

**FAA Aerospace Forecasts  
Fiscal Years 2021-2041**

## Economic Environment

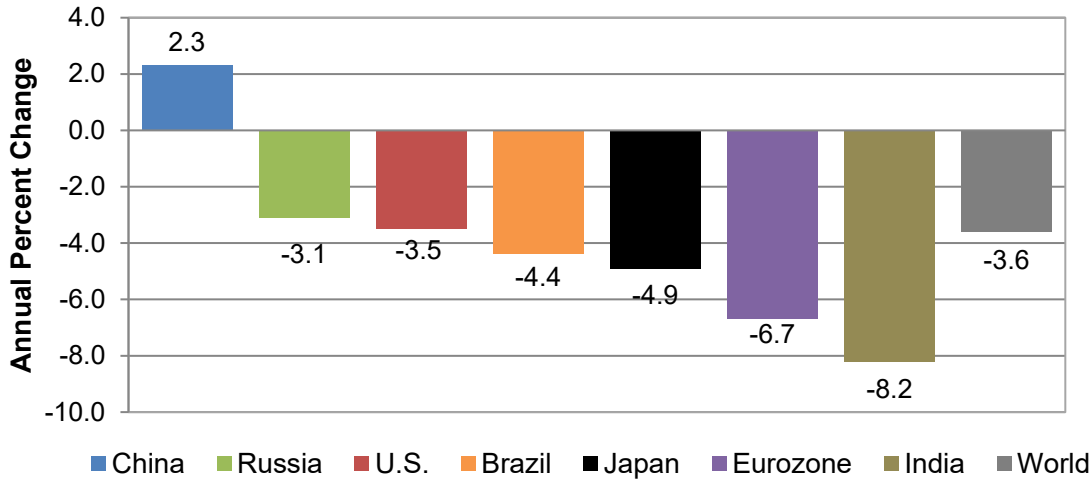
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Economies around the world were devastated by measures necessary to bring the COVID-19 virus under control such as stay-at-home orders, limits on gathering sizes for both public and private events, quarantine measures and even border closures. In 2020, global real GDP contracted by 3.6 percent, a rate considerably better than that predicted during the early months of the pandemic but still the most severe decline since 1946. Near-term forecasts have also shifted significantly from one month to the next as factors such as government support programs, COVID-19 case counts, and vaccine development and vaccination progress are all rapidly changing. In the most recent forecast, IHS Markit projects that world economic growth will rise to 5.1 percent in 2021, up from the 4.5 percent used in the preparation of this Aerospace Forecast. By 2023, the recovery and payback from the downturn is complete and the forecast of world real GDP growth has returned approximately to the long-term trend rate of 2.8 percent – unchanged in recent months.

In the U.S., enhanced unemployment benefits, high personal savings rates, and a pick-up in consumer spending on services all contribute to GDP strength in 2021 and 2022. Compared to the U.S., real GDP growth in Western Europe will be somewhat slower in the near- and medium-term. Relatively more

strict COVID-19 containment efforts in some countries and slower vaccine rollouts contribute to slower economic growth. On the other hand, the manufacturing sector has provided economic support for several countries and U.S. fiscal stimulus will further boost exports from that sector. Similarly, Japan's economic rebound in the near-term is supported by export demand from the U.S. and Asia, but restrained by sluggish consumer spending and its longstanding demographic trends. In emerging markets, China's growth rate slowed in 2020 but did not contract, underpinned by the government's drastic but effective COVID-19 containment measures that allowed early restoration of normal economic activities. In other large emerging markets, Brazil provided large fiscal stimulus that moderated the downturn in 2020 but the combination of the considerable increase in public debt plus the withdrawal of that stimulus will dampen the rebound in the medium-term. Russia, like many other countries, saw its contraction in 2020 driven by a sharp drop in consumer spending and those new spending patterns combined with low oil prices and slow vaccination progress will all dampen the recovery. While India's economic recovery may be restrained by a second wave of infections and a slow vaccine rollout, in the medium-term its growth will be supported by favorable demographics and a relatively low savings rate.

**World Economic Growth in 2020**

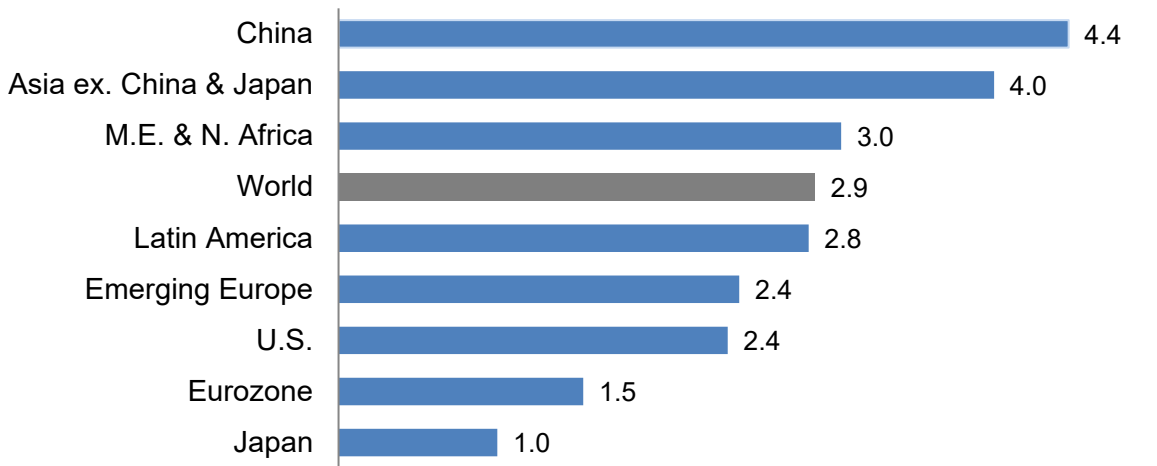


Source: IHS Markit

IHS Markit forecasts world real GDP to grow at 2.9 percent a year between 2021 and 2041. Emerging markets, at 3.9 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 (1.8 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 1.0 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 2021-2041)**

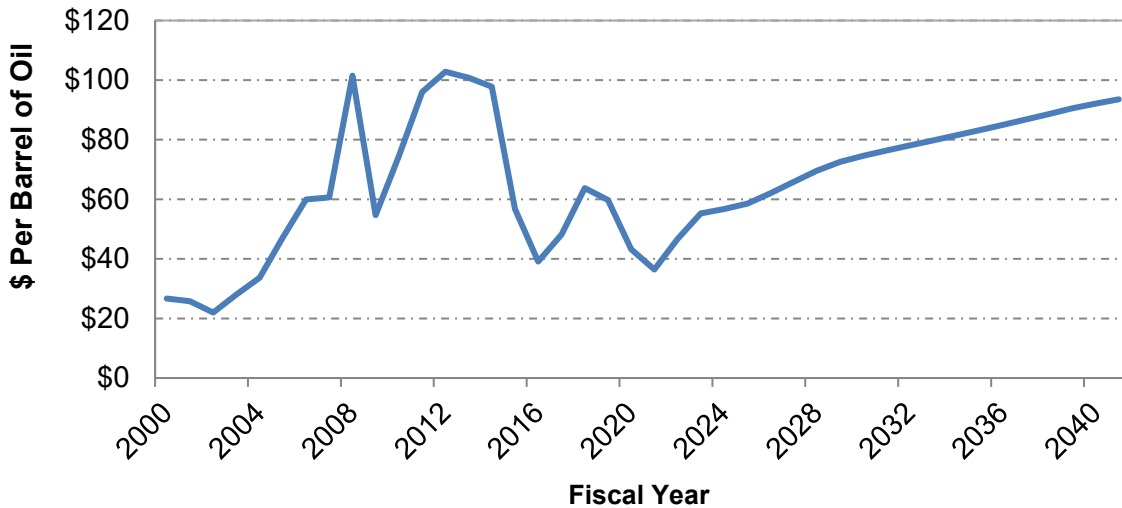


Source: IHS Markit, Dec 2020 World Forecast

As global economic output declined in 2020, so did the demand for oil resulting in a sharp drop of almost 30 percent in prices. After holding at about \$60 per barrel in both 2018 and 2019, the price fell to \$43 per barrel in 2020 and is projected to continue down to \$36 per barrel in 2021 based on increasing

supply. 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 remain below \$100 per barrel throughout the forecast horizon.

