# Global Port Development Report

(2021)

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

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May 2022

# Foreword

In 2021, against the backdrop of the expanding global vaccine coverage, the huge fiscal stimulus from various governments, and a low base for economic development in the previous year, the world economy enjoyed a phased recovery. The trade demand of major economies picked up sharply, and the global seaborne trade and port production also gradually recovered. However, the port industry development still faced risks, including repeated global pandemic outbreaks, the prevalence of trade protectionism, labor shortages, and geopolitical tensions. To this end, we kept an eye on the development of global ports, analyzed the new features and trends, and summarized and promoted new concepts, technologies, methodologies and models emerging during port development so as to provide support for the 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 (2021) 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

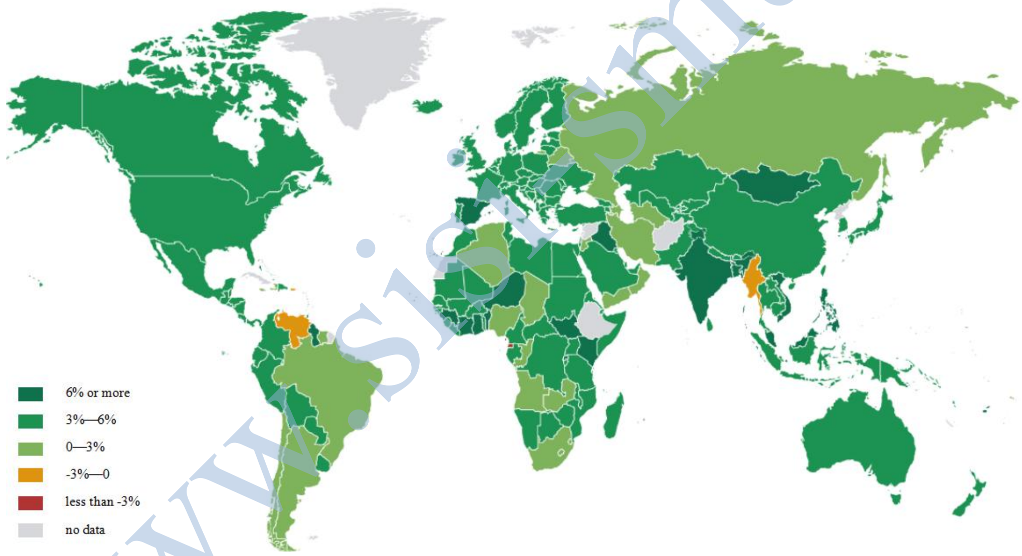
May 2022

# CATALOG

# I. Overview of Port Development Environment in 2021

## 1.1 Overview of Global Economic Development

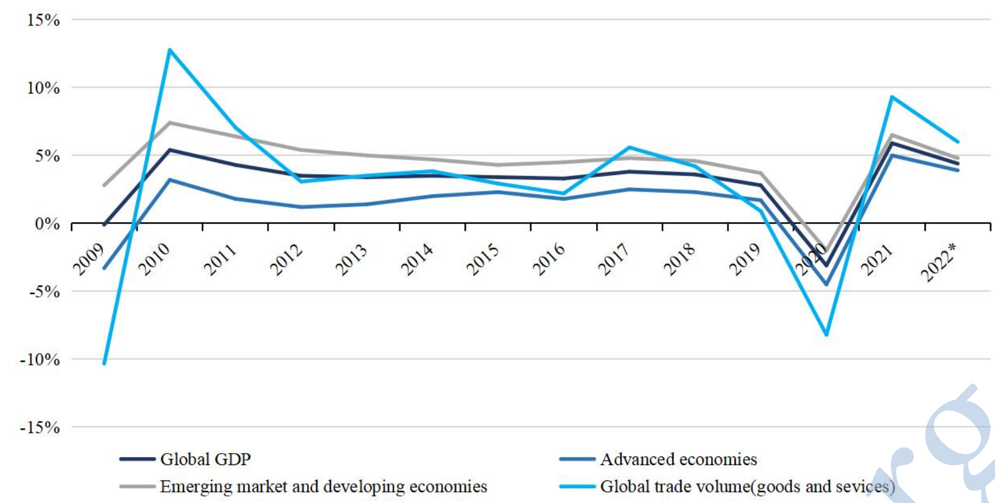
**The world economy resumed activity in 2021, but economic downside risks continued to loom.** In 2021, with the expanding global vaccine coverage, the huge fiscal and tax incentives from various governments, and a low base for economic development in the previous year, the global economy picked up significantly. However, the spread of the mutated virus in the second half of the year kept the supply chain interrupted longer than expected, which exacerbated the inflationary pressure in many countries and weakened the global economic growth momentum. According to the World Economic Outlook report released by the International Monetary Fund (IMF) in January 2022, the global economic growth rate in 2021 was 5.9%, growing by 9 percentage points and returning to the positive range from the negative growth in 2020, the worst hit year by the pandemic. Specifically, the growth rates of developed economies, and emerging markets and developing economies were 5.0% and 6.5%, respectively.




Source: IMF data.

**Figure 1-1** GDP Growth Rate of Major Global Economies in 2021

Major economies in the world returned to positive growth, with the growth rates of multiple economies growing by more than 10 percentage points. However, the economic recovery of various countries was still uneven, with developed economies recovering faster than developing economies. Due to the increased vaccination rates and fiscal and monetary incentives, China and the United States, the two major economies, played a positive role in boosting the world economy. In contrast, the growth prospects for less developed countries or economies such as South Asia, Sub-Saharan Africa, and Latin America, as well as the Caribbean area remained uncertain. Currently, the spillover effects of novel coronavirus mutations and delayed vaccine iterations, continued high inflation pressure, and persistent supply chain issues among other factors are still threatening and hindering the process of world economic recovery.




Note: * indicates projections.

Source: IMF data.

**Figure 1-2** Growth Rate of Global Economy (2009-2022)

**The European economy rebounded, with mixed economic performance across the continent.** In 2021, the constraining effects of the COVID-19 pandemic on the Euro Area's economy loosened, largely due to the increased vaccination coverage, the gradual lifting of lockdown measures, and the release of consumption power. Meanwhile, the internal trade exchanges in the Euro Area and the demand for global imports surged, boosting consumption and investment and contributing to the gradual pickup of the economic growth in the area (5.2%). As far as the economies in the Euro Area are concerned, the drivers and momentum of economic recovery were quite different. In France, the growth of household consumption and the hotel service industry boosted economic recovery. The industrial manufacturing on which the German economy depends was greatly affected by supply chain disruptions, and the economic recovery momentum was relatively weak.

**Table 1-1** GDP Growth Rate of Major European Economies

| Major European economies | 2021（%） | 2020（%） | Change (Percentage) |
|---|---|---|---|
| **Euro area** | **5.2** | **-6.4** | **11.6** |
| Germany | 2.7 | -4.6 | 7.3 |
| United Kingdom | 7.2 | -9.4 | 16.6 |
| Italy | 6.2 | -8.9 | 15.1 |
| Russia | 4.5 | -2.7 | 7.2 |
| Netherlands | 3.8 | -3.8 | 7.6 |
| Spain | 4.9 | -10.8 | 15.7 |
| Belgium | 5.6 | -6.3 | 11.9 |
| France | 6.7 | -8.0 | 14.7 |
| Latvia | 4.5 | -3.6 | 8.1 |
| Ireland | 13.0 | 5.9 | 7.1 |

| | | | |
|---|---|---|---|
| Portugal | 4.4 | -8.4 | 12.8 |

Source: IMF data.

## 1.2 Overview of Global Trade Development

Global trade rebounded strongly in 2021 after the pandemic. The weakening pandemic restrictions, the implementation of economic stimulus policies, and the rally in consumer demand among other factors drove the growth of international trade. However, with the negative impacts of intensifying supply chain disruptions, outbreaks of virus mutations, and increasing inflationary pressures, the global consumer demand weakened in the second half of the year, slowing down the trade growth. According to WTO estimates, the global trade volume rose by 10.8% in 2021, and the growth rate marked an increase of 16.1 percentage points compared with 2020.

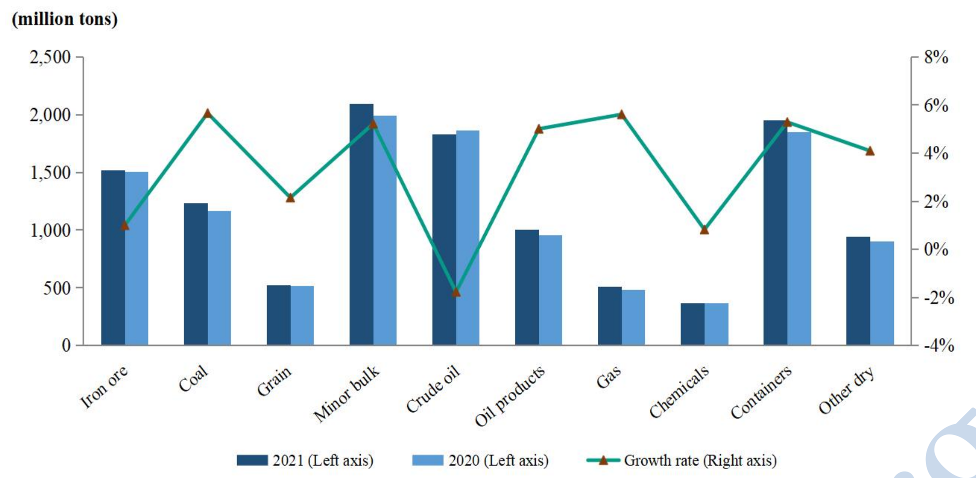
**Table 1-2** Growth Rate of Global Goods Trade Volume (2017-2021)

| | | 2017 | 2018 | 2019 | 2020 | 2021 | Change (Percentage) |
|---|---|---|---|---|---|---|---|
| Global Goods Trade Volume | | 4.8% | 3.1% | 0.1% | -5.3% | 10.8% | 16.1 |
| Export | North America | 3.4% | 3.8% | 0.3% | -8.6% | 8.7% | 17.3 |
| | South and Central America | 2.2% | -0.2% | -2.2% | -4.7% | 7.2% | 11.9 |
| | Europe | 4.1% | 1.9% | 0.6% | -7.9% | 9.7% | 17.6 |
| | Asia | 6.7% | 3.7% | 0.8% | 0.3% | 14.4% | 14.1 |
| Import | North America | 4.4% | 5.1% | -0.6% | -6.1% | 12.6% | 18.7 |
| | South and Central America | 4.4% | 5.6% | -2.6% | -9.9% | 19.9% | 29.8 |
| | Europe | 3.9% | 1.9% | 0.3% | -7.6% | 9.1% | 16.7 |
| | Asia | 8.5% | 5.0% | -0.5% | -1.2% | 10.7% | 11.9 |

Source: WTO.

## 1.3 Overview of International Shipping Market Development

In 2021, the annual seaborne trade volume increased by 3.2% year-on-year to 11.97 billion tons, basically recovering to the pre-pandemic level. However, the crude oil market remained sluggish, largely due to the lack of supply from OPEC+. The continued high oil price and the introduction of low-carbon policies in some countries to limit fossil fuels further curbed the global demand. On the other hand, the container and dry bulks markets recovered well. The international container shipping market continued to expand under the explosive growth of trade demand. However, with the spread of port congestion, shipping prices continued to rise, and the growth rate slowed down in the later phase. Due to the limited production capacity in some countries, the recovery of iron ore was not satisfactory, and the coal trade volume increased greatly due to the high global demand for electricity.

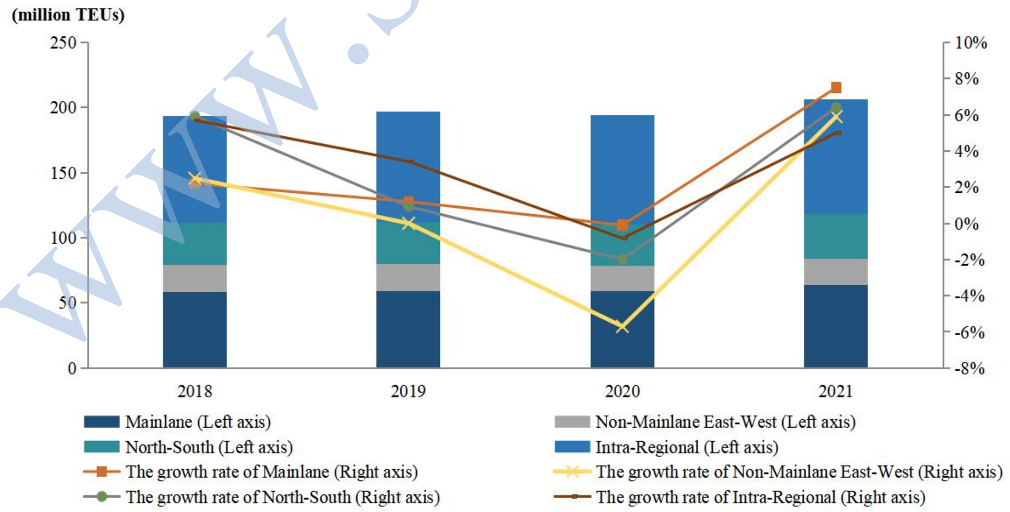



Source: Clarkson website.

**Figure 1-3** Growth Rate of Seaborne Volume of Global Cargo by Different Types (2020-2021)

## 1.3.1 Global container shipping volume stays high

In 2021, consumer spending in various countries gradually shifted from trade in services to trade in commodities, resulting in a sharp rebound in container trade. The global container shipping market expanded vigorously, with freight rates soaring and containers becoming scarce, and container port congestion also became more obvious. In the second half of the year, with the disappearance of the low base effect in China and other markets, as well as demand overdrafts and rising seaborne freights, the growth rate of container shipping volume slowed down. Overall, the global seaborne container trade volume rose by 6.1% in 2021, the best year ever for the container market.

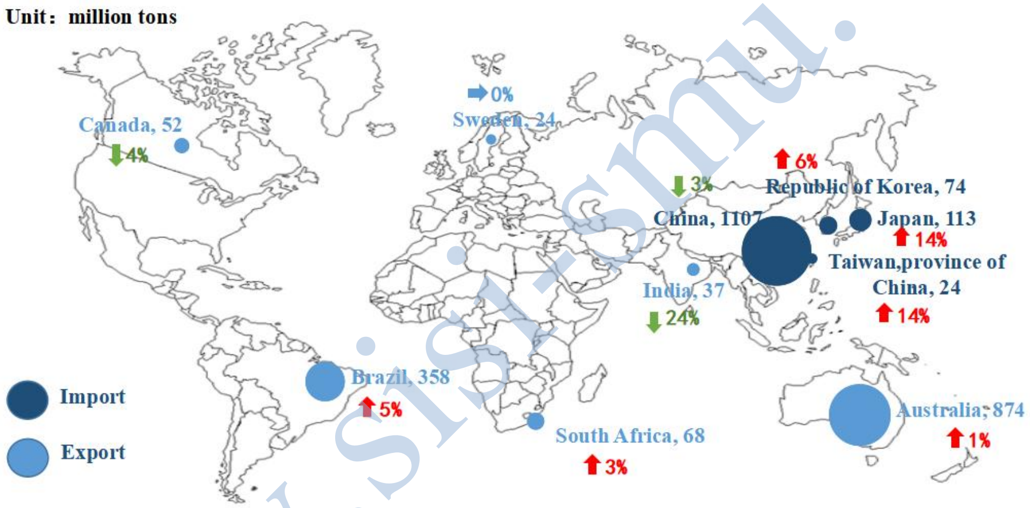



Source: Clarkson website.

**Figure 1-4** Container Shipping Volume and Growth Rate of Various Routes around the world (2018-2021)

## 1.3.2 Global major bulks trade growth varies

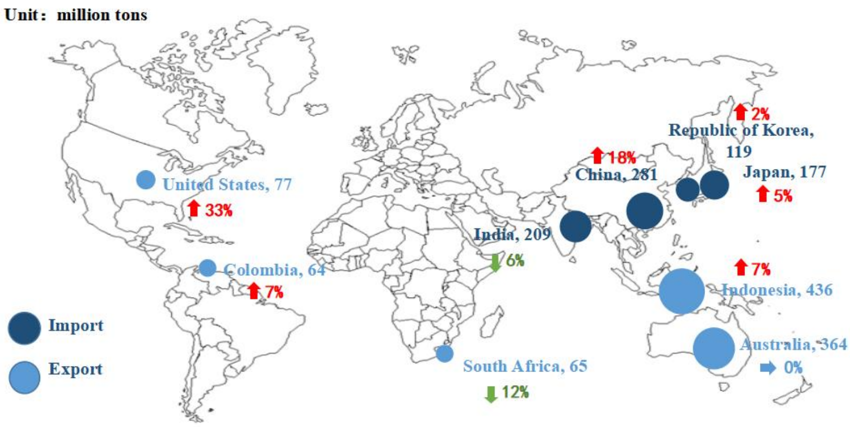
**The global iron ore trade volume increased slightly.** In 2021, the global iron ore seaborne trade recorded a slight growth rate of 1.0%. From the perspective of demand, due to the rising international ore prices, China's steel production stayed limited, thereby reducing the demand for iron ore. However, the recovery of European and American manufacturing increased the demand for iron ore. From the perspective of supply, Rio Tinto and Vale encountered obstacles in iron ore production in the first half of the year. Although India's domestic mines resumed production of iron ore in the first six months, the domestic crude steel production capacity was released in the second half, and the supply of its own steelmaking raw materials was insufficient, reducing the iron ore exports. In Australia, due to weather conditions and ore traders' restrictions on production, which increased sales prices, some mines were suspended. The tension between China and Australia further limited the latter's iron ore exports.




Source: Clarkson website.

**Figure 1-5** Import and Export Seaborne Volume of Global Iron Ore in 2021

**The global coal trade volume increased significantly.** In 2021, the global seaborne trade of coal achieved substantial growth of 5.7%. The seaborne coal volume climbed rapidly since the second quarter, with an increase of 14.9%. From the perspective of demand, the rapid economic recovery after the easing of the global pandemic stimulated the electricity demand, and the price of natural gas soared to a record high, jump-starting the demand for coal. From the perspective of supply, after Australia's coal exports to China were restricted, Australia began to tap markets to India and Korea, but it was still not enough to drive a substantial increase in exports. China's imports of U.S. coal grew substantially due to tensions between China and Australia. In addition, India, Japan, Europe, and other regions also became major export destinations for the United States.

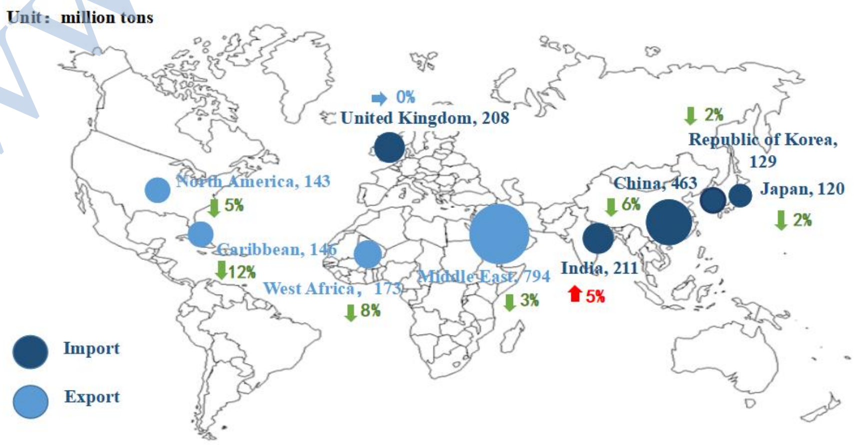



Source: Clarkson website.

**Figure 1-6** Import and Export Seaborne Volume of Global Coal in 2021

## 1.3.3 Global liquid bulks market sends discouraging signs

Two consecutive voluntary production cuts by Saudi Arabia and insufficient supply from OPEC+ led to a continuous rise in oil prices. The performance of the global oil product market remained sluggish. Liquid fuel consumption exceeded production. The global oil product demand was further curbed, and the annual crude oil seaborne trade volume dropped by 1.8%. From the perspective of demand, China restricted the use of petrochemical energy due to high oil prices and the "carbon peak" target, and strengthened liquefied natural gas imports. Europe and other places saw relatively high PMI, while oil inventories were low, and the demand for auto fuel remained strong. North America benefited from fiscal stimulus policies and its own energy production suspension and maintained moderate imports of oil products. From the perspective of supply, OPEC+ actively controlled the pace of production increases, resulting in a lag in the release of crude oil production capacity. Extreme weather such as cold waves and hurricanes in the United States further hurt crude oil production.




Source: Clarkson website.

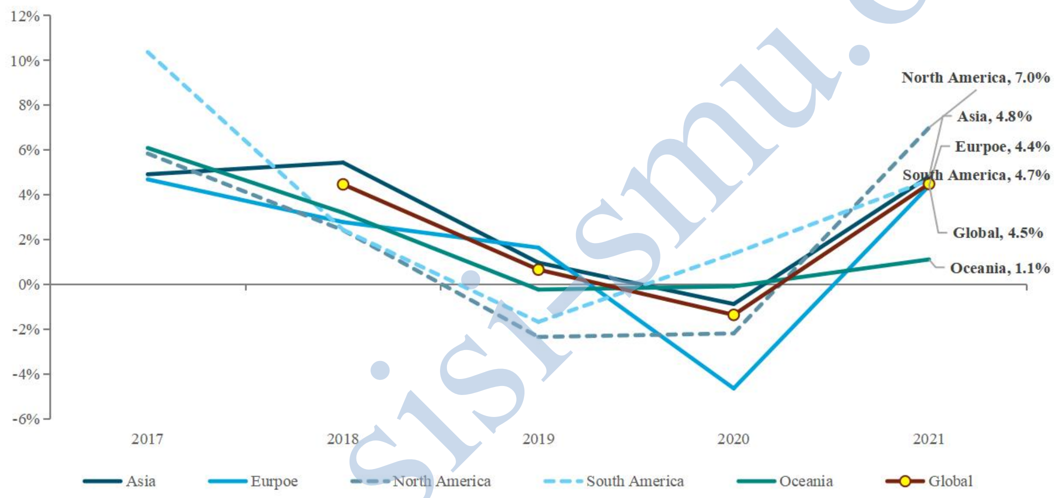
**Figure 1-7** Import and Export Seaborne Volume of Global Crude Oil in 2021

# II. Overview of Global Port Production in 2021

## 2.1 Overview of Global Port Throughputs

### 2.1.1 Overview of global port cargo throughputs

In 2021, the cargo throughput of the world's major ports[1] increased by 4.5% year-on-year, a rise of 5.9 percentage points compared with 2020, showing a gradual recovery amid the pandemic. Most of the world's ports returned to the growth range, and the growth rate of ports increased significantly compared with 2020. From a regional perspective, the growth rate of port throughput on all continents rebounded across the board. Apart from Oceania, which saw an increase of 1.1%, all other continents recorded a growth rate higher than 4%.

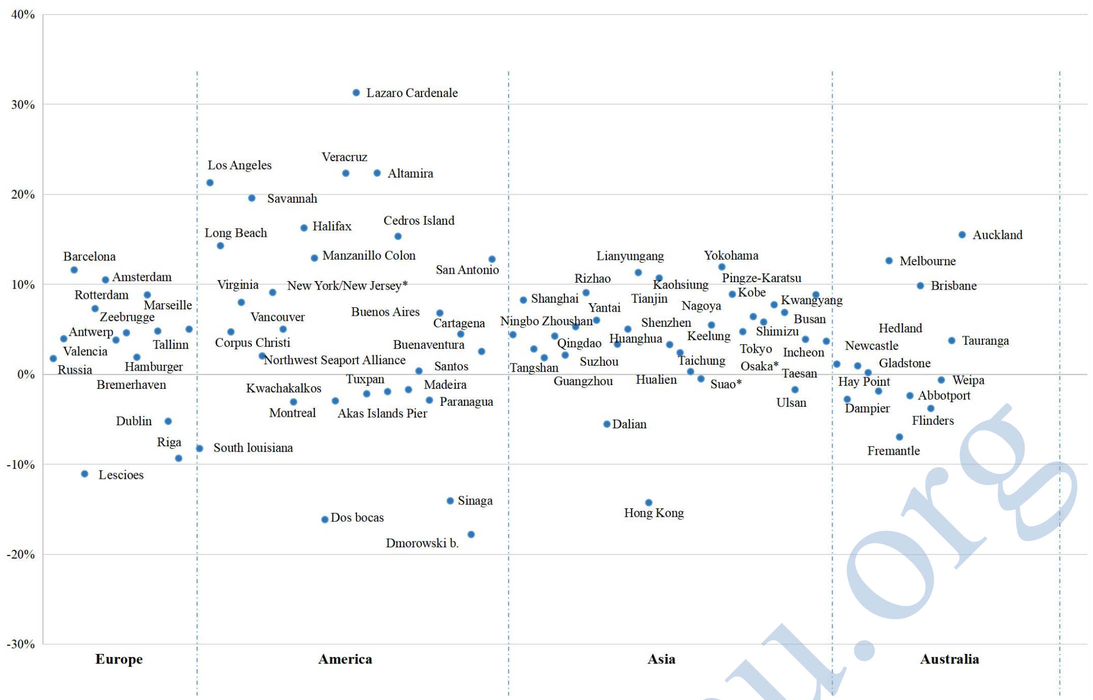



Note: * indicates projections.

Source: Websites of various port authorities, sorted by SISI.

**Figure 2-1** Cargo Throughput Growth Rate of Global Major Ports in Various Regions (2017-2021)

[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 of the United Nations and the World Bank and Clarksons analysis of international maritime trade data, the port throughput (totaling about 23.9 billion tons) covered in this report accounted for about 70% of the global total throughput of coastal ports.




Source: Websites of various port authorities, sorted by SISI.

**Figure 2-2** Cargo Throughput Growth of Global Major Ports in 2021

## 2.1.2 Rankings of the world's top 50 ports by cargo throughput

In 2021, the world's top 50 ports posted sound production recovery and their cargo throughput totaled 16.29 billion tons, a year-on-year increase of 4.1%, with 39 ports posting positive year-on-year growth and 10 ports registering growth higher than 10%. Jiangyin Port in China recorded the fastest growth at 36.6%. The rankings of 10 of the top 20 ports changed. Qingdao Port and Rizhao Port surpassed Guangzhou Port and Tianjin Port with a growth rate of 4.3% and 9.1%, respectively, swapping their places. Rizhao Port is expected to catch up with Australia's Port of Hedland in 2022 to take the 8th spot.

**Table 2-1** Global Top 50 Ports by Cargo Throughput in 2021

| Ranking | Port | 2021 (million tons) | 2020 (million tons) | YoY growth rate |
|---|---|---|---|---|
| 1（1） | Ningbo Zhoushan | 1224.1 | 1172.4 | 4.4% |
| 2（2） | Shanghai | 769.7 | 711.0 | 8.2% |
| 3（3） | Tangshan | 722.4 | 702.6 | 2.8% |
| 4（5） | Qingdao | 630.3 | 604.6 | 4.3% |
| 5（4） | Guangzhou | 623.7 | 612.4 | 1.8% |
| 6（6） | Singapore | 599.6 | 590.7 | 1.5% |
| 7（7） | Suzhou | 565.9 | 554.1 | 2.1% |
| 8（8） | Hedland | 553.3 | 547.1 | 1.1% |
| 9（10） | Rizhao | 541.2 | 496.2 | 9.1% |
| 10（9） | Tianjin | 529.5 | 502.9 | 5.3% |
| 11（11） | Rotterdam | 468.7 | 436.8 | 7.3% |

| | | | | |
|---|---|---|---|---|
| 12（12） | Busan | 442.5 | 411.2 | 7.6% |
| 13（13） | Yantai | 423.4 | 399.4 | 6.0% |
| 14（18） | Taizhou | 352.9 | 301.1 | 17.2% |
| 15（24） | Jiangyin | 337.6 | 247.1 | 36.6% |
| 16（15） | Dalian | 315.5 | 334.0 | -5.5% |
| 17（17） | Huanghua | 311.3 | 301.3 | 3.3% |
| 18（16） | Nantong | 308.5 | 310.1 | -0.5% |
| 19（19） | Gwangyang | 292.1 | 273.3 | 6.9% |
| 20（20） | Shenzhen | 278.4 | 265.1 | 5.0% |
| 21（23） | Fuzhou | 273.5 | 249.0 | 9.9% |
| 22（25） | Lianyungang | 269.2 | 241.8 | 11.3% |
| 23（21） | Nanjing | 268.6 | 251.1 | 6.9% |
| 24（27） | Zhanjiang | 255.6 | 233.9 | 9.3% |
| 25（29） | Antwerp | 239.8 | 231.0 | 3.8% |
| 26（14） | Zhenjiang | 237.1 | 350.6 | -32.4% |
| 27（31） | Port Klang | 235.4 | 223.0 | 5.6% |
| 28（26） | Yingkou | 230.0 | 238.2 | -3.5% |
| 29（28） | Itaqui | 228.0 | 231.9 | -1.7% |
| 30（32） | Xiamen | 227.6 | 207.5 | 9.7% |
| 31（36） | South louisiana | 222.0 | 183.0 | 21.3% |
| 32（22） | Hong Kong | 213.7 | 249.3 | -14.3% |
| 33（30） | Los Angeles | 208.5 | 227.2 | -8.2% |
| 34（33） | Qinhuangdao | 200.5 | 200.6 | 0.0% |
| 35（40） | Chongqing | 198.0 | 165.0 | 20.0% |
| 36（37） | Long Beach | 196.4 | 171.8 | 14.3% |
| 37（34） | Dongguan | 189.0 | 198.6 | -4.8% |
| 38（35） | Ulsan | 184.7 | 187.9 | -1.7% |
| 39（39） | Nagoya* | 177.8 | 168.5 | 5.5% |
| 40（42） | Ho Chi Minh Port | 169.1 | 163.2 | 3.6% |
| 41（48） | Tanjung Pelepas | 168.1 | 144.6 | 16.2% |
| 42（50） | Qinzhou | 167.0 | 136.5 | 22.3% |
| 43（41） | Newcastle | 166.1 | 164.5 | 0.9% |
| 44（38） | Dampier | 165.2 | 169.9 | -2.8% |
| 45（44） | Incheon | 158.3 | 152.2 | 4.0% |
| 46（46） | Vancouver* | 152.8 | 145.5 | 5.0% |
| 47（58） | Jiujiang | 151.8 | 120.5 | 26.0% |
| 48（47） | Corpus Christi | 151.7 | 144.9 | 4.7% |
| 49（57） | Fangcheng | 148.0 | 121.8 | 21.5% |
| 50（45） | Santos | 147.0 | 146.5 | 0.4% |

Note: (1) * indicates projections;(2) Busan, Gwangyang, Ulsan, Pyeongtaek Karatsu in South Korea, Vancouver in Canada, Melbourne in Australia, Los Angeles and Long Beach in the United States are counted as revenue tons;

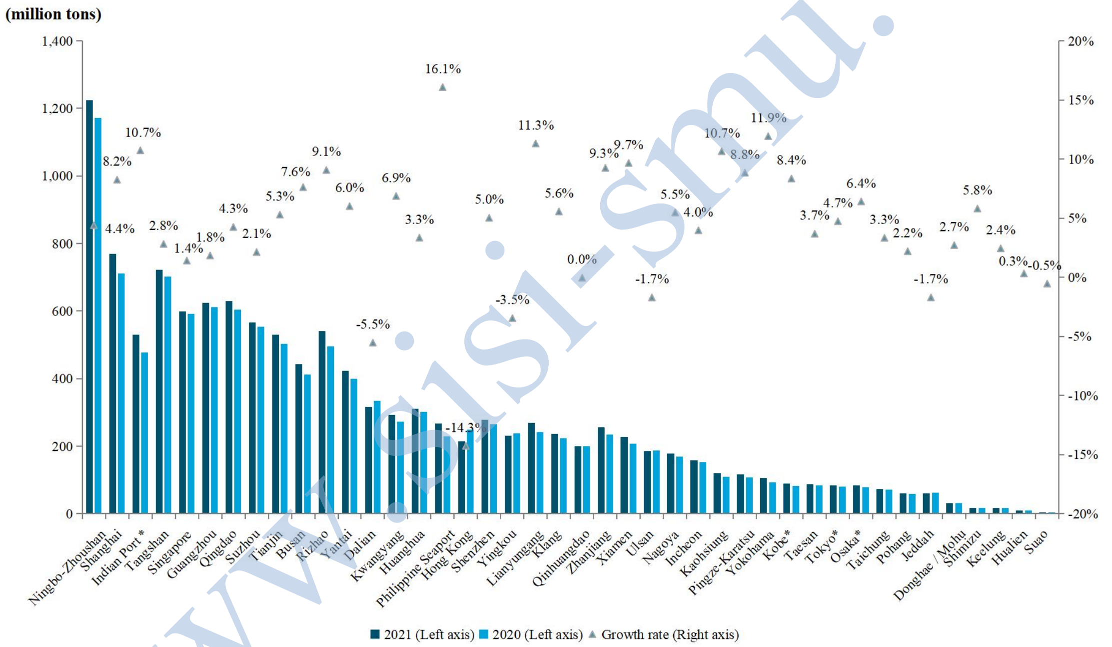
South Louisiana, Corpus Christi statistics are short tons, which have been converted into metric tons;(3) In the "Port Ranking" column, the numbers outside the brackets are the port's 2021 ranking, and the numbers in brackets are the 2020 ranking.

Source: Websites of various port authorities, sorted by SISI.

## 2.1.3 Cargo throughput analysis of ports in different regions

### (1) Growth of Asian ports rebounds steadily

In 2021, cargo throughput of major Asian ports saw strong growth. However, the throughput of Southeast Asian ports fluctuated greatly due to the repeated virus outbreaks. Although the pandemic eased in the first half of the year, and that helped the recovery of exports, the cases climbed again after the third quarter, leading to the closure of cities and shutdowns. Nevertheless, the sea freight of Southeast Asian ports soared, and orders flowed to China. Against this backdrop, the throughput of major Asian ports[2] increased by 4.8% in 2021.




Note: * indicates projections.

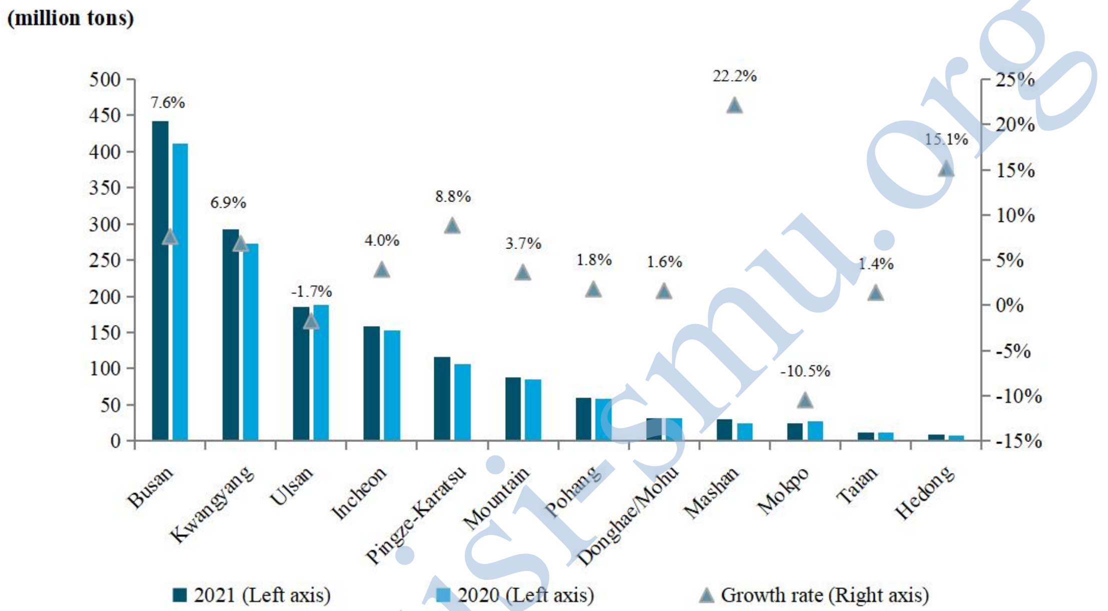
Source: Websites of various port authorities, sorted by SISI.

**Figure 2-3** Cargo Throughput and Growth Rate of Major Asian Ports (2020-2021)

**The growth rate of port throughput in mainland China showed a "V"-shaped trend.** Due to the influence of the low base in the same period of 2020, the growth rate of China's port throughput reached 24.4% in February 2021, but then slowed down later before a slight pickup at the end of the year. The annual cargo throughput was about 15.55 billion tons, with a year-on-year growth rate of 6.8%. Compared with other ports in the world, China's port production remained relatively stable due to the relatively early recovery and policy dividends.

[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.

**Korea's port throughput steadily recovered.** In 2021, Korean ports recorded a total cargo throughput of 1.58 billion tons, a year-on-year increase of 4.7%. Except Port of Ulsan and Port of Mokpo, which remained in the negative growth range, all other ports basically reversed the trend and started to rise. The growth of Korean ports was largely driven by the increase in the exports of automobiles, machinery, and petrochemical products, and iron ore imports. Specifically, the sales of automobiles in Korea increased by 22.9% year-on-year, while the housing supply policy drove the increase in the demand for cement and ore imports. The demand for coal was subject to low-carbon environmental protection requirements. As a result, the volume of bituminous coal imported by power plants in Incheon, Daesan, and other places fell year-on-year.




Source: Websites of various port authorities, sorted by SISI.

**Figure 2-4** Cargo Throughput and Growth Rate of Major South Korean Ports (2020-2021)

**The overall throughput of Southeast Asian ports rebounded.** In 2021, relying on the increase in the exports of electronic products and other industrial goods, the growth of port throughput in the Philippines hit a new high. Ports such as Port of Kelang and Port of Tanjung Pelepas in Malaysia largely undertook the transshipment freight demand of the Eurasian route. Under the continuous growth of Eurasian trade, they also maintained sound stable growth. The throughput of Singapore Port also maintained a slight increase, but it was still lower than the level in 2019. On the one hand, it was affected by tropical storms in Southeast Asia and tightened prevention and control measures. On the other hand, the unstable global shipping supply chain delayed the dispatch of empty containers, making it unable to promptly meet the shipping needs of liner companies and cargo owners and resulting in a slightly insufficient drive for port growth.

**Table 2-2** Cargo Throughput and Growth Rate of Major Southeast Asian Ports (2018-2021)

(unit：million tons)

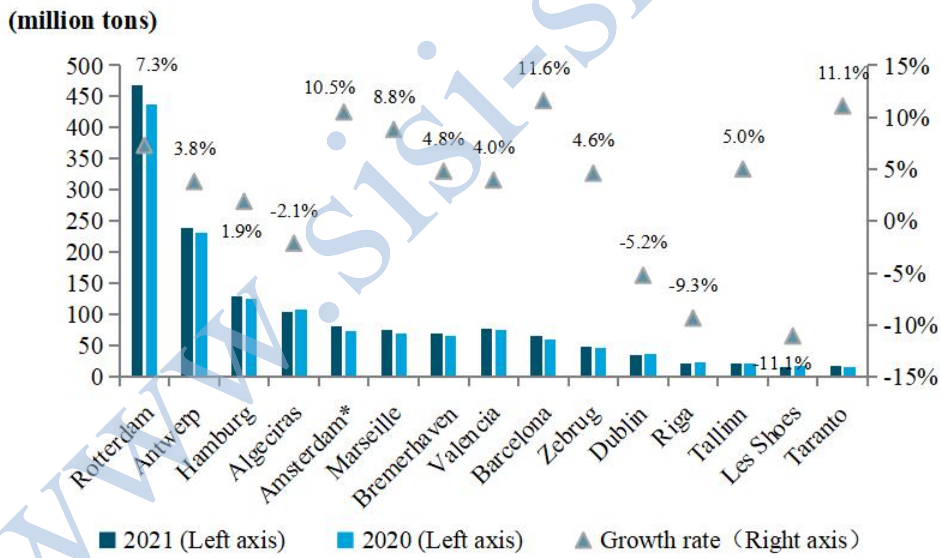
| Country | 2018 | 2019 | 2020 | 2021 | Growth rate (2020) | Growth rate (2021) |
|---|---|---|---|---|---|---|
| Philippines | 261.0 | 266.2 | 244.0 | 266.8 | -8.4% | 9.3% |

| | | | | | | |
|---|---|---|---|---|---|---|
| Malaysia | 567.6 | 595.2 | 565.8 | 590.3 | -4.9% | 4.3% |
| Vietnam | - | 725.0 | 755.2 | 767.0 | 4.2% | 1.6% |
| Singapore | 630.1 | 626.5 | 590.7 | 599.6 | -5.7% | 1.5% |

Source: Websites of various port authorities, sorted by SISI.

## (2) The growth of European ports rebounds sharply

In 2021, European nations gradually relaxed restrictions on cargo flows between countries for industrial and economic development, and the port trade volume rose accordingly. After the continuous recovery of oil refining and steel production capacity in the Netherlands, the Port of Rotterdam's trade demand also increased significantly. Coupled with the recovery of consumer spending, the port throughput rose by as much as 14.6% in the third quarter. The Port of Antwerp was boosted by the import trade of industrial chemicals and fruits and vegetables and maintained a robust growth momentum. Among small and medium-sized ports, the Port of Tallinn actively promoted the development of ro-ro and dry bulks trade, and the routes such as Helsinki and Stockholm were reopened. Meanwhile, the warehouses and terminals received high investment for expansion, and the production situation in 2021 was also favorable. However, the Port of Riga was seriously affected by the pandemic, and the national industrial recovery process was slow. The demand for bulk cargoes such as coal, ore, timber, and oil was weak and the cargo throughput maintained a decline of 9.3%.



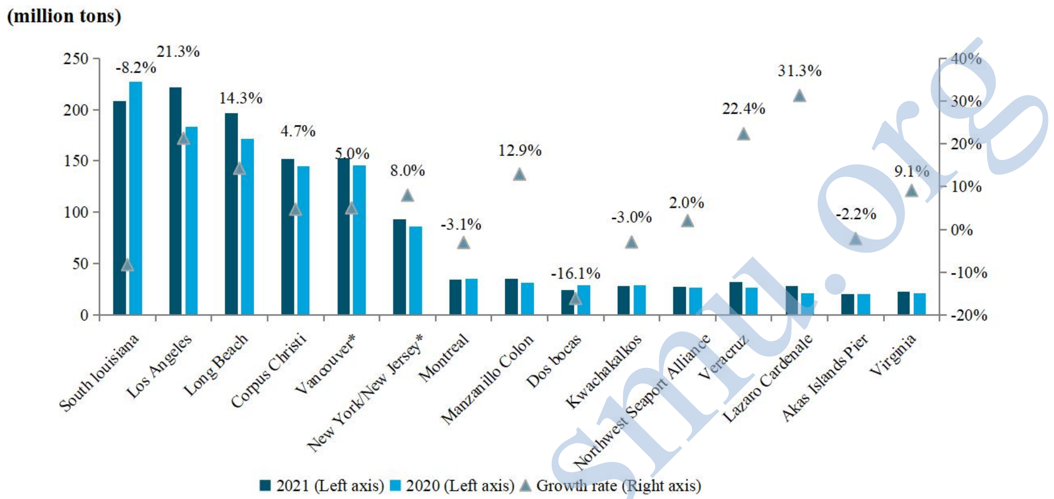

Source: Websites of various port authorities, sorted by SISI.

**Figure 2-5** Cargo Throughput and Growth Rate of Major Ports in Europe (2020-2021)

## (3) North American port throughput soars

In 2021, under the weakened pandemic prevention and control measures and high fiscal and taxation stimulus policies, North American industries resumed production and consumption picked up dramatically. The trade demand rebounded sharply, and the throughput growth of major North American ports rose from -2.2% to 7.0%. Port-wise, the Port of Long Beach and the Port of Los Angeles received government investment to augment terminal facility construction and extend operating hours under the policy. As a result, the throughput of the two ports increased sharply by

14.3% and 21.3%, respectively. Due to the decline in U.S. soybean, corn, and other grain exports, as well as severe weather such as hurricanes, the production scale of the Port of South Louisiana plunged by 8.2%. In contrast, small and medium-sized ports such as Port of Virginia were boosted by the manufacturing industry recovery and its demand for imported production raw materials and processing parts. At the same time, due to the shortage of labor and equipment in the trucking and warehousing industries, the land transportation efficiency dropped significantly. As a result, grain such as self-produced soybeans supplied to other parts of the United States was preferentially traded by water, further contributing to the growth of port throughput.




Note: * indicates projections.

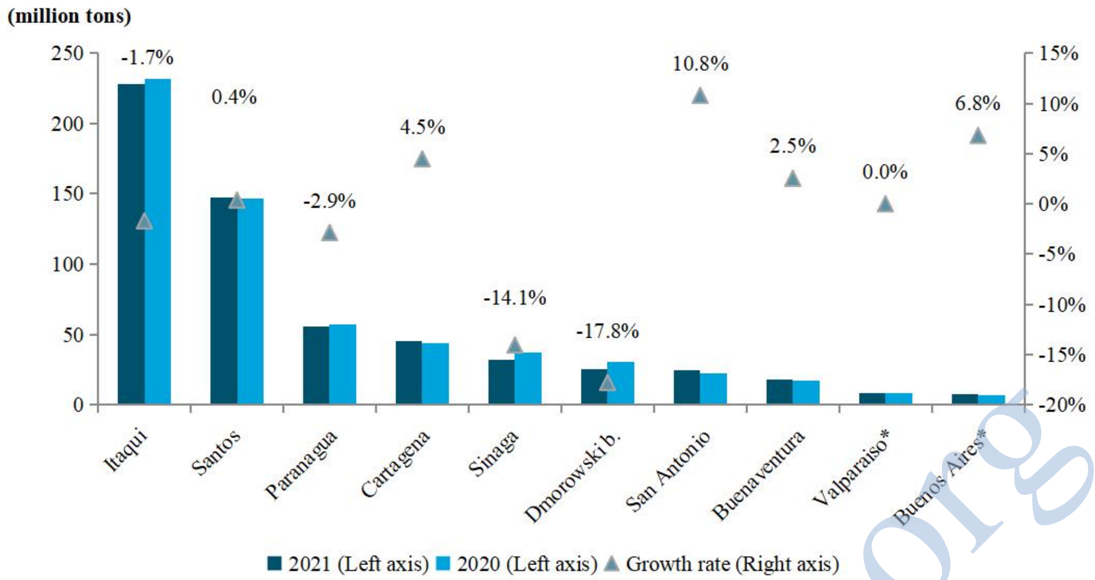
Source: Websites of various port authorities, sorted by SISI.

**Figure 2-6** Cargo Throughput and Growth Rate of Major Ports in North America (2020-2021)

### (4) Cargo volume at South American ports grows steadily

In 2021, boosted by the strong demand for foreign-trade exports, South American ports recorded growth for three consecutive years. In 2021, the ports' throughput growth further rebounded to 4.7%. However, the performance varied from port to port, largely due to the sluggish economic recovery under the influence of the pandemic. Coupled with the influence of severe weather such as hurricanes, droughts, and political turmoil in some areas, the industrial development and economic and trade recovery in various regions were relatively uneven.

Specifically, the cargo throughput of Brazilian ports increased by 4.7% mainly due to China's huge trade demand for grain, coal, ores, etc. The mining output at the Port of Buenos Aires recorded its best performance in the past six years, contributed by the local economic support for the shipping industry. Meanwhile, due to domestic strikes and blockades and frequent disruptions to the global logistics chain, ports in Colombia, such as Gulf of Morrosquillo, recorded double-digit declines.




Note: * indicates projections.

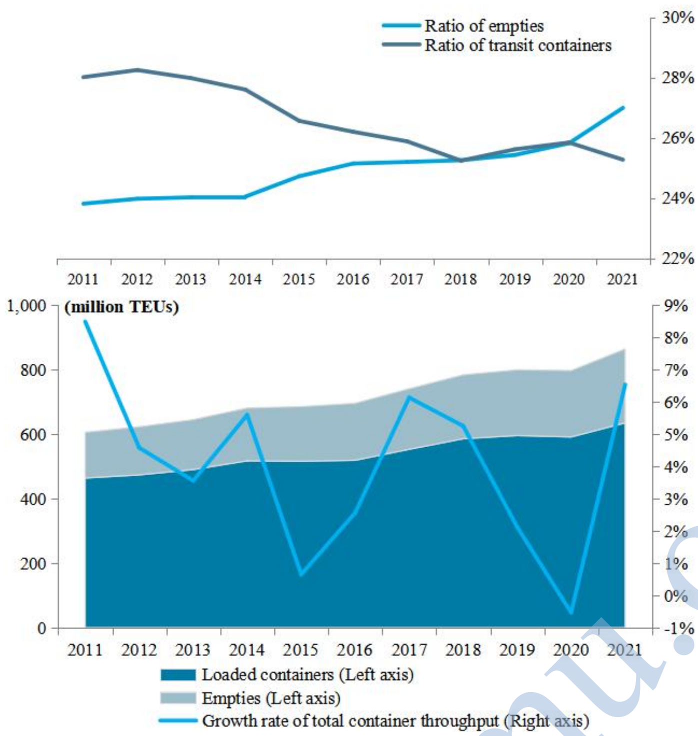
Source: Websites of various port authorities, sorted by SISI.

**Figure 2-7** Cargo Throughput and Growth Rate of Major Ports in South America (2020-2021)

## 2.2 Overview of Container Throughputs of Global Ports

### 2.2.1 General analysis of container throughput of global ports

In 2021, the international container shipping market was generally in short supply, and port container trade showed a rapid rebound. The total port container throughput exceeded the pre-pandemic level, primarily due to the low base in the same period of 2020 and the surge of seaborne trade volume driven by the fiscal stimulus announced by various countries. However, it remains to be seen whether this trend will continue.




Source: Drewry, sorted by SISI.

