FAA Aerospace Forecasts
Fiscal Years 2023-2043

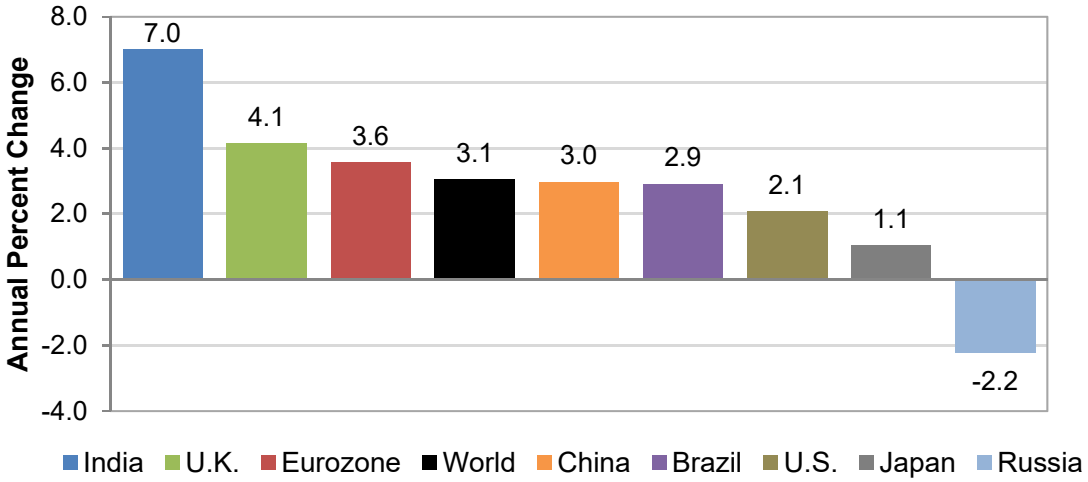
Economic Environment

In 2022, global real GDP expanded solidly as the economic recovery from the effects of the pandemic continued. After surging 6.1 percent in 2021, GDP rose by 3.1 percent in 2022, a rate similar to that over the decade prior to 2019. Despite these two years of strong growth, the level of GDP is not expected to return to its pre-pandemic path for several more years. After providing considerable fiscal and monetary stimulus during the pandemic, countries have turned their attention to controlling deficits and reining in inflation, both of which contribute to moderating GDP growth in the coming years.

In the U.S., real GDP growth slows from 2.1 percent in 2022 to 0.7 percent in 2023 as COVID-19 relief measures wear off, consumer spending normalizes and higher interest rates slow activity. Compared to the U.S., real GDP growth in the European Union plus U.K. was somewhat stronger in 2022 at 4.1 percent but slightly weaker at 0.3 percent in 2023. Aggressive deficit reduction efforts, high energy costs and interest rates all dampen growth in the near-term and combine with the area's lower trend rate. In Japan, border reopenings support exports, particularly to China, as well as inbound tourism that combine with expansionary fiscal policies to produce real GDP growth of 1.2 percent in both 2023 and 2024. Trend growth rates of under one percent return in the second half of the decade as the country's persistent problems of weak consumer spending, and population and demographic trends continue. Although China's growth remained positive through the pandemic, its zero-COVID policy resulted in real GDP growth of just 3.0 percent in 2022, very low for a country that averaged 7.7 percent in the decade ending in 2019. For the remainder of the 2020's, growth is expected to come in at about 5.0 percent weighed down by stalled economic and banking-sector reforms, and high rates of household savings.

In large emerging markets, Brazil's considerable fiscal stimulus was withdrawn in 2022, pulling growth down to 2.9 percent. Growth slows further to 1.7 percent in 2023 due to slowdowns in the U.S. and Europe that restrain exports, tourism and capital flows, as well as from high domestic inflation necessitating high interest rates. Russian growth has turned negative, however, due to Western sanctions. In 2022 it was estimated at -2.2 percent and -2.8 percent in 2023. Positive growth returns in 2024 but remains hampered by the E.U.'s shift to other fuel sources and the similar loss of markets for other exports, in addition to productivity losses due to the departure of Western companies and skilled professionals. India has seen strong support from the unwinding of pent-up domestic demand countered by slowing global growth that moderated exports, resulting in growth of 5.4 percent in 2023. In the medium-term its growth will be driven by favorable demographics including strong consumer spending from growing middle-income households, increasing contributions from the service sectors, and undeveloped natural resources.

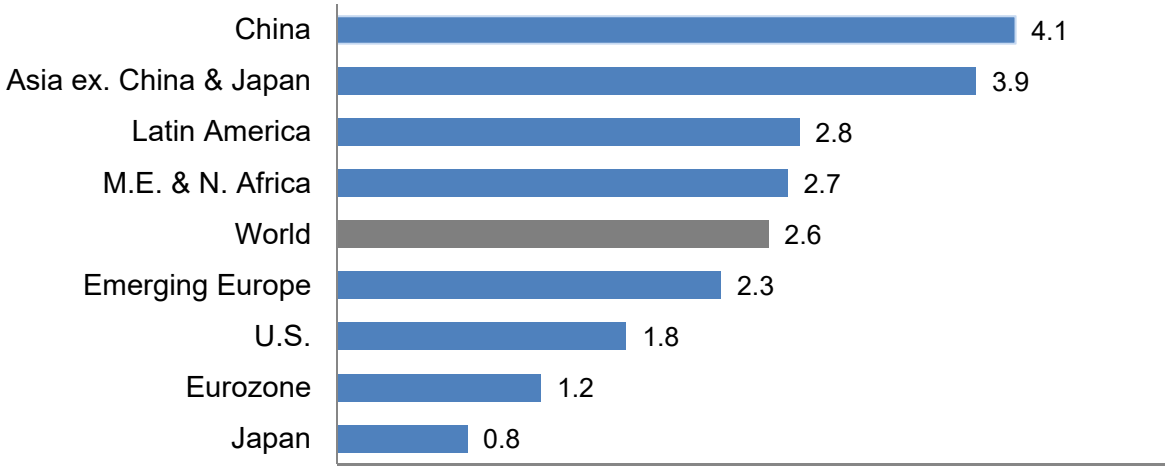
World Economic Growth in 2022



Source: IHS Markit

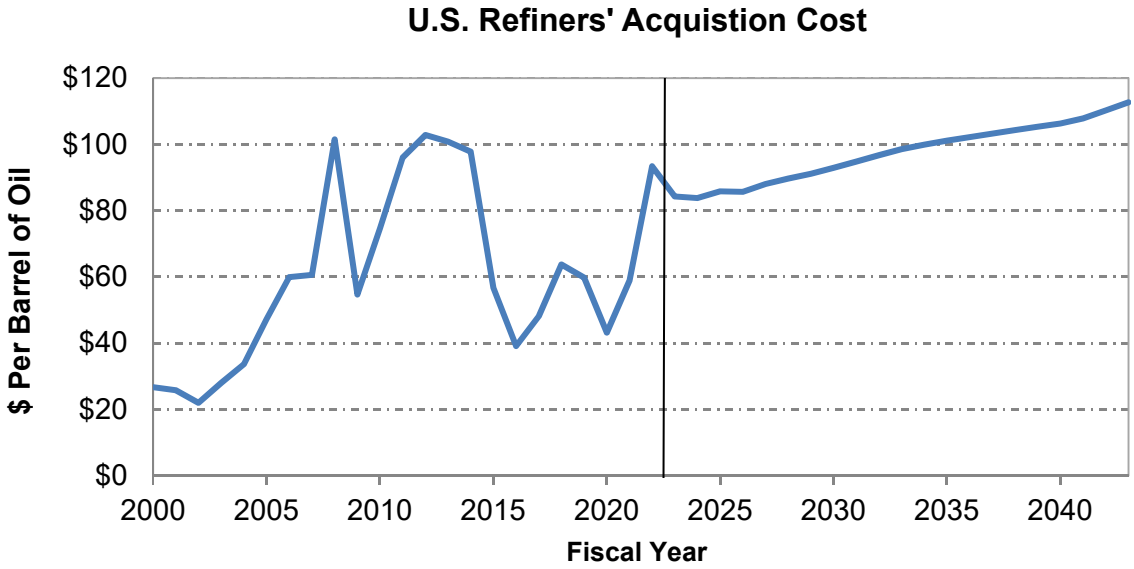
IHS Markit forecasts world real GDP to grow at 2.6 percent a year between 2023 and 2043. Emerging markets, at 3.8 percent a year, are forecast to grow above the global average but at lower rates than in the early 2000's. Asia (excluding Japan), led by India and China, is projected to have the fastest growth followed by Africa and Middle East, Latin America, and Eastern Europe. Growth in the more mature economies (1.5 percent a year) will be lower than the global trend with the fastest rates in the U.S. followed by Europe. Growth in Japan is forecast to be very slow at 0.8 percent a year reflecting deep structural issues associated with a shrinking and aging population.

Asia and Middle East/N. Africa Lead Global Economic Growth
(annual GDP percent growth 2023-2043)



Source: IHS Markit, Jan 2023 World Forecast

Oil spiked to $93 per barrel in 2022 in the wake of Russia's invasion of Ukraine. After receding slightly in 2023, prices remain stagnant for a few years before beginning to climb as economic activity accelerates. Over the long-run, IHS Markit expects the price of oil to increase due to growing global demand and higher costs of extraction. IHS Markit forecasts U.S. refiner's acquisition cost of crude to rise to $113 per barrel at the end of the forecast horizon.



Source: IHS Markit

U.S. Airlines

Domestic Market

Mainline and regional carriers[1] offer domestic and international passenger service between the U.S. and foreign destinations, although regional carrier international service is confined to the border markets in Canada, Mexico, and the Caribbean.

Over the coming years, the commercial air carrier industry will be focused on managing through the aftereffects of the pandemic. Although demand has been returning to 2019 levels, the progress has been unsteady and uneven across segments making it difficult to plan and manage capacity. Furthermore, carriers face numerous factors constraining their ability to add capacity back into networks – factors that will take years to resolve. As predictability returns and balance sheets strengthen, carriers will pay down debt burdens accumulated during the pandemic and transition to more traditional long-term business strategies.