### U.S. Refiners' Acquisition Cost



Source: IHS Markit

## U.S. Airlines

### Domestic Market

Mainline and regional carriers<sup>3</sup> 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 recovering from the devastating consequences of the COVID-19 pandemic. First, carriers will work

to identify and assess demand as it returns fitfully from the lows reached in 2020. Next, and as load factors rise, the focus will shift to adding capacity back into networks in a cautious and deliberate manner. With demand beginning to approach 2019 levels, balance sheets strengthen allowing carriers to adopt the more customary longer-term strategies.

<sup>3</sup> 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.

The unpredictable demand environment carriers faced in the second half of 2020 is expected to extend throughout 2021. The first part of the year will likely see a continuation of weak activity punctuated by spikes around holidays. Travel will be almost entirely confined to leisure segments of the population and recreational geographic markets. As the year progresses, increasing vaccinations and greater control over infections will begin to support steadier growth in activity due to pent-up demand for leisure travel by the broader population and to a wider range of destinations. Activity remains low, however, and carriers seek to stimulate demand by holding fares down.

The growing and increasingly predictable activity will allow carriers to return capacity to typical markets, and reduce reliance on purely recreational destinations. Utilization rates will rise and carriers will bring parked and stored aircraft back online. Activity grows slowly, however, as it is restrained by the economy and labor markets that also heal slowly. Although leisure travelers continue to make up the majority of passengers, shoots of a business travel recovery begin to emerge. Employees slowly become more comfortable with travelling again and employers find ways to satisfy duty-of-care requirements. Along with strengthening demand will come rising fares.

In the third phase, activity begins to approach 2019 levels and industry conditions begin to normalize. Leisure travel has largely

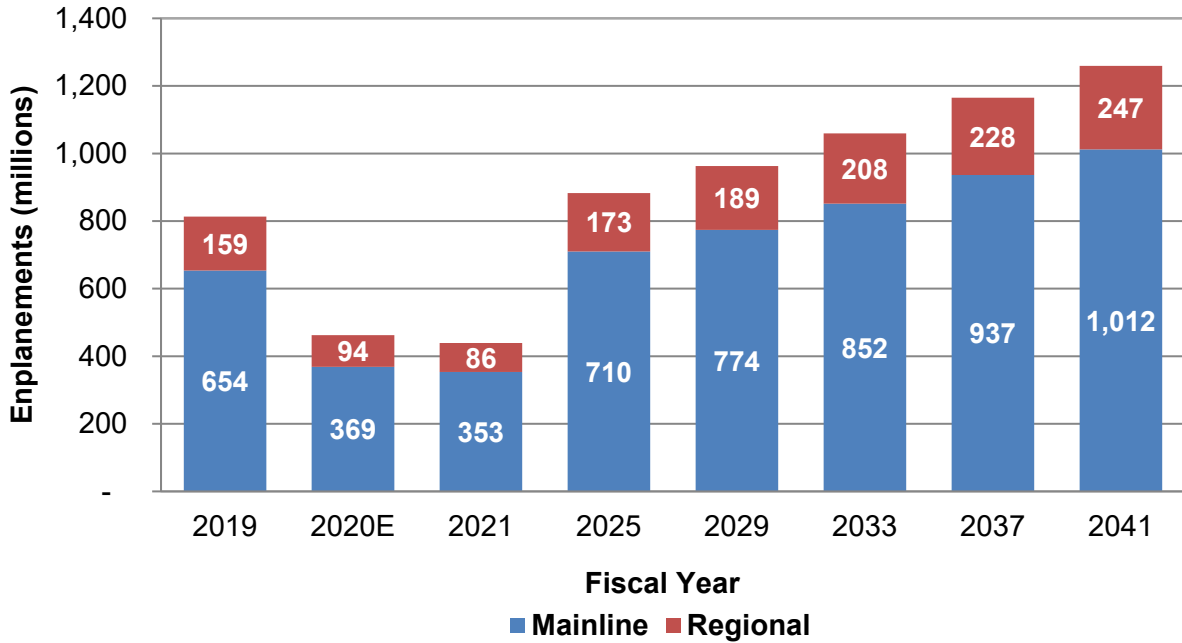
returned to pre-pandemic levels and business travel is steadily catching up. Carriers remain somewhat constrained by debt incurred to survive the crisis and forgo some capital investments in favor of strengthening their balance sheets.

Throughout the recovery from the pandemic, several trends emerged that subsequently will, to greater or lesser extent, be reversed. Low-cost carriers targeting leisure travelers benefitted from relative strength in this segment. The sharp curtailment of business travel, on the other hand, impacted legacy carriers and those serving key business markets. And all carriers received a boost from low fuel prices that were due in part to reduced energy demand worldwide.

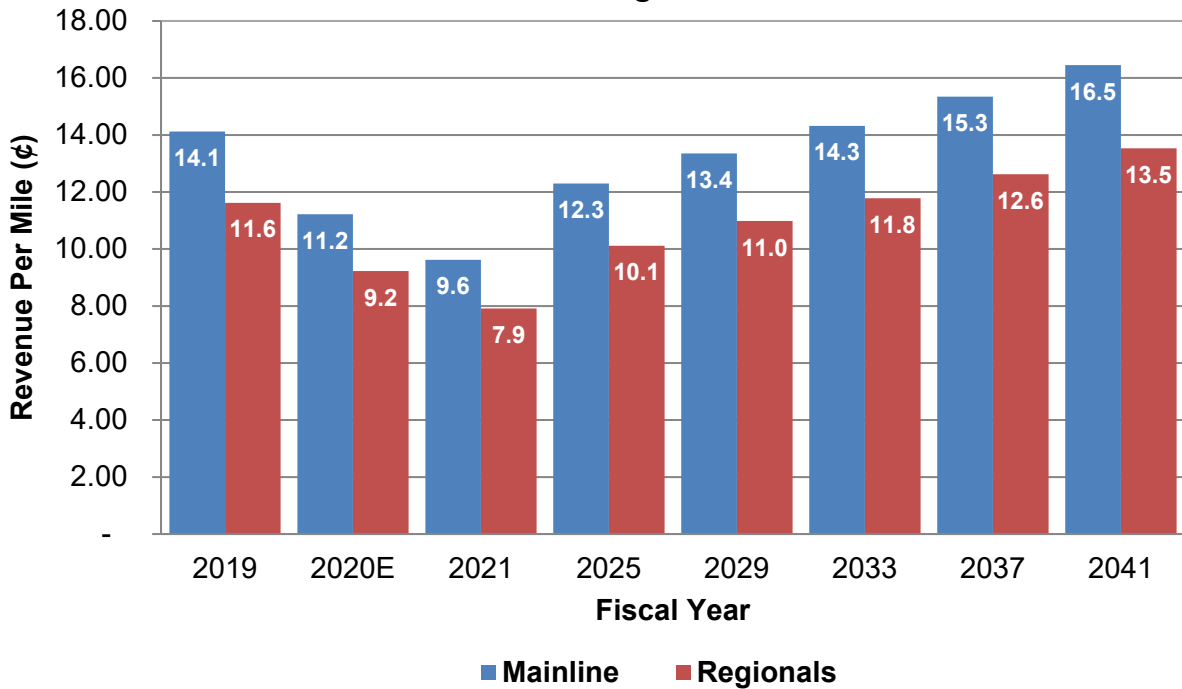
Regional carriers suffered very similar consequences of COVID-19 as did the mainline group. In 2020, regionals provided 11.5 percent of domestic capacity, up just slightly from 11.1 percent in 2019. In terms of traffic, regionals saw marginally better performance than their mainline counterparts, claiming 11.2 percent of RPM in 2020 compared to 10.4 percent in 2019. The deviations in 2020 are expected to be temporary as travel patterns and airline operations begin their recovery to more normal conditions.

The regional market continues to face pressure as the regionals compete for even fewer contracts with the remaining dominant carriers; this has meant paltry growth in enplanements and yields.

**U.S. Commercial Air Carriers  
Domestic Enplanements by Carrier Group**



**U.S. Commercial Air Carriers  
Domestic Passenger Nominal Yield**



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. Furthermore, as mainline carriers cut service to smaller cities during 2020, it was the regional partners that were most affected. While regional airlines had previously faced some pilot shortages, this problem evaporated with the onset of the pandemic and the resulting capacity cuts. As regional carriers recover and activity returns to 2019 levels, both of these concerns are expected to reverse: service to smaller cities will return and flight crews will again be in short supply.

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 2020. A consequence of this drive to replace their 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 2020, mainline seats per aircraft continued to grow but at about half the previous pace as carriers parked or retired many of their largest aircraft.

