EMBRAER

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OUTPERFORM.

MARKET OUTLOOK 2023

BANGKOK, THAILAND

MARKET OUTLOOK 2023

ROCKY COAST, MONTENEGRO

TOWARD A MORE SUSTAINABLE AND CONNECTED AVIATION INDUSTRY

The post-pandemic world is finally here, but the skies are still not totally clear for the aviation industry. The Ukraine-Russia conflict is compounding the lasting effects of covid, causing economic uncertainty, supply chain disruptions, and labor shortages across the board. Although the world is certainly headed towards normality, most predictions indicate that we'll still feel many of these effects over the course of this year.

I'm glad to see that airlines are shopping for airplanes again. Yet the unpredictability of the times in which we live demonstrates the importance of having flexibility to navigate smoothly through both the good and bad times ahead. And the up-to-150-seat segment has a key role to play in that.

In a changing world, efficient connectivity will be more important than ever. Not only because it gives an economic competitive advantage to airlines, but because it will be an asset to countries. Strong, autonomous economies must be really good at moving goods and people. Working from home is changing demand demographics, and new "Zoom cities," named after the famous video conference app, will demand efficient, more widespread and connected air service.

All that is happening while we face the biggest challenge of our generation, which is making sure we have a clean environment for our children and grandchildren. Aviation will play a part in reaching that goal. New generation aircraft – such as our E-Jets E2s – provide significant reductions to carbon emissions, and that's happening right now. In the coming years, new products that are in development today will achieve real, net-zero emission commitments. Those products will, accordingly, first appear in the regional category.

It's clear that the industry's 2050 zero-emissions target will have a huge impact on the types of aircraft that will fly in the future. Also clear is that regional aviation will be pivotal in paving the way for a more sustainable and more connected aviation industry, which is the focus of our Market Outlook 2023.

We hope you enjoy reading it as much as we enjoyed putting it together.

Arjan Meijer
President & CEO
Embraer Commercial Aviation

EXECUTIVE SUMMARY

BANGKOK, THAILAND

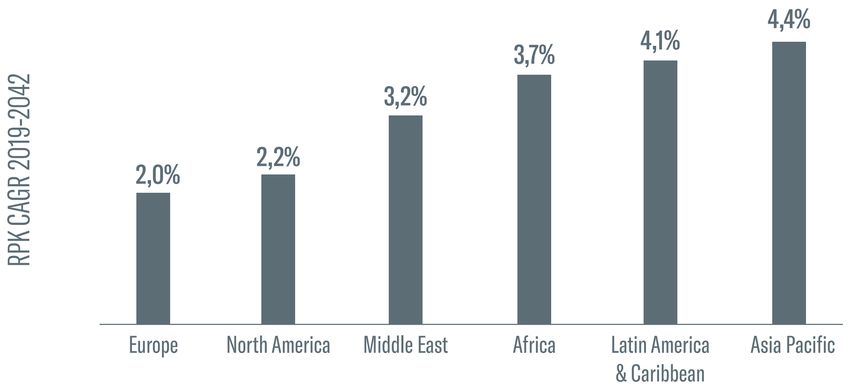
AIR TRANSPORT DEMAND FORECAST: RPK GROWTH RATES BY REGION

World passenger traffic is expected to grow at an average annual rate of 3.2% (CAGR) between its pre-pandemic level at the end of 2019 and 2042. The rate is a notable deceleration compared to pre-pandemic growth rates for the next two decades, a reflection of the effects of the pandemic itself, expected deceleration of the global economy, and effects of the Russia-Ukraine conflict.

We maintain our forecast that global RPKs will return to 2019 levels in 2024, driven by a prolonged pandemic recovery period in some regions of the world, and by changes in industry dynamics.

Over the next 20 years, Asia Pacific (including China) will show the strongest growth rate, increasing its RPKs by 4.4% annually. This will be followed by Latin America (4.1%), Africa (3.7%), the Middle East (3.2%), North America (2.2%) and Europe (2.0%, including CIS).

WORLDWIDE AIR TRANSPORT DEMAND GROWTH: 2019-2042



Source(s): Embraer

World RPKs will reach 17.7 trillion by 2042. Asia Pacific will be the largest market by then, with 42% of global traffic. Combined, Europe and North America will generate 38% of total air transport demand.

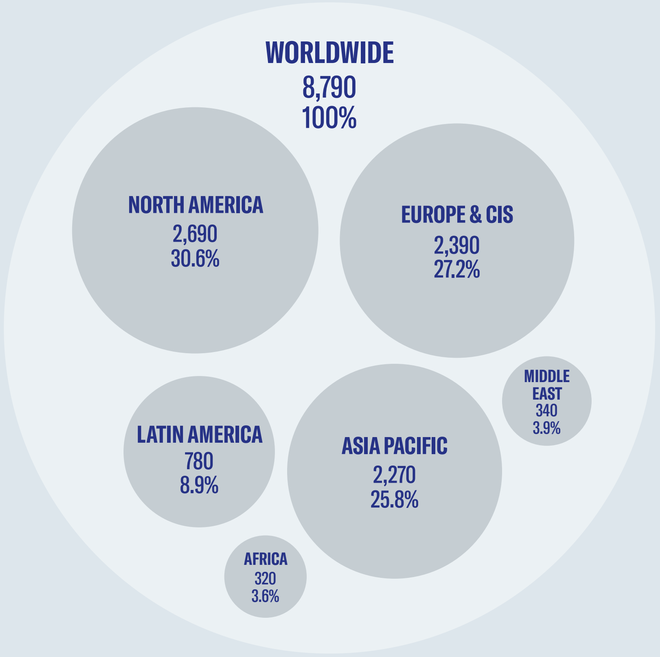
THE UP TO 150-SEAT MARKET

Embraer foresees world demand for 11,000 new up-to-150-seat aircraft over the next 20 years with a market value of USD 650 billion. Replacement of aging aircraft will account for 55% of all new deliveries while 45% will be used to grow markets.

THE JET SEGMENT

Smaller aircraft will drive worldwide demand for 8,790 up-to-150-seat jets. Of these, 48% will support market growth and 52% will replace aging aircraft. The trend to smaller aircraft reflects overall weaker demand growth, traffic patterns favoring short-haul versus long-haul, an increasing need for flexibility, connectivity, and efficiency, and fleet and network transitions to a decarbonized industry through new technology.

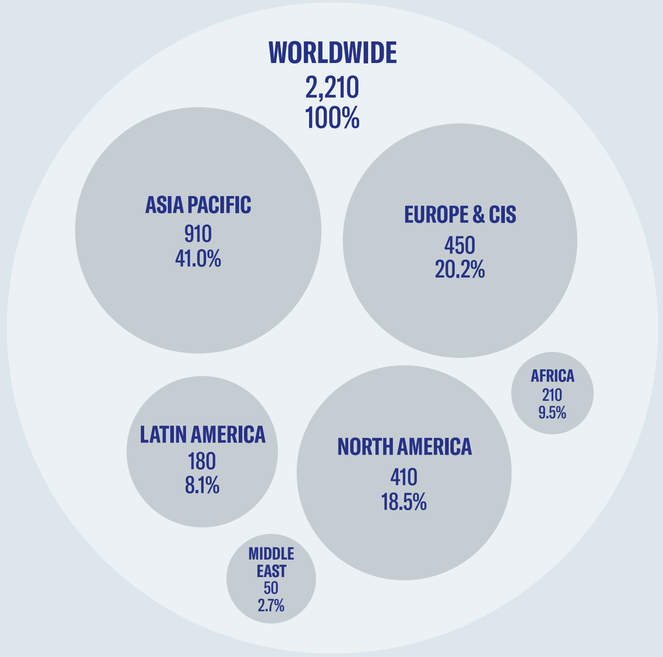
The need to enhance flexibility through narrowbody complementation also benefits the up-to-150-seat jet segment. In uncertain times, being able to address demand with the optimal capacity size - maximizing profitability - is more important than ever.



JETS UPTO 150 SEATS - NEW DELIVERIES / SHARE OF TOTAL

THE TURBOPROP SEGMENT

Short-haul operations will drive worldwide demand for 2,210 turboprops, mostly focused in Asia Pacific, Europe, and North America.



TP - NEW DELIVERIES / SHARE OF TOTAL

A NEW GLOBAL MAP

A New Global Map /

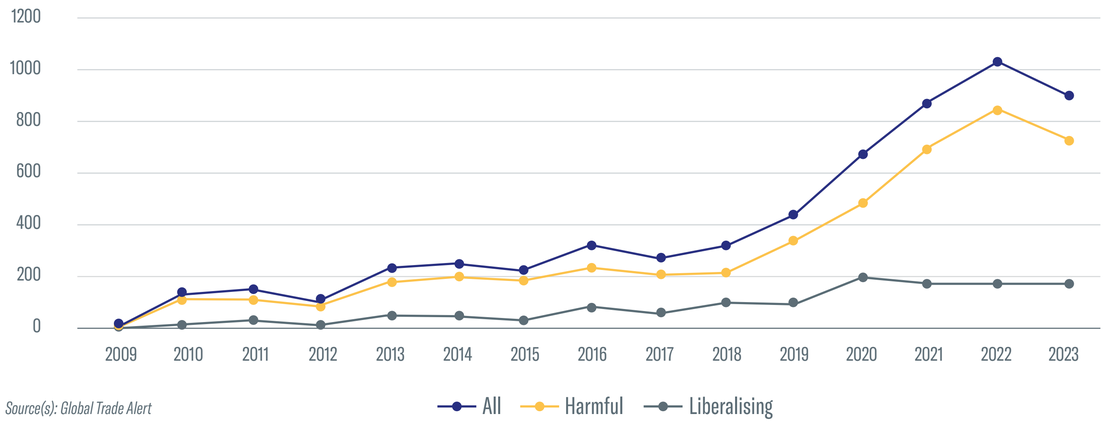
The impact of trends that emerged from the pandemic is starting to transform the current air transport model.

The first trend is a fragmentation of the global economy into competing blocs, with each bloc trying to pull as much of the rest of the world closer to its respective strategic interests and shared values. This fragmentation may well coalesce around two blocs led by the two largest world economies.

Geopolitical tensions and the pandemic have further weighed on cross-border trade and global value chains. Rising antagonism between the USA and China, in particular, has resulted in trade restrictions and the adoption of industrial policies in technology-intensive sectors (ie. semiconductors). Shortages of health-related products at the onset of the pandemic prompted nearshoring and even the nationalization of some supply chain segments.

