas imports from Russia. In addition, natural gas was used as an important transitional energy in the energy transformation of countries worldwide. The LNG shipping market ushered in new development opportunities as importers/exporters invested more in building LNG regasification/liquefaction terminals to meet their LNG import and export demands.


**Figure 5-1 Distribution of Major Newly-Expanded Ports around the World in 2022**

## 5.1 Comments on investment and construction of container terminals

### 5.1.1 Asia posted steady progress in port construction

**1. China continued to advance port construction steadily**

China continued to steadily advance the construction of waterway transport facilities (including ports) in 2022, with the growth rate of fixed-asset investment for waterway transport reaching 9.2%. **The capacity of its coastal container hub ports was steadily expanded, with efforts devoted to the contiguous development of terminals. Significant progress was made in the capacity expansion planning of Shanghai Port**, and the construction project of Xiaoyangshan North Operation Area was advanced, which is expected to increase Shanghai Port's throughput by 11.5 million TEUs in 2035. Additionally, **the contiguous development trend of China's large container terminals became more evident. Ningbo-Zhoushan Port** built up the second "10-million-level TEUs" port area. **Yantian Port Area of Shenzhen Port** planned to complete three 200,000-ton super-large automated berths for containers by the end of 2025. **Qianwan Port Area of Qingdao Port** planned to connect the Phase 3 automated terminal project with the Phase 1 and Phase 2 projects in 2023 to gain a scale advantage. **The Phase 1 to Phase 4 container terminals of the Nansha Port Area of Guangzhou Port** were expected to be integrated for coordinated operations.

**Inland river container ports were still in a period of rapid expansion, striving to build new inland river container ports following high standards.** The fixed-asset investment in inland waterway transport has expanded in recent years and maintained a high growth rate of 10.4% in 2022. After the Phase 4 container terminal of **Taicang Port** became the first yard-automated terminal in the Yangtze River Basin in 2021, **Hefei Port** also entered the unmanned automation deployment test stage with the application of unmanned container handling vehicles. **Jining Longgong Port** 6#–8# automated container berths received joint debugging and testing of equipment. **Wuhan Yangluo Port** also launched a smart transformation project. A new round of "terminal revolution" was kick-started across inland river ports in the country.

**2. Multiple countries in Southeast Asia accelerated port construction planning**

**International transit hub ports steadily advanced long-term development planning.** Five berths were put into use in the Phase 1 project covering 21 berths (20 million TEUs throughput) of the Tuas Mega Port at the **Port of Singapore,** and the Phase 1 project is expected to wrap up by 2027. **Malaysia** planned to increase the throughput capacity of the Port of Kelang to 32 million TEUs by 2040, and the Port of Tanjung Pelepas planned to increase its handling capacity by 3.5 million TEUs by 2025. Port of Laem Chabang in **Thailand** planned to increase its capacity to 27 million TEUs in 2040 and 34.5 million TEUs in 2050. The Phase 3 project of the Port of Laem Chabang progressed steadily in 2022, and the two berths will be put into operation in 2025 and 2029, respectively.

**Many countries in Southeast Asia sped up their port development and investment planning.** For example, the Port of Patimban in **Indonesia** signed a container terminal expansion contract in 2022 to increase the throughput capacity by 2 million TEUs. In addition, the Sihanoukville Autonomous Port, the largest port in **Cambodia**, was carrying out its container terminal construction project (2021–2025) and received a new concessional loan of USD 310 million from the Japanese government in 2022 to support

its expansion and modernization endeavours. Meanwhile, Cambodia's third large multi-purpose international port - Kampot Multi-Purpose Deep-water Port - was officially started.

**3. Port investment and construction in the Middle East and South Asia were relatively prudent.**

**The construction investment heat in the Middle East was eased slightly, and multiple countries built their terminals to reduce dependence on regional transhipment hubs.** However, ports in the Middle East region experienced obvious overcapacity, and the construction investment boom eased slightly. Despite this, some major port investment and construction projects in the Middle East were announced in 2022. **The Port of Khalifa** officially launched the expansion project with a total investment of 4 billion dirhams. **Iraq** again proposed the rail plan to replace Suez Canal and built the largest port, Al-Faw Grand Port, at the Shatt Al-Arab river estuary to transport goods to Europe via Turkey.

**The investment and construction of ports in South Asia remained stable, with India planning to build a large container transhipment terminal. India** proposed building a large container transshipment terminal in the Galathea Bay at a cost of USD 5 billion in 2022 to eliminate its dependence on overseas transhipment ports and recover this part of business loss. The terminal is designed to offer a handling capacity of 4 million TEUs. The Port of Chittagong in **Bangladesh**, which undertakes more than 90% of Bangladesh's import and export trade, completed and put into operation the Patenga Container Terminal (PCT) in 2022, costing USD 240 million in investment. The terminal will be operated by Red Sea Gateway Terminal (RSGT) and increase the handling capacity to the Port of Chittagong by 500,000 TEUs.

### 5.1.2 American ports actively invested in construction

**1. U.S. ports started a wave of investment and construction**

**The supporting funds for the infrastructure bill were gradually ready, and the government funds drove the development of port infrastructure.** Biden officially signed the *Infrastructure Investment and Jobs Act* (IIJA) at the end of 2021, in which the five-year plan period and the USD 17 billion port infrastructure investment would be gradually implemented in 2022. For example, port construction projects were funded through the Port Infrastructure Development Program (PIDP) of the United States Maritime Administration (MARAD), with more than USD 703 million announced in October 2022 to support 41 port construction projects, being the biggest amount since the establishment of PIDP. The focuses included offshore wind power, port equipment electrification, and port expansion projects.

**The U.S. container hub ports issued large-scale investment and construction plans.** For example, the **California** state government issued a budget of USD 1.2 billion for a lump-sum port construction fund in early 2022 to provide financial support for California port and logistics infrastructure construction. In addition, the **Port of**

**Savannah** announced a plan in early 2022 to invest USD 540 million to increase its handling capacity to 9.5 million TEUs by 2025, including the expansion of the No. 1 berth of the Garden City Terminal, waterway deepening, and off-port yard construction among other measures. Ports such as the Port of Boston, the Port of New Orleans, and the Port of Baltimore also had plans for port expansion or construction.

**2. Other countries in the Americas were also actively carrying out port construction**

As the global pandemic situation eased, countries in Central and South America began to actively resume production, and investment in port construction gradually increased. Meanwhile, many overseas investments from developed countries and economic powers also came in.

**Ports around Panama in the Americas launched construction, vying for the growing supply of cargoes in the eastern part of the Americas. On the one hand, large container terminals were constructed in the estuary area of the Panama Canal**. For example, Notarc Management Group (NMG) completed the Panama Canal Container Port (PCCP) franchise rights acquisition with a total investment of USD 1.4 billion. On the other hand, new logistics solutions were planned to replace the Panama Canal, and Zergratran, an American transportation infrastructure company, was planning to start a container transhipment project in northern **Colombia**. It would build underground tunnels and use magnetic levitation technology to transfer containers between the Atlantic and Pacific coasts in northern Colombia.

**Brazil, Mexico, Peru, and other countries in Central and South America were actively carrying out port investment and construction.** The **Mexican** government planned to build three new container terminals in 2022 and would receive USD 230 million of investment to expand the Port of Manzanillo, Mexico's largest container port. **Brazil**'s Ministry of Infrastructure contracted with six private terminal operators to build new terminals to help Brazil become more competitive in international trade. The **Peruvian** government continued to expand the investment from domestic and foreign investors in Peru to promote economic development. DP World Callao's invested USD 340 million in expanding Muelle Sur, the southern terminal of Port of Callao. China COSCO Shipping Group made staged progress in its USD 3 billion investment in constructing the Chankai Port, and the project was expected to be completed in 2024.

### 5.1.3 European ports strengthened renovation and expansion efforts

**Major European container hub ports actively announced new investment plans for port expansion/construction.** The three basic ports in Europe enhanced port capacity and improved logistics channels through investment and expansion. The **Port of Rotterdam** planned to develop a new container terminal at Europahaven. **After the merger, the Port of Antwerp-Bruges renovated and expanded the Europa terminal** to improve terminal trafficability. The **Port of Hamburg** concluded the huge works of the Elbe River and Outer Elbe channels. Apart from the three base ports, other major container hub ports also had investment plans. The **Port of Bremerhaven** announced

its expansion and upgrading plan, and construction is expected to start in 2026. TIL announced an investment of EUR 700 million in TPO and TNMSC container terminals in Port of Le Havre, France, making the port a gateway to Northwest Europe.

**The Port of Gdańsk consolidated its status as a container hub port in the Baltic Sea region.** As a result, the Port of Gdańsk became the largest container port in the Baltic Sea region in 2021. In November 2022, it launched the construction project of DCT Gdansk's third deepwater terminal (T3), which is expected to increase the port's handling capacity to 4.5 million TEUs after completion in 2025. The geographical location of the Port of Gdańsk makes it a gateway to Central and Eastern Europe and a transhipment center in the Baltic Sea region. With the rapid growth in throughput and active investment in construction, the port is expected to rank among the top ten container ports in Europe.

**The Mediterranean transhipment hub ports actively promoted the expansion of container ports.** The **Port of Tanger-Med** automated terminal APM Terminals MedPort Tangier was still expanding and developing. Its Phase 2 and Phase 3 expansion projects were expected to be put into operation in 2024 and 2025, respectively, increasing the port's trafficability by 2.1 million TEUs. The **Port of Valencia, Spain**, planned to build a new container terminal costing EUR 1.4 billion, targeting a goal of "the most environmentally friendly terminal in the world". The construction was planned to be completed by 2030 to increase the throughput capacity by 5 million TEUs.


Note: "■" refers to under construction; "■" refers to construction planned; and "■" refers to construction completed.

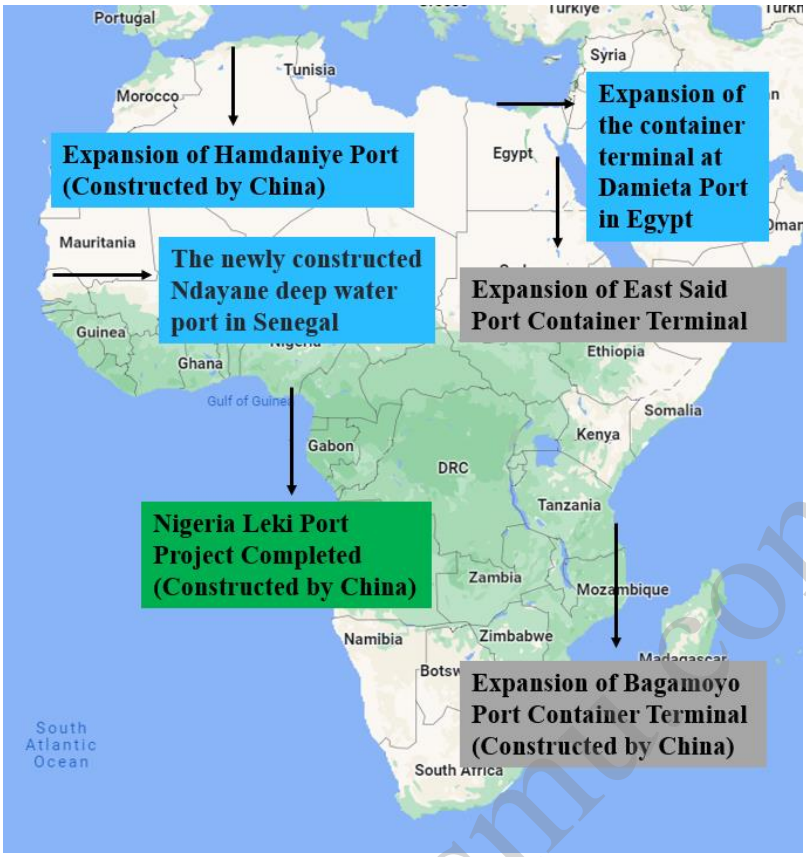
**Figure 5-2 Distribution of Newly Expanded Container Terminals in Europe**

### 5.1.4 Africa was committed to improving port infrastructure

Many African countries were committed to improving port infrastructure and actively attracted foreign capital to narrow the gap with ports in other parts of the world.

**China actively participated in the construction of African ports.** First, the **Bagamoyo Port** project was announced to start construction in 2023 and is expected to have a handling capacity of 20 million TEUs by 2045. Second, the **Nigerian Lekki Port project** undertaken and operated by China Harbour Engineering Company Limited (CHEC) was completed, with a franchise period of 45 years. It is the first modern deep-water port in the Gulf of Guinea controlled by a Chinese-funded enterprise, and also one of the largest ports in West Africa. Finally, the **Port of El Hamdania**, invested in and constructed by China, was under construction. After completion, it will have a handling capacity of 6.5 million TEUs and 26 million tons and be operated by Shanghai International Port Group for 25 years.

**Capital owners such as terminal operators and shipping companies were also actively building and investing in terminals on the African continent.** First, shipping companies invested in constructing container terminals at the mouth of the Suez Canal one after another to meet the transhipment needs. For example, the Damietta Alliance Container Terminal joint venture by three European logistic giants planned to invest in the development of the Phase 1 project of the No. 2 container terminal "Tahya Misr 1" in **Damietta Port**, Egypt, as a Hapag-Lloyd's dedicated strategic transhipment hub in the Eastern Mediterranean. In addition, Maersk signed a cooperation agreement with the Suez Canal Authority to invest USD 500 million in building the second container terminal in **East Port Said**. Global terminal operators were also actively deploying container terminals in Africa. For example, DP World's **Ndayane deep-water port** in Senegal, with a total investment of USD 1.13 billion in two phases, started construction in early 2022. It is expected to provide a handling capacity of 1.2 million TEUs after the completion of the Phase 1 project.

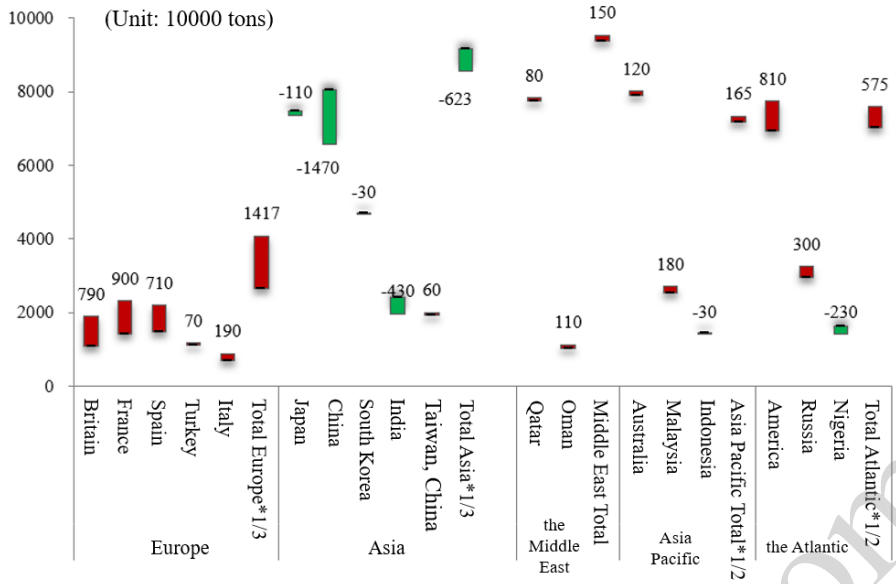



Note: "■" refers to under construction; "■" refers to construction planned; and "■" refers to construction completed.

**Figure 5-3 Distribution of Newly Expanded Container Terminals in Africa**

## 5.2 Comments on investment and construction of new energy terminals

After the military conflicts in Ukraine, the main trend of the global natural gas market in 2022 was that Europe accelerated the substitution of pipelined natural gas import from Russia and strengthened natural gas cooperation with the United States. As a result, the LNG shipping market embraced new development opportunities. Due to the surging LNG import costs, Asian countries, especially China, reduced their seaborne LNG imports. Overall, the LNG shipping trade fluctuated dramatically due to the geopolitics and natural gas prices in 2022. The medium and long-term global LNG shipping trade will most likely show diversification and expansion trends, and more countries will build LNG terminals to participate in LNG international shipping trade.




Source: Clarksons.

**Figure 5-4 LNG Import Volumes and 2021–2022 Gaps of Major Global Seaborne LNG Importers/Exporters**

### 5.2.1 European countries restarted construction of LNG import terminals

Europe proposed the "RE Power EU" energy independence plan in 2022, hoping to speed up its independence from Russia's natural gas, and imported a large amount of LNG in the second half of the year. Given the insufficient capacity of LNG import terminals in various countries, many countries restarted the previously shelved LNG regasification terminal import development projects, and planned to invest in terminal construction and development. Imported LNG will be transported by sea by way of other regions such as the United States, Australia, Qatar, and Saudi Arabia for diversified sources of LNG imports.

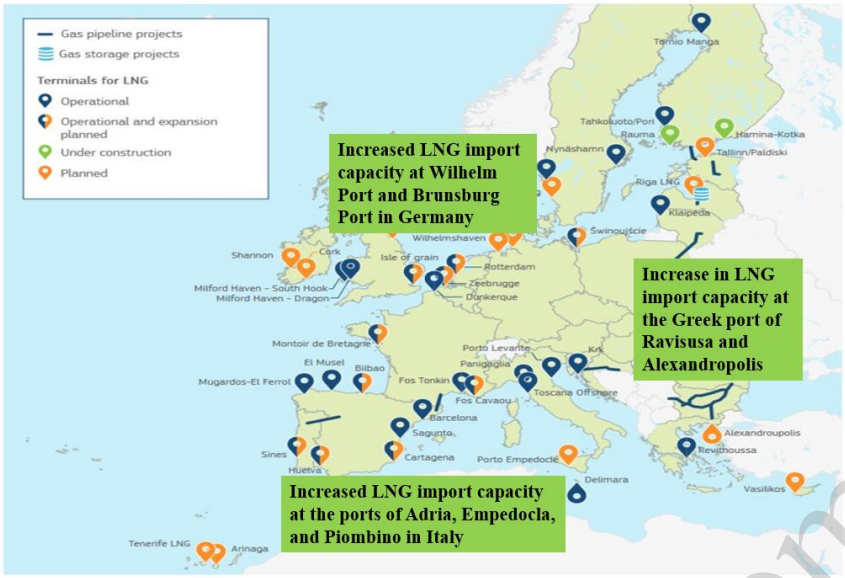



Chart source: European Commission.