**Figure 2-8** Container Throughput, Growth Rate and Ratio of Empty and Transit Containers of Global Ports

### 2.2.2 Rankings of global top 20 ports by container throughput

In 2021, the overall production situation of the world's top 20 container ports was strong. Only Hong Kong Port and Port of Antwerp declined slightly, while all other ports recorded growth rates. The top 100 container ports in the world (see the attached table for the rankings of the top 100 ports) performed well, with more than 86 ports seeing growth year-on-year, and 42 of them at a rate higher than 10%. Port-wise, China, thanks to its effective prevention and control of the pandemic, still seized 7 places among the top 10 and 28 places among the top 100 (including Hong Kong, China, and Chinese Taipei). Shanghai, Ningbo Zhoushan, and Shenzhen ports still registered high growth from a large base. Meanwhile, driven by the import demand, the rankings of U.S. ports rose overall, and several ports hit new highs in terms of container throughput. 9 ports listed among the top 100 in the world recorded an overall growth rate of 16.2%. Some ports in Europe ushered in a sharp rebound. In particular, Port of Le Havre and Port of Barcelona showed strong growth, while the three European hubs, namely Rotterdam, Antwerp, and Hamburg, showed stable production performance, though their rankings dropped slightly.

**Table 2-3** Global Top 20 Ports by Container Throughput in 2021

| Ranking | Port | 2021 (million TEUs) | 2020 (million TEUs) | Growth rate |
|---|---|---|---|---|
| 1（1） | Shanghai | 47.0 | 43.5 | 8.1% |
| 2（2） | Singapore | 37.5 | 36.9 | 1.6% |
| 3（3） | Ningbo Zhoushan | 31.1 | 28.7 | 8.2% |

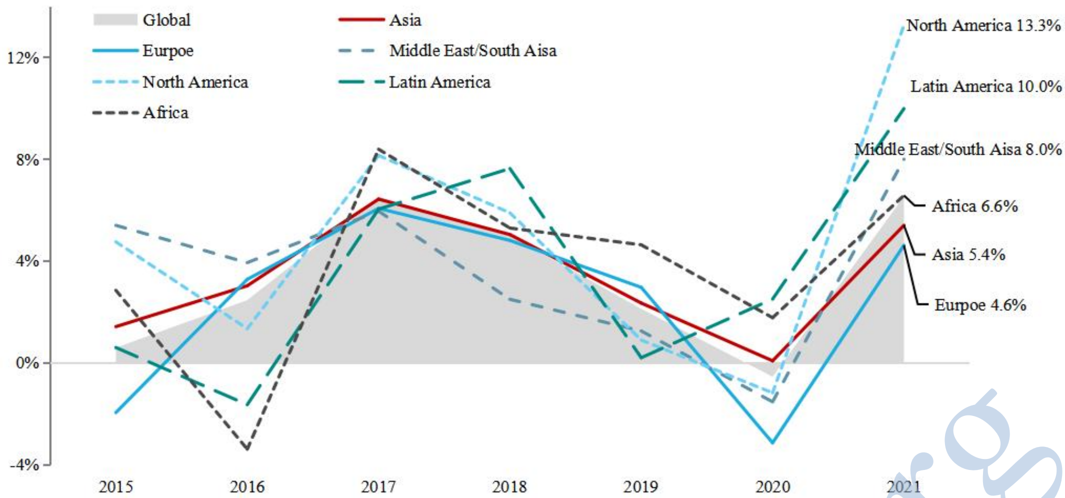
| | | | | |
|---|---|---|---|---|
| 4（4） | Shenzhen | 28.8 | 26.6 | 8.4% |
| 5（5） | Guangzhou | 24.2 | 23.2 | 4.4% |
| 6（6） | Qingdao | 23.7 | 22.0 | 7.7% |
| 7（7） | Busan | 22.7 | 21.8 | 4.0% |
| 8（8） | Tianjin | 20.3 | 18.4 | 10.4% |
| 9（9） | Hong Kong | 17.8 | 18.0 | -0.9% |
| 10（10） | Rotterdam | 15.3 | 14.4 | 6.6% |
| 11（11） | Dubai | 13.7 | 13.5 | 1.9% |
| 12（12） | Klang | 13.7 | 13.2 | 3.7% |
| 13（14） | Xiamen | 12.1 | 11.4 | 5.6% |
| 14（13） | Antwerp | 12.0 | 12.0 | -0.1% |
| 15（15） | Tanjong Palapas | 11.2 | 9.8 | 14.3% |
| 16（17） | Los Angeles | 10.7 | 9.2 | 15.9% |
| 17（16） | Kaohsiung | 9.9 | 9.6 | 2.5% |
| 18（19） | Long Beach | 9.4 | 8.1 | 15.7% |
| 19（21） | New York/New Jersey | 9.0 | 7.6 | 18.5% |
| 20（18） | Hamburg | 8.7 | 8.5 | 2.0% |

Source: Websites of various port authorities, sorted by SISI.

Note:In the "Port Ranking" column, the numbers outside the brackets are the port's 2021 ranking, and the numbers in brackets are the 2020 ranking.

### 2.2.3 Container throughput analysis of ports in different regions

In 2021, all continents recorded positive growth in container throughput, and the growth momentum of the Americas was the strongest. In North America, thanks to the surging import demand from the United States, the container throughput increased by 13.3%. In Europe, the repeated outbreaks and the shortage of raw materials and labor weakened the throughput growth of ports (4.6%). Driven by the trade recovery in Europe and the United States, Asia's export volume grew rapidly, but the rising seaborne shipping freights restrained trade demand to a certain extent, and the annual growth rate of container throughput stood at 5.4%.




Source: Drewry, sorted by SISI.

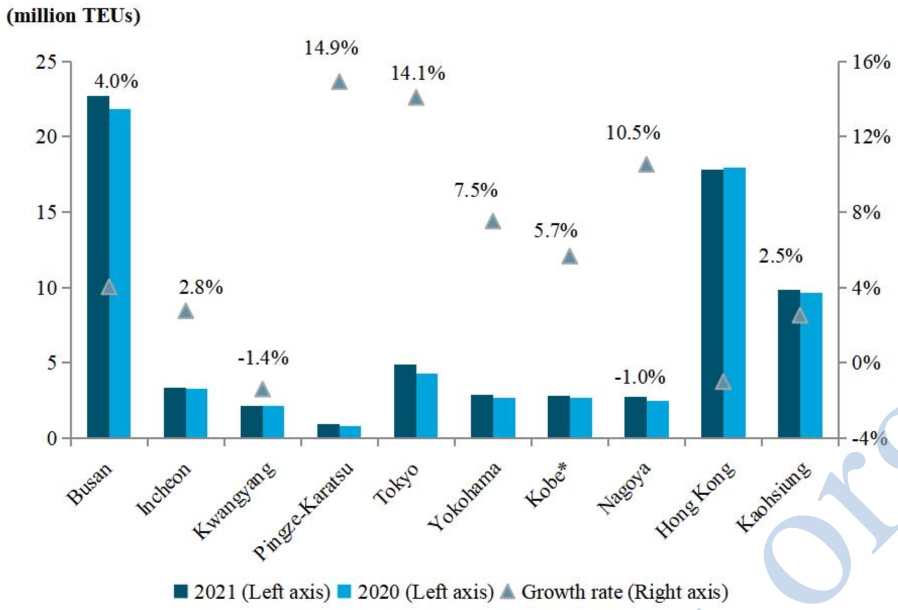
**Figure 2-9** Container Throughput Growth Rate of Ports in Various Regions (2015-2021)

## (1) Container throughput of Asian ports rises steadily

In 2021, the Asian container shipping market continued to grow steadily. Driven by the global economic recovery, export and transshipment demands increased steadily, with the annual growth standing at 5.4%. Due to the good prevention and control of the pandemic outbreaks in China, the stable production of the industrial manufacturing industry provided important support for the container port throughput growth in Asia. Japan and Korea also recorded rapid increases in throughput driven by industries such as chips and automobiles.

**The container throughput growth in mainland China rose and then fell.** In 2021, the total container throughput of ports in mainland China was 283 million TEUs, a year-on-year rise of 7.0%, and a substantial increase of 8.3% compared with that before the pandemic. From a quarterly perspective, the throughput rose significantly by 19.3% year-on-year in the first quarter, due to the low base in the same period of the previous year. However, as the expansion of production and business activities of enterprises slowed down and the impact of policies such as "power cuts" continued to shrink, the growth rate was only 0.1% in the fourth quarter.

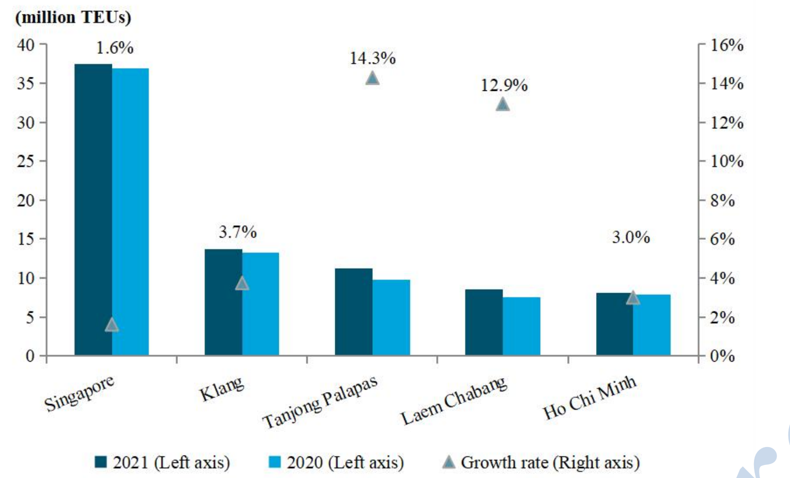
**The container volume of other East Asian ports rebounded steadily.** Driven by semiconductors, automobiles, and petrochemical products, Korea achieved steady growth in port container volume. Specifically, the Port of Busan not only relied on commodity exports, but also actively attracted transit cargoes - when Shanghai and Ningbo Zhoushan ports suffered congestion - to increase port container throughput. Boosted by the global economy recovery and the sound domestic pandemic control, the manufacturing industry in Japan resumed production, and the exports of steel, automobile, and other industries grew well, driving the substantial growth of throughput at major container hub ports.




Source: Drewry, sorted by SISI.

**Figure 2-10** Container Throughput and Growth Rate of other East Asian Ports (2020- 2021)

**Container throughput of Southeast Asian ports grew slowly.** Southeast Asian ports seized the opportunity of industrial transfer under the pandemic, actively added trade routes to China, Japan, and Korea, and strived to expand the industrial scale. The container throughputs of its ports also increased rapidly. However, due to tropical storms in Southeast Asia, the tightened prevention and control measures in some areas, and geopolitical conflicts and other factors, international trade suffered and the growth rate fell sharply after the third quarter. In terms of ports, Singapore kept upgrading its container handling facilities and streamlining its operational procedures. It also rechanneled container ships and shortened the voyage. It opened the Keppel Terminal and used the new Tuas Mega Port. Thanks to its efforts, the container traffic at the port maintained a steady increase. The Thai government offered subsidies to the exported containers from the Port of Bangkok and the Port of Laem Chabang to stimulate maritime trade. The Port of Laem Chabang maintained a competitive edge by exporting electronic and chemical products, furniture items, fruits, etc. as well as nonstop service between the Port of Laem Chabang and the Port of Kelang, leading to a double-digit growth rate.

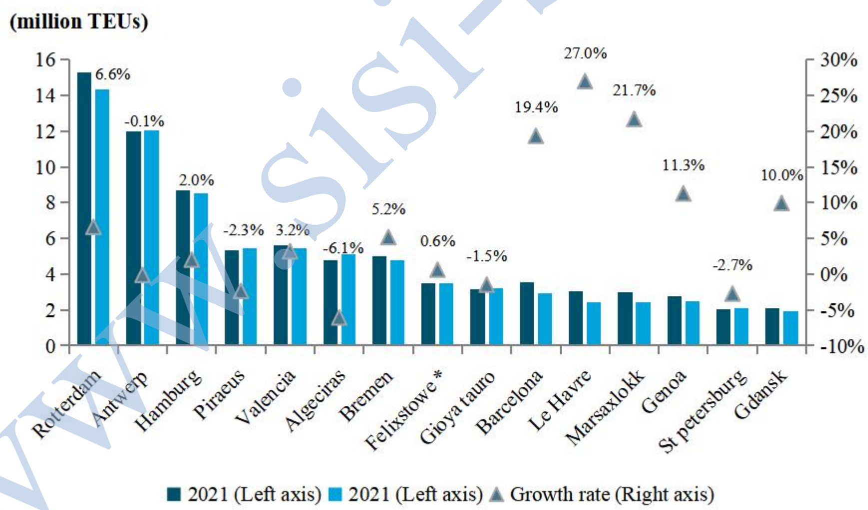



Source: Drewry, sorted by SISI.

**Figure 2-11** Container Throughput and Growth Rate of Southeast Asian Major Ports (2020- 2021)

## (2) Container volume of European ports rebounds sharply

Boosted by the industrial recovery and trade growth, European ports welcomed a sound recovery in container throughput. However, the insufficient logistics capacity of the ports and the delay of large ships among other reasons caused serious congestion at European ports.




Note: * indicates projections.

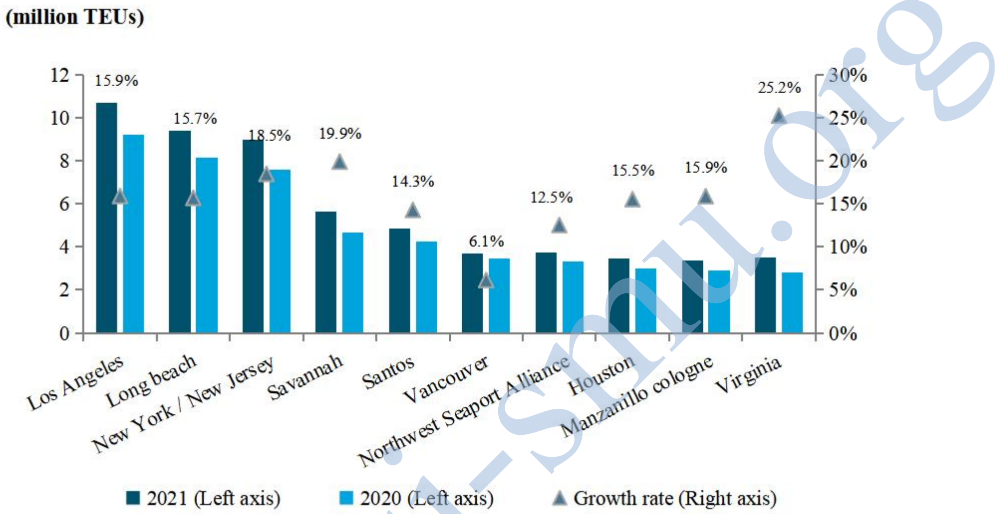
Source: Websites of various port authorities, sorted by SISI.

**Figure 2-12** Container Throughput and Growth Rate of European Top 15 Ports (2020- 2021)

## (3) Container throughput of American ports grows vigorously

In 2021, all major ports in the Americas recorded double-digit growth in throughput. The container throughput growth of North American ports turned from negative to positive, namely 13.3%, and peaked in the second quarter, largely due to the low base and the strong import demand. In 2021, the manufacturing and commodity consumption demand picked up rapidly, promoting the robust growth in container throughput of North American ports. In the second half of the year, the manpower shortage at terminals deteriorated due to the Omicron variant, and a large number of containers were stranded at the ports hindering the port operations. As a result, the container throughput growth maintained the recovery growth.

In 2021, the container throughput growth of Latin American ports also turned from negative to positive, recording a sharp rise of 14.2 percentage points to 10%, and the container throughput in the first to third quarters achieved double-digit year-on-year growth. On the one hand, the low base in the same period of the previous year led to the high throughput growth. On the other hand, benefiting from the infrastructure renovation and expansion of many ports in Latin America, the port production efficiency in the region improved.




Source: Websites of various port authorities, sorted by SISI.

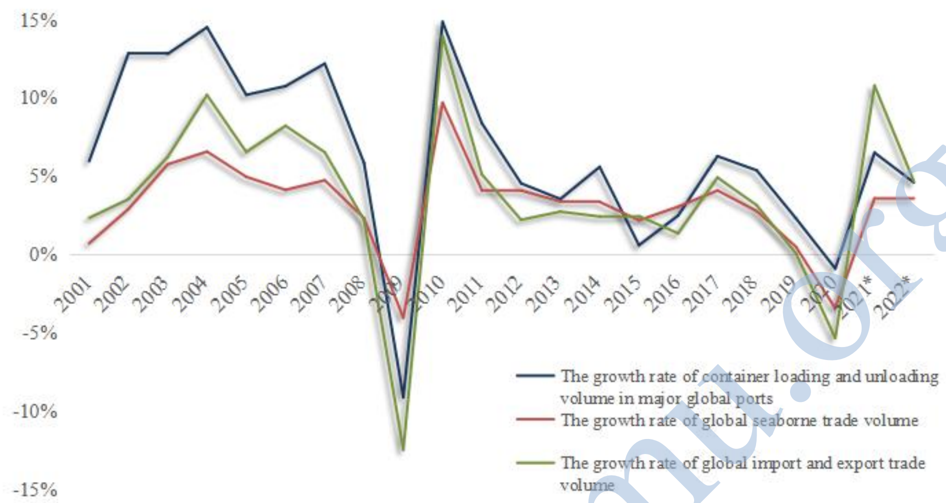
**Figure 2-13** Container Throughput and Growth Rate of American Top 10 Ports (2020- 2021)

### (4) Container throughput of African ports resumes growth

In 2021, the container throughput of African ports grew at a fast pace. Apart from the low base, the growth was largely attributable to the port capacity expansion resulting from the port development funds provided by the World Bank and domestic and foreign governments. Meanwhile, African ports actively cooperated with shipping companies, such as Hapag-Lloyd's new offices in Kenya, Nigeria, and other places to increase the port business. However, the recovery of African ports was still slower than that of other regions. Although the year-on-year growth in the region increased from -4.1% to 6.6%, the actual throughput only rose by 1.94 million TEUs, which was slower than that of other regions. The main cause was the low vaccination coverage in Africa, as well as the weak debt and financial capacity and the occasional insurgencies and conflicts.

## Topic 1: The Fastest Growing Container Ports in the World over the Past Decade

Global trade vitality has been in a downward path since the 2008 financial crisis. The proportion of global commodity trade in GDP has dropped from about 50% in 2007 to 40%, and it is still in the cycle of "anti-globalization". Therefore, by dividing 2001-2021 into two 10-year intervals, the latter 10 years has decreased significantly compared with the previous 10 years in average annual compound growth rate of import and export trade volume, maritime trade volume and container throughput. However, the container handling volume of major ports in the world still has an average annual compound growth rate of 3.8% from 2011 to 2021.




Note: * indicates projections.

**Figure 1** Growth of Major Global Shipping and Economic and Trade Indicators from 2001 to 2022

In order to evaluate the growth of major container ports in the world in recent 10 years, the top 100 container ports around the world in 2021 are selected as candidates. Based on their container throughput data in recent 10 years and compared with the two derived indicators of compound growth rate and throughput increment, the ranking of container ports with the fastest scale growth in recent 10 years is obtained for the exchange and reference of people in the industry. In addition, considering that the scale growth logic of large ports is different from that of small and medium-sized ports (the increment of large ports is large, but the growth rate is low, while the growth rate of small and medium-sized ports is high, but the increment is small), it is divided into two lists with 10 million TEUs as the dividing line.

## 1. Chinese ports have the strongest growth in the list of "10 million TEUs" ports

In 2021, there were 16 ports in the world with a container throughput of more than 10 million TEUs, mainly distributed in China, Southeast Asia, Europe, and the United States. Among them, Chinese ports have the strongest growth, occupying the top of the list.

**Table 1** The Fastest Growing Container Ports in the World from 2011 to 2021 (10 million TEUs)

| Port | Nation or Region | Container throughput (10,000 TEUs) | | 10-year compound growth rate (%) | 2011-2021 Increment (10,000 TEUs) | Incremental ranking | Growth ranking |
|---|---|---|---|---|---|---|---|
| | | 2011 | 2021 | | | | |
| Ningbo Zhoushan | China | 1469 | 3108 | 8.7% | 1639 | 1 | 1 |
| Shanghai | China | 3170 | 4703 | 4.5% | 1533 | 2 | 7 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Qingdao | China | 1302 | 2371 | 6.9% | 1069 | 3 | 3 |
| Guanzhou | China | 1440 | 2418 | 5.9% | 978 | 4 | 5 |
| Tianjin | China | 1150 | 2027 | 6.5% | 877 | 5 | 4 |
| Singapore | Singapore | 2994 | 3747 | 2.5% | 753 | 6 | 14 |
| Busan | South Korea | 1618 | 2269 | 3.8% | 651 | 7 | 9 |
| Shenzhen | China | 2257 | 2877 | 2.7% | 620 | 8 | 13 |
| Xiamen | China | 646 | 1205 | 7.2% | 559 | 9 | 2 |
| klang | Malaysia | 960 | 1374 | 4.1% | 414 | 10 | 8 |
| Tanjung palapas | Malaysia | 750 | 1120 | 4.6% | 370 | 11 | 6 |
| Rotterdam | Netherlands | 1188 | 1530 | 2.9% | 342 | 12 | 12 |
| Antwerp | Belgium | 860 | 1202 | 3.8% | 342 | 13 | 10 |
| Los Angeles | America | 794 | 1067 | 3.3% | 273 | 14 | 11 |
| Dubai | United Arab Emirates | 1300 | 1377 | 0.6% | 77 | 15 | 15 |
| Hongkong | Hong Kong, China | 2438 | 1779 | -3.4% | -659 | 16 | 16 |

Note: considering that the compound growth rate is easily affected by the low throughput base in 2011 and has high results, the increase of port scale is mainly reflected in the growth of production scale, so it is sorted based on the throughput increment. Table 2 is the same as sorting rules.

**(1) China's core hub ports maintained relatively high growth**

All the above-mentioned Chinese ports in table 1 are the core hub ports among China's five major port clusters. With its core hub status in the region, they have continued to maintain a relatively high growth rate with a large base. In addition, the top five ports in Table 1 are all Chinese ports, with a throughput increment of more than 8 million TEUs in 10 years, showing a good growth performance.

Among them, the throughput of Ningbo Zhoushan Port has doubled in recent 10 years. On the one hand, it made full use of the advantages of deep water, location, and service, and continued to build a dense sea route network with the four major shipping alliances; On the other hand, it has become the fastest growing container port in the world in the past decade thanks to its efforts on optimizing the hinterland-sea rail intermodal transport network and improving its operation mode. With the construction and operation of phase I-IV terminals of Yangshan Port, the container throughput of Shanghai Port continued to grow. Since the container throughput surpassed Singapore port for the first time in 2010, it has ranked first in the world for 12 consecutive years. In 2021, the planned production target of 47 million TEUs in 2025 has been completed ahead of schedule through launching new foreign trade routes of Yangshan Phase IV Wharf.

Qingdao Port continued to build an efficiency and service brand, optimize innovative operation processes and technology, and invest in the construction of an international logistics channel. While ensuring the steady growth of container throughput, the handling efficiency remained at a high level. Guangzhou Port has made great efforts on developing foreign trade container business with BRDI countries and has formed a pattern of Nansha Port as the leader and other port areas as a support and common development. Its container throughput has risen to the fifth of the world in the past 10 years, surpassing Hongkong Port and Busan Port. Tianjin Port has pushed for port transformation and upgrading by promoting intelligent development in automatic transformation of traditional container terminals, and speeding up transportation of bulk goods such as iron ore and non-ferrous metals to container transportation. It broke through the threshold of 20 million TEUs in 2015 in the adverse effects of COVID-19 in 2020 and has made great breakthroughs in building an international shipping hub in the north.

**(2) The scale of Southeast Asian ports has developed rapidly in the fierce competition**

The Malacca Strait gathers three major hub ports of Singapore, Bason and Tanjung Palapas. In the fierce competition of goods sources, the three ports have performed well in container throughput in recent 10 years. Singapore Port has a compound growth rate of 2.5% and an increment of 7.53 million TEUs in recent 10 years. Although lower than many Chinese ports, Singapore Port is still the main hub port in Southeast Asia with a throughput of 37.47 million TEUs, and "Tuas Port" and industrial park with a capacity of 65 million TEUs have been planned and under construction to stabilize its hub position. However, with the development of ports in Southeast Asia, the transshipment sources of Singapore Port will also be diverted. Among them, Bason and Tanjung Palapas Ports in Malaysia strive for the source of goods by relying on the low-price strategy and joint-venture berths with Maersk, Mediterranean Shipping and other large liner companies. Although these ports have experienced some twists and turns, they still have a good performance overall.

**(3) The container throughput of European and American hub ports increased steadily**

Compared with the rapid growth of Asian hub ports, the throughput growth of European and American ports is at an "average" level. Affected by the slowdown of regional economic growth, the driving force of European hub ports is less than that of Asia, but major ports such as Rotterdam and Antwerp still actively invest in infrastructure and improve collecting and distributing system to consolidate the hub position in the region. American ports have been restricted by the wharf workers' Union for a long time, resulting in low efficiency in port operation and great difficulty in wharf automation construction; In addition, labor negotiations often led to strikes affecting port operation, resulting in the slow growth rate of port container volume. At present, the substantial increase in container throughput of U.S. ports in the list mainly benefited from the explosive growth of import demand in 2021. The container volume of Los Angeles Port has been hovering around 9.3 million TEUs in the previous four years.

## 2. The fastest growing ports are mostly distributed along the "Maritime Silk Road"

The ports with container throughput less than 10 million TEUs are shown in table 2. It can be seen that most of the ports at the top of table 2 are emerging ports (with a small scale and an annual compound growth rate of more than 10% in 2011), and most of them are distributed along the coast of the "Maritime Silk Road".

**Table 2** The Fastest Growing Container Port in the World from 2011 to 2021 (less than 10 million TEUs)

| Port | Nation or Region | Container throughput (10,000 TEUs) | | 10-year compound growth rate (%) | 2011-2021 Increment (10,000 TEUs) | Incremental ranking | Growth ranking |
|---|---|---|---|---|---|---|---|
| | | 2011 | 2021 | | | | |
| Mundra | India | 134 | 666 | 19.5% | 532 | 1 | 1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Tangier Med | Morocco | 207 | 717 | 14.8% | 510 | 2 | 6 |
| King Abdullah | Saudi Arabia | 100 | 281 | 18.8% | 281 （Converted to 402） | 3 | 3 |
| Gaime | Vietnam | 79 | 494 | 19.4% | 394 | 4 | 2 |
| Rizhao | China | 141 | 517 | 15.6% | 376 | 5 | 5 |
| Qinzhou | China | 40 | 463 | 18.6% | 363 | 6 | 4 |
| Piraeus | Greece | 168 | 531 | 13.6% | 363 | 7 | 10 |
| Haiphong | Vietnam | 221 | 579 | 11.3% | 358 | 8 | 11 |
| New York/New Jersey | America | 550 | 899 | 5.6% | 349 | 9 | 34 |
| Ho Chi Minh | Vietnam | 467 | 809 | 6.3% | 342 | 10 | 29 |
| Suzhou | China | 470 | 811 | 6.2% | 341 | 11 | 30 |
| Long beach | America | 606 | 938 | 5.0% | 332 | 12 | 38 |
| Colombo | Sri Lanka | 426 | 725 | 6.1% | 299 | 13 | 32 |
| Laem Chabang | Thailand | 573 | 852 | 4.5% | 279 | 14 | 42 |
| Savannah | America | 294 | 561 | 7.5% | 267 | 15 | 24 |
| Dongguan | China | 16 | 340 | 14.6% | 240 | 16 | 7 |
| Abu Dhabi | United Arab Emirates | 77 | 329 | 14.2% | 229 | 17 | 8 |
| Tangshan | China | 34 | 329 | 14.1% | 229 | 18 | 9 |
| Fuzhou | China | 145 | 345 | 10.1% | 200 | 19 | 12 |
| Yantai | China | 171 | 365 | 8.8% | 194 | 20 | 15 |

Notes :(1) In the calculation process, ports container throughputs less than 1 million TEUs in 2011 are replaced by 1 million TEU, in order to avoid the false compound growth rate due to the small throughput base in 2011. (2) King Abdullah Port was opened in 2014, with a throughput of 1.31 million TEU in 2015, but the throughput in 2014 was not known, so it was replaced by 1 million TEU in 2014; For comparability consideration, the compound growth rate and increment of the port are converted to a certain extent.

**(1) Rizhao port and Qinzhou Port have become the pacesetters of port growth in China**

In the past 10 years, China's container transportation industry has maintained rapid development, and Rizhao port and Qinzhou Port were the front runners. Qinzhou Port was strongly driven by the new western land-sea corridor. The number of sea-rail combined freight trains has grown rapidly, and the domestic and foreign trade container routes basically covered the coastal areas of China and the major ports of ASEAN countries. In the past 10 years, the container throughput achieved increment of 3.63 million TEUs with annual compound growth rate of 18.6%. Under the target of building a coastal container hub for domestic trade, Rizhao Port not only put efforts on wharf construction and automatic transformation, but also make in-depth cooperation with Ningbo Cosco, Qingdao Zhongchuang and other domestic trade shipping enterprises by increasing routes, expanding cabin capacity and expanding transit, achieving rapid growth in throughput scale.

**(2) Mundra Port has become the largest container port in India**

Mumbai is one of India's oldest ports. To address congestion problem, the Indian government built the Jawaharlal Nehru Port (JNPT) to divert some of the cargo, but there is limited room for further expansion. The Mundra Port, owned by Adani port and The Special Economic Zone (APSEZ), has absorbed most of the container growth in northwest India in recent years. Mundra port overtook JNPT to become the largest container port in India in 2020-2021 (Indian fiscal year). The rise of Mundra Port has only been in recent 10 years, during which it has grown rapidly with double-digit growth for many years, In addition, the private port becoming the largest container port in India also indicated that the freight volume of Indian ports gradually shift from state-owned ports to private ports in the future.

**(3) Piraeus and Tangirmede have become the largest container ports in the Mediterranean**

Before 2019, The Port of Valencia in Spain firmly secured the position of the largest container port in the Mediterranean, but the title was won by the Port of Piraeus in 2019 and the port of Tangirmede in 2020, which quickly became the new hub of the Mediterranean. The rapid expansion of Piraeus port resulted from COSCO Shipping Group's taking over its port container business when COSCO Shipping Group formally took over the management rights of Container Terminals No. 2 and No. 3 in 2010, and acquired 67% of the equity of Piraeus Port Authority in 2016. Thanks to the introduction of management technology and experience and the layout of routes, port container volume maintained a rapid growth. Morocco's Tangirmede port, located at a key pass in the Strait of Gibraltar, has served transshipment demand from West Africa, Western Europe and even the East Coast of the Americas since its establishment in 2007. In the past 10 years, the container throughput has grown rapidly. Especially in 2021, the container volume jumped by nearly 25% to 7.17 million TEUs, which was far ahead of Algeciras port in Spain, consolidating its position as the largest container port in the Mediterranean.

## 3. Compare the fastest growing ports by stages

In order to fully tap the production performance of the world's top 100 container ports in recent 10 years, and to further analyze the throughput growth in different periods, we would like to show the performance of the world's top 100 container ports from different angles.

**(1) The fastest growing ports in successive periods**

According to data, from 2011 to 2021, 13 ports maintained a continuous container volume growth in 10 years, which are Shanghai, Ningbo Zhoushan, Shenzhen, Guangzhou and other 9 China's ports, as well as Singapore Port, Turkey Izmit Port, India Mundra Port and Vietnam Gai Meh Port. In addition, the ports with the longest continuous growth rate of more than 10% are Qinzhou Port (the growth rate of more than 20% for six consecutive years), Tangshan Port (the growth rate of more than 10% for seven consecutive years) and Gaimei Port (the growth rate of more than 20% for three consecutive years).

**(2) The port with the largest increment of container scale in each year**

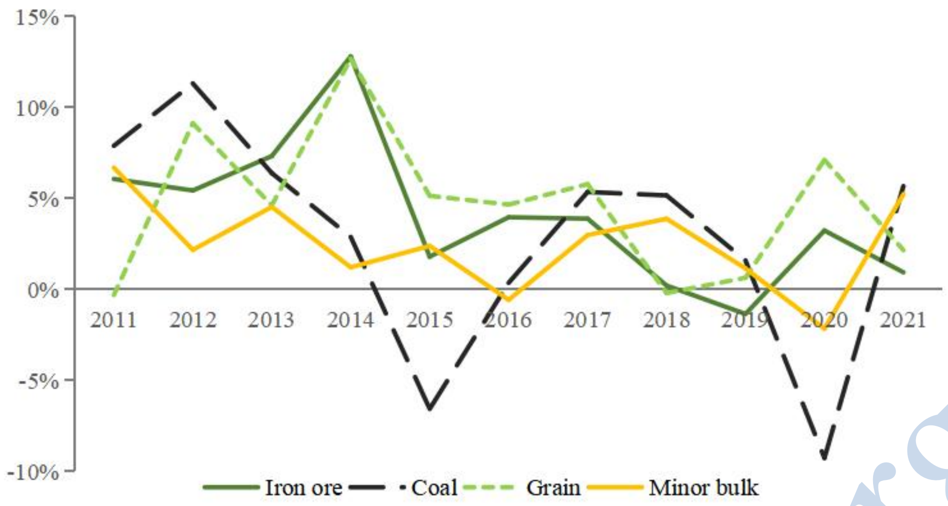
According to the analysis of container volume data from 2011 to 2021, Shanghai Port, Ningbo Zhoushan Port and Singapore Port had the largest scale increment in each year interval (1-6 years), which mainly due to the large volume of the three ports and maintaining a good growth trend. In the list of one-year interval, Shanghai Port was the top in 2021, resulting from the strong external demand after the epidemic in 2021, new establishment of the inland Container Hub (ICT), Northeast Asia Empty Container Transportation Center, and innovative measurements of "joint handling and unloading". In the 2-year interval list, the fastest growing years are from 2017 to 2018 in which global container shipping market become prosperous in 2017 and a large number of mergers and acquisitions of shipping enterprises further intensified the market concentration. In 2018, due to the gradual warming of Sino US trade friction, the two sides imposed tariffs on each other. At the end of 2018, a large number of containers were shipped in advance due to worries, the liner density increased, and the port container throughput also increased.

**Table 3** Ports with the Fastest Growing Scale from 2011 to 2021

| Serial number | | Port | Year | Increment (10,000 TEUs) | Serial number | | Port | Year | Increment (10,000 TEUs) |
|---|---|---|---|---|---|---|---|---|---|
| 1 year interval | 1 | Shanghai | 2021 | 353 | 4 year interval | 1 | Ningbo Zhoushan | 2014-2017 | 726 |
| | 2 | Shanghai | 2017 | 310 | | 2 | Ningbo Zhoushan | 2017-2020 | 716 |
| | 3 | Ningbo Zhoushan | 2017 | 305 | | 3 | Ningbo Zhoushan | 2016-2019 | 692 |
| | 4 | Singapore | 2018 | 293 | | 4 | Ningbo Zhoushan | 2015-2018 | 691 |
| | 5 | Singapore | 2017 | 277 | | 5 | Shanghai | 2018-2021 | 680 |
| 2 year interval | 1 | Singapore | 2017-2018 | 570 | 5 year interval | 1 | Shanghai | 2017-2021 | 990 |
| | 2 | Shanghai | 2017-2018 | 488 | | 2 | Ningbo Zhoushan | 2017-2021 | 952 |
| | 3 | Ningbo Zhoushan | 2017-2018 | 479 | | 3 | Ningbo Zhoushan | 2014-2018 | 900 |
| | 4 | Ningbo Zhoushan | 2016-2017 | 399 | | 4 | Ningbo Zhoushan | 2013-2017 | 894 |
| | 5 | Ningbo Zhoushan | 2013-2014 | 376 | | 5 | Shanghai | 2014-2018 | 839 |
| 3 year interval | 1 | Singapore | 2017-2019 | 630 | 6 year interval | 1 | Ningbo Zhoushan | 2013-2018 | 1068 |
| | 2 | Shanghai | 2018-2019 | 617 | | 2 | Shanghai | 2016-2021 | 1049 |
| | 3 | Ningbo Zhoushan | 2018-2019 | 597 | | 3 | Ningbo Zhoushan | 2016-2021 | 1046 |
| | 4 | Ningbo Zhoushan | 2017-2018 | 573 | | 4 | Ningbo Zhoushan | 2014-2019 | 1018 |
| | 5 | Singapore | 2016-2018 | 468 | | 5 | Ningbo Zhoushan | 2012-2017 | 992 |

## 2.3 Overview of Dry Bulks Throughputs of Global Ports

In 2021, the global dry bulks shipping achieved recovery growth, and the recovery growth of coal and minor bulks might become an important support for the global dry bulks shipping demand in 2021. Among the major bulk cargo ports, the **Asian region** was boosted by the recovery of the economy and manufacturing industry and recorded a strong demand for dry bulks imports. The dry bulks throughput of major Asian dry bulks handling/transit ports performed well. Major ports in China, Korea, and India all achieved positive growth. Economic activities in the **European region** resumed and the demand for imported coal increased as the natural gas prices stayed high. The pickup of German steel production drove up the iron ore and non-metal imports. As a result, ports such as Rotterdam and Antwerp saw a significant rebound in cargo throughput. Affected by China's decreased demand for iron ore imports, the throughput growth of Port of Hedland dropped slightly. Due to the Australia-China tensions, Australia's coal exports to China dropped by more than 85% year-on-year, combined with the falling iron ore production, the dry bulks throughput of the Port of Hay Point is still in a declining trend.




Source: Clarkson website, sorted by SISI.

**Figure 2-14** Growth Trend of Global Seaborne Trade in Major Dry Bulk Goods (2011-2021)

**Table 2-4** Dry Bulk Cargo Throughput and Growth Rate of Some Global Ports in 2021

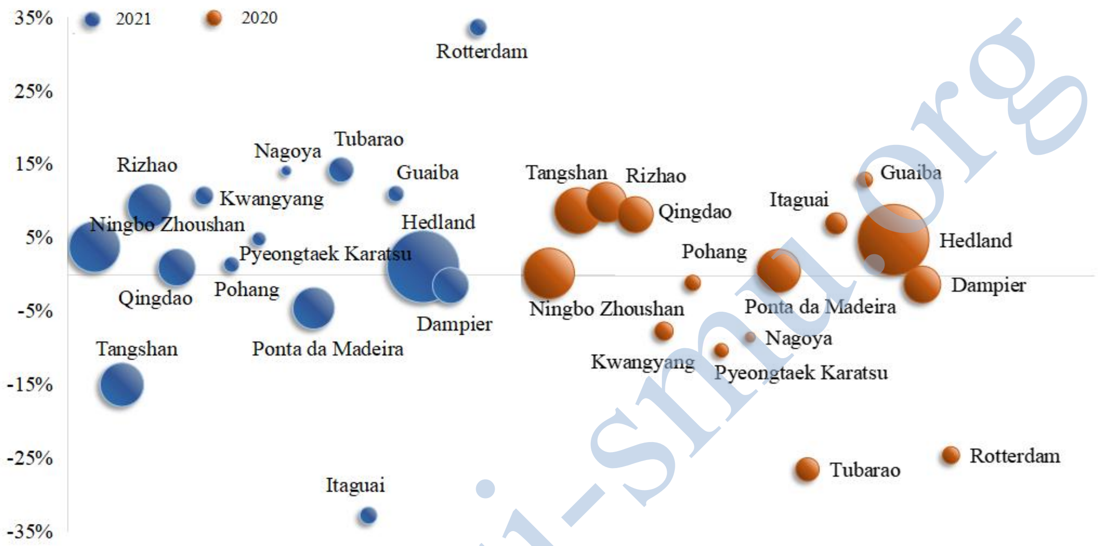
(Unit：million tons)

| Region | Port | 2019 (miillion tons) | 2020 (miillion tons) | 2021(million tons) 1Q | 2021(million tons) 2Q | 2021(million tons) 3Q | 2021(million tons) 4Q | 2021(million tons) Total | 2020 YoY Growth Rate | 2021 YoY Growth Rate |
|---|---|---|---|---|---|---|---|---|---|---|
| Asia | Tangshan | 547.9 | 588.3 | 144.9 | 149.4 | 156.9 | 157.8 | 609.1 | 7.4% | 3.5% |
| | Ningbo Zhoushan | 578.5 | 570.6 | 143.2 | 164.2 | 151.3 | 155.9 | 614.5 | -1.4% | 7.7% |
| | Qinghuangdao | 204.3 | 181.2 | 48.4 | 43.5 | 41.5 | 48.2 | 181.6 | -11.3% | 0.2% |
| | Kwangyang | 84.3 | 77.1 | 21.3 | 20.7 | 20.6 | 21.7 | 84.2 | -8.6% | 9.1% |
| | Pohang | 47.1 | 45.6 | 11.5 | 11.9 | 10.6 | 12.7 | 46.7 | -3.1% | 2.3% |
| | major ports in india | 254.0 | 231.8 | 69.6 | 64.9 | 50.8 | 56.7 | 242.0 | -8.8% | 4.4% |
| Europe | major ports in spain | 90.8 | 77.1 | 19.7 | 21.0 | 22.4 | 22.0 | 85.1 | -15.2% | 10.4% |
| | Rotterdam | 74.5 | 63.8 | 18.4 | 19.3 | 20.5 | 20.6 | 78.7 | -14.3% | 23.4% |
| | Antwerp | 13.9 | 11.6 | 3.4 | 3.0 | 3.1 | 3.9 | 13.3 | -17.0% | 15.4% |
| Oceania | Hedland | 515.7 | 540.7 | 127.4 | 144.5 | 136.4 | 142.3 | 550.6 | 4.9% | 1.8% |
| | Hay point | 116.6 | 101.0 | 23.5 | 27.1 | 25.4 | 23.3 | 99.2 | -13.3% | -1.9% |
| America | South louisiana | 113.4 | 125.3 | 38.2 | 29.0 | 21.3 | 34.4 | 122.8 | 10.5% | -2.0% |
| | major ports in Mexico | 117.9 | 101.2 | 25.2 | 16.6 | 41.0 | 28.0 | 110.7 | -14.2% | 9.4% |
| | major ports in Colombia | 96.5 | 70.9 | 20.0 | 18.5 | 19.9 | 18.6 | 77.0 | -26.5% | 8.6% |
| | Ponta da Madeira | 190.1 | 191.3 | - | | | | 182.4 | 0.6% | -4.7% |
| | Santos | 65.7 | 75.7 | 16.7 | 22.0 | 16.9 | 14.8 | 70.5 | 15.2% | -6.9% |

Source: Websites of various port authorities, sorted by SISI.

### 2.3.1 Analysis of the global iron ore port production

In 2021, most of the major iron ore handling ports recorded positive growth, but the growth rates dropped to varied extent compared with 2020. The growth rates of several major iron ore ports such as the Ningbo Zhoushan Port, the Ponta da Madeira, and the Port of Hedland all fell. The decline was primarily due to the transition from the new normal to a carbon-neutral era, the reduced demand as a result of China's power cuts, crude steel production curbs and scrap substitution, as well as the non-full release of the iron ore production capacity.

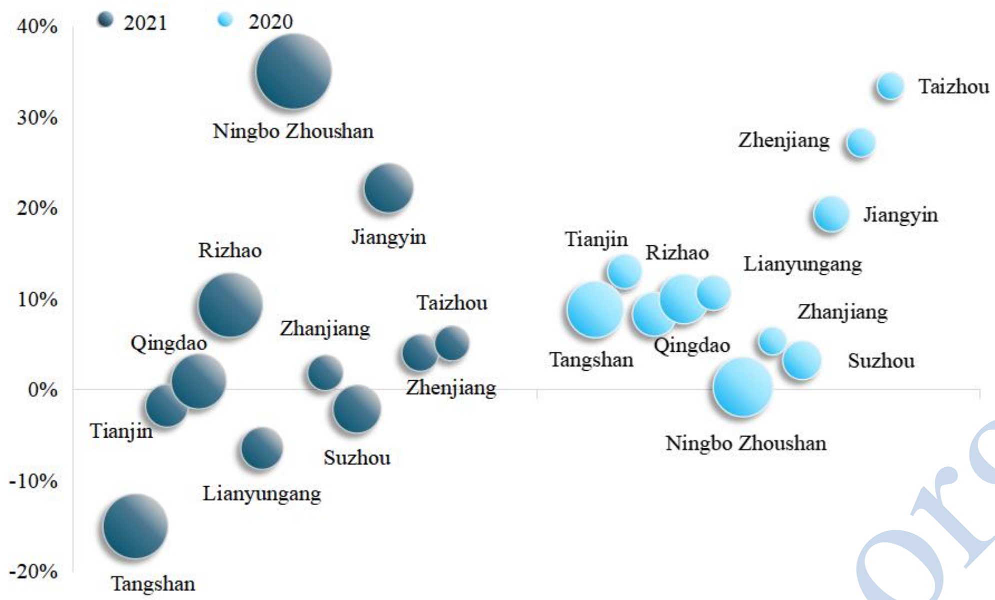



Note: The bubble size in the chart reflects the throughput scale of iron ore cargo.

Source: Websites of various port authorities, sorted by SISI.

**Figure 2-15** Bubble Chart of Throughput Growth of Global Major Iron Ore Ports (2020-2021)

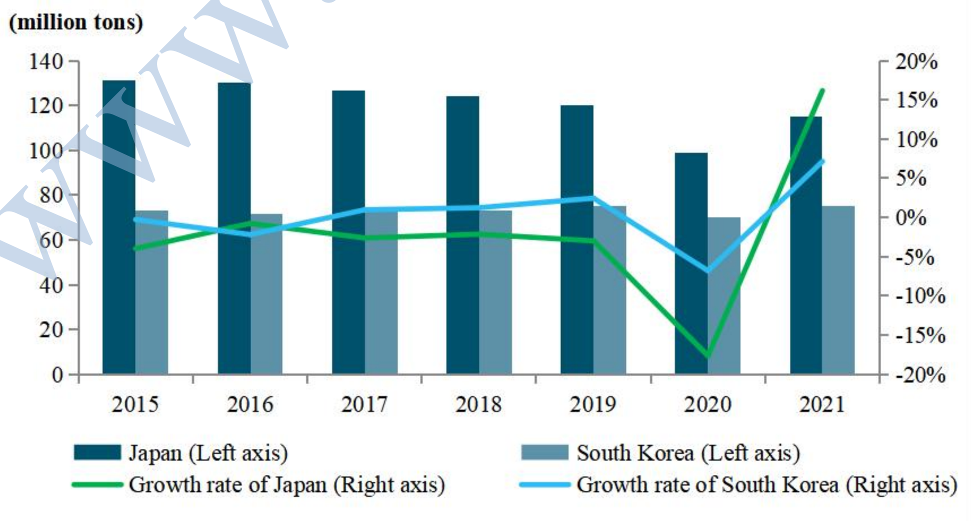
**The growth rate of iron ore throughput at Chinese ports slowed down.** In 2021, the iron ore throughput of China's ports increased by 1.4%. Specifically, the inbound export volume shrank slightly, while the domestic-trade iron ore throughput increased by 4.2%. However, the overall growth marked a significant drop of 6.5 percentage points from the 7.9% increase in 2020. China's iron ore demand followed a downward trend and presented a completely different trend in the first and second half of the year. In the first half, the production of enterprises recovered rapidly after the holiday, the infrastructure construction and the real estate market continued to boost the demand for steel, and the profits of steel mills increased significantly. In the second half, however, the supply and demand were both weak. The demand fell quickly due to the crude steel production restrictions, and the prices also went downward. In terms of regions, according to Mysteel statistics, the arrivals in East China and South China increased, while those in North China, Northeast China, and along the rivers declined. Specifically, the arrivals in East China were 350 million tons, an increase of 14.42 million tons year-on-year, and the arrivals in South China were 110 million tons, an increase of 6 million tons year-on-year.




Source: Websites of various port authorities, sorted by SISI.

**Figure 2-16** Bubble Chart of Throughput Growth of China Major Iron Ore Ports (2020-2021)

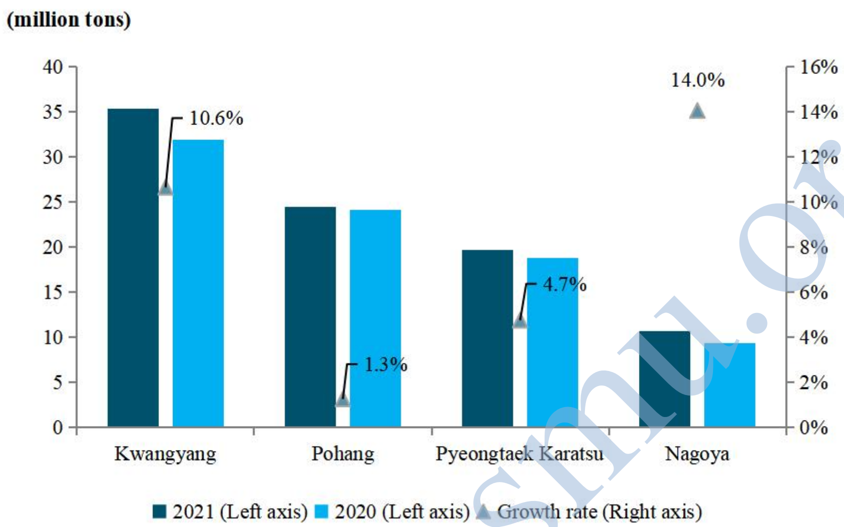
**Iron ore imports of Japan and Korea showed a V-shaped trend.** As the construction and manufacturing industries recovered, Japan's crude steel production stepped up, and the iron ore demand increased by 16.2%. However, in the face of the rising virus infection rate and the impact of the economic downturn, the iron ore imports failed to recover to the level before the outbreaks, and the slower-than-expected recovery in the auto sector also hindered the demand for steel. The increasing orders to the shipbuilding industry promoted the recovery of the Korean steel industry. In view of the fluctuating raw material prices such as iron ore, Korean buyers tried to diversify their import sources. However, the demand for scrap iron still curbed the iron ore imports to a certain extent.




Source: Clarkson website sorted by SISI.

