BOEING

Commercial Market Outlook
2019–2038

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Executive Summary
2019–2038

2,240 Deliveries
$105 Billion
Regional Jet

32,420 Deliveries
$3,775 Billion
Single Aisle

8,340 Deliveries
$2,630 Billion
Widebody

1,040 Deliveries
$300 Billion
Freighter

44,040
World Deliveries
2038 Total Fleet: 50,660

3.4%
Fleet Growth

2.7%
GDP Growth

4.6%
Traffic Growth

$6,810B
Airplane Market Value

4.1%
Service Growth

$9,100B
Services Market Value

North America
9,130 Deliveries
2038 Total Fleet: 10,930
Service Market Value: $1,865B

Europe
8,990 Deliveries
2038 Total Fleet: 9,340
Service Market Value: $1,980B

Russia and Central Asia
1,280 Deliveries
2038 Total Fleet: 1,940
Service Market Value: $270B

Latin America
2,960 Deliveries
2038 Total Fleet: 3,380
Service Market Value: $500B

Africa
1,160 Deliveries
2038 Total Fleet: 1,620
Service Market Value: $215B

Middle East
3,130 Deliveries
2038 Total Fleet: 4,030
Service Market Value: $790B

Asia-Pacific
17,390 Deliveries
2038 Total Fleet: 19,420
Service Market Value: $3,480B


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Foreword

Since the advent of aviation more than a century ago, commercial air travel has grown in astonishing ways, powered by forward-looking innovations. Our industry, though, has encountered setbacks along the way. The past year, in particular, has challenged us at Boeing and sharpened our focus on the future that we are building together with the industry.

As we developed our latest Commercial Market Outlook, we looked back at the data from across the decades. What is clear is that our industry is extremely resilient, innovative and sustainable, and destined for a steady climb.

From our first published market forecast in 1961, the number of commercial operators in the forecast has grown to nearly 200, and passenger traffic has grown by a factor of nearly 70. More recently, since 2000, the global airline network has expanded 2.5 times, while industry innovation and productivity have enabled travelers to fly for nearly 40 percent lower average fares in real terms.

And yet, despite the size of commercial aviation today, there are still clear skies ahead. Manufacturers and their supplier partners are bringing on line new capabilities — including truly long range jets that can profitably serve close to 10,000 mile missions — while airlines are finding success with new networks and different business models.

With the release of Boeing's 2019 Commercial Market Outlook (CMO), we see continued opportunities for product innovation, fleet productivity and network expansion as this dynamic industry continues to evolve. Overall, we again project a rising requirement for new jetliners — 44,000 over the next two decades — as operators refresh and grow their fleet to meet the increase in passenger and cargo demand. These airplanes, in turn, will fuel the multi-trillion services market as operators maintain, repair and overhaul their jets and train pilots and technicians to operate them safely and efficiently. Combined, we see a commercial aviation market valued at $16 trillion through 2038.

On behalf of the team of Boeing experts who analyze and compile the market forecast each year, I invite you to see how the tremendous market demand will play out in different regions of the world and across various product and services segments.

All of us take great pride in the fact that the Boeing CMO remains the industry standard for objectivity and accuracy. We hope it is a useful tool to inform your long-range planning for the future. I, for one, cannot wait to see where commercial aviation goes from here…

RANDY TINSETH

Vice President
Commercial Sales & Marketing
The Boeing Company

Commercial Aviation Market Dynamics

Aviation is a dynamic industry that continuously adapts to various market forces. Forecasting long-term demand for airplanes requires assumptions and predictions about the macro trends and drivers that will shape the airline industry far into the future.

The Boeing Commercial Market Outlook has a long tradition of accurately predicting airplane demand because it combines understanding of both the underlying structural changes and current market dynamics. The forecast team also considers detailed market-specific drivers in each region.

The three key macro-environment dimensions that drive airplane demand forecasts are broadly categorized as:

- Underlying demand for air travel
- Regulatory, infrastructure, and technology developments
- Specific airline strategies and products offered in the market

DEMAND FOR AIR TRAVEL

Year-over-year traffic growth averaged 6.7 percent during the past five years as measured in Revenue Passenger Kilometers (RPKs). This growth is well above the long-term average of 5 percent. Low air fares, higher living standards with a growing middle class in large emerging markets, the growth of tourism and travel relative to total consumer spending in major economies, and new airline business models are all driving this strength in air travel growth.

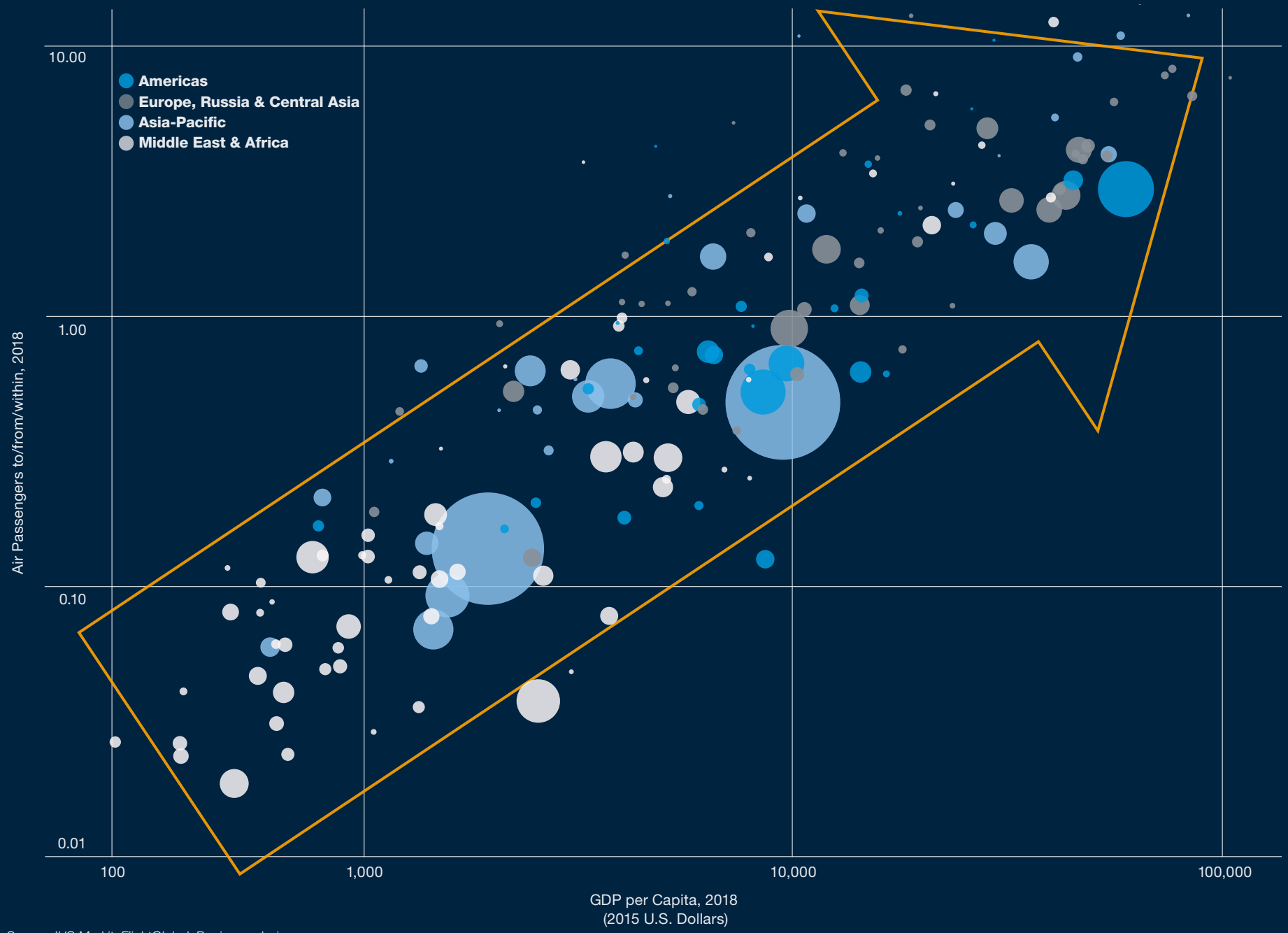
Growing economies and incomes stimulate air traffic demand

Emerging markets around the world continue to drive economic growth. They accounted for more than 60 percent of the world's economic growth between 2008 and 2018. In the last 10 years, routes between or within emerging markets accounted for approximately 40 percent of new passenger traffic. (See Figure 2 on page 6.)

A feature of these emerging economies is rapid urbanization. As people enter the urban middle class, their propensity to travel increases dramatically. (See Figure 1.) According to the World Bank, over 4 billion people now live in cities globally, with unprecedented access to air travel from nearby airports. Over 300 million people in China and India are

Figure 1: Propensity to Travel

Rising income levels lead to more air travel demand



Source: IHS Markit, FlightGlobal, Boeing analysis

expected to enter the middle class within the next 10 years.

Consumer spending bolsters air travel demand

Despite uneven economic growth in recent years, the elements comprising this growth over the last decade have supported increasing demand for air travel. This includes increased consumer spending and a transition to service-based economies in emerging markets.

Private consumption accounts for over half of global economic activity, and continues to rise as automation increases and the service sector grows relative to manufacturing. In contrast, industrial production has been more volatile, lifting air cargo traffic to double digits gains in 2017 before cooling towards trend in 2018.

Travel and tourism is a growing part of consumer spending

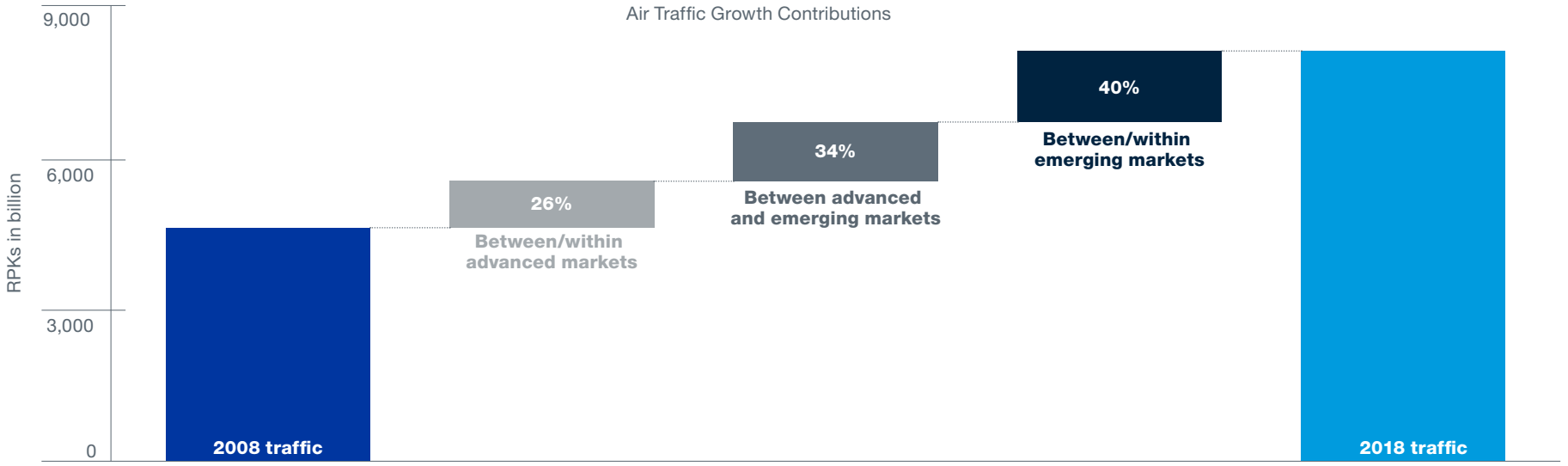
The outlook for strong air travel demand is consistent with broad consumer demand trends and travel and tourism outlooks. According to the World Tourism Organization, international tourist arrivals grew 6 percent in 2018, faster than overall economic growth. The World Travel and Tourism Council expects an additional 700 million international tourist arrivals in 2029 over 2018 totals. This will fuel a direct tourism and travel contribution to global GDP growing at 3.6 percent per year in real terms over the next 10 years.

INFRASTRUCTURE AND REGULATION

The regulatory environment, infrastructure and technological developments have a highly influential role to play in shaping the future of air travel. This includes new and expanded airports, reduced market regulation (market liberalization) and environmental regulations.

Figure 2: Air Traffic Between Emerging Markets Led Growth In Last Decade

Since 2008, three-quarters of traffic growth touched emerging markets



Source: Boeing Commercial Market Analysis

Airport infrastructure

After nine straight years of above-trend passenger growth, many airports are experiencing pressure on operational capacity. This is particularly acute in high-growth regions such as Southeast Asia, China, and India and in Western airports where airport expansion is artificially restricted, such as in many parts of Europe.

New airports and facilities

Adding airports is the most direct means of increasing capacity in the system. Between 2012 and 2018, the world added a net 176 airports. Most of these (165) were in the Asia-Pacific region. While many airports were newly built, some recommenced commercial service or were converted from military use.

Growth through improving existing facilities is more prevalent in well-established aviation markets, with most of the new airports being built in emerging markets. The Asia-Pacific region leads this investment boom with 17 new airports and 17 additional runways planned to open by 2030. (See Figure 3.)

Secondary airport growth has also been strong in many regions, absorbing passenger growth from a nearby primary, or hub, airport. Low cost carriers have grown rapidly at secondary airports because here they avoid the expense, delays and congestion of many primary airports.

Increasing efficiency

Airports also grow capacity through increasing operational efficiency. This includes improved air traffic control, more efficient use of airport gates, added runways and longer operating hours.

Airlines may also carry increased numbers of passengers through fuller airplanes (higher load factors), adding seats to each cabin, using larger airplanes, and increasing airplane utilization.

Airports investing for the long-term

As airports and airlines adapt to market conditions, there will be short-term challenges at some busy airports. The analysis behind the Boeing Commercial Market Outlook assumes that sufficient investment in airport infrastructure will be made in the long run to support increased demand for air travel.

Airline market liberalization

Increasingly liberal market regulation around the world has long been a key driver of growth in passenger travel. Beginning with the 1978 deregulation of the commercial airline industry in the United States, such market liberalization stimulates demand because it both allows entrepreneurs to enter the market and increases competition between established businesses. This allows latent demand to be satisfied and provides the positive conditions for innovation in service delivery that drives additional demand, growing the overall size of the market.

Figure 3: Airport Development and Improvements in Asia-Pacific Is Accelerating

17 new airports and 17 additional runways planned by 2030

● New Airports
● New Runways

2019–2023		2024–2030
Beijing-Daxing, CN	Qingdao, CN	Melbourne, AU
Dalian, CN	Xiamen, CN	West Sydney, AU
Chengdu, CN	North Bali, ID	Bangabandhu, BD
Ezhou, CN	Mumbai, IN	Jeju, KR
Foshan, CN	New Delhi, IN	Manila, PH
Hohot, CN		Long Thanh, VN
Haikou, CN	Okinawa, JP	Guangzhou, CN
Shanghai, CN	Incheon, KR	Guiyang, CN
Fouzou, CN	Bangkok, TH	Shenzhen, CN
Xian, CN		Fukuoka, JP
Zhengzhou, CN		Busan, KR
Hong Kong, CN		Singapore, SG
Bangalore, IN		Taipei, TW

Source: CAPA, MLIT Japan, Narita Airport, Boeing analysis

Growing networks and lower fares

Liberalization has encouraged significant traffic growth by removing constraints on route entry, pricing, service capacity, and airline cooperative arrangements. As airline competition and operating efficiency have improved, pricing has fallen in real terms while flight frequencies and product choices have increased for passengers worldwide. In addition, improved air services often directly and indirectly stimulate economic growth, creating a virtuous circle that leads to further air transport growth, which in turn leads to added economic growth.

The development of low cost carriers (LCCs) is a primary example of the outcome of market liberalization. Such low cost airline business models would not have flourished without the relaxation of government-regulated airline ticket pricing and removal of regulatory barriers to new market entrants. Recent strong growth of LCCs in the ASEAN area of Southeast Asia illustrates the high impact of such market liberalization. New entrants into these markets have dramatically reduced airfares and added vast numbers of new routes, particularly within the region.

Open Skies boosting international and long-haul liberalization

Open Skies agreements have also promoted strong growth in the commercial airline industry, extending liberalization and higher levels of competition to international and long-haul markets. Importantly, these trends

have withstood rising populism and geopolitical tensions. A case in point is the recently ratified US–Brazil Open Skies agreement, which highlights the mutual economic benefits of a healthy and growing aviation market.

The expectation is that the trend toward more liberal air travel markets continues, as consumers have come to expect increased choice and lower prices for airline travel. It is certainly crucial for the continued health and growth of air travel that such market liberalization continues around the world.

Environmental regulation and technology

Active management and reduction of emissions from airline activities is critical to air travel growth. As such, the aviation industry has made commitments to limit the growth of emissions over the short and medium term, and by 2050 to produce half the level of emissions generated in 2005.

Relentless drive for fuel efficiency

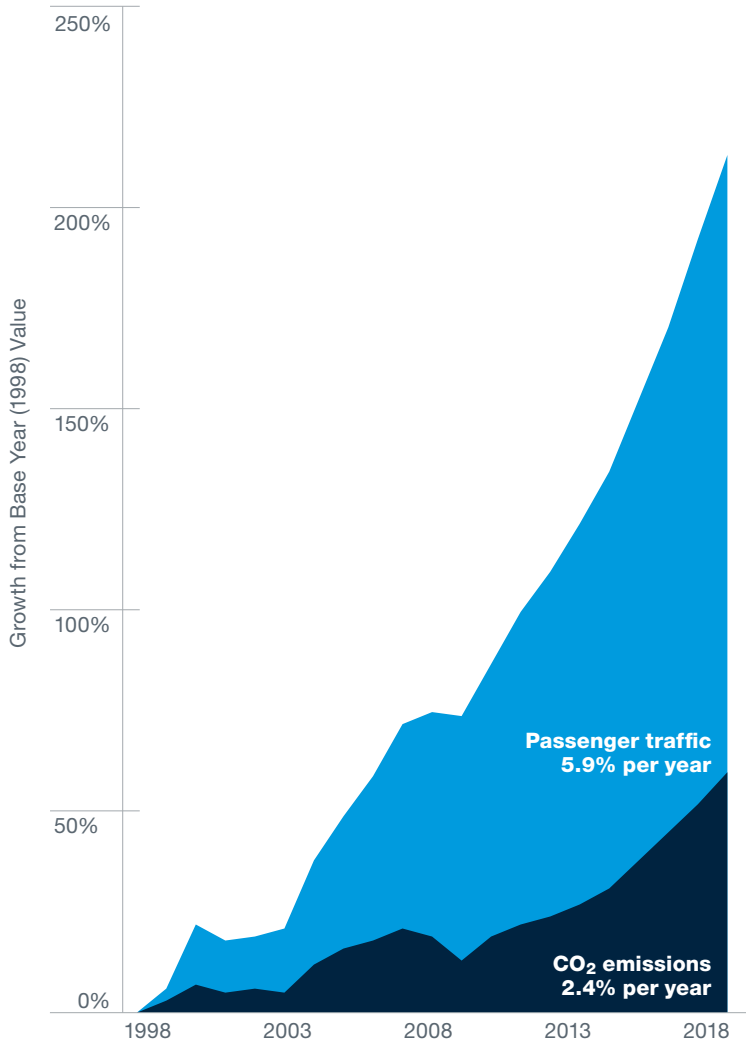
Aircraft and engine manufacturers are making long-term investments in technological innovation to reduce emissions. Over the past twenty years this has already delivered growth rates for carbon dioxide (CO_2) emissions that are less than half the rate of air traffic growth overall, and the industry continues to invest heavily in future reductions. Across the aviation system, CO_2 emissions per unit of travel (revenue passenger kilometer, RPK) are now 51 percent less than 20 years ago. Total air traffic in 2018 was more than triple the 1998 level. Over the same 20 years, CO_2 emissions from air travel increased by only one third of the volume growth. (See Figure 4.)

The interests of airlines and environmental concerns are to some extent aligned, in that lowering costs demands lower fuel use and therefore lower emissions on a given journey. Efficiency improvements are being realized through new airplane and engine technology. Airlines are increasingly making better use of the available cabin space with comfortable yet low profile seating to extract more productivity from the same airplanes. Airports, airlines and airspace managers are implementing advanced strategies for more efficient operations.

Industry implementing global carbon offsets

The aviation industry has committed to a global carbon offset program known as CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation). From 2019 onwards, commercial airlines flying international routes are required to report their CO_2 emissions. With carbon offsets in place for emissions growth above the international aviation 2020 baseline, this program will incentivize a significant reduction in the growth rate of net CO_2 emissions from commercial aviation.

Figure 4: Air Traffic Growth Is Decoupled from CO_2 Emissions Growth



Note: CO_2 growth estimated for 2017 & 2018

Source: ICAO, Boeing analysis

Airline Business Model Drivers

Airlines are developing a range of new business strategies and product offerings to deliver more value to travelers. These include lowering fares, unbundling product offerings to allow customers to pay for only the services they want, and broadening airline networks to increase connectivity.

As the industry continues to evolve, few airlines will remain pure low cost carriers or pure network airlines. Many airlines are adopting features from other business models to adapt their product offerings to both offer more value to their customers and to respond to innovations in their competitors' service.

Many network carriers in North America have added a "basic fare" that includes no extras. In Europe, some of the larger network airline groups have established low cost subsidiaries to compete with other LCCs for point-to-point business. Conversely, some low cost carriers are adding premium service, connections, and introducing long-haul service.

LOW COST CARRIERS

The worldwide spread of low-cost carriers (LCC) and ultra-low-cost carriers (ULCC) has been instrumental in the steady decline in average airfares over the past several decades. Since the concept was first introduced in the 1970s, LCCs have become a prominent global airline business model.

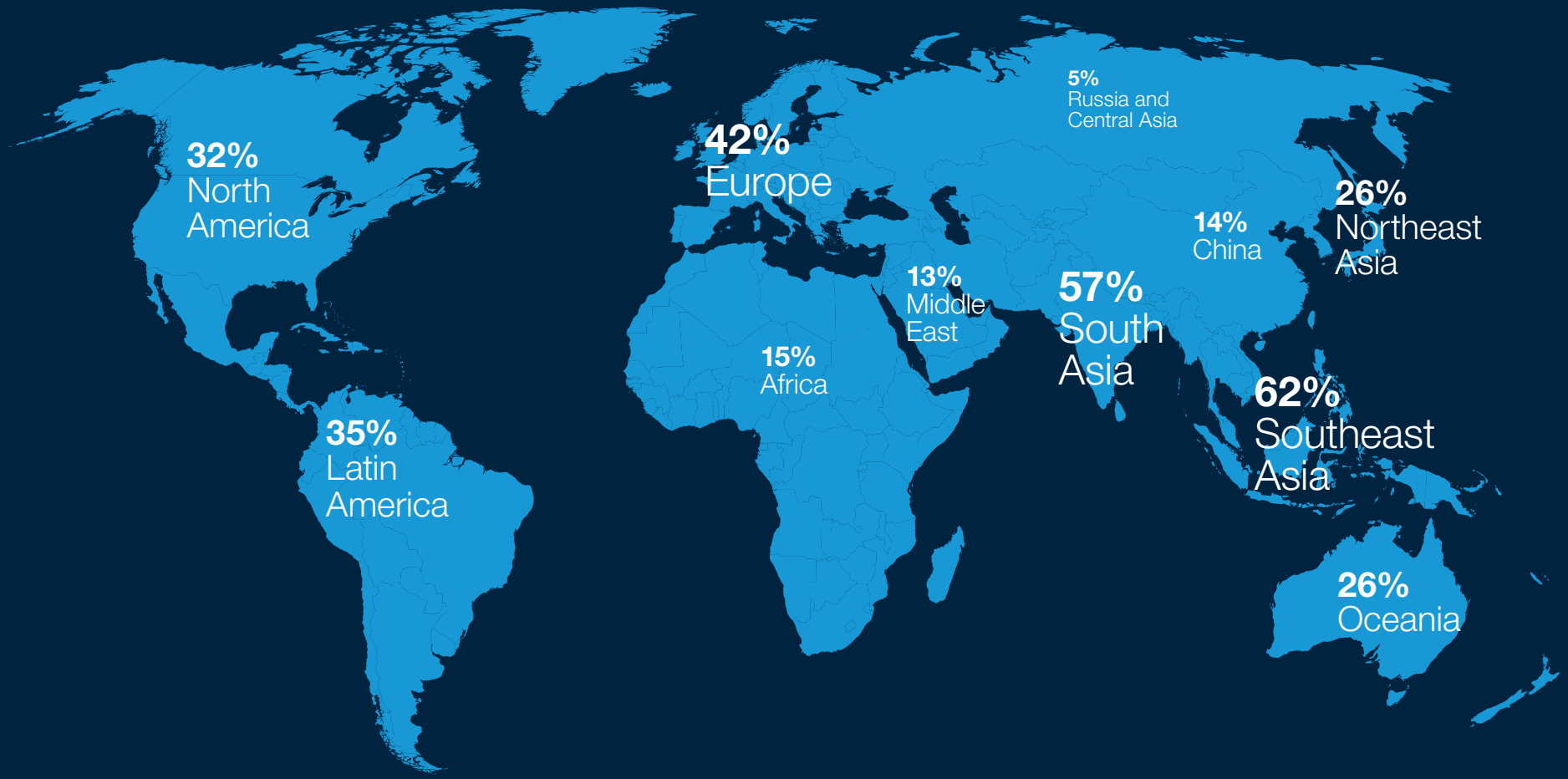
As the business model expanded in different parts of the world, LCC operations have developed a common value proposition: maximize profitability through cost reduction, particularly in the short-haul segment. LCCs are characterized by the following strategies:

- Short-haul, point-to-point flights, often with secondary airport operation
- Single-aisle fleet standardization
- Single-class, higher-density airplanes
- High utilization and quick turnaround
- Lower yield but higher volume concept
- Basic services plus ancillary revenues
- Technology leveraged to lower distribution costs (now primarily Internet)
- Lower labor and marketing, overhead, and general administration expenses

LCC market share varies by region

Despite their earlier adoption of a deregulated market, North American low cost carriers provide about 30 percent of seat capacity in the region's short-haul segment, in contrast to more than 40 percent for European LCCs in short-haul markets. Since the early 2000s, rapid expansion of low cost airlines in Asia has been a key driver of overall growth in the short-haul market. This has in part been due to liberalized bilateral agreements and the Open Skies agreement of the Association of Southeastern Asian Nations (ASEAN). As a result, low cost carriers account for more than 60 percent of capacity in some Asian markets. Low cost airlines in other regions have also been growing low-cost capacity at annual rates of over 10 percent during the past decade. (See Figure 5.)

Figure 5: LCC Short Haul Market Share Varies by Region



33% Global Average

Note: Annual seats, short-haul only (<3,000nm)

Source: Innovata by Cirium/Diio by Cirium

LCC Outlook

Our long-term outlook shows LCCs leading the growth in single-aisle demand. LCCs are projected to add over 13,000 new aircraft in the single-aisle category. Of our forecasted single-aisle deliveries to LCCs, 62 percent will be for growth, both to open new markets and to add frequencies in existing markets, while the remaining 38 percent will replace retiring airplanes.

NETWORK AIRLINES OFFER UNRIVALED CONNECTIVITY AND RANGE OF SERVICE CHOICES

Network airlines are adapting their business strategies to boost competitiveness with rapidly growing low cost airlines. In the past decade, airline consolidation and network restructuring — predominantly in the United States, but also in other regions — has strengthened balance sheets. Many network carriers are well placed to withstand the increasingly competitive business environment.

Hub development

Global airline networks are well positioned for future growth at their hub locations with extensive regional and domestic services that feed their long-haul markets. Over the last decade, network airlines have increased their networks by over 700 destinations. (See Figure 6.) Total long-haul capacity and frequencies (routes longer than 5,500km or 3,000nm) from the 20 largest hub airports increased by 44 percent and 36 percent respectively between 2008 to 2018. The number of cities served from these hubs increased by 14 percent. Other amenities that enhance the value proposition of the global network carriers versus LCCs include differentiated cabin offerings and upgrades, extensive frequent flier programs, and expanded route networks through alliance partnerships.

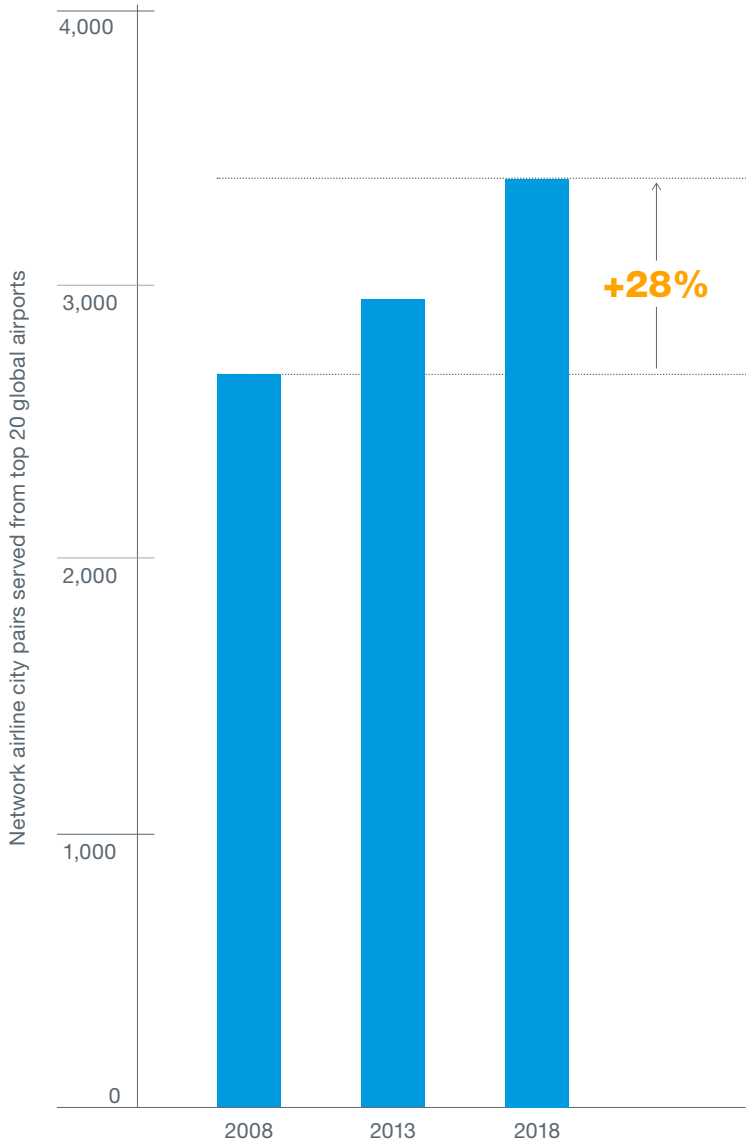
Global "superconnector" carriers are a subcategory of the network carrier business model. Their "one stop to anywhere" business model is very popular with passengers looking for efficient ways to travel to far off destinations. Growth of this business model has been enabled in the past decade by the introduction of airplanes with improved range sufficient to travel nonstop to destinations as far from the Middle East as the US west coast and Australia.

New airplane technology shaping airline networks

Airline network hubs serve as the portals to any region in the world. The new generation of widebody aircraft open up new markets or time-of-day windows that are not financially viable with older aircraft. We expect that this trend will continue to accelerate. The 787 Dreamliner has earned a reputation

Figure 6: Network Carriers Growing Hubs

>700 new destinations added from top 20 airports over last decade



Source: Innovata by Cirium/Diio by Cirium

as a primary vehicle for opening new nonstop markets, including recently announced services on Boston–Casablanca, Hangzhou to Melbourne and Iguazu Falls to Madrid.

Airplane size on these routes has grown only slightly, increasing by 6 percent over the last 10 years. Projections that capacity constraints at large hub airports would lead to a concentration of very large airplanes there have not materialized. Even at the largest hub airports, growth continues to follow the service fragmentation pattern of the industry at large.

