FAA Aerospace Forecast Fiscal Years 2022–2042

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Economic Environment

In 2021, global real GDP expanded sharply as countries began to recover from the worst of the economic effects of COVID-19. After falling 3.5 percent in 2020, GDP surged by 5.6 percent in 2021, a rate not seen since the early 1970s. Despite this high rate of growth, the level of GDP is not expected to return to its pre-pandemic path until about the middle of the decade. The recovery was supported by widespread fiscal stimulus, the availability of COVID-19 vaccines and the revival of consumer spending that had been curtailed in 2020. Moving into 2022 and 2023, countries are expected to shift their foci to dealing with COVID-19 as an endemic disease, to fiscal restraint, to rising interest rates and to reducing inflation, all of which contribute to moderating GDP growth in the coming years.

In the U.S., real GDP growth slows from 5.5 percent in 2021 to 4.3 percent in 2022 and 2.9 percent in 2023 as the effects of COVID-19 relief measures wear off, consumer spending normalizes and interest rates rise. Compared to the U.S., real GDP growth in the Eurozone will be somewhat slower in the near- and medium-term at 3.7 percent in 2022 and 2.2 percent in 2023. Aggressive deficit reduction efforts, high energy costs and supply chain disruptions all dampen growth in the near-term followed by continued slowing toward the area's trend rate. In Japan, the recovery was somewhat delayed by stringent COVID-19 control measures and

increased cases in the second half of 2021. resulting in real GDP growth rates that rise in 2022 before receding in 2023. Some of the near-term strength will be due to increased exports, particularly autos, as supply chain disruptions fade. Although China's growth remained positive in 2020 and jumped to 8.1 percent in 2021, the country's zero-COVID policy tamps down growth in 2022 and 2023 to 5.5 percent, or slightly below its trend rate. Additionally, exports slow as global consumer spending shifts out of goods and back to services. In efforts to support growth, the government is easing monetary policy and boosting infrastructure investment. In other large emerging markets, Brazil provided large fiscal stimulus causing growth to surge in 2021 but then fall back sharply in 2022 as that stimulus was withdrawn. Further constraining growth, Brazil's central bank hiked interest rates sharply in an effort to rein in the country's high inflation. Russia, like Brazil, began raising interest rates in 2021 to counter inflation, thus restraining GDP growth. On the other hand, the energy sector, consumer spending and investment activity are expected to counterbalance that restraint.. While India's pandemic stimulus spending has been relatively modest, in the mediumterm its growth will be supported by favorable demographics including strong consumer spending from growing middle-income households.



World Economic Growth in 2021

Source: IHS Markit

IHS Markit forecasts world real GDP to grow at 2.8 percent a year between 2022 and 2042. 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 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 2022-2042)

Source: IHS Markit, Dec 2021 World Forecast

Accompanied by the rebound in global economic activity was increased demand for oil in 2021, pushing prices up. After dropping from about \$60 per barrel to \$43 in 2020, the price returned to \$60 and is projected to continue up to \$75 in 2022. Again, however, this forecast does not include the impacts of the Russian invasion of Ukraine, which will likely push prices even higher in 2022 and beyond. 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 \$87 per barrel at the end of the forecast horizon.



U.S. Refiners' Acquistion Cost

U.S. Airlines

Domestic Market

Mainline and regional carriers² 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.

² 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 previous two years will improve in 2022. Driving the predictability will be the continued lifting of COVID-19 precautions, the working off of pent-up demand, and employees returning to offices as they become more comfortable with travelling again and employers find ways to satisfy duty-ofcare requirements. Increasingly predictable activity allows carriers to return capacity to typical markets, and reduce reliance on purely recreational destinations. Load factors and utilization rates will rise and so will fares.

In the final recovery phase, activity approaches 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 2021, regionals provided 11.6 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 11.3 percent of RPM in 2021 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 implies 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. And as mainline carriers cut service to smaller cities over the past two 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 2021. 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 2021, mainline seats per aircraft bumped up to almost 13 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 bevond 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 FY2021. 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 6.7 percent in FY2021. And in the third quarter of 2021, revenue from baggage fees exceeded that in the same quarter of 2019 even though total passenger revenue remained down nearly a third.

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 both enplanements and RPM dropping across both mainline and LCC carriers to about 55 percent of 2019's levels. However, by 2021 the strength of LCC's became apparent again as their enplanements and RPM had recovered to about 70 percent of 2019 levels while mainline traffic edged up to about 60 percent. In fact, 2021 saw the inaugural operations of three new small LCCs, Aha!, Avelo and Breeze, all of which are targeting smaller, underserved cities with point-to-point flights independent of mainline contracts.