**Figure 2-17** Iron Ore Imports Volume and Growth Rate of Japan and South Korea (2015-2021)

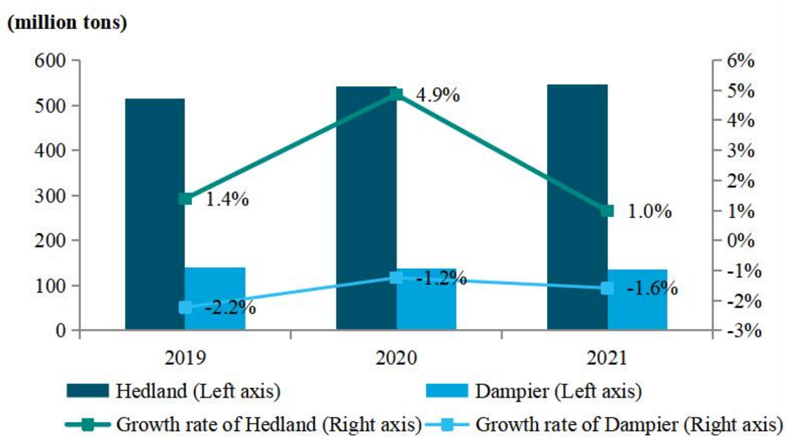
In terms of ports, the Port of Gwangyang, the Port of Pohang, and the Port of Pyeongtaek/Dangjin all turned to positive growth. The upturn in the auto and ship markets boosted demand for steel plates, and the expanded housing supply policies also increased iron ore shipments. In 2021, the iron ore price exceeded the highest level in the past 10 years. The Korean steel manufacturing giant POSCO was an early investor in the mining industry, and still maintained a high profit as a result. However, Hyundai Steel faced greater pressure due to the absence of mining investment, and the steel manufacturing costs became an issue.




Sources: Websites of various port authorities, sorted by SISI.

**Figure 2-18** Iron Ore Throughput and Growth Rate of Major Ports in Japan and South Korea (2020-2021)

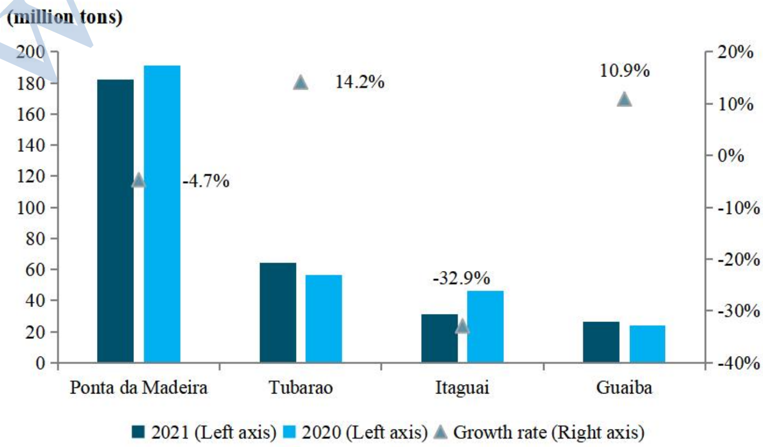
**Australia's iron ore throughput growth slowed down.** In 2021, the growth of Port of Hedland, the world's largest iron ore shipping port, slowed down. Although its iron ore exports to China dropped by 3%, the export volumes to Japan, South Korea, Vietnam, and Chinese Taipei increased. The share of shipments to China fell to 83.1% from a peak of 86.6% in 2020. In addition, the Port of Hedland which served BHP Billiton (BHP) and FMG, recorded growth in 2021 was primarily due to the steady growth of FMG production. The iron ore throughput of the Dampier Port, which served Rio Tinto, fell by 1.58%. This was largely due to the poor handover of Rio Tinto's new mine projects and the unsmooth trial operations of the new West Angelas iron ore deposit, resulting in the insufficient production and supply during the transition period.




Sources: Websites of various port authorities, sorted by SISI.

**Figure 2-19** Iron Ore Throughput and Growth Rate of Hedland and Dampier Port (2019-2021)

**Brazil iron ore throughput recovery was weak.** Overall, the iron ore throughput of Brazilian ports did not recover to the level before the pandemic, with its year-on-year growth falling to 4.3%. Brazil's Samarco mine restarted in December 2020 after five years of closure due to a deadly tailings dam break, fueling Brazil's iron ore supply. Nevertheless, the iron ore shipments from Brazil remained constrained by mine operations. In terms of ports, the Port of Ponta da Madeira and the Port of Itaguaí registered larger declines. Brazil's Vale witnessed lower iron ore throughput at its southeastern and northern ports due to delays in licensing and lower operating rates. In addition, social controversies caused by environmental violations at the second-largest iron ore exporter CSN affected its iron ore operations at the Port of Itaguaí, and the heavy rainfall in the southeastern region also hindered the transportation at the Port of Itaguaí and others. The iron ore throughput of Ponta da Madeira decline was largely attributable to the six-month maintenance after the fire of the terminal loader at the beginning of the year, which seriously affected the iron ore transportation capacity of the port. Tensions in Sino-Australian relations increased China's purchase demand for Brazilian iron ore, and both the Port of Tubarão and the Port of Guaíba achieved sound growth in throughput.

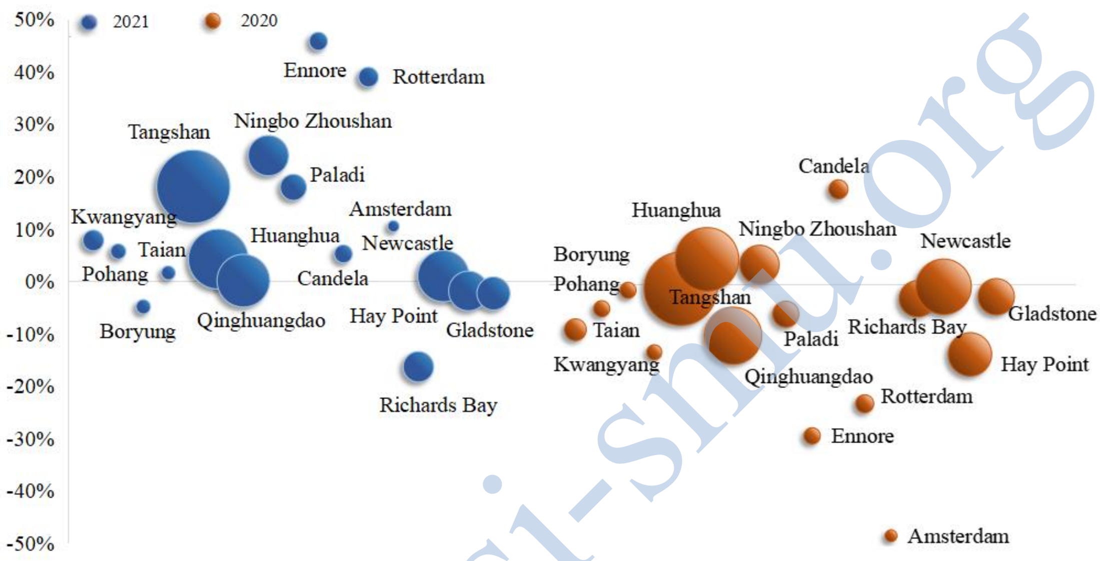



Sources: Websites of various port authorities, sorted by SISI.

**Figure 2-20** Iron Ore Throughput and Growth Rate of Major Brazilian Ports (2020-2021)

### 2.3.2 Analysis of global coal port production

In 2021, the surging power demand caused by industrial production resumption enabled the recovery growth of most of the world's major coal handling ports in throughput. The figures of 2021 in the bubble chart improved overall compared with 2020. The coal throughput of major coal hub ports such as Tangshan Port, Qinhuangdao Port, and Port of Newcastle got rid of negative growth, with the Port of Kamarajar in India, the Port of Rotterdam in the Netherlands, and the Port of Gwangyang in South Korea, in particular, registering the sharpest growth.

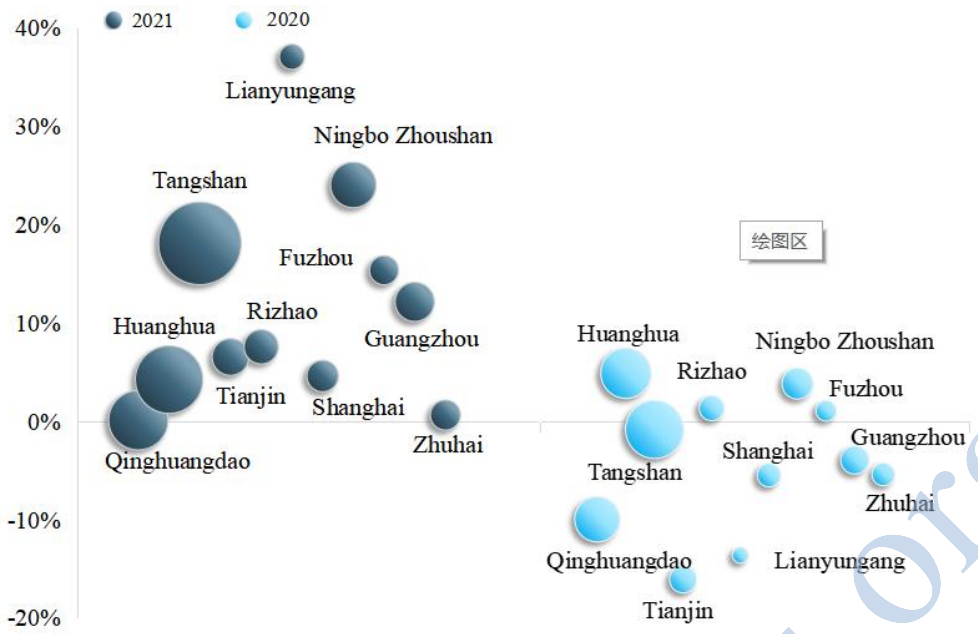



Note: The bubble size in the chart reflects the throughput scale of coal cargo.

Sources: Websites of various port authorities, sorted by SISI.

**Figure 2-21** Bubble Chart of Throughput Growth of Global Major Coal Ports (2020-2021)

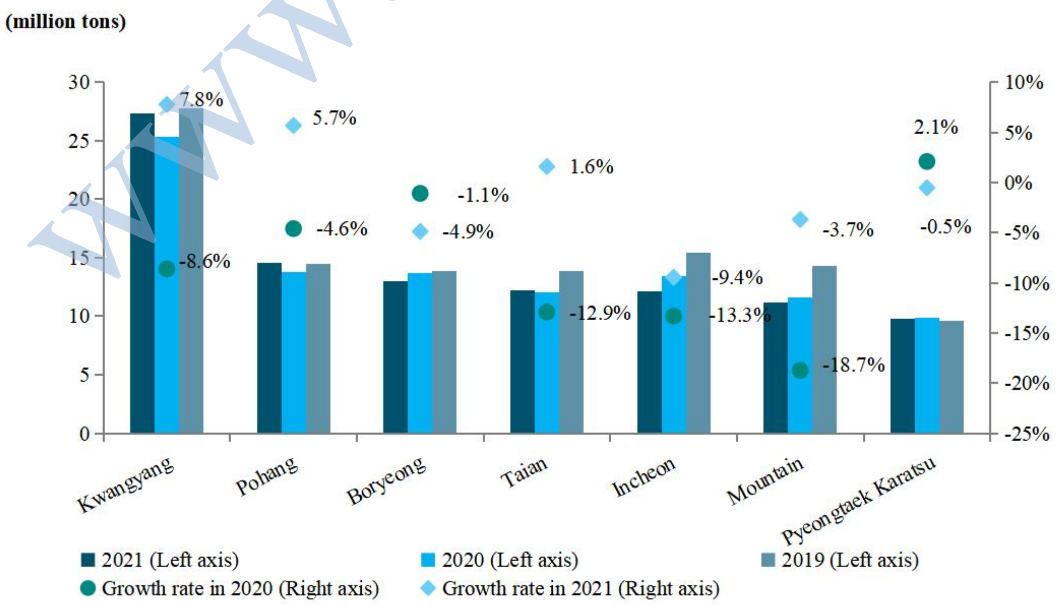
**Coal growth of Chinese ports rebounded strongly.** In 2021, China's coal supply and demand relationship experienced a tight supply for more than six months and a sufficient supply after the policy support for production and supply security at the end of the year. During the period, raw coal production and coal imports increased by 4.3% and 6.6%, respectively, and the transportation needs of coal for both domestic and foreign trade improved greatly. Therefore, the coal throughput of Chinese ports in 2021 rose by 10.8%, marking a strong rebound from the -2.7% growth in 2020. Specifically, the imports (21.3%), domestic-trade shipping volume (7.6%), and domestic-trade handling volume (11.1%) all increased substantially. In terms of ports, the production of major waterborne shipping and handling ports of coal in China also rose significantly. Specifically, Tangshan Port performed well (increasing by 18.1%), and the shift of thermal coal waterborne shipments of Bohai Rim ports to Caofeidian Port and Jingtang Port became more evident. In contrast, Qinhuangdao Port only recorded slight growth of 0.1%. The major coal unloading ports in the south also generally performed well, with Lianyungang and Ningbo Zhoushan ports both increasing by more than 20%.




Sources: Websites of various port authorities, sorted by SISI.

**Figure 2-22** Bubble Chart of Throughput Growth of Major Coal Ports in China (2020-2021)

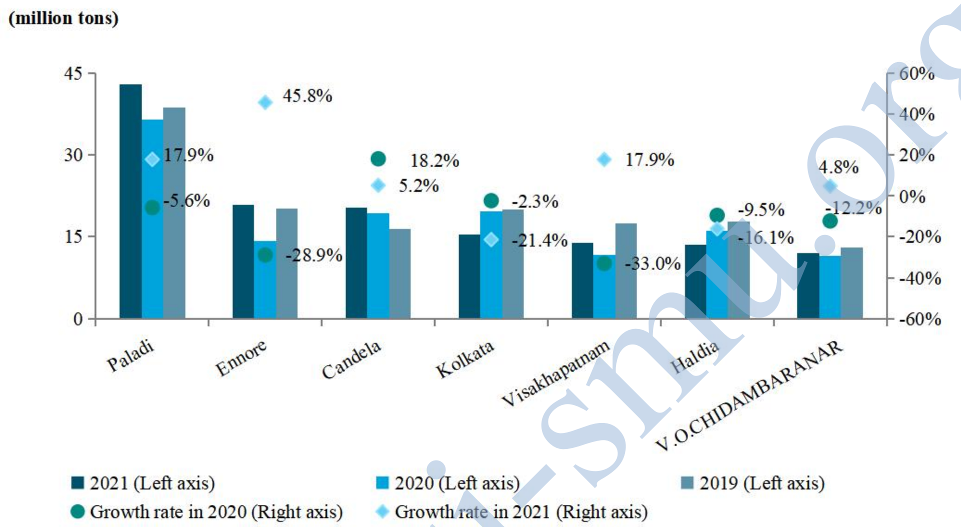
**Coal throughput of ports in South Korea grew significantly.** In 2021, due to the surging overall power demand in South Korea, its coal imports rose by 1.59% and the coal throughput of ports across the country increased by 5.0% to 132 million tons. However, due to the negative growth for three consecutive years as well as the low-carbon environmental requirements, the coal-fired power generation fell, and the 149 million tons of coal throughput in 2018 is expected to be the peak. Among major coal handling ports in South Korea, Port of Gwangyang and Port of Pohang maintained sound growth, while the Port of Boryeong, the Port of Taean, the Port of Incheon, and the Port of Taesan recorded weak growth.




Sources: Websites of various port authorities, sorted by SISI.

**Figure 2-23** Coal Throughput and Growth Rate of Major Ports in South Korea (2019-2021)

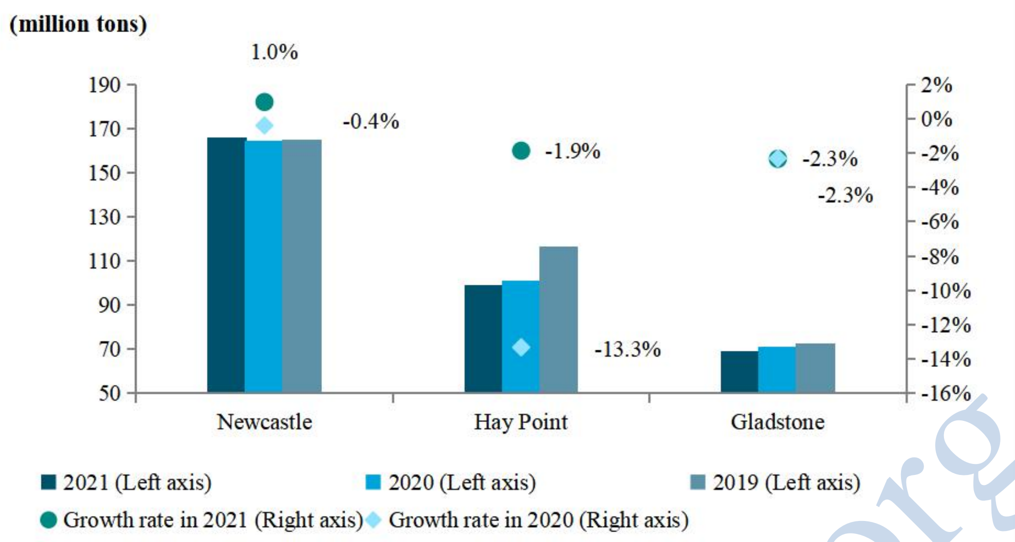
**Coal throughput at Indian ports rebounded strongly.** In 2021, the coal throughput of Indian ports soared by 10.5% to 144 million tons, a strong rebound from the -13.0% growth in 2020. Since Indian seaborne coal import volume in 2021 was still in the negative range and India's domestic coal production reached 804 million tons (increasing by 7.0%), it can be seen that the Indian coal industry is turning from imports to exports, and the country will further develop coal resources to satisfy domestic needs. Its coal throughput increase will be largely from domestic-trade transportation. Most of the major coal ports showed a positive growth trend. Port Paradip, which recorded the highest coal throughput, saw its coal throughput rise by 17.9%, while the coal throughput of the Port of Kamarajar fluctuated greatly in the past two years.




Sources: Websites of various port authorities, sorted by SISI.

**Figure 2-24** Coal Throughput and Growth Rate of Major Ports in India (2019-2021)

**Growth at Australia's major coal ports was sluggish.** Due to China's continued export ban on Australia, Australia turned to India, Japan, and Korea for coal exports. However, it was still unable to offset the reduction in exports to China. The coal throughputs of the Port of Gladstone and the Port of Hay Point in 2021 were both in the negative growth range. The demand for thermal and coking coal increased in 2021, but the inclement weather and the inland flooding disrupted shipments at the Port of Newcastle. Environmental protests continued to disrupt the port and surrounding rail infrastructure. As a result, the coal throughput at the Port of Newcastle rose only marginally.



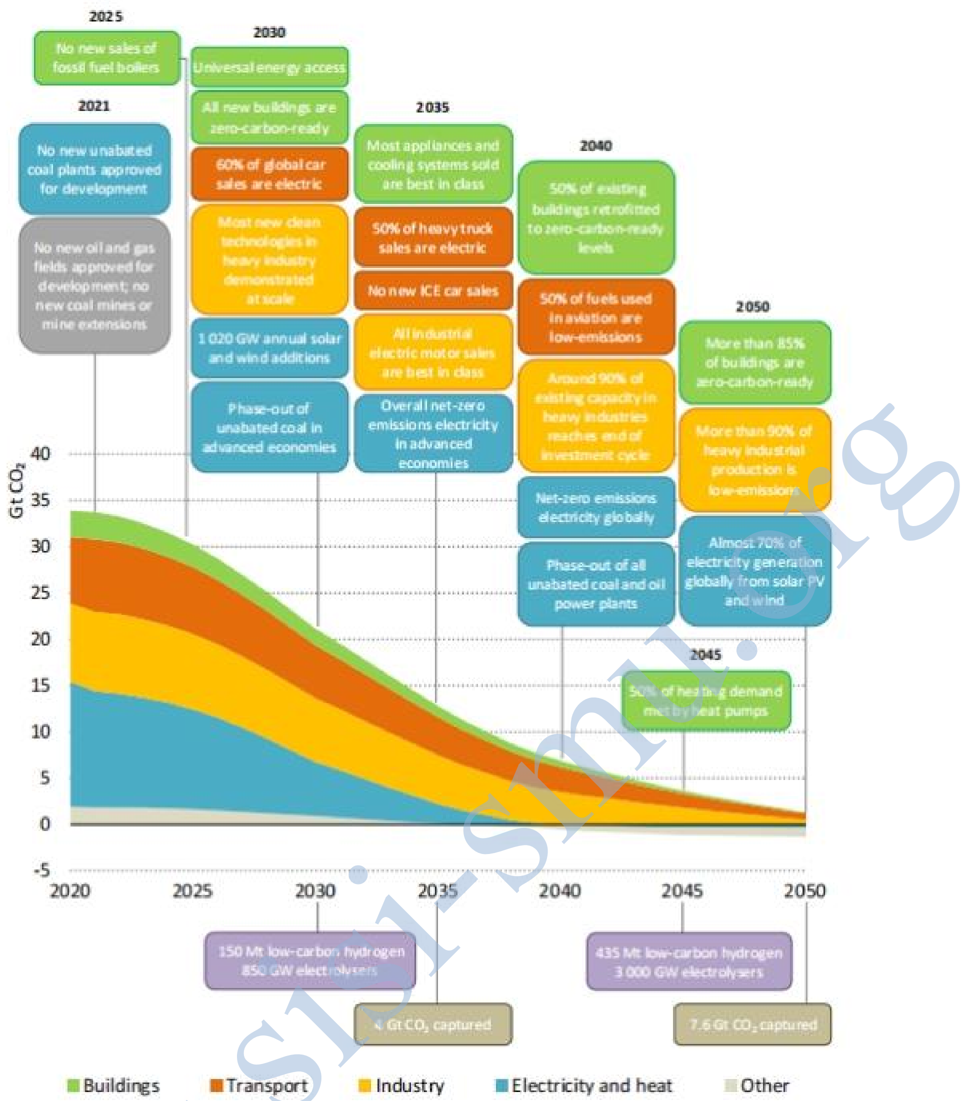

Sources: Websites of various port authorities, sorted by SISI.

**Figure 2-25** Coal Throughput and Growth Rate of Major Australian Ports (2019-2021)

# Topic 2: Production Environment and Trends of Bulks Ports amid Global Energy Transition

## 1. Global carbon emission reduction policies promote disruptive changes in high-emitting industries

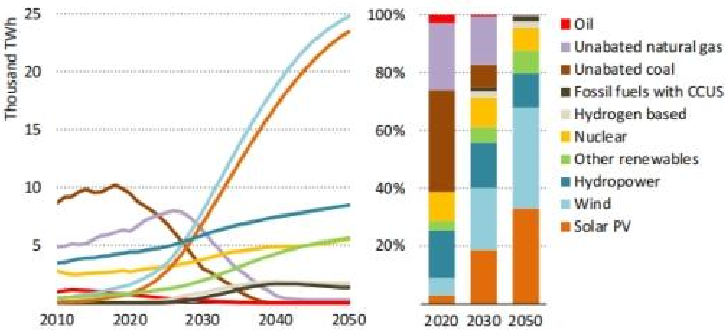
In the face of the increasingly severe global climate change, the Paris Agreement's goal of achieving "carbon neutrality" by 2050 has become a common pursuit. Carbon emission reduction gradually turned into part of the plans, roadmaps, and specific measures of various governments in 2021. The market share of new energy represented by wind energy and solar energy grew rapidly, and the energy structure on the global scale accelerated the transition from fossil energy to new energy. Disruptive changes are expected in the power, industry, transportation, and other industries, which will also affect the basic landscape of the port and shipping industry.




Source: Net Zero by 2050 A Roadmap for the Global Energy Sector, International Energy Agency (IEA).

**Figure 1** Global Roadmap and Key Milestones for Achieving Zero Carbon in 2020-2050

**Natural gas and renewable energy will become the new favorites of the power industry.** Although the proportion of coal and oil in the power generation structure has been declining in recent years, coal-fired thermal power generation remains the most important method of power generation (accounting for 35.1% in 2020). Besides, coal-fired thermal power generation is concentrated in the Asia-Pacific region. (The coal-fired power generation in China and India accounted for 27.5% of the global total electricity generated.) Among the zero-carbon roadmaps proposed by countries around the world, most of them put forward plans to reduce thermal power generation, and natural gas and renewable energy will become the most important power generation fuels in the future.

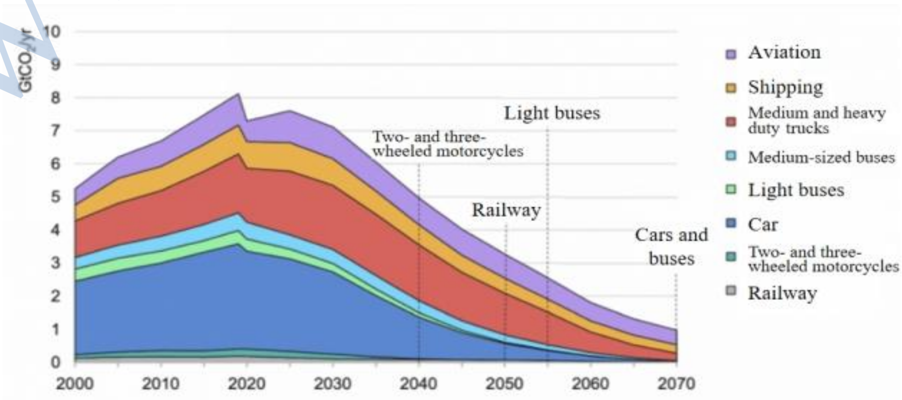



Source: Net Zero by 2050 A Roadmap for the Global Energy Sector, International Energy Agency (IEA).

**Figure 2** Global Power Generation and Proportion of Different Energy Sources

**The accelerated energy structure transition has promoted the advent of the fourth industrial revolution.** This transition driven by the carbon emission reduction policy is not only a change within the energy industry, but it also helps reshape the industrial system. The fourth industrial revolution supported by the quantum information intelligence technology, the controllable nuclear fusion, and the biotechnology among other technologies is coming, and energy utilization will enter the "intelligent new energy era". High energy-consuming industries such as iron and steel manufacturing, non-metallic mineral products, and petrochemicals will also face the challenges of output restrictions, technological process transformation, and capacity replacement.

**Electrification + hydrogen technology will help the transportation industry move toward zero carbon.** Road transport accounts for 74.5%, the largest share, of carbon emissions in the global transport industry, and the International Energy Agency (IEA) expects the global transport volume (measured in passenger kilometers) to double by 2070. Technological developments, including electrification and hydrogen technology, combined with a shift in the energy mix to low-carbon sources of electricity, will offset the rising carbon emissions from increased transport volumes and help the transport industry move toward zero carbon. Currently, new energy vehicles are developing rapidly, with their penetration rate rising sharply. The freight field is also actively implementing the multimodal transport and new freight mode of "highway to railway, and highway to waterway" to reduce the dependence on road transport which has high energy consumption.

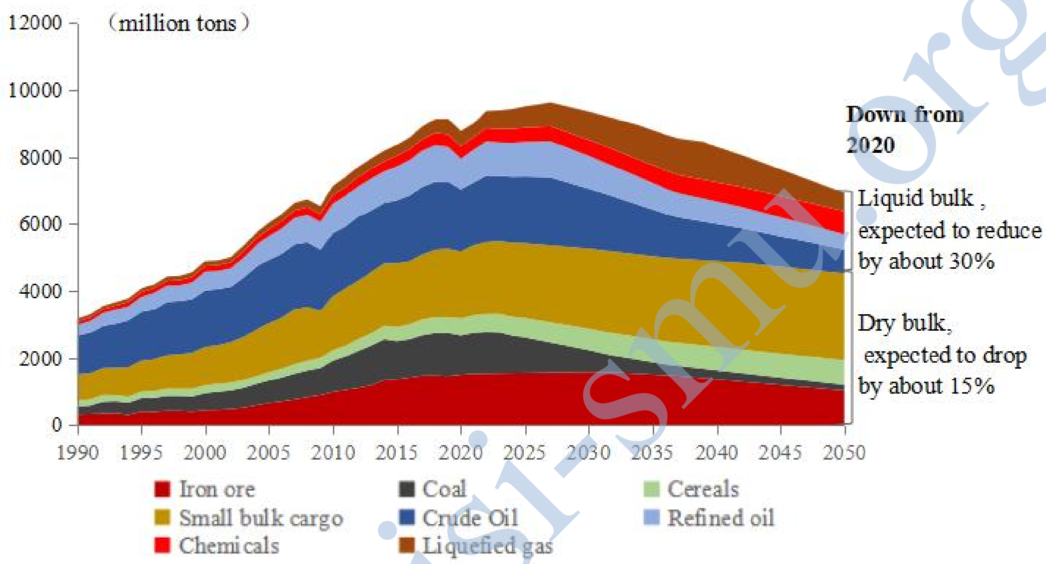



Source: International Energy Agency IEA, International Commission on Clean Transportation (ICCT).

**Figure 3** Trends in Carbon Dioxide Emissions by Mode of Transport, 2000-2070

## 2. Global bulks shipping demand and landscape changes against the dual-carbon background

In terms of the port and shipping industry, the uneven distribution of resource supply and demand has given rise to the demand for bulks shipping trade. However, the response and reform of various industries in the face of the carbon emission reduction requirement will lead to changes in the demand for various resources in the future. Such changes will spread to the seaborne bulks trade demand. Overall, the increase of bioenergy and hydrogen fuel will offset the decline of coal, oil, and natural gas to a certain extent, but the overall demand for seaborne bulks trade volume continues to show a sharp decline, and the trade flow is also changing greatly.




Note: Historical data comes from Clarkson, and the forecast data is based on relevant reports from Bloomberg, the International Energy Agency, Clarkson and other institutions.

**Figure 4** Analysis of the Impact of Carbon Neutrality on Global Bulk Cargo Transportation

**The seaborne coal shipping volume continued to decline after a slight rebound, and will retain a certain share in the long run.** The peak of global coal demand decline is over (with a slight rebound expected in the next two years). The international community regards coal as the primary energy source to be reduced, and countries around the world will gradually cut the proportion of coal-fired power generation. In the zero-carbon roadmap of China's steel industry, a short-flow process or a hydrogen-rich blast furnace process with less carbon emissions will be implemented. The demand for thermal coal or coking coal will be slashed, the coal demand will continue to decline, and the seaborne trade volume will also fall. In the long run, the coal demand will retain a certain share with the maturity of the carbon capture and storage (CCS) technology, but there will be a small demand for seaborne high-quality coal trade. For this reason, the long-term demand for seaborne coal trade will shrink significantly.

**The seaborne oil shipping volume will decline after reaching a peak around 2027, and the long-term seaborne oil shipping demand will be largely for chemical oil.** Transportation and chemical industries are the two biggest customers of oil (accounting for about 75% of the total demand), but with the gradual popularization of new energy vehicles and trucks and the declining share of oil in power generation fuels, oil demand is expected to fall after it peaks in around 2027. The long-term transportation oil demand will drop greatly, and most of the seaborne oil trade will be for chemical oil. In addition, due to poor infrastructure in less developed countries, the oil demand will fall or slow down the growth, while areas with strong refining and chemical industries in developed regions will maintain their oil demand. In addition, the oil industry will focus on exploiting existing oilfields and the low-cost resources discovered. The seaborne trade flow of oil will become more concentrated in the future.

**The natural gas demand will decline after peaking around 2035, and its seaborne trade volume will increase and decrease accordingly.** Natural gas has proven to be a good transitional alternative energy in the near future against the current background of carbon emission reduction, and a relatively large increase is expected before 2035. However, with the continuous development of energy storage technology, hydrogen energy, smart grid, and other technologies and the requirements for deep emission reduction, the demand for natural gas will be eroded by hydrogen and other clean energy sources in the long run. But due to its abundant reserves and clean and low-carbon characteristics, natural gas will remain a reasonable energy choice. The transportation methods of natural gas include pipeline transportation and shipborne shipping of liquefied natural gas. The increase in natural gas demand before 2035 will be largely from the Asia-Pacific region, and the demand in the Asia-Pacific region is mostly met by seaborne imports from Qatar, Russia, Australia, and other places, pushing the seaborne trade volume to increase accordingly. The reduction in natural gas demand in the Asia-Pacific region and Europe after 2035 will also cut the seaborne trade volume.

**The technology for large-scale hydrogen transportation is not yet mature, but shipping will inevitably be the main mode of transportation in the future.** Hydrogen energy is a kind of secondary energy with abundant sources, clean and carbon-free, flexible and efficient, and rich in application scenarios. China, the European Union, Japan, South Korea, and other regions/countries have all regarded hydrogen energy as an integral part of the long-term energy structure. The manufacturing and application scenarios of hydrogen energy are currently not well-developed, but shipping will surely be one of the main modes of large-scale hydrogen transportation. In 2021, Japan promoted seaborne hydrogen shipping with liquid hydrogen and liquid organic hydrogen carriers (LOHC). The seaborne hydrogen trade will maintain a certain share in the future.

**The sufficient supply and demand of iron ore will continue for a long time.** The steel industry is the biggest customer of iron ore. By 2050, the steel demand is expected to increase by 60%. Specifically, China's steel demand is now close to its peak, and future demand growth will largely depend on India and emerging countries such as Pakistan and Nigeria. In terms of iron ore demand, China, as the largest importer of iron ore, won't record great increases in iron ore imports due to its production restrictions on steel mills, gradual advancement of short-flow processes, and promotion of domestic iron ore. However, as infrastructure demand in emerging countries grows rapidly and the domestic scrap steel reserves are limited, China will retain some demand for iron ore imports. Therefore, it is expected that the supply-demand relationship of iron ore will be relatively loose for a long time in the future, and its seaborne trade volume will edge down.

**The seaborne shipping volume of minor bulks will maintain steady growth.** There are many types of minor bulks as it's a market with more diversified needs. Most of them are raw materials for industrial production and are the basis for economic development. Therefore, the demand for minor bulks often follows the growth of GDP. The main driver of minor bulks growth in the past 10 years was China. Imports of metals and minerals such as bauxite and manganese ore and imports of forestry products have grown strongly. Moreover, China will take control of the lithium batteries supply chain by virtue of its leading status in key mineral refining. The imports of raw materials for key metals such as lithium, cobalt, nickel, and manganese and the seaborne import and export volumes of finished products will become an important contributor to increase.

## 3. Impact on bulks ports and countermeasures for port development

Based on the estimates of future bulks shipping trade demand and against the background of reduced total demand for seaborne bulks shipping trade, changes in cargo categories, and changes in trade patterns, ports also need to find a direction for development in environmental changes.

**(1) Major bulks importers should plan the transit and distribution systems for imported bulk cargoes in advance**

In view of the reduced total demand and higher environmental protection requirements, major importers of bulk cargoes will face the challenge of shrinking demand for port operations. The short supply at ports will pass gradually. In the future, port resources should be integrated and the transit and distribution systems of bulks terminals should be properly planned and constructed to improve efficiency and utilization via large bulks terminals, so as to avoid blind construction and the resulting loss of port operations. For example, China has basically completed the port integration of "one port in one province", but some groups are not very clear about the transit and distribution systems of bulks terminals internally. Therefore, each port group needs to clarify the regional layout of bulks ports' transit and distribution systems in addition to the overall layout of Chinese ports, and large bulks terminals outside the plan should be prohibited, especially coal and oil terminals.

**(2) Large-scale specialized and automated dry bulks terminals are necessary conditions for becoming a regional bulks hub port**

As port groups and ships are getting increasingly bigger, the point-to-point transportation of dry bulks will be partially transformed into the transfer and distribution via the regional bulks hub port. In particular, a transfer and distribution system for iron ore based on a 400,000-ton level handling terminal will be built. The necessary condition for becoming a bulks hub port in the port group is to become a large-scale specialized and automated terminal. On the one hand, the automation technology with constant breakthroughs made will make it possible to automate dry bulks terminals. On the other hand, large-scale professional dry bulks terminals can greatly enhance operational efficiency and energy consumption efficiency to gain competitive edges, reduce logistics costs, and boost the efficiency of the entire bulks transfer and distribution system.

**(3) Plan the layout in advance for bulks shipping to cope with growing demand**

Compared with the significant reduction in the seaborne shipping volumes of coal and crude oil, metals and minerals such as bauxite and manganese ore in minor bulks will become the main drivers. In particular, China will rely on the advantages of the lithium battery industry to become a core logistics link for key minerals and finished products. Therefore, it is necessary to plan the import and export routes of key minerals and finished products in advance. In addition, biomass fuel will take up a share in the future energy structure. For this reason, attention should also be paid to the relevant terminal construction planning for biomass raw materials and fuel. Specifically, it should be noted that natural gas is generally regarded as a transitional energy source, and the construction of relevant terminals should take into account the country's energy selection and industrial planning without overbuilding.

**(4) Prepare in advance for the general overcapacity of bulks terminals**

As the demand for seaborne bulks trade declines, the overcapacity of bulks terminals may become common on the global scale, especially in the economically developed regions such as Western Europe and the eastern coastal areas of China where demand dropped significantly. The terminals that have been weeded out or receive functional changes should be well handled on the basis of demand forecast and bulks transit and distribution systems. On the one hand, ports with better coastlines can transform their terminal functions via proper renovation. On the other hand, the coastlines closer to cities can serve cities and coastal or riverside landscape or industrial parks can be developed.

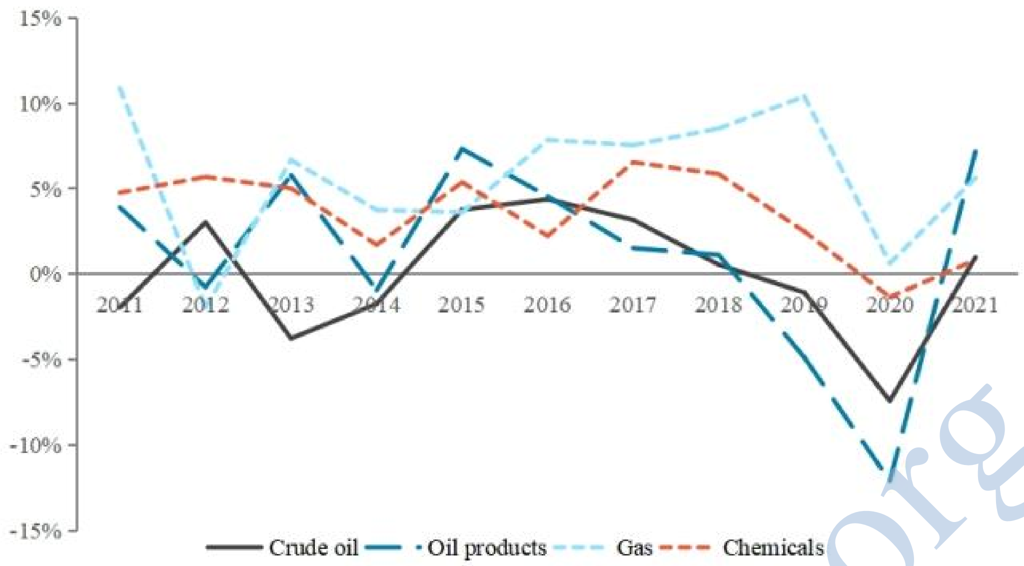
**(5) Bulks ports also need to pay attention to low-carbon and environmentally friendly green construction**

In addition to coping with the changes in the external environment and demand, bulks ports should also improve their energy efficiency and reduce carbon and pollutant emissions. On the one hand, the concept of zero-carbon terminals has emerged in recent years, and many terminals have begun to test new energy sources such as wind energy and hydrogen energy to achieve zero-carbon operations. The low-carbon and environmental protection performance of terminals is bound to become an important indicator for evaluating terminal development level despite the lower electrification level of bulks terminals and the difficulty for achieving breakthroughs. On the other hand, the port-city synergy concept has been increasingly widely accepted, and the prevention and control of sewage and dust in the dry bulks terminals has received more attention. It is also necessary for bulks ports to pay attention to planning and investment in wind and dust suppression, port sewage and wastewater treatment, and energy consumption management, so as to enhance the ports' green and environmental protection performance.



## 2.4 Overview of Liquid Bulks Throughput of Global Ports

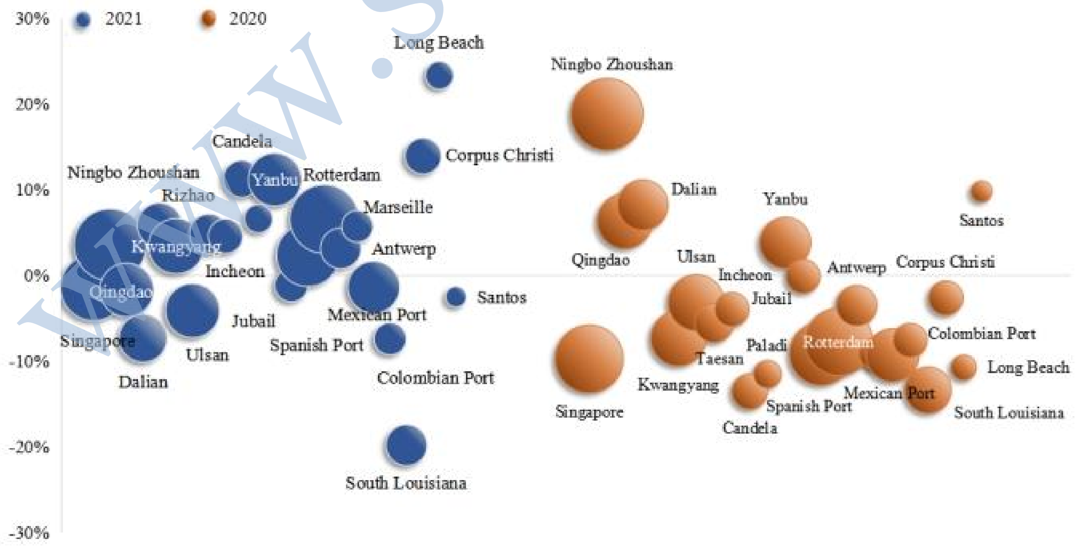
In 2021, the global seaborne liquid bulks shipping market showed a strong recovery momentum. The world's major liquid bulks shipping volume was 3.73 billion tons, a year-on-year increase of 3.1%, a strong recovery from the -7.1% decline in 2020. The seaborne trade volume of the four major types of liquid bulks basically resumed positive growth. Specifically, the seaborne trade volume of crude oil increased slightly after falling for two consecutive years. The refined oil products recorded the biggest pickup, contributing 65 million tons of increase, the highest among the four major cargo categories. Liquefied gas resumed the high growth rate again (5.6% against the average 7.6% rate from 2016 to 2019 before the pandemic). The seaborne trade volume of chemical products was relatively stable.




Sources: Clarkson website, sorted by SISI.

**Figure 2-26** Growth Trend of Global Seaborne Trade Volume of Major Liquid Bulks Cargo (2011-2021)

In 2021, the throughput of major liquid bulks ports around the world presented a landscape where all other regions except China saw growth. The liquid bulks volume growth of major ports in China shrank. This was largely because the lower oil price in 2020 led to a 7.3% increase in China's crude oil imports. In 2021, the oil price continued to rise and China implemented the dual carbon policies in the second half of the year, which restricted the use of petrochemical energy, weakening the growth momentum. Ports in regions outside of China recorded recovery growth of liquid bulks throughput to varied degrees.



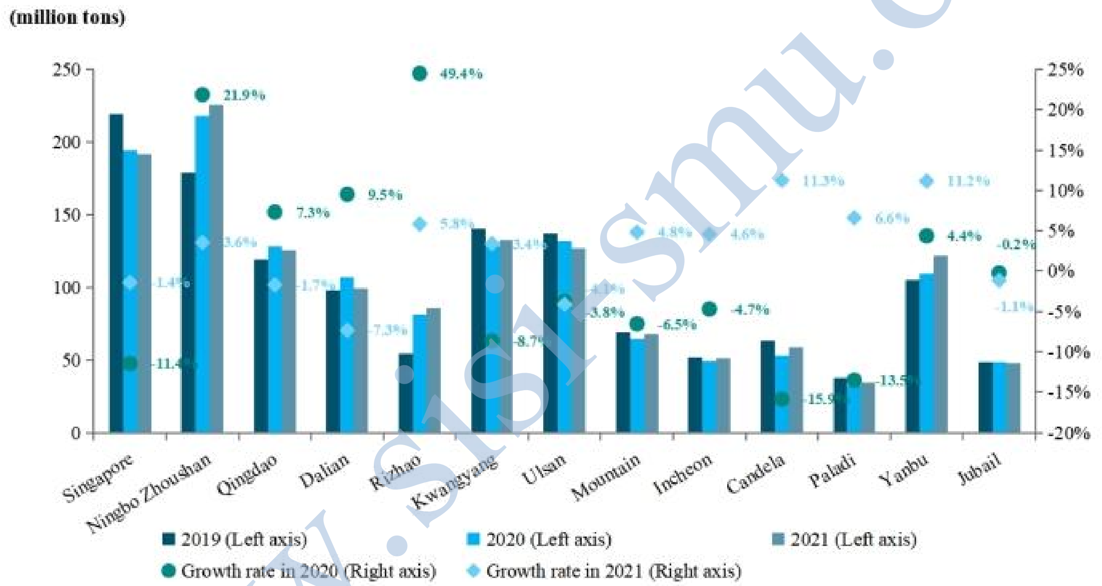

Sources: Websites of various port authorities, sorted by SISI.

Note: The bubble size in the chart reflects the throughput scale of the liquid bulks cargo.

**Figure 2-27** Bubble Chart of Throughput Growth of Global Major Liquid Bulks Cargo Ports in 2021

## 2.4.1 Liquid bulks throughput of Asian ports generally rebounds except for China

In 2021, the liquid bulks throughput growth in Asian ports also showed a diametrically opposite trend between China and other countries. The growth rate of liquid bulks throughput of China's major ports generally dropped significantly compared with 2020. The growth rate of liquid bulks throughput of other ports in Asia generally picked up compared with 2020. Most major liquid bulks ports in South Korea, India, and Saudi Arabia returned to positive growth. In addition, the Port of Singapore, the world's largest bunkering port, recorded declines in liquid bulks throughput for four consecutive years (from 233 million tons in 2017 to 192 million tons in 2021). But the fuel oil sales volume and the number of tanker arrivals in the same period didn't drop significantly, and the total tonnage of arriving oil tankers even increased by 17.0%.

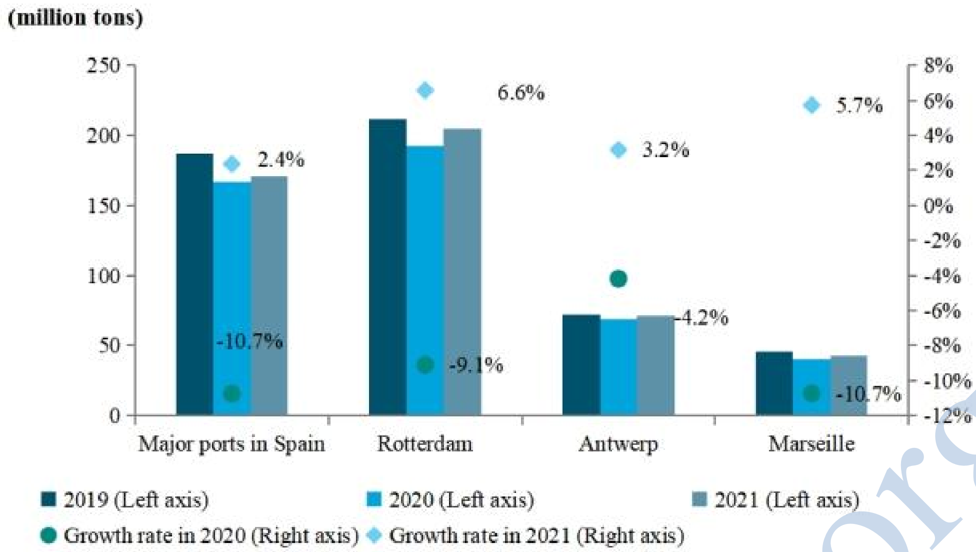



Source: Websites of various port authorities, sorted by SISI.

**Figure 2-28** Liquid Bulks Throughput of Major Asian Ports (2019-2021)

## 2.4.2 Liquid bulks throughput of European ports rebounds steadily

In 2021, the European PMI was relatively high and demand for automotive fuels increased. Meanwhile, the oil inventories were low, so liquid bulks demand gradually recovered. The global demand for chemicals boomed due to a recovery in industrial production. Although the Port of Antwerp still recorded a rapid decline in crude oil handling, the strong exports of chemicals at the port, Europe's largest petrochemical cluster, drove liquid bulks throughput into the positive growth range. In addition, the strong growth in gasoline throughput also offset the declines in diesel and fuel oil throughput. The Port of Rotterdam increased multiple types of marine fuels, with significant increases in LNG, fuel oil, and naphtha imports from Russia, and higher diesel exports to the United States. Sponsored by the government, the Port of Marseille developed railways and waterways connecting the port, becoming a strong support to the liquid bulks transportation.

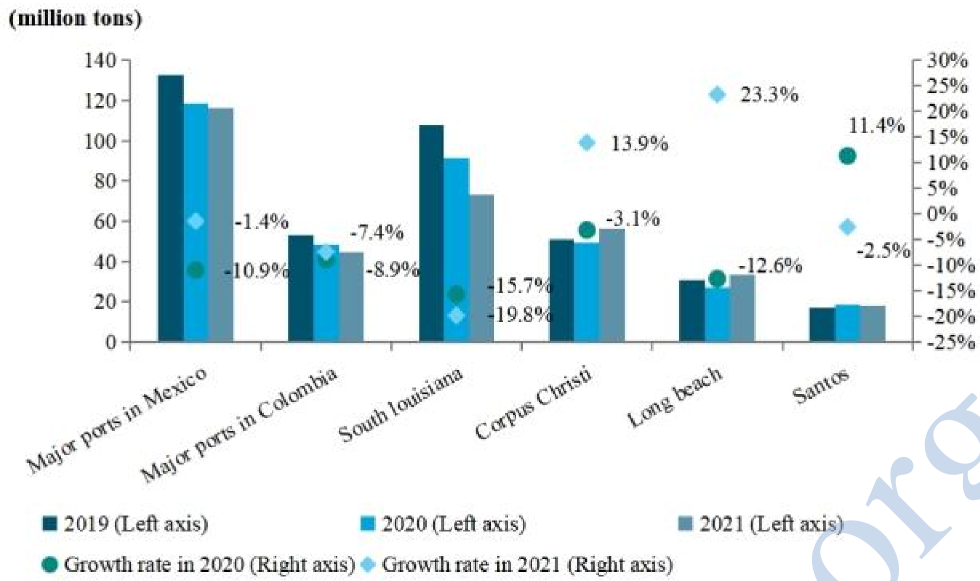



Source: Websites of various port authorities, sorted by SISI.