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. In the middle two quarters of 2020, change fee revenue fell by about 90 percent compared to 2019, while other miscellaneous fees contracted by less than 50 percent. 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.

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. In 2015, Delta introduced “Basic Economy” fares that provided customers with a main cabin experience at lower cost in exchange for fewer options. In February 2017, American began offering its version, and United deployed its version of Basic Economy fares across its domestic network in May 2017.

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, and regionals' had risen 2 percent, low cost carrier enplanements grew by 39 percent. RPMs over the same period show a similar pattern with mainline RPMs up almost 27 percent, regional RPMs up 11

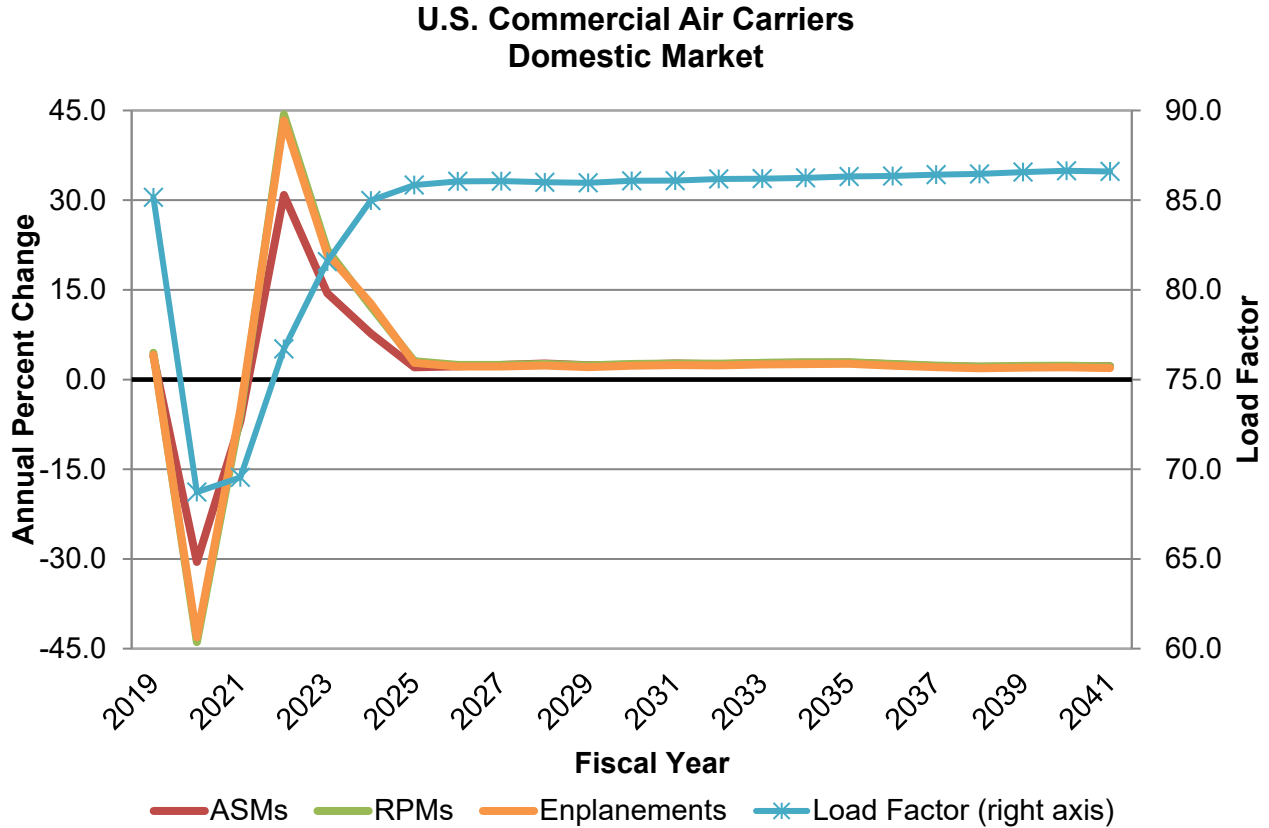
percent and LCC RPMs fully 48 percent higher. These longer term trends were interrupted in 2020 with both enplanements and RPM dropping across all categories by about 40 percent from 2019. Nevertheless, the strength of LCCs is expected to continue in coming years.

2020 also saw other trends interrupted. U.S. commercial air carriers' total number of domestic departures had risen for the second year in a row in 2019, and ASM had risen each of the previous nine years. But then in 2020, departures and ASM declined sharply, falling almost 30 percent from the prior year. On the demand side, RPMs and enplanements, which had grown for nine consecutive years, saw even steeper declines of 40 percent in 2020. The prior trends were a result of the expanding size of aircraft and higher load factors.<sup>4</sup> In 2019, the domestic load factor bumped up to 85.2 percent – a new historic high – but then tumbled to 68.7 percent in 2020 as passengers stopped flying to a greater extent than carriers could match.

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<sup>4</sup> Commercial air carriers encompass both mainline and regional carriers.





System (the sum of domestic plus international) capacity contracted 35.9 percent to 791 billion ASMs in 2020 while RPMs plummeted 47.3 percent to 550 billion. During the same period, system-wide enplanements fell 44.2 percent to 511 million. 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 in 2020, travel restrictions associated with COVID-19 caused this split to continue as domestic capacity was curtailed less than international: -30.5 percent for domestic compared to -49.5 percent for international. However, as U.S. carriers shift their focus to recovery, international capacity growth will outpace domestic, mainly because the international reductions in 2020

were much more severe. Subsequent years through 2041 see carriers continue to expand capacity in international markets faster than domestic as the domestic market continues to mature.

U.S. mainline carrier enplanement growth in the combined domestic and international market was -44.9 percent in 2020 while regional carriers carried 41.3 percent fewer passengers.

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 43.6 percent. Similarly, mainline passengers in international markets had posted a tenth consecutive year of growth in 2019 and that trend was broken in 2020 with a 53.4 percent decline.

Domestic mainline enplanement growth is forecast to drop further in 2021, falling 4.2 percent before beginning a recovery in 2022 with a 43.3 percent increase. The two subsequent years, 2023 and 2024, also see strong rates of growth and domestic mainline enplanements return to 2019 levels in early 2024. With the recovery complete, domestic enplanements resume growth driven by economic fundamentals and average 2.3 percent over the remainder of the forecast. International mainline enplanements follow a similar path with strong growth early in the

### 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 performance continued in 2020 although rather than appearing as stronger domestic growth, it manifested as a less severe decline: domestic enplanements fell 43 percent in 2020 compared to 53 percent for international. International travel was 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, even as leisure travel was supporting domestic markets. International travel is expected to continue to be constrained over the next two to three years by varying levels of COVID-19 infections and governmental responses across countries. Individuals will also be making personal assessments of the

recovery that slows as enplanements return to 2019 levels in 2025. From then through the end of the forecast in 2041, international enplanements are expected to grow at an average of 3.3 percent.