The outbreak of the pandemic in 2020 interrupted other domestic trends as well. U.S. commercial air carriers'3 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 30 percent from the prior year. On the demand side, RPM and enplanements, which had grown for ten consecutive years, saw even steeper declines of 40 percent in 2020. Because of the faster demand-side growth, load factors rose in ten of the eleven years leading up to 2020, reaching 85.2 percent, before dropping sharply in that year to 68.6 percent, as passengers stopped flying to a greater extent than carriers could match. As leisure travelers returned in 2021, load factors began to recover and reached 72.4 percent.

³ Commercial air carriers encompass both mainline and regional carriers.



U.S. Commercial Air Carriers Domestic Market

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 continued during the downturn in 2020 and the start of the recovery in 2021. In 2021, domestic enplanements rose to 62 percent of 2019's level after being at 57 percent a year earlier, but international enplanements were flat at 47 percent, increasing less than a percentage point from 2020. International travel continues to be 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 supports domestic markets. International travel is expected to continue to be constrained over the next two years by varying levels of COVID-19 infections and governmental responses across countries. Individuals will also be making personal assessments of the risks of travel and will likely be less comfortable travelling internationally than domestically due to uncertainties surrounding border closures and other restrictions.



U.S. Carriers - RPMs





The early 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. From FY2022-2024, average annual growth rates for international ASM and enplanements are projected at 30 percent while RPM are forecast to grow at an annual rate of 49 percent as aggregate trip lengths grow due to increasing Atlantic and Pacific activity. From FY2024-2042, annual growth for ASM and enplanements are forecast to grow at 3.0 and 3.4 percent, respectively, while RPM will grow at a rate of 3.2 percent. Taking these two periods as a whole gives annual growth rates from FY 2022-2042 for ASM, RPM and enplanements of 6.5, 8.8, and 6.9 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 longterm trends than the higher rates of the recent pre-pandemic years. Rising oil prices, however, will create some drag on this otherwise supportive environment for air travel demand.

The past two years have been particularly difficult for carriers serving international markets because no amount of marketing, low fares or other strategizing could overcome the border closures and other restrictions related to COVID-19 that were constraining demand. For countries with few restrictions or that have lifted restrictions, activity has already been strong and, in some cases, at or above 2019 levels. As other countries lift restrictions this year and next and uncertainties surrounding travel diminishes, activity is expected to resume smartly. In 2022, ASM are forecast to grow 53 percent. RPM will double from its low level in 2021 (just 30 percent of 2019's level) and enplanements will grow 64 percent. Load factors fell further in 2021, reaching 54 percent, almost 30 percentage points below where they were in 2019 because carriers retained some capacity to protect market share. As RPM recovers in 2022, load factors also rise sharply, to 70 percent and are nearly fully recovered by 2024.



U.S. Commercial Air Carriers International Market

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 2021, enplanements to Latin America had recovered the most followed by the Atlantic region and, in a distant third, the Pacific region.

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 contrast to the other two regions that saw declines in 2021, Latin enplanements rose by 34.9 percent while RPMs rose 22.6 percent. 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 in some countries. Enplanements and RPMs are forecast to increase 41.6 and 46.3 percent, respectively, in 2022, before resuming single-digit growth and gradually slowing to a long-term trend rate of around 4 percent. Both enplanements and RPM are expected to recover to

2019 levels in 2023. Over the twenty-year period 2022-2042, Latin America enplanements are forecast to increase at an average rate of 5.8 percent a year while RPMs grow 6.2 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 are expected to come off the bottom and recover to about 20 percent of 2019 levels. Because many countries in the Pacific region have had relative success in controlling COVID-19 transmission, travel restrictions have been slow to lift, leading to the slow recovery in 2022 and in the Although initial growth is medium term. strong in percentage terms due to the low base, trend growth is comparatively slow. Consequently, enplanements take 7 years to fully recover to 2019's level and RPM reach that milestone in 2025. From FY2022-2025, Pacific enplanements and RPM are forecast to double each year on average, and in the long-term from FY2025-2042, grow at rates of 2.4 percent and 2.8 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 61.1 percent and then a further 47.1 percent in 2021 to bottom out at 21 percent of 2019's level. Subsequent percentage gains are large, returning enplanements to 2019 levels in 2024. The historical and forecast path for RPM is quite similar and for the medium-term from FY2022-2024, RPM grows at an average annual rate of 67 percent while enplanements grow at a rate of 71 percent. 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 2022 to 2042, enplanements and RPM in the Atlantic region are forecast to grow at an average annual rate of 10 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, and recovered less in 2021, 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, and all regions remained well below 2019 levels.

FAA projects total international passenger growth of 79.7 percent in 2022 as global economic growth stabilizes and COVID-19 restrictions abate. 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 2024. Moderate global economic growth averaging 2.8 percent a year over the next 20 years (2022-2042) is the foundation for the forecast growth of international passengers of 7.7 percent a year, as levels increase almost five fold from 99 million in 2021 to 470 million in 2042.