**Figure 2-29** Liquid Bulks Throughput of Major European Ports (2019-2021)

### 2.4.3 Liquid bulks throughput of American ports shows varied performance

In the first half of 2021, the U.S. crude oil inventories were high and exports also increased boosted by the LNG demand in Asia and Europe. As a result, the throughput of both the Port of Corpus Christi and the Port of Long Beach rose sharply. In the second half of the year, refineries in the New Orleans region and around the Gulf of Mexico of the United States were partially shut down due to hurricane, causing the production in the Port of South Louisiana to plummet. Besides, the shale oil operators scaled back production due to the impact of the cash flow crisis, reducing U.S. refined oil inventories and leading to a moderate demand for imports. Impacted by the 2021-2025 debt reduction strategic plan, Petrobras canceled the refinery construction plan and related projects, and intended to sell its domestic refineries, which reduced the oil production of Santos to a certain extent. In addition, the high LNG price and short supply led to slower growth of Santos' imports. However, with the sharp increase in fuel oil shipments, the throughput still exceeded the pre-pandemic level.




Source: Websites of various port authorities, sorted by SISI.

**Figure 2-30** Liquid Bulks Throughput of Major American Ports (2019-2021)

# III. Overview of Port Operations and Management in 2021

## 3.1 New Developments Trends of Port Logistics

### 3.1.1 The European Year of Rail sets off a new wave of multimodal transport expansion

In 2021, the European Union launched the "European Year of Rail" initiative to strengthen people's awareness of rail freight. Railways have long been pursued as a relatively economical, safe, and sustainable mode of transportation. Europe has been working to increase the market share of railway transportation in recent years. During the repeated pandemic outbreaks, freight methods such as China-Europe trains and sea-rail intermodal transport are like the "savior" of the global supply chain, and a new round of multimodal transport expansion boom started again.

**European countries increased investment in railway networks at ports to address the "last mile" problem.** According to the goals of the European Rail Freight Association, the rail transport volume will increase from 420 billion ton-km to about 1 trillion ton-km by 2030, an annual growth rate of about 6.1%. The sea-railway intermodal transport will also be the main cargo collection, distribution, and transportation mode of European ports, and the inbound and outbound railways will also usher in large-scale construction. Currently, the rail modal share in cargo collection, distribution, and transportation of major European hub ports still has much room for improvement. The share of Port of Felixstowe is about 17%, of Port of Zeebrugge it is about 15%, of Port of Rotterdam about 10% and that of Port of Antwerp around 8%. The Port of Antwerp and the Port of Valencia both recorded a share of around 7%. If the rail modal share of ports can be increased to 40%-50%, it will have a significant impact on the overall market share of railway freight in Europe.

**Multimodal transport service providers accelerated the expansion of service networks to seize more market share in sea-railway intermodal transport.** In view of the great market potential, many world-leading multimodal transport service companies, such as Rail Cargo, Hupac, and DB Group, have intensified efforts to expand the service network. Meanwhile, global shipping giants such as Maersk, CMA-CGM, and Mediterranean Shipping are also stepping into the multimodal transport sector by launching innovative multimodal transport service lines. In 2021, Mediterranean Shipping successively opened new sea-railway intermodal transport routes such as "China, Japan, South Korea-Russia-Europe's main hub ports" and "Germany-Italy-Turkey", and developed a new modern multimodal transport terminal (Westdorpe) in the Netherlands to expand its hinterland in Europe. In addition, the world's top two container ports are also promoting the multimodal transport business. In 2021, Shanghai Port opened the first China-Europe train and realized two-way operations with the Port of Hamburg. The Port of Singapore and the Port of Duisburg-Ruhrorter established a joint venture to expand the China-Europe freight train market.

## 3.1.2 The International North–South Transport Corridor (INSTC) officially gets underway

In June 2021, the first freight train departed from Finland and entered Iran and then India via the railway network of Russia and Azerbaijan, marking the official launch of the International North-South Transport Corridor (INSTC) that runs through Eurasia. The INSTC started from an intergovernmental agreement between Russia, Iran, India, and Azerbaijan. Since then, a total of 13 countries have ratified the agreement. The corridor extends from northern Europe to Southeast Asia. Due to the basic conditions, geopolitics, and other factors, the progress of the INSTC construction was slow or even stagnant for many years. It was not until the United Nations lifted sanctions on Iran in 2016 when the project regained its momentum and speeded up construction.

**The economic benefits of the INSTC are obvious, and it may become an alternative to the Suez Canal.** INSTC connects the Nordic countries and the northwest of the Eurasian Economic Union to the countries around the Persian Gulf and Indian Ocean through the Caucasus and Central Asia. The corridor involves three main routes: 1) the west route along the west coast of the Caspian Sea through Russia and Azerbaijan; 2) the east route along the east coast of the Caspian Sea through Kazakhstan and Turkmenistan; and 3) the middle trans-Caspian Sea route through the container routes. Compared with the sea route through the Suez Canal, the freight through INSTC can greatly shorten the freight time. For example, it takes 30 to 45 days to transport cargoes from Mumbai to St. Petersburg through the traditional route of the Suez Canal, while now it takes 15 to 24 days through the INSTC sea-land combined transport. The importance of the south-north passage is undoubtedly further highlighted when the pandemic continues to rage and the Suez Canal is congested.


Source: Eurasian Development Bank.

**Figure 3-1** INSTC — Meridional Corridor of the Eurasian Transport Framework

## 3.2 New Development Trend of Port Operations

### 3.2.1 Port and shipping logistics chains turn to 'involution' integration

**Shipping enterprises exhibited increasing interest to invest in ports, and the number of terminal operators with composite backgrounds rises.** In 2021, Mediterranean Shipping (MSC) made several acquisitions of port and shipping assets. First, it acquired Log In Logistica Intermoda, a Brazilian integrated logistics solutions provider, at a price of about $4.79 per share, valuing the company at more than $500 million. It later acquired the African logistics company of the French conglomerate Bolloré Group for 5.7 billion euros. However, MSC was very cautious when it came to acquisitions prior to this and focused on the traditional container shipping business for a long time, with its last acquisition made in 2019. In 2021, French CMA CGM bought back Fenix Marine Services, a Los Angeles port terminal sold four years ago, at three times its original price, and Hapag-Lloyd bought a 30% stake in the German deep-water port Wilhelmshaven.

**Port enterprises accelerated cross-border mergers and acquisitions and deployed global end-to-end logistics.** In 2021, PSA International, the world's largest port operator, acquired BDP, an American supply chain company with end-to-end logistics capabilities, officially embarking on becoming a full-service logistics provider. DP World also continued to strengthen the acquisition and integration of downstream links in the supply chain. In 2021, DP World successively bought North American logistics giant Syncreon and South African logistics behemoth Imperial Logistics to further strengthen the control over the supply chain.

Both port enterprises and shipping enterprises have shown their ambition for greater control over supply chain services. Port and shipping giants are accelerating presence in every corner of the logistics supply chain. Apart from addressing excess throughput capacity, cost reduction, efficiency enhancement, and scale expansion, this "involution" integration to a great extent aims to prevent the impact from highly uncertain "black swan" events such as the COVID-19 pandemic, climate change, and geopolitics.

### 3.2.2 Ports deepen resource sharing due to supply chain issues

**The resource sharing of port infrastructure equipment continued to strengthen.** To alleviate the long-running shortage of trailer chassis for ports, the United States introduced the concept of "chassis sharing pool". Traditionally, chassis are primarily owned by private leasing companies, while the chassis in the sharing pool are bought and used by port terminals, liner companies, or third parties to maximize the utilization of chassis resources in regional port groups. In addition, ports can also create "dual transaction" transportation through the chassis sharing system, that is, a container truck can process two cargo orders during the same trip, so as to realize the cargo collection, distribution, and transportation mode of "loaded container in, loaded container out". To further deepen the sharing and utilization of chassis resources, Georgia Ports Authority (GPA), Jacksonville Port Authority (Jaxport), North Carolina Ports Authority (NC Ports), and Ocean

Carrier Equipment Management Association (OCEMA) further strengthened strategic cooperation in 2021 to expand and upgrade the South Atlantic Consolidated Chassis Pool (SACP) to fully meet the service needs of ports along the southeastern coast of the United States.

**Sharing of port data resources gained pace.** The Port of Long Beach, in partnership with a technology consulting firm, launched a "Supply Chain Information Highway" data-sharing platform in 2021, allowing stakeholders to integrate their existing systems to facilitate information sharing digitally throughout the supply chain and streamline cargo flows. The Port of Los Angeles also planned a pilot with the Federal Maritime Commission (FMC) to explore building a data-sharing system to improve supply chain process. During the pandemic, the European Port of Hamburg was also committed to accelerating data sharing. By creating a port-wide digital network community/platform (Home PORT), the port guided the data sharing of relevant stakeholders, so as to enhance the visibility of port logistics supply chain and minimize the port congestion risk.

## 3.3 New Development Trend of Port Management

### 3.3.1 Port operations in emerging economies become further market-oriented

**India pushed for the transformation of major state-run ports to the landlord port model.** In 2021, the Indian government introduced the *Major Port Authorities Act* 2021 to replace the current *Major Port Trusts Act* (1963) to promote port development, aiming to change the previous port management model and give major ports, including Chennai, Cochin, Nehru, Calcutta, Mormugao, Mumbai and other major Indian ports, more autonomy in making decisions. Under the new legislative framework, 12 major state-run ports became independent governing bodies, and each port's authority has the power to set its own fees and charges based on market conditions. In June 2021, the Indian government finalized the public-private partnership of seven berths in major ports, which is expected to attract $274 million foreign investment and the berths will be operated and managed primarily in the PPP model.


Source: Maritime India Vision 2030.

**Figure 3-2** Key Point of Major Port Authorities Act 2021

**Brazil advanced the massive privatization of its ports.** In recent years, Brazil has pinned its hope of getting out of the economic stagnation on the privatization of state-owned assets. Through implementation of the "Investment Partnerships Program", some state-owned assets were privatized to attract private and overseas investment, promote Brazil's marketization, and make up for the fiscal deficit. Due to the pandemic, Brazilian ports once again ushered in a privatization boom. In 2021, Brazil sold four inland liquid cargo terminals in Itaqui and the terminal for processing logs and pulp in the southern coastal port Pelotas (Pelotas). Brazil is expected to tender 22 privatization projects with a bid value of more than $2 billion in 2022, including the terminal of Port of Santos, the largest port in South America.

## 3.3.2 Network security becomes a new focus of port management

Port cyberattacks have taken place one after another in recent years, posing the greatest risk to port authorities and the wider port communities. According to statistics from the International Association of Ports and Harbors (IAPH), the attacks on the network OT systems of port and shipping enterprises have increased by 900% since 2017, and cyber threat activities have increased significantly during the pandemic. In 2021, The South African national transportation company suffered cyberattacks successively, preventing local freight companies from completing the cargo imports and exports. Several major South African ports, including Port of Durban and Port of Cape Town, were forced to suspend operations. The business of major ports in South Africa was almost all paralyzed.

In 2021, the IAPH released the *Cybersecurity Guidelines for Ports and Port Facilities*, calling for enhanced awareness among senior strategic leaders of ports on cybersecurity management. The guidance was developed to help ports around the world assess their readiness against cybersecurity attacks while properly evaluating the true financial, commercial, and operational impact of a cyberattack. The IAPH said that establishing a dedicated internal cybersecurity steering committee is one of the effective ways to strengthen port cybersecurity management, which can not only delegate cybersecurity management powers and responsibilities but also promote consensus, ensure implementation coordination, and reduce possible duplicated security spending. Meanwhile, senior executives should first identify the characteristics of relevant threat actors in the process of developing a port cybersecurity strategy, and predict their motivations and goals, so as to turn strategies into tactics in a timely manner when suffering cyberattacks.

# IV. Comments on Global Terminal Operators in 2021

In 2021, the accelerated vaccine coverage and the surging consumer demand promoted the rebound of the world economy. Global terminal operators then adjusted their operations and development strategies accordingly, terminal investment and acquisitions activities became more frequent. Global terminal operators have also augmented investment in digital technologies such as blockchain, and continued to expand logistics services to speed up the transition into integrated logistics service providers.

## 4.1 COSCO Shipping Ports enjoys steady development

In 2021, the container shipping market generally improved, and the shipping industry entered a relatively prosperous range. COSCO Shipping Ports seized the market opportunities to improve its port and shipping service quality while expanding its holding network. In 2021, the company's business indicators steadily improved, recording a cumulative container throughput of 129.29 million TEUs, a year-on-year increase of 4.4%, and its equity throughput rose by 3.7% year-on-year to 39.87 million TEUs.

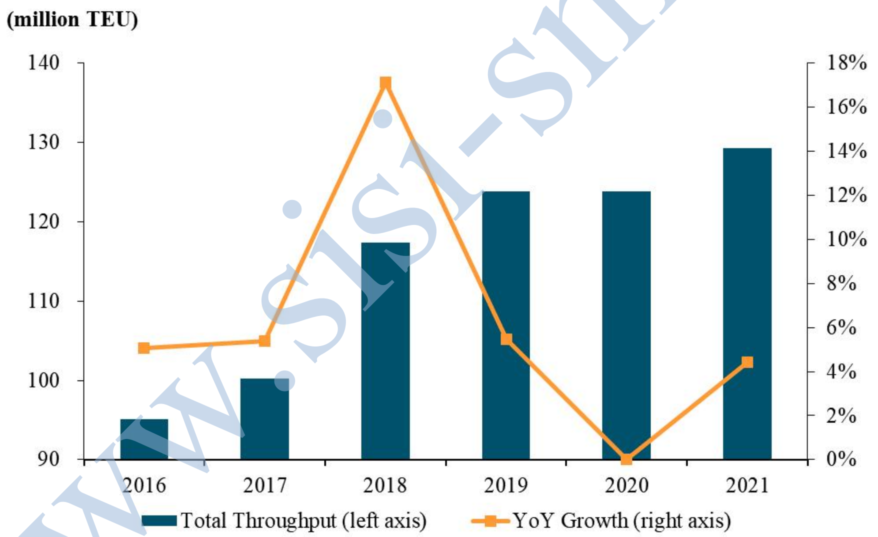



**Figure 4-1** Cross Throughput and Growth Rate of COSCO Shipping Port in 2016 -2021

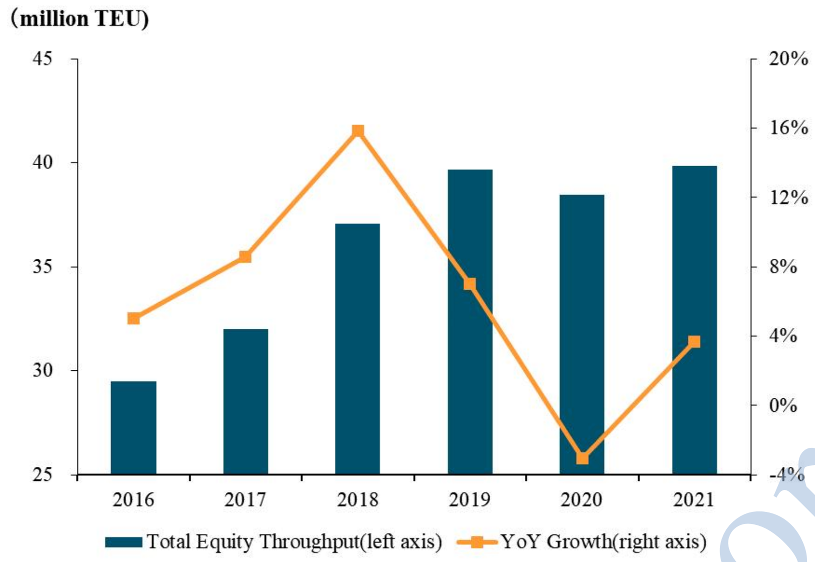



**Figure 4-2** Equity Throughput and Growth Rate of COSCO Shipping Port in 2016 -2021

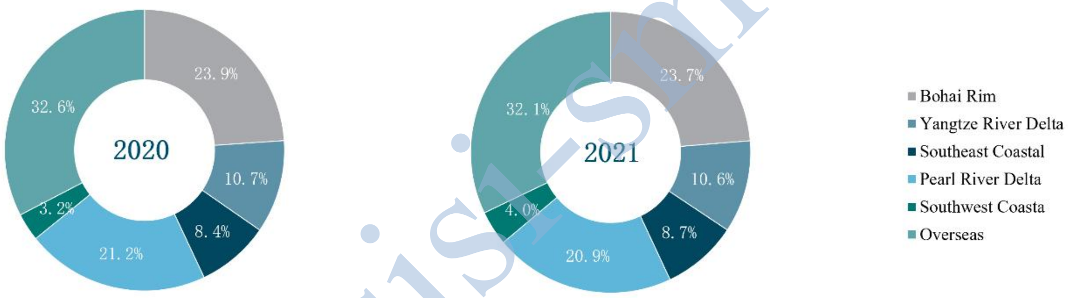



**Figure 4-3** Proportion of Equity Throughput of COSCO Shipping Port by Region in 2021 and 2020

In terms of profit, COSCO Shipping Ports continued to optimize its business plan in 2021, focusing on strengthening its partnership with shipping companies. Coupled with its effective control over costs, the company's revenue per container rose quickly, with its operating income rising by 20.7% year-on-year to $1.21 billion. Its terminal profitability also surged. Specifically, its net profit in 2021 increased by 38.1% year-on-year to $430 million, with the gross profit up by 39.8% year-on-year to $330 million.

## 4.2 China Merchants Port's business rises significantly

In 2021, China Merchants Port also seized the opportunity, with its terminal business continuing to improve. Its various production and financial indicators hit new highs, and the company's cumulative container throughput and equity throughput of the year increased by 12.0% and 9.4% year-on-year, respectively.

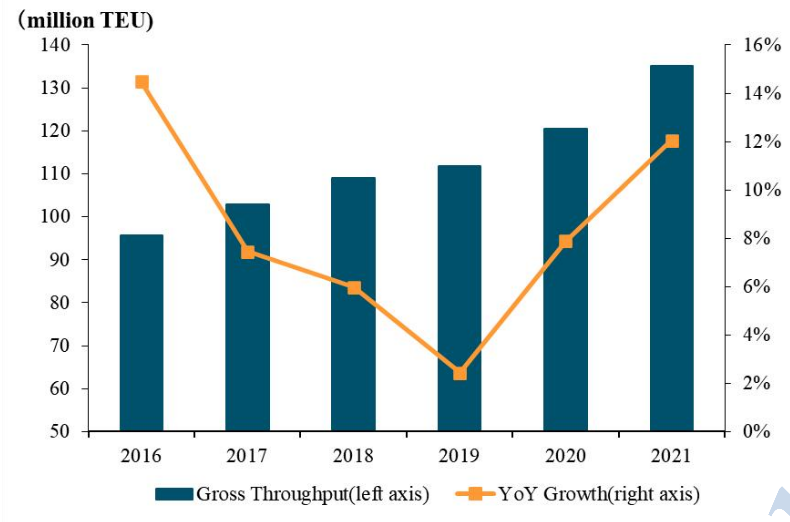



**Figure 4-4** Gross Throughput and Growth Rate of China Merchants Port in 2016 -2021

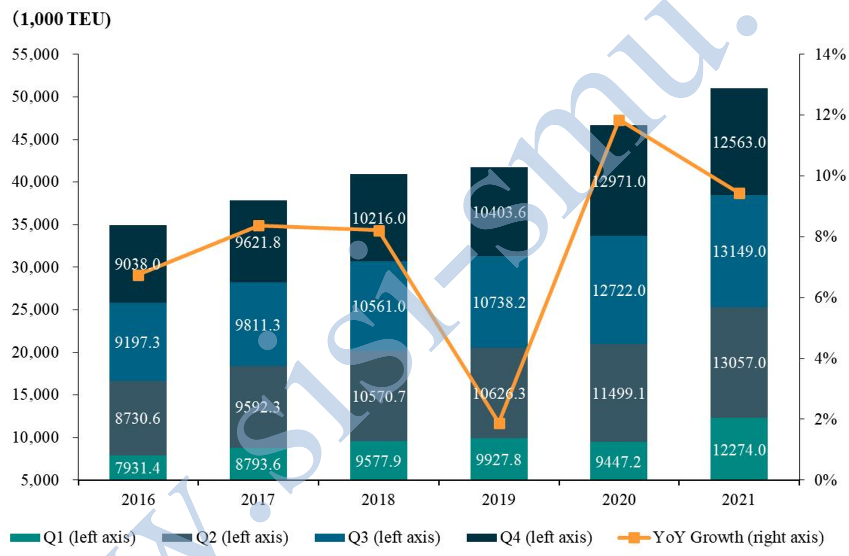



**Figure 4-5** Quarterly Equity Throughput of China Merchants Port in 2016 -2021

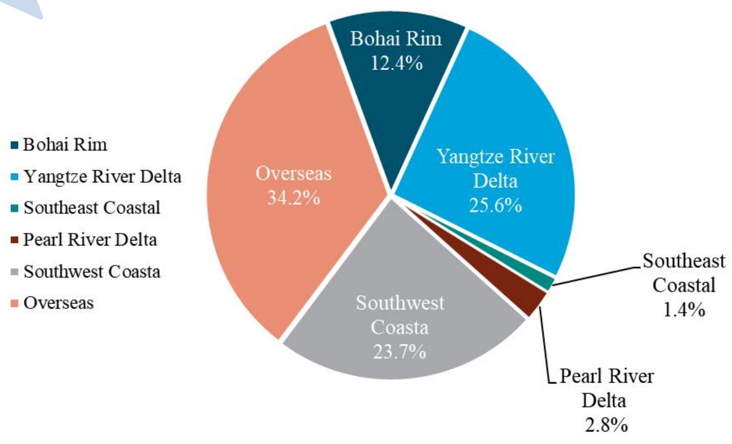
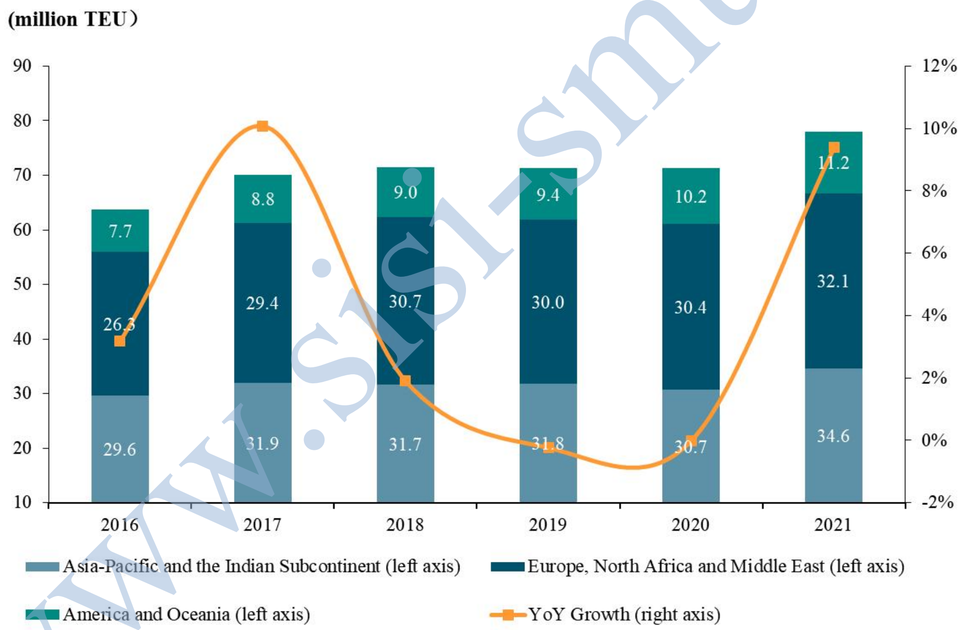



**Figure 4-6** Proportion of Equity Throughput of China Merchants Port Holdings by region in 2021

In terms of profitability, although the global pandemic was volatile in 2021 and the economic recovery in different regions tended to be differentiated, China Merchants Port, as a comprehensive port service provider with global presence, relied on its vast terminal network and achieved significant increases in operating revenue and profits. Specifically, its operating revenue stood at HK$11.85 billion, a year-on-year increase of 32.5%, and its profit attributable to equity holders was HK$8.14 billion, a year-on-year rise of 58.1%.

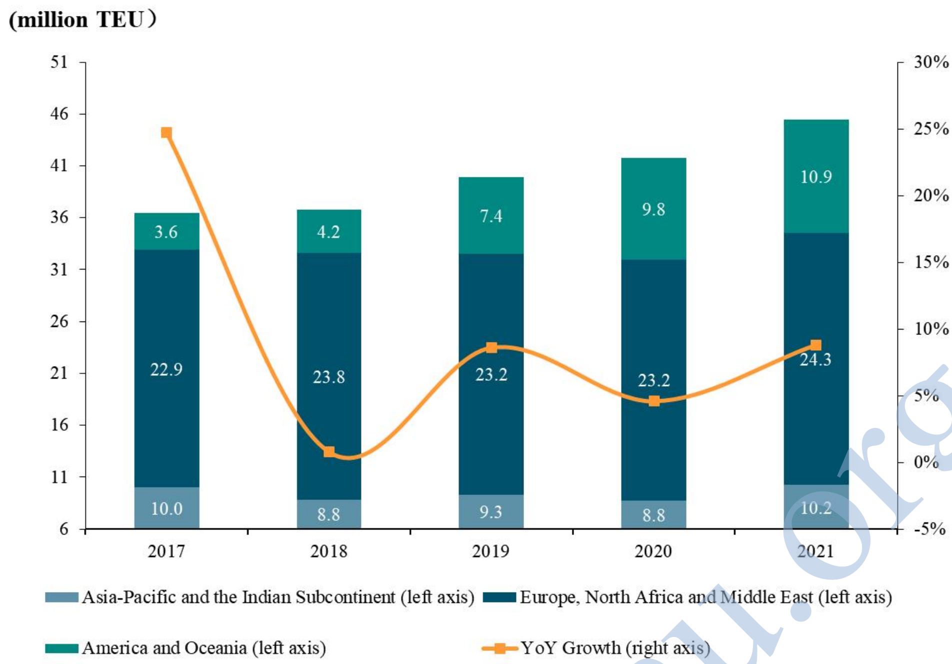
## 4.3 DP World's business continues to improve

DP World grasped the important opportunity of the global industrial chain and trade chain adjustments, and overcame the negative impacts from the pandemic and geopolitics among other factors, improving profitability by controlling costs and managing capital expenditures. Meanwhile, it accelerated the expansion of business scope and improved the existing terminal infrastructure, while vigorously developing digitalization to maintain strong competitiveness. In 2021, the group's business operations grew robustly and its Gross container throughput rose by 9.4% year-on-year.




Source: Website of DP world, sorted by SISI.

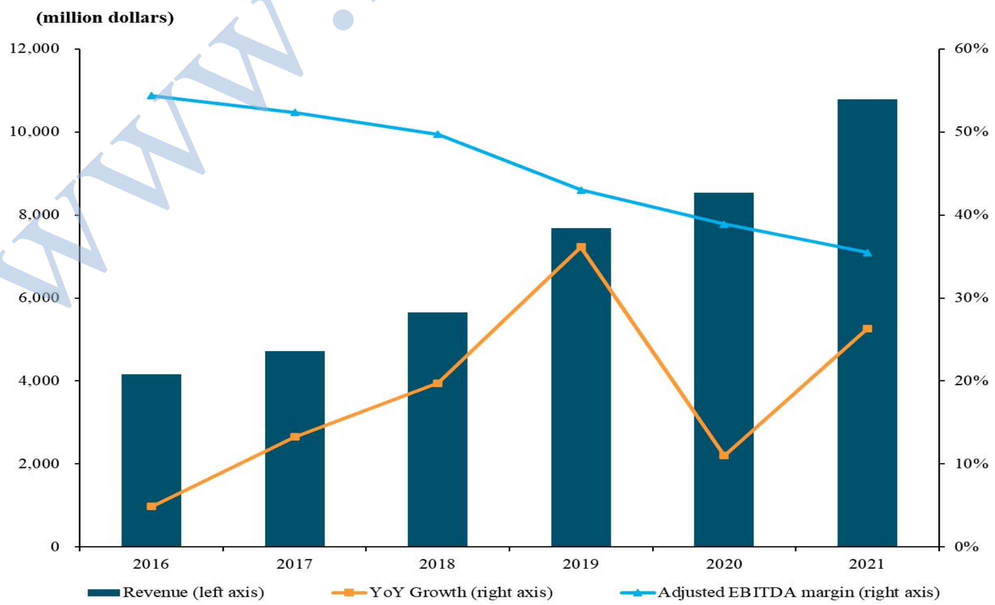
**Figure 4-7** Gross Throughput and Growth Rate of DP World by Region in 2016-2021




Source: Website of DP world, sorted by SISI.

**Figure 4-8** Container Equity Throughput and Growth Rate of DP World by Region in 2017-2021

In terms of profitability, DP World's operating revenue in 2021 increased by 26.3% year-on-year to \$10.78 billion, driven by its booming container business, as well as acquisitions in Angola and of Unico and Transworld and the new franchising project. The group's adjusted EBITDA was as high as \$3.83 billion, up by 8.2% year-on-year, while the adjusted EBITDA margin in 2021 fell by 3.4 percentage points to 35.5% due to the consolidation of the lower-margin logistics business.




Source: Website of DP world, sorted by SISI.

**Figure 4-9** Operation Performance of DP World in 2016-2021

## 4.4 APM Terminals achieves record high performance

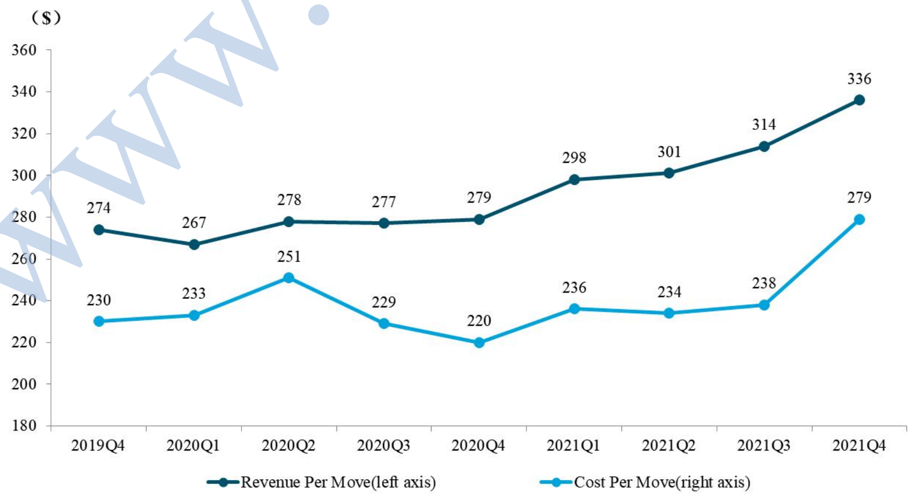
In 2021, APM Terminals' global container business achieved substantial growth. Except in Africa and the Middle East where the business volume decreased slightly, APM Terminals recorded positive business growth in all other regions, especially Asia, which recorded the best performance. Due to the merger of Port of Pipavav in India, the business growth in Mumbai, and the container volume dividend from the two new berths in Yokohama, Japan, the company's financially consolidated throughput in Asia soared by 25.6% year-on-year. In North America, the commodity consumption increased significantly after the pandemic, which led to a year-on-year rise of 16.7% in financially consolidated throughput in the region. In Africa and the Middle East, the pandemic didn't cease, and countries such as Aqaba, Jordan, Bahrain experienced significant economic downturn. The unfavorable market environment reduced the demand for container shipping. In addition, the strict blockade measures adopted due to the pandemic interrupted some maritime logistics services, and the regional financially consolidated throughput showed negative growth.

**Table 4-1** Financially Consolidated Volume of A.P. Moller-Maersk in 2020 and 2021

(Unit: million moves)

| Region | 2021 | 2020 | YoY Growth |
|---|---|---|---|
| North America | 3.2 | 2.8 | 16.7% |
| Latin America | 2.5 | 2.3 | 8.6% |
| Europe, Russia and Baltics | 2.6 | 2.4 | 8.0% |
| Asia | 2.5 | 2.0 | 25.6% |
| Africa and Middle East | 1.9 | 1.9 | -3.6% |
| Total | 12.8 | 11.5 | 11.3% |

Source: Website of A.P. Moller Terminal, sorted by SISI.



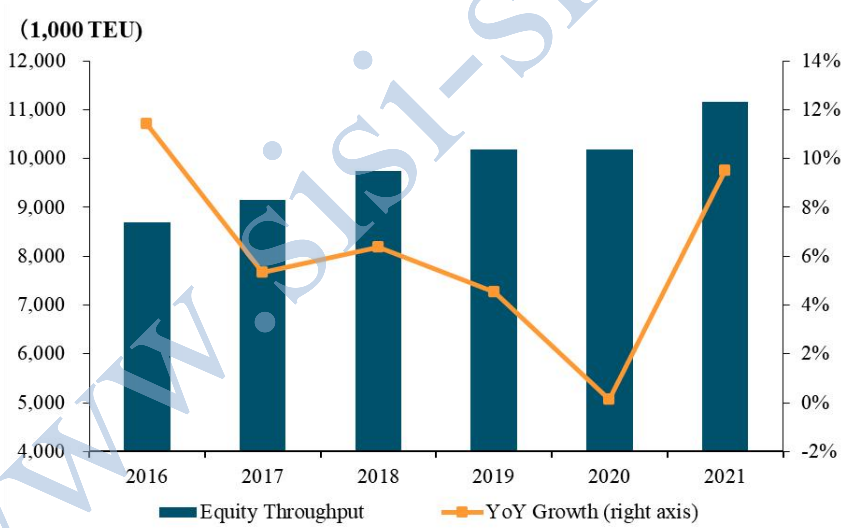

Source: Website of A. P. Moller Terminal, sorted by SISI.

**Figure 4-10** Revenue Per Move and Cost Per Move of A.P. Moller-Maersk in 2019.Q4-2021.Q4

In terms of profitability, APM Terminals benefited from the recovery of global trade activities, the growth of container business, and the large number of container demurrage charges caused by port congestion, and its terminal revenue went up significantly. Specifically, driven by the high import consumer demand in North America, the throughput in the region increased by 17%. Meanwhile, the serious port congestion pushed up the terminal storage costs, and the revenue increased rapidly. The situation in Europe was basically the same. In Africa and the Middle East, due to the weaker pandemic prevention and control, the market recovered slowly, and the container throughput decreased by 3.6%. However, the better location mix of Aqaba in Jordan and Port of Apapa in Nigeria and the lower container handling costs offset the impact of less business orders on the profits, and the overall profit of the sector rose by 3%.

## 4.5 ICTSI records strong growth

In 2021, benefiting from the recovery growth of global economy and trade, freight demand remained high, and some terminals signed new contracts with shipping companies. ICTSI's terminal business achieved strong growth. In 2021, the company completed a container throughput of 11.16 million TEUs, a year-on-year increase of 9.5%. Its port segment revenue surged by 24.0% year-on-year, with the profit margin rising to 61%.




Source: Website of ICTSI, sorted by SISI.

**Figure 4-11** Equity Throughput and Growth Rate of ICTSI in 2016-2021

**Table 4-2** Equity Throughput of ICTSI by Region in 2019- 2021

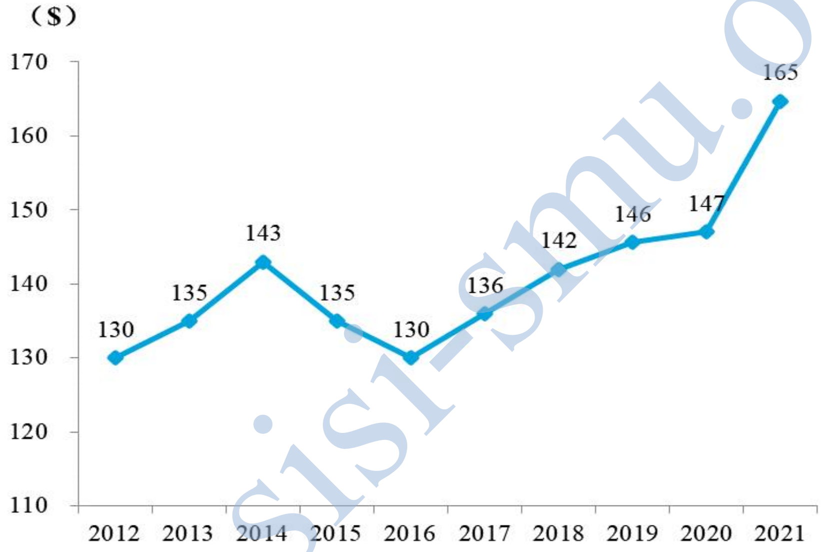
(Throughput: million TEUs; Revenue: million dollars)

| | 2019 | | 2020 | | 2021 | |
|---|---|---|---|---|---|---|
| | Throughput | Revenue | Throughput | Revenue | Throughput | Revenue |
| **Asia** | 4.85 | 696 | 4.70 | 695 | 5.13 | 837 |
| **Americas** | 2.98 | 423 | 3.09 | 449 | 3.38 | 603 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **EMEA** | 2.35 | 363 | 2.40 | 362 | 2.66 | 426 |
| **Total** | 10.18 | 1481 | 10.19 | 1506 | 11.16 | 1865 |

Source: Website of ICTSI, sorted by SISI.

In 2021, as the global economy and trade picked up from a low, the company's terminal container business enjoyed substantial growth. With the adjustment of tariffs on RMB and US dollars, and the integration of some new terminals and businesses, the business performance of ICTSI improved significantly. Its operating revenue in 2021 reached a record high of $1.87 billion, and the revenue per container reached a record high of $165 per container. The earnings before interest, tax, depreciation, and amortization (EBITDA) were $1.14 billion, a year-on-year increase of 30%.

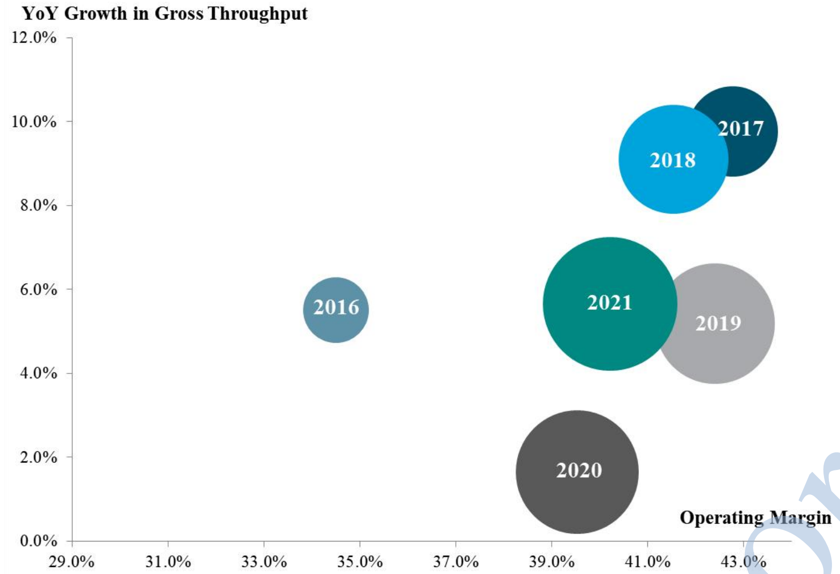



Source: Website of ICTSI, sorted by SISI.

**Figure 4-12** Revenue Per TEU of ICTSI in 2012-2021

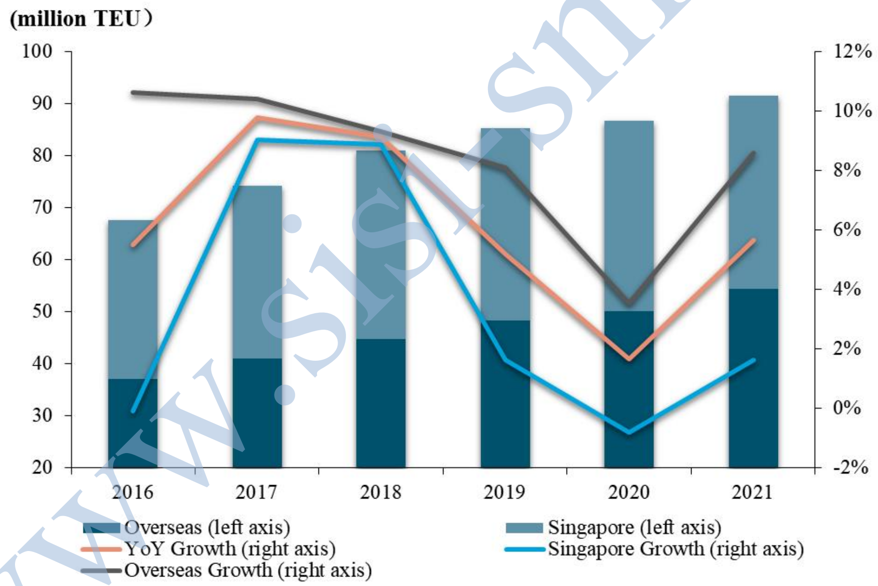
## 4.6 PSA International's business grows steadily

In 2021, against the background of large-scale disruption of the global supply chain, PSA International was committed to upgrading its terminal infrastructure, launching new systems and new processes for terminal operations, streamlining the operational model, and actively expanding port business to enable stable production and operations. PSA International recorded a total container throughput of 91.5 million TEUs in 2021, a year-on-year increase of 5.6%. Its operating revenue increased by 11.7%, with the operating profit margin hitting about 40.2%.




Source: Website of PSA, sorted by SISI.

**Figure 4-13** Gross Throughput Growth Rate and Operating Margin of PSA in 2016-2021

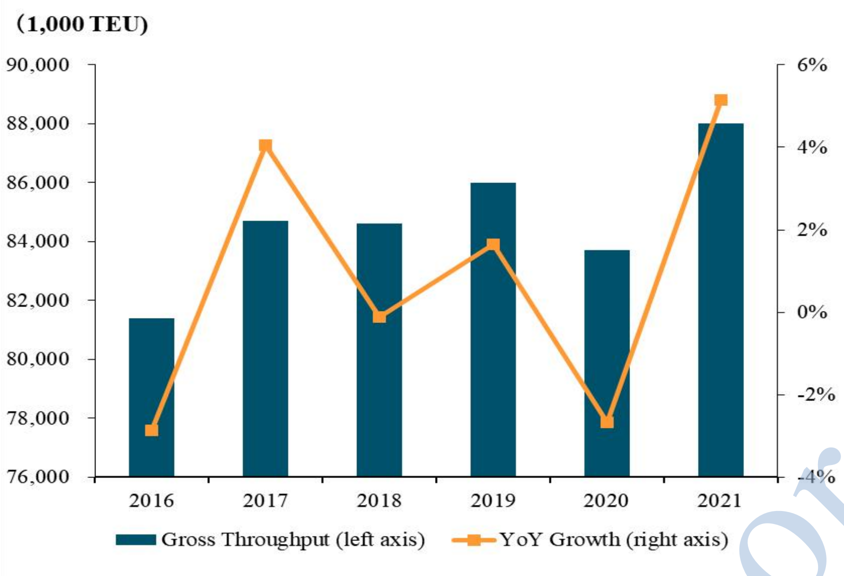



Source: Website of PSA, sorted by SISI.

**Figure 4-14** Gross Throughput and Growth Rate of PSA by Region in 2016-2021

## 4.7 Hutchison Ports business rebounds

In 2021, Hutchison Ports achieved sound growth in its trust business and the throughput of ports in Europe and Asia areas among others. Its overall business scale gradually recovered to the level before the pandemic. Its container throughput increased to 88 million TEUs from 83.7 million TEUs in 2020. In addition, Hutchison Ports started to vigorously expand its terminal business, showing its confidence in the port industry.




Source: Website of CK Hutchison Industrial Co. Ltd., sorted by SISI.

**Figure 4-15** Gross Throughput and Growth Rate of Hutchison Ports in 2016 -2021

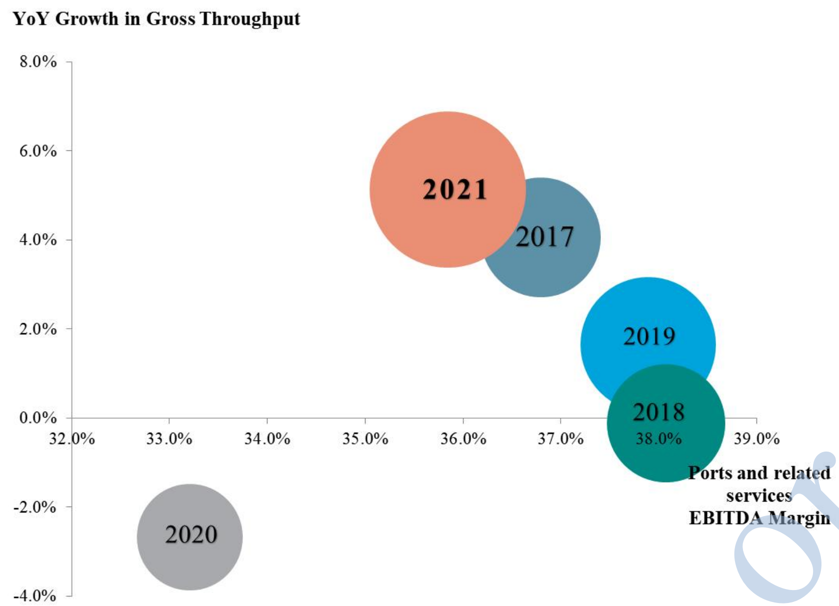
**Table 4-3** Gross Throughput and Growth Rate of Hutchison Ports by Region in 2020- 2021

(Unit: million TEUs)

| Region | 2021 | 2020 | YoY Growth |
|---|---|---|---|
| **HPH Trust** | 24.5 | 23.7 | 3.4% |
| **Mainland China and Other Hong Kong** | 13.9 | 13.5 | 3.0% |
| **Europe** | 16.9 | 15.2 | 11.2% |
| **Asia, Australia and Others** | 32.7 | 31.3 | 4.5% |
| **Total** | 88.0 | 83.7 | 5.1% |

Source: Website of CK Hutchison Industrial Co. Ltd., sorted by SISI.

In terms of profitability, the container business growth and the surging warehousing revenue in the United Kingdom, Rotterdam in the Netherlands, and Mexico boosted the company's revenue. Overall, Hutchison Ports' operating revenue in the port and related services sectors in 2021 increased by 28.7% year-on-year to HK$42.29 billion, and the EBITDA rose by 39% year-on-year to HK$15.16 billion.




Source: Website of CK Hutchison Industrial Co. Ltd., sorted by SISI.

**Figure 4-16** Gross Throughput Growth and Ports and Related Services EBITDA Margin of Hutchison Ports in 2017 -2021

# V. Overview of Terminal Investment and Construction 2021

Global port investment and construction resumed in 2021. On the one hand, due to the impact of the pandemic, a large number of port projects originally planned to start construction in 2020 but suspended due to manpower shortage were launched in 2021. On the other hand, the frequent port congestion and closures due to outbreaks aggravated the instability of the supply chain, compromising the ports' supply elasticity and further stimulating the demand for port construction. In addition, various countries have augmented their fiscal and taxation support for infrastructure construction under the pandemic, which has fostered ports' enthusiasm for construction. In terms of terminal construction types, the trade demand for anti-pandemic materials, office supplies, electronic products, medical supplies, and food among other commodities surged as outbreaks continued, and container ports had a far larger demand for expanding capacity than bulks ports. Meanwhile, with environmental protection policies promulgated, the trade demand of petrochemical energy declined in the market, while the liquefied natural gas imports increased significantly. This highlighted the insufficient capacity of LNG terminals, leading to a construction boom.


**Figure 5-1** Distribution of Major Terminals Construction in 2021

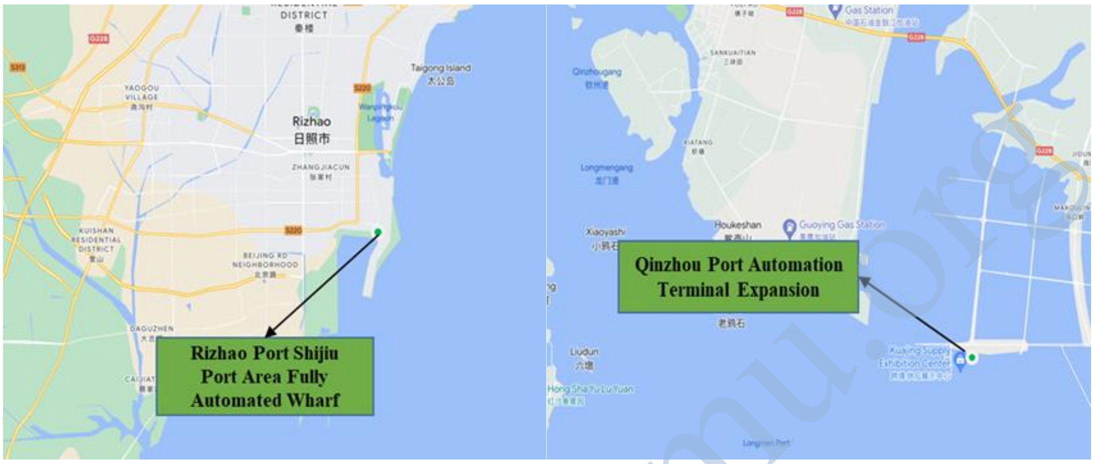


## 5.1 Investment and Construction of Container Terminals

### 5.1.1 Production capacities of Asian ports are released quickly

#### 1. China's ports comprehensively accelerated automation construction

China's terminal automation process is gradually spreading from large ports to small and medium-sized ones. In 2021, Rizhao Port adopted the "handling along shoreline + horizontal transportation by unmanned container trucks", completing the full automation transformation of traditional container terminals. Its mode marked a breakthrough of the vertical arrangement of handling operations mode of other fully automated container terminals and achieved "accurate to centimeters" operations through "Beidou + 5G" and the domestic terminal operating system. The Qinzhou Port of Beibu Gulf used a "U"-shaped layout to automate the berths and depots in the Dalanping port area. After the renovation, the annual throughput capacity of the port area increased by 1.02 million TEUs. In addition, the port's rear depot is adjacent to the railway center to facilitate seamless sea-railway intermodal transport.