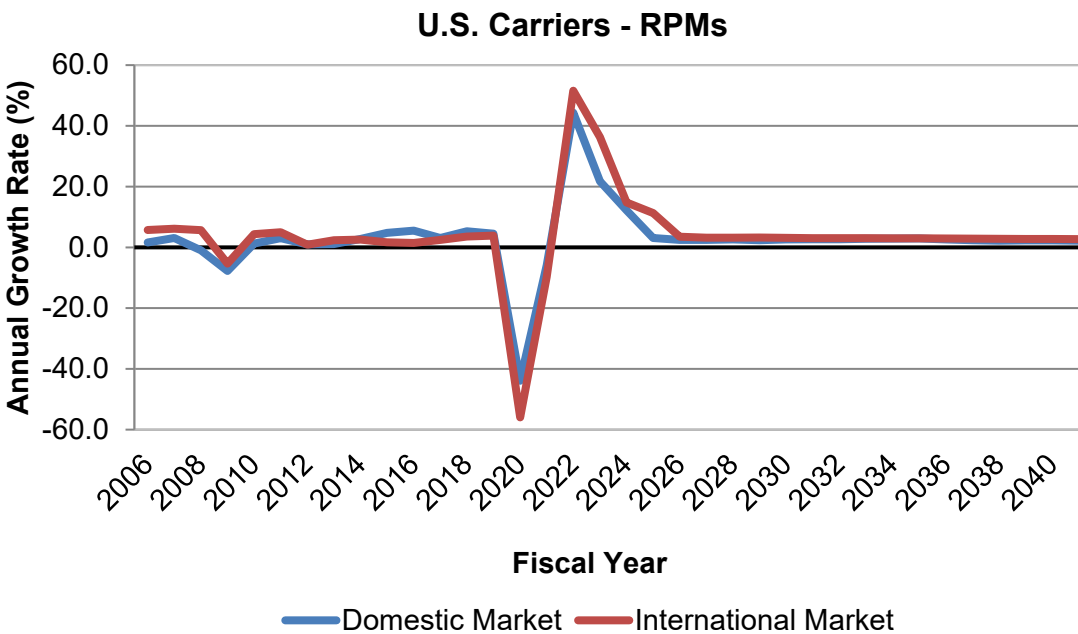
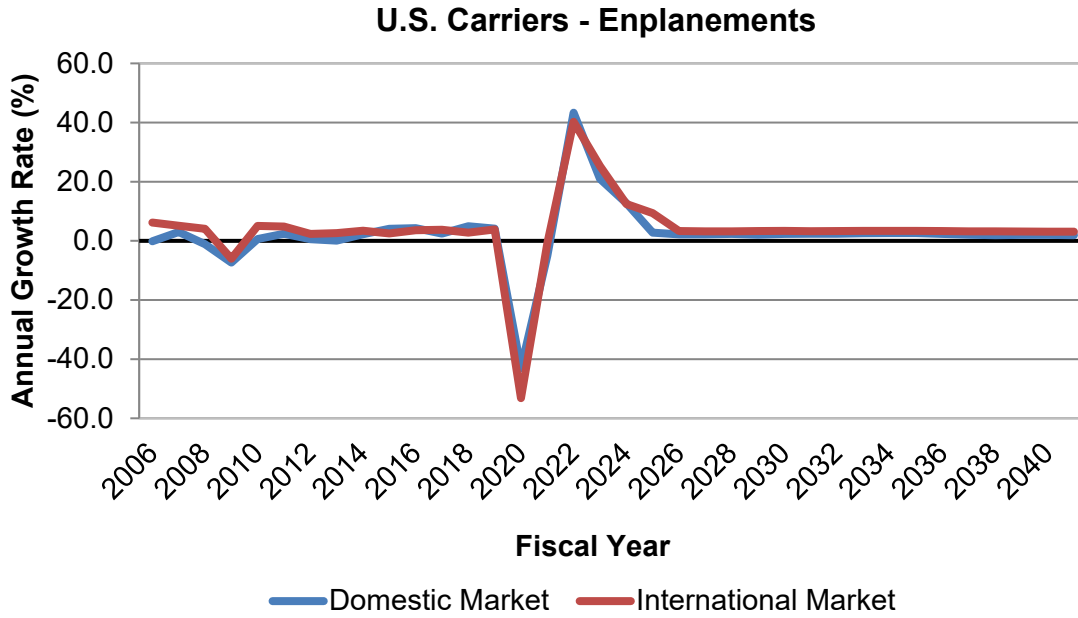
Although carriers cut capacity, the drop in traffic was even greater and system load factor fell from 84.5 percent in 2019 to 69.5 in 2020 – a drop that far exceeded those following both 9/11 and the Great Recession. Load factor gradually recovers, returning to its 2019 level in 2025.

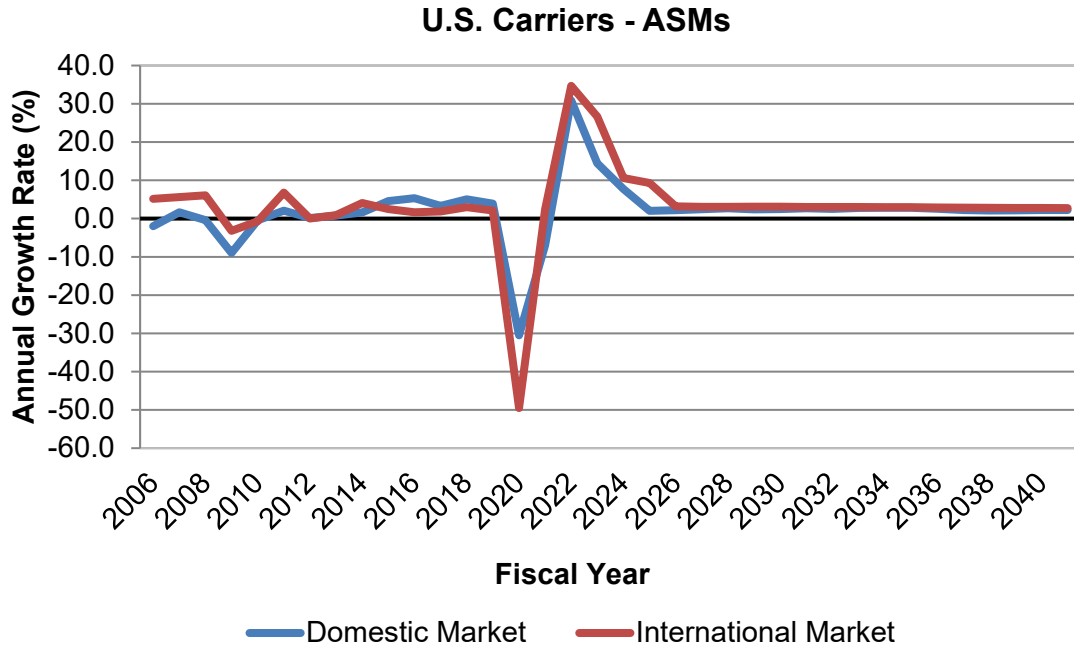
risks of travel and will likely be less comfortable travelling internationally than domestically. The early years of the recovery will see some strong growth rates as activity levels come off a low base but these will return to more typical rates once levels approach 2019 values expected in early 2025. From FY 2021-2025, average annual growth rates for ASM and RPM are projected to be just over 16 percent while enplanements are forecast to grow at 19 percent. From FY 2025-2041, annual growth for ASM and RPM is forecast at 3.0 percent while enplanements will grow at a rate of 3.1 percent. Taking these two periods as a whole gives annual growth rates from FY 2021-2041 for ASM, RPM and enplanements of 6.0, 6.6, and 6.1 percent, respectively.

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 dampened credit growth, 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. In turn, this has been driven

by trade disputes as well as China's continuing gradual slowdown which has been managed by the government and is unlikely to decline sharply. Overall, global conditions appear set to return to a stable path once the pandemic has been brought under control

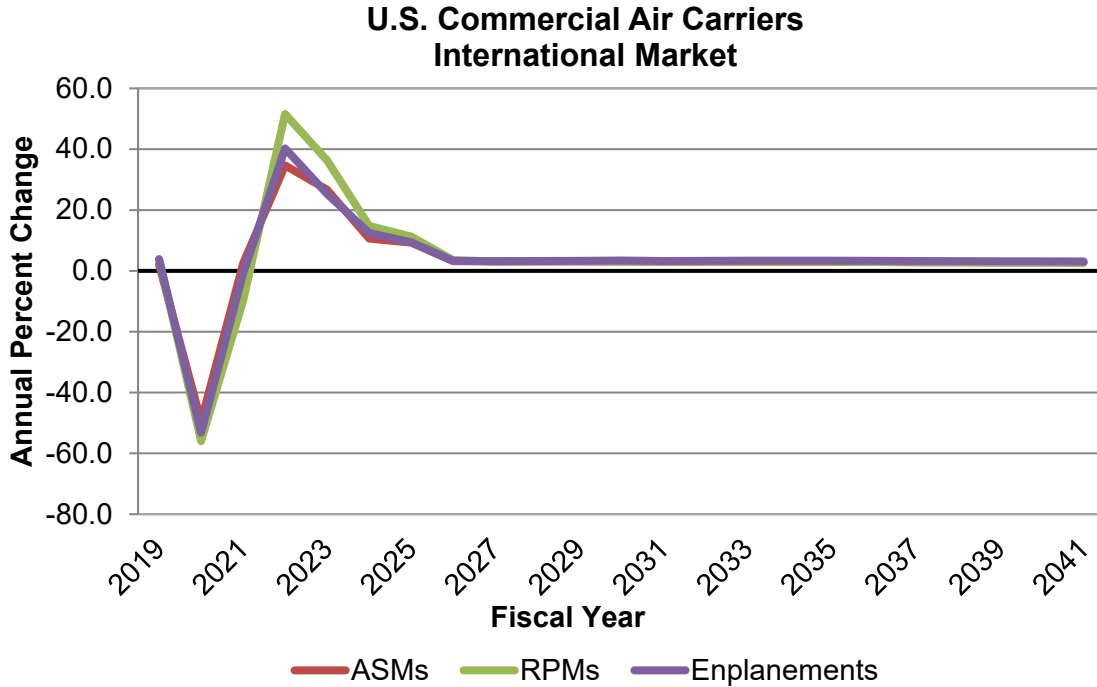
but with growth rates that are closer to long-term trends than the higher rates of the recent pre-pandemic years. Nevertheless, combined with moderate oil prices, this presents a supportive environment for air travel demand.