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 20 percent more passengers 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 (2022-2042), the Atlantic region grows at an average annual rate of 9.4 percent while Latin America grows at a rate of 5.1 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 2021 were just 10 percent of those in 2019 and combined with stringent COVID-19

System

System (the sum of domestic plus international) capacity contracted 35.9 percent to 791 billion ASMs in 2020 while RPMs plummeted 47.4 percent to 549 billion. During the same period, system-wide enplanements fell 44.3 percent to 511 million. Supported by domestic and Latin markets, activity began to recover in 2021 as ASM, RPM and enplanements expanded by 4.8 percent, 3.3 percent and 9.0 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 in 2020 and 2021, travel restrictions associated with COVID-19 caused this split to largely continue as domestic capacity was curtailed less than international: down 25.5 percent in 2021 from 2019 for domestic compared to down 51.4 percent for international. However, as U.S. carriers shift their focus to recovery, international capacity 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 2022 to 2042, passengers between the United States and the Pacific region are forecast to grow 13.8 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 12.6 percent over the forecast period, slightly faster than the Atlantic region. Total passenger counts return to 2019 levels in 2023, about the same as in the Latin America region.

growth will outpace domestic, mainly because the international reductions in 2020 and 2021 were much more severe. Subsequent years through 2042 see carriers continue to expand capacity in international markets faster than domestic as the international markets see stronger income growth and the corresponding demand for travel.

U.S. mainline carrier enplanement growth in the combined domestic and international market was 8.2 percent in 2021 while regional carriers carried 12.1 percent more passengers – a difference explained by the greater reliance of mainline carriers on lagging international markets.

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 43.7 percent, but followed by a 9.1 percent increase in 2021. Similarly, international mainline passengers had posted a tenth consecutive year of growth in 2019, a trend that was broken in 2020 with a 53.4 percent decline but, in contrast to the domestic side, was followed by a small 1.4 percent increase. Domestic mainline enplanement growth is forecast to accelerate in 2022, rising 30.0 percent as the recovery proceeds. Another year of strong growth in 2023 returns domestic enplanements to 2019 levels in that year. With the recovery complete, domestic enplanements resume growth driven by economic fundamentals and average 2.5 percent over the remainder of the forecast. International mainline enplanements follow a similar path with

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 51.3 billion revenue ton miles (RTMs) in 2021, a large 16.9 percent increase from the previous year that raised RTM 19.7 above 2019's level. Domestic cargo RTMs increased 11.7 percent to 19.9 billion in 2021 while international RTMs expanded 20.4 percent to 31.4 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 surge in 2020 and 2021 RTM was supported by consumers purchasing goods to enhance time spent at home as strong growth early in the recovery that slows as enplanements return to 2019 levels in 2024. From then through the end of the forecast in 2042, international enplanements are expected to grow at an average of 3.5 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 gradually recovers, returning close to its 2019 level in 2025.

necessitated by the pandemic, and by surface transportation disruptions caused by worker shortages due to COVID-19 illnesses. 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 of total RTMs in 2020 and 2021, with passenger carriers flying the remainder. Total RTMs flown by the all-cargo carriers increased 12.3 percent in 2020 while total RTMs flown by passenger carriers fell by 37.8 percent but in 2021, both all-cargo and passenger carriers saw increases of about 17 percent. Although many passenger carriers reconfigured aircraft to accommodate more cargo, the sheer drop in passenger flights in 2020 outweighed that increase, resulting in the steep drop of passenger carrier RTM. As passenger flights return, the share of cargo on all-cargo carriers will ease, dropping from 88 percent in 2021 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, longterm 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 16.9 percent in 2021, total RTMs are expected to grow 2.5 percent in 2022. 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 3.2 percent over the forecast period (from 2022 to 2042).

Following the surge in 2021, domestic cargo RTMs are projected to moderate in subsequent years as the boost from the pandemic fades. Between 2022 and 2042, domestic cargo RTMs are forecast to increase at an average annual rate of 2.6 percent. In 2021, all-cargo carriers carried 93.4 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 92.7 percent by 2042 based on increases in capacity for all-cargo carriers.

International cargo RTMs 20.4 percent surge in 2021 dissipates in 2022 as surface transportation snarls are resolved. As with domestic markets, RTM carried by all-cargo carriers grew strongly in 2020 while that transported by passenger carriers fell even more sharply, but by 2021 both types grew again. With the post-pandemic return of passenger flights, RTM on passenger aircraft is expected to grow rapidly, increasing about 18 percent per year from 2022 to 2024. Over the same period, all-cargo RTM is roughly flat as some tonnage is lost to passenger carriers in 2022. Following the period of recovery, growth for both types of carriers returns to long-run trend rates. For the forecast period (2022-2042), international cargo RTMs are expected to increase an average of 3.6 percent a year based on projected growth in world GDP with the Pacific International region having the fastest RTM growth (4.0 percent), followed by Other (3.5 percent), Atlantic (3.3 percent), and Latin America region (2.1 percent).

