



World Air Cargo Forecast 2022–2041

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Foreword

Boeing's World Air Cargo Forecast (WACF) is a biennial addendum to the Commercial Market Outlook, focused on a comprehensive and long-term view of the air cargo market. The forecast offers in-depth analysis of the global air trade markets, including trends, regional market developments, and the world's freighter fleet growth.

The tumultuous effects of the pandemic in the last two years have upended expectations and caused challenges for long-term planning and analysis. However, the overall aviation and aerospace industries remain resilient, and that extends to the air cargo market.

Our intention for this forecast is to arm our customers, our stakeholders, and the industry at large with valuable information that helps them make the best decisions for the future of air cargo and global trade. We hope the 2022 WACF meets that vital need.

We couldn't have done this without our skilled contributors, who offer decades of expertise in market analysis, trend forecasting, and air cargo traffic analysis:

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The next WACF update will appear in fourth-quarter 2024. We welcome any questions or comments. Please reach out to us at:

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Executive Summary

50%

long-term share of air cargo traffic carried by freighters

1,600

global freighter fleet growth by 2041

8%

freighter share of the commercial airplane fleet

940

production freighter deliveries by 2041

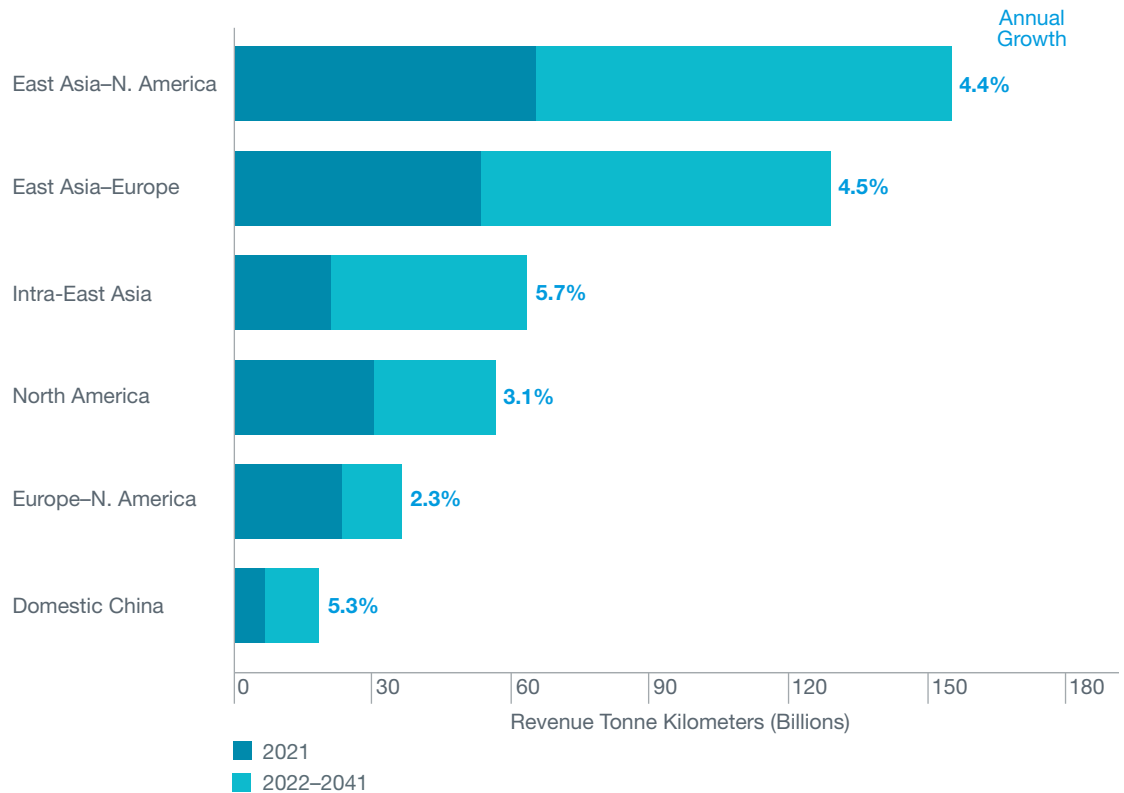
4.1%

annual air cargo traffic growth through 2041

1,855

freighter conversion deliveries by 2041

Top Air Cargo Traffic Flows Forecast
(~70% of Global Traffic)



Air Cargo Overview



Air Cargo Overview

A Unique Value Proposition

Air cargo is one part of global goods distribution networks. Across all modes, shippers seek shipments arrive at their destination on time, undamaged and at a reasonable price, regardless of transport mode.

Different transport modes—road, rail, maritime and air—can often move the same commodities. In domestic and intra-regional markets, ground transport typically dominates. However, express and distribution networks as well as supply chain planners often see air as part of the network.

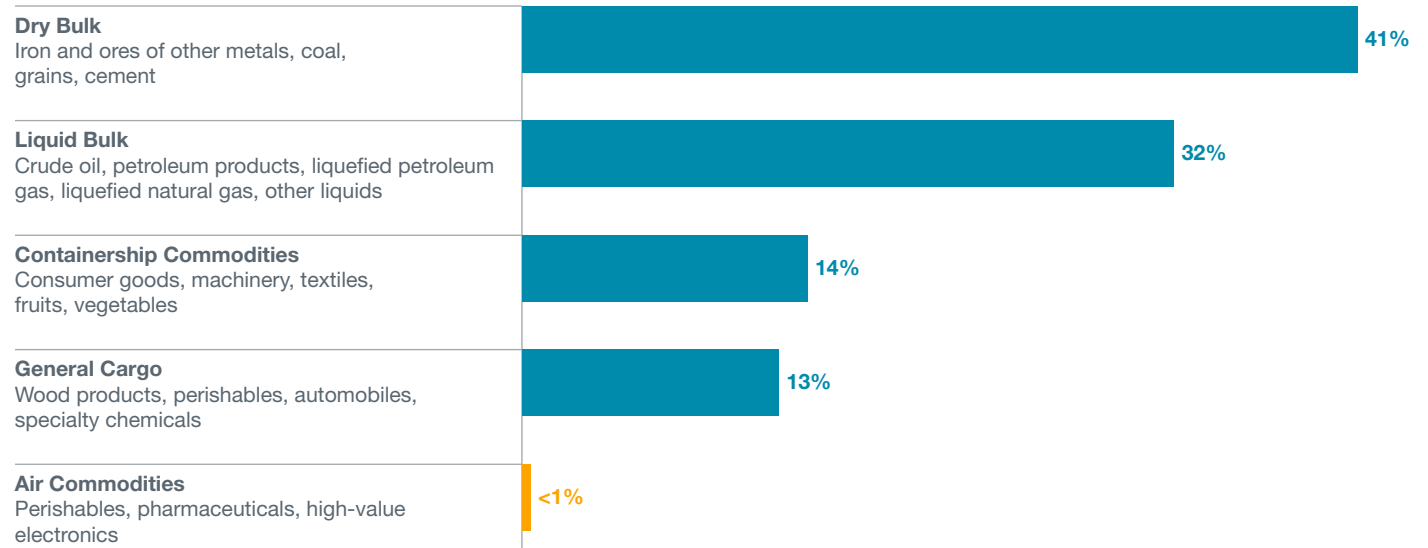
For intercontinental freight, shippers usually have only two choices: air and maritime. Maritime transport offers the primary benefit, low cost; air transport offers the benefits of speed and reliability.

Maritime for Tonnage, Air Cargo for Value

Measured in tonnes of goods moved, the maritime transport industry is much larger than the air cargo industry. In 2021, the world maritime industry carried an estimated 11.1 billion tonnes, compared to 60.9 million tonnes of air

cargo. By weight, 86% of the world's maritime trade is in raw materials and other bulk items. Most of these commodities, such as oil, metal ores, and grains, are low in value, not time sensitive, and shipped in specialized vessels. These cargoes cannot be directly compared to the high-value, dry commodities associated with air transport. However, while air cargo accounts for less than 1% of the world's trade tonnage, the high value of these goods means it is responsible for about 35% of the value of all globally shipped goods.

World Trade Focuses on Bulk Commodities



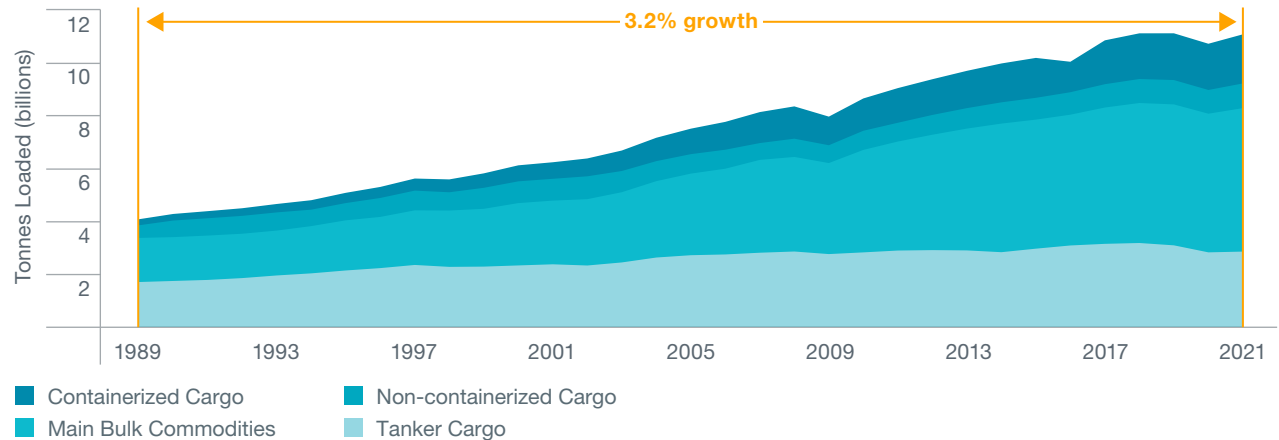
Source: S&P Global GTA

Modal Competition

Containership dynamics influence air cargo markets due to modal competition. Containerized cargo is the maritime sector that most closely corresponds to air cargo. While the majority of maritime cargo is low-value bulk, containerships carry some of the same commodities as air cargo does, while offering a low-cost alternative for goods that do not require high speed and peak reliability.

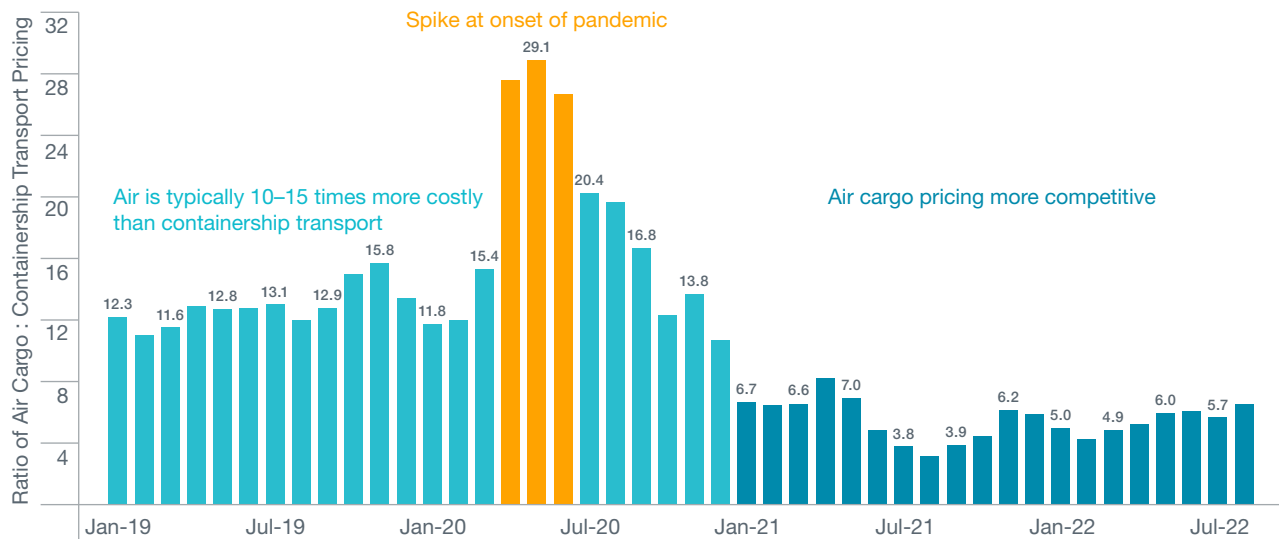
Before the COVID-19 pandemic, air cargo service generally cost 10 to 15 times more than containership cargo per unit weight, but it offered shorter transit times and higher reliability. Goods shipped by air are typically high in value, time-sensitive, and perishable, so they require speedy, reliable transit. Due to operational challenges in shipping since the pandemic's onset, the air-to-maritime cost ratio has dropped by more than half, with mid-2022 air service rates only 4 to 8 times higher than maritime, even as air cargo yields nearly doubled pre-pandemic levels.

Containerships Increase Maritime Market Share



Source: CRSL

Air Cargo Service: More Competitive Than Ever



Note: Comparison of East-West Air Freight Price Index and Drewry's East/West Container Freight Rate Index (converted into cost per kg basis; basis 4,500kg per teu)
Source: Drewry Maritime Research

Air Cargo Overview

While both maritime shipping and air cargo yields are normalizing as capacity challenges recede, maritime yields may remain elevated due to industry consolidation. In 2000, the top 10 containership operators handled 62% of the world's shipping capacity. In 2022, that share rose to 86%.

Requirements Vary, Air Cargo Responds

Varying requirements drive a range of air cargo services. From an end user's perspective, general freight and express offerings are fairly easy to distinguish in terms of commodity and time-definiteness. However, from a business-model perspective, the lines between express and general air cargo continue to blur. Traditional providers are expanding their time-definite offerings, while express carriers, freight airlines, and postal authorities often provide general cargo service.

Ultimately, cargo customers benefit from increased service options and lower prices, as competing services enter the market.

International Express is Booming

International express growth is outpacing the overall air cargo market. The international express market grew at a healthy average rate of 7% per year between 2011 and 2021. International express traffic grew 10% in both 2020 and 2021.

Higher-than-average annual growth boosted the express share of international air cargo traffic from 4.1% in 1992 to 13.4% in 2008. The international express share remained at about 13% of total international traffic during the 2008–2010 global financial crisis, but share growth resumed in 2011, and market share reached 21% in 2021.

The Containership Top 10 Consolidate

Top 10 leading providers now control 86% of capacity deployed



Source: OAG – May Schedule Sample

General Freight Compared to Express



Express

- ~21% of international air cargo traffic
- Includes first mile pickup and last mile delivery
- Total control of logistics flow from shipper to consignee
- Optimized air network around main and regional hubs
- Extensive ground network
- Usually documents and small packages

General Freight

- ~79% of international air cargo traffic
- Capacity is sold to freight forwarders
- Responsible for moving freight from airport to airport
- Usually refers to larger, bulky shipments (more than 70 kg)

Source: OAG – May Schedule Sample

Air Cargo Overview

General Freight Remains Strong

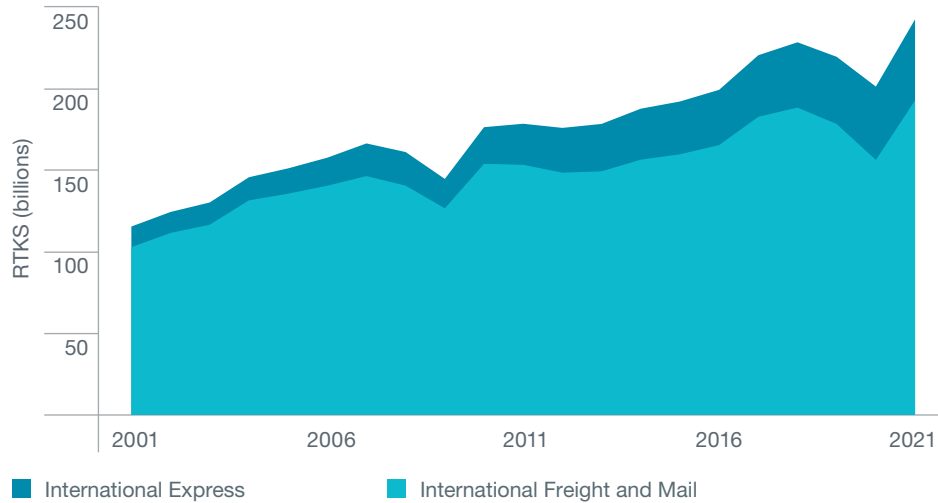
General freight transport comprises the majority of total world air cargo, including all goods shipped by air except mail products. General freight comprises 81% of worldwide revenue tonne-kilometers, and is integral to the global supply chain worldwide. Carriers specializing in general freight generated half of the world's air cargo industry revenues in 2021.

E-Commerce Distribution Networks Expand

Rapid expansion in e-commerce is expected to boost air cargo growth. The complex logistics of e-commerce rely heavily on local postal systems, express networks, and, in some cases, extensive insourced distribution networks managed by retailers. Air cargo packages are generally not identified specifically as e-commerce by shippers, and airmail shipments are typically bundled in bags with assorted documents and parcels. However, it is clear that e-commerce is

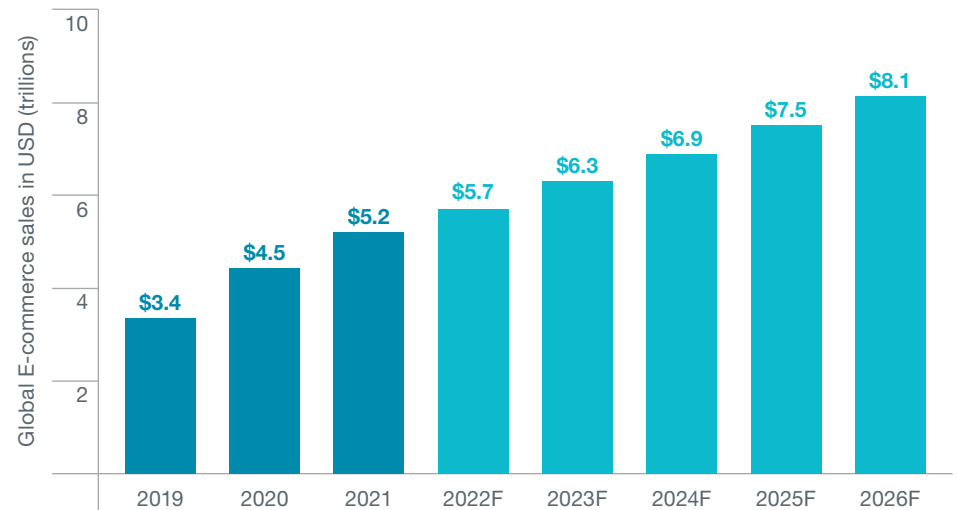
revolutionizing customer expectations and air cargo logistics. Global e-commerce revenues are expected to more than double pre-pandemic levels by 2026, reaching \$8.1 trillion—up from \$3.4 trillion in 2019, and five times higher than the \$1.5 trillion spent in 2015. While domestic e-commerce business is often supported by large ground networks, growth in cross-border e-commerce, as well as emerging markets without well-established postal and ground networks, will promote an increased role for air cargo.

Express Carrier Air Cargo Share Growing



Source: Cargo Facts Consulting, IATA, ICAO, US Department of Transportation

Global E-Commerce Revenues Expected to Be More Than Double Pre-Pandemic by 2024



Source: eMarketer June 2022

Air Cargo Overview

While e-commerce is a global phenomenon, market size and growth vary by country. China represents the largest e-commerce market in the world, after overtaking the United States in 2013. In 2021, the Chinese market surpassed \$2 trillion, more than double the United States market, which is estimated at \$960 billion. The European market was roughly one third the size of China's market, at \$665 billion, in 2021. While currently much smaller, many emerging markets such as India and Brazil are now seeing high growth and rapid network expansion.

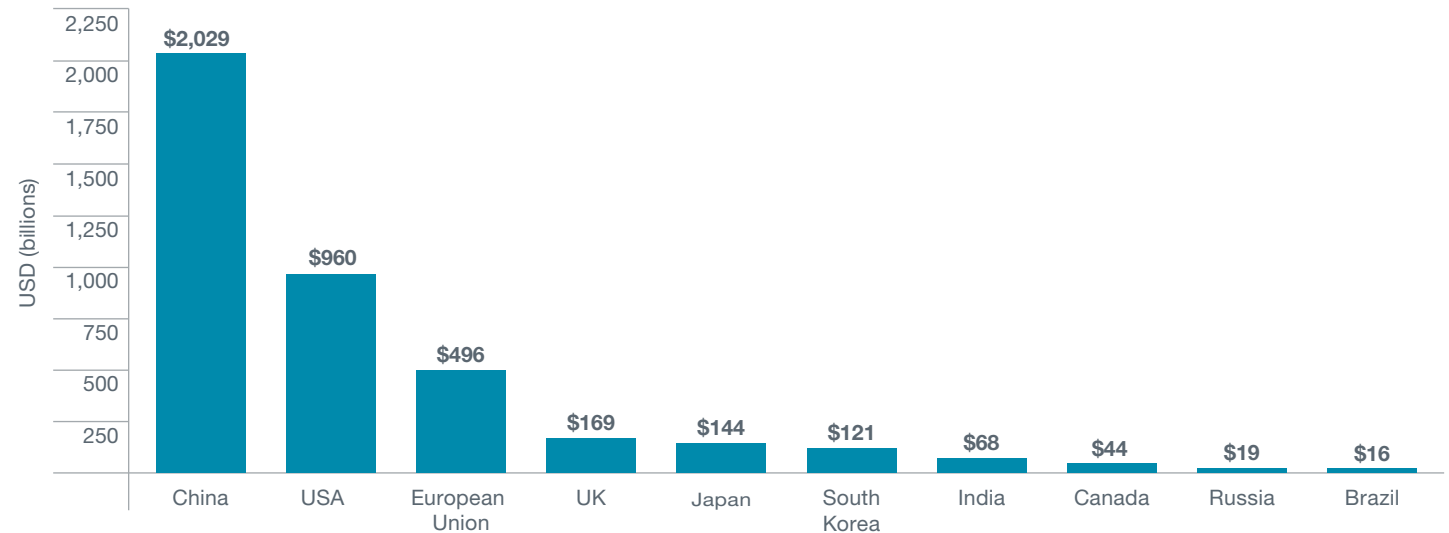
Airline Business Models Vary

Airlines adopt business models tailored to specific air cargo markets. Air cargo operators fall into four main categories:

- *Belly-only operators* provide air cargo capability within existing passenger networks.
- *Cargo specialists* provide dedicated main-deck freighter capability for general freight, charter operations, and specialized loading and carriage capabilities.
- *Combination carriers* leverage both dedicated main-deck freighters and the belly capacity of extensive passenger networks to provide reliable air connections, particularly to and from home markets and hubs.
- *Express carriers* operate main-deck freighter fleets of all sizes to provide time-definite services as well as general air cargo capability. Express carriers typically utilize standard body and medium-widebody freighters to support their hub operations.

China's E-Commerce Market: World's Largest

2021 E-Commerce Revenues



Sources: Cargo Facts Consulting, eMarketer, Shopify, US Census Bureau, and www.data.gotohui.com

Freighters Are Indispensable

Freighters are critical for airlines competing in air cargo markets. While nearly half of the world's air cargo has historically been carried in the bellies of passenger airplanes, freighters are a key component of the customized scheduling and operations flexibility that many air cargo customers need. As a result, airlines with main-deck freighters in their fleets earn 90% of the air cargo industry's revenue.

While increasingly capable widebody passenger airplanes helped the air cargo industry grow in the decade preceding the pandemic, we expect dedicated freighters to continue to carry at least 50% of the world's air cargo traffic, even after long-haul passenger networks recover to pre-pandemic levels and beyond. There are several key reasons for freighter preference in air cargo flows:

- Most passenger-belly capacity does not serve key cargo trade routes.
- Twin-aisle passenger schedules often do not meet shipper timing needs.
- Freight forwarders prefer palletized capacity, which is not available on single-aisle aircraft.
- Passenger bellies cannot transport hazardous materials and project cargo, two important sectors in air cargo flows.

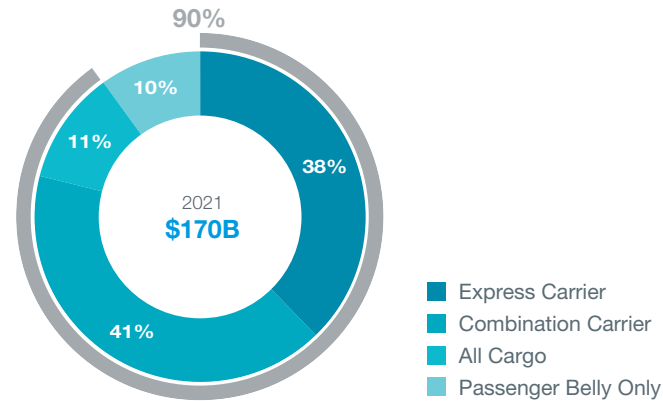
- Payload-range considerations on passenger airplanes may limit cargo carriage, increasing the risk that cargo will fail to arrive on time.

The COVID-19 pandemic highlighted the importance of main-deck freighters in the global air transportation system. With high air cargo yields and greatly reduced long-haul international networks, conditions were favorable for many airlines to use passenger widebody fleets for cargo-only operations, in order to generate much-needed cash flow and industry capacity. These "freighters" replaced some of the capacity shortfall, and even (in some cases) generated quarterly profits for carriers, despite minimal passenger operations. While long-haul passenger operations are still recovering, enough passenger capacity has returned to most markets that almost all freighter operations have been discontinued.

In normal times, airplanes generate more revenue in passenger service. However, the experience of the past two years has highlighted the value of cargo operations. For airlines looking to diversify risk and operations coming out of the pandemic, that experience has provided an incentive to incorporate cargo operations in their network and fleet planning.

Freighters Critical to Air Cargo Competition

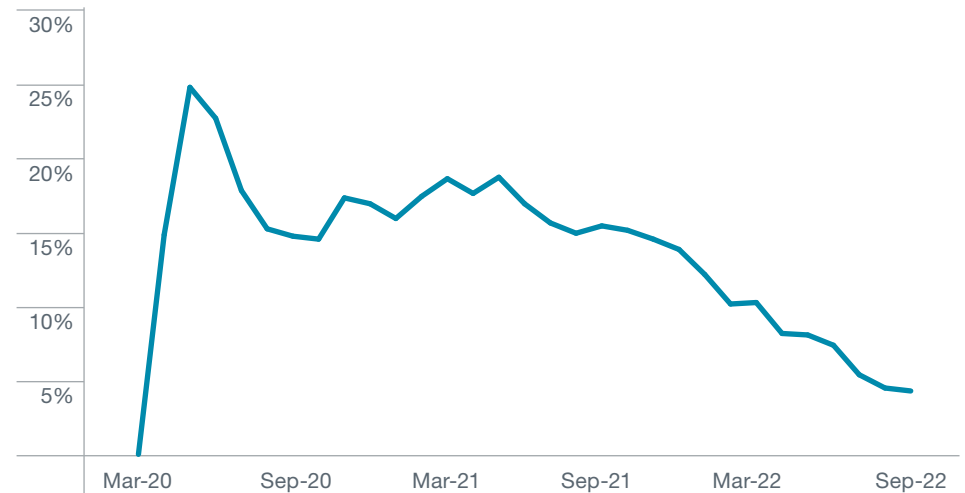
Airlines operating freighters generate 90% of industry cargo revenues



Source: Cirium, US Department of Transportation, Airline data

Passenger Widebody Freighter Capacity Vacates the Market

'Preighter' share of scheduled air cargo capacity



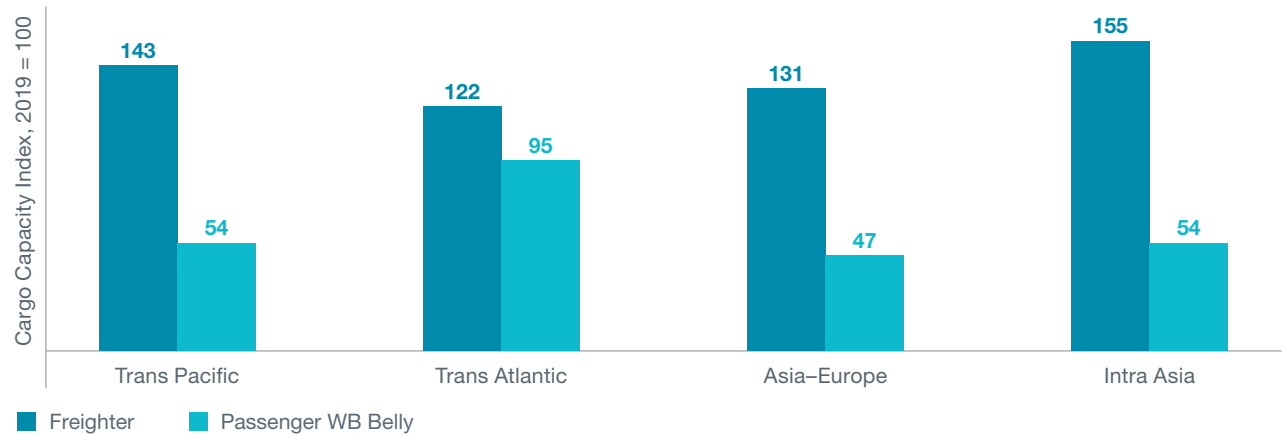
Source: IATA

Near-Term Dynamics

Air cargo capacity and yield trends were severely disrupted by the pandemic, but are beginning to see a return to longer-term trends. Before the pandemic, nearly 50% of air cargo worldwide was transported in widebody passenger cargo holds. This capacity virtually disappeared in March, 2020, as passenger widebody service was suspended globally. Freighters responded to this disruption by operating at above-normal utilization levels, delaying freighter retirements, and bringing new and parked airplanes into their fleets to compensate for the cargo-hold shortfall. While overall air cargo capacity has regained 2019 levels, the ratio of main-deck freighter capacity to belly capacity remains elevated, with nearly two thirds of all air cargo capacity being carried on main decks, as long-haul passenger networks continue to rebuild.

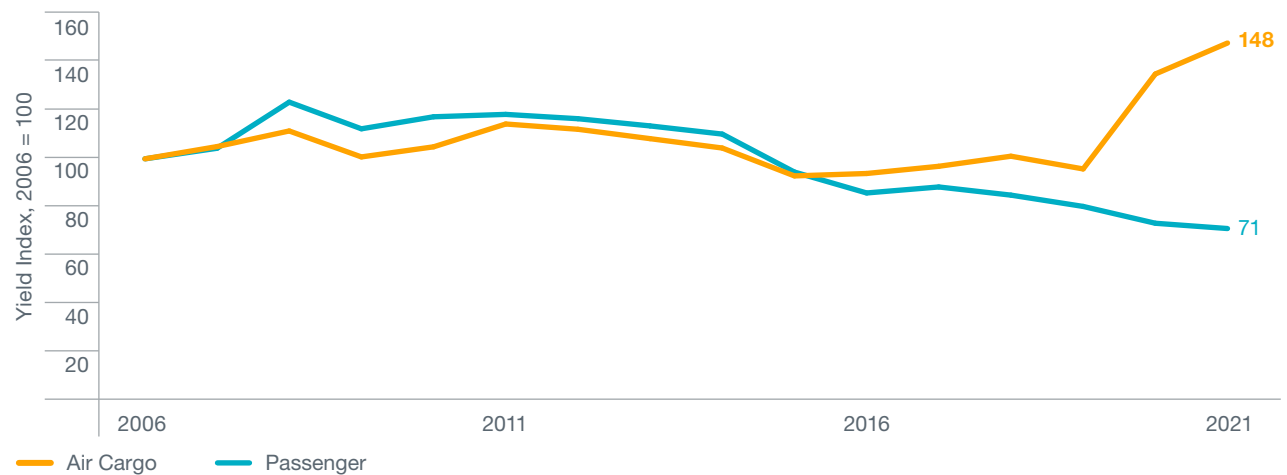
In the decade prior to the pandemic, air cargo yields averaged a 3% annual decline. Falling oil prices in 2014, declining fuel surcharges, and trade dynamics contributed to the softer yield environment.

Main-Deck Freighter Share Still Elevated



Source: FlightRadar24 Week 14-44 of 2022 compared to Week 14-44 of 2019

Air Cargo Yields Climbed Rapidly in 2020 and 2021, Decoupling From Passenger Yields



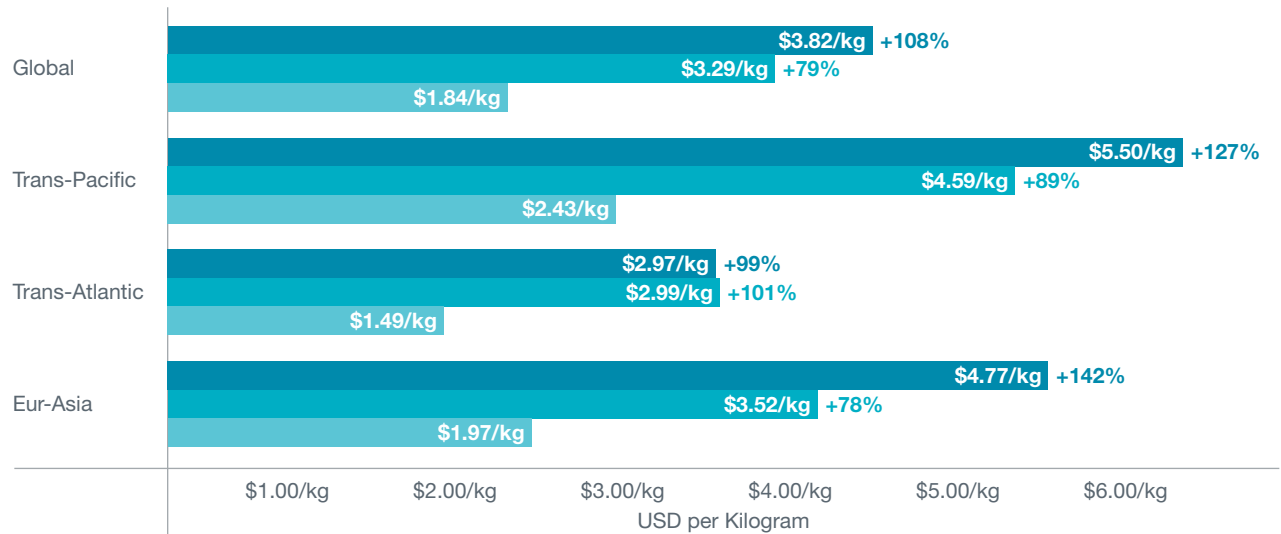
Source: AAPA, IATA, ICAO, US DOT, Airline data, Boeing

Air Cargo Overview

During the pandemic, air cargo capacity disruption, strong air cargo demand, and congested supply chains all boosted air cargo yields well above long-term average rates. In 2021, some flows saw rates that tripled pre-pandemic averages. Yields are now starting to fall as supply chains and long-haul passenger networks recover, bringing air cargo belly capacity back into the market. However, rates in the third quarter of 2022 are still roughly double the pre-pandemic averages. Since March, 2022, higher fuel prices have contributed to these elevated levels, but the overall supply-demand balance continues to be a key factor in bringing additional capacity needs back into air cargo markets.

With air cargo traffic volumes now running near pre-pandemic levels, and yields elevated, global air cargo revenues have reached all-time highs. In 2021, air cargo revenues hit \$170 billion, up from \$100 billion in 2019. Combination and all-cargo carriers have seen the largest increases, with both segments roughly doubling their 2019 revenues in 2021, while revenues for express and belly-only carriers increased roughly 45% compared to pre-pandemic levels.

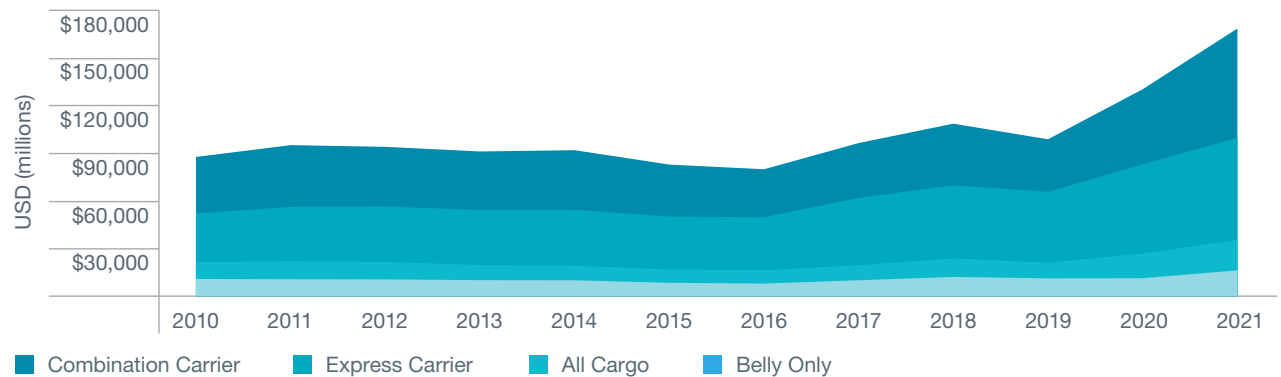
Global Yields Easing, But Still High



■ Post-Pandemic ■ Pandemic ■ Pre-Pandemic

Pre-Pandemic = March 2018 to February 2020 | Pandemic = March 2020 to February 2022 | Post-Pandemic = March 2022 to present
Source: IATA CargoIS

Air Cargo Revenues Exceed Pre-Pandemic Levels



Long-Term Dynamics

The global economy and world trade have demonstrated long-term resilience despite near-term challenges. It has been a tumultuous two and a half years since the COVID-19 pandemic brought most activity to a halt. The shock turned out to be very deep, but it was short-lived by historical standards. After dropping 9% between fourth-quarter 2019 and fourth-quarter 2020, global GDP regained its pre-crisis peak by the first quarter of 2021.

Global trade in goods made an even more impressive comeback. Initially

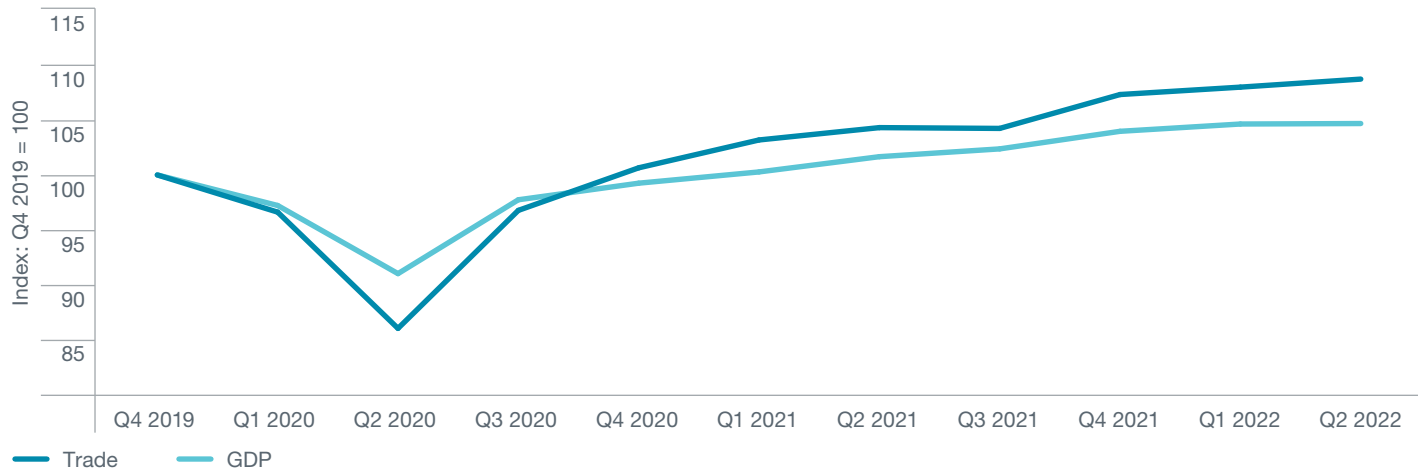
disrupted by production shutdowns and uncertainties, the exchange of goods resumed quickly. Medical goods and protective equipment moved around the globe and, as lockdowns took their toll on in-person service activities, consumers turned to purchases of goods instead. Industrial production and global trade were higher than 2019 levels by the end of 2020. Growth continued for the global goods trade in 2021 and into 2022, as consumer spending remained robust and producing industries invested and expanded. As a result, the volume of global trade was more than 8% higher

in fourth-quarter 2022 than in fourth-quarter 2019, and it surpassed the previous all-time high of 2018.

However, as 2022 drew to a close, the outlook for growth and trade became much less certain. Strong demand for goods created friction in supply chains, leading to price hikes and inflation. This, in turn, set central banks on the path to sharply tighter monetary policies. Russia's invasion of Ukraine has thrown commodity and agricultural markets into turmoil, and China's stance toward COVID-19 continues to disrupt trade flows and raise uncertainties about demand.

Near-term metrics such as the Purchasing Managers' Index signal stalling, if not declining, activity in the goods-producing sector. Forecasts for both GDP growth and trade expansion have been revised sharply downward. Many advanced economies are projected to experience a recession in 2023. As the pandemic recedes, consumers are redirecting their spending toward services, and high inflation could sap consumption overall. Goods consumption looks ready to normalize or even undershoot trend rates, after a period of extraordinary growth. All this is likely to subdue

GDP and Trade Quick to Recover



Air Cargo Overview

near-term trade growth. On the other hand, strong household balance sheets and solid labor markets continue to support demand in many economies. In addition, the easing of supply chain frictions could release backed-up flows of goods, and so introduce a near-term tailwind.

The probable slowdown in economic activity and trade will pose challenges. Uncertainty about the extent of rebalancing efforts and the speed of subsequent recovery could increase and linger into 2023. But growth and trade have proven resilient before. Most experts predict a relatively shallow recession, and trade remains a crucial part of the global economy. The pandemic has shown how important global linkages are for the provision of medical equipment and vaccines, as well as for the delivery of goods to people and companies as they adjust to changing external circumstances. Supply chains are diversifying, and many emerging markets are undeterred

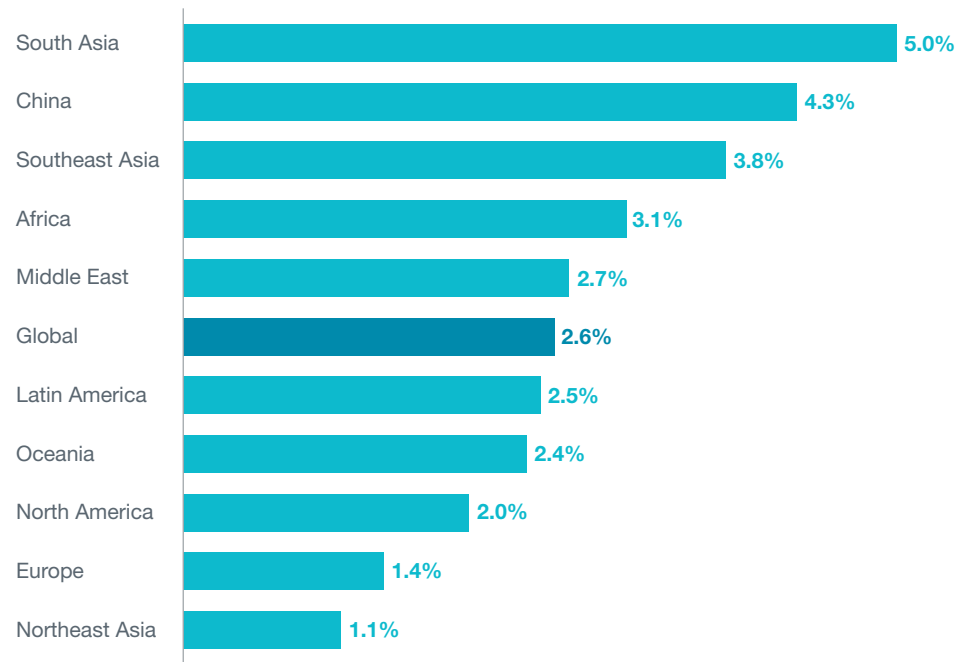
in their pursuit of global integration as the key to higher standards of living. A case in point is the recent Regional Comprehensive Economic Partnership trade agreement, which links economies across Asia that account for about 30% of the world's GDP. The European Union, which continues to advance free trade agreements as well, recently revealed that 2021 exports to preferential trade partners surpassed €1 trillion for the first time.

Over the next 20 years, global GDP is expected to grow 2.6% on average. South Asia will lead the world with 5% growth, followed by China and Southeast Asia. Advanced manufacturing and expanding consumer economies—key building blocks for global trade—will drive growth for these regions. Trade is expected to expand at 2.8% on average over the next 20 years, with essential contributions not only from South and Southeast Asia, but also from many developing countries, as

well as substantial, established traders like China. Advanced economies remain foundational parts of the global economy. While GDP is expected to grow at less than the global average, the size and economic breadth of these markets makes them indispensable as traders of advanced goods and services, as well as destinations for the exports of many emerging economies.

Asian Economies Lead Global Growth

Annual Real GDP Growth, 2022–2041



Source: S&P Global Intelligence, 3Q2022

A Prominent Role for Structural Factors

Express networks are proliferating. E-commerce doubled its share of retail sales over the past five years, and this high growth rate was incorporated in pre-pandemic forecasts. But, as with many things COVID-related, it was a trend that accelerated, with adoption rates taking a big jump during the pandemic. Today, consumers are more acclimated to online shopping, and they have high expectations for fast service.

COVID pulled ahead pre-pandemic forecasts and expectations with container speed and reliability less suited in some cases to serving the demand. In addition to accelerating growth, the global impact of the pandemic has boosted plans to develop express networks in emerging markets—particularly China—and also has raised expectations for the segment overall, particularly in the standard-body and medium-widebody freighter categories.