While 2020 was a very difficult year for carrier management because no amount of marketing, low fares or other strategizing could generate the much-needed activity, 2021 will likely be equally challenging. Carriers will be eager to add capacity to capture revenue as long as that revenue covers the additional variable costs. Further, the added capacity will have the competitive purpose of defending market share. While the locations and extent of any demand recovery are extremely uncertain, overall activity will be

weak. In 2021, ASM are forecast to grow 2.5 percent. RPM and enplanements, however, are expected to fall (partly due to the timing of fiscal 2020, which included five strong months) by 9.7 and 0.7 percent, respectively. Load factors have already reflected this tension as they dropped from 82.9 percent in 2019 to 72.3 percent in 2020. They fall further in 2021 to a low of 63.8 percent before returning gradually close to 2019 levels in 2025.



The impact of COVID-19 on travel by region has varied somewhat, 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. In 2020, enplanements to Latin America suffered the least compared to the previous year, followed by the Pacific and Atlantic regions.

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. Enplanements in 2020 fell an estimated 48.7 percent while RPMs fell 48.9 percent. Positive growth is projected to resume in 2021, supported in part by leisure traffic to warm weather destinations and by the relatively low number of COVID-19 cases and travel restrictions in

some countries. Enplanements and RPMs are forecast to increase 16.0 and 20.8 percent, respectively, in 2021, and continue with double-digit increases in the following three years. RPM are expected to recover to 2019 levels in early 2026. Over the twenty-year period 2021-2041, Latin America enplanements are forecast to increase at an average rate of 6.2 percent a year while RPMs grow 6.5 percent a year.

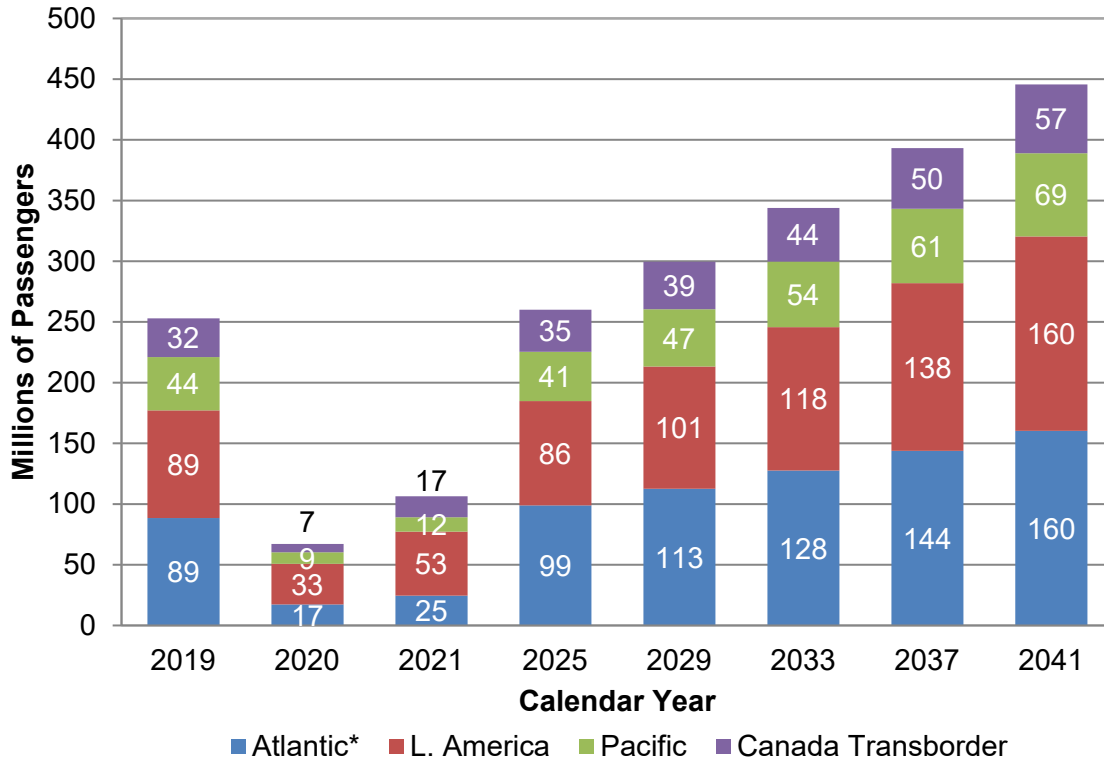
The Pacific region is the smallest in terms of enplanements despite the economic growth and potential of air travel to the region's emerging markets. In 2020, U.S. carriers saw enplanements drop 57.9 percent from their 2019 levels, as many countries closed their borders early in the year, especially China, a very large market in the region. Meanwhile, traffic (RPMs) tumbled by 58.4 percent. In 2021, enplanements and RPM are expected to decline further though at slower rates: -36.0 and -32.2 percent, respectively. Because many countries in the

Pacific region have had relative success in controlling COVID-19 transmission, travel restrictions will be slow to lift, contributing to the continued travel decline in 2021. Strong increases are projected for the following two years and RPM returns to 2019 levels in 2025. For the twenty-year period 2021-2041, Pacific enplanements are forecast to increase at an average rate of 5.7 percent a year while RPMs grow 6.3 percent a year. 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 have a majority of their service in the region to Japan as opposed to faster growing countries.

With roughly twice the enplanements of the Pacific region in recent years, the Atlantic region ranks in the middle. After contracting in 2015 and 2016, Atlantic enplanements have

accelerated steadily in recent years reaching 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 61.1 percent and 2021 is projected to see another, smaller decline. Percentage gains in subsequent years are large, returning enplanements to 2019 levels in early 2025. While 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 twenty-year period from 2021 to 2041, enplanements and RPM in the Atlantic region are forecast to grow at an average annual rate of 6.9 percent.

**Total Passengers To/From the U.S.  
American and Foreign Flag Carriers**



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 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.

FAA projects total international passenger growth of 58.3 percent in 2021 as global economic growth rebounds. The strongest passenger growth is expected in the Latin region and the slowest in the Pacific. Similar to

growth rates of enplanements on U.S. carriers, total passenger growth rates in the early years of the forecast are high, returning passenger numbers to 2019 levels in 2025. Moderate global economic growth averaging 2.9 percent a year over the next 20 years (2021-2041) is the foundation for the forecast growth of international passengers of 9.4 percent a year, as levels increase more than six-and-a-half times from 67 million in 2020 to 446 million in 2041.

The Atlantic and Latin American regions were of comparable size in 2019 and both reach the end of the forecast period again at similar sizes although the 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 (2021-2041), the Atlantic region grows at an average annual rate of 11.2 percent while Latin America grows at a rate of 7.7 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, stringent COVID-19 travel restrictions combined with sluggish Japanese GDP growth will offset some of the strong economic growth and rising incomes in China, India and South Korea, resulting in

a relatively slow return to 2019 passenger levels in 2027. From 2021 to 2041, passengers between the United States and the Pacific region are forecast to grow 9.9 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 10.5 percent over the forecast period, similar to the Atlantic region. Total passenger counts return to 2019 levels in 2024, the fastest of the four regions.

## 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 43.9 billion revenue ton miles (RTMs) in 2020, up 2.3 percent from 2019 with domestic cargo RTMs increasing 9.6 percent to 17.8 billion while international RTMs contracted 2.1 percent to 26.1 billion. In the prior year (2019) domestic RTM increased just 2.8 percent and international declined 1.3 percent. The surge in 2020 domestic RTM was supported by consumers purchasing goods to enhance time spent at home as necessitated by the pandemic. Air cargo RTMs flown by all-cargo carriers comprised 88.0 percent of total RTMs in 2020, with passenger carriers flying the remainder.

Total RTMs flown by the all-cargo carriers increased 12.2 percent in 2020 while total RTMs flown by passenger carriers fell by 37.8 percent. Although many passenger carriers reconfigured aircraft to accommodate more cargo, the sheer drop in passenger flights outweighed that increase, resulting in the steep drop of passenger carrier RTM. As passenger flights return, the share of cargo on passenger carriers will increase, rising from 12 percent in 2020 to about 19 percent in 2024.

