

# MARKET OUTLOOK 2022



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## MESSAGE FROM ARJAN MEIJER

### “CONNECTIVITY IS AT THE CORE OF GLOBAL TRADE”

When the pandemic finally began to fade, people hoped they could relive the good old days of 2019. Yet the fallout from covid is preventing a quick return to those boom times. High inflation, supply chain disruptions and staff shortages are hitting everyone hard. Aviation is feeling those effects too, and they're delaying the industry's recovery. Airlines that couldn't fight the covid storm perished. With fewer seats, the escalating price of crude oil and jet fuel, huge pent-up demand for air travel, and the Ukraine-Russia conflict, airfares began to rise. The pilot shortage in the USA and staff shortages in Europe forced many flights to be cancelled in high season. That has had an impact on ticket prices and is discouraging many

people from flying. Yet air travel connects people and is an engine that drives global trade. Such connectivity powers development and progress. Fewer people flying produces weaker economic activity and lower growth rates. Right now, airlines have a lot on their plates. They are restructuring to keep connectivity levels while sustaining their margins by rehiring staff, adding greener airplanes, and investing in training. The global trends in last year's market outlook remain solid: digitalization and work-from-home are driving people away from big urban centers and reducing demand for corporate travel. Environmental pressures are stronger than ever, and new products are being created to achieve net-zero

emission commitments. Regionalization is restructuring supply chain strategies. These things are encouraging consumers and industry players to be more prudent in how they manage their resources. This has tremendous implications for the types of aircraft that will fly in this new, emerging environment. Regional aviation is key in paving the way for a more

sustainable and connected aviation industry. I hope you enjoy reading our Market Outlook 2022 in which we examine the present to predict the future direction of commercial aviation.



**Arjan Meijer**  
President & CEO  
Embraer Commercial Aviation

A handwritten signature in black ink, appearing to read 'Arjan Meijer', written over a white background.

# EXECUTIVE SUMMARY



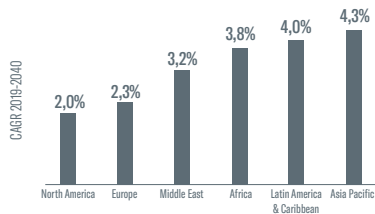
## AIR TRANSPORT DEMAND FORECAST: RPK GROWTH RATES BY REGION

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 2041. 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 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 4.3% annually. This will be followed by Latin America (4.0%), Africa (3.8%), the Middle East (3.2%), Europe (2.3%, including CIS) and North America (2.0%).

WORLDWIDE AIR TRANSPORT DEMAND GROWTH: 2019-2041



Source(s): Embraer Market Analysis

World RPKs will reach 17.3 trillion by 2041. 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.

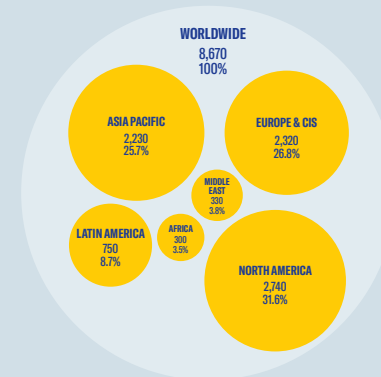
## THE UP TO 150-SEAT MARKET

Embraer foresees world demand for 10,950 new aircraft with up to 150-seats over the next 20 years with a market value of USD 650 billion. Replacement of ageing aircraft will account for 57% of all new deliveries while 43% will be used to grow markets.

## THE JET SEGMENT

Smaller aircraft will drive worldwide demand for 8,670 jets up to 150-seat capacity. Of these, 42% will support market growth and 58% will replace ageing aircraft. The trend to smaller aircraft reflects overall lower demand growth, traffic patterns favoring short-haul versus long-haul, an increasing need for flexibility, connectivity, and efficiency, and fleet and network transition to a decarbonized industry through new technology.

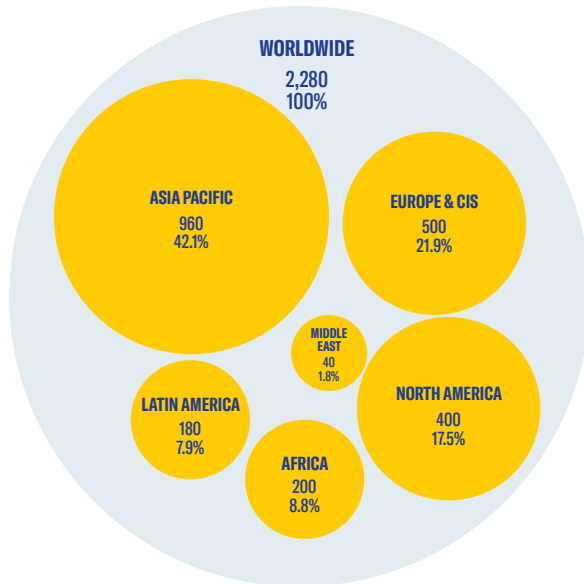
JETS UP TO 150 - NEW DELIVERIES / SHARE OF TOTAL



## THE TURBOPROP SEGMENT

Short-haul operations will drive worldwide demand for 2,280 turboprops, mostly focused in Asia Pacific, Europe, and North America.

TP - NEW DELIVERIES / SHARE OF TOTAL





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# GLOBAL TRENDS



## THE EMERGENCE OF A NEW AIR TRANSPORT SECTOR

The fallout from the global pandemic is transforming air transportation. We're in new territory, again.

Today's air transport system evolved from a profound change in global dynamics. The rise of China, the fall of the Berlin Wall, and the advent of the Internet created the conditions for globalization to transform the world economy. A completely new air transport model had to be developed to support the economies of that new environment.

In 1992, the U.S. introduced its 'Open Skies' policy under which a first new bilateral was signed with the Netherlands. This removed restrictions on gateway access in both markets so that any U.S. carrier and any Dutch carrier was permitted to fly between any point in the USA and any point in the Netherlands. It also removed capacity, frequency and price controls. It paved the way for the creation of alliances and the development of global hubs. New passenger demand beyond the hubs completely changed the demand curve. Airlines had to evolve their strategies to the new landscape.

An efficient air transport system was essential for regions and countries to better capture the opportunities of an economy in full transformation. Deregulation was the tool that accelerated the emergence of a new air travel model. In Europe, for example, the Liberalization Act created the opportunity for Low Cost Carriers to rapidly expand across the continent.

Trends are emerging with new patterns of demand that will give rise to a new air transport model. The forces of regionalization, the opposite of globalization, digitalization of commerce and consumerism in our daily lives, and the push to greater environmental

## THE WORLD CHANGES, AIR TRANSPORT MUST ADAPT



responsibility in every sector of the economy mark the beginning of a new era in air transport.

The Russia-Ukraine conflict has profoundly changed the geopolitical landscape, contributed to the slowdown of globalization, and further disrupted supply chains. It almost certainly will accelerate the shift from global to regional sourcing that had emerged from the China-U.S. trade war and pandemic and climate-related events. Greater regionalization means that countries will pursue strategic autonomy, prioritizing investment and growth of their own economies. That economic growth depends on an efficient air transport system. In turn, that efficiency increasingly depends on internal and external connectivity.

It's still too early to tell how digitalization will change the world socially, economically, and the way we live. Yet we all know how vital the digital world was in helping us endure quarantines and lockdowns. Nearly three years after the pandemic struck, we're seeing its effects in our daily lives and in business. Corporate travelers, for example, may not be quick to return to the skies.



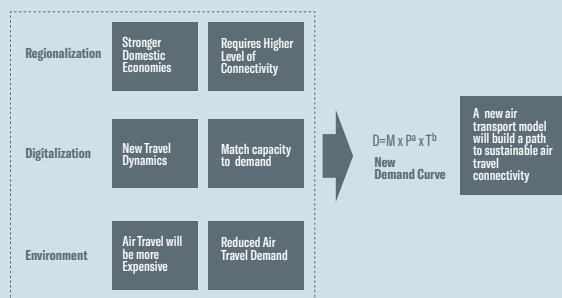
Despite pent-up demand, companies realized tremendous savings by replacing travel with digital meetings. Travel is the third-highest controllable corporate expense after salaries and sales & marketing costs. Those savings went straight to the bottom line.