New Players in the Air Cargo Arena

Some shipping companies are exploring a shift to more vertically integrated operational strategies. Historically, freight forwarders were the

primary interface between producers and shipping companies. Some shipping companies now aim to compete in the freight-forwarder space by developing their own full-service solutions. For customers, the value propositions here are the elimination of modal uncertainty and the de-risking of service levels. To provide this integrated mobility of goods, some shipping container and logistics companies are acquiring airplanes to provide the promised range of service levels.

This trend suggests some aggregate movement of shipping volumes from sea to air. While the volumes will not likely be large relative to total global trade, even small shifts toward the speed, reliability, and risk mitigation of air could be significant, considering that air cargo now represents only about 1% of global trade volumes.

In addition to growth among established logistics providers, markets around the world are seeing a range of air cargo newcomers, including a spurt of operations growth for smaller general-freight and express airlines. A fleet analysis in the fourth quarter of 2022 revealed roughly 40 more operators than pre-pandemic. In addition, some belly-only operators have added main-deck freighters to their fleets, in efforts to diversify revenues.

Strategic Supply Chain, Logistics Innovations

Globally, the pandemic experience highlighted the risks of the just-in-time supply chains that had evolved over the previous several decades. As labor shortages constrained both shipping and manufacturing, single-source supply chains became points of failure. As a result, many goods companies and logistics firms today are exploring diversified supply chains as a way of mitigating future risk. If the past two decades saw the pendulum swing toward reduced costs and greater efficiency, the years ahead suggest a swing toward diversity and reliability. In the near future, supply chain resilience will be recognized as a key performance indicator.

This trend likely will bolster air cargo demand for two reasons: First, air cargo's flexibility and point-to-point service are ideal for multi-node supply chains. And, second, the pandemic has demonstrated the value of air cargo's speed and reliability. As manufacturers and logistics providers consider ways to diversify supply chains, a range of transport modes is likely to be one more instrument in the toolbox for some commodities.

Air Cargo Overview

Multiple Drivers of Growth

A range of issues beyond cyclical economic trends influence air cargo market growth forecasts. Among them are modal competition, globalization, market liberalization, and new air-eligible commodities.

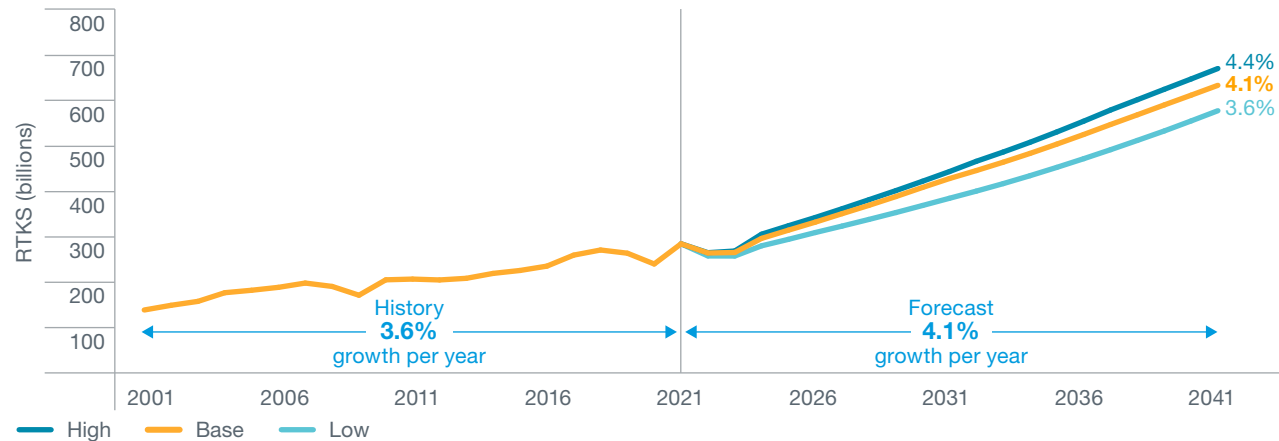
Complementing the 2.6% long-term economic growth outlook, trade and industrial production will be key drivers for air cargo growth. We forecast that trade will outpace economic growth, increasing 2.8%, and that industrial production will grow 2.2%, both annually, over the next two decades. These economic factors, as well as the regulatory and industry structure dynamics highlighted above, support Boeing's forecast that air cargo traffic, measured in revenue tonne kilometers, will grow an average of 4.1% annually from 2022 to 2041.

Multiple, Complex Factors Influence Markets

Industry Structure		
<ul style="list-style-type: none"> Air & Service Labor Constraints Directional Imbalances E-commerce Growth 	<ul style="list-style-type: none"> Manufacturing Relocation & Diversification Modal Competition Network Development 	<ul style="list-style-type: none"> New Commodities Shipper Utilization Supply Chain Logistics Development
Regulatory		
<ul style="list-style-type: none"> Airport Operational Curfews Environmental Regulations 	<ul style="list-style-type: none"> Market Liberalization New Trade Relationships 	<ul style="list-style-type: none"> Trade Quotas & Restrictions
Economic		
<ul style="list-style-type: none"> Currency Revaluations Export Promotion 	<ul style="list-style-type: none"> Geopolitical Dynamics National Development Programs 	<ul style="list-style-type: none"> Oil/Fuel Prices & Availability Regional GDP Growth

Air Cargo Traffic to Double Over Next Two Decades

Average Annual Growth, 2022–2041



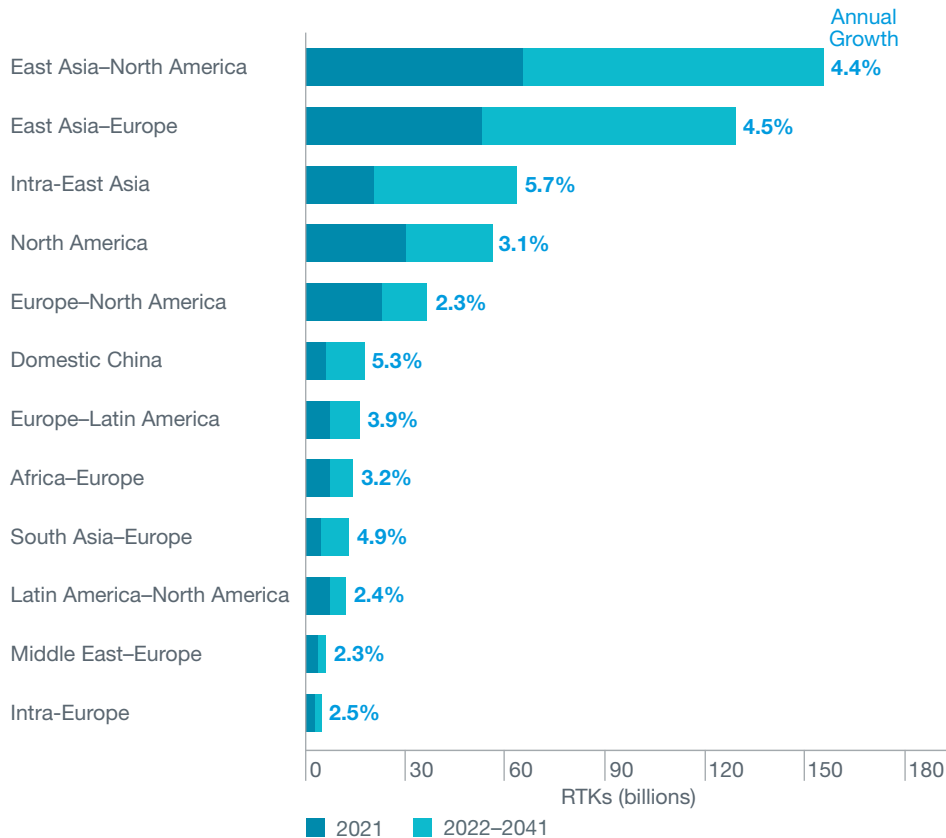
Air Cargo Overview

East Asian markets lead the global air cargo forecast in both volumes and growth rates. Today, the Transpacific and Europe-to-East Asia air cargo flows are the largest. By the end of the forecast period, the intra-East Asia region will become the third largest global market, up from the number-five position in 2021, with 5.7% projected

average annual growth. Driving this shift will be increasing goods production and booming consumer markets. Industrial production, trade, and express-market growth are forecast to propel traffic growth of 5.3% in the domestic China market, the second fastest-growing flow in our 20-year forecast. The intra-North

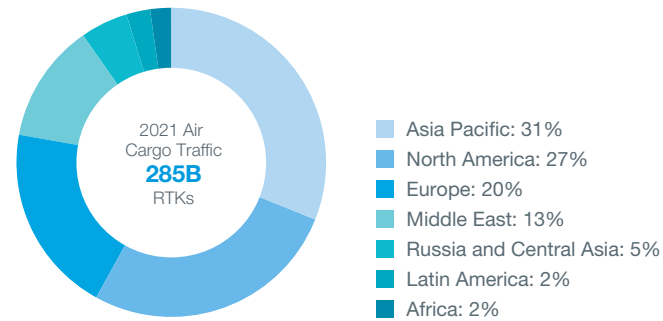
America and Transatlantic air cargo flows will round out the top five markets by the end of the forecast period, with large markets today but slower growth rates due to the more mature market dynamics of Europe and the United States.

East Asia Markets Will Lead



Regional Traffic Will Diversify

Market Share by Airline Domicile



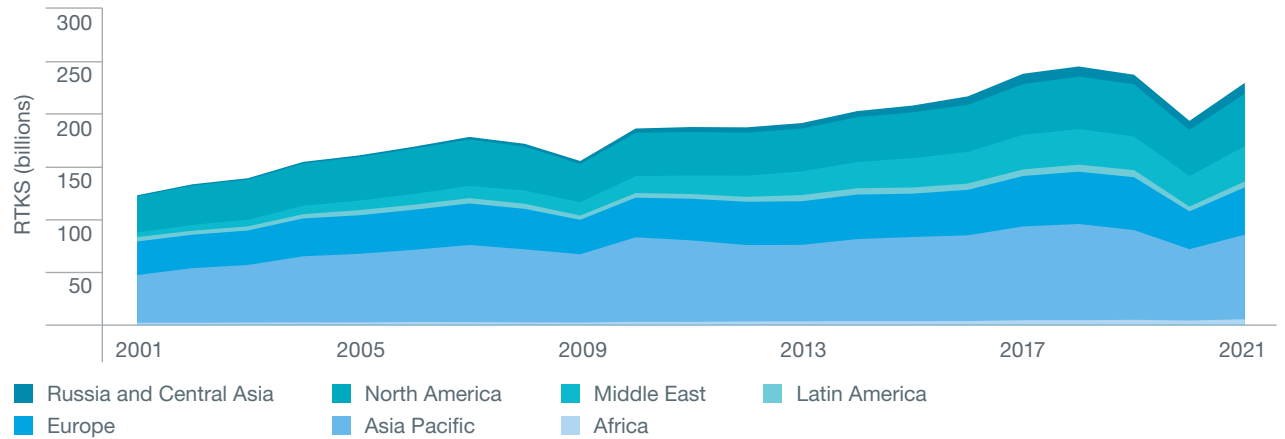
Source: IATA, ICAO, US DOT, Airline data, Boeing

Air Cargo Overview

Since 2000, carriers based in the Middle East have leveraged their geographic position at the crossroads of Africa, Asia, and Europe. Middle East carriers quickly expanded their widebody passenger and freighter fleets, which allowed them to increase their share of world air cargo traffic from 4% in 1999 to 13% in 2021. In 2021, airlines based in East Asia, Europe, North America, and the Middle East accounted for 91% of all world air cargo traffic. In charter traffic, North American airlines are the leading providers.

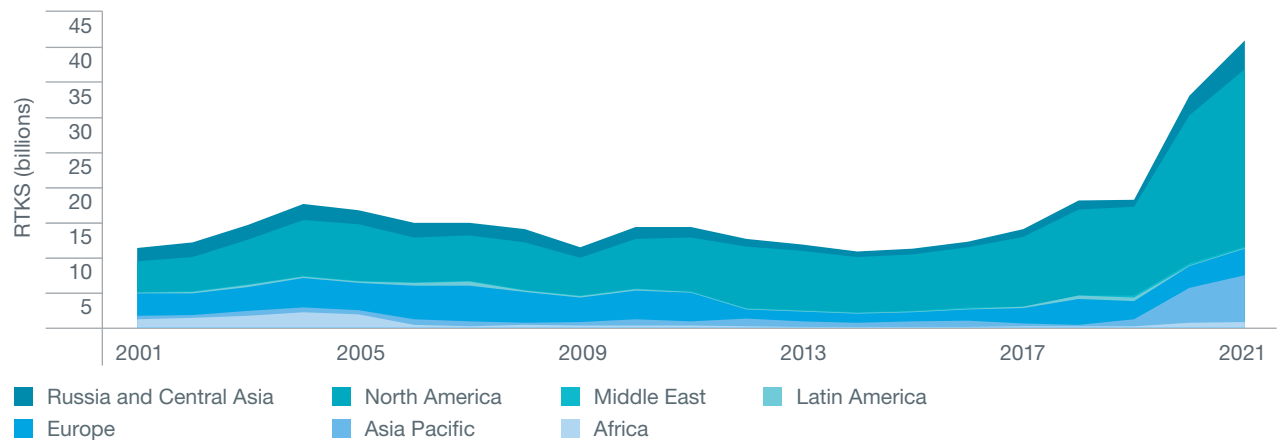
Growing domestic markets and intra-regional flows are the key drivers for the deployment of standard-body and medium-widebody freighters, while the longer-haul intercontinental flows, typified by the top three regions (Transpacific, Transatlantic, and Europe-Asia), will be the primary users of large-body freighters. These dynamics underpin the Boeing freighter fleet forecast.

Asian Airlines Lead Scheduled Air Freight



Sources: IATA, ICAO, US DOT, Airline data, Boeing

North American Airlines Lead Charter Freight



Sources: IATA, ICAO, US DOT, Airline data, Boeing. 2021 data preliminary and may include some preighter operations.

Africa

For the purposes of this forecast, we define Africa as the entire continent of Africa plus the nations of Cape Verde, the Comoros Islands, Madagascar, Mauritius, Mayotte, Réunion, São Tomé and Príncipe, and the Seychelles.



Nairobi, Kenya

Highlights

- In 2021, air cargo moved by Africa-domiciled carriers grew by 10% over 2019 levels. Year-to-date growth (through August, 2022) has improved to 12% against 2019, despite minimal improvement in cargo capacity.
- Africa's air cargo market is still predominantly driven by the trade flow with Europe, with perishables defining the northbound traffic, and consumables and industrial goods driving the other direction.
- Continued demand for perishables in advanced economies, growing foreign investment in African regions, and a growing number of working-age consumers are some of the key drivers behind annual growth projections of 3.2% and 5.4% over the next 20 years for the Europe and East-Asia markets respectively.

Five Countries Lead African International Air Trade

Most African international air trade is conducted by a small number of economies.

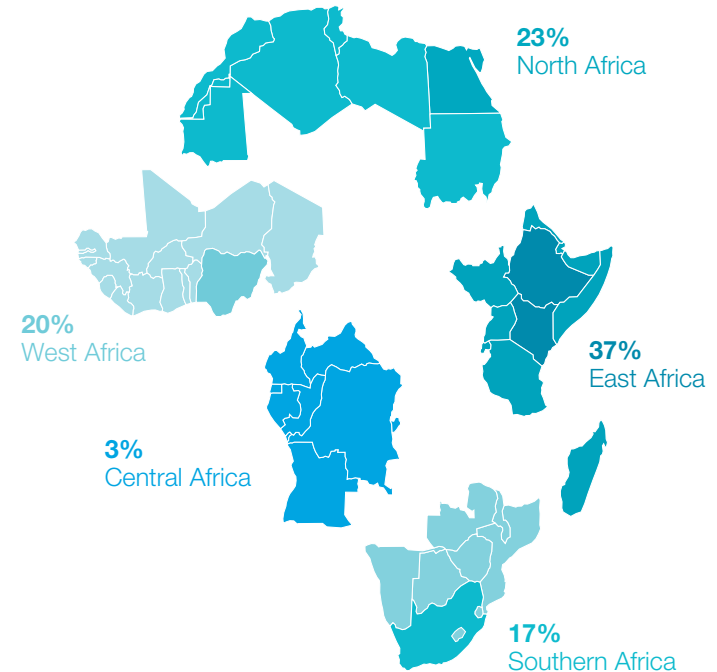
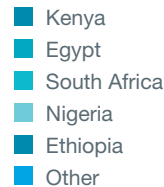
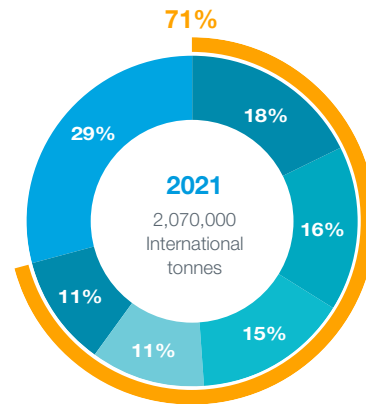
Africa can be divided into five distinct economic subregions: North Africa, Southern Africa, East Africa, West Africa, and Central Africa. The East Africa subregion has the largest share

of outbound air cargo traffic, while more import traffic comes into the North Africa subregion. However, traffic in this direction is more widely spread across all subregions. Central Africa represents the smallest share of traffic in both directions and is heavily dependent on imports.

As of 2021, leading international air cargo markets on the African continent included Kenya (18%), Egypt (16%),

South Africa (15%), Nigeria (11%), and Ethiopia (11%). Of these, South Africa experienced the greatest growth over 2020, improving 34% in international air freight. Overall, African air cargo traffic bounced back from pandemic-driven lows in 2020, growing 20% in 2021.

Kenya, Egypt, South Africa, Ethiopia, and Nigeria Lead African International Air Cargo Handled; East Africa Is Largest Subregion



Source: ACI

Established Relationships Drive African Air Trade Patterns

The Africa–Europe market accounts for approximately 2.7% of global air cargo tonnage and 2.8% of global air cargo traffic in tonne-kilometers.

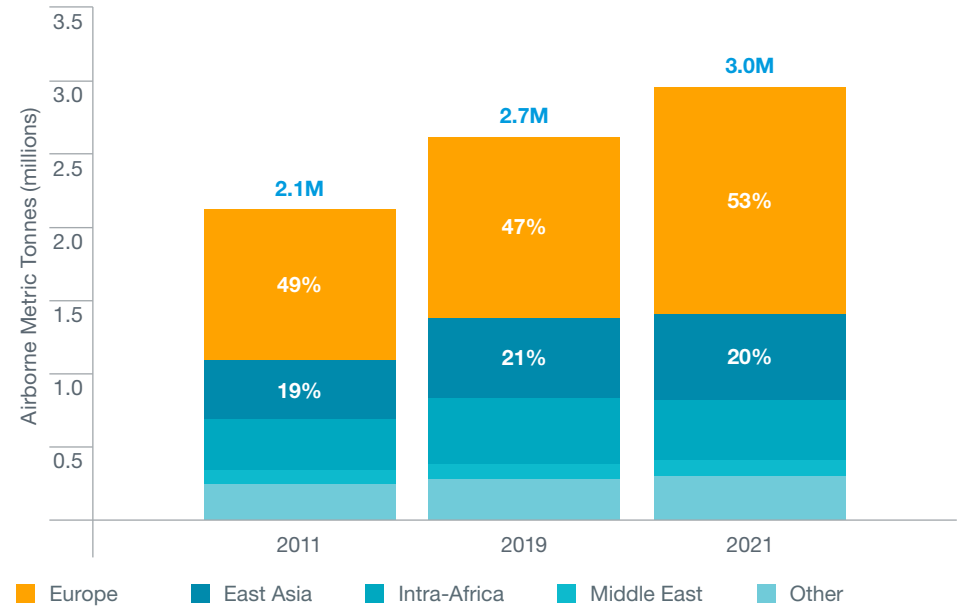
Based on regional air trade and airport statistics, overall African air trade was estimated at 3.0 million tonnes in 2021. While East Asia, Middle East, and Intra-Africa flows are critical markets for the region, Europe accounts for 53% of African cargo and commands the majority of Africa’s international air trade, largely because of its proximity and long-standing historical and investment ties.

Asia’s share of Africa’s international air trade suffered a bit during the pandemic, but remains the next largest at 20% in 2021. Growing Chinese investment and commercial ties to Africa are the principal drivers of growth in this market. Rich in natural

resources, Africa continues to draw Chinese enterprises seeking new raw materials to fuel the country’s industrial expansion.

Trade among African nations was estimated at 326,000 tonnes for 2021, which accounts for 11% of the total Africa cargo market. When we include domestic traffic, intra-Africa trade accounts for 14% of the total market. Despite some loss of traction during the pandemic, new free-trade and air-service agreements (such as the African Continental Free Trade Area and Single African Air Transport Market measures) encourage operators to develop new intra-Africa air cargo lanes. Implementation is key to stimulating more economic growth within the continent. In addition, current ground infrastructure limitations will continue to drive a special need for air cargo within Africa, because development projects are limited by the difficulty of securing substantial financial investments.

Europe Gained Ground Lost During the Pandemic, as a Mature Trade Relationship Proved More Resilient



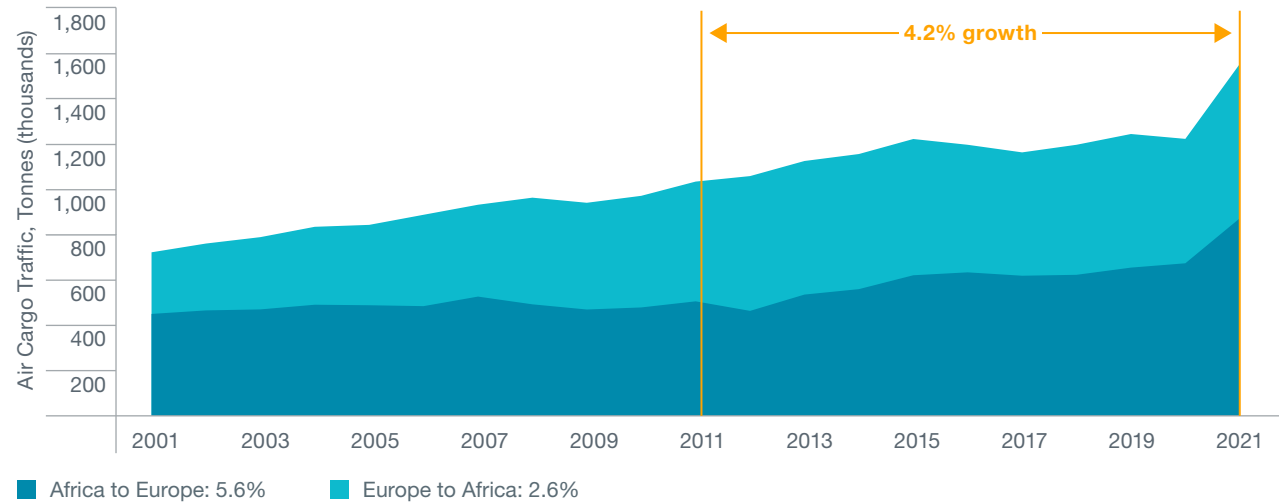
Source: S&P GTA, ACI, and Boeing analysis

Africa–Europe Traffic

Air cargo flows between Africa and Europe grew over the past decade.

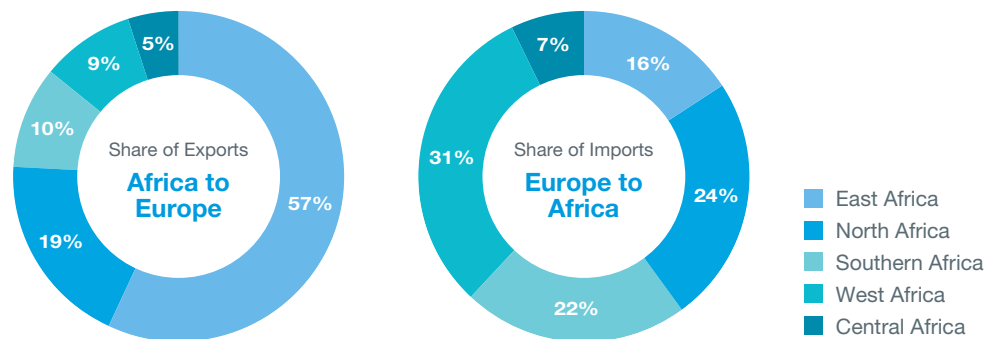
Traffic from Africa to Europe experienced volatile growth over the last decade, averaging 5.6% per year since 2011, growing 30% in 2021, and even growing 3% in 2020, despite the pandemic. Europe-to-Africa air flows showed similar volatility, yet averaged a lower growth rate of 2.6% per year since 2011. Air cargo imports from Europe contracted in 2020 by 7% before rebounding in 2021, with growth of 24%. The directional imbalance between Africa-to-Europe and Europe-to-Africa is relatively small, although northbound trade is steadily growing into a majority, most recently representing 56% in 2021.

Traffic Between Africa and Europe Saw a Boost During the Pandemic Growing 27% in 2021



Source: S&P GTA, US Department of Commerce, ACI and Boeing analysis

East Africa Dominates Exports to Europe; West Africa Takes More Imports

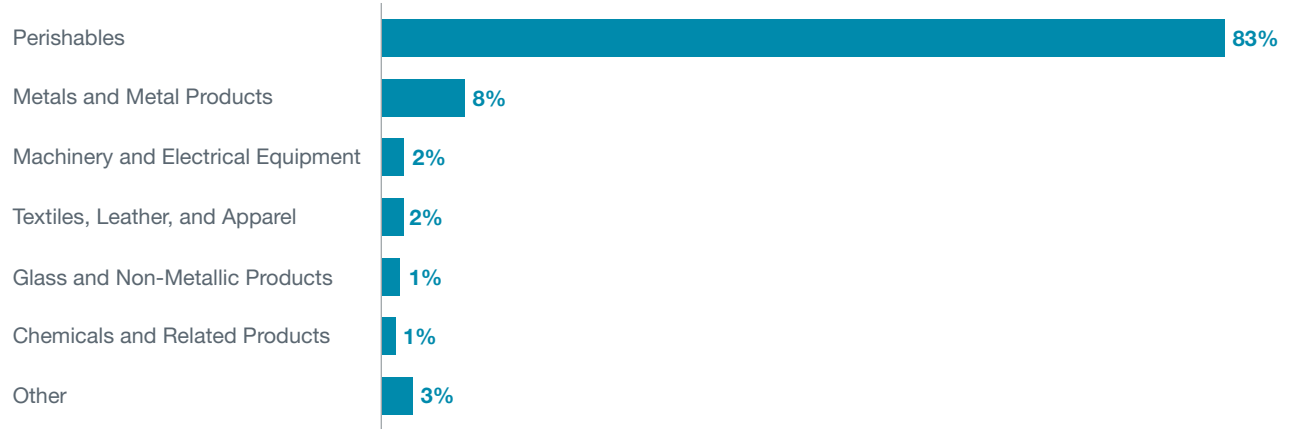


Traffic between Africa and Europe depends heavily on the strong perishables trade. In the northbound direction (Africa to Europe), perishable traffic is largely driven by fresh-cut flowers (48%), most of which are produced within the East Africa subregion. In the Europe-to-Africa direction, the commodity mix is more balanced, with machinery and electrical equipment representing the largest category. Other industrial goods, however, play a large role in air cargo traffic—particularly chemicals and related goods, a category in which pharmaceutical goods make up 39%. An interesting development for 2021 can be seen in the import of art and collectors’ pieces from Europe, which is up significantly from previous reported years.

Perishables Drive African Exports to Europe; Fresh-Cut Flowers Out of East Africa Top the List

Africa to Europe

880,000 Tonnes

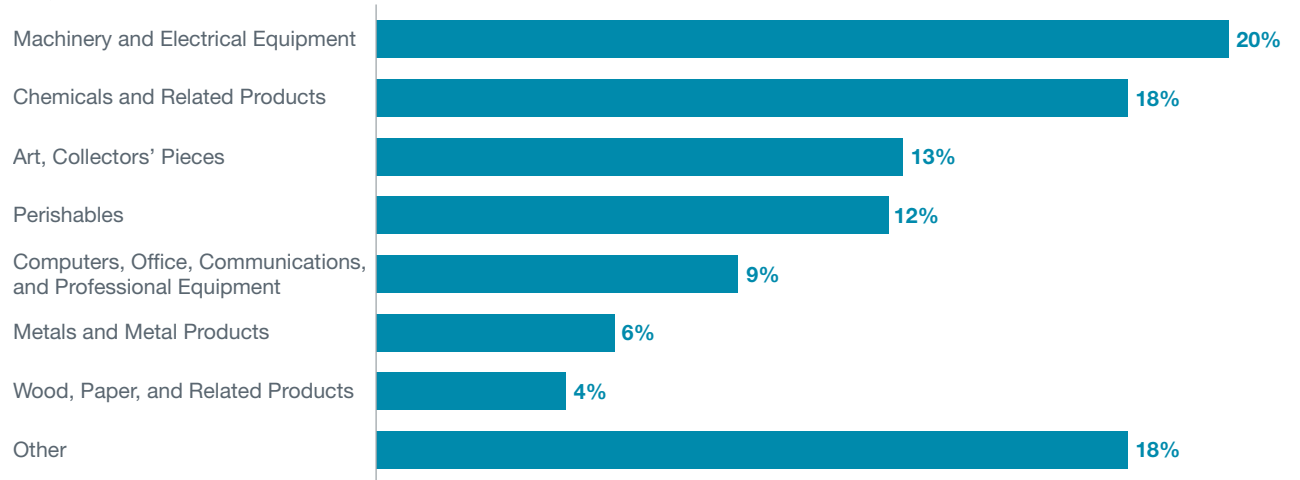


Source: S&P GTA Dashboard

Large Spike in Imported Art During the Pandemic Was Behind Changes in Commodity Mix

Europe to Africa

689,000 Tonnes



Source: S&P GTA Dashboard

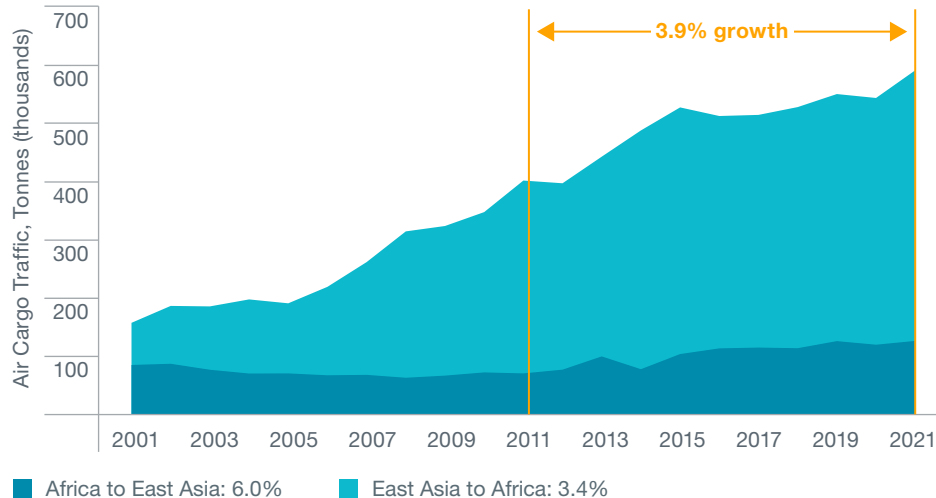
Africa–East Asia Traffic

Africa–East Asia air cargo trade is driven by continued Asian investment and African consumer demand.

The developing Africa–East Asia air cargo market has increased 3.9% per year on average in the past decade. Capital investments in African extractive industries, and growing African economies that demand more consumer goods—especially

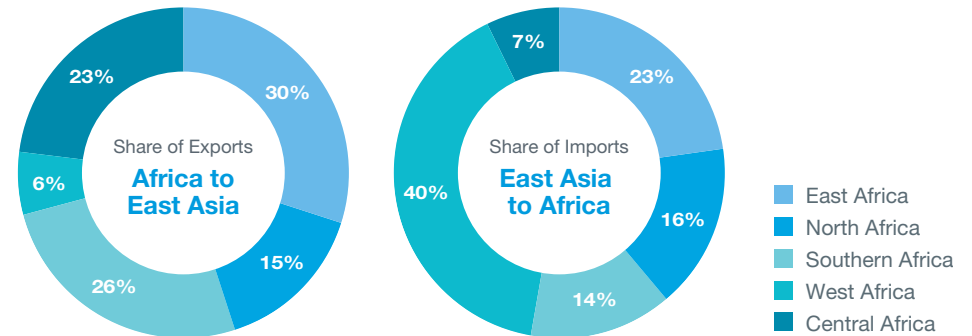
from China—will continue to drive these markets. Air cargo flows are significantly imbalanced, with nearly four times as much Asian air cargo entering as leaving Africa. Compared to Europe, Central Africa represents a bigger part of the exports to East Asia, although East Africa still exports the most outbound goods. Inbound trade between the regions is more concentrated in the West Africa subregion.

Traffic Between Africa and East Asia Experienced a Less Robust Snapback in 2021, Growing Only 9% YOY



Sources: S&P GTA, US Department of Commerce, ACI and Boeing analysis

Central Africa Plays a Bigger Role in Exports to East Asia; West Africa Is Largest Importer

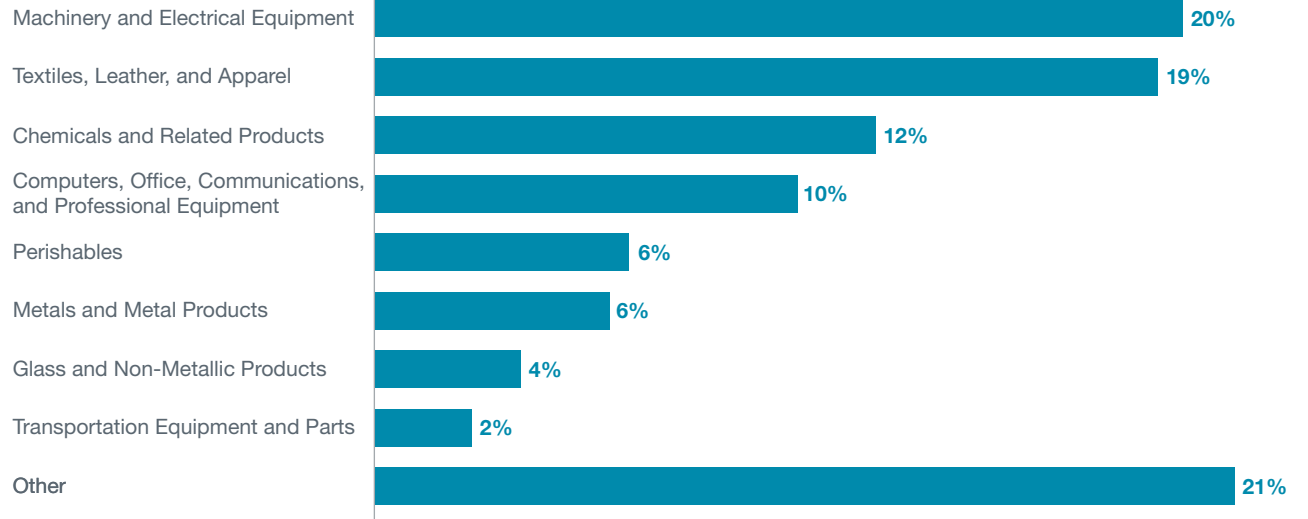


Traffic moving from East Asia into Africa consists of a wide variety of commodities, mostly finished and industrial goods. Machinery and electrical equipment represent the largest share of imported traffic, followed closely by textiles, leather, and apparel, with the bulk of that (39%) being footwear and apparel. Chemicals and related products, as well as computers and professional equipment, make up a large portion of imported goods, evidence of East Asia's—primarily China's—industrial and commercial investment in the continent. Of the chemicals and related products category imported from East Asia, 34% of it is pharmaceutical goods. Eastbound trade (Africa to East Asia) is heavily driven by natural resources, with metals and metal products and perishables accounting for nearly three quarters of the traffic.

Industrial Goods and Apparel Top List of Traded Commodities From East Asia to Africa in 2021

East Asia to Africa

465,000 Tonnes

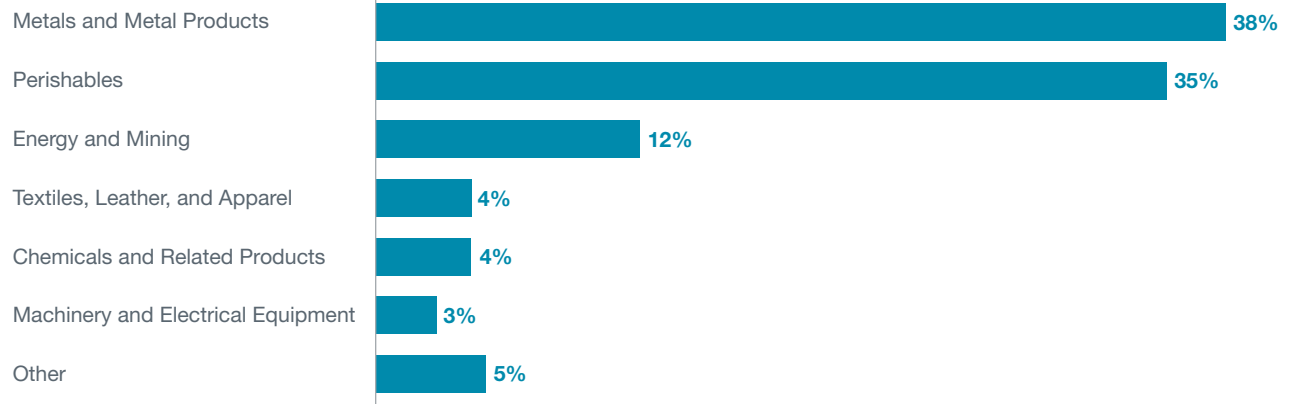


Source: S&P GTA Dashboard

Natural Resources Drive African Exports to East Asia

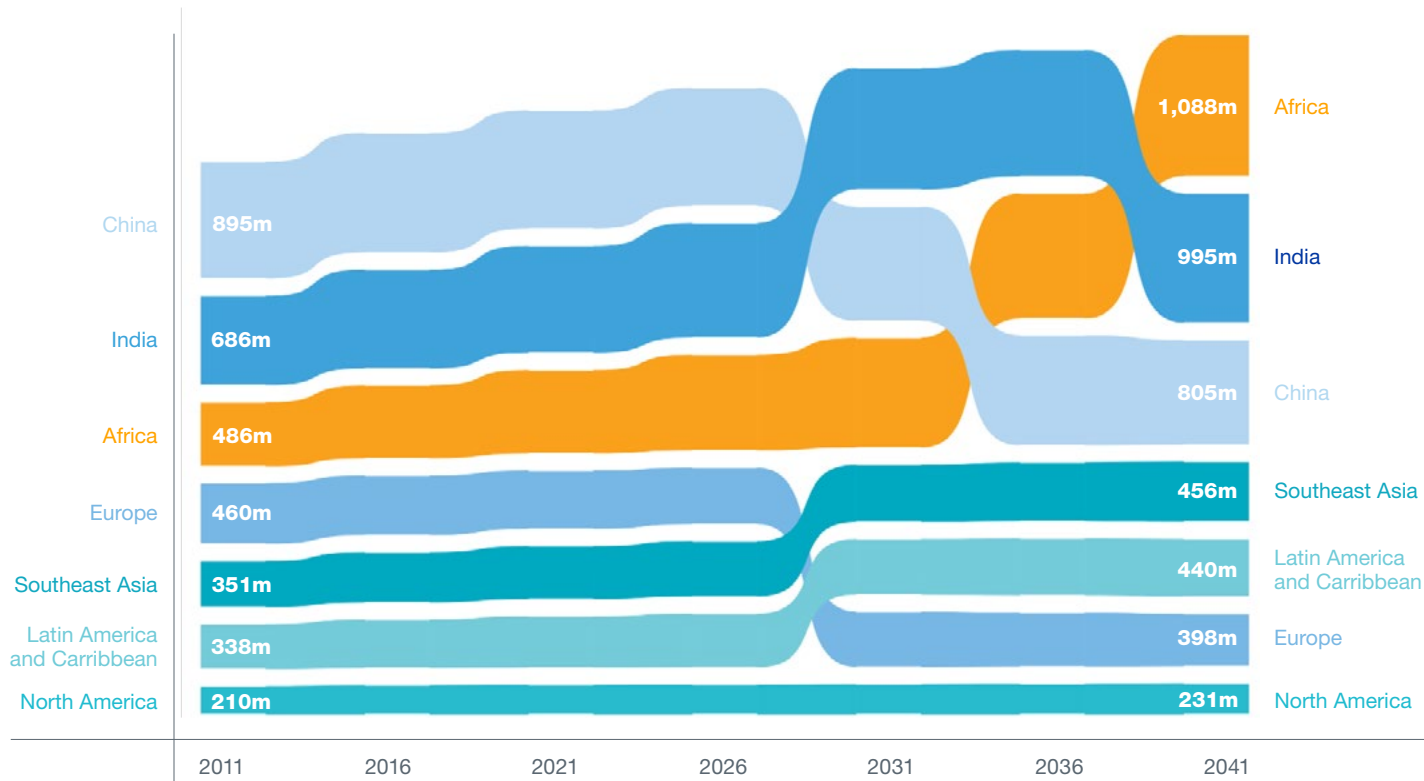
Africa to East Asia

125,000 Tonnes



Source: S&P GTA Dashboard

Africa's Working Age Population Growing Significantly



Source: UN Probabilistic Population Projections, 2022

Africa Forecasts

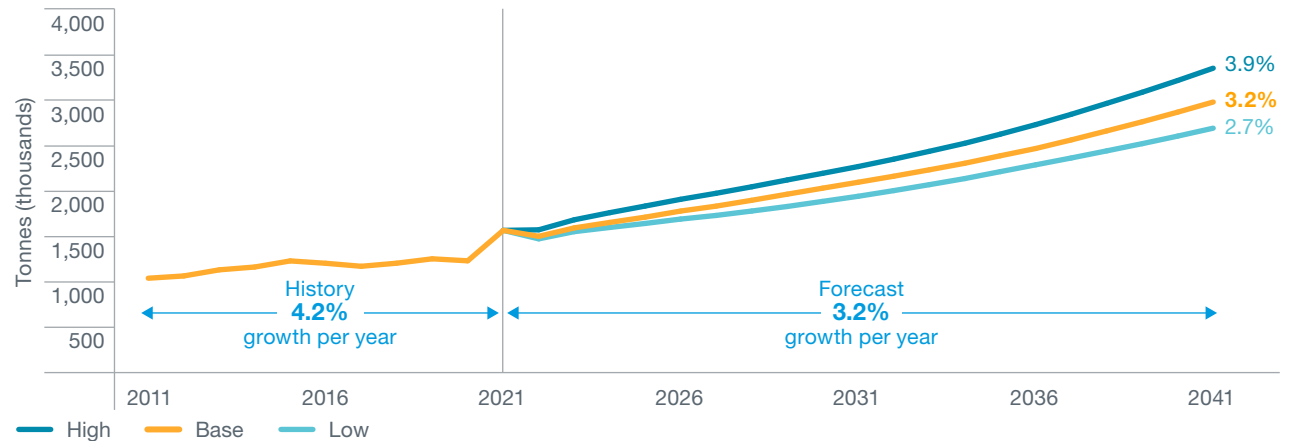
Driven by developing economies, rich natural resources and a rapidly growing working-age population, Africa represents an opportune market for industrialization and air cargo growth. Overall, air cargo trade between Africa and Europe will grow 3.2% per year, while Africa–East Asia air cargo trade will expand at an average annual growth rate of 5.4%.

Both directions in the Africa–Europe market will grow at relatively similar rates. The Africa-to-Europe market is expected to average 3.3% growth per year. European economic growth, African economic diversification into manufactured products, and continued moderate growth in African perishables are assumed in the baseline forecast for this air-trade flow.

A slightly lower level of growth is forecast for the Europe-to-Africa market, at 3.2%. This is mainly due to higher growth, observed in 2021, which created a greater base year. From a 2019 base, this flow is expected to grow 3.6% per year. The base growth-rate forecast reflects African consumer buying power for goods that arrive by air, as well as increased investment in industries that depend on air cargo for time-critical shipments. As the manufacturing base in Africa continues to develop, the diversity of inbound air cargo should increase, reducing its vulnerability to swings in commodity prices.