**Figure 5-5 Distribution of Major LNG Terminals in Europe (Existing / Under Construction / Planning)**

**The future new import capacity of terminals in Europe will be primarily from countries such as Germany, Greece, Italy, and the Netherlands. Germany** planned to peak its LNG import capacity at 70.7 million tons annually by 2030 and become the world's fourth largest LNG importer. For this reason, it planned to build 10 Floating Storage Regasification Units (FSRU) in the short and medium term. After the landside LNG import terminals are completed, some FSRUs will be decommissioned. After **Greece** reduced the pipelined natural gas import from Russia, Revithoussa LNG, the only LNG import terminal in the country, was under surging pressure. To alleviate this tension, Greece planned several FSRU projects. **Italy** planned to restart the LNG import terminal projects in Gioia Tauro and Porto Empedocle. The two terminals will become operational in 2025 and 2026 in succession.

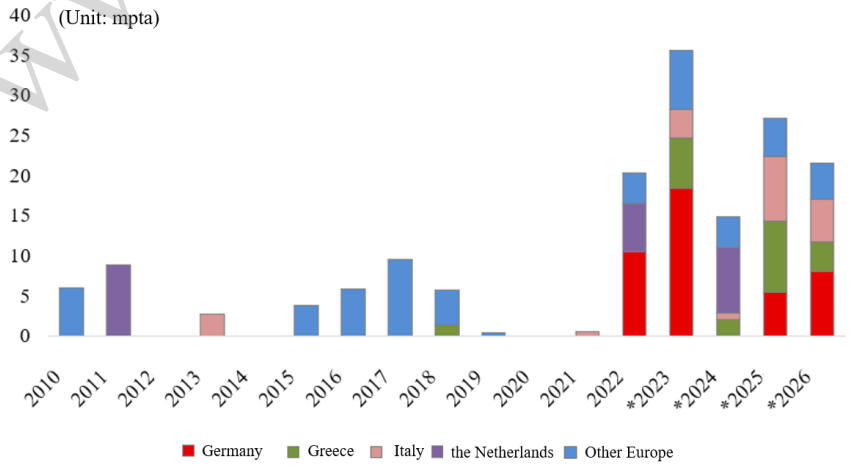



**Figure 5-6 New LNG Import Terminal Capacity in Europe in 2010–2026**

### 5.2.2 The United States continued to expand LNG export terminals

The United States was already tied with Qatar as the world's largest exporter of liquefied natural gas (LNG) in 2022, benefiting from its several billion US dollars of investment in LNG infrastructure. The United States built multiple LNG export terminals since 2016, which often operated at almost full capacity shortly after entering service. For example, the Calcasieu Pass (with a capacity of 10 million tons per year) that was put into operation in early 2022 was almost at full capacity after it entered service, boosting the United States' natural gas export volume to grow by 12% to 78 million tons in 2022. With the LNG demand expected to grow, especially as Europe planned to expand the LNG import from the United States and the United States continued to build and expand the capacity of LNG export terminals, it is estimated that the LNG export capacity in the United States will reach 21.7Bcf/d by the end of 2027.

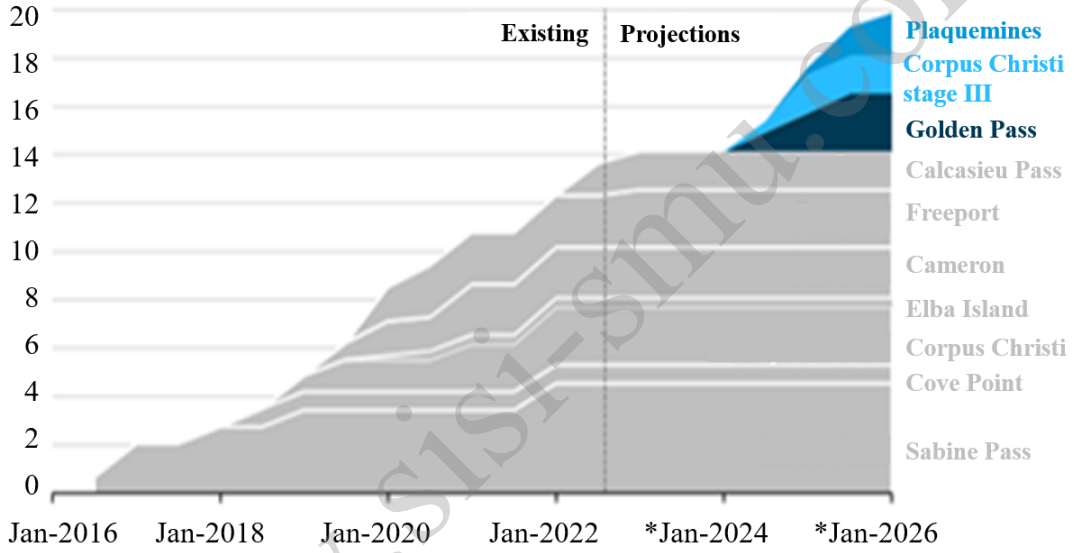



Chart source: U.S. Energy Information Administration (EIA).

**Figure 5-7 Trend of Number and Scale of LNG Liquefaction Terminals in the United States**

### 5.2.3 China sped up LNG import terminal construction

China's LNG import volume in 2022 declined due to factors such as fierce competition from Europe, high spot prices, and lower domestic demand amid the COVID-19 pandemic. However, the Chinese government adhered to the energy transformation goal. China steadily advanced its investment and construction of LNG import projects and facilities to meet the growing demand for natural gas. It newly invested in constructing two new LNG receiving stations in 2022, but the newly added capacity was not large enough, namely, the Hangjiaxin LNG receiving terminal of 1 million tons per year and the CNOOC Yancheng "Green Energy Port" LNG receiving station of 3 million tons per year. China has about 50 projects under construction or planning to serve the energy transformation goal. The facilities will be completed and put into operation in succession between 2023 and 2029.

### 5.2.4 Many Southeast Asian countries started to import LNG

Southeast Asia is expected to become the major area of LNG import growth in the next decade, considering the rapid growth of population and economy and the demand to transform toward decarbonized energy in the region.

**Traditional LNG importers in Southeast Asia had a weak demand for expansion, and only Thailand launched large-scale construction of new import terminals.** Singapore and Malaysia had no plans for large-scale construction. Thailand planned to build new import terminals in response to the depletion of natural gas resources in the Gulf of Thailand. The Nong Fab LNG receiving terminal, with an annual import capacity of 7.5 million tons, was put into use in 2022. An import terminal will be operational in 2025 and 2027, respectively.

**Multiple Southeast Asian countries faced a rapidly growing demand for LNG imports and planned the construction of import terminals to meet the demand.** Amid its efforts to look for and develop new gas fields, **the Philippine** government approved seven LNG import projects (as of early 2023), which will be put into operation successively from 2023 to 2025. **Vietnam** strove to implement its energy development strategy, including using clean energy in place of coal-fired electricity generation, and its first LNG terminal, Vung Tau LNG, and state-owned Thi Vai LNG will enter service in the first half of 2023 to handle imported LNG.

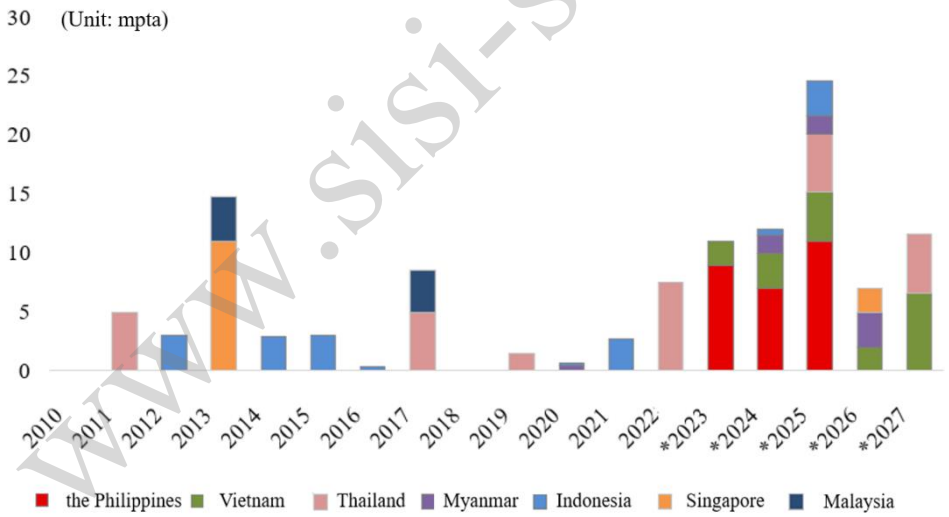



**Figure 5-8 Trend of Number and Scale of LNG Liquefaction Terminals in Major Countries in Southeast Asia**

# Chapter 6 Overview of Global Port Technology and Information in 2022

## 6.1 Port Automation Development

### 6.1.1 Developments of port automation technologies

Automated terminal technology covers all cargo handling operations, including ship berthing, loading and unloading operations, horizontal transport, yard management, and cargo collection, distribution, and transportation at ports. The Tuas Mega Port in Singapore and the Port of Ashdod in Israel, among other ports, launched new automated terminals for service in 2022. In addition, the automation technology of various links at container terminals continued to develop, with breakthroughs in horizontal transport and cargo collection, distribution, and transportation links. Full automation was also realized at dry bulk terminals and was gaining speed for wider application.

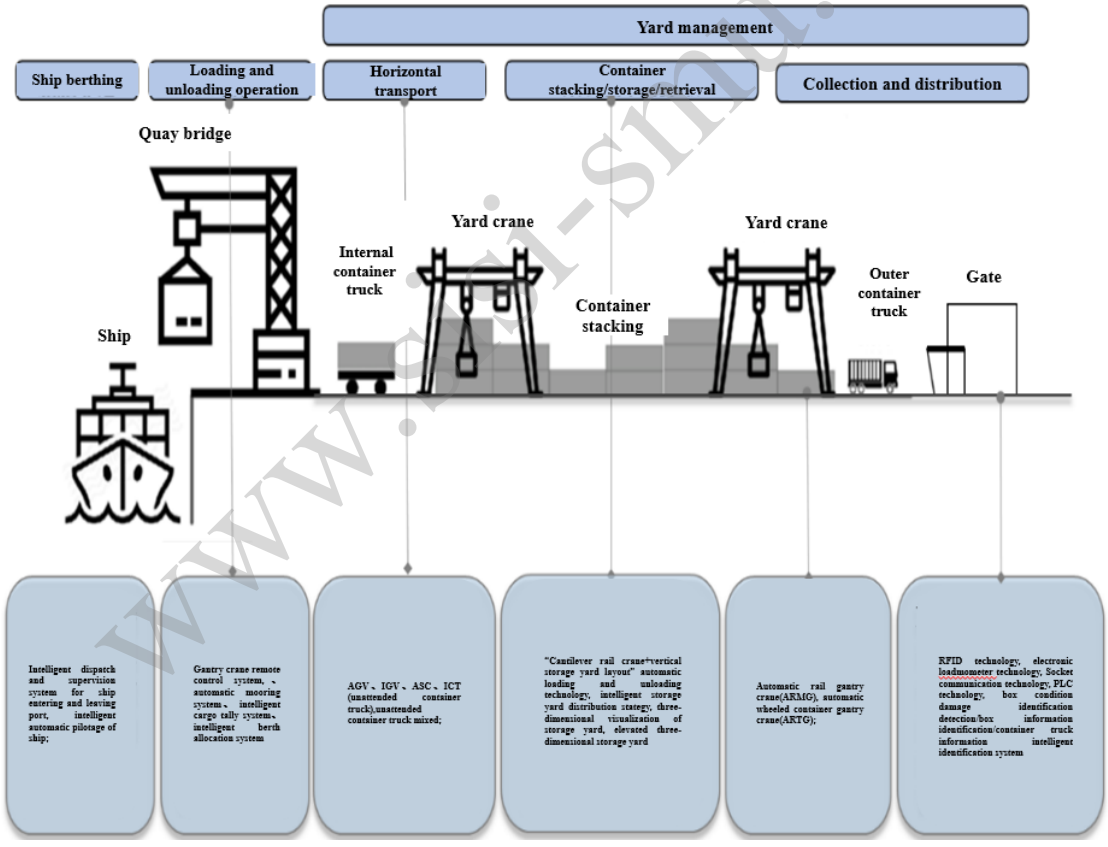



**Figure 6-1 Development of Key Automation Technologies in Different Operation Links at Terminals**

**(1) Horizontal transport automation evolved toward unmanned operations at a faster pace**

With the maturity and application of technologies such as satellite positioning, 5G

communication, and machine vision in recent years, horizontal transport equipment and solutions with different advantages and characteristics such as AGV, ASV, ICT, IGV, ART, AIGT, and IMV emerged one after another. The above horizontal transport equipment can be divided into four categories according to the navigation and positioning mode and whether a tractor exists: automatic guided vehicles (AGVs) for containers, automated straddle carriers (ASCs) for containers, intelligent container trailers (ICTs), and intelligent guided vehicles (IGVs) for containers.

An analysis of the application of port horizontal transport equipment in 2022 revealed the following trends. ICTs realized the phased progress of becoming "safety supervisor free" and supported unmanned operations at terminals with both manned and unmanned equipment operations. IGVs and ICTs received wider applications to replace AGV solutions and became the main automated horizontal transport solution. The ASC solution was not applicable in China, but was widely used at automated container terminals outside of China.

**(2) Off-port container collection, distribution, and transportation solutions received faster innovation**

Traditionally, the landside cargo collection, distribution, and transportation outside the port were largely realized via rail or highway transportation, but both transportation means have defects. Generally, the rail transport solution still possesses significant cost and environmental benefits for medium- and long-distance transportation. Therefore, highway-to-rail and highway-to-waterway solutions received a vigorous promotion in recent years. In addition, various innovative cargo collection, distribution, transportation, and automation solutions were explored and tested to identify better alternatives or supplements. Such solutions included extending the operation area of unmanned container trucks at ports to off-port roads carrying both manned and unmanned trucks, building "super high-speed rail" to respond to point-to-point rapid transport demands, and utilizing the vertical space to build an air-rail transportation system. Furthermore, as various technologies such as autopilot technology get mature and popularized, they will place a significant assisting role in the existing cargo collection, distribution, and transportation solutions or even replace the current solutions in some way to realize automated freight transportation in a wider range and more complex road conditions.

### 6.1.2 Dry bulks terminals entered the stage of full automation

**(1) China's dry bulks terminals accelerated the popularization of full automation**

China's dry bulk terminals gained speed in popularizing full automation in 2022, following Rizhao Port's full automation at the end of 2021. The dry bulks automation technology made breakthroughs at multiple ports. For example, Yantai Port in the Shandong province realized automated operations throughout the process of mixed blending, truck loading, ship loading, and hold cleaning at the end of 2021. In addition, Rizhao Port's control technology of professional dry bulk terminals made progress and recorded a higher efficiency in 2022. Apart from the above, many dry bulk terminals in

China also pushed forward their full automation process. For example, the unmanned dry bulks terminal demonstration area of the Qingdao Port was officially put into operation and upgraded and transformed the traditional dry bulks terminal into a full-process, full-system automated terminal covering a full range of equipment models.