Note: “ ”Under construction;“ ”Proposed construction;“ ”Completed.

**Figure 5-2** Location Map of China Rizhao Port and Beibu Gulf Port Automated Container Terminals

In addition to the automation renovation, ports such as Tianjin and Guangzhou have been approved to build automated container terminals. Specifically, the intelligent container terminal in Section C of Beijiang Port Area of Tianjin Port realized joint commissioning and testing of berths in January 2021, and built a 200,000-ton intelligent container terminal. Three 200,000-ton berths were arranged on the 1,100-meter shoreline. The terminal adopts the "horizontal arrangement of handling operations in the depot + centralized unlocking on the ground by a single trolley" process. With a designed capacity of 2.5 million TEUs/year, the terminal utilizes 3D laser ship scanning to achieve "sea-side automatic alignment" and "land-side one-click container drop" among other functions.

## 2. Southeast Asian ports ushered in a phased release of production capacity

Boosted by China-proposed Belt and Road Initiative and the Regional Comprehensive Economic Partnership (RCEP) trade agreement, Southeast Asia remained enthusiastic about port construction. Countries such as Malaysia and Singapore launched construction revolving around container transit hubs, while Vietnam and Thailand were committed to expanding container operations at port gateways to meet the expected rapid growth in trade volume. Specifically, the Tuas Mega Port, the world's largest container port under construction in Singapore, put into operation the first two berths completed in the first phase of the 21 berths at the end of 2021. On the one hand, this can relieve the congestion of ships arriving at the port caused by schedule delay, and on the other hand, it can further consolidate Singapore's status as a transit hub on the China-Europe route.

In contrast, the construction pace in Malaysia and Thailand was relatively slow. Malaysia planned to invest 750 million ringgit (about $180 million) to expand the production capacity of the Port of

Tanjung Pelepas, including building new berths to improve the handling capacity, and increasing 18 cranes in the expanded depots to increase the yard capacity to 12.5 million TEUs. In addition, Thailand has signed a $927 million contract with the Gulf Energy Development Public Company to develop the Phase 3 Terminal F of Port of Laem Chabang, which will open for operations in 2025. The terminal will increase the container processing capacity to 4 million TEUs to strengthen Thailand's export capabilities and trade advantages.


Note: " " Under construction; " " Proposed construction; " " Completed.

**Figure 5-3** Location Map of Port Construction in Southeast Asia

## 3. Port construction process in the Middle East and India continued to accelerate

During the pandemic, the import demand for medical supplies and daily necessities in the Middle East, India, and other countries surged. Ports such as India's Port of Mundra, Jawaharlal Nehru Port, Abu Dhabi Ports in the United Arab Emirates, and King Abdullah Port in Saudi Arabia all showed strong growth. The insufficient port capacity got increasingly prominent, and the port construction process was accelerated. In 2021, India's Mumbai Port Trust received a construction permit from the Maharashtra Coastal Zone Management Authority and planned to fill the basins of Princess Dock and Victoria Dock to build a container terminal and two marine berths that are connected via an overhead road, so that larger container ships can reach the Port of Mumbai directly to ease port congestion. Sri Lanka, on the other hand, further strengthened the construction of the Port of Colombo. It planned to invest $1 billion to expand the second phase of the East Container Terminal to handle large container ships and improve the cargo handling efficiency.


Note：“ ” Under construction; “ ” Proposed construction; “ ” Completed.

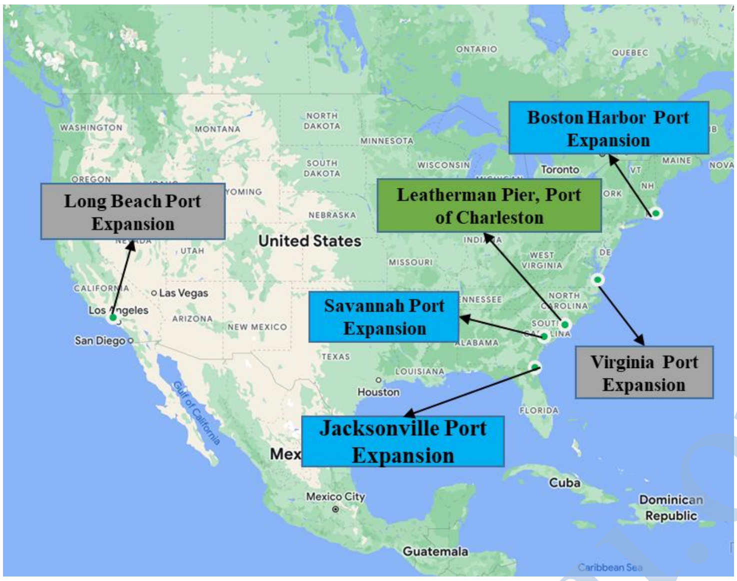
**Figure 5-4** Location Map of Port Construction in South Asia and West Asia

Compared with India in South Asia, the ports in the Middle East had stronger willingness for port construction. The Israeli government participated in the investment of 5 billion new shekels (about $1.54 billion) in Port of Haifa, with a coastline of more than 700 meters and a throughput capacity of 1.06 million TEUs/year. Currently, it is the only terminal in Israel that can accommodate large container of 400 meters, and will boost Israel's economic growth and trade development. The Abu Dhabi Ports in the United Arab Emirates and the terminal operator of CMA-CGM invested $154 million to jointly build a container terminal at the Port of Khalifa. The project was kick-started in 2021, with a designed throughput capacity of 1.8 million TEUs per year, aiming to serve the Ocean Alliance and the routes between Abu Dhabi and South Asia, West Asia, Europe, the Mediterranean, and the Middle East.

## 5.1.2 Port construction demand in the east of the United States surges

### 1. Construction projects on the east and west coasts of the United States proceeded concurrently

In 2021, poor logistics and port congestion in the United States became a global focus due to the surging trade in goods under the pandemic. The U.S. government made an emergency allocation of $17 billion in November to improve infrastructure such as coastal ports and inland ports and waterways, with a view to easing port congestion as soon as possible. The Port of Jacksonville spent $104 million to expand container berths again, increasing the shoreline by 213 meters to enhance the terminal capacity. The Massachusetts Port Authority invested $850 million to build the Port of Boston and purchased new Neo-Panamax cranes to enhance the port's operating capacity. The Port of Virginia, which is also located in the east, also planned to expand the railway depot at the Norfolk Terminal and optimize the cargo collection, distribution, and transportation facilities to handle cargoes at the port quickly. Due to the continued congestion, the Port of Long Beach in the United States received about $53.2 million from the United States Maritime Administration of the United States Department of Transportation to strengthen the upgrading and transformation of railway facilities at the terminal, so as to improve the cargo collection, distribution, and transportation efficiency at the port and reduce the impact from saturation of rear depots on port production efficiency.

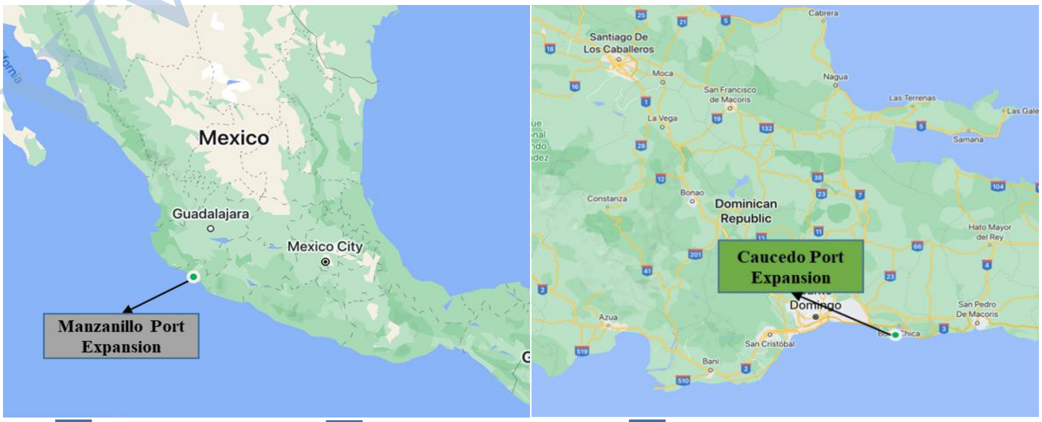



Note: " " Under construction; " " Proposed construction; " " Completed.

**Figure 5-5** Location Map of Port Construction in the United States

## 2. Port construction pace in other countries on the Americas slowed down

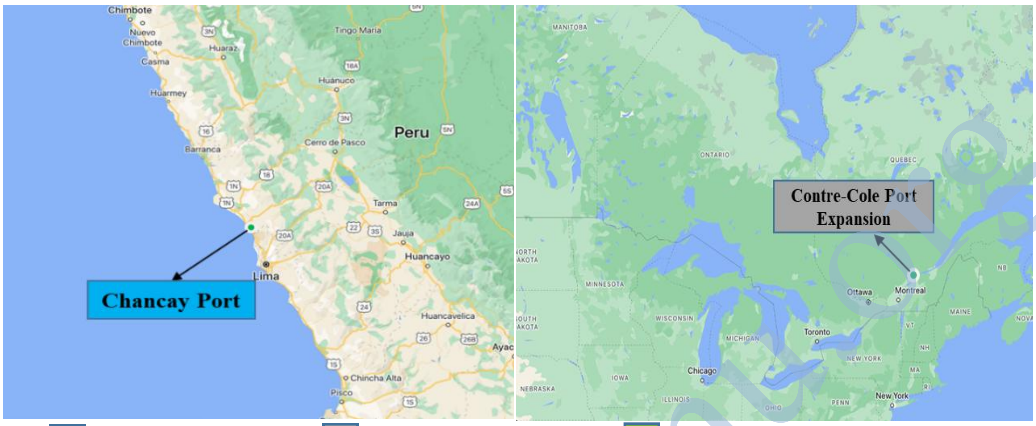
Apart from the United States, which speeded up port facility construction in the face of port congestion, other countries on the Americas were still cautious in port facility construction, and most of their funds were allocated to pandemic prevention and control, industrial production resumption, and living needs for residents. Their enthusiasm for infrastructure construction such as ports was not high, and such construction projects were mostly led by global terminal operators. Specifically, ICTSI invested $230 million in the expansion and operations of the second container terminal at the Port of Manzanillo, Mexico, increasing the terminal capacity from 1.4 million TEUs to 1.7 million TEUs. DP World focused on investment and construction of the Port of Caucedo, the Dominican Republic. It expanded berth to accommodate ships of more than 13,000 TEUs and further increased the port's capacity to 2.5 million TEUs.




Note: " " Under construction; " " Proposed construction; " " Completed.

**Figure 5-6** Location Map of Port Construction in Mexico and Dominica

COSCO Shipping Ports and Volcan Compañía Minera S.A.A. signed a port investment agreement of $3 billion, including the acquisition of a 60% stake in Peru's Chancay Port Terminal for $225 million, and a plan to build Chancay Port into Peru's largest port. In addition, Canada focused on the container terminal construction at the Port of Contrecoeur, promoting international procurement and trade growth through port expansion and providing services to Quebec, Ontario, and the Midwest of the United States. After the expansion, the annual processing capacity of the terminal is expected to reach 1.15 million TEUs.



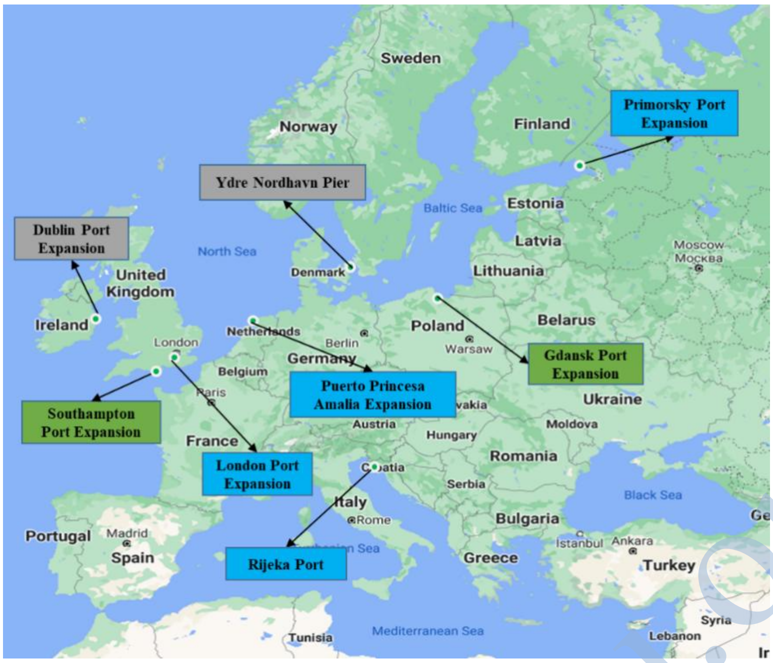

Note: " " Under construction; " " Proposed construction; " " Completed.

**Figure 5-7** Location Map of Port Construction in Peru and Canada

## 5.1.3 Europe strengthens construction of branch line ports

### 1. Europe witnessed enthusiasm for construction of branch line ports

The COVID-19 pandemic and economic downturn dealt a heavy blow to European countries. In order to promote economic and trade growth in the EU region, European ports shifted their investment focus from hub ports to small and medium-sized branch line ports in the region. APM Terminals won a 50-year concession to build and operate a new container terminal at the Port of Rijeka, Croatia, which is expected to have an annual handling capacity of 1.05 million TEUs upon completion. The Port of Malmö in Copenhagen will also build a new container terminal with a shoreline of 550 meters in length, aiming to reduce the time and cost for transporting cargoes to the Danish capital region. The Port of Gdańsk, Poland, also invested $1.6 billion in the modernization of the outer port road, railway network, waterway widening, and terminal facilities. The Port of Rotterdam Authority also invested in the further expansion of the Princess Amalia Harbour, which is expected to increase the annual throughput of the Port of Rotterdam by 4 million TEUs.



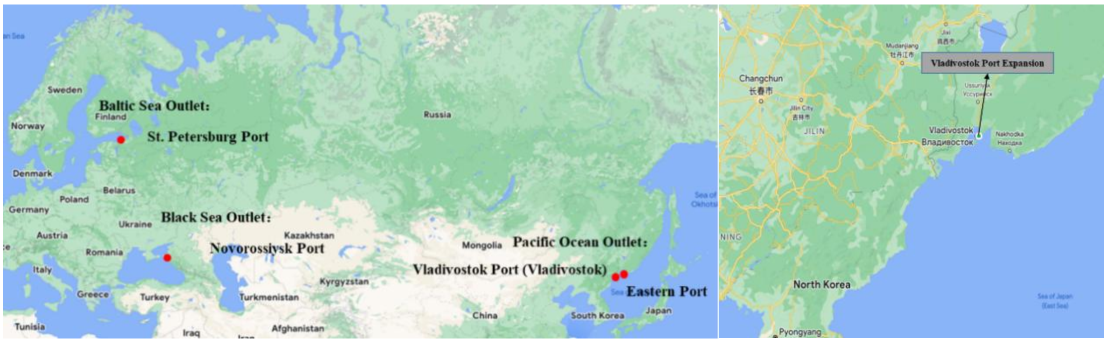

Note: " " Under construction; " " Proposed construction; " " Completed.

**Figure 5-8** Location Map of Port Construction in Europe

In addition, the UK has always been actively promoting the construction of port facilities and exploring ways to boost economic and trade through large-scale infrastructure construction. In 2021, the United Kingdom invited DP World to invest $415 million in new berths at the Port of London and expanded an 11.5-acre empty container storage park at the Port of Southampton. In order to meet the import and export trade needs of Ireland, the Port of Dublin is also actively formulating a container terminal expansion plan to increase the container handling capacity by 612,000 TEUs.

## 2. Russia consolidated the export gate to the Pacific Ocean

The Port of Vladivostok acts as the gateway to the Pacific Ocean and is of great significance to Russia. In 2022, the Russian-Ukrainian conflict forced the Sea Port of St. Petersburg, the transit port serving Nordic ports such as Rotterdam, Hamburg, and Gdańsk, to close. Before the conflict broke out, Russia had already started to strengthen the construction and development of the Port of Vladivostok. In September 2021, DP World and Fesco, the largest multimodal transport operator in Russia, jointly studied the feasibility of developing container berths at the Port of Vladivostok and planned to open an Arctic route on that basis to transport cargoes from East Asian countries by ship and rail to the Port of Vladivostok where the cargoes will be loaded on Arctic-class container ships to the Port of Murmansk in northwestern Russia and then to ports in northwestern Europe. In addition, Russia's federal agency FSUE and Primorsky UPK signed an agreement to build a deep-water general-purpose port in Vyborg in the Leningrad region. The port will be capable of handling 150,000-ton breakbulk, ro-ro, and container ships, handling about 65 million tons of cargoes annually.

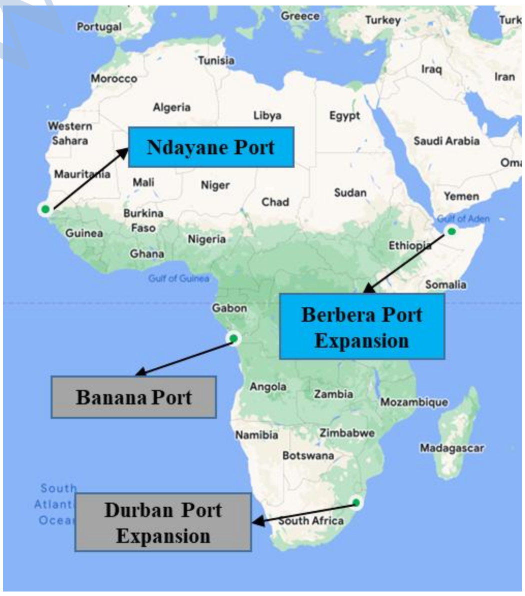



Note: “ ” Proposed construction.

**Figure 5-9** Distribution of Major Ports in Russia's Estuaries

## 5.1.4 Africa accelerates port construction in underdeveloped areas

Africa has been regarded in recent years as one of the most potential regions for economic and trade development in the world. A large amount of international capital has entered the African market to promote the construction of ports and other infrastructure, and port investment has also begun to gradually shift to small and medium-sized ports with more potential in the surrounding area. In 2021, DP World invested $1.1 billion in the construction of the Ndaya Inner Port in the Senegal region. Meanwhile, Congo also actively promoted the construction of Port of Banana, which aims to attract large container ships from Europe and Asia, with an annual handling capacity of 450,000 TEUs. In addition, the Somali region of Africa strengthened the construction of the Port of Berbera. After the expansion project, the operating capacity of the port will be increased by 500,000 TEUs per year. South Africa will spend $7 billion on the expansion and modernization of the Port of Durban to create additional container capacity. Upon the expansion completion, the port's container handling capacity will increase to 11 million TEUs and become a hub connecting southern Africa and the entire African continent.




Note: “ ” Under construction; “ ” Proposed construction.

**Figure 5-10** Location Map of Port Construction in Africa

## 5.2 Investment and Construction of Bulks Terminals

Boosted by the fiscal and taxation stimulus policies in various countries, the infrastructure construction scale increased significantly from 2020 to 2021, which temporarily pushed up the demand for international dry bulks transportation. However, in the medium and long term, the bulks trade will follow a decline trend. Therefore, the enthusiasm for building bulks terminals in various countries was not high, and only the Asian region continued to steadily advance the construction of bulks terminals.

### 5.2.1 Bulks terminal construction in southern China moves slowly

After several rounds of construction and years of development, China's port facilities have reached a moderately advanced state. In particular, its bulks terminals started early, and many large 400,000-ton bulks terminals have been built. Therefore, the high-speed construction period of China's bulks terminals is over. China took the lead to recover economic and industrial activities thanks to its proper control of the pandemic. Its export demand for industrial products surged, driving up the demand for bulks trade such as coal and ore. Moreover, its policies encouraged the construction of waterborne shipping infrastructure, and China's bulks terminal construction progressed continuously. However, the features of construction have shifted from the comprehensive rollout to a more targeted manner for the purpose of addressing local capacity shortages. In the future, the construction of China's bulks and general cargo terminals will be significantly reduced.

### 5.2.2 West Asia will become a main area for bulks terminal construction

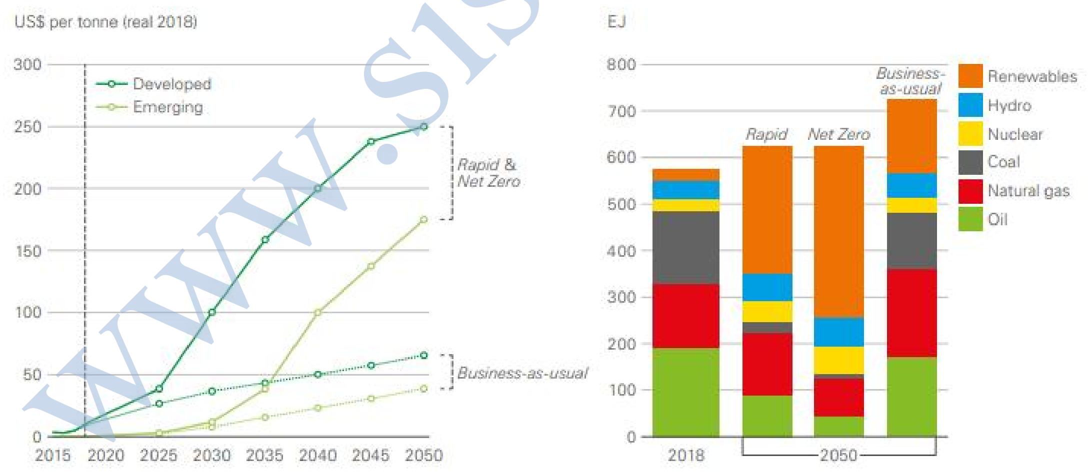
Compared with China, which has a relatively high level of infrastructure construction, and Africa, where economic development is relatively lagging behind, other Asian regions such as India and Pakistan have more potential for development and may become the main regions for bulks trade and terminal construction in the future. In 2021, India invested 23.9 billion rupees (about $315 million) to build a new 250,000-ton deep-water dry bulks terminal at Port of Paradip on the east coast. Meanwhile, it also built new bulks terminals in the Kalamboli area of Mumbai to serve the local stone market. Pakistan, on the other hand, planned to invest $70 million in the construction of an international bulk cargo terminal to increase its coal handling capacity to 170,000 tons per year.

## Topic 3: Global New Energy Port Construction Trends

With the increasingly grim environmental requirements in the world, the lift of IMO's "carbon emissions" requirements for shipping, and the stricter environmental protection policies promulgated in various countries, the global energy structure shows an increasingly evident trend of transformation, and traditional fossil energy sources are gradually turning to new energy and renewable energy. During the transition, alternative energy sources such as liquefied natural gas, hydrogen, ammonia, and methanol in the international shipping market are gradually attracting market attention. Although IMO's policies have accelerated the application of "low-sulfur" fuels and LNG and other energy sources among global ships, the two types of fuels still release a large amount of carbon dioxide emissions and cause environmental pollution. Therefore, the research and development of clean energy have been accelerated. As global new energy ships gradually enter operations, many ports are also vigorously building corresponding terminals and bunkering facilities.

## 1. The capacity demand of fossil energy terminals will be reduced but not completely replaced

Port is an extension of trade and port construction should also change according to the changes in energy trade structure and ship fuel demand. First, the green and low-carbon concept in the energy trade field has become a global consensus, and the environmental protection policies of various countries have been strengthened based on the established goals. New energy applications that are different from traditional petrochemical energy such as coal and crude oil are inevitable. However, in terms of the global energy consumption scale, it is not realistic to completely eliminate coal and petroleum energy, at least not so before 2050. It is also difficult to fully shift to new alternative energy all at once. As per various research on the energy industry, it is expected that liquefied natural gas will serve as an important "substitute" for coal and oil production reduction before 2035, but natural gas is not a "zero-carbon" clean energy, so the final share of natural gas in the energy system will be partially taken by renewable energy as the latter's technology gradually matures (renewable energy mainly includes wind, solar energy, geothermal energy, and bioenergy).




Source: World Energy Outlook (2020), British Petroleum.

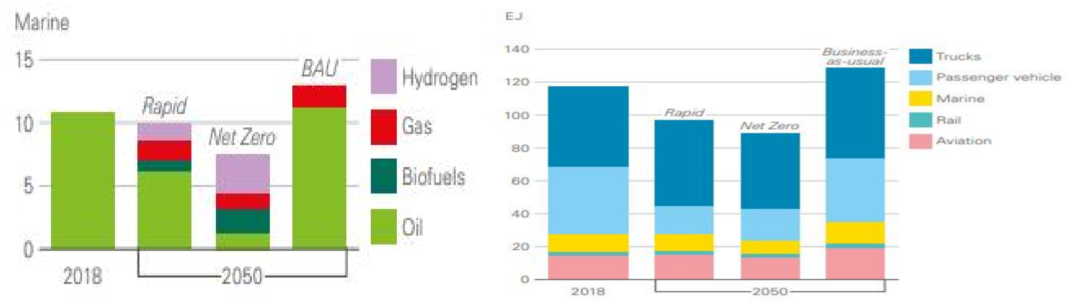
**Figure 1** Primary Energy Proportion and Consumption Trend under The Transition of Low-carbon Energy System

According to the forecast in Energy Outlook of British Petroleum, an internationally renowned oil company, the energy consumption is expected to increase by about 10% by 2050, and renewable energy will account for more than 40% in the medium- and long-term energy structure. The demand for natural gas will peak in 2035 and it will maintain a share of around 20%. The share of coal energy will drop sharply from the current 25% to 5% and of oil from 32% to 17%. The share of other non-petrochemical energy sources, including hydropower and nuclear energy, will increase from 10% to 18%. However, some other analysts believe that if it is difficult to break through the economic or technical bottlenecks in the large-scale use of renewable energy, the development and utilization of nuclear energy will increase significantly in the future, and it will mainly rely on China and other countries with nuclear energy research and development conditions. No matter what the situation is, the general trend is relatively certain that the demand for oil and coal energy will drop significantly and the demand for liquefied natural gas will remain in a stable range after a narrow increase.

Meanwhile, the three energy sources of coal, oil, and natural gas cannot be completely weeded out in global energy consumption. The reason is that, on the one hand, the huge consumption scale of global energy cannot be fully satisfied by renewable energy alone, and on the other hand, because of the difference in energy production and consumer distribution, renewable energy such as solar energy and wind energy must be converted to electricity and stored in batteries for transportation instead of being transported directly. This introduces a high cost for electricity storage and transportation, making the transfer far less cost-effective than using natural gas and petrochemical energy. In view of this, the demand for coal and crude oil handling terminals will fall greatly. Specifically, the capacity demand for coal terminals will drop by at least 50% and for oil terminals by at least 30% (excluding the newly built terminals in some areas to address port capacity insufficiency). In addition, the capacity demand for LNG terminals is still on the rise and is expected to increase by at least 25%. However, it is projected that after the demand for natural gas shipping peaks in 2035, the terminal capacity demand will gradually fall back to the current level. (Based on the general use period of LNG ships, the construction momentum of LNG carriers can be maintained for another 5-10 years).

## 2. Energy terminals are still required in future ship fuel supply system to support fuel supply services

In addition to predicting the development trend of energy handling ports through the changes in the global energy structure, the prediction can also be done through the transformation status of marine fuel oil, because the corresponding energy terminals are needed in the fuel supply system of major bunkering ports to supply fuel to bunker ships. According to the requirements of the International Maritime Organization (IMO), low-sulfur fuel oil and liquefied natural gas for ships will become the main options in the short and medium term. However, although their pollution emissions are slightly lower than those of traditional petrochemical energy sources, they are not real clean energy and still cannot meet the requirements of the International Maritime Organization for carbon emissions by 2050 (a 70% reduction in carbon intensity and a 50% cut in total $CO_2$ emissions). Therefore, A.P. Moller-Maersk, CMA-CGM, COSCO Shipping, and other international liner companies have carried out research and practice on the use of methanol, hydrogen, ammonia, and other clean energy in ships, hoping to achieve "carbon reduction" and "zero-carbon" goals from the source.




Source: World Energy Outlook (2020), British Petroleum.

**Figure 2** The Total Energy Demand in Transport Industry and Maritime Industry

According to the forecast of energy consumption structure for seaborne ships, although the share of renewable energy in the social energy consumption structure will increase significantly in the future, ships, as long-distance transportation method, cannot connect to the power grid and require much single-time energy supply. Therefore, it is impossible for ships to rely heavily on renewable energy such as solar energy and wind energy, nor can they use a pure electric energy supply system (which is also disadvantageous due to a longer charging time and the absence of a super-large-capacity battery panel). Therefore, it is predicted that in the energy system of seaborne ships in 2050, oil products may continue to maintain a big share at about 60% and the remaining 40% will be evenly divided among natural gas, biofuels (biodiesel and bioethanol, of which biodiesel is obtained by esterification of vegetable oil with methanol), and hydrogen energy.

## 3. Construction of energy terminals for LNG bunkering services will become mainstream in the short and medium term

As a marine fuel, LNG is receiving wide application in the global shipping industry for its no sulfide particle emissions and low carbon dioxide emissions. The global shipbuilding industry started to use LNG as ship fuel in 2010. According to DNV-GL statistics, the actual number of LNG-powered ships in operation by the end of 2021 was 251, but the number of construction orders was as high as 403, and the new orders in 2021 alone were 240, showing the huge growth of LNG-powered ships. Although the global LNG price has been rising in recent years, undermining its economical efficiency as a ship fuel, it cannot be replaced by other renewable energy sources for a long time in terms of technology, safety, and output. With the increase in the number of LNG-powered ships being built, the LNG technology has become more mature, and its application scale as a marine fuel will continue to grow.

According to the forecast of S&P Global Platts, LNG will lead the green transformation of the shipping industry in the next 10 years, and the share of LNG consumption will increase from 4.6% in 2021 to 10.7% in 2030. By then, the number of LNG-powered ships may rise to more than 4,000, so LNG bunkering services will become an important part of new energy port construction in the future. In contrast, there are currently only a few ports in the world that can provide LNG bunkering services, and the bunkering facilities and operating specifications are not perfect enough. The ports that can provide LNG bunkering services are largely located in North America, Europe, with a small number of LNG bunkering facilities in China and Southeast Asia. Therefore, the construction of LNG bunkering facilities should be stepped up to meet the large-scale construction trend of LNG-powered ships.

**Table 1** Summary of Global Ports That Can Provide LNG Bunkering Services in 2020-2021

| Area | Nation | Port | LNG Terminal Services |
|---|---|---|---|
| Europe | Germany | Bremen Port | The ship-to-ship LNG bunkering operation was carried out for the cruise ship Iona, marking a milestone in the opening of ship-to-ship LNG bunkering in Bremen Port. |
| | | Brunsbuttel Port | German LNG bunkering network developer LIQIND has completed the bunkering procedure of its first ocean-going vessel. |
| | Spain | Los Barrios Port | Utility company Endesa plans to invest around 30 million euros to develop LNG bunkering facilities and renovate terminals to supply LNG to ships. |
| | | Bilbao Port | Oil and gas company Repsol builds an LNG bunkering terminal to supply ships from Brittany Ferries. |
| | | Gibraltar Port | Shell has secured an LNG bunkering licence from the Spanish government, allowing it to develop a range of LNG bunkering services. |
| | Netherlands | Rotterdam Port | CMA CGM's LNG-powered vessel CMA Jacques Saade completes the largest ever LNG bunkering operation. |
| | Belgium | Antwerp Port | LNG solutions company KCLNG and cryogenic equipment supplier Cryostar have signed a contract to build an LNG-powered ship and truck bunkering facility in the Belgian port of Antwerp. |
| | Copenhagen | Malmo Port | Nordic energy company Gasum has completed the first ship-to-ship LNG bunkering operation. |
| | Finland | Helsinki Port | Eesti Gaas provides truck-to-ship LNG bunkering operations for bulk carriers Viikki and Haaga. |
| | Poland | Szczecin Port | The LNG bunkering station was put into use, which promoted the development of LNG fuel for ships in the Baltic Sea. |
| | Lithuania | Klaipeda Port | The first LNG bunkering operation was carried out. |
| | French | Marseille Port | CMA CGM and gas company Total Energies have launched the first ship-to-container LNG bunkering operation. |
| Asia | China | Shanghai Port | Shanghai International Port Group and CMA CGM signed an LNG bunkering service agreement, and will provide LNG bunkering services for CMA CGM's 15,000 TEU dual-fuel vessel at Yangshan Port. |
| | | Shenzhen Port | The signing ceremony of the Shenzhen Offshore International LMH bunkering center construction project was held in Yantian, Shenzhen, marking the official settlement of the first offshore international LNG bunkering center in China. |
| | Singapore | Singapore Port | Ship-to-ship bunkering of CMA CGM's ocean-going container ships, the first ship-to-ship LNG bunkering of container ships, and the third LNG bunkering license granted to Total Marine Fules. |
| | Japan | Yokohama Port | NYK Line, NYK Cruises, Ecobunker Shipping and the City of Yokohama have signed a memorandum of understanding to carry out LNG bunkering operations. |
| America | the United States | Galveston Port | The U.S. small-scale energy transition services provider Stabilis Solutions and Galveston Wharves have signed a memorandum of understanding to promote the use of LNG as a marine fuel. |
| | | New Orleans Port | Signed a memorandum of understanding with CLEANCOR Energy Solutions, a subsidiary of SEACOR Holdings, to jointly develop solutions for LNG bunkering for ship operators. |
| | | Corpus Christi Port | Signed a memorandum of understanding with Stabilis Solutions, a small-scale LNG and hydrogen supplier, to promote the use of LNG as a marine fuel. |
| | | Jacksonville | The first ship-to-ship LNG bunkering of a foreign-flagged vessel |

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|---|---|---|---|
| | | Port | was completed. |
| | | Canaveral Port | LNG bunkering barge Q-LNG4000 arrives at Port Canaveral, Florida, making it the first LNG cruise port in the Americas. |
| | | Virginia Port | Joining the SEA/LNG Alliance to scale up LNG bunkering marks the growing viability and environmental sustainability advantages of LNG as a US domestic and international shipping carrier. |
| Oceania | Australia | Hamilton Port | A collaboration between New Zealand's Hamilton-Oshawa Port Authority and REVLNG enables ships to be bunkered with LNG during any layover. |

Source: collated by Shanghai International Shipping Institute.

## 4. Medium- and long-term hydrogen energy refueling services have huge potential

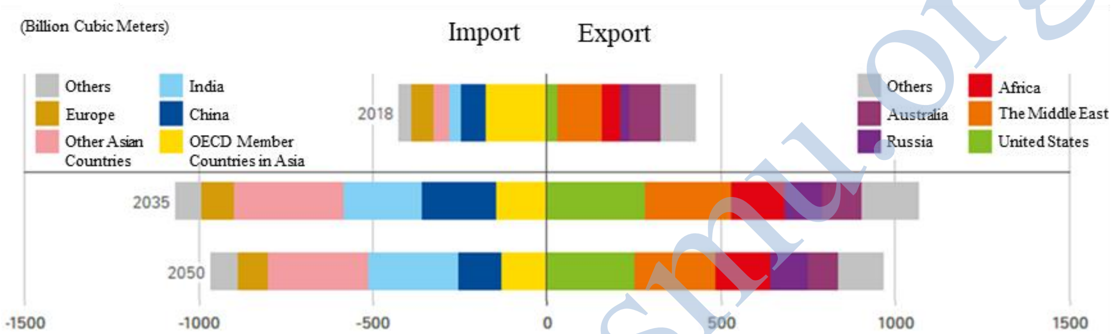
Hydrogen, as a fuel for ships, has a high combustion calorific value and low storage density, which is good for storage and efficient utilization of ship fuel. As a result, hydrogen is attracting more and more attention. However, only a few shipping companies, including A.P. Moller-Maersk, NYK Lines, DFDS, and Klaveness, have announced the possibility of using hydrogen as a fuel, while engine makers such as MAN and Wärtsilä are developing hydrogen-powered engines. However, compared with other alternative energy sources, hydrogen has huge potential for medium- and long-term hydrogen energy refueling services. First, its production conditions are already available, and the shipping industry can use hydrogen as fuel. Second, many places in the world have begun to build hydrogen energy plants, and countries such as Norway, China, Japan, Singapore, and Denmark have already started to construct hydrogen production and storage facilities in industrial areas near ports. Finally, unlike biofuels and methanol fuels, hydrogen contains no carbon and is less expensive to produce than other $CO_2$ fuels.

## 5. Bioenergy will serve as an effective supplement

Bioenergy (methanol) is used as fuel for ships and is widely favored by ships for short-distance shipping because of its good economical efficiency and environmental friendliness. However, the number of ships that use methanol as fuel in the world is very small, largely because the research/development and application technologies of methanol-powered ships still need breakthroughs, and the construction technology of methanol engines needs further study. There are currently only six ships in the world that use methanol as fuel, and most of them use methanol in conjunction with other fuels instead of using methanol alone. At the end of 2021, European shipbuilding companies will jointly construct the world's first methanol-powered tugboat, which is expected to be completed in 2023. It will also be the world's first methanol-powered ship in the true sense. Compared with conventional fuels, methanol can reduce carbon emissions by up to 15% and sulfur oxide emissions by about 99% during the combustion process. Because of its less environmental pollution, methanol is expected to become one of the clean fuels for ships in the future. Ports in some countries have begun to refuel ships with methanol. In May 2021, the Port of Rotterdam provided methanol refueling services for the dual-fuel carrier "Takaroa Sun" of Japan NYK Bulkship (Asia) Pte. Ltd. through barges. The Port of Antwerp in Belgium will launch a project on the sustainable production of methanol and may introduce a methanol-powered tugboat in the near future.

## 5.3 Investment and Construction of New Energy Terminals

Although natural gas is expected to become a short- and medium-term "substitute" for the reduction of fossil energy consumption before 2035, and be gradually replaced by renewable energy and nuclear energy (wind, solar, geothermal and biomass energy) after 2035, the energy demand is also expanding with economic development. According to the forecast of British Petroleum (BP), the global natural gas consumption demand will increase from the current 3.8 trillion cubic meters to 4.6 trillion cubic meters in 2035, and then fall back to 4 trillion cubic meters around 2050. Coupled with the uneven distribution of global LNG resources, there will still be a large demand for seaborne trade, so the global LNG terminals may experience a period of construction and expansion before 2030.

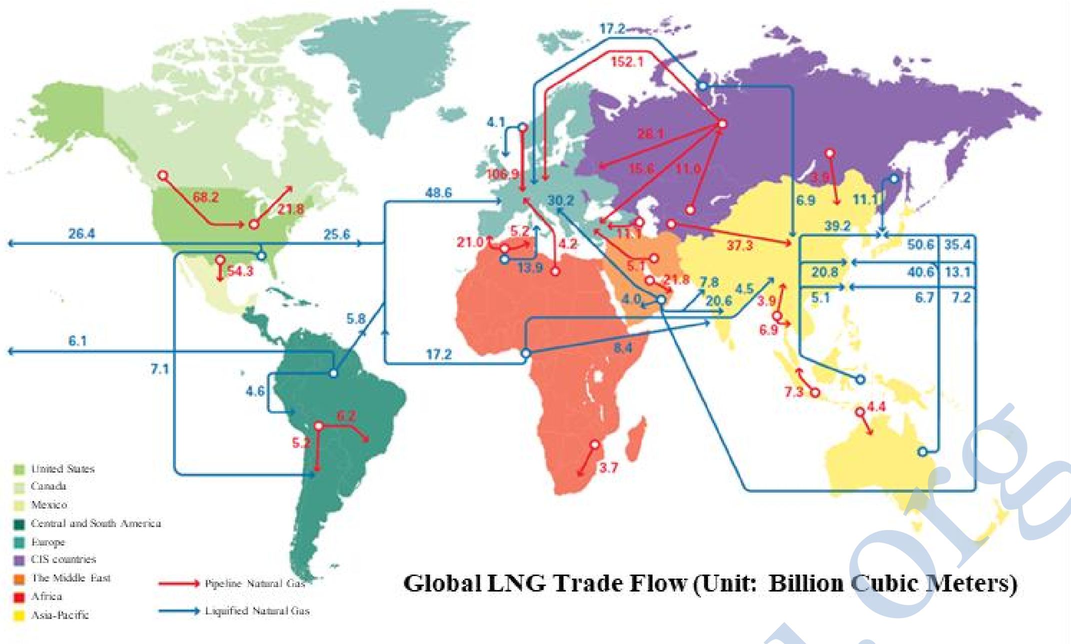



Source: World Energy Outlook (2020), British Petroleum.

**Figure 5-11** LNG Import and Export Scale Forecast

### 5.3.1 China's LNG terminal construction continues to advance

China and Europe are the countries with the largest demand for LNG, and most of Europe's natural gas is transported through pipelines from Russia and Norway. Therefore, China is the main driver of the growth of global LNG shipping demand, contributing 35% of global demand and 80% of seaborne shipping volume. Due to the requirements of energy demand transformation, Chinese ports are actively promoting the construction and expansion of LNG terminals under the guidance of national policies. Specifically, Huafeng Zhongtian, Jiangyin, Jiaxing, Guangdong Jieyang and other LNG receiving stations have a processing capacity of about 1-3 million tons per year, and the scale is relatively limited. Moreover, the LNG processing capacity of the Tianjin facility completed in 2021, the Tangshan facility currently under construction and other ports in North China has far exceeded that of other regions, which is closely related to the industrial structure and energy demand in northern China.




Source: World Energy Outlook (2020), British Petroleum.

**Figure 5-12** LNG Import and Export Flow

## 5.3.2 LNG terminal construction in South Asia speeds up

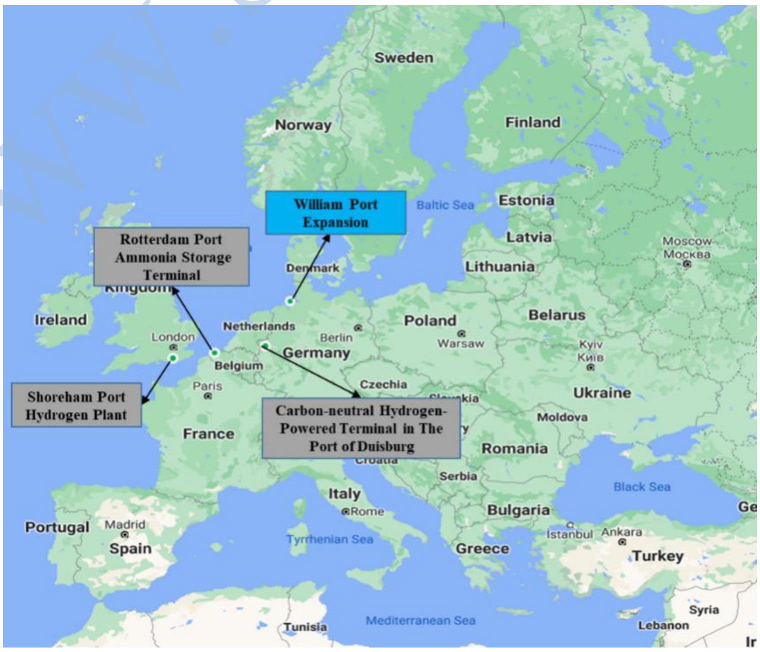
Due to the continued strong demand for LNG trade and the rising international natural gas prices, natural gas exporters such as Southeast Asia and South Asia have stepped up construction of facilities to expand natural gas exports and trade. Specifically, Vietnam cooperated with Japan Petroleum Exploration Company Limited (Japex) to build a natural gas terminal in the Nam Dinh industrial park in Haiphong city in the northeast, and invested about $1.4 billion in building an LNG receiving facility of 450 trillion Tbtu in the Bình Thuận province in central Vietnam. In the Philippines, the Atlantic Gulf and the Pacific Construction Group will also jointly build the first domestic LNG terminal to be actively involved in the international maritime trade of natural gas. The project is scheduled to be completed and put into operation in the summer of 2022. Sri Lanka also started building the country's first LNG receiving facility in 2021, with plans to provide fuel for power plants and promote the country's clean energy transition. The project is expected to be put into operation in 2023. The Karnataka government in India, the New Mangalore Port Trust (NMPT), and Singapore project developer (LNG Alliance) have jointly established a new natural gas receiving facility in Karnataka with an initial design capacity of 4 million tons per year. Meanwhile, a new LNG receiving facility will be built in the eastern part of Haldia, India, for the storage and regasification of natural gas.

## 5.3.3 Europe ushers in a boom in LNG terminal investment

The demand for natural gas is strong in all EU countries. With the outbreak of the Russian-Ukrainian conflict, Europe's natural gas supply may be cut off at any time. In addition, as the pandemic situation gradually improves due to the use of vaccines, Europe has to enhance the construction of LNG terminals to open up channels for importing natural gas energy by sea from the United States, the Middle East and other regions before the energy crisis occurs. In order to expand the natural gas receiving capacity, the Port of Zeebrugge has officially launched a project to expand the terminal facilities and will start construction in 2022. The British Finch Construction Limited and three major group companies jointly expanded the "Grain LNG", which will build 190,000 cubic meters of gasholders to increase the storage capacity. Countries in southern Europe are also planning to build LNG terminals. LNG terminal construction plans have been proposed by Spain at the Port of Bilbao, by Croatia in Krk Island, and by Italy in Sardinia. Meanwhile, Greece is also strengthening LNG terminal construction on a large scale, and the Greek government will build a new LNG receiving facility in Alexandroupolis.

## 5.3.4 New energy terminals become the mainstream of European construction

European ports actively responded to low-carbon initiatives proposed by organizations such as the International Maritime Organization, and have tightened the standards for terminal and berth construction under a series of rules such as emission control areas and prevention of ship-caused environment pollution. Specifically, the Port of Rotterdam actively promoted energy replacement. It supports ammonia as an alternative energy source for maritime and other industries and plans to develop an ammonia storage terminal at the Port of Rotterdam. The Port of Shoreham in the United Kingdom is building a 2 MW electrolysis plant near the locks to provide zero-emission green hydrogen for the port and ships by creating a hydrogen energy center. The German Port of Duisburg-Ruhrorter will also build the first climate-neutral container terminal based on the hydrogen technology in 2023. It has installed a sustainable energy system in the port, becoming the first fully climate-neutral operated terminal to use hydrogen and provide energy to adjacent areas.




Note: "  " Under construction; "  " Proposed construction.

**Figure 5-13** Location Map of Clean Energy Port Construction in Europe

# VI.Overview of Port Technology and Information in 2021

## 6.1 Port Automation Development

### 6.1.1 Developments of port automation technologies

Since the first automated terminals appeared in the 1990s, automated terminal technology has experienced constant development and innovation. Currently, many terminals around the world can achieve fully automated operations. But it is more common to improve the local automation level to solve specific problems. In 2021, port congestion became the driver of reform and technological development, and new progress was made in automated depot management technologies at terminals and horizontal transportation among other aspects.

#### (1) Unmanned container trucks at terminals transformed to commercial applications

There are three solutions to the automation of horizontal transportation at ports, namely automatic guided vehicles (AGV), unmanned straddle carriers (ASC), and unmanned container trucks. In 2021, many ports around the world made significant progress in the unmanned container truck solutions. In December 2021, China Mobile Research Institute (Shanghai) released the *Technical Requirements for Unmanned Container Vehicles in Ports*, which has provided a standard and basis for the unmanned horizontal transportation in the terminal port areas, which is conducive to the cooperation, development, and continuous innovation of the industry. In addition, Xiamen Port, Ningbo Zhoushan Port, Tianjin Port, Port of Hamburg, and other ports have carried out pilot projects of unmanned container trucks in ports with partners and the results have been remarkable.

#### (2) Machine vision helps ports improve automation coverage

With the rise of AI technology in recent years, image recognition technology based on machine vision has been more widely used in port automation. As an important supplement to existing information acquisition technologies, it has greatly helped ports achieve a higher degree of automation. The current application scope of image recognition technology in port automation is gradually expanding, being an important technical support in the fields of unmanned container trucks and digital twin ports, among others. As the image recognition technology matures, more automation technologies based on machine vision are expected to be applied to the port field to help improve the coverage of automated processes.

### 6.1.2 Formulation of port automation standards speeds up

In 2021, the continued pandemic and port congestion further accelerated the development of container terminal automation, which also spawned a number of relevant standards in the field of container terminal automation. A white paper on automated container terminals was published in May 2021 as part of the *Terminal Industry Committee 4.0 (TIC 4.0)* initiative, laying the groundwork for standardized operations in automated container handling. As of March 2022, *TIC 4.0* was updated, including semantic descriptions, five types of data models, 10 types of datasets, 53 definitions, and multiple examples of automated container terminal processes, to Version 3.

In 2021, China's Ministry of Transport organized the compilation of the *Guidelines for the Construction of Automated Container Terminals*, and an English edition of this document and the *Design Specifications for Automated Container Terminals* compiled in 2019 was released globally together. In addition, China's existing automated terminals were also actively promoting the formulation of relevant standards. Qingdao Port has developed the *Qingdao Port Automated Container Terminal Standard System (2020)* based on its experience in the construction and operation of automated container terminals. Xiamen Ocean Gate Container Terminal developed the *Technical Requirements for Unmanned Container Vehicles in Ports* in its "Smart Port 2.0" program.

## 6.2 Port Digital Development

### 6.2.1 Terminal operation management system TOS enters a new phase of development

#### (1) Cloud-based terminal management system (TOS) accelerated development

Faced with the chaotic logistics supply chain in the world, the port industry urgently needs solutions that can streamline and optimize operations, so that ports can be put into operation quickly or improve operational efficiency. To this end, Navis, a major third-party software service provider in the world, and DP World, a global terminal operator, proposed their own solutions.

