



Commercial Market Outlook 2022–2041

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Executive Summary

20-Year Market Demand

 **2,120 Deliveries**
Regional Jet

 **30,880 Deliveries**
Single Aisle

 **7,230 Deliveries**
Widebody

 **940 Deliveries**
Freighter

41,170
Global Deliveries

2.8%
Fleet Growth

2.6%
GDP Growth

3.8%
Traffic Growth

47,080
2041 Fleet

2.1M
New Personnel

\$3,615B
Services Market Value

North America
9,310 Deliveries
2041 Total Fleet: 10,810
Services Market Value: \$1,045B

Europe
8,550 Deliveries
2041 Total Fleet: 9,360
Services Market Value: \$850B

Russia and
Central Asia*

China
8,485 Deliveries
2041 Total Fleet: 9,630
Services Market Value: \$545B

Northeast Asia
1,345 Deliveries
2041 Total Fleet: 1,570
Services Market Value: \$190B

South Asia
2,345 Deliveries
2041 Total Fleet: 2,610
Services Market Value: \$135B

Southeast Asia
4,255 Deliveries
2041 Total Fleet: 4,500
Services Market Value: \$245B

Latin America
2,240 Deliveries
2041 Total Fleet: 2,880
Services Market Value: \$165B

Africa
1,010 Deliveries
2041 Total Fleet: 1,570
Services Market Value: \$80B

Middle East
2,980 Deliveries
2041 Total Fleet: 3,400
Services Market Value: \$275B

Oceania
650 Deliveries
2041 Total Fleet: 750
Services Market Value: \$85B

*CMO 2022 does not include a forecast for airplane deliveries to Russia due to sanctions against aircraft exports

Foreword

For more than six decades, Boeing has produced an annual Commercial Market Outlook (CMO), drawing upon our deep understanding of global aviation with a long-term forecast for the future of the industry.



Ihssane Mounir
Senior Vice President
Commercial Sales & Marketing
The Boeing Company

The last two years have undoubtedly been tumultuous across commercial aerospace, with the 2020 and 2021 CMOs providing perspective on the fundamental resilience of commercial aviation. The 2022 CMO provides another waypoint as the industry continues its recovery.

Despite the unprecedented challenges and disruptions brought about by the COVID-19 pandemic, dedicated aviation professionals have worked tirelessly to adapt and maintain this essential element of the global transport system. Time and again the aviation industry has proven its resilience through global cycles and external shocks, as demonstrated in the trends shown across decades of Boeing analysis.

This year, Russia's war in Ukraine has had a direct impact on the aviation industry, most notably that it will not be

possible to deliver airplanes in Russia. Although there is demand for airplanes in the Russia and Central Asia region, there is a high level of uncertainty of how long this situation will persist. For that reason, we have chosen not to publish a forecast for the Russia and Central Asia region.

As commercial aviation emerges from the pandemic, Boeing continues to work closely with our customers, suppliers, regulators and wider industry partners in order to enable them to plot a course for long-term, sustainable growth. We hope the 2022 CMO will provide a useful foundation for the future planning of each of our stakeholders, committed to a sector that is not only vital to the transportation of people and goods, but essential to the wider global economy.

Commercial Traffic

Despite the challenges of the last two years, air travel demand drivers have changed little. The commercial aviation industry remains efficient, resilient, and an essential part of the modern world.

Taking the Long View

Boeing's Commercial Market Outlook reflects a long-term, non-cyclical view of the aviation market, in keeping with the time scales of developing and building airplanes; and supporting commercial airlines. The processes and outcomes that the forecast addresses are measured in decades. This perspective is maintained even in times of rapid or dramatic change.

The world has recently experienced a number of inherently unpredictable, high-impact events with uncertain influence on the future. The world will work through the challenges over the course of the upcoming decades, although the exact details and timetables are uncertain. The risks of today's global situation are fluid and large enough that specific predictions about near-term developments can shift dramatically in a matter of days or weeks.

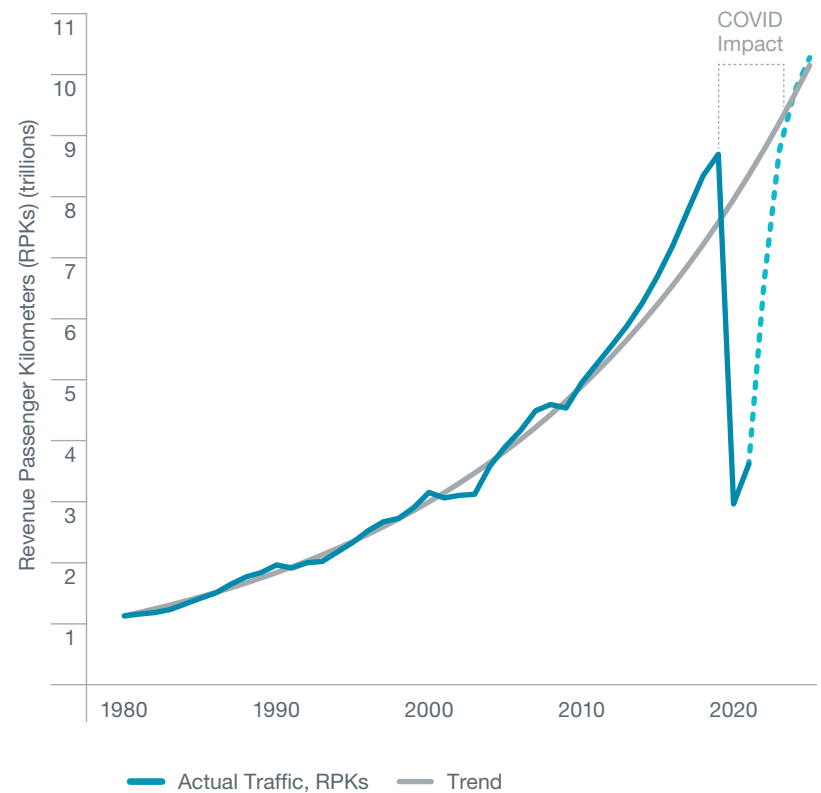
This year's outlook reflects slightly lower expectations of growth for the aviation industry. The forecast aims to put recent events in a longer-term context and provide insights about the future path of the aviation industry.

Air Travel Drivers

Rarely an end in itself, air travel is largely motivated by other desires: to complete a business deal, to meet with distant colleagues, to visit with families and friends, to experience different places and cultures, or to relax in a beautiful location. Demand for air transportation is therefore a "derived demand" for a service that is consumed as an intermediate good, as people pursue the final goals that truly motivate them.

Historic and Future Traffic Trend

Aviation Proven Resilient Over and Over Again



Commercial Traffic

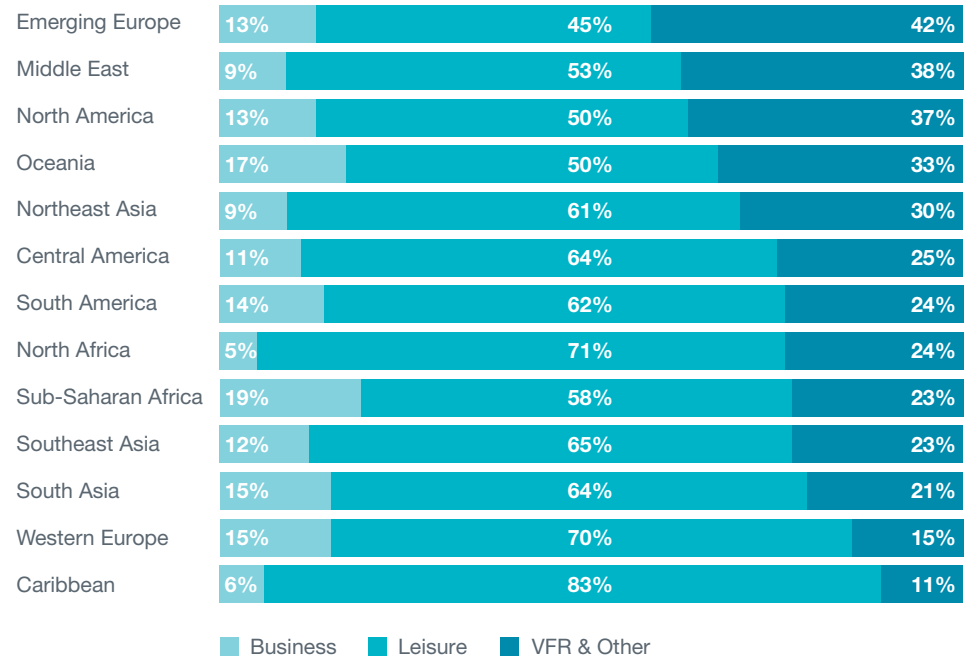
Although any given passenger, on any given journey, may be traveling for multiple reasons, it is helpful to divide travel demand into four major categories:

- **Leisure:** This is largely vacation or holiday travel, but it can also include shorter excursions, such as a weekend in a destination city. It is often price-sensitive, and often (but not always) booked in advance. Leisure travel accounts for more than 60% of arrivals globally.
- **Visiting Friends and Relatives (VFR):** People value their friends and families, and want to see them in person. Family visits during certain holidays often hold considerable importance. Examples include Chinese New Year and, in the U.S., Thanksgiving. Communication technology is still not an adequate substitute for physical presence. VFR demand is often price-sensitive, as entire families may travel together. It is also one of the more keenly felt demands and one of the first to return in the post-pandemic environment.

- **Business:** There are different reasons for business travel, and each type has been coming back at a different speed. In general, travel related to sales and customer work has been quick to return, while the MICE (Meetings, Incentives, Conferences, and Exhibitions) sector has been slower. Paralleling the broader market, demand for shorter-haul and domestic business travel is recovering well before international travel. While it represents a minority of travelers, business demand accounts for an outsized share of revenue for some routes and airlines, making it a matter of keen interest for the industry.
- **Other:** This category includes academic study, religious pilgrimage, medical tourism, and long-term relocation among other things.

While supply and demand for air travel remain disrupted, the current challenges are not expected to have permanently changed the underlying drivers of demand. Business still needs to be conducted; families still wish to re-unite; people still aspire to vacations.

Arrivals by Purpose of Travel



Source: Oxford Economic, Tourism Decision Metrics

Short-Haul Leads Market Growth

The forecast includes a robust outlook for short-haul travel. Historically, short-haul demand has been amenable to stimulation through improved offerings such as new direct routings and lower fares. That trend is expected to continue, particularly in developing markets where a large share of the population have not flown before. In our forecast, travel within regions accounts for almost 60% of industry total growth, with intra-China travel alone accounting for 17% of new Available Seat Miles (ASM) produced by the industry.