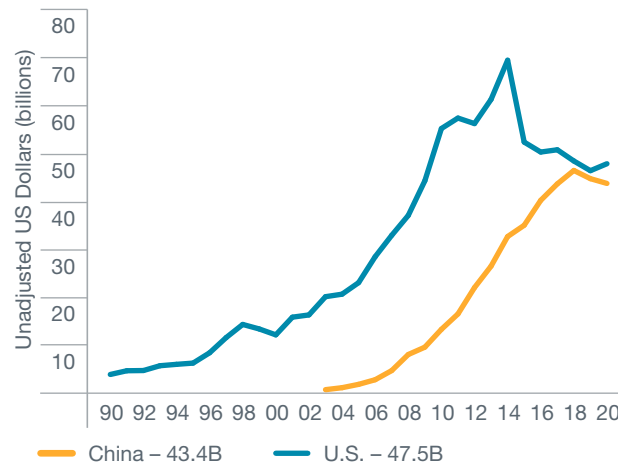
The Africa–Europe Market Will Grow 3.2% per Year

Average Annual Growth, 2022–2041



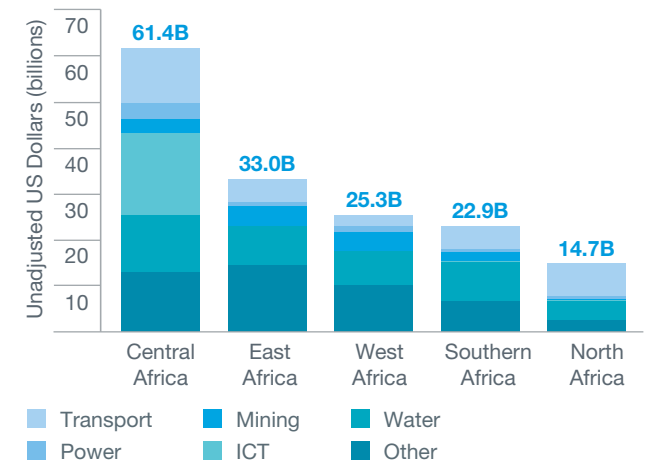
Chinese Foreign Direct Investment (FDI) Has Grown Rapidly, Approaching US Investment Levels

Chinese FDI vs US FDI to Africa, Stock



Source: John Hopkins School of Advanced International Studies – China Africa Research Initiative

Chinese Loans by Subregion and Sector



Source: Boston University Development Policy Center – Chinese Loans to Africa Database

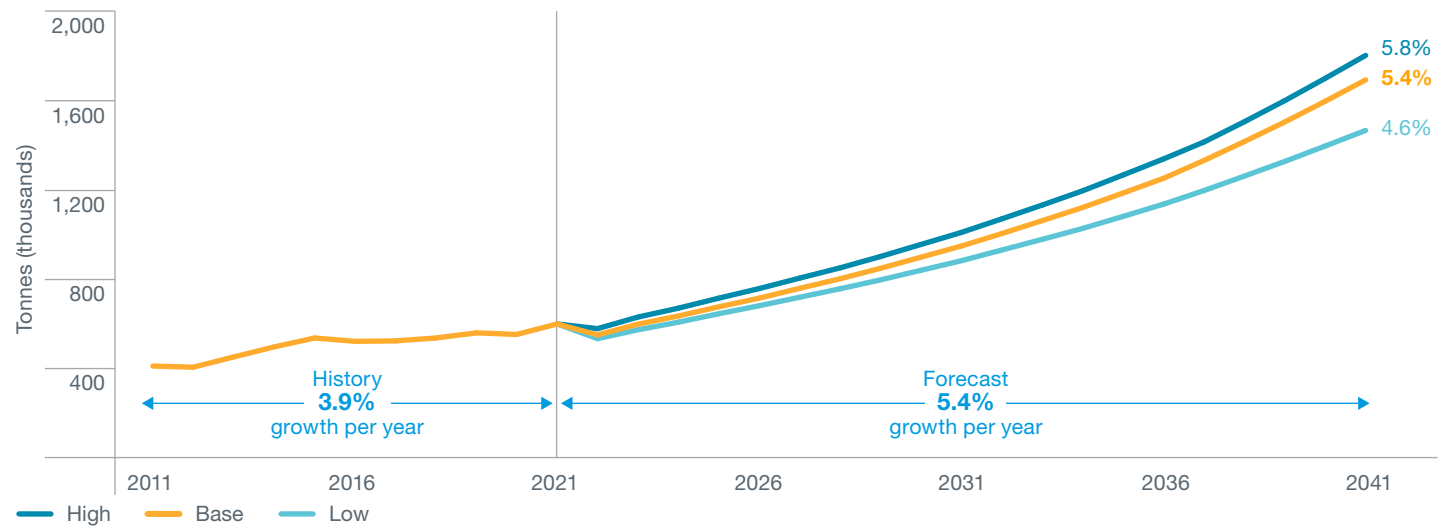
Africa

Growth in African air trade with East Asia will be driven principally by Asian imports into the continent. China's foreign direct investment (FDI) in Africa grew at a rate of 12% per year between 2011 and 2020, while, during the same period, U.S. FDI contracted an average of 2% per year.

By implementing Prosper Africa measures and U.S.–Africa strategy proposals, the U.S. hopes to counter growing Chinese investment and geopolitical influence in the region. It is difficult to conclude that the recent growth of U.S. FDI in 2020 is a result of these initiatives. Analysis of data on loans from China to Africa shows that the majority of lending is directed to the Central Africa subregion, with most of that money channeled toward the mining sector. Transport, power, mining, information and communication technologies, and water are the sectors borrowing the most in U.S. dollars.

Follow-on investment by China in African extractive industries and infrastructure, combined with continuing urbanization and rising demand for consumer goods in Africa, will propel East Asia-to-Africa air trade growth at a rate of 5.7% per year for the forecast period. Conversely, Africa-to-Asia air cargo trade will expand at a slower rate of 4% per year, with higher growth expected later in the forecast period as Africa slowly develops industrial ties with East Asia.

The Africa–East Asia Market Will Grow 5.4% per Year



Domestic China



Shanghai

Highlights

- China is the world's largest e-commerce market, valued at more than \$2 trillion in 2021.
- Domestic air cargo traffic in China declined 27% in the first half of 2022 due to the continuing impacts of China's COVID-19 policies.
- High-speed rail freight service shows potential, especially in providing additional cargo capacity during peak times, complementary to air cargo service.
- Led by e-commerce and express markets, domestic air trade in China will grow 5.3% annually.

Market Overview

China is the world's manufacturing colossus, with key industries producing commodities in such categories as apparel, automotive, computing, and telecommunication equipment. Most of these goods are intended for export and have traditionally been transported by air. Domestic China's air cargo traffic has grown by 6.2% annually over the last two decades. It accounts for 7.5% of the world's air cargo traffic by tonnage, and for 2.3% of the global air cargo market in tkm.

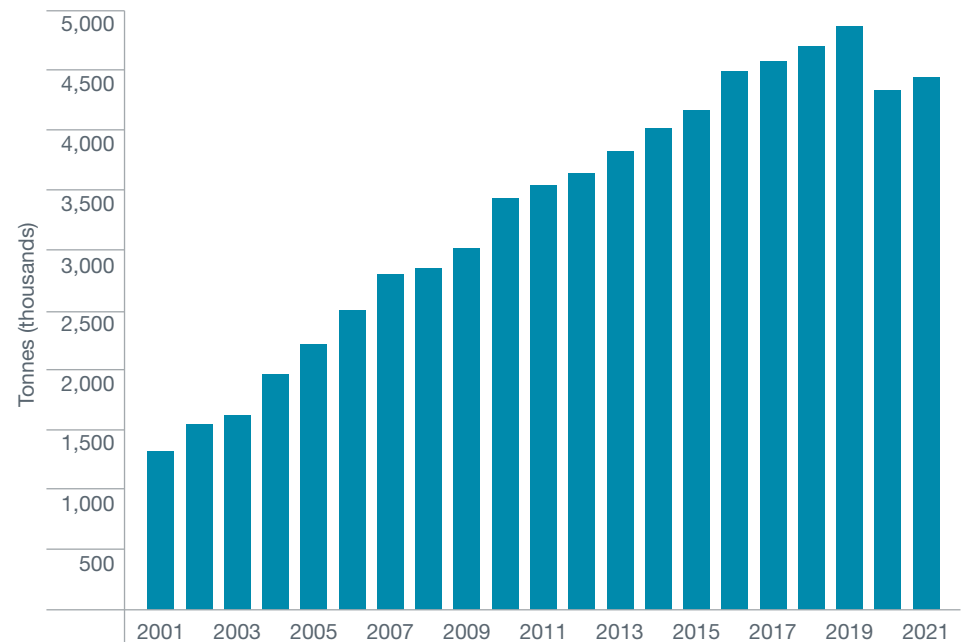
The Stimulus of Consumer Demand

Tremendous increases in air trade with countries throughout Asia, Europe, and North America have long been major drivers of growth in domestic Chinese air cargo traffic. During the past decade, consumer demand in China's rapidly developing cities has become another important stimulus, as China shifts to a consumption-driven economy. The service/consumption sector now contributes more than 53% of China's GDP.

At 4.5 million tonnes transported annually, the domestic China air cargo market is second only to that of the United States. China's market grew 6.2% annually over the past 20 years and, as the shift toward a consumer economy continues, air cargo demand will further expand. Air cargo activity is concentrated in the coastal and southern provinces, home to the bulk of the country's 1.4 billion people and its \$15.4-trillion economy.

China's domestic air cargo market grew 2.3% in 2021, after a decline of 10.9% in 2020. For the first six months of 2022, China's domestic air cargo traffic also declined, by 27%, mostly due to the ongoing impacts of China's COVID-19 policies. But China's economic growth is forecast to reach 3.8% and 4.9% for 2022 and 2023, respectively.

Domestic China Air Cargo Grew 6.2% per Year Since 2001



Source: CAAC

Domestic China

E-Commerce Spurs Growth

Rapidly expanding e-commerce and express markets are major growth drivers for domestic air cargo. In fact, China boasts the world's largest e-commerce market, valued at more than \$2 trillion in 2021, a rise of 19.1% over 2020. During the past ten years, its annual growth rate has been 30%, about 1.8 times the 17% rate of the US.

The pandemic dramatically accelerated e-commerce growth as consumers shopped online to avoid COVID-19 exposure. For 2021, combined sales by Alibaba and JD.com set a record of \$139 billion—64% over 2020. Alibaba Singles' Day sales in 2021 reached \$84.5 billion, an increase of 14% in comparison with the previous year. Purchases during JD.com's 618 Shopping Festival amounted to US\$53.8 billion, an increase of more than 30% over 2020. Sales of luxury goods increased by 40% over the prior year. Interestingly, consumers purchased US\$46.9 million worth of iPhones in the first few minutes after they went on sale on November 1.

Consequently, in 2021 more than 105 billion parcels had to be moved—an increase of 28.3% per year from 2016 through 2021. China's airlines responded by growing their freighter fleet by 63% over the same period. By year's end, 2021, 143 freighters were operating to meet China's domestic e-commerce and express-market demand. This buildup primarily consisted of standard-body and medium-widebody freighters, which make up 77% of the China-domiciled freighter fleet.

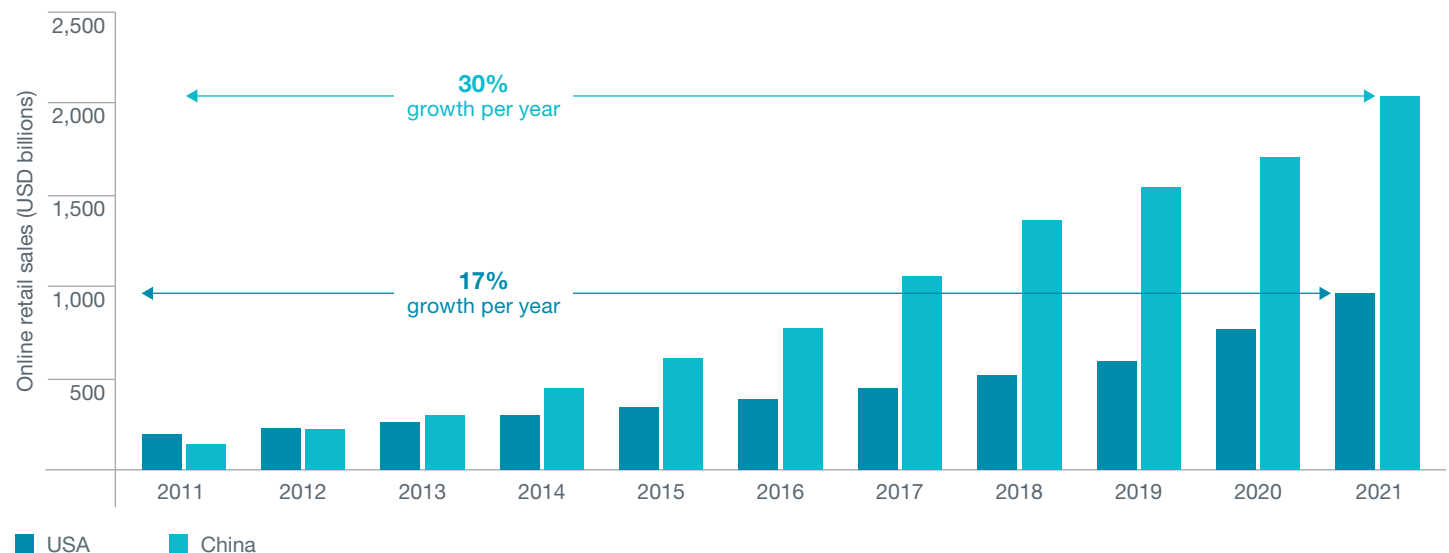
How HSR Could Complement Air Freight

Meanwhile, China boasts the world's longest, most heavily used high-speed rail (HSR) network. Built over the past 14 years, the network connects most major cities with nearly 40,000 kilometers of track—not all of it concentrated in the coastal and southern provinces. That stretch of track could double by 2035 under a plan recently announced by the state-owned China Railway Group.

The expansion of HSR service brings us to the question of freight transport. Strong growth in the e-commerce and express-cargo markets illustrates the need to deliver goods rapidly. At \$2.03 trillion, China commands the world's largest e-commerce market, which has grown 21% per year over the last five years.

Research shows that the HSR passenger network actually could provide a foundation for HSR freight development, especially on

China's Online Retail Sales Have Passed \$2 Trillion



Source: US Census Bureau and www.data.gotohui.com

Domestic China

high-density routes during peak periods. But HSR freight service faces significant challenges.

For example, HSR in China is primarily designed for passenger traffic, not freight. Although freight has been carried in vacant HSR passenger carriages, passenger traffic constrains operating time and service schedules. And even this qualified freight service is limited to small or light cargo by the weight limits of infrastructure designed for passenger trains.

Other infrastructure concerns include platforms that lack freight access or transshipment facilities; widely separated stations and parcel distribution centers; and stations without cargo warehouses, stacking areas, machinery for loading and unloading, or large-scale sorting facilities.

What's more, on the business side, dedicated high-speed freight lines would require significant volume guarantees from mail and parcel delivery companies or other shippers.

So, over all, the present passenger-dedicated system will need to be fundamentally transformed, emerging as a mixed passenger-freight service.

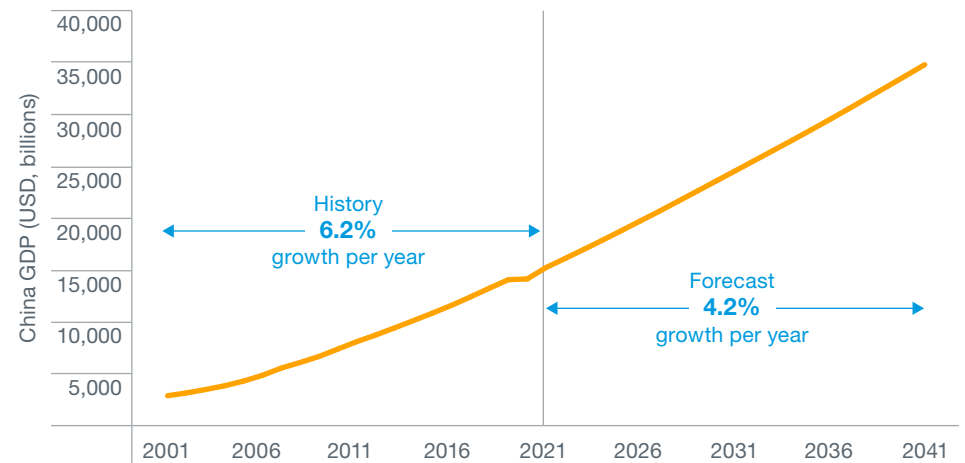
This HSR freight service may at first be limited to a few dense lanes that support local express-package traffic demand. But, eventually, given China's strong e-commerce and express market growth, HSR freight services could complement the air cargo business.

Context: Outpacing the Average

China's GDP is forecast to grow 4.2% per year and increase 2.3 times over the next 20 years. China currently accounts for 58% of all East Asia GDP and is projected to account for 66% by 2041. For this forecast, base-, low-, and high-growth GDP models were developed to forecast domestic China air cargo growth. The low- and high-growth air cargo scenarios reflect GDP projections for 0.5% below and 0.5% above the baseline GDP per capita growth, respectively.

Overall, domestic China air trade will grow 5.3% annually for the forecast period, with most rapid growth in the first half and some slowing in the second half, in conjunction with growth rates.

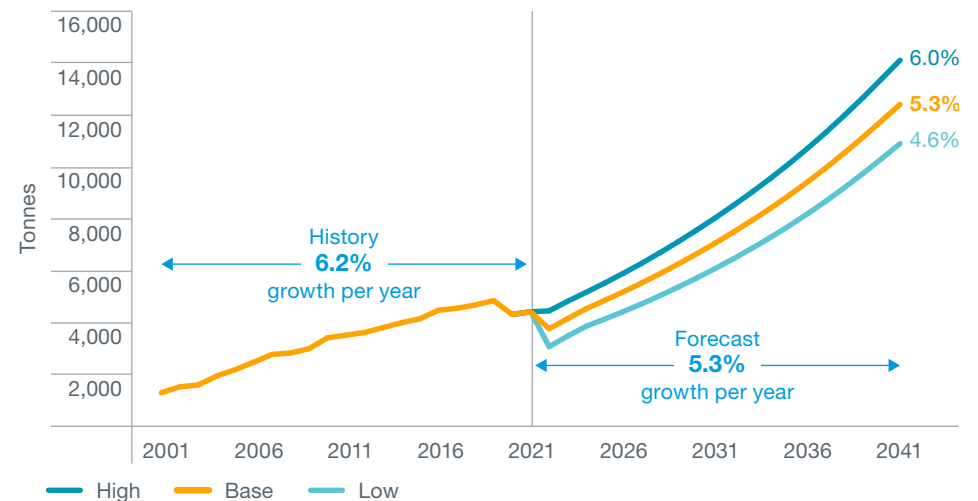
China's GDP Is Expected to Increase 2.3 Times in the Next 20 Years



Source: S&P GTA

Domestic China Air Cargo Traffic Will Grow 5.3% per Year

Average Annual Growth, 2022–2041



East Asia– North America

For the purposes of this forecast, we define East Asia as Australia, Cambodia, China, Hong Kong, Indonesia, Japan, Macau, Malaysia, New Zealand, the Philippines, Singapore, South Korea, Taiwan, Thailand, and Vietnam. We define North America as Canada and the United States.



Seoul, South Korea

Highlights

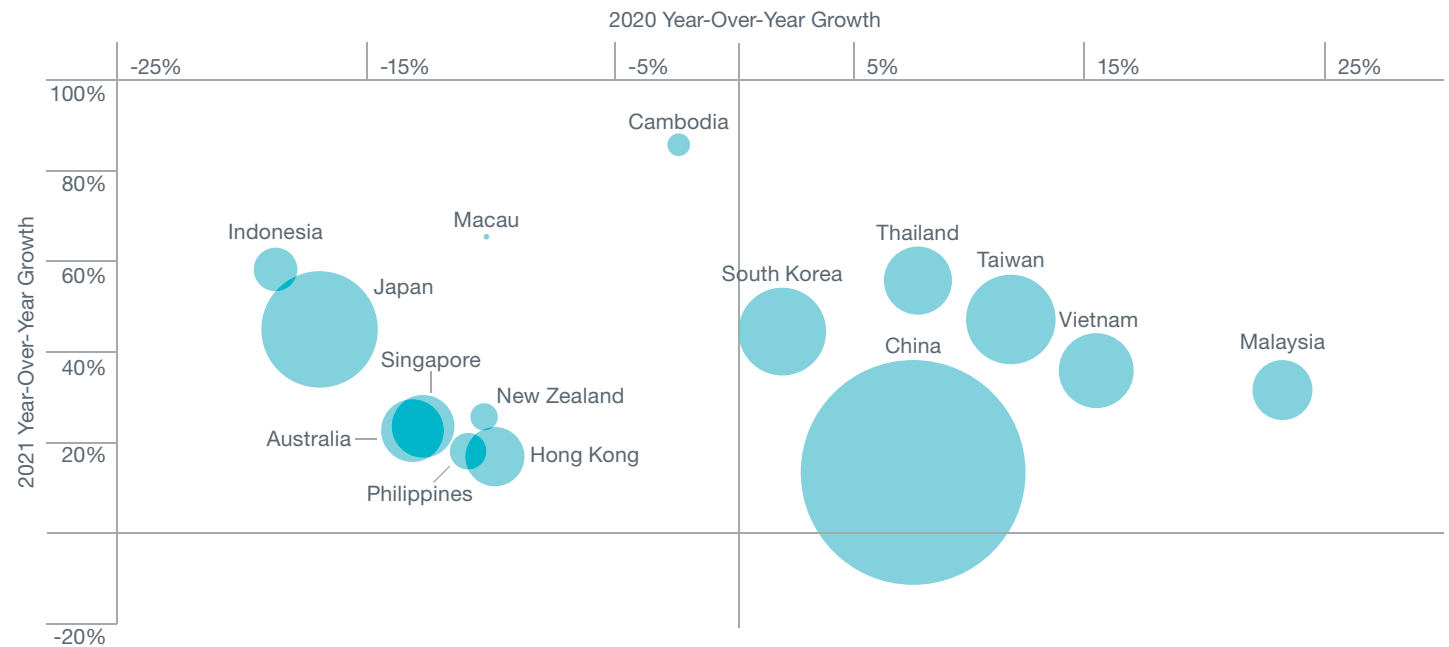
- The transpacific air cargo market has grown by nearly 30% since 2019, but growth slowed in the first half of 2022 due to COVID-19 restrictions, economic headwinds, and supply chain challenges.
- China, Japan, Taiwan, and South Korea remain the top Asian air cargo markets, collectively responsible for roughly 70% of total volumes. Vietnam is the fastest growing market and is now the fifth largest.
- Economic fundamentals, supply chain diversification, and manufacturing investment throughout Asia are key drivers behind the 4.4% annual growth projected for the East Asia–North America flow.

Market Overview

The East Asia–North America market represents 23.1% of the world’s air cargo in tonne-kilometers and 9.2% in tonnage. Over all, the market grew 1.3% and 27.9% in 2020 and 2021, respectively. Air freight in the East Asia-to-North America direction increased

from 2.8 million tonnes in 2020 to 3.5 million tonnes in 2021. Westbound air freight volumes from North America to East Asia increased from 1.4 million tonnes in 2020 to 1.9 million tonnes in 2021.

East Asia–North America Air Freight Market Grew 28% in 2021



Source: US Department of Commerce and IHS S&P Global

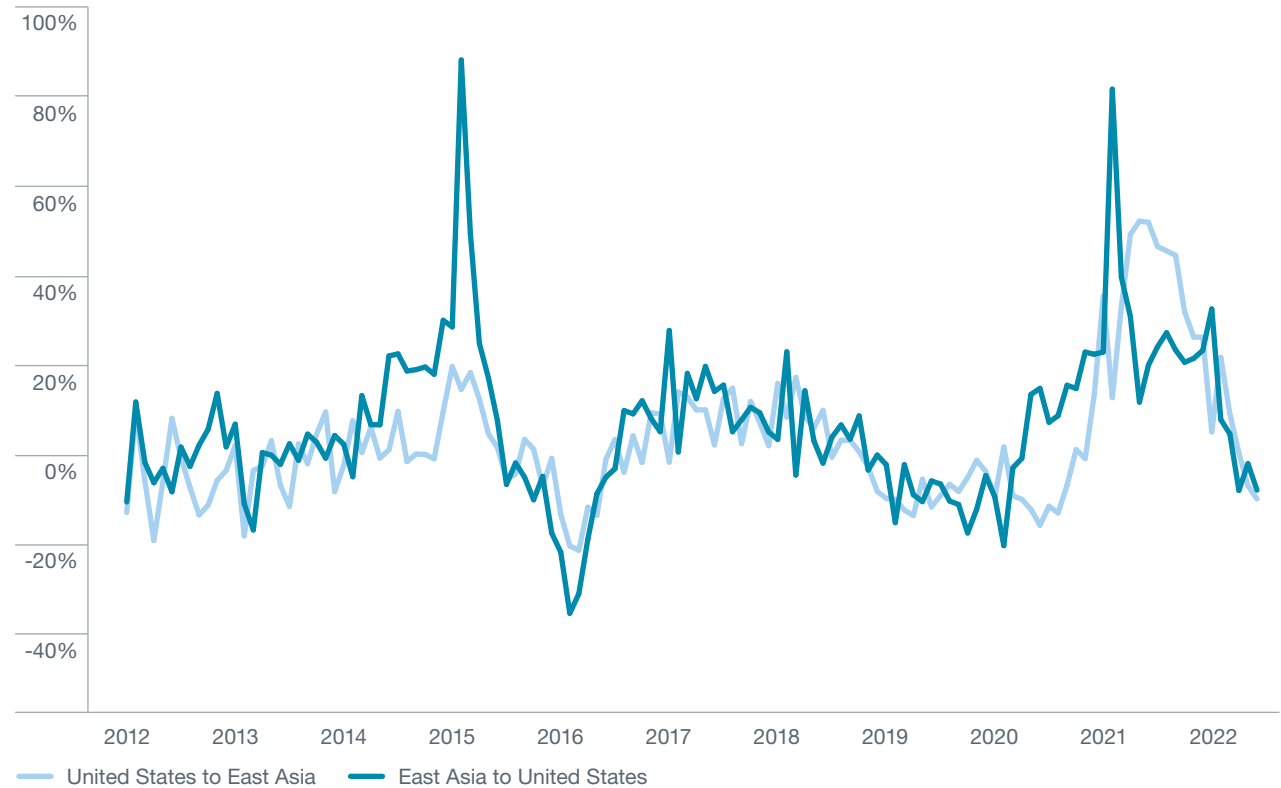
East Asia–North America

The United States accounts for nearly 90% of the overall air trade market between East Asia and North America. U.S. monthly market activity can therefore approximate the overall transpacific market. During the first six months of 2022, overall East Asia–U.S. air cargo traffic grew 2.5%, compared with the first six months of 2021. Traffic grew 1.8% and 2.8% in the U.S.-to-East Asia and East Asia-to-U.S. directions, respectively.

For the first quarter, U.S.–East Asia air cargo traffic grew 12.7%, with U.S. imports growing 13.7% and U.S. exports growing 11.1%. Further COVID outbreaks leading to additional restrictions in a number of countries, a rise in inflation, and high energy prices resulted in a U.S.–East Asia air cargo traffic decline of 6.4% in the second quarter of 2022.

East Asia–North America Air Freight Grew 2.5% for First Half of 2022

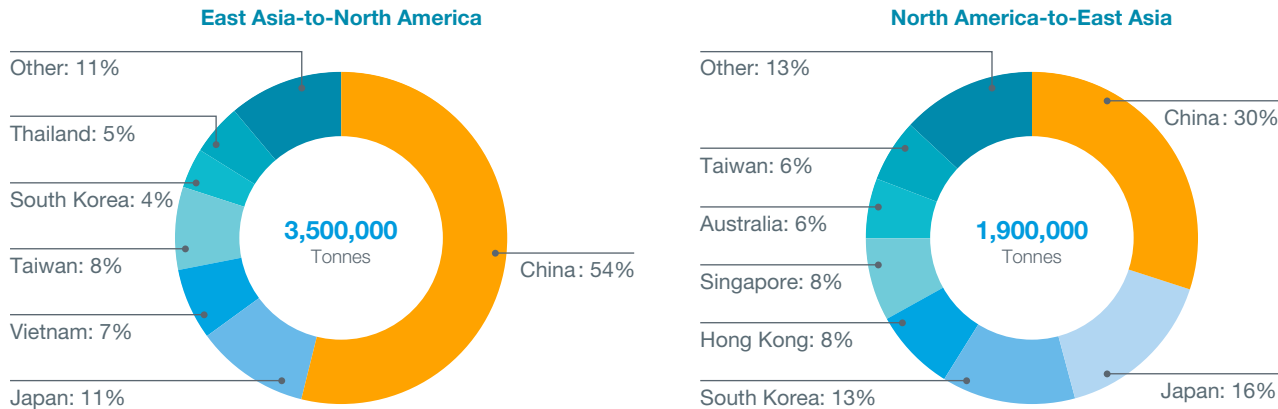
Monthly Change in Air Cargo Tonnage Year Over Year



Source: US Department of Commerce

East Asia–North America

China Accounts for 46% of Transpacific Air Cargo Market



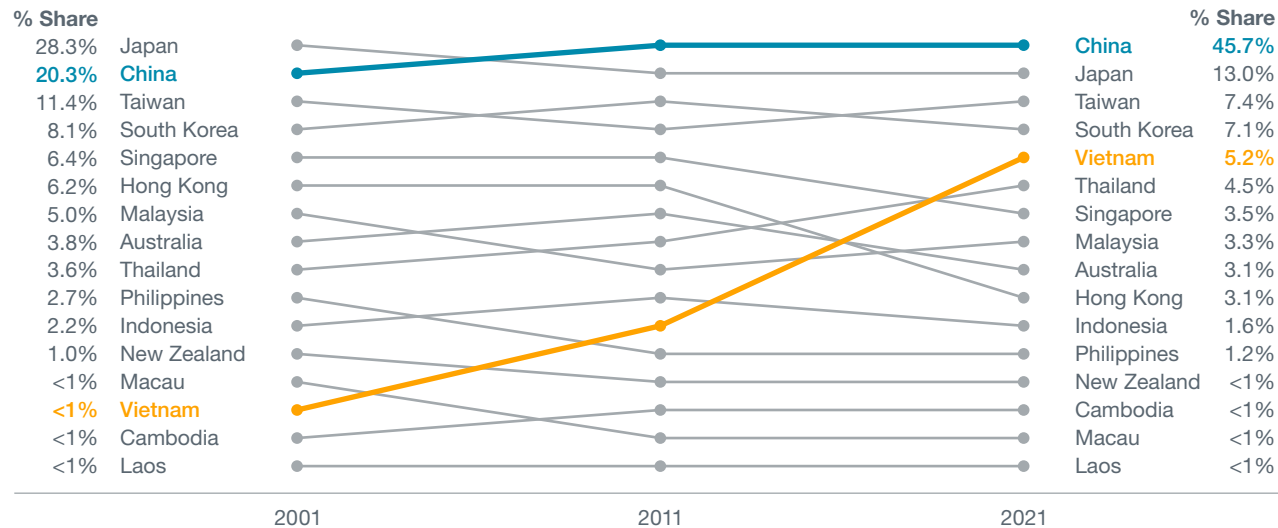
Source: US Department of Commerce and IHS Markit

Country Market Shares Vary Widely

The China–North America air cargo market grew 7.4% and 15% in 2020 and 2021, respectively. China continues to represent the largest air cargo market in the East Asia–North America market; its market share rose from 20% in 2001 to 43% in 2011, and stood at 46% in 2021. This increased Chinese dominance led to a decline in Japan’s share from 28% in 2001 to 16% in 2011 and 13% in 2021.

Vietnam is the fastest growing air cargo market, expanding 20.6% per year over the past 20 years. Vietnam’s market share has increased from 0.3% in 2001 to 5.2% in 2021, and now accounts for 7% of the East Asia-to-North America market.

China Market Remains Dominant; Vietnam Grew Significantly Over Two Decades



Source: US Department of Commerce and S&P Global

Drivers of Eastbound vs. Westbound Flow

Four commodity categories account for 75% of East Asia-to-North America air cargo traffic: apparel; computers and communication equipment; machinery and electrical equipment; documents and small packages. In the opposite direction, nearly 50% of all traffic falls into two categories: machinery and electrical equipment; chemicals and related products.

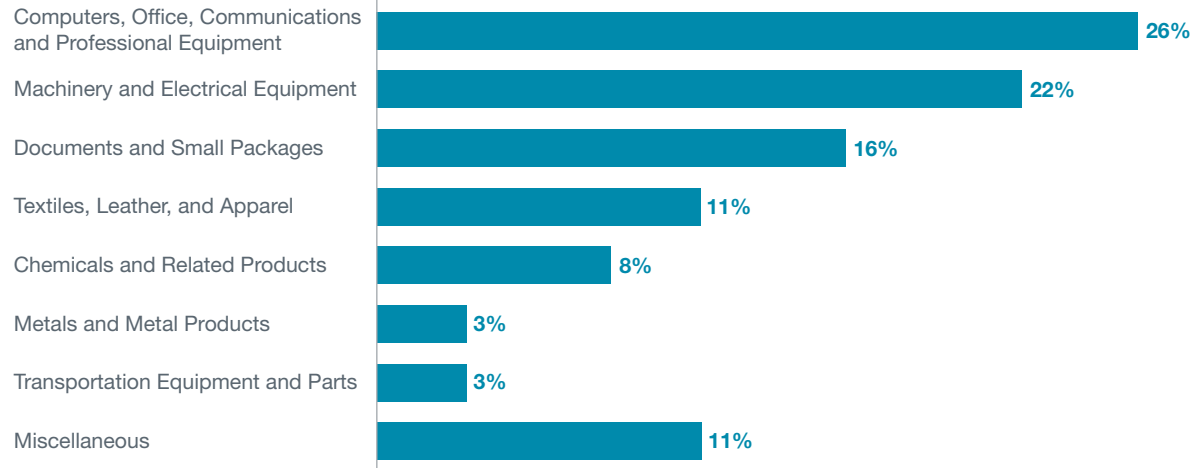
East Asian exports to North America grew 6.2% and 24.4% in 2020 and 2021, respectively. Communication equipment; chemicals and related products; machinery and electrical equipment; and documents and small packages grew 20.2%, 25.7%, 43.5%, and 22%, respectively. Textiles, leather, and apparel declined 17%.

North American exports to East Asia grew 34.7% in 2021, after a decline of 7.2% in 2020. Office and communication equipment grew 21%; chemicals and related products grew 71.1%; machinery and electrical equipment grew 33.5%; and documents and small packages grew 36.8%. Vegetables and animal products grew 34% in the same period.

Consumer Goods Drive Eastbound Transpacific Flow; Manufacturing Materials Drive Westbound Flow

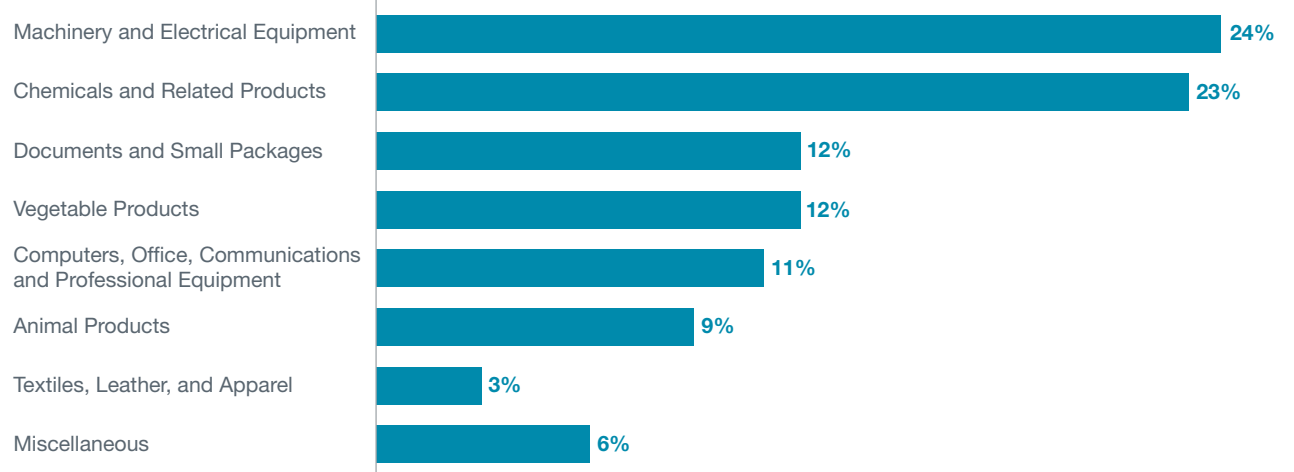
East Asia-to-North America

3,500,000 Tonnes



North America-to-East Asia

1,900,000 Tonnes



Source: S&P Global and US Department of Commerce

Growth for East Asia–North America Traffic

Total air tonnage on the transpacific route is determined by the combined economic activities of North American and East Asian countries, international trade patterns, and the various types of trade commodities. Economic growth in the importing region primarily determines directionality, but flow is also influenced by exchange rates, which affect the cost of imported goods in national currencies.

As COVID moves from a pandemic to an endemic, much of its impact continues, affecting the growth forecast for air trade between East Asia and North America. According to China’s Global Times, air transport costs rose more than 30% in 2020, compared to pre-pandemic levels, but air freight demand continues to accelerate, despite rising cost and supply chain crises (due to COVID disruptions), coupled with a boom in demand.

The COVID pandemic, and subsequent supply-chain disruptions across the globe, have accelerated some companies’ diversification

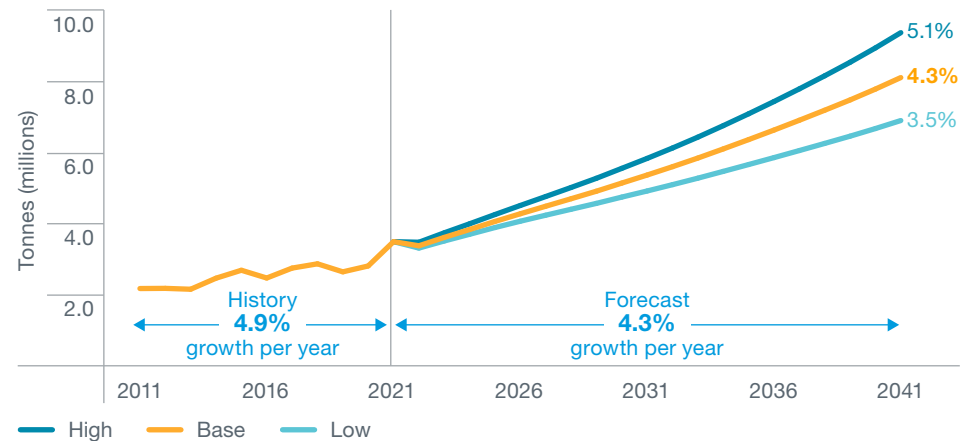
strategies in manufacturing. While China remains the market-leading giant in manufacturing across East Asia, companies are beginning to incorporate “China Plus One” strategies, in which investment in manufacturing becomes increasingly attractive in other Asian regions.

Alongside the China-plus-one strategy is the desire for East Asian countries to relocate their manufacturing domestically. Both Taiwan and Japan are offering subsidies and assistance to bring high-tech manufacturing back home. Taiwan has implemented an “Invest Taiwan” initiative that offers attractive loans to motivate manufacturing relocation, and Japan has allocated ¥2.2 billion to shift production back to domestic plants.

External investment is also increasing in East Asian countries. Vietnam and Malaysia are experiencing development booms in high-value manufacturing, and Thailand, Indonesia, Singapore, and South Korea are becoming increasingly attractive for manufacturing of other goods such as automotive parts, machinery, pharmaceuticals, and packaged goods.

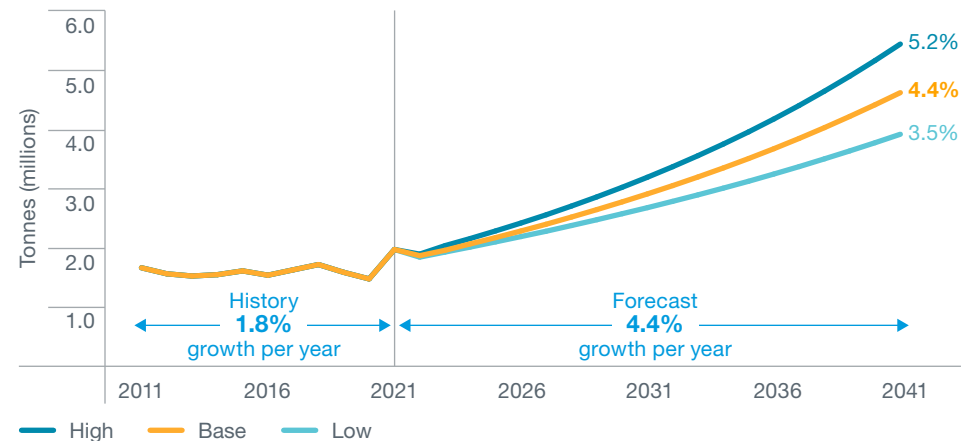
East Asia-to-North America Air Cargo Traffic Will Grow 4.3% per Year

Average Annual Growth, 2021–2041



North America-to-East Asia Air Cargo Traffic Will Grow 4.4% per Year

Average Annual Growth, 2021–2041



East Asia–North America

Despite booming demand and efforts to relocate manufacturing domestically, China remains competitive—and the fastest-growing market for manufacturing investment, a position that contributes significantly to forecast growth in air trade among East Asian and North American routes. According to the United Nations Conference on Trade and Development, foreign direct investment (FDI) increased in China by nearly 25% over the past five years, more than 17% of it from 2020 to 2021. Vietnam also experienced high growth of almost 10% over the past five years, reinforcing East Asia’s emergence as an increasingly attractive and high-growth market.

On East Asian–North America trade routes, the forecast assumes growth will increase as FDI in the region continues to grow, especially as the global market recovers from COVID supply chain pressures, and demand increases for air-transported goods.

North American exports to East Asia grew at a lackluster rate of 1.8% over the last decade, due not only to the economic slowdown, but also to disasters that included Japan’s 2011 tsunami and nuclear catastrophe. Record flooding in Malaysia, Thailand, and Indonesia during 2014 and 2015, which displaced 367,000 people, also hampered growth.

North American exports to East Asia are forecast to grow 4.4% per year over the next two decades, driven largely by the rise of the Asian middle class. In 2020, the Asian middle class reached 2 billion people, compared to 647 million in the Americas. Asia is expected to account for 65% of the world’s middle class (which will reach an estimated 3.5 billion) by 2030. China’s middle-class population is expected to nearly double, from more than 400 million in 2021 to over 750 million by 2041.

Asia’s fast-growing middle class is driving demand and shaping consumption patterns across sectors that range from travel to luxury goods to food, where consumption trends emphasize health and sustainability. As an example, food-related products like beef, fish, pork, and vegetables increased from 15% in 2011 to 20%, as a share of North America-to-Asia tonnes, in 2021.



Europe– East Asia

For the purposes of this forecast, we define Europe as all 27 member countries of the European Union plus Albania, Gibraltar, Iceland, Norway, Switzerland, Turkey, the United Kingdom, and the countries of the former Yugoslavia. We define East Asia as Australia, Cambodia, China, Hong Kong, Indonesia, Japan, Macau, Malaysia, New Zealand, the Philippines, Singapore, South Korea, Taiwan, Thailand, and Vietnam.



Hong Kong

Highlights

- The Europe–East Asia air cargo market has grown 4.3% since 2001, but growth slowed in the second decade due to the European sovereign debt crisis and COVID-19.
- The Europe-to-Asia flow is expected to approach parity with Asia-to-Europe, as Asia's growing middle class accelerates a shift to a consumption economy, increasing the demand for European goods.
- Robust economic fundamentals, a growing Asian middle class, and manufacturing investment throughout Asia are key drivers behind the 4.5% annual growth projected for the East Asia–Europe flow.

Strong Growth in 2021; Challenging Market Dynamics in 2022

The Europe–East Asia market represents 18.8% of the world's air cargo in tonne-kilometers, and 9.2% in tonnage.

After contracting 8.4% in 2020 due to pandemic impacts, the overall Europe–East Asia market grew 15.7% in 2021. The Europe-to-East Asia flow grew 14.6% in 2021 after contracting 12.8% in 2020, while, in the East Asia-to-Europe direction, traffic contracted 4.1% in 2020 and grew 16.8% in 2021.

Air freight in the East Asia-to-Europe direction increased from 2.5 million tonnes in 2020 to 2.9 million tonnes in 2021. Eastbound (from Europe to East Asia) air freight volumes increased from 2.2 million tonnes in 2020 to 2.6 million tonnes in 2021.

Europe–East Asia air cargo traffic grew an average of 4.3% per year over the last two decades. After the global economic downturn of 2008/2009, the market quickly recovered, growing 5.7% per year between 2009 and 2017, but then saw no growth in 2018, followed by a decline of 2% in 2019.

Europe's economic slowdown contributed to the situation. After growing 3% in 2017, the European economy slowed to 2.1% and 1.7% growth for 2018 and 2019, respectively. The introduction of the mandatory Worldwide Harmonized Light Vehicles Test Procedure (WLTP) for EU car manufacturers also played a role in the slowdown. This stricter new control system for fuel consumption and emissions applied not only to new vehicles, but also to vehicles that were already approved under the previous system but had not yet been sold.



Air Trade Flow Dynamics

Europe–East Asia annual trade growth includes overall air traffic flows between Europe and Asia and also contains some sixth-freedom traffic that flows air cargo via other regions. Thus, the chart does not represent the actual trade flows by direction. Comparisons, therefore, should not be made between the chart at right and the following air trade flow analysis.

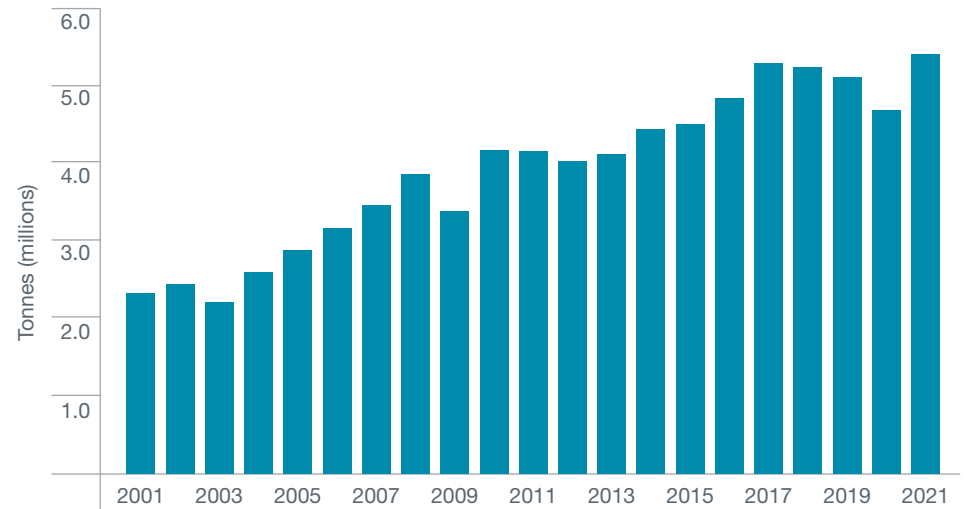
Between 2004 and 2008, Europe’s imports from East Asia grew 12% per year, while its exports to Asia grew at 8.4%. By 2008, Europe was importing 2.3 million tonnes from East Asia and exporting 1.6 million tonnes to the same region. The gap between Europe’s imports and exports narrowed, reaching parity in 2011 due to the global economic downturn of 2008 and 2009, as well as aggressive financial stimulus in Asia. China led the way with a stimulus package equivalent to 3.2% of its GDP in 2009.