NETWORK AIRLINES LEAD GROWTH IN NEW AIRCRAFT DEMAND

Network carriers will account for the largest overall share of new aircraft. They will require more than 18,000 new aircraft, with nearly two thirds of these (11,000) being single-aisle airplanes. Network airlines are forecast to take delivery of over 6,200 widebody passenger aircraft of which more than half (55 percent) will be in the small widebody category. With these airplanes, they will continue to fragment the market and serve an ever increasing number of routes. About half of our forecasted deliveries to large network carriers will be for growth, both to open new markets and to add frequencies in existing markets, while the remaining half will replace retiring airplanes.

EMERGENCE OF LOW-COST LONG-HAUL

Historically, short-haul travel accounts for the vast majority of low cost airline capacity, but low cost long-haul is increasing rapidly. In 2008, only 1 percent of LCC capacity was on flights of more than 5,500km (3,000nm). By 2018, this grew to more than 4 percent.

As market structures become more complex and consumer behaviors continue to evolve, hybrid and low cost long-haul (LCLH) business models are emerging. Low cost carriers are meeting passenger demands by extending more affordable travel to long-haul markets. At the same time network carriers are entering the LCLH market with their own low cost subsidiaries. While Charter or Inclusive Tour (IT) airlines have provided a similar long-haul low cost product for some time, the vertically-integrated business structure of the all-inclusive tour company differs significantly from LCLH carriers. Low cost long-haul airlines only compete for business as an airline, not as a vertically integrated travel company.

LCLH business model

Developing a low-cost business model for long-haul service is more challenging than it is for short haul. LCLH airlines face higher capital costs and higher costs to support their wider network. More extensive regulatory oversight and the need for a feeder network drive greater operational complexity. It is also

challenging for them to achieve higher airplane utilization than their traditional competitors because their longer stage lengths mean that an airplane will turn fewer times in a day. A hallmark of the short-haul LCC model — short turn times — is less important for the low cost long-haul airline.

Low cost long-haul service also typically provides relatively few premium seats, meaning that on routes with significant demand for premium service, network carriers can take advantage of revenue opportunities that offer less potential for the LCLH airline.

Network airlines introducing LCLH

Some network carriers operate a separately branded low cost long-haul carrier of their own, forming an airline group that can compete in all markets. Examples are LEVEL from IAG, Jetstar from Qantas Airways, Scoot from Singapore International Airlines, and Eurowings from Lufthansa. This segmented approach to the market serves both to set passenger expectations that the on-board experience will not be comparable to that of the full-service parent and to minimize fare dilution to the premium brand.

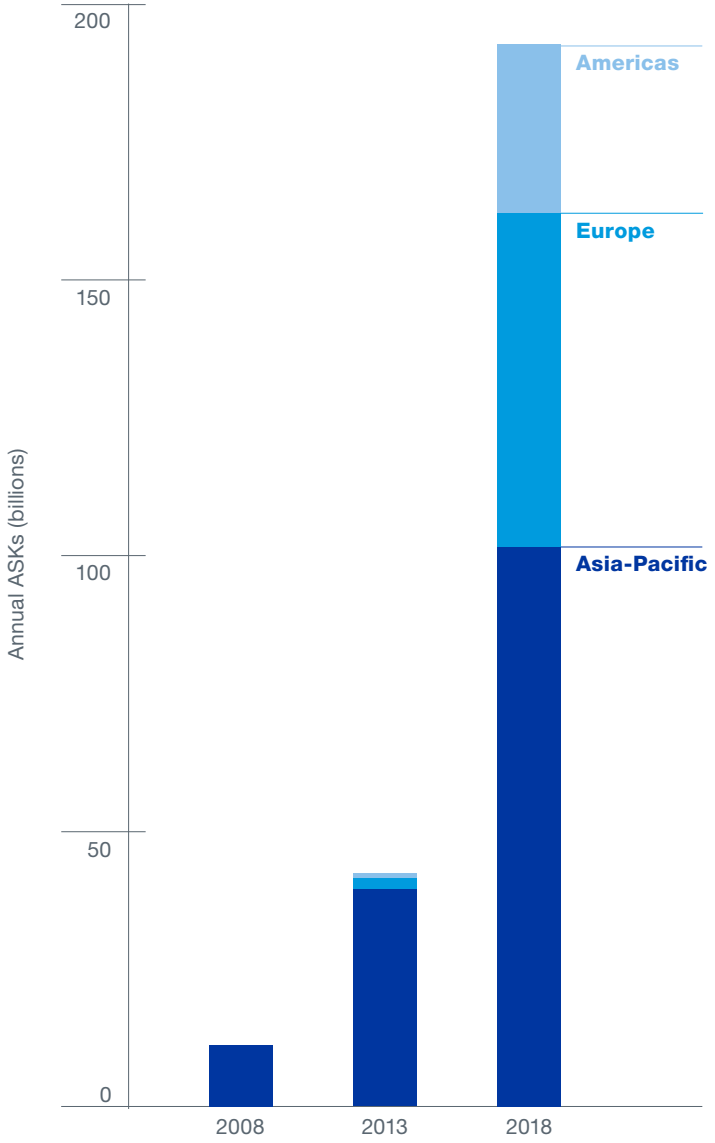
Network LCLH operations are most common on leisure routes where yields are not sufficient to support the full-service carrier or to smaller cities that can only support a smaller number of weekly frequencies than is usual for a full-service offering. These airlines can gain significant competitive advantage from the parent carrier's feed traffic, alliance arrangements, and financial resources.

LCLH Outlook

Over the last decade there have been more than ten new low cost long-haul market entrants, with most operating across the North Atlantic and within Asia. A number of new such airlines have been announced - both independent entities and subsidiaries of network carriers.

Although it's still too early to determine the long-term success of the LCLH model, growth in the segment indicates that many price-sensitive passengers are eager for this type of offering. (See Figure 7.)

Figure 7: Low-Cost Long Haul Has Grown Rapidly in Recent Years



Note: Widebody airplanes operated by LCLH carriers on routes > 3000nm

Source: Diio by Cirium, Boeing Analysis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Commercial Traffic and Fleet Outlook

Air travel has proven to be a resilient market. As the commercial aviation industry evolved from its infancy in the 1940s through the dawn of the jet age, the number of passengers traveling annually grew from about 100 million in 1960 to just over 1 billion in 1987. It took 18 years to double to 2 billion passengers, and growth has accelerated requiring only 7 years to reach 3 billion, and only 4 years to reach 4 billion passengers. Robust growth is expected to continue, especially in regions such as China, South Asia, and Southeast Asia as these economies expand and more people begin to travel. (See Figure 8.)

OUTLOOK FOR 4.6 PERCENT AVERAGE ANNUAL PASSENGER TRAFFIC GROWTH

Airline passenger traffic is expected to grow by an average annual rate of 4.6 percent over the next 20 years.

Air travel growth within Asia is set to make it the world's largest overall travel market, with rapid growth within China making its domestic market the largest of all. The appeal of affordable travel on long one-stop flights enabled by Middle Eastern airlines' central location will help drive higher-than-average growth on those routes. In the well developed markets of North America and Europe, domestic growth rates are below the global average, and growth is focused on increasing connections to faster-growing emerging markets. These differing growth profiles result in an increasingly diverse global air travel market. (See Figure 9 on page 18.)

STRONG AIR TRAVEL GROWTH DESPITE CYCLICAL CHALLENGES

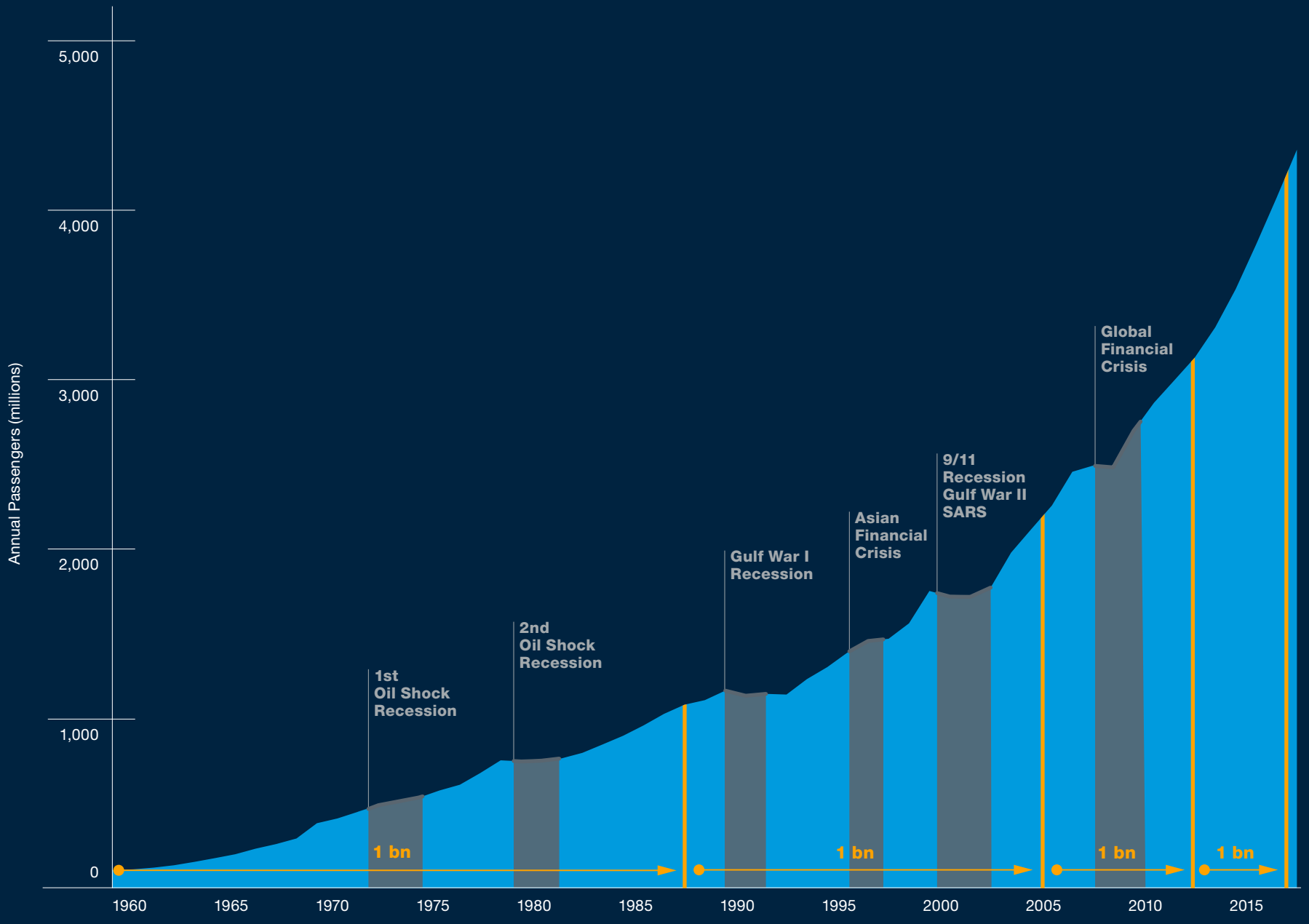
The years since 2010 have been marked by uneven economic growth, exchange rate and commodity price volatility, and concerns about international trade and the free movement of people. While these developments might suggest lower air travel growth, the opposite has been the case. Since 2010, global revenue passenger-kilometers (RPKs) have grown at an average pace of 6.7 percent, well above the 5 percent per year performance over the past three decades.

People in emerging markets have more opportunity to travel due to rising incomes, accompanied by improved service and lowered prices resulting from increased competition in the airline sector. This expansion, tied to structural changes of these economies and their air transport industries, is less subject to cyclical fluctuations. Twenty years ago, the majority of passengers traveled on airlines based in Europe or North America, but today more than half travel on airlines outside those regions. By 2038, 40 percent of passengers will travel on an airline based in the Asia-Pacific area.

NEW AIRPLANE DEMAND TOPS 44,000 DELIVERIES THROUGH 2038

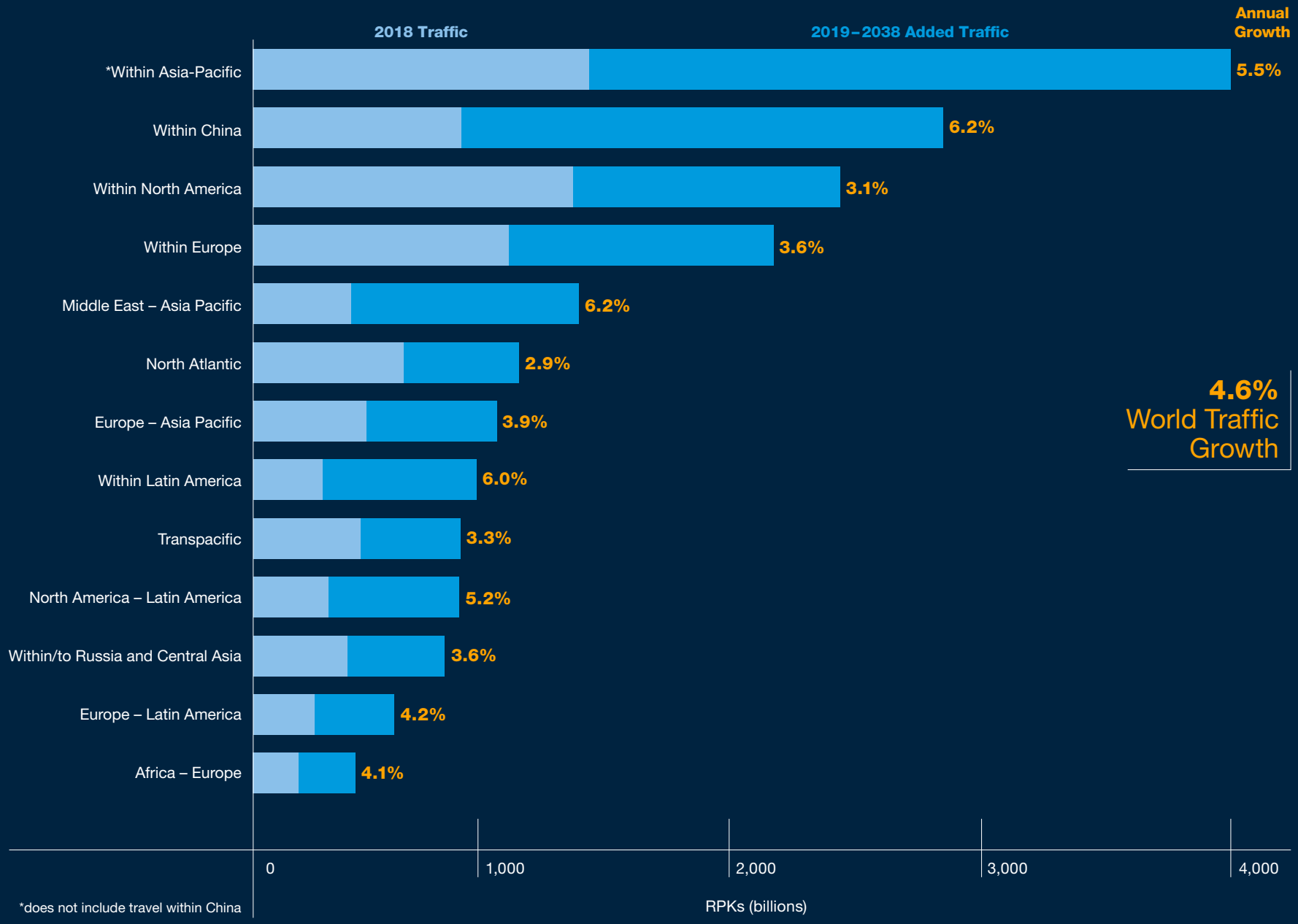
Demand in the commercial market is forecast to more than double in the next two decades. To meet this demand, the in-service fleet will grow at an average annual rate of 3.4 percent, with the number of jet airplanes in service nearly doubling to 50,660. To support future

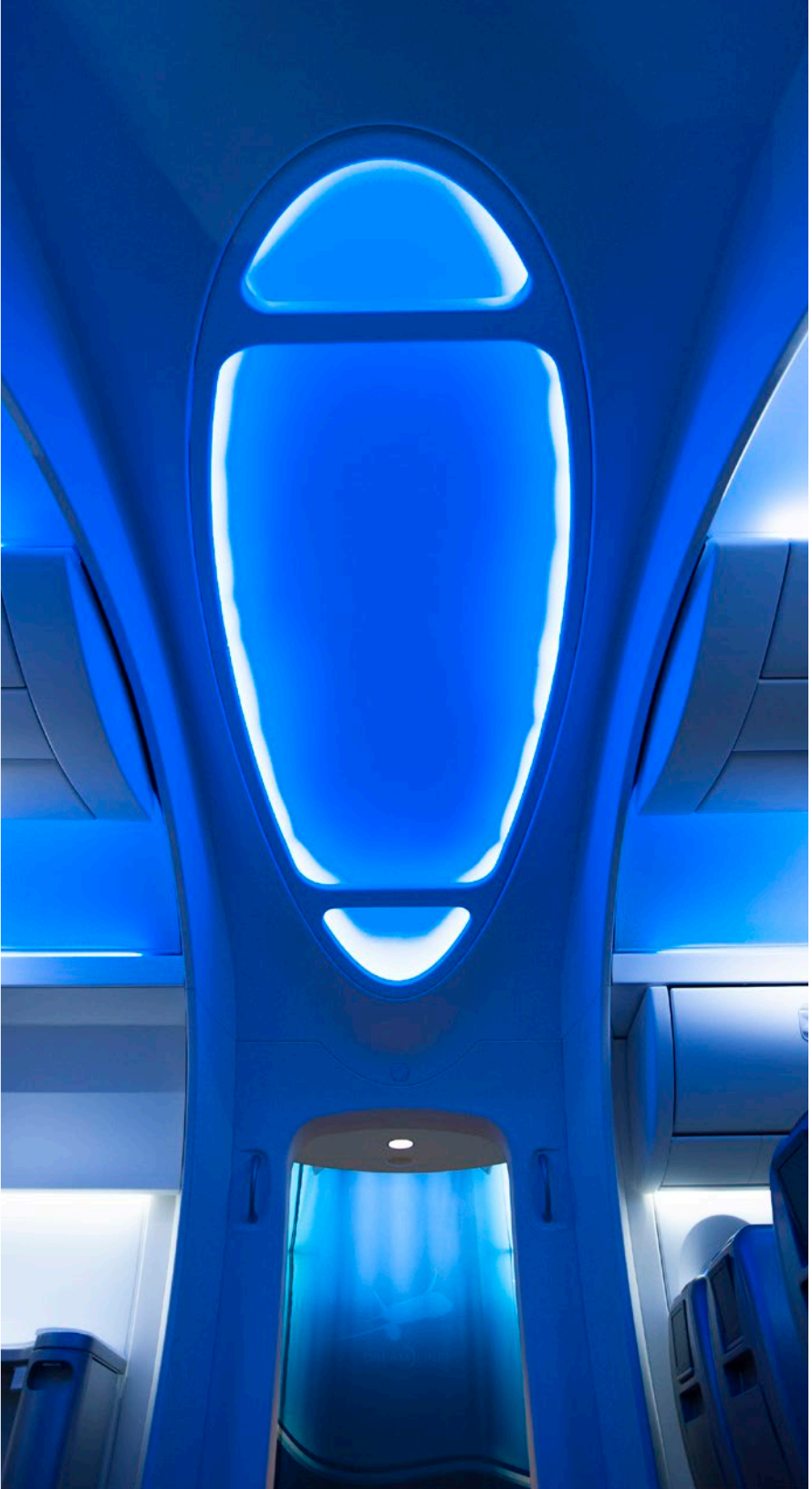
Figure 8: Air Travel Resilient Despite Financial and Geopolitical Challenges



Source: ICAO / IATA December 2018

Figure 9: Top Global Traffic Flows





fleet needs, Boeing forecasts a need for more than 44,000 new airplane deliveries, valued at over US$6 trillion.

Single-aisle airplanes command the largest share of new deliveries at more than 70 percent, with airlines needing more than 32,400 in the next 20 years. These new airplanes will continue to enable growth for low-cost carriers and will provide required replacements for older, less-efficient airplanes. In addition, more than 9,000 new widebody airplanes will be delivered, which will allow airlines to serve new markets — passenger and cargo — more efficiently than in the past.

Based on air travel demand growth trends, Boeing forecasts that by 2038, approximately 40 percent of all new airplanes will be delivered to airlines based in Asia. An additional 40 percent will be delivered to airlines in Europe and North America combined, with the remaining 20 percent delivered to the Middle East, Latin America, Russia & Central Asia, and Africa.

AIRLINE PRODUCTIVITY INCREASES MODERATE AIRPLANE DEMAND

Air travel growth can be accommodated in two primary ways: increasing passenger load factors and increasing overall capacity. Airlines have been remarkably effective at increasing load factors. In the early 1990s, load factors averaged 65 percent, but have steadily increased to 80 percent or more today. This represents average systemwide load factors which include seasonal fluctuations, time-of-day and day-of-week variations, and differences in regional travel demand characteristics. This improvement in productivity has been enabled by a variety of factors, including improved scheduling and yield management systems and information technologies that make travel simpler and easier for passengers. While there is opportunity to further improve load factors, achieving consistently higher levels will be challenging.

Airlines can also increase overall capacity without adding to the number of airplanes in their fleets. Increased flying hours per aircraft add to available capacity. Airlines utilize the same available cabin space to accommodate more seats through the use of ergonomically designed, slim profile seats providing the same personal space at lower seat pitch. More compact galleys and space-saving lavatories have also freed space for higher seating capacity without adding airplanes. Airlines may also replace older aircraft with slightly larger ones.

If airlines were still operating at 2009 load factors, utilization rates, seat density, and airplane gauge in 2018, the equivalent of 7,100 airplanes would have been required over and above the 6,700

actually delivered to accommodate the traffic flown. (See Figure 10.)

GROWING IN-SERVICE FLEET DRIVES DEMAND FOR AIRPLANE REPLACEMENT

Airplanes are durable assets and typically remain in service for twenty to thirty years, and sometimes for even longer. Airplanes are typically retired when the cost to retain and operate the airplane exceeds the revenue it generates. The decision to replace an airplane is driven by considerations such as its age, the number of flight hours and pressurization cycles the airplane has undergone, and maintenance requirements. In some instances, retiring even a relatively new airplane and re-selling its parts (parting-out) can yield the best economic return.

As well as saving costs through lower fuel consumption, newer airplane types provide improved range and payload capability, allowing airlines to serve markets not possible with older equipment.

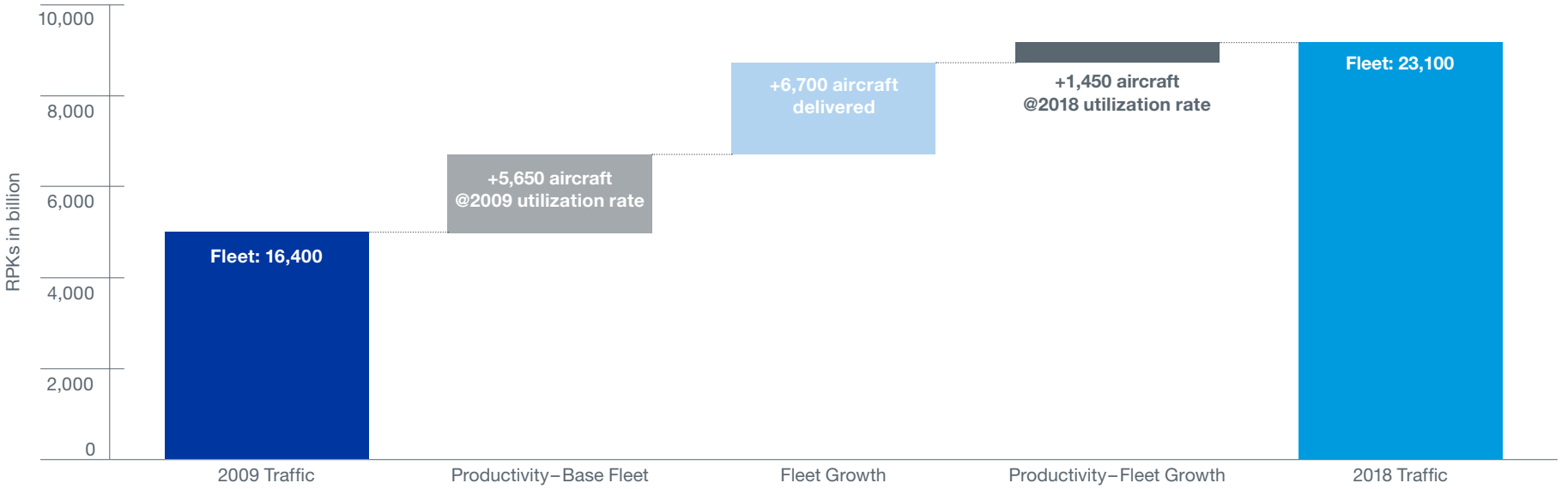
Short-term vs. long-term trends

Despite short-term fluctuations, long-term retirement rates have remained steady at roughly 3 percent of the fleet. The number of actual retirements has increased with the overall fleet size. Boeing research shows that airplane retirement ages have been stable over the past 20 years, and a difference of about 7 years between the retirement ages of freighters and passenger airplanes. Freight airplanes are often used for longer due to their lower utilization rates and more volatile revenues in the cargo sector. (See Figure 11.)

While the absolute number of deliveries from 2010 to 2018 rose each year, the proportion utilized for growth varies widely from year to year. (See Figure 12.) The growth proportion was lowest from 2012 to 2014, when fuel prices were highest, indicating that airlines were parking and retiring relatively more airplanes during more challenging growth conditions.

Figure 10: 2009–2018 Global Productivity Gains

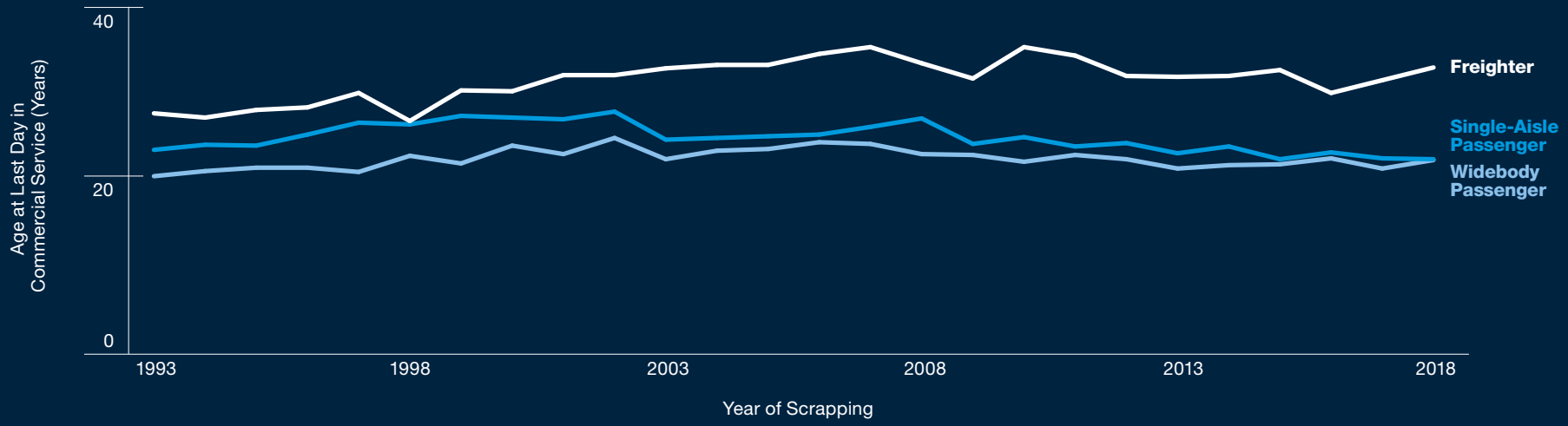
Traffic increased by 1.8X while fleet increased by only 1.4X



Source: IATA, Diio by Cirium, Cirium's Fleets Analyzer, Boeing analysis

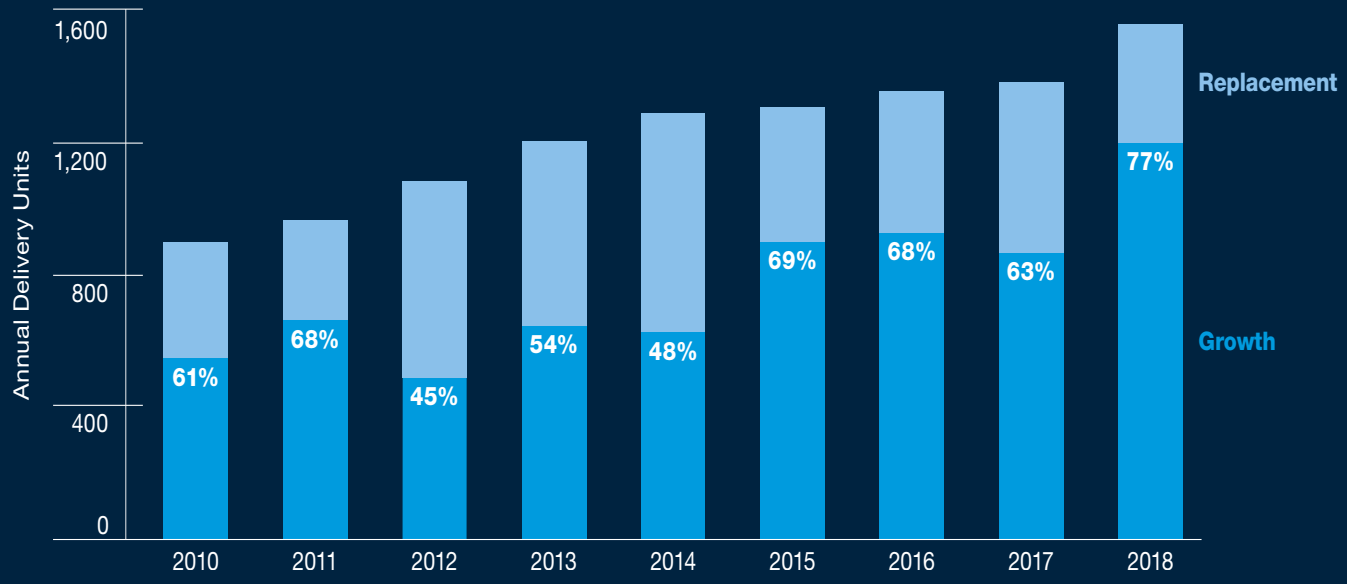
Figure 11: Commercial Airplane Lives Are Stable

Retirement age of commercial jets



Source: Cirium's Fleets Analyzer 4-25-2019, Boeing analysis

Figure 12: Share of Airplane Deliveries for Growth Varies Widely from Year to Year



Source: BCA Market Analysis with data from Cirium's Fleets Analyzer March 31, 2019

In our 20-year forecast, 56 percent of new deliveries are for growth, and 44 percent for replacement. The fleet in 2038 will consist of 19,210 airplanes replacing airplanes currently in the fleet, 24,830 providing for system growth, and 6,620 retained from the 2018 fleet. (See Figure 13.)

Oil price impact on replacement demand

While the price of oil strongly influences airlines' short-term retirement strategies, the fleet replacement decision is not driven primarily by short-term oil price fluctuations. Rather, replacing an airline's fleet is a long-term investment based on multiple factors including market competition, maintenance costs, fuel efficiency, and performance. Although lower oil prices make the short-term economics of fleet renewal less compelling, long-term fleet management considerations compel airlines to continue replacing older airplanes.

SINGLE-AISLE AIRPLANES MAKE UP THE MAJORITY OF THE GLOBAL MARKET

Today, single-aisle airplanes comprise nearly 70 percent of the global passenger jet fleet. In the next 20 years, this share will increase to nearly 75 percent, or more than 35,000 passenger airplanes. (See Figure 14.)

