



# World Air Cargo Forecast

**2016-2017**



## Foreword

The Boeing Company issues the biennial World Air Cargo Forecast (WACF) to provide a comprehensive, up-to-date overview of the air cargo industry. The forecast summarizes the world's major air trade markets, identifies major trends, and presents forecasts for the future performance and development of markets, as well as for the world freighter airplane fleet.

World air cargo traffic has struggled to maintain sustained growth since the end of the global economic downturn in 2008 and 2009. After bouncing back in 2010, then stagnating in 2011 and 2012, air cargo began growing again in mid-2013, even growing 4.8% in 2014. Growth accelerated in the first quarter of 2015, but, then traffic volumes remained flat for the rest of that year. Air cargo traffic gathered some strength after a weak first quarter of 2016, and is projected to return to trend growth by 2018. Despite the weak growth of the past decade, more than one-half of air cargo is still carried on freighters.

Data represented as historical in this document were compiled from many sources including, but not limited to: Air Cargo Management Group (ACMG), Airports Council International (ACI), the Airlines for America (A4A), the Association of Asia-Pacific Airlines (AAPA), the Association of European Airlines (AEA), Boeing Foreign Trade Database (TRADE), Eurostat, IHS Economics, IHS World Trade Service, the United Nations Council on Trade and Development (UNCTAD), Clarkson Research Services Limited (CRSL), Drewry Maritime Research, the International Air Transport Association (IATA), International Civil Aviation Organization (ICAO), Civil Aviation Administration of China (CAAC), China Statistical Bulletin, Statistics Canada, and the US Department of Transportation (DOT) Form 41. Our databases are revised regularly as individual sources revise their respective publications.

This document would not be possible without the efforts of several contributors. The Boeing World Air Cargo Forecast 2016/2017 production team included Boeing Commercial Airplanes Design Services, the Writing and Editing Services team, and our colleagues in the Market Analysis Group. Special thanks are due to David Franson for his diligent efforts on the world freighter fleet forecast. Many thanks are due to Naohiro Horie for his efforts to build our Airline Cargo Traffic Database (ACTD), a database on air cargo traffic that includes nearly 760 airlines, as well his research and authoring of the Intra-Europe and South Asia chapters. Matthew Kosmal researched and authored the Intra-Asia chapter. Heather Mozzoni researched and developed the Latin America–North America chapter. Jayden Lee researched and modelled our Africa chapter. Andrea Johnson researched and analyzed historical airline cargo revenues, as well as assisted in the development of the CIS and Europe–Latin America chapters.

**The next update to the WACF will appear fourth quarter 2018.** The authors welcome any questions or comments readers may have. All queries and suggestions should be directed to:

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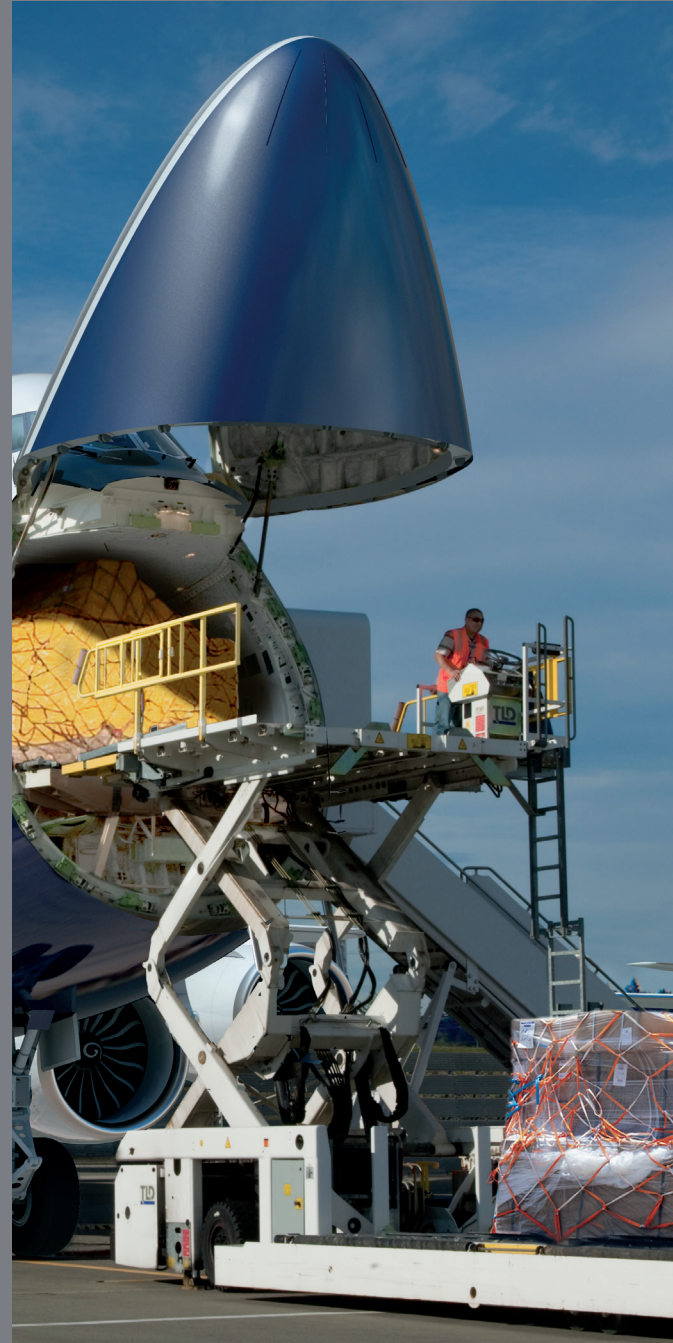
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# Table of Contents

|                                    |    |
|------------------------------------|----|
| Executive Summary                  | 1  |
| World Overview                     | 5  |
| North America                      | 17 |
| Latin America and North America    | 21 |
| Latin America and Europe           | 24 |
| Europe and North America           | 27 |
| Intra-Europe                       | 30 |
| Middle East                        | 33 |
| Africa                             | 36 |
| Asia and North America             | 40 |
| Europe and Asia                    | 43 |
| Intra-Asia                         | 45 |
| South Asia                         | 48 |
| Commonwealth of Independent States | 51 |
| Domestic China                     | 55 |
| World Freighter Fleet              | 58 |
| Glossary                           | 63 |
| Appendix                           | 66 |



# Executive Summary



## After rebounding in 2014, air cargo traffic slowed in 2015

Demand for air cargo transport grew a modest 1.9 percent in 2015 after 4.8 percent growth in 2014. The growth in 2015 marked the third consecutive year of positive growth following a 1.2 percent decline in 2012. Air cargo growth in 2016 has been below long-term trend, reflecting continued sluggish world economic and trade growth. Air cargo traffic will gradually accelerate in 2016 and 2017, and will return to long-term trend growth in 2018. World air cargo traffic is forecast to grow an average 4.2 percent per year over the next 20 years to reach a total of more than twice the number of RTKs logged in 2015. The number of airplanes in the freighter fleet will increase by 70 percent by the end of the forecast period.

Air trade on the lanes that connect Asia with Europe and Asia with North America grew well above long-term trend, but most of that growth occurred during Q1 2015 as automobile component recalls boosted freighter volumes, and the threat of U.S. west coast port labor action diverted containership flows into airplanes. Weak growth on trade lanes tied to Latin America was attributable to the faltering Brazilian economy and the fall in commodity prices in late 2014 and early 2015. The same fall in commodity prices, particularly oil, adversely affected African air cargo. Domestic and some intra-regional markets were surprisingly resilient in the face of weak economic and trade growth, particularly the intra-Europe and domestic China markets. World air cargo traffic began to grow again in Q2 2016, albeit weakly, with year-to-date expansion of just 1.4 percent as of August 2016. The industry is expected to achieve approximately 2 to 3 percent growth for the full year 2016.

## Weak economic activity and slack trade curbed air cargo traffic growth

Since 2011, two principal causes have been responsible for weak air cargo growth: an underperforming world economy and lackluster growth in trade.

In 2015, worldwide GDP growth continued a pattern of below-trend growth that has been evident since the global economic downturn. Several emerging markets continue to face a challenging economic environment amid low oil prices, and the advanced economies are enduring a relatively slow economic recovery. Yet, despite current challenges and many political risks, fundamental growth factors, such as productivity increases via technology diffusion, economic reform, and available production capacity, remain in place. GDP growth is expected to grow above trend by the end of the decade and average 2.9 percent over the next two decades.

In a struggling world economy, global goods trade has experienced slower than expected growth as well. Trade

## 2015 air cargo growth by major market

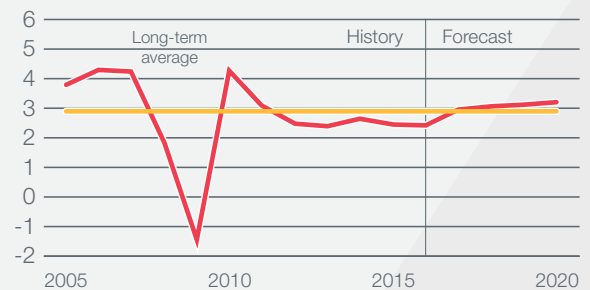
| Region                      | Percentage |
|-----------------------------|------------|
| World                       | 1.9        |
| Asia-North America          | 6.5        |
| Europe-Asia                 | 6.5        |
| Intra-Asia                  | 1.3        |
| Europe-North America        | 1.8        |
| Intra-North America         | 2.5        |
| Domestic China              | 4.9        |
| Latin America-Europe        | 0.6        |
| Latin America-North America | -4.1       |
| Africa-Europe               | 0.6        |
| South Asia-Europe           | -4.1       |
| Middle East-Europe          | 11.1       |
| Intra-Europe                | 5.0        |

## GDP growth below trend, but forecast to recover

Source:  
IHS Economics,  
September 2016

### Real GDP growth

year over year, by percentage



● Real GDP growth

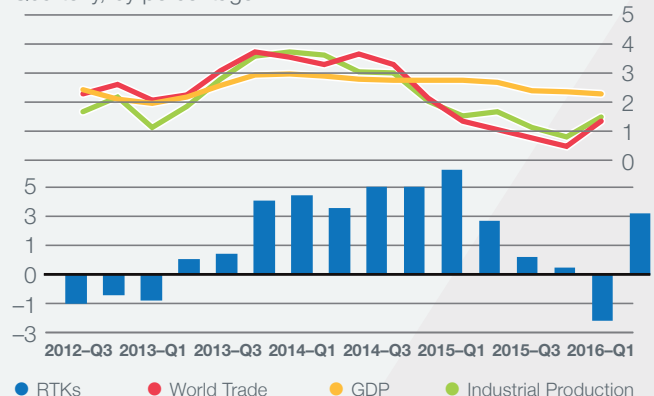
● Trend growth

## Air cargo closely linked to global trade and industrial production

Source:  
Oxford Economics, IATA,  
ATA, BCA

### Change over prior year

Quarterly, by percentage



● RTKs

● World Trade

● GDP

● Industrial Production

growth averaged just 2.9 percent between 2012 and 2015, a sluggishness not seen since the 1980s. Generally, cyclical, and thus largely temporary, effects explain most of the weakness. In particular, weak industrial production is key to understanding the most recent weakness in global goods trade. A lack of solid global industrial growth means fewer goods are traded, both in final and intermediate form.

Beyond the current trade slowdown, some longer lasting factors, such as a shift towards services trade, the shortening of supply chains, and the threat of protectionism, pose risks to global trade.

### E-commerce has potential to bolster air cargo growth

Global e-commerce is projected to more than double over the next five years, growing from \$1.7 trillion to \$3.6 trillion by 2020. E-commerce sales in the US have grown 15 percent per year on average over the last 15 years, and stood at \$342 billion in 2015.

The Asia-Pacific region is the fastest growing e-commerce trading bloc, with China at the forefront. China is the world's largest e-commerce market with \$590 billion of goods sold in 2015. Online retail sales in China were half that of the US in 2010 and by 2013 surpassed the US, growing at an average of 56 percent per year. Domestic China parcel shipments and revenue grew 55 percent and 39 percent per year respectively from 2010 to 2015. It is forecast that by 2020, China's e-commerce market will be bigger than the combined existing markets of the US, Britain, Japan, Germany, and France.

The emergence of FedEx in 1971 ignited the express revolution, providing nationwide door-to-door delivery of documents and small packages within one to two days. The explosive growth of e-commerce demand for business to consumer (B2C) deliveries of retail purchases may usher in the next freight transportation revolution. The major express carriers, including UPS, DHL, and FedEx, as well as newer entrants such as SF Express in China, all serve e-commerce flows. Amazon has begun building its own logistics network to augment capacity provided by others.

### World air cargo traffic growth detail

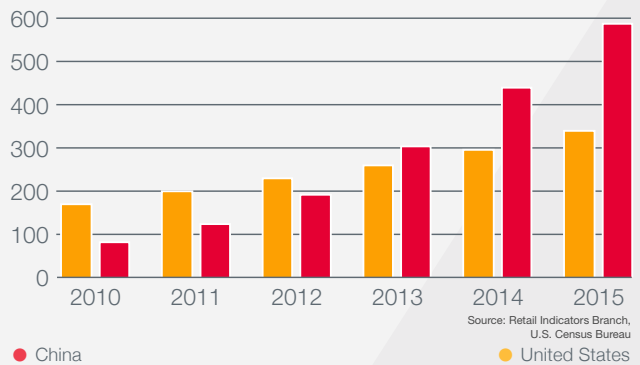
#### Markets connected to Asia will lead growth.

Over the next 20 years, world air cargo traffic will grow 4.2 percent per year. Air freight, including express traffic, will average 4.3 percent annual growth, measured in RTK. Airmail traffic will grow more slowly, averaging 1.7 percent annual growth through 2035. Overall, world air cargo traffic will increase from 223 billion RTKs in 2015 to 509 billion RTKs in 2035.

Asia will continue to lead the world in average annual air cargo growth, with domestic China and intra-Asia markets expanding 6.2 percent and 5.5 percent per

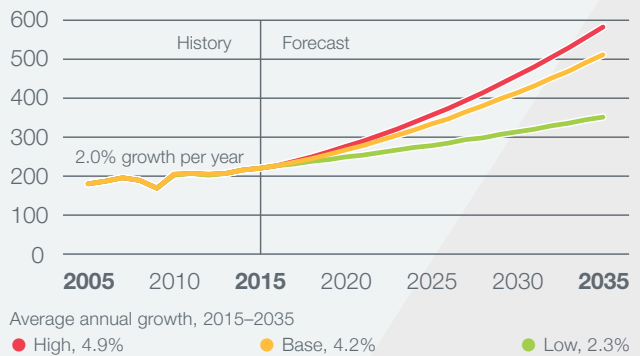
### China online retail sales have overtaken the U.S. to become world's largest national e-commerce market

e-commerce sales  
USD billions



### World air cargo traffic will more than double over the next 20 years

RTKs  
in billions



### Historical and forecast air cargo growth rates

| Region                      | History<br>2005–2015<br>by percentage | Forecast<br>2015–2035<br>by percentage |
|-----------------------------|---------------------------------------|--|
| World                       | 2.0                                   | 4.2                                    |
| Asia–North America          | 1.9                                   | 4.6                                    |
| Europe–Asia                 | 2.1                                   | 4.6                                    |
| Intra-Asia                  | 2.1                                   | 5.5                                    |
| Europe–North America        | 0.4                                   | 2.4                                    |
| Intra–North America         | –1.4                                  | 2.2                                    |
| Domestic China              | 7.6                                   | 6.2                                    |
| Latin America–Europe        | 3.3                                   | 3.8                                    |
| Latin America–North America | 0.7                                   | 4.3                                    |
| Africa–Europe               | 0.4                                   | 3.8                                    |
| South Asia–Europe           | 3.5                                   | 5.0                                    |
| Middle East–Europe          | 3.6                                   | 3.9                                    |
| Intra–Europe                | 1.6                                   | 2.2                                    |

year, respectively. The Asia–North America and Europe–Asia markets will grow slightly faster than the world average growth rate. Latin America markets with North America and with Europe will grow at approximately the world average growth rate, as will Middle East markets with Europe. Established markets expand slower than developing markets, so North America and Europe air cargo growth rates will be below the world average rate.

### Importance of freighters in the air cargo industry

Airlines that operate freighters generate 90 percent of total air cargo industry revenues.

Air cargo accounts for less than 1 percent of world trade tonnage, yet 35 percent of world trade value is carried by air. A high value industry, air cargo is critical for serving markets that demand speed and reliability for the transport of goods. The highest value commodities, including computing equipment, machinery and electrical equipment, account for the highest share of airborne trade tonnage versus their share of containership tonnage. Over the next 15 years as the world GDP grows and the world population demands higher value goods, the value per ton of total traded goods across the world is forecast to rise. As the average value per ton of traded goods rises, a larger percentage of trade will become addressable by air cargo. Air cargo will remain a preferred solution for transporting higher value goods that are time sensitive and economically perishable.

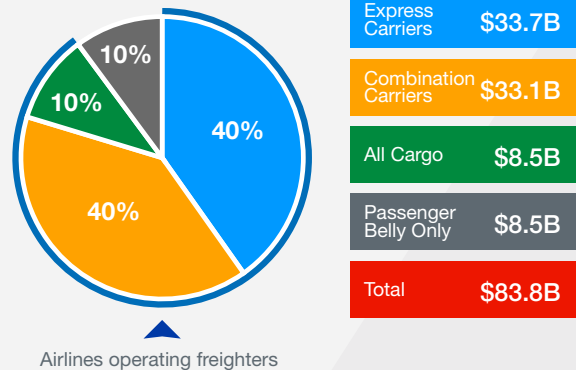
Freighters are particularly well suited for transporting high-value goods because they provide highly controlled transport, direct routing, reliability, and unique capacity considerations (volume, weight, hazmat, and dimensional). The distinct advantages of freighter aircraft allow operators to offer a higher value of service. Airlines operating freighters generate 90 percent of air cargo industry revenues, a percentage that has remained relatively constant over time. Additionally, more than half of air cargo traffic is carried on freighters. The introduction of new widebody passenger airplanes with larger lower-hold capacity (sometimes referred to as “passenger belly” capacity) has not significantly reduced the freighter share over time. While lower-hold capacity increased 27 percent from 2010 to 2015, the number of large freighters in service increased by 8 percent over this same period. The share of cargo carried on freighters remains high in markets across the world, especially in the world’s two largest trade routes, Asia–North America and Asia–Europe, where more than 70 percent of total air cargo traffic is carried by freighter airplanes.

Express carriers continue to operate substantial freighter fleets, flying 40 percent of the widebody freighters and generating 40 percent of air cargo industry revenues in 2015. These operators use freighters as a link in their door-to-door proprietary transportation network—a network that is tailored to the needs of their customers by using unique schedules and specialized airplanes. The business

### Freighters are critical to compete in air cargo markets

Source: Flight Global, U.S. DOT F41, airline reports, and Boeing estimates (2015 data)

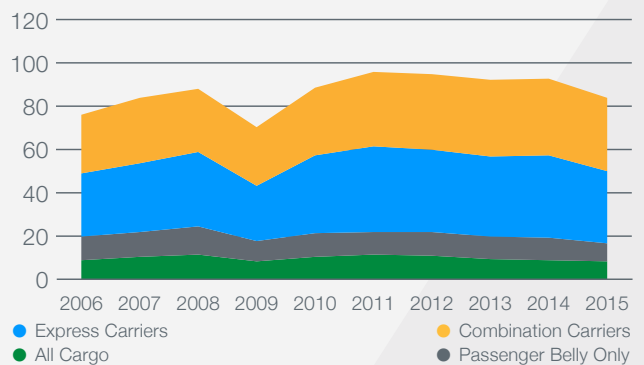
Airlines operating freighters generate 90% of industry revenues



### Express and combination carriers consistently generate the majority of world air cargo revenue

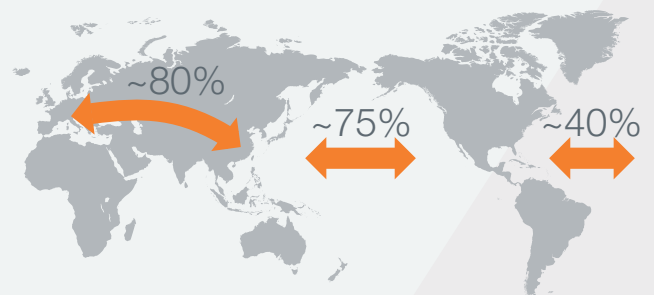
Air cargo revenue, USD billions

Source: Flight Global, U.S. DOT F41, airline reports, and Boeing estimates



### Freighters play a key role in major east-west markets

Total air cargo traffic carried by freighters by percentage



model of express carriers cannot be replicated using only lower-hold capacity.

The majority of the remaining large freighter capacity is deployed for air freight. Air freight demand is highly concentrated—85 percent of scheduled large freighter flights operate out of the top 50 cargo airports, including airports across North America, Asia, and Europe. Over the past five years, only 30 percent of the lower-hold capacity of new widebody aircraft has served primary cargo airport routes. This underscores the need for freighters to serve these markets and airports. Range restrictions on fully loaded passenger flights and the limited number of passenger frequencies serving high-demand cargo markets make freighters essential where both long-range and frequent service are required.

Freighters will continue to carry more than half of the world’s air cargo for the next 20 years, as the majority of players in the industry continue to rely on and augment their cargo operations by flying freighters.

### Freighter fleet outlook

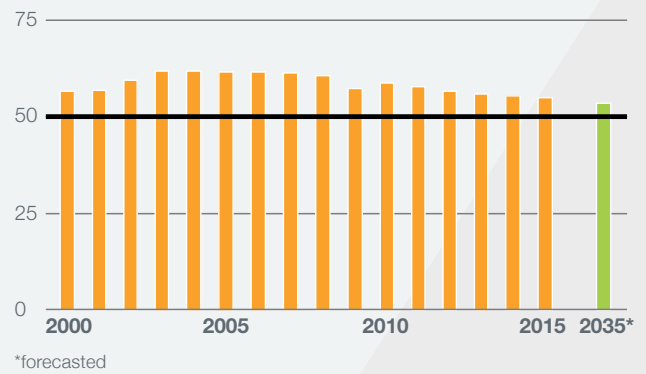
The number of airplanes in the worldwide freighter fleet will increase by 70 percent during the next 20 years as air cargo traffic more than doubles.

With air cargo traffic more than doubling by 2035, the world freighter fleet will grow by more than 70 percent, from the current 1,770 airplanes to 3,010 airplanes by the end of the forecast period. Growing demand for regional express services in fast developing economies will increase the standard-body share of the freighter fleet from 36 percent today to 42 percent in 20 years. All new deliveries of standard-body freighters will be converted passenger airplanes. The growth of the standard-body share of the fleet will result in a decline in the large- and medium-widebody shares of the total fleet over the forecast period, from 31 and 33 percent to 28 and 31 percent, respectively.

Of the 2,370 projected freighter deliveries, 1,130 will replace retiring airplanes, with the remainder expanding the fleet to meet projected traffic growth. More than 60 percent of deliveries will be freighter conversions, nearly 88 percent of which will be standard-body passenger airplanes. A projected 930 new production freighters, valued at \$270 billion, will be delivered, of which almost 60 percent will be in the large-freighter category.

### Freighters carry more than half of air cargo traffic

World RTKs carried on freighters by percentage



### Freighter fleet will increase by more than half - Standard-body freighters gain share





## Air cargo traffic slowed again in 2015

World air cargo traffic has struggled to maintain sustained growth since the end of the global economic downturn. The traffic fall caused by the 2009/2009 recession showed a strong recovery in 2010 followed by a period of slow growth. After stagnating in 2011 and 2012, air cargo began growing again in mid-2013, even growing 4.8 percent in 2014. Growth accelerated in Q1 2015 as the industry benefited from the threat of US west coast port labor action and automobile component recalls, but, thereafter, traffic volumes remained flat for the rest of that year.

World air cargo traffic has averaged 5.0 percent growth per year since 1985. The growth rate actually exceeded 6 percent in several years throughout the 1980s, 1990s, and early 2000s. Growth slowed as fuel prices began to rise in 2005 as some shippers began to divert freight to less expensive modes of transport.

The global economic downturn, the worst economic contraction since the Great Depression, dragged down all modes of freight transport. World air cargo traffic dropped 12.9 percent over 2008 and 2009, and then jumped 19.2 percent in 2010 as businesses globally replenished their inventories. The global economic recovery was slower than expected and air cargo growth from 2011 through 2013 was flat. Year 2014 was marked by strong growth, and the expansion continued in the first quarter of 2015, but softened for the rest of that year. As a result of all these events, world air cargo traffic grew only 2.0 percent annually between 2005 and 2015, and only 1.5 percent per year since the end of 2007. Containership traffic also slowed during this timeframe.

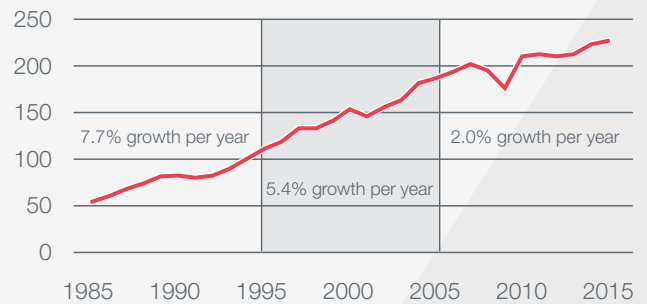
World air cargo traffic declined in the first quarter of 2016 compared with an unusually strong Q1 2015 when the threat of US west coast port labor action temporarily diverted some cargo from maritime to air. World air cargo traffic began to grow again in Q2 2016, showing an expansion of just 1.4 percent as of August 2016. The industry is anticipated to achieve approximately 2 to 3 percent growth for the full year of 2016. Air cargo traffic will gradually accelerate in 2017 and will return to long-term trend growth in 2018 as the world economy and trade recover to long-term trend growth rates.

## Air cargo growth varies by airline domicile and service type

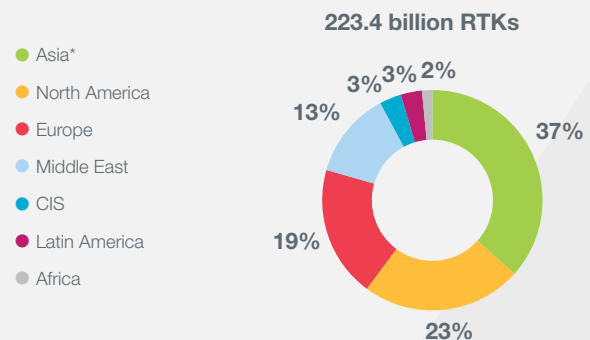
The market share of airlines based in Asia and the Middle East has grown relative to that of airlines based in other regions. Scheduled air freight continues to claim the largest share of the air cargo market relative to charter and mail services.

World air cargo traffic has slowed over the past decade

RTKs  
in billions



2015 air cargo market share by airline domicile



\* Includes South Asia and Oceania.



Regional air cargo market shares have changed significantly during the past two decades. Airlines based in Asia Pacific, Europe, and North America have accounted for nearly 80 percent of the world's air cargo traffic for that entire 20-year period. Airlines based in North America led all other world regions with a 35 percent share of the world's air cargo traffic in 1992. This changed during the 1990s and early 2000s as the share flown by airlines based in Asia Pacific, including those based in China, grew from 28 percent in 1992 to 40 percent in 2010, reflecting the rapid expansion of Asian export markets.

Since 2000, however, carriers based in the Middle East have leveraged their geographic position at the crossroads between Africa, Asia, and Europe. Middle East carriers have quickly expanded their widebody passenger and freighter fleets, allowing them to increase their share of world air cargo traffic from 5 percent in 2005 to 13 percent in 2015. In 2015, airlines based in Asia Pacific, Europe, North America, and the Middle East accounted for 92 percent of all world air cargo traffic.

World air cargo is composed of three main service sectors: scheduled freight, charter freight, and mail. Scheduled freight is the largest component, accounting for 90 percent of all world air cargo traffic. Scheduled freight includes general and express (sometimes referred to as "integrator") freight. The scheduled freight market share has remained more or less stable since 1992. Most shippers use regularly scheduled cargo services whenever possible because it is generally the least expensive way to ship by air. Scheduled freight grew 1.4 percent in 2015 compared with 2014.

Charter air freight (sometimes referred to as nonscheduled freight) accounts for 6 percent of world air cargo traffic. The charter sector captures traffic with urgent or special handling requirements. Nearly all urgent or special handling cargo is carried on freighter airplanes, rather than in the lower hold of passenger airplanes. The charter freight market share generally rises during periods of strong world air cargo growth and, conversely, falls during times of slow or negative traffic growth. The charter segment grew 7.1 percent in 2015.

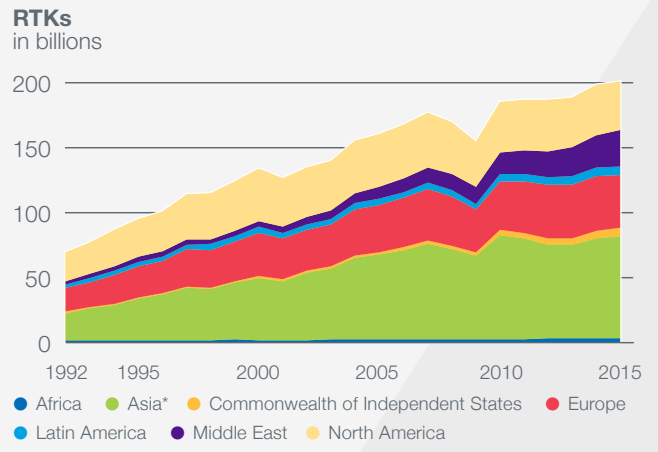
## Large widebody freighter ACMI services

Large widebody ACMI providers have seen volatile traffic volumes since the global economic downturn, but they still comprise 5 percent of world air cargo traffic.