While demand showed more predictability in 2022 than in the previous two years, its strength and characteristics were still not the

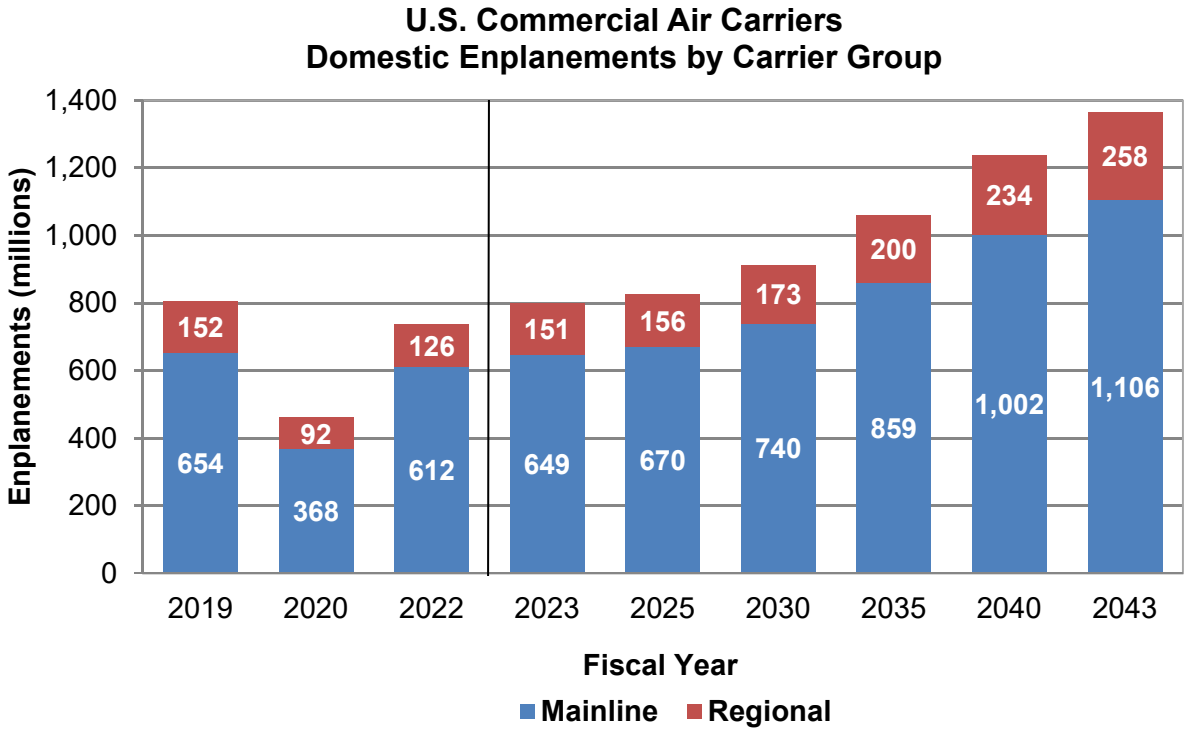
[1] Mainline carriers are defined as those providing service primarily via aircraft with 90 or more seats. Regionals are defined as those providing service primarily via aircraft with 89 or fewer seats and whose routes serve mainly as feeders to the mainline carriers.

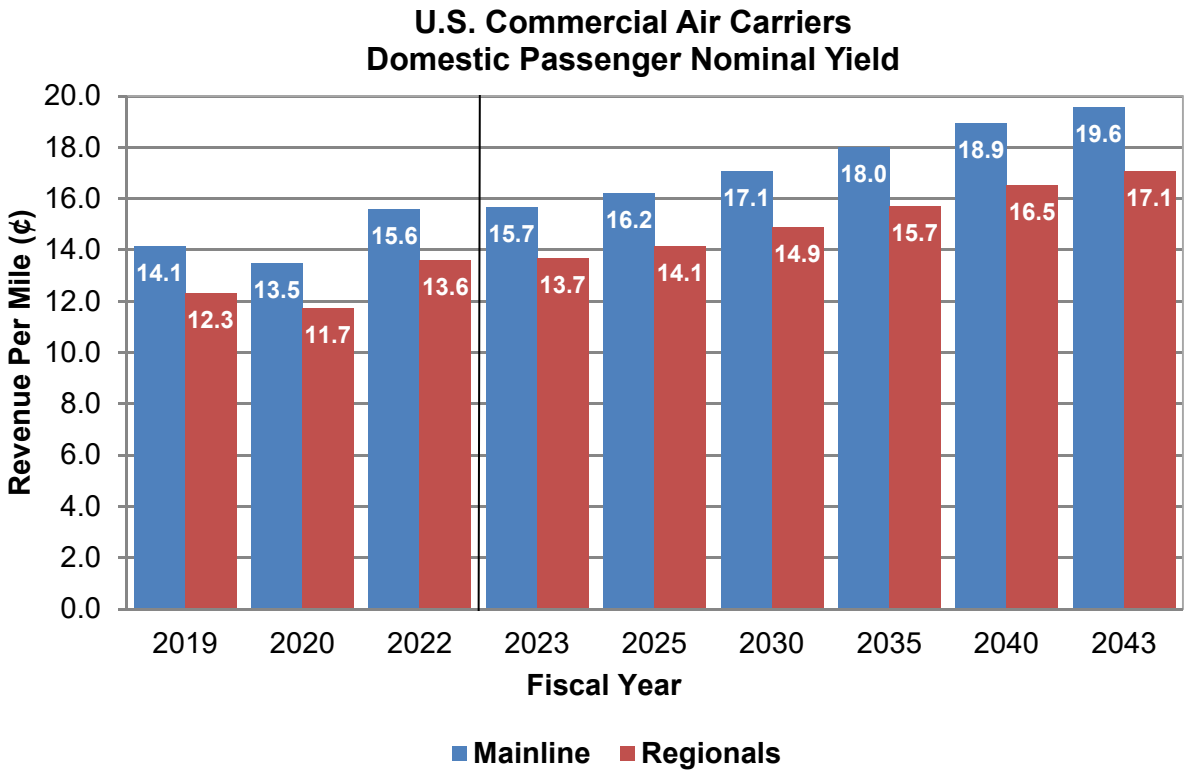
same as in the pre-pandemic environment and it may be years before it returns to that previous normal. Leisure traveler demand is expected to continue as the main driver while business trips remain well below prior levels and are growing only slowly. And although leisure travelers are demonstrating confidence by booking further out from departure, the day-of-week and seasonal patterns have been shifted by an increase in blended leisure and business trips. By geographic region, the altered balance between leisure and business has shifted demand towards medium-sized and sun-belt cities, and away from transcontinental routes and coastal destinations. Overall demand will return to 2019's level in 2023 but its characteristics will not be the same, complicating carrier's ability to capture it.

Air carriers' ability to manage capacity is further complicated by constraints that arose during the pandemic and that will take years to unwind. Hiring and training bottlenecks have left carriers, regionals especially, short staffed for pilots as well as maintenance crews. And even where staffing levels are above where they were in 2019, such as for gate and ramp agents, the large proportion of new hires has lowered productivity. The effects of supply chain disruptions linger, and combined with similar staffing issues, are hampering manufacturers' ability to deliver new aircraft creating years-long backlogs. Finally, under-staffing at a few ATC facilities is limiting the number of aircraft that can be handled in those places. These issues will all be slow to reverse and weigh on the forecast of capacity production for the next three to five years, or possibly longer.

Higher airfares have already resulted from increased labor expenses necessary to attract and retain workers and this elevated spending is expected to be permanent. Beyond that, the industry-wide damping of capacity relative to demand has allowed carriers to pass through other fare increases that are helping to begin paying down debt incurred during the pandemic. Until debt returns to more typical levels, it will act as an additional restraint on investment and expansion.

During the first years of the pandemic, regional carriers suffered very similar consequences of COVID-19 as did the mainline group. However, in 2022, regionals provided 9.3 percent of domestic capacity, down from 10.7 percent in 2019, a result of both the shift in demand and difficulty supplying capacity as flight crews moved up to higher paying mainline jobs. In terms of traffic, regionals saw similar declines, dropping to 8.9 percent of RPM in 2022 compared to 10.0 percent in 2019. The deviations in 2022 are expected to be temporary as travel patterns and airline operations continue the slow recovery to more normal conditions.


U.S. Commercial Air Carriers
Domestic Enplanements by Carrier Group
Enplanements (millions)
1,400
1,200
1,000
800
600
400
200
0
152
654
92
368
126
612
151
649
156
670
173
740
200
859
234
1,002
258
1,106
2019
2020
2022
2023
2025
2030
2035
2040
2043
Fiscal Year
Mainline
Regional


U.S. Commercial Air Carriers
Domestic Passenger Nominal Yield
Revenue Per Mile (¢)
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
14.1
12.3
13.5
11.7
15.6
13.6
15.7
13.7
16.2
14.1
17.1
14.9
18.0
15.7
18.9
16.5
19.6
17.1
2019
2020
2022
2023
2025
2030
2035
2040
2043
Fiscal Year
Mainline
Regionals

The regionals have less leverage with the mainline carriers than they have had in the past as the mainline carriers have negotiated contracts that are more favorable for their operational and financial bottom lines. And as mainline carriers cut service to smaller cities over the past three years, it was the regional partners that were most affected. Furthermore, mainline carriers successfully reduced costs by offering voluntary retirements to flight crews but as activity picked up they drew replacements from the ranks of the regionals, exacerbating their pre-pandemic pilot shortages. As regional carriers recover and activity returns to 2019 levels, service to smaller cities is expected to return. Regional pilot shortages, however, are likely to persist through next year due to the time required for training and recruitment.

A trend for regionals that was largely unaffected by the pandemic is the longstanding increase in the number of seats per aircraft. This measure rose by more than 55 percent over the decade from 1997 to 2007 and although it slowed more recently to an increase of 17 percent in the ten years ending in 2019, that same pace generally continued in 2022. A consequence of this drive to replace 50 seat regional jets with more fuel-efficient 70 seat jets is that capital costs have increased. The move to the larger aircraft will prove beneficial in the future, however, since their unit costs are lower.

Mainline carriers have also been increasing the seats per aircraft flown although, unlike that for the regionals, the trend had been accelerating. From 1997-2007, mainline seats per aircraft expanded just one-half of one percent but from 2009-2019, the measure grew 10 percent. In 2022, mainline seats per aircraft bumped up to 12 percent over the decade as carriers flew some of their idle long-haul international aircraft on domestic routes.