A number of factors drive the robust global demand for new single-aisle airplanes. Due to their size and flexibility, single aisle airplanes are fundamental to the business strategy of the rapidly growing low cost carriers and airlines

Figure 13: A Newer Generation of More Efficient Airplanes Will Replace Older Aircraft and Provide Capacity for Growth

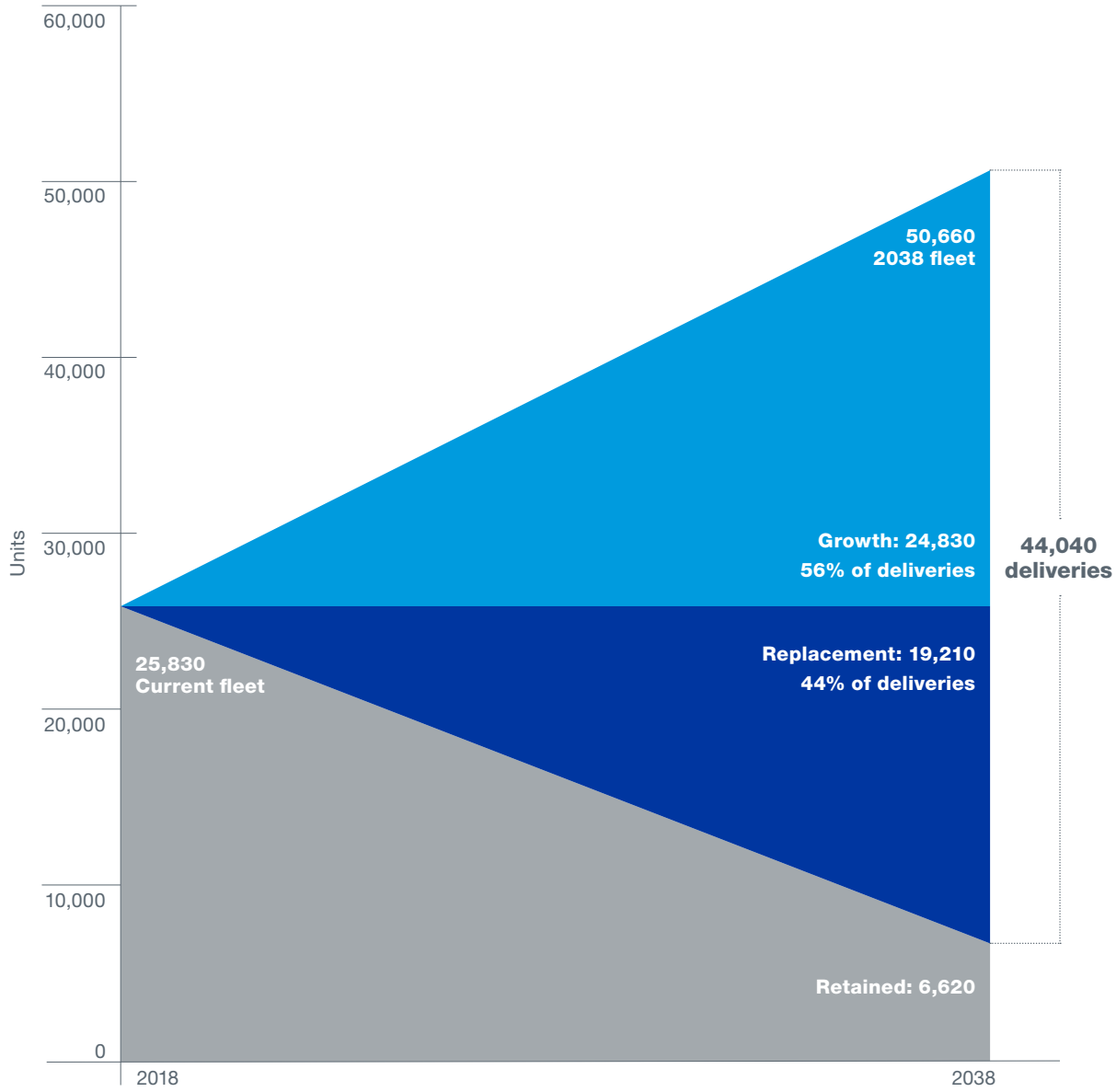
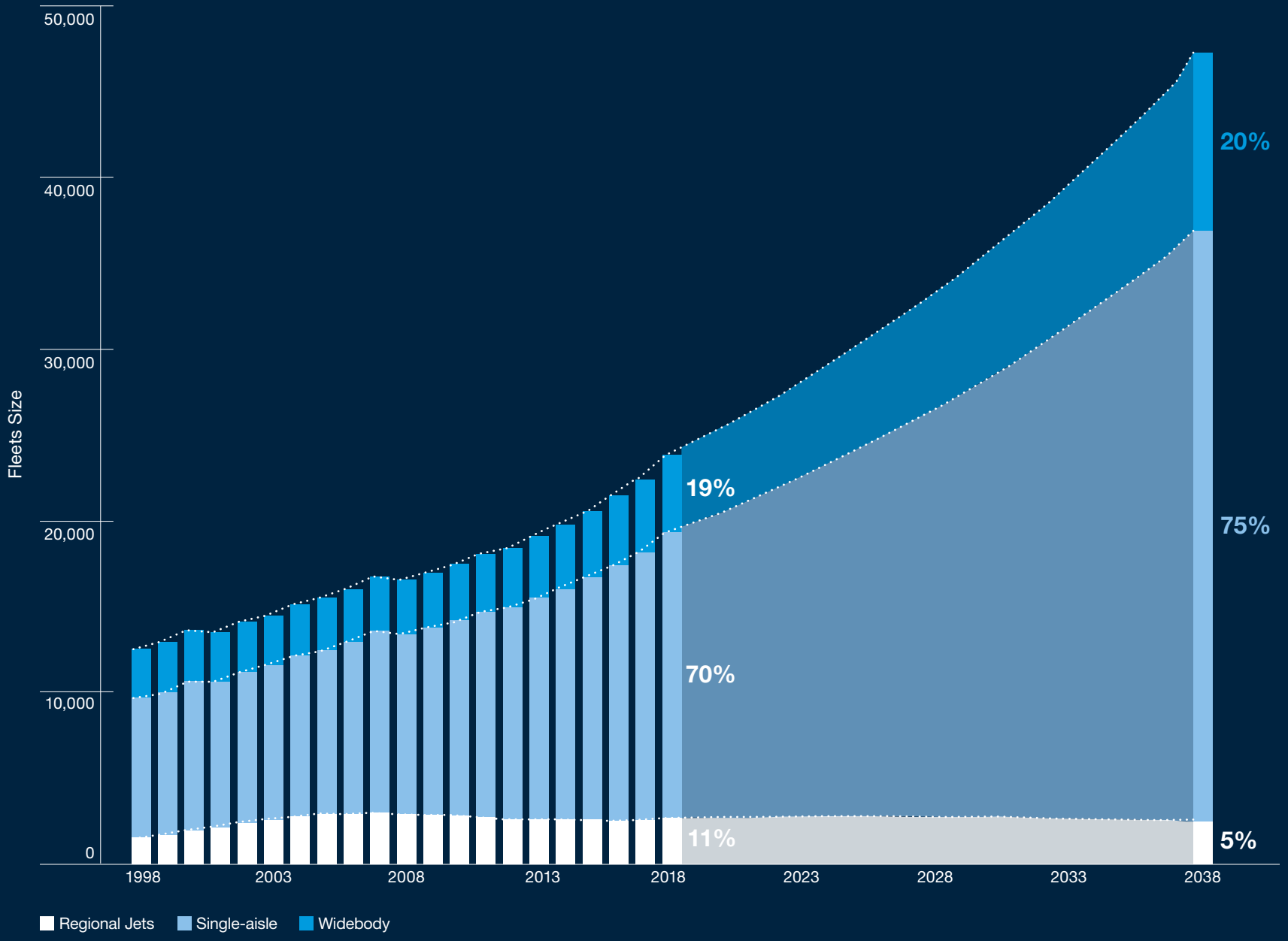


Figure 14: Passenger Fleet Expected to Double

Single-aisle segment fastest growing, increasing share from 70 to 75 percent of total fleet



Source: Cirium's Fleets Analyzer; Boeing Analyses

operating in emerging markets around the world. There is strong replacement demand in the well-developed aviation markets, where there are large fleets of older airplanes. The three largest regional markets for new single-aisle airplanes are Asia-Pacific, Europe, and North America, which account for almost 90 percent of global LCC capacity. Over 80 percent of all single-aisle deliveries will be in these regions.

The expansion of low cost carriers is anticipated to take their share of the global single-aisle fleet from almost 30 percent to over 37 percent. In 20 years' time, more than 13,000 single-aisle airplanes will be in the LCC fleet. Network carriers will continue to account for over half of new passenger airplane demand with over 20,000 airplanes in the fleet by 2038.

As airplane technology improves, more efficient and capable single-aisle airplanes connect city pairs that have not been previously within reach, or profitable. Although the majority of single-aisle flights are short-haul flights (less than 5,500km or 3,000nm), airlines are to some extent looking to use single-aisle airplanes on longer-range routes. Since 2016, almost 40 new single-aisle routes of longer than 5,500km (3,000nm) have been introduced.

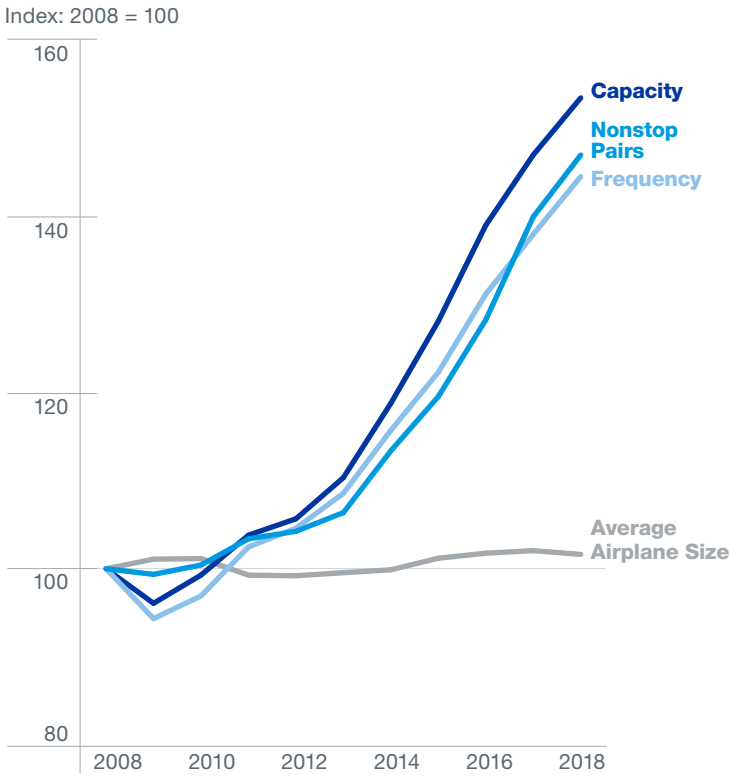
NEW TECHNOLOGY, MORE FRAGMENTATION IN THE WIDEBODY MARKET

Boeing forecasts demand for 8,340 new passenger widebody deliveries by 2038. Passengers typically prefer the convenience of nonstop flights, and as regulation of airline service in international markets has relaxed, long-haul markets have become increasingly fragmented. New, more efficient widebody airplanes serve an increasing number of long-haul city pairs. This rising market fragmentation is boosting demand for smaller widebody passenger airplanes. (See Figure 15.)

Large twin-aisle airplanes provide flexible capacity configurations for use across a wide range of markets where there is very high demand for travel, where premium service is paramount, where global superconnector airlines operate, where airports are especially congested, and where there are airspace constraints. These effects are compounded in the many long-haul markets where time differences between cities restrict the marketable time windows for flight departures.

Evidence of this demand and market growth can be seen in larger widebody order and delivery trends where successive larger widebody airplane generations have outsold their predecessors. The success of today's larger widebody airplanes has seen demand levels double that of the 747-400, despite the introduction of advanced new smaller widebody airplanes. (See Figure 16.)

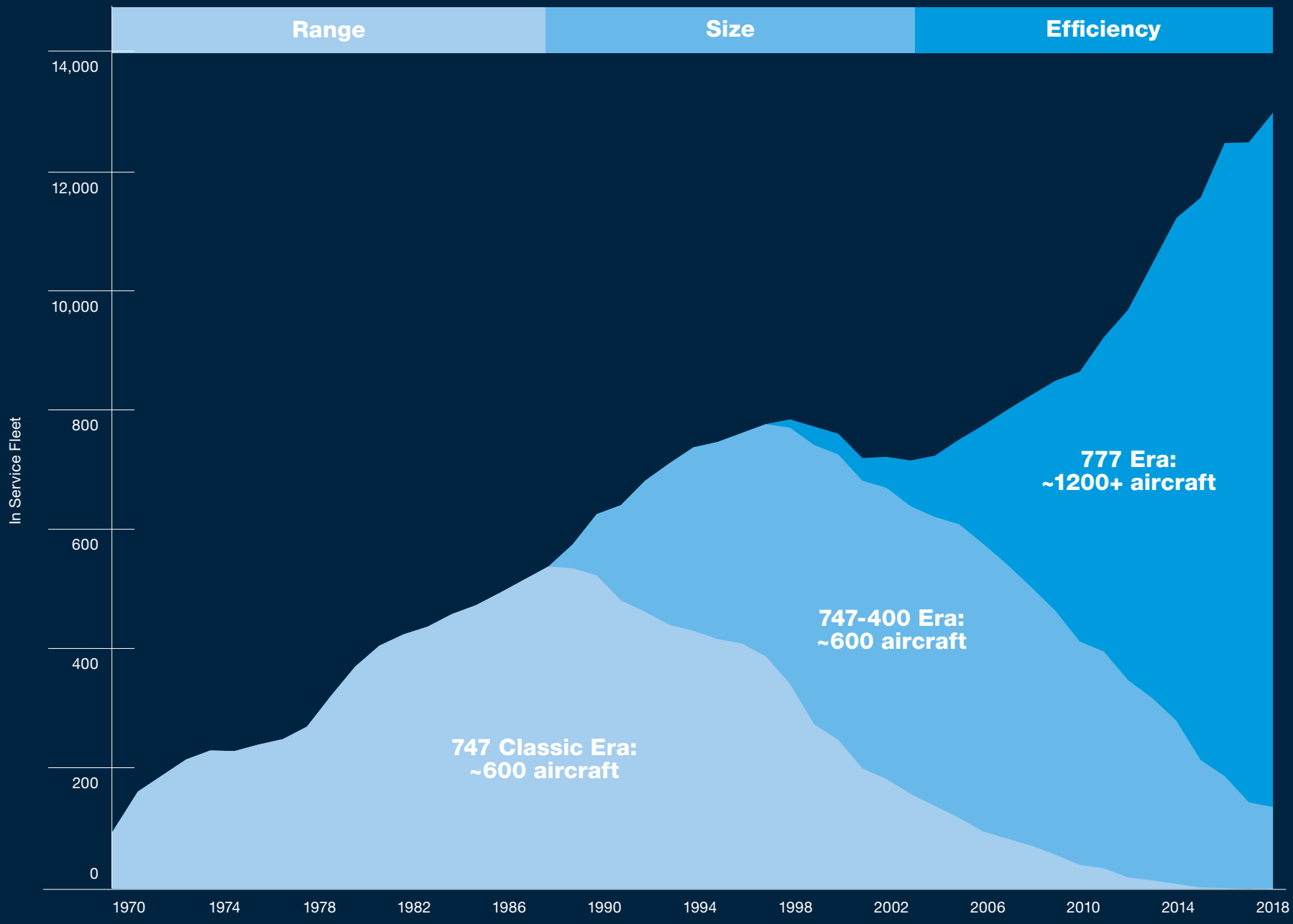
Figure 15: Widebody Fragmentation Offers More Frequencies and Nonstops



Note: Long-haul widebody markets only (> 3,000nm)

Source: OAG/Innovata by Cirium

Figure 16: Larger Passenger Widebody Eras are Driven by Market Needs



Note: 747, 777-300, 777-300ER, A340-600, A350-1000, and A380 are included

Source: Cirium's Fleets Analyzer

Air Cargo Outlook

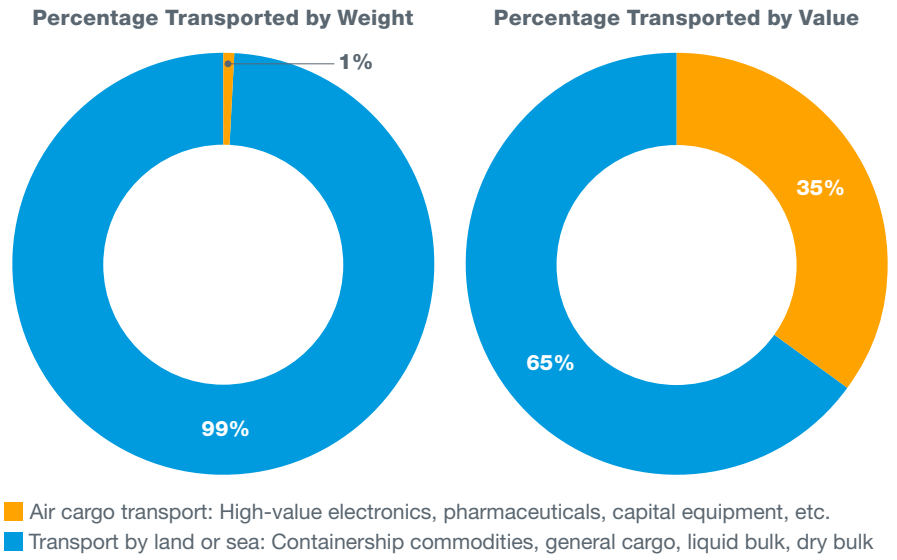
Air cargo transport is a critical component of the world economy. While it represents less than one percent of global trade by tonnage, air cargo transports more than 35 percent by value. The large disparity between tonnage and value reflects air cargo's unique position in transporting goods that often require a high level of speed, reliability, and security.

AIR CARGO DEMAND DRIVEN BY WORLD TRADE AND INDUSTRIAL PRODUCTION; 4.2 PERCENT TRAFFIC GROWTH FORECAST OVER NEXT 20 YEARS

Air cargo demand growth is closely linked to industrial production, a primary measure of manufacturing output. Air cargo plays an important role in the manufacturing sector by transporting high value, time-sensitive component inputs which become manufactured finished products that are subsequently shipped to markets worldwide. Global trade, including high-value and time sensitive consumer goods are also key to air cargo traffic growth. (See *Figures 17 and 18.)*

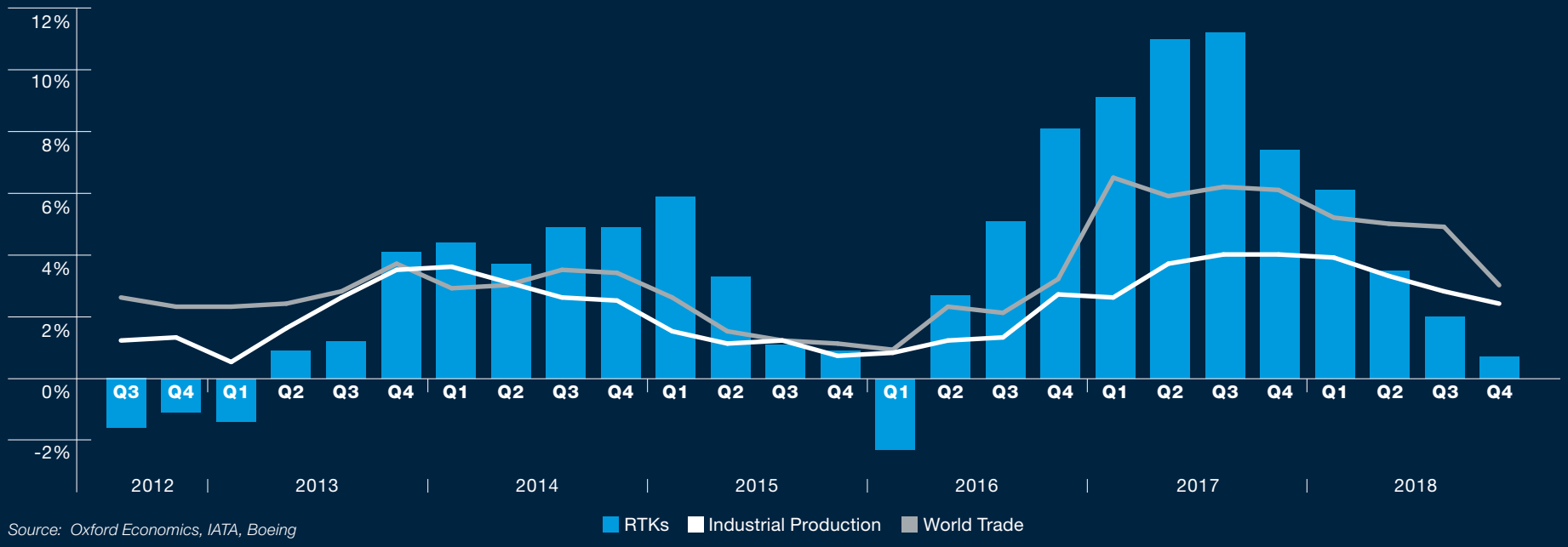
Long-term world trade growth has historically averaged approximately 5 percent during the past four decades, with air cargo growth outpacing that at about 5.3 percent. The future world trade growth rate is projected to be 3.4 percent, which will support an air cargo growth rate of 4.2 percent.

Figure 17: Air Cargo is Focused on High-Value and Time-Sensitive Commodities



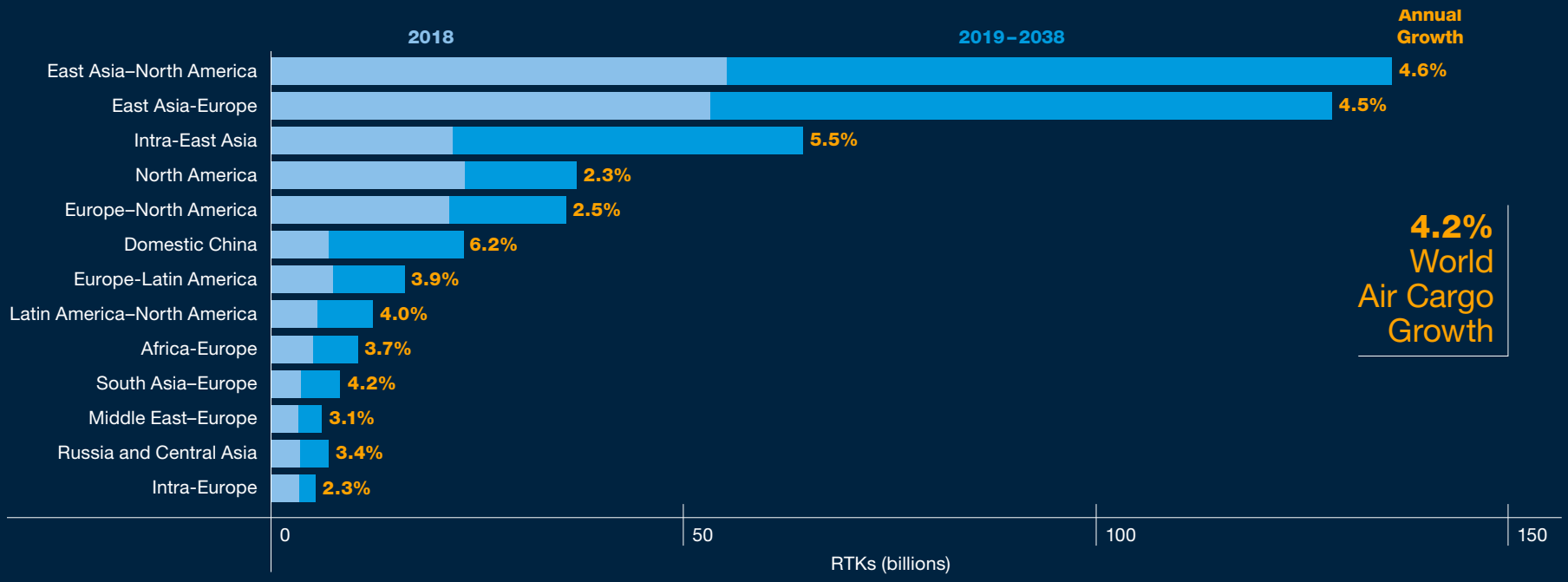
Source: IATA

Figure 18: Air Cargo Growth Closely Linked to Industrial Production and World Trade



Source: Oxford Economics, IATA, Boeing

Figure 19: East Asia Markets Will Continue to Lead Industry Growth



Source: Boeing

The strong growth of East Asia as a manufacturing hub, plus rising consumer income levels, have boosted the share of global air cargo flows touching East Asia by 25 percent in the past 20 years. East Asia is also forecast to lead economic growth over the next two decades. As a result, air cargo markets to, from, and within this region are forecast to grow above trend at 4.8 percent over the next 20 years. Furthermore, the share of world air cargo traffic associated with East Asia, will increase from 52 percent in 2018 to 58 percent by 2038. (See *Figure 19 on page 27.*)

FREIGHTERS ARE CRITICAL TO AIR CARGO GROWTH

Freighters comprise only 8 percent of the total commercial jet fleet, yet they carry more than 50 percent of all air cargo traffic. Lower-hold cargo capacity on passenger flights has been expanding as airlines deploy new jetliners with improved range and cargo capability, such as the 777-300ER. However, passenger widebody fleet growth does not necessarily mean significantly more cargo carrying capability deployed on key cargo flows.

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, hazardous materials, and dimensions). These distinct advantages allow airlines with dedicated freighters to offer better service to shippers. As a result, airlines with main deck freighters generate nearly 90 percent of air cargo industry revenue. Due to this value proposition, freighters are expected to continue carrying more than half of global air cargo. (See *Figure 20.*)

NEED FOR 1,040 NEW AND 1,780 CONVERTED FREIGHTERS PROJECTED OVER THE NEXT 20 YEARS

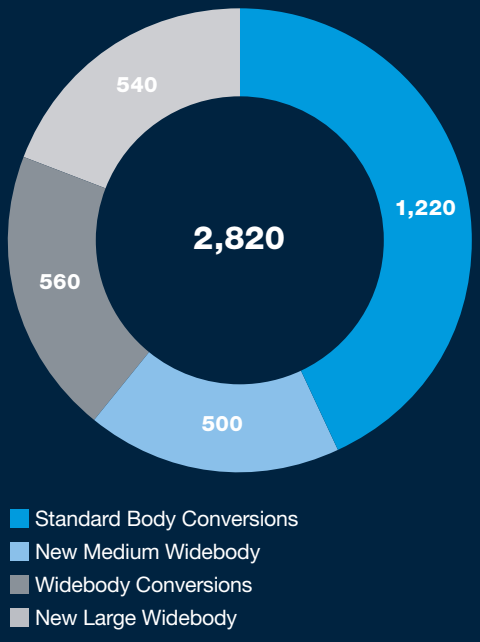
With the future of economies and production systems developing to support "on-demand" provision of goods and services, air cargo will remain a vital service. If the cargo networks of the future are to be fast, reliable, and effective, they must — as they do today— include freighters.

Replacement of aging airplanes, plus growth requirements, will create a demand for 2,820 freighter deliveries in the next 20 years. (See *Figure 21.*) Of these, 1,780 will be passenger airplane conversions. The remaining 1,040 airplanes, valued at $300 billion, will be new freighters. The overall freighter fleet will increase by more than half — from 1,970 airplanes in 2018 to 3,400 by 2038. (See *Figure 22.*) This represents 73 percent fleet growth over the next 20 years. During this time period, the fleet share of large widebody freighters will decline from 29 percent to 25 percent, medium wide body freighter fleet share will increase from 32 percent to 35 percent, and standard body freighter share will increase from 38 percent to 40 percent.

Figure 20: Freighters Will Remain the Backbone of the World Air Cargo Industry

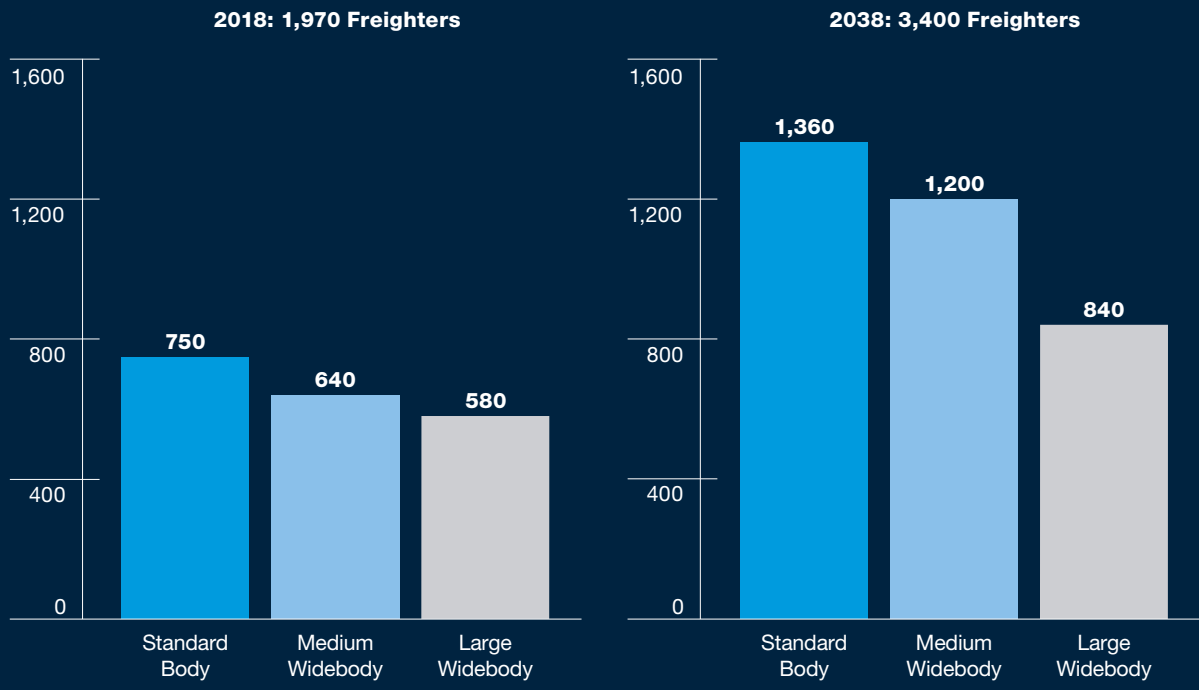
Passenger lower-hold capacity, while plentiful, is not sufficient to meet air cargo traffic demand

Figure 21: Freighters Market Will Require 2,820 Additional Freighters



Source: Boeing

Figure 22: Freighter Fleet Will Nearly Double; Standard Body Freighters to Gain Share



Services Outlook

The International Air Transport Association (IATA) compiles the expenses of International Civil Aviation Organization (ICAO) member airlines, which totaled $854 billion in 2018. Airline operating expenses include all activities designed to attract customers and to deliver passengers and cargo to their destinations. Embedded in these activities is a set of support services necessary to operate fleets effectively.

For 2019, we estimate that world airline expenses, including nonscheduled airlines and airlines of non-ICAO member countries, will total nearly $908 billion. Of that spend, services account for one third and this investment in commercial aviation services is forecast to grow 4.2 percent per year over the next 20 years (See Figure 23 and Figure 24).

This section includes analysis for all commercial market segments. Our 10-year Services Market Outlook (SMO) covers the commercial, business aviation, general aviation, civil helicopter, and government support and services functions commonly found in the market today and represents a view of the specific services for which Boeing serves.

Key Macro Market Forces Driving Demand for Commercial Aviation Support and Services

New Technologies: Through data collection, automation, and artificial intelligence, customers will experience personalized air travel services. Operationally, adoption of technologies such as connected electronic flight bags will not only reduce weight but

Figure 23: Commercial Aviation Services

Demand has grown for aftermarket services designed to increase availability, extend the lives of airplanes, and lower operational costs.