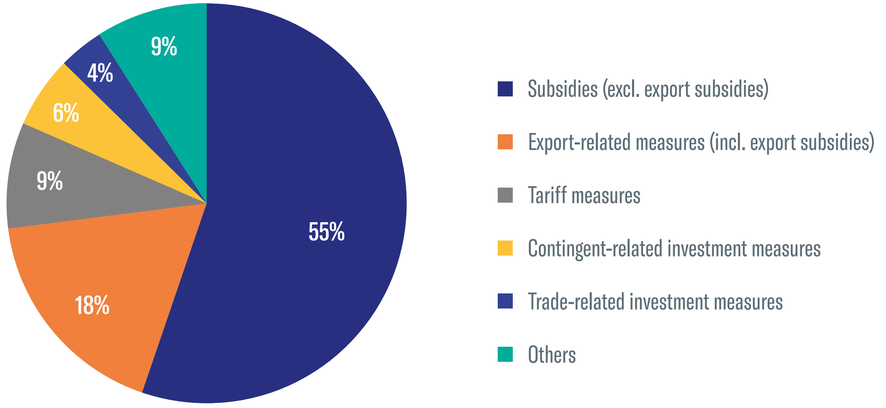
Here is how trade interventions have evolved over the years.

NEW TRADE INTERVENTIONS PER YEAR



Source(s): Global Trade Alert

POLICY INSTRUMENTS USED



Source(s): Global Trade Alert

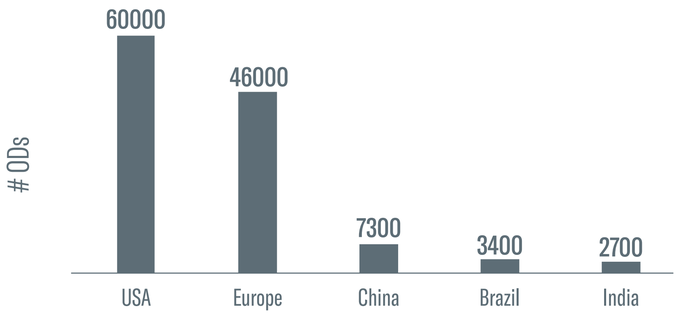
The Russia-Ukraine conflict has further raised geopolitical tensions in that trade may be increasingly driven by geopolitical rather than economic considerations. Overall, efforts to boost the reliability of sourcing, improve responsiveness to demand, or prioritize national security concerns are likely to result in relocation and shortening of some supply chains.

In response, governments are legislating increased supply security, notably through the Inflation Reduction Act in the United States and the Strategic Autonomy Agenda in Europe. These could, in turn, accelerate fragmentation as firms also adjust in anticipation of mandated changes. Indeed, in the wake of the Russian invasion of Ukraine, the number of global firms planning to regionalize their supply chains almost doubled to around 45% compared to the previous year (European Central Bank, April 2023).

A NEW CONNECTIVITY MAP

All this could have far-reaching implications for air transport. Efficient connectivity will be more than an economic competitive advantage - it will be an asset. The USA and Europe have the most developed air networks in the world, serving some 60,000 and 46,000 Origin/Destination city pairs (ODs) respectively. China follows, although it has an extensive high speed rail network, Brazil and India lag further behind. The Strategic Autonomy Agenda, the first trend to emerge from the pandemic, will drive a higher degree of air connectivity, not lower.

AIR TRAVEL ACCESS IS AN ASSET



Source(s): Sabre

The second trend is the Social Revolution. Previously identified as Digitalization, now three years from the onset of the pandemic, it is becoming clear that its effects will be felt throughout society.

Zoom towns — named after the pandemic darling and symbol of that era — are cities that saw tremendous growth from people moving away from big urban centers to work remotely during the pandemic.

A Zoom town is a smaller town that has experienced or is experiencing a significant increase in population growth. With more people working remotely, many have chosen small-town living.

Zoom towns continue to be relevant because companies are still adopting remote work policies. Employees are no longer obligated to live near their workplaces and instead choose to move to areas that offer better living standards and lower housing costs.

Overall, 4.9 million people left American cities for smaller population areas in 2020, according to the U.S. Census Bureau. This migration is impacting air travel for Zoom city residents who still demand airline network connectivity.

Here are the 10 best Zoom towns in the USA as ranked by the U.S. Census Bureau.

Top 10 “Best” Zoom Cities - 2020

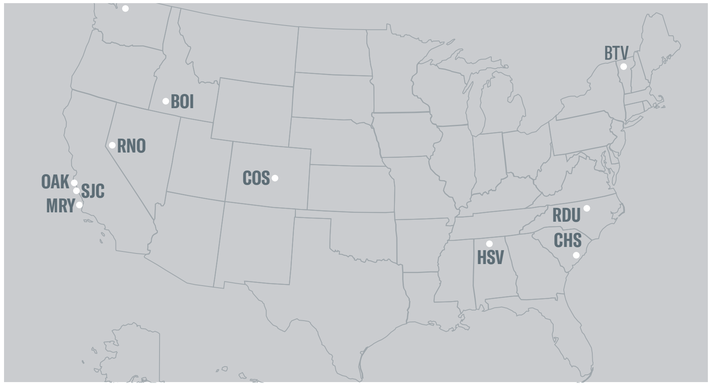
City	State
Boise	Idaho
Cary	North Carolina
Carmel	Indiana
Fremont	California
Burlington	Vermont
Huntsville	Alabama
Charleston	South Carolina
Colorado Springs	Colorado
Reno	Nevada
Centennial	Colorado

Source: U.S. Census Bureau

A New Global Map /

Each of these cities is served by a local or nearby airport identified in the map below.

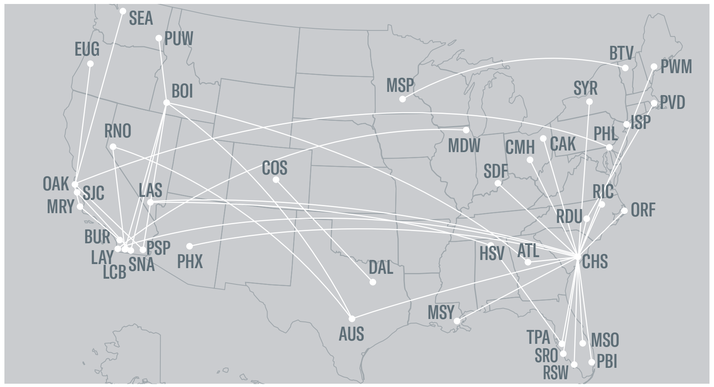
AIRPORTS SERVING A ZOOM CITY



Source(s): Sabre

From 2021 to 2023, 44 new markets were opened by these airports.

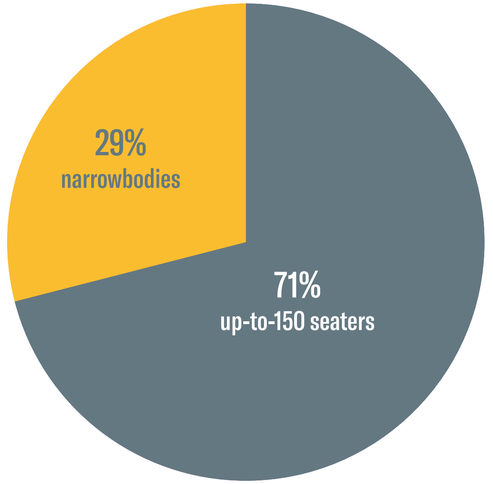
NEW MARKETS OPENED BY AIRPORTS SERVING A ZOOM CITY



Source(s): Sabre

71% of all flights in these markets are flown by up-to-150-seat aircraft.

AIRCRAFT TYPE DEPLOYED TO INCREASE AIR SERVICE TO ZOOM CITIES



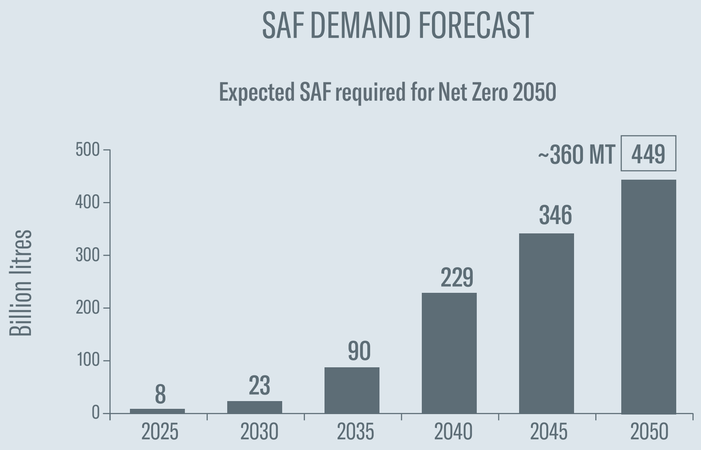
Source(s): Sabre

The up-to-150-seat segment will be a key tool for the current air transport model to transition to one that is more efficient and connected.

A NEW PRICING ENVIRONMENT

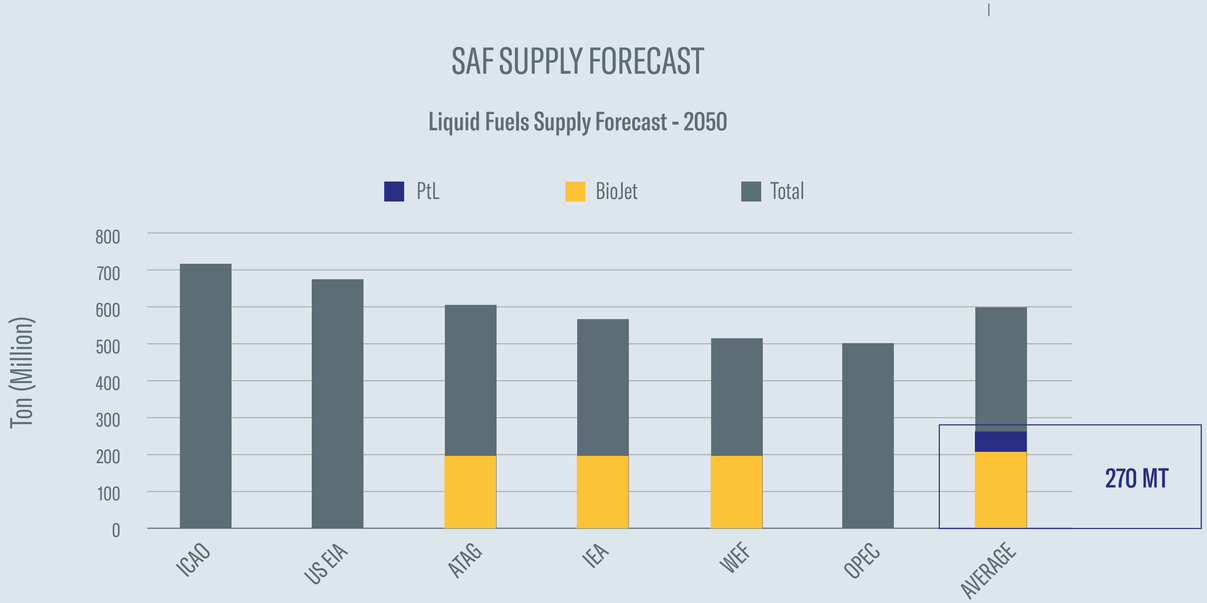
The high cost of Sustainable Aviation Fuel (SAF) will be a common item for airlines in all regions. Today, SAF costs around six times the price of jet fuel.