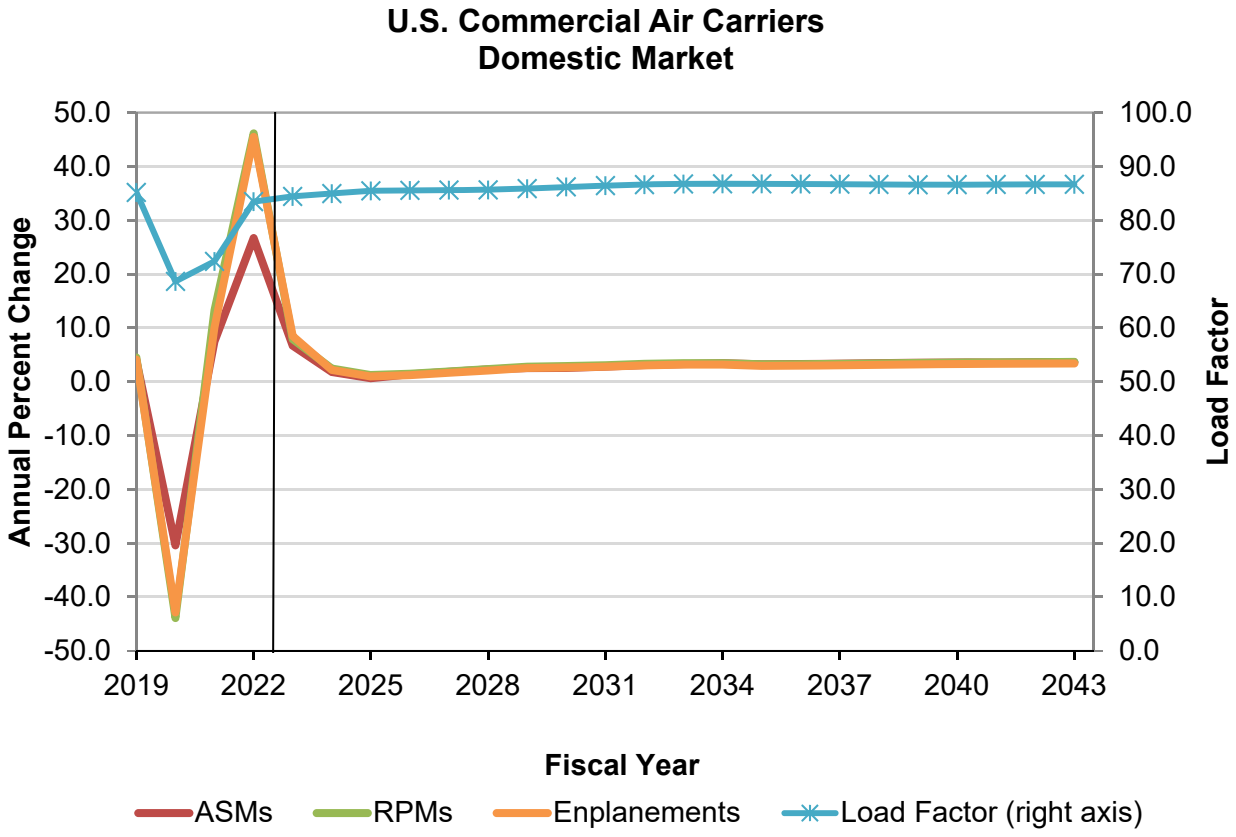
Another continuing trend is that of ancillary revenues. Carriers generate ancillary revenues by selling products and services beyond that of an airplane ticket to customers. This includes the un-bundling of services previously included in the ticket price such as checked bags, on-board meals and seat selection, and by adding new services such as boarding priority and internet access. After posting record net profits in 2015, U.S. passenger carrier profits declined subsequently on rising fuel and labor costs, and flat yields, but were supported by ancillary revenues. Even in 2020 when profits turned to staggering losses, this remained a meaningful source of revenue for carriers.

On the other hand, revenue management systems that have grown increasingly sophisticated in recent years became almost worthless in 2020. These systems enable carriers to price fares optimally for each day and time of flight, and to minimize foregone revenue. But, because they rely on historical data to make price and schedule predictions, the unprecedented nature of the collapse in 2020 meant they could provide little guidance and carriers were forced to assess market conditions without the benefit or precision of that quantitative analysis.

While revenue management systems will regain their important role once travel demand returns to more normal rhythms, one source of ancillary revenue, change fees, was broadly scrapped in 2020. As traveler plans were forced to change due to COVID-19-related restrictions, airlines began dropping fees for itinerary changes in many ticket classes. As a share of total passenger revenue, cancellation fees dropped from about 2 percent in FY2019 and the years prior to under

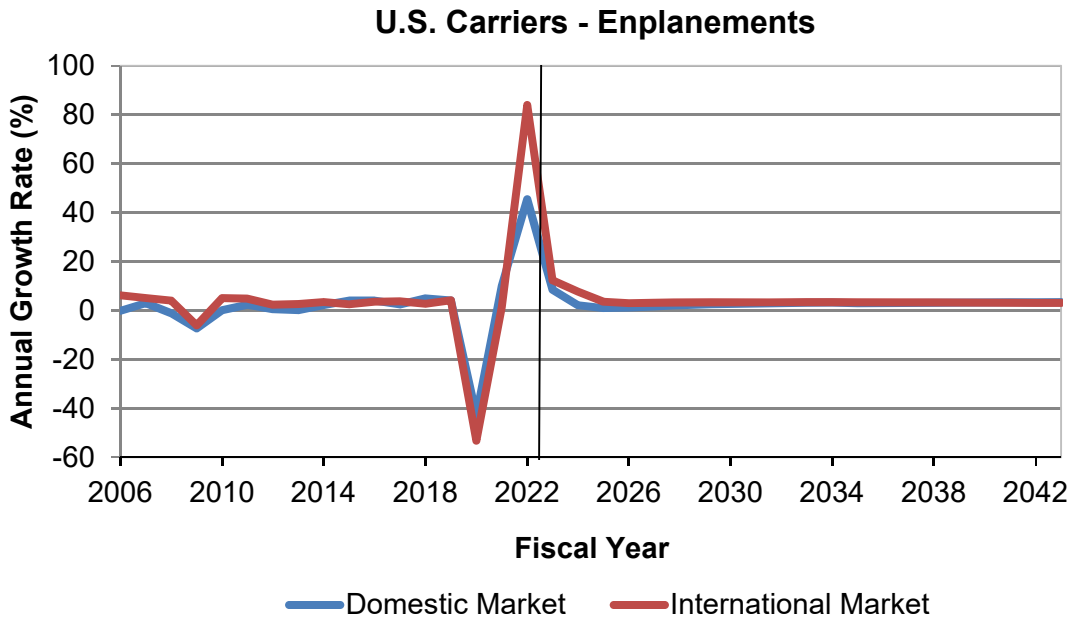
1 percent in FY2022. Some airlines have stated that the elimination of change fees is a permanent move and won't be reversed with the end of the pandemic. In contrast, baggage fees seem unlikely to be rescinded as their share rose from 4.0 percent to 4.6 percent in FY2022.

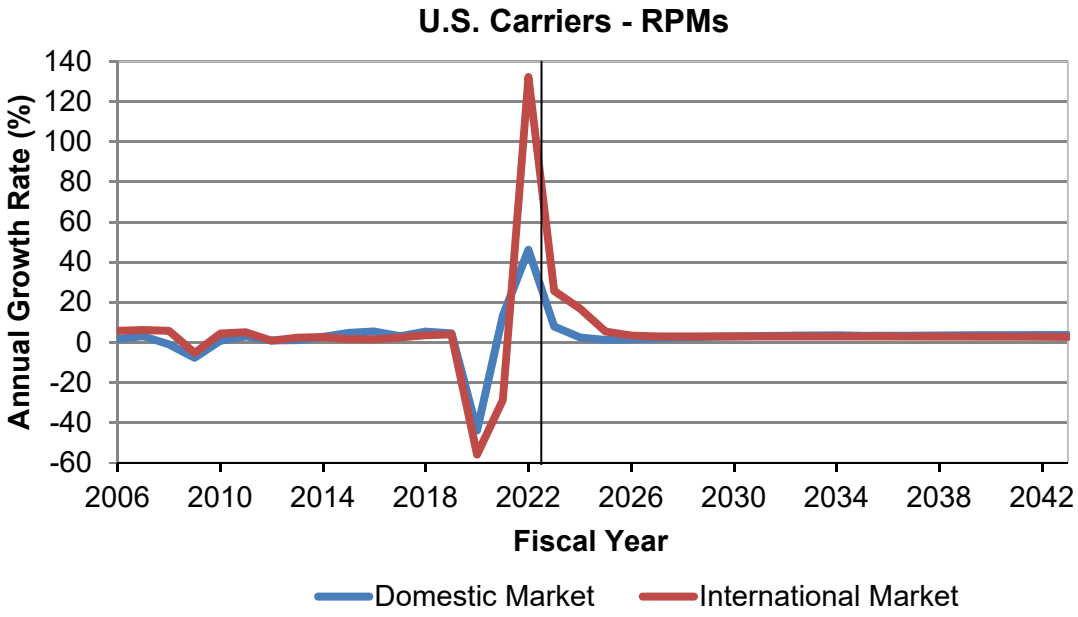
Other methods of segmenting passengers into more discreet cost categories based on comfort amenities like seat pitch, leg room, and access to social media and power outlets were unaffected by the pandemic. The offering of Basic Economy fares has been part of an effort by network carriers to protect market share in response to the rapid growth low cost carriers (LCC) have achieved in recent years. In 2019, mainline enplanements had increased almost 23 percent since 2007 but low cost carrier enplanements grew by 39 percent. RPM over the same period show a similar pattern with mainline RPMs up almost 27 percent and LCC RPM fully 48 percent higher. These longer term trends were interrupted in 2020 with enplanements and RPM dropping across both mainline and LCC carriers to about 55 percent of 2019's levels. However, by 2022 the strength of LCC's became apparent again as their enplanements and RPM had recovered to about 97 percent of 2019 levels while mainline traffic lagged slightly at about 92 percent.