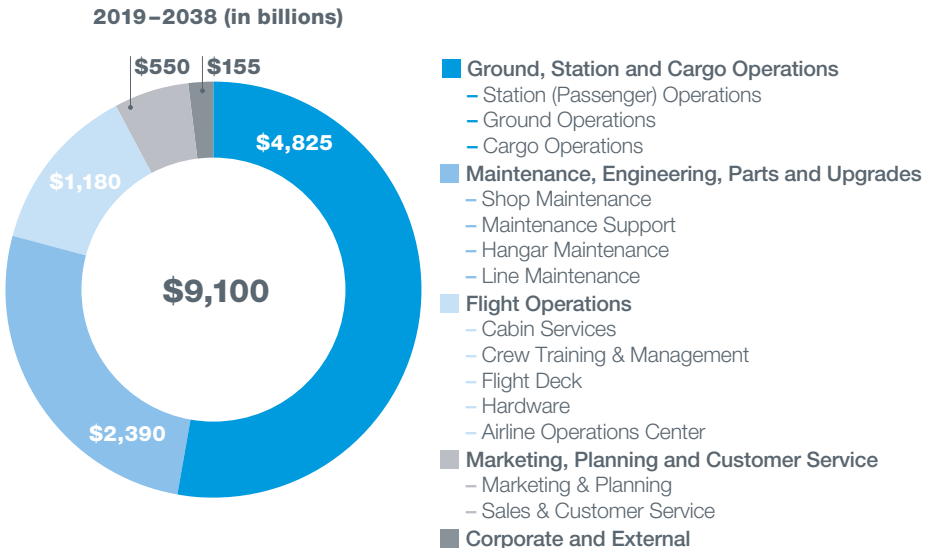
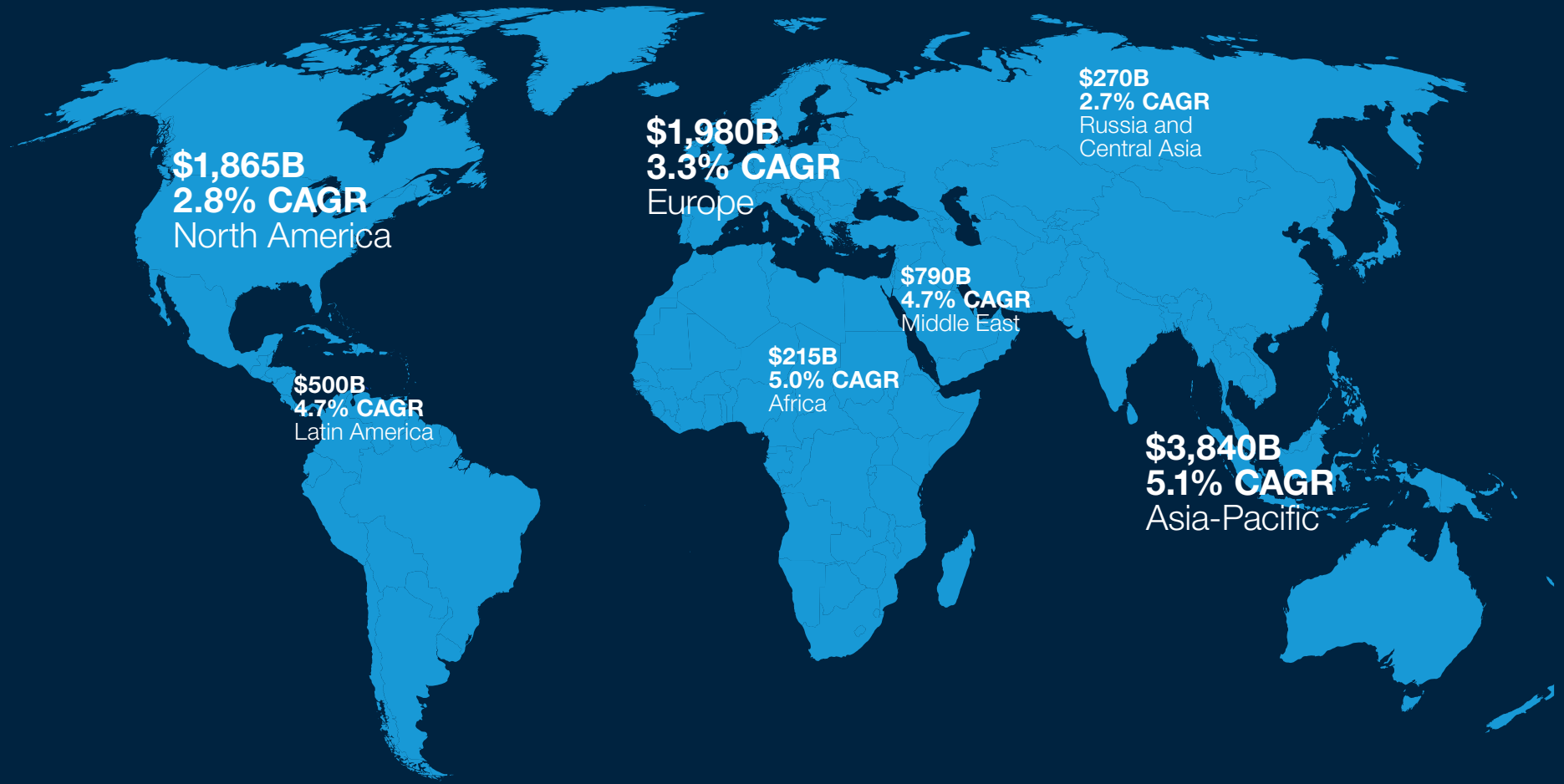


Figure 24: Commercial Aviation Services Market Demand by Region 2019–2038



also allows pilots to quickly access, update, and share real-time information between the flight deck and ground crew. Additionally, as detailed flight data from these devices is collected over time, trends can be identified to more accurately predict and improve maintenance and performance.

Operational Efficiency: The exponential growth of the connected fleet is enabling the industry to transition from asset-specific analytic solutions to fleet-wide cognitive solutions. Airlines are pursuing data analysis projects and finding that the effort pays off in reducing delays, cancellations, and unplanned maintenance events. Tools such as performance-based navigation, crew scheduling optimization, and fuel efficiency software are also being implemented to lower costs and minimize flight disruptions.

Demonstrating Value: Airlines are investing heavily to unlock new revenue streams and adjacent markets. Ancillary offerings have become a key revenue stream for a majority of airlines, and the range of services being offered to customers is widening every year. As digital natives become a larger share of the consumer base, the expectation of technology making their lives easier transfers into how they travel and the ease of which their experience can be customized.

FOUR PRIMARY SEGMENTS IN THE AVIATION SERVICES MARKET

Commercial aviation services market segments in the forecast are grouped by function: corporate overhead; marketing and planning; flight operations; maintenance and engineering; and ground, station, and cargo operations. While these segments are diverse in terms of sales, activity scope, capital intensity, and competitive environment, we expect growth to generally track fleet growth rates.

While our SMO includes the values of commercial aviation services purchased for corporate overhead functions as well as air traffic management, those segments are not covered in detail in this document. Following are key trends driving demand in the four largest market segments.

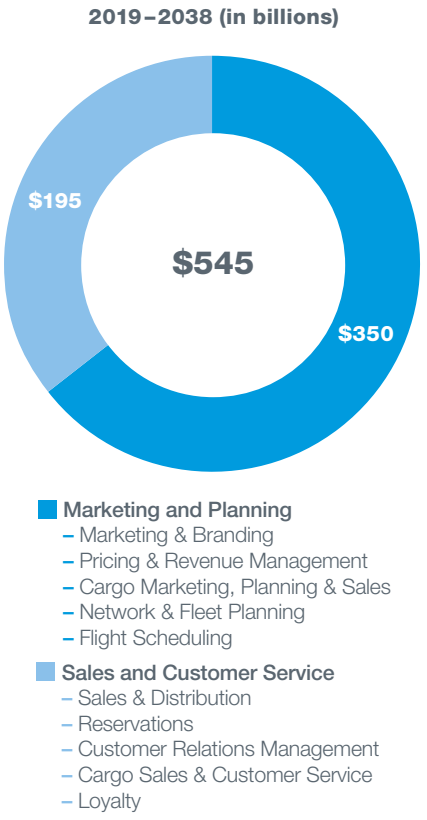
Marketing, Planning and Customer Service

Marketing, Planning, and Customer Service is the area of airline activity that manages customer relationships, captures travel reservations and payments, and uses that information in planning activities that ultimately drive airline operations (See Figure 25). Airlines may obtain these services in house, through outsourcing, or through some combination of the two.

Most of the activities in this segment rely heavily on both in-house and vendor-provided IT systems. Nearly 50 percent of the total spend for airline's marketing,

Figure 25: Marketing, Planning and Customer Service

The growing use of A.I. in aviation is one contributing factor to the 5.2 percent growth of this segment over the next 20 years. This segment is forecast to comprise 6 percent of airline spend.



planning, and customer service functions will be on IT systems and support. These systems are often complex and highly integrated with other airline systems. We also see airlines evolving to use analytic and prognostic algorithms to enhance their planning capabilities and outcomes.

Revenue Diversification: Airline ancillary revenue is generated from non-ticket sources such as baggage fees and on-board food and services. This revenue stream has become a key component of profitability for many airlines, particularly LCCs. Globally, airlines are estimated to have earned $92.9 billion from ancillaries last year, representing about 10.7 per cent of airline revenue for 2018, up from 4.8 percent in 2010.

The range of services being offered to customers is widening every year. While baggage still accounts for roughly 60 percent of LCC ancillary revenue, airlines are increasingly offering hotel and car hire services to customers onboard and throughout their distribution channels. Upgraded onboard connectivity and improved customer data profiles are enriching in-flight e-commerce solutions by allowing for a more personalized shopping experience.

Seamless Travel Experience: The air travel experience is becoming increasingly defined by ensuring personalization and seamless travel from start to finish. Today's passenger is more connected than ever before thanks to growth in smart wearable technology, artificial intelligence, and social media. As these technologies mature, the expectation is that their capabilities will integrate into their travel experience as well. Airlines are integrating their applications with these technologies to not only minimize disruption and optimize their schedules, but also unlock additional revenue opportunities.

Digital Transformation: The expansion of digitalization to create an improved passenger experience continues to be a top priority for airlines. Around the world, airlines continue to replace staffed ticket counters with self-check-in kiosks, and many have replaced printed boarding passes with at-home check-in, mobile check-in, mobile boarding passes, and self-bag-tagging.

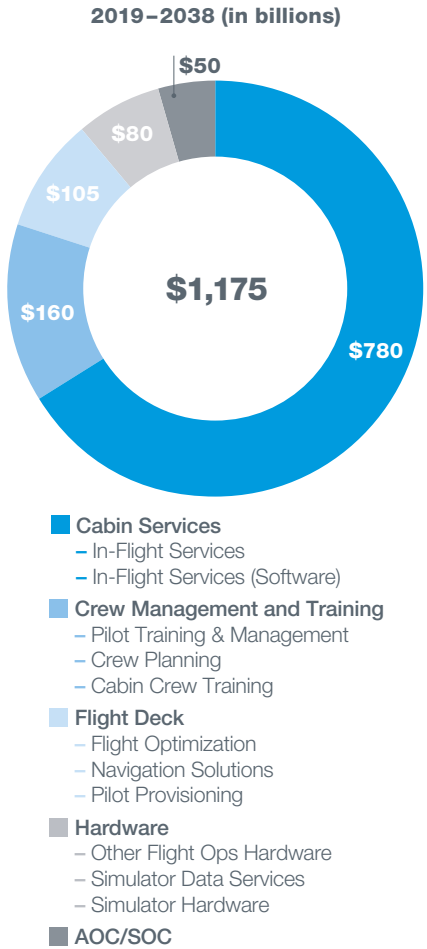
One area seeing increased interest and experimentation is blockchain, which the airline industry can capitalize on for its secure transfer and recording of data. It fundamentally holds potential advantages in any task that involves the sharing and transfer of data. From ticketing to loyalty programs to identity protection, this segment of an airline's operations is ripe for disruption from blockchain.

Flight Operations

Flight Operations includes services associated with the flight deck, cabin services, crew training and management, airplane operations while in flight, and the airline operations center (AOC) (See Figure 26). Growth in the Flight Operations services market is highly correlated with commercial fleet and passenger traffic growth rates.

Figure 26: Flight Operations

This segment is forecast to comprise 13 percent of airline spend and grow at 3.7 percent per year. The industry is forecast to need 645,000 new pilots and 881,000 new cabin crew to serve projected travel demand.




NO STEP

Technology and the growth of the e-enabled fleet are driving growth in Flight Operations services, specifically with respect to passenger service, flight deck tools, flight and crew planning software, and airplane health and systems management.

Exponential Growth of Connected Aircraft: Over the next twenty years, the percentage of connected aircraft is estimated to increase from 30 percent to over 75 percent of the global fleet. Increased connectivity will bring new opportunities for real-time airplane tracking, troubleshooting, and data analysis. New Aircraft Interface Device (AIDs) hardware coupled with the electronic flight bag enables further integration with the flight deck. As detailed flight data is collected over time, trends can be identified to more accurately predict and improve performance and operational efficiencies such as fuel performance and navigating around turbulent weather conditions.

Sustainable Pilot Pipeline: The global pilot supply remains tight, and the industry is taking steps to build a healthier and more sustainable pilot pipeline for the future. Salaries and bonuses are increasing, cadet programs are becoming more abundant, and governments are partnering with training providers to develop indigenous talent.

Transforming Student Learning: As aviation evolves to become an increasingly data-rich environment, pilot training is also undergoing a transformation. With the wealth of historical data available, evidence and competency-based training (EBT/CBT) programs are increasingly being adopted to change how pilots are trained and assessed.

Maintenance, Engineering, Parts and Upgrades

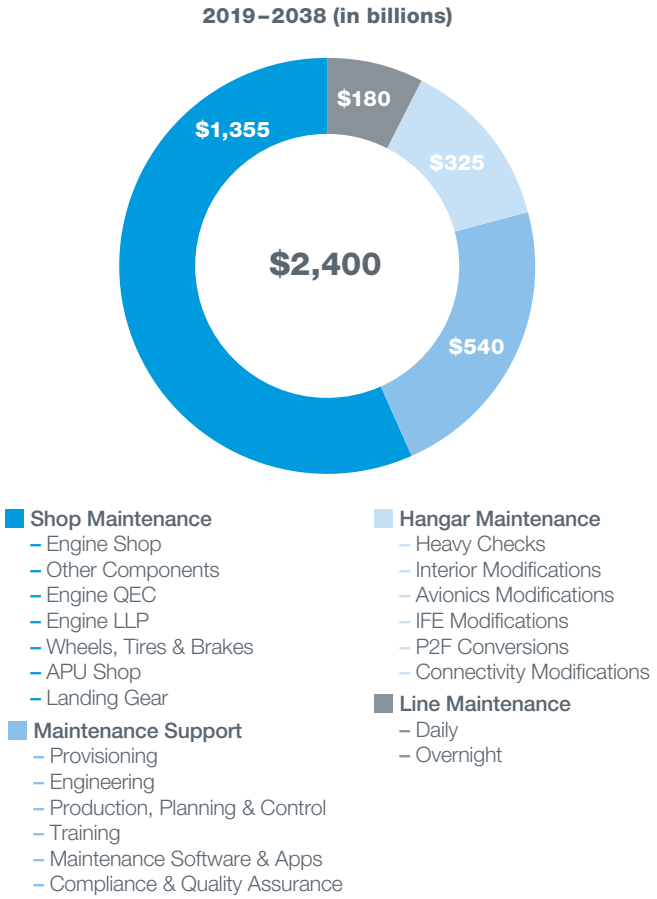
Maintenance includes those tasks required to upgrade, maintain or restore the airworthiness of an aircraft and its systems, components, and structures (See Figure 27). Regulators require that an operator establish a maintenance and inspection program to accomplish those tasks, carried out by certified personnel. There is a growing trend for airlines, particularly startups or low-cost carriers (LCC), to forego the expense of setting up full-service maintenance departments, opting instead to outsource some or all of these services.

Some maintenance activities that were traditionally accomplished with the airplane temporarily out of service in the hangar are now being addressed overnight while an airplane is undergoing line maintenance. This migration of tasks into line maintenance is beginning to blur the division between the line and hangar maintenance categories.

Increasingly Sophisticated Aircraft and Technology: The percentage of new, next-generation aircraft is forecast to increase to over 50 percent of the fleet in 2038 from 13 percent today. Additionally, new innovations such as image recognition and robotics are increasingly used in maintenance inspections and related tasks. These advances may result in operational adjustments and

Figure 27: Maintenance, Engineering, Parts and Upgrades

This segment will grow by 4 percent annually as MRO providers adapt and invest to handle new advanced materials. This segment is forecast to comprise 26 percent of airline spend.



investments as service providers prepare to address next generation equipment, evolving maintenance scope and intervals, and new material.

Increased Interiors and Connectivity Modifications: Cabins supporting ancillary revenue generation will continue to drive the demand for interior modifications and airplane connectivity. Airlines are investing in diverse cabin layouts to facilitate customized product offerings such as the rising popularity of premium economy class.

By the end of the next decade, we expect that two-thirds of aircraft will have some form of connectivity whether through retrofit or an off-the-line capability. The majority of connectivity upgrades currently taking place occurs via aircraft modification as in-service airplanes are outfitted with new and improved high-speed systems. Today, more than one thousand airplanes are upgraded annually. This pace will continue a few more years and then slow as airplanes are delivered off the production line with connectivity as the new standard. However, the evolution of this technology ensures that a modest level of modification will continue indefinitely.

Additive Manufacturing Shaping the Supply Chain: The use of additive manufacturing (3D-printing) in the aviation industry made significant progress over the last several years. Printing of complex aircraft components instead of assembling them from various parts is gradually becoming a common aviation industry standard. At present, it is mainly used for non-critical flight components and rapid tooling in maintenance, repair, and overhaul (MRO) operations. Eventually, additive manufacturing will impact logistics operations, with MROs and airlines being able to print a part or tool and have it in short order. The benefits to airlines can range from greatly reduced time and impact of an 'aircraft on ground' to less capital required for spare parts on inventory.

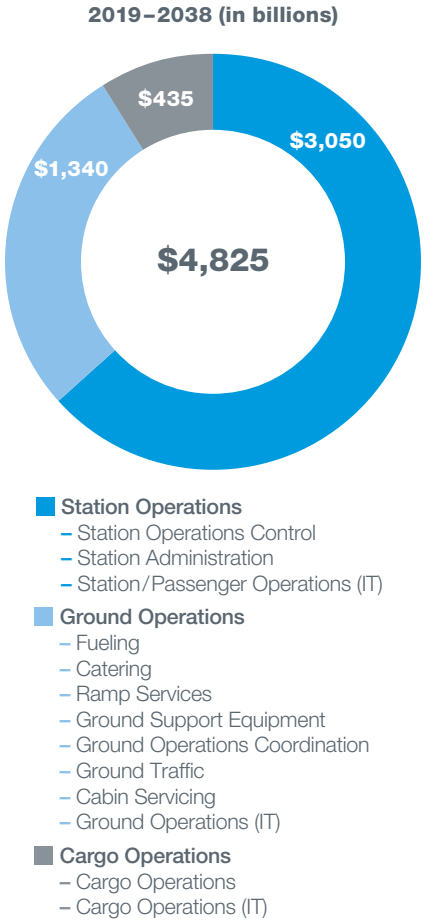
Ground, Station and Cargo Operations

This segment captures the key elements of airport operations that coordinate and manage the services required to receive an airplane, turn it around for the next flight, and release it for departure. We segment this market into three categories: ground operations, station operations, and cargo operations. The Ground, Station, and Cargo services market closely correlates with number of passengers served (See Figure 28).

Cargo Traceability & Actionability: The ability to track shipment whereabouts, monitor and mitigate potential delays, and pinpoint at-fault parties in damage cases are becoming more valuable. Demand for "smart supply chains" where data flows during shipment and handoffs become seamless will increase. Further, there is an opportunity for blockchain technology to help create secure shipment and handling records, and pinpoint responsible parties when damages occur. Artificial Intelligence can power predictive software to determine delay factors such as weather, headwinds, and customs holdovers. Proper monitoring and real-time alerts

Figure 28: Ground, Station and Cargo Operations

As airlines and airports invest in technology such as biometrics to speed up boarding processes and improve passenger experience, this segment is forecast to comprise 53 percent of airline spend and grow at 4.1 percent annually.



of temperatures moving out of range will also be critical. Per industry sources, the global cold chain logistics market is predicted to grow 7.6 percent annually reaching nearly $300B by 2023.

Biometric Technology: Continued biometric adoption in passenger air travel will modernize passengers' self-service journey. Identities will increasingly be validated via biometric recognition technology. Automated self-service baggage drops with biometric identity checks remove human agent bottle necks upon check-in. Shortened boarding times will allow for greater gate turnover, supporting more flights and increased revenues while deferring immediate infrastructure expansion needs.

Smart Airports: Smart airports provide a holistic approach to air travel where, through data collection, automation, and artificial intelligence (AI), customers receive personalized experiences. Air transport stakeholders benefit from increased security, revenue, and cost savings. Customers can manage their journeys through smart phones with a single booking that covers transportation to the airport, the flight, and to the traveler's ultimate destination. Beacons connecting passengers' mobile phones to real time information allow customers to interact with the airport, receive real-time updates, and track baggage as they move throughout. The meta-data from these beacons give airports and carriers visibility into passenger movement, allowing airport operators to analyze information real time to make better decisions such as reacting to customer flow and manage flight changes or disruptions.

Asia-Pacific

17,390
Deliveries

4.6%
Fleet Growth

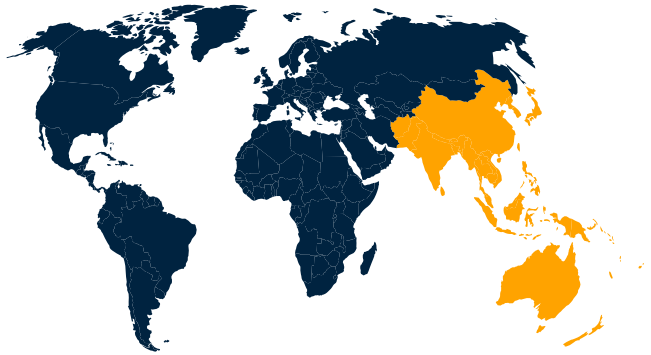
3.9%
GDP Growth

5.5%
Traffic Growth

$2,830B
Airplane Market Value

5.1%
Service Growth

$3,480B
Services Market Value



As the largest region in the world with 60 percent of the global population, Asia-Pacific continues to be a primary contributor to global aviation growth.

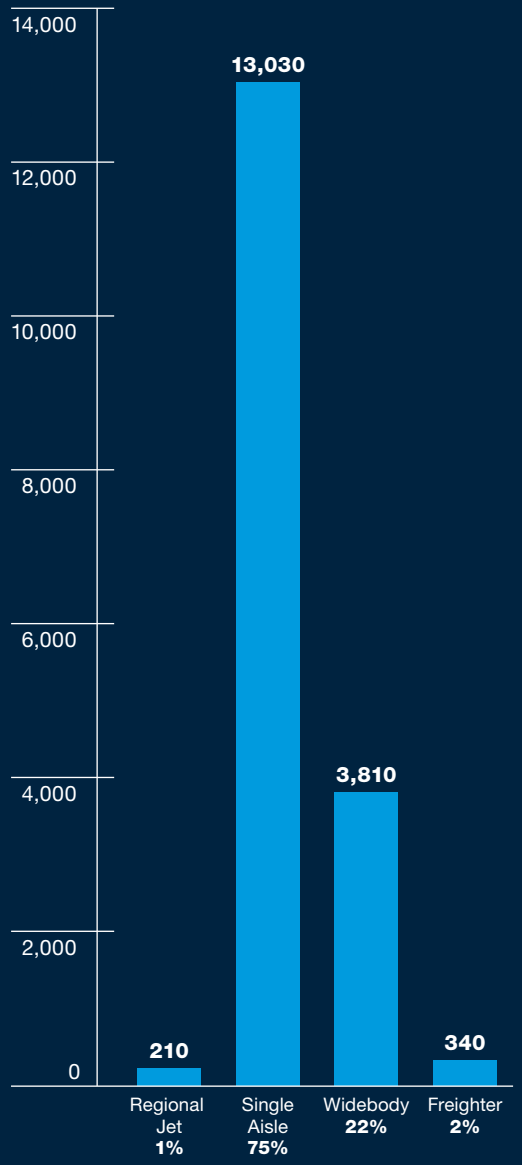
Over the past decade, the region has surpassed the world average in many key drivers closely correlated with industry growth such as GDP, income growth, and world trade. In addition, the region's vast geographical area including many island nations, generates a strong demand for air travel. Today, roughly one quarter of world air travel is flown within Asia, the highest share of intra-regional air travel globally. Boeing forecasts intra-Asia traffic's share will increase to almost 35 percent of all global air travel over the next 20 years.

With wide ranging economic and demographic diversity, each of the five sub-regions in Asia-Pacific contributes to regional growth in varying ways. In some slower growing economies, liberalizing markets and increased airline competition are boosting air travel demand. In addition, airlines in these more mature economies are often seeing growth opportunities in long-haul markets as well as connections to faster growing economies within Asia. Asia-Pacific is also home to some of the fastest growing economies in the world, where strong economic and disposable income growth are combining with new airline strategies and business models to spur above average air travel growth. Despite the heterogeneity in the region, many key structural demand forces will drive 5.5 percent average annual air traffic growth for carriers in the region over the next two decades.

Deliveries 2019–2038

40%

The share of all new airplanes that will be delivered to the Asia-Pacific region over the next 20 years.



Fleet Composition

21%

The share of widebody airplanes in the total Asia-Pacific 2038 fleet. Driven by continued market fragmentation, the widebody fleet is projected to more than double in the next 20 years.

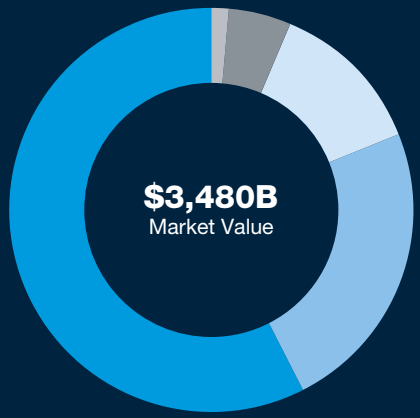
40%

The share of the global single-aisle fleet in Asia-Pacific in 2038, a 72% share of the region total fleet.

	2018	2038
Regional Jet	**2%** 140	**1%** 260
Single Aisle	**72%** 5,680	**72%** 13,950
Widebody	**22%** 1,710	**21%** 4,080
Freighter	**4%** 350	**6%** 1,130

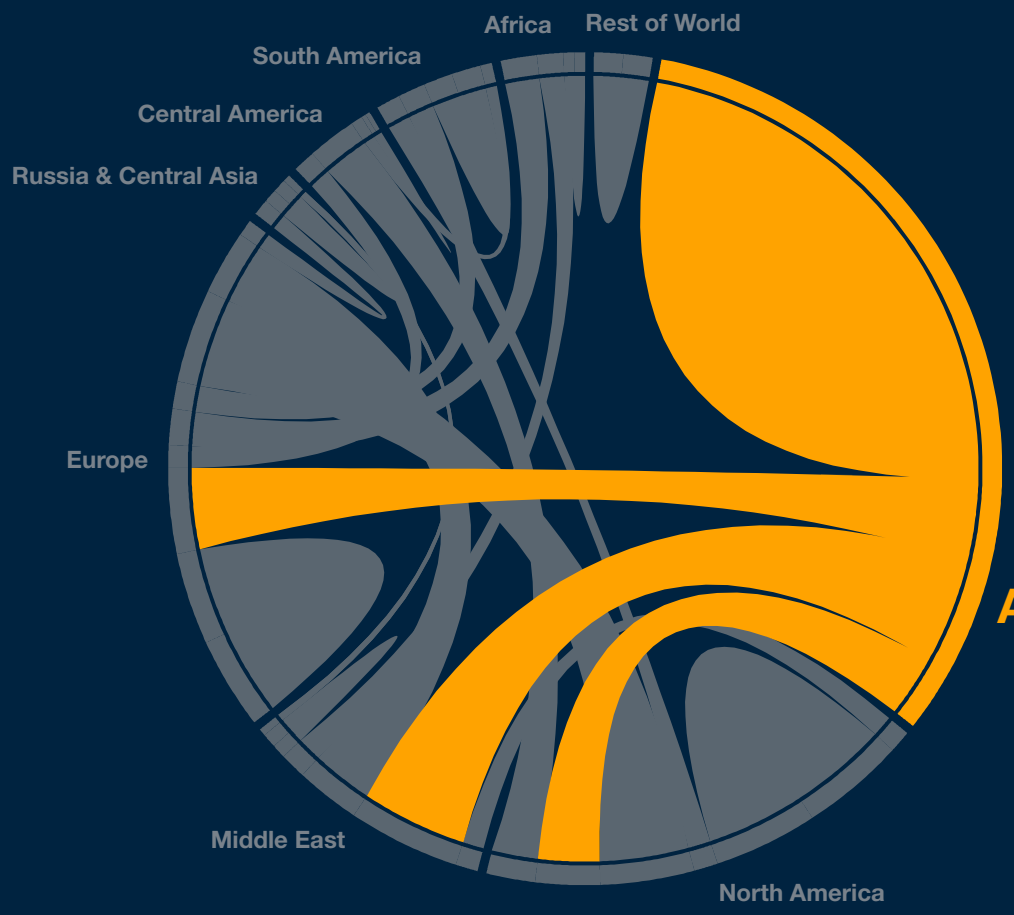
Services Market Value and Growth Rate

The labor supply challenge is magnified in Asia-Pacific because of its strong growth forecast with heavy emphasis on developing infrastructure to train a new generation of aviation workers.



	Market Value ($B)	Growth Rates
Corporate & External	50	4.5%
Marketing, Planning & Customer Service	175	6.0%
Flight Operations	440	4.8%
Maintenance & Engineering	820	5.2%
Ground, Station and Cargo Operations	1,995	5.1%

Traffic Forecast To/From/Within Asia-Pacific in 2038

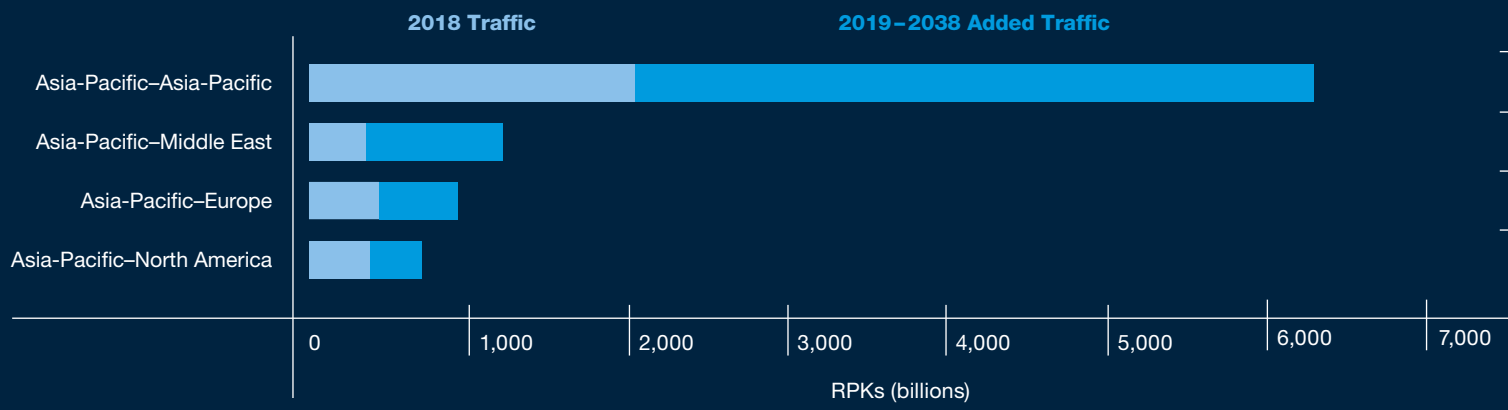


32%

Intraregional Asia-Pacific Revenue Passenger-Kilometer (RPK) passenger share of total world RPKs is currently at 26 percent, but is expected to grow to 32 percent by 2038.

Note: Thickness of the line corresponds to the share of traffic for the selected flow.