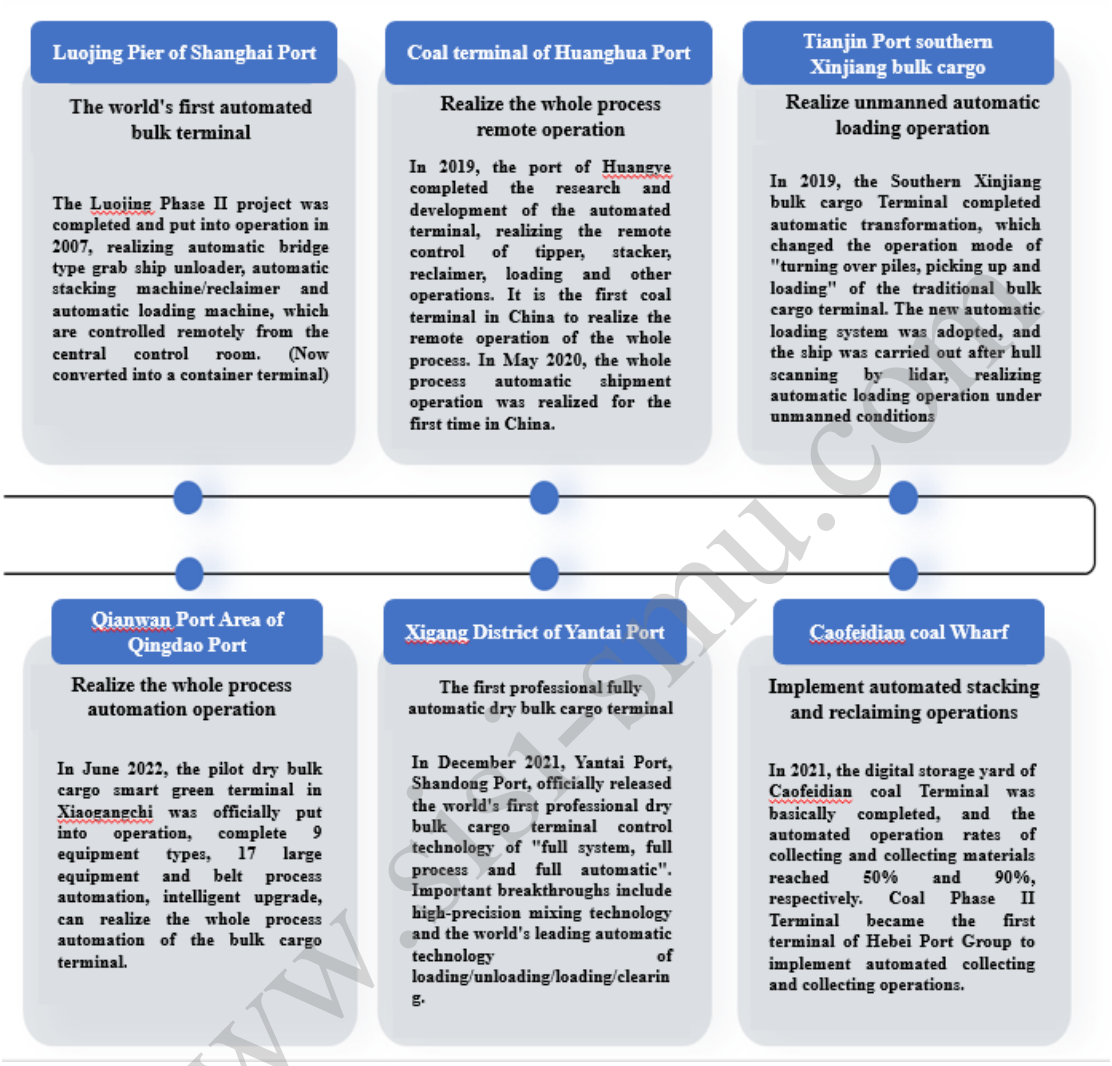



**Figure 6-2 Automation Process of Dry Bulks Terminals in China**

### (2) "Bulks-to-container" automated handling process further developed

Many ports applied automated loading and unloading solutions in 2021 to address the increasing bulks-to-container volume. In 2022, ports further innovated the automated bulks-to-container operations, increasing operating efficiency and cutting single-container costs. For example, Rizhao Port launched the "bulks-to-container" automatic process system, and Jingzhou Port developed an automated container loading system for bulk cargoes. With the "bulks-to-container" automated operation process and various supporting facilities improved, the "bulks-to-container" volume will continue to grow.

## 6.2 Port Digital Development

### 6.2.1 Ports strengthened digital coordination of the logistics industry chain

**(1) Just-in-Time (JIT) concept embraced deepened application in the port and shipping field**

The Just-in-Time (JIT) concept is embodied as the "punctual arrival of ships" in the port and shipping industry. It means optimizing the ship's speed strategy to make it arrive at the port at the agreed time and berth directly. This can adjust the speed for lower fuel consumption, emissions, and costs and shorten the waiting time at the port to reduce the "carbon footprint". Against the backdrop of continuous supply chain disorder and green emission reduction in the port and shipping industry, the JIT concept embraced deepened application in the port and shipping field in 2022.

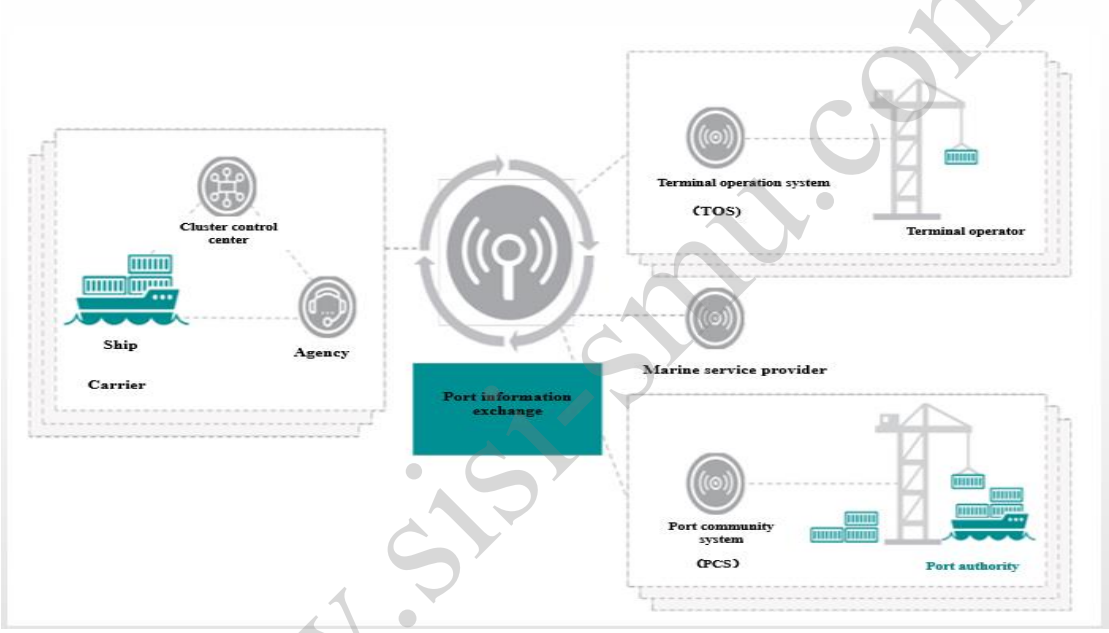



Chart source: Digital Container Shipping Association (DCSA).

**Figure 6-3 Electronic Information Exchange Standards for JIT Port Calls**

**The data exchange standards of the port JIT system were improved.** DCSA released the Just-in-Time (JIT) Port Call Data Definitions version 1.2 Beta in 2022, including data definitions and standard interfaces that provide 110 event time stamps, aiming to better implement the JIT concept by improving data exchange standards.

**Many ports successively launched JIT services and products.** For example, Portchain Connect, a newly-established firm, is committed to optimizing ship berthing solutions through AI algorithms. Its service solutions were further mature in 2022 and entered the commercialization stage, as evidenced by its cooperation with Shekou Container Terminals (SCT) of Shenzhen Port, DP World Antwerp Gateway of the Port of Antwerp, and London Container Terminal. For another example, HHLA, a terminal operator at the Port of Hamburg, launched its JIT port call product Heyport and planned to introduce it to the global market. In addition, the port also implements JIT services

by opening the application programming interface (API) of the port information system.

**(2) European and American ports strengthened digital coordination of rear freight operations**

As shown in the port congestion incidents in the past two years, cargo collection, distribution, and transportation links in the rear part of the port were a weakness, especially in the ports of Los Angeles, Long Beach, and Rotterdam in European and American countries. Therefore, the ports proposed in succession to strengthen the digital coordination of rear freight operations in 2022. The United States Department of Transportation (USDOT) released the Freight Logistics Optimization Works (FLOW) project. Under the project, a three-party supply chain data management organization was established to integrate the supply chain data of a large number of private firms, including shipping companies, port agencies, terminal operators, truck drivers, railways, warehouses, and cargo owners to share and apply cargo flow data and alleviate port congestion. The Port of Rotterdam Authority proposed the Rail Connected plan, aiming to promote digital development and data sharing of railway freight and improve the efficiency and transparency of cargo collection, distribution, and transportation services via railway.

### 6.2.2 Port network security / data governance legislation gained speed

With the development of next-generation information technologies such as 5G, AI, and cloud computing and their deeper integration with traditional industries such as industry and transportation, the port and shipping industry is exposed to various security threats on the internet, highlighting a higher frequency of cyber attacks. To tackle this issue, countries worldwide and international port and navigation organizations are actively exploring how to ensure port network security. U.S. ports were suffering from increasingly frequent and diverse cyber attacks. Its hub ports strengthened the port's cybersecurity infrastructure. Specifically, the Port of Los Angeles officially launched the Cyber Resilience Center (CRC) to enhance its identification, warning, and response to cyberattacks. The Port of New York-New Jersey established a maritime cybersecurity alliance in 2020 to improve information sharing among port users. The top-level design of China's port-dedicated cybersecurity and data governance needed to be strengthened. Specifically, it was urgent to formulate regulations on port cybersecurity management to safeguard the digital and intelligent development of ports in China.

## 6.3 Port Intelligent Development

### 6.3.1 AI application in the port field continued to deepen

The AI technology enjoyed deepened application in the port field in 2022. Ports were attaching more importance to improving the intelligence level of port information management systems. The Port of Tanjung Pelepas (PTP) deployed Innovez One's AI-aided port management information system (PMIS) in 2022 to optimize port scheduling and efficiency. DP World completed the TOS upgrading of the Port of Southampton,

introducing new intelligent features to grow port productivity. Ports in Shandong province of China innovatively released the intelligent management and control system for fully automated container terminals A-TOS, achieving human brain-like production command and scheduling, planning and decision-making, and system testing, operation and maintenance. In addition to the widely used intelligent identification of container truck gates, intelligent supervision systems, and intelligent planning of container yards, among other scenarios, the AI application was constantly diversified at ports. For example, AI technology was used at the Tanger Terminal of APM Terminals to offer decision support on whether to re-stack containers on windy days, and Australia's Curtin University developed AI tools to monitor the erosion of concrete port structures by seawater.

### 6.3.2 Ports around the globe promoted digital twin port development

As an emerging technology, digital twins refer to establishing high-precision, multi-dimensional, and all-round dynamic models in the virtual world on the computer to simulate entities in the physical world based on certain mapping rules and connecting up the virtual and physical worlds to enable real-time interactive communication, mutual control, independent iterations and updates of the two. Many ports worldwide promoted the development of digital twin ports in 2022, making progress in twin space, twin precision, and visualization. It is envisioned that global ports will be in a unified digital twin space someday, which will greatly elevate the global port and shipping network efficiency and simulate past and future events. However, many technical challenges remain to be addressed, and the digital twins standards must also be unified.

**Table 6-1 Digital Twins Application Cases at Various Ports in 2022**

| Port（System name） | Specific application of digital twin in port |
|---|---|
| Port of Tianjin（Jinhong system） | In December 2022, Tianjin Port released the world's first comprehensive port digital twin technology base, which builds a unified base for port digital twin based on unified standards, unified architecture and unified data specifications. It has the advantages of flexible deployment (flexible deployment between multiple devices on demand) and soft bus (super devices can be freely combined to meet the requirements of different scenarios). In the future, independent and controllable industry standards, core technology products and industrial ecology will continue to be formed, which is of great significance for the promotion of port digital twin technology. |
| Shanghai Yangshan Phase IV automated terminal（Yangshan four stage number intelligence platform） | In September 2022, SIPG took the lead in launching the multi-dimensional and full-process digital twin platform of super large automated container terminal at Yangshan Phase IV Automated Terminal, which realized the precise three-dimensional modeling of geographic information and terminal equipment, as well as the high-precision modeling of facilities and equipment such as roads, storage yards, containers, quay Bridges, yard Bridges and AGVs. At the same time, the super precision behavior and rule modeling of shore bridge, field bridge and AGV are restored, and the high precision simulation of equipment operation is realized. |

| | |
|---|---|
| Meishan Port Area, Zhoushan Port, Ningbo（Ali Cloud super fusion digital twin platform） | In July 2022, Ali Cloud officially released the super fusion digital twin platform, which can integrate and calculate the data of perception, simulation, control, visual and other four domains. At present, it has been widely used in highways, urban traffic, terminals, airports and other scenes. The construction of "Digital Meishan Visualization System" in Meidong Dock of Zhoushan Port of Ningbo accurately restored the container operation scene of Meishan Port area of more than 3.2 million square meters, with over 100,000 1:1 digital twins operating in the system. |
| Hainan port（Intelligent video control platform for 3D immersion situation research and judgment） | A real scene model is established to visually manage key data such as personnel density, vehicles, layout control and early warning of Hainan port. The dynamic surveillance video is combined with the static three-dimensional scene to express the real scene of the city in an all-round way and assist scientific and intuitive command. (It has not yet been completed and put into use). |
| Port of Hamburg（TwinSim Digital Twin Port Project） | August 2022 Research teams from the Institute of Information Systems at the University of Hamburg are currently developing the "TwinSim" digital twin port project for the Port of Hamburg, Funded by the Innovative Hafentechnologien (IHATEC) program of the German Federal Ministry of Digital and Transport (BMDV) for 3.5 million euros, the project will first be deployed and tested at the EUROGATE container terminal in the Port of Hamburg. |
| Port of Busan（VARLOS port monitoring system） | In November 2022, the VARLOS Port monitoring system used GIS data to build digital twins. its application focus is to provide a real-time and visual monitoring of the production and operation conditions within the scope of the port. At the same time, the system also has real-time interaction, data collection, prediction and simulation functions, to help the port to carry out efficient port logistics management. |

# Special Topic 4: Analysis and Prospect of Innovative Technology Application at Global Ports

The port and shipping industry started a wave of digital transformation amid the global pandemic outbreaks in the past two years. Innovative technologies such as 5G, cloud computing, and AI were extensively used in the port and shipping sectors. In particular, China developed rapidly in automated terminals and smart ports and planned to promote in-depth integration of next-generation technologies such as the internet, AI, big data, and supercomputing with transportation to become a country with strong transportation. It is foreseeable that the port and shipping industry will remain an important "experimental field" for the exploration and implementation of various innovative technologies in the future. Based on the current developments and prospects of various innovative technologies, the feasibility, application scenarios, and implications of these technologies in the port and shipping industry, as well as exploration cases, are sorted out and reviewed in this section.

## 1. Internet of Things technology lays the foundation works of port data

The Internet of Things refers to the technology that enables ubiquitous connections between things and things and between things and people through various information sensors, network transmission, and intelligent perception, identification, and management of objects and processes. The Internet of Things technology is the foundation of smart port development, including big data analysis, AI algorithms, and metaverse space construction. These endeavours must be initiated based on the port data via the Internet of Things technology. This section starts the analysis of sensors and communication networks to figure out the application status of IoT technology at ports.

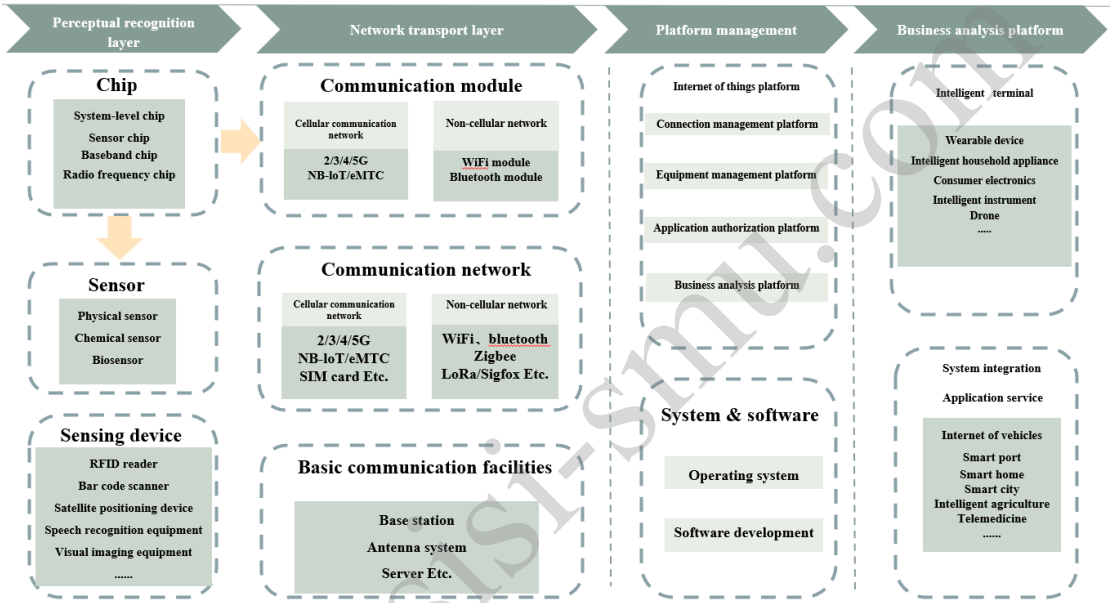



Chart source: Qianzhan Industrial Research Institute.

**Figure 1 Industrial Structure of the Internet of Things**

**Expansion of port sensing equipment supported all-around perception at ports.** The current smart ports can connect various production equipment to the Internet of Things platform to share the underlying data. For example, all the 100,000-plus various sensors serving the six major production factors (people, vehicles, containers, ships, machines, and yards) at the Tianjin Port are connected to the Internet of Things platform. In addition to the traditional information sensing equipment such as radio frequency identification (RFID), infrared sensors, and laser scanners, more types of equipment and sensors will be connected to the IoT platform of the port to enable all-round perception. (1) A UAV IoT network will be established to support equipment inspection, operation monitoring, oil spill or floating waste detection, and other purposes. (2) More sensors, such as 3D sonar sensors, port water quality monitoring sensors, harmful gas recognition sensors, and weather sensors, will be introduced.

**6G communication network technology supports digital twin ports development.** 5G communication technology has received extensive application in the automation

and intelligent development of ports at home and abroad, supporting intelligent functions such as remote high-definition monitoring, AI-aided analysis of cargo ships, high-precision positioning, and intelligent networked piloted vehicles. However, the higher form of the port Internet of Things will be a "digital twin" world combining virtuality and reality, which requires a 6G communication network with stronger wireless performance. (The 6G network will enable global connectivity via space, air, sea, and ground communication by building a ground communication network, a satellite communication network, and a deep-sea ocean network.) China is already at the forefront of 5G technology and digital twin port development. China Mobile is actively deploying its 6G network and plans to implement commercial use of 6G in around 2030. Ports will be the first to start trials as high-quality test sites.