Since 2011, Europe-to-East Asia and East Asia-to-Europe volumes grew 2.1% and 3.2%, respectively. The Europe-to-East Asia flow is expected to remain close to parity with East Asia-to-Europe, as the higher disposable

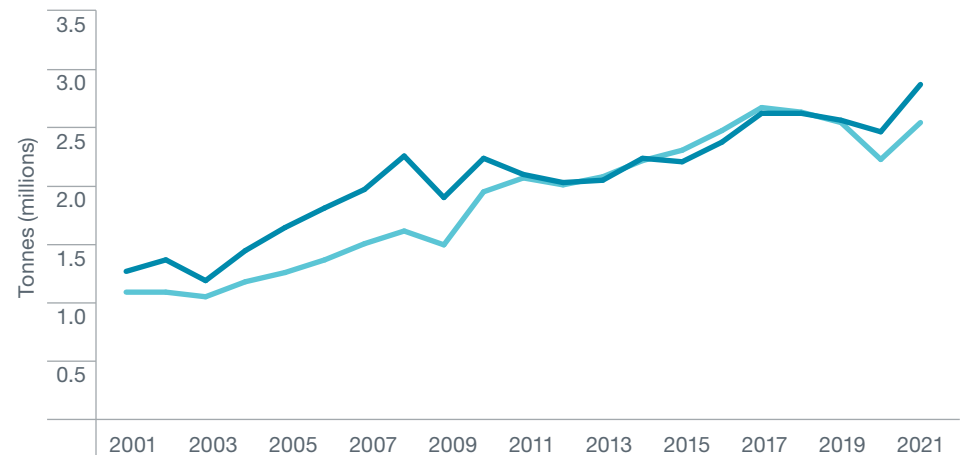
income of Asia’s growing middle class accelerates a shift to a consumption economy, increasing the demand for European goods.

More recently, the pandemic significantly disrupted economic activity as well as international air travel between the two regions, impacting both air freight demand and capacity. Before COVID-19, passenger widebody belly capacity accounted for 57% of all Europe–East Asia air cargo capacity. With the onset of the pandemic, nearly 40% of the Europe–East Asia air cargo capacity exited the market. As a result, freighter operators raised their fleet utilization and load factors to unprecedented levels. Despite increased operations, the additional freighter capacity was not sufficient to compensate for the lost belly capacity of passenger aircraft. This led to escalating cargo yields. While beginning to moderate as passenger capacity gradually returns to the market, Europe–East Asia cargo rates remain elevated due to the Ukraine War, which has reduced cargo capacity and caused airlines to implement a “war surcharge” until normal operations return.

The Europe–East Asia Air Cargo Market Has Grown 4.3% per Year



European Air Imports From East Asia Account for 53% of the Market



— East Asia-to-Europe, 4.2% Per Year Growth
 — Europe-to-East Asia, 4.4% Per Year Growth

Air Trade Commodities

In the Europe-to-East Asia flow, three commodity categories account for 60% of all air cargo traffic. In descending order, they are machinery and electrical equipment; perishables such as meat, fish, fruits, vegetables, and flowers; and documents and small packages. In the East Asia-to-Europe direction, three commodity categories also account for 77% of air trade. Here,

the categories are machinery and electrical equipment; computers, office, and communication equipment; and documents and small packages.

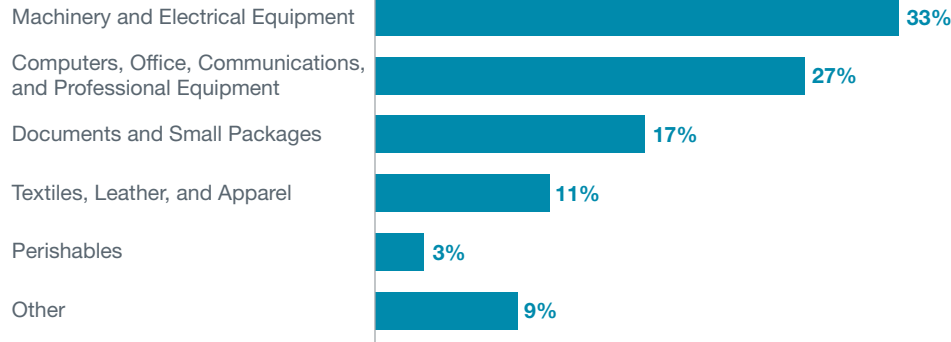
One particularly fast-growing market segment between Europe and East Asia has been documents and small packages, sometimes referred to as traditional express traffic. This trade flow has average 6.7% annual growth in annual shipment count in

both directions since 2001, as the movement of business samples, legal documents, and other expedited small-batch items between Europe and East Asia has increased. The total bidirectional express market averaged over 1 billion shipments in 2021.

Commodities Flows for Europe–East Asia Air Cargo Market

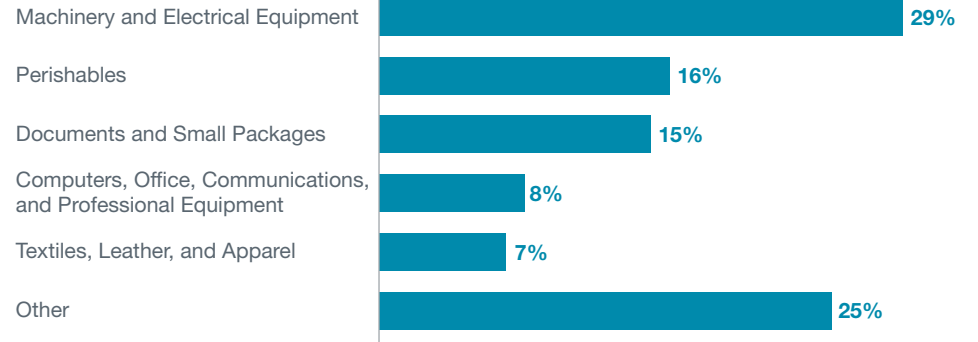
East Asia-to-Europe

2.9M Tonnes



Europe-to-East Asia

2.6M Tonnes



Air Cargo Market Forecast

Air trade flowing in both directions of the Europe–Asia air cargo market is forecast to grow an average of 4.5% per year during the next 20 years. The flow from East Asia to Europe is projected to grow at an average rate of 4.3% per year over the next two decades. The flow from Europe to East Asia is forecast to grow 4.6% per year during the upcoming 20 years.

Analysis: Economic Growth and Supply Chain Dynamics Drive Outlook

Europe-to-East Asia cargo traffic growth slowed to 2.1% over the last 10 years, from 4.3% over the last 15 years, due in part to the COVID-19 pandemic, during which traffic declined 12.8% in 2020.

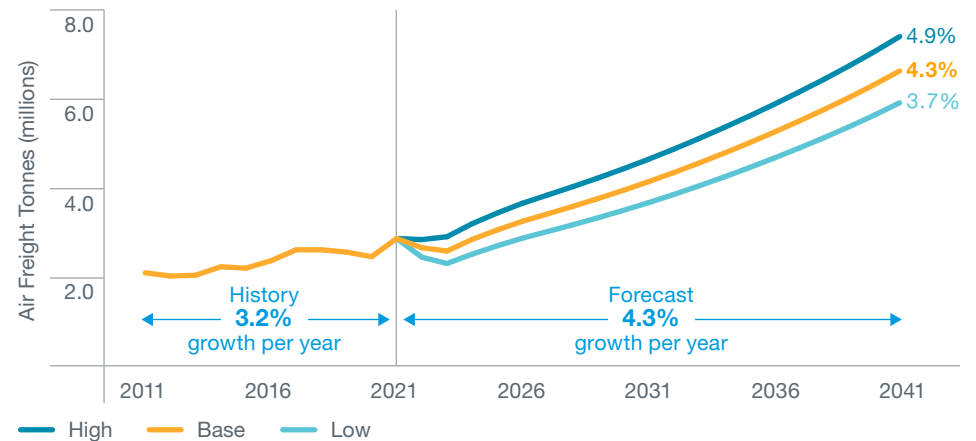
Our forecast anticipates that above-global-average economic growth in East Asia will continue, as a result of strong economic development initiatives. Asia’s GDP is forecast to grow 3.5% per year during the next

20 years. China will continue to play a major role, with expected GDP growth of 4.2% per year over the next 20 years. China’s economy currently accounts for 57% of East Asia’s GDP, and will increase to 66% by 2041. The established economies of Europe are expected to grow 1.5% per year.

Evolving supply chain strategies also contribute to the flow’s outlook. The pandemic, coupled with geopolitical developments—including US–China tensions and the Ukraine War—highlighted the vulnerabilities of the global supply chains and their dependence on the production outputs of a limited number of economies. Supply-chain disruptions across the globe have accelerated the manufacturing diversification strategies of some companies. While China remains the market-leading giant in manufacturing across East Asia, companies are beginning to incorporate a China-plus-one strategy, in which manufacturing-sector investment is becoming increasingly attractive in other Asian regions.

East Asia-to-Europe Air Cargo Traffic Will Grow 4.3% per Year

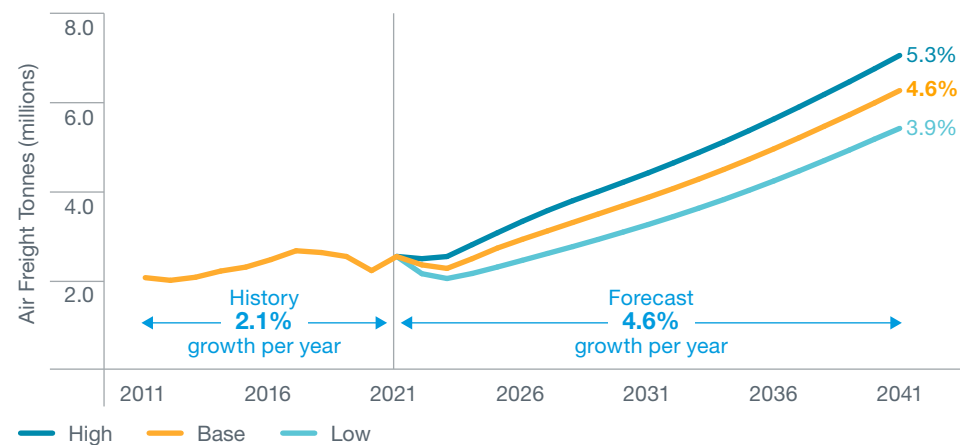
Average Annual Growth, 2022–2041



Source: S&P Global, Boeing Analysis

Europe-to-East Asia Air Cargo Traffic Will Grow 4.6% per Year

Average Annual Growth, 2022–2041



Source: S&P Global, Boeing Analysis

Over the last five years, flows of Foreign Direct Investment to Indonesia, Malaysia, the Philippines, Thailand, Singapore, and Vietnam have averaged about 11%, up from 6% between 2012-2017. Infrastructure initiatives and manufacturing account for this growth. Vietnam and Malaysia are experiencing strong development growth in high-value manufacturing, and Thailand, Indonesia, and Singapore are becoming increasingly attractive investment regions for the manufacture of other goods, such as automotive parts, machinery, pharmaceuticals, and packaged goods.

One Belt, One Road: Primarily Complementary to Air Cargo

China's Belt and Road Initiative (BRI), also known as "One Belt, One Road," was launched in 2013 and is one of the most ambitious global infrastructure projects in history. China plans to invest up to \$8 trillion in 115 countries, building roads, railways, maritime shipping lanes, and airports to better connect China to Central Asia, Southeast Asia, Russia, Europe, and Africa. This vast investment will

stimulate economic growth in the region, supporting increased trade volumes. Europe–East Asia is expected to benefit from BRI due to improved connectivity and lower cost of trade. The project is targeted for completion in 2049.

From a modal perspective, growing China-to-Europe connectivity will impact freight markets. The cost of rail is twice the cost of sea freight, but only a quarter the cost of air freight. Transit times for rail average 13–18 days, compared to 30 days for ocean and five days for air freight. (Those

figures include customs clearance, warehousing, etc.) From a commodity level, the value per kilogram of products moved by rail is much closer to sea than to air. As these comparisons illustrate, rail is more competitive with sea freight than with air freight.



Europe and North America

For the purposes of this forecast, we define Europe as all 27 member countries of the European Union plus Albania, Gibraltar, Iceland, Norway, Switzerland, Turkey, the United Kingdom, and the countries of the former Yugoslavia. We define North America as Canada and the United States.



Amsterdam

Highlights

- Europe–North America air trade growth is largely driven by industrial growth in manufacturing equipment and chemicals, while apparel has more recently increased its growth contribution.
- Five countries—France, Germany, Italy, the Netherlands, and the United Kingdom—account for nearly 65% of all European air trade with North America, while emerging European countries gained market share in recent years.
- The Europe–North America air cargo market grew 6% since 2019, but has slowed due to the Russia-Ukraine war and supply-chain challenges. The long-term outlook is for 2.3% growth annually.

Market Overview

Air trade between Europe and North America accounts for approximately 6.1% of the world's air cargo tonnage, and 8.2% of its tonne-kilometers. Europe–North America air trade rebounded in 2021, while emerging countries supported significant growth.

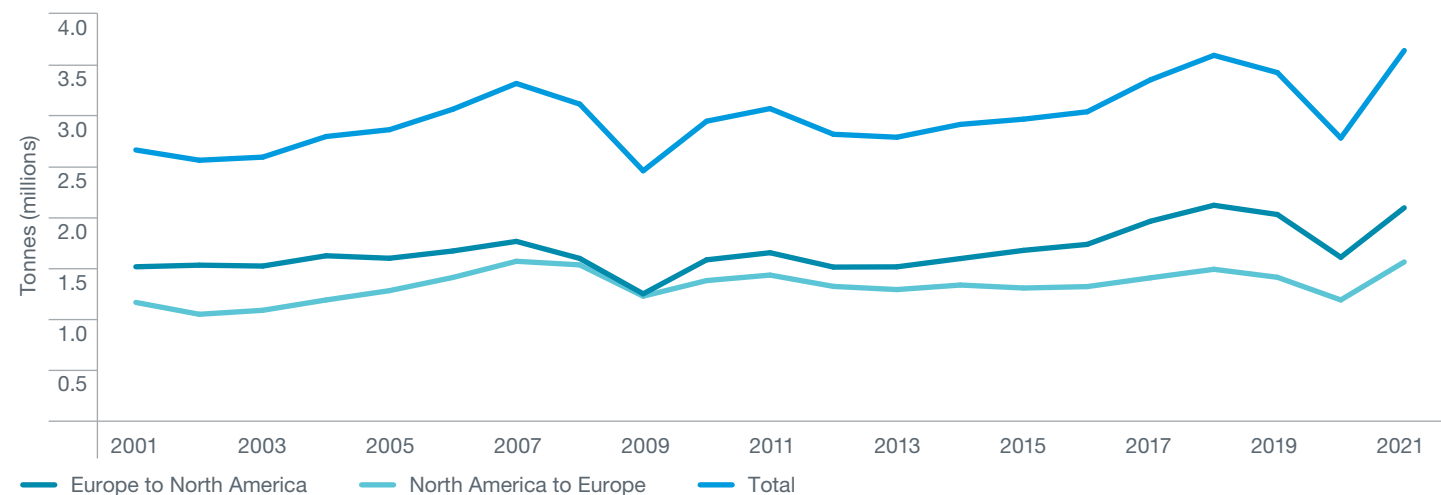
Overall Tonnage Rises

The Europe–North America air cargo market has, historically, been volatile. Most recently, the snapback from pandemic disruptions, and the ensuing pent-up demand for goods, accelerated 2021 air cargo tonnage as consumers boosted e-commerce

spending. Total air trade was down 19% in 2020, but up 31% in 2021, compared to average annual growth of 1.6% over the last two decades. In the U.S.-to-Europe direction, annual air cargo traffic contracted 16% in 2020 due to pandemic constraints, but expanded 32% in 2021. In the Europe-to-U.S. direction, annual air cargo traffic contracted 21% in 2020 and expanded 31% in 2021.

Overall, the market saw its highest volumes ever in 2021, up 6% over pre-pandemic levels. Total air cargo tonnage between Europe and the United States was 3.6 million tonnes in 2021 compared to 2.7 million tonnes in 2020.

Europe–North America Total Air Trade Has Grown an Average of 1.6% per Year Over the Last Two Decades



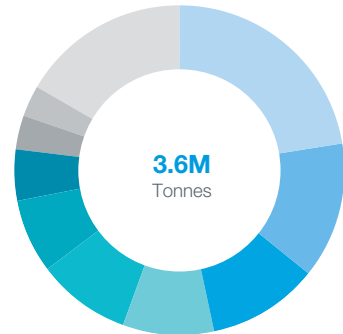
Source: US Department of Commerce TRADE, S&P GTA

European Air Trade Diversity Increases

On average, since 1980, five countries—France, Germany, Italy, the Netherlands, and the United Kingdom—accounted for nearly 65% of all European air trade with North America. Recently, however, fast-growing trade in the Central and Eastern European Countries (CEEC) has increased the region’s air trade share. With the majority of the CEEC joining the EU in the early 2000s, more than 1,800 German companies invested in 3,500 projects in the CEEC between 2006 and 2017, boosting both trade and income growth.

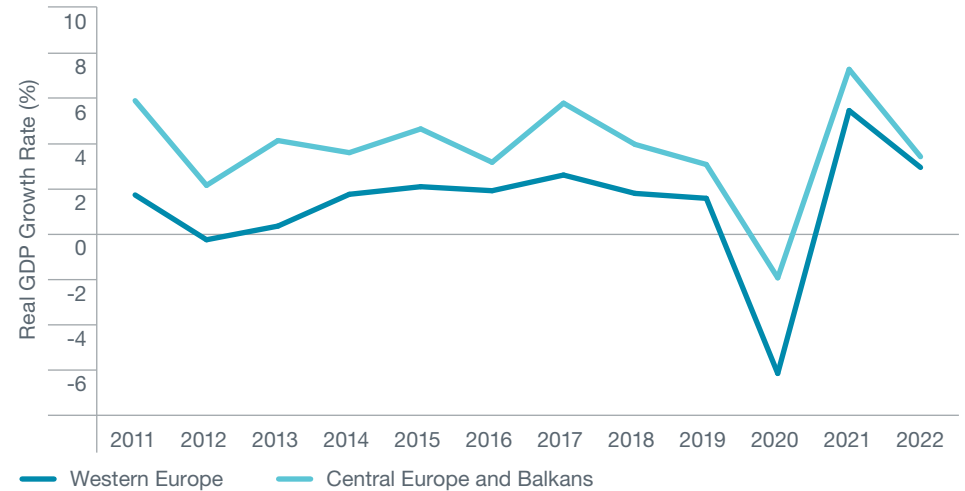
Eastern Europe was a bright spot for trade in 2021, with Poland’s year-over-year industrial growth rate at 15%, while Western Europe recovered from pandemic losses, enabling countries such as the United Kingdom and Germany to see growth of 5%. However, industrial growth slowed again in early 2022 due to the Russia–Ukraine war’s impacts on energy prices and manufacturing supply chains.

Five Countries Account for 65% of Europe–North America Air Trade



Germany: 23%	Eastern Europe: 7%
United Kingdom: 13%	Belgium: 5%
Italy: 11%	Norway: 3%
France: 9%	Switzerland: 3%
Netherlands: 9%	Other: 17%

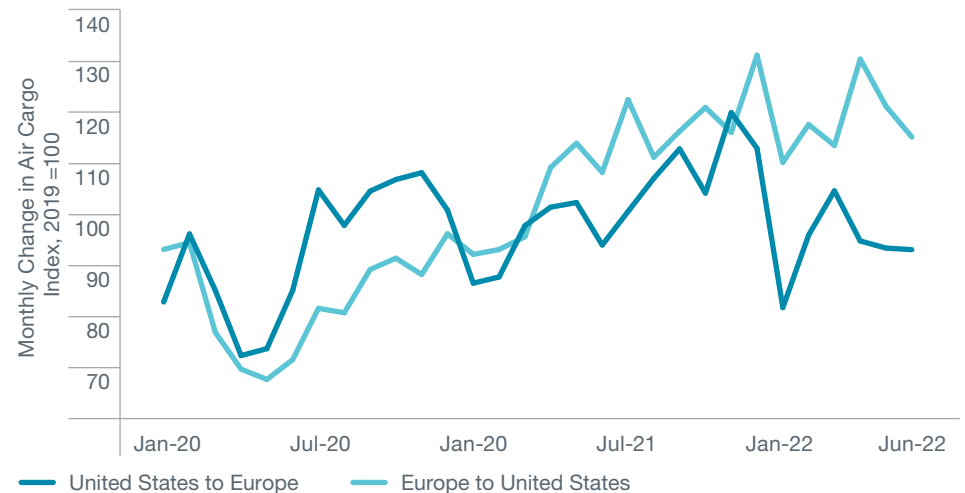
Real GDP Growth Rate (Europe)



Source: IHS Markit

Europe–US Air Trade Slowed at the Start of the Russia–Ukraine War

Steady improvement after initial shock in April



Europe and North America

Industrial Commodities Drive Cargo Growth

Industrial production of certain commodities is a key driver of growth in air cargo flows.

Seven commodity groups make up approximately 75% of the air cargo flows from Europe to North America. Industrial and manufactured goods, like components and processing equipment, are key elements of both eastbound and westbound flows. Chemicals and capital equipment compose the second largest group, with express shipments trailing close behind as the third largest commodity

group. In the North America-to-Europe direction, capital equipment, chemicals, and express shipments made up nearly 55% of all air trade volumes in 2021.

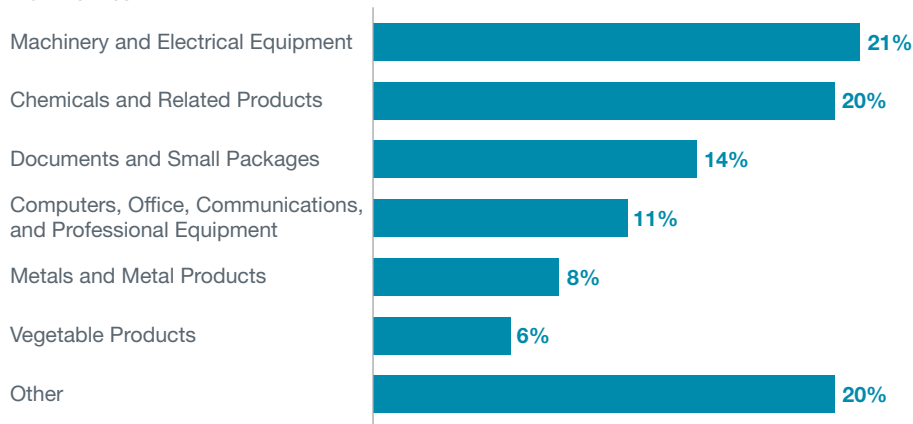
With these commodities in mind, both belly capacity and dedicated freighters are key to the North American and European markets. As the largest long-haul passenger flow, the transatlantic routes demand high capacity, greater frequencies, and diversity of destinations from airplanes with enhanced belly cargo capabilities, which often carry commodities like express shipping and small bulk cargo.

Oversized cargo such as machinery and industrial commodities like chemicals, combined with the varied and unique demands of shippers and shipping regulations, support dedicated freighter capacity. Before the pandemic, dedicated transatlantic freighter capacity was roughly one third of the total. After the pandemic's onset, the ratio of belly to main deck cargo capacity flipped, with main deck freighters supplying two thirds of that capacity. Transatlantic shipping leads the recovery of long-haul passenger capacity, so this ratio is starting to normalize, with current shares running close to half-and-half.

Top Commodities Account for About 80% of the Directional Flows

North America to Europe

1.5M Tonnes

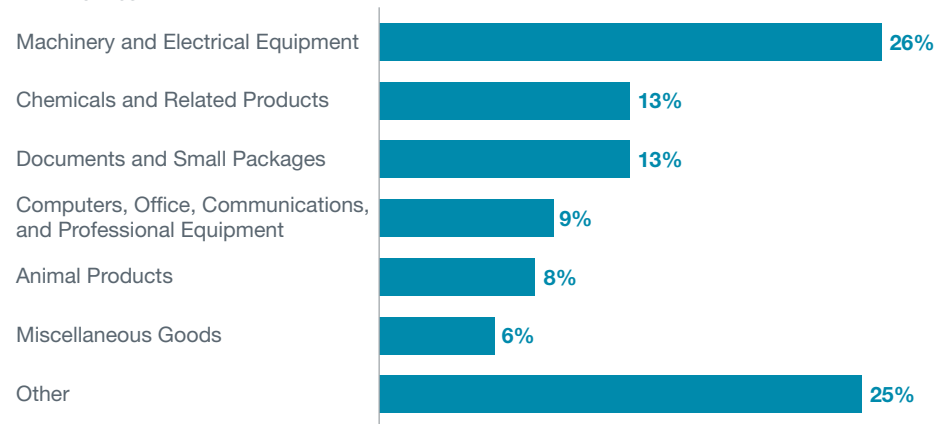


Source: US Department of Commerce TRADE, S&P GTA

Top Commodities Account for 75% of the Directional Flows

Europe to North America

2.1M Tonnes



Source: S&P GTA Dashboard, Eurostat Trade Data

Europe–North America Forecast: 2022–2041

GDP growth in Europe and North America will continue to be the broadest-based driver of air trade between these two mature economies. Baseline economic growth projections for Europe and North America through 2041 anticipate an average annual growth of 1.3% and 1.7%, respectively. Low- and high-growth scenarios are based on projections of 0.5% below and above baseline GDP growth rates.

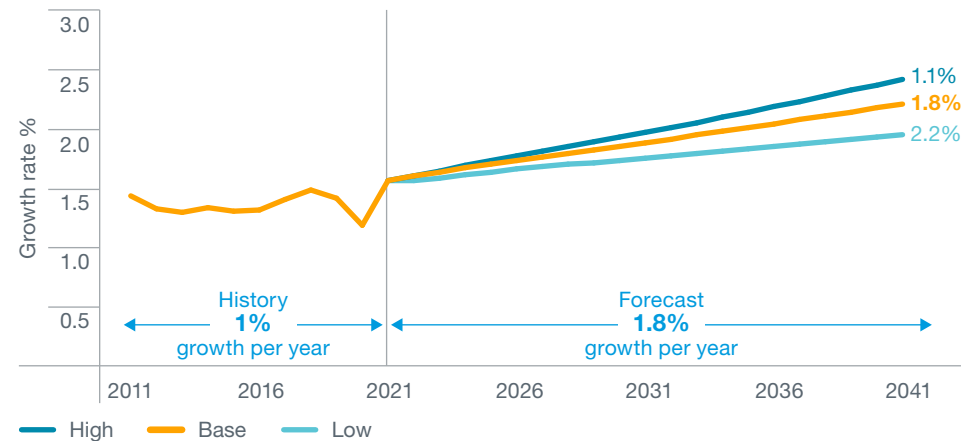
Baseline growth of total air trade in this market over the next 20 years is projected to be 2.3% annually, compared to the 1.6% annual average of the previous two decades. European and North American economies are working to bolster high-technology industrial development for commodities like chips and semiconductors, most recently investing in infrastructure and capital equipment to support operations in both regions. As a result,

air commodities are forecast to grow slightly faster than historical trends. Air trade in the North America–Europe direction will average 1.8% growth per year, and will grow slightly faster in the Europe–North America direction, at an average of 2.7% per year.

For comparison, according to the S&P Global Trade Atlas, the containership sector between Europe and North America will expand 2% annually through 2035. Pandemic shocks caused reliability to waver in maritime shipping due to high containership costs, harbor union strikes, labor shortages, and COVID-19 outages, which prompted suppliers to seek alternate modes of transportation. Air cargo was the answer, providing quick, reliable service in a time of need. This experience reaffirmed the complementary roles of air cargo and maritime shipping, as they empower global businesses to fully recover and succeed in the long term.

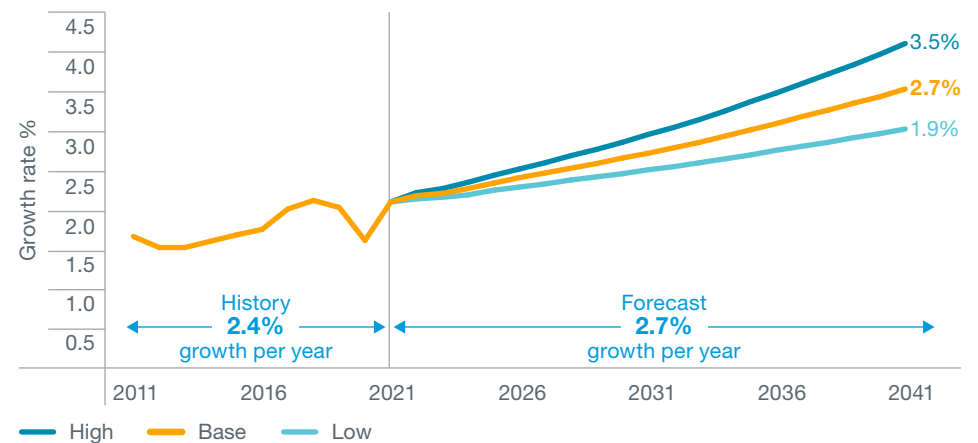
North America to Europe Air Trade Forecast to Grow 1.8% per Year

Average Annual Growth, 2022–2041



Europe to North America Air Trade Will Grow 2.7% per Year

Average Annual Growth, 2022–2041



Intra-East Asia and Oceania

This section focuses on countries of the eastern Pacific Rim: Australia, China (including the special administrative districts of Hong Kong and Macau, unless otherwise noted), Indonesia, Japan, Malaysia, New Zealand, the Philippines, Singapore, South Korea, Taiwan, Thailand, and Vietnam. No domestic flows are examined in this section; for China's domestic flows, please see "Domestic China," page 29.



Ho Chi Minh City, Vietnam

Highlights

- Above-global-average economic and trade expansion will fuel air cargo traffic growth.
- Double-digit e-commerce growth will drive express-network development, further supporting a robust air cargo outlook.
- Supply chain diversification and regional terrain constraints mean that air cargo will remain a key component of the goods-transport infrastructure.

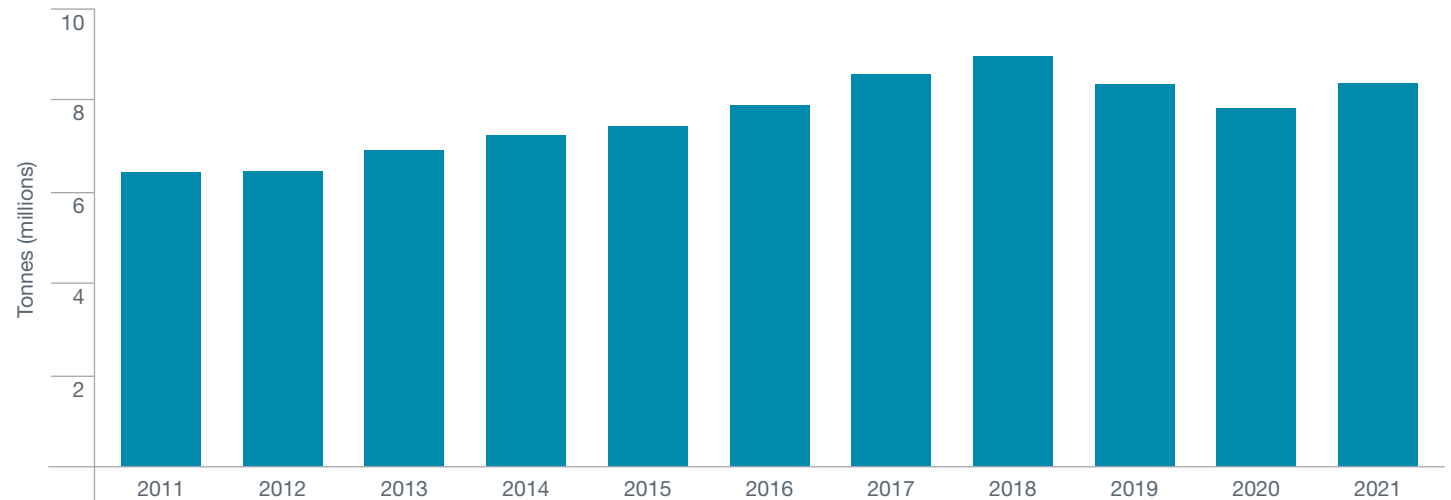
Market Overview and Recent Dynamics

The intra-Asia air cargo market remains one of the world's largest trade flows, despite increasing economic uncertainties.

Despite tonnage that grew nearly 5% per year between 2011 and 2018, intra-East Asia and Oceania cargo trade

volume contracted by more than 12% overall in 2019 and 2020, due to trade disputes, pandemic constraints, and supply chain challenges. Currently, the flow represents 7.4% of the world's air cargo in tonne-kilometers, and 14.1% in tonnage. By 2041, the flow is forecast to carry 12% of global air cargo traffic in tonne-kilometers and become the third largest market in the world.

Region's Air Cargo Growth 2.6% per Year Since 2011



Source: AAPA, ICAO TFS, Airline/airport sources, Government Trade Statistics

Economic Fundamentals Support Long-Term Growth

China, which represents more than 50% of the region's GDP, will continue to lead economic output and hold its position as the region's primary air cargo customer. Economies and trade in other Asian countries are also expected to see strong growth, which will bolster the overall intra-Asia trade outlook.

In the region's mix of mature and emerging markets, established economic growth rates are among the world's highest. Despite uncertainties such as currency depreciation, high inflation, and rising oil prices, intra-Asia trade has continued to expand at well above the average rate. The region experienced a decrease in air cargo volume in 2019, as did most other parts of the world, falling 5.4% in 2019 due to trade disputes, weaker manufacturing activities, and lower consumer and business confidence. However, before the onset of COVID-19, the region was starting to show recovery in the fourth quarter of 2019 and early 2020. Now, nearly three years into the pandemic, restrictions have started to ease, and the region's near-term GDP outlook remains resilient, despite uncertainties

in the global economy. We forecast continued expansion of private consumption and industrial production in the post-pandemic environment.

In the longer term, the region's Asian economies are projected to grow at an average annual rate of 3.6%, expanding the overall GDP by nearly 50% in the next 20 years. China will continue to increase its share of the region's GDP in two ways: First, its economy, expected to grow 4.3% per year, will account for nearly 65% of the region's overall GDP by 2041.

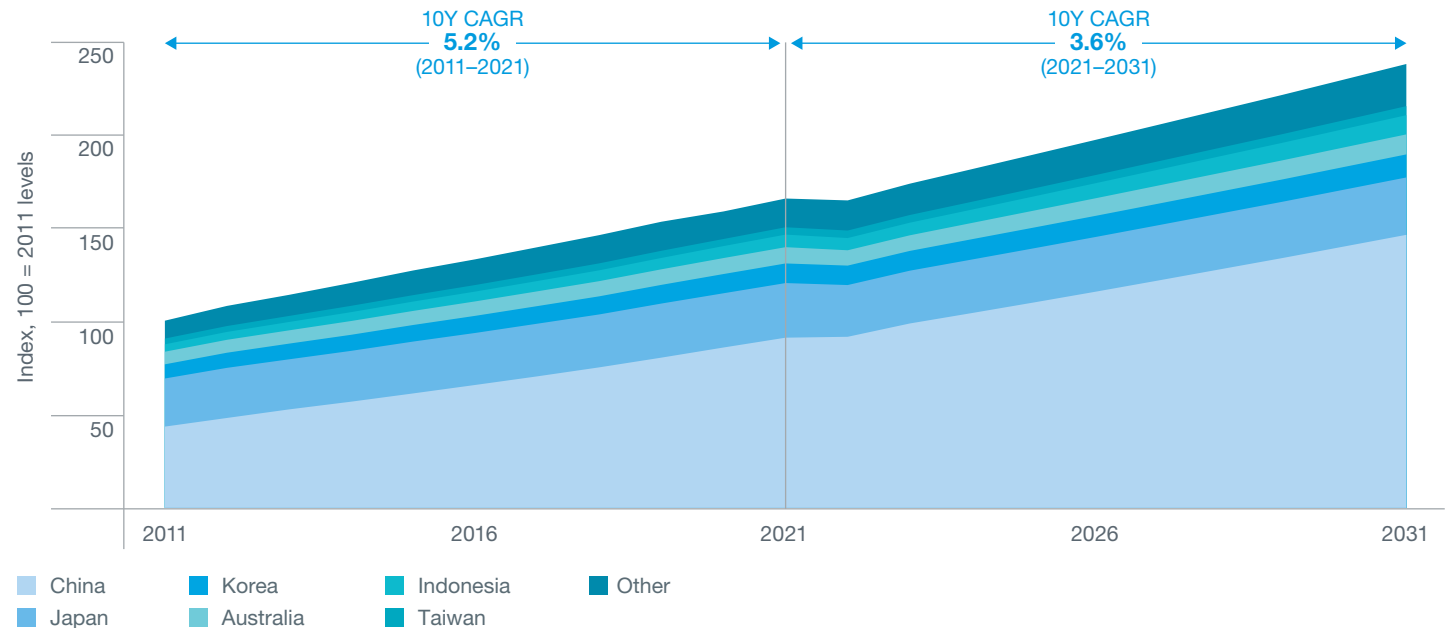
Second, China's influence will broaden, as it shifts further toward consumer-driven production of higher-value manufactured goods.

It is worth noting that air cargo traffic in critical subassemblies and parts has grown to support the emerging supply chains of various Asian manufacturing sectors. At the same time, "China-plus-one" strategies have led many of the region's countries to establish manufacturing hubs outside China. Emerging markets in Southeast Asia have been the primary beneficiaries of

these trends, due to competitive labor costs, high productivity, and business environments that favor direct foreign investment. Pandemic-driven supply chain optimization and de-risking look likely to accelerate this dynamic.

While these developments likely will affect all traffic that touches China—especially when it involves parts and subassemblies such as automotive components and machinery—air cargo demand is not expected to change notably over all, but rather to shift to other country pairs in the region.

Resilience Expected in GDP Growth



Source: S&P Global

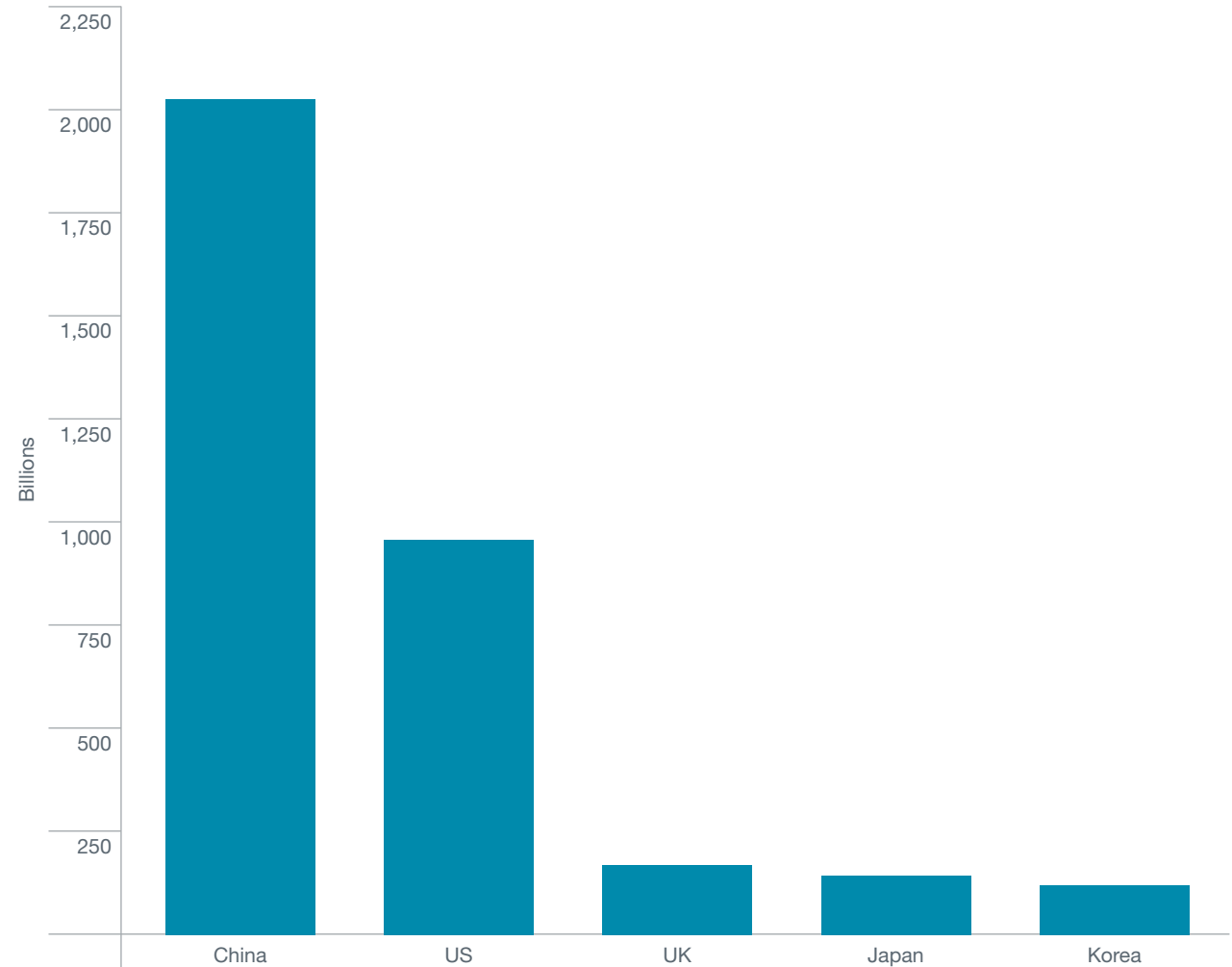
E-Commerce Market Expansion Will Drive Growth

China is the largest e-commerce market in the world. Even before the pandemic, the region's e-commerce market was growing at double-digit rates. This growth accelerated during the pandemic, as e-commerce became the preferred consumer purchasing behavior. China, Japan, and Korea are among the five largest e-commerce markets globally, and they continue to expand their market shares of retail sales in both domestic and cross-border transactions.

With a growth rate of 20.6% in 2022, Southeast Asia is forecast to see the world's fastest e-commerce retail growth. Over the next three years, Southeast Asia's e-commerce revenue is expected to increase more than 15% annually, reaching a projected market volume of nearly \$220 billion by 2025. As the e-commerce market (both domestic and cross-border) further expands, the demand for faster and more reliable movement of goods will particularly benefit the air cargo market, especially in areas that lack well-established postal and ground network support.

E-Commerce Is a Key Growth Factor

Top 5 E-Commerce Sales by Country (2021)



Sources: US Census Bureau, eMarketer

Multiple Factors Will Propel Air Cargo Development

A variety of dynamics, both geographic and demographic, are speeding air cargo development.

Home to 30% of the global population, the region inherently offers vast market potential. As the source of a high proportion of the world's consumer goods, it represents a stronghold of both supply and demand. And, while today's surging consumerism has fed explosive economic growth, geopolitical tensions elsewhere in the world soon may impose new stresses on intra-Asia supply chains.

Asia is the largest continent, encompassing about 30% of Earth's landmass. Its terrain varies widely: mountain ranges; plateaus; plains, deserts, and steppes; rivers, lakes, and seas. Many of these features impede ground transportation.

Consequently, the range and effectiveness of ground-transport infrastructures vary by country and

region. For example, nations like Japan, South Korea, and Taiwan enjoy the advantages of well-developed ground infrastructures, and contribute significantly to Asia's trade volumes. But the reach of an island- or peninsula-based ground system is limited to domestic markets.

At the same time, despite the past decade's rapid ground-infrastructure developments, challenging terrains still limit access to vast expanses of China and Southeast Asia.

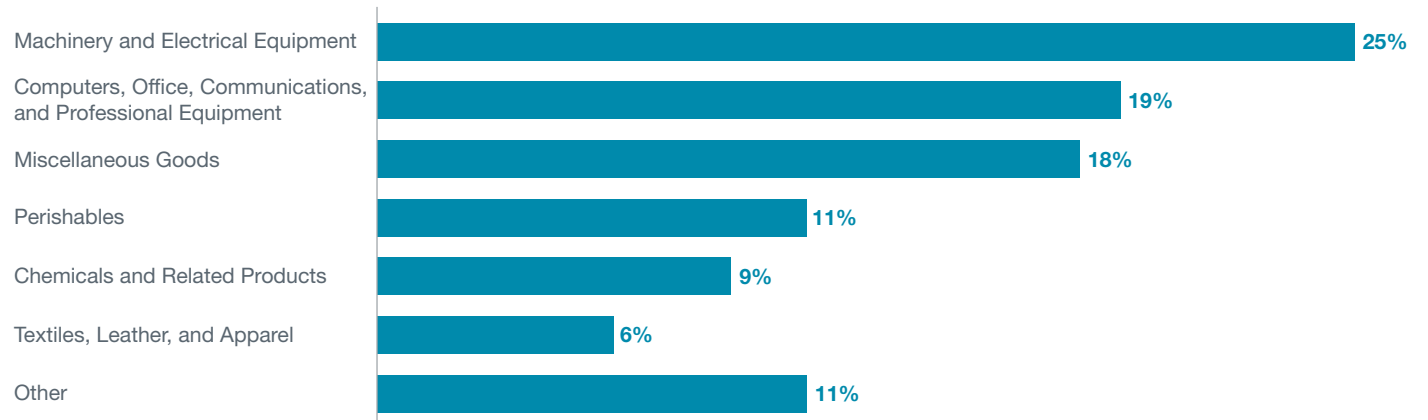
Taken together, those dynamics mean that much of the region's trade still depends on air transport.