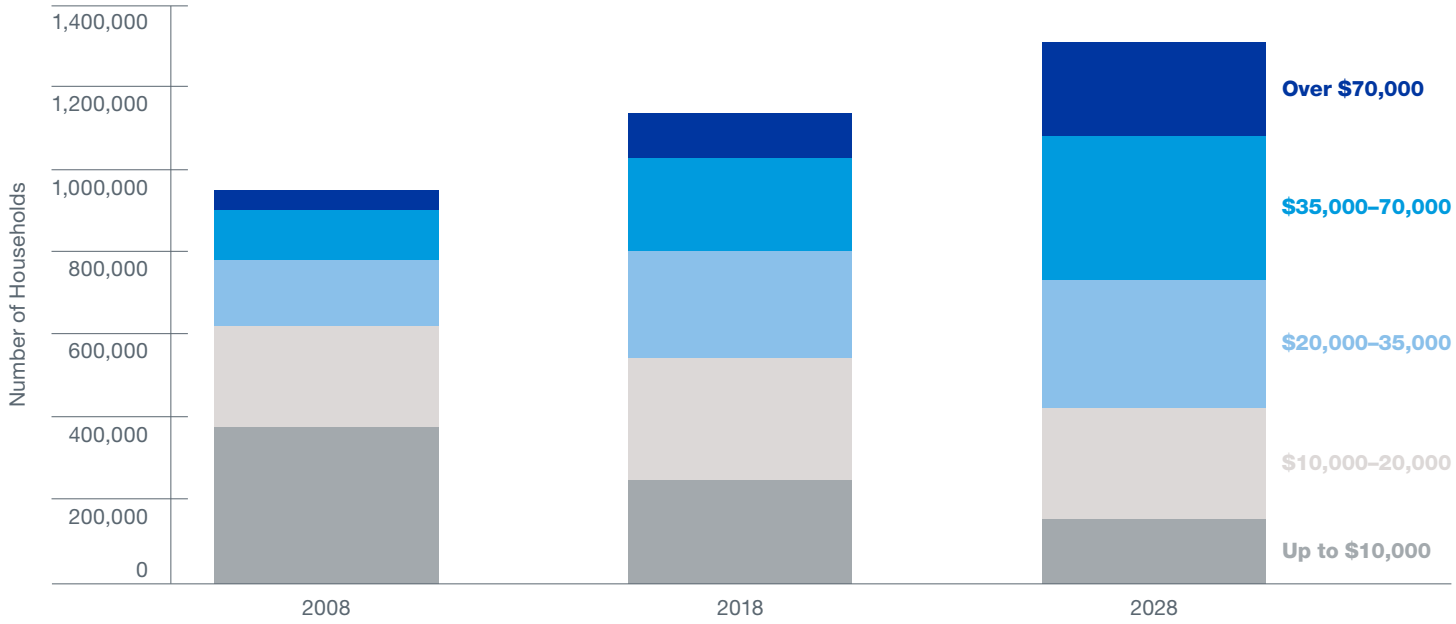
Asia-Pacific Air Travel Growth Varies By Market



	Annual Growth Rate	Forecast Growth Multiplier
Asia-Pacific–Asia-Pacific	5.8%	3.1X
Asia-Pacific–Middle East	6.2%	3.3X
Asia-Pacific–Europe	3.9%	2.1X
Asia-Pacific–North America	3.2%	1.9X

Asia-Pacific Household Numbers by Income Band

The share of households earning at least $20,000 (purchasing power parity) to double from 2008 to 2028

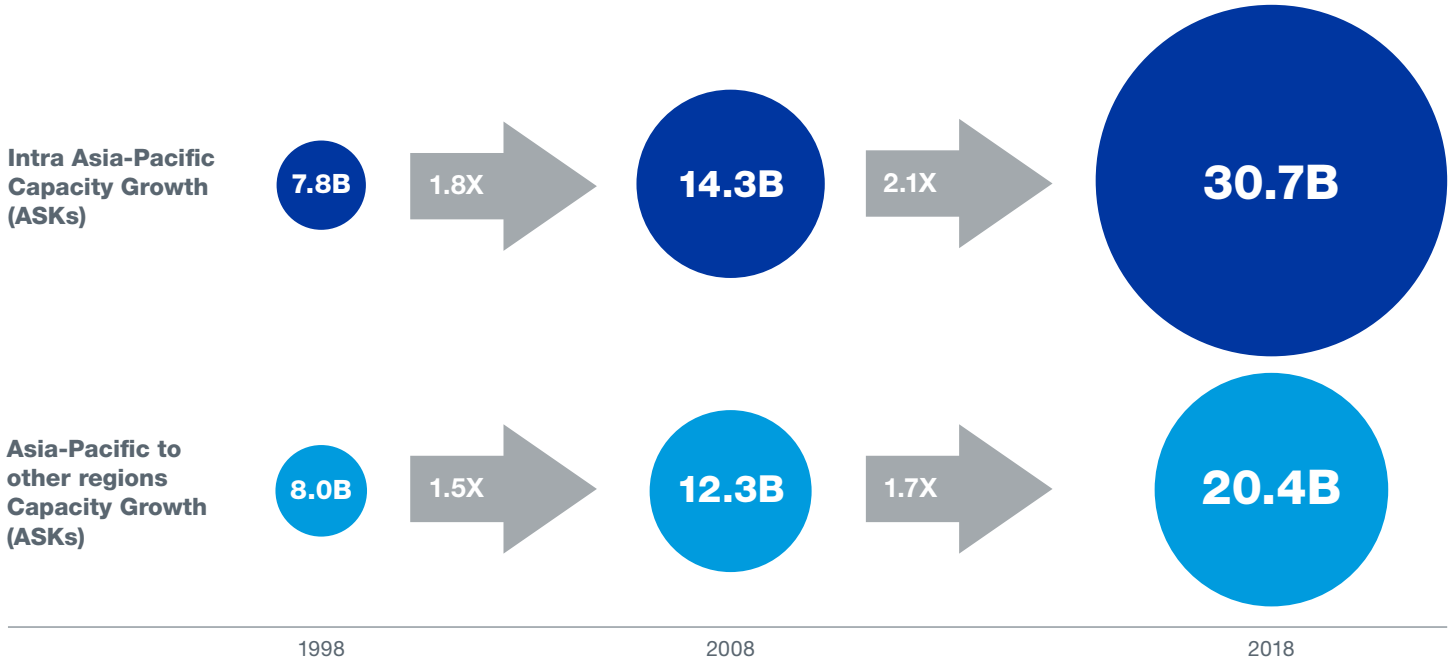


The expected robust growth in Asia-Pacific's middle class will further stimulate passenger growth in the coming years, as a greater percentage of the region's 4.2B population will be able to travel by air.

Source: Oxford Economics

Asia-Pacific Has Led the World in Growth This Decade

Asia-Pacific's impressive growth in air travel has increasingly shifted toward intra-regional air travel even as air travel growth to other regions has also been strong. The vast distances between countries in this region, along with the increasing economic ties and fast growing economies within the region, has stimulated this growth.



North America

9,130
Deliveries

1.9%
Fleet Growth

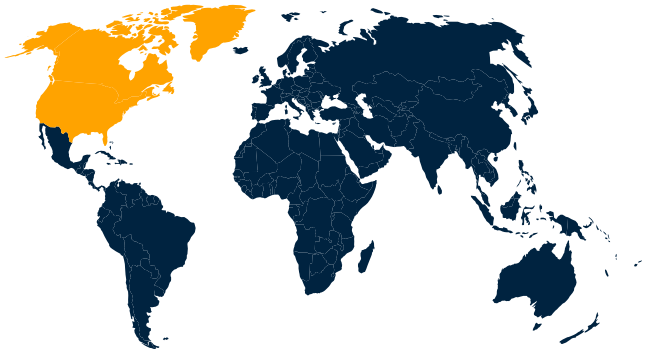
1.9%
GDP Growth

3.2%
Traffic Growth

$1,155B
Airplane Market Value

2.8%
Service Growth

$1,865B
Services Market Value



The commercial aviation market in North America continues to flourish, further placing the challenges from bankruptcy and consolidation from the beginning of the decade in the rearview mirror.

Operators have maintained focus on capacity discipline as annual load factors improved systemwide in the region with international load factors reaching the highest levels in five years.

Airlines in North America have accounted for more than half of global industry profitability in the last six years. They have maintained exceptional profitability despite the expense of a rapidly increasing workforce and rising fuel prices that fluctuated higher in recent years but still far below the peak periods.

After years of stagnation, the North America in-service fleet has increased for the sixth consecutive year. In fact, 2018 saw the fleet grow 4.1 percent, the highest year-over-year increase since the turn of the century. However, capacity growth continues to outpace fleet growth, in part because of the trend of single-aisle aircraft cabin densification and upgauging.

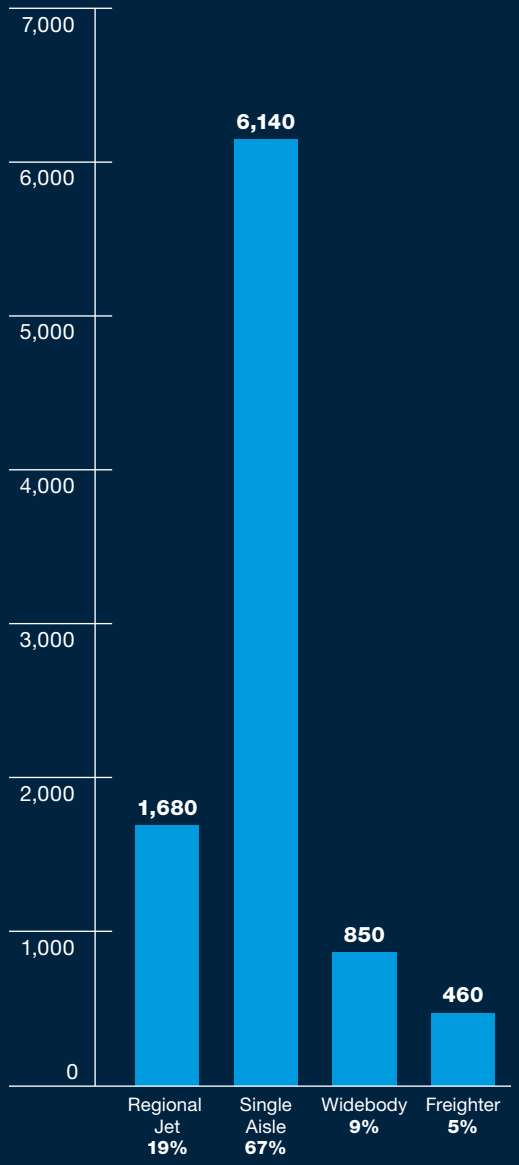
As operators strive to optimize their fleet, airlines in the region are also factoring in structural changes to their operations. They are making more equity investments to acquire stakes in other operators, leveraging those investments and alliance or joint venture partners to extend international networks and cover a larger global footprint.

North America is poised to maintain strong traffic growth over the next 20 years, particularly in the domestic market. Network operators continue to focus and invest in hub strength in the form of increased capacity and airport improvements. Single-aisle airplanes will comprise a much larger share the future fleet as the segment will account for two-thirds of all deliveries. The widebody forecast includes the operational flexibility of small and medium sized airplanes as well as large widebodies for high demand markets.

Deliveries 2019–2038

63%

The share of deliveries during the forecast period for replacement of existing airplanes, with the other 37 percent for growth.



Fleet Composition

95%

The share of growth in the passenger fleet from single aisle airplanes, despite capacity growth through upgauging and cabin densification in the category.

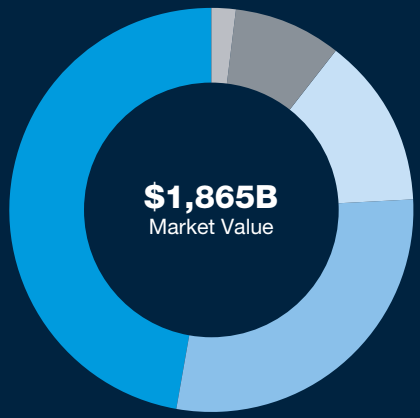
45%

The increase of the total fleet in North America during the next 20 years, a mature market with more modest fleet growth rates compared to other regions.

	2018	2038
Regional Jet	**24%** 1,840	**15%** 1,680
Single Aisle	**55%** 4,130	**65%** 7,060
Widebody	**9%** 670	**9%** 990
Freighter	**12%** 910	**11%** 1,200

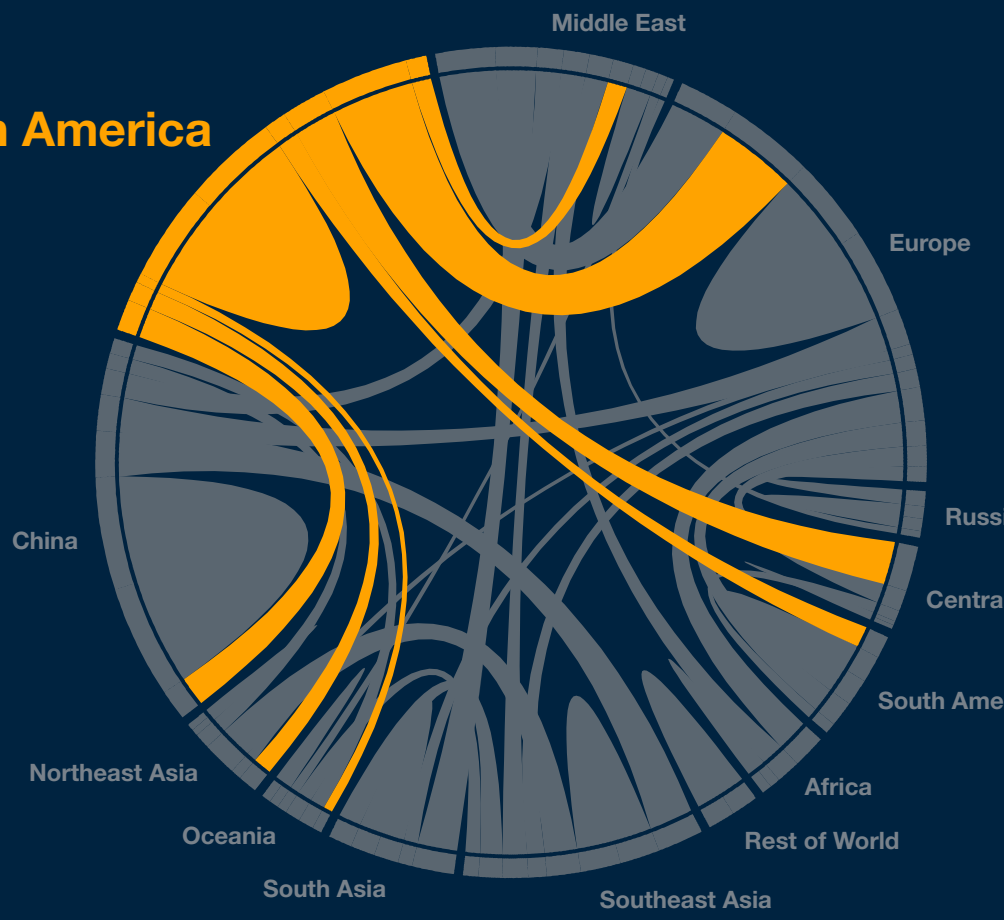
Services Market Value and Growth Rate

Above average growth expected in marketing, planning and customer service areas as carriers seek ways to capitalize on ancillary revenues, upgraded self-check-in systems and mobile applications.



	Market Value ($B)	Growth Rates
Corporate & External	40	2.4%
Marketing, Planning & Customer Service	160	5.1%
Flight Operations	255	2.6%
Maintenance & Engineering	530	2.5%
Ground, Station and Cargo Operations	880	2.6%

Traffic Forecast To/From/Within North America in 2038



Note: Thickness of the line corresponds to the share of traffic for the selected flow.

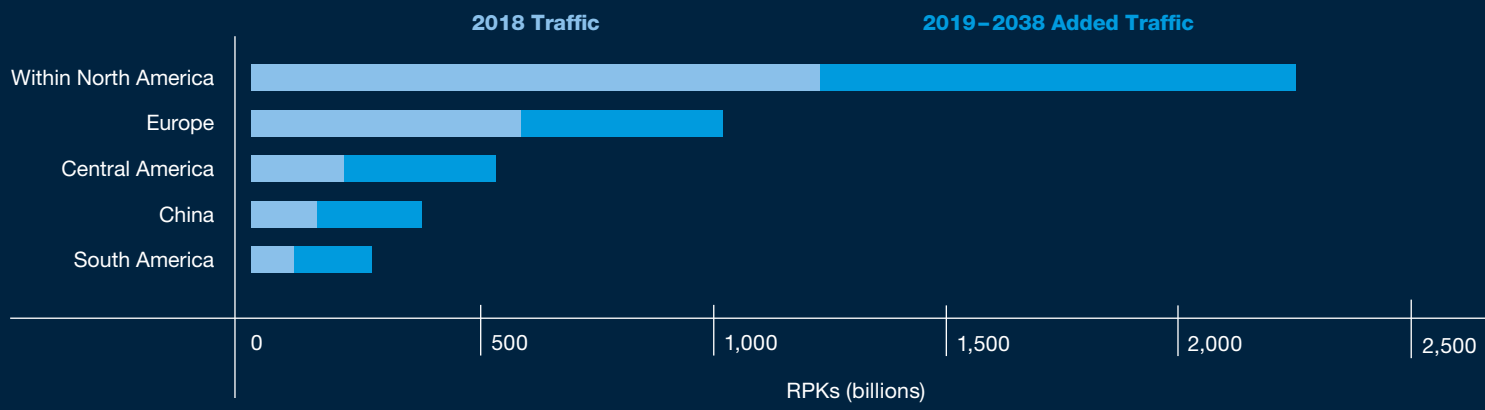
1 Trillion

The total number of transatlantic RPKs by the year 2038, an increase of 440B over the next 20 years.

5.2%

The growth rate for flows to/from North America and Latin America through 2038, the highest of any major region.

North America Air Travel Growth Varies By Market



	Annual Growth Rate	Forecast Growth Multiplier
Within North America	3.1%	1.8X
Europe	2.9%	1.8X
Central America	5.1%	2.7X
China	4.9%	2.6X
South America	5.4%	2.9X

North America Passenger Fleet Growth Has Accelerated the Last 5 Years in Every Segment

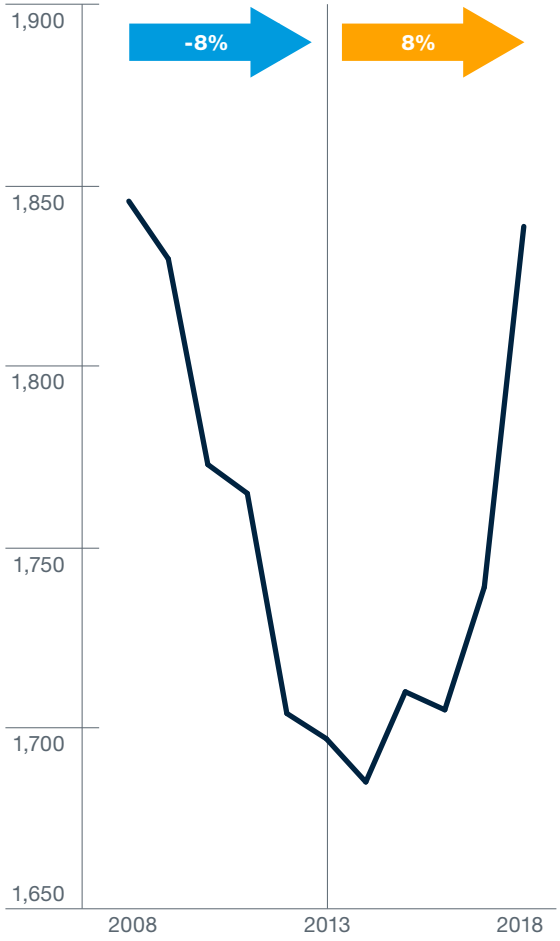
The share of parked fleet hit a twenty year low in 2018, further contributing to the rise of in-service fleet

The regional jet fleet has rebounded the last few years as operators continue to add as many large 76-seat variants as they can within the scope clause limits. The large segment now accounts for 43% of the RJ fleet, 3.5X as many as 2008.

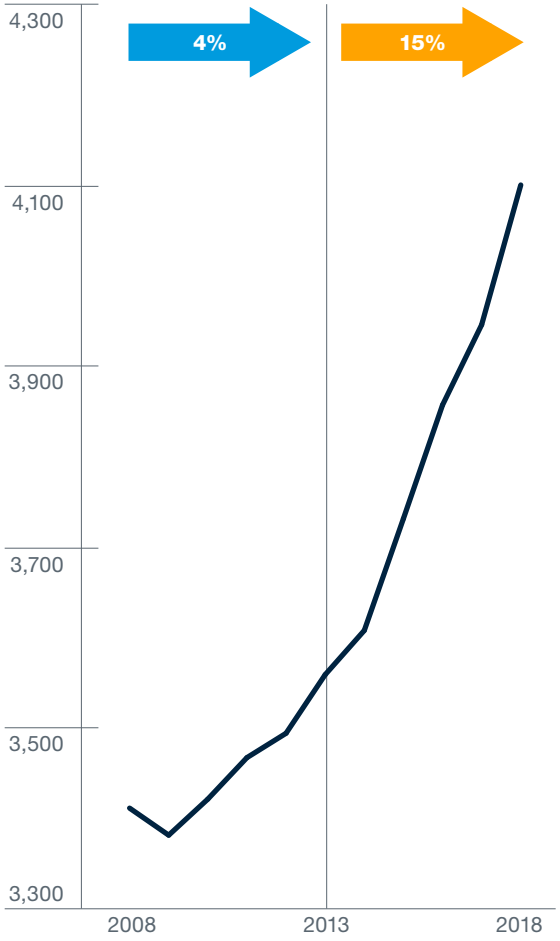
The improvement in productivity has been a key driver of profitable growth as domestic traffic has grown 23% the last five years. Densification and upgauging in the single aisle fleet has provided significant capacity growth in recent years and further expansion will also require investment for fleet additions in the future.

Widebody deliveries have increased 2.5x in the last five years compared to the previous five-year period. The majority of the fleet additions have been for growth, an increase of over 100 units during that time.

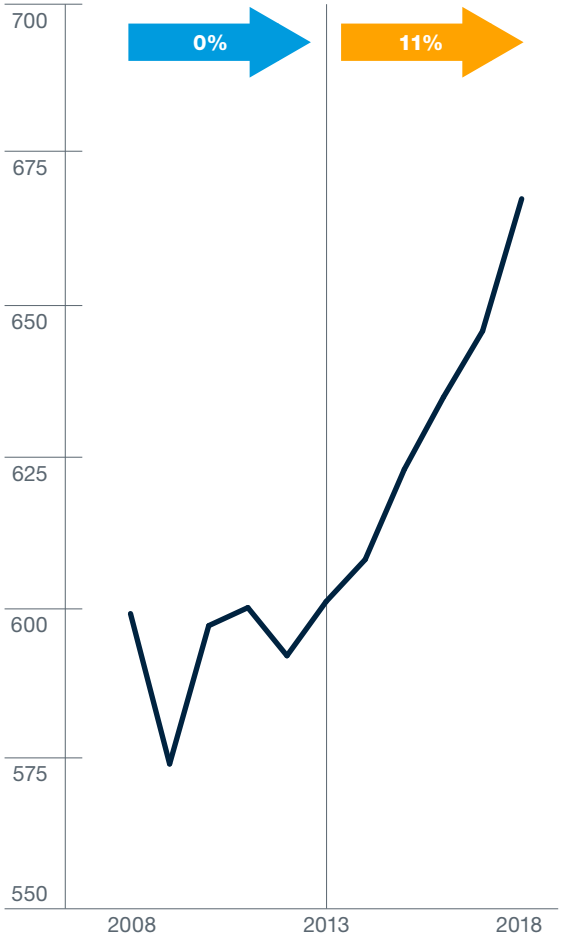
Regional Jet Passenger Fleet



Single Aisle Passenger Fleet



Widebody Passenger Fleet



Europe

8,990
Deliveries

2.9%
Fleet Growth

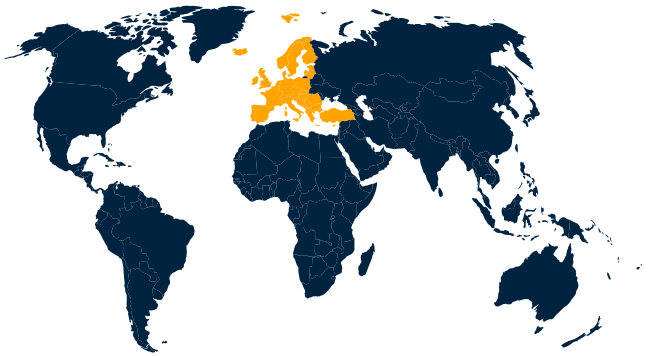
1.6%
GDP Growth

3.6%
Traffic Growth

$1,370B
Airplane Market Value

3.3%
Service Growth

$1,980B
Services Market Value



European air traffic continued its strong run in 2018, with network airlines carrying 6.5 percent more passenger traffic than in 2017 and the largest low-cost carriers (LCC) in Europe reporting an increase in passengers of 9.9 percent.

These strong traffic increases came in the face of GDP growth in Europe of only 2.9 percent, suggesting that European aviation is not entirely dependent on GDP to generate traffic growth.

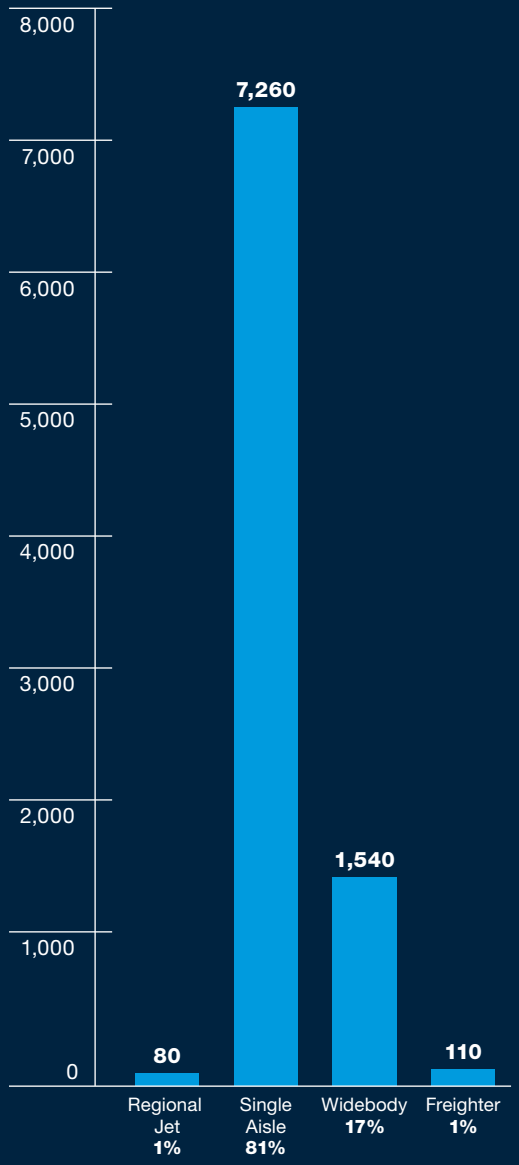
European airlines acquired 336 new airplanes in 2018, over 80 percent of them single-aisle. The European aviation market is expected to grow during the next 20 years, with airlines forecast to acquire almost 9,000 new airplanes valued at over $1.3 trillion. Single-aisle airplanes will comprise the majority of deliveries, representing an 80 percent share of total deliveries.

European short-haul service has become a battleground, with large LCCs continuing to grow aggressively and the LCC subsidiaries of large network groups pushing back and defending their market share in intra-Europe point-to-point service. This competition has resulted in lower fares and more service choices, benefiting the passenger.

Network carriers have been challenged by competition from large Middle Eastern airlines in some long-haul markets. The Middle East carriers have captured significant share by providing one-stop service from Europe to destinations such as India, Australia, and Southeast Asia, where the geographic advantage of Middle East carriers is greatest. Combined O&D market share on these flows for the three large European network carrier groups has dropped from over 23 percent in 2002 to under 12 percent in 2018.

Deliveries 2019–2038

Europe's large installed base of airplanes drives substantial demand for replacement. Replacements represent over half of total European deliveries.



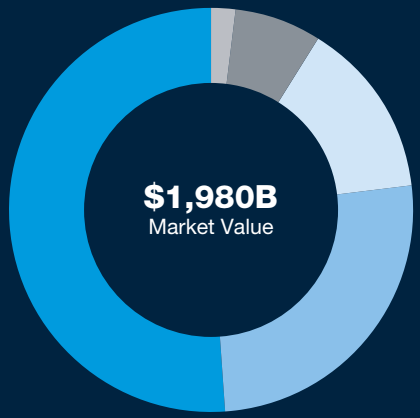
Fleet Composition

76%
The 2038 share of single-aisle airplanes in the European fleet, driven largely by rapid growth of LCCs on short-haul routes.

	2018	2038
Regional Jet	**5%** 260	**1%** 80
Single Aisle	**71%** 3,740	**76%** 7,070
Widebody	**18%** 950	**18%** 1,720
Freighter	**6%** 310	**5%** 470

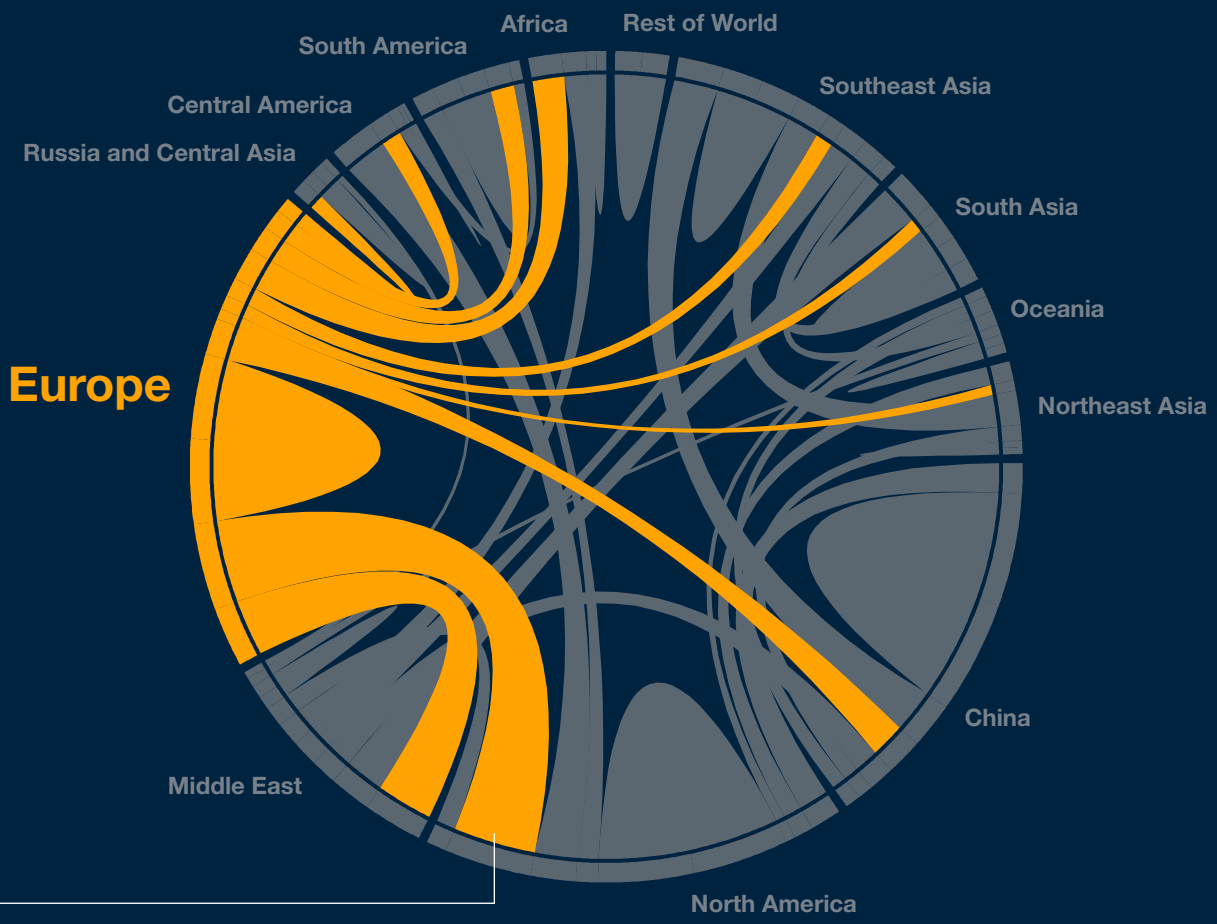
Services Market Value and Growth Rate

Stable and healthy region for aviation services. However, the skills shortages for technicians could dampen growth in this region.