## 2. AI technology helps ports achieve high-degree intelligence

Artificial intelligence (AI) is an extended theory, methodology, technology, and application system that simulates human intelligence. It can handle structured and semi-structured tasks in place of humans and has been widely used in scenarios such as automatic driving, intelligent gates, and intelligent dispatching in the port sector. The current AI technology in application belongs to weak artificial intelligence and enables relatively simple human brain functions such as speech recognition, image recognition, and natural language processing. The future strong artificial intelligence technology will support more functions such as perception, language, judgment, memory, and association. However, strong artificial intelligence functions are primarily used in the commercial AI field, and those applied to the port field are empowered by industrial AI technology, which features higher security, accuracy, and reliability requirements than commercial AI. An outlook at the technical application level is provided below.

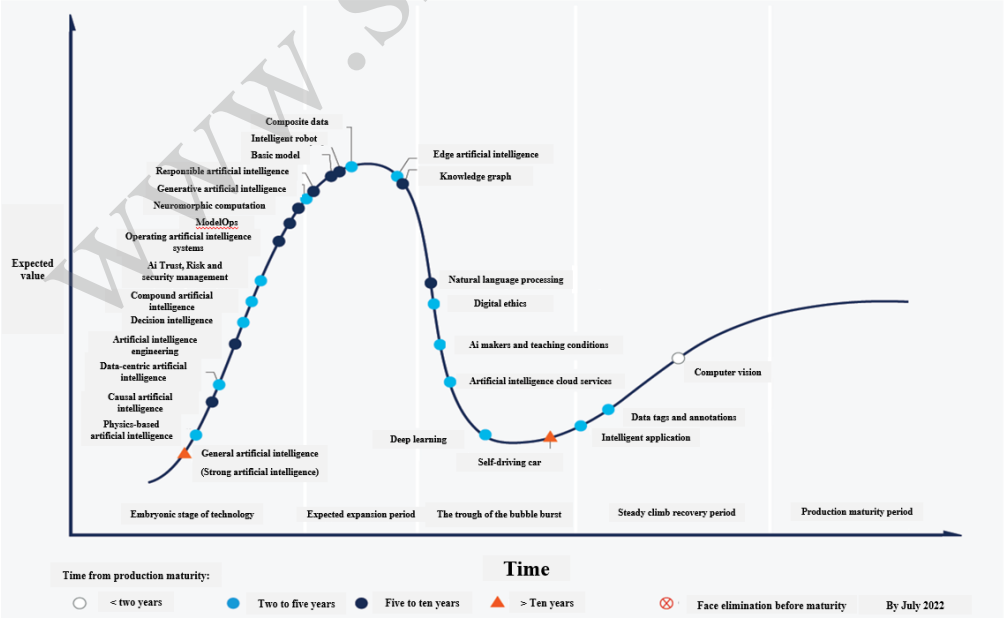



Chart source: Gartner.

**Figure 2 Maturity Curve of AI Technology in 2022**

**Decision Intelligence (DI) supported port operations to realize a high level of autonomous decision-making.** Based on the engagement degree of humans and AI in the decision-making process, intelligent decision-making can be divided into three levels: decision support (offering analysis to support human decision-making), decision-making enhancement (offering AI-aided decisions for humans to select from), intelligent decision-making (Ai-aided autonomous decision-making based on normative analysis and prediction). Currently, most global hub ports actively promote port automation, digitalization, and intelligence. However, most are still in the decision support or enhancement stage, where machine learning, data mining, big data, and other technologies are employed to find rules for human decision-making assistance. Human factors still play a dominant role, and limitations such as information omission and weak real-timeliness of analysis may occur when the data size and complexity grow. Therefore, introducing more decision-making support functions to the BI dashboard for port operation decision-making is an important means to improve port operations. A port intelligent operation system can be used to achieve independent decision-making for production, independent analysis of production deviations, and automation of equipment operations, among other functions. Currently, the cargo handling operations at some ports already reach a relatively high intelligent level of decision-making automation. For example, intelligent gates at ports can make independent release decisions through container damage identification and inspection, container information recognition, and container truck information recognition. The future DI will be integrated into a wider range of port production processes, including intelligent decision-making of the overall operation scheduling system and intelligent individual equipment through edge AI. As a result, a higher level of automation can be achieved ultimately across port operations and scheduling.

**The edge AI technology extends port intelligence to equipment terminals.** Edge AI is a combination of edge computing and artificial intelligence. Supported by the 5G communication technology, edge AI enables real-time processing and response and retains important data to be sent back to the cloud through local machine learning algorithms that run directly on edge hardware devices. It highlights the advantages of a smaller bandwidth, lower latency, and better privacy security, an important supplement to traditional centralized cloud computing. With ports moving toward digitalization, various terminals such as self-driving vehicles, intelligent robots, and cameras will also surge in number. Edge AI boasts a bright future for application. For example, the intelligent video surveillance system of the port, combined with the AI algorithms in the cameras on the front end, can realize independent identification, early warning, and disposal of port waterfront violations. In addition, terminal devices at the ports, such as lighting, sensors, and drones, will reach high intelligence and autonomy through edge AI. With the comprehensive analysis by the port cloud data center, Artificial Intelligence of Things (AIoT) featuring artificial intelligence + Internet of Things can be realized to make all port-related elements digitized and connected intelligently.

### 3. Digital twin ports for constructing virtual mirrors in the metaverse

As the metaverse gained popularity at the end of 2021, Web 3.0 (the third generation of the World Wide Web, or Web3) also came under the spotlight. It can be understood as a "decentralized internet based on blockchain technology", which integrates blockchain, AI, the Internet of Things, communication technology, cloud computing, and other innovative technologies to jointly form the underlying rules for the future network world to operate. Conversely, the metaverse is a "virtual/mirror native world" built on the Web3 operating system [3]. The current main applications of Web3 and metaverse technologies are cryptocurrency (token) transactions, cryptocurrency-based decentralized finance (DeFi), and virtual games. Its applications in industry, transportation, and logistics fields are still under preliminary exploration and are dominated by visualization, simulation, operation optimization, driverless vehicles, fault diagnosis, and equipment maintenance functions by building a digital twin model (a virtual mirror world). However, the industrial digital twin world has not yet been connected to the existing network. In addition, considering the lower simulation accuracy, incomplete policies and regulations, and late economic returns, among other reasons, only some exploratory studies on its application are carried out, such as exploration at ports with a higher digital and automated level in the port industry.

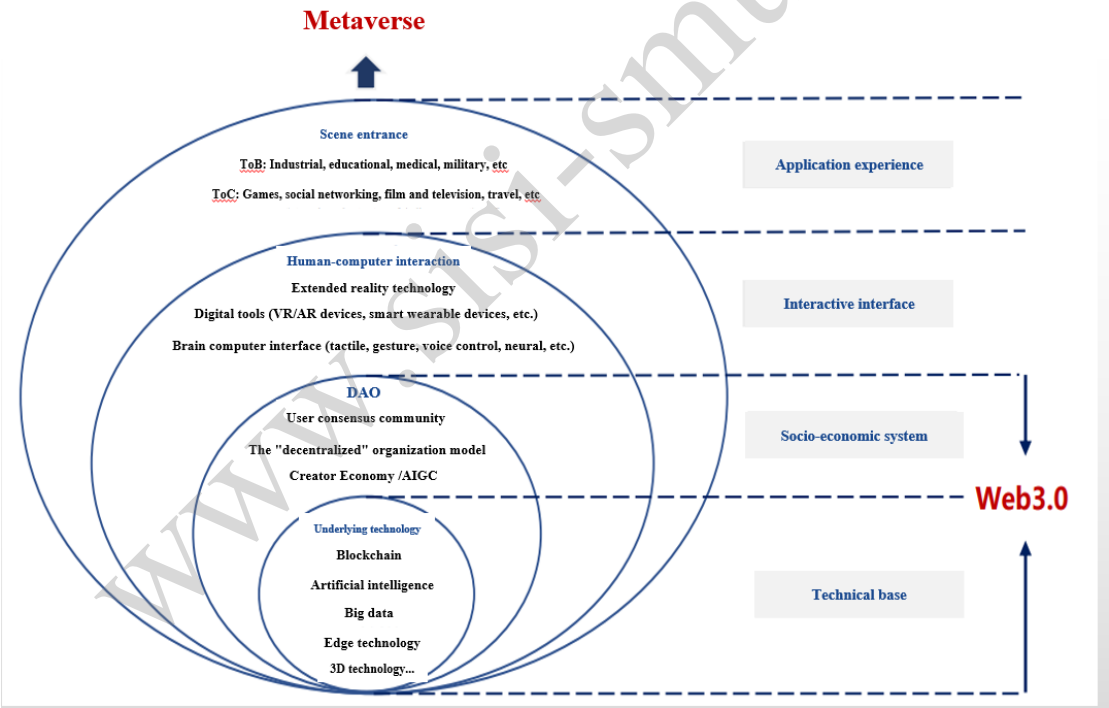



Chart source: AVIC Securities Co., Ltd.

**Figure 3 Relationship between Web 3.0 and metaverse**

Ports in the future metaverse and Web 3.0 scenarios are envisioned as follows. **(1) Make**

[3] The metaverse explained by Deloitte of "three worlds in one, control and management integrated" proposed that the virtual mirror world is a reproduced image of the real world in the virtual world, which is called the "Digital Twin". The virtual native world is a brand new world created in the virtual world that is different from the real world.

**an all-round, systematic, and high-precision digital twin of the port** so that the port operation and production processes are fully digital and visualized, which facilitates lean management of production operations, time-space backtracking (for fault diagnosis and safety accident review, etc. of port machinery equipment), simulation (for trial and error of new port equipment launches and iterative technology upgrades), virtual-real interactions (for an enhanced experience of man-machine interactions and decision-making support, which can be helpful during skill training) and other functions to maximize production efficiency and cut costs. **(2) Strengthen the digital collaboration between the port and the upstream and downstream of the industrial chain through the metaverse.** In the Web3-based metaverse, the port will be connected to a larger (on a city/country/world scale) virtual mirror world. This will at least enables digital twin development and connectivity of key urban infrastructure in the current digital twin city development. At that time, the port will be closely connected to the city and industries in the digital twin world to enhance the port's operational decision-making and full-process logistic supply chain services. However, a digital twin system with more sensors and a higher level of digitalization will also be exposed to more severe cybersecurity and data security risks. As a major national infrastructure, ports will face higher risks of data leakage, considering the open and transparent characteristics of the Web3 decentralized mode. Therefore, the integration degree of ports to the Web3-based metaverse should be well-weighed and determined.

### 4. Quantum computing enhances cybersecurity and operation optimization

Quantum computing is a new computing model that observes the laws of quantum mechanics to control quantum information units for computing. It will realize a leap in human computing power and is gradually applied to cybersecurity, big data, and artificial intelligence. Global quantum computers are still in the prototype stage, facing many bottlenecks in practical application. However, ports such as the Port of Rotterdam and the Port of Los Angeles, as well as global terminal operators such as PSA Singapore and DP World, have begun to explore the potential of quantum computing in port logistics. The current exploration includes two main directions: cybersecurity and port logistics scheduling and planning.

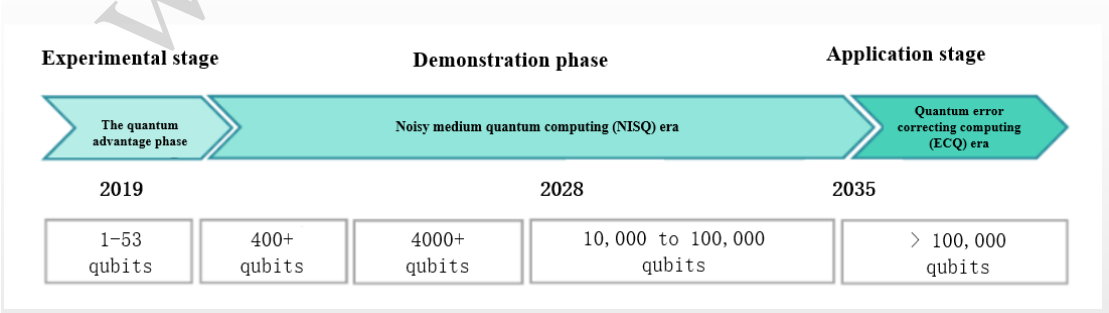



Chart source: iCV TAnK.

**Figure 4 Quantum Computing Development Stages and Computing Power**

**Improve port communication network security based on quantum key**

**distribution (QKD) technology.** The supercomputing power of quantum computing technology will pose a serious threat to the existing network encryption architecture. In particular, it can directly crack the customary public key encryption mode with brute force, leading to data leakage, communication network destruction, and other risks. To this end, the Port of Rotterdam focused on cybersecurity issues and drew on the technical strengths of QuTech, a quantum technology research institution in the Netherlands, to develop a multi-user quantum network based on quantum key distribution (QKD) technology. This network provides the Port of Rotterdam community system Portbase users with keys generated by the quantum technology for information transmission to secure the port's communication network data. The solution is expected to become operational by 2023. Although quantum computing isn't developed enough to pose a subversive threat to the existing port security, port enterprises need to perform exploration and research in advance to tackle cybersecurity challenges in the quantum computing era, considering ports' role as a national key infrastructure.

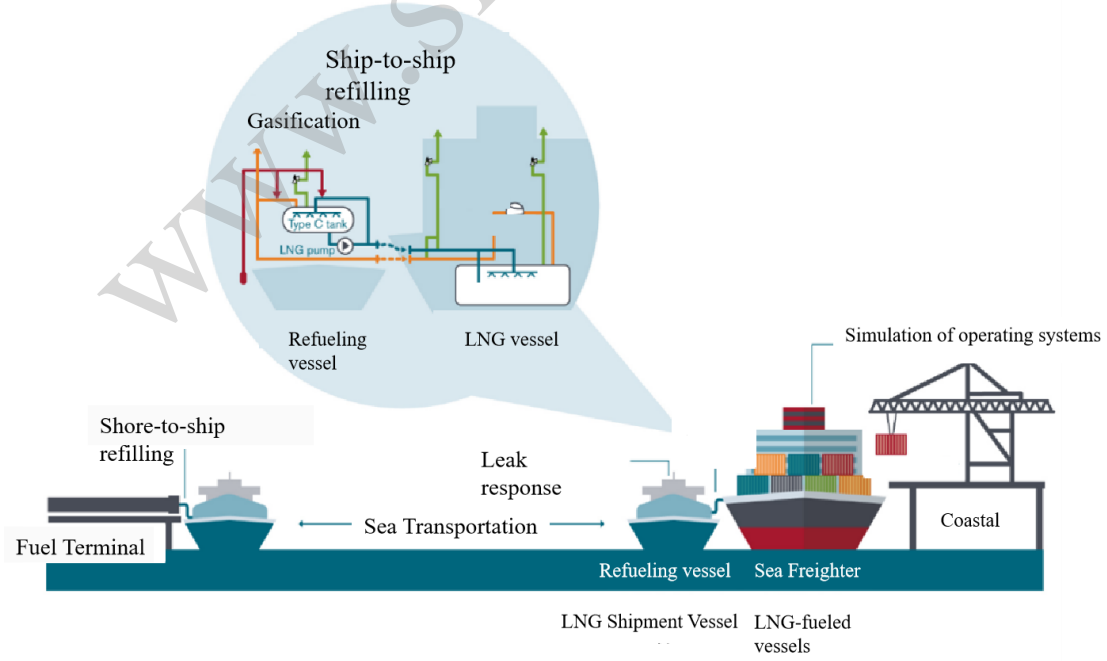
**Quantum computing can address large-scale combinatorial optimization issues for port operation scheduling.** Compared with the traditional binary bit (bit), the quantum bit (qubit) of quantum computing has an additional superposition state of 0 and 1, enabling quantum computers to perform parallel operations and data processing more efficiently to resolve large-scale combinatorial optimization problems. As a result, quantum computing is suitable for optimising ports with complex production scheduling systems. In early 2022, the quantum analysis company SavantX deployed a HONE (hyper-optimized node efficiency) quantum-driven AI engine for Pier 300 at the Port of Los Angeles, using an annealed quantum computer to optimize cargo handling and truck scheduling operations at the port. After this deployment, all four indicators of daily handling volume per dockside crane, truck turnover time, dockside crane utilization rate, and average dockside crane moving distance were optimized by 30%–60%, achieving sound optimization results. In addition, PSA Singapore and DP World were also committed to optimizing their global port logistics chains by leveraging the power of quantum computing. Quantum computing has become an important way to further optimize port efficiency in the future.

# Chapter 7 Overview of Global Green and Ecological Port Development in 2022

## 7.1 Development of Green Port Alternative Energy

### 7.1.1 LNG bunkering business at ports developed rapidly

In 2022, the global seaborne LNG trade volume exceeded 300 million tons. 355 LNG ships were in service, and 521 were ordered and under construction. A huge demand was expected in the in-port LNG bunkering market. Currently, LNG bunkering is the major alternative energy-filling solution at ports, and all ports are stepping up efforts to develop LNG bunkering infrastructure. 181 ports worldwide provided LNG bunkering services in 2022, an increase of 44 ports compared with the previous year. Ports invested in LNG bunkering equipment to attract relevant energy companies and provided cooperation platforms and preferential terms for enterprises to promote LNG production, processing, and bunkering business development in the port area. The Port of Ras Laffan in Qatar is the world's largest LNG export port, with an annual LNG throughput of more than 70 million tons. Port Arthur and Barrow Island Port in Australia also recorded an annual LNG throughput of over 20 million tons. Currently, 24 LNG receiving stations have been set up in China's port clusters, with an annual designed receiving capacity of 110 million tons. 7 LNG receiving station projects are still under construction.




Source: Det Norske Veritas.

**Figure 7-1 Ship-to-Ship LNG Bunkering Process**

LNG bunkering is carried out through three main methods at ports, namely "vehicle-to-ship", "ship-to-ship", and "port-to-ship". Specifically, the ship-to-ship method supports synchronous operations of passengers and cargoes, featuring faster bunkering and flexible manipulations. It is suitable for large ships on international routes and represents the trend of the LNG bunkering business. The Port of Rotterdam is the first port to apply ship-to-ship bunkering technology. It cooperated with Shell as early as 2018 to complete the world's first ship-to-ship bunkering. The Port of Singapore, in cooperation with LNG bunker supplier FueLNG, took the lead in completing ship-to-ship LNG bunkering for car carriers. In China, Shenzhen Port completed the bunkering to the world's largest LNG bunkering ship "Haiyang Shiyou 301", with a total bunkering volume of 30,000 cubic meters. Meanwhile, Ningbo-Zhoushan Port and Shanghai Port also successively piloted bonded LNG bunkering services for international ships.