CARGOES TOS+ is an integral part of the four key sub-categories of DP World's digital trade services - Internet of Things (IOT+), HD video analysis (AVA+), general cargoes (GC+), and terminal management systems (TOS+). CARGOES TOS+ will integrate terminal operations related systems through an integrated platform to provide terminal operators with real-time mobility information on vessels, gates and depots. In 2021, DP World Luanda in Angola and DP World Limassol in Cyprus were both equipped with cloud-based CARGOES TOS+ (ZODIAC), and Zodiac TOS was installed in 34 of DP World's 80 terminals. It is expected that all terminals will use the system in 2023, which will help DP World better integrate and manage its terminal resources.

#### (2) China's terminal management system (TOS) strived to catch up

In 2021, many TOS systems independently developed by domestic ports in China were launched in succession. In June 2021, the fully automated terminal in the Guangdong-Hong Kong-Macao Greater Bay Area completed the first full-process real ship operations, using the automated terminal software system from joint research and development of Shanghai Zhenhua Heavy Industries Company Limited, Guangzhou Port Group, and Huadong Electron Software Technology. The system has integrated advanced technologies of the next-generation IoT perception, big data analysis, cloud computing, artificial intelligence, 5G communication, and others to realize information-based and intelligent management and control of all aspects of the terminal production operations. In July, Zhenhua Heavy Industries successfully applied the independently developed TOS system to the Zhonggu Qinzhou project, aiming to help the project realize the goal of "intelligent, automated, paperless, and integrated". In November, Guangzhou Port Data Technology Co., Ltd.'s GZTOS system based on the management characteristics of small terminals was launched in Huadu Port. The system uses the Software as a Service (SaaS) application mode to effectively improve the efficiency of software development and adaptation to terminal.

## 6.2.2 Global ports accelerate deployment of 5G network facilities

The demand for high-stability, high-performance network connections in new scenarios such as remote office, online learning, and automation has surged amid the pandemic, and the global networks gained pace toward 5G networks. In the port field, the construction of smart ports based on 5G network technology is still in the early demonstration stage. Currently, terminal operators and large equipment manufacturers are the main drivers. In 2021, many ports around the world announced the 5G network pilot projects, primarily for network connections between handling and transportation facilities with the infrastructure, such as high-definition cameras, optical image recognition (OCR) cameras, container trucks, cranes, and ships.

**Table 6-1** Global Port 5G Technology Application Progress

| Port | 5G Technology Application Progress |
|---|---|
| Felixstowe | In January 2021, Hutchison Whampoa's Port of Felixstowe joined partners such as Three UK and Blu eMesh Solutions in a 5G pilot, with the project expected to be completed in September 2022, making it the largest port in the UK to deploy 5G technology and the Internet of Things (IoT). |
| Seattle | In January 2021, Nokia and Tideworks Technology are partnering to deploy Nokia Digital Automation Cloud (DAC), a digital automation services platform that includes a high-performance, industrial-grade LTE/5G private wireless network, at Port of Seattle Terminal 5. |
| Barcelona | In March 2021, Telefonica, a Spanish telecommunications service provider, will deploy a pilot 5G network at the Port of Barcelona for AP Muller Terminal to connect cranes, vehicles and personnel in the port area to improve port management through data sharing. The project is expected to go live in the summer of 2022. |
| Sohar | In March 2021, Oman Telecom (Omantel), Hutchison Port Sohar and Huawei collaborated to launch the first 5G Smart Port Proof of Concept (PoC) demonstration to improve the overall operational efficiency of the port. |
| Southampton | In April 2021, Associated British Ports (ABP) partnered with Verizon Business to install a private 5G telecommunications network at the Port of Southampton on the UK's south coast to take full advantage of the new technology for digital transformation. |
| Auckland | In May 2021, the Port of Oakland entered into an agreement with network operator Geoverse to develop a dedicated private LTE/5G network at the port to support applications such as container yard workflow analysis, environmental monitoring, smart gate management and drone surveillance. |
| Pusan | In May 2021, Busan Port Authority (BPA) partnered with LG Uplus Corp, a Korean cellular service provider, to establish a 5G-based ultra-high-speed seaport infrastructure at the Port of Busan, becoming the first port in Korea to establish a 5G network and successfully apply it to its operations. |
| Kalmar | In June 2021, terminal equipment supplier Kalmar partnered with communications companies Telia and Nokia to set up an independent 5G network and pilot it at its technology center in Tampere, Finland, to develop more efficient and safer container |

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| | handling solutions. |
| UIPA | In August 2021, the Utah Inland Port Authority (UIPA) announced a partnership with Quay Chain Technologies to develop a private LTE/5G network designed to digitally enhance port logistics throughput and ensure smooth inland logistics access to seaports such as Los Angeles, Long Beach and Oakland. |
| Tuxpan | In October 2021, the Tuxpan Port Terminal (TPT), Mexico's first automated container terminal, began advancing a 5G network pilot aimed at enabling fast, low-latency connectivity to various data sources within the terminal, with future plans to deploy expanded capabilities such as digital twins and analog operations. |
| Saint Petersburg | In October 2021, Global Ports Group (GPG) partnered with Russian digital service provider Rostelecom to apply 5G digital infrastructure at the Port of St. Petersburg, using a high-speed data transmission network to support the operation of terminal transportation equipment. |
| Yibin | In November 2021, the Yibin Port 5G Smart Port Phase I Project of Sichuan South Port Company completed preliminary acceptance. |

## 6.3 Port Intelligent Development

### 6.3.1 Digital twin and simulation modeling prediction

In 2021, many ports around the world started the exploration and application of the digital twin technology in the port field. Most of the ports currently have a good technical foundation, but they lack digital twin data resources, and various derivative applications are still in their infancy. Most of them are simple applications to improve the capabilities of "point scenarios", while there is a large room for improvement in whole-lifecycle applications, complex system applications, etc.

**Table 6-2** Examples of Digital Twin Applications in Ports Around The World

| Port | 5G Technology Application Progress |
|---|---|
| Hainan Free Trade Port | In March 2021, Hainan unmanned intelligent control enterprise "Hainan Aviator Technology Co., Ltd." using digital twin technology, combining big data mining, three-dimensional GIS, video fusion, to establish a intelligent video control platform. |
| Rotterdam | Working with IBM, Cisco, Axians and other companies to use the Internet of Things (IoT) and digital twin technology to collect and analyze environmental data such as climate and hydrology in the port area in real time to more accurately predict the best time for ships to berth and leave the port, helping reducing port congestion. |
| Brazil | In March 2021, Wilson Sons Brazil, a major Brazilian port operator, acquired a minority stake and commercial exclusivity in Israeli startup Docktech to use its digital twin technology to monitor port channel depths and reduce waste of dredging resources. |
| Esbjerg | In April 2021, the Port of Esbjerg entered into a partnership agreement with Honeywell to identify, monitor and analyze carbon emissions through Honeywell's digital twin data visualization platform. In the future, this digitalization project will monitor and manage complex water and heating systems and fine-tune management of the port's energy consumption. |
| Huelva | A digital twin technology based on photographic imaging of the port is being developed. The system will allow customers to keep track of cargo movements and trace the cargo transportation process, and the next step of the system will be equipped with an artificial intelligence system to predict cargo loading and unloading times for intelligent cargo management. |
| Portsmouth | In September 2021, IOTICS said it will apply digital twin technology in the "Shipping, Hydrogen and Port Ecosystem (SHAPE UK)" project at Portsmouth International Port in the UK to build a modular green hydrogen power system for the |

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| | port. |
| Guangzhou | In October 2021, Port Development Terminal and Data Company jointly developed and broadened the digital application scenario of the safety production management platform to create a digital and visualized online monitoring platform based on a realistic three-dimensional model of the whole terminal. |
| Shanghai East Container Terminal | In November 2021, Shanghai East Container Terminal, in conjunction with Wuhan Kotei digital twin technology, built a centimeter-level precision twin entity for more than 40 physical entities in the port, whose functions mainly include: large-scale container management, dynamic data driving in real time, and mobile navigation. |

## 6.3.2 Drone application process is accelerated

In the port field, drones are mostly used at a superficial level, such as auxiliary lookouts during pilotage, identification of sea drifting garbage in port areas, and inspections of marine and inland waterways. They are all based on the inter-drone flight control system, imaging and photography, drone image transmission, drone obstacle avoidance, and wireless communication systems, playing the advantages of drones such as high efficiency and good maneuverability to improve the port management level.

### (1) The Port of Antwerp uses drones to identify sea drifting garbage

The Port of Antwerp produces about 50 tons of sea drifting garbage every year. Since the Port of Antwerp covers an area of more than 120 square kilometers, manual cleaning is very difficult. The port has developed a "machine vision" application for this purpose. Based on drone-taken images, the port can automatically build a port area map to accurately indicate the location of sea drifting garbage and assist in the cleaning work. Digitalization has helped improve the port area cleaning efficiency. The port will independently develop a drone network to provide real-time port information, and connect it with the port security system to perform tasks in infrastructure inspection, berth management, oil spill detection and more.

### (2) Teesport and Port of Long Beach use drones for port inspections

In 2021, drone operator Heliguy partnered with the Teesport in the UK to equip the latter with an M300 RTK including H20T cameras and Z15 highly bright spotlights, primarily for port emergency response, surveillance and surveying, as well as infrastructure management. At the U.S. Port of Long Beach, drones help inspectors capture high-quality videos of port infrastructure such as storm drains, fire hydrants, and fenders and bollards along the terminals, allowing workers to inspect cranes and other hard to detect port machinery. Camera-equipped drones will collect data and transmit it to the cloud to detect abnormalities, such as container stacking errors, which will improve the accident handling efficiency and secure significant economic benefits.

# VII. Overview of Global Green Port Development in 2021

## 7.1 Green Port Construction Measures

### 7.1.1 Energy transition is the first option for building a 'zero-carbon' terminal

In essence, "zero-carbon" terminal construction is not only about emissions caused by the current energy consumption during port production, but also about energy tracing. The electric energy converted from petrochemical energy cannot be regarded as truly clean energy, and only electric energy converted from primary energy sources such as solar energy and wind power is a "zero-carbon" energy source. Only when the port actively explores alternative clean energy for direct use or clean energy for power generation can port operations become a truly "zero-carbon" terminal.

**Table 7-1** Comparison of Advantages and Disadvantages of Various Types of Alternative Clean Energy in Ports

| Fuel | Viability | Power mode | Technological maturity | Applicability | Advantages | Disadvantages |
|---|---|---|---|---|---|---|
| Solar energy | 85% | Convert electricity | Higher | Medium | The technology is relatively mature | Conversion power is limited and susceptible to weather |
| Wind energy | 80% | Convert electricity | Higher | Higher | The technology is relatively mature | Offshore wind energy investment is large and energy supply is limited |
| Hydrogen energy | 65% | Direct combustion | Medium | Medium | Better for mobile devices | High cost, relatively low energy density, low temperature storage, energy loss during the reconversion of electrical energy |
| | | Convert electricity | Lower | Higher | Faster R&D and suitable for a wide range of equipment applications | |
| Green hydrogen | 55% | Direct combustion | Medium | Higher | Higher energy density and proven experience | Costly and toxic |
| | | Convert electricity | Lower | Higher | The engine requires less space and convenience | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Biofuels | 10% | Convert electricity | Higher | Lower | Existing equipment is easier to use | Energy is limited and not easily available, and different types of bioenergy vary greatly, making it difficult to form standards |
| Methanol | 10% | Direct combustion | Rarely mentioned | Rarely mentioned | Maersk experimented in the field of ships | — |
| Nuclear energy | <5% | Use thermal energy | Medium | Lower | The technology is relatively mature | High investment, social resistance, and little mention by the government |

Source: Decarbonizing Shipping- All hands-on deck, Shell and Deloitte (2021), sorted by SISI.

## 1. Climate-neutral container terminals based on hydrogen technology

Since green hydrogen is a renewable fuel based on the electrolysis process without carbon emissions, inland river ports that value environment protection enjoyed the priority for trial operations in the field of port logistics. In 2021, the Port of Duisburg-Ruhrorter cooperated with COSCO Shipping Logistics, Hupac, and HTS Group to build a multimodal transport station in a former coal port. The station is scheduled to be completed in 2023. The Port of Duisburg-Ruhrorter will install six new gantry cranes, twelve tracks that each one has 730-meter-long , and multiple inland ship terminals in the 240,000-square-meter logistics hub, and use hydrogen-powered locomotives to achieve "zero emissions" in the port area.

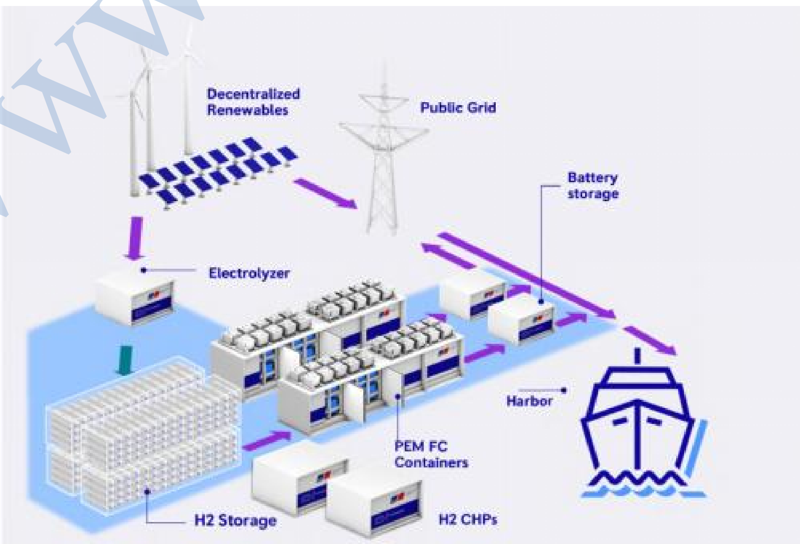



**Figure 7-1** Hydrogen Energy System and Power Supply Facilities at the Port of Duisburg

In addition, Chinese ports are also actively exploring the development and utilization of hydrogen energy. In 2021, China Energy Investment Corporation (China Energy) and Shandong Port Group signed a strategic agreement. Under the agreement, Shandong province has decided to build a hydrogen energy hub around the two ports of Weifang and Qingdao to realize hydrogen energy application demonstration of "port-highway-trunk line logistics". Specifically, Qingdao Port has put into use a hydrogen-powered automatic rail crane (powered by hydrogen fuel cells and lithium battery packs). With the development and promotion of hydrogen energy, the hydrogen energy application in Qingdao and Weifang ports will be wider in the future.

## 2. Global coastal areas actively promote "wind energy ports"

According to the *Global Wind Energy Report 2021* released by the Global Wind Energy Council (GWEC) in 2021, the current total installed capacity of wind energy in the world was 649 GW, and the newly installed capacity in the last year reached 93 GW, an increase of 14.3%. Based on this installed capacity, wind energy facilities can reduce about 1.1 billion tons of carbon dioxide emissions every year, which is equivalent to the sum of carbon emissions in South America. In addition, according to statistics, although the current installed capacity of offshore wind power facilities accounts for only 4.75% of the total, the development potential is huge. It is estimated that led by China, the United States, and Japan, the compound growth rate of newly installed capacity in the world from 2022 to 2025 will exceed 38%. Specifically, according to the World Wind Energy Association estimates, China alone has an offshore wind resource development potential of more than 3,500 GW.


Source: Historical data from GWEC, according to Guosen Securities Economic Research Institute forecast.

**Figure 7-2** Forecast of Global Offshore Wind Power Installed Capacity and Annual Growth Scale by Region (GW)

There is a mutually beneficial ecological environment between offshore wind energy and ports. At present, many provinces in China have started the construction of offshore wind power ports. Shandong, Zhejiang, Guangdong, Jiangsu, and other coastal provinces have issued relevant plans. Japan, Korea, and other emerging markets of offshore wind energy have also announced plans for port construction. In March 2021, the U.S. Bureau of Ocean Energy Management officially launched the offshore wind power installation planning and support program, exploring offshore wind turbines in waters off the Atlantic and Pacific coasts, the Gulf of Maine, the Gulf of New York, the Mid-Atlantic and the Gulf of Mexico, as well as the waters near North Carolina and California. The program will be first unveiled in the Port of New York-New Jersey on the east coast of the United States, and 30 GW of offshore wind power installations are expected to be completed by 2030. In 2021, the French government launched the "National Low-Carbon Strategy" and planned to launch an offshore wind farm project near the Port of Le Havre in 2022 (also known as "the largest industrial renewable energy project in France"), marking the industrial and energy transition of the port.

### 7.1.2 Digital collaboration reduces emissions from ships in port

Digitization itself cannot play a role in energy conservation and environmental protection, but digital information systems can expand the managed scope and enable traceability and real-time intervention technically, which helps realize the goals of reducing energy consumption and carbon emissions through management optimization. In early 2021, the Port of Rotterdam began working with A.P. Moller-Maersk, Mediterranean Shipping, and the International Maritime Organization (IMO) to conduct a joint test of the Just In Time (JIT) model for ships scheduled to arrive at the port. During the one-month test period, the average fuel consumption of 26 ships through the "JIT" mode fell by 9%, and their speed was significantly optimized 12 hours before arrival. Meanwhile, the delayed arrival at the port also greatly reduced the ship emissions at the port and could effectively alleviate the congestion caused by ships staying in the port.


**Figure 7-3** The Port of Piraeus Uses the PIXEL Ports Project for Better Manage of Vessels

### 7.1.3 'Reclaimed water works' to deal with water pollution at ports

The protection of water resources in ports has also been a key concern in the industry for a long time, especially the dust spraying of bulks terminals, as well as the treatment of ship ballast water and the recycling of water resources at ports. As a major importer of bulk cargoes, China is a major importer of bulk commodities such as coal and ore, consuming a great amount of water resources at ports, especially in northern ports where the watering demand is higher throughout the seasons. Taking Qinhuangdao Port in China as an example, the water used for dedusting in the East Port area exceeds 34 million tons. By setting up a "reclaimed water work" to treat and reuse the sewage, water for dedusting use at the port can be saved, providing more possibilities for the port to handle ships' ballast water.

The *International Convention for the Control and Management of Ships' Ballast Water and Sediments* (the Convention) has been developed by the International Maritime Organization and is effective globally, so ships are not allowed to discharge untreated ballast water directly into the sea as they used to. Under normal circumstances, ship ballast water is processed to remove large-scale organisms and particulate matter (≥ 50μm), inactivate marine plankton, bacteria, and viruses, and remove sludge among other links. Although according to the Convention, the International Maritime Organization gives four options, but most international ships have not been equipped with a ballast water management system (BWMS) that meets the requirements of the Convention, so the ballast water and sewage of most ships are still received and processed by the port. In terms of ports, not only should a "reclaimed water work" be established to treat port sewage as soon as possible, but fixed receiving facilities such as berths should also be set up, along with mobile receiving facilities such as barges and trucks, to meet the sewage treatment requirements of ships sailing internationally.

**Figure 7-4** Establish a Flexible Ship "Ballast Water" Treatment Method

## 7.1.4 'High' ports should be built to save land resources

With the development of port cities, the "port-city contradiction" has become prominent, which greatly affects the landside areas of ports. Not only have the landside areas of the rear depots become limited, but the overlap of cargo collection, distribution, and transportation channels at ports and the urban transportation systems has been controversial. To promote port-city ecological integration, port capacity expansion has to aim "high". The concept of "double-storey" or "multi-storey" terminal designs was proposed as early as in the planning of the Tuas Mega Port construction in Singapore.

In August 2021, the global terminal operator DP World took the lead in building and testing the three-dimensional depot "BOXBAY elevated storage system" at Berth 4 of Port of Jebel Ali in Dubai. The storage system stores containers in an 11-storey rack, which increases the capacity of traditional container terminals by 200%. According to the measurement, BOXBAY can reduce the need for transshipment equipment at the terminal, that is, it cuts the expected energy consumption by 29% for the same operations of every 19.3 movements per hour between each bridge crane and straddle carrier and every 31.8 movements per hour on each land crane, and the maintenance costs can be significantly reduced as well. In June 2021, the intelligent aerial rail collection, distribution, and transportation system (demonstration section) built in Qingdao Port of Shandong province was completed. The system not only is driven by electricity throughout the whole process, but also greatly reduces pollutant emissions and urban noise. Compared with the traditional container trucks, the energy consumption per move can be cut by more than 50%. Besides, the intelligent aerial rail system is a breakthrough, taking only 30% of the area for road construction, and the construction cost is lower than the original railway solution by more than 50%. Moreover, it can effectively solve the less efficient cargo distribution and transportation in the port area due to arrivals of trains and urban traffic congestion and road safety hazards caused by highway transportation vehicles.

**Figure 7-5** Shandong Port Intelligent Air Rail Collection and Transportation System

## 7.2 Green Port Development Policies

### 7.2.1 Singapore launches LNG bunkering incentives

Echoing the transformation of ship energy, the Maritime and Port Authority of Singapore (MPA) has also actively introduced LNG bunkering incentives, hoping to consolidate its status as the "Asian LNG fuel supply center". Singapore's annual LNG fuel supply capacity is as high as 1 million tons, capable of providing about 300 ship-to-ship LNG bunkering services. In February 2021, the MPA not only issued operating licenses to third-party LNG fuel suppliers to ensure LNG supply to ships arriving at the port, but also launched incentive measures to give a 25% discount on port fees for ships using LNG fuel during their stay in the port. An additional 10% discount is available if the ship uses the port's LNG-powered boat service. In addition, the MPA is also actively establishing the Global Centre for Maritime Decarbonisation (GCMD), which will cooperate with 31 organizations, including shipping companies, classification societies, research centers, energy companies, and financial institutions, to jointly reduce greenhouse gas emissions and implement the established decarbonization path and achieve "low carbon" and "zero carbon" development of the shipping industry.

### 7.2.2 EU may include ports and shipping into the 'carbon trading' system

The European Commission announced in July 2021 the "fit for 55" energy and climate package, which set forth the goal of reducing Europe's greenhouse gas emissions to 55% by 2030. Major revisions were also made to the EU-ETS system, with plans to include the shipping industry into the EU-ETS system starting from 2023. The European Sea Ports Organisation (ESPO) on behalf of the 22 member states, and the Norwegian Maritime Authority, supported this proposal, and emphasized that the government should strengthen the infrastructure construction for alternative fuels and establish a tax system for the excess emissions from using traditional energy sources. According to the revised EU Emissions Trading System (EU-ETS) draft, the transition period for including port and shipping sectors to the emissions trading system has been clarified to be brought forward from 2026 to 2025. That is, the port and shipping industries will only have a three-year transition period after the entry into the system in 2023. If the International Maritime Organization fails to agree on carbon emissions measures in line with the Paris Agreement before the end of September 2028, the coverage of the EU-ETS limits will be increased from 50% to 100% of inbound and outbound voyages under the jurisdiction of member states. In addition, a specific shipping fund will be set up to allocate at least 75% of shipping "carbon tax" revenue to support energy efficiency enhancement and decarbonization technology development for ports and ships.

**Table 7-2** European Port Environmental Monitoring Indicators

| Index（%） | 2013 | 2017 | 2018 | 2019 | 2020 | 2021 | 13-21 year change |
|---|---|---|---|---|---|---|---|
| **Port waste** | 67 | 88 | 84 | 79 | 79 | 80 | +13 |
| **Energy efficiency** | 65 | 80 | 80 | 76 | 75 | 77 | +12 |
| **Air quality** | 52 | 69 | 67 | 62 | 67 | 71 | +19 |
| **Consumes water** | 58 | 71 | 72 | 68 | 69 | 70 | +12 |
| **Water mass** | 56 | 75 | 76 | 71 | 67 | 70 | +14 |
| **Port area noise** | 52 | 64 | 68 | 57 | 54 | 64 | +4 |
| **Sediment quality** | 56 | 65 | 58 | 54 | 59 | 60 | +4 |
| **Carbon footprint** | 48 | 49 | 47 | 49 | 52 | 59 | +11 |
| **Marine ecology** | 35 | 44 | 40 | 40 | 46 | 46 | +11 |
| **Land environment** | 38 | 37 | 38 | 37 | 41 | 40 | +2 |
| **Soil quality** | 42 | 48 | 38 | 32 | 41 | 40 | -2 |

Source: ESPO Environmental Report - Eco Ports (2021);

Notes: Percentages represent feedback from surveyed units on the importance of the relevant impacts.

# VIII.Evaluation of Comprehensive Service Time Efficiency of 20 Major Container Ports in the World Based on AIS Big Data in 2021

To strengthen the life safety at sea and improve the 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 reflect the trend of the port and shipping market in a timely manner. 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. In 2021, we selected 20 major container ports in the world to continue the follow-up study, and calculate the rules of ship arrivals and the characteristics of service time at the port, in an aim to directly reflect the development characteristics of the port and shipping market in 2021 and the impacts of major events on the port and shipping industry. Key statistical indicators included the numbers and types of ships arriving at the port, the berth operation time after berthing, and the auxiliary operation time after ship arrival at the port. Auxiliary operations include tugging, pilotage, waiting for berthing, and port inspections. After calculation and statistics, the following characteristics were identified.

## 8.1 Overall Analysis of Comprehensive Time Efficiency

### 1. Total number of ships arriving at ports dropped significantly

The calculations showed that the number of ships arriving at the world's 20 largest container ports in 2021 dropped by 15.3% compared with 2020, and by 24.4% compared with 2019, falling for two consecutive years. Unlike 2020 when ship arrivals at ports reduced because ship enterprises suspended ships for pandemic prevention and control, in 2021, most of the world's ports had established relatively mature prevention and control measures and almost all of their shipping capacities were put to the market driven by the high freight rates. The main causes for the declined number of ship arrivals included the following. First, the ship turnover efficiency of ships on various global routes dropped significantly due to the long waiting time and delay of shipping schedule caused by port congestion, and the overall capacity loss reached 17%. Second, since many ports around the world were congested, ship enterprises reduced ports of call to avoid multiple or long-time waits for call. Third, the frequent emergencies and bad weather caused temporary interruptions to the supply chain. The terminal operations had gaps, reducing terminals' effective operation days.

In terms of monthly performance, ship arrivals at the ports dropped as a routine in February due to the Chinese Spring Festival holiday. In April, the ship arrivals fell to a certain extent due to the jam of the Suez Canal. Later, port operations were paused in the middle of the year due to pandemic outbreaks at Yantian Port and Ningbo Zhoushan Port as well as the worsening of port congestion in the United States, with the supply chain chaos obviously intensified. The ship arrivals at the port from June to the end of the year showed a downward trend month by month.

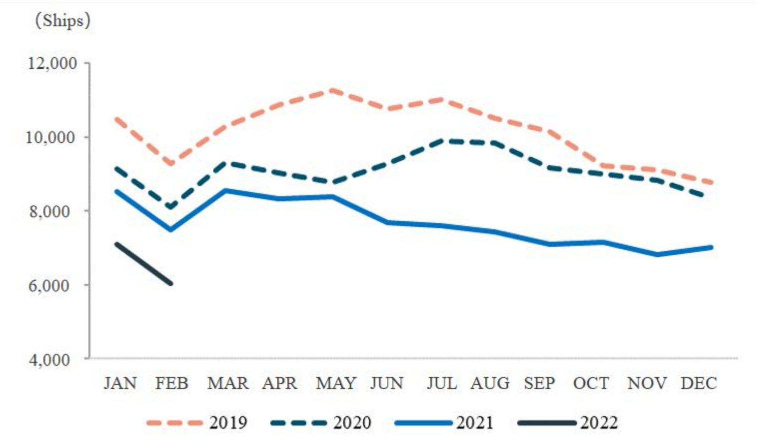



**Figure 8-1** Monthly Trend of Ships Arriving Volume at the World's Top 20 Container Ports in 2020-2021

## 2. Structure of arriving ships was basically the same as in 2020

Although ship arrivals at ports in 2021 fell significantly, the structure of arriving ships was not much different from that in 2020, according to statistics. Compared with the data in 2019, the share of arriving ships above 4,000 TEUs dropped significantly. As per analysis, the main reasons explaining the structure of arriving ships in 2021 are as follows. (1) Although Clarksons statistics showed that the shipping capacity of 15,000+ TEUs rose by as much as 15.4% in 2021 and the average idle capacity of global container fleets throughout the year was only less than 1%, the terminals that were capable of handling super-large container ships were relatively fixed and most of the arriving ships had to line up for long, with the actual effective capacity loss standing high. Therefore, the share of 12,000+ TEU arriving ships increased slightly by 0.4% to 8.0%, but it failed to recover to the pre-pandemic level of about 9%. (2) To avoid delays caused by port congestion, trunk routes were significantly shortened, as evidenced by the fewer ports of call per voyage and the higher handling volume per voyage. The operational strategies were similar to those taken to cope with the insufficient cargo volume in 2020 when pandemic was rampant, implying a similar structure of arriving ships. (3) Although large ships arriving at the port decreased according to the absolute number of arrivals, the container throughput of each port increased overall to varied degrees in 2021, and barging was still required to channel the traffic at the port. Therefore, the share of 0-4,000 TEUs ships in 2021 remained about 60% in the overall arriving ship structure, running flat with that in 2020.


**Figure 8-2** The Proportion of Container Ship Types in the Port from 2019 to 2021

## 3. Ship retention time at port increased significantly

The ship retention time of the major 20 container ports in the world increased to a large extent, with the average ship stay at the port up by 24.1%, according to statistics. Specifically, the berth operation time and the auxiliary operation time rose by 27.8% and 9.6%, respectively, both increasing greatly. The reasons included the following. On the one hand, the further increased handling volume per ship prolonged the berth operation time, and congestion of the rear cargo collection, distribution, and transportation channels of some ports in the United States and Europe deteriorated container delays at ports, undermining the ship berthing operation efficiency. On the other hand, the labor shortage amid repeated pandemic outbreaks failed to be resolved fundamentally, preventing the port efficiency from reaching the optimal level. As per data, the average ship stay at port was still high in early 2022, without any sign of improvement. The congestion deteriorated the long ship retention at the port and things were not expected to improve much in 2022.

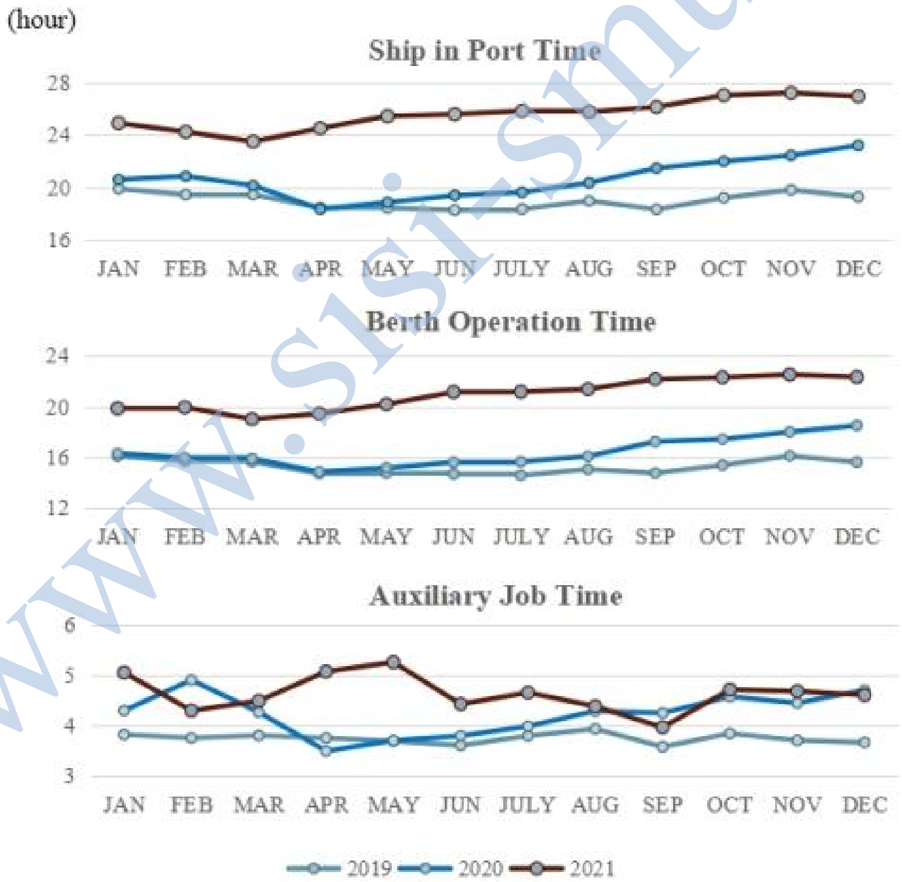



**Figure 8-3** Trend of Ship Occupancy Time in Global Top 20 container ports (2019- 2022)

# 8.2 Comments on Comprehensive Time Efficiency of Major Ports

## 1. Structure analysis of arriving ships at the world's 20 major container ports

### (1) The number of ships arriving at each port declined across-the-board

In 2021, 19 of the world's 20 major container ports registered year-on-year drop in the number of ships arriving at the port. Specifically, the decrease of one port was between 0% and 10%, and 18 were between 10% and 20%. The statistical data reflected a number of features worthy of attention. 1) The average growth rate of ship arrivals at the 20 ports was -15.3%, while the average container throughput growth was 5.3%, showing the increased handling operations per arriving ship. The difference between the two was 20.6 percentage points, lower than the difference of 27.5 percentage points in 2020, indicating that the growth trend of single-vessel handling operations slowed down. 2) Only the Port of Tanjung Pelepas recorded positive growth in ship arrivals (4.9%), which displayed great resilience in coping with challenges, and the container throughput also increased by 14.3%.

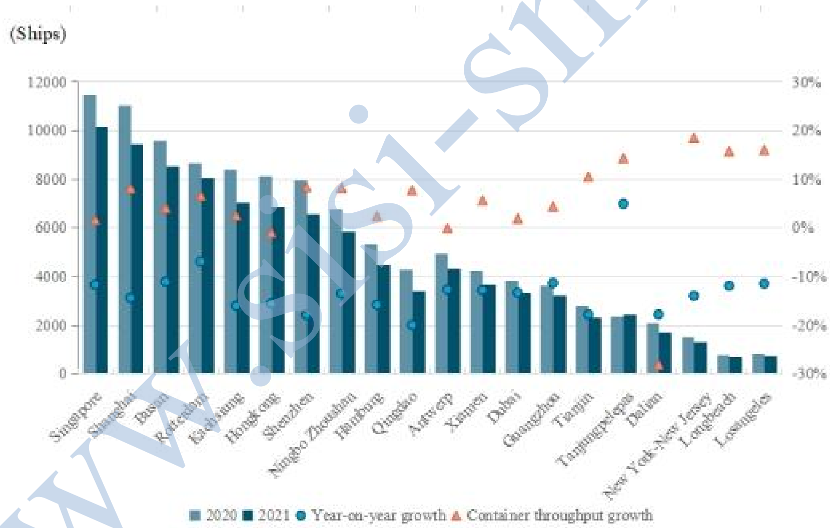
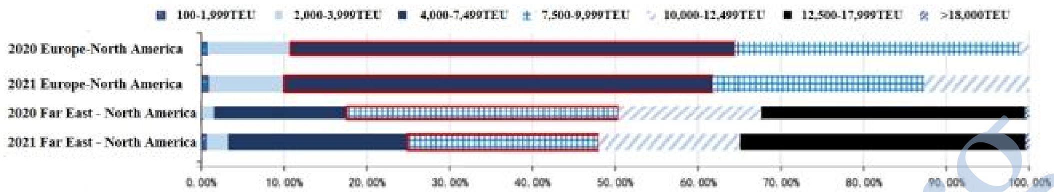



**Figure 8-4** Global Main Container Port Throughput Growth Rate, Number and Growth Rate of Arriving Ships

### (2) Share of large ships arriving in the United States increased significantly

According to the data, the shares of ships > 8,000 TEUs changed from 50.0%, 50.6%, and 44.4% to 46.9%, 53.1%, and 51.6% of the arriving ships at the three ports of Los Angeles, Long Beach, and New York/New Jersey, respectively, in 2021. Specifically, the share of large ships at the Port of Los Angeles and the Port of New York/New Jersey generally increased, and only the Port of Long Beach showed a downward trend, largely caused by the decline in the number of ships of 8,000-12,000 TEUs. According to the analysis, the congestion of U.S. ports worsened in 2021, but the freight rate repeatedly hit record highs, and ship enterprises had a strong willingness to invest in capacity, leading to the continuous capacity increases of the Asia-Pacific-North America route. Ship enterprises kept launching ships to meet the freight needs on the route. The share of the route in the global total shipping capacity increased from 18% to 22% in 2021, while the share of Europe-North America route remained stable at 4%. Meanwhile, to avoid long-term port wait due to congestion, most of the shipping capacity put into operation by ship enterprises was large-scale ships, for the purpose of improving turnover efficiency and the profit per voyage. Alphaliner data showed that the share of medium-sized and large ships in Asia-Pacific-North America and the Europe-North America ship structure also increased significantly.




Source: Alphaliner.

**Figure 8-5** Structure of the Global Container Fleet by Route in 2020-2021




**Figure 8-6** Structure of Ships Calling at the World's 20 Largest Container Ports in 2020-2021

## 2. Operational efficiency evaluation of the world's top 20 container ports in 2021

### (1) The operation time of berths at each port increased significantly, and the auxiliary operation time was relatively stable

The ship retention time at the port increased by 24.1% (berth operation time and auxiliary operation time were extended by 27.8% and 9.6%, respectively) in 2021. It can be seen that the increase of berth operation time is the main reason for the rise of ship retention time. In terms of ports, the berth stay time at major U.S. ports increased significantly. The time of the Port of Los Angeles and the Port of Long Beach rose by 31.6 and 34.9 hours, respectively, and the increase in berth stay time was significantly higher than that of ports in other regions. The average rise of berth operation time of the three major European hub ports of Rotterdam, Antwerp, and Hamburg also exceeded 20%, largely due to the larger size of the arriving ships. Specifically, ships of 18000+ TEUs accounted for 54.8%, an increase of nearly 3 percentage points over last year.

### (2) The trends of berth operation time and auxiliary operation time were opposite to the ship size trend

According to Figure 8-7, the average berth operation time of the 20 major container ports in the world was proportional to the ship size, largely because some fixed operation processes during ship berthing such as ship mooring won't take more time as the ship size grows. In addition, it can be found that the slope of the broken line in 2021 in the figure is significantly larger than that in 2019 and 2020, reflecting the increased sensitivity of the relationship between the ship size and the ship stay time at port in the event of port congestion. However, as large ships mostly serve trunk routes and have multiple ports of call, they more tend to call at few ports and increase the cargo handling volume per port in the event of port congestion. In contrast, smaller ships often serve lightering between a smaller number of ports, with narrower changes in container loads. The auxiliary operation time is inversely proportional to the ship size. Large ships enjoy higher priority for entry to port. Therefore, the larger the ship's container capacity, the shorter the auxiliary operation time. The slope of the broken line in 2021 is significantly lower than that in 2019 and 2020, that is, the larger the ship size, the faster the auxiliary operation time decreases, especially for ships of 0-4,000 TEUs and 4,000-8,000 TEUs. This is largely due to the extreme congestion at the port in 2021 when ports would first try to accommodate ships from trunk routes during berth scheduling, and smaller barges often needed longer wait time. For example, in the port congestion in Europe, ports such as Rotterdam ensured the priority of trunk route ships for berthing, aggravating the berth shortage on branch lines due to long-term insufficiency of infrastructure construction. As a result, a large number of barges were stranded at ports and some barge operators were on the verge of bankruptcy.

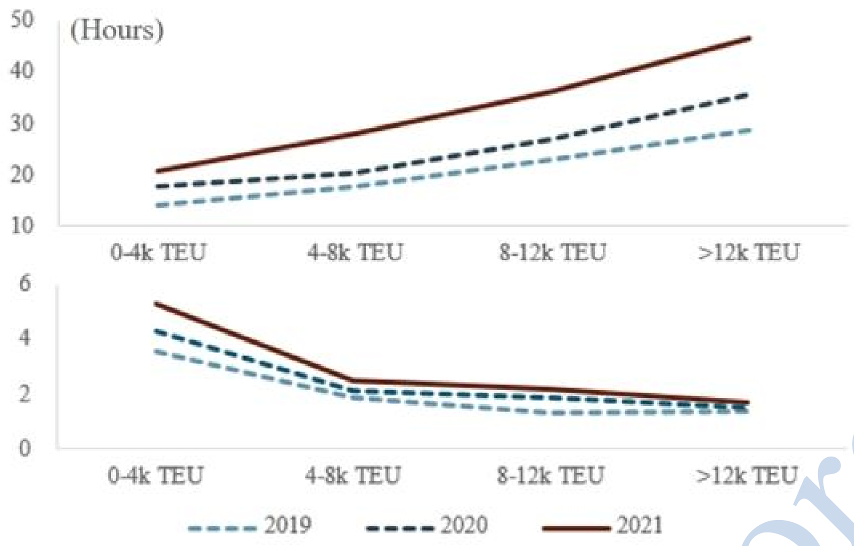



**Figure 8-7** Trend of Docktime/Non-docktime of the World's Top 20 Ports by Ship Type (2019-2021)

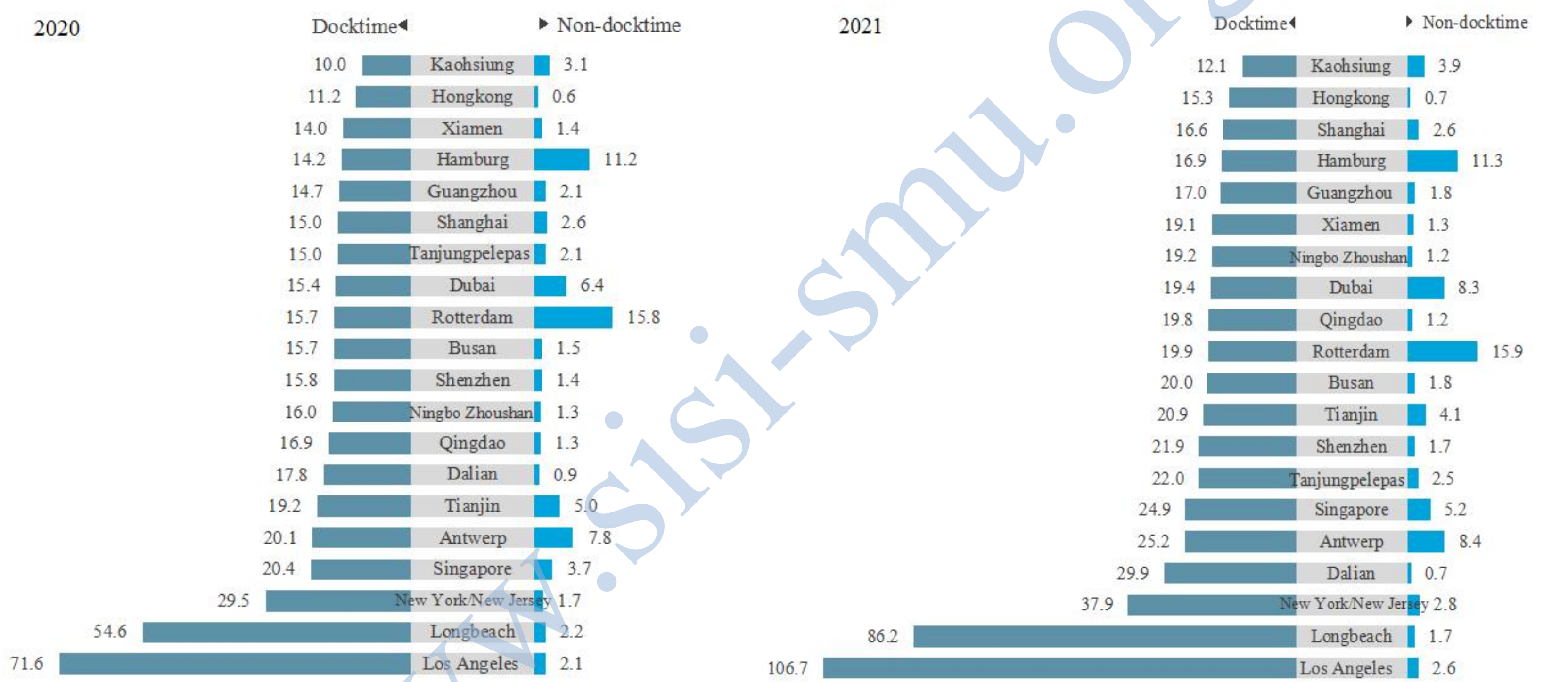



Figure 8-8 Operational Efficiency of the World's Top 20 Container Ports from 2020 to 2021

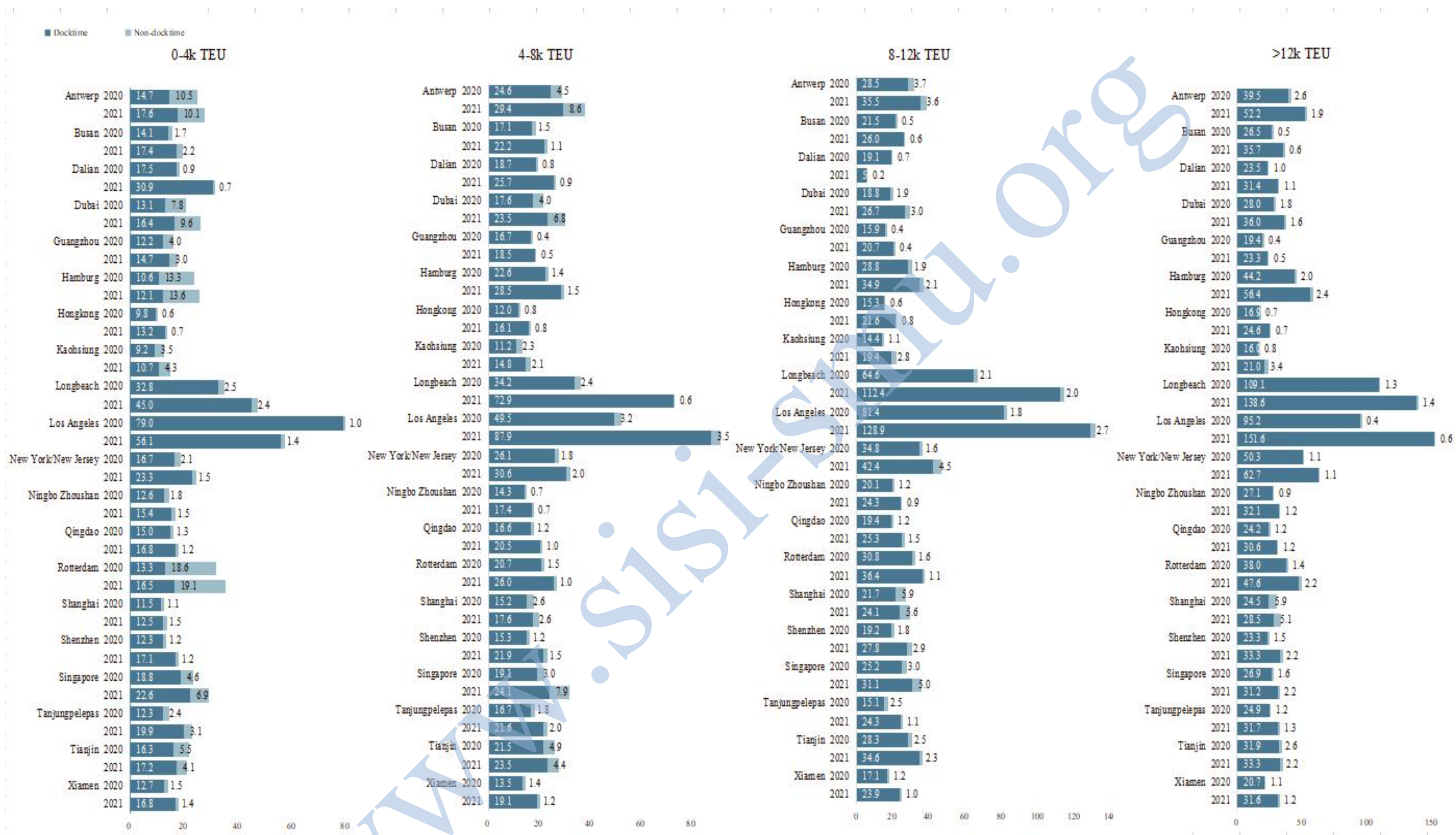
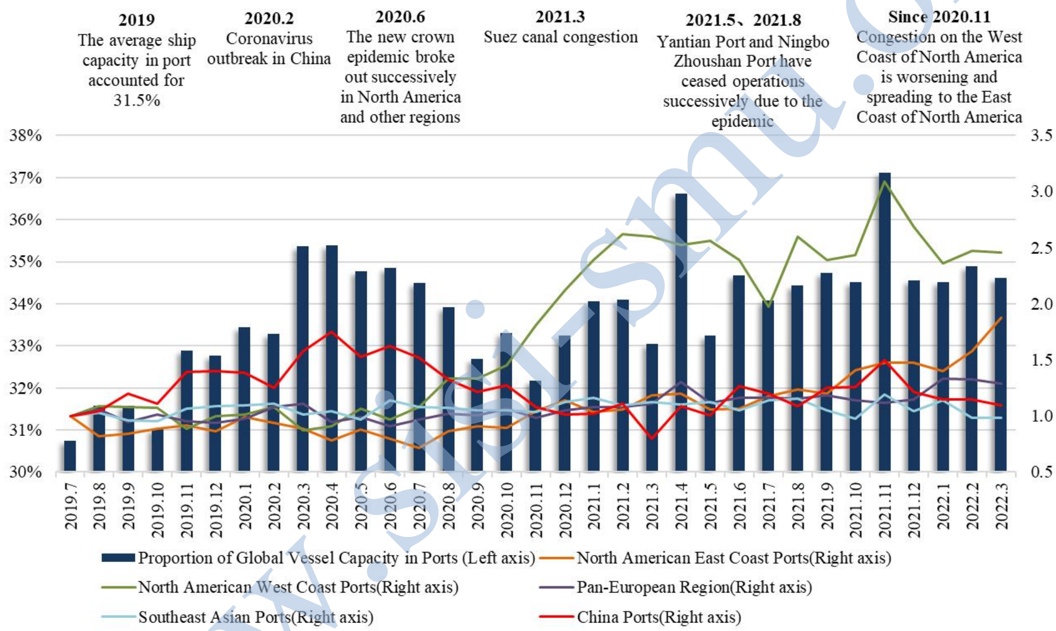



**Figure 8-9** Operating Efficiency of the World's 20 Largest Container Ports by Ship Type (2020-2021)

# Topic 4: Review and Prospect of Global Port Congestion in 2021

## 1. Global port congestion worsened in 2021

In 2021, the U.S. import demand remained high. Coupled with the emergencies such as the jam of the Suez Canal and the closure of Chinese ports, port congestion continued and even deteriorated. According to the Clarksons Containership Port Congestion Index, the global port congestion eased slightly at the end of 2020 and then deteriorated, and this congestion was different from the congestion in 2020, which was caused by pandemic prevention and control. The global port congestion in 2021 was mainly caused by the insufficient capacity of U.S. ports, and the frequent occurrence of "black swan" events further exacerbated the severity of congestion in the short term.