	Market Value ($B)	Growth Rates
Corporate & External	40	2.4%
Marketing, Planning & Customer Service	140	4.7%
Flight Operations	280	3.0%
Maintenance & Engineering	510	3.2%
Ground, Station and Cargo Operations	1010	3.3%

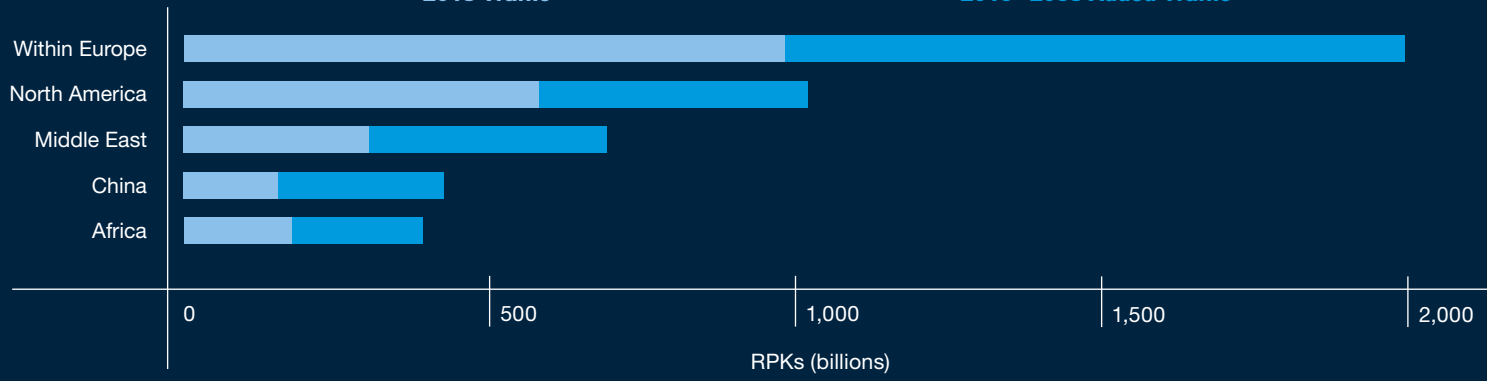
Traffic Forecast To/From/Within Europe in 2038



The emergence of the low-cost long-haul (LCLH) business model is driving traffic growth and fragmentation of nonstop city pairs on Europe–North America routes. The LCLH share of North Atlantic departures has grown from 1.1 percent in summer 2012 to almost 6 percent in summer 2018. The number of unique city pairs served nonstop on this flow has similarly grown from 10 in summer 2012 to 64 in summer 2018.

Note: Thickness of the line corresponds to the share of traffic for the selected flow.

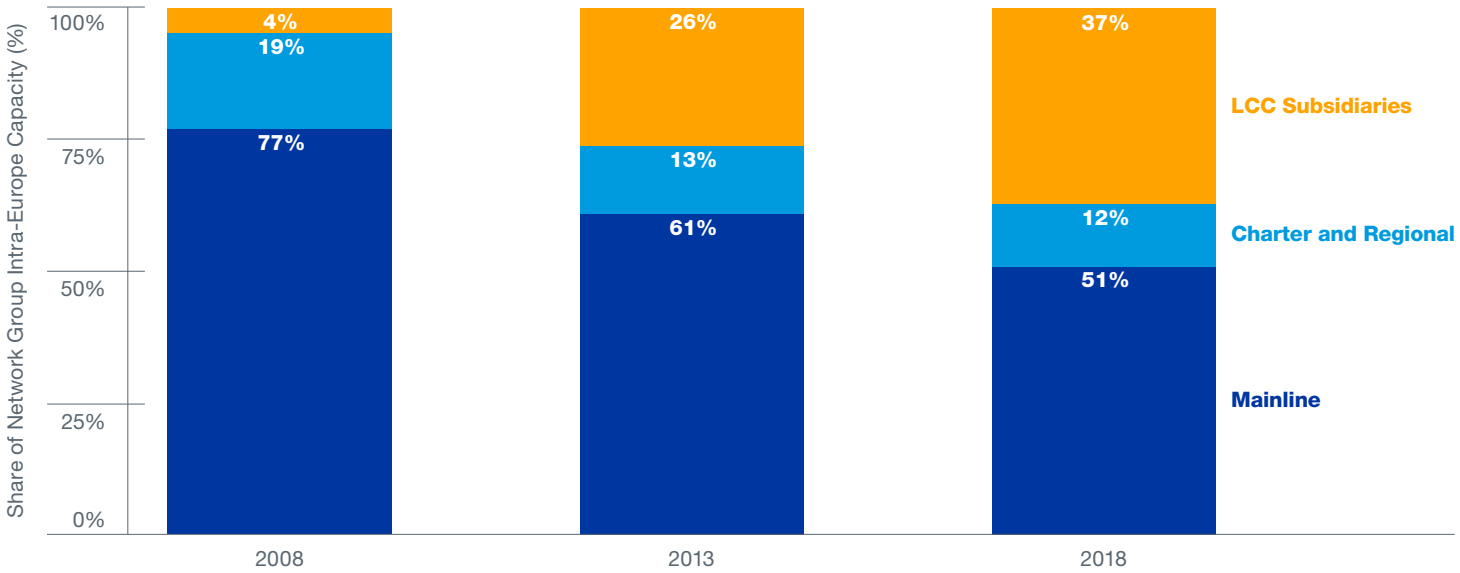
Europe Air Travel Growth Varies By Market



	Annual Growth Rate	Forecast Growth Multiplier
Within Europe	3.6%	2.0X
North America	2.9%	1.8X
Middle East	4.3%	2.3X
China	5.2%	2.8X
Africa	4.1%	2.2X

Network Groups Shift Flying to LCC Subsidiaries

LCC subsidiaries help address cost disadvantages vs. LCC competitors



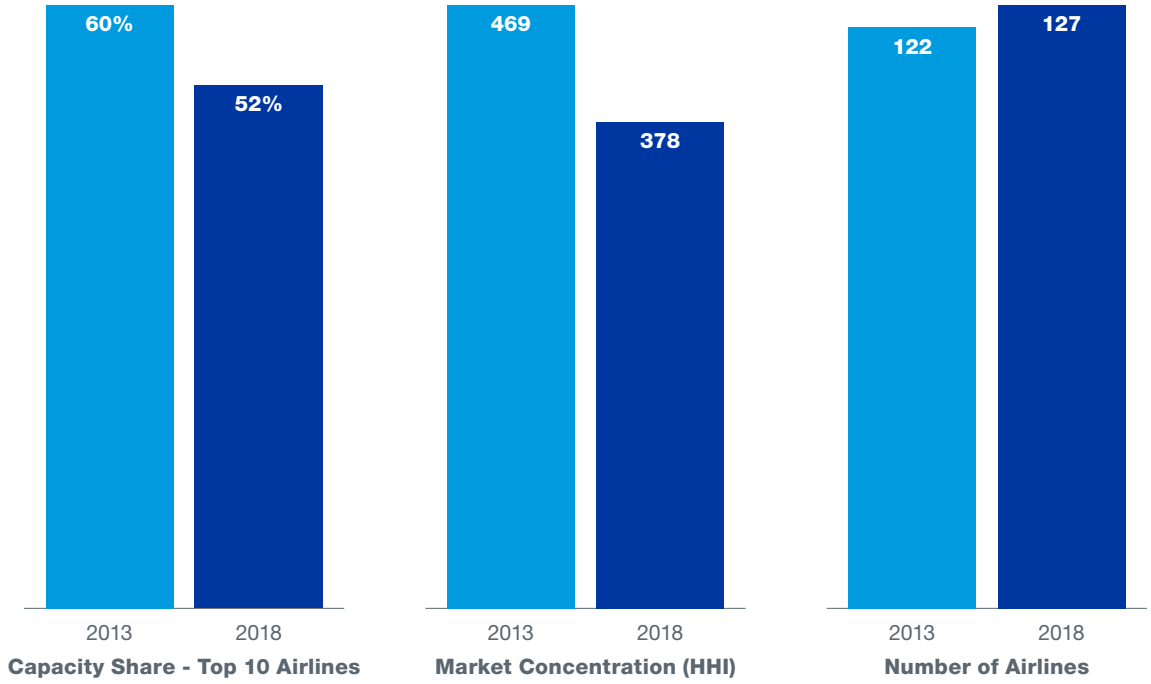
Large European network carriers are moving increasing amounts of intra-Europe flights to their LCC subsidiaries. LCC subsidiary intra-Europe capacity for the three large European network carrier groups has grown from 4 percent in 2008 to 37 percent in 2018.

Source: OAG/Innovata by Cirium

European Airline Industry is Not Becoming Significantly More Concentrated

The European aviation market continues to consolidate, with the WOW Air, Primera Air, Small Planet and Germania insolvencies, along with the Qatar acquisition of Meridiana (Air Italy) and the Virgin/Stobart acquisition of Flybe in the past year. Since 2015, over 20 airlines have failed, merged, or been acquired.

This trend toward consolidation has raised concerns that the European aviation market is becoming highly concentrated. However, research indicates that this concern is perhaps premature. The capacity share of the top 10 airlines has declined from 60% in 2013 to 52% in 2018. The HHI, a measure of industry concentration, has declined from 469 to 378 in the same period, indicating that a relatively unconcentrated market has become less concentrated. The number of airlines based in Europe has held steady since 2012 when the recent wave of European airline consolidation began. These measures taken together indicate that while the most recent airline casualty may grab the headlines, the underlying industry remains quite competitive.



Source: OAG/Innovata by Cirium

Middle East

3,130
Deliveries

4.9%
Fleet Growth

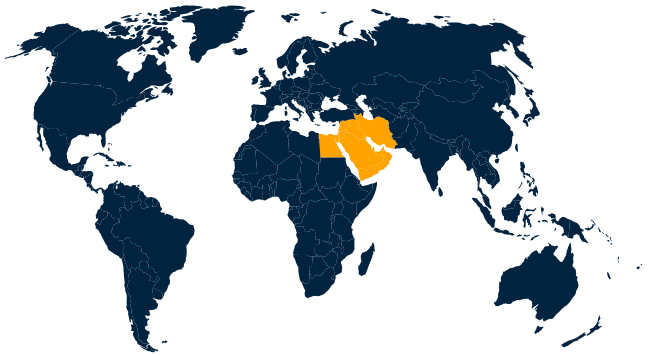
3.2%
GDP Growth

5.1%
Traffic Growth

$725B
Airplane Market Value

4.7%
Service Growth

$790B
Services Market Value



The Middle East has a centuries-old role connecting the economies and populations of Asia, Europe, and Africa.

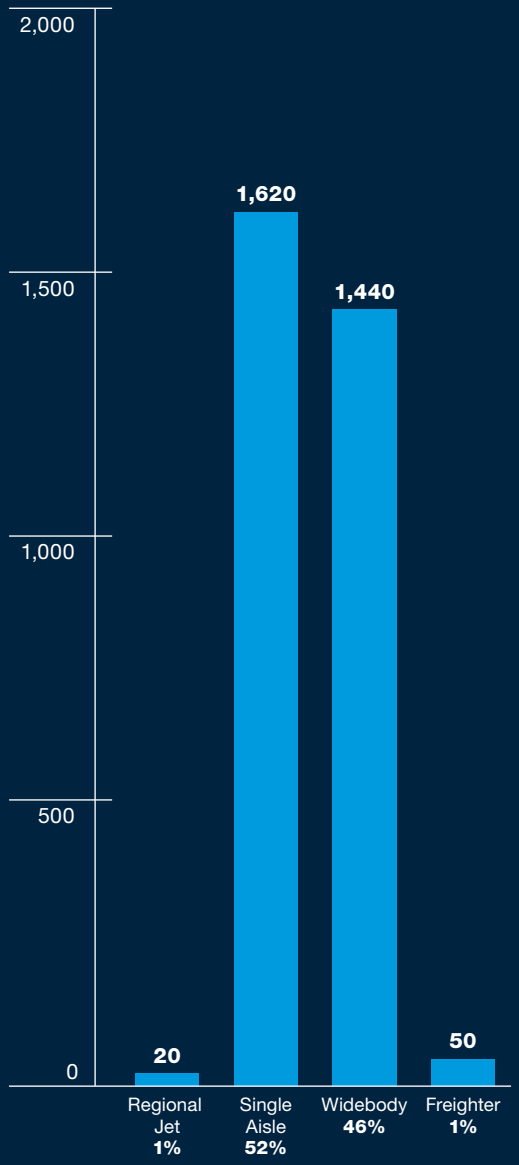
In the 21st century, this role finds expression in an “anywhere to anywhere” business model founded on efficient twin-engine widebodies, sixth freedom connections, and open markets. An eight-hour flight from the region’s hubs can reach 80 percent of the world’s population, and the same boundary will also contain 70 percent of global economic growth for the next two decades.

The region also has many opportunities located within its own borders. Liberalization of certain markets enabled the build out of low-fare airline networks in the recent past, which has stimulated short-haul travel. Development of low-fare networks continues, with the domestic market in Saudi Arabia potentially being the next growth area.

The tourism industry is well-developed in some locations, but remains underdeveloped in others. Governments in the region understand the importance of tourism to economic diversification—when developed and encouraged, economies in the region have seen tourism contribute over 10 percent of GDP.

Deliveries 2019–2038

46%
The share of forecasted deliveries in the widebody segment, the highest of any region.



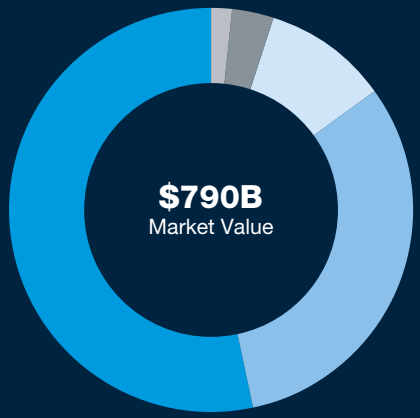
Fleet Composition

Widebody airplanes claim high share of the fleet in this region. The preference for widebodies is driven by two main factors: their usefulness in serving high-volume routes to Asia and Europe, and their key role in providing one-stop itineraries on ultra long-haul markets such as London to Sydney.

	2018	2038
Regional Jet	**3%** 50	**1%** 30
Single Aisle	**43%** 670	**50%** 2,000
Widebody	**49%** 750	**46%** 1,860
Freighter	**5%** 80	**3%** 140

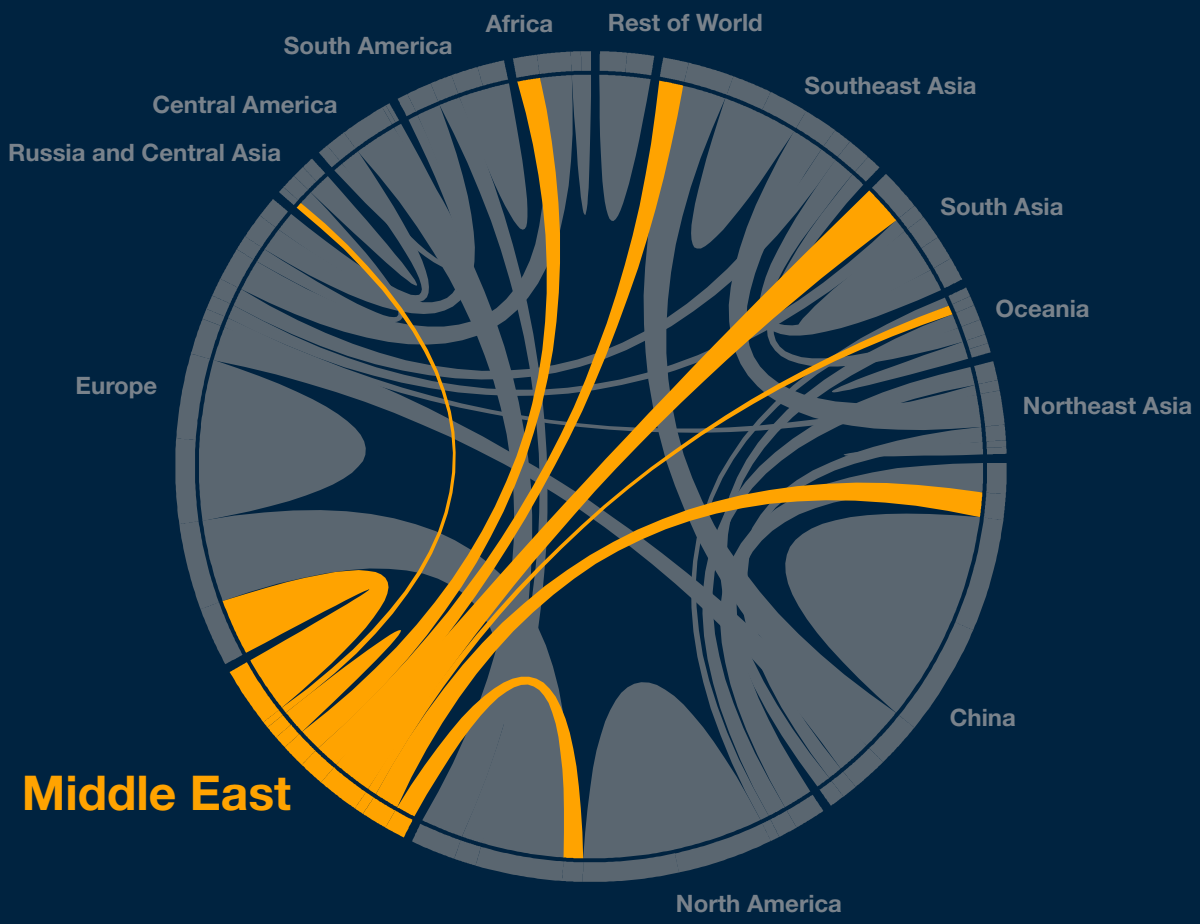
Services Market Value and Growth Rate

This region's large widebody market demands high interior modifications as the airlines compete for premium travelers and build ancillary revenues.



	Market Value ($B)	Growth Rates
Corporate & External	15	4.1%
Marketing, Planning & Customer Service	25	4.5%
Flight Operations	80	4.6%
Maintenance & Engineering	250	4.9%
Ground, Station and Cargo Operations	420	4.6%

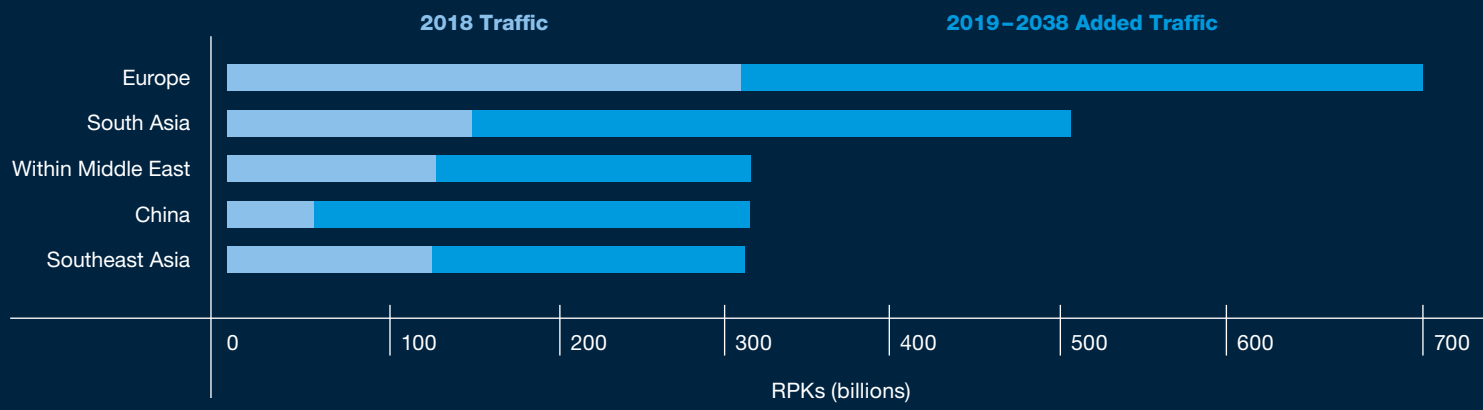
Traffic Forecast To/From/Within the Middle East in 2038



The largest interregional traffic flows for the Middle East are those to Europe, South Asia, and Southeast Asia. The region's hubs lie close to great-circle routes connecting Europe and Southeast Asia, implying minimal penalties for distance in connecting itineraries, as well as the opportunity to build geographically balanced connecting hubs.

Note: Thickness of the line corresponds to the share of traffic for the selected flow.

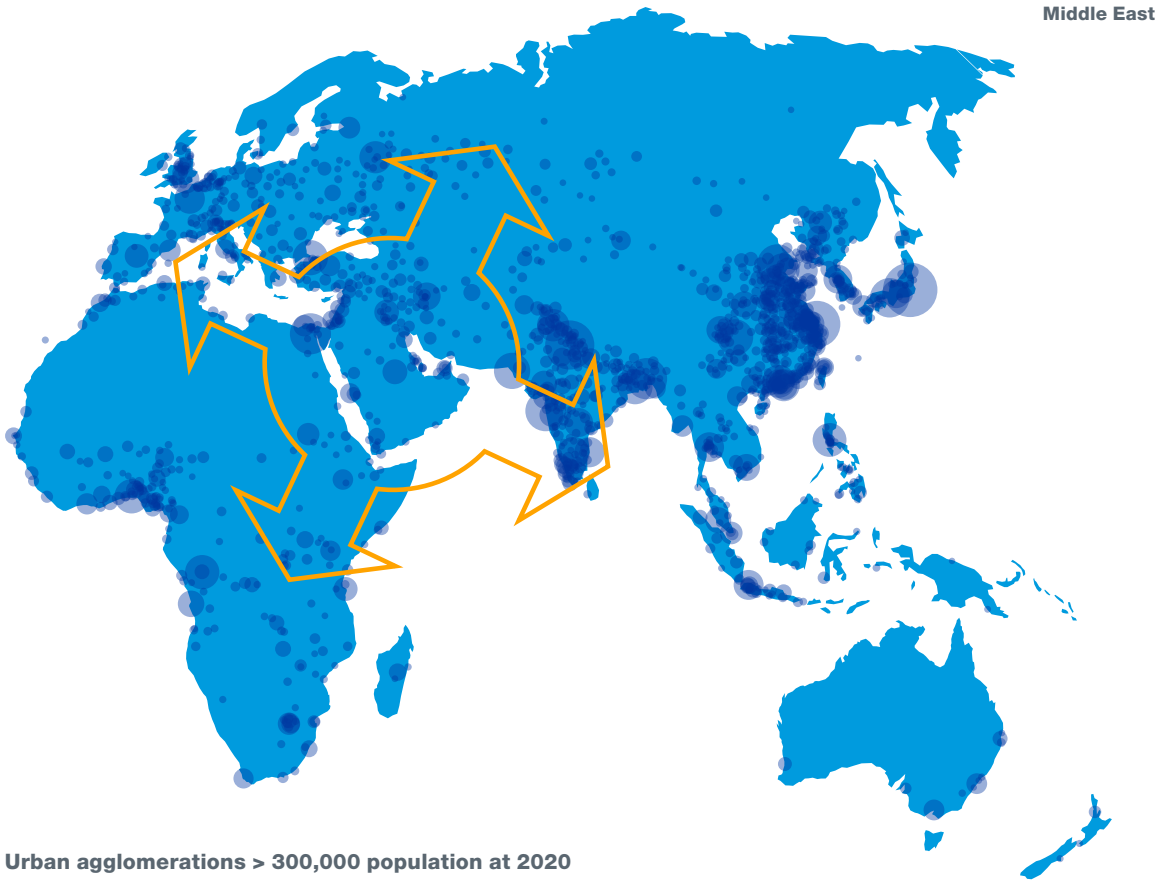
Middle East Air Travel Growth Varies By Market



	Annual Growth Rate	Forecast Growth Multiplier
Europe	4.3%	2.3X
South Asia	6.4%	3.4X
Within Middle East	4.7%	2.5X
China	9.4%	6.0X
Southeast Asia	4.8%	2.5X

Connecting Africa, Europe, & Asia

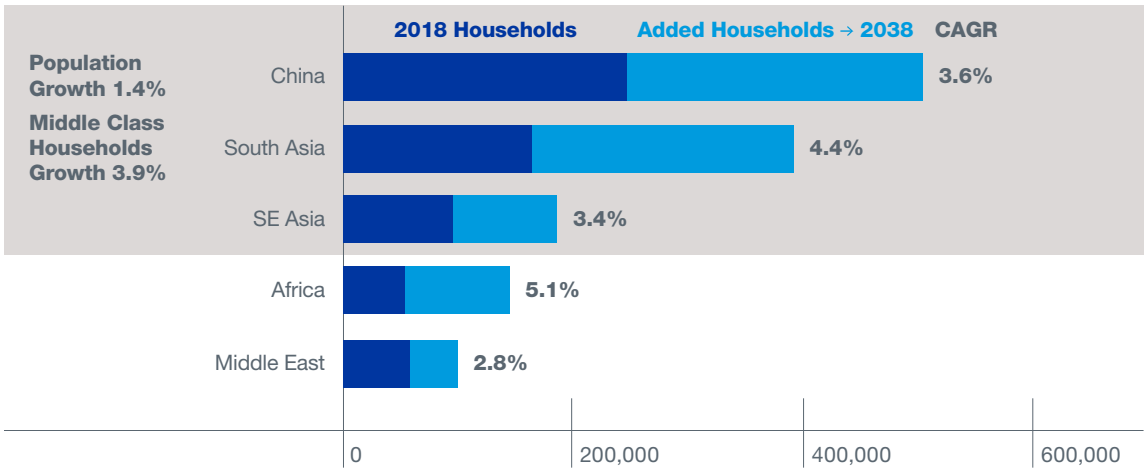
Middle East to China traffic is forecast to see high growth rates, reaching six times its current size by 2038. While Africa-China routes can be served directly with widebody airplanes, the distances between major population centers can be 10,000 km or more, potentially limiting the number of city pairs that can be profitably served from either end of the trade route. In this respect, Middle Eastern airlines may be well positioned to replicate earlier successes in connecting South/ Southeast Asia with Europe.



Urban agglomerations > 300,000 population at 2020

Source: United Nations, World Urbanization Prospects

Emerging Asia Middle Class Growing >2x Faster than Population



Note: Middle class households: >20,000 US$ of income

Exposure to fast-growing markets in Asia is a key advantage for airlines in the Middle East. Not only does the region have well-established trade and labor ties with emerging markets in Asia, but the shares of population who have the financial ability to travel is growing more rapidly than the populations of these countries. Taking together China, South Asia, and Southeast Asia, we expect population growth of 1.4% per annum over 20 years. The number of households with over US$20,000 in income will grow nearly 3x faster, at 3.9% per year. While this growth is not part of the "home" market for airlines in the Middle East, the region's airlines are well positioned to serve these new travelers for destinations within the Afro-Eurasian landmass.

Source: Oxford Economics, Boeing Analysis

Latin America

2,960
Deliveries

3.9%
Fleet Growth

2.9%
GDP Growth

5.9%
Traffic Growth

$395B
Airplane Market Value

4.7%
Service Growth

$500B
Services Market Value

Continued growth in the middle class as well as rising income levels will continue to drive long-term economic expansion in Latin America.

Aviation is a key component of this growth dynamic as it facilitates trade, travel, and tourism, while promoting globalization and technology development.

Since 2010, annual passenger traffic growth to/from/within Latin America has averaged 5.9 percent, and we project this same robust growth rate for the next 20 years. The largest traffic flow will be intra-South America, projected to grow by 6.7 percent on average, driven by the continent's free-trade blocks Mercosur and Andean Community, as well rapidly-growing domestic markets in Colombia and Argentina.

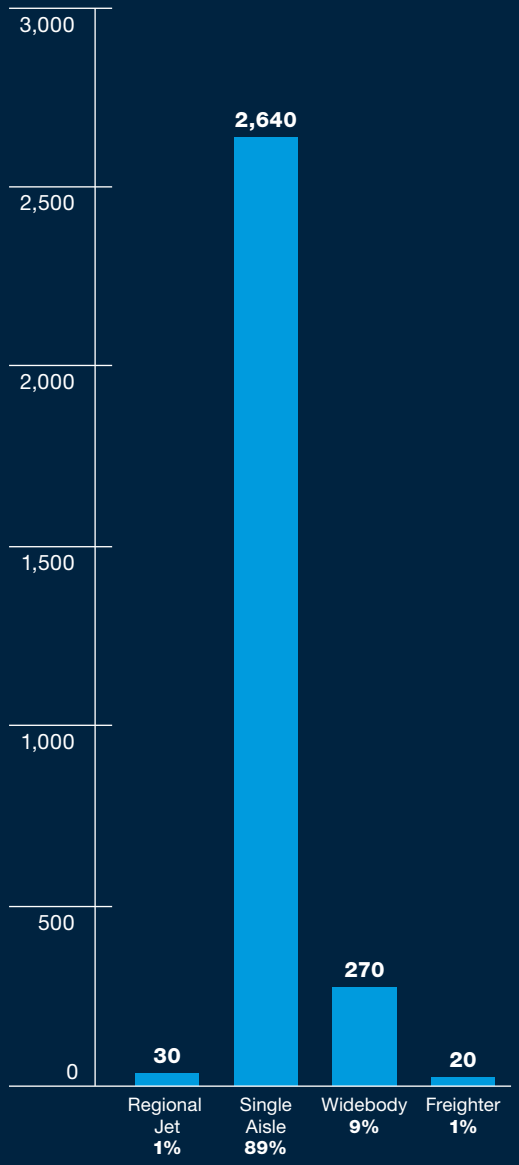
The region's next largest traffic flow is between Central America and North America. Boosted by the Mexico-USA open skies pact signed in 2015, Low Cost Carriers have tripled their capacity since 2012 on the flow. This traffic growth also is a result of greater economic cooperation from trade pacts such as NAFTA and CAFTA, leisure tourism, and passengers visiting friends & relatives (VFR).

Increasing liberalization plays a key role in driving passenger traffic growth. In the region's largest economy and aviation market, Brazil, an open skies agreement with the US was recently ratified. Brazil is taking further steps to lift visa restrictions to the US and other developed markets, as well as allowing greater foreign ownership of Brazilian carriers. In Argentina, the government's decision to lift domestic price floors has stimulated traffic and invited foreign LCC's to operate routes within the country. Chile has historically been open with foreign airline ownership, and two of its airlines are planning to launch subsidiaries in neighboring countries.

We project the region to require 2,960 new jet aircraft deliveries over the next 20 years, with 2,640 of the demand in the single aisle segment (89 percent). For longer-haul segments, airlines in the region are forecast to need nearly 300 new twin aisle airplanes to achieve greater connectivity to some of the strongest global growth markets.

Deliveries 2019–2038

Strong single-aisle airplane demand to meet the intra-South America and Central America-North America traffic needs.



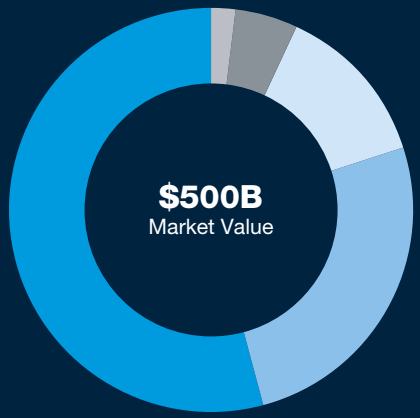
Fleet Composition

Regional jets will comprise a smaller share of the fleet, as Latin American carriers gravitate towards larger single aisle jets that provide higher revenue potential and greater range.