IATA released its SAF Demand Forecast that shows a worldwide requirement for 360 million tons - MT (449 billion liters) by 2050.



Source: IATA

Other organizations have published forecasts for the supply of liquid fuels. On average, the fuel production industry will be able to supply 600 MT of liquid fuels by 2050. Some entities included SAF (PtL-Power to Liquid and BioJet) in their forecasts. By 2050, the fuel industry will produce 270MT of SAF, a shortage of 90MT from the estimated IATA requirement.



Sources: EC-ETD, IRENA World Energy Outlook 2022, IEA Energy Technology Perspectives 2022, IATA Sept 2022, easyJet Investor Relations

Air travel will become more expensive yet SAF will be a key component for civil aviation to become a low carbon industry. Airlines that depend on maintaining their low-fare business model will need to adapt to the new pricing environment.

BLOUBERGSTRAND, CAPE TOWN

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CHALLENGE.
CREATE.
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AFRICA

Africa /

STONE TOWN, THE CAPITAL OF ZANZIBAR, TANZANIA

/KEY MESSAGES

/ Shaping the future: aviation is still in its infancy – huge opportunity to build a robust, efficient foundation.

/ Fundamentals of the region lead to crossover aircraft: demand leans towards thinner markets that are better served by smaller aircraft to efficiently increase frequencies, load factors, and yields.

/ Foster intra-regional connectivity: intra-regional connectivity is central to promoting growth but needs the right equipment and political coordination.

Economic & Traffic Growth 2019-2042

GDP	RPK
3.3%	3.7%

New Deliveries 2023-2042

Up to 150-Seat Jets:	TurboProps:	150-210 Seat NBs:
320	210	340

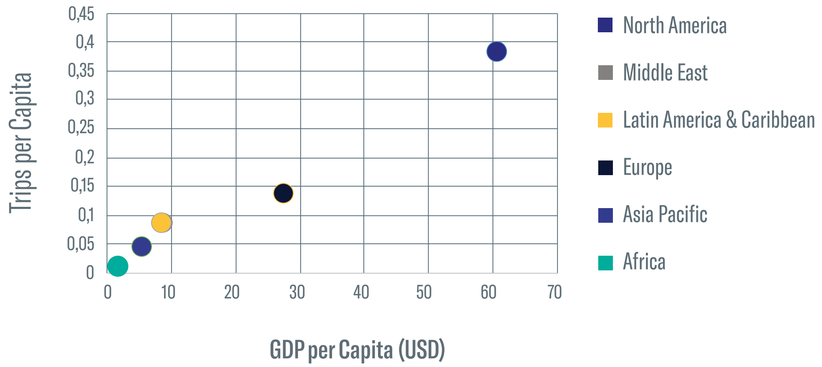
FLEET IN SERVICE - UPTO 150

2023:	2042:
506	579

Africa /

Compared to other regions, Africa is still in the early stages of developing its economy and the continent's air transport system. As of 2023, the propensity to travel is the lowest among world regions yet it also shows the magnitude of untapped potential.

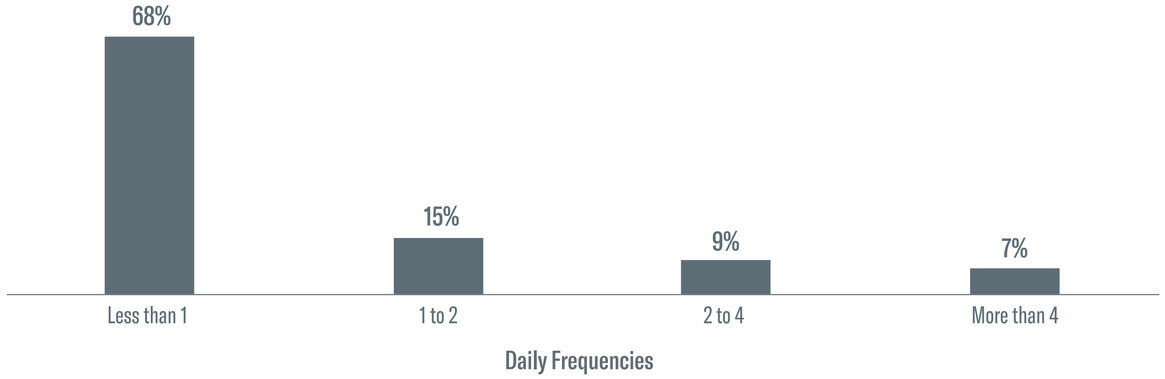
PROPENSITY TO TRAVEL



Source: Sabre, IHS Markit

stemming from few frequencies (almost 70% of domestic and intra-regional markets have less than one daily flight), the absence of nonstop flights in many markets, and operating inefficiencies from regulatory restrictions. The up-to-150-seat jet segment can address most of these issues.

DOMESTIC AND INTRA-REGIONAL MARKETS – FREQUENCY PROFILE



Source: Sabre

After the pandemic, airlines face some degree of resizing and restructuring, with some even upsizing their operations to meet the demand left behind by bankrupt airlines. Consequently, there is a new opportunity to address the persistent problems of the region: low load factors due to overcapacity, poor connectivity

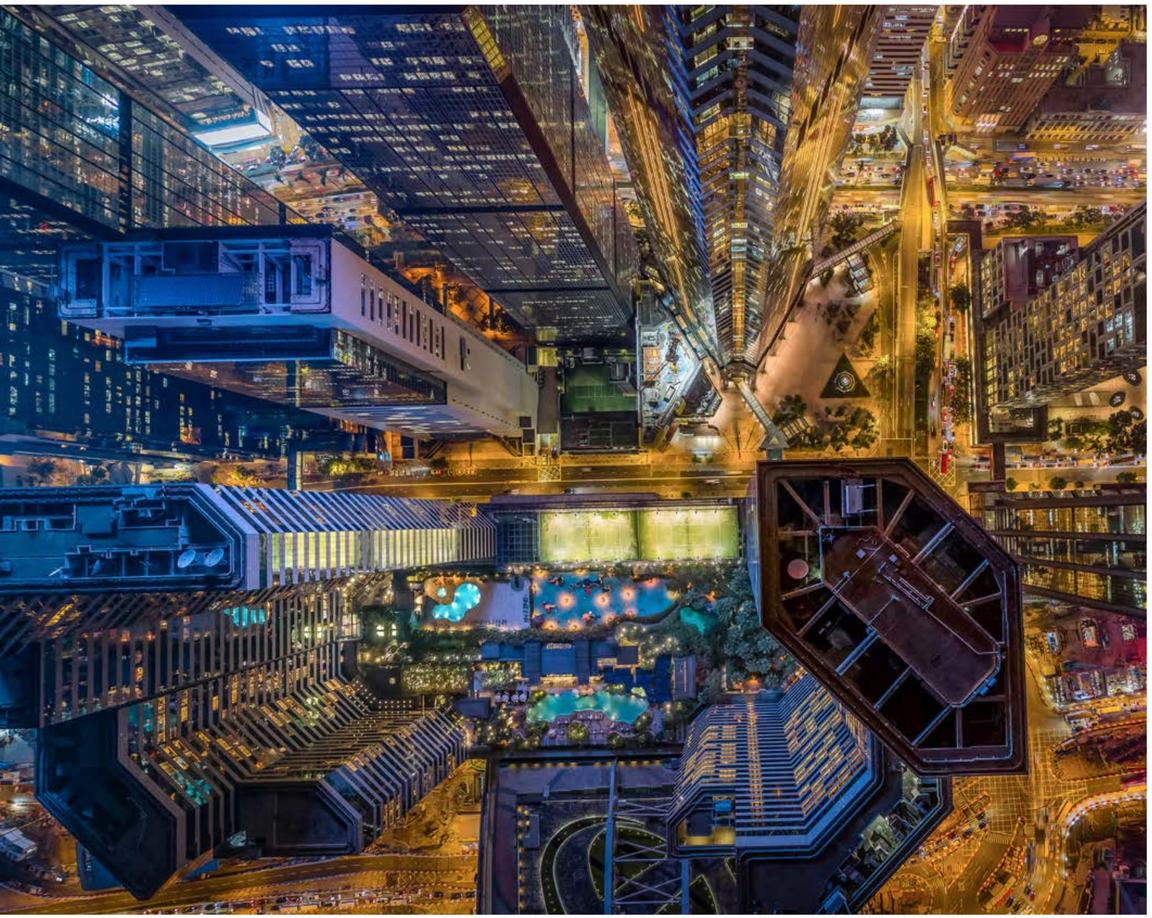
Aviation can play a fundamental role in the drive for long-term African economic and social prosperity. In most countries, air travel is an essential service and a catalyst for promoting tourism and fostering trade and regional development.

Some initiatives that could help build a stronger foundation for the aviation sector include a push for a more collaborative environment and targeting better cooperation between African airlines. This would support the development of intra-regional markets and increase local carrier competitiveness against airlines from other regions of the world.

CHINA & ASIA PACIFIC

HONG KONG, CHINA

China & Asia Pacific /



HONG KONG, CHINA

/KEY MESSAGES

/ Increasing synergy between turboprops, up-to-150 seat jets, and narrowbodies to address operational inefficiencies, grow markets, and facilitate network expansion using aircraft with new-generation economics.

/ Finding new opportunities and pockets of growth to expand networks: new point-to-point routes, service to secondary cities, hub-feeding, and regional aviation development. Fleet flexibility for different business applications.