Airlines will need to adapt to serving fewer high-fare business passengers by matching capacity to demand while still offering a sufficient number of daily flights.

But it is the environment that has the most focus among industry stakeholders. The 2050 target is set and there is a clear roadmap to reach emissions and sustainability goals in the medium and long terms. Technology, Air Traffic Control, SAF availability, economic contributions – all of these are mapped yet not all are resolved.

The new post-pandemic environment is leading towards weaker demand for more expensive air travel. From 2022 to 2030, airlines will need to adapt their fleet strategies to satisfy the new demand profile, build a path to sustainability, and be ready for a low-carbon future.

### NEW TRENDS ↔ NEW DYNAMIC ↔ INDUSTRY TRANSITION

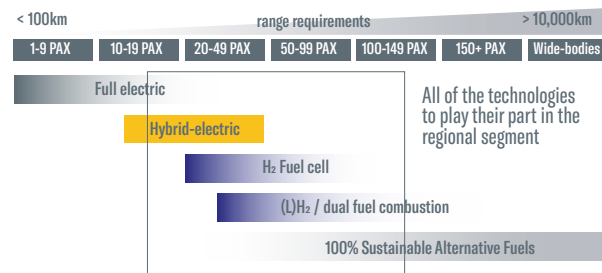


$D = M \times P^a \times T^b$ , where  $D$  = Demand,  $M$  = market sizing parameter that represents underlying population and interaction between cities,  $P$  = average price of air travel,  $T$  = total trip time, reflecting changes in frequency,  $a$  &  $b$  = price and time elasticities of demand.

## REGIONAL SEGMENT TO LEAD THE TECH REVOLUTION

Regional Aviation will have a key role in the path to a low-carbon industry. New programs will tend to focus on smaller capacity aircraft to refine applications for new technologies.

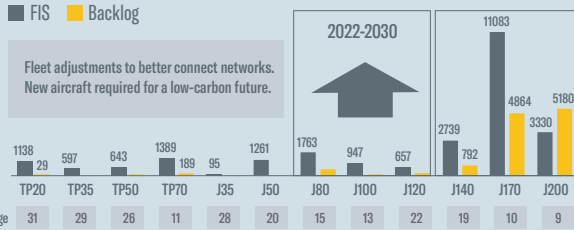
### HIGH-LEVEL MAP OF THE MOST PROMISING TECHNOLOGIES PER SEGMENT (2025-2050)



The current world fleet-in-service is unprepared for the transition to new technologies. It is dominated by large narrow-bodies. From 2022 to 2030, airlines will need to adopt more flexible fleets, adding more 80 to 120-seat jets to better match capacity to demand and ensure a high degree of network connectivity.

## FIS UNPREPARED FOR TECHNOLOGICAL TRANSITION

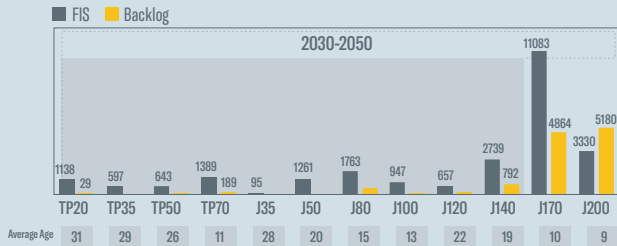
Network adaptation will be required



Source: Cirium, 2022

From 2030 to 2050, new zero-emissions aircraft will be added to airline fleets. Regional aviation will play a key role in operating these aircraft and will drive the air travel sector to sustainable connectivity.

## TOWARDS A SUSTAINABLE AIR TRAVEL



Source: Cirium, 2022





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# AFRICA

Chefchaouen, Morocco

# /KEY MESSAGES

- Regional aircraft powers business in Africa:** In 2019, 85% of markets with more than 3 daily frequencies were operated by up to 150-seat aircraft. Since 2010, 94% of new markets with at least one daily frequency were launched with aircraft in this same segment.
- All set to grow:** The up to 150-seat fleet supports achieving healthy load factors on thin routes, boosting connectivity with more frequencies, and introducing new destinations.
- Sustainability in aviation to bring opportunities in Africa:** Replacing aging aircraft by more efficient and sustainably powered aircraft is key for Africa to achieve its net-zero goals.

## Economic & Traffic Growth 2019-2041

|             |             |
|-------------|-------------|
| GDP         | RPK         |
| <b>3.2%</b> | <b>3.8%</b> |

## New Deliveries 2022-2041

|                      |             |                   |
|----------------------|-------------|-------------------|
| Up to 150-Seat Jets: | TurboProps: | 150-210 Seat NBs: |
| <b>300</b>           | <b>200</b>  | <b>340</b>        |

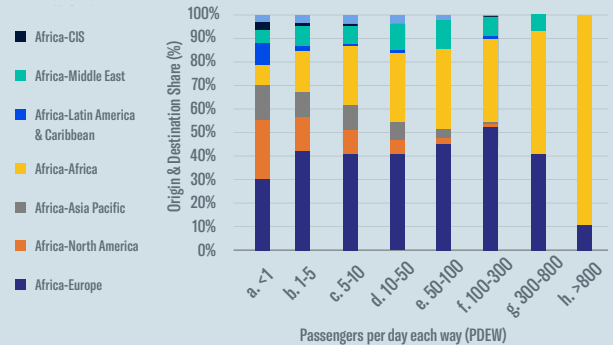
## FLEET IN SERVICE - UPTO 150

|            |              |
|------------|--------------|
| 2019:      | 2041:        |
| <b>760</b> | <b>1,193</b> |

While the global trends of reshoring and deglobalization can reduce African manufacturing jobs, the environmental agenda promoting green energy may benefit Africa because of the continent's ability produce hydrogen and solar energy.

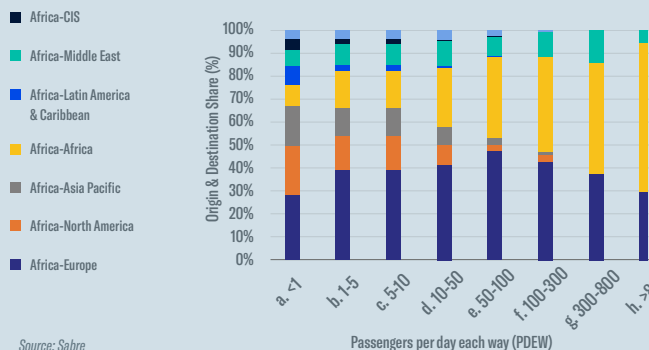
Between 2010 and 2019, carriers from the Middle East and Europe grew their share and accounted for a high proportion of daily high-density African O&D traffic flown. A trend to greater regionalization may reduce the Africa Europe share. However, geopolitical forces associated with the Russia-Ukraine conflict may bring new business opportunities to African countries as Russia seeks export markets beyond the northern hemisphere.

## AFRICAN ORIGINATED MARKETS PROFILE - 2010



Source: Sabre

## AFRICAN ORIGINATED MARKETS PROFILE - 2019



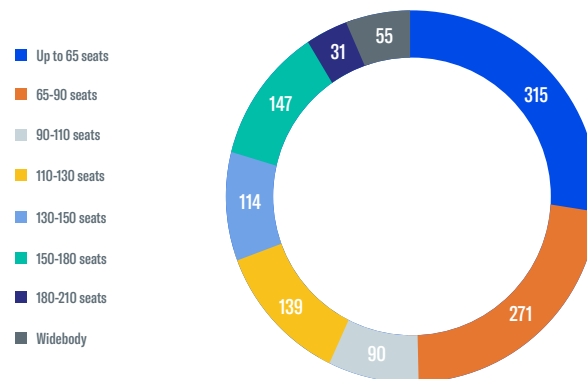
Source: Sabre

African aviation has enormous potential to grow intra-regional markets in the future. Access to air travel is still not for the masses. Implementation of partnership initiatives on the continent can change that by opening new routes, with more flight frequencies, more direct flights, and lower fares.