	2018	2038
Regional Jet	**6%** 90	**1%** 30
Single Aisle	**78%** 1,240	**85%** 2,890
Widebody	**10%** 160	**10%** 340
Freighter	**6%** 90	**4%** 120

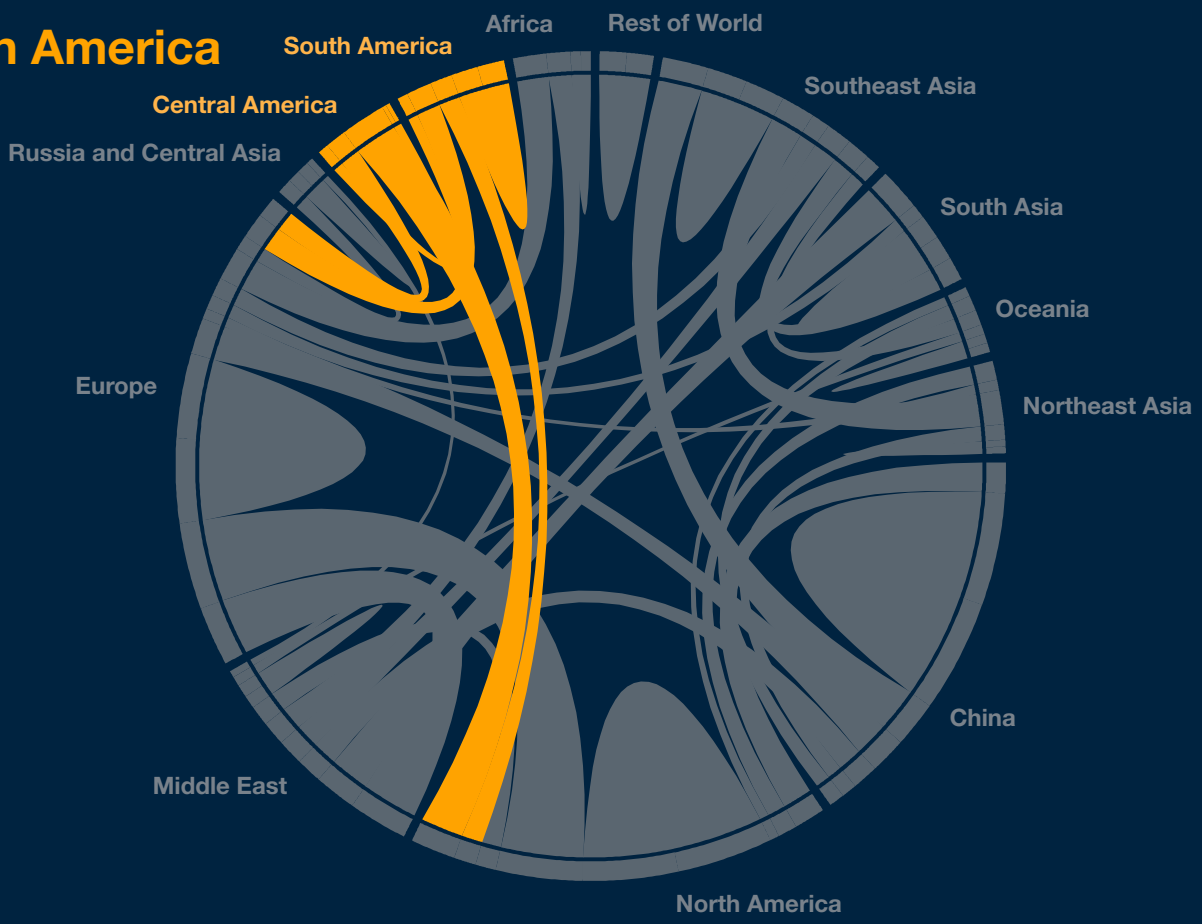
Services Market Value and Growth Rate

LCCs are driving growth of local services infrastructure. However, the demand for maintenance services may outpace supply in the near term.



	Market Value ($B)	Growth Rates
Corporate & External	10	3.3%
Marketing, Planning & Customer Service	25	4.9%
Flight Operations	65	4.3%
Maintenance & Engineering	130	4.8%
Ground, Station and Cargo Operations	270	4.7%

Traffic Forecast To/From/Within Latin America in 2038

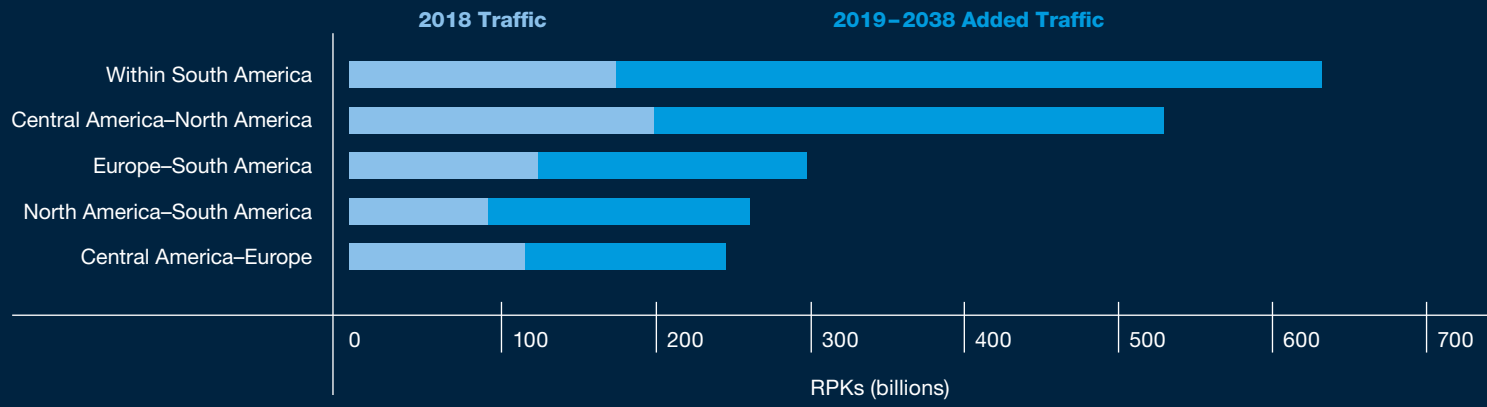


Significant steps in South American airspace liberalization, coinciding with and driving the growth of the LCC model, result in intra-South America traffic flows growing at the fastest rate and being the dominant flow in the Latin America region.

Traffic between Central America & Caribbean and North America will remain strong, as North American & Latin LCCs continue to grow their service in this flow.

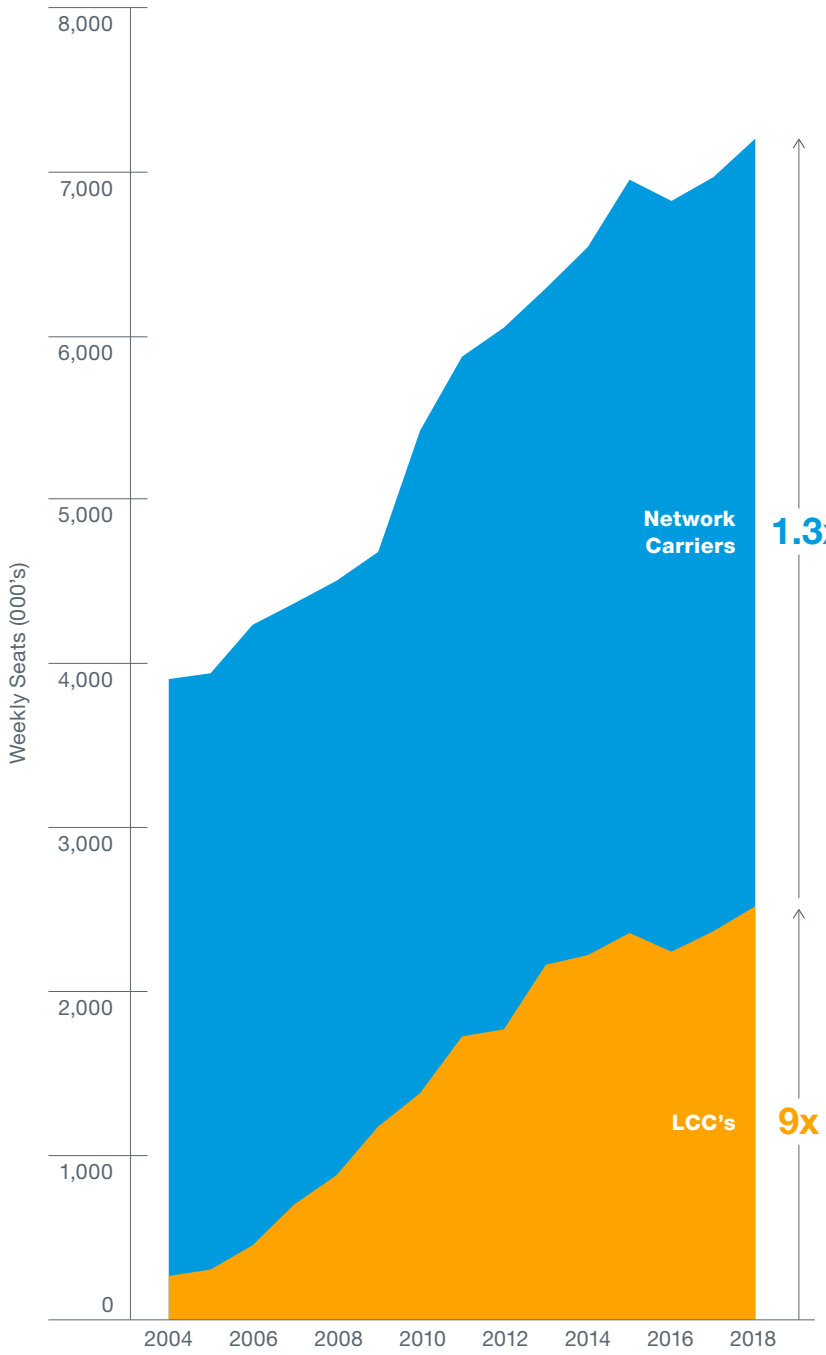
Note: Thickness of the line corresponds to the share of traffic for the selected flow.

Latin America Air Travel Growth Varies By Market



	Annual Growth Rate	Forecast Growth Multiplier
Within South America	6.7%	3.7X
Central America–North America	5.1%	2.7X
Europe–South America	4.5%	2.4X
North America–South America	5.4%	2.9X
Central America–Europe	3.9%	2.1X

LCCs Have Been Driving Growth in the Region for the Last 15 Years



1.04 million

The number of weekly seats added by network carriers since 2004

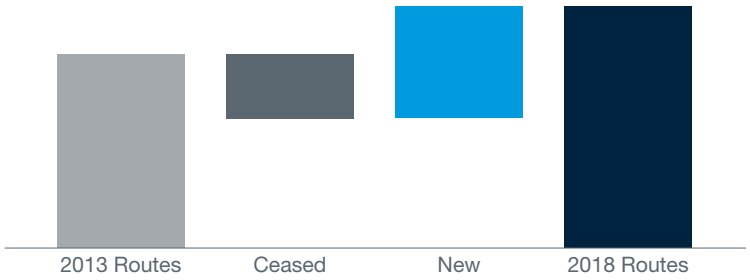
2.25 million

The number of weekly seats added by LCCs since 2004

Source: OAG

LCC Routes Have Grown by 25% the Last 5 Years

Latin American LCC Routes



Source: Diio/Innovata 2013, 2018

2018 Latin America Domiciled LCC Routes

89%

The share of the region's LCC seat capacity is for domestic travel.

147,000

The weekly LCC cross-border seats added in the last 5 years, more than doubling over the period.

Russia and Central Asia

1,280
Deliveries

2.1%
Fleet Growth

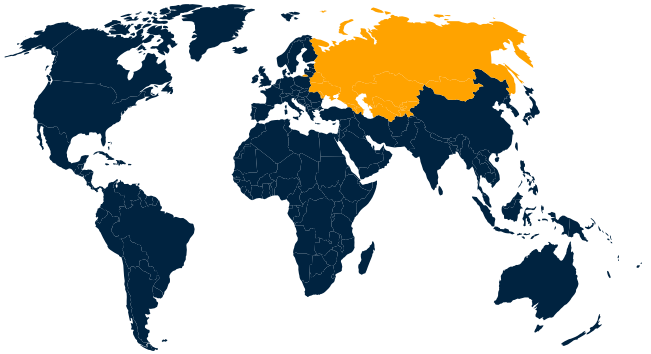
2.0%
GDP Growth

3.3%
Traffic Growth

$160B
Airplane Market Value

2.7%
Service Growth

$270B
Services Market Value



The economies of Russia and Central Asia have rebounded from recession in 2015–16, and air travel growth has followed.

Russia, in particular, experienced very strong compound annual passenger growth of 8.8 percent since 2008. The region as a whole saw 7.8 percent seat capacity growth over the last 10 years.

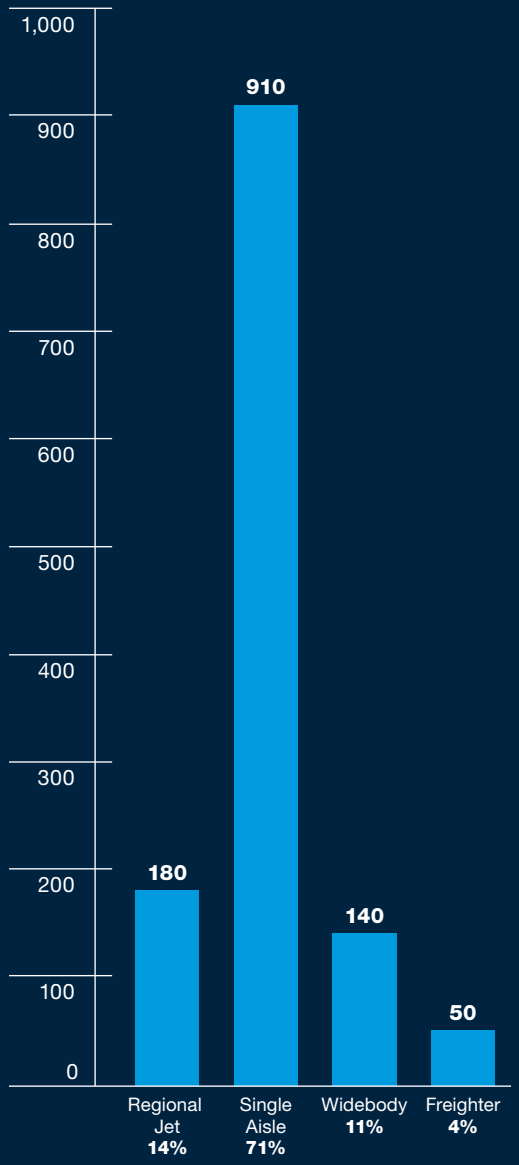
Structural drivers are also boosting air travel demand. The LCC market share in the region grew from one to five percent between 2013 and 2018 led by airlines in Russia. LCCs are also starting to form in other countries, either as stand-alone airlines or as subsidiaries. A second factor is visa transformation. Visa Free, Electronic Visa, and Silk Road Visa are all initiatives underway to simplify travel from/to/within the region. The effects of these drivers can be seen in region's network growth. Over 500 new city pairs to/from/within the region have been added over the last decade, while the number of flights has grown by over 80 percent.

Despite a vast land area covering 11 time zones, population and air services in the region are heavily concentrated around Moscow, western and southern Russia, and Central Asia. These three areas represent more than 75 percent of total capacity flown within the overall region. These demographic and regional characteristics have led to unique fleet requirements to serve a combination of shorter-haul, high-density markets, as well as longer-haul routes with lower demand.

Air cargo is also vital for the region, and freighter operators in Russia and Central Asia are well-positioned geographically to meet the growing demand between Asia, Europe, the Middle East, and Africa. The large freighter fleet has almost doubled over the last 10 years.

Deliveries 2019–2038

85%
The share of total deliveries in the single aisle and regional jet segments.



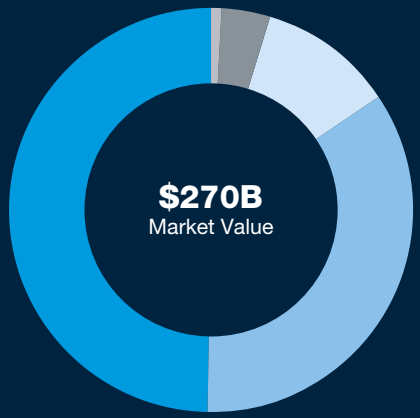
Fleet Composition

63%
Airlines in the region continue to modernize their fleets. Overall fleet mix is expected to shift to more single aisle jets (63%) as low cost airlines grow their fleets.

	2018	2038
Regional Jet	**16%** 200	**17%** 330
Single Aisle	**61%** 770	**63%** 1,210
Widebody	**10%** 130	**10%** 200
Freighter	**13%** 170	**10%** 200

Services Market Value and Growth Rate

In Russia and neighboring Central Asia, the growth of services at 2.7 percent will be slightly lower than its European neighbor and similar to that of North America.

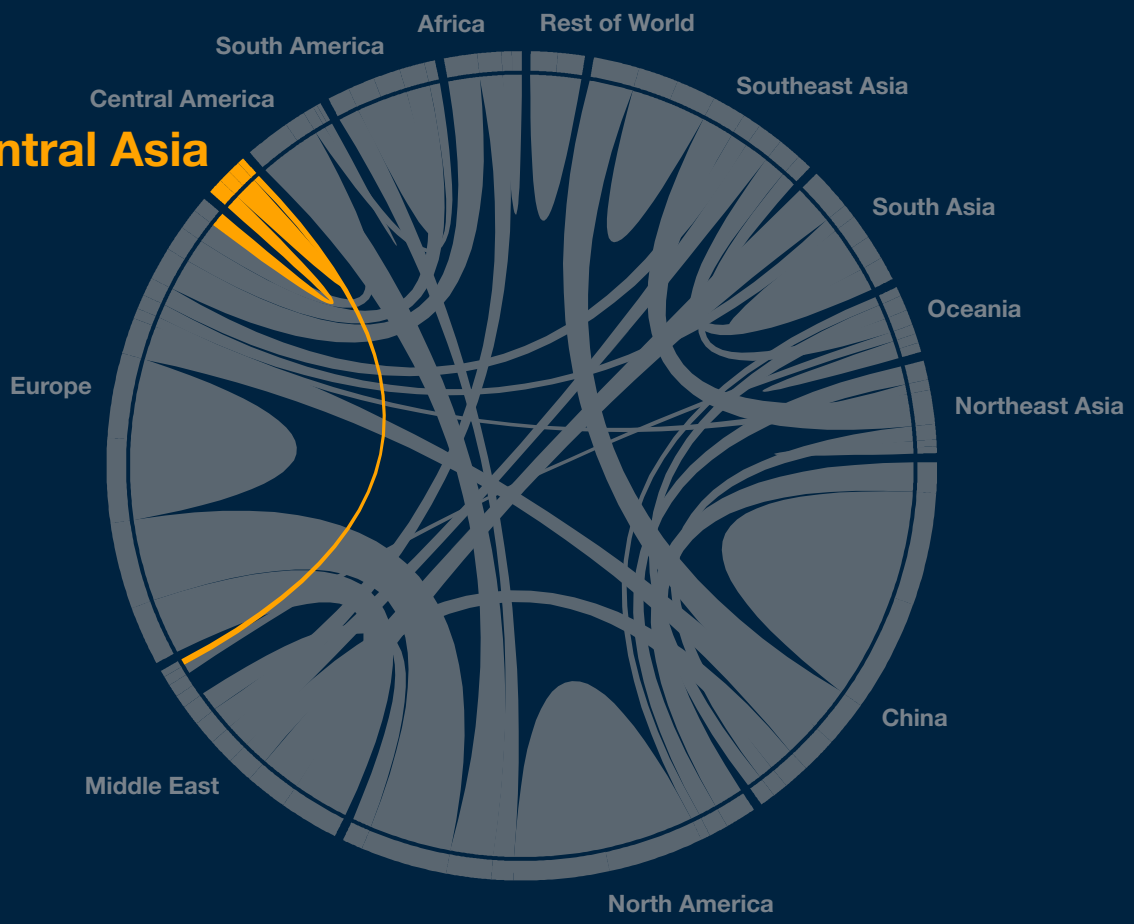


	Market Value ($B)	Growth Rates
Corporate & External	<5	2.7%
Marketing, Planning & Customer Service	10	2.9%
Flight Operations	30	2.7%
Maintenance & Engineering	95	3.0%
Ground, Station and Cargo Operations	135	2.5%

Traffic Forecast To/From/Within Russia and Central Asia in 2038

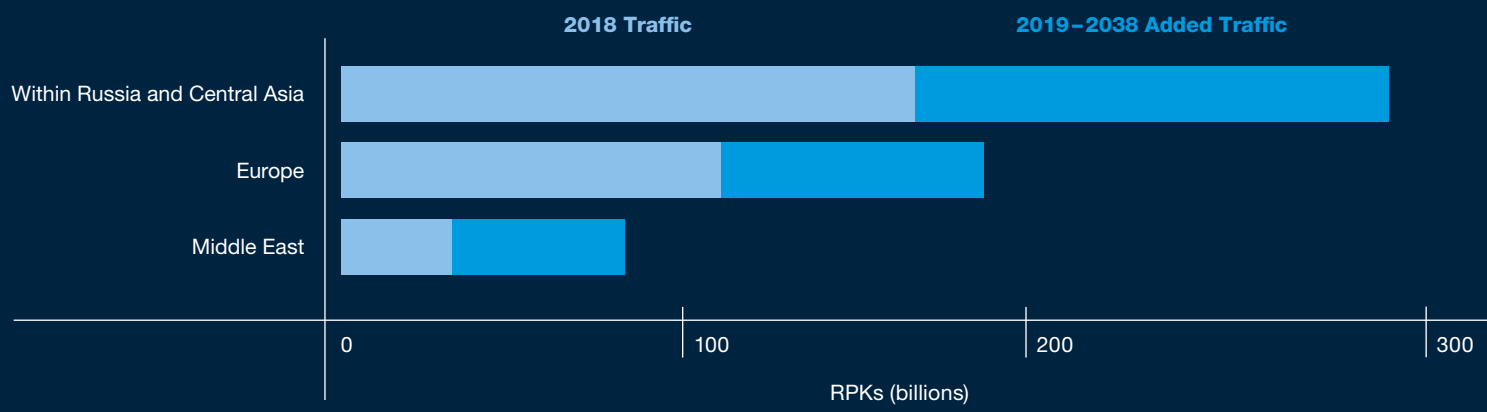
Russia and Central Asia

Beyond intra-regional traffic, demand between the region and Europe will remain the second largest flow, while traffic between Russia & Central Asia and other regions are expected to grow faster.



Note: Thickness of the line corresponds to the share of traffic for the selected flow.

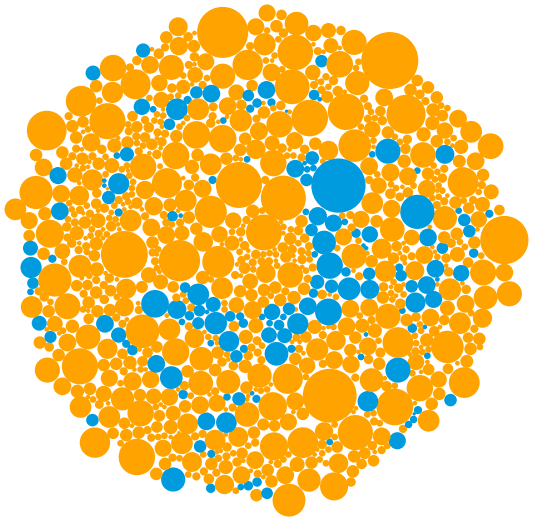
Russia and Central Asia Air Travel Growth Varies By Market



	Annual Growth Rate	Forecast Growth Multiplier
Within Russia and Central Asia	3.1%	1.8X
Europe	2.7%	1.7X
Middle East	4.9%	2.6X

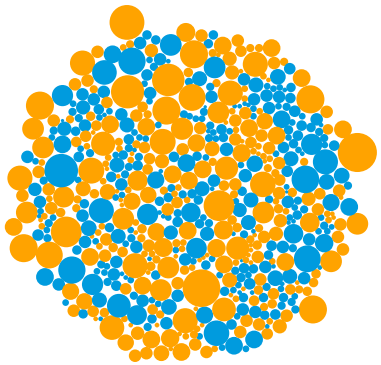
Within Russia & Central Asia

Connectivity within the Russia & Central Asia region has increased dramatically over the last decade despite two recessions. Due to geographic and demographic characteristics, Russian destinations dominate the region's network. Over 80 percent of the routes within this flow serve Russian airports as the origin and/or destination. Of the roughly 1,000 intra-regional routes flown in 2018, over 60 percent served domestic Russian markets. Routes touching Russia also see the highest service levels, represented by the size of the bubbles below. Over 80 percent of airport pairs with at least daily service are flown to and/or from airports in Russia.



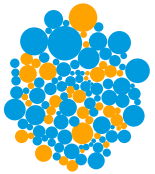
Europe - Russia & Central Asia

Travel demand between Europe and Russia & Central Asia is seeing stimulation as LCCs pick up momentum in the region and open new markets. Relative to intra-regional traffic, this flow is more evenly balanced in terms of network breadth across the region. Half of all routes to/from Europe are to countries in the region outside of Russia.



Middle East - Russia & Central Asia

This traffic flow is forecast to see almost 5 percent compound annual growth over the next twenty years as airlines in both regions increase service levels. Like the Europe-Russia & Central Asia flow where parts of the regions share borders and cultural ties, the network shows broad connectivity across the region. Two-thirds of all routes to/from the Middle East are to countries in the region outside of Russia.



Airport Pair

Weekly Flight Frequency of Airport Pair

Routes to/from/within Russia

Others

Source: OAG / Innovata

Africa

1,160
Deliveries

4.0%
Fleet Growth

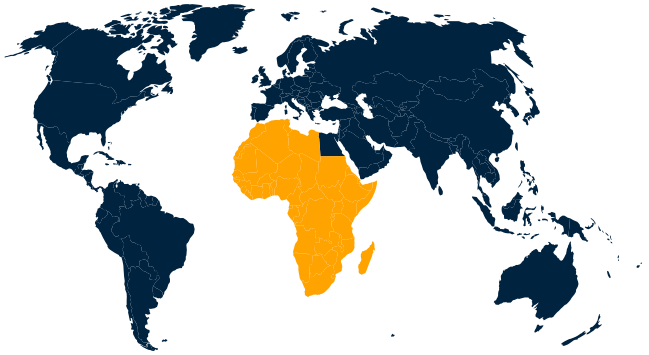
3.4%
GDP Growth

5.9%
Traffic Growth

$175B
Airplane Market Value

5.0%
Service Growth

$215B
Services Market Value



Graced by vast natural resources and a growing, young workforce, Africa is a region forecast to see strong traffic and airplane demand growth in the next two decades.

Economic diversification is boosting the economic growth outlook. Since African economies are heavily reliant on energy and mining, more than 3x the world average, many economies are susceptible to the volatility of changing global market prices. At nearly half of current exports, energy and mining are forecasted to contribute a lower share, around 40 percent, in the next 5 years, with substantial increases in textiles, machinery, and chemicals.

African countries' propensity to travel is as diverse as the continent itself. In certain leading African economies, it would take the average citizen 10-15 years to fly as often as his or her counterpart flies in 1 year in a different country with a similar GDP per capita. We see the same disparity when comparing such African countries to those with similar per capita GDPs in emerging markets in Southeast Asia or Latin America. As the aviation markets of these high-GDP, low aviation service countries mature, they will strongly impact the continent's fast projected growth rates in the next two decades.

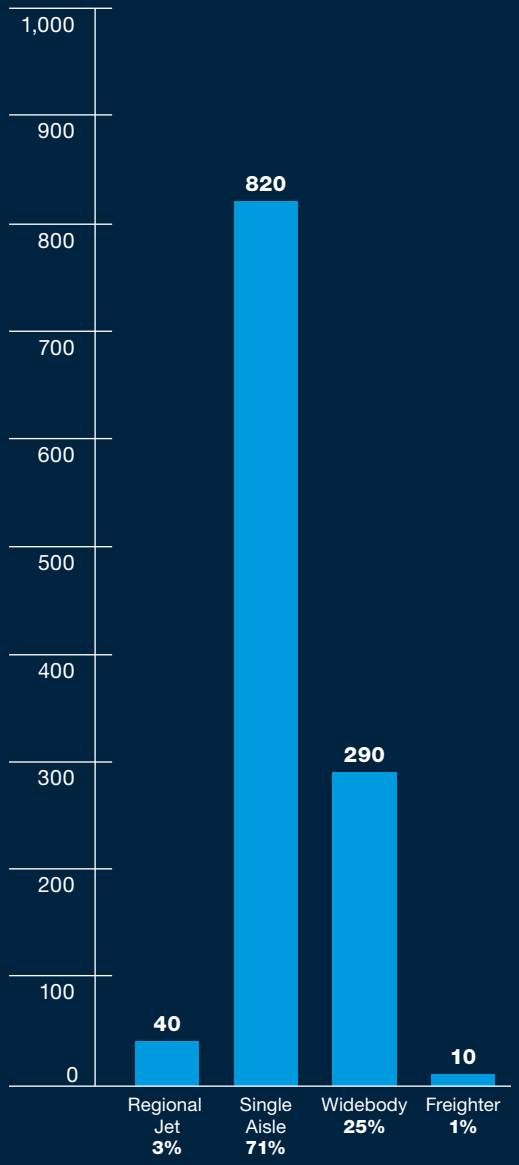
We project African air traffic to grow on average by 5.9 percent, led by strong growth within Africa. Buoyed by the adoption of an African open skies treaty, the African Union's Single African Air Transport Market (SAATM) has been signed by countries comprising 80 percent of the African market. Building on the 1999 Yamoussoukro Decision, SAATM not only removes intra-continental flight restrictions, but also adopts a framework for safety, dispute resolution, and fair competition. Operation of SAATM is projected to stimulate traffic, improve service, and facilitate trade and tourism among the member states.

We forecast African carriers to require 1,160 new jet aircraft deliveries over the next 20 years, 75 percent for growth of the current fleet. Single Aisle airplanes will constitute 71 percent of the projected new deliveries. African airlines are forecast to need nearly 300 twin aisle aircraft for growth in longer range and higher capacity growth markets.

Deliveries 2019–2038

75%

The share of deliveries for growth vs replacement as benefits of air liberalization and projection of the world's largest working age population will stimulate passenger demand.



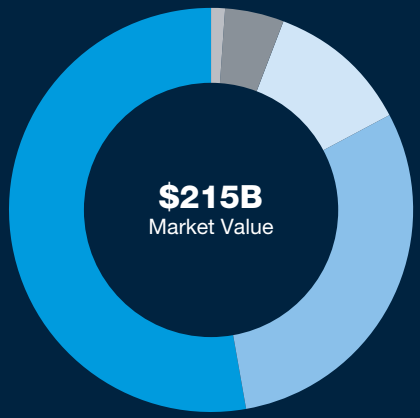
Fleet Composition

Widebodies gain importance to provide the range and cargo capabilities for African countries to connect directly to key growth markets both inside and outside of the continent.