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 2.3 percent in 2020, total RTMs are expected to grow 5.5 percent in 2021, primarily due to strong increases in passenger carrier RTM growth. 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 3.0 percent over the forecast period (from 2021 to 2041).

Following a 9.6 percent surge in 2020, domestic cargo RTMs are projected to moderate in subsequent years as the boost from the pandemic fades. Between 2021 and 2041, domestic cargo RTMs are forecast to increase at an average annual rate of 1.6 percent. In 2020, all-cargo carriers carried 93.4 percent of domestic cargo RTMs. The all-cargo share is forecast to decline modestly to 91.1 percent in the medium-term as

passenger flights return to the system. In the long-term, the all-cargo share rises only slightly to 92.1 percent by 2041 based on increases in capacity for all-cargo carriers.

International cargo RTMs fell 2.1 percent in 2020 after posting a 1.3 percent decline in 2019. As with domestic markets, RTM carried by all-cargo carriers grew strongly in 2020 while that transported by passenger carriers fell even more sharply: 11.6 percent compared to -40.8 percent. With the post-pandemic return of passenger flights, RTM on passenger aircraft is expected to grow rapidly, increasing about 19 percent per year from 2021 to 2024. Over the same period, all-cargo RTM grows at about 2 percent per year as passenger carriers capture much of the overall growth. Following that period of recovery, growth for both types of carriers returns to long-run trend rates. For the forecast period (2021-2041), international cargo RTMs are expected to increase an average of 3.8 percent a year based on projected growth in world GDP with the Pacific International region having the fastest RTM growth (4.3 percent), followed by Other (4.1 percent), Atlantic (3.2 percent), and Latin America region (3.1 percent).

The share of international cargo RTMs flown by all-cargo carriers was 84.2 percent in 2020 and is forecast to decline steadily during the recovery period before gradually increasing in line with historical trends and ending at 78.4 percent in 2041.

## General Aviation

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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,”<sup>5</sup> 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.

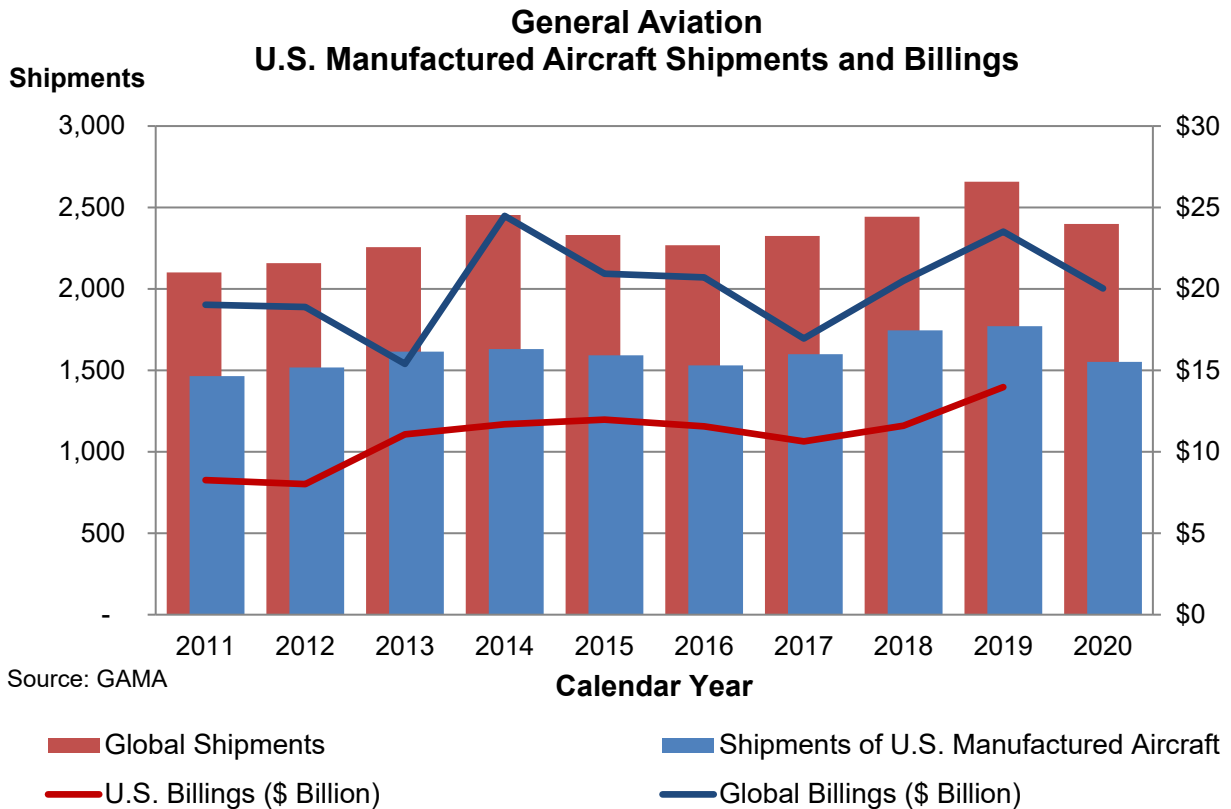
The results of the 2019 GA Survey, the latest available, were consistent with the results of surveys conducted since 2004 improvements to the survey methodology. The active GA fleet was estimated to be 210,981 aircraft in 2019 (0.4 percent decline from

2018), as increases in fixed wing turbine, rotorcraft, lighter-than-air and light sport aircraft (LSA) were offset by decreases in the fixed wing piston, experimental aircraft and gliders. Total hours flown were estimated to be 25.6 million, up 0.2 percent from 2018. Increases in fixed wing piston aircraft, rotorcraft, LSA, experimental and lighter-than-air aircraft hours offset declines in fixed wing turbine aircraft and glider hours.

In 2020, deliveries of the general aviation aircraft manufactured in the U.S. decreased to 1,552, 12.4 percent lower than in CY 2019. Deliveries of single-engine piston aircraft were up 3.2 percent, while the much smaller segment of multi-engine piston deliveries were down by 46.6 percent (summing to a 0.1 percent decline in the fixed engine piston deliveries). Business jet deliveries declined by 29.8 percent and turboprop deliveries were down by 17.7 percent, amounting for a 24.5 percent decrease 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 decreased in 2020 by 14.8 percent to \$20 billion, nearly the same level as in 2018.

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<sup>5</sup> An active aircraft is one that flies at least one hour during the year.



GAMA also reported the rotorcraft deliveries declined at a global level in 2020 in both piston and turbine segments by 20.7 percent and 16.9 percent, respectfully.

Against these current conditions, we expect the GA sector, which was not as severely affected by the pandemic as the airlines, to recover sooner to its 2019 levels by aircraft type than the other sectors. Then, the long-term outlook for general aviation, driven by turbine aircraft activity, remains stable. The active general aviation fleet, which showed a decline of 2.8 percent between 2019 and 2020, is projected to slightly increase from its current level, as the increases in the turbine, experimental, and light sport fleets remain just above the declines in the fixed-wing piston fleet. The total active general aviation fleet changes from an estimated 204,980 in

2020 to 208,790 aircraft by 2041 (a small increase of 0.1 percent annually). When measured from pre-COVID-19 levels in 2019, the active GA fleet of 210,981 remains statistically flat, or experiences an annual decline of 0.05 percent on average.

The more expensive and sophisticated turbine-powered fleet (including rotorcraft) is projected to grow by 12,990 aircraft between 2020 and 2041 to total 45,530 in 2041, an average rate of 1.6 percent a year during this period, with the turbojet fleet increasing 2.3 percent a year. When measured from the 2019 levels, the growth rate for the turbine-powered fleet is also 1.6 percent. The growth in U.S. GDP and corporate profits are catalysts for the growth in the turbine fleet.