/ Achieving sustainable and green growth will require aircraft versatility and efficiency, regardless of demand.

Economic & Traffic Growth 2019-2042

GDP	RPK
3.6%	**4.4%**

New Deliveries 2023-2042

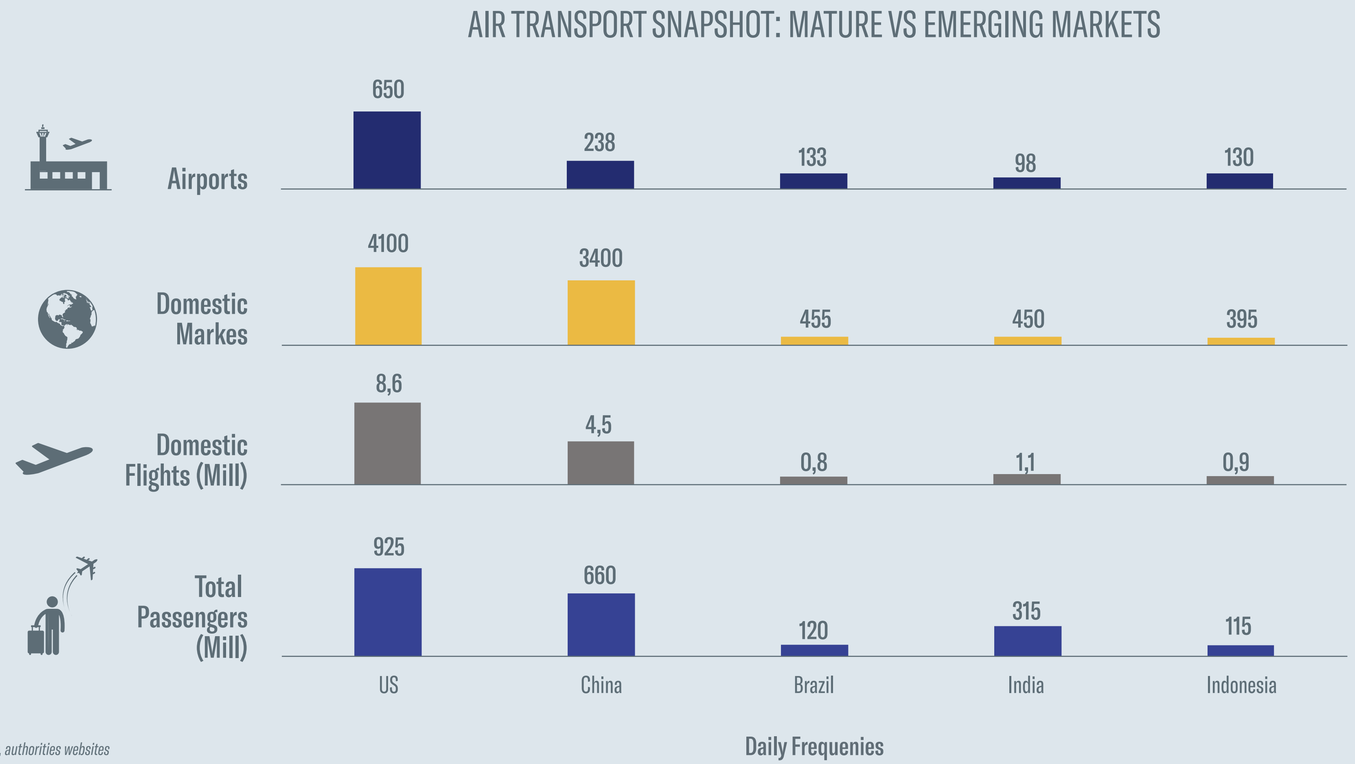
Up to 150-Seat Jets:	TurboProps:	150-210 Seat NBs:
2,270	**910**	**7,040**

FLEET IN SERVICE - UPTO 150

2023:	2042:
1,351	**3,336**

TREMENDOUS POTENTIAL FOR NEW AIR LINKS

To understand the magnitude of potential domestic air connectivity in large Asian countries, we compare it to North America. They share much in common - large populations distributed across expansive geography with a range of small, medium, and megacities.



Source: Sabre, authorities websites

The U.S. has five times more domestic origin-destination city pairs yet only one third of China's population, for example. City pairs with 10 or fewer passengers per day (PDEW) account for 85% of U.S. domestic origin-destination demand. Travelers can access a network that links almost any city to any other city frequently and conveniently.

Source: Sabre

Unlike in China, India, and Indonesia, U.S. airports and airlines are extremely efficient in flowing connecting traffic. At 56% of U.S. airports, more than half of the passenger throughput is connections. The percentage of connecting traffic is comparatively tiny, almost negligible, for the three big domestic Asian countries.

CHALLENGING THE DYNAMICS OF PASSENGER FLOWS

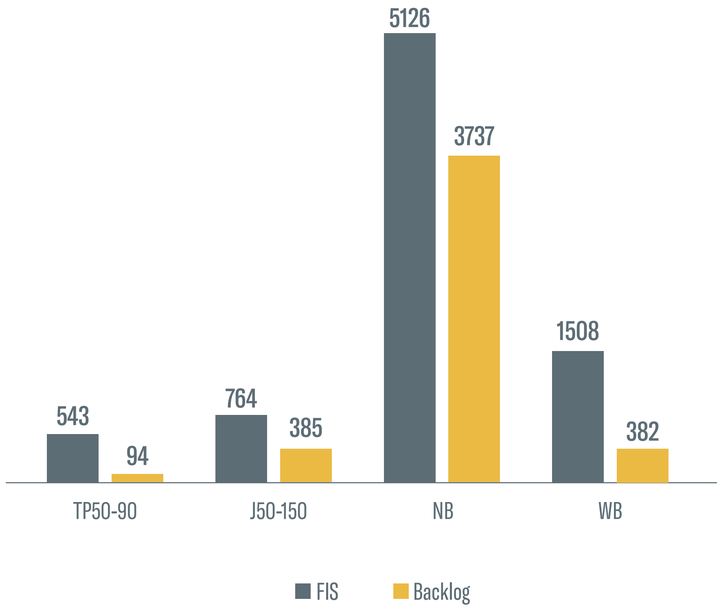
The acquisition of smaller jets is key to establishing greater network connectivity. The aircraft develop regional hubs, provide air travel to secondary cities, and improve the quality of service through more frequencies.

Future growth, especially to secondary cities, is often limited at airports that are not served by small-capacity jets. Smaller aircraft can access low and medium-density markets more profitably than larger aircraft. Regional airports attract more passengers when they offer frequent flights that link more cities.

The number of markets that can be served is indirectly proportional to aircraft size. Airports in Germany and the Netherlands, for example, link more international cities than countries in Asia.

Airlines in European countries deploy fleets of small-capacity aircraft across vast networks that connect their hubs with markets of varying densities. Even travelers living in tertiary cities have one-stop access to the world, a characteristic of the power of connectivity.

AN UNBALANCED FLEET IN SERVICE



Source: Cirium Fleet Analyzer

Asia's fleet-in-service is mostly comprised of large narrowbody jets, of which the number will keep increasing given the current backlog from the region's airlines. This unbalanced fleet limits an airline's ability to reach its full potential for efficiency, connectivity, and sustainability. This will need to change for the region to keep growing at the pace it needs to stay competitive in the future.

Moreover, the sustainability agenda will play a key role in the region's air transport fleet and network strategy. Asia's historical emissions were low but increased faster than the global average in recent years. The region's share of global greenhouse gas emissions doubled from 22% to 44% between 1990 and 2019. This level is expected to remain until mid-century under current policies. The Paris Agreement goals can be met with modest mitigation costs, bringing long-run advantages for the economy - a robust and efficient energy matrix, diverse food production, and more external investments.

EUROPE & CIS

BARCELONA, SPAIN

Europe & CIS /

SALTSTRAUMEN BRIDGE, NORWAY

/KEY MESSAGES

/ Addressing the path to sustainable connectivity: greener flights will cost more which will raise ticket prices and reduce demand for air travel. Intra-European traffic is mostly served by low-frequency large narrow bodies. Aircraft size will become too large.

/ The current network will need to have a more flexible fleet: Today's air transport model was built on the concept that different market sizes can all be served by large narrow bodies. This model is unrealistic for the impending technological transition, the social revolution, the strategic autonomy of the European economy, and to sustain efficient connectivity. Small aircraft will lead air transport into a low-carbon industry.

Economic & Traffic Growth 2019-2042

GDP	RPK
1.4%	**2.0%**

New Deliveries 2023-2042

Up to 150-Seat Jets:	TurboProps:	150-210 Seat NBs:
2,390	**450**	**4,150**

FLEET IN SERVICE - UPTO 150

2023:	2042:
1,401	**2,988**

A NEW PRICING ENVIRONMENT

Costs to decarbonize air travel in Europe start to increase in 2024 with the ramping up of kerosene taxes on intra-European flights, the SAF blending obligation in 2025, and the phasing out of free emissions allowances by 2027.

Decarbonization Effects on Cost and Revenue

Costs

- Fuel taxation (ETD - Energy Taxation Directive)
  - SAF Blending Obligation 2% (2025) – 63% (2050)
  - Synthetic Aviation Fuels 0.7% (2030) – 28% (2050)
- Ramping up Kerosene Taxes (IE Flights)
  - 10% (2024) – 70% (2050)
- Emissions Trading Scheme
  (Phasing out free emissions allowances after 2027)
- SAF pricing (SAF supply will not meet the demand by 2050)

Revenue

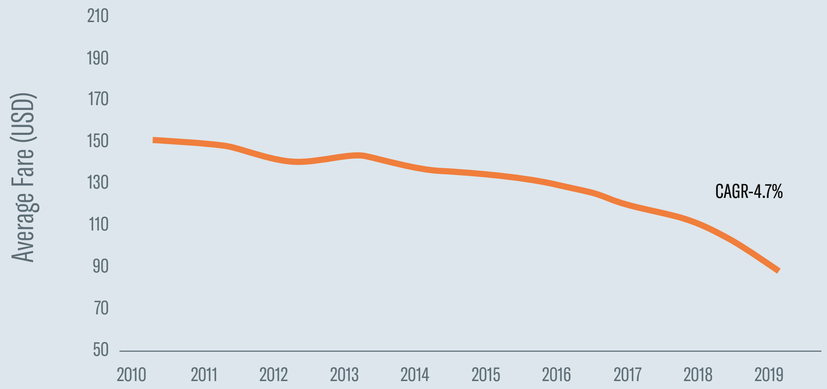
- Higher ticket prices
  (vs historical CAGR 2010-2019 of -5%).