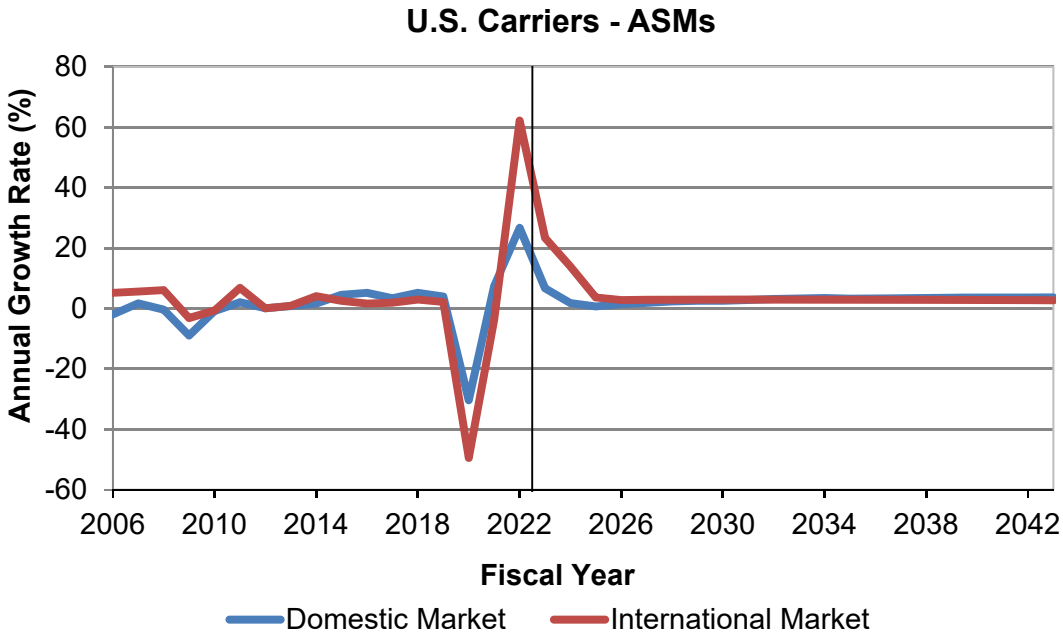


International Market

Over most of the past decade, the international market has been the growth segment for U.S. carriers when compared to the mature U.S. domestic market. In 2015 and 2016, growth in the domestic market surged, outpacing international markets. However, in 2017 enplanement growth in international markets exceeded that in domestic markets, only to be reversed again in 2018 and 2019. That relative strength of domestic activity compared to international intensified during the downturn in 2020 and subsequent recovery. In 2022, domestic enplanements had returned to 92 percent of 2019's level after being at just 63 percent a year earlier, while international enplanements showed even stronger improvement, reaching 87 percent, compared to 47 percent in the previous year. International travel has been particularly impacted by border closings, quarantine requirements and other travel restrictions, as well as the uncertainty of when requirements might change. The fall off of business travel also contributed to the decline and slower recovery, even as leisure travel supported domestic markets. International travel is expected to show further gains in 2023 as the last restrictions are lifted and business travel continues its recovery.





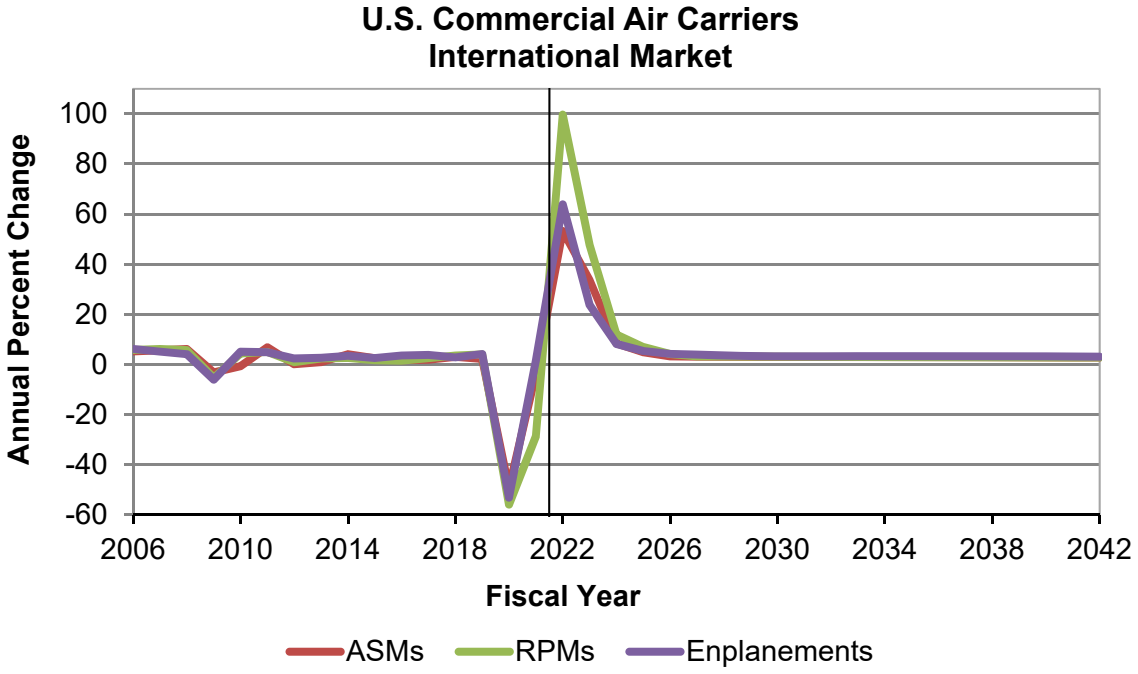


The next two years of the international recovery will see some strong growth rates as activity levels come off a low base but these will return to more typical rates once levels approach 2019 values expected in 2024. For FY2023 and FY2024, the average annual growth rate for international ASM is forecast to be 19 percent, RPM are projected at 21 percent and enplanements at 10 percent as aggregate trip lengths grow due to increasing Atlantic and Pacific activity. From FY2024-2043, annual growth for ASM and RPM are forecast to grow at 2.9 and 3.0 percent, respectively, while enplanements will grow at a

rate of 3.3 percent. Taking these two periods as a whole gives annual growth rates from FY 2022-2043 for ASM, RPM and enplanements of 4.3, 4.6, and 3.9 percent, respectively.

Load factors recovered sharply in 2022, reaching 77 percent, well above the low of 54 percent in the previous year but still below 2019's 83 percent. Load factors are projected to rise throughout the remainder of the decade before plateauing at 82 percent through the end of the forecast.

In the long-run, growth of major global economies will slow from the above-trend rates of recent, pre-pandemic years. Several moderating factors are at work, including high inflation and interest rates, reduced global trade, and political stresses. The European and Japanese economies are generally seeing slow but positive growth, in part due to weak trade with Asia. Overall, global conditions appear set to return to a stable path once the economic environment improves with looser financial conditions, diminished risk of recession, and confidence that COVID-19 has become endemic. Rising oil prices, however, will create some drag on this otherwise supportive environment for air travel demand.



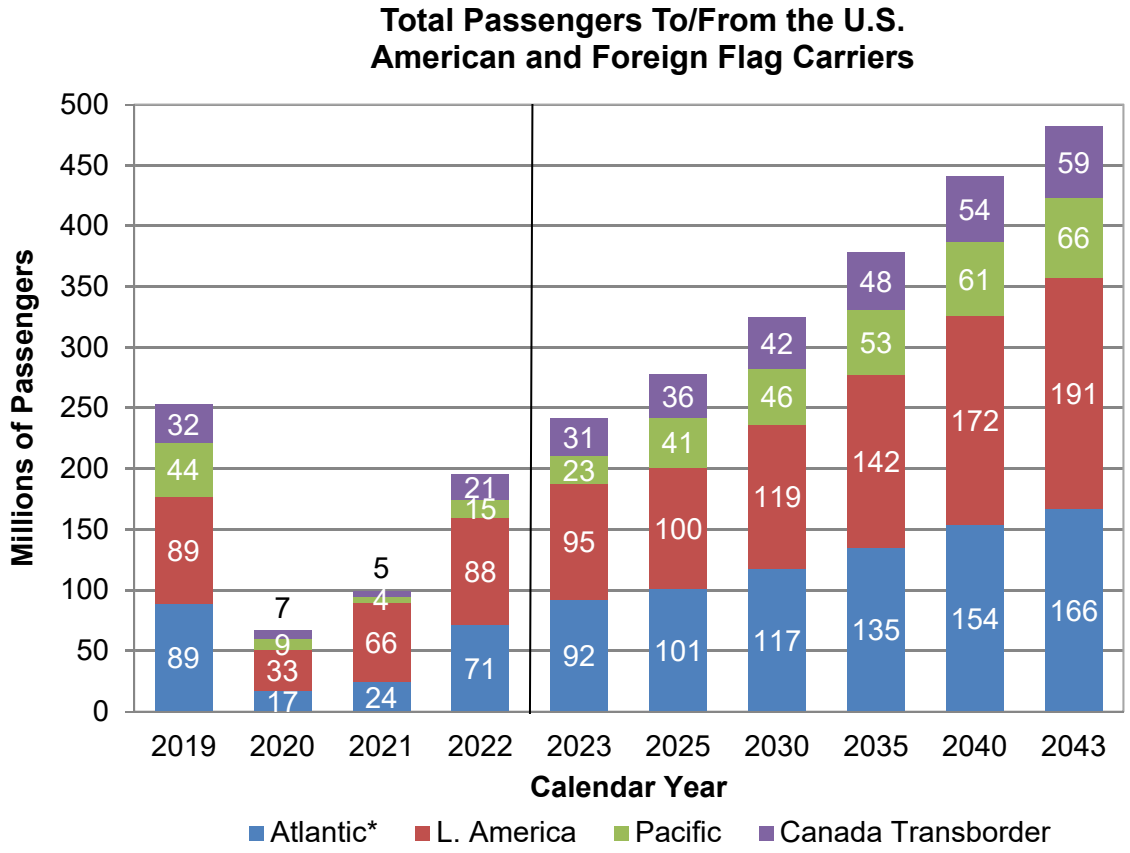
The impact of COVID-19 on travel by region has varied considerably, as will the recovery paths. Factors affecting the responses by market are similar to those affecting travel as a whole: COVID-19 case counts, governmental restrictions, predominant traveler segments, and macroeconomic conditions. As a result, by 2022, enplanements to Latin America had fully recovered followed but the Atlantic region still lagged and the Pacific region had the furthest to go.

For U.S. carriers, Latin America remains the largest international destination with more than twice the enplanements of Atlantic, the

next largest in a typical year, due to its proximity to the U.S., strong trade ties, and popular visitor destinations. In 2022, Latin enplanements rose by 55 percent while RPMs rose 64 percent, pushing both measures above their 2019 levels. Much of the strength was fueled by leisure traffic heading to warm weather destinations and by the relatively low number of COVID-19 cases and travel restrictions. Enplanements and RPM growth are expected to pause in 2023 as other regions become viable to leisure travelers before resuming single-digit growth and returning to a long-term trend rate of around 4 percent. Over the twenty-year period 2023-2043, Latin America enplanements are forecast to increase at an average rate of 3.6 percent a year while RPMs grow 4.0 percent a year.