### 7.1.2 Hydrogen energy production business at ports developed quickly

Hydrogen energy is demanding in storage and transportation conditions and remains in the stage of seeking technological breakthroughs, with fewer ports capable of providing refuelling services. However, hydrogen can be easily decomposed and obtained from water, ammonia, methanol, and other substances, ports around the world are actively cooperating with energy companies to launch green hydrogen production projects. The Port of Rotterdam proposed the strategic positioning of building a "hydrogen energy hub" to achieve an annual hydrogen output of 4.6 million tons by 2030. It also cooperates with Shell, Air Liquide, Saudi Aramco, and other companies to promote hydrogen production with solar and wind energy and study ammonia hydrogen production methods. Besides, it also cooperates with Brazil's Port of Pecem in a hydrogen energy project to build a green hydrogen energy hub, planning to provide hydrogen energy to Europe in the future. Canadian ports cooperated with the Cross River infrastructure Partners to launch hydrogen production facilities in the Port of Belledune, New Brunswick, planning to use 200M watts of clean energy to produce green ammonia. The offshore wind-powered hydrogen production platform developed by hydrogen technology company Lhyfe Co., Ltd. in the Port of Saint-Nazaire, France, combines solar, wind, and wave energy, being the world's first offshore green hydrogen production facility. Scottish Power planned to build a green hydrogen facility at the Port of Felixstowe, which is expected to produce 100M watts of hydrogen energy, capable of powering 1,300 hydrogen fuel trucks.

## 7.2 Green Port Measures Promoted

### 7.2.1 Global ports worked together to create a green shipping corridor

"Green Shipping Corridor" refers to a zero-emission route between two or more ports. Starting from the 2050 decarbonization plan of the International Maritime Organization, the 26th UN Climate Change Conference of the Parties (COP26) in Glasgow in

November 2021 proposed establishing a "green shipping corridor". As a result, 24 countries worldwide have launched 21 green shipping corridor construction initiatives, spanning 5 continents and involving ports, shipping companies, and cargo owners. The call for building a green shipping corridor requires ports to accelerate energy transformation and strengthen the development and application of charging facilities and shipping companies to launch ships with zero-emission capabilities. The Shanghai Port, the Port of Los Angeles, and the C40 Cities Climate Leadership Group announced a joint initiative on January 28, 2022, to establish the "Green Shipping Corridor", the world's first green shipping corridor plan. These entities will cooperate with shipping companies to launch the world's first zero-carbon trans-Pacific container ship by 2030.

Establishing green shipping corridors is closely related to the trade relationships between ports and the political relationships between countries and regions. Given its impact and feasibility, the Global Maritime Forum predicted that the Australia-Japan iron ore shipping route is one of the most potential green shipping corridors. On the one hand, the Australia-Japan route highlights more stringent supervision efforts in carbon emissions and pollution emissions. On the other hand, Japan ranks second in Australia's total iron ore export value globally, and three of the "big four mines" (Vale, BHP Billiton, Rio Tinto, and FMG) that Japan imports iron ore from are located in Australia. The Northeast Asia-US ro-ro shipping route is another route that has the potential to become a green shipping corridor. The cargo owners on the route, namely Japanese electric car manufacturers and Japanese and U.S. governments, have all been committed to promoting decarbonization. Supported by ports and large ship enterprises along the route, the Asia-Europe container route also has a high probability of quickly growing into a green shipping corridor.

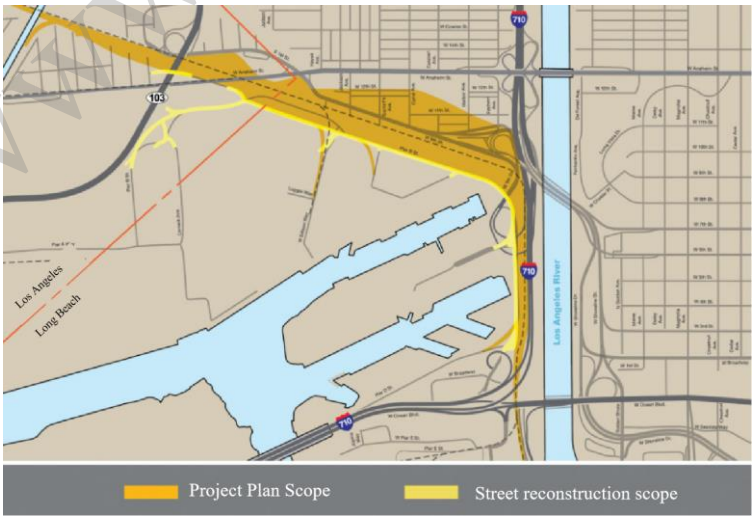
**Table 7-1 International Green Shipping Corridors Announced in 2022**

| Time | Green Shipping Corridor |
|---|---|
| Jan. 28 | Shanghai-Los Angeles/Long Beach Sign Green Shipping Corridor Cooperation Agreement |
| Mar.30 | Muller Zero Carbon Shipping Center and five ports in the Nordic Baltic region launch initiative to establish a European Green Shipping Corridor |
| Apr.6 | Global Maritime Forum led a Letter of Intent (LOI) signed by BHP Billiton, Rio Tinto, Oldendorff Carriers and Star Bulk Carriers Corp. to assess the development of a green shipping corridor for iron ore between Australia and East Asia |
| Apr.13 | Chile's Ministry of Energy and the Maersk-McCainey-Mueller Zero Carbon Shipping Center announced a formal agreement to establish a network of Chilean green shipping corridors |
| May.3 | Nordic Climate and Environment Ministers Announce Zero-Emission Green Shipping Corridor between Ports in the Nordic Region |
| May.17 | Pacific Northwest Ports and Cruise Lines Announce Plans to Explore and Create the World's First "Green Shipping Corridor" for the Cruise Sector |

| | |
|---|---|
| May.26 | Lloyd's Register Maritime Decarbonization Center Announces Collaboration with 11 Industry-Leading Cross-Supply Chain Stakeholders to Develop Fleet Fuel Transition Strategy for a Highly Scalable Green Corridor Cluster |
| Aug.22 | Maritime and Port Authority of Singapore and the Port of Rotterdam sign agreement to develop the world's longest green corridor, with sailing in 2027 |
| Sep.29 | Canada's Halifax Port Authority and Hamburg Port Authority sign MOU to create green shipping corridor between Halifax and Hamburg |
| Oct.12 | Green corridor between Gothenburg Port and North Harbour officially launched |
| Nov.18 | Northwest Seaport Alliance plans to work with the Busan Port Authority to create a green corridor between the Port of Seattle-Tacoma and the Port of Busan |

### 7.2.2 Intermodal transport at ports contributed to carbon emission reduction

As a cargo distribution hub, ports primarily use railways or highways to transport cargoes to inland areas. Railway transport produces less carbon dioxide and pollutants per unit of transport volume than highway transport. The Port of Long Beach actively invested in railway infrastructure to achieve its strategic goal of building the world's first zero-emission seaport. For example, after the Pier B railway project at the port is completed, the current railway yard of the terminal will be expanded from 82 acres to 171 acres, increasing the track length by 130,000 feet, which will greatly improve the logistics efficiency of the port area. In addition, the Port of Long Beach promoted the "Pier G-J" double-track project in the southern basin area. The fourth track project of Ocean Avenue was also advanced simultaneously. The Port of New Orleans used roads and railways to transport cargoes. The state government also planned to invest another USD 100 million to expand container facilities along the railways to enhance the overall logistics network, especially the efficiency of the sea-railway intermodal transport network.




Source: Long Beach Business Journal.

**Figure 7-2 Coverage area of the Pier B railway project at the Port of Long Beach**

### 7.2.3 Ports applied the air dome technology

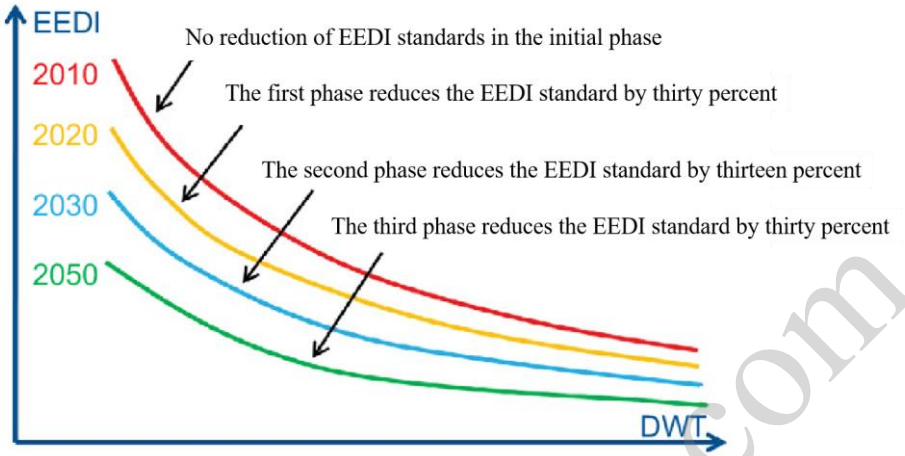
Pollution control of bulk yards is an important part of pollution prevention and control in the port sector. Due to the large area and wide range of materials in the yards, it has long been a challenge to fully seal the storage yards for environmental protection. Compared with traditional storage yard buildings, air-dome buildings use special high-strength materials (PVDF polymer materials) as the outer shell and intelligent technology inside the dome to control the pressure and prop up the air dome. Meanwhile, with solar photovoltaic panels upgraded to boast a lighter weight, higher flexibility, and more environmentally friendly air dome integration, photovoltaic air dome technology enables a combination of photovoltaic and air dome technologies to create a comfortable space for activity while achieving self-sufficiency in clean energy. Compared with steel-structure buildings, photovoltaic air dome buildings can cut the initial construction investment by 50%, with a shorter construction period and almost no maintenance cost, and its service life is as long as 50 years. In addition, the continuous supply of photovoltaic energy can save many energy costs. Currently, 270,000 square meters of air domes have been built at the bulks yards of Lu'anzhou Terminal of Changzhou Port, China, with a total photovoltaic installation of 11.6MW. In addition, 147,000-square-meter air dome buildings are also set up in the Jingtang Port Area of Tangshan Port for storing coal.

Air dome companies are working hard to improve software and hardware configuration while maintaining energy cleanness and economic efficiency advantages. The environmentally friendly air dome enclosure solutions are increasingly digitized, intelligent, and actively applied to port yard construction projects. In the international market, the dome-sealed coal shed project on OBI Island in Indonesia will be completed sealing in June 2022. Air dome suppliers such as DOUL and Metaspace (Beijing) Air Dome Corp. equipped new air dome projects with dust removal devices, intelligent ventilation systems, and indoor environment monitoring systems, among others and used 5G Internet of Things technology to monitor the environment inside the dome in real time to eliminate secondary pollution. Compared with the traditional yard structure, air domes at ports can reduce dust pollution at the whole port by 95% by preventing the diffusion of coal and ore dust.

## 7.3 Green Port Planning and Policies

The port decarbonization process has entered a critical period against "carbon peaking and carbon neutrality". The 27th session of the Conference of the Parties to the UNFCCC (COP27) on November 20, 2022, required ports to accelerate energy transformation, develop alternative energy sources, and actively promote shipping green corridors. Meanwhile, the decarbonization process of the shipping industry is accelerating. The *Amendments to Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL)* of the International Maritime Organization came into effect on November 1, 2022, posing higher requirements on the sulfur content of ship fuel and the energy efficiency design index of ships. In addition,

the Carbon Intensity Indicator (CII) rating system was officially implemented on January 1, 2023. With the full decarbonization deadline approaching, local governments further raised the port carbon emission standards and introduced policies and regulations related to port carbon emissions.




Source: International Maritime Organization, prepared by SISI.

**Figure 7-3 Changes in IMO Energy Efficiency Design Index (EEDI) for Ships**

### 7.3.1 Port of Singapore planned to achieve net zero emissions

Singapore announced the *Maritime Singapore Decarbonisation Blueprint: Working Towards 2050* in March 2022, focusing on 17 green development areas, and planned to invest SGD 300 million to support the decarbonization plan. The Maritime & Port Authority of Singapore (MPA) encouraged port operators to use low-carbon fuels and looked for partners to help operators with their energy transition. One of the goals charted in the Blueprint is to make the Port of Singapore net carbon-neutral by 2050. To achieve this goal, first, Singapore will roll out many digitalization initiatives to improve the port's operational efficiency. Second, the MPA will promote LNG-fueled trailers, cranes, and hydrogen-fueled vehicles at the port and explore the transition to diverse marine fuels. Finally, MPA will partner with the Singapore Registry of Ships (SRS) to promote more green ships. To achieve the 2050 blueprint, Singapore proposed that starting from 2030, all new port vessels operating at the Port of Singapore must achieve net zero emissions.

**Table 7-2 Main Objectives Set out in Singapore's *Maritime Singapore Decarbonisation Blueprint***

| Focus Areas | Objectives |
|---|---|
| Port Terminal | Transition to a low-carbon future through the adoption of cleaner energy, automation and digital technologies, reducing absolute emissions by at least 60% by 2030 compared to 2005 levels; achieving net zero emissions by 2050. |

| | |
|---|---|
| Port Craft | Low carbon energy solutions for all ships in port by 2030 and all-electric propulsion and net zero fuel by 2050, along with a 15% reduction in absolute emissions by 2030 compared to 2021 levels and a 50% reduction in absolute emissions by 2050 compared to 2030 levels. |
| Future marine fuels, bunkering standards and infrastructure | Supporting the future of international shipping by providing low and zero carbon bunker fuels (including biofuels, methanol, ammonia and hydrogen) while enabling green technologies such as carbon capture, storage and utilization to prepare for the multi-fuel refueling transition. |
| Singapore Ship Registry | Recognize and incentivize ship owners to operate green ships, aiming for 50% of the SRS fleet to be green by 2050. |
| Efforts at IMO and other international platforms | Standard setter and bridge builder, advocating for strong, credible and inclusive climate action at IMO and international forums. |
| R&D and Talent | A global offshore decarbonization R&D center, supported by a dynamic ecosystem of talent and expertise to develop and deploy innovations. |
| Carbon Awareness, Carbon Accounting and Green Financing | Establish a green ocean finance center by promoting a green financing landscape and enhancing carbon accounting and reporting. |

### 7.3.2 China sped up port carbon neutrality process

China's Ministry of Transport issued the "14th Five-Year Plan for Green Transport" in January 2022, proposing that ports should accelerate green port development, implement projects such as green port operations, green ships, and green logistics, and improve energy efficiency and environmental management at ports to support carbon peak and carbon neutrality. Furthermore, the *Guiding Opinions of Nine Departments on Building a World-Class Port* proposed to strengthen green port development, promote energy-saving and emission-reduction technologies such as shore power, e-mobility, and clean energy, strictly prevent pollution from ships and port terminals, and improve the environmental quality of ports. In addition, the document requires significantly improving the conservation and recycling levels of port resources by 2025 and reaching the advanced international level of green development at major ports by 2035. Meanwhile, the *Green Port Grade Evaluation Standards* also stipulated green ports' definitions, evaluation items and methods.

# Chapter 8 Evaluation of Comprehensive Service Time Efficiency of Top 100 Container Ports in the World Based on AIS Big Data in 2022

To strengthen life safety at sea and improve navigation safety and efficiency, the International Maritime Organization (IMO) requires ships that meet specific requirements to be equipped with an automatic identification system (AIS). As a result, the AIS system has been widely used worldwide. The AIS data can objectively and promptly reflect the port and shipping market trend. The Port Development Department of Shanghai International Shipping Institute began to measure and evaluate the service efficiency of container ports from ship arrival to departure based on AIS data in 2015. With big data support from Loongship (Beijing) Technology Co., Ltd., we selected 100-plus major container ports in the world for a follow-up study in 2022 and calculated the number and structure of arriving container ships as well as their stay lengths at the port to directly reflect how the development characteristics of the port and shipping market and major events in 2022 impact the port and shipping industry.

## 8.1 Number and Structure Analysis of Arriving Container Ships at Ports

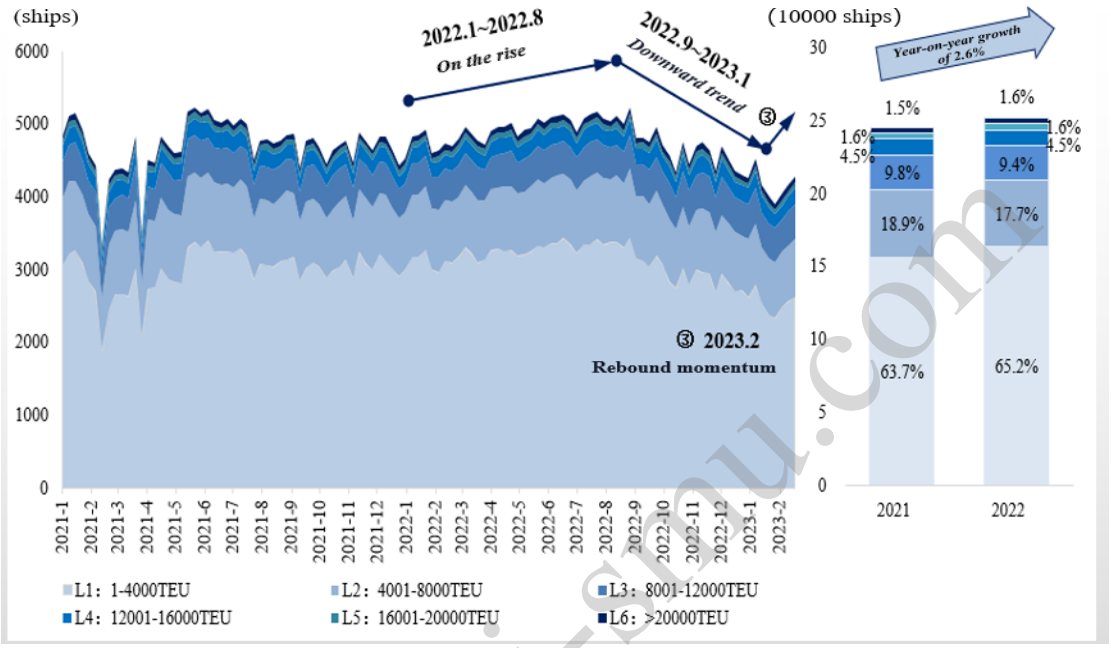
### 1. Total number and general structure of arriving ships at the world's 100 major container ports

The total number of container ships calling at the top 100 ports in the statistical sample in 2022 was 252,000, a year-on-year increase of 2.6%, marking a small increase despite the COVID-19 pandemic and continued port congestion.