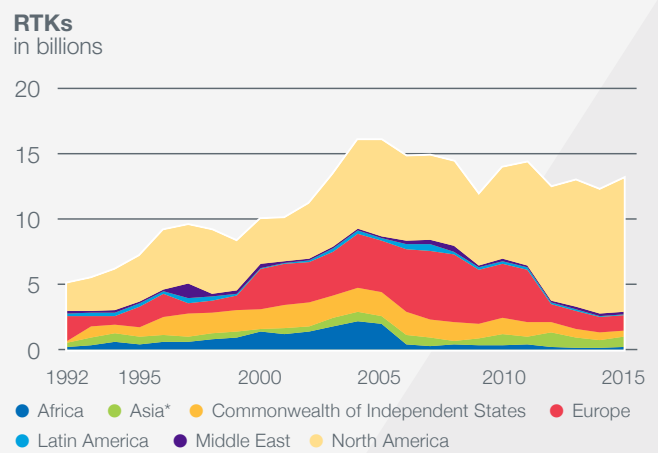
Aircraft, crew, maintenance, and insurance (ACMI) providers, also referred to as "wet lease providers," offer cargo operators the flexibility to obtain lift on a trial basis, augment existing markets, and provide service in markets that are highly seasonal—all with no capital equipment investment required.

Large freighters in long-haul markets account for the most significant segment of the air cargo ACMI business. The

### Asia-domicile airlines are the leading providers for scheduled air freight



### North America-domicile airlines are the leading providers for charter air freight



ACMI business is sensitive to changes in the overall air cargo business, but it has been an established industry subsector since the early 1990s. ACMI providers have maintained approximately a 4 percent to 6 percent share of total world air cargo traffic for the past decade.

Since 1990, ACMI large freighter traffic has grown an average 10.9 percent per year. However, annual growth has been uneven since 2000. ACMI traffic contracted 8.9 percent in 2008 and another 4.6 percent in 2009 as the effects of the global economic downturn took their toll. As demand for dedicated freighter airplane capacity rebounded in late 2009 and 2010, ACMI operators benefited significantly from the limited availability of long-haul freighters in operator fleets.

Since 2010, world air cargo traffic has struggled to show consistent signs of growth. ACMI traffic reflected this situation by declining at 7.7 percent and 13.8 percent in 2013 and 2014, respectively. The tumultuous post-recession drop in demand forced several ACMI providers to exit the business in the 2012–2014 timeframe, but airlines with newer large freighters were generally able to survive this period of slow traffic growth. In 2015, traffic on large widebody ACMI providers surged 12.4 percent as established providers added new capacity and new entrants filled the space vacated by those carriers which left this industry sub-sector.

## International express

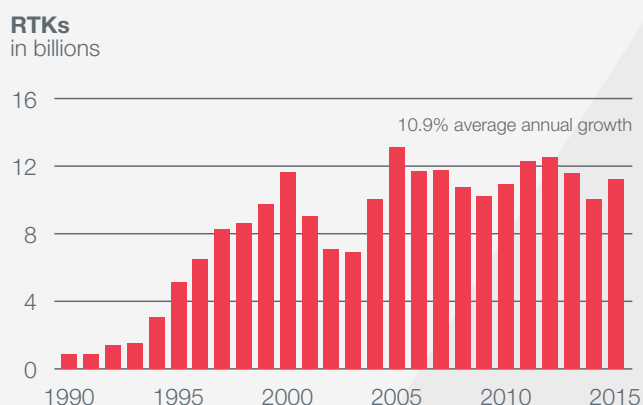
International express traffic continued to grow faster than the average world air cargo growth rate, expanding 7.2 percent in 2014 and 3.6 percent in 2015.

The distinction between express and general air cargo continues to blur. Traditional providers are expanding their time-definite offerings, and express carriers, freight airlines, and postal authorities are consolidating. The acquisition of TNT by FedEx will further change the competitive environment of the express industry. Ultimately, the air cargo customer benefits from increased service options and lower prices as market pressure brings competing service offerings into the market.

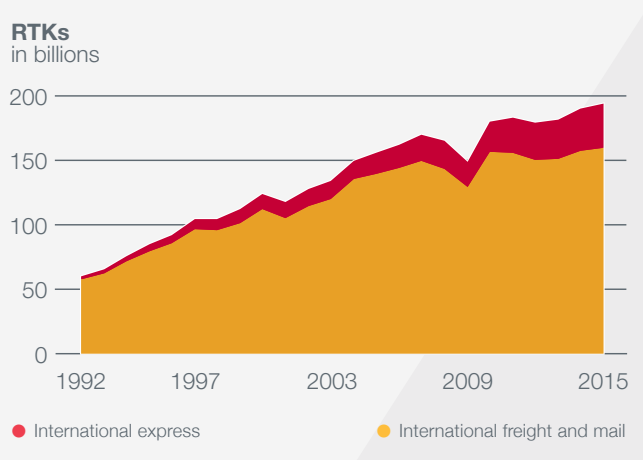
International express traffic grew rapidly from 1992–2008 following the growth pattern of the US express industry in the 1970s and 1980s. International express traffic growth was interrupted in 2009, however, falling 12.6 percent as a result of the global economic downturn. Since 2010, the international express market has continued to grow at a healthy average rate of 7.4 percent per year through 2015.

Higher-than-average annual growth boosted the express share of international air cargo traffic from 4.1 percent in 1992 to 13.4 percent in 2008. The international express share remained at about 13 percent of total international traffic during the global economic downturn from 2008 through 2010. Share growth resumed in 2011 and market share reached 17.0 percent in 2013. Market share in

About 5% of world air cargo traffic is transported by ACMI providers



International express market share reached 17.6% in 2015



2014 and 2015 remained stable at 17.3 percent and 17.6 percent, respectively.

The average international express shipment size has also continued to grow. Average shipment weight is estimated to have increased from 2.7 kilograms in 1992 to 6.8 kilograms in 2015, which indicates a decrease in the shipment of documents and a shift into general air cargo and packages. Expansion of e-commerce beyond domestic markets, moving cross-border to international markets, will enhance the future growth of the international express sector.

## World air cargo and maritime traffic

Air cargo represents a small portion of world trade by weight, but more than one-third by value.

Air cargo is only one part of the global goods distribution network. Shippers demand that shipments arrive at their destination on time, undamaged, and at a reasonable price, regardless of transportation mode. Different transport modes—road, rail, maritime, and air—can often move the same commodities. But shippers usually have only two choices for intercontinental freight: air and maritime. Maritime transport offers the primary benefit of low cost; air transport offers the benefits of speed and reliability.

The maritime transportation industry is much larger than the air cargo industry as measured in tonnes of goods transported. In 2015, the world maritime industry carried an estimated total of 10.8 billion tonnes compared to 52.2 million tonnes for the air cargo industry. By weight, more than 84 percent of world maritime trade is in raw materials and other bulk items. Most of these commodities, such as oil, metal ores, and grains, are low value, not time-sensitive, and shipped by sea in specialized tankers or bulk carriers. This maritime trade cannot be directly compared to the high-value, dry commodities associated with transport by air. It is estimated that less than 1 percent of world trade tonnage is carried by air cargo, but because of the high value of these goods, they represent about 35 percent of the value of goods shipped globally.

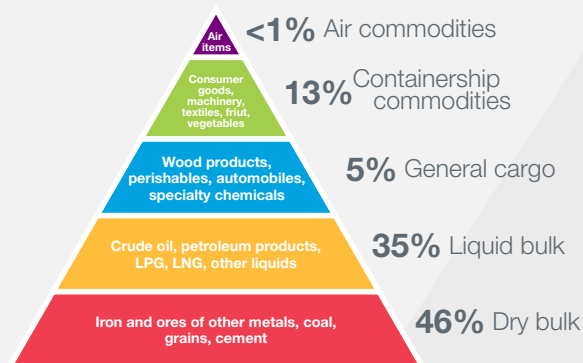
## Containership transportation

Containership traffic growth has been driven by diversion of traffic from other maritime segments rather than air cargo.

Containerized cargo is the sector of maritime freight transport that most closely corresponds to air cargo. While the majority of maritime cargo is bulk and low value, containerships also carry some of the same commodities as air cargo and offer a low-cost transportation alternative for goods that do not require the speed and reliability of air shipment.

### World trade is focused on bulk commodities

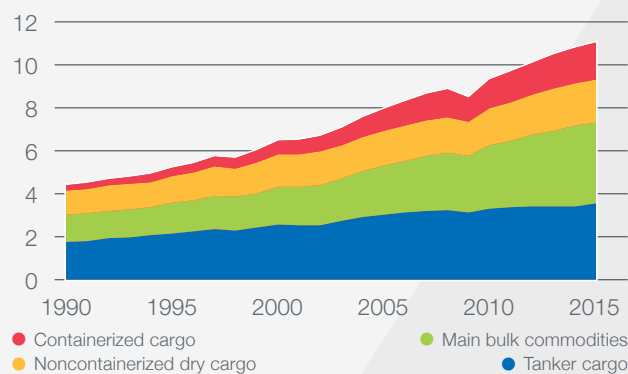
#### Commodity group classifications



### Container trade has grown by taking market share from other maritime segments

Source: UNCTAD, Fearnleys, CRSL

#### Tonnes loaded in billions



Since the late 1980s, globalization and regional specialization of industry, particularly in Asia, have driven rapid growth in containership freight flows. Worldwide containership tonnage in 2015 was estimated to be 1.7 billion tonnes. Containership tonnage has historically grown faster than other maritime transportation segments. From 1990 to 2015, the containerized cargo tonnage growth rate has averaged 7.8 percent annually while tanker cargo, main bulk commodities, and non-containerized dry cargo have averaged 2.5 percent, 5.0 percent, and 2.4 percent, respectively.

Many of the world's trade markets have a directional imbalance: finished products fill available capacity in one direction, but there are fewer goods to be shipped back. This results in an abundance of return capacity available at a low price. Taking advantage of this situation, many bulk and low-cost goods are being shipped by containerized cargo instead of bulk maritime transport. For example, in 2015, waste paper, wood products, scrap plastics, motor vehicle components, and pork were the top commodities by weight shipped on containerships from the European Union (EU) to China. Containership growth has been primarily in transporting these types of products, instead of the high-value goods shipped by air.

## Comparison of containership and air cargo transport traffic

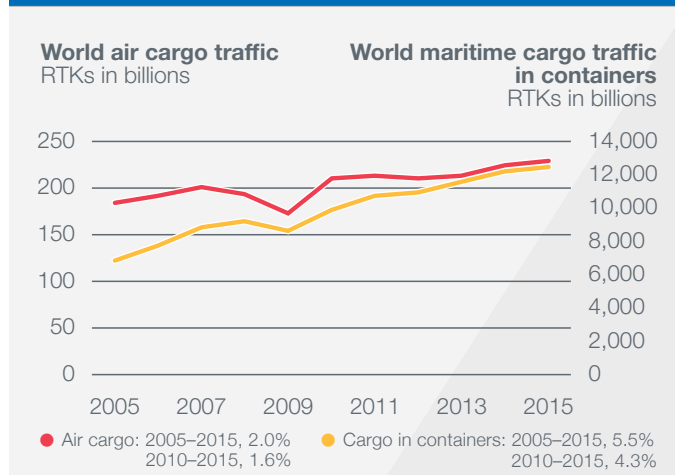
Containership traffic growth has slowed markedly since the global economic downturn.

Containership cargo traffic was estimated at 12.2 trillion RTKs in 2015, while world air cargo traffic was 223 billion RTKs. The largest containership markets, as measured in RTKs, mirror the largest air cargo markets. In 2015, Europe–Asia was the largest containership market, with 3.1 trillion RTKs, followed by Asia–North America with 2.1 trillion RTKs and Europe–North America with 0.4 trillion RTKs.

Until the global economic downturn of 2009, the containership industry grew steadily every year since its inception. Between 1980 and 2008, containership tonnage averaged 9.5 percent growth per year. Both air and maritime cargo had major declines during the global economic downturn. World air cargo traffic fell by 9.6 percent and containership freight dropped 10.8 percent in 2009. Despite measures taken in response to the deteriorating economic conditions and the drop in demand for shipping services, the container shipping industry suffered from overcapacity, low yields, and financial losses.

In 2010, it appeared that the global economy was recovering. Containership capacity was restored and new ships were ordered. When the economic recovery slowed in 2011, the containership industry had severe excess capacity, as the demand for shipping services declined. As a result, containership yields dropped to very low levels to maintain loads.

Both air cargo and containership transport have slowed over the past decade



Just as air cargo traffic growth fell in the period following the global economic downturn, growth of containership traffic also dropped. Weak merchandise trade affected both air cargo and containership trade similarly in 2015: air cargo expanded 1.9 percent, and containership traffic grew only slightly faster at 2.2 percent. Average annual containership growth in RTKs fell to 4.3 percent from 2010 to 2015 after growing at an average annual rate of 6.6 percent the previous five years. While containership growth continues to exceed air cargo growth, it is through the transportation of bulk goods that are not shipped by air.

## Forecasting methods

Several approaches can be used to handle the range and complexity of forecasting challenges. Each approach is carefully matched to the specific issue and application.

Four approaches—econometric modeling, judgmental evaluation, trend analysis, and potential analysis—provide useful forecasts. Econometric modeling helps determine the overall importance of underlying economic factors (e.g., GDP) and provides forecasts that are linked to expectations of those factors. This method is useful for medium- and long-range forecasts in regional markets.

The demand for air freight depends on the economic activity in the importing region or country, conditioned by transportation costs, exchange rates, and relative prices. Econometric modeling may be used to predict demand, assuming that adequate capacity will be in place to meet the demand and that factors not included in the model will exert the same influence as in the past. Judgmental modifications often account for expected changes in non-econometric growth factors. For example, estimating the effect of air service agreements, trade quotas, restrictions on airport night operations, and changes in trade patterns could be vital to an airline's strategic plan. Incorporation of anticipated increases in capacity, route restructuring, and market programs can contribute to more reasonable forecasts.

Often, a simple trend analysis is used to evaluate changes in economic factors. This approach is useful in evaluating general changes in the marketplace that can be attributed to the combined effects of a number of factors. Such trends can be extrapolated into the future. However, extrapolation from a small base with large growth can produce unrealistic results.

Potential analysis is particularly useful for forecasting markets in their early stages of development. For example, commodities transported by air tend to be valued at more than \$16 per kilogram. It is therefore possible to project a potential air cargo market based on the percentage of traded goods (regardless of transport mode) that are valued above \$16 per kilogram.



## Market environment

Although economic activity is the primary influence on world air cargo development, other factors must be considered.

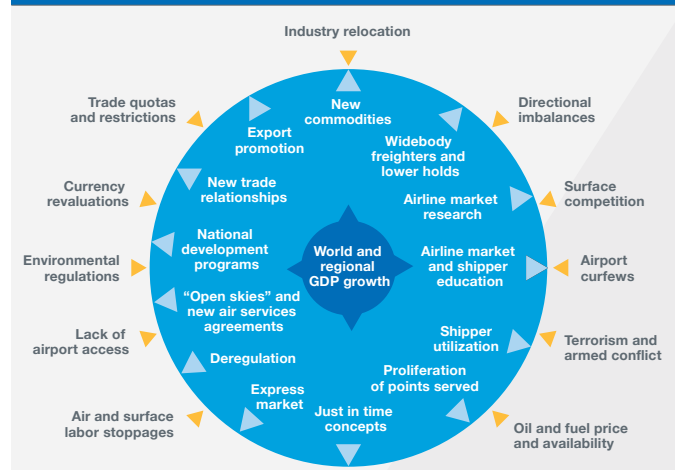
Factors beyond the control of airlines include inventory management techniques, modal competition, environmental regulations, globalization, market liberalization, national development programs, and the introduction of new air-eligible commodities. All these factors play significant roles in air cargo growth. Constraints to economic growth, primarily those originating outside the airline industry, can hinder air transport industry growth dramatically. A variety of air transport industry constituencies and policymakers address these interrelated growth issues.

Fuel price volatility has been a persistent problem for air cargo. Triggered by increasing production and decreasing global demand, the price of crude oil and jet fuel fell dramatically starting in mid-2014. Currently, fuel prices are less than half of the mid-June 2014 price. Lower fuel prices have decreased operating costs and have allowed airline profitability despite low yields. The drop in fuel price appears to have bottomed at about \$30 per barrel in early 2016 and has risen since then. Crude oil prices are forecast to exhibit volatility but increase slowly to \$60 to \$80 per barrel in the next few years.

Competition with other modes of transportation can present a challenge for air cargo. Changes in the container shipping industry have enticed shippers to move their freight away from air cargo. Container shipping pricing is generally 10 to 20 times less expensive than air cargo per unit weight, but transit times are longer and less reliable than air cargo. The goods that are shipped by air are high value, time sensitive, and perishable and require speed and reliability when transported. To continue to compete effectively with container ships, the air cargo industry must ensure that the service benefits of air transportation warrant the price premium charged.

Changes in the behavior of shippers have also affected the air cargo market. Improved telecommunication and information access have had wide-reaching consequences. For example, e-mail and the electronic transmission of documents have reduced the need to ship many types of small parcels and documents that gave express companies their start. In turn, the growth of on-line purchases and the need for quick package delivery has provided another revenue stream for the express companies. Better information and improved supply-chain visibility allow shippers to plan and manage their supply chains with a higher degree of confidence, eroding one of the primary advantages of air cargo. Air cargo has traditionally served as a unique tool that enables shippers to recover from unforeseen events and emergencies. Anecdotal evidence suggests that improved supply-chain visibility has reduced the occurrence of situations that demand the speed and reliability of air transport.

## Forces and constraints for air cargo growth



### Yield trends

Freight yields have declined at an average rate of 2.1 percent per year over the past 20 years.

Since the dawn of the jet age, air cargo yields have been driven lower by productivity gains, technical improvements, and competition between carriers. While declining yields have created pricing pressure on all industry segments, they have also helped stimulate growth for the industry by enabling lower shipping costs for the consumer.

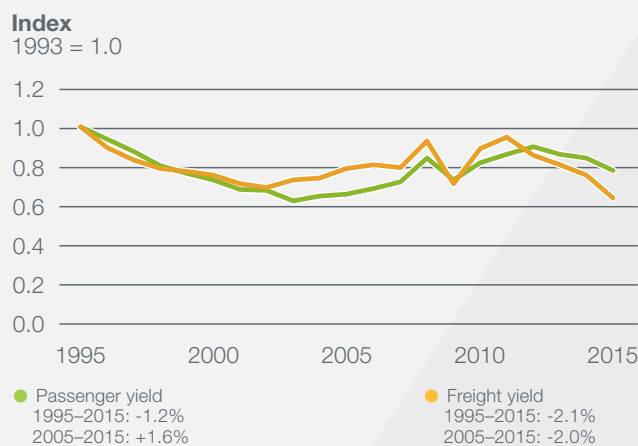
That trend reversed in the last decade, with yields generally increasing on an inflation-adjusted basis. Much of the increase was due to fuel and security surcharges that began to rise in 2003. In 2008, fuel surcharges imposed in response to the fuel crisis helped push yields up 16 percent compared to 2007 yields. Between mid-2003 and mid-2008, spot prices for jet fuel rose almost five-fold. Therefore, with jet fuel representing the largest component of freighter airplanes' cash operating costs, raising prices became a necessity for air cargo operators.

After the cost-driven yield increases of 2003–2008, yields fell again in 2009. The global economic downturn resulted in newfound caution in consumers, and businesses strived to minimize inventory holdings. At the same time, too much capacity remained in the market for too long, leaving operators to suffer from withering price competition.

Growth resumed strongly in 2010, growing 19.2 percent, leading to cargo yields increasing 23.6 percent as demand grew faster than capacity. Unfortunately, this rebound did not last; traffic growth markedly weakened from 2011–2015, growing only 1.7 percent per year. As a result, cargo yield fell approximately 9.0 percent per year over the same time period. In 2015, cargo yields declined a dramatic 14.6 percent, largely as a result of falling fuel surcharges.

Although declining yields help stimulate growth for the industry, the lack of volume growth over the past four years can be attributed to sub-par economic and trade activity. The world economy and trade are projected to improve starting in 2017, and cargo traffic is expected to return to long-term growth, which should alleviate some of the declining yield pressure that airlines currently face.

International air freight yields fell in 2014 and 2015



### World economic and trade growth outlook

The world's economy is forecast to grow at an average annual rate of 2.9 percent.

Global growth in 2015 remained dampened amid volatility in financial markets, commodity prices, and exchange rates. Worldwide GDP growth continued a pattern of below-trend growth evident since the global economic downturn. Advanced economies gradually improved, driven by improving labor markets and solid consumer spending patterns. However, they were unable to further accelerate this pick-up in 2016. Many emerging markets saw economic challenges in an environment characterized by falling commodity prices. Benefitting from low prices, China's growth has remained resilient. China's move from industry to a more service- and consumer-driven economy has accelerated GDP growth—a trend that puts pressure on trade-intensive sectors. Other large emerging markets such as Russia and Brazil are working their way out of deep recession, while India has made some progress unlocking its growth potential via economic reform.

Despite current challenges and many political risks, fundamental growth factors—such as productivity increases caused by technology diffusion, economic reform, and available production capacity—remain in place. GDP growth is expected to grow above trend by the end of the decade and average 2.9 percent over a 20-year time period. The US and Europe will post modest growth rates of 2.3 percent and 1.8 percent, respectively. Emerging markets as a group will see growth of 4.3 percent, led by Asia-Pacific economies (excluding Japan) growing at an average rate of 4.8 percent.

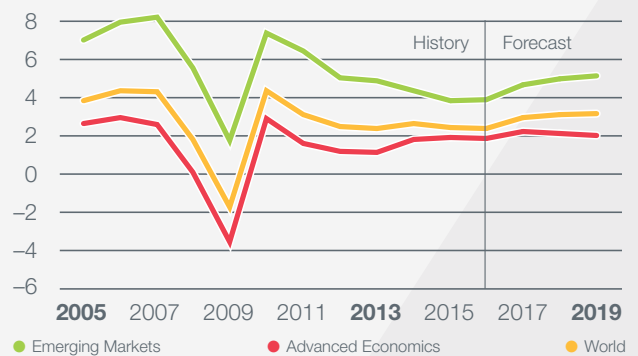
In a struggling world economy, global goods trade experienced slower than expected growth as well. Trade-intensive parts of the economy, such as industrial production, are underperforming, and regional challenges are contributing additional stress. Trade growth averaged just 2.9 percent between 2012 and 2015 – a sluggishness not seen since the 1980s. These underlying factors of global trade impact the outlook of air cargo in the medium and longer term.

Explanations can be grouped broadly into longer-term structural factors and near-term cyclical ones—both of which contribute to the overall picture. But there is one key difference: cyclical effects are temporary and will dissipate over time; structural shifts will have a more lasting impact.

Generally, cyclical, and thus largely temporary, effects seem to have the upper hand. In the early years of the slowdown, the European debt crisis was one main culprit for weak trade growth. Weak growth in Europe exerted a big drag on global trade. Cyclically weak industrial production is key to understanding the most recent weakness in global goods trade. A lack of solid global industrial growth means fewer goods, both final and intermediate, are traded. In its October 2016 World Economic Outlook, the International Monetary Fund (IMF)

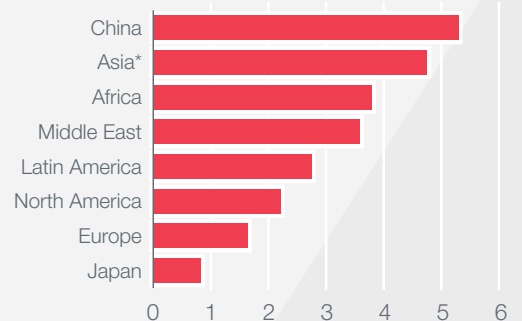
Economic growth set to accelerate through the remainder of the decade

Annual growth in real GDP by percentage



Asian economies lead economic growth over the next 20 years (Source: IHS Economics)

Growth Real GDP by region, CAGR 2015-2035



\*Excludes China and Japan.



identified weakness of trade-intensive investment as contributing up to three quarters of the overall deceleration in global trade since 2012. The World Bank traces recent sluggish investment back to economic challenges in previously fast-growing commodity-exporting countries that are now facing economic challenges after their primary revenue source weakened. In combination with the slowdown in China's industrial sector intensifying in 2015, global trade experienced very little stimulus recently. On the contrary, supply-chain linkages in Asia likely increased the negative impact on trade. Going forward, the importance of cyclical factors implies upside potential for global trade, as these factors diminish over time and overall economic growth picks up. European economic growth looked more solid in 2016, even accounting for the United Kingdom's plan to leave the European Union. Several emerging markets posted encouraging data pointing to adjustment and stabilization. Several forecasting authorities see world merchandise trade returning to growth rates near 4 percent by the end of the decade.

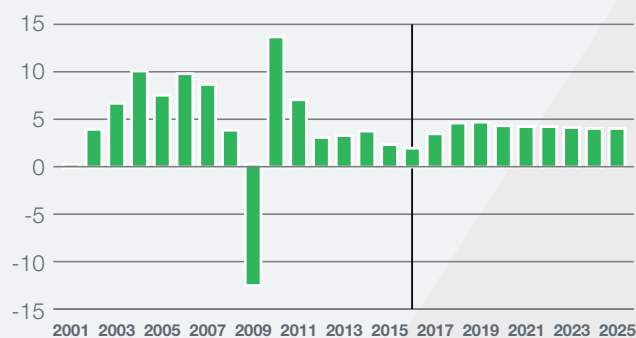
This forecasted merchandise trade growth rate is still well below the extraordinary growth recorded prior to the global economic downturn. Hence, more fundamental factors cannot be completely dismissed. The first one is simply the absence of extraordinary developments, like the end of the Cold War and the integration of China into the world economy, which boosted trade over the past 25 years. Recent protectionist rhetoric in large economies threatens to stall further big achievements in trade liberalization. Longer term, services will make up an ever larger portion of both global consumption and global trade, reducing the growth of traded goods gradually over time. Another potentially more lasting development is that, since the global economic downturn, participation in global value chains is no longer increasing. Some of this participation decline is likely caused by production moving closer to large consumer markets, particularly in China. However, a re-shoring of production in advanced economies is unlikely. Data from the US show sales and employment in foreign affiliates of US multinational companies to have continuously increased from 2009 to 2013, the last available data point; trade between them also grew.

There is little evidence suggesting the end of globalization. Advanced economies can still stave off the recent wave of protectionist sentiment and eventually conclude new large international free trade agreements. Additionally, many emerging markets continue to seek their economic fortunes by opening up to the world and growing their share in world trade. Global goods trade will likely grow around 4 percent per year in the absence of a major crisis. These trends will provide a solid base for air cargo traffic to expand at a rate of 4.2 percent annually through 2035.

## Global trade is overcoming weakness to grow around 4%

Source: IHS World Trade Service

**Growth annually in real merchandise trade**  
by percentage



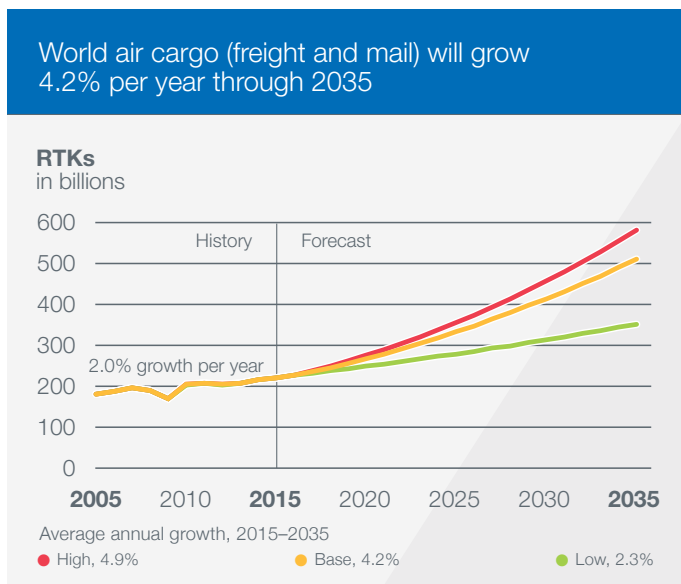
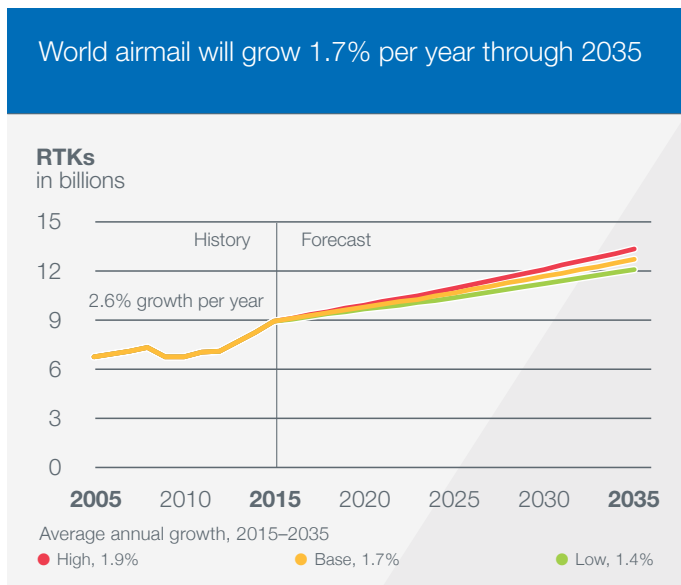
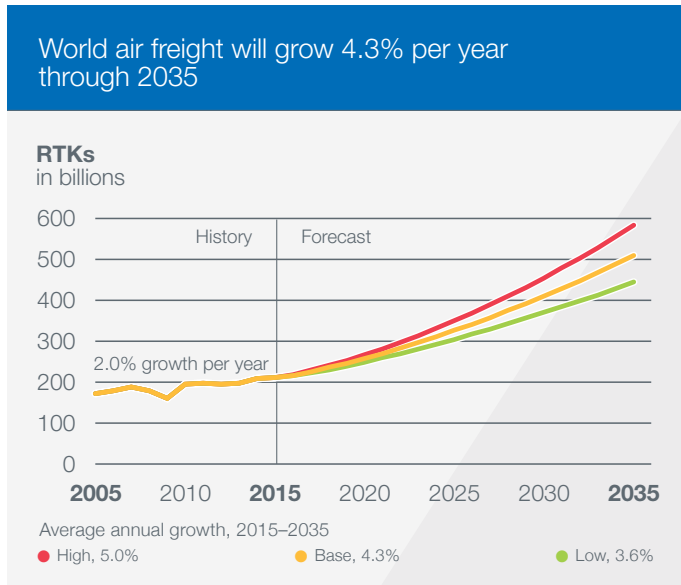
### World air cargo traffic forecast

World air cargo is the sum of freight and mail. World air freight traffic is strongly related to GDP and average yield.