Since water separates most of the region's major manufacturing centers (China, Japan, South Korea), maritime shipment has always been considered an efficient transportation mode. But, when COVID-19 constrained maritime shipping due to labor shortages and elevated transportation costs, some suppliers sought alternatives. As a result, air cargo services gained new business, particularly by delivering high-value industrial goods and perishables—the core air-cargo commodities—reliably and on schedule. So, while air cargo and maritime shipping will continue to play complementary roles in the region, air

cargo services will gain momentum by supporting the development of national economies that are experiencing strong growth in per capita incomes.

The leading commodity sectors in the region—machinery and electrical equipment and computers; office communications; professional equipment—make up almost half of the region's air cargo volumes. The perishables, chemicals, and related product groups each represent about 20% of the trade, while the textiles, leather, and apparel sector accounts for 6%.

Region's Commodity Mix Is Diverse



Air Cargo Growth Forecast at 5.7% Through 2041

Before 2019, intra-Asia air cargo traffic enjoyed an average annual growth of 5.2% over each preceding decade. However, the region's air cargo volume contracted by more than 12% during 2019 and 2020, mostly due to trade disputes, pandemic constraints, and related impacts on air cargo capacity. At 2.6%, growth from 2011 to 2021 reduced the pre-pandemic trend by half.

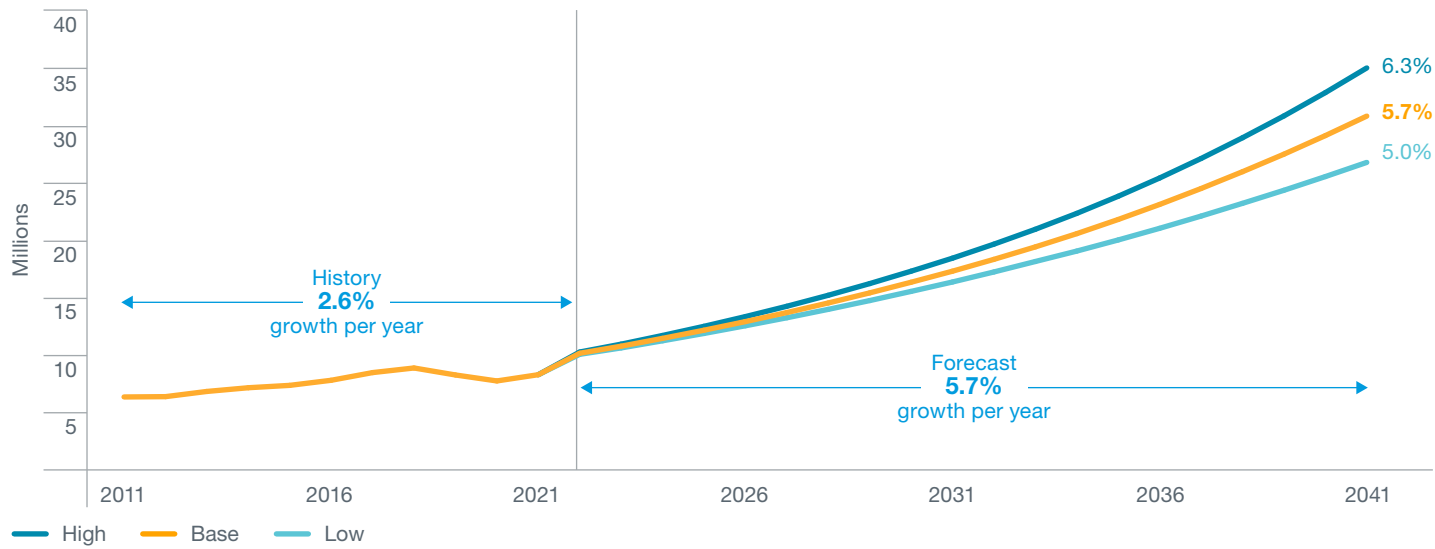
The region relies heavily on the belly capacity of widebody passenger aircraft. While dedicated freighter utilization remains historically high, it is still insufficient to make up for today's shortfall in belly capacity. Belly capacity, however, is expected to recover in the near term, as travel restrictions ease in many of the region's key markets.

Economic forecasts show improved trade and continued robust GDP growth, which will fuel the expansion of air trade in the region. Increased

consumption in the region, combined with demand for intercontinental export markets, will support the return of stronger air cargo traffic growth.

Along with some other, longer-haul flows that touch the Asia-Pacific region, the intra-Asia and Oceania cargo market outlook is expected to remain robust. E-commerce growth and express network development will boost long-term growth in the region. We forecast an average annual growth of 5.7% over the next 20 years.

Region's Air Cargo Market Will Grow 5.7% per Year



Intra-Europe

For the purposes of this forecast, we define Europe as all 27 member countries of the European Union, plus Albania, Gibraltar, Iceland, Norway, Switzerland, Turkey, the United Kingdom, and the countries of the former Yugoslavia.



Frankfurt, Germany

Highlights

- Intra-Europe air cargo traffic exceeded 2020 levels by 17%, but remains 8.5% below 2019 levels. By the end of August, 2022, trans-border general cargo tonnage had grown 6% over the same period in 2021.
- Despite the region's weak overall air cargo traffic performance, pandemic-related changes in consumer behavior drove significant growth in daily express shipments, which jumped approximately 14.5% in 2020.
- Led predominantly by express shipments and longer scheduled-freight hauls to eastern and southern Europe, intra-Europe air cargo traffic is forecast to expand at an annual rate of 2.5% through 2041.

Still Recovering From Pandemic Lows

The intra-Europe air cargo market comprises approximately 4% of the world's air cargo tonnage. However, because the region is geographically compact, it includes only 1% of the world's tonne-kilometers.

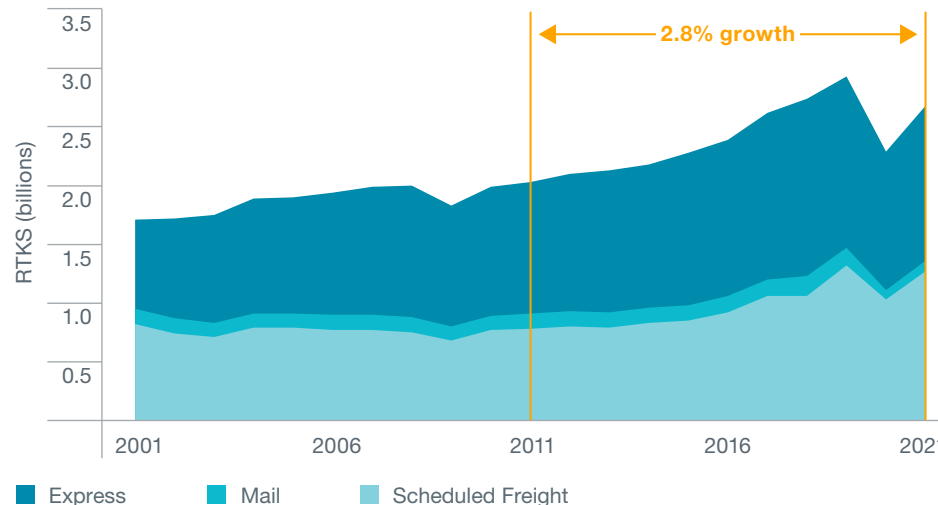
Approximately 68% of all air cargo moving into, within, and out of Europe passes through one or more of the northern European countries (Belgium, Germany, France, Luxembourg, the Netherlands, and the United Kingdom).

This concentration has remained relatively stable throughout recent history. The proximity of markets within Europe generally limits routes to relatively short hauls, typically between 900 and 1,200 kilometers. This analysis surveys domestic and transborder intra-Europe air cargo traffic, regardless of its true origin or destination.

Between 2014 and the onset of the pandemic, expansion in the intra-Europe air cargo market exceeded long-term trends. Growth peaked in 2017, jumping nearly 10% over 2016 levels. However, growth ground to

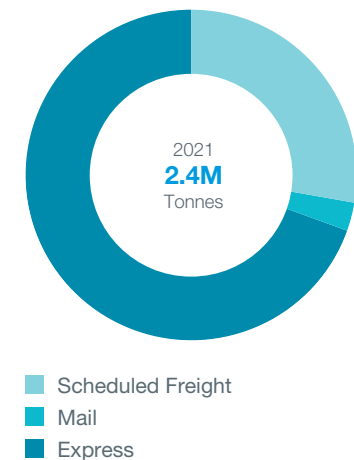
a halt with the arrival of COVID-19, contracting nearly 22% in 2020. Recovery started in 2021, as intra-Europe traffic grew about 17% over 2020. The scheduled freight sector fared slightly better, growing 23% over 2020, but trailing 2019's results by 4%. Meanwhile, accelerated growth in the business-to-consumer (e-commerce) sector helped to mitigate pandemic headwinds, and will continue to play a large role in the region's traffic recovery.

Still Recovering From the Pandemic, the Intra-Europe Air Cargo Market Grew 2.8% per Year in the Past Decade



Source: AEA, ICAO, IATA, OAG, Cirium, Boeing

Express Makes Up Nearly 70% of Intra-Europe Tonnes Moved by Air



Source: AEA, ICAO, IATA, OAG, Cirium, Boeing

Although intra-Europe air cargo tonnage recovered to 2.4 million tonnes in 2021, it still trails 2019 levels by approximately 9%. The express sector made up less than 10% of intra-Europe air trade, over all, in the late 1980s, but now commands nearly 70% of this market. The express sector's share grew to 72% in 2020, at the height of the pandemic, as passenger services were suspended or greatly reduced.

Intra-Europe Air Cargo Traffic Includes Scheduled Freight, Mail, and Express

The three primary components of air cargo traffic within Europe—scheduled freight, mail, and express—grew at differing rates. Express traffic averaged 2.8% growth per year during the past 20 years. Scheduled freight and mail, combined, grew at a slower rate of 1.8% during the same period.

The intra-Europe air cargo market has expanded nearly 3% per year since 2011, although, prior to the pandemic, this rate averaged nearly 5%. Scheduled freight and mail traffic were stagnant in the first decade of the past 20 years, while the express segment alone accounted for nearly all growth in the intra-Europe air cargo market. During the most recent decade,

excluding the pandemic, scheduled freight and mail have recovered, with 6.8% and 1.6% average annual growth, respectively. Much of this growth emanates from network expansion among a small number of passenger airlines on the periphery of Europe.

Except during the 2008–2009 global financial crisis and in 2019 and 2020, express traffic has grown steadily for the past two decades. While express traffic grew 6.4% in 2017 and 6.7% in 2018, this segment of intra-Europe air cargo traffic is estimated to have contracted 3.6% in 2019 and 19.2% in 2020, largely as a result of industrial traffic weakness, network consolidation among major express carriers, and lockdowns earlier in the pandemic.

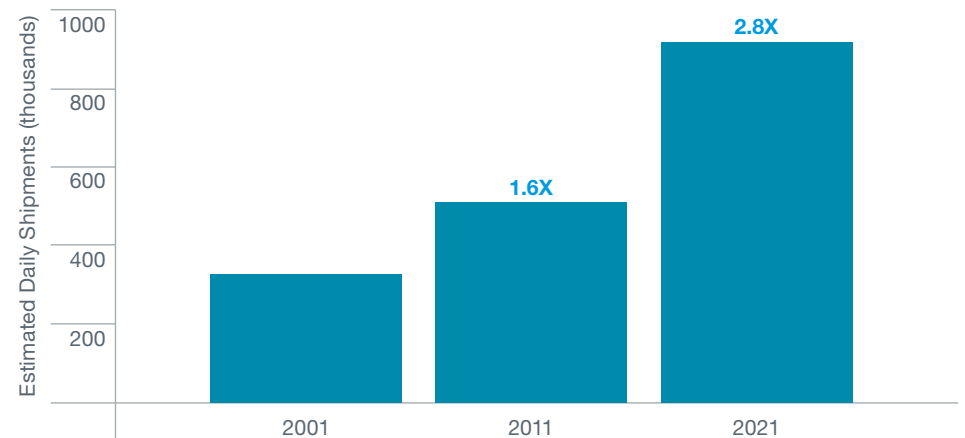
Integrated express carrier traffic has made up more than half of all intra-Europe air cargo tonnage since 2003, reflecting the declining market share of scheduled freight and mail. It is important to note that express network traffic within Europe includes significant general freight, which fills out freighter loads when traffic is light in the small parcels and documents that traditionally make up express cargo.

Nearly all air cargo growth since the late 1990s is a result of the expansion of integrated air express carrier

services. Of course, geography has traditionally favored surface transport within Europe, but the 1990 Schengen Agreement represented a turning point. It eliminated customs inspections of goods moving between several northern European countries—and, later, within most of the EU. This development facilitated intra-Europe truck transport, and reduced the demand for expedited scheduled airfreight service. Consequently, trucking has become the preferred mode of transport for most freight and mail, and even for small-parcel express shipments in short-haul markets.

Intra-Europe Air Express Shipments Have Nearly Tripled Since 2001

International Shipments Only



Source: Cargo Facts Consulting

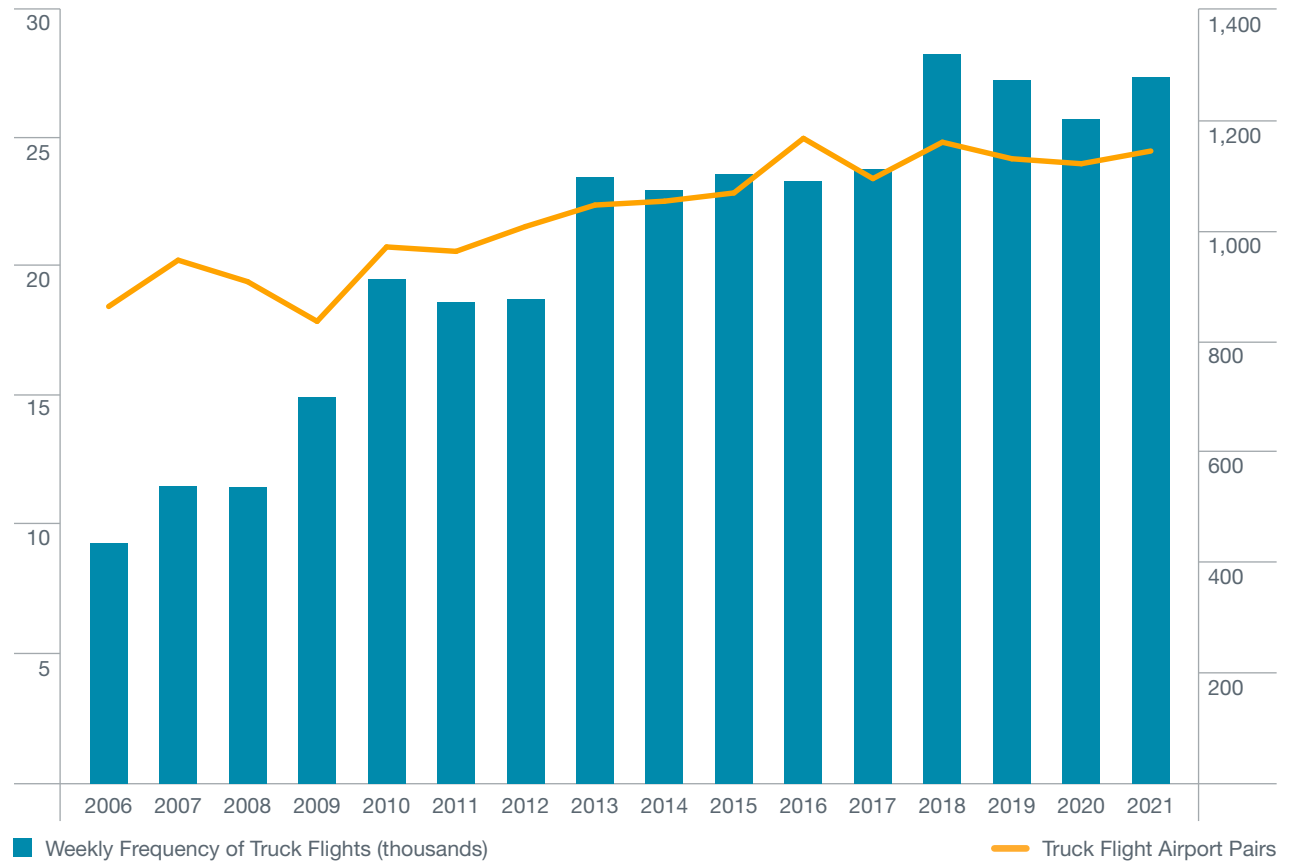
While growth slowed during the 2008–2009 global financial crisis, the estimated number of daily international air express shipments expanded at an average rate of 4.5% annually between 2001 and 2011. Since then, daily shipment-count growth reaccelerated, showing an average 6.1% growth per year as consumers turned to online shopping during the pandemic. Daily intra-Europe express shipments expanded from approximately 326,000 per day in 2001 to 922,000 daily in 2021.

Trucks Complement Scheduled Airplane Freight Services

Air cargo has never been solely an airport-to-airport service. Instead, air cargo is one component of an infrastructure that links the shipper and the consignee. Trucking offers door-to-door and factory-to-distribution center service, which air transport alone cannot provide.

Scheduled airlines that serve the intra-Europe market have used truck flights (trucking services registered with their own flight numbers) to extend their networks and increase scheduling flexibility.

Airline-Scheduled Truck-Flight Frequency Returned to 2019 Levels



Source: OAG – May 2022 Schedule Sample

Intra-Europe

In Europe, long-haul truck-flight operations supplement overall air logistics systems. Truck-flight operations provide regularly scheduled freight service for high-value or work-in-progress goods between manufacturing facilities, especially to and from central and eastern Europe. Scheduled truck operations are often used where demand is too low or infrequent to warrant dedicated freighter airplane service. Their dramatic rise in the past 20 years has clearly contributed to a decline in the growth of scheduled air freight.

Historically, intra-Europe truck-flight activity has grown primarily around major hub airports, where it strengthens carriers' air cargo

networks. Weekly truck-flight frequencies grew 3.9% on average per year between 2011 and 2021. However, according to airline truck-flight schedules, airport pairs of truck flights dropped 2.6% in 2019 and then fell another 0.8% in 2020. Scheduled truck-flight reductions occurred mostly in the domestic markets of France, Germany, Italy, and the United Kingdom, and in a drawdown of certain mainland-Europe markets connected to the UK. Possible reasons for the drawdown include overall industrial production weakness and the trade impacts of Brexit. As we left the most intense pandemic disruptions behind, both airport pairs and weekly frequencies grew in 2021, by 2% and 6.3%, respectively.

Intra-Europe Forecast

Continued growth of express shipments, and increased connections to Eastern and Southern Europe, will drive the expansion of intra-Europe air cargo traffic, which is forecast to grow at an average annual rate of 2.5% per year through 2041. The 20-year forecast growth in air cargo traffic is higher than the 2.3% growth trend recorded during the previous (2001–2021) 20-year period.

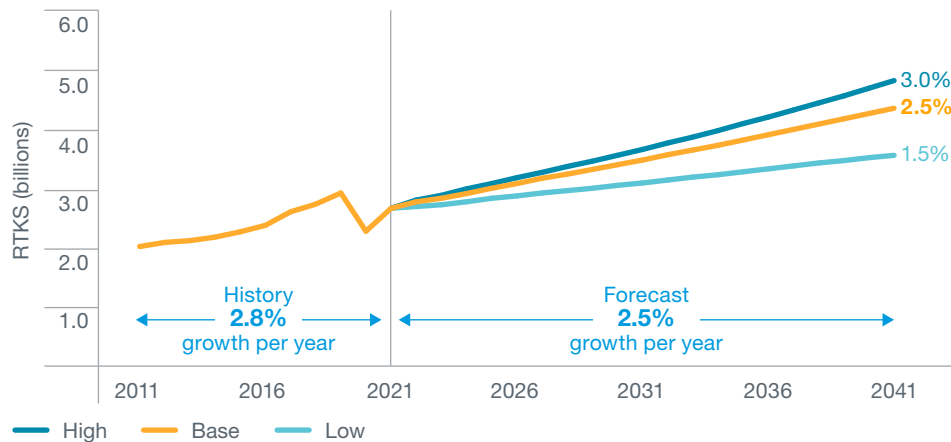
Economic activity (as measured by GDP) and industrial activity will remain the primary drivers of traffic growth in this market. In the long term, our projections show the baseline GDP for Europe averaging 1.5% growth per year through 2041. We assessed GDP projections of 0.5% below and above the baseline, and the results of these growth rates are reflected in our low- and high-growth scenarios. Intra-Europe air cargo traffic growth is forecast to range between 1.5% and 3%.

Rigid labor markets, an aging population, expensive pension systems, and slow economic reforms are expected to limit long-term economic growth, especially in the countries of northern Europe. War in Ukraine, a potential energy crisis, and heightened inflation may curb economic growth and entrepreneurial activity across many European countries, thereby restraining air cargo growth. The effects of the UK's 2020 secession from the European Union are not fully known at this time, but likely overshadowed by impacts of the pandemic. It is, however, worth noting that increased trade barriers are generally a drag on air cargo traffic growth.

On a positive note, if some shippers decide that longer trucking times to distant eastern and southern markets are unacceptable, the prospects for air cargo traffic growth may brighten for the next two decades.

Intra-Europe Air Cargo Traffic Will Grow 2.5% per Year

Average Annual Growth, 2022–2041



Latin America– Europe

For the purposes of this forecast, we define Latin America as the Caribbean Basin, Central America, including Mexico, and South America. We define Europe as all 27 member countries of the European Union plus Albania, Gibraltar, Iceland, Norway, Switzerland, Türkiye, the United Kingdom, and countries comprising the former Yugoslavia.



São Paulo

Highlights

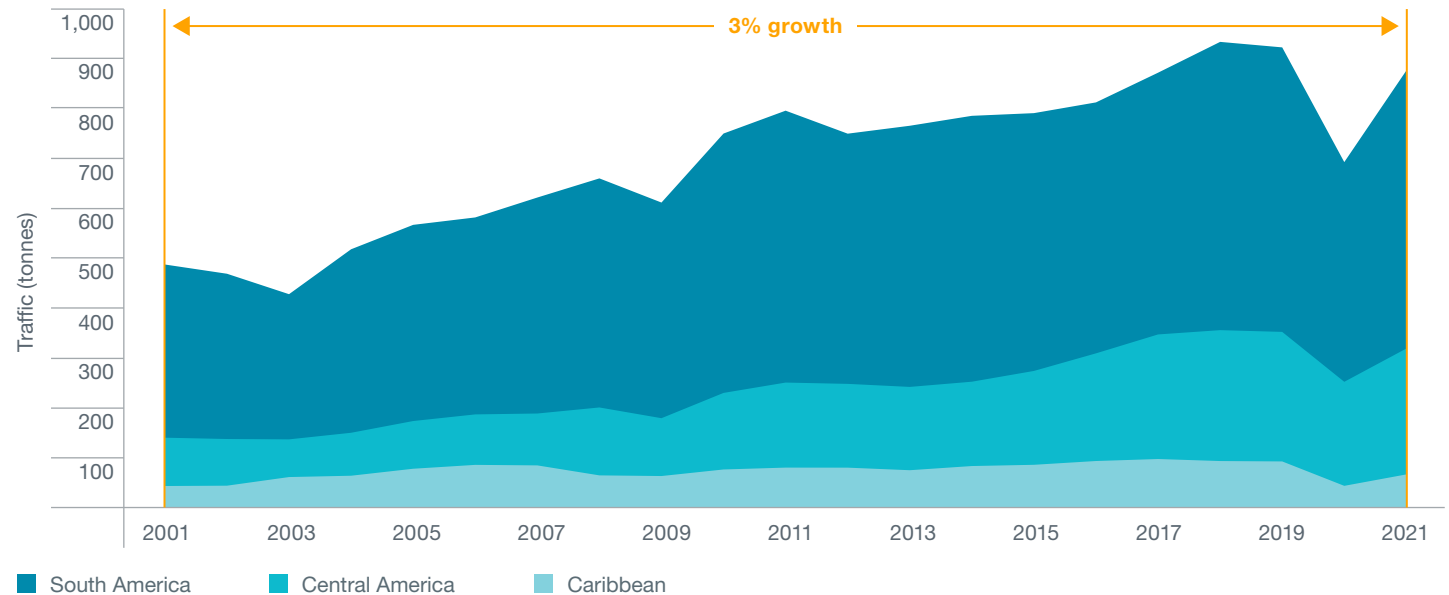
- Though suffering a 24.9% drop due to the pandemic, the Latin America–Europe air trade has rebounded well, growing 26.5% 2020 to 2021.
- The South America subregion dominates the Latin America–Europe flow with 64% of all air trade. However, just two countries account for more than 50% of traffic: Brazil and Mexico.
- Steady growth of agricultural product demand, expanding economies in Latin America, and continued investment in manufacturing are some of the key drivers behind a forecast growth of 3.9% per year over the next 20 years.

Latin America–Europe Market Growth Shows Continued Signs of Improvement

In the Latin America–Europe market, which represents approximately 2.7% of world air cargo traffic in tonne-kilometers, and 1.5% in trade tonnage, air cargo grew 1% per year since 2011.

Amid volatile economic activity, Latin American air trade with Europe proved resilient, growing an average 3% per year over the last two decades, despite a steep drop due to COVID-19. During the pandemic, air trade on this flow fell 24.9% from 2019 to 2020. Although post-pandemic recovery has been strong, with 26.5% growth between 2020 and 2021, levels have yet to fully recover.

Latin America–Europe Traffic has Grown 3% per Year Over the Last Two Decades



Source: Eurostat Trade Data, Airport data from Switzerland, Türkiye and the United Kingdom, Boeing Analysis

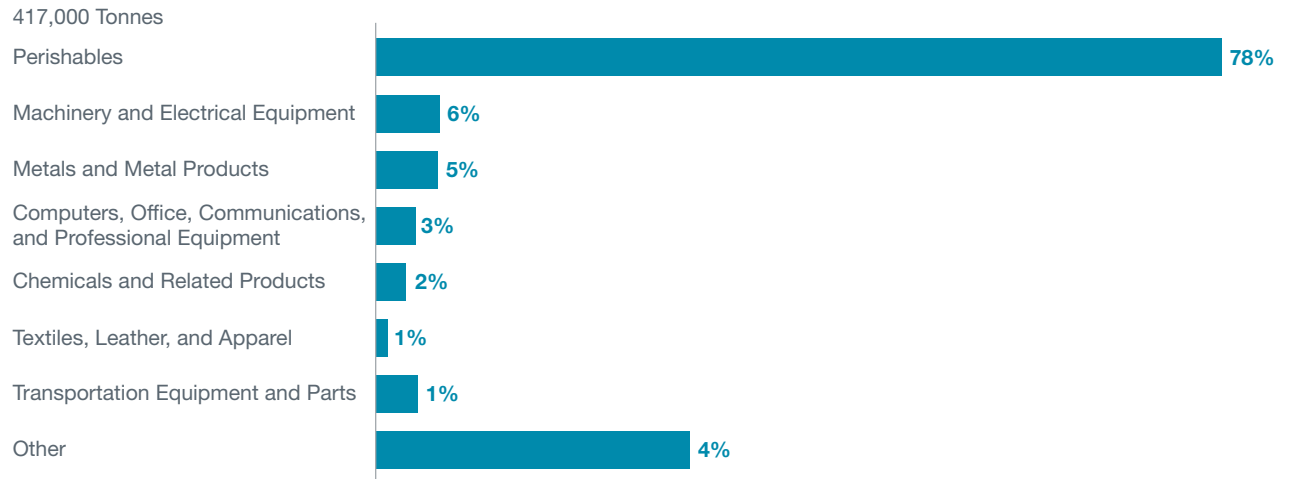
Latin America–Europe

In analyzing air traffic growth, we divide Latin America into three subregions: the Caribbean Basin, Central America, and South America. Air trade growth in Central America remains strong, with a 20-year growth rate through 2021 of 4.9%. During the same period, air trade in the Caribbean subregion grew an average of 2.2% per year, while the growth rate in Latin America's largest subregion, South America, was 2.4% per year.

In 2021, 78% of imports shipped by air to Europe from Latin America were perishable products. South America accounted for 68% of those imports, of which 77% were fruits, vegetables, seafood, and flowers. In the opposite direction, the commodities traded are more diverse: machinery and electrical equipment, chemicals and related products, and transportation equipment and parts, among others. The European Union remains an important trading partner for Latin America, second only to the United States.

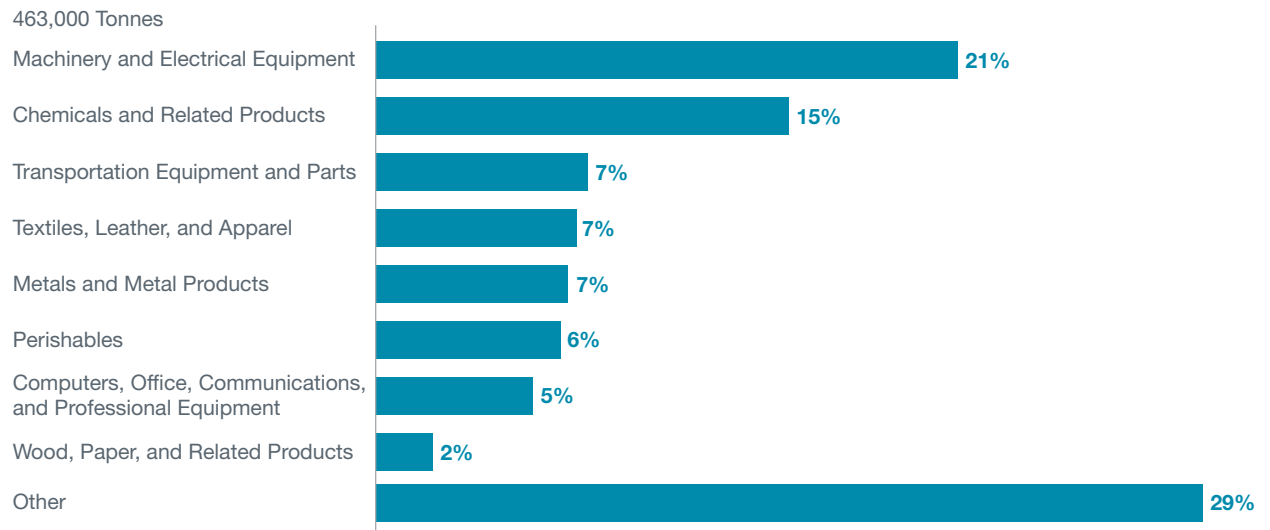
Directional traffic from Latin America to Europe grew 1.9% over the 10-year period ending in 2021. The larger Europe-to-Latin America flow grew just 0.2% over the same period. More recently, traffic to Europe grew 2.4% in the last five years, while traffic growth in the opposite direction remained below 1%.

Perishables Make Up the Majority of Trade From Latin America to Europe



Source: IHS GTA Dashboard, Eurostat Trade Data

Europe to Latin America Trade is Spread Across a Wide Variety of Goods



Source: S&P Global GTA Dashboard, Eurostat Trade Data

Latin America–Europe Air Trade

Of the more than 880,000 tonnes of air cargo transported between Latin America and Europe in 2021, South America accounted for 67% of the market, followed by Central America at 23% and the Caribbean with the remaining 10%.

Brazil and Mexico continue to be the engines of airborne trade with Europe, accounting for over 50% of the traffic in 2021, with Brazil making up 33% and Mexico representing 24%.

Brazil's economic recovery has allowed the country to maintain its majority share of this market, with 53% of South American air trade originating or ending there. Colombia remained the second largest trading country, at 12%. Argentina's air trade share decreased

slightly over the last two years, from 11% in 2019 to 9.5% in 2021, while Ecuador and Chile remained relatively flat.

Central American air trade stands at 29% for 2021, a slight contraction from 2020's 30% traffic figure. Mexico continues to be a major trading partner with Europe, as shown by its 82% share of the market. Panama saw a contraction of 0.3% compared to 2020 levels, whereas Costa Rica grew by 1.4% in 2021.

Brazil and Mexico Account for Over Half of Latin America–Europe Trade



Source: Eurostat Trade Data, Airport data from Switzerland, Türkiye and the United Kingdom, Boeing Analysis

Latin America–Europe Economic Outlook

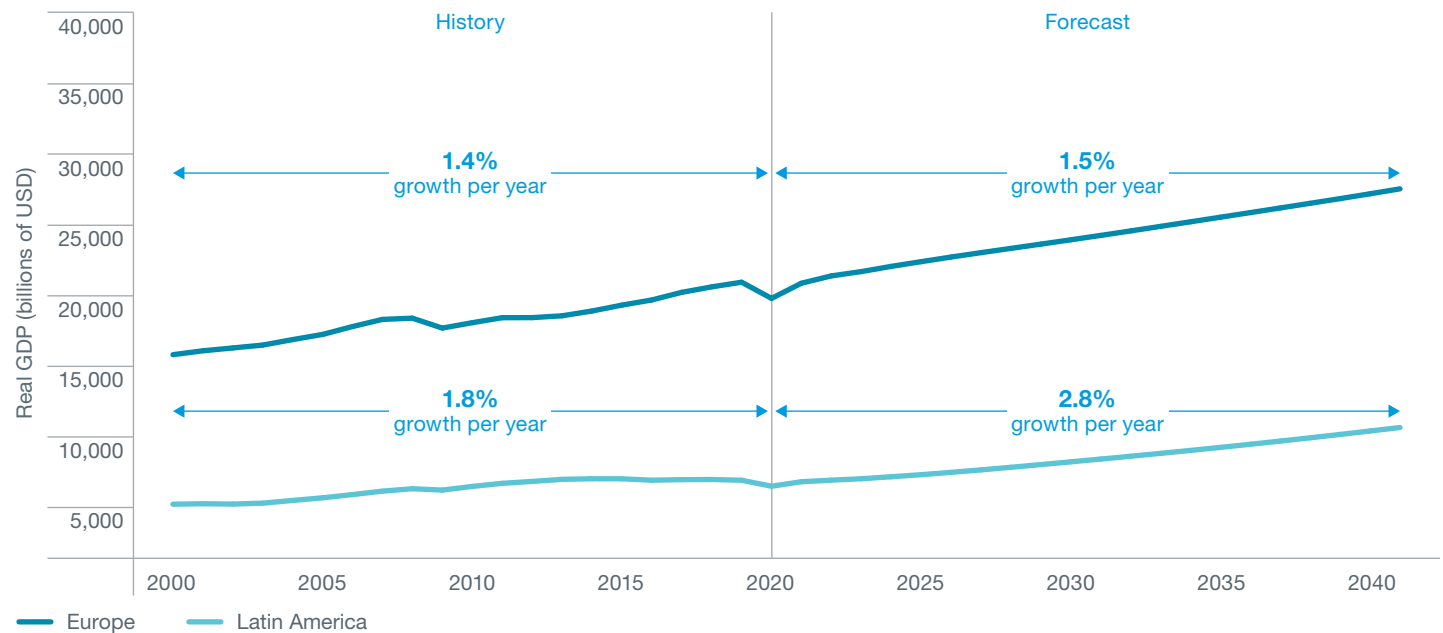
As it did in most economies around the world, the pandemic brought economic contraction in 2020 to both Latin America and Europe, which declined 7.9% and 5.9%, respectively. Although 2021 saw a sharp rebound, with Latin American economies growing 6.4% and European economies growing 5.9%, both were still below 2019 levels by the end of 2021.

Looking forward, economies in Latin America are forecast to grow 2.8% per year between 2022 and 2041. Continued growth of industrial production, particularly in the manufacturing sectors of Mexico and Brazil, along with improved political stability, will drive economic growth.

As Brazil continues its economic recovery, it will account for 51% of South America’s total GDP by 2041. The overall South American economy is expected to grow 3% over the forecast period. The Central American economy is expected to grow at an average rate of 2.4% per year during the 20-year forecast period, with Mexico representing nearly 80% of the subregion’s economy by 2041.

While current concerns around energy and economic health, driven by the Russian–Ukraine war, pose a significant risk to near-term growth expectations, Europe’s economy is forecast to grow at an average annual rate of 1.5% over the long term, reflecting modest, steady long-run growth in the region.

Latin America’s Economy Is Expected to Grow 2.8% per Year



Source: S&P Global Market Economic Analysis

Latin America–Europe Forecast

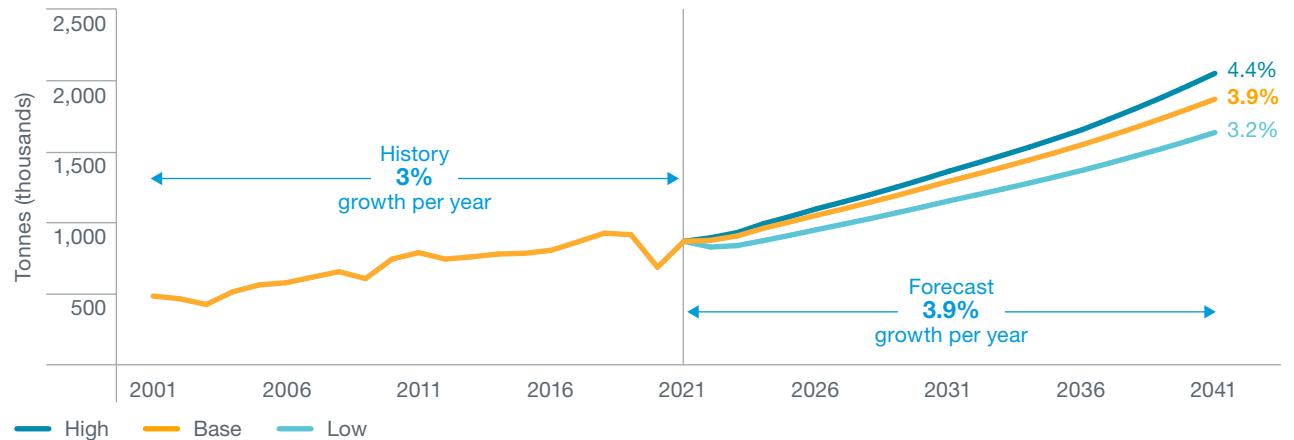
Latin America and Europe continue to work toward greater trade liberalization.

Key trade agreements between the European Union and countries in Latin America, such as the pact with Mexico and the Mercosur trade bloc (made up of Argentina, Brazil, Uruguay, and Paraguay), have improved relations in this trade flow. Current challenges around working conditions in Mexico and political instability in Brazil pose risks for the overall trade outlook, but continued progress on those agreements would support increased air cargo demand between the two regions.

After growing at an annual rate of 3% over the past 20 years, the Latin America–Europe air cargo market is projected to grow 3.9% per year over the next 20 years. The long-term air cargo growth outlook through 2041 shows 4.4% in the Europe-to-Latin America direction and 3.3% in the opposite direction.

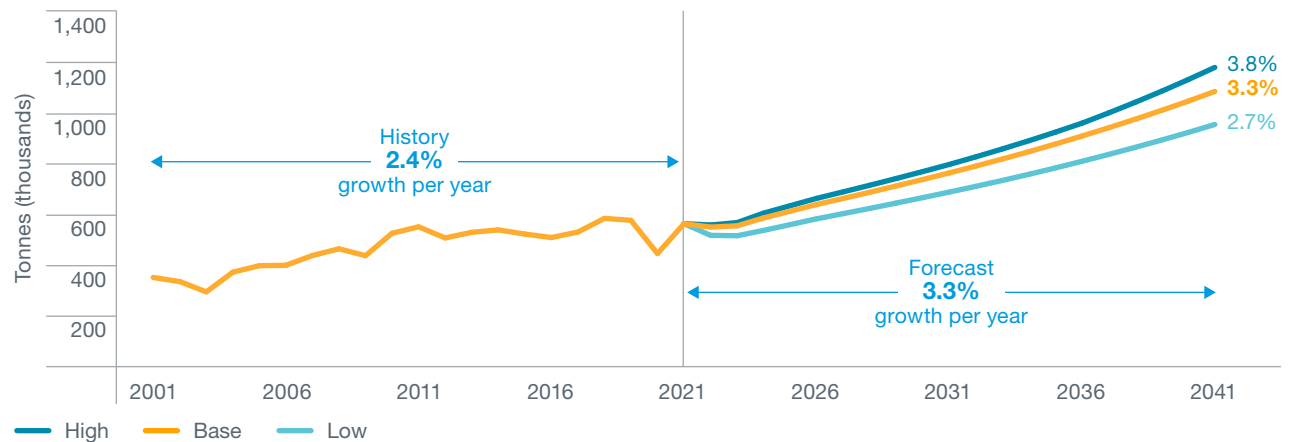
Latin America–Europe Air Cargo Traffic Will Grow 3.9% per Year

Average Annual Growth, 2022–2041



South America–Europe Air Cargo Traffic Will Grow 3.3% per Year

Average Annual Growth, 2022–2041



Latin America–Europe

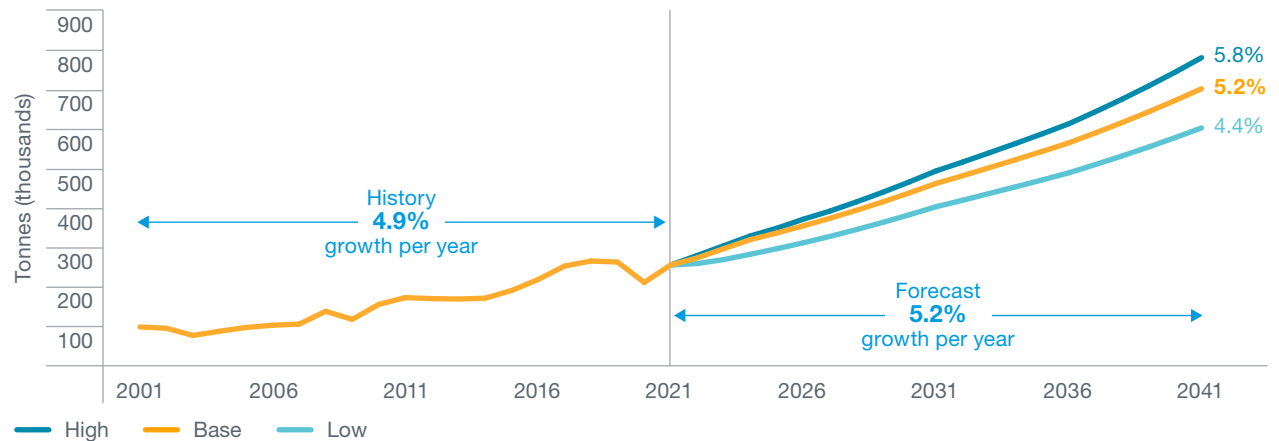
Air trade between South America and Europe is projected to grow an average of 3.3% over the next 20 years. Europe-to-South America air cargo traffic is forecast to grow 3.6% on average, while South America-to-Europe traffic is forecast to grow 3%, driven by European investment in Brazil. The EU, incidentally, is the largest foreign investor in Brazil.

The Central America–Europe market is projected to grow 5.2% on average over the next 20 years. Europe-to-Central America traffic is forecast to grow at a rate of 5.8%, while Central America-to-Europe traffic is forecast to grow 4.1% per year through 2041. Led by a growing trade relationship between Mexico and the European Union, European manufacturing within Mexico’s borders is expected to support higher cargo traffic growth.

Air cargo traffic growth between Europe and the Caribbean has been volatile. However, following the general upward trend over the last two decades, traffic is projected to grow at 2.8% per year through 2041. Air cargo traffic from Europe to the Caribbean is forecast to grow at an average annual rate of 2.8%, while air cargo traffic from the Caribbean to Europe is forecast to grow 2.9% per year over the same period.

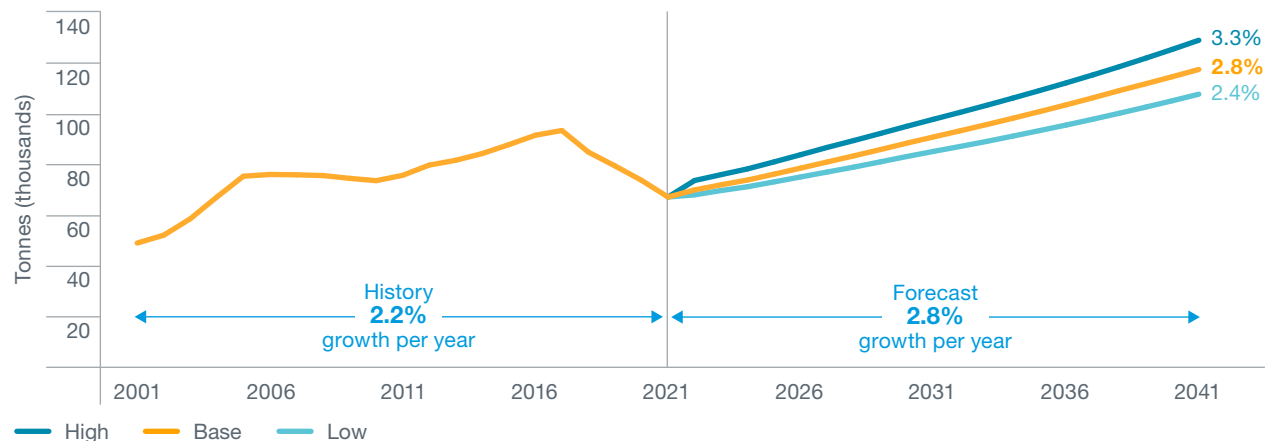
Central America–Europe Air Cargo Traffic Will Grow 5.2% per Year

Average Annual Growth, 2022–2041



Caribbean–Europe Air Cargo Traffic Will Grow 2.8% per Year

Average Annual Growth, 2022–2041



Latin America and North America

For the purposes of this forecast, we define Latin America as the Caribbean Basin, Central America, including Mexico, and South America. We define North America as Canada and the United States.