The use of small aircraft was borne from Africa's lack of infrastructure. However, the current fleet distribution seems ideal for improving the continent's connectivity. Of all new markets established in Africa between 2012 and 2019, 54% were operated with aircraft with 150 seats or fewer. That number grows to 84% if only new intra-African markets are considered.

In 2019, about 80% of intra-African markets were flown by up to 150-seat aircraft. Those same aircraft served 85% of those markets with more than 3 daily frequencies. By comparison, intra-North America numbers were, respectively, 78% and 75%; intra-LATAM 69% and 63%; intra-Europe 30% and 44%; and intra-China 30% and 17%.

## AIRCRAFT SIZE DOMINANCE IN INTRA-AFRICAN MARKETS

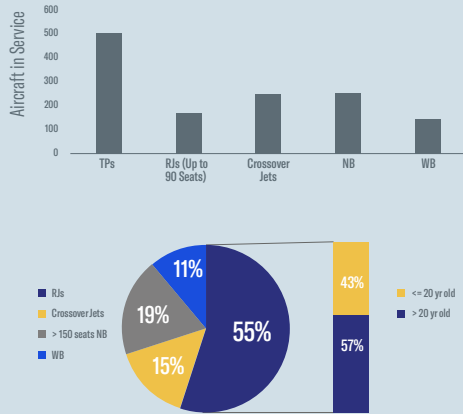


Source: Sabre

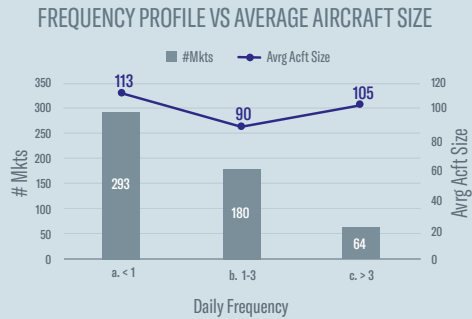
45 of the 48 new markets opened between 2011 and 2019 with more than three daily frequencies were flown with up to 150-seat aircraft. Of the new markets with one or more flights, 94% started operations with aircraft in that segment.

The African commercial fleet is in a sweet spot to transition to renewable-energy powered airplanes because of the average aircraft size and age. New propulsion technology will initially target regional aircraft (55% of the total African fleet). 57% of the fleet in this segment is 21 years of age or older.

## AFRICA FLEET PROFILE



Source: Cirium Fleet Analyzer - May, 2022



Source: Sabre



Medina, Morocco



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# CHINA & ASIA PACIFIC



Ho Chi Minh, Vietnam

# /KEY MESSAGES

- / GDP and RPK growth forecasts for APAC are one of the strongest until 2041, but the Russia-Ukraine conflict puts recovery at risk, with increasing inflation and further destabilization of supply-chains.
- / Still immense potential for connectivity: a huge portion of domestic and intra-regional markets remain underserved with less than one daily flight, while many pockets of growth are still untouched. Companies will need to rethink their fleet strategy to exploit these opportunities without compromising profit.
- / To achieve sustainability goals, governments are requiring airlines to further maximize operational and fleet fuel efficiency in the short-term, while asserting the economic importance of connectivity.

## Economic & Traffic Growth 2019-2041

|             |             |
|-------------|-------------|
| GDP         | RPK         |
| <b>3.6%</b> | <b>4.3%</b> |

## New Deliveries 2022-2041

|                      |             |                   |
|----------------------|-------------|-------------------|
| Up to 150-Seat Jets: | TurboProps: | 150-210 Seat NBs: |
| <b>2,230</b>         | <b>960</b>  | <b>6,765</b>      |

## FLEET IN SERVICE - UPTO 150

|              |              |
|--------------|--------------|
| 2019:        | 2041:        |
| <b>1,768</b> | <b>3,346</b> |

After the vaccine rollout, the world saw more optimistic scenarios throughout 2022 and forecasted better economic perspectives for the future. The sustainability movement has developed clearer goals and stronger momentum, while supply-chains are still fighting to solve the problems caused by continuous disruptions, evaluating a more 'just-in-case' strategy instead of the traditional 'just-in-time.'

But what will be the future of Asia-Pacific, the roaring economic tiger that was chained during the pandemic?

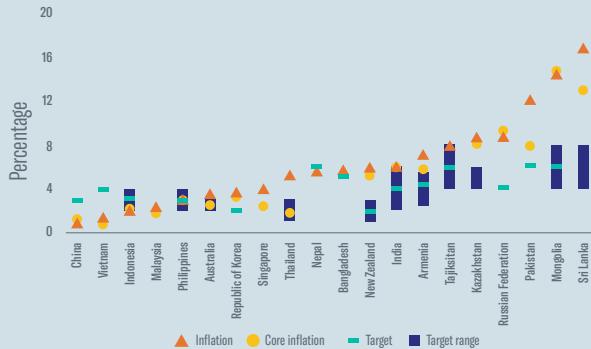
A projected 3.6% GDP CAGR between 2019 and 2041 indicates the region is only behind China in economic potential. Transportation links and connectivity are fundamental to satisfy the expected CAGR growth in RPKs of 4.3%.

The consumer map is being redrawn. Over 3 billion people are projected to join the consumer class by 2030, gradually spending more on leisure, communication, and transportation. E-commerce has grown more than any other retail channel, while already-strong Asian brands gained even more share, which is reinforcing the trend to reshoring and nearshoring. Among all of these trends, governments and private companies will face the same challenge: maximize resiliency, efficiency, and sustainable connectivity.

The Russia-Ukraine conflict is dampening recovery with increasing fuel-prices, commodity shortages, airspace restrictions, and putting further pressure on supply chains. For Asia, this is reflected in increasing inflation and calls for central banks to review monetary, fiscal, climate, and debt policies to reduce stagflation risks.



## INFLATION SURPASSED TARGETS IN MANY COUNTRIES IN THE REGION



Source: CEIC (accessed on 4 March 2022) and Central Bank News, CentralBankNews.info.  
Note: Inflation and core inflation are for the latest month available between December 2021 and February 2022.

The Asia-Pacific aviation industry has a critical role to play in this challenge. For a strong economic backbone, domestic markets must be rethought, built around a strategy that withstands cyclical variations and allows financially healthy growth yet without compromising net-zero emission goals. Because of increased digitalization, development of secondary markets and hub-feeding will be essential to connect the growing number of people living in urban areas (up to 55% in the coming years). Connectivity is fundamental to the economic power of Asia's top 250 cities.

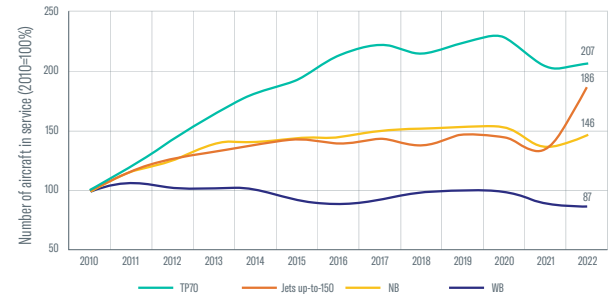
These new connectivity requirements and opportunities must also consider the necessity for infrastructure improvements. In countries such as India and Vietnam, major hubs are becoming heavily

saturated, limiting further market expansion if no regional airport investments are to be made. As economies fully recover and the middle-class increases, the lack of regional infrastructure becomes more apparent.

## Australia and Pacific Islands

Airlines in Australia and the Pacific Islands took strategic action to increase connectivity. They added 100-seat jets to make that capacity segment the highest growing (26%) since 2019. The number of 70-seat turboprops has more than doubled since 2010, giving passengers better access to secondary markets.