**The total number of container ships calling at ports in 2022 showed a trend of rise first and then fell.** The high import demand in the United States continued, and the number of ships calling U.S. ports from January to August increased. In the second half of the year, market consumption demand was suppressed, and liner companies took measures such as suspending voyages and speed slowdown. As a result, the container ship turnover rate decreased, and the number of ships calling at ports gradually decreased. In addition, port labor contract negotiations caused port congestion in the eastern United States, and worker strikes broke out at European ports. As a result, the number of ships calling at ports in the second half of the year fell compared with that in the first half. The number of ships calling China's ports dropped significantly by January 2023. However, various economic indicators stabilized and started to pick up in February. The capacity of China's export routes increased, and the number of ships calling at major global ports also rebounded to a certain extent.

**In terms of the ship type structure, medium-sized and large ships calling at ports**

**in 2022 maintained stable proportions, and the proportion of small ships decreased.** The total proportion of medium-sized and large L4–L6 ships remained unchanged in 2022 (7.6% in 2021 and 2022). The total proportion of small and medium-sized L2 and L3 ships plunged from 28.7% in 2021 to 27.1% in 2022. Small L1 ships recorded a relatively significant increase.




Note: For easier analysis, container ships of 1-24,000 TEUs are divided into six ship types (L1-L6) based on the load capacity at a step of 4,000 TEUs. For example, container ships with 12,001–16,000 TEUs are L4 ships. The same classification and representation methods are used throughout this article.

**Figure 8-1 Total Numbers of Ships Calling at the Top 100 Ports from January 2021 to February 2023**

## 2. Number of structure analysis of arriving ships at major container hubs

The following conclusions are drawn based on the analysis of the top 40 container ports in terms of container throughput in 2022. (1) **The number of ships calling at major container hubs generally increased**. As a result, 27 out of the 40 major ports recorded an increasing number of calling ships. Specifically, 17 of them recorded an increase between 0% and 10%, and 10 recorded an increase of more than 10%. Among the 13 ports with a decline in the number of calling ships, the decline rate was generally within -10%. (2) **The growth rate of the number of ships calling at the port was slightly higher than that of container throughput**. The growth rate (2.6%) of the total number of ships calling at the 40 ports was slightly higher than that of container throughput (1.5%), largely due to insufficient cargo volume in the year's second half. As a result, liner companies suspended or merged routes, and the loading rate of each route followed a fluctuating downward trend in the year.

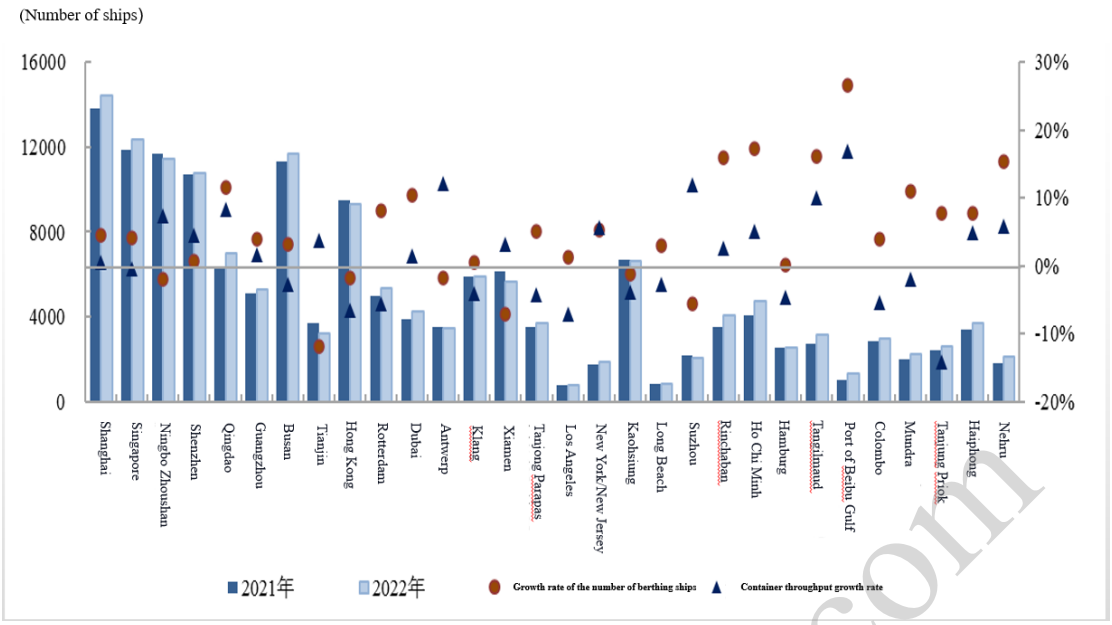



**Figure 8-2 Number of Ships Calling at 30 Global Major Container Hubs in 2021–2022**

**A chart of the year-on-year growth rates of the number of ships calling at the top 30 ports from 2021 to 2022 shows the following trends.** (1) The overall trend is consistent with the changes in the structure of ships calling at the top 100 ports. (2) The numbers of large L5 and L6 ships at ports showed varied trends, among which Shenzhen, Tianjin, Kelang, Xiamen, and Los Angeles ports recorded a larger increase. (3) Among the U.S. ports, the Port of Los Angeles and the Port of Long Beach witnessed a general decline in the number of L2 and L3 calling ships, while the increase in the number of calling ships at the two was from L4 and L1 ships, respectively. The increase in the number of calls (ships) at the Port of New York-New Jersey was largely contributed by L1 and L2 ships. (4) The number of large-scale ships calling at the three major European base ports all fell. In terms of the proportion of large ships, that of the Por of Antwerp and the Port of Hamburg increased, while that of the Port of Rotterdam decreased.

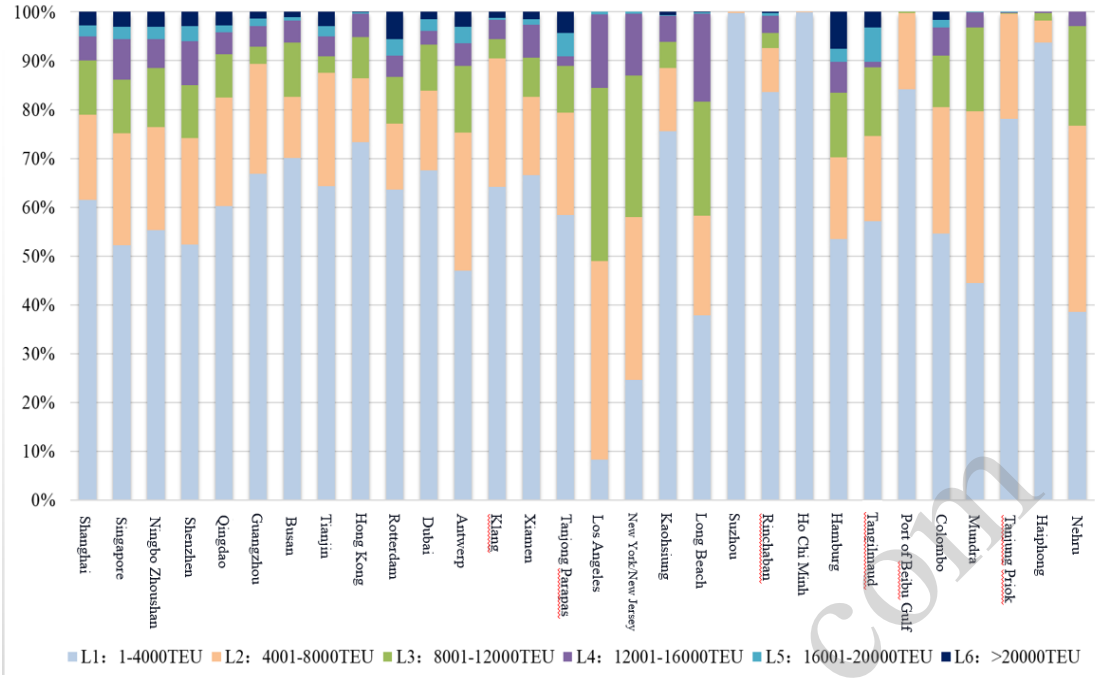



**Figure 8-3 Structure of Ships Calling at 30 Major Container Ports in 2021–2022**

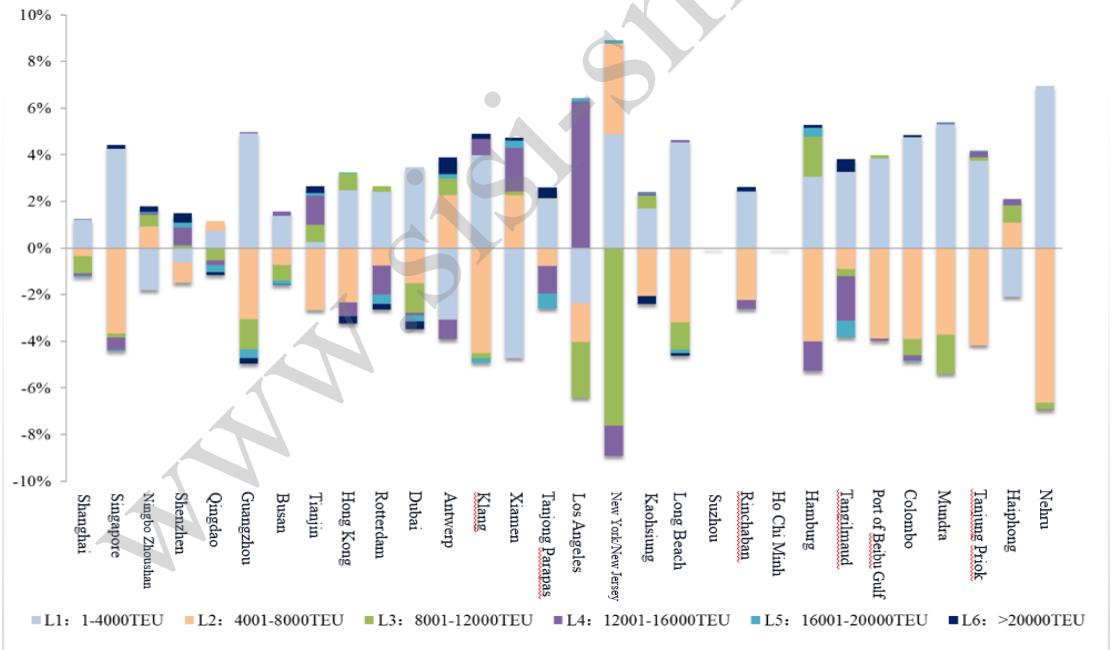



**Figure 8-4 Growth Rates of Number of Ships Calling at 30 Major Container Ports in 2021–2022 by Ship Type**

## 8.2 Analysis of Container Ship Stay Time at Ports

The overall ship stay length at the world's major container ports in 2022 improved slightly, and port congestion featured "shrunk scope, reduced number, prolonged stay, and shifted locations".

### 1. The daily average total number of ships at port/berth didn't change much, but the daily average total number of ships waiting for berth dropped significantly

The average numbers of ships at the port / waiting for berth / at berth at the world's major container ports in 2022 were 1,722 / 451 / 1,354, respectively, a year-on-year growth rate of -1.9% / -15.8% / 1.5%. The average number of ships at port and the total number of ships at berth didn't change much from last year, but the average number of ships waiting for berth dropped significantly. The influencing factors of port congestion had weakened effects in 2022, as the port congestion in the year was primarily a continuation of the congestion in 2021, the peak season in 2022 arrived earlier, and the normalized pandemic prevention and control mechanisms in the society and the at the ports became better developed. As a result, the number of ships congested at ports declined compared with that in 2021.

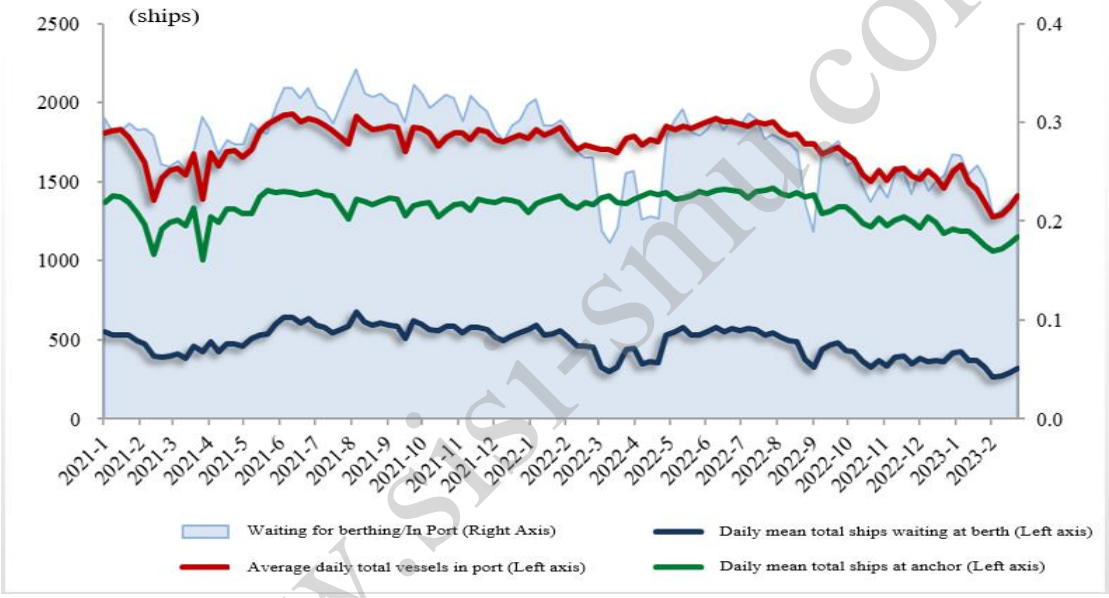
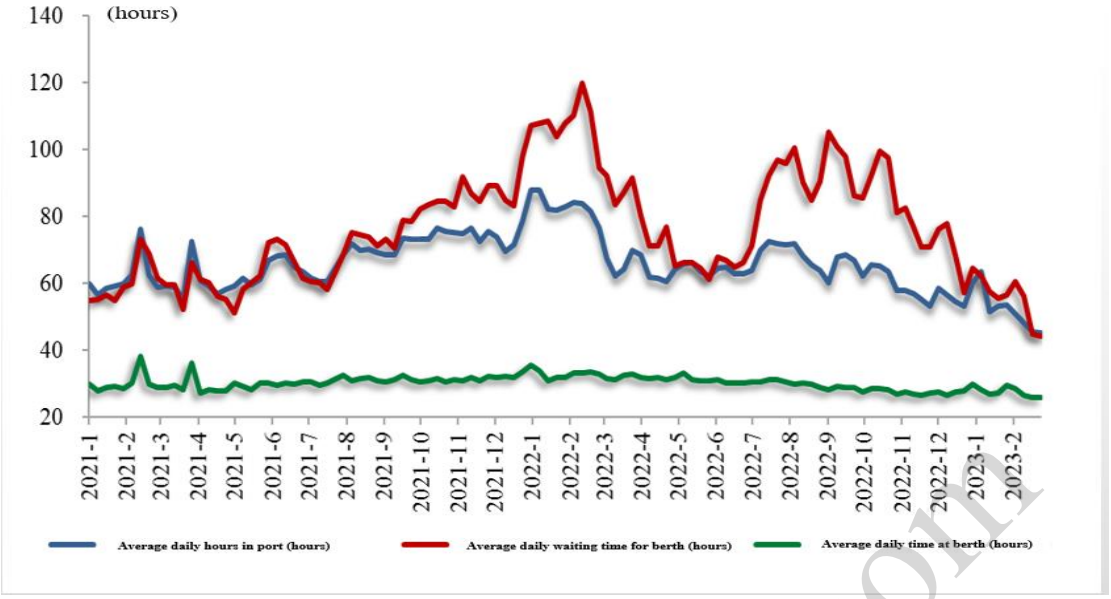



**Figure 8-5 Daily Average Numbers of Ships at Port / Waiting for Berth / at Berth at the World's Top 100 Container Ports (2021.1–2023.2)**

### 2. The daily average ship stay at port/berth was relatively stable, but the daily average waiting time for berth increased significantly

The average ship stays at the port / waiting for berth / at berth in the major global container ports in 2022 stood at 66.4 / 84.0 / 30.3 hours, respectively, a year-on-year growth rate of -0.9% / 18.1% / -1.0%, respectively. Specifically, the daily average ship stays at the port and at the berth decreased slightly, while the daily average time waiting for the berth extended significantly. The main reason is that, although port congestion contracted in scope relatively in 2022, the congested time at ports was generally prolonged waiting for berth, including the congestion at the US West ports in the first half of the year, European ports in the middle of the year, and the US East ports in the second half of the year. As a result, ships usually had to wait for 10 days to several months at the ports.