Low, baseline, and high annual growth of 3.6 percent, 4.3 percent, and 5.0 percent, respectively, are forecast for world air freight traffic. High and low scenarios correspond to GDP growth of 0.5 percent above long-term projections and 0.5 percent below, respectively. The baseline growth scenario is based upon an average annual freight yield drop of 2.9 percent per year. Worldwide air freight is expected to more than double over the next 20 years, increasing from 214.4 billion RTKs in 2015 to 496.4 billion RTKs by 2035.

World airmail is forecast to grow at 1.7 percent per year. Risks that could affect future airmail growth include increasing reliance on Internet communication and more stringent security requirements. Conversely, forces that could drive faster airmail growth include the proliferation of national and cross-border e-commerce services, particularly where national postal authorities work closely with e-commerce firms to provide “last-mile” delivery services.

The baseline forecast for total world air cargo predicts that traffic will more than double between 2015 and 2035. Worldwide traffic will grow from 223.4 billion RTKs in 2015 to more than 509 billion RTKs by the end of the forecast period. Sustained economic growth, along with decreasing yields, are the two primary drivers of growth in the air cargo industry.



### Regional air cargo markets

Air cargo markets linked to Asia, especially the Pacific Rim countries, will lead all other international markets in average annual growth between 2015 and 2035.

The 13 major air cargo trade lanes were representative of the events affecting the air cargo industry in 2015. The threat of the US west coast port labor action, which diverted containership freight to air freight, coupled with automobile component recalls boosted air freight volume on the Asia-Europe and Asia-North America trade lanes during 2015. Increasingly affluent consumers in Asia helped drive strong growth in the Europe-to-Asia air trade lane. The weak Brazilian economy and falling commodity prices resulted in weakness in the Latin America air cargo market. Despite the weak world economy and trade, some domestic and intra-regional markets, such as domestic China and Intra-Europe, grew 4.9 percent and 5.0 percent, well above the world average growth of 1.9 percent for 2015.

Intra-Asia traffic is forecast to grow faster than any other international world market, averaging 5.5 percent growth per year. The Asia-North America and Europe-Asia markets will both grow at an average 4.6 percent per year. Domestic China will be the fastest growing contiguous market in the world, averaging 6.2 percent annual growth for the forecast period.

The mature markets of North America and intra-Europe will grow more slowly, both at 2.2 percent per year over the next 20 years. Also projected to lag behind the world average growth rate are the markets of Europe-North America at 2.4 percent, Middle East-Europe at 3.9 percent, and Africa-Europe at 3.8 percent growth.

The South Asia-Europe and Latin America-North America markets are forecast to exceed the world average at 5.0 percent and 4.3 percent per year, respectively. Air cargo growth in the Latin America-Europe and CIS markets is forecast to grow 3.8 percent and 3.0 percent per year, respectively.

Market shares will continue to change as a result of varying regional growth rates. Intra-Asia is currently the fifth largest air cargo market, but because it is forecast to grow 5.5 percent per year over the next 20 years, it will be the third largest air cargo market by 2035. The share of world air cargo traffic associated with Asia, including the domestic markets of China and Japan and all international markets connected to Asia, will increase from 53.8 percent in 2015 to 60.5 percent in 2035.





## Regional Outlook

### NORTH AMERICA

For the purposes of this forecast, North America is defined as the United States and Canada.

#### Air cargo traffic grew in 2015

Air cargo moving to, from, and within the United States and Canada accounts for 8.8 percent of the world's air cargo traffic in terms of tonne-kilometers and 13.8 percent in terms of tonnage alone.

North American air cargo traffic grew 2.7 percent in 2014 and 2.4 percent in 2015. US domestic air cargo, which accounts for 96.1 percent of the North American market, grew 2.9 percent in 2014 and 2.5 percent in 2015.

Canadian domestic air cargo, which is 2.3 percent of the total North American market, grew 3.0 percent in 2014 and 10.0 percent in 2015. Transborder traffic from the United States to Canada accounts for 1.3 percent of the 2015 North American market, while transborder traffic from Canada to the United States accounts for 0.3 percent of the North American market.

#### US domestic air cargo market

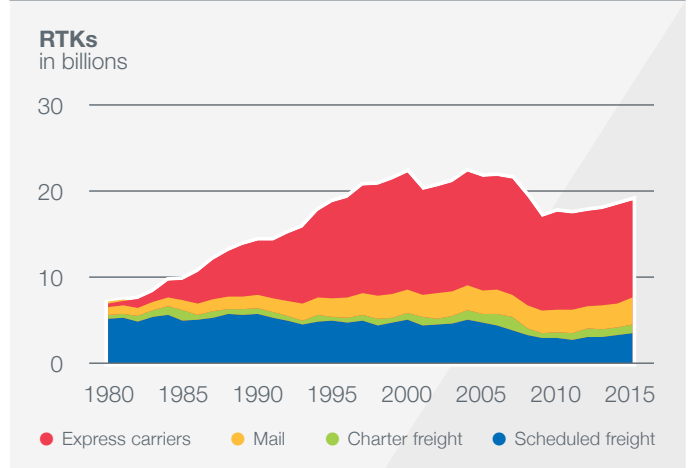
The US domestic market grew a total of 5.4 percent during 2014 and 2015.

The US domestic market is mature and has remained relatively flat in recent years, except during the global economic downturn, which resulted in a drop of 12.4 percent in 2009. Traffic continued a slow recovery in 2014 and 2015, growing 2.9 percent and 2.5 percent, respectively. US domestic traffic grew to 18.7 billion revenue tonne-kilometers (RTKs) in 2014 and 19.2 billion RTKs in 2015.

The express carrier share of the total North America air cargo market declined to 62.1 percent in 2014 and to 59.4 percent in 2015. Express carrier traffic was 11.7 billion RTKs in 2014, a small increase from 11.4 billion RTKs in 2013. In 2015, traffic returned to 2013 levels (11.4 billion RTKs). After increasing consistently during the 1980s and 1990s, the air shipment volume of the express carriers flattened between 2001 and 2007 as the market matured. Volumes remained flat through 2013 following the global economic downturn of 2008 and 2009. Express carrier volume was relatively flat between 2008 and 2013 – within a range of 5.3 and 5.7 million shipments per day for the period – and then experienced growth in 2014 and 2015, increasing to 5.8 million shipments and 6.2 million shipments per day, respectively. While express shipments by air have experienced flat to slow growth in recent years, the express carriers have seen stronger growth in deferred and ground shipments.

Beginning in 2015, there has been renewed interest and activity in expanding U.S. domestic express networks

#### Express service dominates the US air cargo market



to expedite movement of e-commerce flows between distribution centers. This trend may bolster U.S. domestic volumes and growth rates for the next several years above long term trends witnessed since the 1990s.

Scheduled freight traffic in the domestic US market grew 8.5 percent in 2014 and again in 2015 at 6.7 percent. The market share of scheduled US domestic freight carriers increased from 15.3 percent in 2013 to 16.8 percent in 2015.

Scheduled mail accounted for 18.8 percent of the US market in 2015 with 3.6 billion RTKs. Mail traffic increased by 1.9 percent in 2014 and increased again by 10.1 percent in 2015. Chartered operations accounted for 5.0 percent of the US market with nearly 1.0 billion RTKs in 2015. The market share of charter operations has been volatile. After decreasing 7.1 percent in 2013 and 7.3 percent in 2014, charter operations increased 21.0 percent in 2015.

### Canada domestic air cargo market

Canada's share of the region's air cargo market has remained steady.

The Canadian domestic market accounted for 2.3 percent of the total North American air cargo market in 2015. Domestic Canada traffic grew at a modest 3.0 percent in 2014 and surprised in 2015 with a year over year growth of 10.0 percent to log 466 million RTKs.

### Canada's economy grew 1.2 percent in 2015.

Economic recovery sputtered from 2014 to 2015, with GDP growth falling from 2.5 percent to 1.2 percent in 2015. The steep fall in oil prices contributed significantly to this decline.

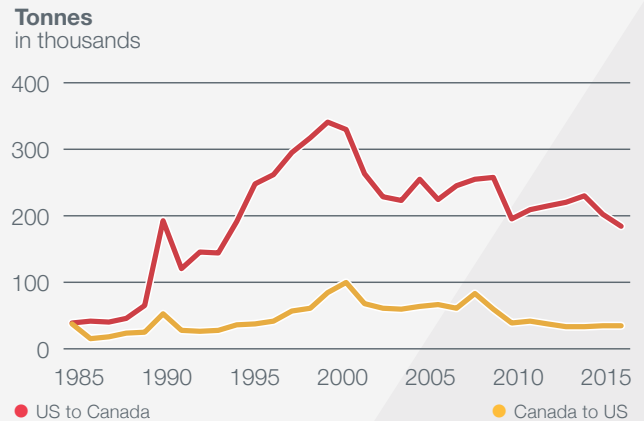
### US-Canada transborder air cargo declined in 2015

The transborder air cargo market was 362,000 tonnes in 2013 and dropped to 336,000 tonnes in 2014. In 2015, transborder air cargo traffic fell again by 8.1 percent to 309,000 tonnes. Traffic from the United States to Canada fell 8.7 percent in 2014 and 9.1 percent in 2015. Traffic from Canada to the United States was up slightly to 0.8 percent in 2014 and fell 2.4 percent in 2015 as the economic recovery slowed in the United States.

Canada's largest trading partner is the United States. In 2014 and 2015, air cargo represented 4.6 percent of Canada's total trade with the United States in terms of value. Northbound tonnage continued to exceed the southbound tonnage, as it has since the mid-1980s.

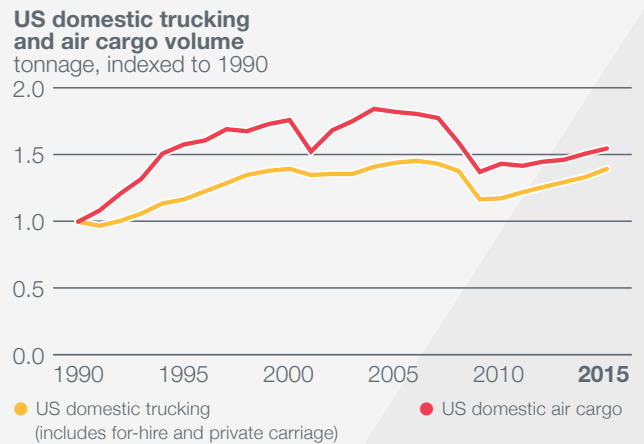
Typical commodities shipped from the United States to Canada included small packages, industrial machinery, electrical machinery, and ferrous products. Commodities shipped from Canada to the United States included industrial machinery, electrical machinery, specialized equipment, and small packages.

### Transborder tonnage northbound continues to exceed that southbound



### Trucking and air cargo traffic are recovering at a slow rate

Sources: IATA, ACMG, and ATA



### Cargo carriers increase use of trucks

Reductions in the size of the passenger fleet, the predominance of narrowbody airplanes on domestic routes, and the demise of scheduled domestic air freight airlines has reduced North American domestic air cargo capacity, measured in available tonne-kilometers.

Continuing the trend of past years, combination carriers continue to rely on trucks to offset the loss of domestic air capacity that has resulted from reduced fleet size and the shift of widebody airplanes from domestic to international markets. Truck flights allow combination carriers to offer service comparable to that of pure cargo carriers. Rising fuel costs magnify the inherent cost advantages of ground transport over air transport and although fuel costs have decreased in the past two years, ground transport has retained its cost advantage over air transport.

The global economic downturn dramatically decreased domestic shipping demand after years of fairly steady growth. In 2008 and 2009, both air and truck tonnage declined significantly. The slow economic recovery that began in 2010 is reflected in slow growth in both truck and air tonnage that has continued through 2015.

### North America economic forecast

The US economy grew 2.4 percent and the Canadian economy grew 2.5 percent in 2014. In 2015, US GDP growth held steady at 2.4 percent and the impact of the oil price plunge led to Canadian GDP declining to 2.3 percent.

Economic growth continues to underperform expectations and thus North American economies have seen only modest GDP growth in the past several years. The sluggish GDP growth has led to continued softness in the growth rate of air cargo.

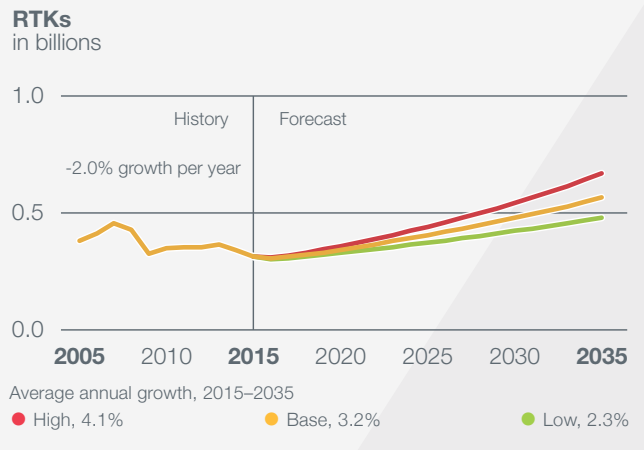
The US GDP grew 2.4 percent in 2014 and in 2015. The Canadian GDP grew 2.5 percent in 2014 and 1.2 percent in 2015. In the long term, the US GDP is forecast to average 2.3 percent growth per year between 2015 and 2035, while Canada's GDP averages 2.0 percent annual growth during the same period.

### North America air cargo forecast

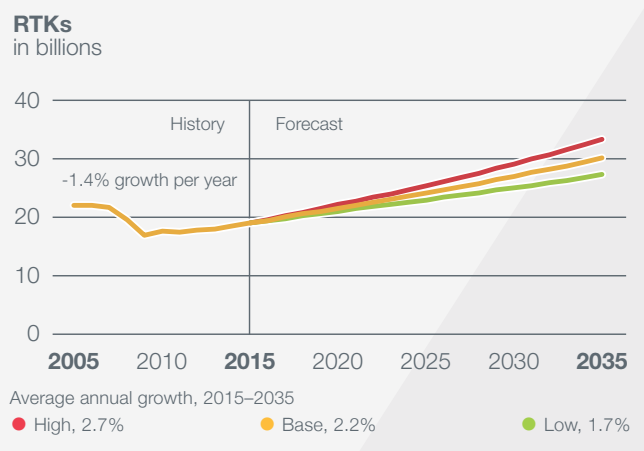
Air cargo traffic in North America grew 2.7 percent in 2014 and 2.4 percent in 2015, reflecting slow recovery from the economic recession. North America air traffic is projected to average 2.3 percent growth over the next 10 years and 2.2 percent over the full 20-year forecast period.

Transborder air cargo traffic is expected to exceed the growth rate of both the GDPs and the domestic air cargo markets of the two countries. Liberalization of air transportation agreements will foster increased

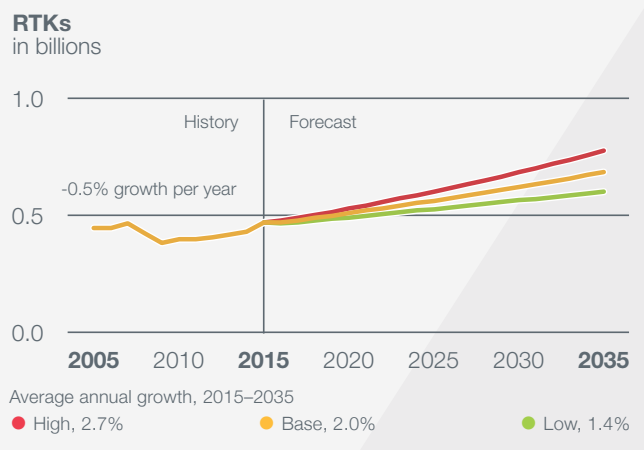
### US-Canada transborder air cargo traffic will grow 3.2% per year



### US domestic market will grow 2.2% per year



### Domestic Canada air cargo market will grow 2.0% per year



use of relatively uncongested and accessible Canadian airports by US shippers for transport to Europe and Asia. Expansion of passenger airline networks across North America will increase transborder air cargo capacity and traffic. Transborder air trade between Canada and the United States is projected to grow 2.8 percent annually over the next 10 years and grow at an average rate of 3.2 percent for the entire forecast period through 2035.

The US domestic market will maintain the dominant share of the total North American market, with about 95.3 percent of the total RTKs. The US domestic market is forecast to grow at an average annual rate of 2.3 percent over the 10-year period from 2015 to 2025 and 2.2 percent over the full 20-year period from 2015 to 2035.

The Canadian domestic market is forecast to grow at an average annual rate of 2.0 percent over the 10-year period from 2015 to 2025 and at the same rate over the full 20-year period from 2015 to 2035, essentially matching Canada's GDP growth. Overall, growth in both North American domestic air cargo markets could be limited by continued expansion of trucking services in the time-definite sector.



## Regional Outlook

### LATIN AMERICA AND NORTH AMERICA

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

#### Air cargo declined 4.1 percent in 2015

The Latin America–North America market, which represents 2.4 percent of the world’s air cargo traffic measured in tonne-kilometers and 2.9 percent measured in tonnes, declined 4.1 percent in 2015 following a decline of 0.1 percent in 2014.

#### Market growth will return over the long term

The Latin America–North America air cargo market decreased by 4.1 percent in 2015 after decreasing by 0.1 percent in 2014. Air cargo traffic from North America to Latin America declined 1.0 percent in 2014 and 10.1 percent in 2015. Air cargo traffic from Latin America to North America grew 0.5 percent in 2014 and declined 0.1 percent in 2015.

This decline in the southbound market is driven by the decline in the Brazilian economy due to the current political environment that has led to uncertainty in the foreign-exchange market. Price instability and currency weakness will cause near-term stagnation in the Brazilian economy, however in the medium and long term, economic health is expected to return and, with it, air cargo traffic.

#### Latin America–US air cargo market

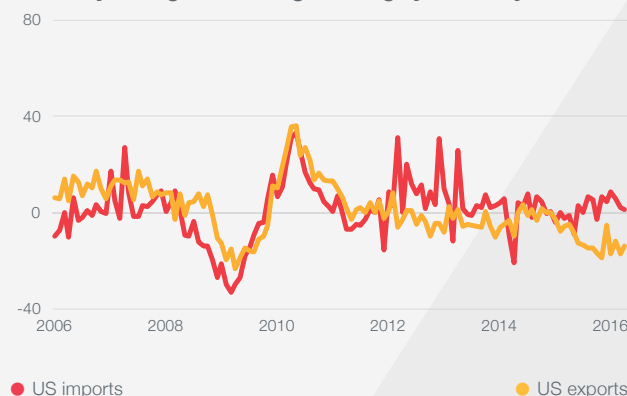
The United States is Latin America’s major North American trading partner, accounting for 94 percent of Latin America’s imports from North America and 90 percent of its exports to North America. Monthly Latin America–US trade, therefore, serves as a good approximation of month-to-month activity in the Latin America–North America air cargo market.

For the purposes of analyzing air traffic growth rates, Latin America can be divided into three subregions: South America, Central America, and the Caribbean Basin. During 2015, South America accounted for 72.3 percent of the total 1.3 million tonne Latin America–North America air cargo market, Central America accounted for 20.8 percent, and the Caribbean Basin accounted for 6.9 percent. Consistent with recent history, air cargo traffic between North America and the various subregions fluctuated at different rates in 2015.

South America–North America air trade declined by 1.4 percent in 2014 and 6.7 percent in 2015 as the Brazilian economy faced a downturn. Brazil’s share of South America–North America trade, measured in tonnes, remains as the third largest, while Chile and Colombia have climbed to first and second largest in recent years.

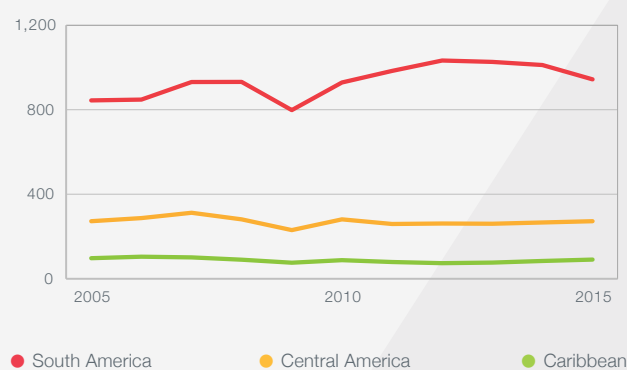
US to Latin America exports have declined in recent years

Monthly change in air cargo tonnage year over year

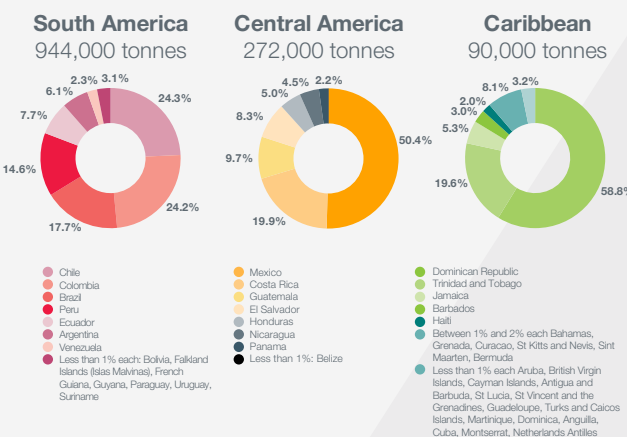


Latin America–North America air cargo is unevenly distributed

Tonnes in thousands



Latin America–North America trade can be classified into subregions



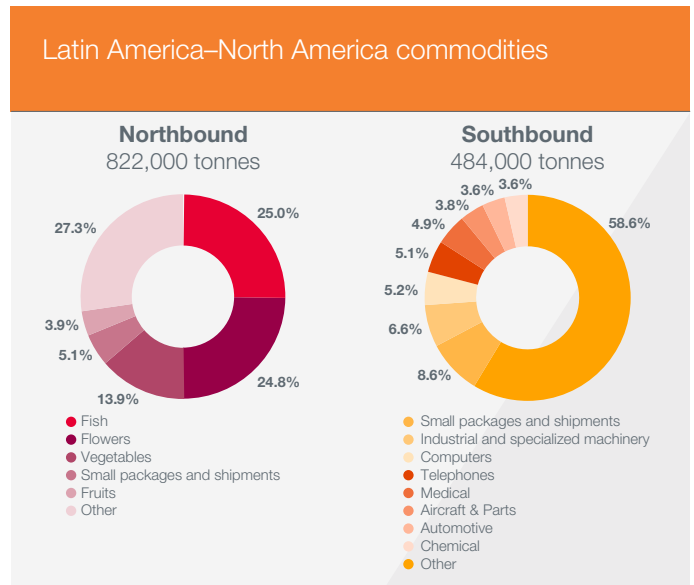


Central America's air trade with North America grew by 2.3 percent in both 2014 and 2015. Mexico remained North America's largest Central American air trade partner and accounted for more than half of the air cargo tonnage shipped between North America and Central America.

The Caribbean Basin's air trade with North America grew 9.4 percent in 2014 and 7.9 percent in 2015. In particular, air trade between North America and the Dominican Republic, one of the Caribbean Basin's larger traders, grew 14.6 percent in 2014 and 11.0 percent in 2015.

## Air trade commodities

Commodities data from 2015 show that cargo flows to Latin America consisted primarily of higher value manufactured commodities (such as machinery, computers, automotive and chemicals), while flows from Latin America were made up primarily of perishables (including flowers, fish, vegetables, fruits, and other small package shipments).



**Latin America–North America  
air cargo forecast**

The total Latin America–North America market for air cargo services is forecast to grow 4.3 percent per year between 2015 and 2035.

Since 2012 the Brazilian economy has been on the decline. In early 2015 a political crisis stimulated an economic recession that has impacted trade volume and increased inflation. It is expected that growth will be slow in the short-term as continued political uncertainty impacts industrial production and GDP growth. Over the next 20 years, however, it is expected that the economies of Brazil and Latin American will show overall growth. In South America and Central America, GDP is forecast to grow 2.6 percent and 3.0 percent per year, respectively, through 2035. The Caribbean Basin economies are projected to grow 3.7 percent during the same period.

The North American economy is forecast to grow at an average annual rate of 2.2 percent over the next 20 years.

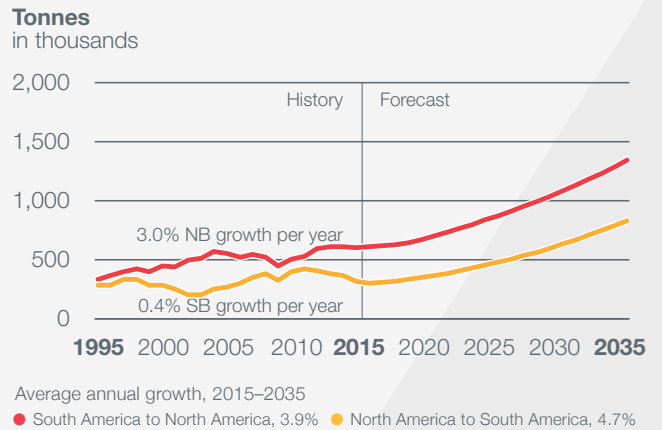
Spurred by economic growth, air trade from Latin America to North America is forecast to grow 4.1 percent per year over the next 20 years, while air trade from North America to Latin America is forecast to grow 4.7 percent.

For the South America subregion, bidirectional air trade with North America is projected to grow at an average annual rate of 4.2 percent over the next 20 years. Traffic from South America to North America is forecast to grow 3.9 percent and traffic from North America to South America is expected to grow 4.7 percent. The slowed growth projection takes into account the recent decline in the Brazilian economy and assumes the longer term strength of the South American economies and a more stable political environment.

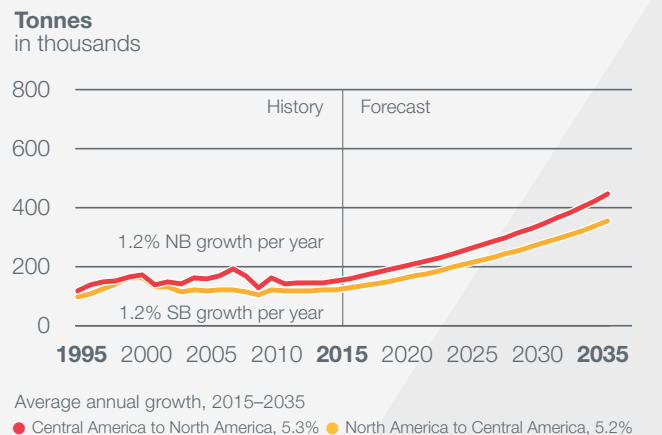
Mexico is forecast to drive Central America’s air trade with North America with growth of 5.3 percent per year during the next 20 years, exceeding the rates of the other Latin America subregions. Air trade from Central America is projected to grow 5.3 percent annually and air trade to Central America will grow 5.2 percent per year.

Air trade between the Caribbean Basin and North America is projected to grow modestly over the next 20 years at a rate of 1.7 percent per year, because the relatively short transit times and lower costs of ocean shipping make it a more cost-effective option for many shippers in this market. Economic growth in Cuba, due to the restoration of diplomatic ties between the US and Cuba, may influence future trade growth.

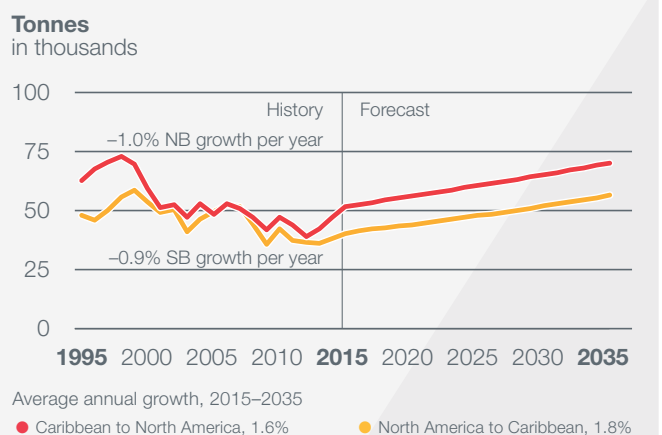
South America–North America air trade will grow 4.2% per year



Central America–North America air trade will grow 5.3% per year



Caribbean–North America air trade will grow 1.7% per year





Regional Markets

**LATIN AMERICA AND EUROPE**

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

**Latin America–Europe market facing slower growth in near term**

In the Latin America–Europe market, which represents approximately 3.0 percent of the world's air cargo traffic in terms of tonne-kilometers and 1.8 percent in trade tonnage, air cargo growth slowed from 2.8 percent in 2014 to 0.6 percent in 2015.

After the past two years of an average of 2.9 percent growth per year, Latin America, impacted by a recent weakening of Brazil's economy, saw total air cargo trade with Europe grow only 0.6 percent in 2015. This growth weakness was evidenced most strongly between South America and Europe, where air trade experienced negative growth of -3.5 percent in 2015. The other Latin America sub-regions of Central America and the Caribbean experienced total air trade growth with Europe of 10.9 percent and 7.0 percent respectively in 2015.

Air trade growth from Latin America to Europe slowed from 9.5 percent in 2014 to 1.8 percent in 2015. Europe to Latin America air trade declined 0.4 percent in 2015 after a decline of 1.7 percent in 2014.