Definitions of “short-haul” vary. For forecasting purposes, we define a range of under 3,000 miles, or about the distance of a six-hour flight, as short-haul. Historically, this has been somewhat less than the maximum range for the 737 — adequate for transcontinental missions in the Americas, although typically not sufficient for trans-Atlantic and longer routes.

A number of factors support projections for short-haul growth and resiliency:

- Ready availability of efficient, capable single-aisle airplanes.

- The growth of low-cost carriers, the most successful of which have focused on single-type, single-aisle fleets.
- Generally liberal competition rules in domestic markets and between neighboring countries, as opposed to intercontinental markets.
- Lower short-haul costs that allow for higher levels of discretionary travel and market stimulation.
- A growing global middle class, for whom air transport is financially accessible. First-time air travelers are more likely to take shorter-haul trips.

Air Travel Offers Good Value

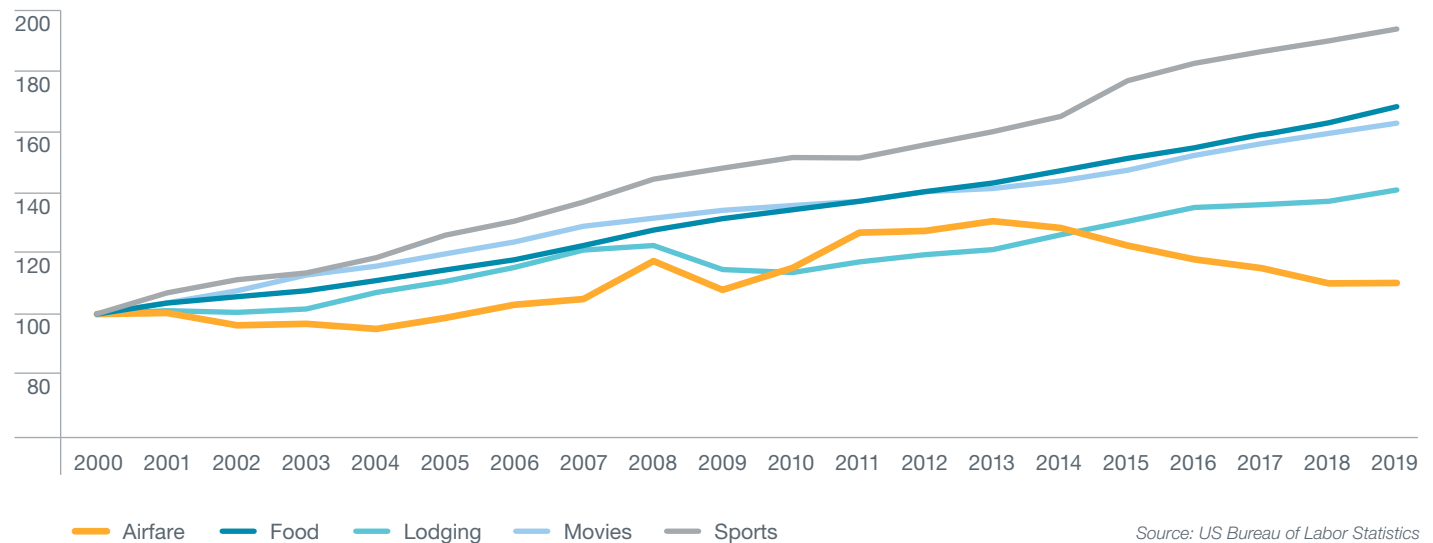
In many regions of the world, vigorous competition and the proliferation of lower-cost airlines have driven airfares down relative to the prices of other relevant travel expenses. Whereas airfares were once the most significant part of travel expenditures, for many consumers this is no longer the case. Motivated bargain hunters can often find fares comparable to or below the price of one night in a hotel room.

The net result is the democratization of air transport, allowing more people to travel more frequently for a greater variety of reasons.

Data from the US Bureau of Labor Statistics illustrates the trend. Air transportation prices rose and fell during the past 20 years, but on average efficiency gains and competition between airlines limited price increases for consumers, while allowing profitable operations. In contrast, expenses such as entertainment (represented here by cinema and sporting-event admissions) saw steady price increases, as did food consumed away from home.

Efficiency Focus and Competition Have Kept Air Transport Cost Low Relative to Other Travel Components

US Prices for Travel-Relevant Sectors, Indexed to 2000



Source: US Bureau of Labor Statistics

Air Travel is Efficient

Aviation serves the desire for mobility in ways that other modes of transportation cannot. Its advantage is largely seen as speed—airplanes travel faster than trains, cars, and buses. But geography, efficiency, and scale can also give rise to significant advantages.

Geography is the starting point from which aviation adds value. The world is a diverse place, with mountains, oceans, national boundaries, and other barriers, both natural and human-made. With aviation, many of these obstacles can be bypassed. For example, a flight between Rome and Barcelona takes about 2 hours, while the equivalent rail journey might take 14 hours to skirt the Mediterranean. This situation is far from unique.

Aviation’s ability to ignore terrain challenges can create other efficiencies: in staffing; in required infrastructure investment; in amortization of capital costs and infrastructure expense across higher levels of production (passenger miles). Through competition, over time the airline industry will tend to pass the savings through to the travelling public. In many instances, these efficiencies can make aviation the lowest-cost travel option, even compared to ground-based alternatives.

Finally, aviation can address certain smaller-scale transport needs with greater efficiency than ground-based modes. For example, a city pair with ~100 passengers per day (each way) would not justify a purpose-built road or rail line, but can easily support air service. Hub aggregation similarly allows lower-demand routes to be served, albeit with connections. Ground-based modes, on the other hand, must dedicate infrastructure to specific routes and often impose circuitry (indirectness) penalties. Aviation can avoid these costs.

Air Travel is Resilient

The airline industry has weathered serious challenges before, but the severe decline in traffic due to the global pandemic far exceeded prior downturns. Despite the severity of this challenge, the industry remains resilient—as does the demand it serves, which defied expectations by coming back stronger in many markets. The forecast calls for a full recovery of global aviation by 2024, along with a return to growth rates comparable to those observed pre-pandemic.

CMO forecasts that overall air traffic will grow at 3.9 percent from 2019 to 2031, and at 3.8 percent from 2019

to 2041. Short-haul traffic (under 3000sm or 5500km) will grow at 4.1 percent from 2019 to 2031 and 4.0 percent from 2019 to 2041. Long-haul traffic (beyond 3000sm or 5500km) will grow at somewhat slower rates—3.3 percent from 2019 to 2031 and from 2019 to 2041.

Air travel is a key component of our modern world. Millions of livelihoods depend on it. Peace, solidarity, sustainability, and international cooperation are among its core values¹. The Boeing Company looks forward to its return and future growth.

¹ Zurab Pololikashvili, Secretary-General, ICAO

Aviation Provides Efficiency, Scale and Geographic Advantages

High-volume Short-haul Air Routes

	Europe/Middle East/Africa	Asia-Pacific	Americas
Island Geographies	Dublin to London Rome to Catania	Seoul to Jeju Hong Kong to Taipei Auckland to Christchurch	Hawaii to U.S. mainland North America to Caribbean
No Rail Link Exists	Abuja to Lagos Dubai to Kuwait City Doha to Muscat	Kuala Lumpur to Singapore Bangkok to Phnom Penh Seoul to Shanghai	Rio de Janeiro to Sao Paulo Bogota to Medellin Los Angeles to Las Vegas
High Duration Difference (distance, terrain, no high speed rail)	Durban to Johannesburg Rome to Barcelona	Melbourne to Sydney Jakarta to Surabaya Delhi to Mumbai	Atlanta to Orlando Los Angeles to San Francisco Montreal to Toronto

Airline Networks and Strategies

The COVID pandemic accelerated airline operational and business innovation. Even as recovery progresses, airlines are pursuing opportunities to improve flexibility, introduce new service offerings, and diversify revenue opportunities.

Change Drives Innovation

Adaptability in response to external events has distinguished commercial aviation for decades. History provides many examples. Novel product-development and efficiency solutions emerged as environmental regulations evolved. New airline and airport security procedures were introduced in the aftermath of 9/11. Business-model innovations were catalyzed by aviation-industry deregulation.

In the same way, factors such as passenger segmentation, optimized revenue management, expanded seating and on-board offerings, and the formation of strategic airline partnerships have enabled carriers to expand their market reach to every corner of the world. Such dynamics will continue to drive market competition—as well as the long-term delivery and fleet outlook.

Some Pandemic Strategies Will Recede

While many airlines dramatically shifted their operations during the pandemic, many of these changes are already fading as market stability returns.

For example, the pandemic's impact on commerce and international travel forced airlines to focus on leisure and domestic demand. In the early months of COVID-19, as leisure travel withstood the shock of the pandemic better than business travel, airlines shifted networks to serve more leisure destinations. Now, with business travel recovering, airlines are rebuilding networks including increased service to more business-focused cities. But they will not recreate pre-pandemic operations; even in relatively stable periods, networks change by up to 10% from year to year.

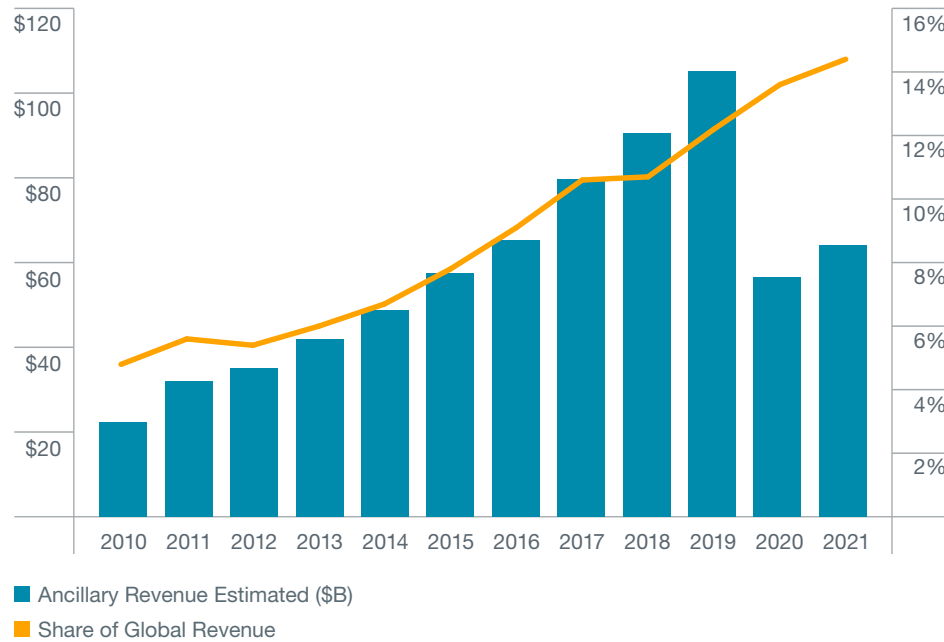
Also, to generate revenues in COVID's challenging passenger

environment, airlines leveraged their air cargo capacity to capitalize on strong demand. In some cases, they redeployed widebody passenger fleets as "p-freighters" when long-haul passenger networks vanished. This trend has also waned as passenger markets come back on line and regulators rescind measures that allowed carriage of medically necessary cargos on passenger main decks. However, as carriers consider ways to diversify revenue streams, air-cargo earnings likely will play a more significant role in network planning than they did before the pandemic.