Air travel will be more expensive.
Passenger demand growth will be reduced.

Source: ETD – Energy Taxation Directive, Objective SkyGreen 2022-2030

The higher costs will be reflected in higher ticket prices. The increases could change demand dynamics since airfares have been decreasing by 5% annually since 2010.

Average Fare Evolution of Point-to-Point Traffic



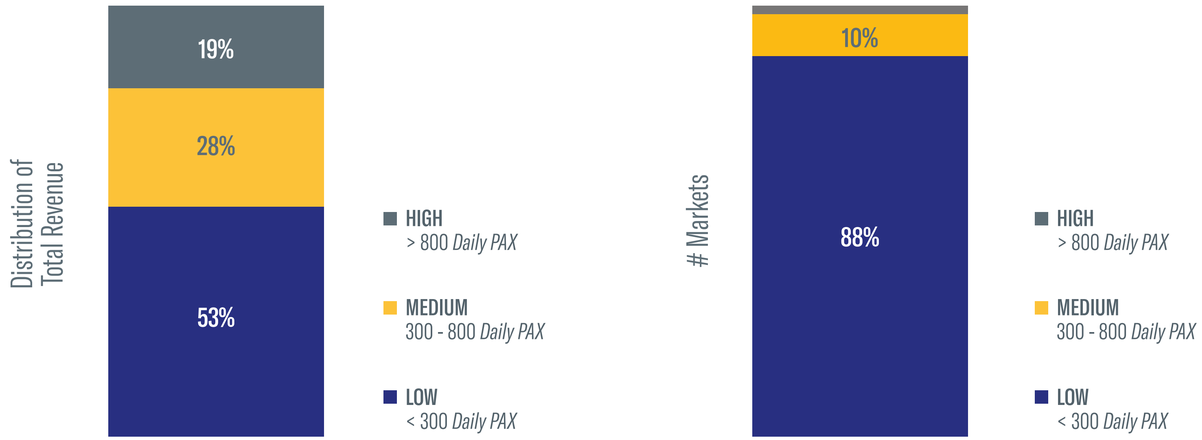
Source(s): Global Trade Alert

Higher ticket prices will impact demand. Intra-European traffic is dominated by airlines that have business models based on continually lower fares.

Today, 53% of total revenue in P2P traffic comes from low density markets (fewer than 300 daily passengers).

Europe & CIS /

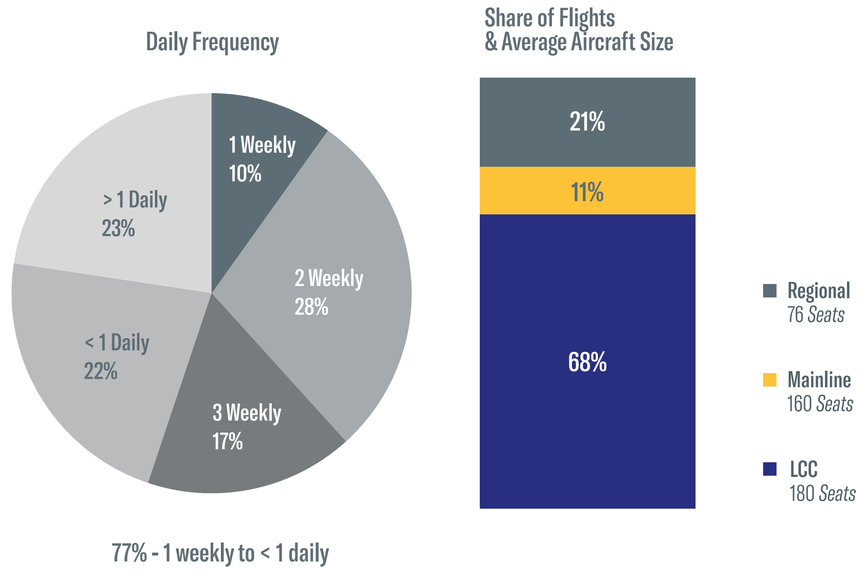
Revenue Profile vs Market Density in P2P



Source: Sabre

Source: Sabre

Low Density Markets Daily Frequency and Business Model Profile



77% - 1 weekly to < 1 daily

Source: Sabre

These markets have a low level of service: 77% are served with less than 1 daily flight (10% of markets have less than 1 flight per week). Low cost carriers operate in 68% of these markets.

If air travel will be more expensive and demand will be reduced, expect some of these markets to lose service while others will see weekly frequencies drop from 2 or 3 to just one.

The 180-seat average aircraft size, the capacity preferred by LCCs, will become too large. The fleet-in-service will need to transition to one that is more balanced in order to maintain efficient connectivity and prepare networks for the arrival of smaller, zero-emissions aircraft by 2040.

LATIN AMERICA & CARIBBEAN

SÃO PAULO, BRAZIL

Latin America & Caribbean /

ENGLISH HARBOR, ANTIGUA ISLAND ON THE CARIBBEAN

/KEY MESSAGES

/ Regional hubs to create new demand flows: better and new infrastructure capacity will build connectivity for underserved and new markets.

/ New connecting flows require a new fleet profile: dormant demand that is not currently served by point-to-point networks will change air travel dynamics.

Economic & Traffic Growth 2019-2042

GDP	RPK
2.5%	4.1%

New Deliveries 2023-2042

Up to 150-Seat Jets:	TurboProps:	150-210 Seat NBs:
780	180	1,540

FLEET IN SERVICE - UPTO 150

2023:	2042:
467	1,052

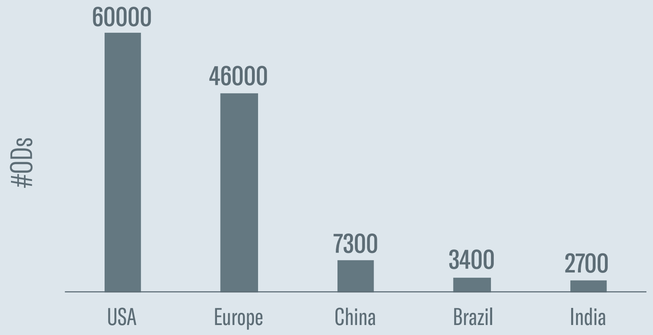
Latin America & Caribbean /

The maturity of air travel in Latin America is low. Brazil's airline network, serving one of the largest countries in the world, has just 3,400 ODs (Origin & Destination) city pairs while there are 60,000 ODs in the USA.

Such poor accessibility is a function of the region's fleet-in-service. Below the J170 seat category, all other aircraft are on average 25 years old. The backlog is concentrated mainly in J170 and J200 segments.

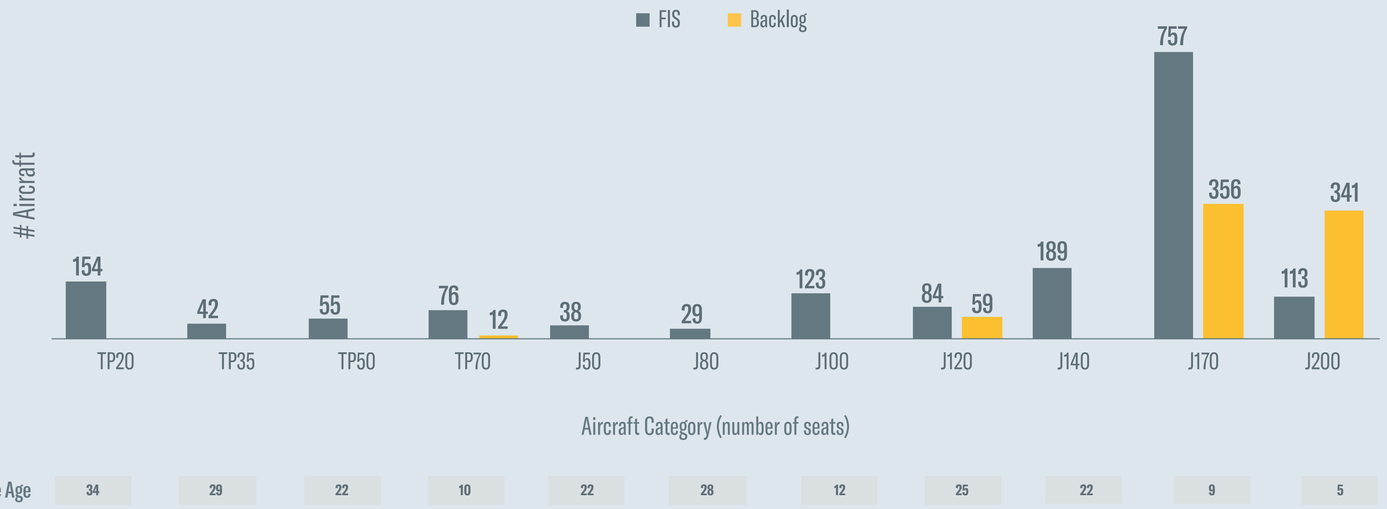
This fleet profile limits connectivity in the region.

Market Maturity



Source: Sabre

Latin America Fleet-In-Service



Source: Cirium Fleet Analyzer

Latin America & Caribbean /

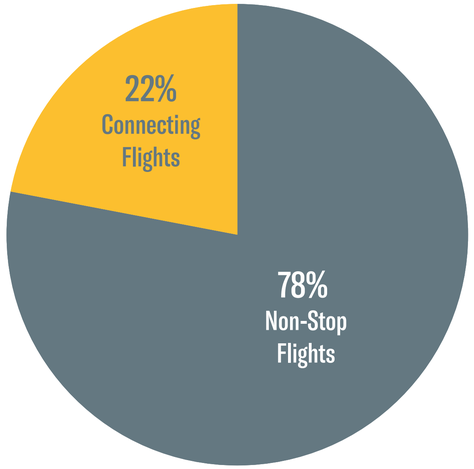
Today, 78% of intra-Latin America traffic is point-to-point. The low share of connecting passengers is related to the high proportion of large narrow-bodies in the current fleet-in-service. Small and medium density markets are most affected because they don't have enough demand to justify nonstop flights.

80% of all markets opened in the region post-covid were domestic while only 20% were intra-Latin America.

Despite the concentration of larger aircraft in the Latin America fleet, 56% of frequencies in new markets were flown with smaller aircraft.