Switching to the Pacific region, it is the smallest in terms of enplanements despite the economic growth and potential of air travel to the region's emerging markets. After falling in 2020 to 42.1 percent of 2019's level, enplanements fell further in 2021 to just 5.8 percent as many countries enforced stringent travel restrictions, especially China, a very large market in the region. RPM also collapsed by similar amounts. In 2022, enplanements and RPM came off the bottom and recovered to about 20 percent of 2019 levels but was held back as some countries' travel restrictions remained in place. In 2023, those measures of activity are expected to continue expanding to above 50 percent. With comparatively slow trend growth, the region's enplanements take time to fully recover to 2019's level but are within 5 percent by 2026 while RPM are fully recovered in that year. From FY2026 through the end of the forecast, Pacific enplanements and RPM are forecast to grow at average rates of 2.3 percent and 2.5 percent, respectively. Although the region is forecast to have the strongest economic growth of any region over the next 20 years, led by China and India, enplanements and RPMs over the period are restrained in part because U.S. carriers continue to provide a majority of their service in the region to Japan as opposed to faster growing countries.

The Atlantic region ranks in the middle between the other two, with pre-pandemic enplanements roughly twice those in the Pacific region and half those in the Latin region. After contracting in 2015 and 2016, Atlantic enplanements began rising to reach 7.0 percent growth in 2019. This growth was supported by U.S. demand as well as growth of Middle East and African markets, even as the European economies slowed in 2019. In 2020, like the other regions, Atlantic enplanements tumbled by 61 percent and then a further 47 percent in 2021 to bottom out at 21 percent of 2019's level. Subsequent percentage gains are large, returning enplanements to 2019 levels in 2023. Although Western Europe is a mature area with moderate economic growth, the economically smaller Middle East and Africa areas are expanding rapidly with GDP growth rates more than twice that of Europe. As a result, a larger share of the forecast aviation demand in the Atlantic region is linked to those two areas, particularly in the second half of the forecast period. Over the forecast horizon from 2023 to 2043, enplanements and RPM in the Atlantic region are forecast to grow at average annual rates of 3.3 percent and 3.6 percent, respectively.



Source: US Customs & Border Protection data processed and released by Department of Commerce; data also received from Transport Canada
* Per past practice, the Mid-East region and Africa are included in the Atlantic category.

Total passengers (including Foreign Flag carriers) between the United States and the rest of the world fell even more in 2020, and have recovered less since, than did U.S. carriers alone. Foreign carriers, without the relative strength of domestic markets for support, were forced to reduce capacity more and thereby sacrificed passenger traffic. Total passengers collapsed by an estimated 73.4 percent to 67 million in 2020 as all regions posted losses led by an 80.4 percent reduction in the Atlantic region. In 2021, the Latin American and Atlantic regions saw sizable growth from the previous year, while the Pacific and Canada Transborder regions saw further declines, but by 2022, all regions posted strong, positive growth.

FAA projects total international passenger growth of 24 percent in 2023 as the recovery progresses, with the strongest passenger growth rates in the Transborder and Pacific regions. Total passenger numbers return to above 2019 levels in 2024 – 2023 for all regions except Pacific which returns in 2028. Over the entire forecast horizon from 2023 to 2043, international passengers average growth of 4.4 percent a year, as levels increase from 195 million in 2022 to 482 million in 2043.

The Atlantic and Latin American regions were of comparable size in 2019 but by the end of the forecast period the Latin American region counts about 15 percent more pas-

sengers and their growth paths differ. Atlantic growth is faster early on and slows relative to Latin American in later years, consistent with GDP forecasts. Over the 20-year forecast period (2023-2043), the Atlantic region grows at an average annual rate of 4.1 percent while Latin America grows at a rate of 3.8 percent. Although European markets in the Atlantic region are mature and relatively slow growing, other markets such as the Middle East and Africa boost overall growth in the region.

In the Pacific region, passenger levels in 2022 were just a third of those in 2019 and combined with stringent COVID-19 travel restrictions and sluggish Japanese GDP growth that offsets some of the strong economic growth and rising incomes in China, India and South Korea, the outcome is a relatively slow return to 2019 passenger levels in 2028. From 2023 to 2043, passengers between the United States and the Pacific region are forecast to grow 7.2 percent a year.

Like the Atlantic region, Canada transborder is another mature market but is considerably smaller. It is projected to grow at an average rate of 5.1 percent over the forecast period, somewhat faster than the Atlantic region.

System

System (the sum of domestic plus international) capacity contracted 36 percent to 789 billion ASMs in 2020 while RPMs plummeted 47 percent to 548 billion. During the same period, system-wide enplanements fell 44 percent to 509 million. After a tentative beginning towards recovery in 2021, activity surged in 2022 as ASM, RPM and enplanements expanded by 34 percent, 60 percent and 49 percent, respectively. In prior years, U.S. carriers had prioritized the domestic over the international market in terms of allocating capacity as the U.S. saw stronger economic growth than many regions around the world. And by 2022, travel restrictions associated with COVID-19 caused this split to largely continue as domestic capacity was curtailed less than international: down 5 percent in 2022 from 2019 for domestic compared to down 21 percent for international. However, as U.S. carriers continue the process of recovery, international capacity growth rates will outpace domestic, mainly because the international reductions in 2020 were much more severe. Subsequent years through 2043 see carriers revert to slightly faster capacity expansion in domestic markets compared to international driven in part by slightly stronger economic activity.

U.S. mainline carrier enplanement growth in the combined domestic and international market was 56 percent in 2022 while regional carriers carried 20 percent more passengers – a difference explained by the shift in leisure demand as well as the more restrictive capacity constraints faced by regional carriers.

In the domestic market in 2019, mainline enplanements marked their ninth consecutive year of increases, a trend that was abruptly halted in 2020 with a decline of 44 percent but followed two years later by a 52 percent increase in 2022. Similarly, international mainline passengers had posted a tenth consecutive year of growth in 2019, a trend that was also broken in 2020 with a 53 percent decline but then in 2022 was followed by a larger 87 percent increase. Domestic mainline enplanement growth is forecast to slow in 2023, rising 6 percent as enplanements

approach 2019 levels. In 2024, domestic enplanements exceed 2019 levels for the first time since the start of the pandemic. With the recovery complete, domestic enplanements resume growth driven by economic fundamentals and average 2.7 percent over the remainder of the forecast. International mainline enplanements follow a similar path with strong growth in 2023, surpassing 2019 in 2024, and trend-like growth through the end of the forecast averaging 3.3 percent.

Although carriers cut capacity aggressively in 2020, the drop in traffic was even greater and system load factor fell from 84.5 percent in 2019 to 69.5 in 2020 and further to 68.5 in 2021 – a combined drop that far exceeded those following both 9/11 and the Great Recession. Load factor recovered sharply in 2022, rising to 81.8 percent. Thereafter, load factor edges gradually higher, plateauing at 85.3 percent in the second half of the forecast.

Cargo

Air cargo traffic includes both domestic and international freight/express and mail. The demand for air cargo is a derived demand resulting from economic activity. Cargo moves in the bellies of passenger aircraft and in dedicated all-cargo aircraft on both scheduled and nonscheduled service. Cargo carriers face price competition from alternative shipping modes such as trucks, container ships, and rail cars, as well as from other air carriers.

U.S. air carriers flew 51.5 billion revenue ton miles (RTMs) in 2022, a mere 0.5 percent increase compared to the previous year's 16.9 percent surge. Domestic cargo RTMs edged down 0.3 percent to 19.8 billion in 2022 while international RTMs expanded 1.0 percent to 31.7 billion. In comparison, for the decade ending in 2019, domestic RTM increased at an average rate of 3.2 percent and international grew at a 3.8 percent rate. The levelling off in RTM resulted from a normalization of consumer purchasing patterns as demand shifted from goods back into services. Air cargo RTMs flown by all-cargo carriers averaged 78.7 percent of the total in the years leading up to 2020 but then spiked to 88.0 percent in 2020 and 2021, with passenger carriers flying the remainder. In 2022, that ratio dropped to 86.3 percent as passenger flights resumed, increasing available belly-hold capacity. Total RTMs flown by the all-cargo carriers declined 1.5 percent in 2022 while total RTMs flown by passenger carriers rose by 0.5 percent. As passenger flights return, the share of cargo on all-cargo carriers will ease, dropping to about 82 percent in 2025.

U.S. carrier international air cargo traffic spans four regions consisting of Atlantic, Latin, Pacific, and 'Other International.'

Historically, air cargo activity tracks with GDP. Other factors that affect air cargo growth are fuel price volatility, movement of real yields, globalization and trade. The forecasts of revenue ton miles rely on several assumptions specific to the cargo industry. First, security restrictions on air cargo transportation will remain in place. Second, most of the shift from air to ground transportation has occurred. Finally, long-term cargo activity depends heavily on economic growth.

The forecasts of RTMs derive from models that link cargo activity to GDP. Forecasts of domestic cargo RTMs use real U.S. GDP as the primary driver of activity. Projections of

international cargo RTMs depend on growth in world and regional GDP, adjusted for inflation. FAA forecasts the distribution of RTMs between passenger and all-cargo carriers based on an analysis of historic trends in shares, changes in industry structure, and market assumptions.

After increasing by just 0.5 percent in 2022, total RTMs are expected to remain flat in 2023 as the normalization of consumer demand for goods versus services continues. Because of steady U.S. and world economic growth in the long term, FAA projects total RTMs to increase at an average annual rate of 2.8 percent over the forecast period (from 2023 to 2043).

Domestic cargo RTMs from 2023 to 2043 are forecast to increase at an average annual rate of 2.0 percent. In 2022, all-cargo carriers carried 92.7 percent of domestic cargo RTMs. The all-cargo share is forecast to decline modestly to about 92 percent in the medium-term as passenger flights return to the system. In the long-term, the all-cargo share rises only slightly to 93.4 percent by 2043 based on increases in capacity for all-cargo carriers.

International cargo RTMs also flattened out in 2022 as surface transportation snarls were resolved. As with domestic markets, RTM carried by all-cargo carriers declined slightly in 2022 while that transported by passenger carriers expanded again at a double-digit rate. With the post-pandemic return of passenger flights, RTM on passenger aircraft is expected to continue growing rapidly, increasing about 14 percent per year in both 2023 and 2024. Over the same years, all-cargo RTM will shrink by about 2 percent per year as some tonnage is lost to passenger carriers. The share of international cargo RTMs flown by all-cargo carriers was 82.3 percent in 2022 and is forecast to decline steadily during the recovery period before gradually increasing in line with historical trends and ending at 80.8 percent in 2043.