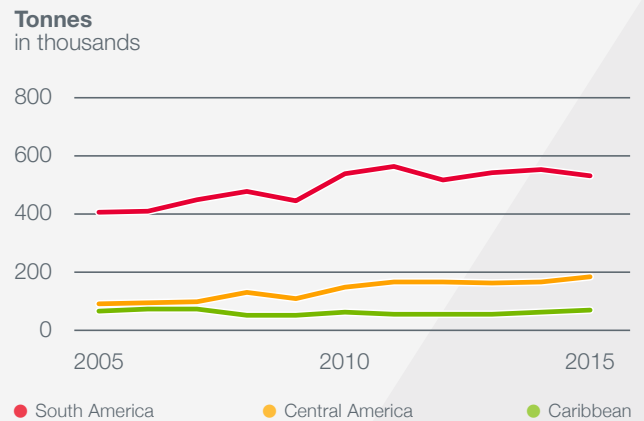
In 2015, vegetable products were the main import shipped via air to Europe from Latin America. In the other direction, machinery and electrical equipment and chemical products were the top air cargo commodities arriving in Latin America from Europe. The European Union remains an important trading partner for Latin America, second only to the United States.

**South America dominates air trade between Europe and the Latin America subregions**

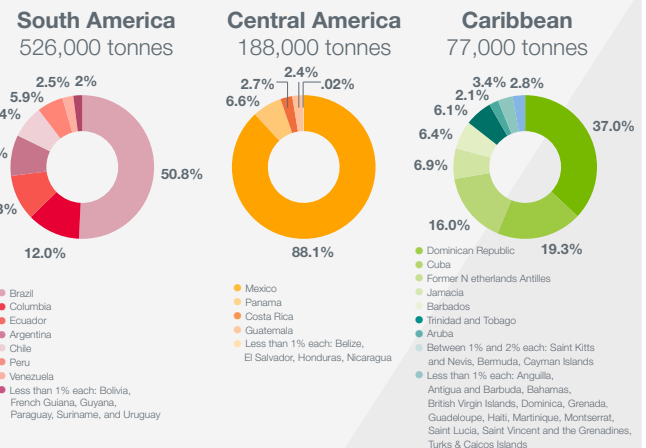
Of the more than 790,000 tonnes of cargo transported by air between Latin America and Europe in 2015, South America accounts for 66.5 percent of the market for air cargo, followed by Central America at 23.8 percent, and the Caribbean with the remaining 9.7 percent.

After a period of relatively high growth, South America's air trade with Europe increased 1.9 percent in 2014, followed by a decrease of 3.5 percent in 2015. Brazil, South America's largest economy, is facing an economic slowdown that will likely continue to impact air trade in the short to medium term. Nonetheless, Brazil accounts for 50.8 percent of air cargo tonnage in the South American sub-region. Columbia's share of overall air trade rose from fourth in 2013 to the second largest in South America, in 2015, followed by Ecuador and Argentina.

Latin America and Europe traffic by subregion



Europe–Latin America trade can be classified into three subregions



Following two years of declining air trade between Central America and Europe in 2012 and 2013, air trade grew 1.2 percent in 2014, followed by a dramatic increase in growth of 10.9 percent in 2015. This partially reflects export growth in Mexico, Europe's most prominent Central American trade partner, and accounts for 88.1 percent of the region's air cargo tonnage to and from Europe in 2015.

Air trade between the Caribbean and Europe came off a year of 15.3 percent growth in 2014, to grow 7.0 percent in 2015. Historically, the Caribbean sub-region in particular has experienced volatile air cargo growth and the very strong growth of the past two years is not expected to be sustained.

Since 2013, growth in air cargo shipments from Latin America to Europe has outpaced those from Europe to Latin America, with air trade growing from 341,400 tonnes in 2014 to 347,453 in 2015. During this same period, air cargo shipments from Europe to Latin America decreased from 445,229 to 443,652 tonnes. Air trade from Europe to the region is expected to recover, as sub-region South America's GDP is boosted by economic recovery in Brazil.

## Economic outlook for Latin America and Europe

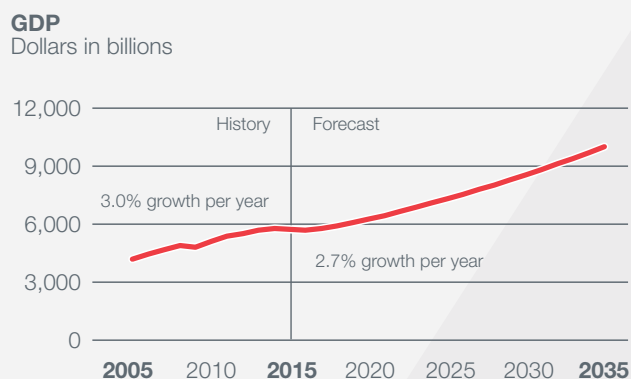
The economies within the Latin America region declined by 0.5 percent in 2015 after 1.1 percent growth in 2014.

Economies of the Latin America region are forecast to grow 2.7 percent per year between 2015 and 2035.

- Despite a near term economic slowdown, Brazil is expected to remain the region's largest economy, accounting for 53.5 percent of South America's total GDP by 2033.
- The South America economy is forecast to grow at an average annual growth rate of 2.6 percent over the forecast period.
- Central America's economy, led by Mexico, the subregion's largest economy, is forecast to grow at an average growth rate of 3.0 percent per year from 2015 to 2035.
- The Caribbean economy is projected to grow an average of 3.2 percent per year during the 20-year forecast period.
- Cuba will remain the largest economy in the Caribbean region, with projected average growth of 4.7 percent per year over the 20-year period.

Europe's economy is forecast to grow at an average annual rate of 1.8 percent from 2015 to 2035.

Latin America's economy will grow 2.7% per year



### Latin America–Europe air cargo market forecast

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

Relations between Latin America and Europe have been maintained through regular summit meetings between heads of state of the two regions since 1999. Air trade has seen some benefit from several trade and association agreements put in place over the last few years. Continued success of these agreements could support increased air cargo demand between the two regions.

After growing at an annual rate of 3.3 percent over the past 10 years, the Latin America–Europe air cargo market is projected to grow at 3.8 percent per year from 2015 through 2035.

Long term air cargo growth outlook for the region, 2015-2035:

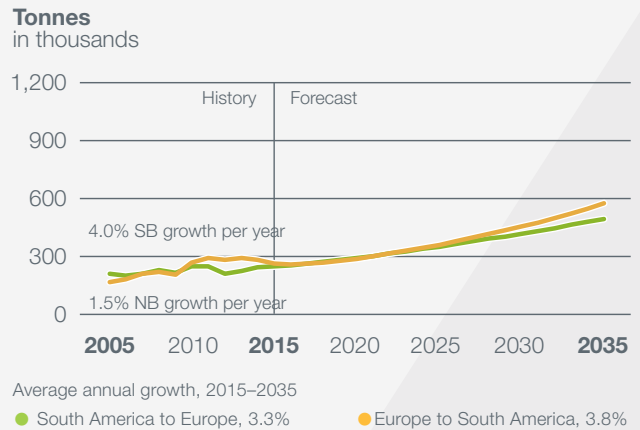
- Europe to Latin America: 4.0 percent
- Latin America to Europe: 3.5 percent

Air trade between South America and Europe is projected to grow an average of 3.6 percent over the next 20 years. Europe-to-South America air cargo traffic is forecast to grow 3.8 percent on average, while South America-to-Europe traffic is forecast to grow 3.3 percent. These rates assume the short to medium term ramifications of economic instability in South America will affect air trade, and will improve and dissipate over time.

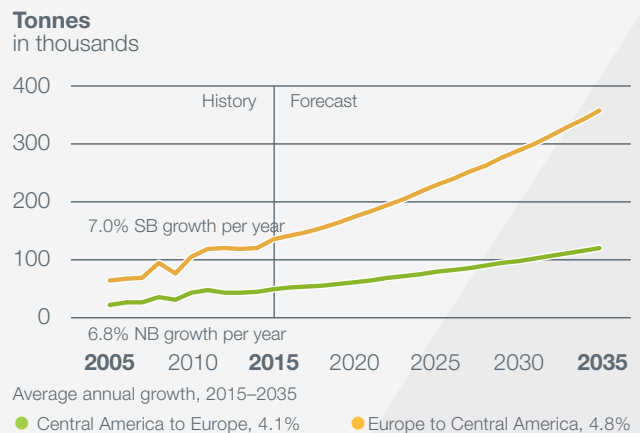
The Central America–Europe market is projected to grow 4.6 percent on average over the next 20 years. Europe to Central America traffic is forecast to grow at a rate of 4.8 percent, while Central America-to-Europe traffic is forecast to grow 4.1 percent per year through 2035.

Growth in air cargo shipments between Europe and the Caribbean is projected to grow at 3.1 percent over the next 20 years. Air cargo traffic from Europe to the Caribbean is forecast to grow at an average annual rate of 2.6 percent; air cargo traffic from the Caribbean to Europe is forecast to grow 3.5 percent per year over the forecast period. Air cargo traffic growth rates for the Caribbean sub-region will depend on continued political reform and integration in the region.

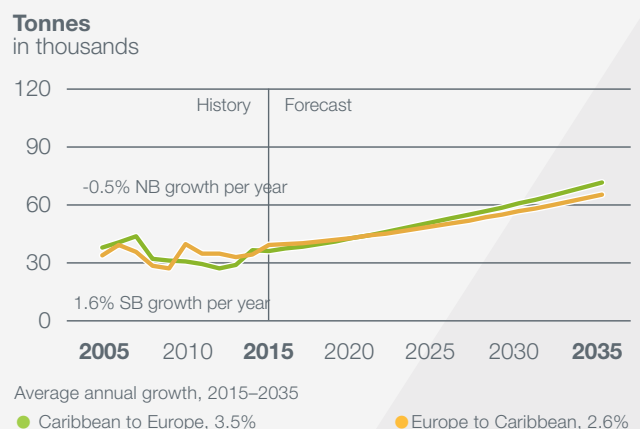
#### South America–Europe air trade will grow 3.6% per year



#### Central America–Europe air trade will grow 4.6% per year



#### Caribbean–Europe air trade will grow 3.1% per year





### Regional Markets

## EUROPE AND NORTH AMERICA

For the purposes of this forecast, we define Europe as all 28 member countries of the European Union (EU) plus Switzerland, Norway, Iceland, Turkey, Albania, Gibraltar, and all the countries of the former Yugoslavia. We define North America as Canada and the United States.

### Market growth returns then weakens again

Europe–North America air trade accounts for approximately 6.5 percent of world air cargo tonnage and 8.3 percent of the world’s tonne-kilometers. Total Europe–North America air trade grew 4.5 percent in 2014 and 1.8 percent in 2015. At 2.95 million tonnes in 2015, the market was off 10.6 percent from its peak of 3.30 million tonnes in 2007.

Air trade between Europe and North America has been volatile for the eight years since the global economic downturn. After dropping 6.2 percent in 2008 and plummeting a further 21.2 percent in 2009, the market rebounded with gains of 20.0 percent in 2010 and 4.2 percent in 2011. The growth rate faltered, however, in the second half of 2011, foreshadowing a contraction that totaled 9.2 percent over the two years ending in 2013.

The United States accounted for nearly 93 percent of North America’s air exports to Europe and almost 90 percent of the region’s air imports from Europe during 2015, so monthly Europe–US air trade closely approximates the overall North Atlantic air cargo market.

Total Europe–US air cargo volumes grew 6.5 percent in 2014 and 1.0 percent in 2015. In the Europe-to-US direction, air trade expanded 7.9 percent in 2014 and 4.2 percent in 2015. Monthly growth in Europe-to-US air trade was mostly positive, year-over-year, throughout 2014 and 2015. During the first six months of 2016, however, Europe-to-US flows continued to expand, growing 3.7 percent, compared to the first four months of 2015.

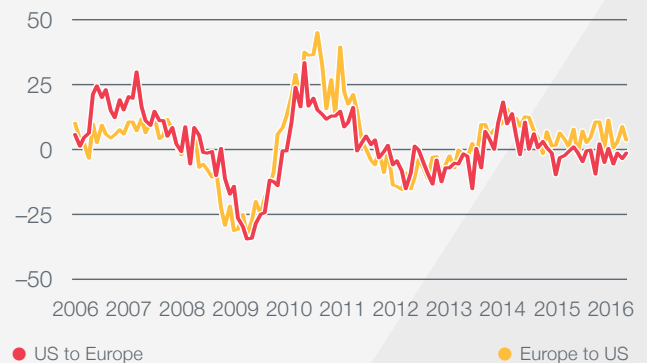
In the US-to-Europe direction, annual air trade grew 4.9 percent in 2014 and fell 2.6 percent in 2015. Year-over-year growth remained through third quarter 2014, only to weaken again during fourth quarter 2014 and throughout 2015. For the first six months of 2016, US-to-Europe air trade fell another 2.9 percent compared to the first four months of 2015.

Canada air trade with Europe is much smaller in volume than that of US air trade with Europe. As a consequence, its growth patterns may not always coincide with those of the United States. Total Canada air trade with Europe declined 12.8 percent in 2014, but grew 9.9 percent in 2015. In the Europe-to-Canada direction, air trade contracted 13.3 percent in 2014, but rebounded 14.0 percent in 2015. In the Canada-to-Europe direction, air trade fell 12.0 percent in 2014, but grew 3.3 percent in 2015.

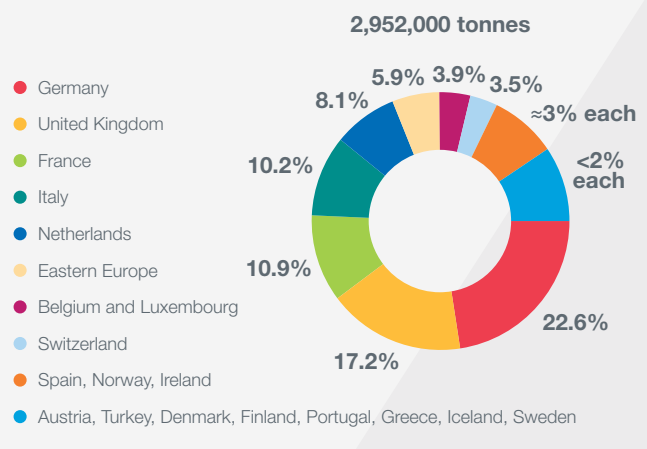
Total Europe–North America (including Canada) air trade grew 4.5 percent in 2014 and 1.8 percent in 2015.

### Europe-US air trade has been weak since Q1 2015

Monthly change in air cargo tonnage year over year percentage



### Five countries account for 69% of Europe–North America air trade



Europe-to-North America flows expanded 5.4 percent and 5.1 percent in 2014 and 2015, respectively. The North America-to-Europe air trade flow grew 3.5 percent in 2014, but then contracted 2.2 percent in 2015.

Since 1980, five European countries—Germany, the United Kingdom, France, Italy, and the Netherlands—have consistently accounted for nearly 70 percent of all European air trade with North America. Air trade with North America grew for all five of these countries during 2014, but weakened during 2015, with overall trade with Germany and the United Kingdom contracting slightly that year. Notably, France air exports to North America picked up modestly in 2014, then expanded nearly 20 percent during 2015.

Eastern European countries, which account for 5.9 percent of total North Atlantic air trade, enjoyed strong air cargo growth with North America, expanding 12.9 percent in 2014, then 10.1 percent in 2015. Growth was especially strident for the large economies of this sub-region, with Czech Republic, Hungary, Poland and Romania all experiencing double-digit growth over the two-year period 2013-2015.

## Europe-North America air trade and total trans-Atlantic merchandise trade

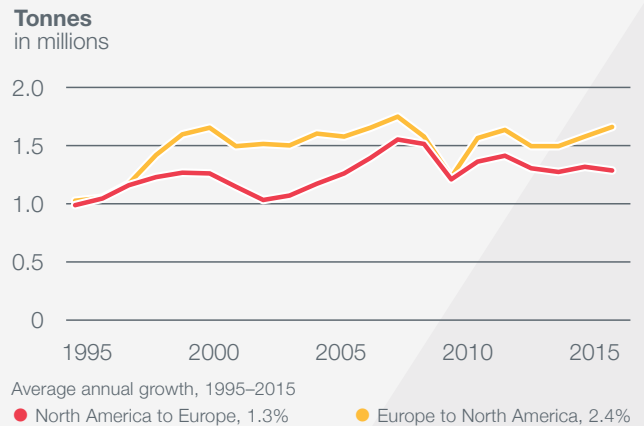
In the 20 years between 1980 and 2000, the North Atlantic air cargo market surged with an average annual growth rate of 7.3 percent, growing from 708,000 tonnes to 2.92 million tonnes. The market has since slowed markedly, averaging only 1.8 percent growth from 2000 to 2007, the last period of sustained growth. The total Europe–North America air trade market was only 1.0 percent bigger in 2015 than it was in 2000, but 10.6 percent smaller than it was at its peak in 2007.

Even after taking the effects of the global economic downturn into account, the growth rate of the past 15 years hangs far below the norm set during the preceding 20 years. However, this slowdown was not confined to air trade. Growth in containership trade between Europe and North America also sagged, expanding only 1.9 percent between 2000 and 2015. The relative directional strength of containership growth has been very similar to air cargo. For the 2000 to 2015 period, Europe-to-North America container flow growth averaged 2.4 percent per year, whereas North America-to-Europe container flow growth averaged 1.0 percent per year. The slowdown in total Europe-North America commerce may reflect the shift of trade and investment toward Asia.

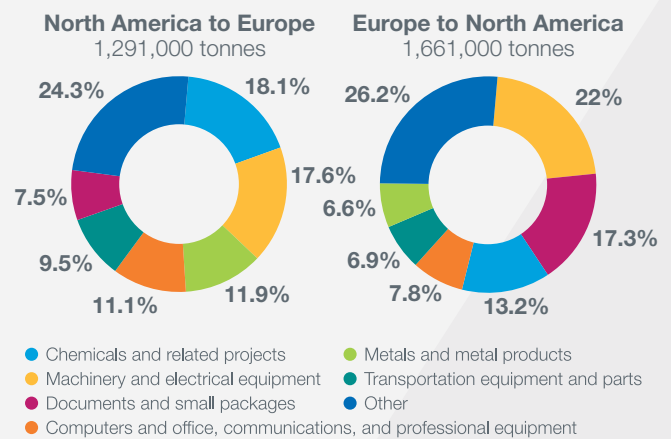
## Air trade commodities

Six commodity categories account for approximately 75 percent of the air cargo flow between the major trading partners of Europe and North America. Industrial products and manufactured goods, which include work in progress shipped from manufacturing facilities on one continent to assembly facilities on the other, are key components of both eastbound and westbound flows.

Europe–North America air trade has grown 1.9% per year since 1995



Top commodities account for approximately 75% of the directional flows



In the North America-to-Europe flow, chemicals, capital equipment (machinery and electrical equipment), metal products, and computing/telecommunication equipment comprised more than one-half of all commodities shipped in 2015. Air trade commodities in this directional trade lane that are forecast to grow faster than trend include computing/telecommunication equipment, beverages and oils, and chemicals.

The top three commodity categories in the Europe-to-North America direction were capital equipment, express shipments, and chemicals and chemical-related products. Air trade commodities in this directional trade lane that are forecast to grow faster than trend include computing/telecommunication equipment, chemicals, and capital equipment.

## Air trade forecast

The baseline GDP projections through 2035 for Europe and North America anticipate average annual growth of 1.8 percent and 2.2 percent, respectively. GDP growth will continue to be the broadest based indicator of trade growth between Europe and North America. Low- and high-growth scenarios are based on projections of 0.5 percent below and 0.5 percent above baseline GDP growth rates.

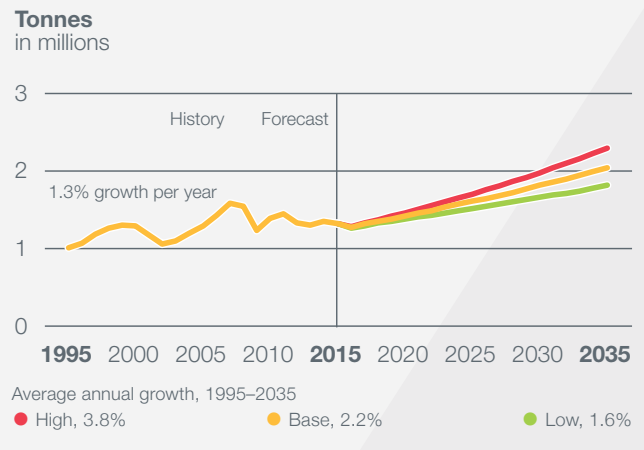
North America-to-Europe air trade baseline growth will average 2.2 percent per year and Europe-to-North America baseline growth will average 2.5 percent per year. The combined total market baseline growth for the next 20 years is projected to be 2.4 percent, compared to 1.9 percent average growth during the past 20 years.

The low growth rate projections assume that both continents will continue to focus on foreign direct investment (FDI) and trade with Asia, at the expense of transatlantic business development. The low-growth North America-to-Europe scenario assumes the possibility of other countries leaving the EU, restrained capital spending, and slow labor market reform. The low-growth Europe-to-North America scenario assumes poor management of government budget deficits, lower capital investment, and relative weakness of the US dollar.

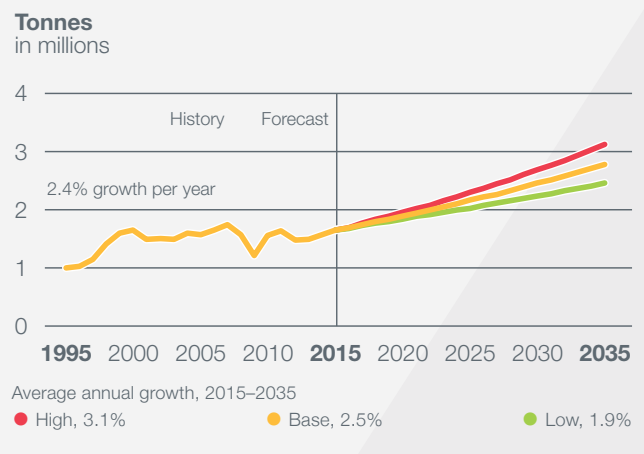
The high-growth North America-to-Europe scenario assumes an expanding European Union, substantive economic reform, deregulation in EU cross-border services, and increasingly flexible labor markets. The high growth Europe-to-North America trade scenario assumes increased capital spending, a stronger dollar, and increased US fiscal discipline.

A country-by-country forecast was used to capture overall market growth in each direction. The effect of currency exchange rates figures in the forecast for each major country pair. Aggregate continent-to-continent flows were modeled in a convergent top-down approach to validate the country-level forecasts.

## North America-to-Europe air trade will grow 2.2% per year



## Europe-to-North America air trade will grow 2.5% per year







## Regional Outlook

### INTRA-EUROPE

For the purposes of this discussion, we define Europe as all 28 member countries of the European Union plus Switzerland, Norway, Iceland, Turkey, Albania, Gibraltar, and all the countries of the former Yugoslavia.

#### Air cargo traffic within Europe reflected global downturn

The intra-Europe air cargo market comprises approximately 3.1 percent of the world's air cargo tonnage, but because the region is geographically compact, only 0.8 percent of the world's tonne-kilometers.

Approximately 72 percent of all air cargo moving into, within, and out of Europe passes through one or more of the northern European countries of Germany, France, the United Kingdom, the Netherlands, Belgium, and Luxembourg. The compact geography of air cargo markets within Europe generally limits routes to relatively short hauls, typically between 900 and 1,200 kilometers.

The intra-Europe air cargo market has been recovering after the stagnation from 2010 to 2013. In revenue tonne-kilometers, intra-Europe traffic has grown 3.9 percent per year since 2013. Between 1990 and 2000, as express carriers built air networks and expanded service offerings, market growth averaged 6.0 percent per year. Traffic growth has eroded since then, however, as relaxation of border controls and harmonization of transport regulations within the European Union allowed truck shipments to compete more effectively with air transport.

#### Intra-Europe air cargo traffic comprises scheduled freight, mail, and express

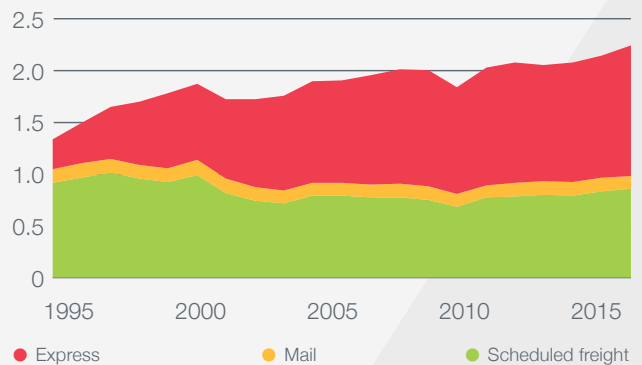
The three primary components of air cargo traffic within Europe—scheduled freight, mail, and express—grow at differing rates. Express traffic averaged 7.6 percent growth per year during the past 20 years. Scheduled freight and mail traffic, on the other hand, were stagnant during the same period. In fact, in 2015, the sum of scheduled freight and mail was 5.9 percent lower than it was in 1995.

Except during the global economic downturn, freight and mail traffic have been stable for the past decade, measured both in tonne-kilometers and in tonnage. The stagnation of these two segments means that the express segment alone accounts for nearly all growth in the intra-Europe air cargo market.

Express traffic increased 1.5 percent in 2014 and 7.6 percent in 2015. Annual traffic growth over the entire decade averaged only 2.4 percent, a marked decline from the previous decade's 13.1 percent average annual growth.

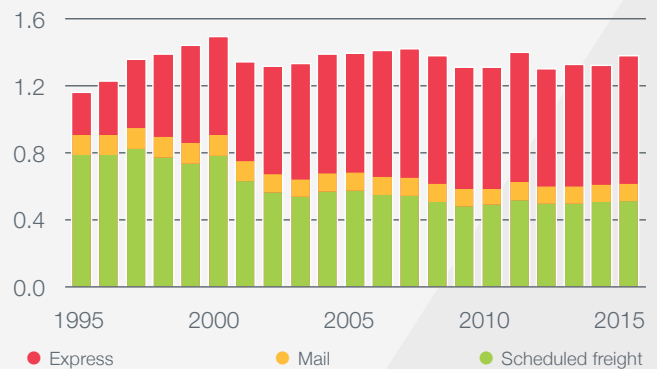
The intra-Europe air cargo market resumed growing in 2013 after a long period of stagnation

RTKs  
in billions



Intra-Europe tonnage has not returned to precession levels

Tonnes  
in millions



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 to fill out freighter loads when traffic is light in the small parcels and documents that traditionally make up express cargo.

Nearly all air cargo growth in the past 20 years is a result of the expansion of integrated air express carrier services. In addition to geographical ease of surface transport within Europe, the Schengen Agreement of June 1990, which removed customs inspection on goods moving between several countries in northern Europe (and later within most of the European Union), facilitated intra-Europe truck transport and reduced the need for expedited scheduled air freight service. Consequently, trucking has become the preferred mode of transport for most freight and mail, even for small-parcel express shipments in short-haul markets. The shift toward ground transport has held overall intra-Europe air traffic to only 1.6 percent average growth during the 10-year period from 2005 to 2015.

After growing an average of 8.6 percent per year during the 10 years between 1997 and 2007, the estimated number of daily international air express shipments declined as a result of the global economic downturn. Shipments revived, however, and have grown at a steady 5.4 percent per year since 2009. Intra-Europe express shipments have grown 3.1 percent on average per year, from 491,800 shipments per day in 2005 to 667,500 shipments per day in 2015.

## Trucks complement scheduled airplane freight services

Air cargo has never been solely an airport-to-airport service. Rather, air cargo is a single component of a transportation 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.

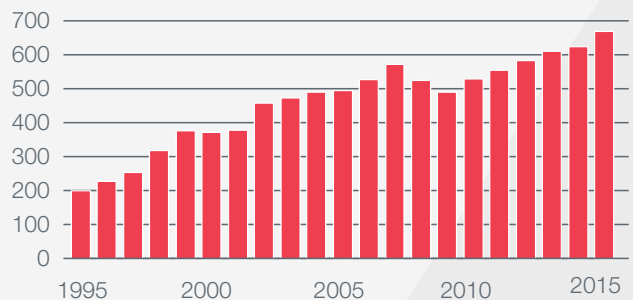
Scheduled airlines that serve the intra-Europe market have used truck flights, trucking services registered with their own flight number, to extend their networks and add scheduling flexibility.

Long-haul truck-flight operations in Europe supplement overall air logistics systems. Their dramatic rise over the past decade has clearly contributed to a decline in growth

Intra-Europe express shipments have increased steadily since the global economic downturn

Estimated daily express shipments\* in thousands

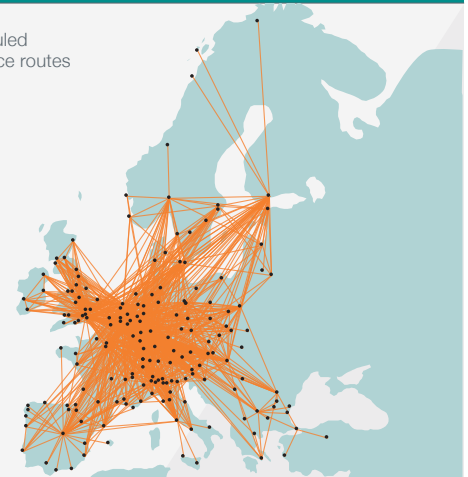
Source: ACMG



\* international shipments only

Truck flights augment scheduled airline capacity

Lines represent scheduled truck-flight cargo service routes as of May 2016.



of scheduled freight carried by air. Since 2006, airport pairs of truck flights grew 3.1 percent on average per year. Weekly frequencies of truck-flights grew 14.3 percent on average per year between 2006 and 2013, but the growth has been at pause since 2013. 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.

## Intra-Europe air cargo forecast

Led predominantly by express shipments and longer scheduled freight sectors to eastern and southern Europe, intra-Europe air cargo traffic is forecast to expand at an average annual rate of 2.2 percent per year through 2035. The 20-year forecast growth in air cargo traffic is lower than the 2.6 percent growth trend recorded during the previous 20-year period from 1995 to 2015.