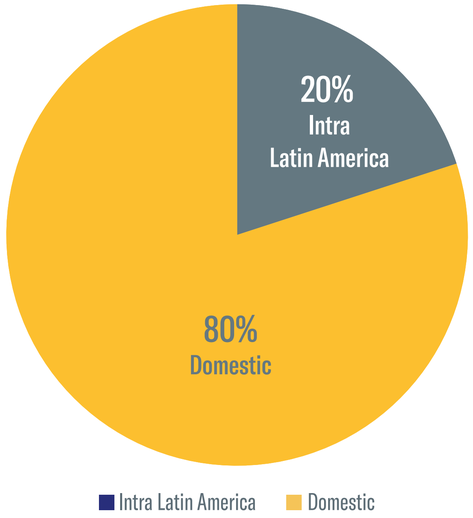
The addition of smaller aircraft in the Latin America fleet is essential for the development of air travel connectivity in the region.

Passenger Flow Profile



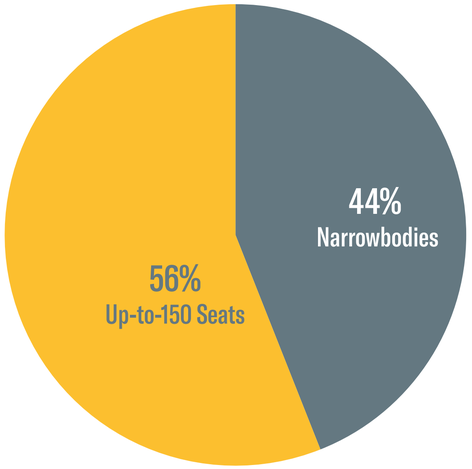
Source: Sabre

Number of New Markets Opened after 2019



Source: Sabre

Aircraft Deployed to Open New Markets after 2019



Source: Sabre

MIDDLE EAST

MADINAT JUMEIRAH, DUBAI

Middle East /

/KEY MESSAGES

/ Domestic and Intra-Regional Operations on the Rise: airlines in the region are starting to look inward for growth opportunities.

/ Aircraft currently deployed are sub-optimal: more than 60% of all domestic and intra-regional markets in the Middle East would be better served by aircraft with up to 150 seats.

Economic & Traffic Growth 2019-2042

GDP	RPK
2.6%	3.2%

New Deliveries 2023-2042

Up to 150-Seat Jets:	TurboProps:	150-210 Seat NBs:
340	50	1,900

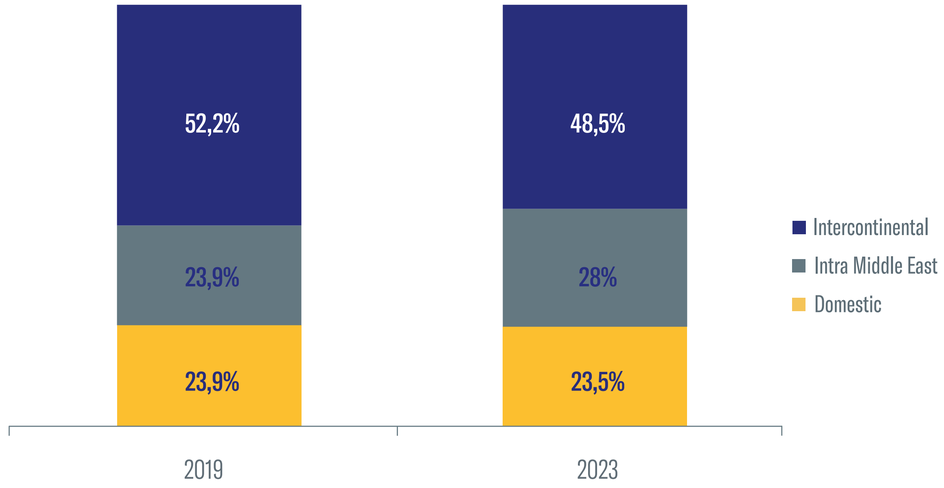
FLEET IN SERVICE - UPTO 150

2023:	2042:
145	424

Historically, Middle Eastern carriers have relied almost exclusively on long-haul, inter-continental flights to fuel growth. Although this global hub strategy has been a boon to the region over the last two decades, demand started to decelerate in the years prior to the onset of the pandemic.

Consequently, airlines began to look elsewhere for opportunities. Between 2019 and 2023, the number of seats offered by Middle Eastern airlines in domestic and intra-regional markets has surpassed those on inter-continental routes.

Market Segmentation
(Number of Seats Offered)

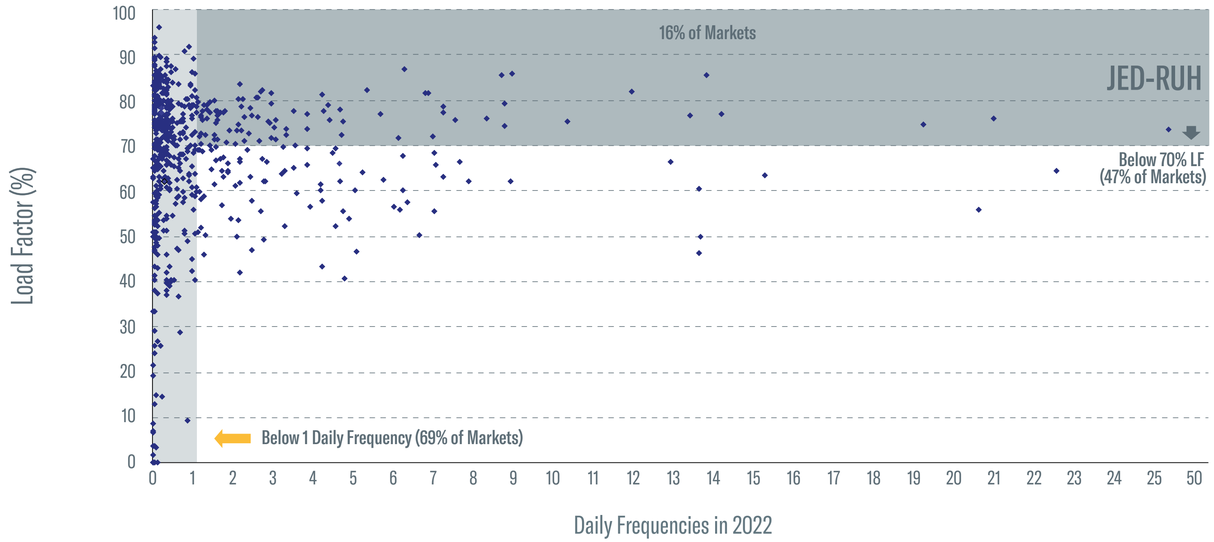


Source: Sabre

Middle East /

Although increasing in importance, domestic and intra-regional market potential is still mostly untapped. By comparison, inter-continental seats offered in Europe and North America markets account for less than 15% of all seats.

LOAD FACTOR VS FREQUENCY
All 587 Intra-Middle East Markets (excluding Turkey)

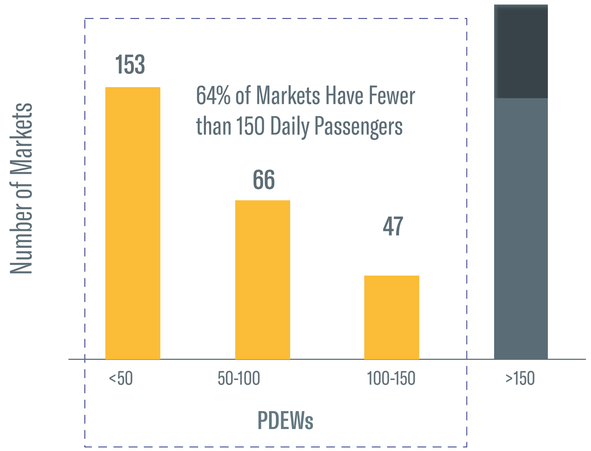


Source: Sabre, Embraer analysis.

Optimal service levels and greater connectivity will develop the full potential of these markets. In 2022, only 16% of Middle Eastern domestic and intra-regional markets (dark grey area) had at least 1 daily frequency (essential for connectivity) and load factors above 70% (essential for profitability).

These figures indicate that the aircraft are too large for the market demand. In fact, 64% of the Middle East's domestic and intra-regional markets in 2022 carried fewer than 150 passengers per day each way (PDEW), while 88% of frequencies were operated by aircraft with more than 150 seats.

MARKET DENSITY PROFILE
All Intra Middle East Markets with at Least 1 Weekly Flight (excludes Turkey)



Source: Sabre, Embraer analysis.

If smaller aircraft served these markets with greater frequency, overall connectivity would improve, including feeding inter-continental flights that are so critical to the region.

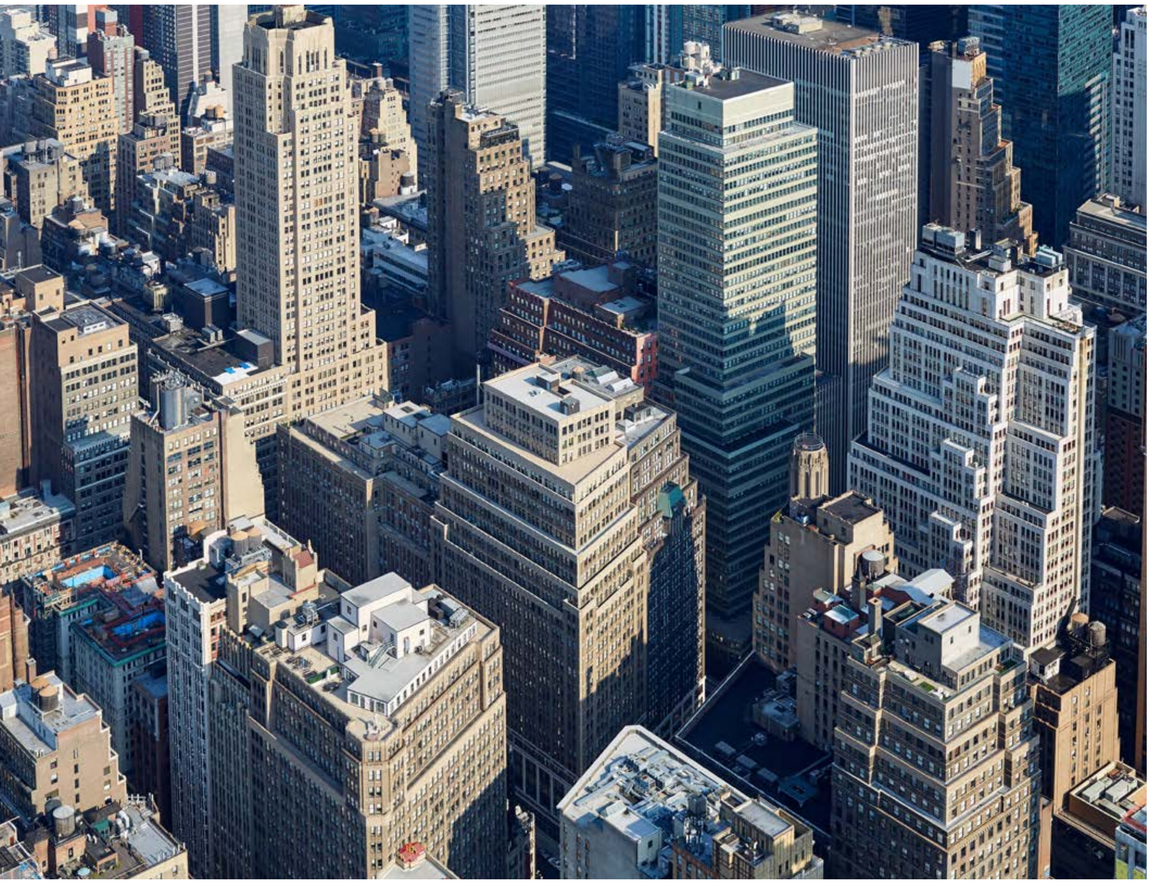
NEW YORK, UNITED STATES

EMBRAER

CHALLENGE.
CREATE.
OUTPERFORM.