Note: Because ships of direct berth were not included in the "Daily average time waiting for berth" statistics, the case where the "Daily average time waiting for berth" is greater than the "Daily average time at port" may exist in the chart.

**Figure 8-6 Daily Average Time at Port / Waiting for Berth / at Berth at the World's Top 100 Container Ports (2021.1–2023.2)**

### 3. Ship stay time generally improved at major container hub ports

(1) The ship stay time at various ports generally improved in 2022. Multiple ports recorded a significantly shorter ship stay at the port / waiting for berth, namely less than 3 days at most ports, and the congestion at the hub port was largely alleviated. (2) Among the ports recording a longer time of ship stay at ports, the Port of New York-New Jersey suffered congestion primarily due to the transfer of cargo volume from the west of the United States in the second half of the year, and the Port of Hamburg congestion was primarily due to the outbreaks of worker strikes. (3) The average time at the berth of various ports also showed a downward trend on the whole, especially the Port of Hochiminh, Hong Kong Port, Port of Colombo, Port of Tanjung Pelepas, Port of Singapore, and Port of Kelang among other highlighting a focus on transhipment services.

**Table 8-1 Annual Average Time at Port / Waiting for Berth / at Berth and Growth Rates of Top 30 Container Ports in 2022**

| Region/Port | Annual mean time in port (hours) | | Annual mean waiting time for berth (hours) | | Annual mean time at berth (hours) | |
|---|---|---|---|---|---|---|
| Ho Chi Minh | 29.0 | -17.9% | 24.7 | -20.7% | 16.2 | -7.8% |
| Hong Kong | 29.4 | -36.0% | 32.5 | -36.7% | 16.3 | -7.2% |
| Haiphong | 31.0 | -7.3% | 24.0 | 26.4% | 24.1 | -1.5% |
| Kaohsiung | 32.8 | 0.8% | 27.6 | -11.1% | 24.2 | 9.1% |
| Tianjin | 34.2 | -12.4% | 30.3 | -7.6% | 25.1 | 1.7% |
| Busan | 34.7 | -13.0% | 29.6 | 13.6% | 25.5 | -1.6% |
| Mundra | 35.0 | -10.0% | 24.5 | -14.2% | 25.7 | -4.4% |
| Xiamen | 37.2 | 7.0% | 36.4 | -8.7% | 21.2 | 2.8% |
| Rinchaban | 37.4 | 2.8% | 32.0 | 23.6% | 26.6 | -3.7% |
| Nehru | 38.0 | -8.4% | 32.5 | 8.7% | 24.8 | -3.6% |
| Guangzhou | 38.0 | -20.4% | 38.4 | -33.7% | 19.4 | -0.8% |
| Tanjong Parapas | 38.6 | -29.8% | 34.9 | -31.6% | 24.8 | -8.8% |
| Singapore | 39.2 | -25.7% | 38.6 | -21.3% | 26.1 | -8.4% |
| Colombo | 40.5 | -10.0% | 23.3 | -10.8% | 27.9 | -10.8% |
| Suzhou | 40.9 | -18.8% | 55.0 | -1.7% | 19.7 | 2.6% |
| Klang | 43.9 | -30.4% | 30.0 | -41.1% | 27.5 | -13.2% |
| Tangilmaud | 48.5 | 9.4% | 58.0 | 36.0% | 22.2 | -1.2% |
| Shanghai | 49.1 | -33.6% | 48.4 | -24.8% | 19.6 | -4.7% |
| Dubai | 50.3 | -21.6% | 28.4 | -5.8% | 37.9 | 0.9% |
| Shenzhen | 52.5 | -21.6% | 57.2 | -19.5% | 24.2 | -3.9% |
| Port of Beibu Gulf | 54.0 | 3.0% | 30.0 | 0.9% | 25.0 | 4.3% |
| Antwerp | 61.7 | -13.9% | 43.5 | -23.1% | 41.5 | 4.7% |
| Qingdao | 64.0 | 42.7% | 62.8 | 74.4% | 22.6 | -7.2% |
| Ningbo Zhoushan | 64.7 | 6.9% | 58.6 | 18.5% | 22.3 | 8.0% |
| Tanjung Priok | 66.8 | -2.4% | 28.2 | 10.4% | 40.8 | -6.6% |
| Rotterdam | 68.7 | -6.8% | 56.0 | -4.0% | 48.3 | -0.2% |
| New York/New Jersey | 136.0 | 93.1% | 186.2 | 134.6% | 51.6 | 11.8% |
| Hamburg | 151.2 | 123.0% | 222.4 | 221.2% | 58.7 | 25.9% |
| Los Angeles | 297.5 | -15.4% | 349.8 | 24.7% | 136.5 | -5.6% |
| Long Beach | 364.3 | -11.4% | 478.0 | 17.6% | 113.7 | -8.5% |



## 4. Trends of Ship Time at Port / Waiting for Berth by Ship Type

**(1) The time of ship stay at port didn't increase linearly with the increase of the container load of the ship**. L3 ships posted a performance similar to that of L5 ships, while L4 ships' performance was similar to that of L6 ships. L3 and L4 ships were the main carriers on the routes from the Far East to North America. Due to the longer ship stay time at North American ports, L3 and L4 ships posted a relatively longer time at port, and the trend of time at the port was also roughly consistent with that of American ports. **(2) Larger ships had a relatively shorter waiting time for berthing due to their higher priority.** Like L2 ships, the average time waiting for berth of larger ships of L5 and L6 types was relatively short, at about 40 hours. **However, larger fluctuations were observed in the time waiting for berth by larger ships**, primarily attributed to their higher requirements for berthing conditions. In the event of worker

strikes at the port or yard congestion, among other situations, larger ships often needed more time to berth.

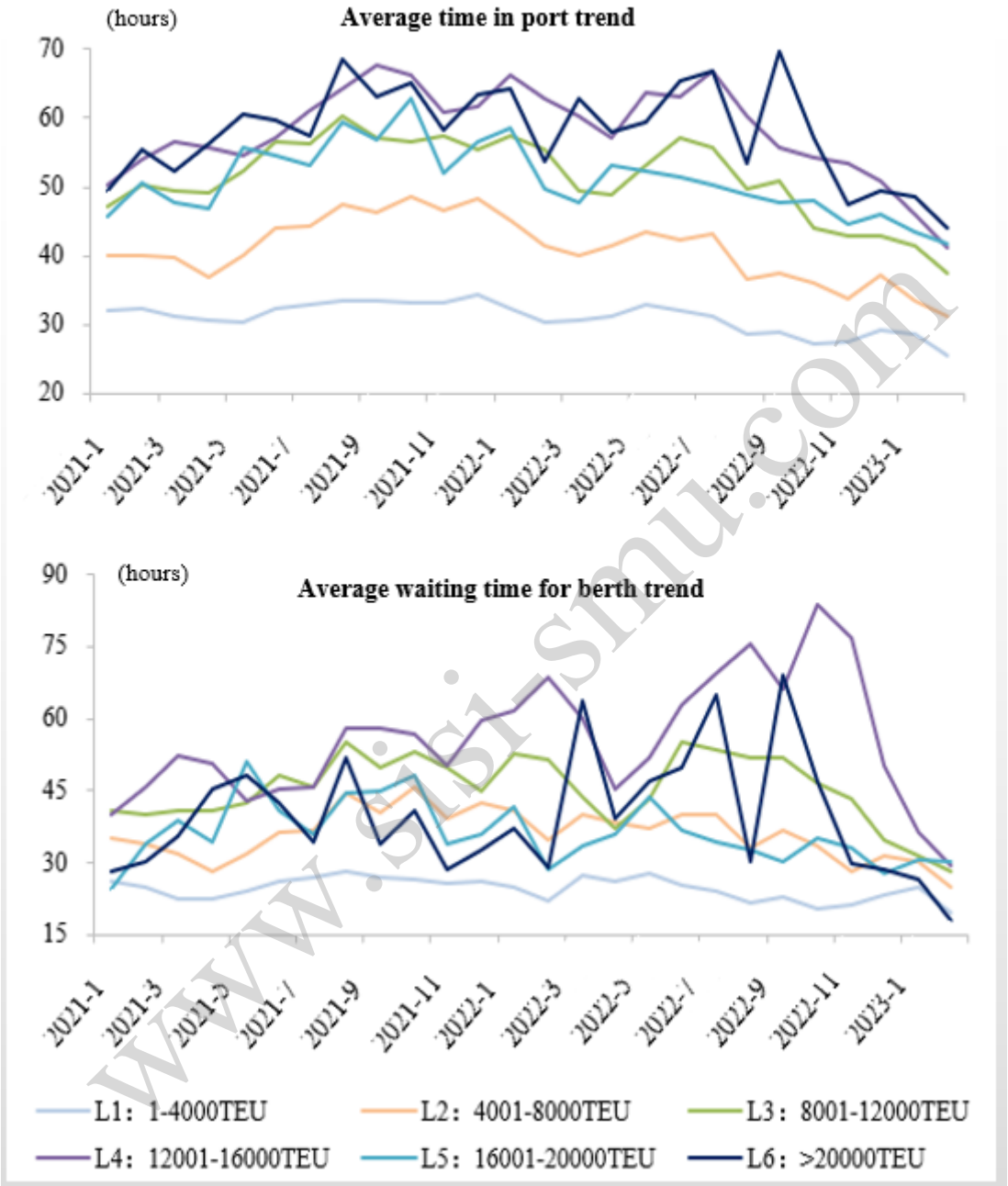
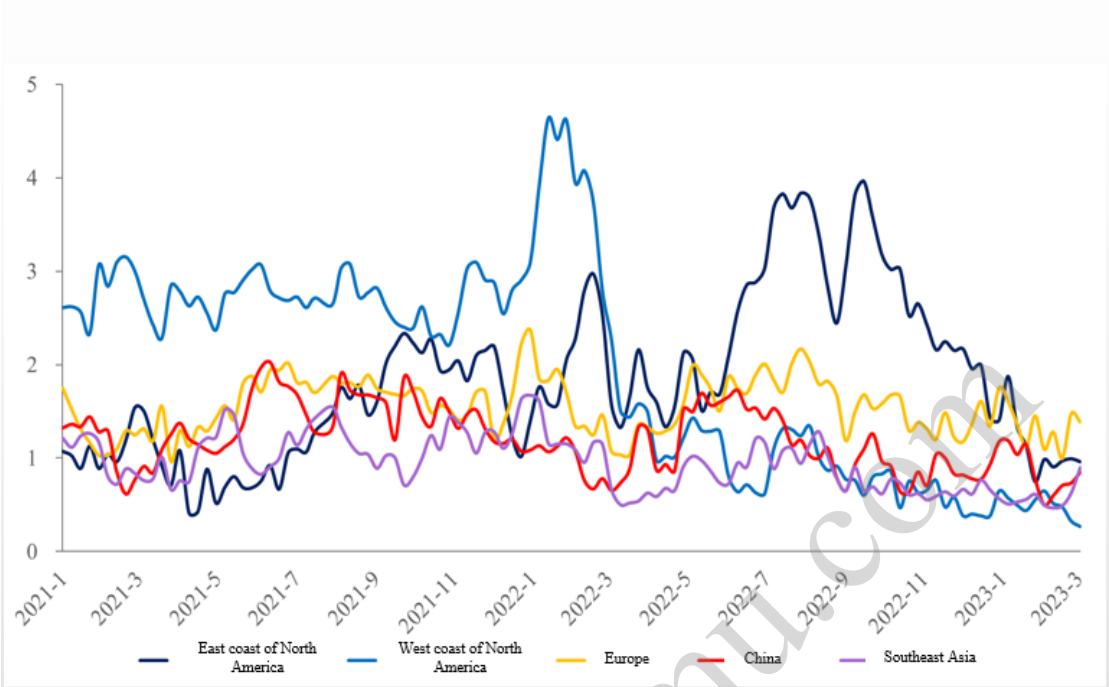



**Figure 8-7 Trends of Monthly Average Time at Port / Waiting for Berth at Top 100 Container Ports by Ship Type (2021.1–2023.2)**

## 8.3 Analysis of Container Ship Stay Time at Ports by Region

"Shift of congestion points" was a major feature of global container port congestion in 2022. North American and European ports recorded poor performance in terms of ship stay time at ports in 2022. Main congestion points in the year shifted between the US

West, European, and the US East regions, while the performance of Southeast Asian ports was relatively stable.




Note: The "Daily average number of ships waiting for berth in December 2020" of various regions/countries was used as the base value, and the indicator values for other periods were presented as multiples of the base value to reflect the congestion situation.

**Figure 8-8 Trends of Daily Average Number of Ships Waiting for Berth at Container Ports in Major Regions/Countries Around the World (2021.1–2023.3)**

## 1. East Asian ports recorded relatively stable performance in terms of ship stay time at ports, and Chinese ports showed strong resilience

The average numbers of ships at the port / waiting for berth / at the berth of major ports in East Asia increased by -5.2% / -19.9% /-0.1% in 2022 year-on-year, respectively, and the average time of ships at the port / waiting for berth / at berth increased by -13.1% / -8.4% / -1.8% year-on-year, respectively. The ship stay time at berth was relatively stable, while the time waiting for berth reduced significantly. Specifically, Chinese ports demonstrated strong resilience amid the pandemic, with the earlier traditional peak export season in 2022. However, as the port operations became more efficient, the number of ships waiting at ports rapidly fell, and the average time waiting for berth in the second half of the year was mostly around two days. Additionally, the pandemic outbreaks exerted a smaller and shorter impact on port production and operations than the previous year, as Chinese ports already had well-developed measures and emergency plans in response to pandemic outbreaks.

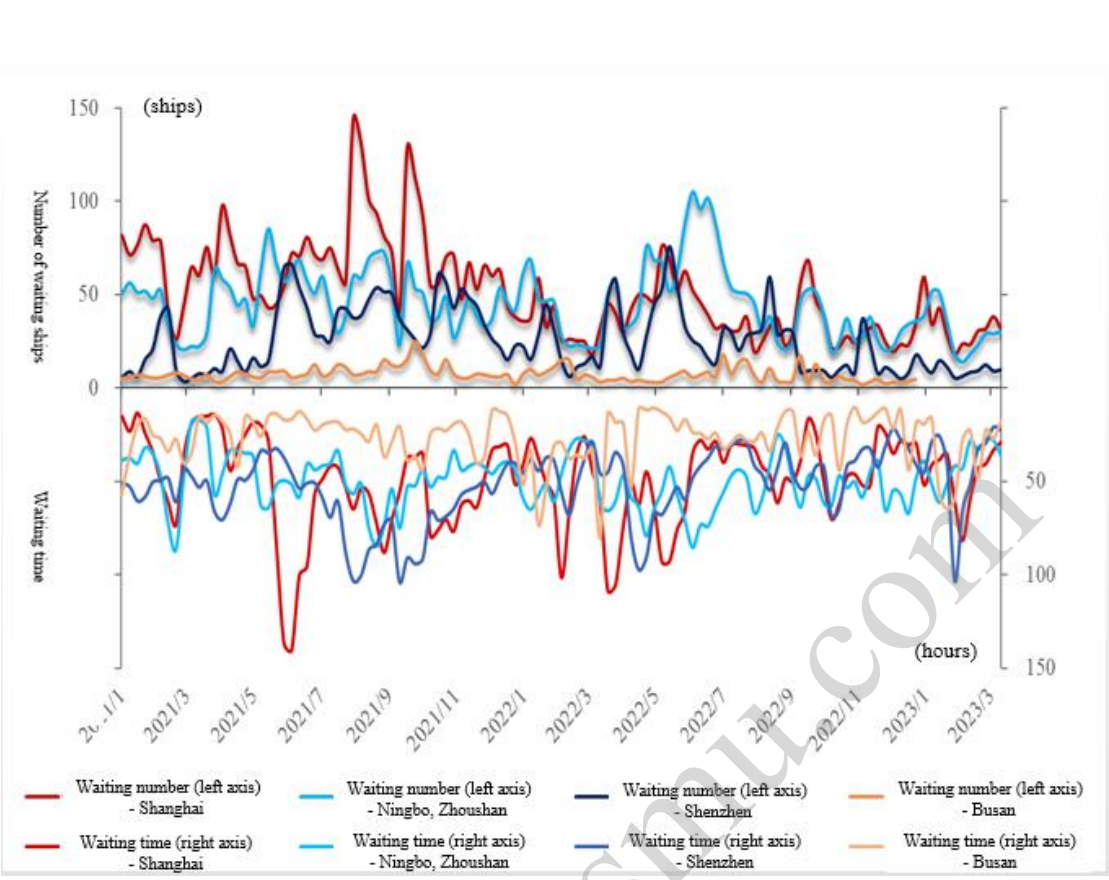



**Figure 8-9 Trends of Numbers and Time of Ships Waiting for Berth at Major Ports in East Asia (2021.1–2023.3)**

## 2. The time of ship stay at Southeast Asian ports improved significantly, and Singapore acted as a "catch-up port"

The average numbers of ships at the port / waiting for berth / at the berth of major ports in East Asia in 2022 increased by -3.2% / -24.2% / 1.4% year-on-year, respectively, and the average time of ship stays at the port / waiting for berth / at the berth increased by -14.6% / -7.9% / -8.6% year-on-year, respectively. As a result, the time of ships waiting for berth improved significantly. The time of ship stay at Southeast Asian ports improved significantly in 2022, and port congestion eased. The Port of Singapore took several measures to improve port efficiency and responsiveness, making the port a "catch-up port".