Key Pre-Pandemic Trends Are Expected to Continue

Airline competition is high across the spectrum of airline operating models due to the emergence of new carriers at the low end of the passenger-price spectrum, and the introduction of

Growth in Ancillary Revenue



Source: Ideaworks

global super-connector models for longer-haul and network-dependent destinations. As a result, passengers have seen average real prices drop and the range of routing and service-level choices expand.

To compete, airlines are creating dynamic business models that augment traditional “network carrier” or “low-cost carrier” classifications. New, blended offerings, tailored to market needs, provide passengers increased flexibility in seating options and on-board services. For example, economy cabin offerings have unbundled service options like seat selection, early boarding, food and beverage service, and checked luggage or carry-on baggage allowing passengers to choose needed services. Ancillary revenues, as a share of total revenues, already had grown by a factor of 2.5 in the decade before the pandemic, bringing in more than \$110 billion annually. Even as passenger traffic dwindled during the pandemic, ancillaries remained a critical revenue component, with airline credit-card programs providing a strong revenue base. Continued revenue-management innovation will further equip airlines to respond to resulting market dynamics.

Meanwhile, passenger segmentation has accelerated. Network airlines created basic economy class to

better compete with low-cost carriers and unbundled fares. No longer a monolithic “coach class” environment, the economy cabin now caters to varied passenger needs and price points. At the other end of the spectrum, airlines are adding premium economy offerings to serve passengers willing to pay more for an improved (if less than business-class) on-board experience. For airlines, these enhanced offerings yield premiums over economy seats. To passengers, they represent greater choice in service level and price point. For these and other reasons, we anticipate continued innovation in passenger experience and service.

A related trend is investment in digital transformation, not only for security and operational efficiency but also for customer service and brand differentiation. Spending in this sector rose to \$31 billion in 2021, despite severe profitability challenges. Typical opportunities include websites and apps that expedite booking and check-in, or provide passengers with real-time travel updates. Investments in technology also foster increased revenues, as when passengers book travel-partner services (such as hotels, local transportation, or rental cars) through the airline platform.

Market Dynamics Reward Fleet Versatility

Fleet decisions in short-haul markets demonstrate the importance of an airplane family. A network's ability to change airplane size—whether to match demand during a day or a season, or to open new markets, or to address growth over the longer term—is an invaluable factor in maximizing revenues and efficiency. Flexibility is critical as markets change and new competitors emerge.

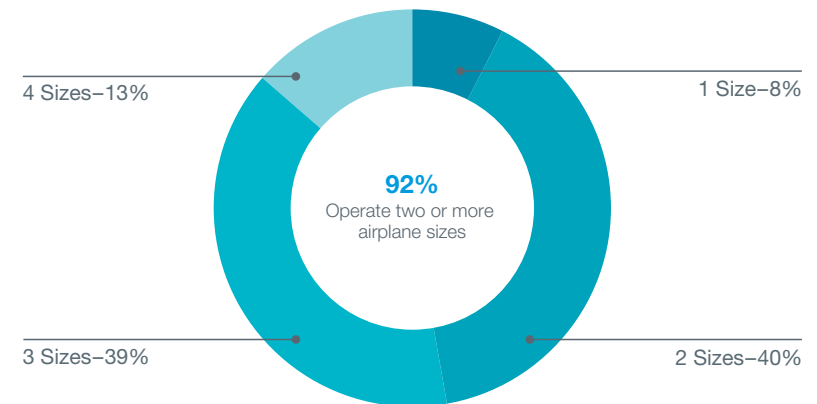
Medium-size single-aisle airplanes remain the largest single-aisle segment, holding a 59% share. In recent years, the large single-aisle fleet has approached a share of 20%, as smaller, single-aisle airplanes have declined to 13% of the single-aisle fleet.

Market shifts to larger cabins enable further passenger segmentation with the introduction of lie-flat first-class seats, and accompanying higher service levels, between some premium, high-demand markets. Low unit costs

also make these airplanes attractive for price-sensitive customers and many leisure routes. In addition, airport capacity constraints have driven airlines in some markets toward larger single-aisle airplanes. Average seating capacity of single-aisle airplanes increases from 166 in 2019 to 182 by the end of the forecast, as airlines optimize their fleets in pursuit of unit cost reductions and enhanced revenue strategies.

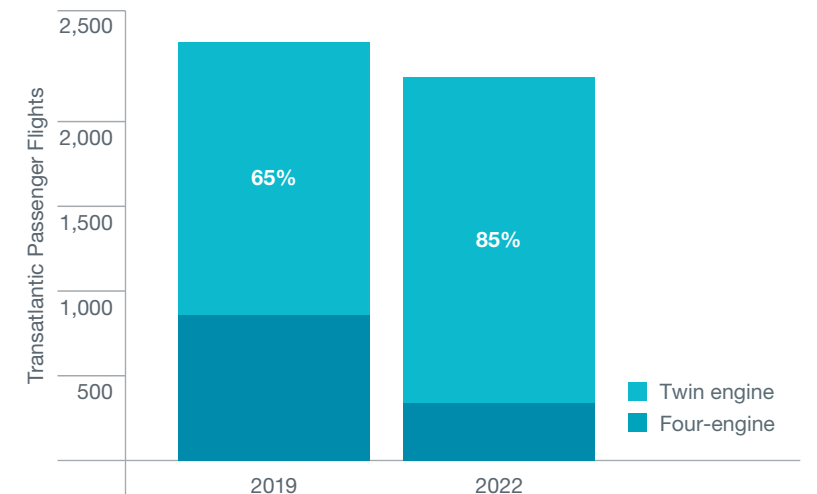
In longer-haul markets, airline passengers value simplified, time-saving point-to-point itineraries whose advantages often justify premium pricing. Smaller-gauge widebody airplanes like the 787, with more efficient, lower-operating-cost technology, have made point-to-point and hub-to-spoke routings more viable, since airlines can operate longer-haul routes at lower risk. Widebody fleet trends confirm this effect: Large widebodies have declined from 30% to less than 5% of the global fleet over the last three decades.

Family of airplanes is indispensable to most single aisle operators



Note: Airlines with jet fleets of at least 30 airplanes.
Source: Cirium Fleets Analyzer

Recovering long-haul markets seeing shift to more versatile twins



Source: Diio by Cirium, July Schedule

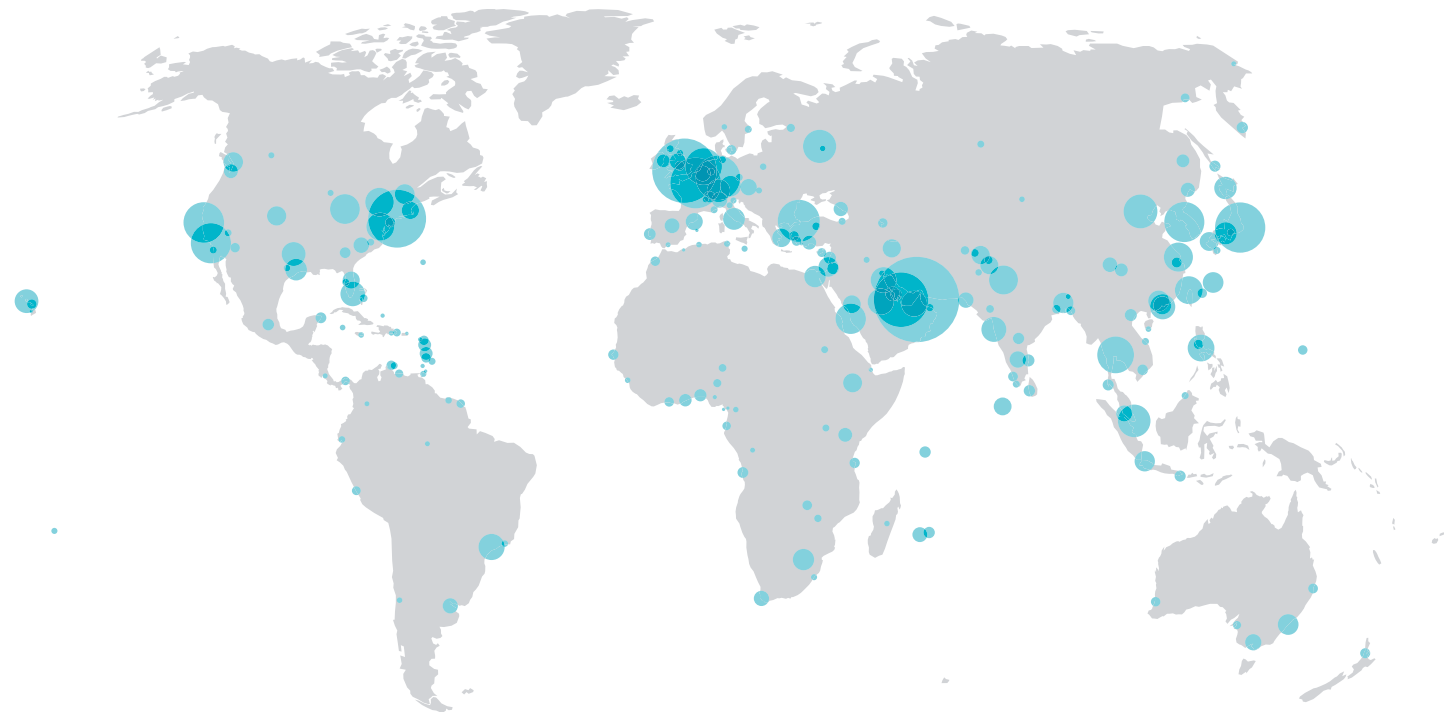
Network hubs will remain integral. Large network and global super-connector airlines will continue to serve large centers of demand, flowing passengers between markets worldwide. Connections through hub airports will remain essential for airlines to feed smaller cities or secondary airports with multiple frequencies where direct service would not be economical.