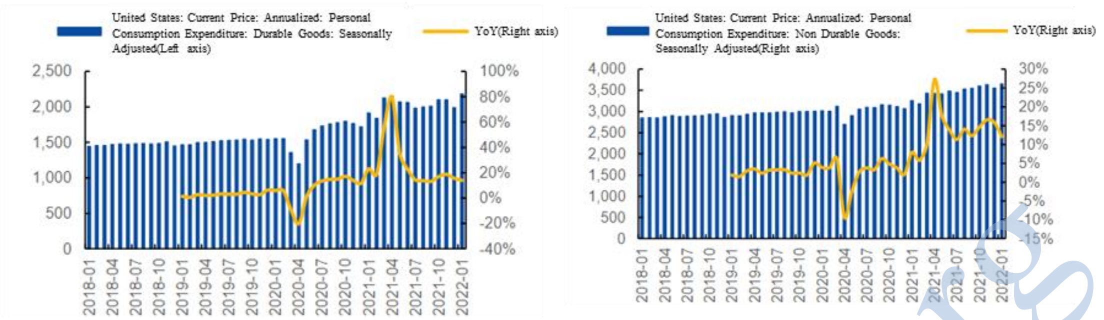

Source: Clarkson.

Note: The broken line in the figure is the change in the ratio of each month to the base value calculated in each region with July 2019 as the base value, corresponding to the right coordinate axis.

**Figure 1** Trend of Clarksons Global Port Congestion Index from July 2019 to March 2022

### (1) Insufficient port capacity in the United States was the main reason for this round of congestion

The United States witnessed repeated pandemic outbreaks in 2021 and the personal cash subsidy policy continued. Besides, the pandemic curbed the consumer demand for services, resulting in continued growth in consumer demand for personal durable goods and non-durable goods. This part of demand should be satisfied by the imports from Asia, leading to the huge pressure on the U.S. ports. However, the much-criticized U.S. port services still failed to cope with the surging import demand. Serious congestion occurred again at the ports of Los Angeles and Long Beach on the west coast of the United States, causing disruption to the global shipping supply chain and further to the ports on the east coast of the United States in the second half of 2021 and early 2022. According to the Kuehne + Nagel Shipping Disruption Index (SDI), 80% of the world's port congestion occurs in North America.




Note: The chart is from Guoyuan Securities, unit: billion US dollars.

**Figure 2** U.S. Personal Consumption Expenditure on Durable Goods, Non-Durable Goods and Growth Rate (2018-present)

### (2) European port congestion is mainly caused by delays in shipping schedules

In 2021, the container shipping volume of the Asia-Europe routes also surged, especially at the end of the year when the restocking demand rose. The annual shipping volume of the Asia-Europe routes was 24.64 million TEUs, a year-on-year increase of 3.2%, which put European ports under great pressure. The congestion of European ports was mainly caused by the jam of the Suez Canal in March and the operation suspension at Yantian Port in May, which led to concentrated ship arrivals in the later period. However, ports' service capacity was limited, which exposed the vulnerability of the European port supply chain whose infrastructure and management model slowly fell behind the market requirements.

### (3) China's prevention and control mechanism helps ports get out of congestion

Chinese ports still played an important role in the global industrial chain in 2021. However, Shenzhen Yantian Port and Ningbo Zhoushan Port Meishan Port Area were closed successively in May and August due to COVID-19 positive cases in the port areas, resulting in ship demurrage out of the ports and impacting the global supply chain. However, due to the relatively mature pandemic prevention mechanism, the two ports implemented prompt production restrictions and their port areas resumed production within 15 days and 7 days, respectively. Currently, the *Guidelines for COVID-19 Prevention and Control for Ports and Fristline Personnel* issued by the Ministry of Transport of China has been updated to the ninth edition, and the prevention and control mechanism of China's ports is also becoming increasingly mature. For this reason, occasional infections are no longer easy to interrupt ports' normal operations. As of March 2022, Chinese ports have largely recovered from congestion.

## 2. This round of congestion is expected to be relieved no earlier than 2022

As port congestion continued in early 2022, the container freight rates, ship charter rates, and port congestion among other indicators failed to show significant improvement. Ship enterprises' new ship capacity will not be put into operation until 2024, and the tight capacity of the global supply and demand relationship will be hard to change in 2022. The current consensus industrywide is that the supply chain tension may last at least throughout 2022.

This report regards this round of congestion a result of the weak link in the port and shipping supply chain and the misalignment with the surging demand in the context of the COVID-19 pandemic. A key link of the supply chain network congestion lies in the coastal ports of the United States. Once the misalignment between supply and demand at the U.S. ports is alleviated, without the impact from other major changes, the effective shipping capacity of ships can be improved and port congestion can also be greatly improved. In terms of the U.S. demand side, although the U.S. fiscal support policy weakened in 2022, the demand for inventory replenishment from traditional U.S. retailers and e-commerce will remain, and there may be a shift from durable goods to non-durable goods. Overall, the consumer demand may stay high. The robust commodity import demand will continue to put pressure on ports. It is predicted that port supply chain disruptions will be difficult to alleviate in the first half of 2022. Moreover, with the changes in the pandemic situation and the negotiations between major port unions on the west coast of the United States, the overall congestion of U.S. ports is expected to continue until 2023.

## 3. Subsequent impact of the global port congestion in 2021

### (1) U.S. ports will remain weak links in the global logistics supply chain

The inefficiency of U.S. ports was fully exposed in the global port congestion in 2021. For this reason, a fund of around $17 billion was earmarked in the Biden administration's Bipartisan Infrastructure Law (Infrastructure Investment and Jobs Act) dedicated to port and waterway infrastructure construction to promote economic development and improve infrastructure. The U.S. Department of Transportation also planned to provide about $450 million for port-related projects to ease port congestion, which will improve the throughput capacity of U.S. ports to a certain extent. However, considering the pressure from the terminal trade union, the act clearly prohibits the use of funds for the construction of terminal automation facilities, and it is impossible to substantially increase the terminal efficiency through automation technologies in the short term. In addition, the U.S. ports took temporary countermeasures such as 24/7 operations to ease congestion. After the congestion was improved, the operational mode returned to the previous one under the pressure of operating costs. The U.S. ports will remain weak links in the global logistics supply chain.

### (2) Many legacy problems remain after congestion is relieved

Port congestion not only undermines the normal operations of ships and cargoes, but part of the temporary countermeasures during the congestion will also require proper handling after the congestion is eased. First, the handling of empty containers. Amid the trade flow imbalance during port congestion, which resulted in container shortage, the container manufacturers produced a great number of new containers to meet the demand in 2021. However, after the concentrated congestion ends, the demand for empty containers will surely fall. It is expected that empty containers may accumulate and be congested at the U.S. terminals and container depots around the beginning of 2023. Shipping companies and container leasing companies need to plan their response strategies soon.

### (3) Regional sub-hub ports embrace a higher status amid the pandemic

As congestion continued, hub ports on trunk routes operated at full capacity for a long time under the greatest pressure. To reduce the resulting delays, ship enterprises might drop ports, change the ports of call, or take other measures, allowing some regional sub-hub ports to have more ship arrivals. These sub-hub ports performed well in 2021 in terms of throughput, and some of them even put forward more ambitious development plans, such as the Port of Savannah in the United States. However, port congestion was a result of imbalanced supply and demand at ports amid the COVID-19 pandemic. If the pandemic gets under control and the port congestion gets alleviated, the service level and logistics cost will be the determinants of port throughput. Large hub ports still have greater advantages. Operators of regional sub-hub ports should consider issues such as the return of shipping routes and redundancy in port construction planning.

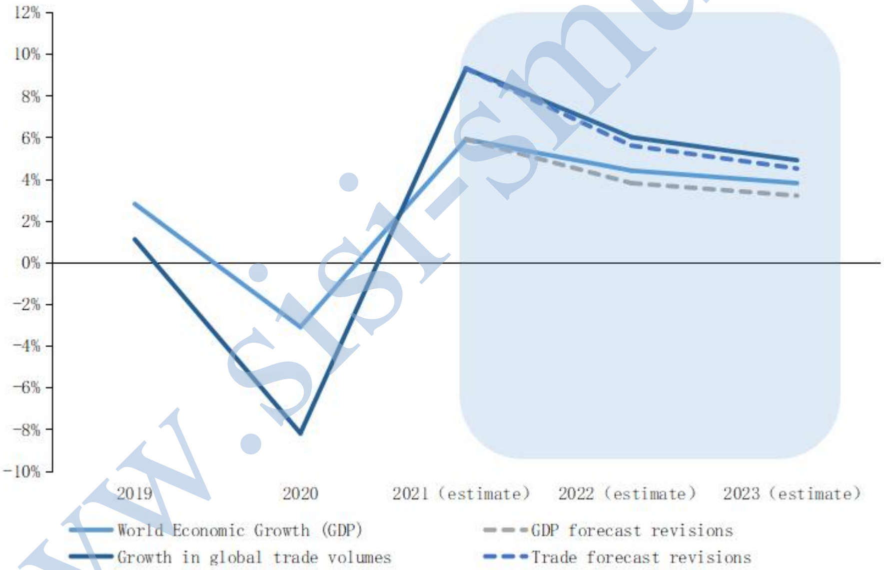
### (4) Congestion will become an important driver for transformation of global ports

Global ports are seeking measures to improve efficiency and ease congestion to avoid port congestion and production shutdown, which will greatly accelerate technical application and industrial transformation in the port sector, and drive the transformation and upgrading of the global port industry. Labor shortage under the pandemic is an important contributor to port congestion. Labor costs also account for a large share in the financial cost structure of terminal operators. After the pandemic, the rise of terminal automation at terminals and the increasing orders for automated terminal equipment will make it a transformative trend for the port industry to reduce labor intensity via technological applications.

# IX.Comments on Global Port Development Trend in 2022

## 9.1 Global Economic and Trade Recovery May Be Hindered

2021 was a year of global economic and trade recovery. With the pandemic situation under control due to the wider coverage of vaccines, the strengthened fiscal and tax policy incentives in various countries, and the low economic and trade base in 2020, the global economy showed a good recovery trend in 2021. However, as the "transmissibility" of the Omicron mutant strain increased significantly at the beginning of 2022 and the virus spread from the American countries to the rest of the world, the prevention and control measures once again restrained the economic growth. Meanwhile, the geopolitical conflict situation escalated again, and the outbreak of the Russian-Ukrainian conflict is expected to trigger a series of economic and trade sanctions against Russia by Western countries such as Europe and the United States, generating a greater uncertainty in the global economic and trade development.




Source: International Monetary Fund, World Economic Outlook (2022.1), SISI revised.

**Figure 9-1** Global Economic and Trade Growth Trend Forecast

According to the Global Economic Outlook released by the International Monetary Fund in January 2022, the growth rate of the world economy (GDP) will drop from 5.9% in 2021 to 4.4% in 2022, and the growth rate of global trade in services and goods will fall from 9.3% to 6.0%. Specifically, one of the reasons for the recovery growth in 2021 was based on the low economic and trade base in the early stage of the outbreaks in 2020, while the expected growth pickup in 2022 manifests the gradual return of production and trade to the right track, which is recovery growth of the global economy and trade without a low base and on the premise of good control over the pandemic situation. However, in view of the spread of the pandemic at the beginning of the year, the conflict between Russia and Ukraine, as well as the expected impact of international economic and trade sanctions among other events, it is expected that the recovery process of the global economy and trade will be hindered again in 2022. The world GDP growth rate may fall below 4%, while the growth of trade volume will be above 5%. On the one hand, the global pandemic situation was relatively effectively controlled. Although the spread of new mutant strains has limited consumption and travel and reduced production efficiency to a certain extent, it didn't cause a large-scale shutdown of production and manufacturing. On the other hand, the economic and trade volumes of Russia and Ukraine in the conflict were relatively limited, and the direct impact of the conflict on global economic and trade was also relatively limited, despite the widespread range.

**Table 9-1** GDP of Global Major Economies and and Global Share in 2021

| Serial number | Country | Total GDP (trillions of dollars) | Global share | Serial number | Country | Total GDP (trillions of dollars) | Global share |
|---|---|---|---|---|---|---|---|
| 1 | United States | 22.97 | 24.47% | 7 | France | 2.92 | 3.11% |
| 2 | China | 17.77 | 18.93% | 8 | Italy | 2.12 | 2.26% |
| 3 | Japan | 5.01 | 5.34% | 9 | Canada | 2.02 | 2.15% |
| 4 | Germany | 4.2 | 4.47% | 10 | Korea | 1.8 | 1.92% |
| 5 | United Kingdom | 3.19 | 3.40% | 11 | Russia | 1.77 | 1.89% |
| 6 | India | 3.08 | 3.28% | Total | | 66.85 | 71.22% |

Source: World Bank, National Statistical Office, sorted by SISI.

The most critical point is that Russia contributed 12% of the world's crude oil and 21% of the natural gas, with Russia's pipeline gas accounting for 35% of Europe's total natural gas imports and crude oil for 29% of Europe's total imports. The manufacturing, consumption, and other industries in Europe will all face stagnation once their energy supply is suspended, which will have an immeasurable impact on the economy. In addition, Russia's copper and aluminum exports accounted for 37% and 16% of the world's total exports, and Ukraine's wheat and corn exports accounted for 12% and 16% of the world's total exports. The resulting global shortage of food and energy will bring certain risks to economic and trade growth. Overall, the impact of the various sudden "black swan" events in 2022 on the economy will be slightly greater than that on trade, and the impact can spread. For example, the economic and trade scale and the direct impact of Russia and Ukraine conflict are within the tolerable range, but the trade sanctions and energy crisis in Europe and the United States and even the world at large triggered by the conflict may have an impact on the global manufacturing and consumer trade far greater than that on Russia and Ukraine themselves.

## 9.2 Growth Rate of Global Ports Faces a Slight Retracement

The global economy and trade will be unpredictable in 2022, but the scale of global seaborne trade and port production may continue to grow. However, the growth rate will decline. Although the impact of the repeated outbreaks and the conflict between Russia and Ukraine will continue throughout the year, especially the spread of mutant strains such as Delta and Omicron, which will cause a significant impact, the global anti-pandemic pattern has taken shape, and various countries have made great progress in their responses to and handling of outbreaks compared with the early period of pandemic. The European energy crisis and economic and trade sanctions due to the Russian-Ukrainian conflict remain uncertain in terms of the scope and implementation. Even if

Russia cuts off the supply of oil, LNG, and other energy sources to Europe, affecting European industrial production and household consumption, it will be beneficial for Europe to increase seaborne commodity trade and energy imports. Meanwhile, the economic and trade sanctions imposed by Europe and the United States on Russia and the withdrawal of some industries from the Russian market have limited impact on the global maritime trade and port production, given the relatively controllable industrial scale.

In 2022, although the world will face headwinds such as the continuous anti-pandemic endeavors, trade protectionism, labor shortage, energy shortage, consumption reduction, geopolitical conflicts, and economic and trade sanctions, the overall layout of the global industrial division of labor has not changed. Moreover, as the regional trade agreements such as RECP come into effect, all countries will actively promote economic growth and trade development. However, although the overall landscape of seaborne trade growth is likely to remain unchanged, the growth rate will significantly drop, leading to a decline in global port throughput growth.

**Table 9-2** Throughput Growth Rate of Major Global Ports from 2017 to 2021 and Forecast for 2022

| | 2017 | 2018 | 2019 | 2020 | 2021 | Forecast：2022 |
|---|---|---|---|---|---|---|
| Cargo throughput growth rate (%) | 5.2 | 4.5 | 0.7 | -1.4 | 4.5 | 1.2 - 1.8 |
| Container throughput growth rate (%) | 6.5 | 5.2 | 2.3 | -0.9 | 6.5 | 3.2 - 3.6 |

Source: SISI Statistical Port Sample Estimation

According to the production data analysis of major global ports in the past years, the global port cargo trade and container throughput have basically recovered to the pre-epidemic level in 2021, and the low base effect has basically disappeared. In addition, in view of the expected hindered global economic and trade recovery in 2022, the container and cargo throughput growth rates may both further decline. Specifically, the global container trade growth may remain at 3.2% to 3.6%, and may fall again after 2023. The cargo throughput growth slowdown may become more obvious, and the growth rate will remain at 1.2% to 1.8%, primarily due to the gradual withdrawal of fiscal stimulus policies in various countries after two years of implementation due to the pandemic. Moreover, the demand for infrastructure construction was also released in the past two years. Meanwhile, the traditional petrochemical energy was restricted under the strict environmental protection policies. For the above reasons, the seaborne shipping volumes of iron ore and coal among other major commodities will slow down the growth. In addition, although there is a possibility of "supply disruption" of oil and natural gas transported by Russian pipelines to Europe, which will increase the European demand for maritime energy imports, the production capacity of other oil and natural gas producing areas cannot record great increases in the short term. Moreover, the higher prices of oil and natural gas will have a certain impact on the import demand of other countries in the world, so the cargo throughput growth at global ports will still be lower than that of container trade.

## ➢ Asian and South American ports continue to lead the growth

Asia, which has put the pandemic under relatively sound control, will once again play a prominent role in global factories in 2021. The steady growth of port trade in China under the strategy of "taking domestic circulation as the mainstay while letting domestic and international circulations reinforce each other", and the expanding port size in Japan, Korea, India, and other countries amid economic and trade recovery have contributed to Asia's status as a leader among global ports in terms of growth rate. In view of the current global pandemic and economic and trade situation, Asian ports are expected to continue to lead the world in terms of performance in 2022. On the one hand, with the RECP trade agreement entering into force, the trade volumes between China, Japan, Korea, and Southeast Asia will gradually increase, leveraging the advantages of "zero tariff" or "low tariff". On the other hand, Asia will continue to serve as a global production and manufacturing base amid the global tensions, especially in the Middle East, South Asia, and West Asia where regional economic and trade numbers continue to show potential to become new growth leaders for the Asian port industry.

In the industrial field, Asian countries welcome increasingly improved manufacturing and technology levels, and the demographic dividend has not completely disappeared. For this reason, the demand for international trade both within and outside the region will remain strong. On the whole, although the growth rate of major ports in Asia in 2022 narrows from the 5% of the previous year, it is expected to stand at about 3% and continue to lead the development of global ports. In South America, Brazil, Argentina, Colombia, Chile, and other countries not only have great potential for their own economic growth, but also have a greater demand for ore, energy, grain, and other cargo trade with Europe. It is expected that South American ports will continue to maintain a growth rate of more than 2.5%.

### ➢ European and North American ports face downside risks

In 2021, European and American ports showed a sound growth momentum under a low base, but they may find it difficult to continue the high-speed growth in 2022. In Europe, on the one hand, the spread of the pandemic has a more serious impact on the overall economic and trade environment, which was relatively sluggish, and the consumer market was relatively weak. On the other hand, influenced by the Russian-Ukrainian conflict, the supply of energy such as oil and natural gas has faced difficulties, affecting European industries and traffic. Their port trade may be hard to maintain the high growth trend. In North America, the strong fiscal stimulus policies in 2021 boosted the U.S. import trade demand, especially the demand for imported pandemic prevention materials and home/office supplies, and energy and infrastructure materials also recorded a large trade scale under the guidance of the policy. However, the U.S. fiscal support policies will expire in 2022. Coupled with high government debt and rising inflation risks, the U.S. government may be unable to maintain the high-level fiscal incentives, meaning that the trade demand of U.S. ports will fall again. Meanwhile, the U.S. ports are about to start labor-management negotiations, and talks look difficult for now, with a risk of strikes. If this is the case, it will lead to large-scale port congestion and cargo stranded at the port, resulting in a throughput decline of North American ports. Generally, European and North American ports are at risk of falling into negative growth in 2022.

### ➢ Port potential in Africa and Australia wanes

With the opening up and economic growth of countries in East Africa and South Africa, they once became the fastest growing regions in global trade. Especially after the introduction of foreign capital, infrastructure developed rapidly, and investment, trade, and local production and consumption demand increased day by day. But after the pandemic, the outbreaks in Africa were extensive due to the lack of health facilities and medical resources, and demand for seaborne trade has declined in the past two years. The port growth potential needs to be revitalized by the industry and consumer market. Meanwhile, Australian ports have maintained sound growth in recent years thanks to commodities such as ore, coal, petroleum gas, lumber, and wool. However, China reduced the imports of coal and ores from Australia at the end of 2020, and mainland China, as a major destination of Australian exports, about 43% of Australia's commodities went to China, has created a huge impact on the growth expectations of Australian ports. Considering the weak trade demand in 2022, Australian ports are likely to find it difficult to sustain sound growth.

### ➢ Container trade returns to slow growth

Compared with the 9.7% growth rate in 2021, the expected growth rate of global port container throughput in 2022 is only 3.2% to 3.6%, showing a significant decline and the pessimistic prospect. Based on the 2020 and 2021 data, the average growth rate was only 3.68%, while the expectations of the World Bank and the International Monetary Fund for the economic and trade growth for 2022 fell again and again. The growth rate of international container trade, which is closely related to economy and trade, is bound to be lowered accordingly. However, impacted by the Russia-Ukraine conflict and the pandemic, Europe is likely to maintain the high commodity import demand, and the intra-regional container trade will increase significantly after the RECP trade agreement comes into effect. Therefore, the global port container throughput is expected to maintain a stable growth rate of above 3%, still higher than the growth of cargo throughput. In addition, the current volatile international relations, geopolitical conflicts, and the possibility of trade sanction escalation still cloud the world. In addition, some countries may continue the trade protection policies and industrial chain relocation amid the pandemic, while global inflation expectations and rising ocean freight rates remain high. Coupled with the risk of strikes by American terminal workers and other factors, the container throughput growth of global ports may decline further.

Although global ports have been performing slightly sluggishly in recent years, container ports around the world still maintain vitality in the medium and long term. Specifically, the container throughputs of ports in Asia and the Middle East are likely to continue to lead the world, while the container volumes of ports in the Americas under the pandemic may continue to rebound. In contrast, ports in Africa and Oceania will register slightly poorer performance, while European ports significantly lack the growth momentum and may become the slowest growing ports.

# Attached Tables

**Table 1** Growth Rate of Global GDP, Trade Volume, and Shipping Volume

(unit：%)

| | Global GDP | Global Shipping Volume | Global trade volume | Average |
|---|---|---|---|---|
| 2007 | 5.6 | 4.4 | 7.2 | 5.7 |
| 2008 | 3.1 | 2.5 | 2.8 | 2.8 |
| 2009 | -0.1 | -4.0 | -11.3 | -5.1 |
| 2010 | 5.4 | 9.3 | 12.7 | 9.1 |
| 2011 | 4.3 | 4.4 | 7.0 | 5.2 |
| 2012 | 3.5 | 3.9 | 3.1 | 3.5 |
| 2013 | 3.4 | 3.4 | 3.6 | 3.5 |
| 2014 | 3.5 | 3.4 | 3.9 | 3.6 |
| 2015 | 3.4 | 2.2 | 2.9 | 2.8 |
| 2016 | 3.3 | 3.0 | 2.3 | 2.9 |
| 2017 | 3.8 | 4.1 | 4.8 | 4.2 |
| 2018 | 3.6 | 2.7 | 3.1 | 3.1 |
| 2019 | 2.8 | 0.5 | 0.1 | 1.1 |
| 2020 | -3.1 | -3.4 | -5.3 | -3.9 |
| 2021 | 5.9 | 3.6 | 10.8 | 6.8 |

Source: IMF data , Clarkson website.



**Table 2** Global GDP Growth Rates and Forecasts by Region

(unit：%)

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022(f) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Global** | 3.4 | 3.5 | 3.4 | 3.3 | 3.8 | 3.6 | 2.8 | -3.1 | 5.9 | 4.4 |
| **Advanced Economies** | 1.4 | 2.0 | 2.3 | 1.8 | 2.5 | 2.3 | 1.7 | -4.5 | 5.0 | 3.9 |
| The United States | 1.8 | 2.3 | 2.7 | 1.7 | 2.3 | 2.9 | 2.3 | -3.4 | 5.6 | 4.0 |
| Euro Area | -0.2 | 1.4 | 2.0 | 1.9 | 2.6 | 1.9 | 1.5 | -6.4 | 5.2 | 3.9 |
| Germany | 0.4 | 2.2 | 1.5 | 2.2 | 2.7 | 1.1 | 1.1 | -4.6 | 2.7 | 3.8 |
| France | 0.6 | 1.0 | 1.0 | 1.0 | 2.4 | 1.8 | 1.8 | -8.0 | 6.7 | 3.5 |
| Italy | -1.8 | 0.0 | 0.8 | 1.3 | 1.7 | 0.9 | 0.3 | -8.9 | 6.2 | 3.8 |
| Spain | -1.4 | 1.4 | 3.8 | 3.0 | 3.0 | 2.3 | 2.1 | -10.8 | 4.9 | 5.8 |
| Japan | 2.0 | 0.3 | 1.6 | 0.8 | 1.7 | 0.6 | 0.0 | -4.5 | 1.6 | 3.3 |
| United Kingdom | 2.2 | 2.9 | 2.4 | 1.7 | 1.7 | 1.3 | 1.4 | -9.4 | 7.2 | 4.7 |
| Canada | 2.3 | 2.9 | 0.7 | 1.0 | 3.0 | 2.4 | 1.9 | -5.2 | 4.7 | 4.1 |
| **Emerging economies** | 5.0 | 4.7 | 4.3 | 4.5 | 4.8 | 4.6 | 3.7 | -2.0 | 6.5 | 4.8 |
| Russia | 1.8 | 0.7 | -2.0 | 0.2 | 1.8 | 2.8 | 2.0 | -2.7 | 4.5 | 2.8 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Developing Asia | 6.9 | 6.9 | 6.8 | 6.8 | 6.6 | 6.4 | 5.4 | -0.9 | 7.2 | 5.9 |
| China | 7.8 | 7.4 | 7.0 | 6.9 | 6.9 | 6.8 | 6 | 2.3 | 8.1 | 4.8 |
| India | 6.4 | 7.4 | 8.0 | 8.3 | 6.8 | 6.5 | 4.0 | -7.3 | 9.0 | 9.0 |
| Latin America and Caribbean | 2.9 | 1.3 | 0.4 | -0.6 | 1.4 | 1.2 | 0.1 | -6.9 | 6.8 | 2.4 |
| Brazil | 3.0 | 0.5 | -3.5 | -3.3 | 1.3 | 1.8 | 1.4 | -3.9 | 4.7 | 0.3 |
| Mexico | 1.4 | 2.8 | 3.3 | 2.6 | 2.1 | 2.2 | -0.2 | -8.2 | 5.3 | 2.8 |
| Sub-Saharan | 4.8 | 5.0 | 3.1 | 1.6 | 2.9 | 3.0 | 2.9 | -1.7 | 4.0 | 3.7 |

Source: IMF data.

**Table 3** Domestic Demand Growth Rates and Forecasts of Advanced Economies

(unit：%)

| | Advanced Economies | The United States | Euro Area | Japan | United Kingdom |
|---|---|---|---|---|---|
| 2008 | -0.3 | -1.3 | 0.3 | -1.3 | -1.7 |
| 2009 | -3.7 | -3.8 | -4.0 | -4.0 | -4.9 |
| 2010 | 2.9 | 2.9 | 1.5 | 2.4 | 2.5 |
| 2011 | 1.5 | 1.5 | 0.8 | 0.7 | -0.2 |
| 2012 | 0.8 | 2.2 | –2.4 | 2.3 | 1.9 |
| 2013 | 1.4 | 1.8 | –0.2 | 2.0 | 2.2 |
| 2014 | 2.0 | 2.3 | 1.4 | 0.3 | 2.9 |
| 2015 | 2.3 | 2.7 | 2.0 | 1.6 | 2.4 |
| 2016 | 1.8 | 1.7 | 1.9 | 0.8 | 1.7 |
| 2017 | 2.5 | 2.3 | 2.6 | 1.7 | 1.7 |
| 2018 | 2.3 | 2.9 | 1.9 | 0.6 | 1.3 |
| 2019 | 1.7 | 2.3 | 1.5 | 0.0 | 1.4 |
| 2020 | -4.5 | -3.4 | -6.3 | -4.6 | -9.8 |
| 2021 | 5.2 | 6.0 | 5.0 | 2.4 | 6.8 |

Source: IMF data , Clarkson website.

**Table 4** Global Manufacturing Purchasing Managers Index

| | Global | The United States | China | Japan | Euro Area | India | Russia |
|---|---|---|---|---|---|---|---|
| 2019-01 | 50.8 | 54.9 | 49.5 | 50.3 | 50.5 | 53.9 | 50.9 |
| 2019-02 | 50.6 | 53.0 | 49.2 | 48.9 | 49.3 | 54.3 | 50.1 |
| 2019-03 | 50.5 | 52.4 | 50.5 | 49.2 | 47.8 | 52.6 | 52.8 |
| 2019-04 | 50.3 | 52.6 | 50.1 | 50.2 | 47.9 | 51.8 | 51.8 |
| 2019-05 | 49.8 | 50.5 | 49.4 | 49.8 | 47.7 | 52.7 | 49.8 |
| 2019-06 | 49.4 | 50.6 | 49.4 | 49.3 | 47.6 | 50.8 | 48.6 |
| 2019-07 | 49.3 | 51.6 | 49.7 | 49.4 | 46.5 | 52.5 | 49.3 |
| 2019-08 | 49.5 | 50.3 | 49.5 | 49.3 | 47.0 | 51.4 | 49.1 |
| 2019-09 | 49.7 | 51.1 | 49.8 | 48.9 | 45.7 | 51.4 | 46.3 |
| 2019-10 | 49.8 | 51.3 | 49.3 | 48.4 | 45.9 | 50.6 | 47.2 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2019-11 | 50.3 | 52.6 | 50.2 | 48.9 | 46.9 | 51.2 | 45.6 |
| 2019-12 | 50.1 | 52.4 | 50.2 | 48.4 | 46.3 | 52.7 | 47.5 |
| 2020-01 | 50.4 | 51.9 | 50.0 | 48.8 | 47.9 | 55.3 | 47.9 |
| 2020-02 | 47.1 | 50.7 | 35.7 | 47.8 | 49.2 | 54.5 | 48.2 |
| 2020-03 | 47.6 | 48.5 | 52.0 | 44.8 | 44.5 | 51.8 | 47.5 |
| 2020-04 | 39.6 | 36.1 | 50.8 | 41.9 | 33.4 | 27.4 | 31.3 |
| 2020-05 | 42.4 | 39.8 | 50.6 | 38.4 | 39.4 | 30.8 | 36.2 |
| 2020-06 | 47.9 | 49.8 | 50.9 | 40.1 | 47.4 | 47.2 | 49.4 |
| 2020-07 | 50.3 | 50.9 | 51.1 | 45.2 | 51.8 | 46.0 | 48.4 |
| 2020-08 | 51.8 | 53.1 | 51.0 | 47.3 | 51.7 | 52.0 | 51.1 |
| 2020-09 | 52.4 | 53.2 | 51.5 | 47.7 | 53.7 | 56.8 | 48.9 |
| 2020-10 | 53.0 | 53.4 | 51.4 | 48.7 | 54.8 | 58.9 | 46.9 |
| 2020-11 | 53.8 | 56.7 | 52.1 | 49.0 | 53.8 | 56.3 | 46.3 |
| 2020-12 | 53.8 | 57.1 | 51.9 | 50.0 | 55.2 | 56.4 | 49.7 |
| 2021-01 | 53.5 | 59.2 | 51.3 | 49.8 | 54.8 | 57.7 | 50.9 |
| 2021-02 | 53.9 | 58.6 | 50.6 | 51.4 | 57.9 | 57.5 | 51.5 |
| 2021-03 | 55.0 | 59.1 | 51.9 | 52.7 | 62.5 | 55.4 | 51.1 |
| 2021-04 | 55.9 | 60.5 | 51.1 | 53.6 | 62.9 | 55.5 | 50.4 |
| 2021-05 | 56.0 | 62.1 | 51.0 | 53.0 | 63.1 | 50.8 | 51.9 |
| 2021-06 | 55.5 | 62.1 | 50.9 | 52.4 | 63.4 | 48.1 | 49.2 |
| 2021-07 | 55.4 | 63.4 | 50.4 | 53.0 | 62.8 | 55.3 | 47.5 |
| 2021-08 | 54.1 | 61.1 | 50.1 | 52.7 | 61.4 | 52.3 | 46.5 |
| 2021-09 | 54.1 | 60.7 | 49.6 | 51.5 | 58.6 | 53.7 | 49.8 |
| 2021-10 | 54.3 | 58.4 | 49.2 | 53.2 | 58.3 | 55.9 | 51.6 |
| 2021-11 | 54.2 | 58.3 | 50.1 | 54.5 | 58.4 | 57.6 | 51.7 |
| 2021-12 | 54.2 | 57.7 | 50.3 | 54.3 | 58.0 | 55.5 | 51.6 |

Source: iFind.

**Table 5** Import and Export Trade Value of Major Economies

(unit：billion dollars)

| | The United States | European Union | China | Japan | Canada | Russia | India |
|---|---|---|---|---|---|---|---|
| 2019-01 | 340.4 | 956.5 | 397.7 | 115.4 | 71.2 | 47.3 | 67.9 |
| 2019-02 | 321.0 | 927.9 | 267.7 | 112.7 | 68.3 | 53.0 | 63.5 |
| 2019-03 | 362.1 | 1004.9 | 365.1 | 124.9 | 79.8 | 58.0 | 76.4 |
| 2019-04 | 349.8 | 953.4 | 374.1 | 118.9 | 77.0 | 58.7 | 68.4 |
| 2019-05 | 368.9 | 987.9 | 386.7 | 114.9 | 82.4 | 52.3 | 76.5 |
| 2019-06 | 350.7 | 929.0 | 375.3 | 116.4 | 77.4 | 52.4 | 66.1 |
| 2019-07 | 358.1 | 977.9 | 399.5 | 125.0 | 76.4 | 55.8 | 66.7 |
| 2019-08 | 360.0 | 830.9 | 395.0 | 117.1 | 77.1 | 56.3 | 65.8 |
| 2019-09 | 346.6 | 940.5 | 397.4 | 119.6 | 75.3 | 56.5 | 63.7 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2019-10 | 367.8 | 1023.3 | 383.7 | 121.5 | 78.7 | 61.0 | 64.2 |
| 2019-11 | 341.9 | 953.8 | 405.7 | 118.0 | 73.3 | 59.1 | 64.3 |
| 2019-12 | 343.2 | 866.8 | 430.0 | 122.0 | 73.6 | 64.0 | 66.7 |
| 2020-01 | 331.1 | 930.0 | 368.5 | 111.4 | 71.2 | 47.7 | 67.0 |
| 2020-02 | 315.5 | 896.1 | 222.8 | 104.8 | 68.1 | 47.2 | 65.6 |
| 2020-03 | 334.2 | 899.9 | 349.4 | 118.0 | 70.7 | 50.5 | 52.8 |
| 2020-04 | 266.5 | 647.6 | 354.1 | 105.3 | 49.5 | 42.6 | 27.3 |
| 2020-05 | 259.7 | 695.5 | 350.4 | 85.9 | 49.6 | 38.2 | 42.1 |
| 2020-06 | 290.1 | 847.1 | 379.5 | 92.9 | 63.2 | 43.6 | 43.4 |
| 2020-07 | 319.6 | 898.4 | 411.8 | 100.6 | 67.5 | 44.3 | 52.9 |
| 2020-08 | 327.7 | 806.3 | 410.4 | 96.4 | 69.3 | 43.2 | 53.9 |
| 2020-09 | 334.2 | 979.5 | 440.7 | 108.2 | 72.8 | 51.3 | 58.0 |
| 2020-10 | 359.0 | 1008.4 | 414.4 | 116.6 | 75.3 | 50.0 | 58.5 |
| 2020-11 | 346.6 | 1013.9 | 458.5 | 113.6 | 73.2 | 52.5 | 56.9 |
| 2020-12 | 355.0 | 970.4 | 485.7 | 122.0 | 74.1 | 60.5 | 69.7 |
| 2021-01 | 339.3 | 935.4 | 465.6 | 114.5 | 72.4 | 44.4 | 69.6 |
| 2021-02 | 324.2 | 989.9 | 373.9 | 112.6 | 70.8 | 51.3 | 68.3 |
| 2021-03 | 396.9 | 1167.0 | 469.7 | 129.7 | 87.2 | 62.1 | 84.1 |
| 2021-04 | 378.9 | 1070.6 | 486.0 | 129.4 | 79.8 | 63.0 | 76.7 |
| 2021-05 | 383.7 | 1072.4 | 483.7 | 116.5 | 83.5 | 59.5 | 71.2 |
| 2021-06 | 398.9 | 1149.2 | 511.6 | 127.7 | 88.4 | 68.7 | 74.6 |
| 2021-07 | 390.8 | 1080.2 | 508.7 | 129.5 | 82.7 | 70.8 | 81.7 |
| 2021-08 | 403.4 | 981.2 | 529.3 | 126.1 | 85.4 | 69.0 | 78.6 |
| 2021-09 | 395.9 | 1137.7 | 543.4 | 129.9 | 82.7 | 70.8 | 90.2 |
| 2021-10 | 425.8 | 1152.2 | 515.0 | 127.7 | 88.6 | 73.4 | 89.2 |
| 2021-11 | 426.2 | 1201.7 | 578.1 | 137.7 | 91.0 | 76.9 | 84.7 |
| 2021-12 | 427.6 | 1145.0 | 586.5 | 143.6 | 90.1 | 88.1 | 99.0 |

Source: WTO.

**Table 6** Seaborne Volume of Goods by Various Types in 2012-2021

(unit：million tons)

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|
| Iron Ore | 1107 | 1188 | 1340 | 1364 | 1418 | 1472 | 1475 | 1454 | 1502 | 1517 |
| Coal | 1112 | 1183 | 1217 | 1138 | 1141 | 1203 | 1264 | 1284 | 1165 | 1231 |
| Grain | 347 | 363 | 409 | 430 | 450 | 476 | 474 | 478 | 512 | 523 |
| Minor Bulk | 1746 | 1825 | 1847 | 1891 | 1880 | 1936 | 2012 | 2036 | 1990 | 2094 |
| Crude Oil | 1954 | 1893 | 1843 | 1912 | 1977 | 2033 | 2054 | 2010 | 1861 | 1828 |
| Oil Products | 954 | 1005 | 985 | 1050 | 1107 | 1117 | 1123 | 1080 | 958 | 1006 |
| Gas | 316 | 320 | 332 | 344 | 371 | 399 | 433 | 478 | 481 | 508 |
| Chemicals | 279 | 293 | 298 | 314 | 321 | 342 | 362 | 371 | 366 | 369 |
| Containers | 1404 | 1474 | 1557 | 1591 | 1666 | 1761 | 1838 | 1879 | 1852 | 1950 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Other | 753 | 779 | 809 | 830 | 855 | 888 | 913 | 927 | 903 | 940 |
| Total | 9879 | 10160 | 10560 | 10863 | 11186 | 11626 | 11949 | 11998 | 11591 | 11967 |

Source: Clarkson website.

**Table 7** Cargo Throughput of Major Global Ports in 2018-2021

(unit：million tons)

| Region | Port | 2021 | 2020 | 2019 | 2018 | 21-20 Growth Rate |
|---|---|---|---|---|---|---|
| Europe | **Spain** | **544.5** | **515.6** | **564.5** | **563.6** | **5.6%** |
| | Algeciras | 105.1 | 107.3 | 109.4 | 107.4 | -2.1% |
| | Valencia | 77.5 | 74.6 | 73.7 | 70.8 | 4.0% |
| | Barcelona | 66.4 | 59.5 | 65.9 | 66.0 | 11.6% |
| | **Portugal** | | | | | |
| | Sines | 42.2 | 46.6 | 41.8 | 47.9 | -9.4% |
| | Leixoes | 15.2 | 17.1 | 19.6 | 19.2 | -11.1% |
| | **Netherlands** | | | | | |
| | Rotterdam | 468.7 | 436.8 | 469.4 | 469.0 | 7.3% |
| | Amsterdam* | 82.1 | 74.3 | 86.9 | 82.3 | 10.5% |
| | **Belgium** | | | | | |
| | Antwerp | 239.8 | 231.0 | 238.2 | 235.3 | 3.8% |
| | Zebruch | 49.2 | 47.0 | 45.8 | 40.1 | 4.6% |
| | **Germany** | | | | | |
| | Hamburg | 128.7 | 126.3 | 136.6 | 135.1 | 1.9% |
| | Bremerhaven | 69.7 | 66.5 | 69.4 | 74.4 | 4.8% |
| | **France** | | | | | |
| | Marseille | 75.0 | 68.9 | 78.9 | 80.5 | 8.8% |
| | **Russia** | **835.2** | **820.8** | **840.2** | **816.7** | **1.8%** |
| | Novorossiysk | 142.8 | 141.8 | 156.8 | 154.8 | 0.7% |
| | Usti-Luga | 109.4 | 102.6 | 103.9 | 98.7 | 6.6% |
| | Port Of Vostochny | 77.7 | 77.4 | 73.5 | 73.5 | 0.4% |
| | St Petersburg | 62.0 | 59.9 | 59.9 | 59.3 | 3.6% |
| | Murmansk | 54.5 | 56.2 | 61.9 | 61.9 | -3.0% |
| | **Ireland** | | | | | |
| | Dublin | 34.9 | 36.9 | 38.2 | 38.0 | -5.2% |
| | **Latvia** | | | | | |
| | Riga | 21.5 | 23.7 | 32.8 | 36.4 | -9.3% |
| | **Estonia** | | | | | |
| | Tallinn | 22.4 | 21.3 | 19.9 | 20.6 | 5.0% |
| | **Italy** | | | | | |
| | Trieste | 55.4 | 54.2 | 62.0 | 62.7 | 2.2% |
| | Genoa | 64.5 | 58.5 | 68.1 | 70.4 | 10.3% |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Turkey** | **526.3** | **496.6** | **484.2** | **460.2** | **6.0%** |
| | **Lithuania** | | | | | |
| | Klaipieda | 45.6 | 47.8 | 46.3 | 46.6 | -4.6% |
| | **Poland** | **113.1** | **103.9** | **108.3** | **100.8** | **8.9%** |
| | Gdansk | 53.2 | 48.0 | 52.2 | 49.0 | 10.8% |
| | **Romania** | | | | | |
| | Constanta | 67.5 | 60.4 | 66.6 | 61.3 | 11.8% |
| **North America** | **The United States** | | | | | |
| | South Louisiana | 208.5 | 227.2 | 234.7 | 275.0 | -8.2% |
| | Los Angeles | 222.0 | 183.0 | 207.3 | 194.5 | 21.3% |
| | Long Beach | 196.4 | 171.8 | 169.9 | 179.7 | 14.3% |
| | Corpus Christi | 151.7 | 144.9 | 110.8 | 96.4 | 4.7% |
| | New York/New Jersey* | 93.2 | 86.3 | 86.2 | 85.0 | 8.0% |
| | Baltimore | 42.7 | 40.8 | 43.6 | 43.3 | 4.6% |
| | Savannah | 41.7 | 34.9 | 35.0 | 33.5 | 19.6% |
| | Northwest Seaport Alliance | 27.3 | 26.8 | 30.0 | 30.2 | 2.0% |
| | Virginia | 23.0 | 21.1 | 19.9 | 22.0 | 9.1% |
| | **Canada** | | | | | |
| | Vancouver* | 152.8 | 145.5 | 144.2 | 147.1 | 5.0% |
| | Montreal | 34.0 | 35.1 | 40.6 | 38.9 | -3.1% |
| | Quebec | 28.5 | 27.0 | 29.0 | 27.6 | 5.6% |
| | Halifax | 4.9 | 4.2 | 4.5 | 4.8 | 16.3% |
| | **Mexico** | **286.1** | **266.7** | **302.9** | **317.0** | **7.3%** |
| | Manzanillo Cologne | 34.9 | 30.9 | 32.2 | 33.6 | 12.9% |
| | Dos Docas | 24.2 | 28.9 | 30.7 | 34.1 | -16.1% |
| | Coatzacoalcos | 27.9 | 28.8 | 28.6 | 29.0 | -3.0% |
| | Veracruz | 32.1 | 26.2 | 28.3 | 29.0 | 22.4% |
| | Lazaro Cardenale | 28.0 | 21.3 | 31.5 | 31.2 | 31.3% |
| | Arcas Islands Pier | 20.2 | 20.6 | 22.7 | 27.8 | -2.2% |
| | Altamira | 21.7 | 17.8 | 21.0 | 23.4 | 22.4% |
| | Tuxpan | 12.9 | 13.1 | 16.2 | 14.5 | -1.9% |
| | Isla de Cedros | 13.3 | 11.5 | 13.5 | 13.9 | 15.3% |
| | **Panama** | **111.3** | **102.6** | **93.4** | **84.6** | **8.4%** |
| **South America** | **Brazil** | **1210.5** | **1155.6** | **1104.1** | **1122.1** | **4.7%** |
| | Itaqui | 228.0 | 231.9 | 229.6 | 235.3 | -1.7% |
| | Santos | 147.0 | 146.5 | 134.0 | 107.5 | 0.4% |
| | Tubarang | 83.0 | 71.7 | 95.8 | 123.5 | 15.8% |
| | Itaguay | 103.3 | 97.5 | 88.7 | 116.0 | 5.9% |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Paranagua | 55.7 | 57.3 | 52.0 | 52.6 | -2.9% |
| | **Argentina** | | | | | |
| | Buenos Aires* | 7.6 | 7.1 | 7.0 | 7.4 | 6.8% |
| | **Colombia** | **168.6** | **163.7** | **195.2** | **199.3** | **3.0%** |
| | Sinaga | 45.5 | 43.5 | 47.5 | 46.0 | 4.5% |
| | Cartagena | 32.0 | 37.2 | 41.9 | 37.8 | -14.1% |
| | Morrosquillo c. de | 24.9 | 30.3 | 32.8 | 30.7 | -17.8% |
| | Buenaventura | 17.9 | 17.4 | 19.0 | 25.9 | 2.5% |
| | **Chile** | | | | | |
| | San Antonio | 24.4 | 22.0 | 22.7 | 22.1 | 10.8% |
| | Valparaiso* | 8.3 | 8.3 | 9.4 | 10.4 | 0.0% |
| **Asia** | **China Mainland** | **9972.6** | **9480.0** | **9186.1** | **9223.9** | **5.2%** |
| | Ningbo Zhoushan | 1224.1 | 1172.4 | 1119.8 | 1038.1 | 4.4% |
| | Shanghai | 769.7 | 711.0 | 716.8 | 716.6 | 8.2% |
| | Tangshan | 722.4 | 702.6 | 656.6 | 637.0 | 2.8% |
| | Guangzhou | 623.7 | 612.4 | 606.3 | 538.3 | 1.8% |
| | Qingdao | 630.3 | 604.6 | 577.5 | 541.6 | 4.3% |
| | Suzhou | 565.9 | 554.1 | 522.7 | 531.8 | 2.1% |
| | Tianjin | 529.5 | 502.9 | 492.1 | 472.8 | 5.3% |
| | Rizhao | 541.2 | 496.2 | 463.7 | 437.5 | 9.1% |
| | Yantai | 423.4 | 399.4 | 386.2 | 333.6 | 6.0% |
| | Dalian | 315.5 | 334.0 | 366.2 | 351.3 | -5.5% |
| | Huanghua | 311.3 | 301.3 | 287.7 | 287.2 | 3.3% |
| | Shenzhen | 278.4 | 265.1 | 257.8 | 251.3 | 5.0% |
| | Lianyungang | 269.2 | 241.8 | 234.6 | 225.3 | 11.3% |
| | Yingkou | 230.0 | 238.2 | 238.2 | 369.8 | -3.5% |
| | Zhanjiang | 255.6 | 233.9 | 215.8 | 221.9 | 9.3% |
| | Xiamen | 227.6 | 207.5 | 213.5 | 212.8 | 9.7% |
| | Qinhuangdao | 200.5 | 200.6 | 218.8 | 231.3 | 0.0% |
| | **Hong Kong, China** | **213.7** | **249.3** | **263.3** | **258.5** | **-14.3%** |
| | **Chinese Taipei** | | | | | |
| | Kaohsiung | 120.1 | 108.6 | 114.0 | 118.8 | 10.7% |
| | Taichung | 73.3 | 70.9 | 69.6 | 72.8 | 3.3% |
| | Keelung | 16.6 | 16.2 | 15.4 | 17.3 | 2.4% |
| | Hualien | 9.0 | 9.0 | 8.8 | 8.7 | 0.3% |
| | Suao | 4.2 | 4.2 | 4.3 | 4.5 | -0.5% |
| | **Japan** | | | | | |
| | Nagoya | 177.8 | 168.5 | 194.4 | 196.6 | 5.5% |
| | Chiba | 134.6 | 134.0 | 140.0 | 140.4 | 0.4% |
| | Tomakomai | 104.8 | 100.3 | 107.3 | 98.1 | 4.5% |
| | Yokohama | 104.8 | 93.6 | 110.6 | 114.0 | 11.9% |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Kitakyushu* | 95.4 | 88.5 | 98.5 | 93.6 | 7.8% |
| | Kobe* | 89.8 | 82.9 | 94.0 | 95.5 | 8.4% |
| | Tokyo | 84.7 | 80.9 | 87.8 | 91.5 | 4.7% |
| | Osaka* | 83.5 | 78.5 | 85.2 | 84.3 | 6.4% |
| | **South Korea** | **1580.7** | **1510.1** | **1656.0** | **1635.6** | **4.7%** |
| | Busan | 442.5 | 411.2 | 442.3 | 461.6 | 7.6% |
| | Gwangyang | 292.1 | 273.3 | 309.7 | 301.9 | 6.9% |
| | Ulsan | 184.7 | 187.9 | 202.4 | 202.9 | -1.7% |
| | Incheon | 158.3 | 152.2 | 157.7 | 163.9 | 4.0% |
| | Pyeongtaek Dangjin | 116.3 | 106.9 | 113.2 | 115.2 | 8.8% |
| | Mountain | 87.6 | 84.5 | 93.1 | 92.6 | 3.7% |
| | Pohang | 59.5 | 58.2 | 60.9 | 60.6 | 2.2% |
| | East Sea/Ink Lake | 31.5 | 30.7 | 34.5 | 34.9 | 2.7% |
| | **India** | **1318.3** | **1236.9** | **1299.5** | **1165.6** | **6.6%** |
| | Candela | 126.8 | 116.7 | 122.9 | 113.4 | 8.7% |
| | Baladibu | 115.7 | 111.5 | 112.5 | 108.1 | 3.8% |
| | Nehru | 76.1 | 62.3 | 69.6 | 66.2 | 22.2% |
| | Visakhapatnam | 68.8 | 71.1 | 68.9 | 69.6 | -3.3% |
| | **Vietnam** | **767.0** | **755.2** | **725.0** | **-** | **1.6%** |
| | Ho Chi Minh | 169.1 | 163.2 | - | - | 3.6% |
| | Ba Ria Vung Tau | 104.4 | 113.3 | - | - | -7.9% |
| | Quang Ninh | 99.8 | 109.3 | - | - | -8.6% |
| | Hai Phong | 91.6 | 85.0 | - | - | 7.9% |
| | **Saudi Arabia** | | | | | |
| | Yanbu | 112.4 | 115.5 | 130.1 | 127.7 | -2.7% |
| | Jeddah | 60.6 | 61.6 | 55.2 | 54.8 | -1.7% |
| | Jubail | 73.4 | 74.5 | 75.8 | 82.6 | -1.5% |
| | Dammam | 32.6 | 36.9 | 33.1 | 31.7 | -11.8% |
| | **Singapore** | **599.6** | **590.7** | **626.5** | **630.1** | **1.5%** |
| | **Malaysia** | **590.3** | **565.8** | **595.2** | **567.6** | **4.3%** |
| | Tanjung Pelepas | 168.1 | 144.6 | 137.2 | 139.8 | 16.2% |
| | Port Klang | 235.4 | 223.0 | 243.1 | 220.7 | 5.6% |
| | **Philippines** | **266.8** | **244.0** | **266.4** | **261.0** | **9.3%** |
| | Manila | 98.9 | 87.6 | 104.7 | 107.6 | 12.8% |
| | **Bangladesh** | | | | | |
| | Chittagong | 116.6 | 103.2 | 103.1 | - | 13.0% |
| | **Iran** | **147.5** | **129.9** | **150.4** | **144.6** | **13.5%** |
| | Bandar Khomeini | 45.7 | 39.1 | 44.1 | 43.1 | 16.7% |
| | Shahid Rajaee | 73.5 | 65.4 | 80.1 | 77.9 | 12.3% |
| **Australia** | **Australia** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Hedland | 553.3 | 547.1 | 521.9 | 518.0 | 1.1% |
| Dampier | 165.2 | 169.9 | 170.8 | 175.6 | -2.8% |
| Newcastle | 166.1 | 164.5 | 170.4 | 165.1 | 0.9% |
| Gladstone | 122.6 | 122.3 | 122.8 | 120.9 | 0.2% |
| Hay Point | 99.2 | 101.0 | 116.6 | 118.4 | -1.9% |
| Melbourne | 103.2 | 91.6 | 93.5 | 95.0 | 12.6% |
| Fremantle | 30.4 | 32.7 | 34.5 | 34.8 | -7.0% |
| Abbottport | 29.1 | 29.9 | 30.1 | 29.8 | -2.4% |
| Brisbane | 31.5 | 28.7 | 25.5 | 33.7 | 9.9% |
| **New Zealand** | | | | | |
| Tauranga | 25.7 | 24.8 | 27.0 | 24.5 | 3.8% |
| Auckland | 6.7 | 5.8 | 6.5 | 6.8 | 15.5% |

Source: Websites of various port authorities.