Following the period of recovery, growth for both types of carriers returns to long-run trend rates. For the forecast period (2023-2043), international cargo RTMs are expected to increase an average of 3.3 percent a year based on projected growth in world GDP with the Other International region having the fastest RTM growth (3.7 percent), followed by Pacific (3.6 percent), Atlantic (2.4 percent), and Latin America region (1.8 percent).

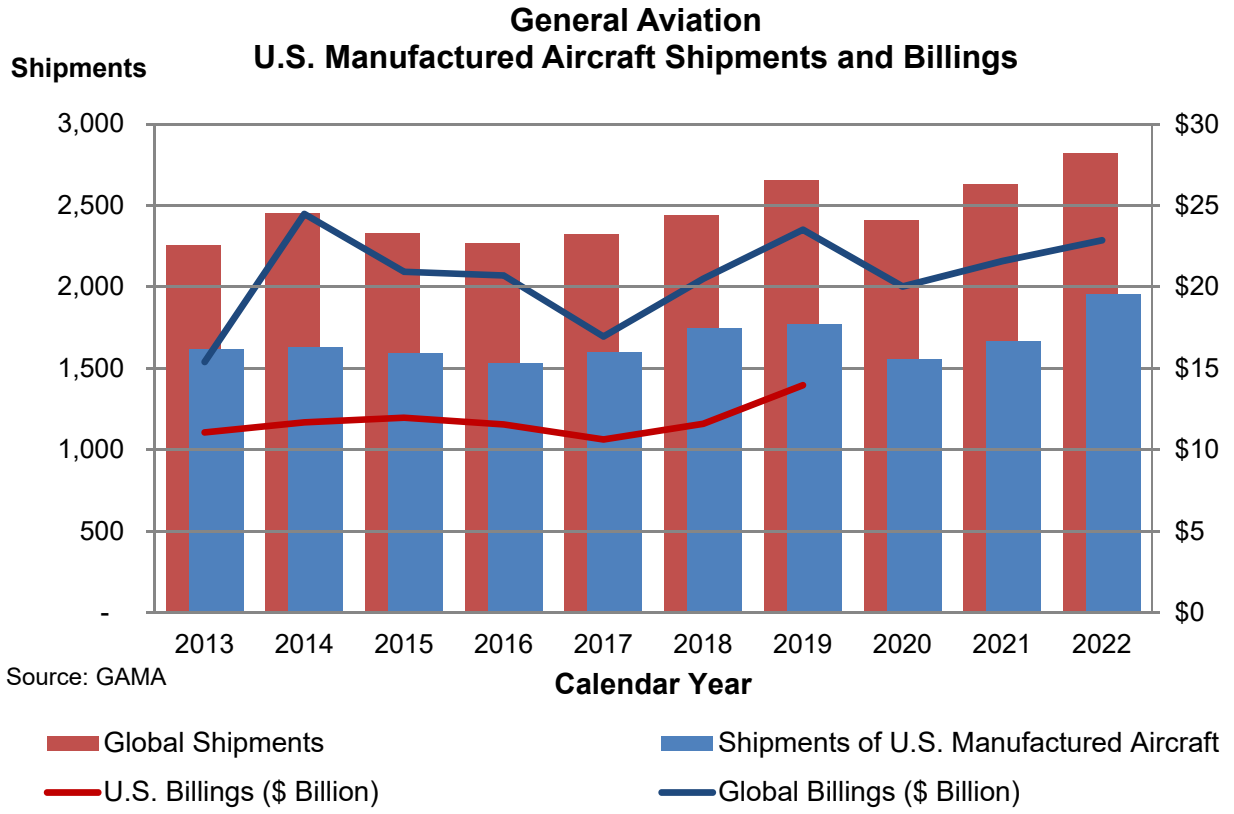
General Aviation

The FAA uses estimates of fleet size, hours flown, and utilization rates from the General Aviation and Part 135 Activity Survey (GA Survey) as baseline figures to forecast the GA fleet and activity. Since the survey is conducted on a calendar year (CY) base and the records are collected by CY, the GA forecast is done by CY. Forecasts of new aircraft deliveries, which use the data from General Aviation Manufacturers Association (GAMA), together with assumptions of retirement rates, generate growth rates of the fleet by aircraft categories, which are applied to the GA Survey fleet estimates. The forecasts are carried out for "active aircraft,"[2] not total aircraft. The FAA's general aviation forecasts also rely on discussions with the industry experts conducted at industry meetings, including Transportation Research Board (TRB) meetings of Business Aviation and Civil Helicopter Subcommittees conducted twice a year in January and June.

The results of the 2021 GA Survey, the latest available, were consistent with the results of surveys conducted since 2004 improvements to the survey methodology. The active GA fleet was estimated to be 209,195 aircraft in 2021 (2.5 percent increase from 2020). Small declines in turbojet and multi-engine piston fleet were more than offset by increases in all the other categories, including a 2.2 percent increase in the largest segment of single-engine pistons, a 2.9 percent increase in rotorcraft, and 6.0 percent increase in experimental aircraft fleets. Total hours flown were estimated to be 26.4 million in 2021, up 17.6 percent from the previous year, 3.4 percent above where they were in 2019 and at their highest level since the historical peak of 2007. Increases were across the board, with the highest absolute and percent increase in turbojet (46.0 percent (much smaller category of gliders and lighter than air aircraft together recorded a 82.0 percent increase in activity).

In 2022, deliveries of the general aviation aircraft manufactured in the U.S. increased to 1,954, 17.0 percent higher than in CY 2021 and 10.3 percent higher than their 2019 level. Deliveries of single-engine piston aircraft were up 15.0 percent, while the much smaller segment of multi-engine piston deliveries were up by 40.0 percent (summing to a 15.4 percent increase in the fixed engine piston deliveries). Business jet deliveries increased by 20.5 percent and turboprop deliveries were up 17.0 percent, amounting for an 18.8 percent increase in fixed wing turbine shipments. While the GAMA statistics for factory net billings were not available yet for the U.S. manufactured GA aircraft, global billings increased in 2022 by 5.9 percent to $22.9 billion.

[2] An active aircraft is one that flies at least one hour during the year.



GAMA also reported the rotorcraft deliveries increased at a global level in 2022 in both piston and turbine segments by 7.2 percent and 5.7 percent, respectively.

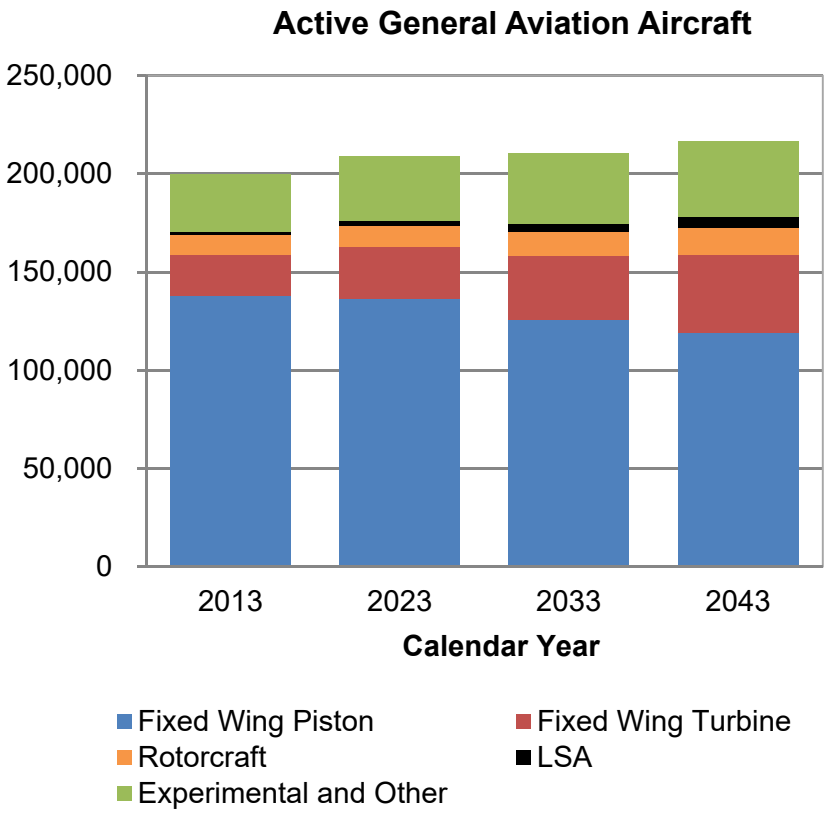
These current conditions indicate the GA sector, which was not as severely affected by the pandemic as the airlines, completely recovered by activity, surpassing 2019 levels. The active fleet was only 0.8 percent below 2019 levels, with the fixed-wing turbine and experimental aircraft categories above their 2019 levels. The long-term outlook for general aviation, driven by turbine aircraft activity, remains stable. The active general aviation fleet, which showed an increase of 2.5 percent between 2020 and 2021, is forecast to increase from its 2021 level of 209,195 aircraft to 216,395 by 2043, as the declines in the fixed-wing piston fleet are offset by increases in turbine, rotorcraft, experimental, and light sport fleets. The total active general aviation fleet grows by a small increase of 0.2 percent annually.

The more expensive and sophisticated turbine-powered fleet (including rotorcraft) is projected to grow by 17,550 aircraft between 2021 and 2043 to total 50,235 in 2043, an average rate of 2.0 percent a year during this period, with the turbojet fleet increasing 2.7 percent a year. When measured from the 2019 levels, the growth rate for the turbine-powered fleet is 1.9 percent. The growth in U.S. GDP and corporate profits are catalysts for the growth in the turbine fleet.