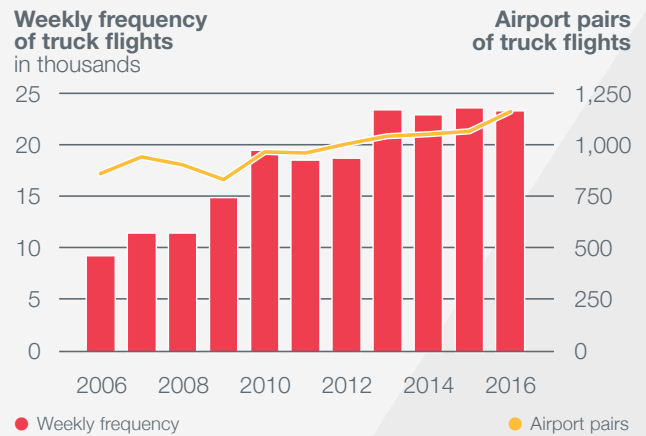
Economic activity, as measured by GDP, and industrial activity will remain the primary drivers for traffic growth in this market. For the long term, the baseline GDP for Europe will average 1.8 percent growth per year through 2035. GDP projections of 0.5 percent below and above the baseline were assessed, and the results of these growth rates are reflected in the low- and high-growth scenarios. Intra-Europe air cargo traffic growth is forecast to range between 1.6 percent and 2.8 percent.

Inflexible labor markets, an aging population, expensive pension systems, and slow economic reforms will limit long-term economic growth, especially in the countries of northern Europe. In the near term, tight fiscal and monetary policies will continue to curb economic growth and entrepreneurial activity, thereby slowing air cargo growth.

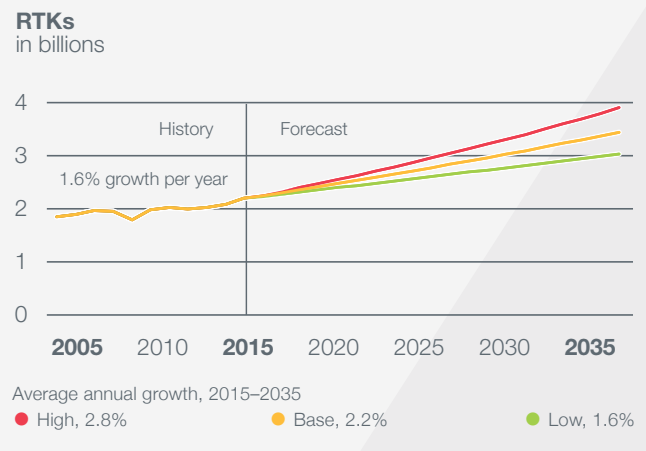
On a positive note, the longer trucking times to distant eastern and southern markets may be unacceptable for some shippers, offering air cargo traffic growth prospects for the next two decades.

Truck-flight airport pairs grew 3.1% per year, but frequency growth flattened since 2013

Source: OAG, May



Intra-Europe air cargo traffic will grow 2.2% per year





## Regional Outlook

### MIDDLE EAST

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

#### Air cargo traffic expands strongly on economic growth

Air cargo moving into, within, and out of the Middle East is estimated to have accounted for 5.2 percent of the world's tonnage and 4.4 percent of the world's revenue tonne-kilometers during 2015.

Despite ongoing political instabilities in parts of the region, the overall Middle East economy continues to expand. However, the region's GDP growth has slowed relative to the period 2001 through 2011 when economic growth averaged 5.2 percent per year. In 2014, GDP growth was 2.6 percent and in 2015 it was slightly down at 2.3 percent, reflecting trouble from the massive decline in oil prices between 2014 and 2015. Over the next 20 years, the annual growth rate is projected to average 3.1 percent. The largest economies in the region—those of Iran, Israel, Saudi Arabia, and the United Arab Emirates—commanded nearly 70 percent of the region's GDP in 2015. The easing of trade sanctions should result in improved economic growth in Iran. However, at this time, the effect of this growth on air cargo cannot be accurately forecast.

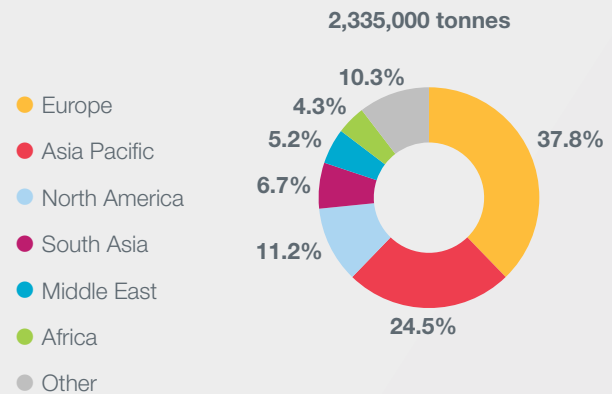
The large volume of air cargo that flows through Middle East cargo hubs reflects the region's history as the crossroad between Africa, Asia, and Europe. Dubai, in the United Arab Emirates, is the largest air cargo center in the region and one of the largest re-export hubs in the world. Doha, in Qatar, and Abu Dhabi, in the United Arab Emirates, follow Dubai in traffic volume.

New infrastructure will reinforce the region's role as a hub. All three of the largest cargo centers in the region—Dubai, Abu Dhabi, and Doha—are expanding their cargo-handling capacity to meet growing air cargo demand. Dubai's new Al Maktoum International Airport is planned to be the world's largest cargo hub. The airport will be home to an integrated operation, combining different transportation modes, logistics, manufacturing, and assembly in a single free-trade zone.

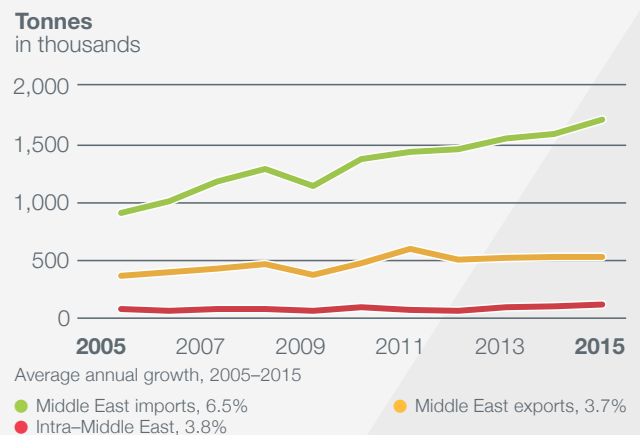
The region also has a significant sea-air market in which goods from South Asia arrive in the Middle East on ships and continue to other regions by air.

The Middle East is diversifying beyond the oil industry, broadening its industrial and business base. A long-term effort in Dubai, for example, has produced an economy that is strong in logistics, tourism, banking, and construction. This diversification will lead to growing air cargo flows.

#### Europe is the largest Middle East air trade partner



#### Middle East air trade grew 5.7% per year, 2005–2015



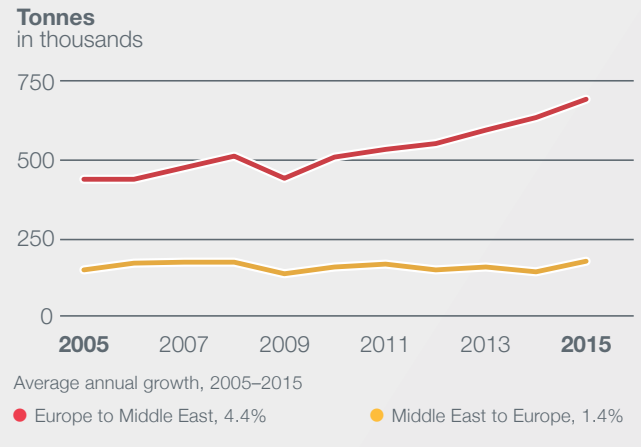
There also has been movement toward economic liberalization and cooperation between countries. These changes should improve the investment climate and economic competitiveness of the region. New roads and trade agreements will facilitate increased cargo flows within the region. Middle East nations should benefit from combining their strength as trading hubs as well as from the growth of their own markets.

## Middle East-Europe traffic is growing

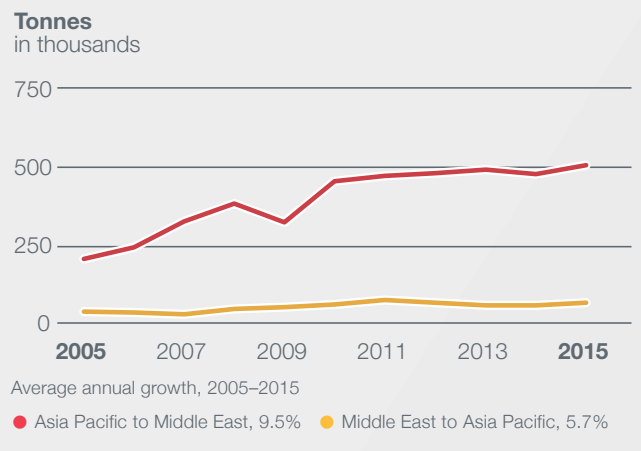
Air cargo traffic between the Middle East and Europe has been growing strongly since 2005. Imports from Europe, the larger of the two directional flows, have averaged 4.4 percent growth per year, outpacing the 1.4 percent growth of exports to Europe.

Accounting for 882,000 tonnes of air cargo in 2015, trade with Europe represented 37.8 percent of the Middle East's international air cargo market. The primary commodities shipped to Europe are garments and perishables. Leading commodities shipped from Europe include telecommunication equipment, machinery, and finished goods. Overall air cargo traffic in both directions has averaged 3.6 percent annual growth for the past 10 years.

Middle East-Europe air trade grew 3.6% per year, 2005–2015



Middle East-Asia Pacific air trade grew 8.9% per year, 2005–2015



### Middle East-Asia Pacific traffic expands

In 2015, Asia Pacific traffic accounted for approximately 24.5 percent of the air cargo market in the Middle East, at 571,000 tonnes.

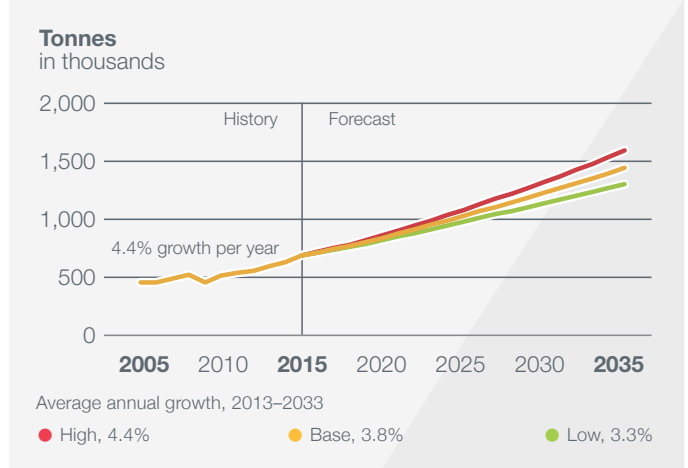
Air cargo shipments arriving from the Asia Pacific region consisted predominantly of textiles, machinery and electrical equipment, and computer equipment. Imports from the Asia Pacific region have increased at a robust annual rate of 9.5 percent since 2005. The air export flow to the Asia Pacific region is very small, but grew at 5.7 percent per year over the past decade.

### Middle East forecast

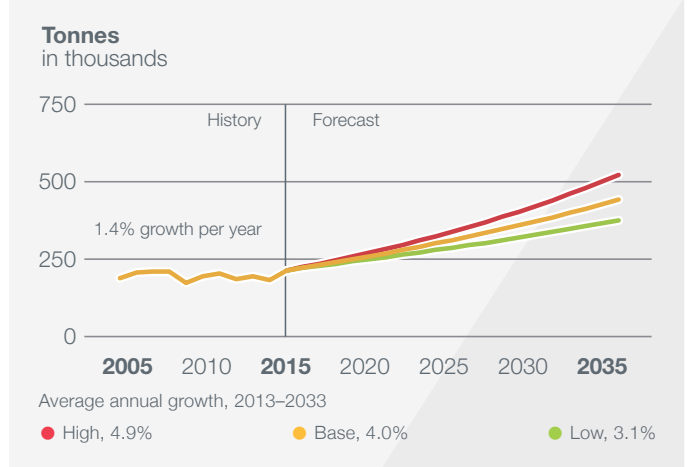
Overall air cargo between the Middle East and Europe is forecast to grow at an average annual rate of 3.9 percent between 2015 and 2035.

Direct flights connecting production centers in Asia and Europe pose some risk to air cargo traffic between the Middle East and Europe. Nevertheless, increasing local exports, coupled with the continued European market for goods transshipped from Asia and Africa, should keep growth in the Middle East air cargo market healthy. The price of oil will have a significant effect on Middle East demand for products from Europe. The rate and extent of diversification from oil-related industries will affect the 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 tends more to the high or low projection.

### Europe-to-Middle East air trade will grow 3.9% per year



### Middle East-to-Europe air trade will grow 4.0% per year





## Regional Outlook

### AFRICA

For the purposes of this forecast, we define Africa as the entire continent of Africa plus the nations of Cape Verde, Madagascar, Reunion, the Seychelles, Mayotte, Mauritius, the Comoros Islands, and São Tomé and Príncipe. Data from ACI, IATA, ICAO, governments and airport authorities, the United Nations, and the US Department of Commerce were used to model air cargo flows associated with Africa.

#### Africa air trade patterns are changing

The Africa–Europe market accounts for approximately 2.3 percent of the world’s air cargo tonnage and 2.3 percent of the world’s tonne-kilometers.

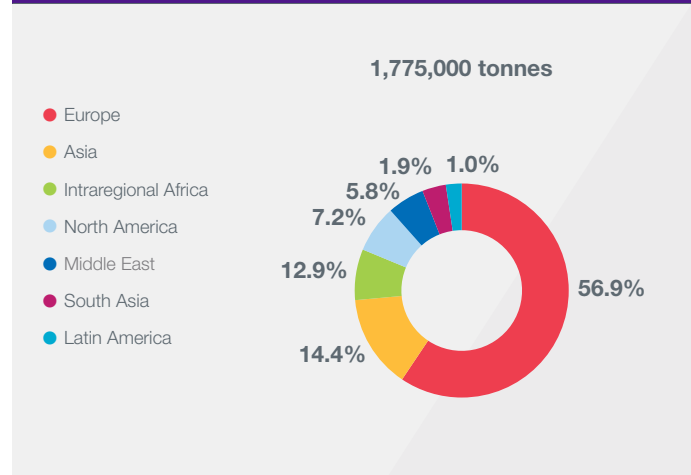
Based on the region’s air trade and airport statistics, air trade originating in or destined to Africa is estimated at 1.8 billion tonnes in 2015. While Asia and North America are also critical parts of the principal markets in the region, Europe accounts for nearly 60 percent of African cargo and commands the majority of Africa’s international air trade largely because of its proximity and longstanding historical and investment ties.

Asia provided 13.9 percent of Africa’s international air trade in 2015. The region—and in particular, China—have built new commercial ties to Africa as Chinese enterprises have sought out new raw materials to fuel that country’s industrial expansion. Robust economic growth in sub-regions such as Southeast Asia also provides a bright prospective of the future trade between Africa and Asia.

In 2015, North America accounted for 7.1 percent of Africa’s international air trade, estimated at 127,400 tonnes. Africa–North America air trade has decreased slightly for the past few years because of a reduction of US demand for African manufactured goods. Yet, Africa’s immense economic potential, increasing integration into global markets, and booming population are creating further trade and investment opportunities between the two regions, as recently discussed by heads of state at the US-Africa Business Forum in September 2016. Although the growth is not as fast as Asia, North America remains to be one of the key partners for the African freight market.

Intra-regional Africa has rapidly expanded its share of African air trade in recent years. Trade among African nations is estimated at 136,400 tonnes for 2015, which accounts for 8 percent of the total African cargo market. This is a 35 percent increase from two years ago, which makes the intra-Africa market one of the fastest growing markets in total African cargo trades. Africa is moving forward to implement new bilaterals and free-trade agreements, such as the Tripartite Free Trade Area Agreement. This agreement among 54 nations in the continent encourages operators to develop new intra-Africa air cargo lanes, which will stimulate more economic growth within the continent. Also, current ground infrastructural 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 is Africa’s primary partner, but intra-Africa and Asia air trades have rapidly expanded their share



In general, African air exports tend to be dominated by perishables, while air imports into the region tend to be industrial machinery and electrical equipment, computers and telecommunication equipment, and manufactured goods.

### Five African countries lead international air trade to/from Africa

The majority of total African international air trade is conducted by a few leading economies among the 57 countries of Africa. Leading international markets on the Africa continent include South Africa, Egypt, Kenya, Nigeria, and Ethiopia, which held 16.1 percent, 15.9 percent, 12.9 percent, 10.7 percent, and 10.0 percent of Africa international air cargo flows in 2015, respectively. International air cargo tonnages of South Africa, Egypt, Nigeria, and Ethiopia have increased for the last two years. Kenya has slightly decreased because of low demand for agricultural produce from the European market. Despite challenges, Kenya is ranked as the third-largest international air trade player in Africa.

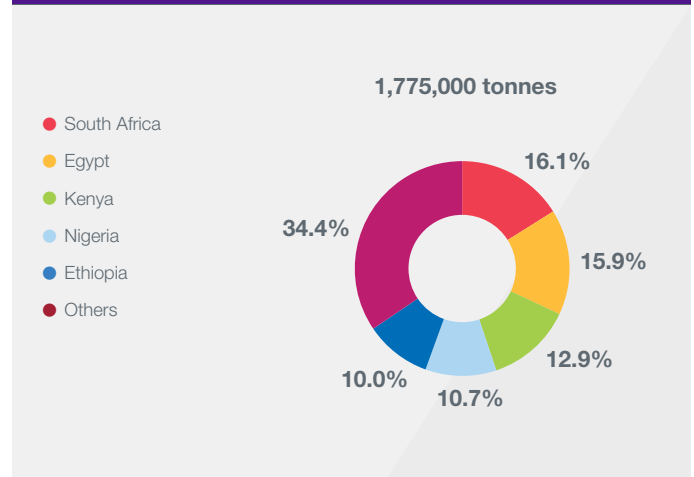
### Africa–Europe traffic

Air cargo flows between Africa and Europe have resumed growing again over the last two years.

With the onset of the global economic downturn in 2008, Africa air exports to Europe continuously declined until 2013. After suffering from more than a half decade of decline, Africa to Europe air flows finally rebounded, to more than 503,000 tonnes in both 2014 and 2015. On the other hand, Europe to Africa air flows rebounded from the recession relatively sooner. Although this flow slightly declined again in 2012–2013, this volatility seems to have normalized in the last two years as the trades in this flow have resumed growing again. The directional imbalance between these two flows is relatively small.

The resumption of growth in Africa air cargo imports after the global downturn in 2008 can be explained by a renewed growth in African extractive industries, related infrastructure development, urbanization, and demand for consumer goods. The growth, however, is easily affected by both African and European politics and economy. Possible factors diminishing Africa air cargo exports and imports include weak European economic growth, Brexit, and disruption to North African industry during the “Arab Spring” uprisings of early 2011. Furthermore, shippers of Africa’s main air cargo–eligible commodity group, perishables, have more plentiful and less-expensive transport options as containership operators have added refrigerated (“reefer”) container capacity at African ports of call. Finally, some loss of African air cargo exports to Europe may be explained by the rapid expansion of Middle East carrier cargo capacity, which may blur the true origins and destinations of cargo moving through their networks.

### Top 5 African countries lead international air trade



### Africa–Europe air trade has improved in the last two years





### Africa-Asia traffic

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

The developing Africa-Asia air cargo market has increased 6.3 percent per year on average over the past decade. Capital investments in African extractive industries (e.g., oil from Sudan and copper from Zambia) 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 about five times as much Asian air cargo entering as leaving Africa.

Two prominent factors continue to complicate estimating the size of this market. First, trade lanes that include both sea and air, principally via airports in the United Arab Emirates, offer the possibility of lower cost transportation between Africa and Asia. As a result, a great deal of Asian cargo arrives in Africa as air cargo from the Middle East. Second, much air cargo from Asia arrives as the excess baggage of small traders who import goods for sale in Africa.

### Africa-North America traffic

North America's air cargo trade is dominated by imports, which have grown 2.7 percent annually since 2005.

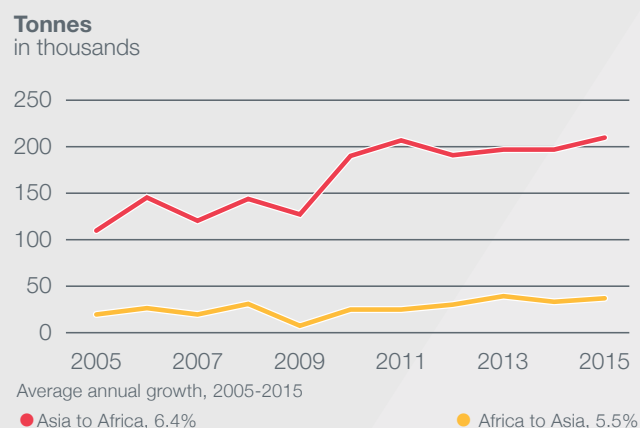
Air cargo trade with North America represents 7.1 percent of Africa's market for international air cargo. Trade in both directions between the two countries was nearly in balance during the early 2000s, but began to diverge in volume levels when demand for North American-manufactured specialty oil and gas extraction equipment began to grow in the mid-2000s. African imports from North America represented 64.3 percent of this regional flow in 2015, largely consisting of small parcels and documents, oil and gas equipment, industrial and mining equipment, and chemicals. African exports declined slightly for the past decade, largely because of a reduction of US demand for miscellaneous manufactured articles. Leading African air cargo exports to North America include apparel, perishables, and automobile components.

### Africa-Middle East and domestic African traffic

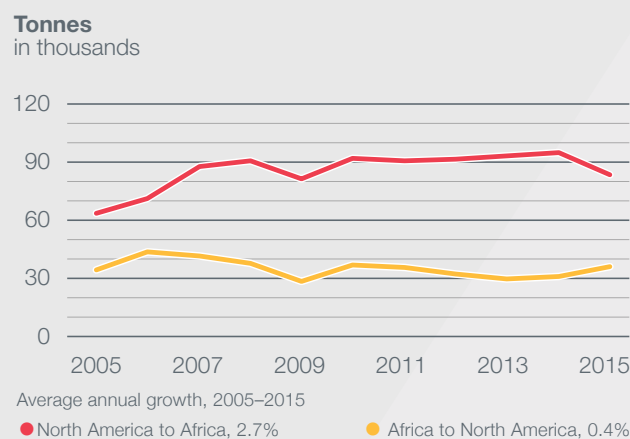
Traditional air cargo trade patterns are supplemented by sea-air trade and by goods flowing from South Africa by air.

The Middle East market accounts for 5.5 percent of African air cargo, estimated at 99,400 tonnes. The most important characteristic of this trade lane is its role as a distribution hub for goods traveling to and from Africa. Traveling to the Middle East are goods such as meat products, fruits and vegetables, and flowers. Products related to the oil industry dominate westbound traffic to

Africa-Asia air trade has been growing in the last decade



Africa-North America air cargo trade has increased since 2005



Africa, supplemented by pharmaceuticals and machinery. Emerging oil and gas production in east Africa markets like Uganda will further expand this trade lane given its close proximity to the Middle East.

Domestic African air cargo is not included in this analysis, but is estimated to total 174,000 tonnes. Domestic air cargo in Africa is strongest in some of the largest economies: Congo-Brazzaville, Democratic Republic of the Congo, Nigeria, South Africa, Angola, and Sudan. Air cargo often offers the most secure and reliable transit in these markets.

## Africa forecasts

Overall, air cargo trade between Africa and Europe will grow 3.8 percent per year, while Africa–Asia air cargo trade will expand at an average annual growth rate of 6.5 percent. Air cargo trade between Africa and North America will grow 5.3 percent per year, albeit from a smaller base than either Europe or Asia.

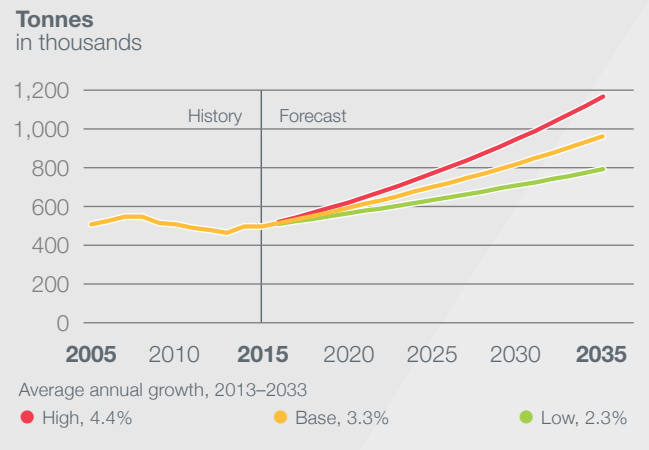
Base, low, and high models were developed to forecast the Africa–Europe air cargo market. GDP projections of 0.5 percent below and above the baseline were assessed, and the results of these growth rates are reflected in the low- and high-growth-rate scenarios. The Africa to Europe market is expected to average 3.3 percent growth per year. European economic recovery, African economic diversification into manufactured products, and resumption of moderate growth in African perishables are assumed in the baseline forecast for this air trade flow.

A higher level of growth is forecast for the Europe to Africa market, reflecting the higher economic growth rates expected for Africa. At 4.2 percent, the base growth rate forecast reflects both African consumer buying power for goods that arrive by air and 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 and reduce its vulnerability to swings in commodity prices.

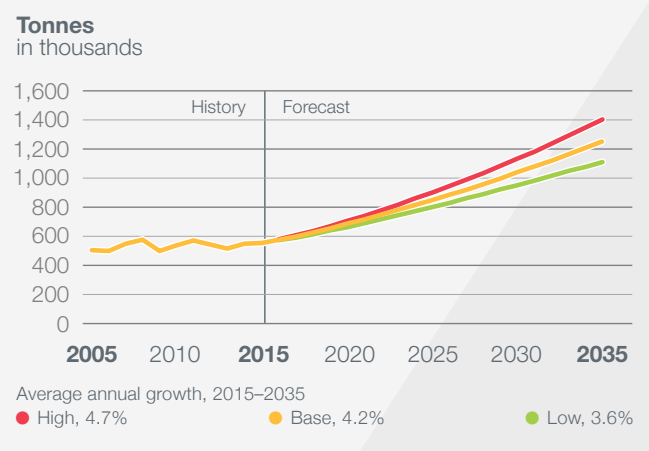
Growth in African air trade with Asia will be driven principally by Asian imports into the continent. Follow-on investment by China in extractive industries in Africa and—equally important—continuing urbanization and rising demand for consumer goods in Africa will propel an Asia to Africa air trade growth at a rate of 6.5 percent per year for the forecast period. Conversely, Africa to Asia air cargo trade will expand at the slower rate of 5.0 percent per year as Africa slowly develops industrial ties with Asia.

Development of African air cargo trade with North America will also remain directional. North America to Africa flows are expected to grow 7.1 percent per year through 2035, driven by continued US and Canadian investment in African extractive industries. Africa to North America air cargo trade will grow at almost the same rate, 3.5 percent per year, as African light manufacturing develops export markets in North America.

### Africa-to-Europe air trade will grow 3.3% per year



### Europe-to-Africa air trade will grow 4.2% per year





Regional Outlook

**ASIA AND NORTH AMERICA**

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

**The Asia–North America market grew 6.5 percent in 2015**

The Asia–North America market represents 22.7 percent of the world’s air cargo in terms of tonne-kilometers and 9.5 percent in terms of tonnage.

The overall Asia–North America market grew 6.5 percent in 2015 and 8.6 percent in 2014. This growth reflects North America economy growth of 2.4 percent in 2014 compared to a growth of 1.6 percent in 2013. Traffic growth continued in 2015 despite the lackluster North America economic growth of 2.3 percent. Much of the 2015 cargo market growth occurred in the first half of the year with the threat of the US west coast port labor action that diverted cargo from sea to air. Market growth in the Asia-to-North America direction, which accounts for over 60 percent of the total flow, traffic grew 13.5 percent and 8.6 percent in 2014 and 2015, respectively. The North America-to-Asia direction grew 1.5 percent in 2014 and 3.2 percent in 2015.

Air freight tonnage in the Asia-to-North America direction was 2.7 million tonnes. The tonnage in the North America-to-Asia direction was approximately 1.6 million tonnes.

The United States accounts for 93 percent of the overall Asia–North America air trade. US monthly market activity can therefore be taken to approximate the overall transpacific market. The overall Asia-US market grew 9.3 percent in 2014 and 7.3 percent in 2015. Asia-to-US air cargo traffic saw growth of 14.7 percent and 9.3 percent in 2014 and 2015, respectively. US-to-Asia traffic grew 1.7 percent in 2014 and 4.0 percent in 2015. During the first six months of 2016, overall Asia-US air cargo traffic contracted 18.8% compared with the first six months of 2015. Traffic contracted 21.7% and 14.3% in the Asia-to-US and in the US-to-Asia direction.