Acknowledging these diverse market needs, airlines have increasingly focused on versatility in their widebody fleets. Three pillars of maximized versatility have emerged: *capability*, *network flexibility*, and *fleet commonality*.

- *Capability* encompasses seating capacity, cargo capacity, range, fuel efficiency, and infrastructure requirements.
- *Network flexibility* enables airlines to deploy an airplane across a range of markets profitably.
- *Fleet commonality* helps airlines minimize introduction and training costs, while they reduce operational complexity.

Historically, the size and seat count of a widebody aircraft corresponded to its range. Advances in airframe and engine technology, however, now allow smaller, twin-engine widebodies like the 787 to serve some of the world's longest routes. As airlines continue to choose a market-driven range of widebodies while prioritizing versatility, the average size and 310-seat capacity of today's widebody fleet will not change materially during our forecast period.

Larger Twin Engine Widebody Airplanes Continue To Play a Key Role in Cities Around the Globe



Source: Diio by Cirium, August 2022 Schedule

Commercial Fleet and Deliveries

While the impact of the pandemic on airlines and air traffic has been substantial, we remain confident in the long-term resiliency of the industry. Boeing forecasts that airline fleets will nearly double by 2041.

Pandemic and War Continue to Impact Aviation

The pandemic's impact on airlines and air traffic has been profound. Now, as pandemic restrictions have eased, we have observed passenger volumes recover rapidly, especially on short-haul routes within single political entities. Long-haul travel has been slower to return; it requires not only passenger demand but also the coordinated lifting of international restrictions, which some governments have been slower to remove. Boeing's 2022 Commercial Market Outlook (CMO) forecasts that global traffic will return to 2019 levels by 2023/24.

Short-haul demand is leading the recovery, with policy dependent long-haul demand lagging the global average.

Another challenge for the aviation industry is Russia's war in Ukraine. The effect has been greatest on airlines domiciled in the Russia and Central Asia region, although some impacts can be felt throughout the industry globally. This year, Russia's war in Ukraine has had a direct impact on the aviation industry, most notably that it will not be possible to deliver airplanes in Russia until sanctions are lifted. Since it is highly uncertain how long this situation will persist, we have

chosen not to publish a forecast for airlines domiciled there.

Note that because of the pandemic disruption and its effects on the in-service fleet, we have chosen to use the year-end 2019 in-service fleet as the base for fleet growth calculations. This means that when compound annual growth rates (CAGRs) are provided, the computation is a 12-year CAGR from 2019 to 2031 (where we would normally quote a 10-year rate), and a 22-year CAGR from 2019 to 2041 (where we would normally provide a 20-year rate). Delivery data reflect the 20-year period from 2022 to 2041, as they have in the past.

In-service Fleet Will Nearly Double by 2041

Pandemic dynamics continue to influence the CMO forecast. Airlines will grow their fleets from 25,900 airplanes in service in 2019 to 35,400 in 2031, an annual rate of 2.6%. By 2041, the fleet is expected to grow to 47,080 airplanes, representing an annual rate of 2.8% over the 2019–2041 period. The pandemic’s impact can be demonstrated by comparing the 20-year fleet totals forecast in pre-pandemic CMO 2019. At that time, we forecast that the fleet would be 7.6% larger at the 20-year point than we do in our current forecast. Roughly half of the difference is attributable to the exclusion this year of Russia and Central Asia.

Single-aisle passenger airplanes command the largest share of both the 2031 and 2041 fleet at 68% and 70%, respectively. The single-aisle fleet will grow from 16,530 airplanes in service in 2019 to 24,230 in 2031, and will total 32,770 airplanes by 2041. These new airplanes will continue to enable growth for low-cost carriers and will replace older, less efficient airplanes.

In 2019, there were 4,660 widebody passenger airplanes in service, 18% of the worldwide fleet. The widebody fleet will grow to 6,190 airplanes in 2031, and to 8,360 airplanes in 2041 — 17% and 18% of the fleet in 2031 and 2041,

respectively. These new airplanes will allow airlines to serve new and existing markets — passenger and cargo — more efficiently than in the past.

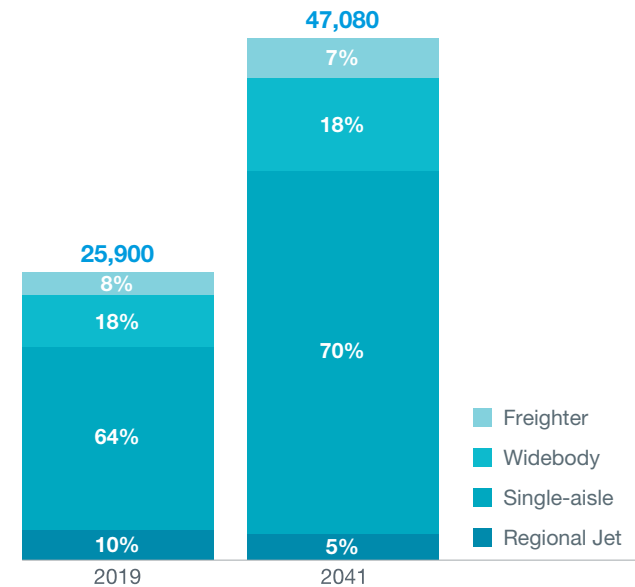
More Than 41,000 New Deliveries Needed Over the Next Two Decades

The pandemic has also had a varying impact on the CMO deliveries forecast. Short-haul service has recovered faster, and is now approaching (or exceeding in some regions) 2019 levels, while long-haul service has not recovered as quickly, due in part to the difficulty of coordinating reopenings across regions. Our forecast reflects this difference. For single-aisle airplanes, compared to CMO 2019, forecast deliveries are down just 1% over 10 years and 2% over 20 years, while widebody deliveries are down over 6% over 10 years and 11% over 20 years.

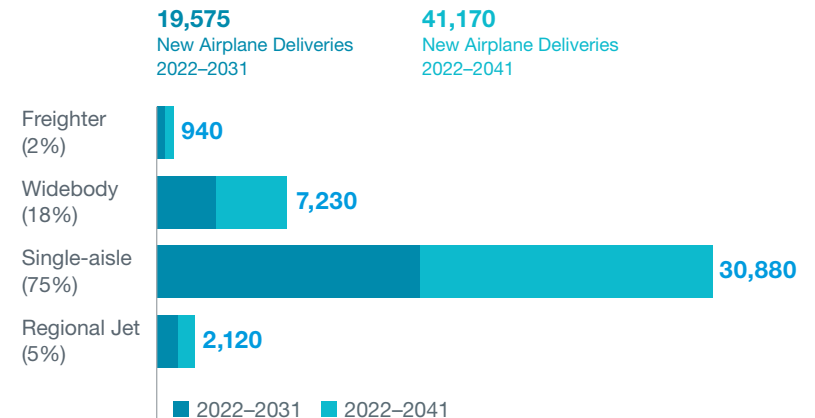
Airlines will take delivery of 19,575 airplanes to meet the needs of the market through 2031. Deliveries over the 20 years through 2041 will be 41,170 airplanes. New single-aisle deliveries will make up 75% of total deliveries, with airlines needing more than 30,880 in the next 20 years. Widebody deliveries over the 20-year forecast period will total 7,230 airplanes, 18% of the total.

Demand for single aisle airplane deliveries from 2022–2031 will total

Single-aisles Grow to 70% Share of Fleet

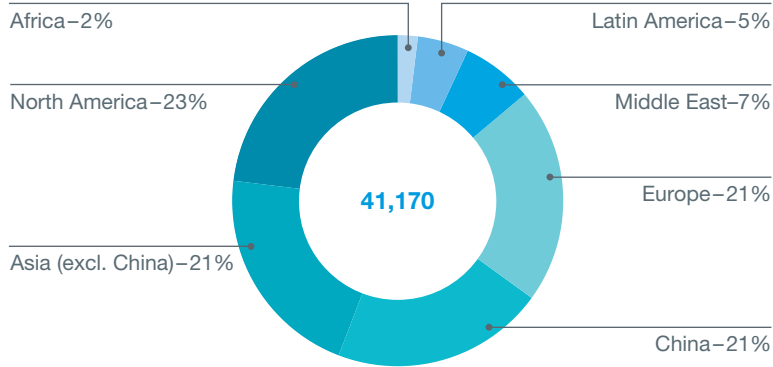


Long-Term Resilience Led by Single-aisles

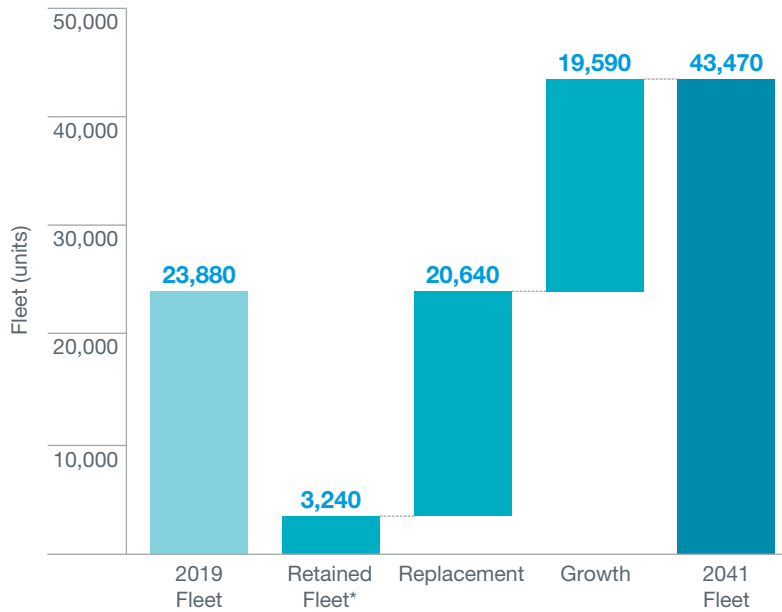


Commercial Fleet and Deliveries

New Airplane Deliveries by Region: 2022–2041



80% Passenger Fleet Renewal Over Next 20 Years



*Retained fleet includes 2020–21 deliveries

14,620 airplanes, a 75% share of new deliveries in the next 10 years. Demand for new widebody deliveries between 2022–2031 will be 3,300 airplanes, representing 17% of the total.