NORTH AMERICA

North America /



NEW YORK CITY, MANHATTAN

/KEY MESSAGES

/ Pilot shortage skewing fleet deployment: regional aircraft are the backbone of the continent's network but are impacted by the pilot shortage. When the situation stabilizes (which should happen in the next few years) the commercial fleet will begin to rebalance, fully restoring connectivity and efficiency levels.

/ The future lies in the middle: large regional aircraft and small narrowbody jets are more important than ever to rebalance the fleet profile. This leads to a sustainable, graduated up-gauge, one that maintains connectivity without compromising on cost.

Economic & Traffic Growth 2019-2042

GDP	RPK
1.7%	2.2%

New Deliveries 2023-2042

Up to 150-Seat Jets:	TurboProps / RJs:	150-210 Seat NBs:
2,690	410	3,780

FLEET IN SERVICE - UPTO 150

2023:	2042:
2,949	3,395

North America /

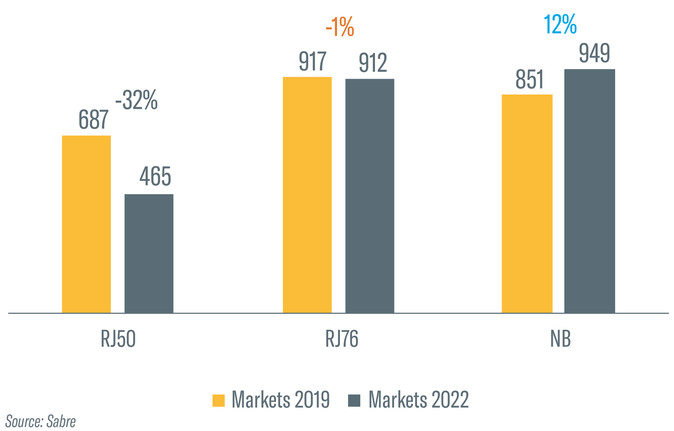
The North American airline market is unique – it leads the world in revenue and profit. Travelers enjoy the single most connected air transport network on the globe, one that allows even the smallest communities to have access to every big city in the world. That connectivity, provided by a robust hub & spoke system, is the North America network's most valuable attribute. Regional aircraft are essential to its function. In 2019, regional aircraft accounted for half of all commercial airline departures in the USA, serving 65% of all airports with scheduled flights.

After the onset of the pandemic, regional aircraft were essential in maintaining vital links. Record high inflation, disrupted supply chains, and especially the across-the-board labor shortages that followed directly affected the segment.

The industry lost many talented professionals but the shortage of pilots had the most severe impact on airlines. The quick recovery in demand had carriers struggling to find pilots since many were laid off or took early retirement in 2020. Because career progression moves from small to large aircraft, regional carriers tend to be more vulnerable to crew shortages than mainline airlines.

The impact affects airline fleets. For example, major carriers in the USA are deploying larger aircraft in more markets post-pandemic.

Major Airline Systems – Number of Markets September 2022 vs 2019

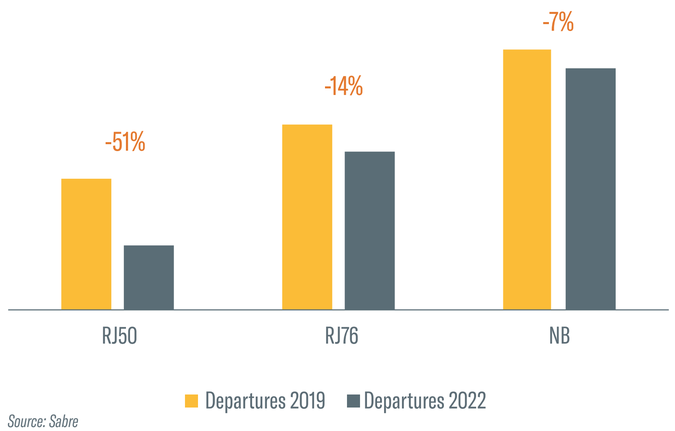


Source: Sabre

Narrowbody jets are replacing some of the routes typically operated by regional aircraft, especially 50 seaters, which are being removed from airline fleets.

Up-gauging comes at a cost: fewer flights. Fewer flights affect network connectivity, the very strength which sets the North American network apart from the rest of the world.

Major Airline Systems – Departures September 2022 vs 2019

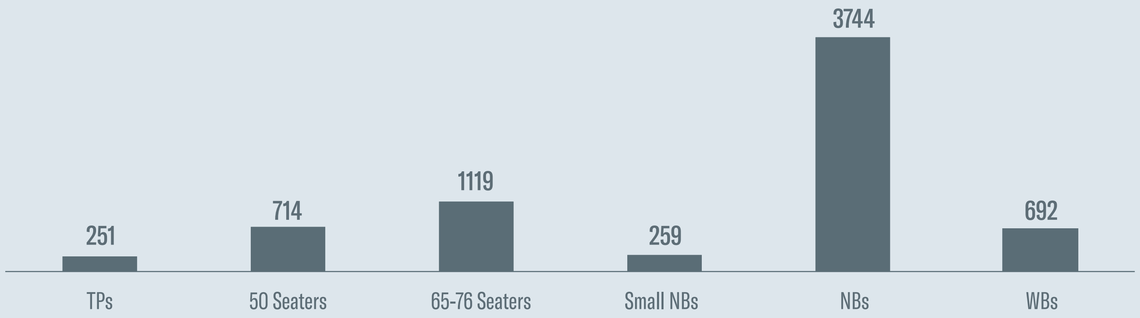


Source: Sabre

Two big changes are evident when examining the North America airline fleet profile between 2019 and 2022: a reduction in the 50-seat segment, and a huge gain in the number of narrowbody jets. This reflects a massive up-gauge, a departure from the traditional graduated increase in capacity across a spectrum of aircraft. What impact will this new fleet profile have on network connectivity and efficiency?

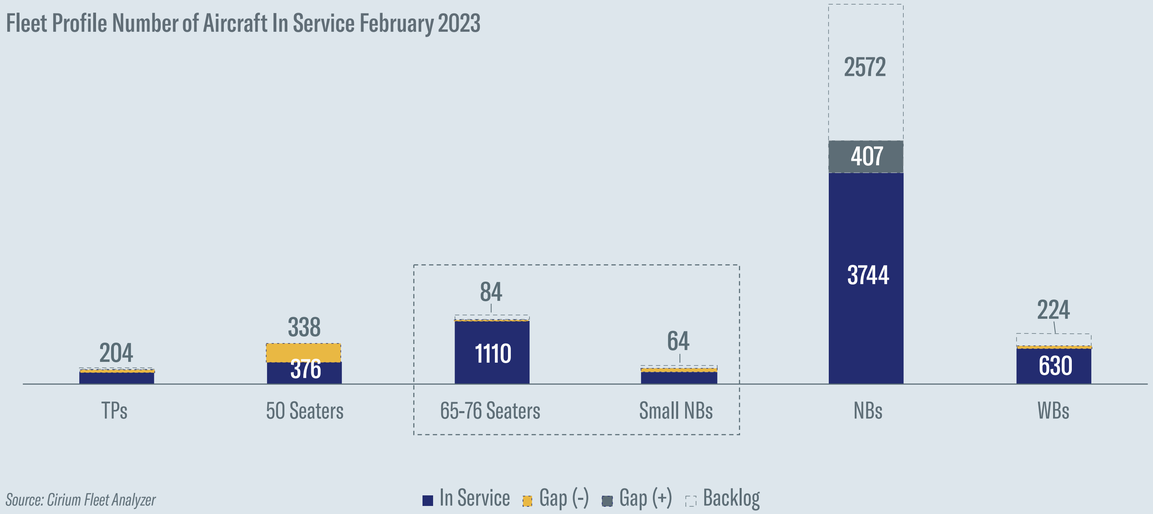
North America /

Fleet Profile Number of Aircraft In Service September 2019

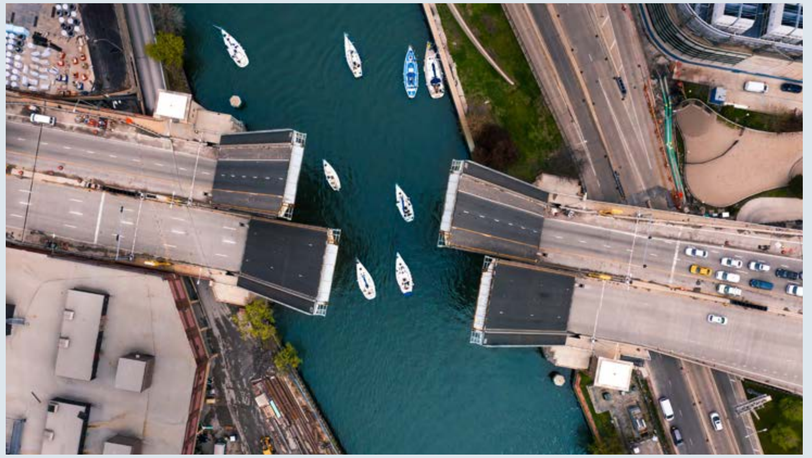


Source: Cirium Fleet Analyzer

Fleet Profile Number of Aircraft In Service February 2023



Source: Cirium Fleet Analyzer



CHICAGO, UNITED STATES

The answer lies in the middle. 65 to 76-seat aircraft will be more important than ever but with pilot scope clauses almost preventing any new regional jet acquisitions in the short-term, the supply of new capacity favours the next largest jet, the small narrowbody. New-generation aircraft in that segment aren't penalized for their size – they have much lower trip costs yet a similar cost per seat compared to the larger narrowbodies. This allows small narrowbody aircraft to bring the best of both worlds to the table: maintain frequencies and connectivity while being as cost effective as larger airplanes.