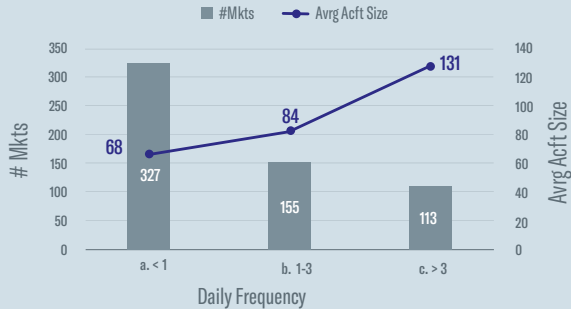
## FLEET IN SERVICE EVOLUTION



Source: Sabre

Even with these additions, over 50% of all intra-regional markets still offer less than one daily flight, an indication of the untapped potential of low-density markets. More regional jets and turboprops would open new routes, with lower risk and historically higher yields.

## FREQUENCY PROFILE VS AVERAGE AIRCRAFT SIZE



Source: Sabre

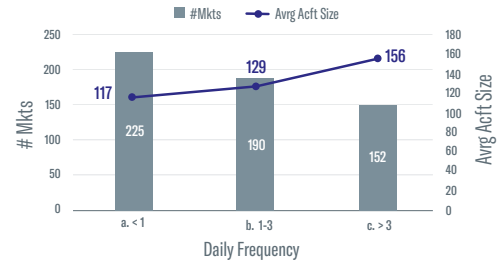
On sustainability, Australia's domestic aviation emissions are being addressed by safeguard mechanisms and the Emissions Reduction Fund. The government's ERF incentivizes businesses to cut the volume of greenhouse gases they create through upgrading equipment and improving productivity. This applies to airlines that could further upgrade their fleets for newer, more fuel-efficient, right-sized aircraft.

## SAARC

Among all Asia-Pacific regions, SAARC countries have traditionally led GDP and RPK growth projections. GDP is projected to grow 5.0% CAGR while RPK growth is even more optimistic, 6.4% CAGR, between 2019 and 2041. India, Bangladesh, and Nepal are currently the top economic performers.

Domestic and intra-regional airline traffic increased steadily from 2010 to 2019 thanks to the expansion of LCCs, yet connectivity is still an issue. Over 40% of intra-regional markets have less than one daily flight served with aircraft with an average of 117 seats. Airlines have ample opportunity to optimize operations. India, as the top economic performer, should open new routes to connect secondary markets and bypass congested hubs, adding nonstop flights and frequencies with higher-yielding fares.

## FREQUENCY PROFILE VS AVERAGE AIRCRAFT SIZE



Source: Sabre

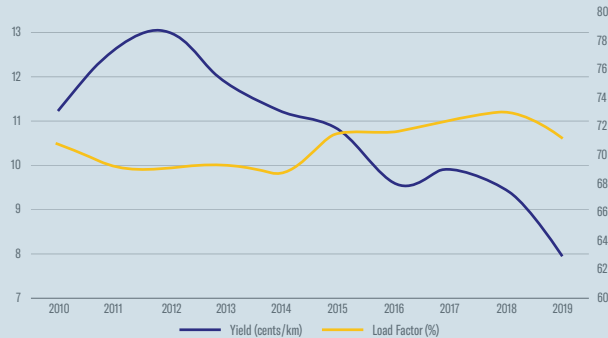
India is taking steps towards SAF production so that it can develop potential markets without compromising the aviation industry's zero-emissions goals. The country is well-positioned to be a leading SAF producer given its access to feedstocks and low-cost solar energy. India could get a good head start on economic development and emission reduction. Airports are expected to monitor their carbon emissions and lead the way with green initiatives. Airlines should focus on operational efficiency and a well-developed fleet strategy.

## ASEAN

Air transport has played an important role for ASEAN countries in accelerating and integrating economies since the Sectoral Integration Protocol for Air Travel was announced in 2004. Air connectivity promotes trade and tourism, major economic drivers, which were heavily impacted by restrictions imposed by countries during the pandemic.

Capacity, measured in ASKs, grew robustly from 2012 (346.92 b) to 2019 (604.19 b). Yields, conversely, declined by 40% in the same period even though load factors remained steady at approximately 73.2%.

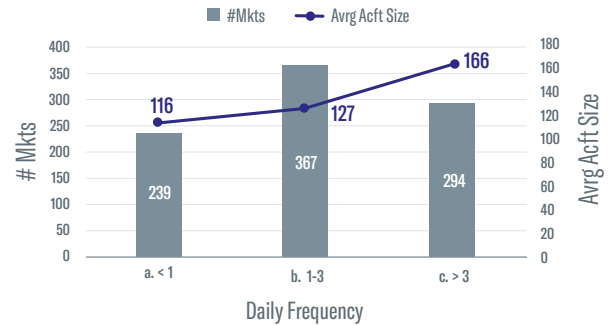
YIELD AND LOAD FACTOR EVOLUTION IN ASIA-PACIFIC



Source: Sabre

Many markets are still underserved - over 200 of have less than one daily flight using an aircraft with an average of 116 seats. Both smaller jets and high-capacity turboprops could fully unlock this potential while increasing operating margins.

FREQUENCY PROFILE VS AVERAGE AIRCRAFT SIZE

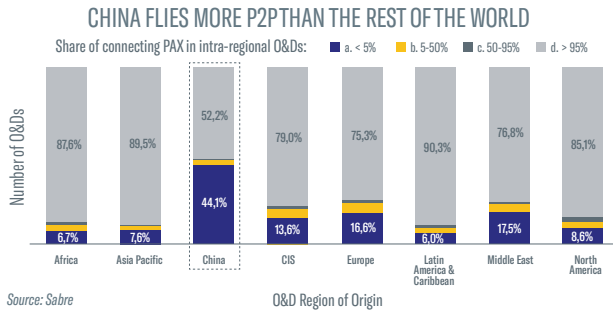


Source: Sabre

Sustainability targets pose new challenges. The aviation industry is required to have higher fuel and flight efficiency by 2030. It must develop decarbonizing technologies in order to transition to 2050's zero-emission goals as described in the ASEAN State of Climate Change Report.

## China

Air travel in China has boomed in the past decade. The number of new O&Ds in 2019 was 62% higher than in 2010. Moreover, the number of high-volume O&Ds (greater than 100 PDEWs) was 149% higher in the same period. However, China adopted a point-to-point strategy to expand its air network. Although it may be easier to manage, point-to-point brings disadvantages in connectivity and sustainability.



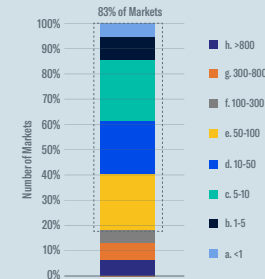
China has focused its efforts on increasing air connectivity locally. Compared to 2010, domestic O&Ds grew 92.5% in 2019 while international O&Ds grew 52.7%. High-volume O&Ds, however, grew evenly (about 150%) for both. From these high-volume O&Ds, domestic markets accounted for 88.4% of the total. Of the remaining 11.6%, O&Ds related to Asia Pacific accounted for 73.8%, North America 11.7%, Europe 8.4%, and the CIS 3.3%.

There is still plenty of room for China to explore thin routes by incentivizing demand in lower-volume PDEW markets. In 2019, about 83% of China's domestic network was concentrated in mid or high-

density markets. Lower demand second and third-tier cities are yet to be targeted.

The Chinese government has been supporting development of the western region and expansion of service to markets that sit at high elevations. These are thin routes that require specific aircraft performance capabilities. Regional aircraft seem ideal to fly these new routes and meet these requirements with high frequency, high payload, and healthy load factors.

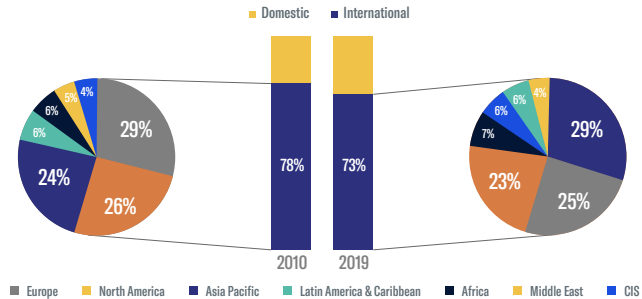
## CHINA DOMESTIC PDEW CLASS DISTRIBUTION



China-originating O&Ds across the globe also changed from 2010 to 2019. Asia Pacific surpassed North America and Europe to become the region with the most O&Ds. Africa and the CIS surpassed Latin America.