By 2041, approximately 42% of new airplane deliveries will be to airlines based in the Asia-Pacific region. An additional 44% will be delivered to airlines in Europe and North America, with the remaining share delivered to the Middle East, Latin America, and Africa. These regional trends are relatively constant across both the 10-year and 20-year forecast horizons.

Over Half of New Deliveries Will Replace Existing Fleet

Airplanes are durable assets that typically remain in service for 20 to 30 years, and sometimes for even longer. An airplane is typically retired when the cost to retain and operate it 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 it 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 which older equipment cannot serve.

The pandemic added another dimension to the retirement/replacement dynamic. At the outset of the pandemic, airlines quickly grounded entire fleets because the economic penalty from operating a significantly reduced schedule with a wide variety of airplane types was substantial. Once grounded, the additional cost of returning a fleet to service—in addition to the higher operating costs of older, out-of-production models—means that many of these less efficient fleets will not return to service. This dynamic affected the growth-replacement balance in our forecasts.

As industry recovery approaches 2019 levels, the share of replacements is returning to ratios more in line with long-term trends. In 2031, the passenger fleet will include 10,430 airplanes replacing airplanes currently in the fleet; 8,660 airplanes providing system growth; and 13,460 airplanes (including 2020–21 deliveries) retained from the 2019 fleet.

The passenger fleet in 2041 will consist of 20,640 airplanes replacing assets currently in the fleet; 19,590 providing for system growth; and 3,240 (including 2020–21 deliveries) retained from the 2019 fleet. For the 10-year forecast, replacements will represent 55% of deliveries. This share declines to 51% in the 20-year forecast.

Boosting Fuel Efficiency, Supporting Carbon-reduction Goals

New airplanes provide significant efficiency gains, and the aircraft that Original Equipment Manufacturers are currently delivering and developing will be 25–40% more fuel-efficient than those they replace in many cases. Fully deploying the latest-generation airplanes is the most significant contribution to carbon emissions reduction available to the aviation industry over the next decade. By 2031, more than 50% of older-generation passenger airplanes in service in 2019 will be replaced by current models that provide significant carbon emissions reduction.

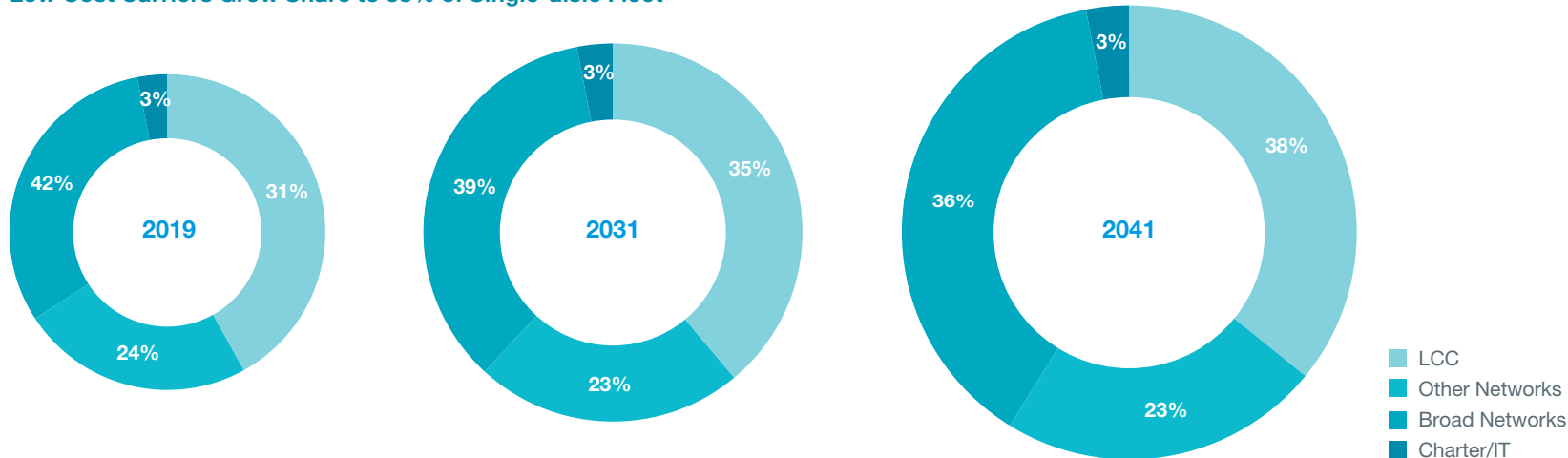
Single-aisle Airplanes: Vital to Both Low-cost and Network Carrier Strategies

A number of factors drive the global demand for new single-aisle airplanes. Due to their size and flexibility, single-aisle airplanes are fundamental to business strategy of the rapidly growing low-cost carriers (LCCs), as well as to airlines operating in emerging markets. Replacement demand is strong in well-developed aviation markets, where large fleets of older airplanes remain. The three largest regional markets for new single-aisle airplanes are Asia-Pacific, Europe, and North America, which account for over 87% of the global LCC fleet, both in 2019 and throughout the forecast

period. About 86% of all single-aisle deliveries for the 10-year and 20-year forecasts will be to these regions.

The expansion of LCCs is expected to take their share of the global single-aisle fleet from 31% in 2019 to 36% in 2031, and to over 38% by 2041. In 10 years, the LCC fleet will include over 8,600 single-aisle airplanes. This number will reach almost 12,600 by 2041. LCCs will account for about 42% of single-aisle deliveries in both the 10- and 20-year time frames.

Low Cost Carriers Grow Share to 38% of Single-aisle Fleet



New Technology, Growing Versatility in the Passenger Widebody Market

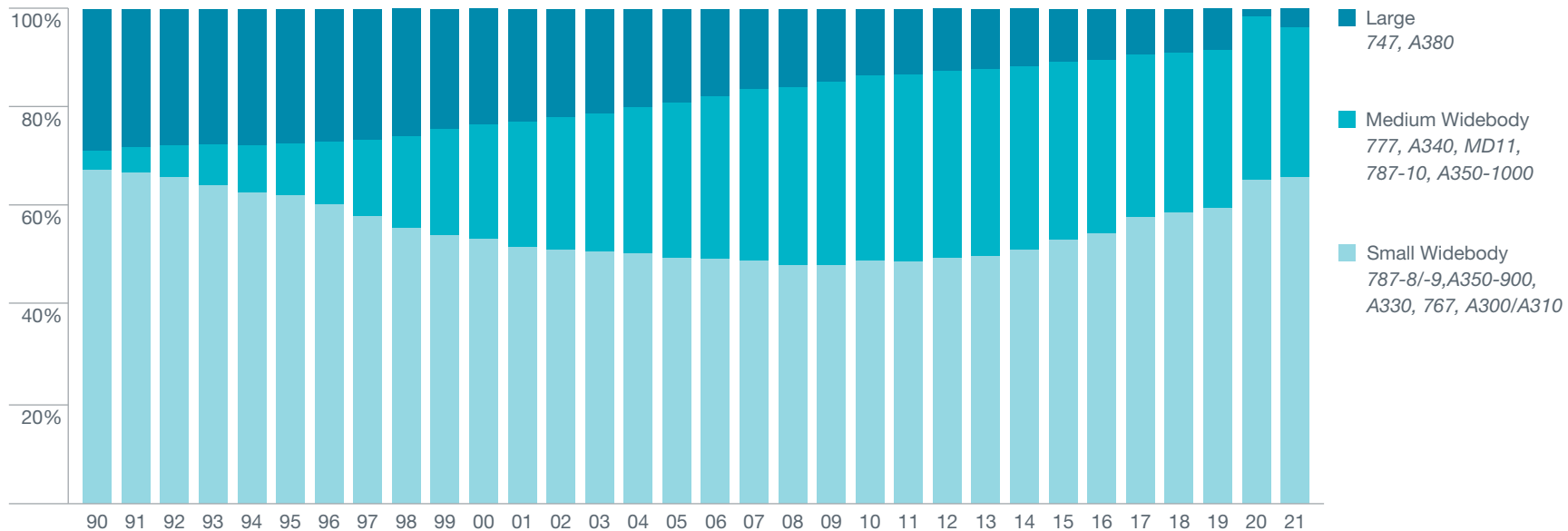
Passengers typically prefer the convenience of nonstop flights, and as airline service regulation in international markets has relaxed, long-haul markets have become increasingly fragmented. The increased range and improved economics of new, smaller widebody airplanes enable airlines to operate profitably on many long-haul city pairs that previously could not support nonstop operations. This rising market

fragmentation is boosting demand for smaller widebody passenger airplanes. Recent data shows that the proportion of smaller widebodies has increased from one half of the in-service widebody fleet to two thirds.

Even as smaller widebody airplanes open new nonstop markets to service, the large end of the widebody market remains important. New, efficient, larger widebody airplanes find applications in markets with very high air travel volumes, where premium service is paramount, where global super-connector airlines

operate, where airports are especially congested, and where airspace constraints are severe. These effects are compounded in the many long-haul markets where time differences between cities restrict the marketable time windows for flight departures. Efficient, larger twin-aisle aircraft now make up about one third of the long-haul fleet.

Small and Medium Widebodies Gaining Share as Airplane Range Has Become Less Dependent on Size



Source: Cirium, Commercial passenger widebody fleet in service at year end

Air Cargo Market Dynamics

Prior to the pandemic, nearly half of the world’s air cargo traveled in the lower holds of widebody passenger aircraft. Much of this capacity disappeared in March of 2020, as most widebody passenger service was suspended worldwide.

Freighter operators responded to the disruption by operating above normal utilization levels, delaying freighter retirements, and bringing new and parked airplanes into the fleet to fill the lower-hold shortfall.

High air-cargo yields and greatly reduced long-haul international networks created favorable conditions for many airlines to use widebody passenger fleets for cargo-only operations that both generated much-needed cash flow and bolstered freight capacity. These “p-freighters” balanced part of the capacity shortfall and even, in some cases, generated quarterly profits for carriers despite minimal passenger operations.