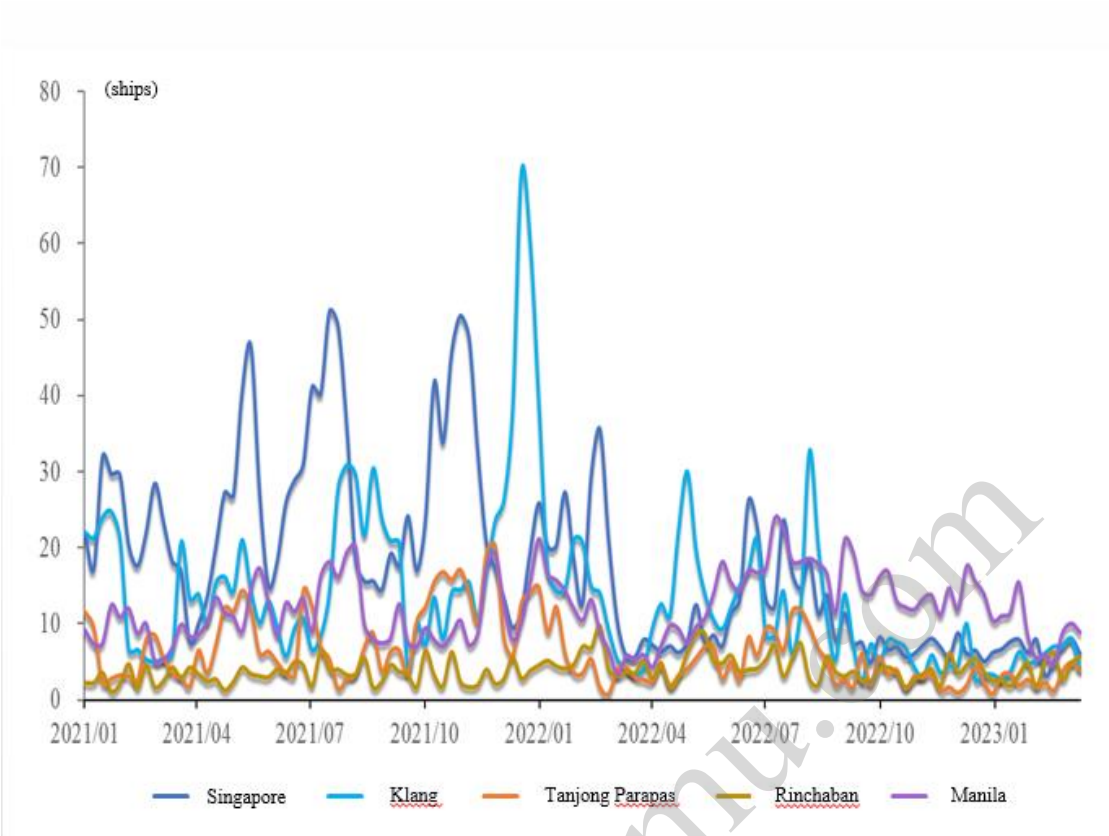



**Figure 8-10 Trends in Number of Ships Waiting for Berth at Major Ports in Southeast Asia (2021.1–2023.3)**

### 3. The number of ships waiting for berth at the US West ports in the second half of the year fell significantly, but the overall time waiting for berth still recorded a large increase

The average numbers of ships at the port / waiting for berth / at the berth of major ports on the west coast of North America in 2022 increased by -22.1% / -48.3% / -1.8% year-on-year, respectively, and the average time of ships at the port / waiting for berth / at the berth grew by -3.3% / 26.3% / -4.0% year-on-year, respectively. The sharp decrease in the average number of ships waiting for berth caused the number of ships at the port to fall, while the average time waiting for berth grew significantly due to the continued congestion at the Port of Oakland. Congestion remained the main feature of the US West ports in the first half of 2022. However, as the cargo flows gradually shifted to the US East in the middle of the year, the ships waiting for berth outside the Los Angeles and Long Beach ports dropped quickly, leading to a sharp decline in the number and time of ships waiting for berth. However, the congestion at the Port of Oakland continued and didn't ease until closer to Christmas.


**Figure 8-11 Trends of Numbers and Time of Ships Waiting for Berth at Major US West Ports (2021.1–2023.3)**

### 4. The number of ships waiting for berth at the US East ports surged, but port congestion eased greatly by the end of the year

The average numbers of ships at the port / waiting for berth / at the berth of major ports on the east coast of North America in 2022 increased by 36.6% / 82.0% / 5.3% year-on-year, respectively, and the average time of ship stay at the port / waiting for berth / at the berth increased by 117.9% / 145.6% / 17.3% year-on-year, respectively. The number and time of ships at the port / waiting for berth / at the berth both improved significantly. In response to the uncertainty of the labor negotiations at the US West ports, the container volume and shipping capacity gradually shifted to ports on the east coast of the United States and the Gulf of Mexico, starting from the end of April 2022. However, many ports on the east coast of the United States continued the congestion, which wasn't relieved until before Christmas at the end of the year. Specifically, the Port of Savannah has been severely congested several times in the past two years. Therefore, the Georgia Ports Authority (GPA) planned to increase the annual throughput of the Port of Savannah to 9.5 million TEUs by 2025.

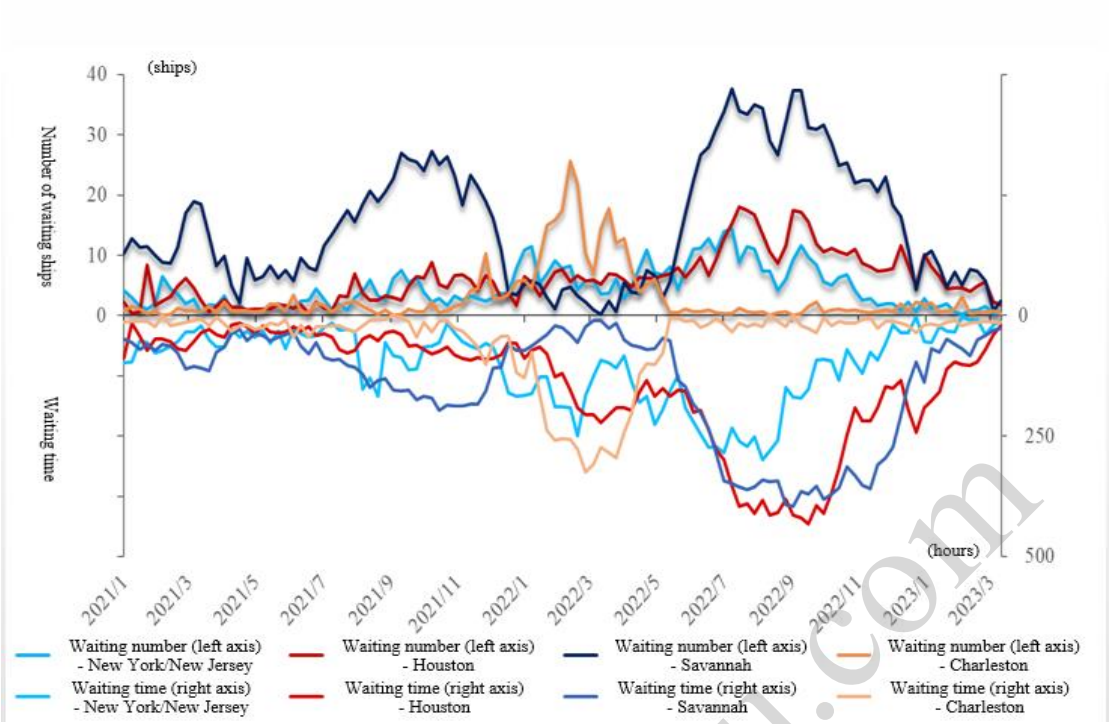



**Figure 8-12 Trends of Numbers and Time of Ships Waiting for Berth at Major US East Ports (2021.1–2023.3)**

## 5. European ports continued the severe congestion, and the daily average time of ships waiting for berth increased significantly

The average numbers of ships at the port / waiting for berth / at the berth of major ports in Europe in 2022 increased by 2.8% / -0.7% / 2.3% year-on-year, respectively, and the average time of ship stay at the port / waiting for berth / at berth increased by 14.2% / 50.3% / 4.8% year-on-year, respectively. The average number of ships didn't change much, but the time of ships waiting for berth increased significantly. Europe was hit by an epic drought in the summer of 2022, leading to a serious drop in water levels in important rivers such as the River Rhine, compromising inland water transport in Europe. In addition, the "strikes" at European ports aggravated the situation in the third quarter. Due to climate change and strikes, European ports frequently fell to congestion. In particular, during the rounds of strikes at ports such as the Port of Hamburg in Germany from June to July, many ships waited several months before entering the berth.

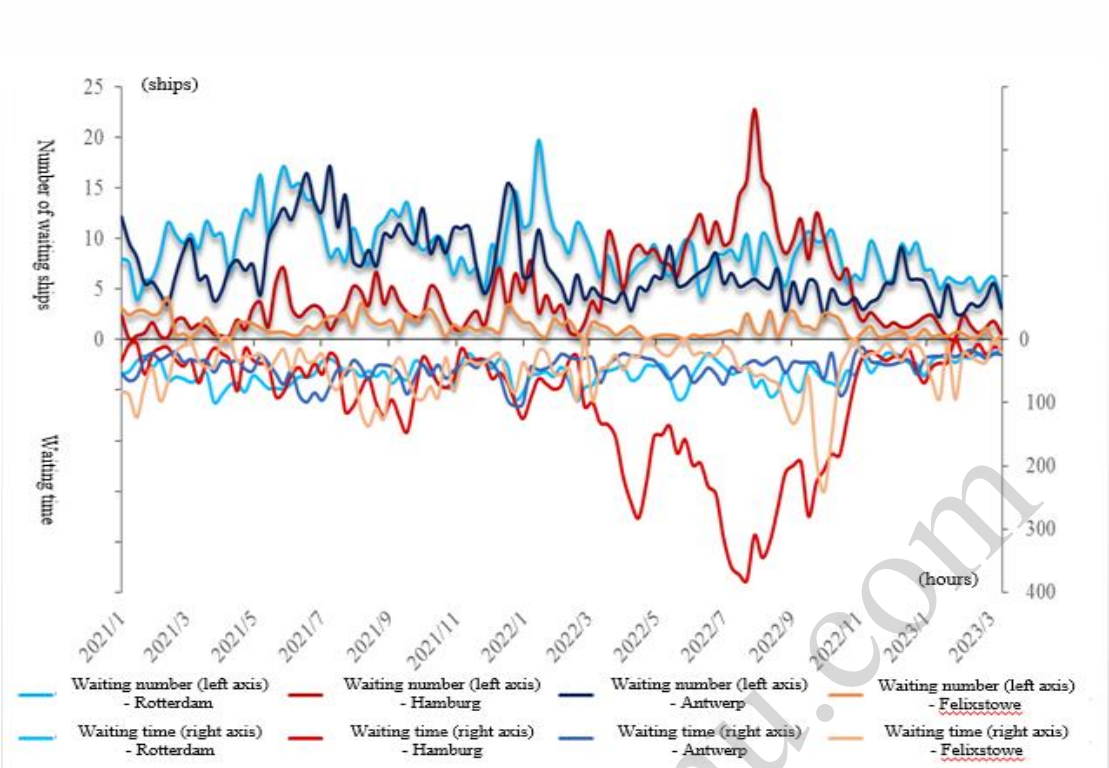



**Figure 8-13 Trends in Number of Ships Waiting for Berth at Major Ports in Europe (2021.1–2023.3)**

# Chapter 9 Comments on Global Port Development Trend in 2023

## 9.1 Global Economy Stabilized and Trade Volume Fell Back

The global fiscal and tax stimulus policies gradually exited the market in 2022. Under high inflation, developed economies took the lead in adopting deflationary policies, leading to economic growth slowdown and a trade demand decline in various countries. The global economic and trade rebound momentum was further interrupted by the geopolitical conflicts, the follow-up impact of the pandemic, and political interference from major powers. If no major changes take place in the international economy and trade and the external environment, global economic growth in 2023 is expected to decline slowly, and international trade growth will slow down significantly. According to the latest forecast in the *World Economic Outlook* issued by the International Monetary Fund (IMF) in January 2023, the global economic growth rate in 2023 will further fall from 3.4% in 2022 to 2.9%, and the growth rate of international trade volume will also descend from 5.4% to 2.4%, showing a mildly subsiding trend. The slow growth trend is expected to continue into the years that follow.

Currently, global economic and trade development depends on the "fundamentals" of production, manufacturing, and construction in various countries, as well as the sudden international events and bilateral/multilateral political and economic relations, which are playing an increasingly obvious role. Black Swan events such as "new types of the pandemic", "great-power politics", "geopolitical conflicts", and "international trade wars" have had a major impact on global economic and trade development, involving economies with a large trade market share such as Europe, United States, China, and Russia. With specific factors excluded, countries worldwide have shaken off the impact of the pandemic on the labor force currently, and the strikes due to inflation in some countries are expected to produce a relatively limited impact. However, the deflationary environment will restrain consumption and trade growth for a longer period. In particular, great power politics in the Americas and a sharp and prolonged economic slowdown in Europe will deal a heavy blow to developing countries. Therefore, major international institutions still maintain a positive attitude towards the global economic and trade environment in 2023, but are very cautious about the growth rate. Therefore, it is expected that, although the global economy and trade will maintain growth in 2023, the growth rate will be very limited.

## 9.2 Global Port Growth Grinding to a Halt

The global economic and trade development in 2022 was affected by the shrinking consumer demand under the deflationary policies and the surging manufacturing costs

caused by the international energy price hikes, and the international seaborne shipping volume declined slightly by 0.7%. The seaborne container shipping volume, as the main transport means of international commodity trade, fell by as much as 3.8%. The cargo throughput at global ports barely maintained positive growth, relying on the large imports of energy materials such as oil products and coal in Europe and the increased domestic freight demand in various regions and countries. However, the cross-border commodity trade primarily relying on container shipping performed poorly in the complex international environment, with its decline rate exceeding that of cargo throughput for the first time in recent years. This demonstrates the huge impact of the weakened market consumption power on international commodity trade.

The global economy will continue to recover slowly in 2023, but the relatively severe global financial market may remain hard to change in the short term. However, as time goes, Europe's "explosive" energy procurement scale may dwindle. As the Organization of Petroleum Exporting Countries (OPCE) trimmed production to maintain oil price levels, the demand for bulk commodity trade may fall in 2023. Although the international consumer market will likely remain sluggish, it may record growth from the falling international liner freight rates (with some new ships to be delivered soon) and a smaller base. It is comprehensively estimated that global ports' container volume growth rate in 2023 may slightly outperform cargo volume and stay low.

**Figure 9-1 Cargo and Container Throughput Growth Rates and Forecasts of Major Ports in the World in Recent Years**

| Year | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | Forecast: 2023 |
|---|---|---|---|---|---|---|---|
| Cargo throughput growth rate (%) | 5.2 | 2.9 | 1.7 | -1.5 | 4.2 | 1.4 | -1.5 – 0.0 |
| Container throughput growth rate (%) | 6.5 | 5.2 | 2.1 | -1.2 | 9.7 | -0.5 | 1.0 – 2.5 |

Source: Sample port data calculations and statistics by SISI.

- **Asian ports posted slower growth, and Australian ports rallied in growth rates**

In 2023, the demand shift of developed markets in Europe and the United States will continue to impact Asian export trade. However, as the impact of the "pandemic" fades, Asian manufacturing and local consumer markets are expected to recover moderately. The strengthened diplomatic partnerships between countries will also further curb the impact of the "geographical conflicts". In addition, Asian countries are actively expanding their domestic demands and augmenting infrastructure investment to promote economic and domestic trade development. They also strengthen economic and trade cooperation and business exchanges between regions through free trade agreements such as the Regional Comprehensive Economic Partnership (RCEP). Therefore, Asian ports are expected to record modest growth in throughput as investment and domestic consumption markets recover. Meanwhile, after Australian

ports experienced a decline in 2022, traders will be calmer in ore mining and transactions on fixed-price contracts, and the cooperation scope with major trading partners is expected to be further expanded. In addition, despite Australia's farther distance from Europe, Europe may become a driver of cargo volume growth at Australian ports as long as the shipping capacity permits.

- **European ports recorded a growth rate decrease from a previous increase, while American ports' growth slowed down**

Amid the "energy crisis", European countries made limited efforts to curb inflation in 2022. However, with the frequent strikes and demonstrations, European countries had to re-examine the regional economic development and monetary policies. As a result, it is expected that Europe will contract the orders for "high-priced" energy sources to avoid a mild decline in economy, and their interest rate raise policies will gradually follow that of North American countries. Against this backdrop, European residents' purchasing power may drop sharply, the demand in the consumer market may plunge, and the volumes of imported bulk commodities and container commodities may fall, leading to a decline in port throughput. On the contrary, North American ports will rely on the initiative of trading with neighboring regions and trade with Europe and the United States to expand port throughput. Meanwhile, they will maintain a high procurement and trade scale with East Asian and Southeast Asian markets. Besides, North America was not severely hurt economically and could secure a large trade surplus via energy outputs. As a result, the procurement demand is expected to be high in 2023. However, the exports of coal, crude oil, and liquefied natural gas will be affected to a certain extent due to the decline in European energy trade capacity.

- **Container trade rebounded slightly, and North American ports may lead the rise**

Apart from the rebound in 2021 after the pandemic, global port container trade growth has been relatively low in recent years. In an environment where the global industrial division of labor is relatively fixed, without new trade demands emerging, the international container trade may "peak". Meanwhile, European and American countries are striving to attract manufacturing industries back to maintain their industrial development and reduce supply chain risks. In addition, the freight demand of the east-west trunk routes dropped significantly against the politicized trade background, and the future growth rate of port container throughput may fluctuate around the "zero growth rate". Nevertheless, due to the widened trade surplus in some countries, the demand for inventory replenishment in European and American countries and the smaller base, the growth rate may pick up slightly in 2023. Specifically, North American ports enjoyed the biggest benefit. The rebound in procurement demand will expand foreign trade. However, the infrastructure capacity of the US East ports may become a bottleneck that limits the container volume increase.

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