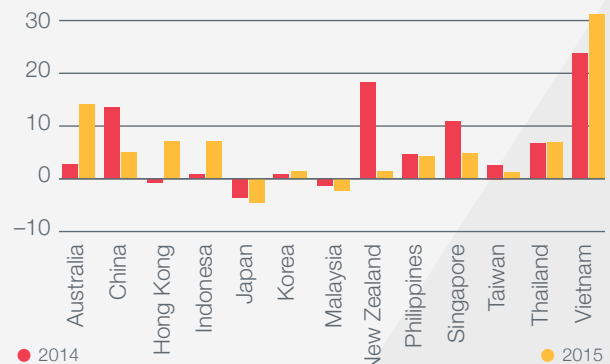
Air freight declined 18.8% from January to June 2016 compared with January to June 2015

Monthly change in air cargo tonnage, year over year percentage

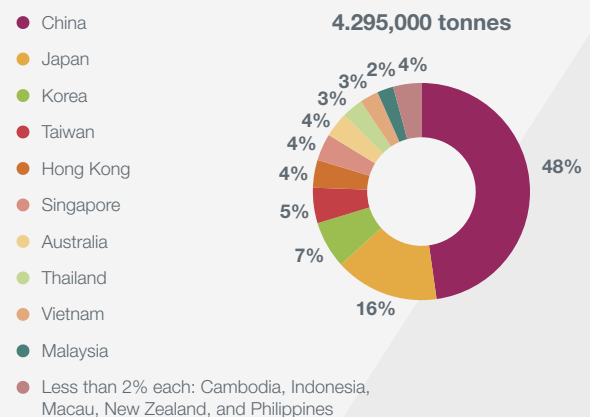


Air freight market grew 6.5% in 2015

Annual growth percentage



China accounts for 48% of the transpacific air cargo market



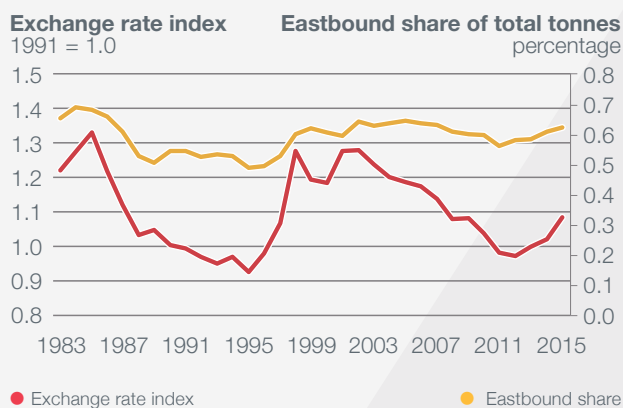
China now accounts for the largest share of the Asia–North America air cargo market. Growing at an average annual rate of 13.6 percent since 1995, China’s market share rose from 10.7 percent to 33.9 percent by 2005 and reached 47.8 percent by 2015. Japan, the second-largest air cargo market in Asia, has a 15.5 percent market share. As China’s market share rose, Japan’s declined, dropping from 34.6 percent in 1995 to 15.5 percent in 2015.

Total transpacific air tonnage is influenced by a combination of factors, including economic activity in North America and Asia, international trade patterns, and commodity mix. The directionality of the flow, on the other hand, is determined by economic growth and purchasing power in the importing region.

Exchange rates affect the price of imported goods in local currencies, which in turn, influence the directionality of cargo flows. A strengthening US dollar increases traffic from Asia to North America. Conversely, a weakening dollar increases flows from North America to Asia.

By way of illustration, between 1985 and 1995, when the US dollar dropped approximately 30 percent with respect to Pacific Rim currencies, the air cargo flow from Asia to North America dropped from 68 percent to 49 percent as a share of the total air cargo traffic between Asia and North America. Conversely, between 2011 and 2015, when the US dollar gained over 10 percent against Asia’s currencies, the flow from Asia to North America rose from 57 percent to 63 percent as a share of total Asia–North America air cargo traffic.

## Exchange rate affects directionality of transpacific trade flow



**Asia–North America air trade commodities**

Three commodity categories account for 60.9 percent of Asia-to–North America air cargo traffic: apparel, telecommunication equipment, and electrical machinery and apparatus. Five categories account for 60.6 percent of the North America–to–Asia traffic: general industrial equipment, documents and small packages, electrical machinery, perishables, and chemical materials.

In the Asia-to–North America flow, the share of Asia’s exports represented by the apparel category grew 9.1 percent in 2014 and 5.6 percent in 2015. The telecommunication equipment category grew 25.0 percent in 2014 then declined 5.8 percent in 2015. The electrical machinery and apparatus category share remained virtually the same at about 15.7 percent.

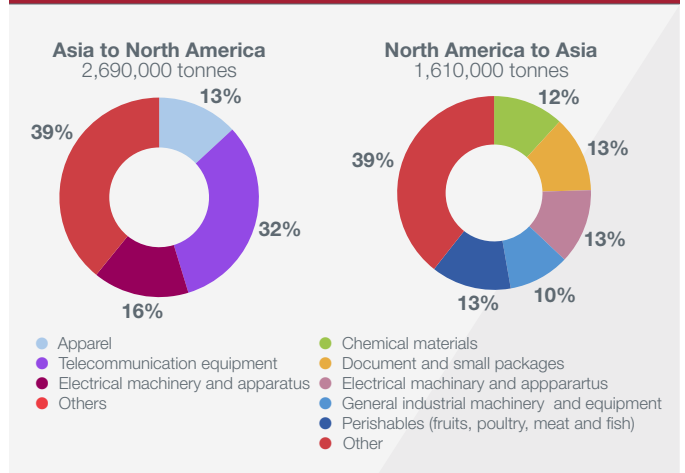
In the North America–to–Asia flow, the general industrial equipment, documents and small packages, electrical machinery and apparatus, and chemical materials categories all grew in 2014 and 2015. Perishables (e.g., fruits, poultry, meat, and fish) grew 8.6 percent in 2014 but contracted 0.6 percent in 2015.

**Asia–North America air cargo traffic forecast**

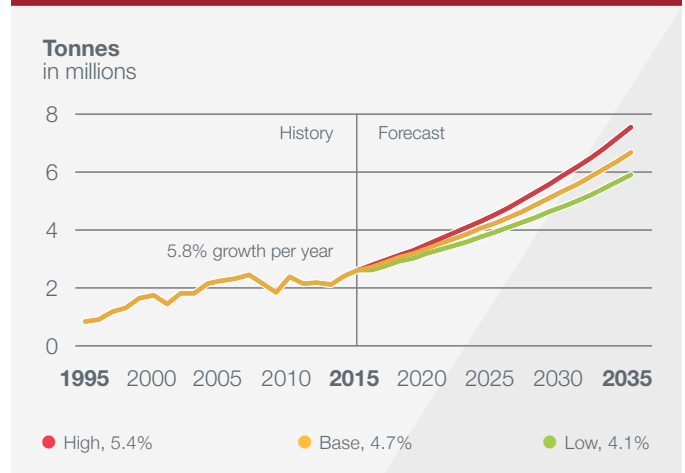
Air trade flowing in both directions across the Pacific is forecast to grow an average of 4.6 percent per year over the next 20 years. The flow from Asia to North America is forecast to grow at an average rate of 4.7 percent per year. The flow from North America to Asia is forecast to grow 4.5 percent per year over the next 20 years.

Air trade scenarios for Asia, to and from North America, were developed for baseline, low, and high economic growth rates. The low- and high-growth scenarios reflect GDP performance that falls 0.5 percent below and above baseline GDP projections.

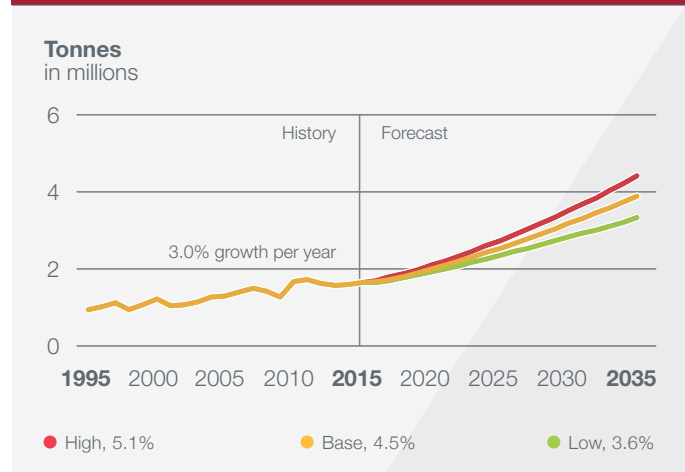
Consumer goods drive eastbound transpacific flow; manufacturing materials drive westbound flow



Asia-to–North America air trade will grow 4.7% per year



North America–to–Asia air trade will grow 4.5% per year





## Regional Outlook

### EUROPE AND ASIA

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

#### Air cargo traffic growth remains strong

The Europe-Asia market comprises approximately 20.3 percent of the world's air cargo traffic in tonne-kilometers and 10.5 percent in tonnage.

Europe-Asia air cargo traffic has averaged 6.4 percent growth per year since 1995. The market grew 6.0 percent in 2014 and 6.5 percent in 2015. The Europe-Asia annual growth chart shows overall air traffic flows between Europe and Asia that also contain some sixth-freedom traffic that flows into or out of other regions. The chart does not represent the actual trade flows by direction. Therefore, comparisons should not be made between the chart and the following air trade flow analysis.

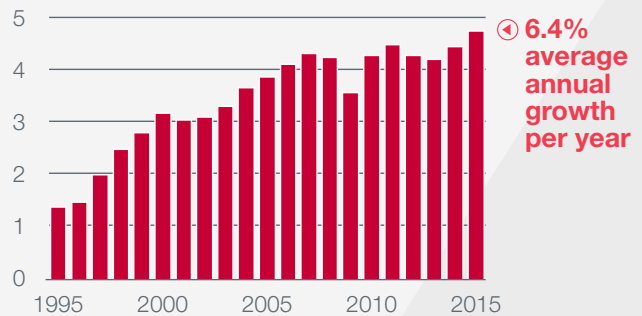
During the early 1990s, Europe's imports showed no growth as the recession that followed the 1991 Gulf War took a heavy toll on the European economy. At the same time, Asia's demand for Europe's goods increased, growing 8.0 percent and 14.5 percent in 1993 and 1994, respectively. In 1995, with the European economy growing at 2.9 percent after seeing virtually no growth after the 1991 Gulf War, Asia-to-Europe flows grew 30.4 percent. By 2005, Europe was importing 2.4 million tonnes from and exporting 1.4 million tonnes to Asia. The gap between Europe's imports and exports narrowed as a result of the global economic downturn of 2008 and 2009 and aggressive financial stimulus in Asia. China led the way with a stimulus package equivalent to 3.2 percent of its GDP in 2009, exceeding the 2 percent GDP stimulus recommended by the International Monetary Fund. The European economy continued to struggle from 2011 through 2013, leading European imports to grow only 2.1 percent in 2011 and contract in 2012 and 2013.

In 2015, the gap between Europe's imports and exports was approximately 956,000 tonnes. The overall Europe-Asia market grew 6.5 percent and 6.0 percent in 2015 and 2014, respectively. The Europe-to-Asia flow grew 7.7 percent in 2015 and 0.2 percent in 2014. In the Asia-to-Europe direction, traffic grew 5.7 percent and 10.1 percent in 2015 and 2014.

Long-term air cargo growth has maintained a steady 6.4 percent average annual rate since 1995 despite these temporary reversals. The air cargo market in the Europe-to-Asia direction has grown 5.3 percent per year over the same 20-year period. In the Asia-to-Europe direction, the market averaged 7.2 percent per year growth.

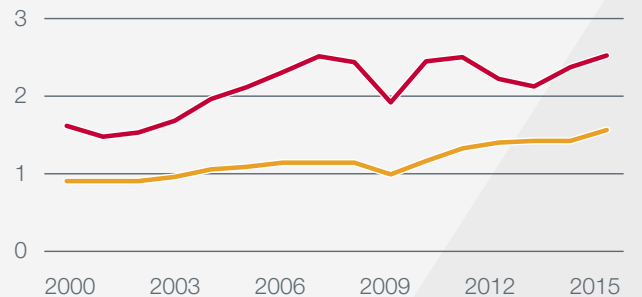
Europe-Asia air cargo market traffic has grown 6.4% per year since 1995

Tonnes  
in millions



Asia air exports to Europe account for approximately 60% of Asia-Europe market

Tonnes  
in millions



Average annual growth, 2000-2015  
 ● Asia to Europe 2.6%  
 ● Europe to Asia 2.9%

### Europe-Asia air trade commodities

In the Europe-to-Asia direction, the top six commodity categories account for 60 percent of air cargo traffic.

In descending order, the categories are machinery and electrical equipment; perishables; computers, office, and communication equipment; documents and small packages; transportation equipment and parts; and apparel. In the Asia-to-Europe direction, the top four commodity categories account for 81 percent of air trade. The categories are computers, office, and communication equipment; machinery and electrical equipment; documents and small packages; and apparel.

One particularly fast-growing market segment between Europe and Asia has been documents and small packages, sometimes referred to as “traditional express traffic.” This trade flow has averaged 6.2 percent annual growth in daily shipment count in both directions since 2000, as the movement of business samples, legal documents, and other expedited small-batch items between Europe and Asia has increased. The total bidirectional express market averaged nearly 420,500 shipments per day in mid-2015.

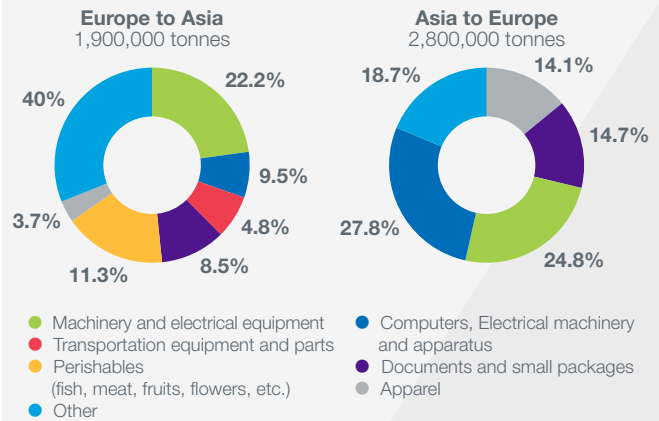
### Europe-Asia air cargo market forecast

Air trade flowing in both directions for the Europe-Asia air cargo market is forecast to grow an average of 4.6 percent per year over the next 20 years. The flow from Asia-to-Europe is forecast to grow at an average rate of 4.5 percent per year. The flow from Europe-to-Asia is forecast to grow 4.9 percent per year over the next 20 years.

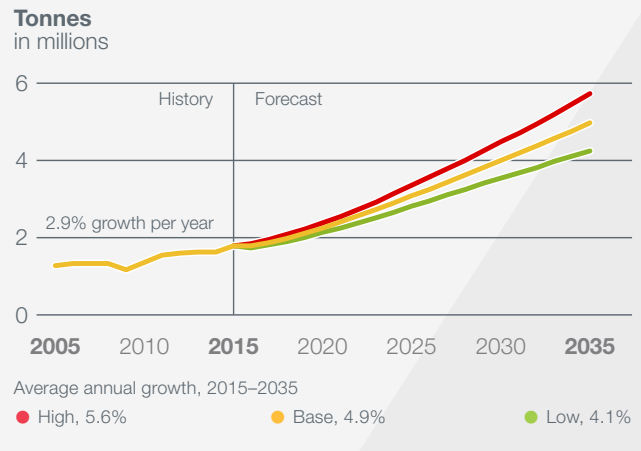
Asia’s GDP will grow 3.7 percent per year over the next 20 years. China will continue to play a major role in Asia, with an expected GDP growth of 5.2 percent per year over the next 20 years. The established economies of Europe are expected to grow 1.8 percent per year.

Base, low, and high models were developed to forecast the Europe-Asia air cargo market. GDP projections of 0.5 percent below and above the baseline were assessed, and the results of these growth rates are reflected in the low and high-growth scenarios.

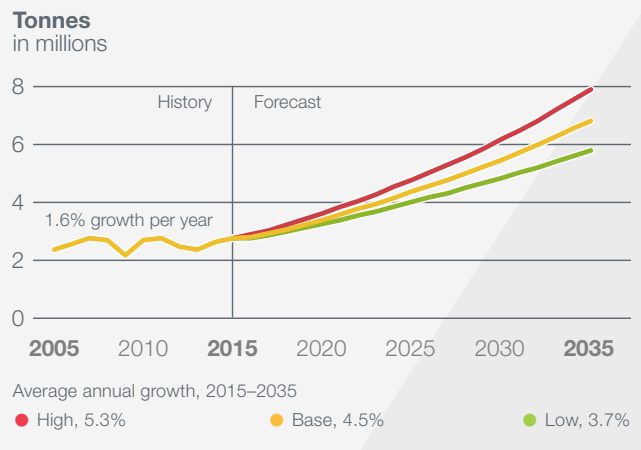
Europe-Asia eastbound flows are more diverse than westbound flows



Europe-to-Asia air trade will average 4.9% growth per year through 2035



Asia-to-Europe air trade will average 4.5% growth per year through 2035





## Regional Outlook

### INTRA-ASIA

For this forecast we define Asia as the eastern Pacific Rim countries: Japan, China (including the special administrative districts of Hong Kong and Macau, unless otherwise noted), Taiwan, Singapore, Thailand, Vietnam, Malaysia, the Philippines, Indonesia, South Korea, Australia, and New Zealand.

NOTE: This section does not examine domestic flows within the nations in Asia. Domestic flows for China may be found in the Regional Markets, Domestic China section. A high-level treatment of Japan's historic and future air cargo growth is presented in the World Overview section and in the Appendix, though Japan's less dynamic domestic market is not analyzed separately.

### Global economic and trade uncertainty will influence near-term air cargo volumes

The intra-Asia air cargo market constitutes 14.9 percent of the world's air cargo traffic in tonnage and about 7.4 percent in tonne-kilometers. Traffic has slowed from historic norms after the recovery from the recent recession showing 2.3 percent annual growth since 2010. Intra-Asia air cargo expansion is closely tied to Chinese and global economic conditions and has followed worldwide market trends. The intra-Asia flow has shown signs of recovery with 4.1 percent growth the last three years, surpassing the worldwide average increases, indicative of a return to stronger long-term growth.

Trade among countries within Asia currently accounts for nearly half of the exports from countries within the region and is expected to expand. Asia's sprawling manufacturing sector pulls critical parts and subassemblies through the supply chain to support the region's air cargo traffic. A large portion of those goods are moved within the region to various industrial locations prior to being completed and exported outside the continent. That makes it particularly problematic to separate intra-Asia international traffic from traffic that is destined for outside the region.

### Unique market conditions

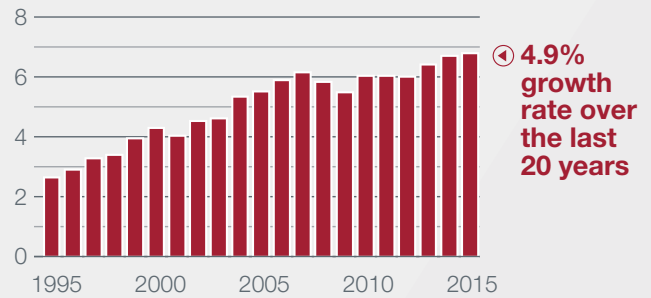
Air cargo in the region is critical to overcoming challenges of unique geographical location and topography.

Businesses are faced with a broad expanse of difficult terrain as they move goods throughout the region. Wide expanses of water and mountainous terrain are among the factors that can limit transportation options. As a result, the region remains highly dependent on air transport for economic growth despite rapid ground infrastructure development in China.

Goods that are in-progress and unfinished account for over half of the region's requirement for cargo services because these products move between factories within Asia during their production cycle. Many of the region's manufacturing centers are separated by water, which makes maritime transport an efficient alternative to meet

Intra-Asia air cargo growth improved despite sluggish post-recession economic performance

Tonnes  
in millions





shipping needs. Nonetheless, the development of national economies within the region will spur the continued growth of demand for air cargo services. The accompanying growth in per capita incomes will further increase the demand for the high-value industrial goods, consumer products, and perishables that are the core commodities of air cargo services.

Intra-Asia air cargo traffic is still relatively concentrated among a few high-volume market segments. However, secondary flows are growing faster, which is reducing the share of the top 10 pairs of regional trade partners to less than one-third of the total. Only one of the top 10 pairs doesn't include China, Hong Kong, Korea, or Taiwan. China plays a key role in the region's air cargo commerce and Hong Kong acts as a transitional hub for all of China. South Korea's economic importance is evident by its participation in both of the largest intra-Asia air cargo markets. Large freighters serving intercontinental markets link the largest intra-Asia markets and limit the need for regional freighters. There is ample lower-hold capacity on widebody passenger flights with the equivalent of more than 50 medium widebody freighter flights per week in the top 10 markets in this region.

Air cargo provides a rapid and dependable supply chain for raw materials, components, and subassemblies flowing between manufacturing centers. Air transport is also crucial to efficient production in the region's industries, and it will continue even though exports to North America and Europe are the primary source of Asia's air cargo growth. The efficiency of air shipments provide producers flexibility to take advantage of locally specialized skills, labor cost differentials, and optimal inventory practices.

### Economic performance and outlook

#### Regional demand grows as economic prospects improve.

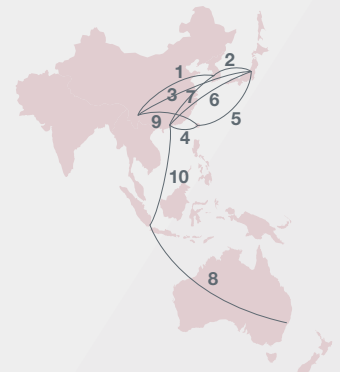
The region has a mix of mature and emerging markets where established Asian economic growth rates are still among the world's highest. Significantly lower fuel prices have reduced costs for operators but have posed challenges with lower yields as fuel surcharges have decreased. Opportunistic carriers have found profitability despite a minimal contraction of revenue. Intra-Asia trade continued to increase faster than the world growth rate despite muted gains from currency depreciation. Near-term projections show continuing increases in private consumption and regional market expansion.

The Asian economies in this region are projected to grow at an average annual rate of 3.7 percent over the next 20 years. China will continue to improve the aggregate outlook as GDP is expected to increase more than 5.0 percent per year while Japan is expected to show less than 1.0 percent improvement over the same period. China and Japan account for more than 70 percent of the region's GDP. China's share will continue to increase over the forecast period from 43 percent in 2015 to more

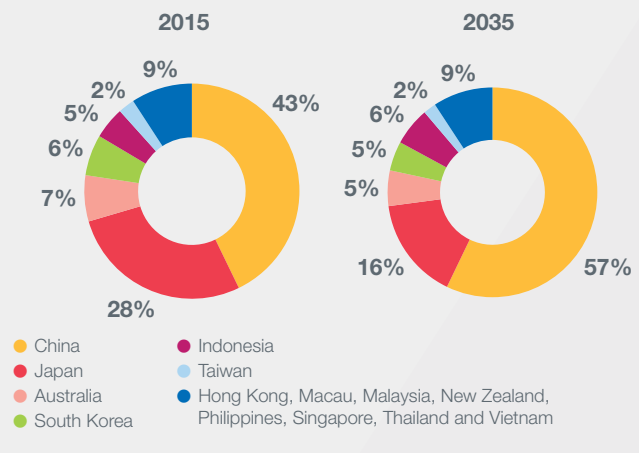
The top 10 economy pairs constitute nearly one-third of the Intra-Asia market

#### Top economy pairs for intraregional air cargo traffic

1. China-Korea
2. Japan-Korea
3. China-Japan
4. Hong Kong-Taiwan
5. Japan-Taiwan
6. Hong Kong-Japan
7. Hong Kong-Korea
8. Australia-Singapore
9. China-Taiwan
10. Hong Kong-Singapore



Mainland China continues growth as an Asian economic power



than 57 percent in 2035. Asia's overall GDP will more than double by 2035, and China will continue to lift the overall economic growth as it shifts to higher value region's manufactured goods, an improving services economy, and continued expansion and development of inland territories. However, economists warn that reliance on foreign consumption, global trade imbalances, protectionism, and political instability are potential concerns moving forward.

### Intra-Asia air cargo traffic forecast

Strong regional economic growth and global demand project long-term annual air cargo growth baseline of 5.5 percent through 2035.

Recent improvements in air cargo within the region demonstrate the strength of the region. Forecasts showing improved trade and continued robust GDP growth indicate expansion of air trade in the region. Increased consumption in the region combined with demand of intercontinental export markets support the forecast of 5.5 percent average annual air cargo growth. The estimated rate would be an improvement over the 4.9 percent annual growth over the previous 20-year period and would be a marked improvement over the 10-year historical rate of 2.1 percent that was impacted by the global economic downturn. Alternate GDP projections, increased and decreased by 0.5 percent, were assessed to provide low and high growth-rate scenarios.





## Regional Outlook

### SOUTH ASIA

For the purposes of this forecast, South Asia (sometimes referred to as the Indian Subcontinent) comprises Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka. Data from IATA, ICAO, European governments, the Indian government and airport statistics, the United Nations, and the US Department of Commerce are used to model South Asia air trade flows.

### South Asia air cargo flow exceeds 2.46 million tonnes per year

The South Asia air cargo market constitutes approximately 6.8 percent of the world's air cargo traffic in tonnage and 5.5 percent in tonne-kilometers.

South Asia continues to expand economically. In 2015, the region's collective economic growth rate of 7.0 percent was the highest of emerging markets. South Asia continues to be one of the largest population centers in the world with nearly one quarter of the world's population, more than 1.7 billion people. India is the international air trade hub of South Asia. Its population alone exceeds 1.3 billion people and the country possesses one of the 10 largest economies in the world.

The three largest air cargo trade flows account for 78 percent of the total South Asia international air cargo market. Asia Pacific is South Asia's leading air trade partner, accounting for 37 percent of the region's total air trade. Air trade with Asia Pacific grew 5.4 percent annually over the last three years to 918,000 tonnes in 2015.

Europe is South Asia's second largest trade partner. Air cargo tonnage between South Asia and Europe expanded 3.5 percent per year over the past decade to 531,000 tonnes in 2015. Foreign carriers transport much of the cargo to and from the region. In India, the largest air cargo market in the South Asia region, foreign carriers transported more than 80 percent of all international cargo to and from the country. Many cargo flights between Europe, the Middle East, and Asia incorporate intermediate stops in South Asia as an add-on service.

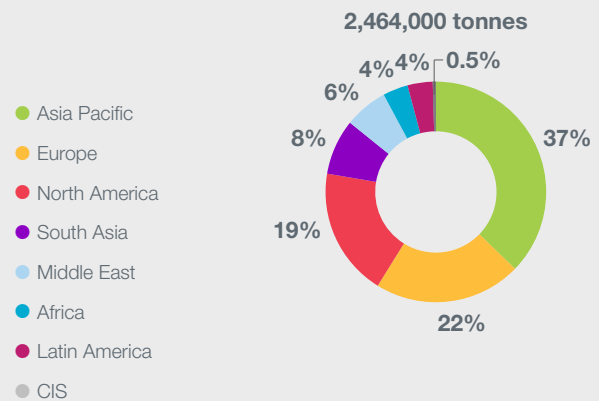
Overall air exports from the region comprise primarily apparel, perishables (including fish and vegetables), and pharmaceutical goods. The leading air imports to South Asia are machinery and electrical equipment, metals, and vegetable products.

### South Asia-Asia Pacific traffic

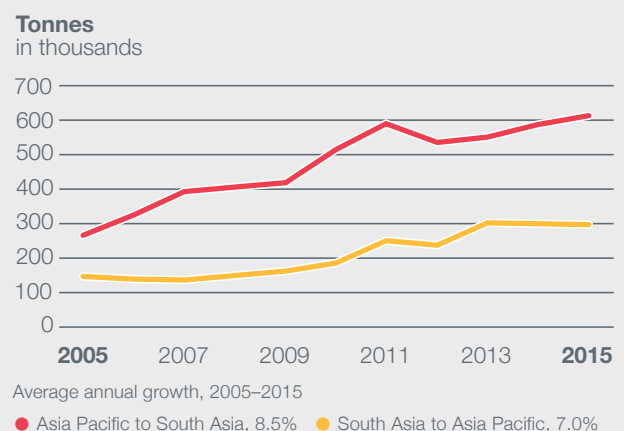
South Asia's air trade with Asia Pacific has grown 8.0 percent annually since 2005.

The imbalance in South Asia-Asia Pacific air trade has been increasing for the past decade. In 2015, South Asia's total air import tonnage outweighed air export tonnage by a ratio of more than two to one. Since 2012, overall air trade between South Asia and Asia Pacific has increased at 5.4 percent annually to 918,000 tonnes

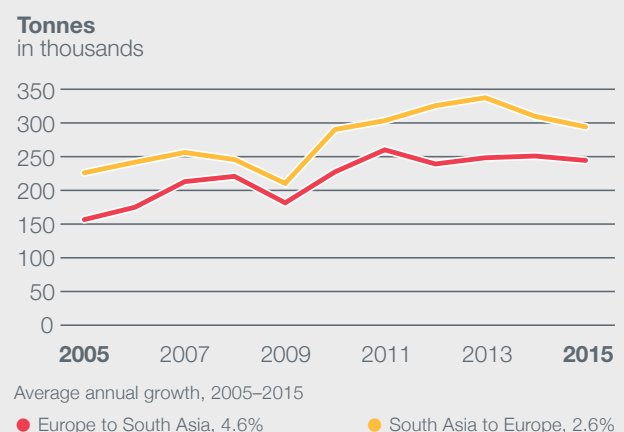
### Asia Pacific is the largest South Asia trade partner



### South Asia-Asia Pacific air trade grew 8.0% per year, 2005-2015



### South Asia-Europe air trade grew 3.5% per year, 2005-2015



from 784,000 tonnes in 2012. South Asia's leading air import commodities from Asia Pacific consist of vegetable products, metals, and electrical machinery. South Asia's air exports to Asia Pacific consist primarily of fish, vegetable products, metals, and pharmaceutical goods.

**South Asia-Europe traffic**

Air trade between South Asia and Europe has increased 3.5 percent per year since 2005.

The air cargo market between South Asia and Europe continues to favor exports over imports. Air exports from South Asia to Europe include apparel and textiles, fish, vegetable products, and pharmaceutical goods. The leading air imports from Europe to South Asia are machinery and electrical equipment, chemicals and related products (including pharmaceutical goods), computers and professional equipment, and metals and metal products.

**Domestic India traffic forecast**

The Indian domestic market has grown rapidly over the past decade, paralleling the development of the Indian economy. From 2005 to 2015, the domestic Indian air cargo market expanded at a 7.6 percent average annual rate. In 2015, domestic Indian air cargo increased 5.6 percent over the 2014 rate to 623,000 tonnes. The expansion is projected to continue at a rate of 6.7 percent per year from 2015 to 2035, when it will reach 2.3 million tonnes flown per year.