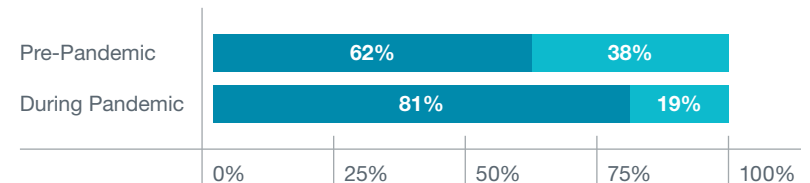
Today, snarls in global supply chains continue to drive air-cargo market dynamics. Maritime container ship reliability and dependability have

degraded markedly, disrupting operations and hampering global supply chains. As a result, air cargo’s value proposition—speed and reliability—has been in high demand, driving 2021 full-year traffic levels up 7% and doubling yields relative to 2019 levels.

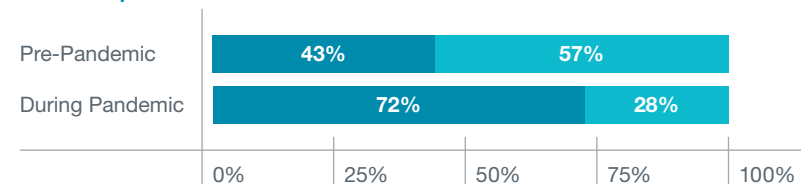
Meanwhile, overall air-cargo capacity has rebounded to 2019 levels. However, the ratio of main-deck freighter capacity to belly capacity remains high, with dedicated freighters hauling roughly two thirds of all air cargo, while long-haul passenger networks remain constrained by international travel restrictions. With the industry still recovering from COVID-19 disruptions, it is too early to definitively confirm structural changes. Yet several trends appear likely to persist, at least into the medium term.

Freighter Share of Global Air Cargo Capacity Remains Elevated on Primary Routes

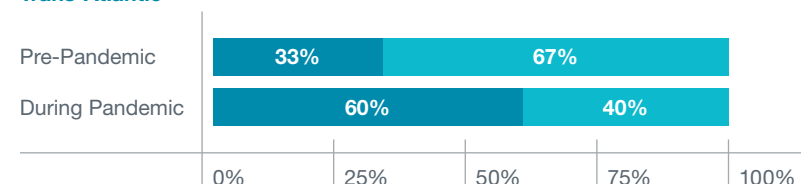
Trans-Pacific



Asia-Europe



Trans-Atlantic



■ Freighter
 ■ Widebody Passenger Belly

Sources: FlightRadar24, Boeing Market Analysis

E-commerce Growth

E-commerce has doubled its share of retail sales over the last five years. We noted this trend in our pre-pandemic forecasts, COVID accelerated the shift. Adoption rates rose during the pandemic, as:

- Consumers embraced online shopping.
- Expectations of fast service climbed.
- Brick-and-mortar inventories lagged and often narrowed.

COVID has effectively pulled ahead of pre-pandemic growth expectations, with container speed and reliability less suited (in some cases) to meet demand. In addition to accelerated growth, the global impact of the pandemic has boosted plans to develop express networks in emerging markets, particularly China, and has raised expectations for the air cargo segment overall—especially for the standard-body and medium-wide-body freighter categories.

Value Relative to Container Shipping

Capacity and reliability challenges have also disrupted the container ship industry, with expectations for a return to pre-pandemic trends continuing to move farther into the future. In addition, the elevated east/west trade imbalance exacerbated by the pandemic, has resulted in a major reduction in the price differential between air cargo and container shipping on major trade lanes. The top 10 leading container ship lines now control nearly 90% of global container capacity, up from 53% in year 2000. This trend, which was underway before the pandemic, has boosted shipping pricing. As of

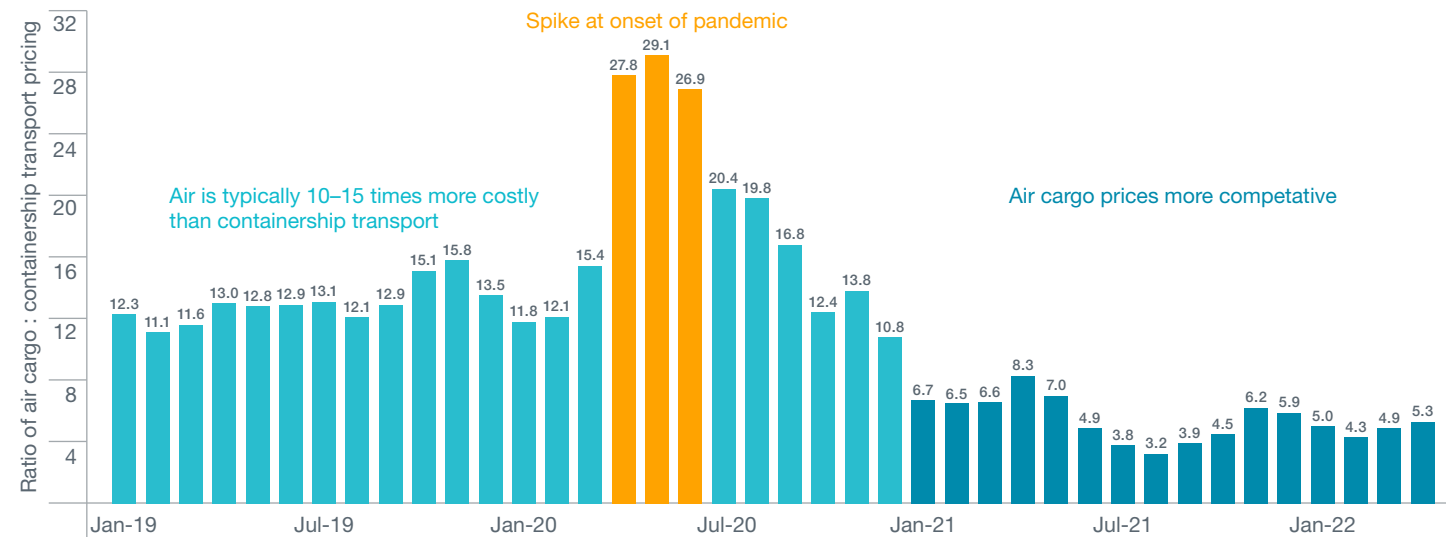
April 2022, container prices were five times higher than the levels of January 2016. This has made the relative pricing of air cargo more attractive. More importantly, the greater reliability and speed of air versus container ship transport has made a modal shift more attractive to shippers eager to reduce delivery uncertainty.

At the same time, some shipping companies are exploring strategic shifts to more vertically integrated operations. Freight forwarders are often the primary interface for companies looking to ship their goods. Shipping companies are building their capabilities to deliver full-service solutions. This value proposition

combines the reduction of modal uncertainty with the transfer of risk to service providers. Some container ship lines are acquiring freighter airplanes to provide integrated goods mobility.

These trends—lower relative pricing due to consolidation, and service expansion due to vertical integration of shippers—suggest that we may see some aggregate movement of shipping volumes from sea to air. While the volumes will not likely be large relative to total global trade, even small shifts toward the speed, reliability, and risk mitigation of air could be significant, given that air cargo makes up only about 1% of all global trade tonnage.

Relative Value of Air Cargo Service More Competitive Than Ever



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

Changes in Supply Chain and Logistics Strategies

The global supply-chain experience during COVID highlighted the risks of the just-in-time supply chains that have evolved over the last several decades. As labor shortages hampered both shipping and manufacturing, supply chains became less reliable—especially single-source chains, which became points of failure. As a result, many goods companies and logistics firms are exploring diversified supply chains to mitigate future risk. The focus on efficiency and costs appears to be shifting to more balance between those drivers and the needs for diversification and reliability. This makes supply chain resilience a key performance indicator.

This trend is likely to increase air cargo demand in two ways:

- Supply chains with more nodes in the system can profit from the flexibility of air cargo and point-to-point service.
- The pandemic has highlighted the value of air cargo’s speed and reliability as a tool to reduce supply chain risk.

As manufacturers and logistics providers consider ways to diversify supply chains, adopting a range of transport modes is likely to be a key strategy.

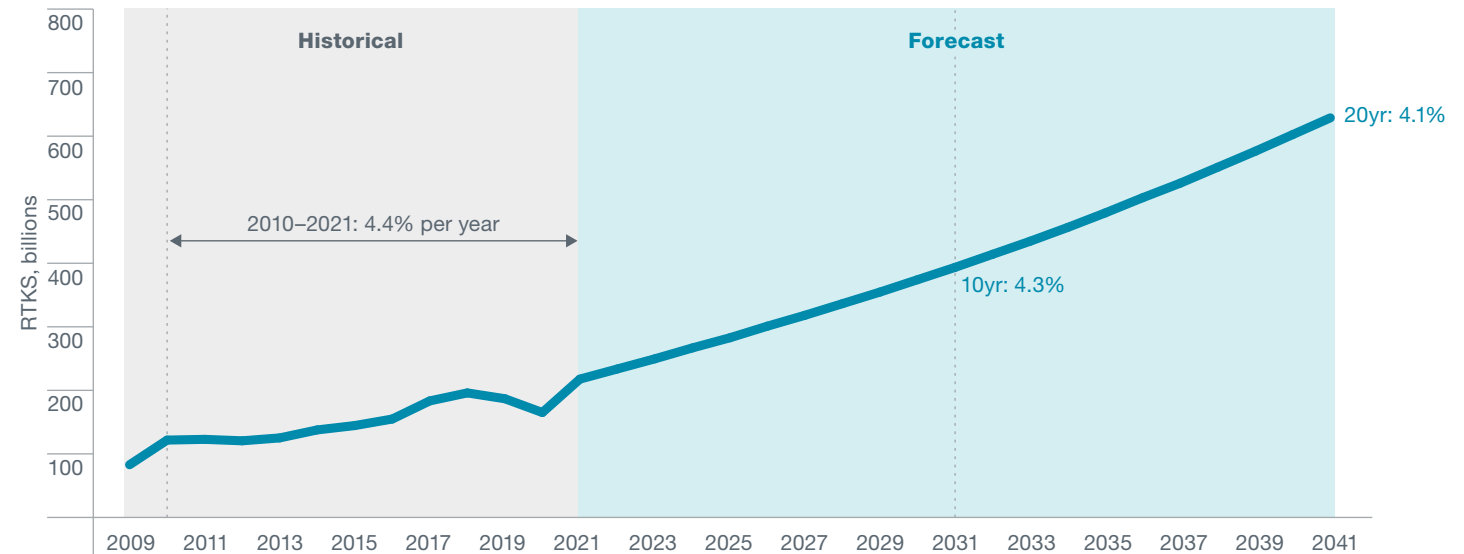
Long-Term Air Cargo Demand Forecast

In addition to the factors discussed above, GDP growth, industrial production growth, and trade growth remain key inputs and drivers of our 20-year outlook. For the period 2022–2041, Boeing forecasts that air cargo traffic, in revenue tonne kilometers, or RTKs, will grow at 4.1% annually, an increase from last year’s forecast of 4.0%.