Santiago, Chile

Highlights

- The 2021 Latin America–North America air cargo market has grown by 21% over 2019 levels. While year-over-year growth slowed in 2022 against a monumental base, it still remains up 22% against 2019 through the first half of the year.
- The Latin America air cargo market is still dominated by the South America subregion, with Chile, Colombia, and Brazil collectively holding roughly 55% of total volumes. Mexico and the Dominican Republic are the leading trade partners for their respective subregions.
- An evolving automotive industry is drawing investment in manufacturing and extraction industries within South America and Mexico, while demand continues for perishables. Those are two of the key drivers behind an annual growth projection of 2.4% over the next 20 years.

Strong Post-Pandemic Recovery

The Latin America–North America market, which represents 2.7% of the world’s air cargo traffic measured in tonnes-kilometers and 3% measured in tonnes, grew 31% in 2021, far surpassing pre-COVID levels. Despite a 7.5% traffic drop between 2019 and 2020 due to the pandemic, recovery has been strong and apparent in all three subregions of Latin America.

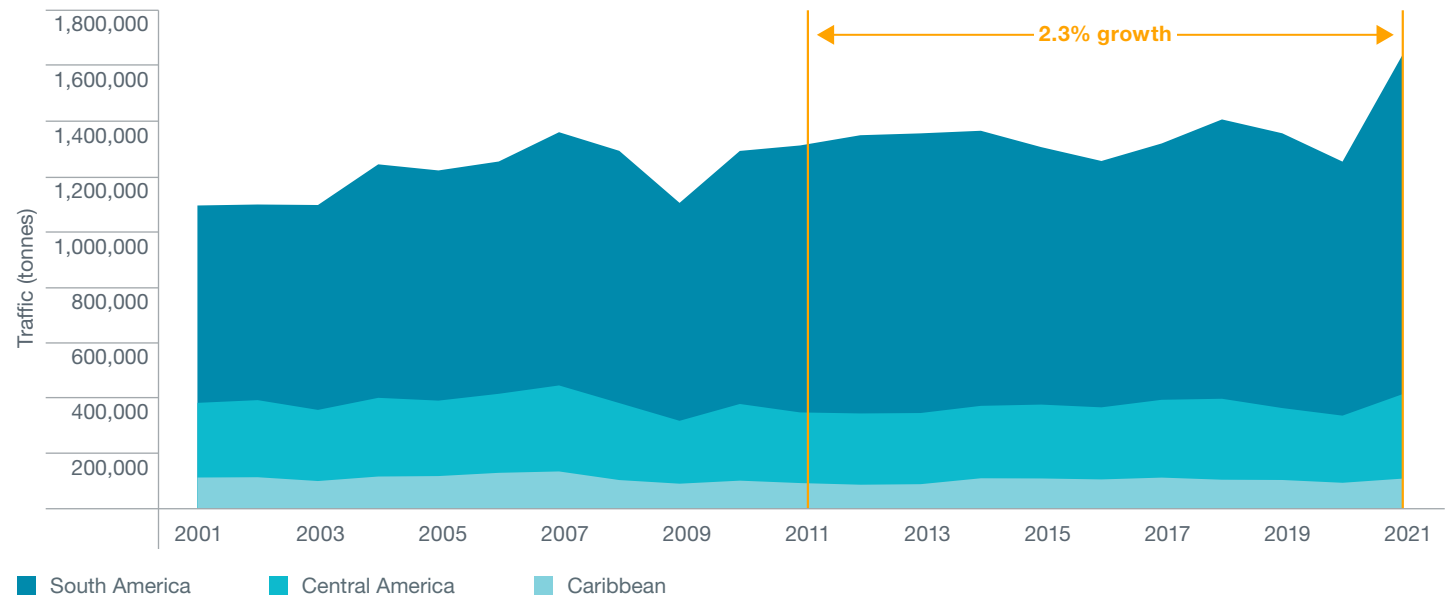
The overall Latin America–North America market has been driven

by strong northbound growth. Southbound traffic has experienced volatility over the last decade, with 2021 traffic finally returning to 2011 levels. Pre-COVID, both northbound and southbound traffic contracted in 2019, with decreases of 3% and 5%, respectively. With the onset of the pandemic, 2020 southbound traffic dropped by 15%, compared to the more modest 4% dip for northbound flow. In 2021, traffic snapped back well beyond pre-pandemic levels, with an overall growth of 31%. This growth was largely led by southbound movement,

which bounced back 46% over 2020 traffic, while the northbound side saw a smaller, yet still notable, growth of 24%.

In December of 2020, member states of the Latin American Civil Aviation Commission (LACAC) signed into action a new multilateral agreement to liberalize the region’s air cargo services. According to ICAO, the agreement expands traffic rights to include seventh-freedom traffic rights, permitting airlines from one of the LACAC member states to provide all-cargo services between two other signatory states without restrictions

Latin America–North America Market Driven by South America Trade



Source: US Trade Data, S&P Global

Latin America and North America

on routes and capacity. The current member states are Brazil, Chile, the Dominican Republic, Ecuador, Guatemala, Panama, Paraguay, Peru, Uruguay and Venezuela.

The agreement was put in place to increase the efficiency of vaccine distribution, and to enable air cargo to better support the region's economic recovery. If extended beyond a temporary agreement, the liberalization of the air cargo market could have positive long-term growth implications for the region.

accounted for 6%. While traffic between the subregions varies, the Latin America–North America market generally moves in the same direction as South America, which represents the large majority of the market.

South America–North America air trade increased by 34% in 2021, leading the region's post-pandemic recovery. Chile is the largest contributor to both the South America subregion and the overall Latin America market at 30% of the subregion traffic. The majority of Chile's and Colombia's air trade

consists of goods going to North America. In contrast, the majority of Brazil's air trade consists of goods coming from North America.

Central America–North America air trade increased by 26% in 2021. Trade between Mexico and North America accounted for 48% of the Central America market. North America–Mexico imports and exports reached near parity in 2021, with a 48% to 52% split, respectively. Air trade both to and from Mexico has seen a reversal of traffic-contraction trends since 2018,

thanks to increased manufacturing activity and post-COVID demand. Costa Rica, Central America's next largest trade partner, saw a staggering increase of 34% in 2021 despite only contracting 8% from 2019 to 2020.

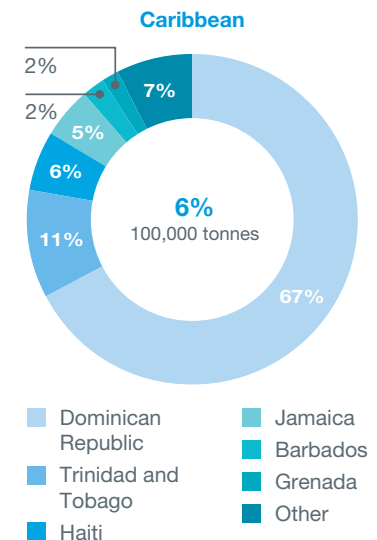
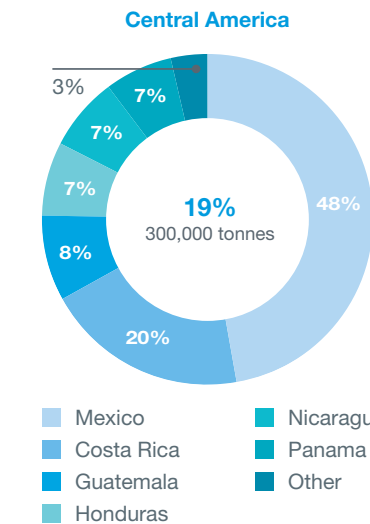
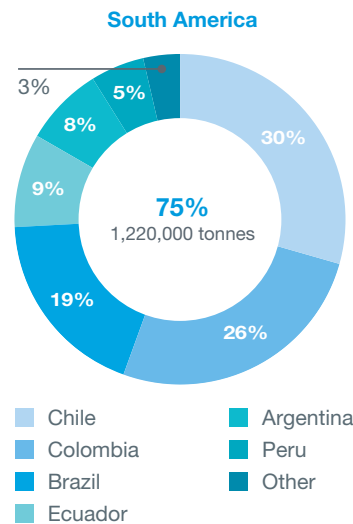
Caribbean–North America air trade increased by 16% in 2021 on a traffic flow where double-digit growth has not been seen since 2014. Imports to the Dominican Republic, which dominates the subregion's market share at 67%, has increased to 72% over 2020.

Latin America–U.S. Air Cargo Market

The United States is Latin America's major North American trading partner, accounting for 90% of bilateral airborne cargo traffic, with a 65% majority of the traffic heading northbound.

In analyzing air traffic growth, we divide Latin America into three subregions: the Caribbean Basin, Central America, and South America. During 2021, South America accounted for 75% of the total 1.6-million-tonne Latin America–North America air cargo market. Central America accounted for 19%, and the Caribbean Basin

South America Makes up 75% of Traffic With North America



Source: US Trade Data, S&P Global

Air Trade Commodities

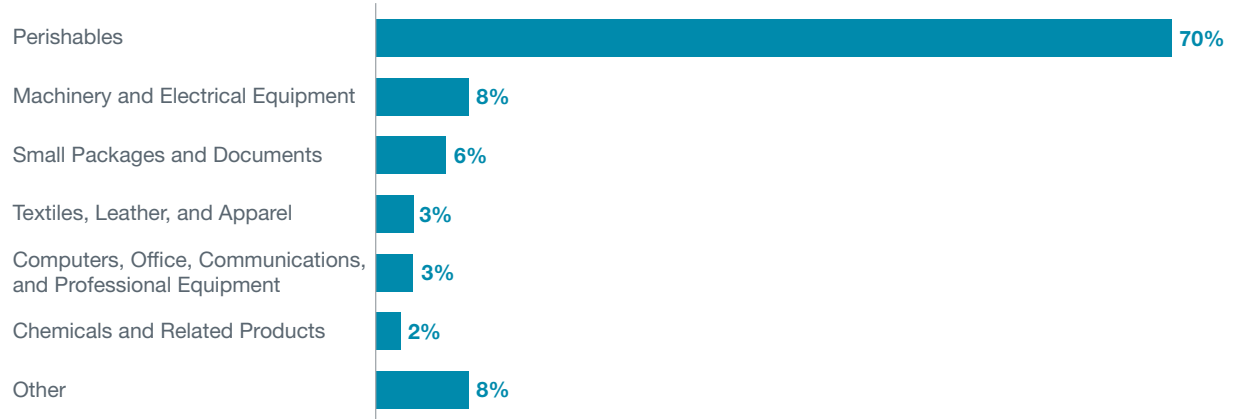
Commodities data from 2021 show an air cargo mix similar to those of previous years.

Northbound movements of goods from Latin America is primarily made up of perishables at 70%. Fresh-cut flowers and seafood account for 42% and 38% of perishable exports, while fruits and vegetables account for another 13%.

Flows from North America to Latin America consist of higher-value manufactured goods, such as industrial machinery, chemicals and related products, and professional equipment.

Perishables Drive Latin America-to-North America Trade

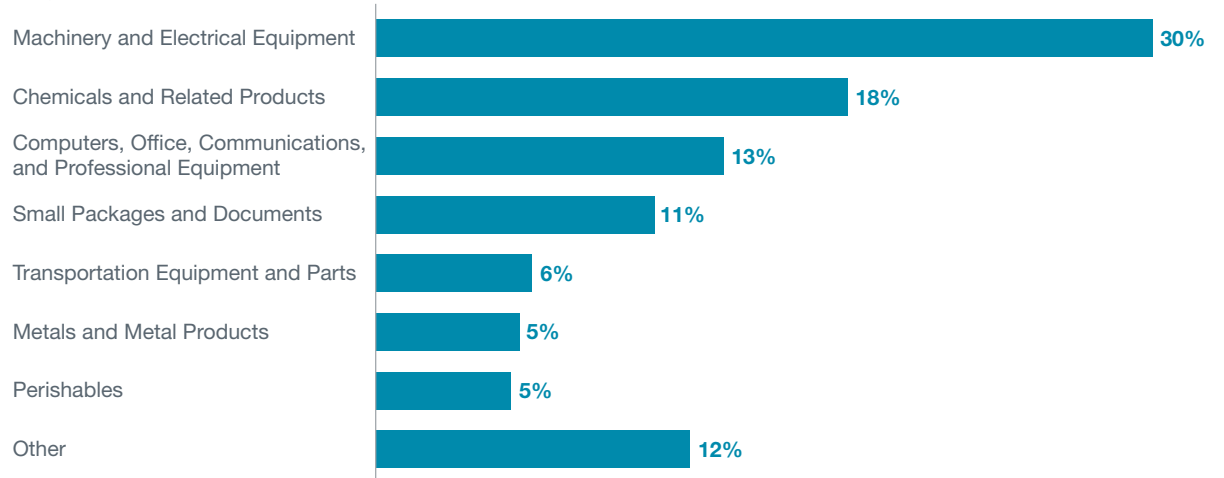
1,060,000 Tonnes



Source: US Trade Data, S&P Global

Industrial Goods Drive North America-to-Latin America Trade

575,000 Tonnes



Source: US Trade Data, S&P Global

Latin America–North America Forecast

The total Latin America–North America market for air cargo services is forecast to grow 2.4% per year from 2022 to 2041.

North America and Latin America are recovering from the pandemic at varying rates, with cargo traffic seeing a robust snapback. Both regions depend heavily on manufacturing, which was put on hold during the pandemic. As production opened up and e-commerce demand accelerated, traffic recovered rapidly in 2021. While the near term is expected to be volatile due to economic dynamics, the outlook is for steadier long-term growth.

Prior to the pandemic, the combined effects of overall global growth and the partial recovery of commodity prices have helped support the Latin American countries that rely on commodities exports. More importantly, many countries in Latin America have also made efforts to improve economic management by implementing policies designed to help stabilize exchange rates, reduce fiscal deficits, and control inflation. In many countries there have been signs of improved labor markets, boosting

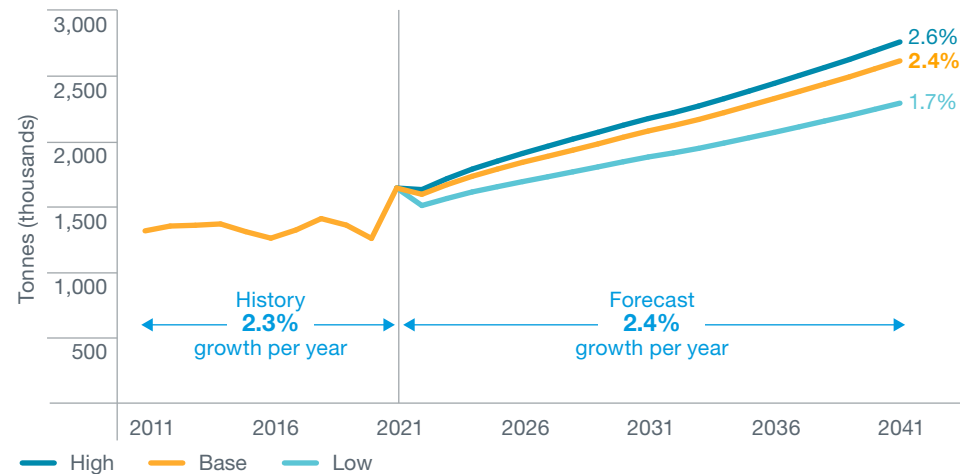
private consumption. In addition, Mexico, Central America, and parts of the Caribbean have benefited from stronger U.S. growth, via trade and increases in remittances. With the signing of the United States–Mexico–Canada Agreement (USMCA), trade risks have decreased for the long term.

The agreement, however, may make trade more difficult in the short term. For instance, in the automotive industry, tariffs are levied (increasing over time) if 40%–75% of the vehicle is not made of U.S. materials by U.S. labor. USMCA will make it costlier for original equipment manufacturers to have parts built in Mexico and flown across the border. Over the last two years, the impact of this agreement was likely overshadowed by the effects of the pandemic. As economies and trade return to normal, we expect the agreement to play a larger role in this traffic flow.

Over the next 20 years, South America’s GDP is forecast to grow 3% per year, while Central America and the Caribbean Basin are forecast to grow 2.4% and 2.7% per year, respectively, through 2041. North America’s GDP is forecast to grow at an average annual rate of 1.9% over the next 20 years. Along with variables such as

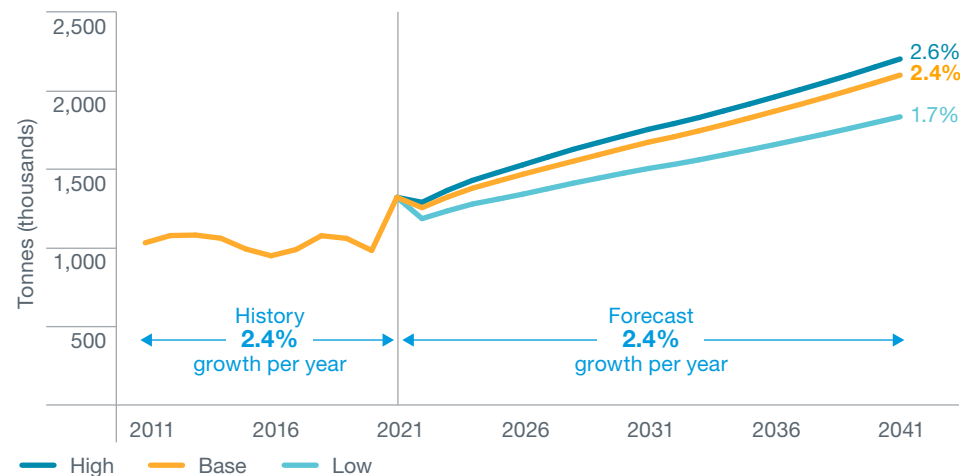
Latin America–North America Air Cargo Traffic Will Grow 2.4% per Year

Average Annual Growth, 2022–2041



South America–North America Air Cargo Traffic Will Grow 2.4% per Year

Average Annual Growth, 2022–2041



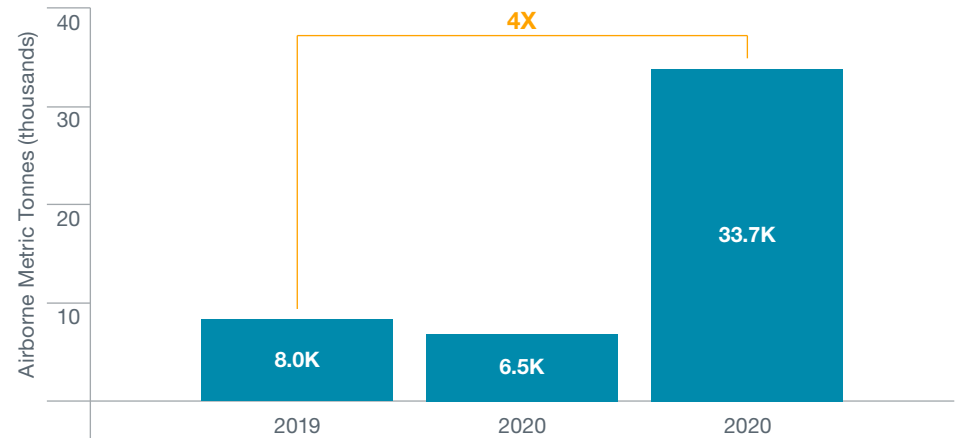
Latin America and North America

retail, industrial production and trade of goods affect the forecast growth in the region. For the Latin America–North America air trade market, this is expected to result in 2.6% growth per year from Latin America to North America, while air trade from North America to Latin America will grow 1.8%.

The South America–North America air trade market is forecast to grow 2.4% per year over the next 20 years. Traffic from South America to North America will grow 2.7% per year, while growth for traffic from North America to South America is projected at 1.8%. This takes into account generally positive outlooks for the South American economy, while considering its potential risks. The South America-to-North America market will continue moderate growth.

A near-term opportunity for the region is lithium mining. South America’s “Lithium Triangle”—Argentina, Bolivia, and Chile—collectively holds more than half of the world’s lithium supply. As the world moves toward a future of clean energy, demand for batteries (and this short-supplied metal) has intensified and caused the price of lithium to skyrocket. With the setting of ambitious 2030–2050 global decarbonization goals, lithium could develop into a fundamental part of South America’s long-term trade flow. Investment for the further development of extraction and production of lithium is already underway, with bilateral talks happening domestically and funding for lithium projects coming from overseas. In fact, the trade of industrial machinery from the U.S. to Chile has spiked at four times the 2019 levels. The industrial machinery category includes mining equipment, electrical equipment, and other types of machinery that could be used for lithium extraction operations.

Trade of Industrial Machinery from the US to Chile Spiked in 2021, 4x 2019 Levels



Source: S&P Global

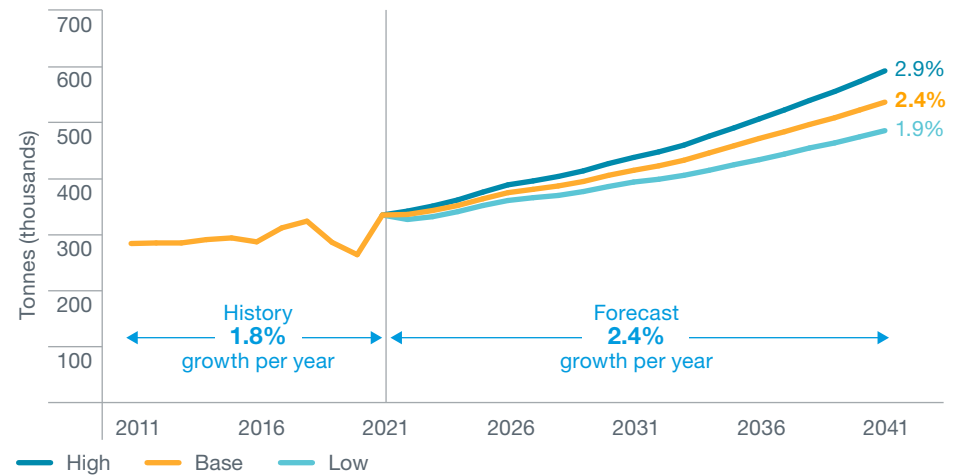
Latin America and North America

In Central America, trade regulations in the USMCA are expected to impact air cargo more than those of previous agreements, resulting in an air trade forecast of 2.4% growth per year over the next 20 years. Most at risk, traffic from Central America to North America will grow at a rate of 2.7% per year. Because a large percentage of the commodities traded to Mexico includes production-related items (machinery, chemicals, etc.), this trade deal will also affect the southbound flow, with growth of 1.8% over the next 20 years. The costs of labor and of migrating manufacturing may prove greater than those of the increased tariffs outlined in the USMCA, allowing for some upside to the region's growth. Overall, Central America's outlook still remains positive, given the economic growth projections.

The Caribbean–North America air trade market is expected to grow 1.8% per year during the next 20 years. Northbound traffic will grow 1.9% per year, while the opposite direction, North America to Caribbean, will grow at about 1.6%. The Caribbean subregion has recovered at a slower pace than both South America and Central America, finishing 2021 only 3% up over 2019 levels. Although Caribbean traffic is expected to return to fundamental growth, it will be at a slightly lower level than previously anticipated.

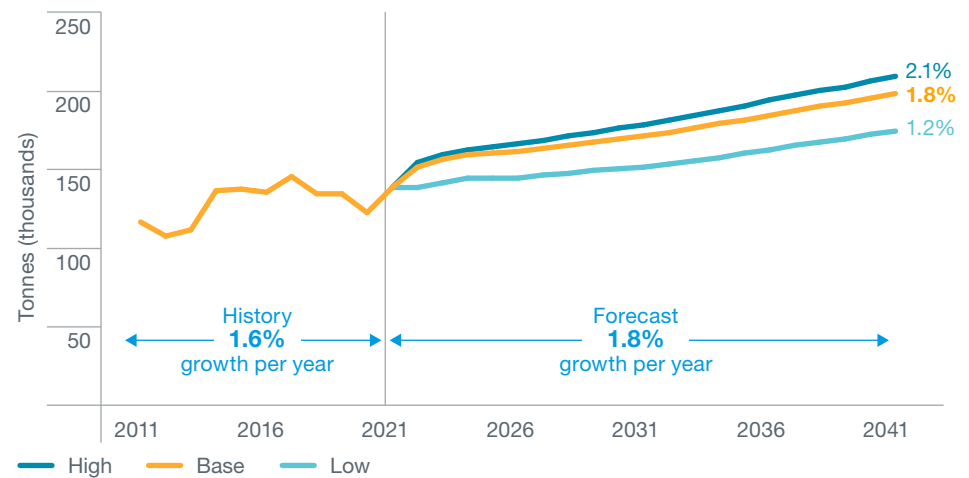
Central America–North America Air Cargo Traffic Will Grow 2.4% per Year

Average Annual Growth, 2022–2041



Caribbean–North America Air Cargo Traffic Will Grow 1.8% per Year

Average Annual Growth, 2022–2041



Middle East

For the purposes of this forecast, we define the Middle East as Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, the Palestinian territories, Qatar, Saudi Arabia, Syria, the United Arab Emirates, and Yemen.



Dubai, United Arab Emirates

Highlights

- Middle East airlines more than doubled their revenue cargo ton kilometers (RTKs) over the last decade with a compound annual growth rate of 7.6%.
- 57% of tonnage handled by Middle Eastern airports is in-transit cargo originating and destined for other global regions.
- Europe is the largest trading partner for the Middle East, accounting for 29% of tonnage and for an annual growth forecast of 2.3% per year for the next two decades.

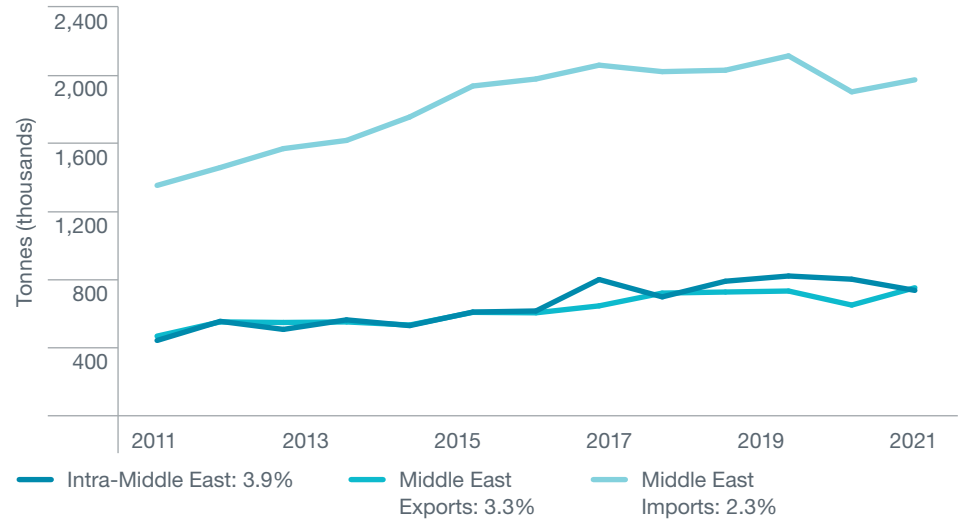
A Vital Crossroads for Trade

The Middle East continues to be a dynamic region for both import/export flows and transit cargo. It remains an important crossroads for air trade in the Eastern Hemisphere and for Middle Eastern air cargo operators, with the use of both freighters and belly cargo growing in importance.

The COVID-19 pandemic created a unique but temporary market dynamic for both air cargo capacity and demand. Border closures and major contractions of passenger flights, including many connections through the Middle East, significantly reduced the amount of belly cargo capacity aboard the region's large widebody fleet during most of 2020 and part of 2021. Critical demand for virus containment and protective equipment, as well as many other commodities, relied heavily on air cargo transport during the pandemic. Significantly constrained belly capacity contributed to strong yields and increased profits for Middle East cargo operators as a result.

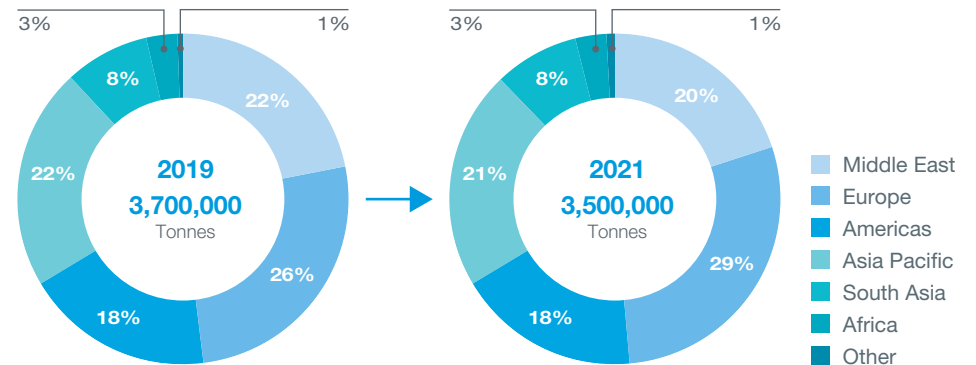
Middle East Air Trade Grew 2.9% per Year

Average Annual Growth, 2011–2021



Source: IHS S&P Global

Europe Maintains Largest Trading Partner Share



Source: S&P Global, Boeing Analysis

Middle East

Air cargo moving to, from, and within the Middle East will account for an estimated 8.3% of global air cargo tonnage and 9.7% in RTKs in 2021. That trade grew 2.9% between 2011–2021, a decline of 2.1% from the prior 10-year growth rate, reflecting pandemic impacts. Overall trade volumes fell from 3.7 million metric tonnes in 2019 to 3.5 million metric tonnes in 2021, with air cargo tonnage contracting by 6% compared to 2019. However, the region's cargo airlines increased their air cargo traffic in terms of freight-tonne kilometers by 10% in 2021 vs 2019. This growth was achieved despite belly capacity on Middle East passenger flights contracting by 36% for the years up

to and after the start of the pandemic in early 2020. Air cargo traffic stayed relatively resilient due to strong increases in dedicated freighter utilization and capacity flown.

Oil and natural gas are the major revenue-producing commodities in the Middle East. Oil prices remained elevated in 2021, contributing to a GDP increase of 3.9%. Strong economic growth continues into 2022 with a further forecast increase of 5.9%—the highest regional gain globally, and one of the few regions with a higher growth forecast than was seen in January 2022.

In mid-2017, the Qatar diplomatic crisis brought disruption that impacted both

passenger travel and air cargo traffic, as flights were re-routed around the airspaces of the opposing countries. Despite this challenge, strong air cargo growth has continued for Qatar. Doha's Hamad International Airport surpassed Dubai International Airport in cargo tonnage handled in 2020, and retained its position as the region's top airport by this metric in 2021.



Transit Hub Infrastructure and Growing Air Cargo Fleets

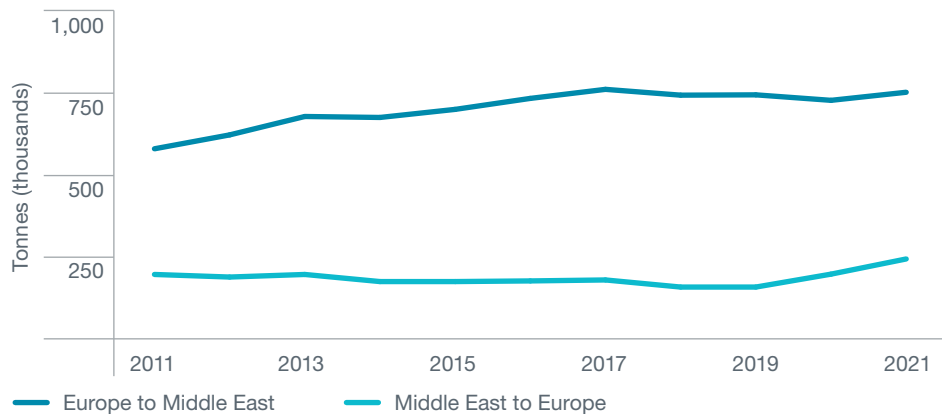
The strategic location of the Middle East positions it well to continue as a transit point for air cargo moving between Europe, Asia, and Africa. Just 43% of the region's total air cargo tonnage originates and/or terminates in Middle East countries, with 57% of the air cargo transferring through Middle East airports to other regions. The Russia–Ukraine conflict, coupled with reduced overflights of the vast expanses of Russia, will likely boost transit cargo flows through the Middle East as a stopover point on key

Asia–Europe routes. The Middle East's strategic location has been an asset to the creation of global superconnector airlines in the region, as demonstrated by their rising status among the top air cargo carriers worldwide, as they utilize both dedicated freighter and passenger widebody belly cargo capacity. The region's airlines more than doubled their cargo ton kilometers in the last decade, a compound annual growth rate of 7.6%. In addition to its status as an air connection hub, the region also has a significant sea/air market, in which goods from South Asia arrive in the Middle East on ships and continue to other regions by air.

Large passenger widebodies and large freighters are essential to Middle East airline fleets, and to network strategies for maximizing cargo payloads and revenues. Large passenger widebodies currently account for 22% of the region's in-service passenger fleet—the highest share of any other global region. Additionally, 25% of the Middle East's backlog and 43% of forecast demand, according to our Commercial Market Outlook, is in this aircraft segment. The facts that large freighters comprise 69% of the region's freighter fleet, and that Middle Eastern airlines account for 30% of the global backlog for this freighter size class, support the growth outlook for the region's flows.

Middle East–Europe Air Trade Grew 2.6% per Year

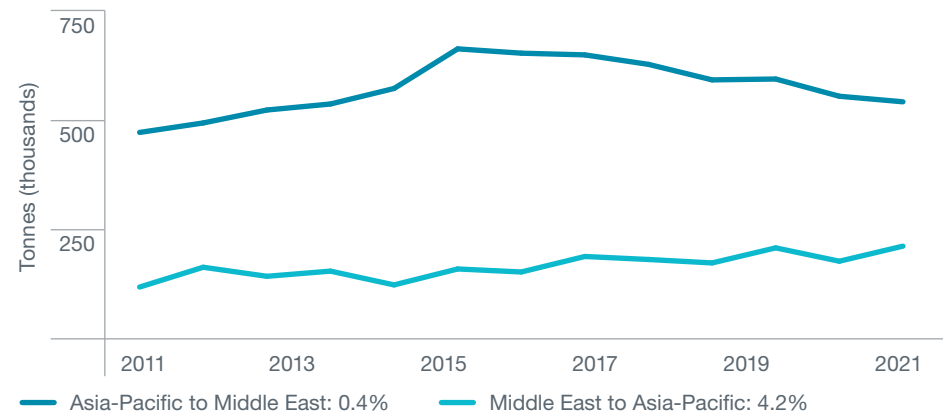
Average Annual Growth, 2011–2021



Source: S&P Global, Boeing Analysis

Middle East–East Asia Air Trade Grew 1.3% per Year

Average Annual Growth, 2011–2021



Source: S&P Global, Boeing Analysis

Moderate Growth for Middle East-Europe Traffic

Air cargo traffic between the Middle East and Europe has grown moderately since 2011. Imports from Europe, much greater than exports from the Middle East, have grown 2.7% per year, while exports to Europe have grown by 2.3%.

Accounting for 994,000 tonnes of air cargo in 2021, trade with Europe represented 29% of the Middle East's international air cargo market. The primary commodities shipped to Europe are metals and chemicals. Leading commodities shipped from Europe include meats and seafood, agricultural products, chemicals, and machinery. Overall air cargo traffic in both directions has averaged 2.6% annual growth since 2011.

Middle East-Europe Forecast

Overall air cargo between the Middle East and Europe will grow at an average annual rate of 2.3% between 2022 and 2041.

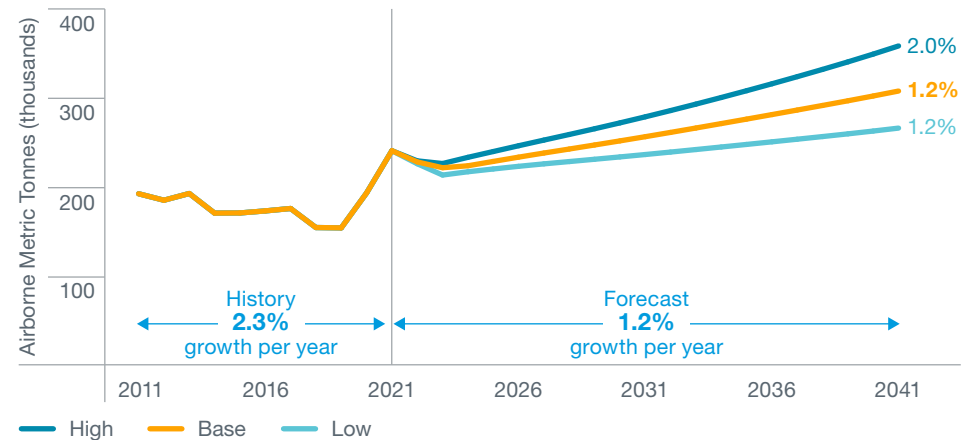
As passenger networks continue to recover, direct flights connecting production centers in Asia and Europe

will continue to boost service and contribute to air cargo traffic growth opportunities between the Middle East and Europe. Reductions in Russian overflights will likely also boost opportunities for growth in the region. Additionally, increasing local exports, coupled with the continued European market for goods transshipped from Asia and Africa, will support healthy growth in the Middle East air cargo market. Finally, a growing middle class in the Middle East will stimulate modest air cargo growth in the future.

Key variables in the long-term growth outlook are oil price levels, which will have a significant effect on Middle East demand for products from Europe via GDP and per capita income levels. In addition, the rate and extent of diversification from oil-related industries will affect long-term growth prospects for air trade to and from the region. In particular, the competitiveness of local products, including perishables, fish, textiles, and the products of emerging light industries, will determine whether the long-term growth trend leans more toward high or low projections.

Middle East-to-Europe Air Trade Will Grow 1.2% per Year

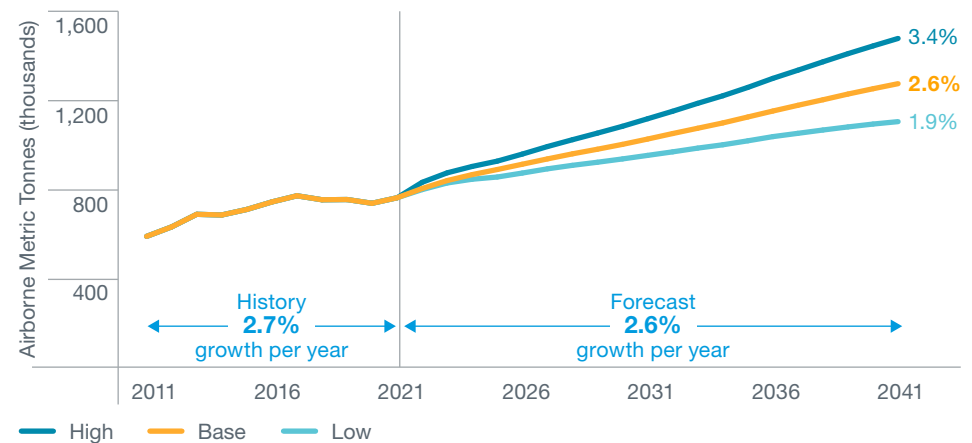
Average Annual Growth, 2022–2041



Source: S&P Global, Boeing Analysis

Europe-to-Middle East Air Trade Will Grow 2.6% per Year

Average Annual Growth, 2022–2041



Source: S&P Global, Boeing Analysis

Middle East–East Asia Shows Strong Growth

In 2021, East Asia traffic accounted for 21% of the air cargo market in the Middle East, at 746,000 tonnes. Air cargo shipments arriving from the East Asia region consisted predominantly of textiles, machinery and electrical equipment, and computer equipment. Imports from the East Asia region have increased at an annual rate of 0.4% since 2011, including a reduction of 9% from 2019 to 2021. The air cargo export flow to the East Asia region is relatively small (one quarter of total trade with the region), but it grew at a robust 4.2% per year over the past decade.

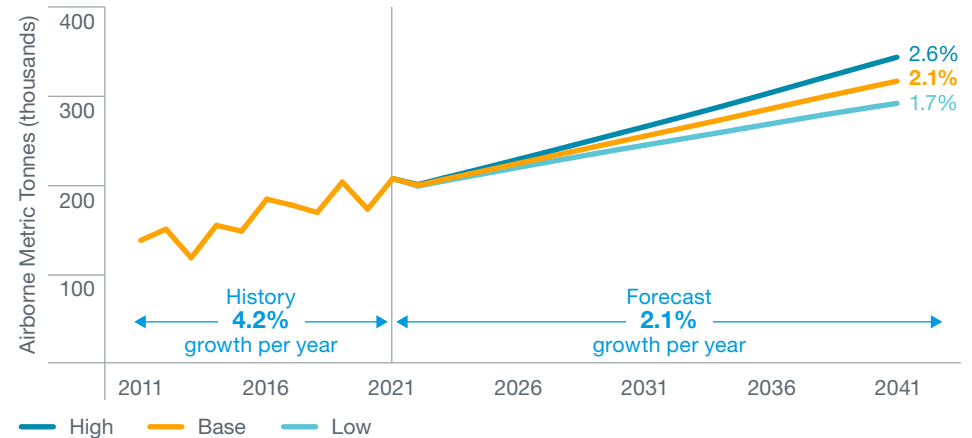
Overall air cargo between the Middle East and East Asia will grow at an average annual rate of 3.1% between 2022 and 2041.

Air cargo to the Middle East from East Asia will continue as the primary directional flow of traffic, increasing

to 77% of overall flow's traffic by 2041. East Asia's continued growth as the center of global manufacturing combined with strong belly cargo capacity growth to and from East Asia will support this traffic growth. Strong e-commerce growth in the Middle East, forecast to grow at an average rate of 18% over the next three years, will also drive imports. Although total cargo traffic between the two regions decreased by 6% from 2019 to 2021 due to COVID supply chain disruptions and passenger flight restrictions, which severely restricted belly cargo capacity, the strong recovery seen thus far in 2022 illustrates the forecast's long-term drivers of growth. As we have seen with the Europe trade flow forecasts, the competitiveness of local products, as well as Middle Eastern economic growth, will be strong determinants of whether the Middle East–East Asia trade forecasts trend toward the baseline, low-, or high-growth scenarios.

Middle East-to-East Asia Air Trade Will Grow 2.1% per Year

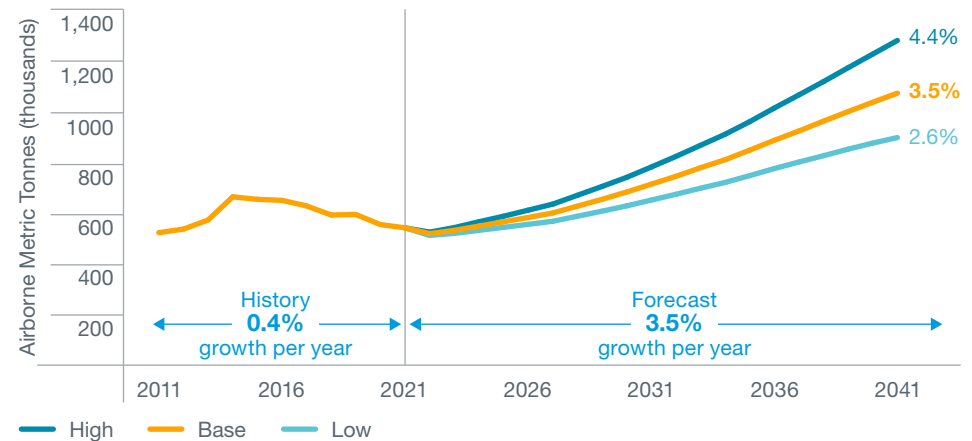
Average Annual Growth, 2022–2041



Source: S&P Global, Boeing Analysis

East Asia-to-Middle East Air Trade Will Grow 3.5% per Year

Average Annual Growth, 2022–2041



Source: S&P Global, Boeing Analysis

North America

For the purposes of this forecast, we define North America as the United States and Canada.



Los Angeles, USA

Highlights

- E-commerce growth will continue to boost overall air cargo growth prospects, particularly over the next 10 years.
- U.S. manufacturing resurgence and supply chain diversification are also bolstering the region's air cargo traffic outlook.
- In the next 20 years, North America's new freighter growth and replacement demand will top all but Asia Pacific's, at 905 units.

Market Overview and Recent Dynamics

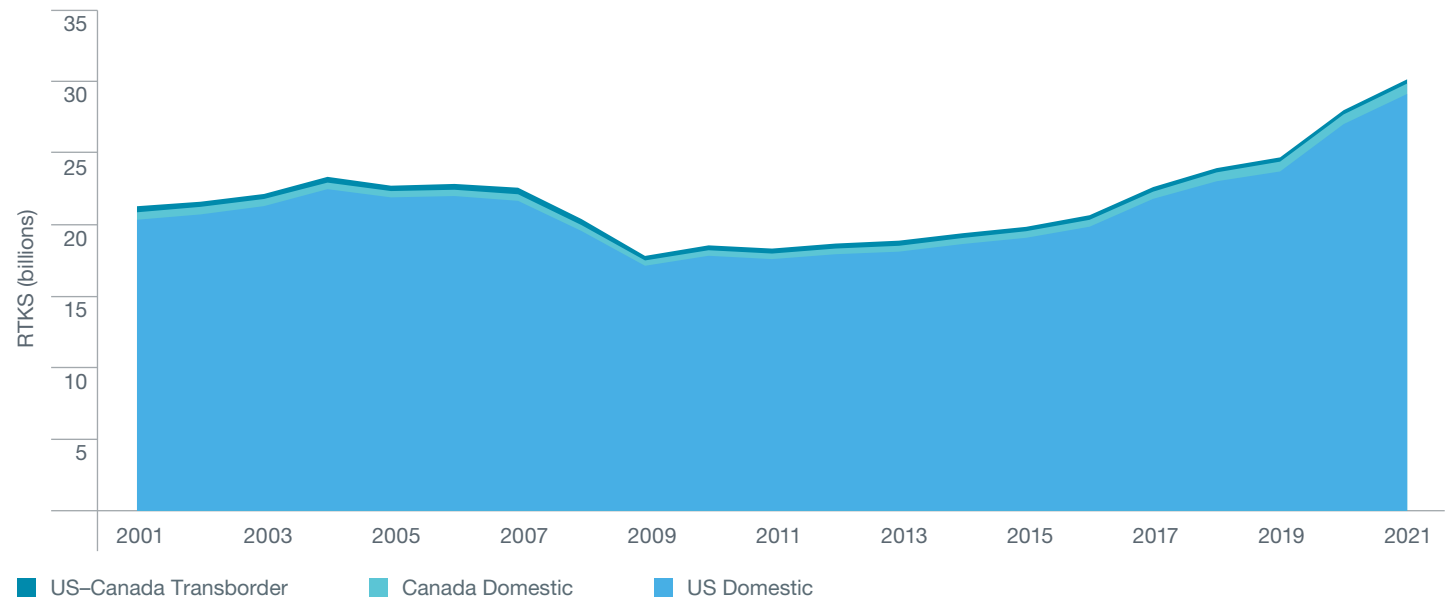
Air cargo moving to, from, and within the United States and Canada accounts for 10.7% of the world's air cargo traffic in tonne-kilometers, and 17.1% in tonnage.