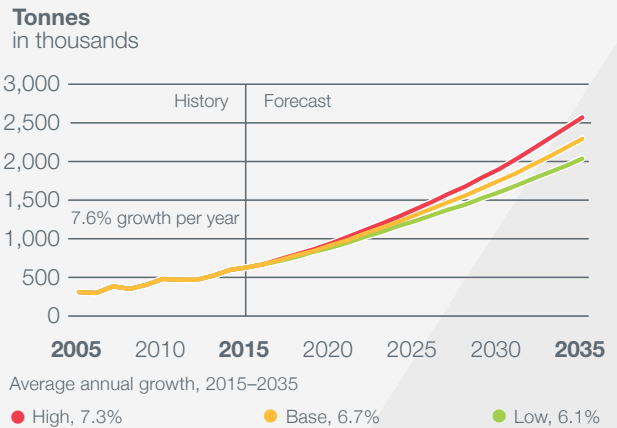
**South Asia-Asia Pacific air cargo traffic forecast**

Air trade with Asia Pacific is expected to continue to expand as the South Asian economies continue to develop. South Asia's GDP will grow 6.2 percent per year over the next 20 years.

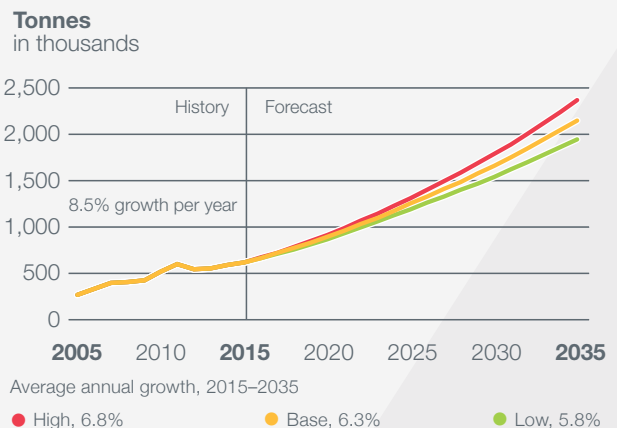
Base, low, and high models were developed to forecast the South Asia-Asia Pacific air cargo market. GDP projections of 0.5 percent below and above the baseline were assessed, and the results of these growth rates are reflected in the low- and high-growth scenarios.

Flows from Asia Pacific to South Asia will grow an average 6.3 percent per year in the base model. China will continue to be a leading air trade partner to South Asia. Flows from South Asia to Asia Pacific will expand 6.7 percent per year for the forecast period. India will play a major role in exporting goods to Asia Pacific as the "Make in India" initiative strives to transform India into a global design and manufacturing hub. Diversification into other industries bodes well for this trade lane.

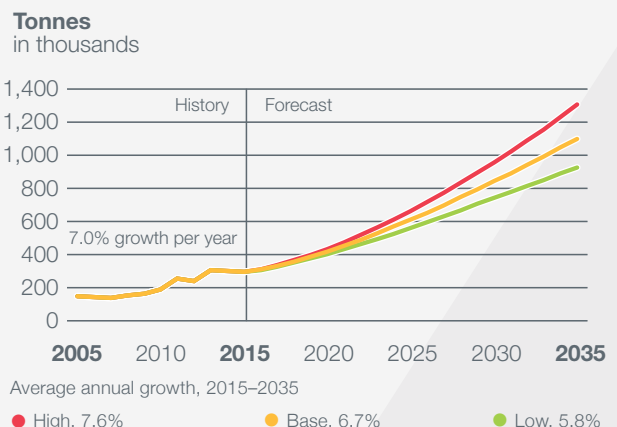
**Domestic India air trade will grow 6.7% per year**



**Asia Pacific-to-South Asia air trade will grow 6.3% per year**



**South Asia-to-Asia Pacific air trade will grow 6.7% per year**



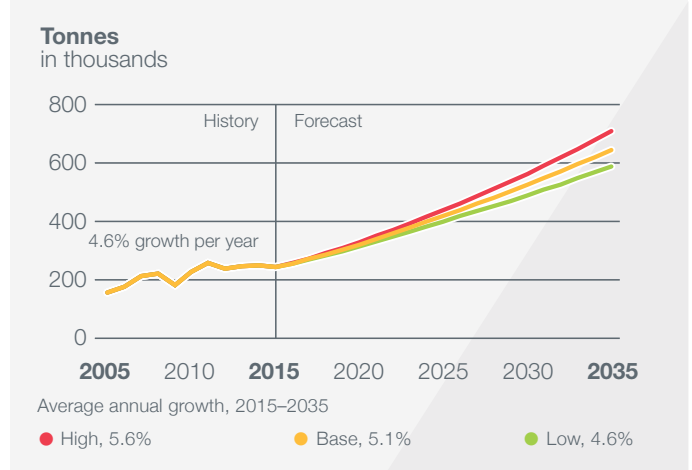
### South Asia-Europe air cargo traffic forecast

Air trade between South Asia and Europe is expected to continue to grow, driven by continued strong growth of the South Asia economies.

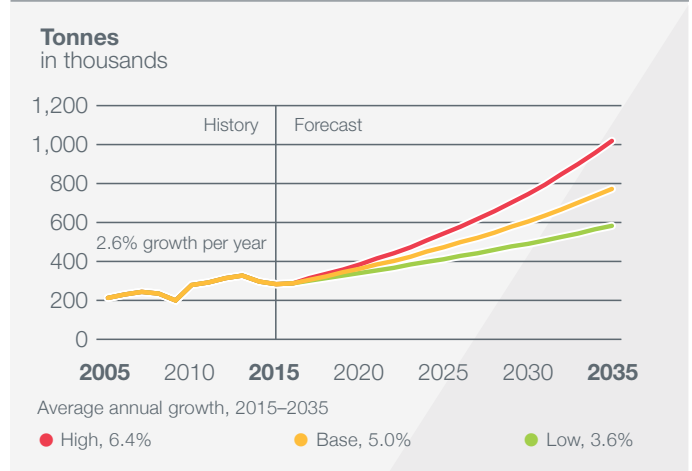
Air trade scenarios for South Asia, to and from Europe, were developed for baseline, low, and high economic growth rates. The low- and high-growth scenarios reflect GDP performance that falls 0.5 percent below and above baseline GDP projection.

Europe-to-South Asia flows are forecast to grow an average 5.1 percent per year in the base model. The growing population in South Asia will become moderately affluent, and eventually it is expected to demand increasing quantities and higher value of goods from Europe. South Asia-to-Europe flows will grow 5.0 percent per year during the forecast period. Continued privatization should make India's industry more cost competitive with its counterparts in Southeast Asia, leading to increased demand for South Asia's goods in Europe.

Europe-to-South Asia air trade will grow 5.1% per year



South Asia-to-Europe air trade will grow 5.0% per year





Regional Outlook

**COMMONWEALTH OF INDEPENDENT STATES**

The Commonwealth of Independent States (CIS) comprises 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. Although Georgia is no longer a member of the CIS, it is bound by common historical, business, and language ties.

**CIS air trade fell in 2014 and 2015**

The CIS market is estimated to account for approximately 1.2 percent of the world's total air cargo traffic in terms of tonne-kilometers and 2.2 percent in terms of tonnage.

Air trade originating in or destined to the CIS was estimated at 1.0 million tonnes in 2015, based on the region's airport statistics. Growth averaged 1.4 percent from 2005 to 2015, based on tonnage handled at airports. Principal markets in the region include domestic Russia, Europe, and Asia. Russia commands the largest share of regional air commerce because of its size and economic concentration. Helped by high oil and gas prices, CIS air trade expanded 50 percent after 2009, peaking at 1.3 million tonnes in 2011. Regional air trade remained nearly the same as 2011 levels in 2012, and then fell modestly in 2013. The contraction in CIS air cargo volumes gathered pace in 2014 and 2015 as investment in the region's extractive industries slowed, consumer spending fell, and trade sanctions were imposed on Russia for its support of the conflict in Ukraine.

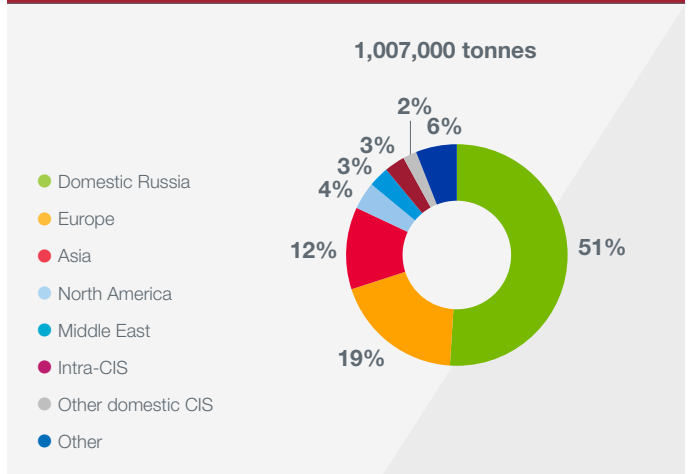
**Domestic air trade**

Domestic air trade is a vital part of commerce in this expansive region, particularly in Russia. In 2015, Russian domestic air cargo comprised about 510,000 tonnes, as reported by airports. As reported by airlines, however, the Russian air cargo flow totaled about one-half of this figure. The region's vast distances and relatively underdeveloped surface transportation links often necessitate air transport to move goods and industrial materials, especially to remote oil and gas extraction projects in the Arctic regions, Siberia, and the Russian Far East. Leading air freight cities, apart from Moscow, include Khabarovsk, Vladivostok, Novosibirsk, Norilsk, and St. Petersburg. The domestic markets of the other 11 CIS countries totaled 11,400 tonnes, as reported by airports.

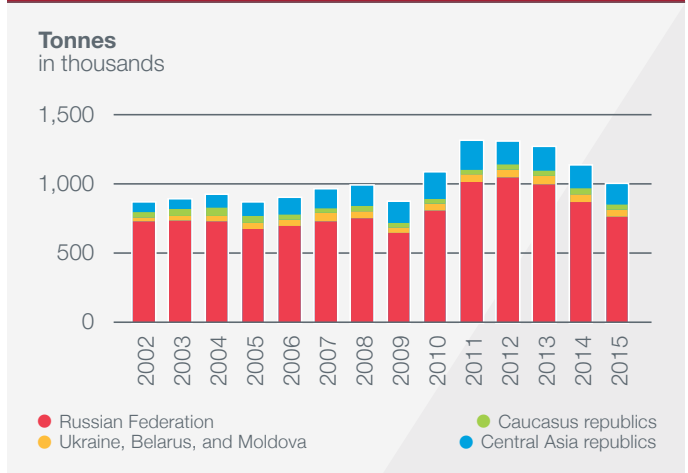
**International air trade**

International trade, including that among the nations within the region and with countries outside the region, accounts for 479,000 tonnes of CIS air cargo. Of that tonnage, 259,000 tonnes flow to and from Russia. Azerbaijan, Ukraine, Kazakhstan, and Uzbekistan account for most of the other 220,000 tonnes. CIS international air trade centers almost exclusively on Europe and the Asia Pacific nations.

Domestic Russia leads all CIS-related air trade



CIS airport air cargo traffic peaked in 2011, only to fall back 24% by 2015



### Imports to CIS

Demand for electronics, apparel, and other consumer goods, particularly from China, Japan, Korea, and Thailand, helps make CIS–Asia traffic one of the region’s strongest flows. However, Russia has implemented customs regulations since 2002 that have curbed direct air import to Russia from Asia, leading some importers to transport Russia-bound freight to nearby countries by air. The freight then enters Russia by truck.

The development of the region’s containership ports, particularly on the Baltic Sea, the Black Sea, and Russia’s Pacific coast, also dampens air imports to the region. From 2002 to 2012, container port activity grew quickly, averaging 11 percent per year, reducing the need to transport relatively low-value consumer goods by air. CIS container port activity peaked at an estimated 3.9 million 20-foot equivalent units (TEU) in 2012. More recently, economic weakness and trade sanctions pulled CIS port activity down to 3.2 million TEU in 2015, of which 67 percent were imports.

CIS–Europe traffic is a large market for this region. Total CIS air trade with Europe was 188,200 tonnes in 2015, of which about 142,500 tonnes were imports from Europe. CIS air imports consist primarily of luxury consumer goods and apparel, industrial machinery, automotive components, and pharmaceutical and medical products. CIS airborne exports to Europe totaled about 45,700 tonnes in 2015. Industrial machinery, industrial chemicals and metals, scientific instruments, and transportation equipment are the main products flown from the CIS to Europe.

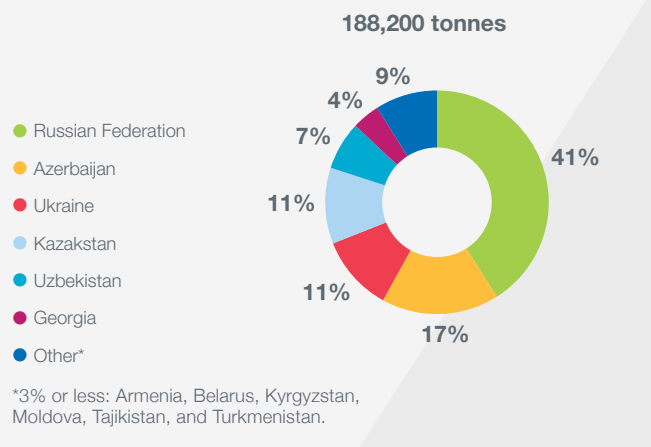
### Considerable non-CIS freight is transported by CIS carriers

To accurately assess CIS air cargo traffic volumes, it is necessary to distinguish between true origin-and-destination traffic and cargo flights that stop in the CIS in transit between countries outside the region. CIS-based operators carry a significant portion of the region’s international cargo on scheduled international flights that pass through the CIS.

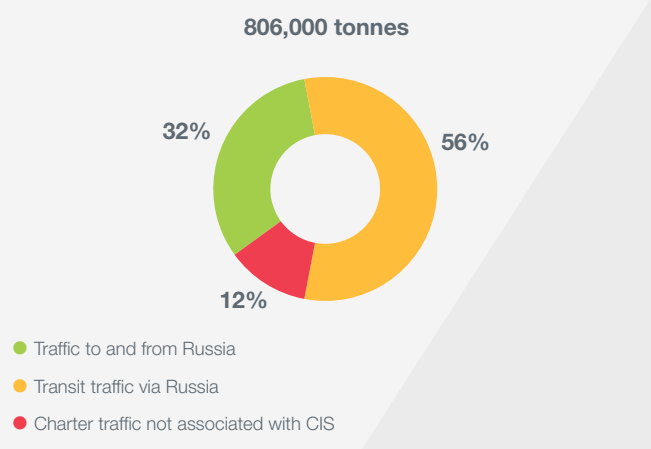
CIS-based operators also provide charter services for multinational firms and foreign governments, carrying freight to and from markets unconnected to the CIS. Russian airlines carried an estimated 547,000 tonnes of non-CIS international cargo in 2015, representing approximately 68 percent of the total international traffic on Russian carriers.

Some Russian-domiciled carriers take advantage of their central location to serve routes between Europe and Asia. In 2015, Russian carriers transported about 279,000 tonnes between Europe and Asia, transiting Russia without commercial stops inside the country.

Russia and Azerbaijan lead CIS air trade with Europe



Russia-domiciled carriers depend on international traffic flows



## Military-design freighters continue to be used for regional air trade

CIS-based airlines operate a significant number of former Soviet military turboprop and jet airplanes that are used to run charter freight flights.

Following the fall of the Soviet Union, the region saw a dramatic increase in the number of former Soviet 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 caused by the low acquisition cost of these aircraft.

The unique loading capabilities of CIS-built freighters, coupled with their ability to operate from airports with lagging infrastructure investment, has allowed operators to move freight that is dimensionally too large or too heavy for civilian widebody freighters via charter flights. A select group of carriers in Russia and Ukraine use very large ramp-loading military freighter aircraft to serve this specialized sector, which accounts for about 43,000 tonnes of freight annually worldwide. Most of this outsize cargo traffic does not originate or terminate in the CIS.

Over the past fifteen years, the number of CIS-built aircraft in service has declined as aging freighters are stored or fully retired. As of year-end 2015, nearly 150 CIS-built freighters are servicing cargo markets, a decline of approximately 130 aircraft over the previous decade. CIS-based airlines are augmenting or upgrading their fleets with Western-built freighters in response to aging airplanes, high fuel consumption, and community noise issues associated with their military freighters.

CIS-built aircraft still in service continue to be called upon for outsize cargo charter services around the world, predominately between Europe, North America, and Asia. Typical industries and groups served by these flights include humanitarian aid efforts, oil and gas extraction, aerospace manufacturing, electrical power generation, entertainment, or other infrastructure development projects.

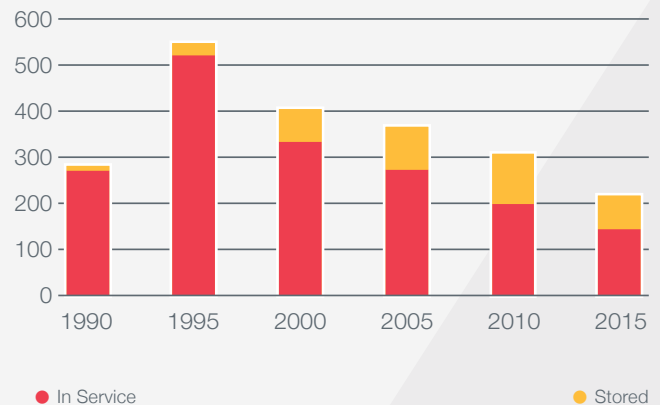
## CIS–Europe air cargo forecast

Assuming peaceful resolution of the ongoing conflict in eastern Ukraine, the CIS–Europe combined import and export air cargo market will grow at an average annual rate of 4.1 percent for the next two decades.

The continuing conflict in eastern Ukraine has cast a pall of uncertainty over the economic future of the entire CIS region. The current CIS air trade forecast assumes a peaceful resolution to this conflict by 2019.

CIS air imports from Europe are forecast to grow 4.2 percent per year, expanding from 142,500 tonnes in 2015 to 323,000 tonnes by 2035. This growth will continue to depend on petroleum prices and the development of the CIS middle class. If petroleum prices return to a forecasted

Nearly 150 CIS-manufactured military-design freighters remain in commercial service

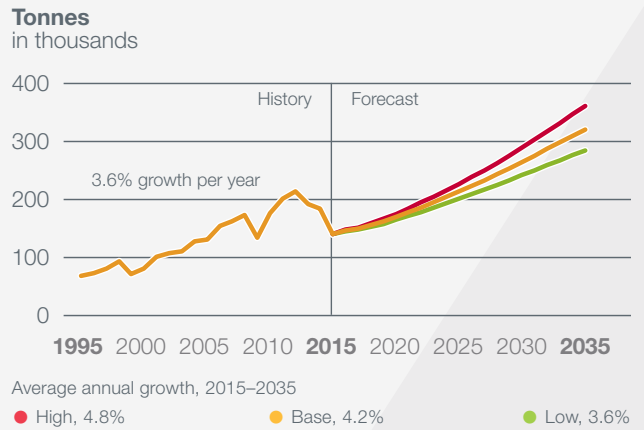




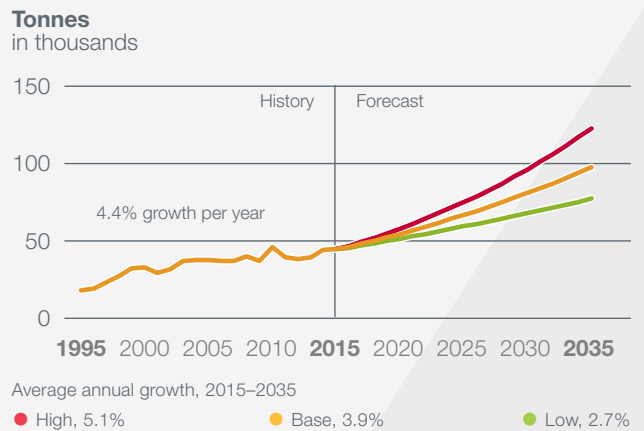
range of US\$60 to \$80 per barrel by 2019, CIS demand for European consumer goods, industrial equipment and spare parts, and oil and gas extraction equipment will remain strong. CIS air import traffic should then develop in accordance with the baseline forecast or even the high-growth projection. Conversely, continued weakness or decline in petroleum prices, a lack of CIS economic diversification, and continuing regional conflicts will drive the trend toward the low-growth projection.

CIS air exports to Europe will grow at a rate of 3.9 percent to reach 98,000 tonnes by 2035. European demand for CIS-produced specialty chemicals and industrial metals, specialized scientific equipment, and aerospace goods will bolster growth for the forecast period. Pro-business legislation and an improved foreign investment climate could promote an export-driven economy for a wide array of manufactured and semi-manufactured goods, leading to the high-growth projection. Conversely, continuing regional conflicts, laws and/or regulations adverse to new businesses, or renationalization of industries would impede air trade growth, leading to the low-growth projection.

Europe-to-CIS air trade will grow 4.2% per year



CIS-to-Europe air trade will grow 3.9% per year





## Regional Outlook

### DOMESTIC CHINA

For the purposes of this forecast, we define domestic China as the mainland, or what is commonly referred to as the People's Republic of China. The special administrative regions of Hong Kong and Macau are not examined in this section.

#### Domestic China air cargo traffic to grow 6.2 percent annually

China's domestic air cargo traffic currently accounts for an estimated 10.2 percent of the world's total air cargo traffic by tonnage, but only about 2.9 percent of the world market in terms of tonne-kilometers.

China has rapidly become the world's premier manufacturing center, with key industries producing commodities such as apparel and computing and telecommunication equipment. Most of these goods are intended for export and have traditionally been transported by air.

The tremendous increase in air trade with other countries throughout Asia, Europe, and North America has long been a major driver of growth in China's domestic air cargo traffic. During the past decade, consumer demand in China's rapidly developing large cities has become another important driver.

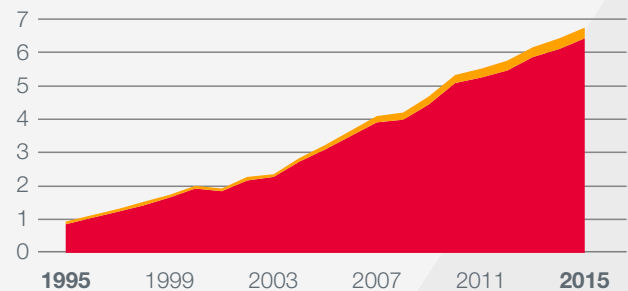
The types of goods transported on China's domestic routes vary by region of the country. In the southeastern provinces, especially in the Pearl River Delta, domestic air cargo consists largely of apparel, home electronics, telecommunication equipment, and light industrial products. From the eastern provinces, goods transported by air include textiles, apparel, electronics, perishable foods, and live animals. In the northern regions, apparel, electronics, and precision instruments are the primary commodities. And in the western provinces, pharmaceuticals, cashmere, cut flowers, and industrial equipment constitute the bulk of the cargo flow.

Strong economic growth, rising foreign investment, and extremely competitive labor rates stimulated 21.3 percent average annual growth in domestic air cargo throughout the 1990s. In 2015, China's domestic air cargo market grew only 4.9 percent, following growth of 4.4 percent in 2014, reflecting a lackluster global and China economic slowdown.

At 4.6 million tonnes transported annually, China's domestic air cargo market is second only to that of the United States. Scheduled freight accounts for 94.2 percent of China's domestic air cargo traffic. Mail accounts for the remaining 5.8 percent. Air cargo activity is concentrated in the coastal and southern provinces, where the bulk of the country's 1.4 billion people and \$8.8 trillion economy are situated.

Domestic China air cargo traffic has grown 10.4% per year since 1995\*

**RTKs**  
in billions



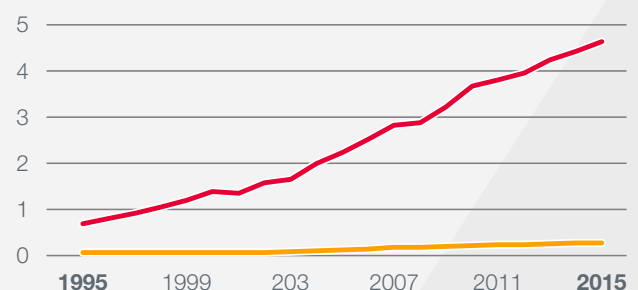
\*In terms of revenue tonne-kilometers.

● Freight

● Mail

China's domestic air cargo market is more than 4.0 million tonnes

**Tonnes of freight and mail**  
in millions



● Freight

● Mail

### China's e-commerce boom

China is the world's largest e-commerce market with US\$590 billion of goods sold in 2015, compared to the US at US\$342 billion. In 2010, China e-retail sales were half the size of the US market, but in three years the China market overtook the US to become the world's largest national e-commerce market. It's forecasted that by 2020, China's e-commerce market will be larger than the existing markets in the US, UK, Japan, Germany, and France combined.

China's GDP slowed 6.9 percent in 2015 after growing 7.3 percent and 7.7 percent in 2014 and 2013, respectively. Although China's economic growth slowed, the personal income of Chinese consumers continued to increase. The growth in consumer purchases reflects the rising standard of living and China's growing middle class.

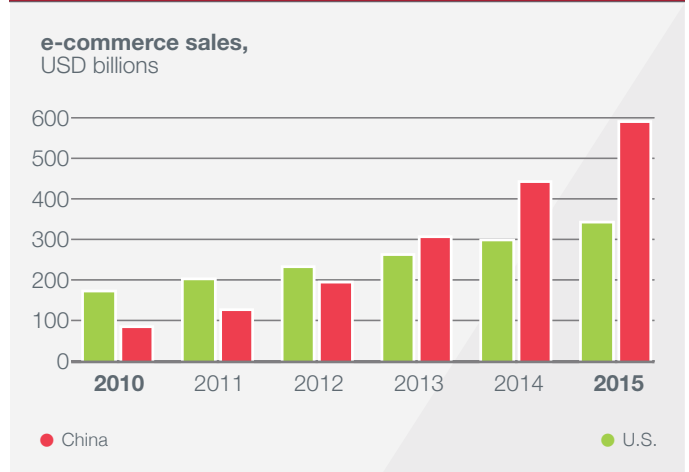
In 2015, China's consumers purchased RMB 3.2 trillion (US\$490 billion) of online retail sales of physical goods, an increase of 31.6 percent compared to 2014, according to the National Bureau of Statistics of China. Of the online retail sales of physical goods, food and clothing increased by 40.8 percent and 21.4 percent, respectively.

Alibaba Group Holding Ltd. reported a record US\$14.3 billion of total value of goods sold during the 24-hour Singles' Day shopping festival on November 11, 2015 — an increase of 53.7 percent over the previous year. In comparison, sales on Cyber Monday, which is the biggest online shopping day in the US, recorded US\$2.98 billion. Black Friday, which is the day following Thanksgiving Day in the US and is regarded as the beginning of the Christmas shopping season with promotional sales from most major retailers, recorded US\$2.74 billion.

China air express volume and revenue continue to expand. The number of parcels grew 55 percent per year and revenue grew 39 percent per year from 2010 to 2015. China Express Association reported that the number of parcels delivered in 2015 reached 20.2 billion, an increase of 49 percent over 2014 and up from 860 million in 2005.

The courier services now cover 70 percent of China's villages and towns. There are more than 60,000 express collection box locations served by 22,000 delivery trucks (added in 2015) and 80 737/757 in-service freighter airplanes. The goal of the States Post Bureau is to provide express delivery services to all villages and towns by 2020.

China online retail sales have overtaken the U.S. to become world's largest national e-commerce market



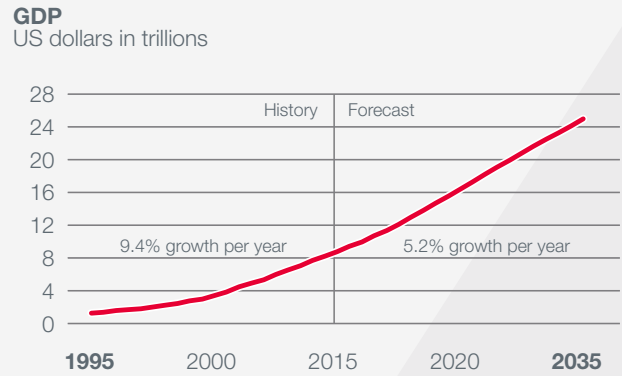
### Domestic China air cargo traffic is projected to expand

China's GDP is projected to grow 5.2 percent per year, on average, during the forecast period. Considering population growth predictions, per capita GDP is expected to exceed its current level by a factor of 2.7 in 20 years.

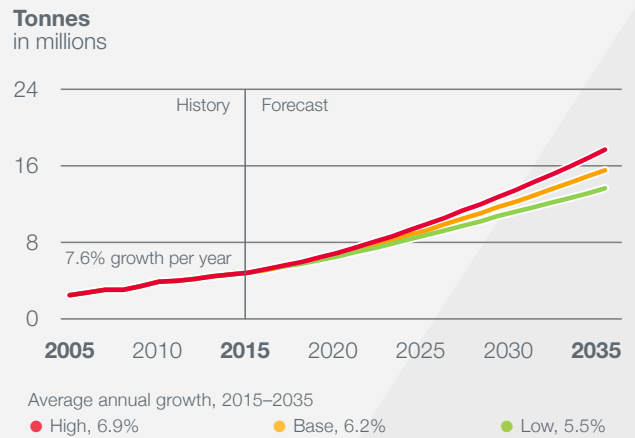
Base-, low-, and high-growth GDP models were developed to forecast China's domestic air cargo growth. The low- and high-growth air cargo scenarios reflect GDP projections for 0.5 percent below and 0.5 percent above the baseline GDP growth, respectively.

Overall, air trade within China will grow 6.2 percent annually for the forecast period, with growth most rapid in the first decade of the forecast period.