Freighter Fleet Forecast

Pre-pandemic, the 2019 world freighter fleet consisted of 2,010 jet airplanes. By the end of 2021, the fleet had grown to 2,250 freighters. In addition, freighter utilization has been operating at approximately 125% of normal levels. Both parked airplanes returning to the fleet and higher-than-normal operations levels have provided the market with much-needed capacity, and will bolster replacement needs throughout the forecast period.

Slight Increase in Long-term Forecasted Traffic Growth Rate



Source: Boeing

Air Cargo Market Dynamics

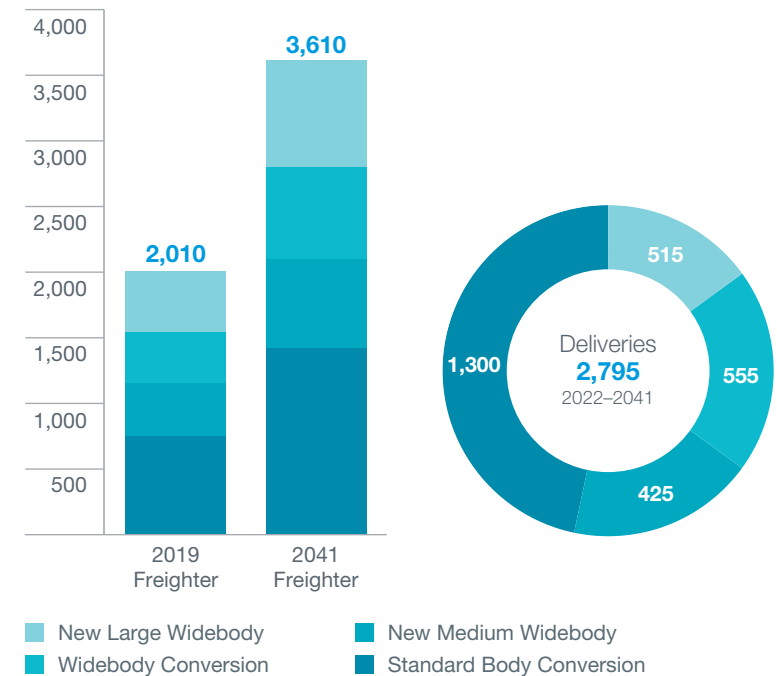
Over the next 20 years, the freighter fleet will grow from pre-pandemic levels by 80%, which represents 3% average annual fleet growth. We forecast approximately 2,800 production-plus-conversion deliveries, with approximately half replacing retiring airplanes, and the remainder expanding the fleet to meet projected traffic growth. Roughly two thirds of deliveries will be freighter conversions from passenger airplanes, about 70% of which will be standard-body passenger aircraft. Reflecting the higher traffic growth outlook, as well as higher replacement needs, this year's forecast is up nearly 7% over last year, with increases across all segments.

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

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

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

Freighter Fleet to Grow 80% by 2041



Services Market Overview

Boeing forecasts the commercial support and services market to be worth \$3.6 trillion through 2041. Commercial services will continue to rebound as aircraft utilization returns to pre-pandemic levels, and play a critical role in both the ongoing market recovery as well as long-term industry growth.

The services market will continue to play an important role in both the ongoing market recovery and long-term growth. While conditions may be difficult in the near-term, operators who emerge from market downturns have historically resumed their growth trajectories through collaboration, adaptation and innovation. As with previous downturns, operators are expected to rebound from the pandemic with updated business models that enable more sustainable and profitable growth.

The pandemic left its mark on operators, air traffic, and related services. While Boeing forecasts that the services market will return to 2019 levels by 2024, full recovery will vary by market segment and region. In the short term, the industry is likely to feel a lingering pandemic effect, as travel demand returns and travel restrictions ease. Labor shortages, along with the indirect ramifications of the pandemic, will continue to impact

supply chains and put pressure on the entire aerospace ecosystem. In the long term, however, it is expected that the services market will return to pre-pandemic growth levels.

The availability of labor, from pilots and cabin crew to technicians and engineers, is expected to be a watch item throughout the decade. Furloughs, layoffs, and early retirements have created near-term shortages of pilots and maintainers. There has already been an uptick in initiatives to boost training and recruitment efforts, as well as investments in digital technologies that mitigate the labor shortage's effects.

Investments in digital solutions allow aircraft operators to avoid disruption, improve productivity, and reduce overall operating costs. Augmented and virtual reality technologies will continue to evolve, and the market will see their increased adoption in the training and maintenance services markets.

A sustainable aerospace future is a growing priority for operators, as interest in aviation's carbon impact rises among the flying public and other stakeholders. The industry will continue to focus on more efficient operations and maintenance procedures to meet commitments for environmental sustainability.

New for the 2022 Commercial Market Outlook (CMO) Services section is a renewed focus on the market segments which cover the commercial services functions commonly found in the market today and represents a view of the specific services Boeing serves. 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. Our 2022 20-year global forecast for commercial aviation services is \$3.6 trillion.

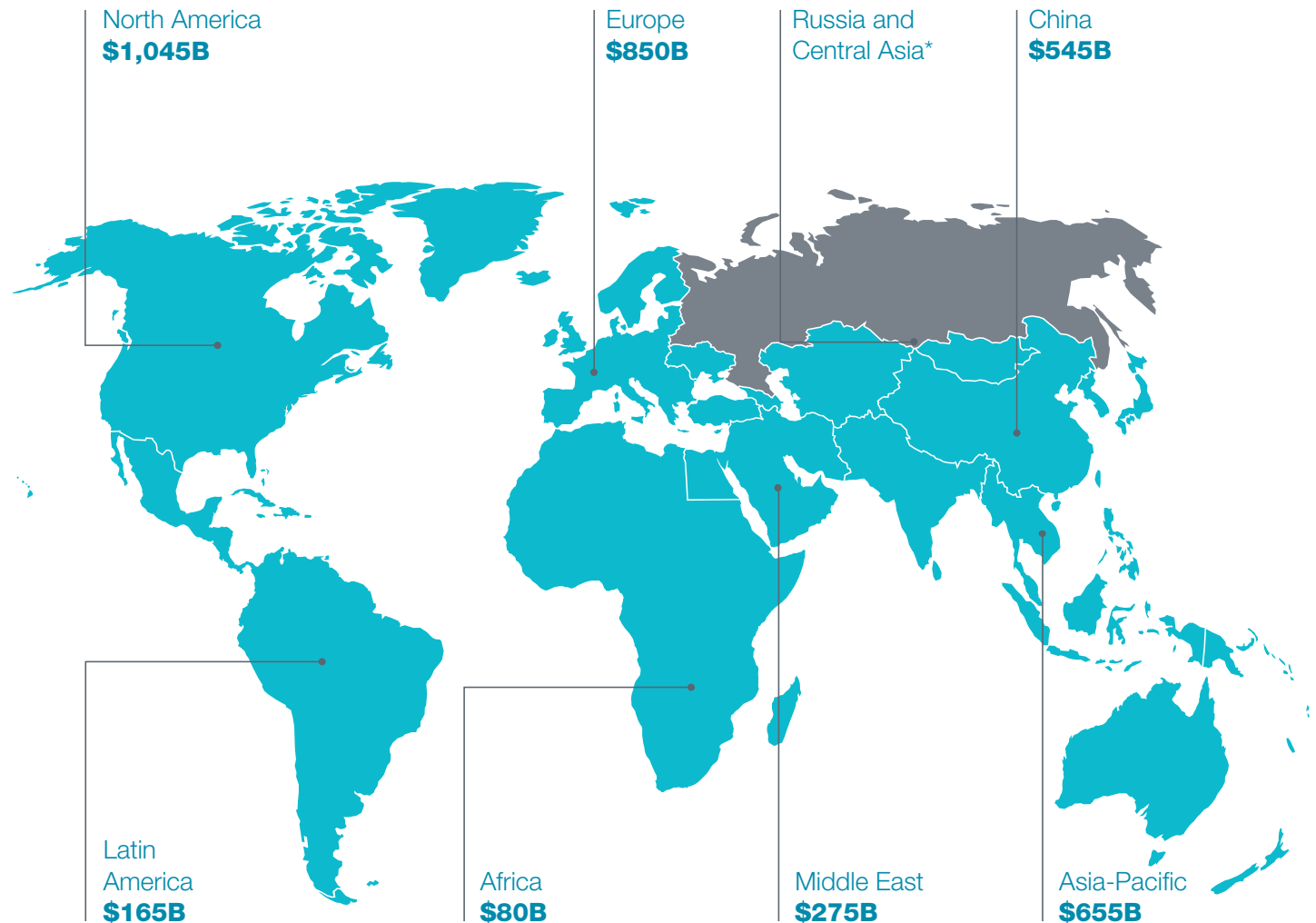
Three Primary Segments in the Aviation Services Market

Maintenance, Repair, Overhaul and Modifications This market segment includes all of the parts, engineering and labor for the functions that provide modifications as well as maintaining, repairing and overhauling (MRO) the in-service fleet. A majority of the MRO activities are driven by fleet utilization and cycles. In total, the MRO market is nearly 70% of our \$3.6 trillion served market.

Training and Professional Services The training and professional services market includes aircrew and maintenance training, simulator products and services, and pilot provisioning services. Effective training and an adequate supply of personnel will remain critical to maintaining the health and safety of the entire aviation ecosystem.

Digital Solutions and Analytics Within the digital solutions and analytics market are products and services to generate, analyze, and leverage data in a safe and secure way. Solutions range from flight navigation software to aircraft health management systems to enterprise resource planning solutions.