Overall, North American air cargo traffic grew 13.3% in 2020 and 7.7% in 2021. U.S. domestic air cargo, which

accounts for over 95% of the North American market, grew 14% in 2020 and 7.8% in 2021, while Canadian domestic air cargo (with 2% of the market) declined 1.4% and grew 7.1%, respectively.

For 2021, United States–Canada transborder traffic comprised just 1% of the North American market.

US Domestic Has Captured 95%+ Share of North American Air Cargo Market



Source: CargoFacts

E-Commerce Accelerates U.S. Domestic Air Cargo Market Resurgence

The U.S. domestic air cargo market, the world's largest, has seen strong growth in recent years, after the relatively flat volumes that followed the global financial crisis. From 2010 to 2016, the U.S. domestic air cargo compound annual growth rate was 1.3%, not quite one third of the long-term (since 1980) growth rate of 3.5%.

The market surged by 14% in 2017, as a strong U.S. economy reflected robust trade with global markets, solid consumer confidence, and U.S. government tax breaks. Volume growth cooled, relative to 2017 levels, in 2018 and 2019, with increases of 4.6% and 3% respectively, due to tariffs and a weakening global economy.

Despite the economic impacts of COVID-19, air cargo growth was surprisingly strong in 2020. A surging e-commerce sector boosted air cargo traffic by 14% compared to 2019.

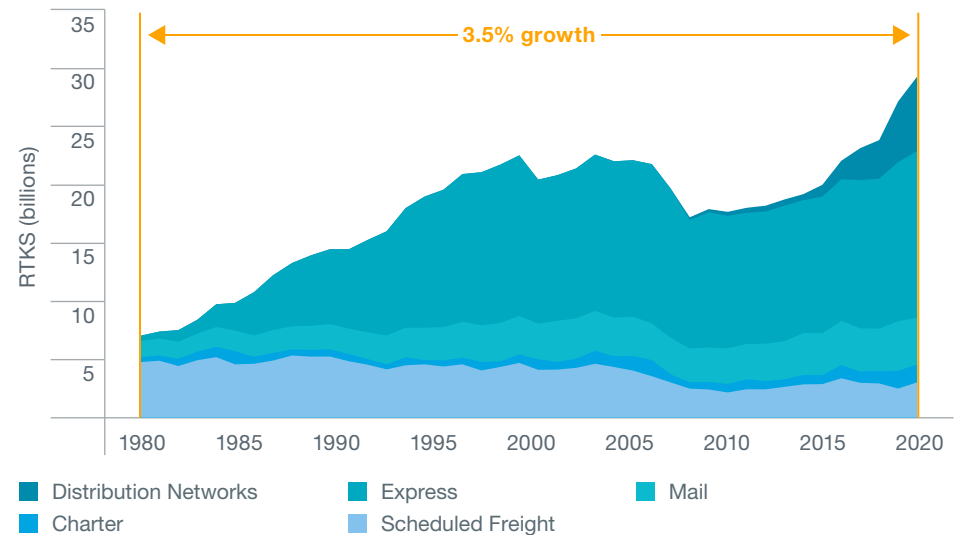
In 2021, with widespread vaccinations easing lockdown constraints, e-commerce growth slowed somewhat. However, pent-up consumer demand, combined with a tight labor market, exacerbated supply

chain disruptions, and air cargo growth remained strong. Supply chains designed around relatively steady demand were unable to keep pace with rapidly changing markets. Higher prices did little to temper market demand.

Through the first eight months of 2022, the U.S. domestic air cargo market continued to show signs of strong growth, up nearly 16% compared to pre-pandemic 2019. However, year over year traffic growth was down 3.5%, compared to 2021's record-breaking levels. Weakness in the global air cargo market reflected macro-economic dynamics, likely to continue into 2023, exerting pressure on U.S. domestic air cargo traffic growth.

In recent years, the U.S. domestic market saw substantial growth in the distribution networks business model that supports e-commerce, and in the expansion of networks to support B2B and B2C customers. Express-carrier and U.S. Postal Service traffic reached all-time highs in 2021, reflecting the strength of e-commerce demand. Express carriers and distribution networks remain the dominant sectors of U.S. domestic air cargo, comprising 71% of the market, a notable increase from 66% a decade ago.

US Domestic Air Cargo Market Has Grown 3.5% per Year Since 1980



Source: CargoFacts

U.S. Trucking Faces Multiple Challenges

The U.S. trucking industry faces a number of challenges. Increasing congestion in urban areas has slowed the flow of goods and raised fuel costs. A shortage of long-haul truck drivers is nudging wages upward, a trend exacerbated by high numbers of driver retirements.

Truck electronic logging devices, required since 2017, originally were

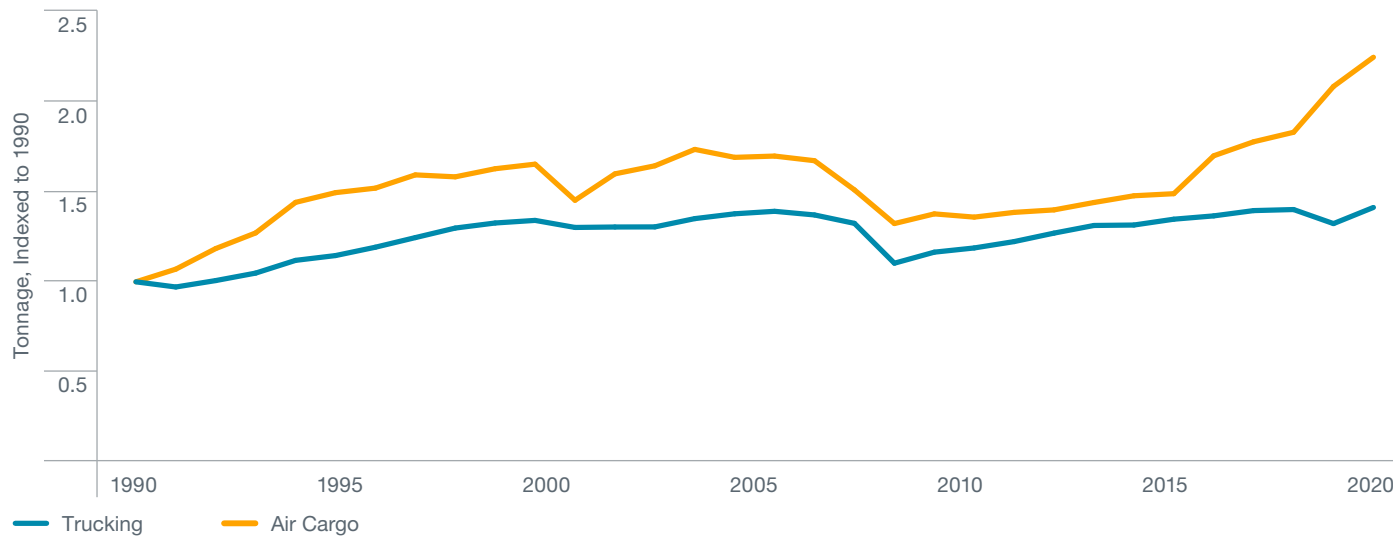
considered an obstacle to driver productivity. Instead, they helped trucking companies identify inefficient wait times at shipping and receiving centers. This discovery led them to improve wait times throughout their networks, and has served to compensate for some lost capacity.

From 2016 through 2021, the domestic air cargo industry has seen an acceleration of tonnage growth at 8.6% annually, while trucking tonnage growth during the same time period

grew at a tepid rate of 1%. The speed and reliability advantage that air cargo offers, along with strong growth in e-commerce, have made air cargo a necessary alternative in meeting market demands, despite its price premium.

Air Cargo Tonnage Growth Has Diverged From Trucking Growth Since 2016

US Domestic Trucking and Air Cargo Tonnage



Source: Cargo Facts, American Trucking Associations (past years' trucking numbers have some adjustments from prior WACF data)

Canadian Growth Exceeds Projections

The Canadian domestic market accounts for a small proportion of the total North American air cargo market, but traffic has grown significantly in the past five years, averaging 8.5% annually. This growth has been driven largely by e-commerce, with the express operators who comprise nearly 70% of Canada’s domestic market spurring robust, double-digit growth from 2018 through 2021 as they built out their networks.

U.S.-to-Canada Traffic Dominates Transborder Air Cargo

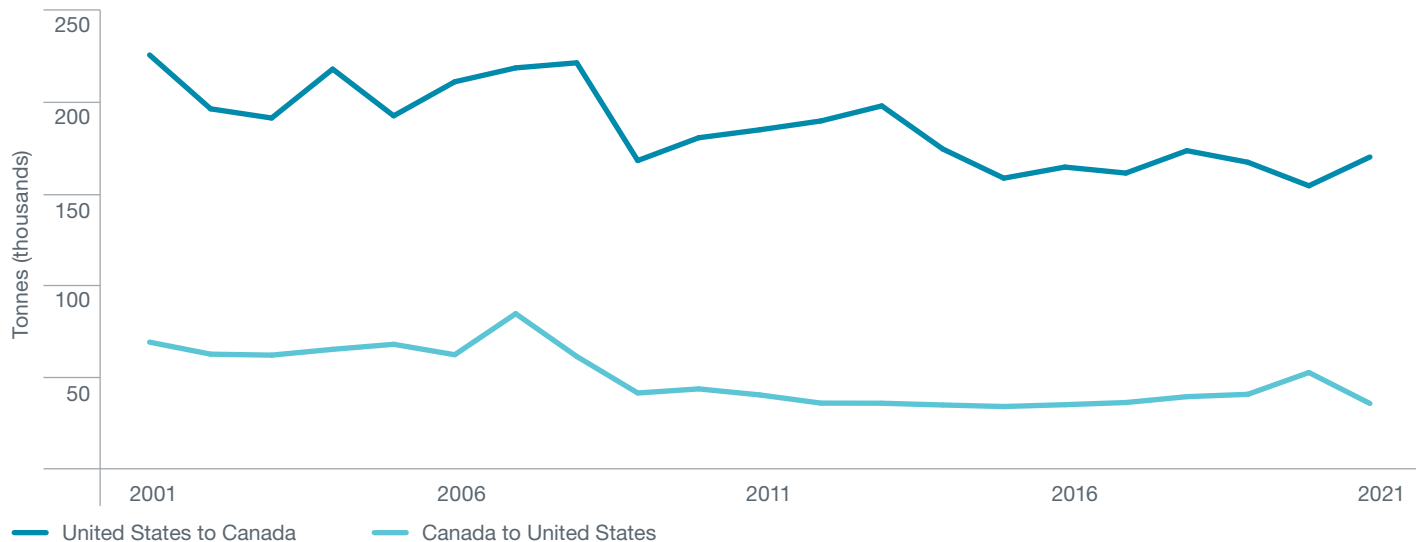
Approximately 90% of Canada’s inhabitants live within 100 miles of the U.S. border. As a result, transborder trade is heavily weighted toward less expensive truck cargo transport.

Historically, transborder air cargo has been dominated by northbound tonnage, primarily due to deliveries of civilian aircraft, aircraft engines, and spare parts from the U.S. to Canada.

In 2019, for example, this commodity category made up about two thirds of the total tonnage northbound to Canada. In 2020 and 2021, this remained in the 35–45% range, reinforcing the importance of this northbound trade category.

Southbound air cargo tonnage is more diverse than the northbound flow, and includes such commodities as motor vehicle parts, machine components, and fresh fish and seafood.

Northbound Tonnage Continues to Exceed Southbound Figures



Source: US Census Bureau, T-100

Growth in the transborder flow—slightly negative from 2011 to 2021—has been lackluster. Nonetheless, the potential for growth in cross-border e-commerce, along with continuing deliveries of commercial airplanes, will support a slow yet positive growth rate over the forecast period.

Economic Outlook Drivers

The U.S. and Canadian economies contracted 3.4% and 5.2%, respectively, in 2020, as a result of the pandemic's impact. In 2021, however, GDP growth for the United States and Canada rebounded to 5.7% and 4.5%, respectively. For the next 20 years, North American GDP growth is forecast at 1.9%, identical to the 2001–2021 GDP growth rate.

Unsurprisingly, industrial production, a bellwether of air cargo growth, has experienced dramatic swings since the pandemic. Before the pandemic, in 2019, U.S. industrial production grew at a paltry 0.7%, a reflection of weakening global growth. In 2020, this growth declined by 7%, but bounced back to 4.9% in 2021. Despite the slowing global economy, U.S. industrial production is expected to grow at 4.2% in 2022.

Supply chain reshoring and risk mitigation are expected to spark a renaissance in North American manufacturing. A significant portion of this increase is expected to involve the manufacture of high-value components—commodities typically transported via air cargo.

Retail sales, a proxy for e-commerce, experienced relatively stable growth in the U.S. prior to the pandemic, but in 2020 fell 0.7%. (By comparison, Canadian sales dropped 2.1%.) However, retail sales in North America did not fall nearly as far as they did in 2009 after the global financial crisis and, in 2021, growth rates were robust at 14.3% and 8.1% for the U.S. and Canada, respectively. This strength reflected the significant shift in consumer spending from services to products during the pandemic. In addition, e-commerce growth accelerated, providing additional support for growth in air cargo.

After increasing consistently during the 1980s and 1990s, express carrier cargo traffic flattened between 2001 and 2007 as the market matured. Traffic remained flat through 2016 following the global financial crisis. However, traffic began to recover

in 2017, and by 2019 express traffic—at nearly 12.9 billion revenue tonne-kilometers (RTK)—finally surpassed levels not seen since 2007. Much of the recent growth can be attributed to renewed interest and activity in expanding U.S. domestic express networks to expedite the movement of e-commerce goods. Traffic has continued to climb, reaching nearly 21 billion RTKs in 2021. Freighter network growth has largely been driven by Amazon as it builds out its network and fleet to source more of its deliveries, now approaching 100 aircraft to support fulfillment operations.



Regional Forecast

Supply chain risk mitigation, e-commerce growth, and favorable U.S. demographics combine to provide a strong foundation for continued domestic air cargo growth.

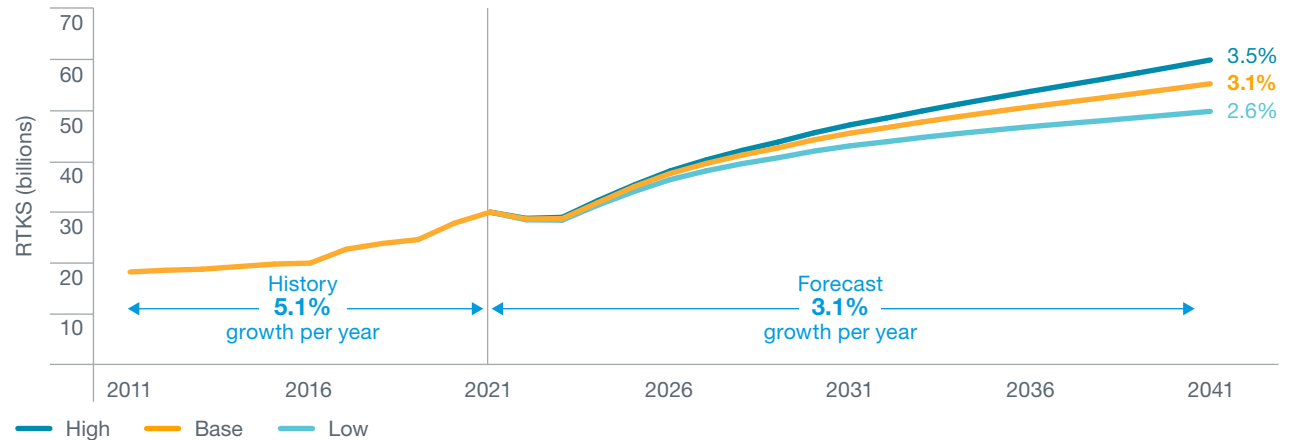
Air cargo traffic growth in North America is expected to average 4.3% over the next 10 years, and 3.1% over the full 20-year period, reflecting the continued rise of e-commerce, a resurgence in domestic manufacturing, and favorable demographics.

The U.S. domestic market will maintain the dominant share of the total North American market, with over 95% of total RTKs.

The U.S. domestic market is projected to grow at an average annual rate of 4.3% during the first 10 years, as e-commerce market share grows and providers continue to build networks and fleets, with growth leveling out in the second 10 years, for 20-year (2022–2041) growth of 3.1%.

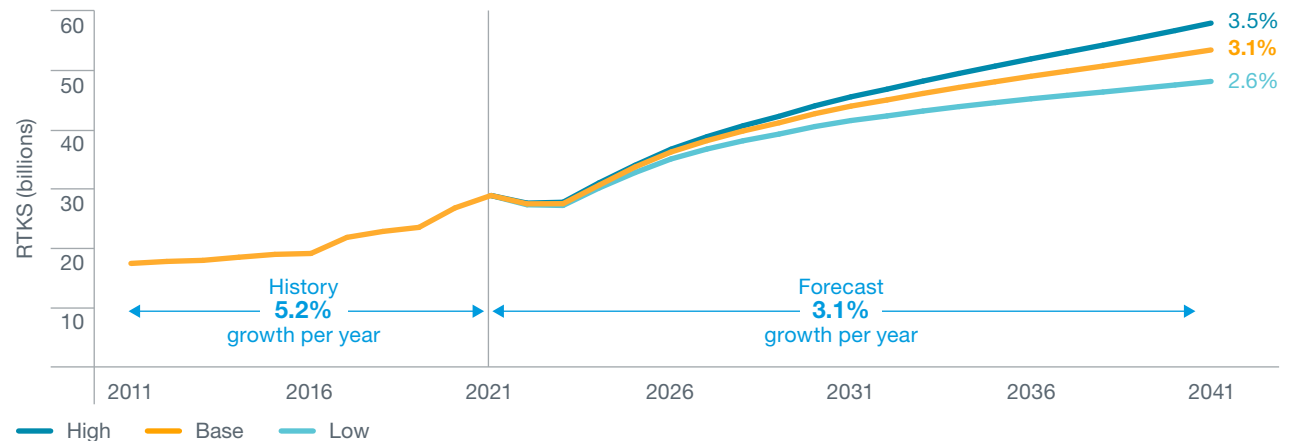
North American Air Cargo Traffic Will Grow 3.1% per Year*

Average Annual Growth, 2022–2041



US Domestic Air Cargo Traffic Will Grow 3.1% per Year*

Average Annual Growth, 2022–2041

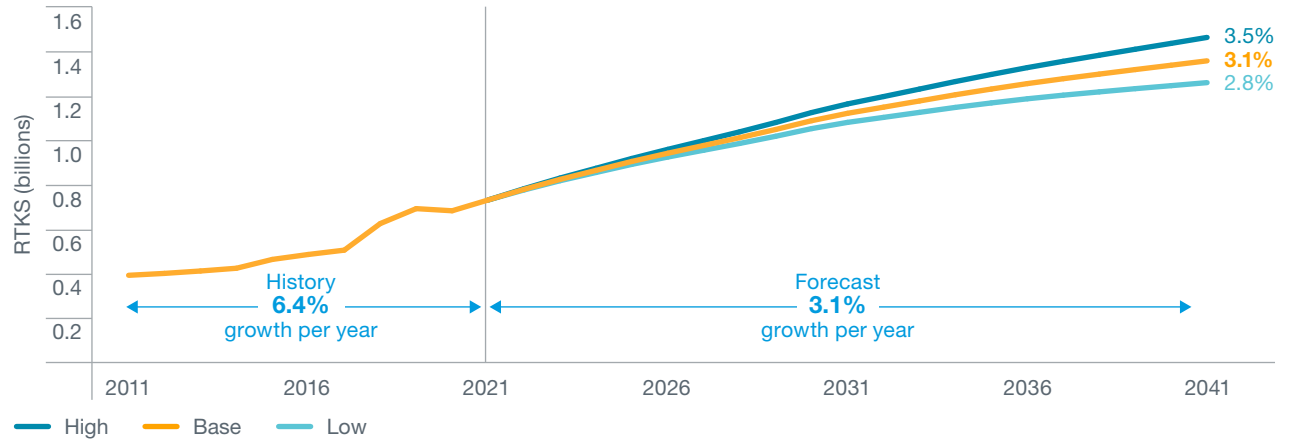


Similarly, the Canadian domestic market is forecast to grow at a higher rate in the first 10 years, due to e-commerce growth, and then to level out at a lower long-term growth rate, for a 20-year growth rate of 3.2% from 2022 to 2041. The Canadian domestic market will average 4.4% growth for the first 10 years, and 3.1% over the 20-year period from 2022 to 2041. In the forecast period, we expect that network buildouts driven by e-commerce growth, in addition to near-term capacity additions that Canadian domiciled carriers are planning, will continue to boost air cargo growth in Canada's domestic market.

Trans-border air cargo traffic is forecast to grow at 1.4% over the 20-year period, in contrast to the slight negative growth rate observed from 2011 to 2021. This forecast projects dynamics closer to the trans-border traffic trends of the past 20 years. Northbound traffic will continue to exceed southbound traffic, reflecting the differences in manufacturing and economic output between Canada and the U.S.

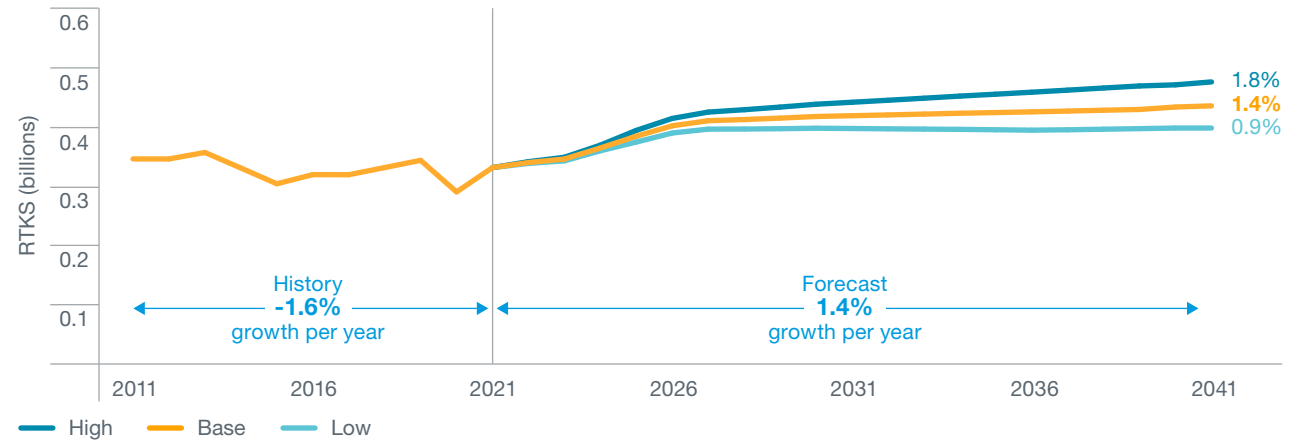
Canadian Domestic Air Cargo Traffic Will Grow 3.1% per Year

Average Annual Growth, 2022–2041



US–Canada Transborder Air Cargo Traffic Will Grow 1.4% per Year

Average Annual Growth, 2022–2041



Russia and Central Asia

For this forecast, we define Russia and Central Asia as 12 of the 15 republics of the former Soviet Union: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, the Russian Federation, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. This region is bound by common ties of history, business, and language.



Almaty, Kazakhstan

Air Trade Rebounds

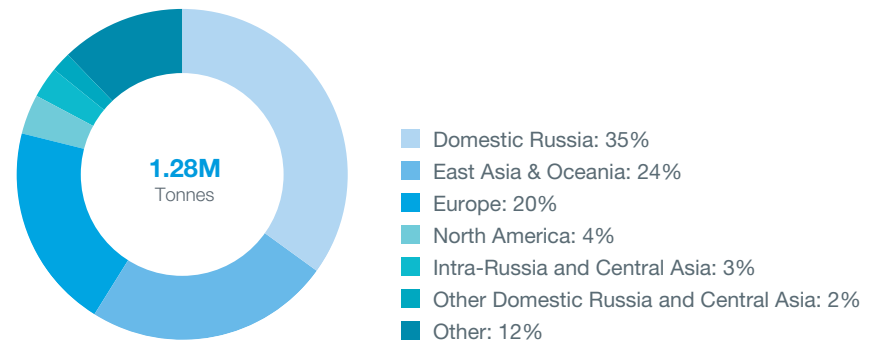
The Russia and Central Asia market accounts for approximately 1.2% of the world's total air cargo traffic in tonne-kilometers, and 2.2% in tonnage.

Air trade originating in or destined for Russia and Central Asia reached an estimated 1.28 million tonnes in 2021, based on the region's airport statistics. Growth averaged -0.4% from 2011 to 2021, based on tonnage handled at airports. Principal markets in the region include domestic Russia, Asia, and Europe, with Russia commanding 74% of regional air commerce because of its size and economic concentration. The Moscow city market was particularly important, as it comprised 50% of the total Russian market, and 37% of air trade for the entire region, in 2021.

Helped by high oil and gas prices, Russia and Central Asia air trade expanded 50% after 2009, peaking

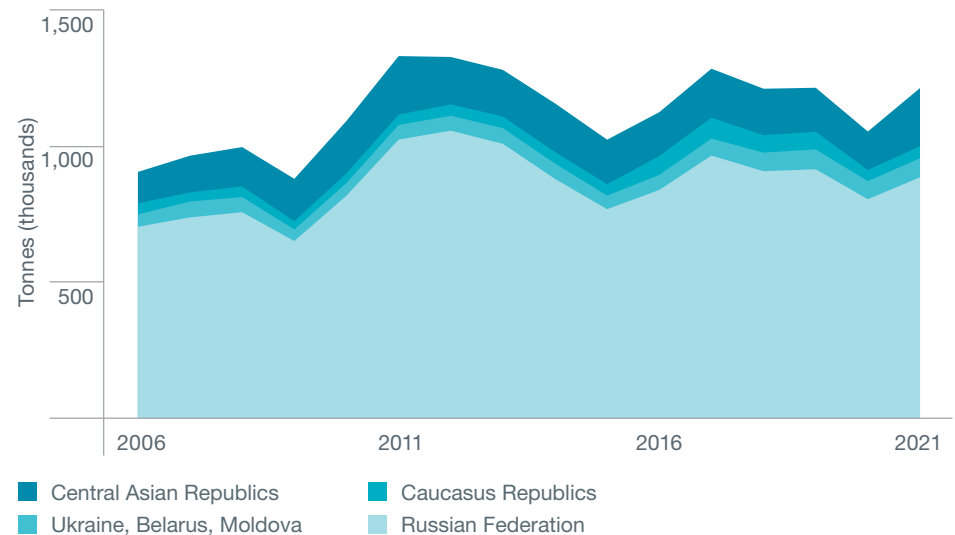
at 1.3 million tonnes in 2011. Levels remained nearly the same in 2012, and fell modestly in 2013. Contraction in the region's air cargo volumes gathered pace in 2014 and 2015, as investment in extractive industries slowed, consumer spending fell, and trade sanctions were imposed on Russia for its support of the conflict in Ukraine. Regional air trade expanded 10% and 14% in 2016 and 2017, respectively, as the world economy recovered, commodity prices stabilized, and Russia reoriented much of its international air trade toward Asia rather than Europe. However, this period of high growth ended in 2018 as overall world trade levels began to weaken in the latter part of that year. The onset of the COVID-19 pandemic in 2020 led to a 13% drop in overall regional air trade, followed by a 21% rebound in 2021.

East Asia and Europe: Leading Air Trade Partners



Sources: TKP, FAVT, ACI, airport statistics, Boeing research

Airport Air Cargo Traffic Near Pre-Pandemic Levels



Sources: TKP, FAVT, ACI, airport statistics, Boeing research

Domestic Trade

Domestic air trade is a vital part of commerce in this expansive region, particularly in Russia. In 2021, airports reported that Russian domestic air cargo comprised more than 452,000 tonnes, although airline reports showed only about half of that total. The region's vast distances and relatively underdeveloped surface transportation links often necessitate air transport for moving goods and industrial materials, especially to remote oil and gas extraction projects in the Arctic regions, Siberia, and the Russian Far East. Along with Moscow, leading air freight cities include Ekaterinburg, Khabarovsk, Novosibirsk, St. Petersburg, and Vladivostok. The domestic markets of the regional bloc's other 11 countries totaled 25,000 tonnes, according to airport figures.

International Trade Partners

International trade, both intraregional and interregional, accounted for 799,000 tonnes of regional air cargo in 2021. Of that, about 495,000 tonnes flowed to and from Russia. Azerbaijan, Kazakhstan, Ukraine, and Uzbekistan account for most of the remaining tonnage. Russia and Central Asia international air trade was focused chiefly on European and East Asian nations.

Since 2014, sanctions have reshaped the region's international air trade, particularly for Russia. Until 2015, the region's largest air trade partner was Europe. Over the past decade, however, East Asia had eclipsed Europe as the region's biggest air trade partner, reaching an estimated 307,000 tonnes in 2021. Furthermore, since 2016, e-commerce-related air imports, particularly into Russia from East Asia, have been key drivers in the region's air cargo growth.

Imports and Exports

Demand for electronics, apparel, and other consumer goods—particularly from China and other East Asian countries—has helped make Russia and Central Asia–East Asia traffic one of the region's strongest flows. In 2002, however, Russia implemented customs regulations that curbed direct air import to Russia from East Asia, leading some importers to transport Russia-bound freight to nearby countries by air before bringing it into Russia by truck, a dynamic that persists.

While international air trade with East Asia has grown faster in the past decade, Russia and Central Asia–Europe air cargo flows connected to Europe were significant until early 2022. Total regional air trade with Europe in 2021 totaled an estimated

256,000 tonnes, of which about 90% were imports from Europe. Air imports consisted primarily of intermediate manufactured goods (subcomponents such as automobile parts), industrial machinery, apparel, flowers, and pharmaceutical and medical products. Airborne exports to Europe, while much smaller than air imports, consisted of intermediate manufactured goods, industrial machinery, jewelry, food products, and aerospace equipment.



Significant Transit Air Cargo Volumes

Russia and Central Asia-domiciled carriers move considerable transit cargo. To accurately assess those traffic volumes, it is necessary to distinguish between true origin-and-destination traffic and cargo flights that stop in the region in transit to countries outside the region. Locally based operators carry a significant portion of international cargo on scheduled international flights that pass through Russia and Central Asia.

In the 1990s, Russian and Central Asia-based airlines began to tap air freight demand between East Asia and Western Europe, taking advantage of their central location to serve routes in the region-to-region market, and often transiting their home-country markets without commercial stops. By 2021, international transit traffic carried by local freighter operators reached an estimated 898,000 tonnes.

Locally based operators also provide charter services for multinational firms, nongovernmental organizations, and foreign governments, carrying freight to and from markets unconnected with their countries of domicile. For the past 30+ years, Russia and Central Asia-based freighter operators, particularly

those operating Soviet-era-designed freighters, have served various niche industry markets. This market totaled more than 84,000 tonnes in 2021.

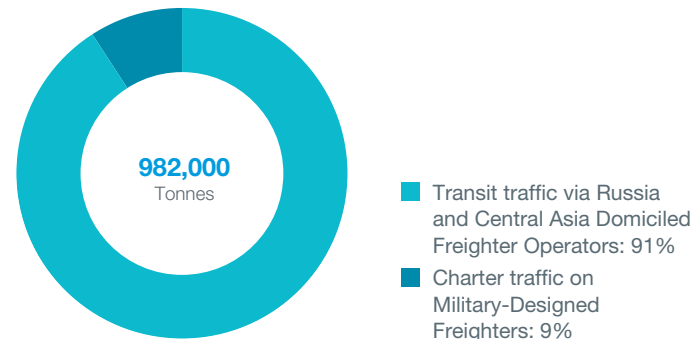
The Role of Former Military Freighters

Russia and Central Asia-based airlines operate a significant number of former Soviet military turboprop and jet airplanes on charter freight flights.

Following the end of the Soviet Union, the region saw a dramatic increase in the number of former military aircraft repurposed for charter air cargo services. The influx of readily available freighter capacity in the 1990s corresponded with a surge in new air cargo carriers attracted by the low acquisition cost of these aircraft.

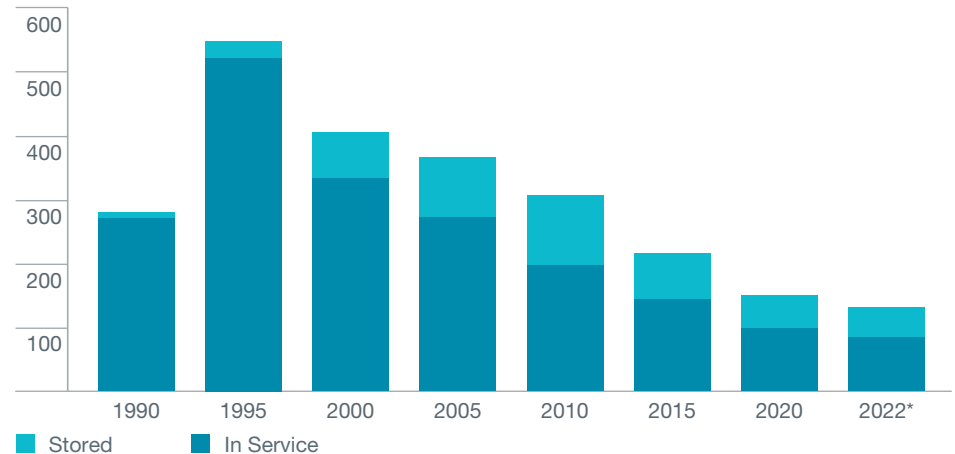
The unique loading capabilities of Russian- or Soviet-built freighters, coupled with their ability to operate from airports with lagging infrastructure investment, have enabled charter-flight operators to move freight that is dimensionally too large, or too heavy, for civilian widebody freighters. Most of this outsized cargo traffic does not originate or terminate in Russia and Central Asia.

Tonnage Moved by Russia and Central Asia-Domiciled Operators



Sources: TKP, airline reports, Boeing research

Military-Design Freighters Decline in Russia and Central Asia Fleets



*As of 30 September 2022

Source: Cirium

In the past two decades, the number of Russian- and Soviet-built aircraft in service has declined, as aging freighters have been stored or fully retired. As of third-quarter 2022, about 84 locally built freighters were serving cargo markets, a decline of more than 400 aircraft since the peak of 520 in 1995. The region's airlines have been augmenting or upgrading their fleets with Western-built freighters in response to such issues as aging hardware, high fuel consumption, and community objections to noise.

Vintage military aircraft still in service continue to be called upon for outsized cargo charter duties around the world, predominately between Europe, North America, and Asia. Typically, these flights are associated with humanitarian aid efforts, oil and gas extraction, aerospace manufacturing, entertainment, electrical power generation, and other infrastructure development projects.

Outlook

The February, 2022, Russian invasion of Ukraine has clouded the prospects of this vast region. By March, many nations had imposed economic and trade sanctions on Russia. Both Russian and Ukrainian airspace were closed to the airlines of many countries, including those based in Western Europe and North America, severely disrupting air trade between East Asia and Western Europe. In October, Eurocontrol forecast that Russian and Ukrainian airspace restrictions would not end before 2028.

Russia-based freighter networks have been almost entirely withdrawn from the world air transport system. The grounding of Russian and Ukrainian freighter fleets was the primary cause of the reduction of the world's in-service, large widebody freighter fleet by almost 4% in March, 2022, relative to year-end 2021 levels.

For the 2002–2021 period, true origin-destination air trade for the Russia and Central Asia region expanded at an average annual rate of 2%, with Russia growing 1.3% on average, but Central Asia growing much faster, at 6.2%. These historic growth rates may offer some guidance regarding this regional market's long-term growth potential.

On a positive note, several established and start-up freighter operators based in the Central Asia and Caucasus regions have announced freighter fleet expansion plans. Their stated target markets include emerging local e-commerce flows as well as the East Asia–Western Europe trading bloc.



South Asia

For the purposes of this forecast, South Asia (sometimes referred to as the Indian Subcontinent) is defined as Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka.



New Delhi

Highlights

- Europe supplanted East Asia as South Asia’s top air cargo trading partner in 2021, with total trade surpassing 817,000 metric tonnes.
- The pandemic severely impacted cargo movements in 2020, but total tonnage recovered in 2021 as capacity returned.
- The Make in India campaign is a primary driver of growth in both imports (machinery and chemicals) and exports (finished products).

Nearly 2.9 Million Tonnes of Cargo per Year

The South Asia air cargo market constitutes approximately 5.9% of the world’s air cargo traffic in tonnage, and 4.8% in tonne-kilometers. It exceeded 2.8 million tonnes in 2021.

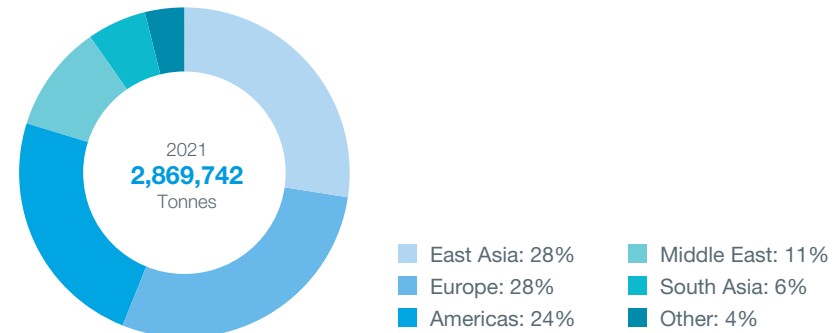
Over the last decade, the South Asian economy steadily grew. GDP in South Asia has increased 5.2% per year since 2011, with a continued outlook that exceeds the world average. In 2021, South Asia was home to nearly a quarter of the world’s population—over 1.8 billion people.

India dominates the South Asia region in terms of freight traffic. In 2021, India was responsible for more than 60% of South Asia’s exports and imports, and the top four airports (by freight traffic) were located inside India’s borders. Pakistan, Bangladesh, and Sri Lanka are the next largest trade countries, together accounting for more than 35% of the region’s trade.

South Asian imports and exports struggled in 2020 as the COVID-19 pandemic disrupted supply chains, closed borders, and hampered movements of people and cargo. However, air cargo to key regions rebounded strongly in 2021, and recovery has continued into 2022.

Europe grew its share of South Asian air trade marginally, from 808,000 metric tonnes in 2019 to 817,000 metric tonnes in 2021. Despite the modesty of this increase, Europe emerged as South Asia’s top trade partner, due to an 8% decline in South Asia–East Asia trade during the same period. Europe’s trade recovery can be attributed to a 7% increase in the Europe-to-South Asia traffic flow, as South Asian importers substituted European imports for imports from East Asia when challenges mounted for East Asian supply chains.

Europe Has Emerged as the South Asia’s Largest Trade Partner



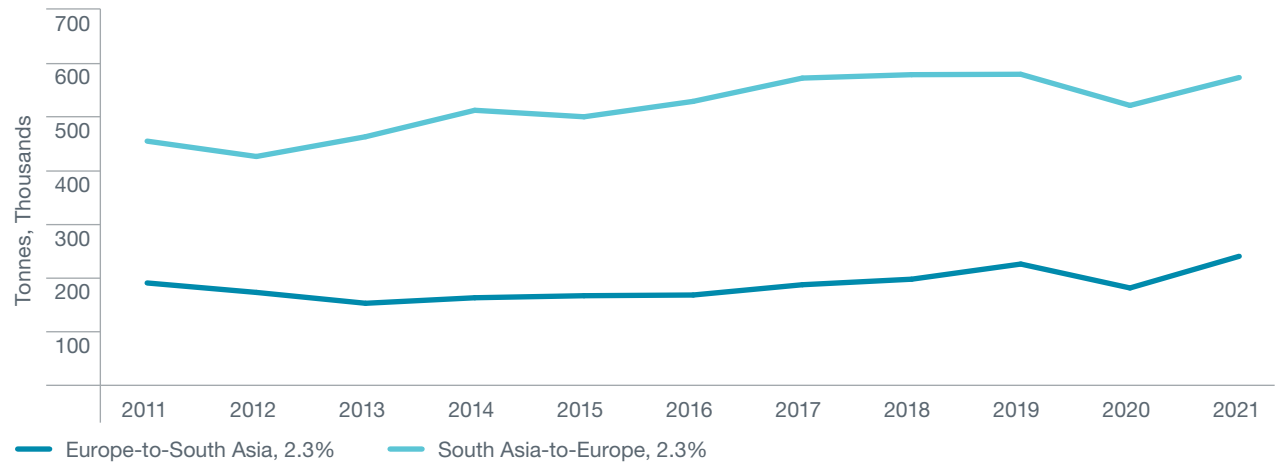
Source: S&P Global, Eurostat, India DGCA, CargoIS, Boeing Analysis

Trade With Europe

Trade between Europe and South Asia maintained a steady 2.3% annual rate of growth over the last decade. Between the two regions, trade has favored South Asian air exports, which achieved 70% of the total. Trade decreased by 13% in 2020, but rebounded with a 15% increase in 2021. More than half of all exports are textiles, with machinery and agricultural goods contributing significant shares. Nearly 40% of the imports from Europe consist of machinery and electronics, while chemicals make up another 20%.

South Asia–Europe Air Trade Grew 2.3% per Year in the Last Decade

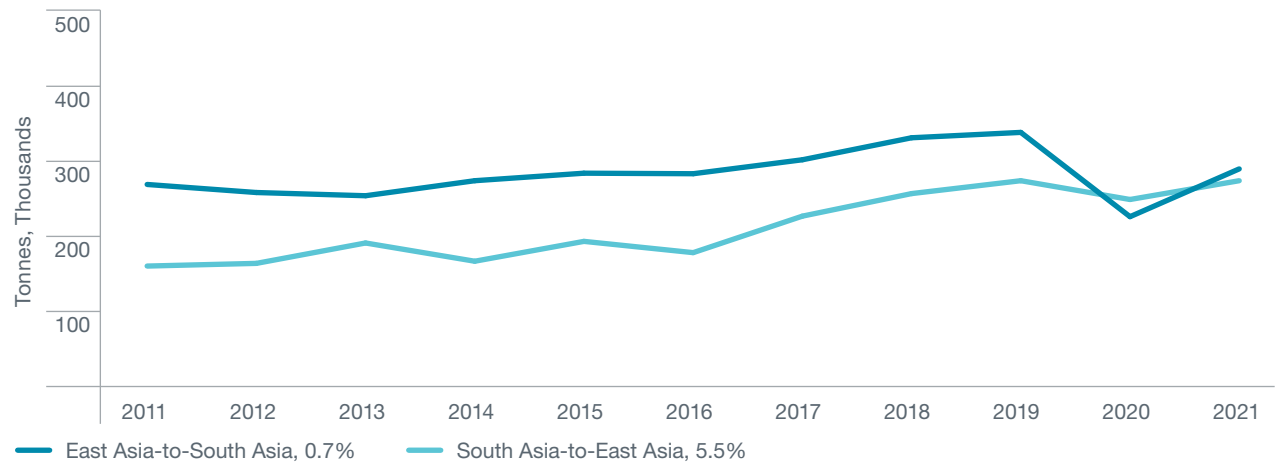
Average Annual Growth, 2011–2021



Source: S&P Global, India DGCA, AAI, Eurostat, country government statistics, CargoS, Boeing analysis

South Asia–East Asia Air Trade Grew 2.7% per Year in the Last Decade

Average Annual Growth, 2011–2021



Source: S&P Global, India DGCA, AAI, Boeing analysis

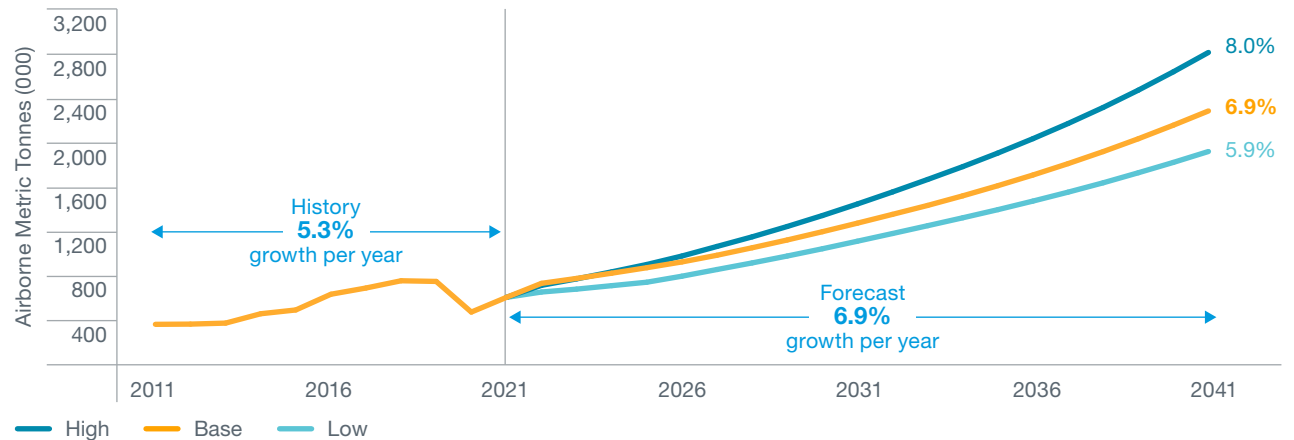
Domestic India Forecast

India’s domestic air cargo trade will continue to see rapid growth of 6.9% per year over the next two decades. Domestic Indian air cargo tonnage has grown significantly—by 5.3%—over the last decade, despite a pandemic-driven 37% decline from 2019 to 2020.