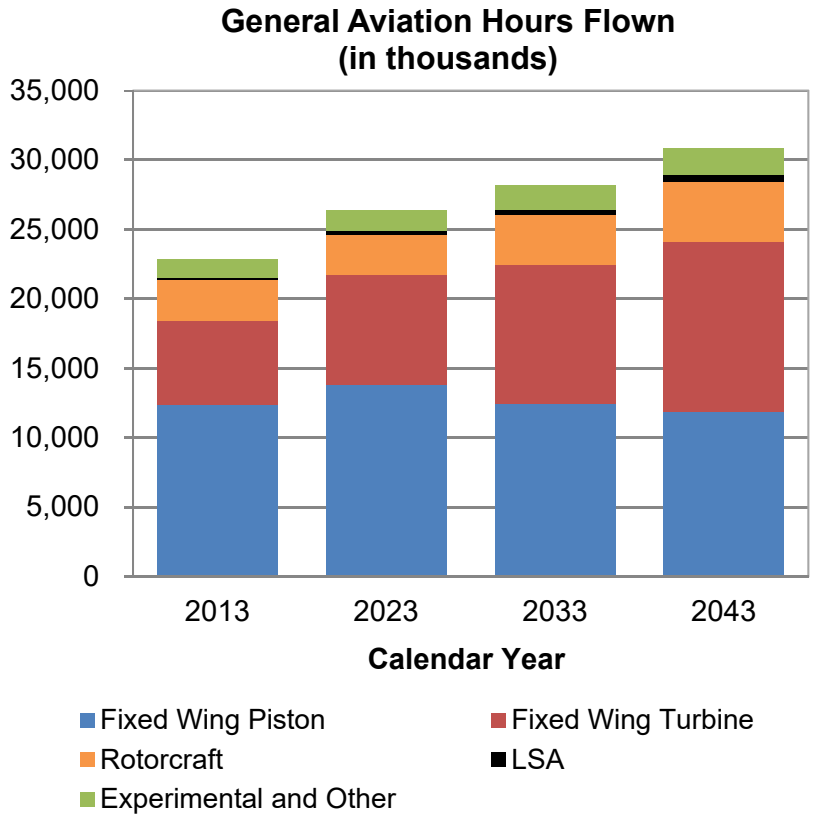
The largest segment of the fleet, fixed wing piston aircraft, is predicted to shrink over the by 19,645 aircraft between 2021 and 2043, an average annual rate of -0.7 percent. Un-

favorable pilot demographics, overall increasing cost of aircraft ownership, availability of much lower cost alternatives for recreational usage, coupled with new aircraft deliveries not keeping pace with retirements of the aging fleet are the drivers of the decline.

On the other hand, the smallest category, light-sport-aircraft (created in 2005), is forecast to grow by 3.2 percent annually, adding about 2,595 new aircraft by 2043, nearly doubling its 2021 fleet size of 2,650.



Although the total active general aviation fleet is projected to marginally increase, the number of general aviation hours flown is forecast to increase an average of 0.7 percent per year through 2043, from 26.4 million in 2021 to 30.8 million, as the newer aircraft fly more hours each year. Fixed wing piston hours are forecast to decrease at a slightly faster rate than the fleet, an average of 0.8 percent a year. Countering this trend, hours flown by turbine aircraft (including rotorcraft) are forecast to increase 2.2 percent yearly between 2021 and 2043. Jet aircraft account for most of the increase, with hours flown increasing at an average annual rate of 2.7 percent between 2021 and 2043. The large increases in jet hours result mainly from the increasing size of the business jet fleet.



Rotorcraft activity, positively impacted by increases in oil prices, associated oil exploration and increasing additional demand through slow recovery in the commercial airlines sector improved in 2021. Potential effects of Advanced Air Mobility (including eVTOLs) in the later years of the forecast period are too uncertain yet to include in the forecast. The active fleet of rotorcraft is projected to grow at a similar rate to the previous year's forecast, 1.5 percent a year, driven by higher growth in the turbine segment, going from a total of (piston and turbine together) 10,032 in 2021 to 13,870 in 2043. Rotorcraft hours are projected to grow by 2.1 percent annually between 2021 and 2043.

Lastly, the light sport aircraft category is forecasted to see an increase of 3.2 percent a year in hours flown, primarily driven by growth in the fleet.

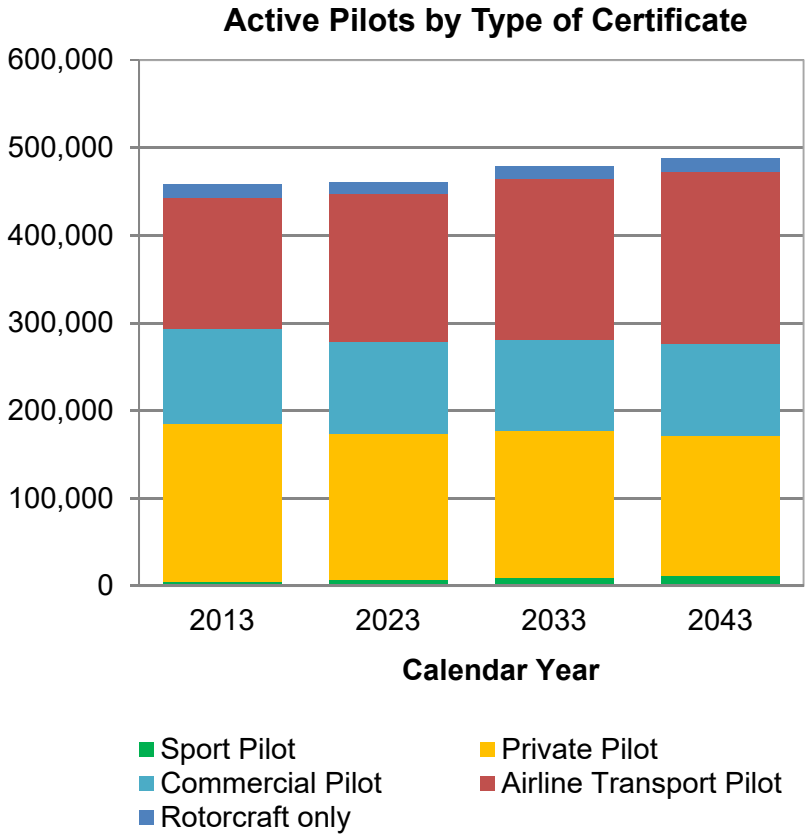
The FAA also conducts a forecast of pilots by certification categories, using the data compiled by the Administration's Mike Monroney Aeronautical Center. There were 756,928 active pilots certificated by FAA at the end of 2022. The number of certificates in most pilot categories continued to increase, while there small declines in the rotorcraft only and recreational certificates. The FAA suspended the student pilot forecast since 2018. The number of student pilot certificates has been affected by a regulatory change that went into effect in April 2016 and removed the expiration date on the new student pilot certificates. The number of student pilots jumped from 128,501 at the end of 2016 to 149,121 by the end of 2017, and to 280,582 at the end of 2022. The 2016 rule change generates a cumulative increase in the certificate numbers and breaks the link between student pilot and advanced certificate levels of private

pilot or higher. There is no sufficient data to perform a reliable forecast for the student pilots.

Commercial and air transport pilot (ATP) certificates have been impacted by a legislative change as well. The Airline Safety and Federal Aviation Administration Extension Act of 2010 mandated that all part 121 (scheduled airline) flight crew members would hold an ATP certificate by August 2013. Airline pilots holding a commercial pilot certificate and mostly serving at Second in Command positions at the regional airlines could no longer operate with only a commercial pilot certificate after that date, and the FAA data initially showed a faster decline in commercial pilot numbers, accompanied by a higher rate of increase in ATP certificates. The number of commercial pilot certificates started to increase since 2017 until showing a slight decline of 0.1 percent in 2022 to 104,498. While the ATP certificate holders increased every year since 2011, significantly reduced number of flights and a large number of parked aircraft due to the pandemic generated an overcapacity for the ATPs employed by the airlines, despite government support to the aviation sector. Consequently, the number of pilots holding an ATP certificate declined in 2020 and 2021, but reached to 166,738 in 2022, a 1.7 percent increase from the previous year (1.1 percent higher than their 2019 level).

Private pilots had stabilized their decline since 2016 at around 162,000 and showed an increase in 2022 to 164,090 from 161,459 in the previous year. Sport pilot certificates, created in 2005, kept their steady increase since their inception to reach 6,957 by December 31, 2022. Rotorcraft pilots continued their decline since 2016 to end up with 13,180 by the end of 2022.

The number of active general aviation pilots (excluding students and ATPs) is projected to increase slightly between 2022 and 2043 from 309,608 to 314,570. The ATP category is forecast to increase by 29,360 (up 0.8 percent annually). The much smaller category of sport pilots are predicted to increase by 2.5 percent annually over the forecast period. Commercial pilot certificates are projected to remain flat between 2022 and 2043. On the other hand, private pilot certificates are projected to decrease at an average annual rate of 0.1 percent over the forecast horizon.


Active Pilots by Type of Certificate
600,000
500,000
400,000
300,000
200,000
100,000
0
2013
2023
2033
2043
Calendar Year
Sport Pilot
Private Pilot
Commercial Pilot
Airline Transport Pilot
Rotorcraft only

FAA Operations

The traffic at FAA facilities underwent drastic changes during the period of 2019 and 2020 from the COVID-19 impact. There was 16.7 percent decline in traffic from 53.3 million in 2019 to 44.4 million in 2020. Activity continued a healthy recovery of 10.2 percent from 47.7 million in 2021 to 52.6 million in 2022. While domestic markets led the way for the recovery from 2020 to 2021, international markets began to pick up steam in 2022. By September 2022, domestic passenger volume has reached 99% of the pre-COVID-19 level while international passenger volume reached 86% of the pre-COVID-19 level.