The four regions with the highest O&D growth were CIS (111%), Asia Pacific (83%), Africa (76%) and Latin America (49%). These were followed by the Middle East (36%), North America (34%) and Europe (33%).

### CHINA INTERNATIONAL O&DS DISTRIBUTION



Source: Sabre

The proportional O&D growth rates clearly reflect China’s recent trade partnerships. The current geopolitical scenario favors the continuation of this growth. The trend to regionalization can further reduce the North American and European shares of the pie.

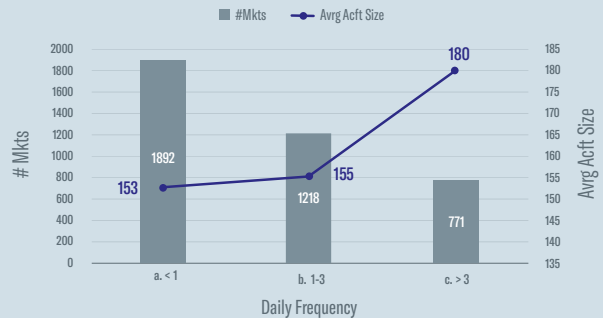
China is focused on expanding connectivity across Asia rather than its inter-continental reach. A change to the hub-and-spoke model and exploration of both domestic and international thin routes using right sized aircraft could develop air connectivity exponentially and bring China closer to the efficiency levels of North America and Europe.

The targets for aviation in the Chinese 14th Five-Year Plan seem plausible. The proposed reduction in kilogram emissions per ton-km is 4.5%. The Plan predicts emissions will peak in 2030 and achieve net-zero by 2060. It is a target date beyond those suggested by other very polluting nations. The requirements that come from the environmental agenda call for a more balanced fleet profile in China.

### KEY TARGETS IN THE 14TH FIVE-YEAR PLAN FOR AVIATION (2021-2025)

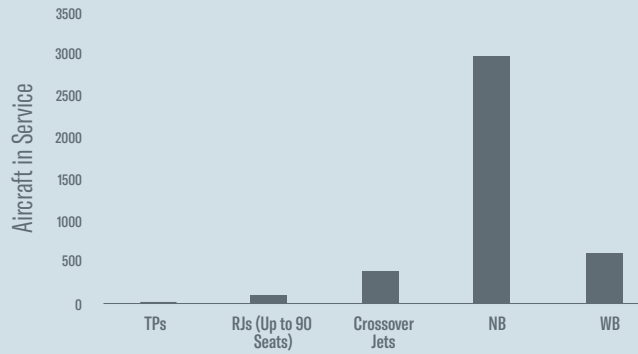
| Targets   | 2020  | 2025     |
|---|-------|----------|
| Carbon emission per ton-km (kg)                                   | 0.928 | 0.886    |
| Energy consumption per passenger in airport (kg standard coal eq) | 0.948 | 0.853    |
| Total turnover (billion ton-km)                                   | 79.9  | 175      |
| Total passengers (million person-times)                           | 420   | 930      |
| Number of civil transport airports                                | 241   | 270      |
| Number of countries connected via air routes                      | 62    | Above 70 |

### INTRA FAR EAST ASIA FREQUENCY PROFILE VS AVERAGE AIRCRAFT SIZE



Source: Sabre

## CHINA FLEET PROFILE



Source: Cirium Fleet Analyzer as of May, 2022



Lhasa, Tibet

# EUROPE & CIS



# /KEY MESSAGES

Small aircraft will build the sustainable air travel in Europe.

- / Addressing the path to sustainable connectivity: emission reductions can be achieved without compromising connectivity efficiency. Matching capacity to the new demand curve is key to building sustainable mobility.
- / Technology-driven fleet transition: current fleet-in-service is unprepared for the new market dynamics and for the technological transition. A new fleet profile will be an additional source for helping the industry achieve sustainable profitability.
- / Regional aviation will be redefined and lead the path to sustainable air travel: the current network will need to adapt to a more balanced fleet. The transition phase will benefit the connectivity efficiency of intra-Europe traffic which is mostly served by low-frequency large narrow-bodies.

## Economic & Traffic Growth 2019-2041

|             |             |
|-------------|-------------|
| GDP         | RPK         |
| <b>1.3%</b> | <b>2.3%</b> |

## New Deliveries 2022-2041

|                      |             |                   |
|----------------------|-------------|-------------------|
| Up to 150-Seat Jets: | TurboProps: | 150-210 Seat NBs: |
| <b>2,320</b>         | <b>500</b>  | <b>4,240</b>      |

## FLEET IN SERVICE - UPTO 150

|              |              |
|--------------|--------------|
| 2019:        | 2041:        |
| <b>2,396</b> | <b>2,990</b> |

Connectivity is essential for a robust European commercial airline network and its ability to become more environmentally sustainable and resilient to future crises. It will be even more essential as the EU focuses on becoming stronger domestically and on building its strategic autonomy. Current connectivity is composed of hub and spoke and point-to-point operations.

Hubs have different roles. Primary hubs like Frankfurt (FRA) and Amsterdam (AMS) serve huge volumes of O&D traffic. Small hubs, like Warsaw (WAW), are essential in facilitating access. FRA, AMS and WAW serve different market densities with different fleet strategies which results in different levels of connectivity. Generally, the smaller the average aircraft size, the higher the average daily frequency.

Any proposal to consolidate frequencies in order to reduce emissions and adjust for lower demand would impact the hub system. Service to many low-density markets (< 300 daily passengers) would be cancelled and daily frequencies reduced. In Frankfurt, for example, approximately 47% of the 55 low-density markets that are served with 1.4 daily flights could be cancelled. Accordingly, any frequency reduction would diminish the ability of a hub to process flows of connecting passengers.



### CONNECTIVITY LEVEL ↔ DIFFERENT MARKET DEMAND SIZES

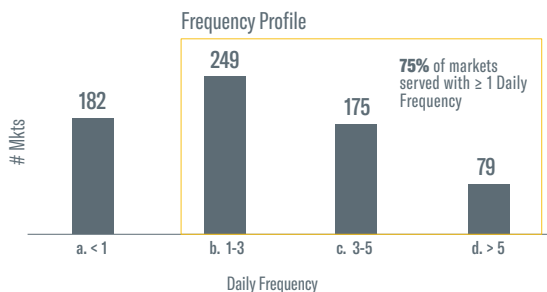
| Hub | # ODs  | %CNX | Avg Acft Size | < 300  |            | 300-800 |            | >800   |            |
|-----|--------|------|---------------|--------|------------|---------|------------|--------|------------|
|     |        |      |               | # Mkts | Daily Freq | # Mkts  | Daily Freq | # Mkts | Daily Freq |
| FRA | 10,500 | 75%  | 160           | 55     | 1.4        | 46      | 4.4        | 7      | 11.5       |
| AMS | 9,700  | 73%  | 130           | 53     | 2.1        | 35      | 4.5        | 4      | 7.3        |
| WAW | 2,500  | 61%  | 100           | 62     | 2.2        | 9       | 6.5        |        |            |

|  |  |  |
|--|--|--|
| Primary airports are responsible for a high degree of air travel mobility.<br>Small airports play a key role in building access to air travel. | Low and medium density markets are better served with mixed fleet.<br>Smaller aircraft allow to more D&Ds to be served with more frequent flights. | Shuttle markets designed for business travelers must offer a high number of daily flights. |
|--|--|--|

Source: Sabre

Today, hubs serve 75% of all markets with at least one daily frequency. This profile would be negatively impacted if frequencies were to be cut.



Source: Sabre

However, capacity constraints at the largest airports, such as FRA and AMS, would naturally result in an increase in average aircraft size. Consequently, low-density markets would not be served by these airports.

Connecting passenger flows in the region would need to be adjusted. Small and medium-density cities would be served through regional hubs which would be configured to support future electric/hybrid 9 to 50-seat regional aircraft and 80 to 120-seat jets.