China's GDP is expected to increase 2.8 times over the next 20 years



Domestic China air cargo is forecast to grow 6.2% per year for the next 20 years





## Air cargo market and the role of freighters

Freighters comprise only 8 percent of the total commercial jet fleet, yet they carry over 50 percent of all air cargo traffic. Their essential role in the global supply chain is underpinned by a number of factors:

- Dedicated freighter services offer control over timing and routing that is unmatched by lower-hold capacity
- Reliability of air cargo services is measured in hours and minutes, not days, as it is in other modes of freight transport
- Freighters offer speed to market for high-value, time-sensitive products such as electronics, pharmaceuticals, fashion goods, and perishable commodities.
- Certain types of cargo cannot be carried in the lower holds of passenger flights, including outsize items, hazardous materials, and cold chain goods
- Mistakes and disruptions occur in the supply chain, creating urgent needs for intermediate goods. Although inexpensive telecommunications and sophisticated software mitigated these risks in recent years, the need for expedited shipments has not been eliminated.
- Major centers of cargo traffic may be located in places without much international passenger demand or service – for such locations, freighters are the most efficient form of cargo transport

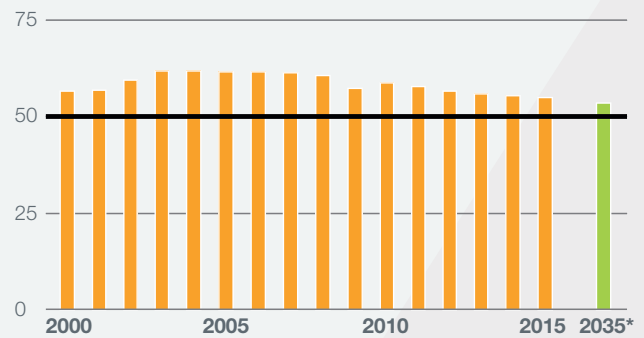
Ninety percent of all air cargo revenues are earned by airlines that operate freighters. Without freighters in the network, an airline's cargo operations cannot compete effectively against the alternatives.

## Fleet forecast methodology

The freighter fleet forecast incorporates the results of Boeing's Current Market Outlook 2016 ([www.boeing.commercial/cmo](http://www.boeing.commercial/cmo)) and builds on Boeing's cargo traffic forecasts, allocating traffic (RTKs) to maindeck and lower-hold services, then to airlines and domicile groups, and finally to equipment types. Results are checked for balance by traffic flow, operator domicile, equipment type, airline market share, and manufacturer/converter capacity. Numerous data inputs include airline cargo traffic data from multiple sources, current business intelligence, and the strategic direction of key players in the industry. Our forecast allows for changes in industrial structure and the strategies of industry players; it is not a simple extension of current trends.

## Freighters carry more than half of air cargo traffic

World RTKs carried on freighters by percentage



\*forecasted

## Freighter fleet will increase by more than half; Standard-body freighters gain share



## Types of freighters

The freighter fleet forecast groups airplanes by capacity, as measured in metric tons.

Standard body freighters are those with less than 45 tonnes of carrying capacity. Fuselage cross-sections are those of 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 production, with the product mix influenced by operator requirements as well as feedstock availability.

Large freighters are those with 80 tonnes of capacity or more. Although large freighters were historically sourced from both the conversion and factory-production channels, in the future we believe that demand in this segment will favor factory production.

## Freighters for replacement and growth

The freighter fleet forecast calls for 3,010 airplanes in service by 2035, an increase of 70 percent over the in-service 2015 fleet of 1,770.

During that time, we forecast 1,130 retirements of older and less efficient types, which will create demand for replacement by new conversions and production airplanes.

In addition, we forecast that 1,240 airplanes will be required for growth. Doubts about the future growth of air cargo have been expressed in the press, but we believe that this negativity is driven by short-term concerns and trends. Longer-term, we expect an increasingly connected world in which goods and people will move more freely than they do today. Passenger lower-hold capacity is an imperfect substitute for the critical advantages of freighter services and the need for dedicated freighters will continue.

## Cargo airlines – cargo specialists and “general market” operators

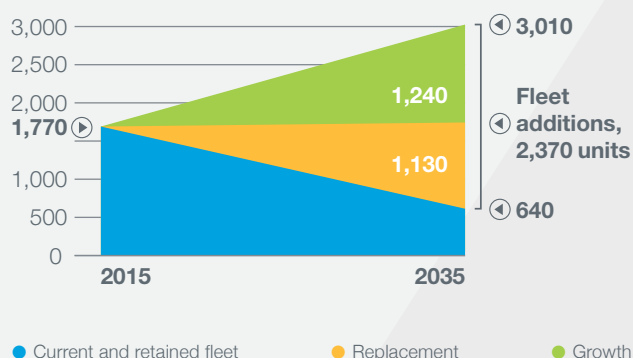
Cargo specialists only operate freighters. They may, or may not, contract with passenger airlines for use of lower-hold capacity. Such players are strong competitors in market niches with specialized requirements, such as oversized cargo or cold chain.

General market operators are often “combination” carriers, flying both passengers and cargo. Lower holds on passenger flights are used to feed freighter flights. Passenger airlines that operate freighters achieve much better load factors in the lower hold than do passenger airlines that carry cargo but do not operate freighters, emphasizing the critical role that freighters play in creating effective cargo networks.

Both operator types tend to use their freighters in similar ways, flying relatively short stages, loading and offloading

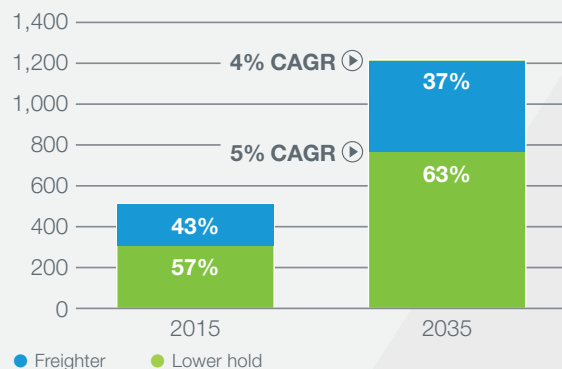
## Freighter fleet additions for growth and replacement

Freighter aircraft in units



## Growth in capacity shifting slightly toward lower hold

Annual ATKs in billions



cargo at various points along a general route, in a pattern often referred to as “load building”. Sixth freedom cargo hubs are also a 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 airplane utilization rates, and are successful at building loads that fully utilize the structural and volumetric capabilities of the aircraft. These airlines emphasize unit costs over acquisition costs resulting in a preference for large, capable, factory-built freighters.

## Cargo airlines – Express

Express carriers have different business models, moving large numbers of smaller shipments, and using other modes of transport to reach the final recipient. For these carriers, the average cargo density (weight/unit volume) is less than for the general freight operators. The time definite services provided by express carriers provide higher yields, and utilization rates (flight hours per day) can be very low without impacting profitability. Networks tend to be of the hub-and-spoke variety, with flights arriving at the central hub at night and departing again to facilitate the morning’s 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 general freight operators, express operators tend to balance unit cost against acquisition cost and the need to cover routes in the network with daily frequencies or better. These airlines fly a mix of freighters, with sizes ranging from small to large, sourcing airplanes opportunistically from conversion suppliers or from airframe manufacturers. Due to this unique focus on the balance of capability, acquisition cost, and unit cost, the express carriers use medium freighters to a greater extent than other cargo airlines. Express carriers also require large numbers of standard body freighters, sourced through the conversion channel, to support the lower-volume nodes in their networks.

## Freighter size categories

| <b>Standard body</b><br><45 tonnes | <b>Medium widebody</b><br>40–80 tonnes | <b>Large</b><br>>80 tonnes |
|------------------------------------|--|----------------------------|
| 707                                | 767 series                             | 747 series                 |
| 727 series                         | 787                                    | 777 series                 |
| 737 series                         | A300 series                            | A350                       |
| 757                                | A310 series                            | AN-124                     |
| A320 series                        | A330 series                            | I196-T                     |
| BAe-146                            | DC-10 series                           | MD-11                      |
| DC-8 series                        | Il-76TD                                |                            |
| DC-9 series                        |  |                            |
| MD-80 SF                           |  |                            |
| Tu-204                             |  |                            |

## Emerging markets and start-ups

Emerging market cargo airlines and start-ups share some common attributes:

- They often serve markets with small cargo volumes
- Their networks are still in early stages of development, limiting opportunities for load-building and 6th freedom operations
- They are more sensitive to acquisition costs than to operating costs

Due to the small cargo volumes and acquisition cost sensitivity, start-ups and emerging market operators gravitate towards 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 converting airplane types that have not proved popular in passenger operations, more conversions are based on types that have widespread use in the passenger market. One consideration is feedstock – the more popular passenger airplanes will become readily available for conversion as they are released from passenger airlines, as there are simply more of them in the fleet. But feedstock availability does not provide the whole story – other factors such as required structural modifications or technical issues may limit the passenger to freighter conversion viability of an airplane type.

## The regional outlook

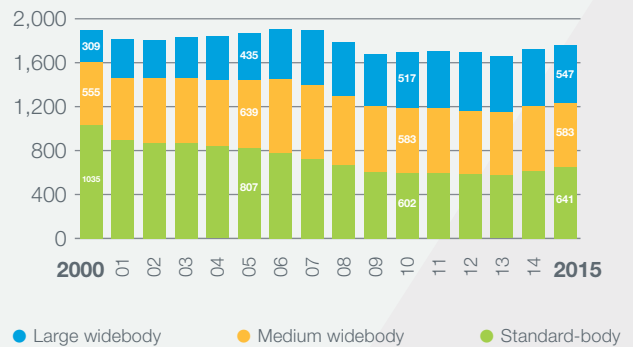
As the engine of global economic growth, the Asia-Pacific region will be the largest market for new and converted freighters in the next 20 years. Notable developments include the build-out of express networks within China, fuelling demand for standard body freighter conversions, and the continued importance of cargo-intensive international routes, supporting the need for large freighters, for growth and the replacement of existing fleet. Most of these will be new, purpose-built aircraft.

North America is the second-largest market for freighter deliveries, with needs driven mainly by express carriers domiciled in the USA. As noted above, these airlines will require a large number of medium widebody freighters, supporting a balance of moving cargo with relatively low-density cargo volumes, and providing daily flights to connect all network nodes. We expect that these airplanes will be mainly sourced as purpose-built aircraft rather than conversions, although the decisions of key industry players can influence the product mix.

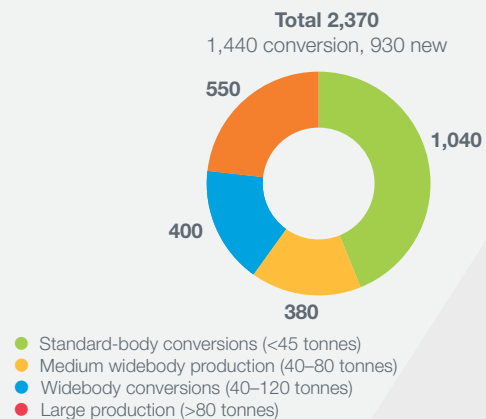
Large freighter demand in Europe, the CIS, and the Middle East is supported by several all-cargo and combination carriers domiciled in these regions, who provide 6th-freedom freight services, and who operate networks that have are global in scope.

## Up-gauging of freighter fleet size continues

Freighter fleet units



## Freighter market will require 2,370 additional freighters



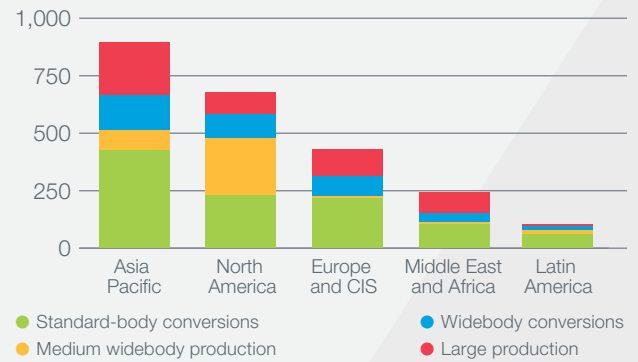


## The future of freighters

Although the air cargo industry suffered setbacks in the aftermath of the global financial crisis, and renewed growth has been slow to come, these conditions should be viewed within the larger context of the way the world, its economies, and its production systems are developing. “On demand” provision of goods and services is becoming the standard in entertainment (streaming video), mobility (ride sharing services), and small retail items (same day delivery of on-line orders). Goods and services are increasingly internationalized – Smart phones are designed in the USA, manufactured in China, and sold throughout the world, while call centers in India and the Philippines handle increasing shares of customer service and technical support needs. In such a world – faster-paced, more international, more dependent on connections between regions – air cargo will remain a vital service for global business. If the cargo networks of the future are to be fast, reliable and effective, they must, as they do today, include freighters.

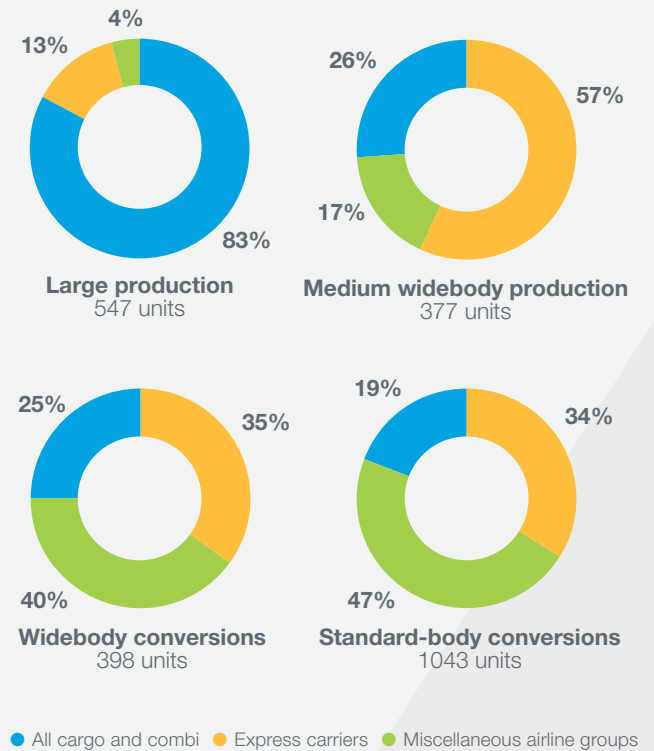
Freighter deliveries vary by region  
New and converted airplanes, 2016-2035

Number of airplanes



Large freighters to general carriers;  
medium widebodies to express carriers

2016–2035, new and converted



# Glossary

|  |  |
|--|--|
| <b>A4A</b>   | Airlines for America   |
| <b>AAPA</b>  | Association of Asia-Pacific Airlines   |
| <b>ACI</b>   | Airports Council International   |
| <b>ACMG</b>  | Air Cargo Management Group   |
| <b>AEA</b>   | Association of European Airlines   |
| <b>Aircraft, crew, maintenance, and insurance (ACMI)</b> | Package (or wet) lease of an airplane. The package includes the airplane, crew, maintenance, and insurance but excludes fuel.  |
| <b>ATA</b>   | Air Transport Association  |
| <b>Air freight</b>                                       | Goods shipped that do not include mail.  |
| <b>Available tonne-kilometer (ATK)</b>                   | One tonne of available freight capacity for one kilometer. Basically, the number of tonnes that can be carried multiplied by the number of kilometers flown.   |
| <b>Brexit</b>  | Stands for “British Exit,” a referendum for the United Kingdom to no longer be a member of the European Union. The vote passed in June 2016.   |
| <b>Business to consumer (B2C)</b>                        | Business transactions between a company and the end consumers of its products.   |
| <b>CAAC</b>  | Civil Aviation Administration of China   |
| <b>CAGR</b>  | Compound annual growth rate  |
| <b>Cargo</b>   | Freight, express, and airmail (for the purposes of this document).   |
| <b>Chartered operations</b>                              | Reservation of an aircraft for private transport of goods and/or people.   |
| <b>Combi (Combination)</b>                               | An airplane capable of simultaneously carrying passengers and cargo on the main deck.  |
| <b>Combination carrier</b>                               | A commercial operator (scheduled and chartered) that carries both passengers and cargo on revenue flights. Most do so on passenger airplanes with cargo in the lower hold, but many of the world’s largest cargo carriers also operate freighters in addition to passenger airplanes.  |
| <b>CRSL</b>  | Clarkson Research Services Limited   |
| <b>Daily shipment count</b>                              | An alternative method of recording revenue cargo traffic volume in addition to more conventional measures such as weight (e.g., tonnes and tons) and combining weight with distance (e.g., revenue tonne-kilometers and revenue tonne -miles). Most often used by integrated (express) carriers because their business is composed largely of smaller parcels. |
| <b>Developing economies</b>                              | Countries with a less developed industrial base and relatively low per capita income.  |
| <b>East-west market</b>                                  | For the purposes of this forecast, we define east-west markets as the bidirectional cargo flows connecting Asia and North America, Europe and Asia, and Europe and North America.  |
| <b>e-commerce</b>  | Transaction of goods or services that takes place electronically using the Internet.   |

|  |   |
|--|---|
| <b>European Union (EU)</b>             | A political and economic region in Europe that currently consists of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom. |
| <b>Express</b>                         | Cargo with a guaranteed or time-definite service component. Express carriers usually are characterized as integrated because, in addition to carrying mostly airport-to-airport, time-definite cargo, they also offer many other services, such as door-to-door pickup and delivery.  |
| <b>Feedstock</b>                       | Used passenger aircraft available and ready to convert to freighters.   |
| <b>Foreign direct investment (FDI)</b> | Investment in a country's manufacturing or service sector by an entity domiciled in another country. Normally a holding of 10 percent or more in an enterprise.   |
| <b>Freight forwarder</b>               | Entity that organizes the shipment of goods from originating company to end market, consumer, or distribution location.   |
| <b>Freight tonne-kilometer (FTK)</b>   | One tonne of cargo carried one kilometer.   |
| <b>Gross domestic product (GDP)</b>    | The total output of goods and services of a country.  |
| <b>Global economic downturn</b>        | The most severe period of economic contraction since the Great Depression. Exacerbated by the mid-2008 doubling of fuel prices, culminating in financial collapse during 2009. Full calendar-year, aggregate worldwide GDP declined 2 percent.  |
| <b>IATA</b>                            | International Air Transport Association   |
| <b>ICAO</b>                            | International Civil Aviation Organization   |
| <b>Integrator</b>                      | A cargo company that offers its customers complete services: pickup, airport-to-airport transport, delivery, and all the supporting ancillary services. Usually synonymous with a carrier that provides express services.   |
| <b>Jet fuel price</b>                  | Price for a one-time open market transaction covering immediate delivery purchased at current market rates.   |
| <b>Load factor</b>                     | Revenue tonne-kilometers divided by available tonne-kilometers.   |
| <b>Maritime transport</b>              | Shipment of goods by sea.   |
| <b>OAG</b>                             | Official Airline Guide  |
| <b>Outsize cargo</b>                   | Freight that is larger than can be accommodated on standard pallets. It is often carried by a nose door-equipped 747 or a purpose-built Russian freighter.  |
| <b>Pacific Rim</b>                     | For the purposes of this document, the major Asia-Oceania economies: Australia, Indonesia, Japan, South Korea, Malaysia, New Zealand, China (including Hong Kong and Macau), the Philippines, Singapore, Taiwan, and Thailand.  |
| <b>Payload</b>                         | Carrying capacity of an aircraft.   |
| <b>Protectionism</b>                   | Act of defending against foreign investment and competition by taxing or restricting imports.   |

|                                      |  |
|--------------------------------------|--|
| <b>Revenue tonne-kilometer (RTK)</b> | One tonne of revenue freight carried one kilometer. Usually used interchangeably with freight tonne-kilometer but can include passenger weight for total revenue.  |
| <b>Schengen agreement</b>            | An agreement initially ratified by Belgium, France, Germany, Luxembourg, and the Netherlands on June 19, 1990. The agreement exempts the citizens of signatory nations from customs inspections. Other countries have since ratified the agreement.                            |
| <b>Scheduled operations</b>          | Aircraft flights operated on a pre-determined schedule.  |
| <b>Sea-air market</b>                | A market in which cargo is transported from origin to destination by sea and air, taking advantage of the lower cost by ship between seaports and the speed of air over landmasses to balance time and cost.   |
| <b>Sixth freedom</b>                 | The right to carry passengers or cargo from a second country to a third country by stopping in one's own country.  |
| <b>Southeast Asia</b>                | Thailand, Malaysia, Indonesia, and Singapore.  |
| <b>Top-down approach</b>             | An analysis technique that begins with a broader (macro) perspective and applies trends and conclusions to more specific situations.   |
| <b>TRADE</b>                         | Boeing Foreign Trade Database  |
| <b>Truck flight</b>                  | Also known as "road feeder service" or "RFS." Cargo that is transported by surface, usually by a dedicated truck, on an airway bill. Carriage between origin and destination may be exclusively by surface or also may feed into airport-to-airport or surface transportation. |
| <b>Twenty-foot equivalent unit</b>   | A unit of measure representing a standard, usually seaborne, shipping container approximately 20 feet long and 8 feet wide. Often transferred between modes of transportation.   |
| <b>UNCTAD</b>                        | United Nations Conference on Trade and Development   |
| <b>US</b>                            | United States  |
| <b>USDOT</b>                         | United States Department of Transportation   |
| <b>Utilization</b>                   | Amount of time that an aircraft is used per unit of time.  |
| <b>Wet lease</b>                     | An arrangement that covers all facets of operating an airplane on a carrier's behalf. Includes the airframe, crew, and most, if not all, of the airplane-related expense items.  |
| <b>WACF</b>                          | World Air Cargo Forecast   |
| <b>WTO</b>                           | World Trade Organization   |
| <b>Yield</b>                         | Airline revenue as measured in units of aggregated weight and distance (e.g., revenue per tonne-kilometer). Inclusion of surcharges, usually security or fuel or both, varies by the carrier reporting.  |

## World airlines by region of domicile RTKs in millions

|                         | 2005          | 2006          | 2007          | 2008          | 2009          | 2010          | 2011          | 2012          | 2013          | 2014          | 2015*         |
|-------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| <b>Africa</b>           |               |               |               |               |               |               |               |               |               |               |               |
| Scheduled freight       | 2,034         | 2,394         | 2,380         | 1,984         | 1,902         | 2,555         | 2,484         | 2,906         | 2,973         | 3,165         | 3,170         |
| Charter freight         | 1,938         | 370           | 246           | 349           | 285           | 336           | 344           | 179           | 99            | 125           | 142           |
| Mail                    | 60            | 50            | 241           | 276           | 250           | 55            | 57            | 62            | 79            | 71            | 70            |
| <b>Total</b>            | <b>4,031</b>  | <b>2,814</b>  | <b>2,867</b>  | <b>2,609</b>  | <b>2,436</b>  | <b>2,946</b>  | <b>2,886</b>  | <b>3,147</b>  | <b>3,151</b>  | <b>3,361</b>  | <b>3,382</b>  |
| <b>Asia and Pacific</b> |               |               |               |               |               |               |               |               |               |               |               |
| Scheduled freight       | 63,670        | 67,085        | 71,610        | 67,312        | 62,724        | 77,512        | 74,649        | 69,884        | 69,330        | 74,395        | 75,840        |
| Charter freight         | 623           | 756           | 678           | 285           | 523           | 843           | 627           | 1,094         | 778           | 571           | 831           |
| Mail                    | 1,396         | 1,451         | 1,577         | 1,722         | 1,695         | 1,837         | 1,964         | 1,968         | 2,168         | 2,510         | 2,649         |
| <b>Total</b>            | <b>65,689</b> | <b>69,291</b> | <b>73,864</b> | <b>69,319</b> | <b>64,942</b> | <b>80,193</b> | <b>77,240</b> | <b>72,946</b> | <b>72,276</b> | <b>77,476</b> | <b>79,319</b> |
| <b>CIS</b>              |               |               |               |               |               |               |               |               |               |               |               |
| Scheduled freight       | 1,489         | 1,690         | 2,381         | 2,644         | 2,785         | 3,898         | 4,508         | 5,059         | 5,263         | 5,680         | 6,526         |
| Charter freight         | 1,858         | 1,776         | 1,389         | 1,451         | 1,148         | 1,253         | 1,108         | 853           | 697           | 604           | 474           |
| Mail                    | 42            | 44            | 53            | 55            | 61            | 76            | 90            | 101           | 112           | 120           | 120           |
| <b>Total</b>            | <b>3,389</b>  | <b>3,511</b>  | <b>3,823</b>  | <b>4,150</b>  | <b>3,994</b>  | <b>5,227</b>  | <b>5,706</b>  | <b>6,012</b>  | <b>6,071</b>  | <b>6,404</b>  | <b>7,120</b>  |
| <b>Europe</b>           |               |               |               |               |               |               |               |               |               |               |               |
| Scheduled freight       | 36,626        | 38,081        | 39,516        | 38,460        | 32,715        | 37,525        | 39,459        | 40,958        | 41,160        | 41,983        | 40,705        |
| Charter freight         | 3,943         | 4,850         | 5,247         | 5,212         | 4,149         | 4,140         | 4,081         | 1,371         | 1,395         | 1,198         | 1,186         |
| Mail                    | 1,067         | 1,065         | 1,082         | 1,079         | 1,036         | 945           | 1,016         | 1,054         | 1,130         | 1,184         | 1,231         |
| <b>Total</b>            | <b>41,637</b> | <b>43,995</b> | <b>45,845</b> | <b>44,751</b> | <b>37,899</b> | <b>42,610</b> | <b>44,556</b> | <b>43,383</b> | <b>43,686</b> | <b>44,365</b> | <b>43,121</b> |
| <b>Latin America</b>    |               |               |               |               |               |               |               |               |               |               |               |
| Scheduled freight       | 5,406         | 4,762         | 5,182         | 4,784         | 4,556         | 5,608         | 6,252         | 5,992         | 6,920         | 6,978         | 6,680         |
| Charter freight         | 233           | 375           | 585           | 240           | 215           | 249           | 150           | 105           | 89            | 89            | 91            |
| Mail                    | 126           | 113           | 115           | 81            | 48            | 56            | 95            | 134           | 132           | 148           | 204           |
| <b>Total</b>            | <b>5,765</b>  | <b>5,250</b>  | <b>5,881</b>  | <b>5,106</b>  | <b>4,819</b>  | <b>5,913</b>  | <b>6,497</b>  | <b>6,231</b>  | <b>7,141</b>  | <b>7,215</b>  | <b>6,975</b>  |

\*Preliminary.

|                       | 2005           | 2006           | 2007           | 2008           | 2009           | 2010           | 2011           | 2012           | 2013           | 2014           | 2015*          |
|-----------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| <b>Middle East</b>    |                |                |                |                |                |                |                |                |                |                |                |
| Scheduled freight     | 9,190          | 10,329         | 11,814         | 12,639         | 12,832         | 16,235         | 17,626         | 20,092         | 22,570         | 24,849         | 27,962         |
| Charter freight       | 98             | 267            | 300            | 467            | 161            | 165            | 163            | 161            | 220            | 162            | 177            |
| Mail                  | 131            | 159            | 191            | 229            | 246            | 271            | 165            | 135            | 161            | 228            | 333            |
| <b>Total</b>          | <b>9,419</b>   | <b>10,755</b>  | <b>12,305</b>  | <b>13,335</b>  | <b>13,239</b>  | <b>16,671</b>  | <b>17,954</b>  | <b>20,388</b>  | <b>22,951</b>  | <b>25,239</b>  | <b>28,472</b>  |
| <b>North America</b>  |                |                |                |                |                |                |                |                |                |                |                |
| Scheduled freight     | 39,966         | 41,697         | 41,818         | 39,744         | 34,818         | 39,497         | 39,695         | 39,285         | 37,507         | 38,878         | 37,871         |
| Charter freight       | 7,415          | 6,503          | 6,496          | 6,461          | 5,437          | 7,029          | 7,913          | 8,762          | 9,769          | 9,537          | 10,253         |
| Mail                  | 4,109          | 4,214          | 3,977          | 3,995          | 3,564          | 3,657          | 3,787          | 3,821          | 4,043          | 4,093          | 4,371          |
| <b>Total</b>          | <b>51,490</b>  | <b>52,414</b>  | <b>52,291</b>  | <b>50,200</b>  | <b>43,819</b>  | <b>50,183</b>  | <b>51,395</b>  | <b>51,868</b>  | <b>51,319</b>  | <b>52,507</b>  | <b>52,495</b>  |
| <b>South Asia</b>     |                |                |                |                |                |                |                |                |                |                |                |
| Scheduled freight     | 1,723          | 1,823          | 1,814          | 2,038          | 1,948          | 2,565          | 2,563          | 2,389          | 2,516          | 2,537          | 2,471          |
| Charter freight       | 0              | 0              | 0              | 0              | 0              | 0              | 0              | 0              | 0              | 0              | 0              |
| Mail                  | 57             | 46             | 57             | 76             | 87             | 86             | 61             | 55             | 52             | 63             | 68             |
| <b>Total</b>          | <b>1,781</b>   | <b>1,870</b>   | <b>1,871</b>   | <b>2,114</b>   | <b>2,036</b>   | <b>2,650</b>   | <b>2,624</b>   | <b>2,444</b>   | <b>2,568</b>   | <b>2,600</b>   | <b>2,539</b>   |
| <b>World airlines</b> |                |                |                |                |                |                |                |                |                |                |                |
| Scheduled freight     | 160,105        | 167,862        | 176,515        | 169,604        | 154,281        | 185,395        | 187,238        | 186,565        | 188,239        | 198,464        | 201,224        |
| Charter freight       | 16,108         | 14,896         | 14,940         | 14,466         | 11,917         | 14,016         | 14,386         | 12,525         | 13,047         | 12,286         | 13,154         |
| Mail                  | 6,987          | 7,141          | 7,292          | 7,515          | 6,986          | 6,983          | 7,235          | 7,331          | 7,877          | 8,418          | 9,046          |
| <b>Total</b>          | <b>183,201</b> | <b>189,900</b> | <b>198,747</b> | <b>191,585</b> | <b>173,185</b> | <b>206,393</b> | <b>208,858</b> | <b>206,420</b> | <b>209,163</b> | <b>219,168</b> | <b>223,423</b> |

\*Preliminary.





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