CARGO MARKET OUTLOOK

Cargo Market Outlook /

/KEY MESSAGES

/ E-Commerce still strong: the forecast for e-commerce penetration growth in the next 5 years is 8% on average, marking a re-acceleration after a tough year.

/ Relevance of crossover standard-body jets: ability to reach more distant destinations or add essential time-on-ground for loading compared to turboprops; replace or complement larger standard-body jets to reach decentralized regions cost-effectively.

Economic & Traffic Growth 2019-2042

GDP	CTK
2.5%	**3.3%**

New Deliveries 2023-2042

Small and Crossover Standard Body Aircraft

600

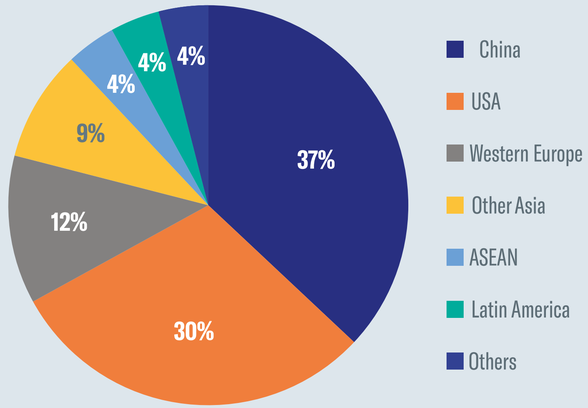
FLEET IN SERVICE - UPTO 150

2023:	2042:
228	**641**

E-COMMERCE STILL STRONG

The trend to online shopping and home delivery was already growing over the last decade, but the pandemic triggered a strong uptick that pushed the demand curve even higher. Between 2017 and 2021, global e-commerce Gross Merchandise Volume (GMV) grew an average of 21% per year (CAGR), reaching USD 3.3 trillion. In that period, e-commerce penetration of all retail sales almost doubled, jumping from 12% to 21%. In volume, China and the USA are the main drivers of e-commerce growth. Together, they accounted for 67% of the global market in 2022.

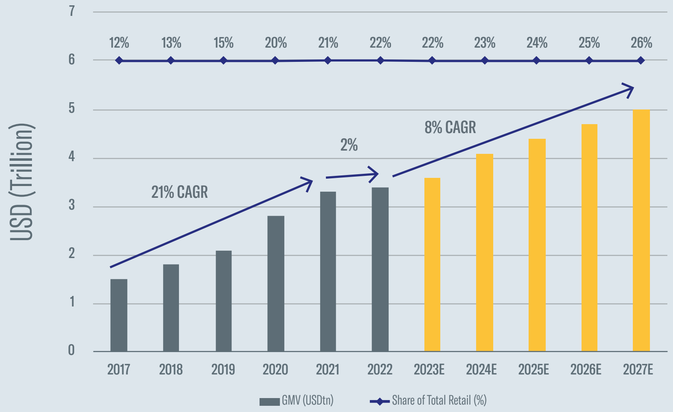
Global E-Commerce Share by Market (%)



Source: adapted from Morgan Stanley Research 2023 estimates, Euromonitor, National Data Sources

The economic turmoil the world faced in 2022 affected e-commerce GMV growth, but Morgan Stanley predicts that was just a bump in the road. After growing only 2% last year, the average growth expected for the next 5 years is 8%, reaching a GMV of USD 5 trillion by 2027. Those figures, although below the 21% CAGR between 2017 and 2021, mark a re-acceleration for e-commerce after what was clearly a tough year.

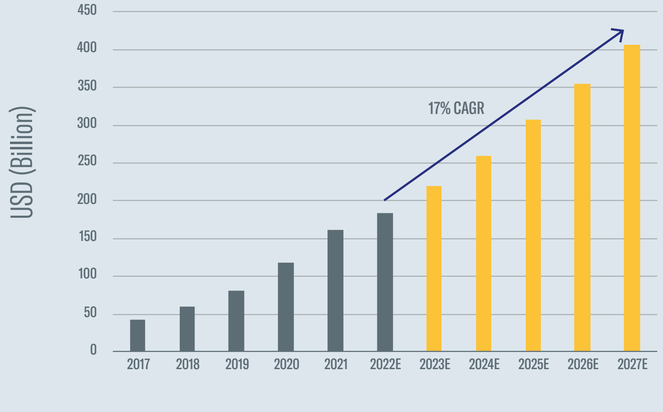
Global E-Commerce Growth



Source: adapted from Morgan Stanley Research 2023 estimates, Euromonitor, National Data Sources

Although mature markets with already high e-commerce penetration are expected to keep increasing their share over the next five years and will lead in volume of goods, it is the emerging economies that will take the lead in percentage growth. The CAGR for the next five years for the top 7 contributing countries (India, Indonesia, Mexico, Vietnam, Philippines, Chile, and South Africa) will reach 17%, which is more than double the global average.

Top 7 Emerging Markets E-Commerce Growth



Source: adapted from Morgan Stanley Research 2023 estimates, Euromonitor, National Data Sources

The development of e-commerce is changing the air cargo environment. Demands for fast delivery and decentralization challenge logistics providers and operators to adapt capacity yet remain competitive while taking advantage of current opportunities.

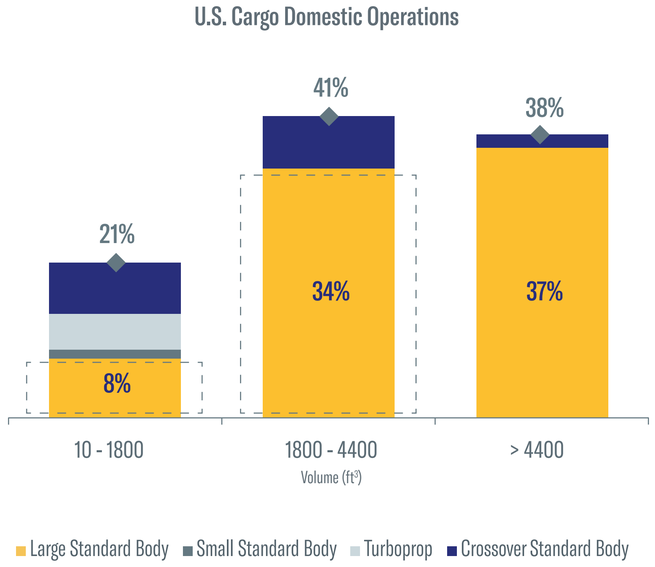
SMALL AND CROSSOVER FLEET ON THE RISE

E-commerce is already changing the profile of cargo carrier fleets. In the last decade, standard-body jets represented around 70% of all passenger-to-freighter (P2F) conversions, compared to 30% in the previous decade. Because of the pandemic, 2022 was the second record year for P2F conversions – 215 in total, with 74% of those being single-aisle aircraft (jets and turboprops).

Such an increase in the supply, however, was not followed by a similar increase in demand. After a phenomenal 2021, CTKs (Cargo Tonne Kilometers) were down by 8% in 2022 compared to the previous year and went below 2019 levels again. This was a direct result of the economic pressures across the globe, such as the risk of recession, high inflation rates, and supply chain disruptions.

Since the last decade, single-aisle aircraft are gaining relevance in the cargo market. Within that segment, there's still a gap between turboprops and larger standard-body jets. That gap is ideal for small and crossover standard-body jets, and the current economic growth and decelerating demand is yet another argument in favor of the segment.

In fact, when it comes to US domestic cargo operations in the last two years, large standard body jets are being sub-optimally deployed. A crossover standard body jet would be the best choice for any flight carrying between 1,800 and 4,400 cu.ft of freight. In fact, 41% of all cargo flights carry that payload volume yet 79% of those flights use large standard-body jets.



Source: US Bureau of Transportation Statistics, T-100, 2021-2022 H1 flights

Bridging this capacity gap is essential to successfully addressing the needs of e-commerce. Since jets fly faster than turboprops, they can reach more distant destinations, add essential additional time-on-ground for loading, and keep up with market growth. They can replace or complement larger standard-body jets in reaching decentralized regions because they can offer more competitive costs per trip. Larger aircraft may offer too much capacity, especially in off-peak periods.

DATA SOURCES

ALL ANALYSIS DEVELOPED USING DATA FROM:

- *S&P Global IHS Markit*
- *The Economist, OECD, World Bank, IMF, McKinsey Global Institute, Morgan Stanley Research, Global Trade Alert*
- *OAG*
- *ICAO, IATA*
- *US Census Bureau, US BTS*
- *Sabre*
- *Cirium Fleet Analyzer*
- *Embraer Market Intelligence*
- *Airlines*
- *Seabury Cargo*

REGIONAL DEFINITIONS

- *North America*
- *Latin America (includes Mexico & Caribbean)*
- *Europe (includes CIS & Israel)*
- *Africa*
- *Middle East (includes Egypt & Turkey)*
- *Asia-Pacific (includes China)*

AIRCRAFT SEGMENTATION

UP TO 150-SEAT AIRCRAFT:

- *Turboprops: ATR42/72, DHC8-100/200/300/400, EMB-120, Saab 340/2000, MA 60/600/700, II114, Fokker 50, D328, TBD TP*
- *Regional Jets: ERJ 135/140/145, CRJ 100/200/550/700/900, E170/E175/E175-E2, Fokker 70, AVRO RJ70/85, ARJ21-700, TBD RJ*
- *Crossover Jets: E190/E195/E2, CRJ1000, SSJ100, Fokker 100, AVRO RJ100, BAe 146-300, 737-200/300/500/600/700, 717, 737 MAX7, MD-87, A318, A319, A319neo, A220-100/300, MC21-200, TBD Crossover Jet*

For more information, please visit: ***www.embraercommercialaviation.com/marketoutlook***

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BANGKOK, THAILAND