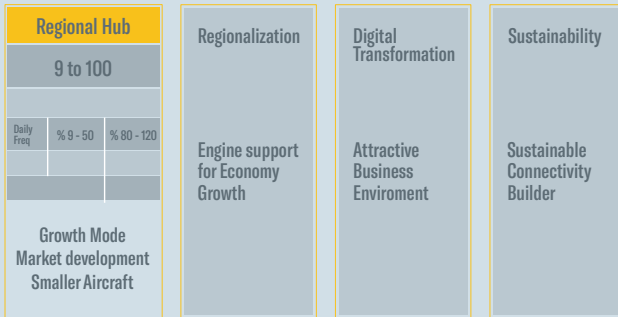
### BALANCED AIRPORT INFRASTRUCTURE | HIGHER CONNECTIVITY

| Hub           | FRA  |            |      | AMS  |            |      | WAW  |            |      | Regional Hub                                    |        |          |
|---------------|--|------------|------|--|------------|------|--|------------|------|---|--------|----------|
| Avg Acft Size | 160  |            |      | 130  |            |      | 99   |            |      | 9 to 100  |        |          |
| Banks         | 5  |            |      | 7  |            |      | 6  |            |      |   |        |          |
|               | Daily Freq   | % Regional | % NB | Daily Freq                                       | % Regional | % NB | Daily Freq                                   | % Regional | % NB | Daily Freq                                      | % 9-50 | % 80-120 |
| <300          | 1.4  | 60%        | 40%  | 2.1  | 78%        | 22%  | 2.2  | 92%        | 8%   |   |        |          |
| 300-800       | 4.4  | 15%        | 85%  | 4.5  | 43%        | 57%  | 6.5  | 88%        | 12%  |   |        |          |
| >800          | 11.5   | 100%       |      | 7.3  | 20%        | 80%  |  |            |      |   |        |          |
|               | Primary Airport Capacity Constraints Larger Aircraft |            |      | Primary Airport Capacity Constraints Mixed Fleet |            |      | Growth Mode Market Addition Smaller Aircraft |            |      | Growth Mode Market development Smaller Aircraft |        |          |

Source: Sabre

Regional hubs will increase overall system connectivity because they will be able to add more, smaller cities. That can encourage industrial growth across Europe and provide frequent, high-quality air service for business travelers. Most importantly, regional hubs will be the builders of sustainable connectivity with low or zero CO2-emission aircraft operations.

### BALANCED AIRPORT INFRASTRUCTURE | HIGHER CONNECTIVITY



Lindau, Germany



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# LATIN AMERICA



Guanajuato, Mexico

# /KEY MESSAGES

- / Regional hubs to create new demand flows: better connectivity for underserved and new markets and better infrastructure capacity balance.
- / New connecting flows require new fleet profile: dormant demand that is not currently served by a predominant point-to-point network will change air travel dynamics.
- / Regional aviation to create a new connectivity backbone in domestic markets and build the path to sustainable aviation: network expansion prepared for the transition to new technology aircraft and to the low carbon industry.

## Economic & Traffic Growth 2019-2041

|             |             |
|-------------|-------------|
| GDP         | RPK         |
| <b>2.5%</b> | <b>4.0%</b> |

## New Deliveries 2022-2041

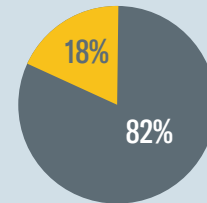
|                      |             |                   |
|----------------------|-------------|-------------------|
| Up to 150-Seat Jets: | TurboProps: | 150-210 Seat NBs: |
| <b>750</b>           | <b>180</b>  | <b>1,500</b>      |

## FLEET IN SERVICE - UPTO 150

|            |              |
|------------|--------------|
| 2019:      | 2041:        |
| <b>876</b> | <b>1,027</b> |

Today, intra South American air traffic is predominantly point-to-point: 82% of all markets carry more than 70% true O&D (true Origin & Destination) passengers.

## PASSENGER FLOW PROFILE

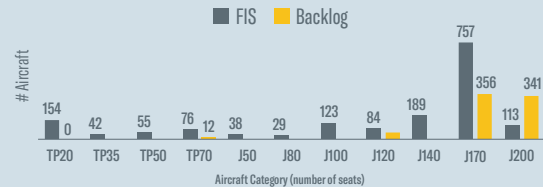


Source: Sabre

■ Non Stop ■ Connecting

The low share of connecting passengers is a direct result of the high proportion of large narrow-bodies in the current fleet-in-service. Small and medium density markets are the most impacted because they don't have enough demand to justify nonstop flights.

## LATIN AMERICA FLEET IN SERVICE

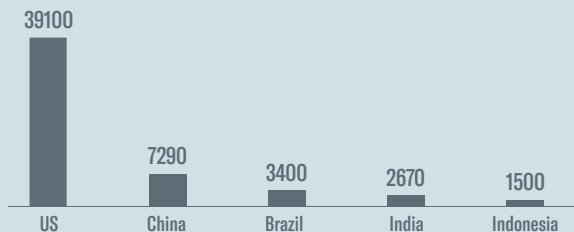


|             |    |    |    |    |    |    |    |    |    |   |   |
|-------------|----|----|----|----|----|----|----|----|----|---|---|
| Average Age | 34 | 29 | 22 | 10 | 22 | 28 | 12 | 25 | 22 | 9 | 5 |
|-------------|----|----|----|----|----|----|----|----|----|---|---|

Source: Sabre

The development of regional hubs is key to the economic development of the region. The potential of O&Ds that can be served through connections is significant. Brazil, for example, has only 8% (3,400) of the O&Ds of the USA (39,100). Even accounting for the difference in the magnitude of economic development, the number is too low.

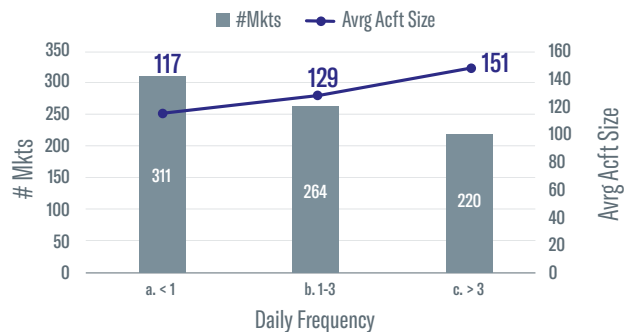
### NUMBER OF ORIGINS AND DESTINATIONS



Source: Sabre

Regional aviation can play a key role by developing local hubs. A low number of daily flights is a function of the high proportion of large aircraft in the Latin American fleet. Regional aircraft can also serve point-to-point markets. There are 311 markets with less than one daily flight flown with an aircraft with an average of 117 seats. Regional aircraft bring additional benefits - lower operating costs and airlines with lower cost structures.

### FREQUENCY PROFILE VS AVERAGE AIRCRAFT SIZE



Source: Sabre



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# MIDDLE EAST



Beirut, Lebanon

# /KEY MESSAGES

- Regionalization may slow down mega-hubs: With companies bringing their factories back, intercontinental traffic tends to decrease. Intra-regional markets are the way to grow.
- Mega-hubs for neighbors and P2P at home: The percentage of intra-regional connecting passengers is low compared to the rest of the world. Connectivity in the Middle East is low - the lack of regional hubs is a contributing factor.

## Economic & Traffic Growth 2019-2041

|             |             |
|-------------|-------------|
| GDP         | RPK         |
| <b>2.4%</b> | <b>3.2%</b> |

## New Deliveries 2022-2041

|                      |             |                   |
|----------------------|-------------|-------------------|
| Up to 150-Seat Jets: | TurboProps: | 150-210 Seat NBs: |
| <b>330</b>           | <b>40</b>   | <b>1,890</b>      |

## FLEET IN SERVICE - UPTO 150

|            |            |
|------------|------------|
| 2019:      | 2041:      |
| <b>257</b> | <b>403</b> |

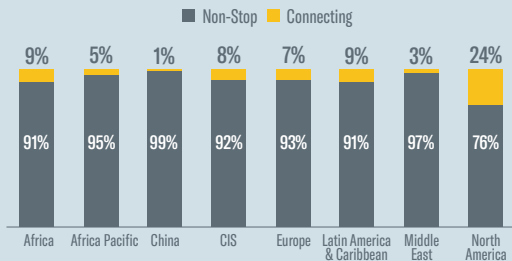
The number of O&D markets in the Middle East grew aggressively until 2014. Since then, it has the characteristics of a mature market. The region's dependence on international traffic makes it susceptible to the volatility and speed of recovery of foreign markets. Intra-regional traffic is weak and lags far behind the rest of the world. Only 13% of the Middle East's 2019 O&D markets was intra-regional. Of international markets, 70% of passengers originated in only five countries - 19.6% from Saudi Arabia, 18% from UAE, 13.6% from Egypt, 11% from Turkey, and 7.8% from Kuwait.