Commercial Aviation Services Market Demand by Region



*CMO 2022 does not include a forecast for airplane deliveries to Russia due to sanctions against aircraft exports

Appendix

Airplane Market Sector Definitions

Passenger Airplanes		
Regional Jets	Single Aisle Airplanes	Widebody Airplanes
AVIC ARJ-700	Boeing 717	Boeing 747
Bombardier CRJ	Boeing 737	Boeing 767
Embraer ERJ Series	Boeing 757	Boeing 777
Embraer 170 Series	Boeing/MDC MD-80, -90	Boeing 787
Fokker 70	Airbus A220 Series	Airbus A300/A310
Sukhoi SSJ100	Airbus A320 Series	Airbus A330
	Bombardier CRJ-1000	Airbus A340
	Comac C919	Airbus A350
	Embraer 190 Series	Airbus A380
	Fokker 100	
	UAC MS 21	

Note: The lists are representative of airplanes in each segment

Freighter Airplanes		
Standard Body	Medium Body	Large Widebody
Boeing 727	Boeing 767	Boeing 747
Boeing 737	Boeing/MDC DC-10	Boeing 777
Boeing 757	Airbus A300/A310	Boeing MDC MD-11
Boeing/MDC MD-80	Airbus A330	Airbus A350
Boeing/MDC DC-9		
Airbus A320 Series		

Note: Standard-body <45 tonnes, medium widebody 40-80 tonnes, large freighter >80 tonnes.

Commercial Airplanes Forecast on a Page

Region	Africa	China	Europe	Latin America	Middle East	North America	Northeast Asia	Oceania	South Asia	Southeast Asia	World
Economic Growth (GDP) (2019–2041)	3.1%	4.3%	1.4%	2.5%	2.7%	2.0%	1.1%	2.4%	5.0%	3.8%	2.6%
Airline Traffic Growth (RPK) (2019–2041)	5.2%	4.9%	3.0%	4.4%	4.0%	2.6%	1.7%	2.6%	6.8%	5.3%	3.8%
Airline Fleet Growth (2019–2041)	3.5%	4.2%	2.7%	2.9%	3.8%	1.6%	1.1%	1.3%	6.2%	4.8%	2.8%
Deliveries (2022–2041)											
Regional Jet	20	340	20	<5	40	1,630	10	10	<5	50	2,120
Single Aisle	740	6,370	7,030	2,030	1,580	6,460	740	440	2,060	3,430	30,880
Widebody	230	1,570	1,390	200	1,290	780	550	200	280	740	7,230
Freighter	20	205	110	10	70	440	45	<5	5	35	940
Total	1,010	8,485	8,550	2,240	2,980	9,310	1,345	650	2,345	4,255	41,170
2019 Fleet											
Regional Jet	130	60	240	80	30	1,890	50	30	10	<5	2,710
Single Aisle	400	3,050	3,690	1,200	660	4,080	560	380	590	1,140	16,520
Widebody	150	620	980	150	740	700	540	120	90	430	4,660
Freighter	60	200	310	110	80	940	80	30	10	30	2,010
Total	740	3,930	5,220	1,540	1,510	7,610	1,230	560	700	1,600	25,900
2041 Fleet											
Regional Jet	120	380	20	30	70	1,630	20	20	<5	50	2,340
Single Aisle	990	6,750	7,100	2,410	1,650	6,920	800	460	2,220	3,470	32,770
Widebody	320	1,680	1,650	280	1,510	970	600	220	300	830	8,360
Freighter	140	820	590	160	170	1,290	150	50	90	150	3,610
Total	1,570	9,630	9,360	2,880	3,400	10,810	1,570	750	2,610	4,500	47,080

Note: World 2019 fleet data includes Russia & Central Asia; rows do not sum for this category

Services Forecast on a Page

Region	Africa	China	Europe	Latin America	Middle East	North America	Northeast Asia	Oceania	South Asia	Southeast Asia	World
Service Market Size (\$B)	\$80	\$545	\$850	\$165	\$275	\$1,045	\$190	\$85	\$135	\$245	\$3,615
New Personnel Demand											
Pilots	20,000	126,000	122,000	35,000	53,000	128,000	22,000	9,000	37,000	50,000	602,000
Technicians	21,000	124,000	120,000	35,000	50,000	134,000	24,000	10,000	34,000	58,000	610,000
Cabin Crew	26,000	162,000	207,000	48,000	99,000	173,000	38,000	18,000	43,000	85,000	899,000
Total	67,000	412,000	449,000	118,000	202,000	435,000	84,000	37,000	114,000	193,000	2,111,000

Regional Traffic Growth

Traffic Flow (RPKs in billions)	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2031	2041	2019–2041 Annual Growth
Africa–Africa	54.6	58.6	61.5	62.9	66.0	67.8	69.4	72.7	21.9	30.3	158.1	269.2	6.1%
Africa–Europe	139.5	143.4	150.5	153.7	153.2	164.2	177.3	187.4	52.6	66.5	277.6	389.9	3.4%
Africa–Middle East	48.5	53.7	58.4	63.4	66.3	70.1	73.5	74.1	18.7	27.6	146.2	254.1	5.8%
Central America–Central America	37.4	40.6	43.4	46.8	53.5	57.0	61.0	65.9	26.7	39.4	101.5	127.7	3.1%
Central America–Europe	84.0	87.1	94.6	100.7	110.3	118.5	121.0	121.9	35.2	50.7	176.9	240.2	3.1%
Central America–North America	122.2	133.5	149.9	167.2	178.5	192.0	201.9	207.4	65.8	106.4	286.5	411.1	3.2%
Central America–South America	25.1	28.3	30.7	34.4	35.8	37.6	40.7	40.4	8.3	12.5	70.7	119.3	5.0%
China–China	402.9	453.5	498.6	551.8	611.3	695.2	774.4	838.5	579.6	666.6	1604.3	2505.4	5.1%
China–Europe	96.4	98.8	104.7	116.3	129.5	140.3	155.9	174.4	22.7	10.0	272.0	402.5	3.9%
China–Middle East	25.4	26.6	31.6	34.6	38.9	43.5	47.9	51.8	8.5	2.2	113.9	194.6	6.2%
China–North America	90.2	91.7	106.0	120.6	135.6	147.5	153.8	150.5	17.2	7.0	263.7	375.3	4.2%
China–Northeast Asia	63.4	62.1	71.1	80.8	88.1	84.1	85.1	91.5	11.7	3.0	138.3	193.0	3.4%
China–Oceania	37.2	37.0	37.1	41.6	52.8	65.0	72.6	70.7	10.3	4.0	103.4	145.4	3.3%
China–Southeast Asia	77.2	90.5	94.5	111.0	128.6	146.3	169.9	177.6	19.5	4.5	384.9	596.2	5.7%
Europe–Europe	690.2	720.8	768.8	827.4	903.6	968.6	1037.1	1070.7	374.4	413.5	1544.9	2141.4	3.2%
Europe–Middle East	185.1	198.8	217.9	246.9	265.0	286.1	314.8	333.8	104.7	104.4	503.4	678.1	3.3%
Europe–North America	418.2	427.7	459.9	491.2	536.6	573.2	616.8	641.9	147.6	157.2	858.3	1121.2	2.6%
Europe–Northeast Asia	73.4	75.5	79.5	81.9	78.9	82.2	91.5	98.5	21.6	16.8	107.3	128.4	1.2%
Europe–South America	106.2	107.6	109.1	110.1	112.3	116.2	126.7	137.1	31.7	39.2	213.5	333.9	4.1%
Europe–South Asia	53.3	53.7	55.9	55.6	56.6	59.3	66.2	60.0	17.1	18.0	101.8	145.3	4.1%
Europe–Southeast Asia	108.4	105.2	109.3	111.7	112.3	115.9	126.1	131.2	29.2	24.9	167.6	215.7	2.3%
Middle East–Middle East	74.9	80.3	87.0	97.2	112.2	118.2	122.6	124.1	41.8	52.5	196.5	280.6	3.8%
Middle East–North America	58.9	63.3	77.2	93.1	103.2	104.4	99.3	99.1	28.3	51.9	165.5	213.3	3.5%
Middle East–Oceania	23.4	32.9	37.3	39.5	48.4	54.8	56.5	51.3	12.6	9.4	85.1	113.5	3.7%
Middle East–South Asia	93.2	100.0	108.3	122.5	137.0	146.5	149.6	144.1	57.6	64.9	338.9	524.1	6.0%
Middle East–Southeast Asia	67.7	81.4	95.0	103.7	115.9	125.5	129.1	128.3	44.5	26.8	258.3	376.5	5.0%
North America–North America	1031.3	1055.5	1090.1	1152.3	1215.3	1273.3	1350.8	1409.5	574.8	1023.3	1864.1	2409.0	2.5%
North America–Northeast Asia	152.7	158.8	162.2	166.6	173.3	183.5	182.8	184.5	48.4	46.0	196.6	225.1	0.9%
North America–Oceania	43.1	45.0	45.3	49.5	54.1	55.6	60.1	60.2	12.5	7.0	84.7	107.5	2.7%
North America–South America	72.8	80.4	84.4	87.4	83.8	86.2	92.0	86.9	20.0	37.6	143.4	216.2	4.2%
Northeast Asia–Northeast Asia	100.7	110.3	117.5	122.5	131.3	136.4	143.2	139.9	70.6	51.8	171.7	193.7	1.5%
Northeast Asia–Southeast Asia	95.8	107.3	120.0	129.8	139.7	157.5	180.9	207.8	43.0	19.9	266.5	380.8	2.8%
Oceania–Oceania	99.4	102.3	104.1	105.1	108.2	108.4	108.3	108.5	26.2	44.2	139.3	164.8	1.9%
Oceania–Southeast Asia	77.0	78.6	84.5	80.3	84.0	86.9	90.9	92.7	16.5	9.4	143.0	187.7	3.3%
South America–South America	151.5	154.9	159.2	163.8	163.7	169.6	182.9	187.0	82.5	109.4	371.1	533.6	4.9%
South Asia–South Asia	64.6	68.1	72.9	80.7	98.7	115.0	136.1	143.1	57.7	76.3	325.1	635.4	7.0%
Southeast Asia–South Asia	33.5	35.5	38.0	39.8	44.2	50.5	54.2	55.8	9.6	3.7	130.1	229.0	6.6%
Southeast Asia–Southeast Asia	155.8	185.8	199.5	217.2	236.1	253.1	268.2	270.3	102.5	79.7	636.1	1079.6	6.5%
Rest of World	359.8	394.6	422.6	424.6	428.9	484.1	558.7	622.1	226.0	316.3	919.2	1219.0	3.1%
Grand Total	5694.6	6029.9	6438.2	6886.1	7391.7	7939.9	8549.9	8913.4	3100.1	3835.0	14030.0	20077.1	3.8%



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