Note: * indicates projections.

**Table 8** Growth Rate of Container Throughput of Ports in The World by Region

(unit：%)

| Region | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| North America | 23.0 | 2.8 | 3.7 | 2.3 | 4.8 | 1.3 | 8.1 | 2.0 | 0.9 | -1.3 | 13.3 |
| Europe | 21.9 | 7.5 | 2.4 | 2.9 | -2.0 | 3.3 | 6.1 | 5.2 | 3.0 | -3.2 | 4.6 |
| Asia | 16.4 | 9.4 | 5.5 | 3.9 | 1.4 | 3.0 | 6.4 | 5.4 | 2.3 | -0.3 | 5.4 |
| Middle East/ South Asia | 5.0 | 5.7 | 5.1 | 0.8 | 5.4 | 3.9 | 6.0 | 2.4 | 1.3 | -1.5 | 8.0 |
| Latin America | 10.9 | 9.1 | 4.5 | 1.3 | 0.6 | -1.6 | 6.0 | 7.7 | 0.2 | 1.4 | 10.0 |
| Africa | -11.1 | 12.1 | 4.2 | 7.0 | 2.8 | -3.4 | 8.4 | 5.4 | 4.6 | 1.5 | 6.6 |
| Oceania | 8.5 | 7.1 | 2.9 | 1.4 | 2.5 | 2.1 | 6.4 | 4.5 | -1.2 | -1.5 | 8.3 |
| Global | 15.1 | 8.2 | 4.6 | 3.2 | 0.6 | 2.5 | 6.5 | 5.2 | 2.1 | -0.9 | 6.5 |

Source: Drewry.

**Table 9** Share of Container Transshipment in the World Ports

(unit：million TEUs)

| Year | Total Container Volume | Proportion of Empty Container | Transshipment | Proportion of transshipment |
|---|---|---|---|---|
| 1980 | 39 | 21.7% | 4 | 10.9% |
| 1985 | 57 | 23.3% | 8 | 13.4% |
| 1990 | 88 | 20.2% | 16 | 17.6% |
| 1995 | 146 | 18.4% | 31 | 21.4% |
| 2000 | 235 | 21.2% | 57 | 24.3% |
| 2001 | 249 | 21.9% | 62 | 24.9% |
| 2002 | 281 | 21.1% | 72 | 25.6% |

| | | | | |
|---|---|---|---|---|
| 2003 | 317 | 20.8% | 82 | 25.9% |
| 2004 | 363 | 20.6% | 97 | 26.7% |
| 2005 | 400 | 20.7% | 105 | 26.3% |
| 2006 | 443 | 21.2% | 118 | 26.6% |
| 2007 | 497 | 21.4% | 137 | 27.6% |
| 2008 | 526 | 21.1% | 150 | 28.5% |
| 2009 | 478 | 21.4% | 136 | 28.4% |
| 2010 | 549 | 21.3% | 155 | 28.2% |
| 2011 | 595 | 23.8% | 168 | 28.3% |
| 2012 | 622 | 24.0% | 177 | 28.5% |
| 2013 | 644 | 24.0% | 180 | 28.0% |
| 2014 | 680 | 24.0% | 188 | 27.6% |
| 2015 | 685 | 24.7% | 181 | 26.4% |
| 2016 | 702 | 24.8% | 181 | 25.8% |
| 2017 | 745 | 25.2% | 193 | 25.9% |
| 2018 | 784 | 25.3% | 198 | 25.4% |
| 2019 | 801 | 25.4% | 205 | 25.7% |
| 2020 | 797 | 25.4% | 206 | 26.3% |
| 2021 | 849 | 27.0% | 215 | 25.2% |

Source: Drewry.

**Table 10** Global Port Container Throughput in 2006-2021

(unit：million TEUs)

| Year | Total | Full | Empty | Growth Rate |
|---|---|---|---|---|
| 2006 | 4.4 | 3.5 | 0.9 | 11.0% |
| 2007 | 5.0 | 3.9 | 1.1 | 12.2% |
| 2008 | 5.3 | 4.2 | 1.1 | 5.8% |
| 2009 | 4.8 | 3.8 | 1.0 | -9.1% |
| 2010 | 5.5 | 4.3 | 1.2 | 14.7% |
| 2011 | 6.0 | 4.6 | 1.4 | 8.5% |
| 2012 | 6.2 | 4.7 | 1.5 | 4.6% |
| 2013 | 6.4 | 4.9 | 1.6 | 3.6% |
| 2014 | 6.8 | 5.2 | 1.6 | 5.6% |
| 2015 | 6.9 | 5.2 | 1.7 | 0.6% |
| 2016 | 7.0 | 5.2 | 1.8 | 2.6% |
| 2017 | 7.5 | 5.5 | 1.9 | 6.1% |
| 2018 | 7.8 | 5.9 | 2.0 | 5.2% |
| 2019 | 8.0 | 6.0 | 2.0 | 2.1% |
| 2020 | 8.0 | 5.9 | 2.1 | -0.5% |
| 2021 | 8.5 | 6.3 | 2.3 | 6.5% |

Source: Drewry.

**Table 11** Container Throughput of Major Global Ports in 2017-2020

(unit：million TEUs)

| Region | Port | 2021 | 2020 | 2019 | 2018 | 21-20 Growth Rate |
|---|---|---|---|---|---|---|
| Asia | **China Mainland** | **282.7** | **264.3** | **261.2** | **249.8** | **7.0%** |
| | Shanghai | 47.0 | 43.5 | 43.3 | 42.0 | 8.1% |
| | Ningbo Zhoushan | 31.1 | 28.7 | 27.5 | 26.4 | 8.2% |
| | Shenzhen | 28.8 | 26.6 | 25.8 | 25.7 | 8.4% |
| | Guangzhou | 24.2 | 23.2 | 22.8 | 21.5 | 4.4% |
| | Qingdao | 23.7 | 22.0 | 21.0 | 19.3 | 7.7% |
| | Tianjin | 20.3 | 18.4 | 17.3 | 15.9 | 10.5% |
| | Xiamen | 12.1 | 11.4 | 11.1 | 10.7 | 5.6% |
| | Suzhou | 8.1 | 6.3 | 6.3 | 6.4 | 28.9% |
| | Yingkou | 5.2 | 5.7 | 5.5 | 6.5 | -7.8% |
| | Dalian | 3.7 | 5.1 | 8.8 | 9.8 | -28.2% |
| | Beibu Gulf | 6.0 | 5.1 | 3.8 | 2.8 | 19.0% |
| | Rizhao | 5.2 | 4.9 | 4.5 | 4.0 | 6.4% |
| | Lianyungang | 5.0 | 4.8 | 4.8 | 4.8 | 4.8% |
| | Foshan | 3.7 | 4.1 | 4.4 | 3.8 | -8.4% |
| | Fuzhou | 3.5 | 3.5 | 3.5 | 3.3 | -2.0% |
| | Yantai | 3.7 | 3.3 | 3.1 | 3.0 | 10.6% |
| | Dongguan | 3.4 | 3.4 | 3.7 | 3.2 | -0.6% |
| | Tangshan | 3.3 | 3.1 | 3.0 | 2.9 | 5.4% |
| | Nanjing | 3.1 | 3.0 | 3.3 | 3.2 | 3.0% |
| | Quanzhou | 2.0 | 2.3 | 2.6 | 2.4 | -13.7% |
| | Wuhan | 2.5 | 2.0 | 1.7 | 1.6 | 26.5% |
| | Nantong | 2.0 | 1.9 | 1.5 | 1.0 | 6.3% |
| | Haikou | 2.0 | 2.0 | 2.0 | 1.8 | 2.0% |
| | Jiaxing | 2.2 | 2.0 | 1.9 | 1.7 | 13.3% |
| | Zhuhai | 2.0 | 1.8 | 2.6 | 2.3 | 10.9% |
| | Shantou | 1.8 | 1.6 | 1.4 | 1.2 | 13.2% |
| | Zhongshan | 1.4 | 1.4 | 1.4 | 1.4 | -0.7% |
| | Zhanjiang | 1.4 | 1.2 | 1.1 | 1.0 | 13.8% |
| | Weihai | 1.3 | 1.2 | 1.0 | 0.9 | 9.8% |
| | Wenzhou | 1.0 | 1.0 | 0.8 | 0.7 | 3.0% |
| | Dandong | 0.2 | 0.2 | 0.4 | 0.9 | -4.8% |
| | **Hong Kong, China** | **17.8** | **18.0** | **18.3** | **19.6** | **-1.0%** |
| | **Chinese Taipei** | | | | | |
| | Kaohsiung | 9.9 | 9.6 | 10.4 | 10.5 | 2.5% |
| | Taichung | 2.0 | 1.8 | 1.8 | 1.7 | 8.7% |
| | Taipei | 2.0 | 1.6 | 1.6 | 1.7 | 24.2% |

| | | | | | |
|---|---|---|---|---|---|
| Keelung | 1.6 | 1.5 | 1.5 | 1.5 | 4.5% |
| **Japan** | | | | | |
| Tokyo | 4.9 | 4.3 | 5.0 | 5.1 | 14.1% |
| Yokohama | 2.9 | 2.7 | 3.0 | 3.1 | 7.5% |
| Kobe* | 2.8 | 2.7 | 2.9 | 2.9 | 5.9% |
| Nagoya | 2.7 | 2.5 | 2.8 | 2.9 | 10.3% |
| Osaka* | 2.4 | 2.4 | 2.5 | 2.4 | 1.3% |
| Shimizu | 0.6 | 0.5 | 0.6 | 0.6 | 9.4% |
| **South Korea** | **30.0** | **29.1** | **29.2** | **29.0** | **3.2%** |
| Busan | 22.7 | 21.8 | 22.0 | 21.7 | 4.0% |
| Incheon | 3.4 | 3.3 | 3.1 | 3.1 | 2.7% |
| Gwangyang | 2.1 | 2.2 | 2.4 | 2.4 | -1.4% |
| Pyeongtaek Dangjin | 0.9 | 0.8 | 0.7 | 0.7 | 14.9% |
| **Singapore** | **37.5** | **36.9** | **37.2** | **36.6** | **1.6%** |
| **Malaysia** | **28.4** | **26.7** | **26.4** | **24.9** | **6.4%** |
| Klang | 13.7 | 13.2 | 13.6 | 12.3 | 3.7% |
| Tanjung Pelepas | 11.2 | 9.8 | 9.1 | 9.0 | 14.3% |
| Penang | 1.3 | 1.4 | 1.5 | 1.5 | -10.1% |
| Johor | 0.9 | 1.0 | 1.0 | 0.9 | -6.8% |
| **Thailand** | | | | | |
| Laem Chabang | 8.5 | 7.6 | 8.0 | 8.1 | 12.9% |
| Bangkok | 1.4 | 1.4 | 1.5 | 1.5 | -2.3% |
| **Vietnam** | | | | | |
| Ho Chi Minh | 8.1 | 7.9 | 7.5 | 6.6 | 3.0% |
| Haiphong | 5.8 | 5.1 | 5.1 | 5.0 | 12.7% |
| Gaime | 4.9 | 4.4 | 3.7 | 3.0 | 12.0% |
| **Philippines** | **7.4** | **6.8** | **7.9** | **7.5** | **8.7%** |
| Manila | 5.0 | 4.4 | 5.3 | 5.1 | 12.2% |
| **India** | | | | | |
| Nehru | 5.6 | 4.5 | 5.1 | 5.1 | 25.9% |
| Mondra | 6.7 | 5.7 | 4.7 | 4.4 | 17.7% |
| **Indonesia** | | | | | |
| Tanjung Priok | 7.5 | 6.9 | 7.6 | 7.8 | 8.8% |
| **Saudi Arabia** | | | | | |
| Jeddah | 4.7 | 4.7 | 4.4 | 4.3 | 0.0% |
| Dammam | 1.8 | 1.9 | 1.8 | 1.7 | -5.1% |
| Jubail | 0.6 | 0.6 | 0.6 | 0.7 | -2.9% |
| **United Arab Emirates** | | | | | |
| Dubai | 13.7 | 13.5 | 14.1 | 15.0 | 1.9% |
| Abu Dhabi* | 3.3 | 3.2 | 2.8 | 1.7 | 2.2% |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Bangladesh** | | | | | |
| | Chittagong | 3.2 | 2.8 | 3.1 | 2.9 | 13.2% |
| | **Sri Lanka** | | | | | |
| | Colombo | 7.3 | 6.9 | 7.2 | 7.1 | 5.8% |
| | **Oman** | | | | | |
| | Salalah | 4.5 | 4.3 | 4.1 | 3.4 | 3.9% |
| | **Pakistan** | | | | | |
| | Karachi | 2.5 | 2.1 | 2.1 | 2.2 | 21.7% |
| | Gdansk | 2.1 | 1.9 | 2.1 | 2.0 | 10.1% |
| | King Atradu | 2.8 | 2.2 | 2.0 | 2.3 | 30.6% |
| **North America** | **The United States** | | | | | |
| | Los Angeles | 10.7 | 9.2 | 9.3 | 9.5 | 15.9% |
| | Long Beach | 9.4 | 8.1 | 7.6 | 8.1 | 15.7% |
| | New York/New Jersey | 9.0 | 7.6 | 7.5 | 7.2 | 18.5% |
| | Savannah | 5.6 | 4.7 | 4.6 | 4.4 | 19.9% |
| | Northwest Seaport Alliance | 3.7 | 3.3 | 3.8 | 3.8 | 12.5% |
| | Houston | 3.5 | 3.0 | 3.0 | 2.7 | 15.5% |
| | Virginia | 3.5 | 2.8 | 2.9 | 2.9 | 25.2% |
| | Auckland | 2.5 | 2.5 | 2.5 | 2.6 | -0.5% |
| | Charleston | 2.8 | 2.3 | 2.4 | 2.3 | 19.1% |
| | Jacksonville | 1.4 | 1.3 | 1.3 | 1.3 | 10.2% |
| | Baltimore | 1.0 | 1.1 | 1.1 | 1.0 | -2.8% |
| | Everglades | 1.0 | 0.9 | 1.1 | 1.1 | 4.3% |
| | **Canada** | | | | | |
| | Vancouver | 3.7 | 3.5 | 3.4 | 3.4 | 6.1% |
| | Montreal | 1.7 | 1.6 | 1.8 | 1.7 | 7.5% |
| | Prince Rupert | 1.1 | 1.1 | 1.2 | 1.0 | -7.6% |
| | Halifax | 0.6 | 0.5 | 0.6 | 0.6 | 17.5% |
| | **Mexico** | **7.9** | **6.5** | **7.1** | **7.0** | **21.6%** |
| | Manzanillo Cologne | 3.4 | 2.9 | 3.1 | 3.1 | 15.9% |
| | Lazaro | 1.7 | 1.1 | 1.3 | 1.3 | 58.5% |
| | Veracruz | 1.2 | 1.0 | 1.1 | 1.2 | 15.8% |
| | **Panama** | **8.6** | **7.7** | **7.4** | **7.0** | **11.5%** |
| | Balboa | 3.6 | 3.2 | 2.9 | 2.1 | 12.6% |
| | Cologne | 4.9 | 4.5 | 4.4 | 4.3 | 10.3% |
| **South America** | **Brazil** | **11.8** | **10.6** | **10.4** | **10.1** | **11.2%** |
| | Santos | 4.8 | 4.2 | 4.2 | 3.2 | 14.3% |
| | Itajai | 1.6 | 1.4 | 1.2 | 1.2 | 15.8% |
| | **Colombia** | **4.6** | **4.4** | **4.4** | **4.3** | **2.7%** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Cartagena | 3.2 | 3.1 | 2.8 | 2.5 | 1.0% |
| | Buenaventura | 1.1 | 1.0 | 1.2 | 1.4 | 4.7% |
| | **Chile** | | | | | |
| | San Antonio | 1.8 | 1.6 | 1.7 | 1.7 | 15.8% |
| | Valparaiso* | 0.7 | 0.7 | 0.9 | 0.9 | 0.0% |
| | **Uruguay** | | | | | |
| | Montevideo | 1.0 | 0.8 | 0.8 | 0.8 | 27.9% |
| | **Ecuador** | **2.4** | **2.3** | **2.3** | **2.2** | **3.3%** |
| | Guayaquil* | 2.1 | 2.1 | 2.1 | 2.1 | 3.3% |
| | **Peru** | | | | | |
| | Callao* | 2.5 | 2.3 | 2.3 | 2.3 | 12.8% |
| **Europe** | **Netherlands** | | | | | |
| | Rotterdam | 15.3 | 14.4 | 14.8 | 14.5 | 6.6% |
| | **Belgium** | | | | | |
| | Antwerp | 12.0 | 12.0 | 11.9 | 11.1 | -0.1% |
| | Zeebrugge | 2.2 | 1.8 | 1.6 | 1.6 | 22.5% |
| | **Turkey** | **12.6** | **11.6** | **11.6** | **10.8** | **8.3%** |
| | Ambali | 2.9 | 2.9 | 3.1 | 3.2 | 1.9% |
| | Mersin | 2.1 | 2.0 | 1.9 | 1.7 | 8.1% |
| | Izmit | 2.0 | 1.8 | 1.7 | 1.6 | 9.3% |
| | **Germany** | | | | | |
| | Hamburger | 8.7 | 8.5 | 9.3 | 8.7 | 2.0% |
| | Bremerhaven | 5.0 | 4.8 | 4.9 | 5.4 | 5.2% |
| | **France** | | | | | |
| | Marseille | 1.5 | 1.3 | 1.5 | 1.3 | 13.8% |
| | Le Havre/Rouen | 3.1 | 2.4 | 2.8 | 0.0 | 27.0% |
| | **Ireland** | | | | | |
| | Dublin | 0.8 | 0.8 | 0.8 | 0.7 | 11.2% |
| | **Spain** | **17.7** | **16.8** | **17.5** | **17.2** | **5.5%** |
| | Valencia | 5.6 | 5.4 | 5.4 | 5.2 | 3.2% |
| | Algeciras | 4.8 | 5.1 | 5.1 | 4.8 | -6.1% |
| | Barcelona | 3.5 | 3.0 | 3.3 | 3.4 | 19.4% |
| | Las Palmas | 1.2 | 1.0 | 1.0 | 1.1 | 13.7% |
| | Bilbao | 0.5 | 0.5 | 0.6 | 0.6 | 10.9% |
| | **Italy** | | | | | |
| | Genoa | 2.8 | 2.5 | 2.7 | 2.7 | 11.3% |
| | Trieste | 0.8 | 0.8 | 0.8 | 0.7 | -2.4% |
| | Gioia Tauro | 3.2 | 3.2 | 2.5 | 2.3 | -1.5% |
| | **Portugal** | | | | | |
| | Leshoues | 0.7 | 0.7 | 0.7 | 0.7 | 2.0% |
| | Lisbon* | 0.3 | 0.3 | 0.5 | 0.4 | 10.7% |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Russia** | | | | | |
| | St. Petersburg | 2.0 | 2.1 | 2.2 | 2.1 | -2.7% |
| | **Poland** | **3.2** | **2.9** | **3.1** | **2.8** | **9.3%** |
| | Gdansk | 2.1 | 1.9 | 2.1 | 1.9 | 10.0% |
| | **Lithuania** | | | | | |
| | Klebida | 0.7 | 0.6 | 0.7 | 0.8 | 4.2% |
| | **Latvia** | | | | | |
| | Riga | 0.4 | 0.5 | 0.5 | 0.5 | -8.4% |
| | **Estonia** | | | | | |
| | Tallinn | 0.2 | 0.2 | 0.2 | 0.2 | 6.0% |
| | **Finland** | | | | | |
| | Helsinki | 0.5 | 0.5 | 0.5 | 0.5 | -8.0% |
| | **Romania** | | | | | |
| | Constanta | 0.6 | 0.6 | 0.7 | 0.7 | -1.8% |
| | **Greece** | | | | | |
| | Piraevski | 5.3 | 5.4 | 5.7 | 4.4 | -2.3% |
| | **United Kingdom** | | | | | |
| | Felix Stowe* | 3.5 | 3.5 | 3.8 | 3.8 | 0.6% |
| | London* | 3.1 | 2.8 | 2.8 | 2.7 | 11.0% |
| | Southampton* | 2.1 | 1.8 | 1.9 | 2.0 | 19.2% |
| | **Malta** | | | | | |
| | Marsaxlok | 3.0 | 2.4 | 2.7 | 3.3 | 21.7% |
| **Oceania** | **Australia** | | | | | |
| | Melbourne | 3.3 | 3.0 | 3.0 | 3.0 | 9.6% |
| | Brisbane | 1.6 | 1.4 | 1.3 | 1.4 | 14.6% |
| | Fremantle | 0.8 | 0.8 | 0.8 | 0.8 | 3.0% |
| | Sydney | 2.8 | 2.5 | 2.6 | - | 9.5% |
| | **New Zealand** | | | | | |
| | Tauranga | 1.2 | 1.3 | 1.2 | 1.2 | -4.1% |
| | Auckland | 0.8 | 0.9 | 0.9 | 1.0 | -7.8% |
| **Africa** | **Morocco** | | | | | |
| | Tangier Med | 7.2 | 5.8 | 4.8 | 3.5 | 24.3% |
| | **Egypt** | | | | | |
| | Side* | 4.1 | 4.0 | 3.8 | 3.1 | 1.5% |
| | **South Africa** | | | | | |
| | Durban | 2.7 | 2.6 | 2.8 | 3.0 | 3.9% |
| | **Togo** | | | | | |
| | Lome* | 2.0 | 1.7 | 1.5 | 1.4 | 12.7% |

Source: Websites of various port authorities.

Note: * indicates projections.

**Table 12** Container Throughput and Growth Rate of Global Top 100 Ports

(unit：million TEUs)

| Ranking | Country | Port | 2021 | 2020 | 21-20 Growth Rate |
|---|---|---|---|---|---|
| 1（1） | China | Shanghai | 47.0 | 43.5 | 8.1% |
| 2（2） | Singapore | Singapore | 37.5 | 36.9 | 1.6% |
| 3（3） | China | Ningbo zhoushan | 31.1 | 28.7 | 8.2% |
| 4（4） | China | shenzhen | 28.8 | 26.6 | 8.4% |
| 5（5） | China | Guangzhou | 24.2 | 23.2 | 4.4% |
| 6（6） | China | Qingdao | 23.7 | 22.0 | 7.7% |
| 7（7） | South Korea | Busan | 22.7 | 21.8 | 4.0% |
| 8（8） | China | Tianjin | 20.3 | 18.4 | 10.4% |
| 9（9） | China | Hong Kong | 17.8 | 18.0 | -0.9% |
| 10（10） | The Netherlands | Rotterdam | 15.3 | 14.4 | 6.6% |
| 11（11） | United Arab Emirates | Dubai | 13.7 | 13.5 | 1.9% |
| 12（12） | Malaysia | Port Klang | 13.7 | 13.2 | 3.7% |
| 13（14） | China | Xiamen | 12.1 | 11.4 | 5.6% |
| 14（13） | Belgium | Antwerp | 12.0 | 12.0 | -0.1% |
| 15（15） | Malaysia | Tanjung Pelepas | 11.2 | 9.8 | 14.3% |
| 16（17） | United States | Los Angeles | 10.7 | 9.2 | 15.9% |
| 17（16） | Chinese Taipei | Kaohsiung | 9.9 | 9.6 | 2.5% |
| 18（19） | United States | Long Beach | 9.4 | 8.1 | 15.7% |
| 19（21） | United States | New York / New Jersey | 9.0 | 7.6 | 18.5% |
| 20（18） | Germany | Hamburg | 8.7 | 8.5 | 2.0% |
| 21（22） | Thailand | Laem Chabang | 8.5 | 7.6 | 12.9% |
| 22（25） | China | Suzhou | 8.1 | 6.3 | 28.9% |
| 23（20） | Vietnam | Ho Chi Minh City | 8.1 | 7.9 | 3.0% |
| 24（23） | Indonesia | Tanjung Priok* | 7.5 | 6.9 | 8.8% |
| 25（24） | Sri Lanka | Colombo | 7.3 | 6.9 | 5.8% |
| 26（26） | Morocco | Tanger Med | 7.2 | 5.8 | 24.3% |
| 27（27） | India | Mundra | 6.7 | 5.7 | 17.7% |
| 28（31） | Vietnam | Hai Phong* | 5.8 | 5.1 | 12.7% |
| 29（39） | India | Jawaharlal Nehru | 5.6 | 4.5 | 26.0% |
| 30（38） | United States | Savannah | 5.6 | 4.7 | 19.9% |
| 31（30） | Spain | Valencia | 5.6 | 5.4 | 3.3% |
| 32（29） | Greece | Piraeus | 5.3 | 5.4 | -2.3% |
| 33（28） | China | Yingkou | 5.2 | 5.7 | -7.8% |
| 34（34） | China | Rizhao | 5.2 | 4.9 | 6.4% |
| 35（35） | China | Lianyungang | 5.0 | 4.8 | 4.8% |
| 36（36） | Germany | Bremen/Bremerhaven | 5.0 | 4.8 | 5.3% |
| 37（41） | Philippines | Manila | 5.0 | 4.4 | 12.3% |

| | | | | | |
|---|---|---|---|---|---|
| 38（42） | Vietnam | Cai Mep | 4.9 | 4.4 | 12.0% |
| 39（40） | Panama | Colón | 4.9 | 4.5 | 10.3% |
| 40（44） | Japan | Tokyo | 4.9 | 4.3 | 14.0% |
| 41（45） | Brazil | Santos | 4.8 | 4.2 | 14.1% |
| 42（33） | Spain | Algeciras | 4.8 | 5.1 | -6.1% |
| 43（37） | Saudi Arabia | Jeddah | 4.7 | 4.7 | 0.0% |
| 44（48） | China | Qinzhou | 4.6 | 4.0 | 17.2% |
| 45（43） | Oman | Salalah | 4.5 | 4.3 | 3.9% |
| 46（47） | Egypt | Port Said* | 4.1 | 4.0 | 1.5% |
| 59（49） | China | Dongguan | 3.8 | 3.7 | 3.0% |
| 47（54） | United States | Seattle/Tacoma | 3.7 | 3.3 | 12.5% |
| 48（46） | China | Foshan | 3.7 | 4.1 | -8.4% |
| 49（53） | Canada | Vancouver | 3.7 | 3.5 | 6.1% |
| 50（32） | China | Dalian | 3.7 | 5.1 | -28.2% |
| 51（55） | China | Yantai | 3.7 | 3.3 | 10.6% |
| 52（50） | Indonesia | Tanjung Perak | - | 3.6 | - |
| 53（59） | Panama | Balboa | 3.6 | 3.2 | 12.6% |
| 54（65） | Spain | Barcelona | 3.5 | 3.0 | 19.4% |
| 55（69） | United States | Virginia | 3.5 | 2.8 | 25.2% |
| 56（52） | United Kingdom | Felixstowe* | 3.5 | 3.5 | 0.6% |
| 57（64） | United States | Houston | 3.5 | 3.0 | 15.5% |
| 58（51） | China | Fuzhou | 3.5 | 3.5 | -2.0% |
| 60（66） | Mexico | Manzanillo | 3.4 | 2.9 | 15.9% |
| 61（56） | South Korea | Incheon | 3.4 | 3.3 | 2.8% |
| 62（57） | United Arab Emirates | Abu Dhabi* | 3.3 | 3.2 | 2.3% |
| 63（61） | China | Tangshan | 3.3 | 3.1 | 5.4% |
| 64（63） | Australia | Melbourne | 3.3 | 3.0 | 9.6% |
| 65（68） | Bangladesh | Chittagong | 3.2 | 2.8 | 13.2% |
| 66（60） | Colombia | Cartagena | 3.2 | 3.1 | 1.0% |
| 67（58） | Italy | Gioia Tauro* | 3.1 | 3.2 | -1.9% |
| 68（62） | China | Nanjing | 3.1 | 3.0 | 3.0% |
| 69（70） | United Kingdom | London* | 3.1 | 2.8 | 11.0% |
| 70（79） | France | Le Havre | 3.1 | 2.4 | 27.0% |
| 71（78） | Malta | Marsaxlokk | 3.0 | 2.4 | 21.6% |
| 72（67） | Turkey | Ambarli | 2.9 | 2.9 | 1.9% |
| 73（71） | Japan | Yokohama | 2.9 | 2.7 | 7.5% |
| 74（84） | Saudi Arabia | King Abdullah | 2.8 | 2.2 | 30.6% |
| 75（72） | Japan | Kobe | 2.8 | 2.7 | 5.7% |
| 76（75） | Italy | Genoa | 2.8 | 2.5 | 11.3% |
| 77（74） | Australia | Sydney | 2.8 | 2.5 | 9.5% |
| 78（81） | United States | Charleston | 2.8 | 2.3 | 19.0% |

| | | | | | |
|---|---|---|---|---|---|
| 79（76） | Japan | Nagoya | 2.7 | 2.5 | 10.5% |
| 80（73） | South Africa | Durban | 2.7 | 2.6 | 3.9% |
| 81（83） | Peru | Callao* | 2.5 | 2.3 | 12.8% |
| 82（87） | Pakistan | Karachi | 2.5 | 2.1 | 21.7% |
| 83（90） | China | Wuhan | 2.5 | 2.0 | 26.5% |
| 84（77） | United States | Oakland | 2.5 | 2.5 | -0.5% |
| 85（80） | Japan | Osaka* | 2.4 | 2.4 | 1.3% |
| 86（91） | China | Jiaxing | 2.2 | 2.0 | 13.5% |
| 87（97） | Belgium | Zebruch | 2.2 | 1.8 | 22.4% |
| 88（88） | Ecuador | Guayaquil* | 2.1 | 2.1 | 3.4% |
| 89（85） | South Korea | Yeosu Gwangyang | 2.1 | 2.2 | -1.4% |
| 90（93） | Poland | Gdansk | 2.1 | 1.9 | 10.4% |
| 91（92） | Turkey | Mersin | 2.1 | 2.0 | 8.1% |
| 92（99） | United Kingdom | Southampton | 2.1 | 1.8 | 19.2% |
| 93（86） | Russia | St Petersburg | 2.0 | 2.1 | -2.8% |
| 94（95） | China | Zhuhai | 2.0 | 1.8 | 10.9% |
| 95（94） | China | Nantong | 2.0 | 1.9 | 6.2% |
| 96（89） | China | Haikou | 2.0 | 2.0 | 2.0% |
| 97（96） | Chinese Taipei | Taichung | 2.0 | 1.8 | 8.7% |
| 98（98） | Turkey | Izmit | 2.0 | 1.8 | 9.4% |
| 99（82） | China | Quanzhou | 2.0 | 2.3 | -13.7% |
| 100（100） | Togo | Lomé* | 2.0 | 1.7 | 13.0% |

Source: Websites of various port authorities.

Note: * indicates projections.

**Table 13** Gross Container Throughput of Hutchison Port in 2008-2021

(Unit: million TEUs)

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|
| **Gross Throughput** | 67.6 | 65.3 | 75 | 75.1 | 76.8 | 78.3 | 82.9 |
| **YoY Growth** | 1.9% | -3.4% | 14.9% | 0.1% | 2.3% | 2.0% | 5.9% |
| | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** |
| **Gross Throughput** | 83.8 | 81.4 | 84.7 | 84.6 | 86.0 | 83.7 | 88.0 |
| **YoY Growth** | 1.1% | -2.9% | 4.1% | -0.1% | 1.7% | -2.7% | 5.1% |

Source: Website of CK Hutchison Industrial Co. Ltd., sorted by SISI.

**Table 14** Gross Container Throughput of PSA in 2014-2021

(Unit: million TEUs)

| | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|
| **Singapore** | 33.55 | 30.62 | 30.59 | 33.35 | 36.31 | 36.90 | 36.60 | 37.20 |
| **Overseas** | 31.89 | 33.48 | 37.04 | 40.89 | 44.69 | 48.30 | 50.00 | 54.30 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Total** | 65.44 | 64.10 | 67.63 | 74.24 | 81.00 | 85.20 | 86.60 | 91.50 |

Source: Website of PSA, sorted by SISI.

**Table 15** Financially Consolidated Container Throughput of A.P. Moller Terminal in 2020-2021

(Unit: million moves)

| Region | 2020 | 2021 | YoY Growth |
|---|---|---|---|
| **North America** | 2.8 | 3.2 | 16.7% |
| **Latin America** | 2.3 | 2.5 | 8.6% |
| **Europe, Russia and Baltics** | 2.4 | 2.6 | 8.0% |
| **Asia** | 2.0 | 2.5 | 25.6% |
| **Africa and Middle East** | 1.9 | 1.9 | -3.6% |
| **Total** | 11.5 | 12.8 | 11.3% |

Source: Website of A.P. Moller Terminal, sorted by SISI.

**Schedule 16** Gross Container Throughput of DP World in 2016-2021

(Unit: million TEUs)

| Region | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|
| **Asia-Pacific and the Indian Subcontinent** | 29.58 | 31.92 | 31.69 | 31.76 | 30.69 | 34.59 |
| **Europe, North Africa and Middle East** | 26.33 | 29.35 | 30.68 | 30.04 | 30.40 | 32.13 |
| **America and Oceania** | 7.73 | 8.79 | 9.04 | 9.45 | 10.15 | 11.21 |
| **Total** | 63.66 | 70.08 | 71.42 | 71.25 | 71.25 | 77.94 |

Source: Website of DP world, sorted by SISI.

**Schedule 17** Gross Container Throughput of Ports Operated by China Merchants Port Group in 2016-2021

(Unit: million TEUs)

| Region | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | YoY Growth |
|---|---|---|---|---|---|---|---|
| **Pearl River Delta** | 17.5 | 18.4 | 18.0 | 17.2 | 17.6 | 18.6 | 5.8% |
| **Western Shenzhen** | 11.0 | 11.2 | 10.7 | 10.2 | 10.6 | 11.5 | 8.7% |
| SCCT | 11.0 | 11.9 | 10.1 | 9.6 | 9.8 | 10.7 | 8.4% |
| CMPS | 0.9 | 0.9 | 0.6 | 0.6 | 0.7 | 0.8 | 11.8% |
| Shenzhen Total | 24.0 | 25.2 | 25.7 | 25.8 | 26.5 | 28.8 | 8.4% |
| **Others in PRO** | 2.1 | 2.3 | 2.4 | 2.5 | 2.7 | 2.7 | 0.4% |
| Shunde | — | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 7.8% |
| Zhanjiang | 0.7 | 0.9 | 1.0 | 1.1 | 1.2 | 1.2 | 0.2% |
| CKRTT | 1.3 | 1.3 | 1.2 | 1.1 | 1.1 | 1.0 | -2.6% |
| **Hong Kong** | 5.1 | 5.8 | 5.9 | 5.6 | 5.6 | 5.7 | 1.7% |
| **Southeast Coast** | 2.1 | 2.5 | 3.5 | 3.4 | 3.5 | 4.1 | 16.9% |
| Zhangzhou | 0.3 | 0.4 | 0.5 | 0.4 | 0.3 | 0.3 | -15.2% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Kaohsiung | 1.7 | 1.7 | 1.7 | 1.6 | 1.6 | 2.0 | 26.9% |
| Shantou | — | 0.4 | 1.3 | 1.3 | 1.6 | 1.8 | 13.4% |
| **Yangtze River Delta** | 39.8 | 43.2 | 45.2 | 46.6 | 46.8 | 50.4 | 7.7% |
| SIPG | 37.1 | 40.2 | 42.0 | 43.3 | 43.5 | 47.0 | 8.1% |
| Ningbo Daxie | 2.7 | 3.0 | 3.2 | 3.3 | 3.3 | 3.4 | 2.6% |
| **Bohai Rim** | 17.2 | 19.6 | 20.8 | 22.6 | 22.5 | 27.1 | 20.4% |
| Tianjin | 2.6 | 2.6 | 2.7 | 4.5 | 7.9 | 8.6 | 9.9% |
| Qingdao | 6.5 | 6.2 | 6.9 | 7.9 | 8.1 | 8.5 | 5.5% |
| Liaoning Port | 8.1 | 10.8 | 11.1 | 10.2 | 6.5 | 9.9 | 51.6% |
| **Overseas** | 16.8 | 18.1 | 20.7 | 20.8 | 28.9 | 33.6 | 16.3% |
| **CMPort Total** | 95.7 | 102.7 | 109.1 | 111.7 | 120.5 | 135.0 | 12.0% |

Source: Website of China Merchants Port Group Co. Ltd., sorted by SISI.

**Table 18** Gross Container Throughput of Ports Operated by COSCO Shipping Ports in 2021

(Unit: 1,000 TEUs)

| | Shareholdings | 2021 | | | | |
|---|---|---|---|---|---|---|
| | | 1Q | 2Q | 3Q | 4Q | Total |
| **Bohai Rim** | | **4383** | **5468** | **5111** | **4163** | **19125** |
| Dalian Container Terminal Co., Ltd | 19% | 768 | 918 | 942 | 956 | 3584 |
| Dalian Dagang Container Terminal Co.,Ltd. | 35% | 4 | 5 | 6 | 6 | 20 |
| Tianjin Port Euroasia International Container Terminal Co., Ltd.(4) | 30% | 756 | 1019 | 878 | 544 | 3197 |
| Tianjin Container Terminals(4) | 16% | 1928 | 2539 | 2394 | 1782 | 8642 |
| Yingkou Terminals | 44% | 611 | 632 | 568 | 494 | 2305 |
| Jinzhou New Age Container Terminal Co., Ltd. | 51% | 163 | 203 | 174 | 195 | 735 |
| Qinhuangdao Port New Harbour Container Terminal Co., Ltd. | 30% | 154 | 152 | 149 | 185 | 641 |
| **Yangtze River Delta** | | **3679** | **4039** | **3886** | **3832** | **15437** |
| Shanghai Pudong Int'l Container Terminals Ltd. | 30% | 596 | 646 | 671 | 688 | 2601 |
| Shanghai Mingdong Container Terminals Limited | 20% | 1675 | 1730 | 1677 | 1763 | 6846 |
| Ningbo Yuan Dong Terminals Ltd. | 20% | 749 | 804 | 811 | 678 | 3041 |
| Lianyungang New Oriental International Terminals Co.,Ltd. | 55% | 246 | 303 | 241 | 219 | 1010 |
| Taicang International Container Terminal Co., Ltd. | 39.04% | 63 | 167 | 127 | 131 | 488 |
| Nantong Tonghai Port Co., Ltd. | 51% | 351 | 389 | 359 | 353 | 1452 |
| **Southeast Coast and others** | | **1362** | **1609** | **1592** | **1587** | 6150 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Xiamen Ocean Gate Container Terminal Co., Ltd. | 70% | 594 | 657 | 664 | 627 | 2541 |
| Quan Zhou Pacific Container Terminal Co., Ltd. | 82.35% | 264 | 337 | 324 | 331 | 1255 |
| Jinjiang Pacific Ports Development Co., Ltd. | 80% | 64 | 105 | 75 | 80 | 323 |
| Kao Ming Container Terminal Corporation | 20% | 440 | 510 | 530 | 549 | 2030 |
| **Pearl River Delta** | | **6990** | **6673** | **7394** | **7785** | **28842** |
| Yantian Int'l Container Terminals Ltd. | 14.59% | 3667 | 2819 | 3731 | 3944 | 14161 |
| Guangzhou Terminals | 39.4% | 2569 | 3040 | 2909 | 3090 | 11608 |
| Hong Kong Terminals | 54.5% | 754 | 814 | 754 | 752 | 3073 |
| **Southwest Coast** | | **1264** | **1344** | **1578** | **1826** | **6012** |
| Beibu Gulf Port Co., Ltd.(2) | 4.3% | 1264 | 1344 | 1578 | 1826 | 6012 |
| **Overseas** | | **6959** | **7280** | **7990** | **7782** | **30011** |
| Piraeus Container Terminal S.A. | 100% | 1145 | 1226 | 1290 | 1035 | 4696 |
| CSP Abu Dhabi Terminal L.L.C | 90% | 158 | 172 | 165 | 202 | 697 |
| Suez Canal Container Terminal S.A.E. | 20% | 866 | 905 | 951 | 926 | 3648 |
| Kumport Liman Hizmetleri ve Lojistik Sanayi ve Ticaret AS | 26% | 305 | 313 | 307 | 323 | 1248 |
| Antwerp Gateway NV | 20% | 542 | 575.1 | 528 | 558 | 2202 |
| COSCO-PSA Terminal Private Ltd | 49% | 1203 | 1173 | 1189 | 1163 | 4727 |
| Busan Port Terminal Co. Ltd | 5.5% | 943 | 1000 | 941 | 926 | 3810 |
| SSA Terminals (Seattle)， LLC | 13.3% | 59 | 73 | 90 | 71 | 293 |
| Euromax Terminal Rotterdam B.V. | 35% | 641 | 692 | 668 | 657 | 2658 |
| Reefer Terminal S.P.A. | 40% | 18 | 19 | 16 | 15 | 67 |
| COSCO SHIPPING Ports (Spain) Terminals S.L.U | 51% | 861 | 919 | 917 | 925 | 3621 |
| CSP Zeebrugge Terminal N.V | 85% | 219 | 214 | 243 | 253 | 931 |
| **Total** (3) | | **24638** | **26413** | **27551** | **26975** | **105576** |

Source: Website of COSCO Shipping Ports Limited, sorted by SISI.

**Schedule 19** Equity Container Throughput of ICTSI by Region in 2019- 2021

(Unit: million TEUs)

| | 2019 | 2020 | 2021 |
|---|---|---|---|
| **Asia** | 4.85 | 4.70 | 5.13 |
| **Americas** | 2.98 | 3.09 | 3.38 |
| **EMEA** | 2.35 | 2.40 | 2.66 |
| **Total** | 10.18 | 10.19 | 11.16 |

Source: Website of ICTSI, sorted by SISI.

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# About Shanghai International Shipping Institute

Founded on July 14, 2008, Shanghai International Shipping Institute (SISI) was inaugurated by government officials from the Ministry of Transport and Shanghai Municipality. Han Zheng, the then Deputy Secretary of the CPC Shanghai Municipal Committee and Mayor of Shanghai, sent a letter of congratulations.

SISI, affiliated to Shanghai Maritime University, is launched by 21 council members. The first session council chair unit was China Shipping (Group) Company. The second session council chair unit is Shanghai International Port (Group) Co. Ltd, while vice council chair unit comprises 22 institutions including China Shipping (Group) Company, Shanghai Group Port Administration Committee, Shanghai Maritime Safety Administration, Shanghai Municipal Education Commission, Shanghai Municipal Transport Commission, Hongkou District People's Government, Wuhan New Port Administration Committee, China Academy of Transportation Sciences, Transport Planning and Research Institute (affiliated to China's Ministry of Transport, hereafter referred to as MOT), China Waterborne Transport Research Institute, COSCO Container Lines Co. Ltd, Sinotrans Eastern Co. Ltd, Shanghai Jinjiang Shipping Co. Ltd, Shanghai Shipping Exchange, China Ports Association, Shanghai Shipowners' Association, Shanghai Freight Forwarders Association, World Maritime University, Shanghai Maritime University, Shanghai Jiaotong University, Ningbo University, and Shanghai University of International Business and Economics. Our registered council members total nearly 400 as of September 2015.

Against the backdrop of Shanghai International Shipping Center construction, SISI endeavors to contribute its share to China's maritime industry and Shanghai's rise as a maritime capital by establishing extensive ties with international maritime organizations, companies and colleges, networking top experts via our research platform which tracks fresh concepts, technologies and trends in the global maritime circle.

SISI is an international maritime consultation and research institute providing government agencies and industry players with decision-making information and consultation service.

SISI is open to government agencies, port authorities, maritime companies, educational institutions, research institutes, industrial associations and organizations, etc., integrating efforts in maritime production, study and research.

SISI is one of the earliest institutions rated as Shanghai University Knowledge Service Platform & Center for Strategic Studies and Key Research Institute of Humanities and Social Sciences. In 2014, SISI was recognized as Collaborative Innovation Center of Shanghai University.

SISI serves as a key government think tank. In August 2012, the Ministry of Transport (MOT) and Shanghai Municipal People's Government signed a Memorandum on Deepening Cooperation to Accelerate Shanghai's Rise as an International Shipping Center which specifies that the two parties will work together to support Shanghai developing into an international shipping center. Since then, SISI was co-sponsored by Shanghai Maritime University and Shanghai Municipal Transport Commission. Weng Mengyong, vice minister of the MOT, visited SISI in April 2015.

Three main functions

- Function 1. Decision-making consultation

Analyze and grasp the growing trend of shipping and port industry, provide sound proposals for government agencies as well as shipping and port enterprises, become instrumental as a think tank for government maritime policymaking and an advisor for industry players, and strive to be a world-famous consultancy specializing in shipping.

- Function 2. Information release

Collect and compile/analyze statistics and information regarding shipping and port business, aviation, shipping finance, seaborne trade, maritime judicature, etc., publish regular reports on international and domestic shipping market as well as global port industry, and release China Shipping Prosperity Index, publish *Global Aviation Industry Development Report*, *China Shipping Finance Development Report*, *China Cruise Industry Development Report*, *China Cruise Market Development Report*, *Shanghai Shipping Policy and Law Development White Paper*, etc., launch China Shipping Database and Shipping & Port Big Data Laboratory, host international shipping and port conferences.

- Function 3. Talent service

Set up an open platform for shipping communications and exchanges, network with top shipping experts, scholars and entrepreneurs and integrate their expertise in shipping research, offer shipping talent training programs and lectures, establish bases for young teachers' practices, postgraduates' cultivation and college students' innovation to create a platform for the gathering of shipping talents.

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