According to IATA, demand (RPK) recovery in the Middle East was still modest at -34.4% compared to 2019, yet better than Asia Pacific (-68.1%) and Africa (-44.7%). Part of the reason is that about 35% of Middle East passengers originate in or are destined to Asia.

The number of passengers connecting in the Middle East on inter-regional O&Ds in 2019 was 2.2 times the 2010 volume. Of total world inter-regional O&Ds with a single connection, 17% connected in the Middle East in 2010. This number jumped to 25.2% in 2019. The number of passengers flying intra-regional O&Ds was double that of 2010.

For a region known for its mega-hubs, the percentage of intra-regional connecting passengers is very low compared to the rest of the world. Only China's connecting number is lower: 99% of passengers travel on non-stop flights. This means that the Middle East prioritizes growing its inter-regional hub capacity over incentivizing intra-regional passenger flow.

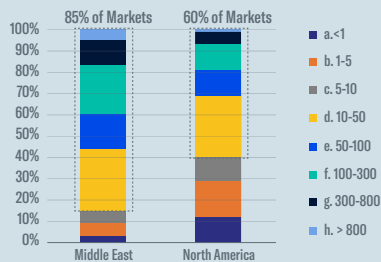
### SHARE OF PASSENGERS CONNECTING IN INTRA-REGIONAL O&DS



Source: Sabre

Emerging global trends, especially regionalization, can play an important role in the Middle East air network. With more companies bringing their factories closer to home, international traffic through Middle East hubs may be adversely affected. At the same time, regionalization may be an opportunity to further explore establishing thin intra-regional routes. For example, 85% of Middle East markets have more than 10 daily passengers each way (PDEWs) while 60% of North American markets, with better connectivity, have the same mid to high-density PDEW volume.

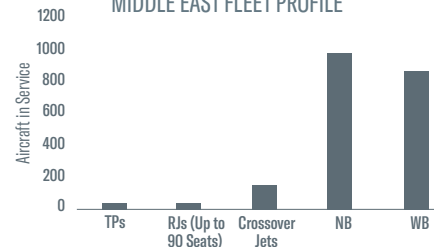
### MIDDLE EAST INTRA-REGIONAL PDEW CLASS DISTRIBUTION



Source: Sabre

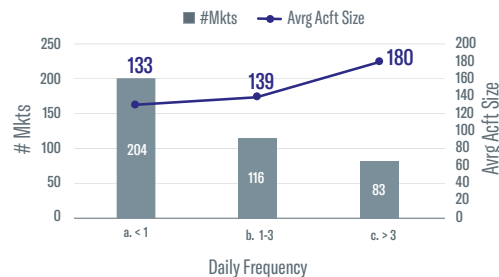
The fleets of airlines in the Middle East and China, by far, face tough challenges to convert to sustainable aircraft. About 89% of the current fleet in the Middle East is comprised of narrowbodies (47%) and widebodies (42%). Using SAF blends alone to achieve environmental targets seems unlikely. Gradual migration to smaller aircraft will be necessary for the region to be in line with the new propulsion technologies that will be the platforms on sustainable aircraft of the future.

### MIDDLE EAST FLEET PROFILE



Source: Cirium Fleet Analyzer as of May, 2022

### INTRA MIDDLE EAST - FREQUENCY PROFILE VS AVERAGE AIRCRAFT SIZE



Source: Sabre





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# NORTH AMERICA



Banff, Canada

# /KEY MESSAGES

- Connectivity at the core: Regional aircraft are the backbone of the region's network; their value was reaffirmed during the pandemic. Their relevance will grow with the need to serve more routes as future demand decentralizes.
- Prepared for the technological transition: Disruptive technologies for zero-emission and pilot work-load reduction will happen first on smaller-capacity aircraft. The region's fleet profile and network are more prepared than other world regions for such a transition.

## Economic & Traffic Growth 2019-2041

|             |             |
|-------------|-------------|
| GDP         | RPK         |
| <b>2.0%</b> | <b>2.0%</b> |

## New Deliveries 2022-2041

|                      |             |                   |
|----------------------|-------------|-------------------|
| Up to 150-Seat Jets: | TurboProps: | 150-210 Seat NBs: |
| <b>2,740</b>         | <b>400</b>  | <b>3,260</b>      |

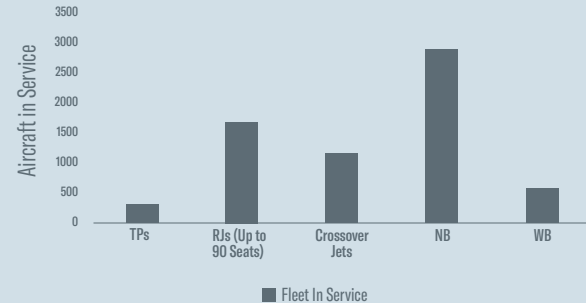
## FLEET IN SERVICE - UPTO 150

|              |              |
|--------------|--------------|
| 2019:        | 2041:        |
| <b>3,927</b> | <b>3,109</b> |

## THE IMPORTANCE OF CONNECTIVITY

A balanced fleet profile has enabled North Americans to be accustomed to connecting from one city to another by air – especially to/from smaller communities. That connectivity, provided by a robust hub & spoke system, is the North American network's most valuable attribute. Regional aircraft are at the core. In 2019, regional aircraft accounted for half of all commercial airline departures in the USA, serving 65% of all airports with scheduled flights.

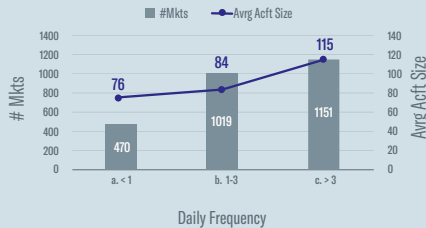
### NORTH AMERICA FLEET PROFILE



Source: Cirium Fleet Analyzer as of May, 2022

The region's balanced fleet not only generates a high degree of connectivity, it also offers high- frequency flights, essential for attracting business travelers. In hub & spoke markets, only 18% have less than one daily frequency, and 44% have more than three. Not surprisingly, the average aircraft size is much smaller than the average of other world regions.

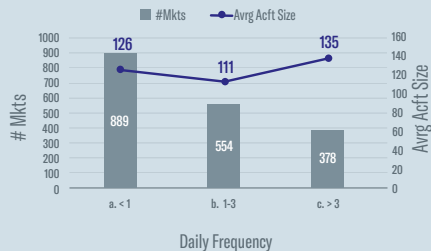
### HUB & SPOKE MARKETS: FREQUENCY PROFILE VS AVERAGE AIRCRAFT SIZE



Source: Sabre

Conversely, in point-to-point markets with few or no connecting passengers, 49% are operated with less than one daily frequency, while only 21% have more than three.

### P2P MARKETS: FREQUENCY PROFILE VS AVERAGE AIRCRAFT SIZE



Source: Sabre

## PERFORMANCE DURING THE PANDEMIC AND A PILOT SHORTAGE

Regional aircraft were essential in maintaining vital links at the onset of the pandemic. Deployment of the fleet contributed to quick recovery of domestic service across the region. By the end of 2021, almost all of the 70 to 76-seat jets were back in service.

However, the quick recovery caused airlines to struggle to find pilots since many were laid-off or took early retirement in 2020. Because of career progression from small to large aircraft, regional carriers tend to be more vulnerable to crew shortages than mainline airlines.