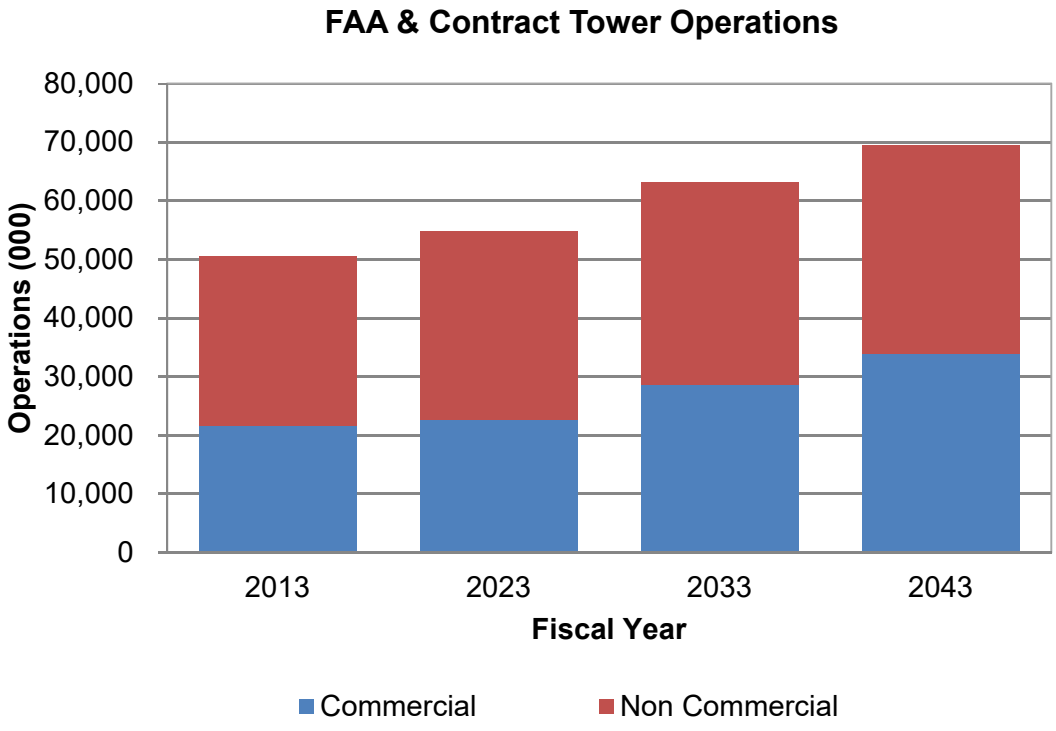
After operations return to pre-pandemic levels, longer-term economic health along with the growth in air travel demand and the business aviation fleet will drive the long-term growth in operations at FAA facilities over the rest of the forecast period. Activity at FAA towers and contract towers is projected to return to pre-COVID levels in 2023 and then increase at an average rate of 1.2 percent a year through 2043 from 54.8 million in 2023 to 69.4 million in 2043. The 1.2 percent annual growth forecast is lower than the 1.5 percent forecast for 2022-2042 last year partially due to the faster aircraft up-gauging. Commercial operations[3] at these facilities are forecast to increase 2.0 percent a year, approximately four times faster than non-commercial operations. The growth in commercial operations is less than the growth in U.S. airline passengers (2.0 percent versus 2.6 percent) over the forecast period due primarily to larger aircraft (seats per aircraft mile) and higher load factors. Both of these trends allow U.S. airlines to accommodate more passengers without increasing the number of flights.

General aviation operations are forecast to increase an average of 0.5 percent a year as increases in turbine powered activity more than offset declines in piston activity. General aviation operations accounted for 55 percent of total operations in 2022. This is slightly higher than pre-COVID share of 51 percent in 2019. The decline of general aviation traffic was relatively mild during the early years of the pandemic where recovery speed was swift, and commercial aviation is now recapturing market share given that its share has increased from 38% to 41% between 2021 and 2022.

The growth in operations at towered airports is not uniform. Most of the activity at large and medium hubs[4] is commercial in nature, as these are the airports where the vast majority (about 89 percent in 2022) of the passenger enplanements in the U.S. occur.

[3] Commercial operations include air carrier and commuter/air taxi operations.

[4] A large hub is defined to have 1 percent or more of total U.S. revenue passenger enplanements in FY 2022. A medium hub is defined to have at least 0.25 percent but less than 1 percent of total U.S. revenue passenger enplanements. In the 2022 TAF there were 30 large hub airports and 34 medium hub airports.



Given the growth in airline demand and most of that demand is at large and medium hubs, activity at the large and medium hubs is forecast to grow substantially faster than smaller airports including small FAA towers[5] and FAA contract towers[6]. The forecasted annual growth in operations is 2.2 percent at large hubs, 1.8 percent at medium hubs, 0.8 percent at small FAA towers, and 0.6 percent at FAA contract towers between 2023 and 2043.

Among the 30 large hubs, the airports with the fastest long-term annual growth forecast are those located along the coastal sections of the country where most large cities are located. Large cities have historically shown to generate robust economic activity, which in turn drives up the airline demand. On the other hand, many of the large hub airports located in the middle of the country are forecast to have slower long-term annual growth. In terms of COVID-19 recovery, the airports with mostly domestic traffic and the ones located at popular leisure destinations are forecast to have shorter recovery timeline.

FAA Tracon (Terminal Radar Approach Control) Operations[7] are forecast to grow slightly faster than at towered facilities. This is in part a reflection of the different mix of activity

[5] Small FAA towers are defined as towered airports that are neither large or medium hubs nor FAA contract towers.

[6] FAA contract towers are air traffic control towers providing air traffic control services under contract with FAA, staffed by contracted air traffic control specialists.

[7] Tracon operations consist of itinerant Instrument Flight Rules (IFR) and Visual Flight Rules (VFR) arrivals and departures at all airports in the domain of the Tracon as well as IFR and VFR overflights.

at Tracons. Tracon operations are forecast to increase an average of 1.4 percent a year between 2023 and 2043. Commercial operations accounted for approximately 55 percent of Tracon operations in 2022 and are projected to grow 2.0 percent a year over the forecast period. General aviation activity at these facilities is projected to grow only 0.4 percent a year over the forecast.

The number of IFR aircraft handled is the measure of FAA En-Route Center activity. Growth in airline traffic and domestic leisure aviation is expected to lead to increases in activity at En-Route centers until the business aviation sector recovers. Over the forecast period, aircraft handled at En-Route centers are forecast to increase at an average rate of 2.0 percent a year from 2023 to 2043, with commercial activity growing at the rate of 2.3 percent annually. Activity at En-Route centers is forecast to grow faster than activity at towered airports and FAA Tracons because more of the activity at En-Route centers is from the faster growing commercial sector and high-end (mainly turbine) general aviation flying.[8] In 2022, the share of commercial IFR aircraft handled at FAA En-Route centers is about 80% percent, which is greater than the 55 percent share at Tracons or the 41 percent share at FAA and Contract Towers.

[8] Much of the general aviation activity at towered airports, which is growing more slowly, is local in nature, and does not impact the centers.

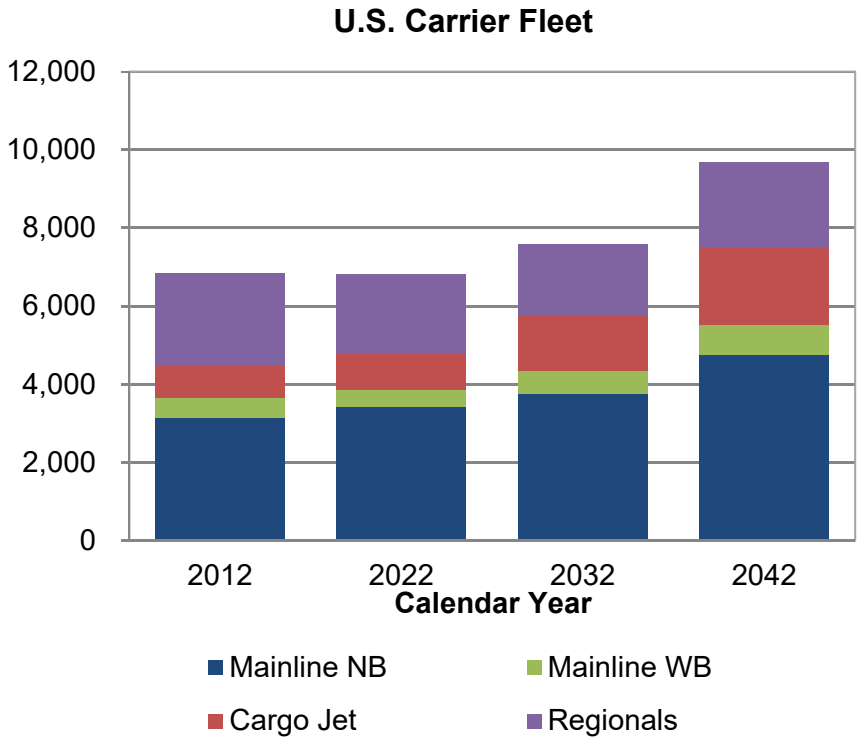
U.S. Commercial Aircraft Fleet

Boosted by the sharp recovery in demand for air travel and cargo, the number of aircraft in the U.S. commercial fleet grew by 18 percent in 2021-22 (an increase of 1,055 aircraft), with many coming off 'parked' status. The total number of commercial aircraft is forecast to increase from 6,852 in 2022 to 10,286 in 2043, an average annual growth rate of 2.0 percent a year. The continued recovery in demand from the COVID-19 downturn along with long-term post-COVID increases in demand for air travel and growth in air cargo is expected to fuel increases in both the passenger and cargo fleets.

Between 2022 and 2043 the number of jets in the U.S. mainline carrier fleet is forecast to grow from 3,915 to 5,925, a net average of 96 aircraft a year as carriers continue to remove older, less fuel efficient narrow body aircraft. As the industry recovers from the COVID-19 downturn, many aircraft that were temporarily parked are returning to the fleet, resulting in a large increase in the fleet (approximately 193 aircraft per year) in the first two years of the forecast and then slower rates thereafter. The narrow-body fleet (including E-series aircraft as well as A220-series at JetBlue and A220-series at Delta) is projected to grow 80 aircraft a year as carriers replace current technology 737 and A320 family aircraft with the next generation MAX and Neo families. The wide-body fleet grows by an average of 19 aircraft a year as carriers add 777-8/9, 787's, A350's to the fleet while retiring 767-300/400 and 777-200 aircraft. In total the U.S. passenger carrier wide-body fleet increases by 3.2 percent a year over the forecast period.

The regional carrier fleet is forecast to increase from 2,002 aircraft in 2022 to 2,387 in 2043 as the fleet expands by 0.8 percent a year (18 aircraft) between 2022 and 2043. Carriers remove 50 seat regional jets and retire older small turboprop and piston aircraft, while adding 70-90 seat jets, especially the E-2 family in the second half of this decade. By 2043, the number of jets in the regional carrier fleet totals 2,158, up from 1,626 in 2022. The turboprop/piston fleet is forecast to shrink by 39% from 376 in 2022 to 229 by 2043. These aircraft account for 9.6 percent of the regional fleet in 2043, down from 18.8 percent in 2022.

The cargo carrier large jet aircraft fleet is forecast to increase from 935 aircraft in 2022 to 1,974 aircraft in 2043 driven by the growth in freight RTMs. The narrow-body cargo jet fleet is projected to increase by 20 aircraft a year as 737-800/900MAX's are converted from passenger use to cargo service. The wide body cargo fleet is forecast to increase 30 aircraft a year as new 777-8/10 and converted 767-300 aircraft are added to the fleet, replacing older MD-11, A300/310, and 767-200 freighters.


U.S. Carrier Fleet
12,000
10,000
8,000
6,000
4,000
2,000
0
2012
2022
2032
2042
Calendar Year
Mainline NB
Mainline WB
Cargo Jet
Regionals