	2018	2038
Regional Jet	**18%** 130	**5%** 90
Single Aisle	**54%** 400	**63%** 1,020
Widebody	**20%** 150	**23%** 370
Freighter	**8%** 60	**9%** 140

Services Market Value and Growth Rate

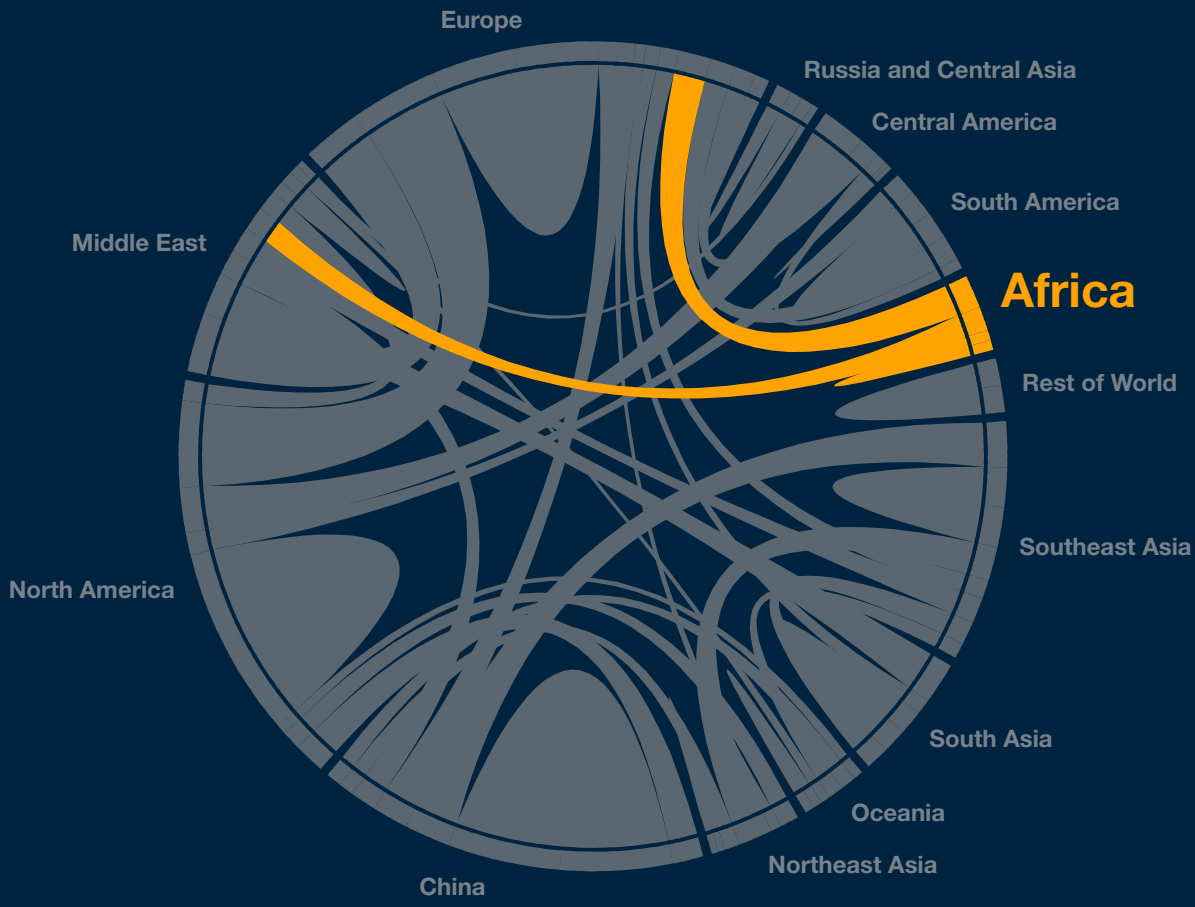
Robust airline services growth is forecast in Africa, particularly technology investments in airline flight operations and scheduling functions.



	Market Value ($B)	Growth Rates
Corporate & External	<5	4.3%
Marketing, Planning & Customer Service	10	5.3%
Flight Operations	25	4.9%
Maintenance & Engineering	65	5.1%
Ground, Station and Cargo Operations	115	4.9%

Traffic Forecast To/From/Within Africa in 2038

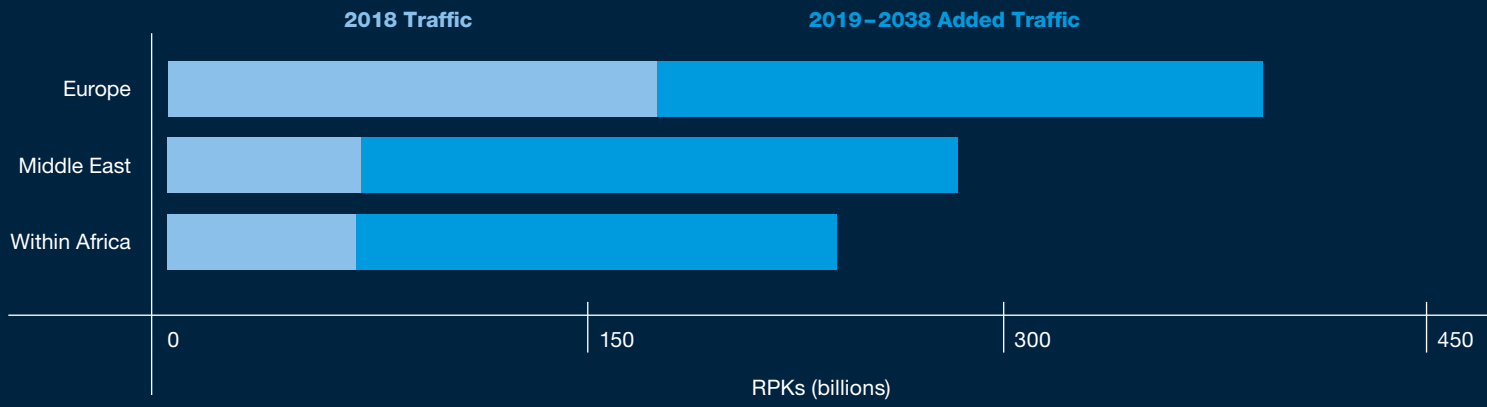
Africa to Middle East traffic flows will grow at the fastest rate, keeping up recent trends of Middle Eastern sixth freedom carriers serving high growth African markets. The increased business ties between Africa and Asia-Pac, such as China's Belt and Road initiative, will strongly contribute to driving traffic in this flow. Middle Eastern airlines currently carry nearly half of passengers flying between Africa and East Asia.



Resilient intra-Africa flow growth is supported by Africa-domiciled broad network carriers and recent adoption of the SAATM open skies treaty which will stimulate passenger demand.

Note: Thickness of the line corresponds to the share of traffic for the selected flow.

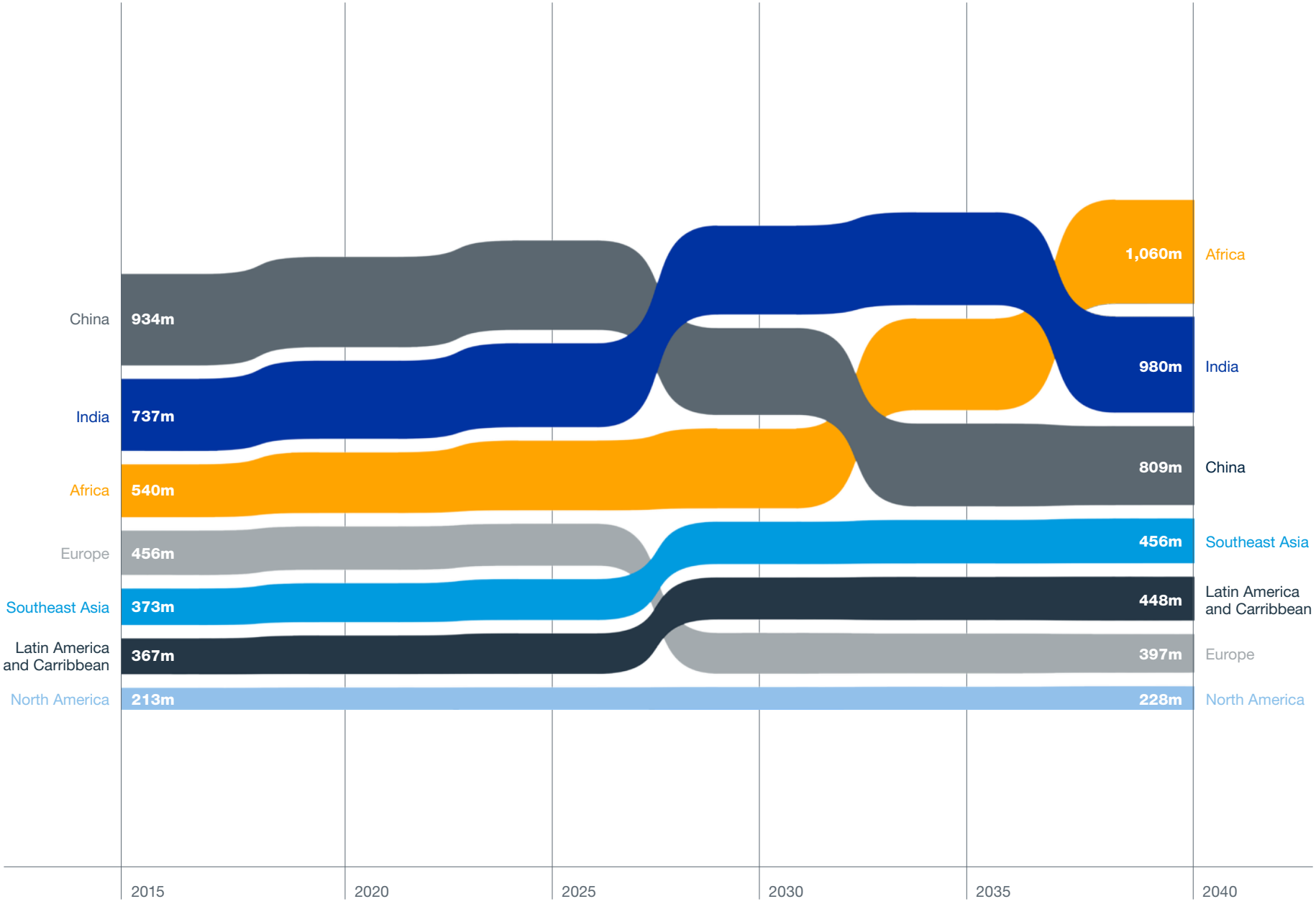
Africa Air Travel Growth Varies By Market



	Annual Growth Rate	Forecast Growth Multiplier
Europe	4.1%	2.2X
Middle East	7.3%	4.1X
Within Africa	6.6%	3.6X

African Growth in Working Age Population

Africa's working age population is on a trajectory to surpass both India and China in the coming decades. Africa experienced the fastest growth rate in the last decade, and is projected to surpass this growth rate in the next decade.



Source: UN Probabilistic Population Projections, 2017

Forecast Methodology

Boeing publishes the Commercial Market Outlook (CMO) on an annual basis to measure the effects of new or significant trends developing in the aviation industry and their resulting impact on future aircraft demand. The CMO is a top-down, bottom-up forecast that matches passenger and cargo traffic demand with a corresponding level of capacity. The CMO produces a long-range fleet forecast of all commercial jet aircraft in service, including passenger airplanes with more than 30 seats and freighters.

The forecasting process begins with the creation of a capacity forecast for the next 20 years. Travel demand is forecast for 63 intraregional and interregional traffic flows. Different flows have different drivers and are therefore modeled differently. Global- and country-level economics are considered during the development process, but recently other forces, including the rapid global expansion of low-cost carriers and regional variations, contribute significantly to the capacity forecast.

AIR TRAVEL DEMAND FACTORS

The CMO is a long-term, noncyclical forecast that looks beyond short-term shocks to address underlying trends in the aviation industry. Generally, factors that can influence air travel growth in a market can be grouped into one of three categories: economic activity, ease of travel, and local market attributes.

Economic Activity

Economic activity is the most easily understood and quantified. Key factors include:

- Country and regional GDP development.
- Population and per capita income trends.
- Labor-force composition.
- International trade, economic, and investment links.

Ease of Travel

While economic indicators have strong explanatory power in some markets, there is a risk that regression of traffic on economic variables can overstate the importance of economic drivers, because in these markets another set of factors is changing at the same time. In many cases, these influencers are related to ease of travel.

Ease of travel can improve in many ways. Some of the more common examples include:

- More open air services agreements between countries.
- Liberalized domestic market regulation.
- Emerging technology (e.g., new airplanes that enable new routes).
- Business-model innovation (e.g., low-cost airlines driving down fares).
- Airline network improvements (e.g., new nonstop city pairs, greater frequencies).

Local Market Attributes

Demand changes as countries develop economically. Emerging markets throughout the world show that air travel is one of the first discretionary expenditures added as consumers join the global middle class. In developed markets growth comes mainly from discretionary travel. GDP per capita matters less in these market contexts.

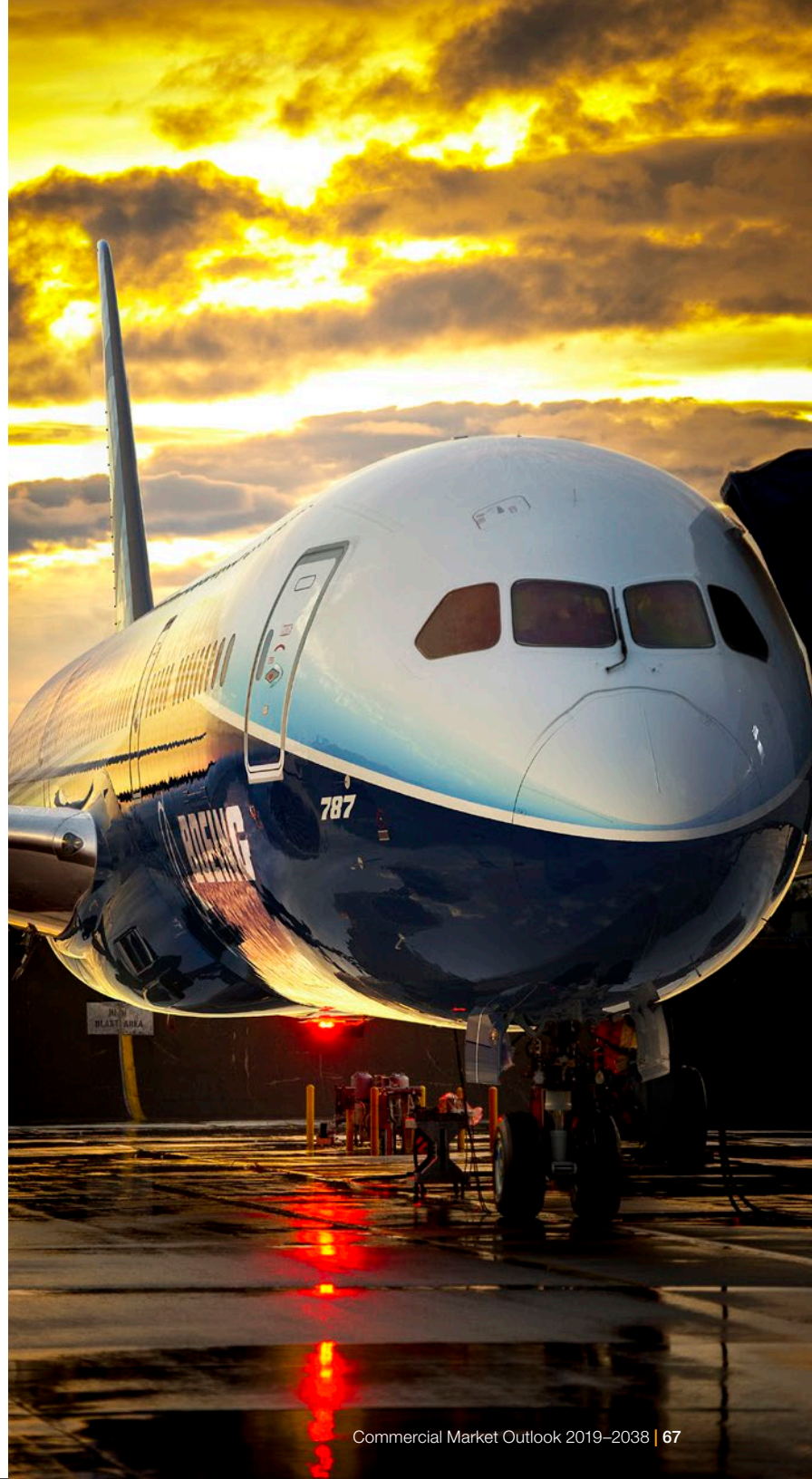
Within a given region, propensity to travel, measured in trips or in revenue passenger-kilometers, generally increases with per capita income and magnitude varies considerably. Generally, markets that are more open are more responsive to changes in per capita income because airlines are freer to add routes, frequencies, and seats to capture demand. In a more regulated environment, demand may increase with GDP per capita, but lower service quality and higher pricing may restrain travel growth. Geography may also influence travel within a region, with island geographies or poorly connected land masses necessitating more air travel than might otherwise be the case.

AIRPLANE DEMAND

The product forecast phase is the final step of the process. With detailed knowledge of airlines' current fleets and short-term fleet plans, inclusive of seating configurations, aircraft utilization, fleet retirement schedules, and a sold-aircraft backlog, a base is established to assign current production or future aircraft products to an airline's long-term fleet. Again, several factors are considered during this phase, including an airline's strategy and brand as well as its current and future route network, and matching those with the appropriate aircraft product that maximizes profitability and capability. The capacity of the incoming and existing fleets must equal the total capacity targets for each participating regional flow and time period.

FORECAST UTILITY

Boeing utilizes the outputs of the forecast process to make key business decisions, including the market demand changes for existing aircraft, market demand for future aircraft product scenarios, and future production capacity and personnel planning. Boeing also uses the forecast to encourage alignment in how industry stakeholders, including governments, regulatory bodies, suppliers, and airlines, view the aviation industry and its prospects.



Appendix

COMMERCIAL AIRPLANES FORECAST ON A PAGE

2019–2038

	Asia-Pacific	North America	Europe	Middle East	Latin America	Russia & Central Asia	Africa	World
Economic Growth (GDP)	3.9%	1.9%	1.6%	3.2%	2.9%	2.0%	3.4%	2.7%
Airline Traffic Growth (RPK)	5.5%	3.2%	3.6%	5.1%	5.9%	3.3%	5.9%	4.6%
Airline Fleet Growth	4.6%	1.9%	2.9%	4.9%	3.9%	2.1%	4.0%	3.4%
MARKET SIZE								
Deliveries	17,390	9,130	8,990	3,130	2,960	1,280	1,160	44,040
Market value ($B)	2,830	1,155	1,370	725	395	160	175	6,810
Average value ($M)	160	130	150	230	130	130	150	150
Unit share	39%	21%	20%	7%	7%	3%	3%	100%
Value share	42%	17%	20%	11%	6%	2%	3%	100%
DELIVERIES								
Regional Jet	210	1,680	80	20	30	180	40	2,240
Single Aisle	13,030	6,140	7,260	1,620	2,640	910	820	32,420
Widebody	3,810	850	1,540	1,440	270	140	290	8,340
Freighter	340	460	110	50	20	50	10	1,040
Total	**17,390**	**9,130**	**8,990**	**3,130**	**2,960**	**1,280**	**1,160**	**44,040**
MARKET VALUE ($B)								
Regional Jet	10	85	5	<5	<5	5	<5	105
Single Aisle	1,535	710	845	190	310	95	90	3,775
Widebody	1,180	240	485	520	80	40	85	2,630
Freighter	105	120	35	15	5	20	<5	300
Total	**2,830**	**1,155**	**1,370**	**725**	**395**	**160**	**175**	**6,810**
2018 FLEET								
Regional Jet	140	1,840	260	50	90	200	130	2,710
Single Aisle	5,680	4,130	3,740	670	1,240	770	400	16,630
Widebody	1,710	670	950	750	160	130	150	4,520
Freighter	350	910	310	80	90	170	60	1,970
Total	**7,880**	**7,550**	**5,260**	**1,550**	**1,580**	**1,270**	**740**	**25,830**
2038 FLEET								
Regional Jet	260	1,680	80	30	30	330	90	2,500
Single Aisle	13,950	7,060	7,070	2,000	2,890	1,210	1,020	35,200
Widebody	4,080	990	1,720	1,860	340	200	370	9,560
Freighter	1,130	1,200	470	140	120	200	140	3,400
Total	**19,420**	**10,930**	**9,340**	**4,030**	**3,380**	**1,940**	**1,620**	**50,660**

COMMERCIAL SERVICES FORECAST ON A PAGE

2019–2038

	Asia-Pacific	North America	Europe	Middle East	Latin America	Russia & Central Asia	Africa	World
SERVICES MARKET SIZE ($M)								
Corporate & External	48,600	46,250	40,650	6,900	7,150	2,500	2,300	154,350
Marketing, Planning & Customer Service	176,650	160,600	141,000	26,350	25,150	9,000	8,500	547,250
Flight Operations	441,500	253,750	278,150	82,850	64,700	28,850	24,350	1,174,150
Maintenance & Engineering	821,850	527,850	510,400	252,000	128,050	93,250	64,500	2,397,900
Ground, Station and Cargo Operations	1,992,300	877,700	1,011,700	420,450	272,100	136,950	116,950	4,828,150
Total	**3,480,900**	**1,866,150**	**1,981,900**	**788,550**	**497,150**	**270,550**	**216,600**	**9,101,800**
SERVICES MARKET GROWTH RATES								
Corporate & External	4.5%	2.4%	2.4%	4.1%	3.3%	2.7%	4.3%	3.2%
Marketing, Planning & Customer Service	6.0%	5.1%	4.7%	4.5%	4.9%	2.9%	5.3%	5.2%
Flight Operations	4.8%	2.6%	3.0%	4.6%	4.3%	2.7%	4.9%	3.7%
Maintenance & Engineering	5.2%	2.5%	3.2%	4.9%	4.8%	3.0%	5.1%	4.0%
Ground, Station and Cargo Operations	5.1%	2.6%	3.3%	4.6%	4.7%	2.5%	4.9%	4.1%
Total	**5.1%**	**2.8%**	**3.3%**	**4.7%**	**4.7%**	**2.7%**	**5.0%**	**4.1%**
SERVICES MARKET SIZE BY SERVICE TYPE ($M)								
Maintenance & Engineering	806,650	501,450	490,550	251,300	125,700	93,000	64,050	2,332,700
Training & Pilot Services*	65,800	26,550	38,350	16,500	10,350	6,800	4,950	169,300
Information Services*	186,950	352,150	261,650	5,000	28,650	2,150	4,850	841,400
ATM	30,000	12,350	15,250	6,150	4,300	2,200	1,750	72,000
Marketing & Planning	111,000	43,450	53,800	23,900	15,250	8,050	6,600	262,050
Cabin Services	324,750	118,350	159,750	66,600	46,400	21,950	18,500	756,300
Ground Handling	1,955,750	811,850	962,550	419,100	266,500	136,400	115,900	4,668,050
Total	**3,480,900**	**1,866,150**	**1,981,900**	**788,550**	**497,150**	**270,550**	**216,600**	**9,101,800**
NEW PERSONNEL DEMAND								
Pilots	244,000	131,000	118,000	64,000	41,000	23,000	24,000	645,000
Technicians	249,000	123,000	111,000	65,000	39,000	23,000	22,000	632,000
Cabin Crew	323,000	161,000	186,000	102,000	51,000	29,000	29,000	881,000
Total	**816,000**	**415,000**	**415,000**	**231,000**	**131,000**	**75,000**	**75,000**	**2,158,000**

*Reclassified markets to better align digital training solutions
Note: Values in USD Rounded to Nearest $50M

PASSENGER TRAFFIC FLOW BETWEEN REGIONS

Traffic Flow (RPKs in billions)	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2028**	**2038**	**2018-2038 Annual Growth**
Africa–Africa	41.6	43.9	48.7	51.1	54.5	53.7	56.6	59.2	62.9	65.4	67.2	122.0	239.0	**6.6%**
Africa–Europe	125.6	128.2	135.5	134.1	140.4	140.4	146.5	153.2	153.8	163.9	175.1	264.6	391.3	**4.1%**
Africa–Middle East	24.9	32.9	36.4	39.4	48.6	50.8	53.7	59.5	62.5	66.2	69.0	167.1	282.2	**7.3%**
Central America–Central America	32.3	29.8	31.3	32.2	33.8	36.5	38.7	42.5	48.7	51.9	55.2	73.4	99.3	**3.0%**
Central America–Europe	83.3	77.1	73.8	73.7	78.3	82.1	87.4	95.3	104.8	112.3	114.3	179.2	245.3	**3.9%**
Central America–North America	115.8	104.7	112.7	114.5	132.0	138.3	153.0	170.1	180.5	190.7	197.5	333.7	529.3	**5.1%**
Central America–South America	13.1	14.0	18.3	19.2	23.2	28.5	30.8	34.2	35.5	37.1	39.9	69.6	126.5	**5.9%**
China–China	236.5	287.4	335.4	380.1	411.3	460.8	509.2	564.7	629.8	715.1	800.7	1,740.1	2,648.3	**6.2%**
China–Europe	82.5	77.3	82.1	94.2	96.7	96.9	105.2	121.1	132.9	141.7	153.7	290.8	425.6	**5.2%**
China–Middle East	11.5	14.8	19.2	21.8	26.4	30.0	34.5	37.7	43.9	47.7	50.7	153.9	305.5	**9.4%**
China–North America	62.7	60.9	71.4	85.4	87.1	89.5	98.1	107.5	119.1	132.0	140.9	232.4	366.8	**4.9%**
China–Northeast Asia	48.4	43.2	51.8	51.5	60.9	60.7	66.2	73.0	81.0	78.6	80.3	135.2	181.4	**4.2%**
China–Oceania	21.4	22.8	27.4	31.4	34.1	35.0	37.7	44.3	55.4	66.8	72.6	121.4	180.7	**4.7%**
China–Southeast Asia	50.6	45.3	54.7	63.0	73.8	82.5	89.4	109.9	127.0	144.4	166.0	333.1	540.7	**6.1%**
Europe–Europe	660.5	624.9	640.2	659.5	676.6	714.0	760.3	796.8	859.4	930.6	982.5	1,475.0	1,998.5	**3.6%**
Europe–Middle East	115.2	131.2	143.8	153.3	178.0	196.8	210.9	242.5	260.1	280.2	300.3	465.7	699.3	**4.3%**
Europe–North America	432.4	405.4	418.6	430.2	432.9	441.8	462.7	475.0	499.7	537.9	579.2	789.2	1,019.0	**2.9%**
Europe–Northeast Asia	69.0	59.4	64.3	63.8	75.9	74.3	77.8	81.3	78.4	81.3	89.6	103.0	122.5	**1.6%**
Europe–Russia & Central Asia	42.9	45.8	55.3	67.3	75.2	84.0	86.7	78.9	74.2	87.7	104.3	136.3	177.2	**2.7%**
Europe–South America	75.2	79.3	82.9	89.8	99.6	102.4	102.1	104.4	107.4	112.1	122.4	186.5	296.8	**4.5%**
Europe–South Asia	55.5	51.3	53.8	54.1	53.9	56.4	57.2	57.5	58.3	60.9	67.2	101.8	169.2	**4.7%**
Europe–Southeast Asia	101.5	95.9	97.1	100.4	106.6	105.3	108.0	111.3	111.8	115.3	123.9	161.6	216.9	**2.8%**
Middle East–Middle East	63.4	68.6	77.9	82.4	76.5	86.3	91.7	102.2	116.1	120.4	122.1	204.9	305.9	**4.7%**
Middle East–North America	29.5	41.6	45.7	50.3	57.1	63.2	73.7	88.3	98.8	100.9	96.2	164.8	240.9	**4.7%**
Middle East–Oceania	16.1	19.7	24.5	26.7	31.4	33.3	36.1	37.4	41.5	47.8	49.4	77.3	113.3	**4.2%**
Middle East–Russia & Central Asia	8.3	9.1	11.3	14.1	16.1	19.0	20.6	19.6	19.2	23.4	29.9	53.1	78.2	**4.9%**
Middle East–South Asia	49.5	64.8	75.1	83.0	87.3	95.1	100.5	114.4	129.8	140.8	144.0	299.8	493.5	**6.4%**
Middle East–Southeast Asia	45.4	46.7	56.3	61.3	66.4	79.0	89.4	97.6	109.0	118.0	119.6	206.5	302.7	**4.8%**
North America–North America	974.1	915.1	946.3	976.3	984.7	998.4	1,029.9	1,077.7	1,120.1	1,164.7	1,229.2	1,692.6	2,252.7	**3.1%**
North America–Northeast Asia	139.4	120.2	128.4	135.4	149.0	150.4	154.0	160.5	168.2	178.4	178.3	204.5	226.0	**1.2%**
North America–Oceania	32.3	34.8	34.9	38.3	40.3	43.1	43.3	48.3	53.4	55.1	58.5	86.4	111.0	**3.3%**
North America–South America	52.7	56.9	60.9	66.7	72.0	79.2	82.7	86.9	83.2	85.6	90.0	164.2	260.0	**5.4%**
Northeast Asia–Northeast Asia	84.9	81.9	84.6	81.9	92.6	103.9	107.6	112.5	116.8	123.3	126.9	146.5	157.7	**1.1%**
Northeast Asia–Southeast Asia	87.7	74.3	79.6	92.3	104.9	113.3	124.2	134.6	143.9	159.7	179.6	265.6	400.0	**4.1%**
Oceania–Oceania	72.0	73.3	78.4	83.8	92.0	99.0	100.0	102.8	105.3	106.0	105.5	158.9	219.2	**3.7%**
Oceania–Southeast Asia	57.4	54.7	61.1	66.9	71.5	77.8	83.2	80.0	83.5	86.1	89.2	129.1	179.4	**3.6%**
Russia & Central Asia–Russia & Central Asia	88.9	76.9	87.6	103.1	107.1	118.3	125.3	138.1	134.9	148.3	158.3	210.0	289.0	**3.1%**
South America–South America	81.6	86.9	115.8	134.4	141.9	147.4	155.7	159.1	156.8	161.6	172.8	346.9	631.6	**6.7%**
South Asia–South Asia	40.1	43.8	49.5	58.6	63.8	68.1	71.4	79.2	97.0	114.4	130.5	295.1	574.3	**7.7%**
Southeast Asia–South Asia	24.3	21.9	28.5	29.2	34.0	36.2	38.4	40.4	44.6	50.7	53.5	138.8	276.0	**8.6%**
Southeast Asia–Southeast Asia	93.2	96.0	113.1	130.7	145.1	166.6	176.9	194.0	212.3	228.2	238.3	504.3	937.1	**7.1%**
Rest of World	96.3	101.7	124.4	136.9	151.4	159.9	168.9	170.9	183.0	202.3	232.7	411.3	631.6	**5.1%**
Grand Total	**4,639.2**	**4,564.2**	**4,938.7**	**5,262.2**	**5,585.0**	**5,898.0**	**6,246.0**	**6,664.5**	**7,104.3**	**7,635.3**	**8,157.4**	**13,396.4**	**19,941.3**	**4.6%**

COMMERCIAL AIRPLANE MARKET SECTORS

PASSENGER AIRPLANES			
Regional Jets	**Single Aisle Airplanes**		**Widebody Airplanes**
Antonov An-148, -158	Boeing 707	Airbus A220, A318, A319, A320, A321	Boeing 747
AVIC ARJ-700	Boeing 717	Airbus A319neo, A320neo, A321neo	Boeing 767
Avro RJ70, RJ85	Boeing 727	BAe 146-300, Avro RJ100	Boeing 777, 777X
BAe 146-100, -200	Boeing 737-100 through -600	Bombardier CRJ-1000	Boeing 787
Bombardier CRJ	Boeing 737-700, -800, -900ER	Comac C919	Boeing/MDC DC-10
Dornier 328JET	Boeing 737-MAX 7, MAX 8, MAX 9, MAX 10	Embraer 190, 190E2, 195, 195E2	Boeing/MDC MD-11
Embraer ERJ-135/140/145	Boeing 757	Fokker 100	Airbus A300, A310
Embraer 170, 175, 175E2	Boeing/MDC DC-9	UAC MS 21-200/300	Airbus A330
Fokker 70, F28	Boeing/MDC MD-80, -90	Illyushin IL-62	Airbus A340
Mitsubishi MRJ		Tupolev TU-154, -204, -214	Airbus A350
Sukhoi Superjet 100		Yakovlev Yak-42	Airbus A380
Yakovlev Yak-40			Lockheed L-1011
			Illyushin IL

FREIGHTER AIRPLANES		
Standard Body	**Medium Widebody**	**Large Widebody**
Boeing 707	Boeing 767	Boeing 747-100 through -400
Boeing 727	Boeing/MDC DC-10	Boeing 747-8F
Boeing 737	Airbus A300	Boeing 777
Boeing 757-200	Airbus A310	Boeing/ MDC MD-11
Boeing/MDC MD-80	Airbus A330	Airbus A350
Boeing/MDC DC-8/9	Lockheed L-1011SF	Illyushin IL-96T
Bombardier CRJ	Illyushin IL-76TD	Antonov An-124
Airbus A320, A321		
BAe 146		
Tupolev Tu-204		

Note: Standard-body <45 tonnes, medium widebody 40-80 tonnes, large freighter >80 tonnes
Production and conversion (SF) models assumed for each type unless otherwise specified

Commercial Market Outlook
2019–2038

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