Airlines are already working on solutions - opening new or expanding their own pilot schools and providing tuition financing and loans to new students. In the short-term, until the situation stabilizes, expect the demand for pilots to exceed supply.

The trend to work-from-home and migration of office staff away from large urban centers should raise the attractiveness of regional airports. Some demand may be captured by other modes of transport which, in turn, can impact feed to airline hubs and future air traffic growth.

## LOOKING AHEAD

North America is a good example of the transformative trends in commercial aviation that are emerging in the post-pandemic world. Digitalization is impacting the demand for business travel. Work-from-home affects the frequency and flow of people to corporate offices in large urban centers.

Regionalization means companies will look inward which, in turn, will determine where people will travel. Partners that share political and geographic proximity, such as Mexico, stand to make huge gains as businesses in North and Central America “near-shore” or “friend-shore” supply chains and logistics.

Of paramount importance is the green movement and the decarbonization of industry. Disruptive, zero-emission technologies will be refined on smaller capacity aircraft and may be only feasible on those airplanes in some cases. This will necessitate an industry shift to regional aircraft in the coming decades. Given the region’s current fleet profile and network characteristics, North America, more than anywhere else in the world, is ready for an efficient transition to new-technology aircraft.



A low-angle photograph of a large stack of intermodal containers in blue and orange, with an airplane flying in the sky above. The sky is bright blue with scattered white clouds. The containers are stacked in a way that creates a sense of depth and scale, leading the eye towards the top of the frame where the airplane is flying.

# BONUS CHAPTER: CARGO MARKET OUTLOOK

# /KEY MESSAGES

- / E-Commerce stronger for longer: COVID sharply increased the baseline upon which e-commerce will grow yet growth rates are still expected to be strong.
- / Changing fleet profile: Smaller aircraft are gaining relevance in the cargo industry and there is a gap to bridge between turboprops and large standard-body jets.
- / 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 2022-2041

| GDP         | RTK         |
|-------------|-------------|
| <b>2.6%</b> | <b>4.0%</b> |

## NEW DELIVERIES

Small and Crossover Standard Body Aircraft

|                  |            |
|------------------|------------|
| <b>2022-2041</b> | <b>700</b> |
|------------------|------------|

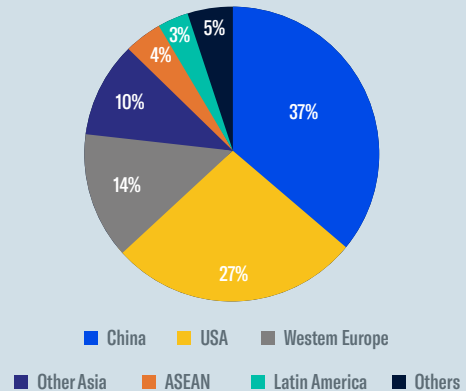
## FLEET IN SERVICE

|            |            |
|------------|------------|
| 2022:      | 2041:      |
| <b>314</b> | <b>711</b> |

## E-COMMERCE LONG-TERM GROWTH

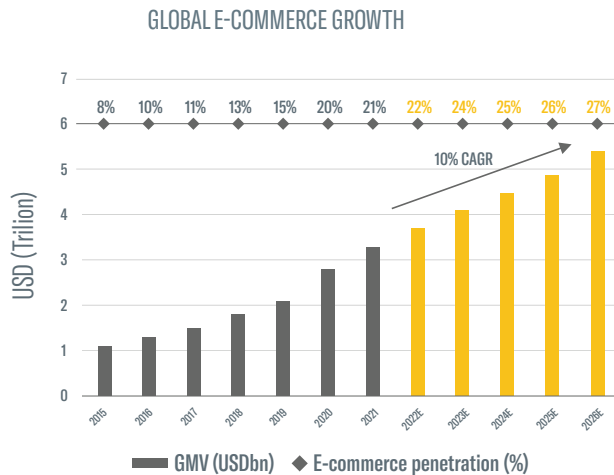
The trend to online shopping and home delivery was already growing over the last decade, but the pandemic triggered a strong uptick that pushed the demand curve even higher. Between 2019 and 2021, global e-commerce Gross Merchandise Volume (GMV) grew an average of 26% per year (CAGR), reaching USD3.3 trillion. In that period, e-commerce penetration of all retail sales jumped from 15% to 21%. In volume, China and the USA are the main drivers of e-commerce growth. Together, they accounted for 64% of the global market in 2021.

GLOBAL E-COMMERCE SHARE BY MARKET (%)



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

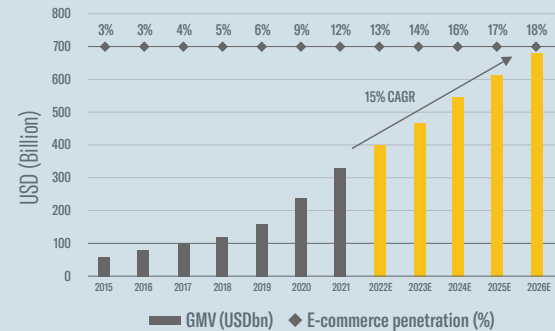
The baseline on which e-commerce will grow increased in 2020 and 2021. Forecasts suggest growth won't stabilize any time soon. Morgan Stanley predicts a GMV of USD 5.4 trillion in 2026 (a 10% per year CAGR), with a penetration of 27% of all retail sales by then.



Source: adapted from Morgan Stanley Research 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 17 contributing countries will reach 15%, which is 50% higher than the global average.

### EMERGING MARKETS E-COMMERCE GROWTH



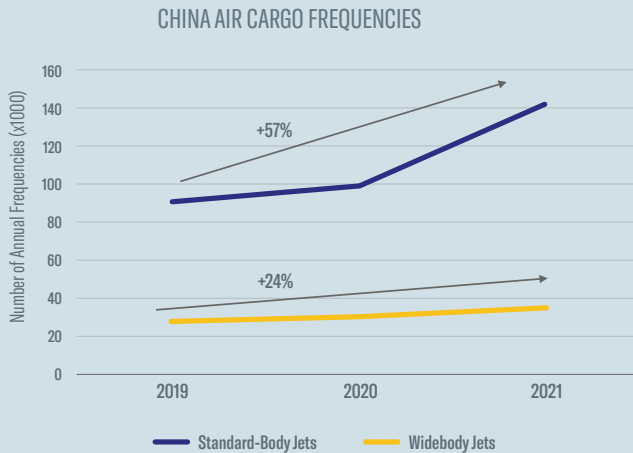
Source: adapted from Morgan Stanley Research estimates, Euromonitor, National Data Sources

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. E-retailers, for instance, are looking for more verticalization in their operations in order to take a bite out of this market.

## A NEW FLEET PROFILE

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, 2021 was a record year for P2F conversions – 140 in total, an all-time high, with 77% of those being single-aisle aircraft (jets and turboprops). 2022 is already on track to beat those numbers.

In China, for instance, the largest market for e-commerce in the world, full-freighter 2019 standard-body jet frequencies increased at much higher rate than those of widebody jets.



Source: Seabury Cargo

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.

Bridging such a 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. In fact, 33% of domestic freighter departures in the USA between 2019 and 2020 were sub optimally deployed with excess capacity.

Naturally, small and crossover standard-body jets can also complement the more traditional uses of air freight, such as the distribution of perishables and high-value items.



## DATA SOURCES

### ALL ANALYSIS DEVELOPED USING DATA FROM:

- / IHS Markit
- / The Economist, OECD, World Bank, IMF, McKinsey Global Institute
- / OAG
- / ICAO, IATA
- / A4A, A4E, CAAs, AEA, ALTA, CAPA, AFRAA
- / CAAC (Civil Aviation Administration of China)
- / Sabre
- / Cirium Fleet Analyzer
- / Embraer Market Intelligence
- / Airlines
- / Seabury Cargo

For more information, please visit:  
[embraermarketoutlook2022.com](http://embraermarketoutlook2022.com)

## REGIONAL DEFINITIONS

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



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