Historically, trade growth has been driven by India’s expanding economy, which grew 5.3% per year in real GDP over the past decade. The current baseline growth scenario is 60 basis points higher than our 2020 forecast, and is driven by strong Indian economic recovery, as well as a base year (2021) that had 19% less tonnage than 2019 due to the pandemic.

Domestic India Air Trade Will Grow 6.9% per Year

Average Annual Growth, 2022–2041



Source: India DGCA, AAI, Boeing analysis



South Asia–Europe Forecast

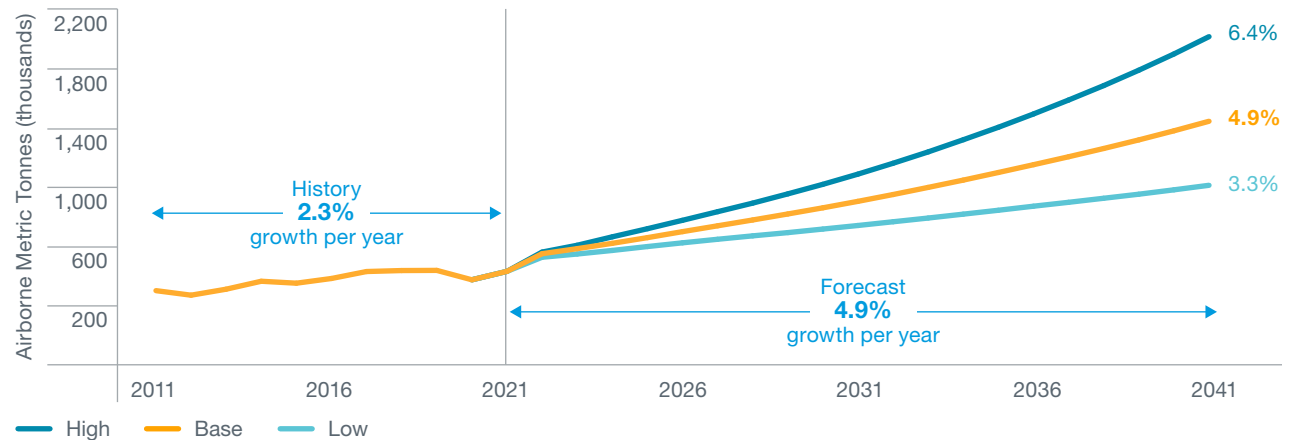
As South Asia's economy sustains its rapid expansion, trade between South Asia and Europe is expected to keep growing.

Forecasts for both exports to and imports from Europe point to above-trend growth. South Asia's rapidly growing population and middle class will drive demand for imported European products. At the same time, the region's expanding manufacturing base will increasingly require imported goods such as chemicals, machinery, and electrical equipment.

South Asia remains competitive in terms of production costs, which will drive continued air export growth to Europe. In addition, the shortage of reliable supply chains in East Asia, due to pandemic containment measures, has also motivated producers to diversify the lists of countries in which they manufacture. South Asia should see a boost as this sentiment grows.

South Asia-to-Europe Air Trade Will Grow 4.9% per Year

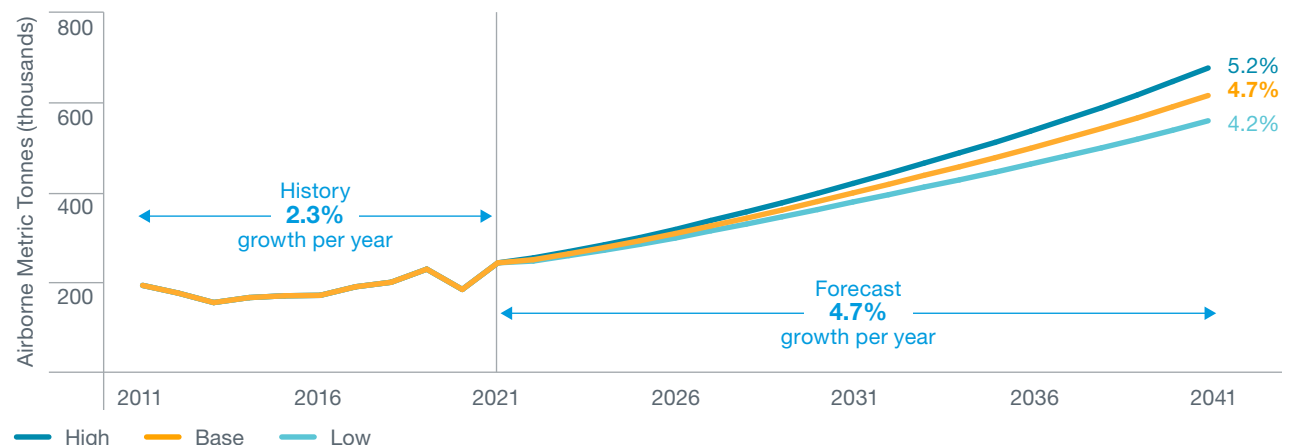
Average Annual Growth, 2022–2041



Source: S&P Global, India DGCA, AAI, Eurostat, country government statistics, CargoIS, Boeing analysis

Europe-to-South Asia Air Trade Will Grow 4.7% per Year

Average Annual Growth, 2022–2041



Source: S&P Global, India DGCA, AAI, Eurostat, country government statistics, CargoIS, Boeing analysis

Trade With East Asia

South Asia's air trade with East Asia has grown 2.7% annually since 2011. Historically, imports from East Asia accounted for approximately 60% of the trade between these regions. However, over the last decade, that share has declined and, in 2021, exports to and imports from East Asia each amounted to 50% of the total. Imports from East Asia have been growing at 0.7%, a rate slowed by the pandemic due to a 33% drop in tonnage. In contrast, South Asian exports to East Asia have grown at 5.5% per year over the last decade. South Asia's renewed focus on growth

in manufacturing, both for export and for domestic consumption, has contributed to this trend.

South Asia–East Asia Forecast

South Asia's air trade with East Asia is expected to keep expanding, as South Asian economies continue to develop.

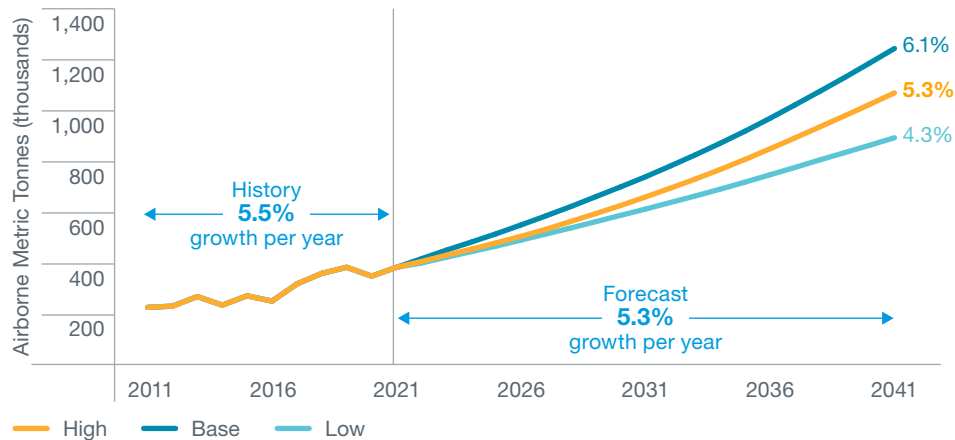
Despite weak demand for air cargo exports to and imports from East Asia during the pandemic, strong growth is forecasted in both directions. Continued economic and population growth in South Asia will drive the expansion of e-commerce imports,

and stimulate imports of historically important commodities (such as machinery and chemicals) that support manufacturing growth. Imports are forecast to increase at a robust annual rate of 7.5%.

Political tensions between India and China, intensified by border skirmishes in 2020, may impede air trade between the two regions. This friction has prompted India to expand trade ties with, and secure strategic and financial investments from, other East Asian and Oceania nations like Australia, Japan, South Korea, and Taiwan.

South Asia-to-East Asia Air Trade Will Grow 5.3% per Year

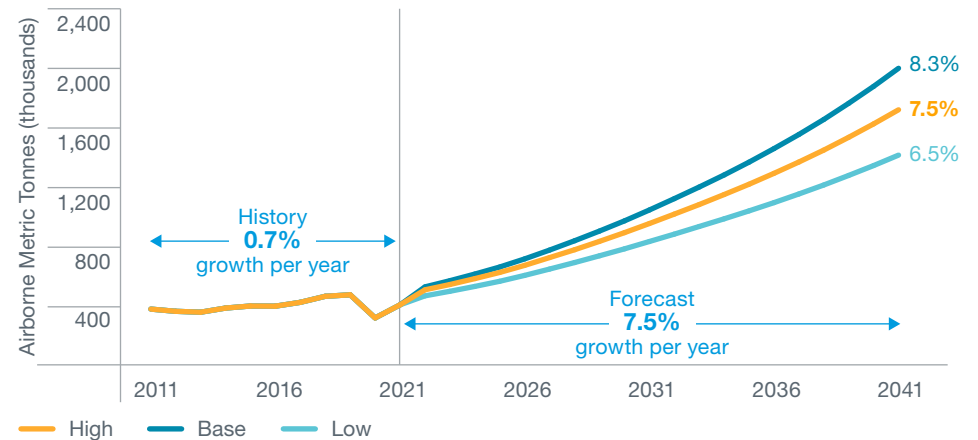
Average Annual Growth, 2022–2041



Source: S&P Global, India DGCA, AAI, Boeing analysis

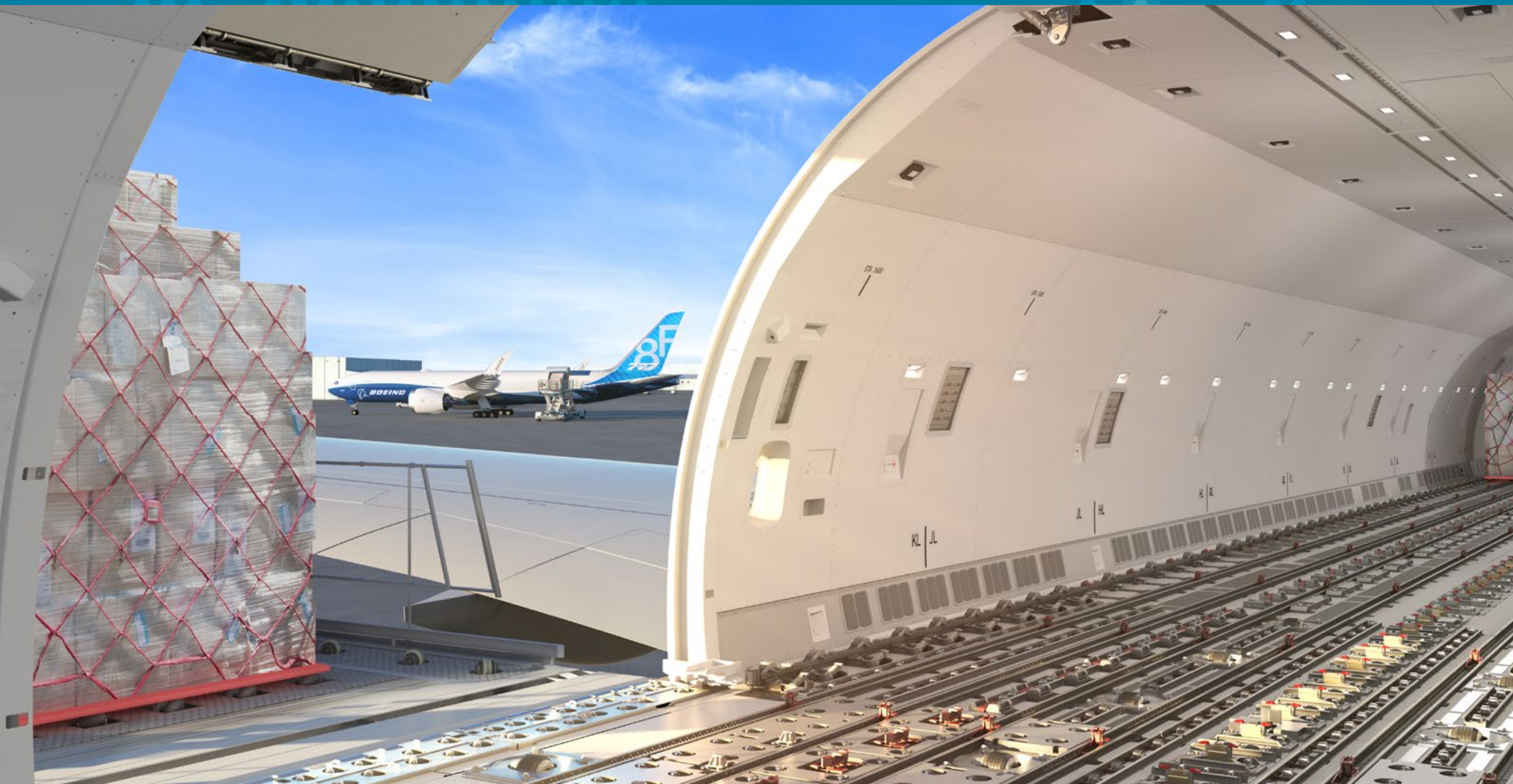
East Asia-to-South Asia Air Trade Will Grow 7.5% per Year

Average Annual Growth, 2022–2041



Source: S&P Global, India DGCA, AAI, Boeing analysis

Freighter Fleet Forecast



The Role of Freighters in Air Cargo

Before the COVID-19 pandemic, freighters made up less than 8% of the total commercial jet fleet, yet they carried more than 50% of all air cargo traffic. As the pandemic continued, at the end of 2021, freighters represented nearly 10% of the total commercial jet fleet, and carried approximately 70% of all air cargo traffic. A number of factors underpin their essential role in the global supply chain:

- Of the 21,000 jet transports in service at the end of 2021, more than 70% were single-aisle and/or regional jet airplanes without lower holds to accommodate freight pallets or containers. But freight forwarders prefer palletized capacity, which is only available on widebody passenger or freighter airplanes.
- Most passenger airplanes with lower-hold capacity do not serve key trade routes. For such routings, freighters are the most efficient form of cargo transport.
- Dedicated freighter services offer control over timing and routing that lower-hold capacity cannot match. Air cargo is an industrial tool, and demand for cargo capacity surges

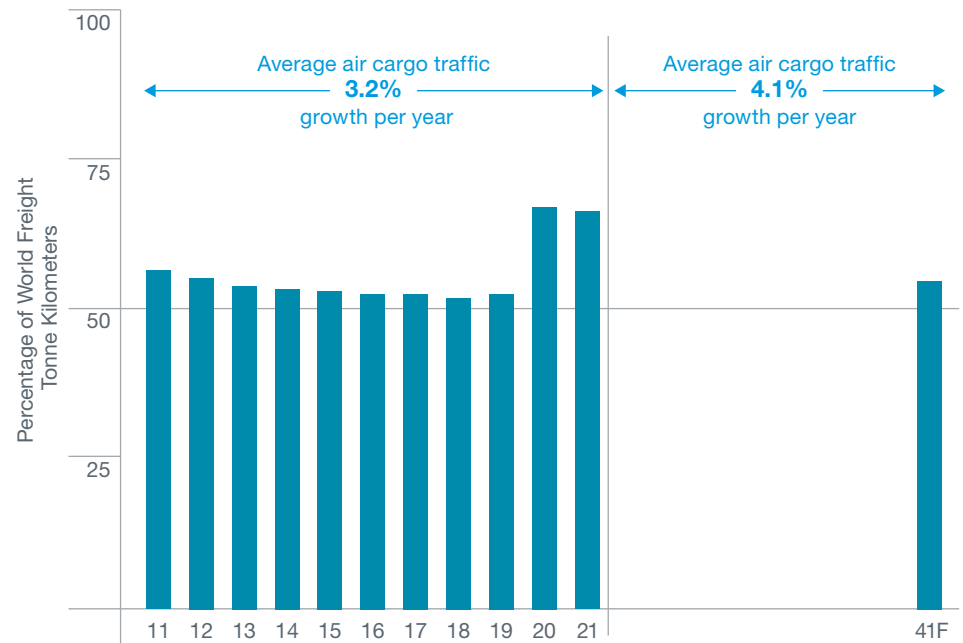
around production schedules as shippers try to use freighters during shipping time between factories as “warehouses in transit.” Few twin-aisle passenger airline schedules are timed to meet the needs of those industrial shippers.

- Freighters offer greater speed to market for high-value, time-sensitive products such as capital equipment, electronics, pharmaceuticals, fashion goods, and perishable commodities.
- The lower holds of passenger airplanes are severely limited for transporting hazardous materials and project cargo (a group of shipments moving as one aggregated consignment).

Nearly 90% of all air cargo revenue is generated by airlines that operate freighters. By augmenting airline cargo operations, freighters help airlines compete more effectively.

Passenger airplane operations that were suspended when the pandemic began in 2020 have yet to recover to normal levels. This has underscored the importance of freighters, which have seen an almost 25% rise in utilization to compensate for the loss of lower-hold capacity in twin-aisle passenger airplanes.

Freighters Will Continue to Carry Over 50% of World Air Cargo Traffic



Sources: IATA, ICAO, and Boeing

Freighter Types

This freighter fleet forecast categorizes airplanes by capacity measured in tonnes.

Standard body freighters offer less than 45 tonnes of carrying capacity. With the same fuselage cross sections as single-aisle airplanes, standard-body freighters are supplied to the industry almost exclusively through the conversion channel. The uptake of factory-built small freighters has been modest and is not expected to increase.

Medium widebody freighters have capacities of 40 to 80 tonnes. In cross section, these are twin-aisle airplanes.

They are supplied through both conversion and factory production, with the product mix influenced by operator requirements as well as feedstock availability.

Large freighters provide more than 80 tonnes of capacity. Although large freighters historically came from both conversion and factory production channels, we believe that future demand will favor factory production. In a segment where utilization rates often match those of passenger widebodies, carriers value the efficiency and unit cost advantages of new, factory-built products.

Freighter Fleet Size Categories

Standard Body <45 tonnes	Medium Widebody 40–80 tonnes	Large Widebody >80 tonnes
Boeing 727	Boeing 767	Boeing 747
Boeing 737	Boeing DC-10	Boeing 777
Boeing 757	Airbus A300/A310	Boeing MD-11
Boeing MD-80	Airbus A330	Airbus A350
Boeing DC-9	Ilyushin Il-76TD	Antonov An-124
Airbus A320 Series		Ilyushin Il-96T

*Note: Production and conversion (SF) models assumed for each type unless otherwise specified
Source: OAG/Innovata by Cirium August 2022*



Replacement and Growth

Our freighter fleet forecast points to 3,610 airplanes in service by 2041, an increase of 80% against the in-service 2019 fleet of 2,010.

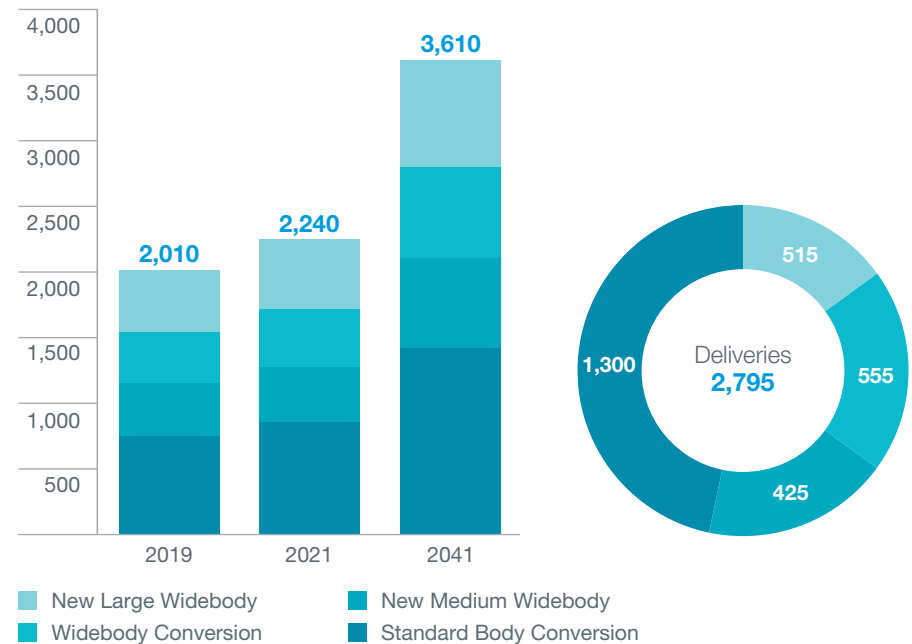
Pre-pandemic, the 2019 world freighter fleet consisted of 2,010 jet airplanes. By the end of 2021, the fleet had grown to 2,250 freighters. At the same time, freighter utilization operated at approximately 125% of normal levels. The return of parked airplanes to the fleet, combined with higher-than-normal operations levels, has added much-needed capacity, and will fulfill replacement demands throughout the forecast period.

Over the next 20 years, the freighter fleet will grow from pre-pandemic levels by 80%, which represents 3% average annual fleet growth. We forecast approximately 2,800 production-plus conversion deliveries, with approximately half of them replacing

retiring airplanes, and the remainder expanding the fleet to meet projected traffic growth. Roughly two thirds of all deliveries will be freighter conversions of passenger airplanes, about 70% of which will be standard body aircraft. Reflecting the higher traffic growth outlook, as well as higher replacement needs, this year's forecast is up nearly 7% over last year, with increases across all segments.

In the standard body segment, the fleet is projected to grow by 90% over 2021 levels, as viable feedstock becomes more available and e-commerce network growth boosts demand. The segment will continue to see conversions to meet growth and replacement demand, with a projected 1,300 conversions. On the replacement side, more efficient airplanes will increase sustainability—and further boost capacity, as today's conversions are larger than many of the airplanes being replaced.

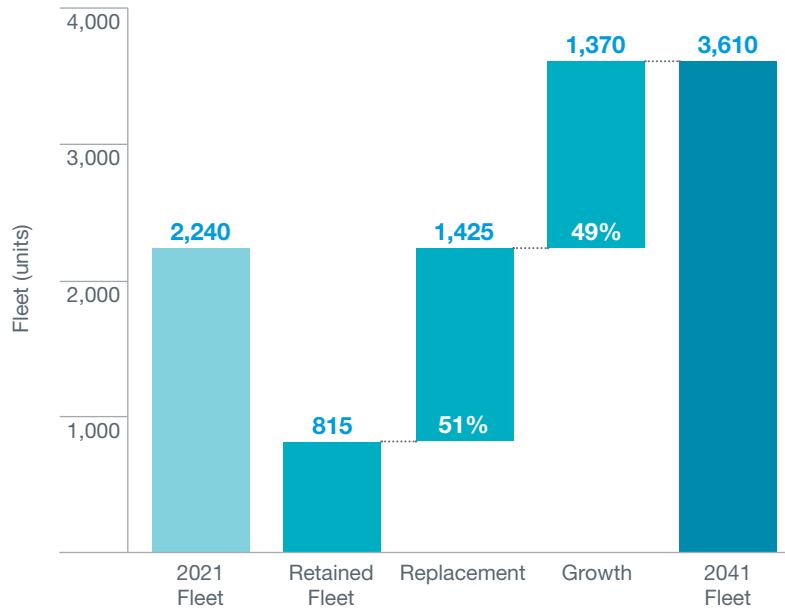
Freighter Fleet to Grow by Nearly 1,400 Aircraft by 2041



Source: Boeing Market Analysis CMO 2022 – Forecast period 2022–2041

Freighter Fleet Forecast

Freighter Deliveries to Boost Fleet Efficiency, Support Demand Growth



Source: Boeing Market Analysis CMO 2022 – Forecast period 2022–2041

In the widebody segment, the fleet is forecast to grow by nearly 75%. Both conversions and production deliveries are higher than last year. Expanding express networks will drive growth in the medium segment. And, in the large widebody freighter category, just over half of the 660 airplanes flying at the end of 2021 are nearing retirement age. As a result, projected new widebody demand of 515 units will account for both replacements and future growth. New demand for widebodies will remain robust, as their advantages in unit cost, utilization, and range make them vital to operators for long-haul, general air cargo service.

Cargo Specialists and General-Market Operators

Cargo specialists operate only freighters. They may, or may not, contract with passenger airlines for the use of lower-hold capacity. Such players are strong competitors in market niches with specialized requirements such as oversized or cold-chain cargo.

General-market operators are often combination carriers, flying both passengers and cargo. They use lower holds on passenger flights to feed freighter flights. Historically, the passenger lower-hold cargo load factor has been about half the cargo load factor of dedicated freighter operations. The fact that passenger airlines that operate freighters achieve much better lower-hold load factors than those that carry cargo, but do not operate freighters, demonstrates the critical role freighters play in creating effective cargo networks.

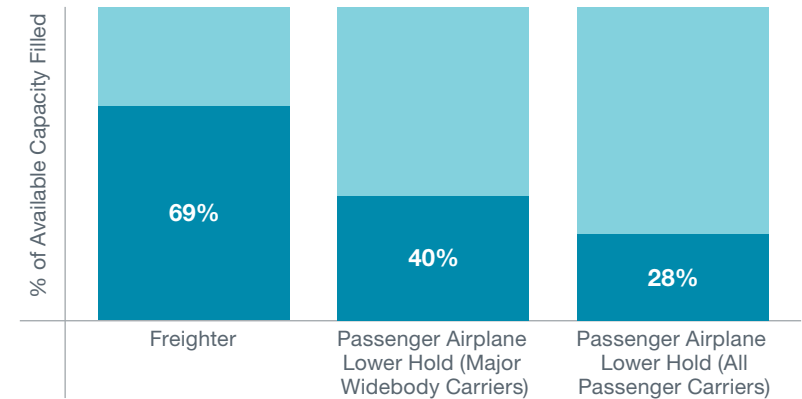
Freighter Fleet Forecast

Both operator types tend to use their freighters in similar ways. They fly relatively short stages, loading and offloading cargo at points along a general route in a pattern known as “load building.” Sixth-freedom cargo hubs are another feature of these networks, given that the bilateral agreements covering cargo carriage tend to be more liberal than those covering passenger travel.

Cargo specialists and general-market operators have high utilization rates and are successful at building loads that fully utilize an aircraft’s structural and volumetric capabilities. Because these airlines emphasize unit costs over acquisition costs, they prefer large, capable, factory-built freighters.

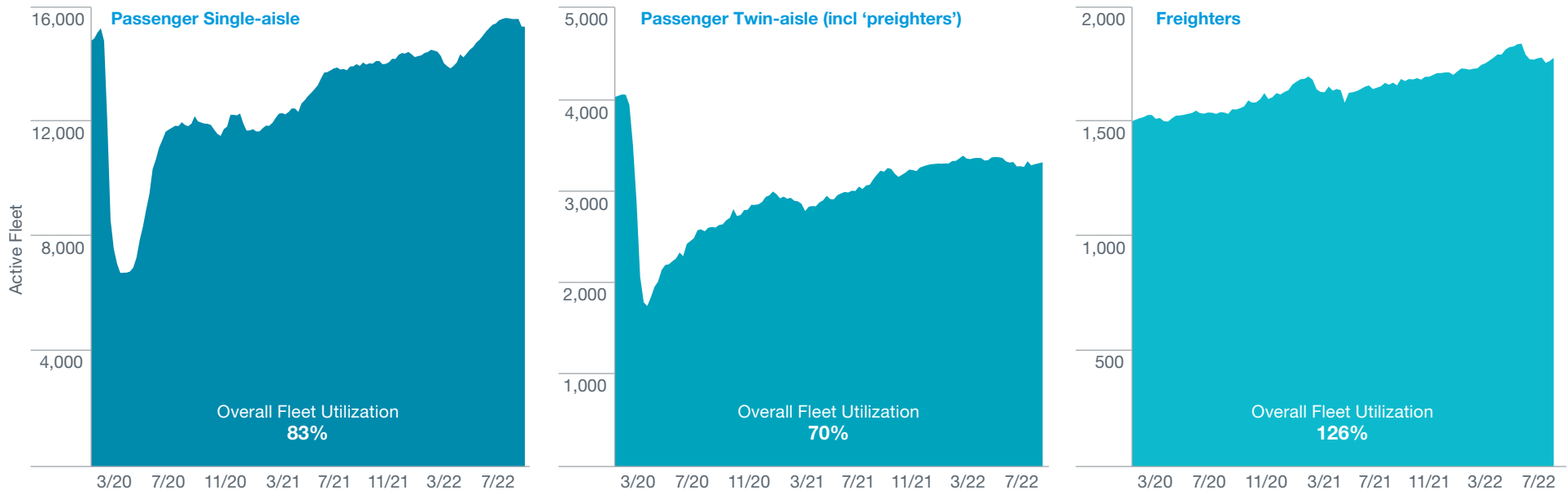
Freighter Cargo Load Factors Double That of Passenger Lower Holds

2021 Cargo Load Factors by Segment



Sources: IATA, ICAO, Boeing

Freighter Fleet and Utilization Jump to Fill Void Left by Reduced Passenger Services



Sources: FlightRadar24 for jets only, BR&T Europe, Boeing, Data through Week 38 (9/11–9/17), normalized with 2019 schedule and FR24 operations

Express Carriers

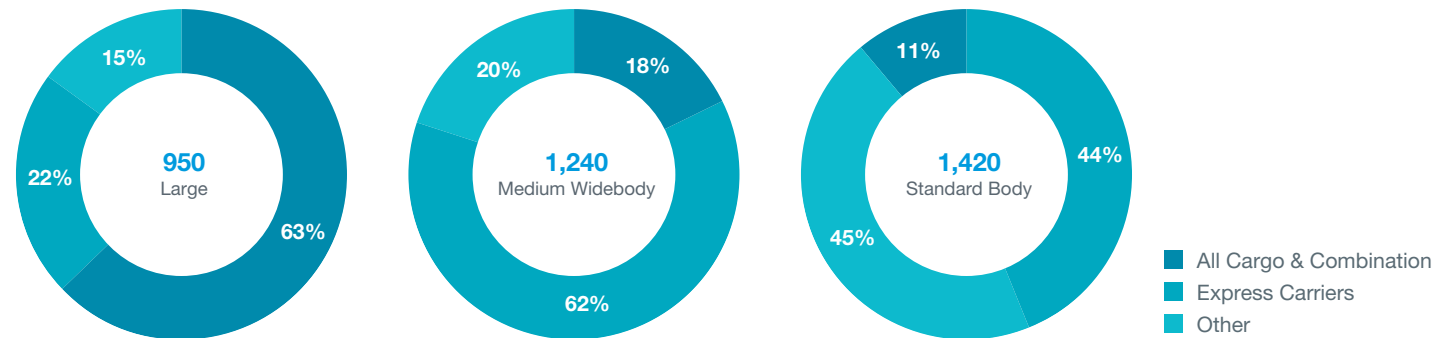
Express carriers have a distinct business model. They move large numbers of smaller shipments, and use other modes of transport to reach the final recipients. For these carriers, the average cargo density (weight per unit volume) is less than that of general freight operators. The time-definite services they provide offer higher yields. Utilization rates (in flight hours per day) can be very low without impacting profitability. Networks tend to be hub-and-spoke, with flights arriving at hubs by night and departing quickly to facilitate morning deliveries. Much of this flying is domestic, or within defined trading blocs, rather than on long-haul international routes.

Because payload density and airplane utilization are lower than those of general freight operators, express operators tend to balance unit cost against acquisition cost and the need to cover network routes with daily or better frequencies. These airlines fly

a mix of small to large freighters, and source airplanes opportunistically from conversion suppliers or airframe manufacturers. Because of their unique focus on the balance of capability, acquisition cost, and unit cost, express carriers use medium freighters to a greater extent than other cargo airlines. Express carriers also acquire large numbers of standard body freighters through the conversion channel, to support lower-volume nodes in their networks.

Large Freighters Serve General Carriers; Medium Widebodies Handle Express

Freighter Fleet by 2041
3,610 Freighter Aircraft



Emerging Markets and Startups

Emerging-market cargo airlines and startups share several attributes:

- They often serve markets with small cargo volumes.
- Their networks are still in the early stages of development, with limited opportunities for load building and sixth-freedom operations.
- They are more sensitive to acquisition costs than operating costs.

Because of their small cargo volumes and sensitivity to acquisition cost, startups and emerging market operators gravitate toward standard body freighters, which cost much less to purchase than other types of freighters. Similarly, these airlines favor converted airplanes, given the limited options and higher costs of purpose-built freighters.

While there is a niche for the conversion of airplane types that have not proved popular in passenger operations, more conversions are based on widely used types. One

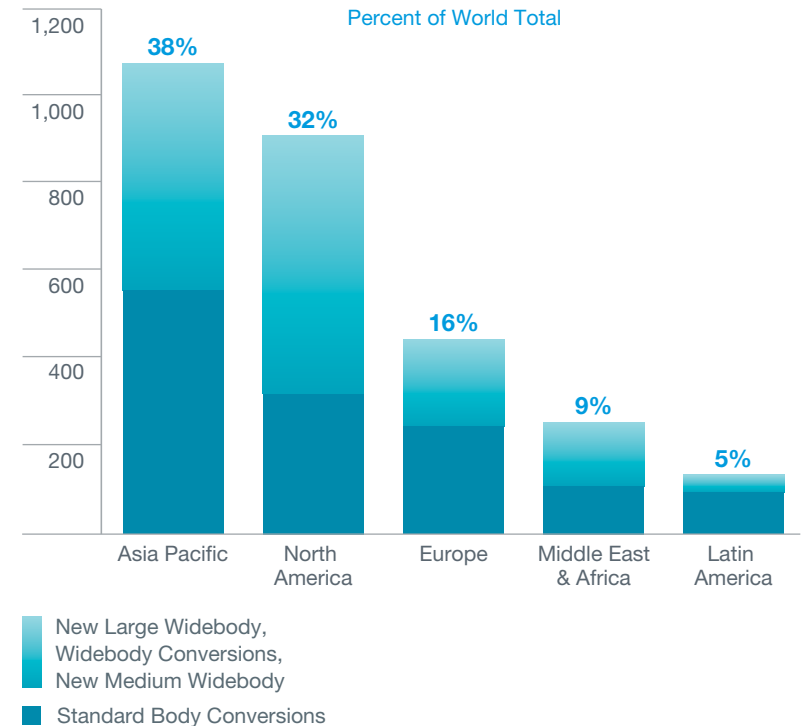
consideration is feedstock: Popular passenger airplanes become readily available for conversion as passenger airlines release them, and there are simply more of them in the fleet. But feedstock availability is not the only determinant. Other factors, such as required structural modifications or technical issues, may limit an airplane type's passenger-to-freighter conversion viability.

Regional Outlook

Regionally, the Asia-Pacific market forecast holds the highest traffic growth, as carriers continue to build out their express networks and supply chain support needs. For the region as a whole, the total freighter fleet is forecast to become roughly the same size as the North American fleet by the end of the forecast period. This will represent growth of over three times the pre-pandemic fleet. In contrast, the more mature North American fleet is projected to grow by one third, but it will need roughly as many deliveries as Asia-Pacific to efficiently and sustainably replace the existing fleet.

Asia Pacific Region to Lead Freighter Deliveries

New and Converted Airplanes
2022–2041



Source: Boeing Market Analysis CMO 2022 – Forecast period 2022–2041

Forecast Methodology



Every two years, Boeing publishes the World Air Cargo Forecast, a comprehensive overview of the air cargo industry. This year's forecast summarizes the world's air trade markets, identifies major trends by region, and projects the performance and development of both global markets and the world's freighter fleet. Our process considers key global economic indicators that impact air cargo, consults a wide range of industry data sources, and employs a variety of analytical methods. Among our resources are econometric modeling, judgmental evaluation trend analysis techniques, and the Boeing Freighter Fleet Forecast.

Econometric Modeling

Econometric modeling is most useful for medium- and long-range forecasts in regional markets. It helps us determine the importance of underlying economic factors such as GDP, industrial production, and world trade, and links our forecast to future expectations of those factors.

Judgmental Evaluation

Judgmental evaluation often accounts for expected changes in non-econometric growth factors. Air-service agreements, trade quotas,

restrictions on airport night operations, evolving supply chains, shifting consumer behaviors, and changes in trade patterns all could influence an airline's strategic plan. As a result, our market and flow forecasts incorporate anticipated increases in capacity, route restructuring, and market programs.

Trend Analysis

Trend analysis enables us to evaluate changes in economic and market factors that can be extrapolated into the future. This approach is useful in evaluating marketplace changes that can be attributed to the combined effects of a number of factors. By surveying large datasets, we achieve meaningful sample sizes and broad-based results.

Freighter Fleet Forecast

Rather than simply extending current trends, our Freighter Fleet Forecast allows for changes in industrial structure. It begins with air cargo traffic data, sorted by main-deck and lower-hold services, domiciles and airline groups, and equipment types. We check the results for balance in terms of traffic flow, operator domicile, equipment type, airline market share, manufacturer capacity, and conversion capacity. Our inputs include the

Boeing-developed Airline Cargo Traffic Database, up-to-date business intelligence, and the strategic directions of industry players.

Sourcing

Data represented as historical in this document were compiled from many sources, including (but not limited to) the Airports Authority of India, Airports Council International, the Association of Asia Pacific Airlines, the Boeing Foreign Trade Database, Cargo Facts Consulting, Cirium Diio Mi, the Civil Aviation Administration (China), Clarkson Research Services Ltd., the Directorate General of Civil Aviation (India), Drewry Maritime Research, Eurostat, the Federal Agency for Air Transport (Russia), the International Air Transport Association, the International Civil Aviation Organization, Oxford Economics, S&P Global, the Transport Clearing House (Russia), the U.N. Council on Trade and Development, the U.S. Department of Commerce, and the U.S. Department of Transportation.

The World Air Cargo Forecast is integrated with Boeing's Commercial Market Outlook. Find out more at [Boeing – CMO](#).

ACMI: A package lease that includes an airframe, crew, maintenance, and insurance, but excludes fuel. See *Wet lease*.

Air freight: Goods, other than mail, shipped by air.

ATK: Available tonne-kilometer. A metric of freight capacity; the weight that can be carried, multiplied by the distance flown.

Cargo: For the purposes of this document, freight, express, or airmail.

Chartered operations: The business of reserving aircraft for private transport of goods or passengers.

Combination carrier: A scheduled and chartered commercial operator that carries both passengers and cargo on revenue flights. Most utilize passenger airplanes with lower-hold cargo, but many operate freighters as well as passenger aircraft.

Daily shipment count: A metric of revenue cargo traffic volume. Less commonly used than measurements such as weight (e.g., tonnes) or weight combined with distance (e.g., revenue tonne-kilometers), except by integrators who specialize in smaller parcels.

Express shipment: Guaranteed or time-definite cargo service. In addition to airport-to-airport transport, express shippers also offer services such as door-to-door pickup and delivery. See *Integrator*.

Feedstock: Retired passenger aircraft available for conversion to freighters.

Freight forwarder: A business that manages the shipment of goods from originators to end markets, consumers, or distribution locations.

FTK: Freight tonne-kilometer. A metric of freight traffic; one tonne of cargo carried one kilometer.

Integrator: A full-service cargo company that offers pickup, airport-to-airport transport, delivery, and ancillary support services. Often referred to as an express shipment provider. See *Express shipment*.

Load factor: A metric of available seating or cargo capacity that is filled by passengers or freight; measured in revenue tonne-kilometers divided by available tonne-kilometers.

Outsize cargo: Freight too large for standard pallets. Often carried by nose-door equipped 747s or purpose-built Russian freighters.

Payload: The portion of an aircraft load that provides revenue.

RTK: Revenue tonne-kilometer. A metric of performance; one tonne of revenue freight carried one kilometer. Usually interchangeable with freight tonne-kilometer, but may include passenger weight for total revenue. See *FTK*.

Scheduled operations: Aircraft flights operated on predetermined schedules.

Sea-air market: A mode of transportation that balances time and cost by leveraging the lower cost of maritime shipping (between seaports) and the speed of air shipping (over landmasses).

Sixth freedom of the air: The right to transport, via a carrier's home state, passengers or cargo between two other states.

Truck flight: Cargo covered by an air waybill but carried on the ground by dedicated surface vehicles. Carriage between origin and destination may be exclusively by surface or may feed into airport-to-airport or airport-to surface transportation. Often considered a feature of road feeder service.

Utilization: The number of hours effectively flown by an airplane in a given unit of time.

Wet lease: An arrangement that covers all facets of operating an airplane on a carrier's behalf, including airframe, crew, and most (if not all) airplane-related expenses. See *ACMI*.

Yield: A metric of airline charges, expressed in units of aggregated weight and distance (e.g., revenue per tonne-kilometer). Inclusion of surcharges (such as security or fuel) varies by the carrier reporting.

World Airline by Region of Domicile

RTKs in millions

Africa	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021*
Scheduled freight	2,603	2,508	2,910	2,970	3,206	3,211	3,279	4,105	4,079	4,474	3,926	5,034
Charter freight	339	346	180	98	125	142	139	179	194	210	743	841
Mail	56	57	62	79	77	75	111	135	116	117	81	108
Total**	2,998	2,911	3,152	3,148	3,407	3,427	3,529	4,419	4,390	4,801	4,751	5,983

Asia Pacific	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021*
Scheduled freight	78,142	75,363	70,640	70,573	75,878	77,995	79,577	86,731	88,907	83,957	67,687	79,746
Charter freight	843	627	1,094	778	571	831	850	337	248	986	4,914	6,535
Mail	1,887	2,014	2,015	2,236	2,527	2,640	2,710	2,974	2,841	2,609	1,527	1,463
Total**	80,872	78,003	73,749	73,587	78,976	81,466	83,136	90,042	91,997	87,552	74,128	87,744

Europe	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021*
Scheduled freight	37,792	39,717	41,263	41,638	42,495	41,314	43,379	48,127	49,935	50,439	42,132	51,423
Charter freight	4,101	4,077	1,361	1,373	1,268	1,308	1,572	2,203	3,700	2,578	3,070	3,758
Mail	946	1,016	1,054	1,146	1,187	1,266	1,225	1,289	1,233	1,236	759	612
Total**	42,838	44,810	43,678	44,157	44,950	43,888	46,176	51,619	54,868	54,253	45,961	55,793

Latin America	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021*
Scheduled freight	4,393	4,481	4,742	5,877	5,974	5,934	5,992	6,306	6,734	6,797	6,309	6,796
Charter freight	230	134	80	118	77	49	73	134	408	506	118	110
Mail	55	93	132	130	147	123	70	67	228	244	154	227
Total**	4,677	4,708	4,954	6,125	6,198	6,106	6,134	6,507	7,371	7,547	6,581	7,133

Middle East	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021*
Scheduled freight	16,226	17,656	20,165	22,683	24,986	28,133	30,324	33,081	34,000	32,173	29,232	35,231
Charter freight	146	148	148	217	150	174	207	90	84	303	293	228
Mail	266	161	132	158	224	331	440	557	725	700	383	359
Total**	16,638	17,966	20,445	23,058	25,361	28,637	30,970	33,728	34,808	33,177	29,908	35,818

North America	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021*
Scheduled freight	41,300	41,443	40,977	40,679	42,897	43,475	44,672	48,167	49,773	49,729	44,130	49,973
Charter freight	7,036	7,722	8,803	8,518	7,894	8,108	8,582	10,001	12,232	12,704	21,205	25,379
Mail	1,911	1,907	1,827	1,855	1,686	1,757	1,645	1,879	1,871	1,894	1,578	1,656
Total**	50,248	51,072	51,608	51,053	52,478	53,339	54,899	60,047	63,876	64,327	66,913	77,007

*Preliminary; complete for airline reports received as of October 2022.

**RTK totals may not sum equally because of numerical rounding.

World Airline by Region of Domicile

RTKs in millions

Russia and Central Asia	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021*
Scheduled freight	4,144	4,687	5,148	5,281	5,713	6,540	8,106	9,919	9,718	9,256	8,649	10,178
Charter freight	1,603	1,396	1,014	780	769	776	758	1,008	1,252	993	2,833	4,081
Mail	86	98	113	119	131	131	143	203	208	240	25	28
Total**	5,833	6,181	6,275	6,181	6,613	7,447	9,007	11,131	11,178	10,490	11,507	14,287

South Asia	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021*
Scheduled freight	2,565	2,563	2,389	2,516	2,543	2,466	2,385	3,001	3,310	2,539	1,224	1,437
Charter freight	0	0	0	0	0	0	0	0	0	0	107	207
Mail	86	61	55	52	63	68	66	87	82	71	28	25
Total**	2,650	2,624	2,444	2,568	2,606	2,534	2,451	3,088	3,392	2,610	1,359	1,669

World	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021*
Scheduled freight	187,166	188,418	188,234	192,218	203,691	209,067	217,713	239,437	246,457	239,363	203,289	239,818
Charter freight	14,298	14,450	12,681	11,883	10,854	11,387	12,180	13,952	18,118	18,281	33,282	41,139
Mail	5,292	5,408	5,390	5,776	6,043	6,389	6,410	7,191	7,305	7,111	4,536	4,477
Total**	206,756	208,276	206,306	209,877	220,589	226,844	236,303	260,580	271,880	264,755	241,107	285,434

*Preliminary; complete for airline reports received as of October 2022.

**RTK totals may not sum equally because of numerical rounding.



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