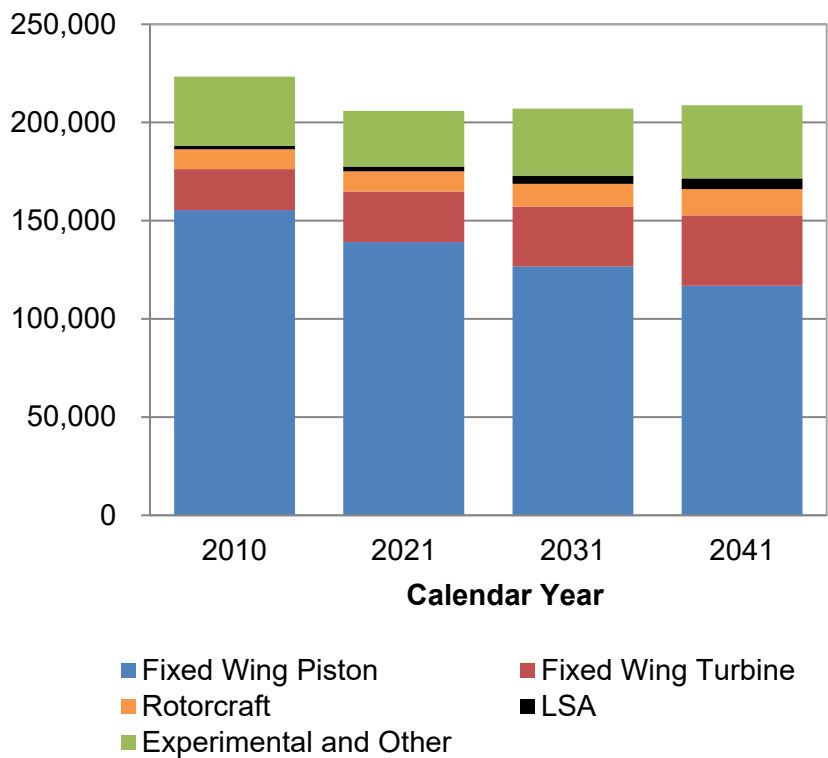
The largest segment of the fleet, fixed wing piston aircraft, is predicted to shrink over the

forecast period by 23,410 aircraft (an average annual rate of -0.9 percent – whether it is measured from the fleet of 141,396 in 2019 or 140,315 in 2020, by the time it reaches to 116,905 in 2041). Unfavorable 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.

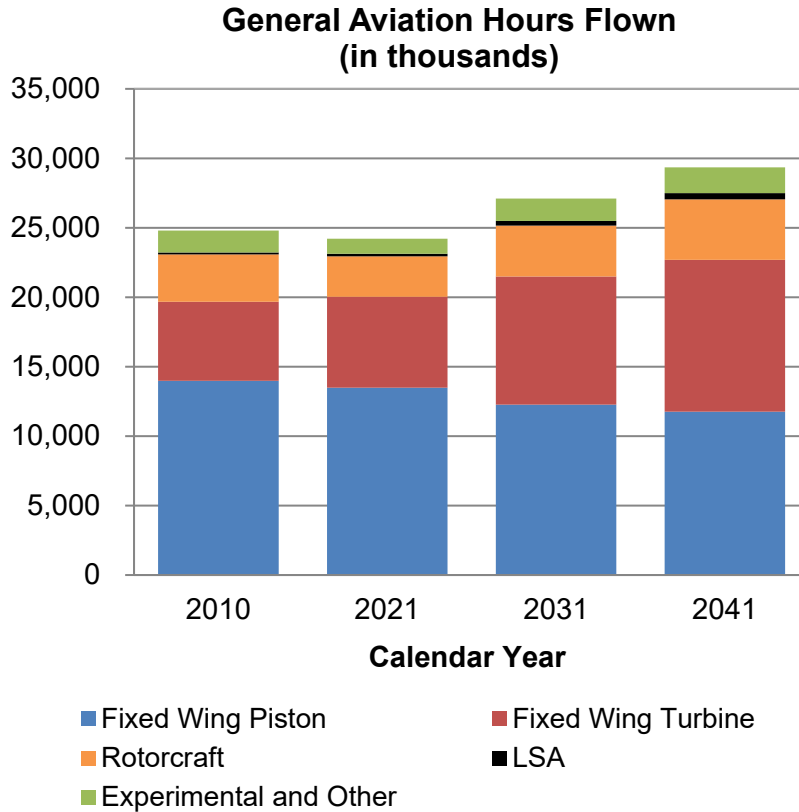
On the other hand, the smallest category, light-sport-aircraft (created in 2005), is forecast to grow by 4.5 percent annually, adding about 3,270 new aircraft by 2041, doubling its 2019 fleet size of 2,675.

**Active General Aviation Aircraft**



Although the total active general aviation fleet is projected to marginally decline, the number of general aviation hours flown is forecast to increase an average of 0.6 percent per year through 2041, from 25.6 million in 2019 to 29.4 million, as the newer aircraft fly more hours each year. Fixed wing piston hours are forecast to decrease by 0.9 percent, the same rate as the fleet decline.

Countering this trend, hours flown by turbine aircraft (including rotorcraft) are forecast to increase 2.2 percent yearly between 2019 and 2041. Jet aircraft are expected to account for most of the increase, with hours flown increasing at an average annual rate of 3.1 percent over the forecast period. The large increases in jet hours result mainly from the increasing size of the business jet fleet.



Rotorcraft activity, which was not as heavily impacted by the pandemic conditions as most of the other aircraft categories, faces the challenges brought by lower oil prices, a continuing trend. The low oil prices impacted utilization rates and new aircraft orders both directly through decreasing activity in oil exploration, and also through a slowdown in related economic activity. Their active fleet is projected to grow at a slower rate than the previous year’s forecast, more so for the piston segment, to reach from a total of (piston and turbine together) 10,198 in 2019 to 13,390 in 2041. Rotorcraft hours are projected to grow by 1.7 percent annually over the forecast period.

Lastly, the light sport aircraft category is forecasted to see an increase of 4.0 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 691,691 active pilots certificated by FAA at the end of 2020. The number of certificates in some pilot categories continued to increase, while there were different rates of declines in the rotorcraft only, ATP, private, and recreational certificates. The FAA has suspended the student pilot forecast for the forth-consecutive year. 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

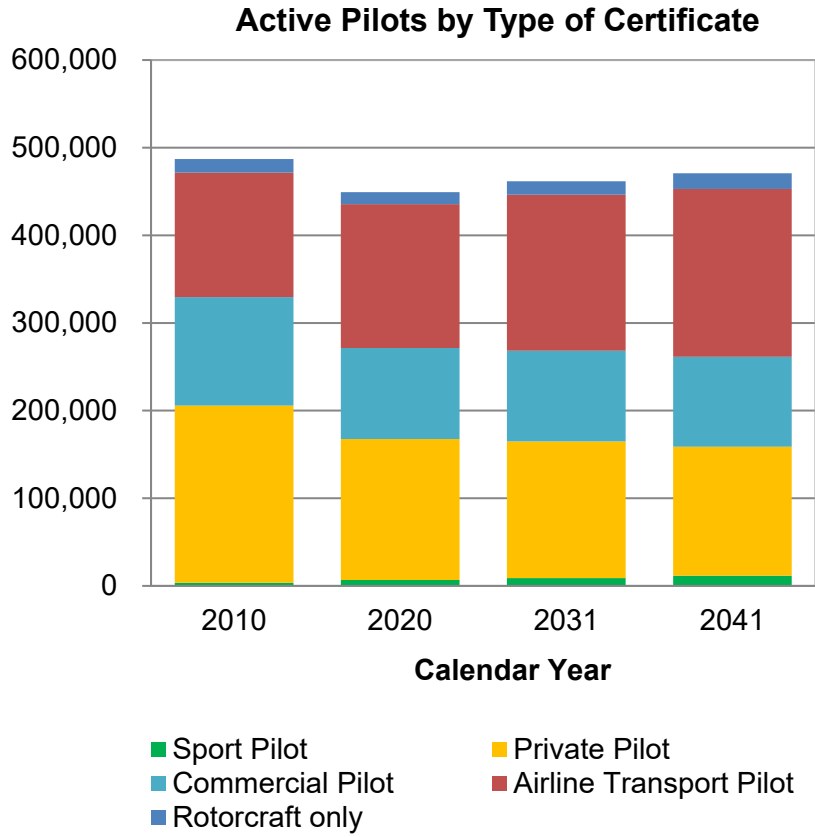
222,629 at the end of 2020. The 2016 rule change generates a cumulative increase in the certificate numbers and breaks the link between student pilot and advanced certificate levels of private pilot or higher. There is no sufficient data yet to perform a reliable forecast for the student pilots.

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 both commercial pilot and ATP certificates had increased until 2012 for three years. Commercial pilot certificate holders continued to increase in 2020 to 103,879. 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 slightly declined in 2020 for the first time since 2011 to 164,193 (still higher than the 2018 level).

Private pilots experienced a slight decrease in 2020 as well, from 161,105 in 2019 to 160,860. Sport pilot certificates, created in 2005, kept their steady increase since their inception to reach 6,643 by December 31, 2020. Rotorcraft pilots continued their decline since 2016 to end up with 13,629 by the end of 2020.

The number of active general aviation pilots (excluding students and ATPs) is projected to decrease about 2,650 (down 0.04 percent yearly) between 2020 and 2041. The ATP category is forecast to increase by 27,400 (up 0.7 percent annually). The much smaller category of sport pilots are predicted to increase by 2.7 percent annually over the forecast period. On the other hand, both private and commercial pilot certificates are projected to decrease at an average annual rate of 0.42 and 0.06 percent, respectively until 2041.



## FAA Operations

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The traffic at FAA facilities underwent drastic changes from 2019 to 2020 due to COVID-19. Activities declined about 17 percent from 53.3 million in 2019 to 44.4 million in 2020. The recovery from the pandemic will drive the near term growth. Consequently, elevated growth is predicted to last until around 2025 and 2026. After the predicted operations reach the pre-pandemic level, the 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. The forecast annual growth rates during the period of 2021 to 2041 will be significantly greater than what was predicted last year as a result of robust growth in the near term from the pent-up demand. Activity at FAA and contract towers is forecast to increase at an average rate of 1.9 percent a year through 2041 from 44.4 million in 2021 to close to 64.2 million in 2041. Commercial operations<sup>6</sup> at these facilities

are forecast to increase 3.4 percent a year, approximately five times faster than non-commercial operations. The growth in commercial operations is less than the growth in U.S. airline passengers (3.4 percent versus 5.6 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 (which accounted for 56 percent of operations in 2020) are forecast to increase an average of 0.75 percent a year as increases in turbine powered activity more than offset declines in piston activity.

The growth in operations at towered airports is not uniform. Most of the activity at large and medium hubs<sup>7</sup> is commercial in nature, given that these are the airports where most of the passengers, about 88 percent in 2020, in the system fly to.

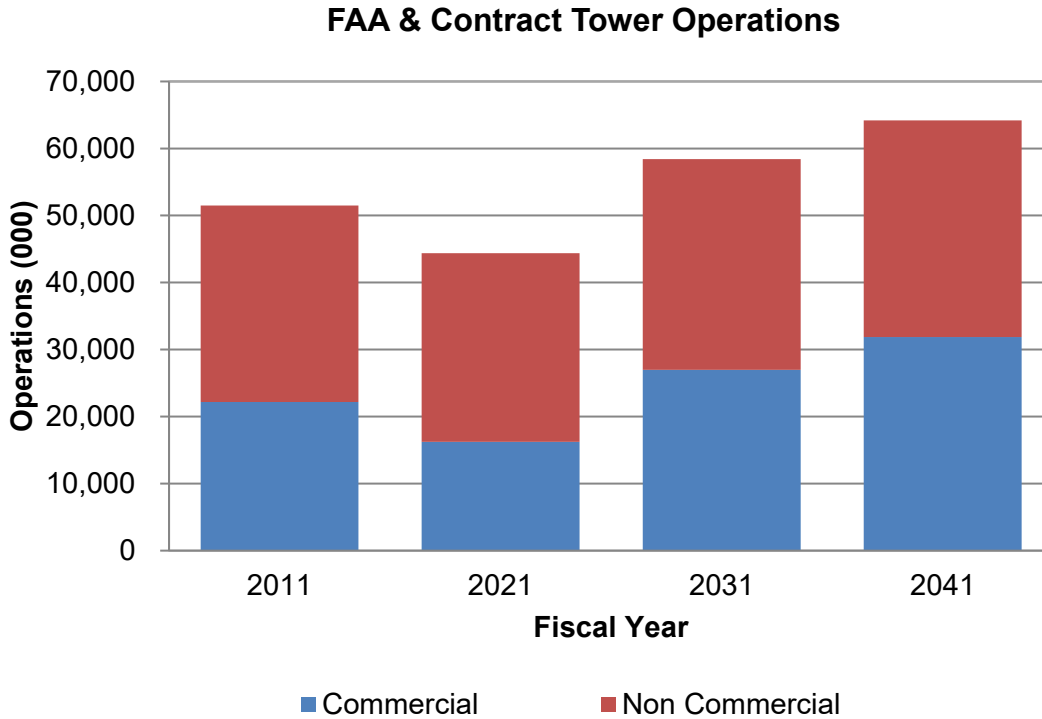
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<sup>6</sup> Sum of air carrier and commuter/air taxi categories.

<sup>7</sup> A large hub is defined to have 1 percent or more of total U.S. revenue passenger enplanements in FY 2019. 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 2020 TAF there were 30 large hub airports and 32 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 small towered airports including small FAA towers<sup>8</sup> and FAA contract towers<sup>9</sup>. The forecasted annual growth is 3.9 percent at large hubs, 3 percent at medium hubs, 1 percent at small FAA towers, and 0.8 percent at FAA contract towers between 2021 and 2041.

Among the 30 large hubs, the airports with the fastest annual growth forecast are those located along the coastal sections of the country where most large cities are located.

<sup>8</sup> Small FAA towers are defined as towered airports that are neither large or medium hubs nor FAA contract towers.

<sup>9</sup> FAA contract towers are air traffic control towers providing air traffic control services under contract with FAA, staffed by contracted air traffic control specialists.

Large cities have historically shown to generate robust economic activity, which in turn drives up the airline demand. On the other hand, the airports forecast to have slower annual growth tend to be located in the middle of the country.

FAA Tracon (Terminal Radar Approach Control) Operations<sup>10</sup> are forecast to grow slightly faster than at towered facilities. This is in part a reflection of the different mix of activity at Tracons. Tracon operations are forecast to increase an average of 2.5 percent a year between 2021 and 2041. Commercial operations accounted for approximately 54 percent of Tracon operations in

<sup>10</sup> 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.

## FAA Aerospace Forecast Fiscal Years 2021–2041

2020 and are projected to grow 3.4 percent a year over the forecast period. General aviation activity at these facilities is projected to grow only 0.96 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 business aviation is expected to lead to increases in activity at En-Route centers. Over the forecast period, aircraft handled at En-Route centers are forecast to increase at an average rate of 3.4

percent a year from 2021 to 2041, with commercial activity growing at the rate of 4 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.<sup>11</sup> In 2020, the share of commercial IFR aircraft handled at FAA En-Route centers is about 80 percent, which is greater than the 54 percent share at Tracons or the 39 percent share at FAA and Contract Towers.

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<sup>11</sup> 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

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After shrinking by 22.9% in 2020 (1,746 aircraft), the number of aircraft in the U.S. commercial fleet is forecast to increase from 5,882 in 2020 to 8,756 in 2041, an average annual growth rate of 2 percent a year. Increased demand for air travel and growth in air cargo is expected to fuel increases in both the passenger and cargo fleets.

Between 2020 and 2041 the number of jets in the U.S. mainline carrier fleet is forecast to grow from 3,181 to 5,101, a net average of 30 aircraft a year as carriers continue to remove older, less fuel efficient narrow body aircraft. The narrow-body fleet (including E-series aircraft as well as A220-series at Jet-Blue and A220-series at Delta) is projected to grow 73 aircraft a year as carriers replace the 757 fleet and current technology 737 and A320 family aircraft with the next generation MAX and Neo families. The wide-body fleet grows by an average of 20 aircraft a year as carriers add 777-8/9, 787's, A350's to the fleet while retiring 767-300 and 777-200 aircraft. In total the U.S. passenger carrier wide-body fleet increases by 1.1 percent a year over the forecast period.

The regional carrier fleet is forecast to increase slightly from 1,853 aircraft in 2020 to 1,944 in 2041 as the fleet expands by 0.2 percent a year (4 aircraft) between 2020 and 2041. 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 after 2021. By 2031 only a handful of 50 seat regional jets remain in the fleet. By 2041, the number of jets in the regional carrier fleet totals 1,838, up from 1,434 in 2020. The turboprop/piston fleet is forecast to shrink by 75% from 419 in 2020 to 106 by 2041. These aircraft account for just 5.5 percent of the fleet in 2041, down from 22.6 percent in 2020.

The cargo carrier large jet aircraft fleet is forecast to increase from 848 aircraft in 2020 to 1,711 aircraft in 2041 driven by the growth in freight RTMs. The narrow-body cargo jet fleet is projected to increase by 15 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 26 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.