The share of international cargo RTMs flown by all-cargo carriers was 84.6 percent in 2021 and is forecast to decline steadily during the recovery period before gradually increasing in line with historical trends and ending at 80.3 percent in 2042.

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,"⁴ 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 2020 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 204,140 aircraft in 2020 (3.2 percent decline from 2019), as increases in fixed wing turbine were more than offset by decreases in pistons, rotorcraft, lighter-than-air and light sport aircraft (LSA), and experimental aircraft. Total hours flown were estimated to be 22.5 million in 2020, down 12.0 percent from 2019. Decreases were across the board, with the highest absolute decline in fixed wing piston hours (10.3 percent), and highest percentage decline in lighter than air aircraft (44.6 percent) and glider activity (28.7 percent), followed by rotorcraft hours (19.6 percent).

In 2021, deliveries of the general aviation aircraft manufactured in the U.S. increased to 1,670, 7.4 percent higher than in CY 2020 (still 5.7 percent lower than the 2019 level, but has been improving). Deliveries of singleengine piston aircraft were up 2.3 percent, while the much smaller segment of multi-engine piston deliveries were down by 51.6 percent (summing to a 0.5 percent increase in the fixed engine piston deliveries). Business jet deliveries increased by 14.7 percent and turboprop deliveries were up 18.6 percent, amounting for a 16.6 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 2021 by 7.7 percent to \$21.6 billion.

⁴ An active aircraft is one that flies at least one hour during the year.



General Aviation U.S. Manufactured Aircraft Shipments and Billings

GAMA also reported the rotorcraft deliveries increased at a global level in 2021 in both piston and turbine segments by 27.5 percent and 13.8 percent, respectively.

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 longterm outlook for general aviation, driven by turbine aircraft activity, remains stable. The active general aviation fleet, which showed a decline of 3.2 percent between 2019 and 2020, is projected to increase from its 2021 level of 204,405 aircraft to 208,905 by 2042, as the declines in the fixed-wing piston fleet were offset by increases in turbine, rotorcraft, experimental, and light sport fleets. The total active general aviation fleet grows by a small increase of 0.1 percent annually. When

measured from pre-COVID-19 levels in 2019, the active GA fleet of 210,981 experiences an annual decline of 0.04 percent on average.

The more expensive and sophisticated turbine-powered fleet (including rotorcraft) is projected to grow by 15,750 aircraft between 2021 and 2042 to total 46,060 in 2042, an average rate of 1.9 percent a year during this period, with the turbojet fleet increasing 2.6 percent a year. When measured from the 2019 levels, the growth rate for the turbinepowered fleet is 1.8 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 22,055 aircraft between 2021 and 2042, an average annual rate of -0.8 percent.

When measured from the 2019 fleet of 141,396 in 2019, the annual decline averages 1.0 percent. 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 3.5 percent annually, adding about 2,890 new aircraft by 2042, doubling its 2019 fleet size of 2,675.



Active General Aviation Aircraft

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 1.1 percent per year through 2042, from 22.5 million in 2020 to 29.6 million, as the newer aircraft fly more hours each year. Fixed wing piston hours are forecast to decrease by 0.6 percent, at a slightly lower rate than that of the fleet decline. Countering this trend, hours flown by turbine aircraft (including rotorcraft) are forecast to increase 3.2 percent yearly between 2020 and 2042. Jet aircraft are expected to account for most of the increase, with hours flown increasing at an average annual rate of 3.8 percent between 2021 and 2042. 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, had been facing the challenges brought by lower oil prices, a trend currently moving in the opposing direction. By the time this forecast was completed, it was too early to include the most recent changes. 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. The active fleet of rotorcraft is projected to grow at a faster rate than the previous year's forecast, driven by higher growth in the turbine segment, going from a total of (piston and turbine together) 9,746 in 2020 to 13,530 in 2042. Rotorcraft hours are projected to grow by 2.2 percent annually between 2021 and 2042.

Lastly, the light sport aircraft category is forecasted to see an increase of 3.9 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 720,605 active pilots certificated by FAA at the end of 2021. The number of certificates in some pilot categories continued to increase, while there were different rates of declines in the rotorcraft only, ATP, 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 250,197 at the end of 2021. 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 2021 to 104,610. 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 2021 for the second year in a row, to 163,934 (still higher than the 2018 level), after growing every year since 2011.

Private pilots increased in 2021, from 160,860 to 161,459, to a level higher than where they were in 2019, after a slight decline in 2020. Sport pilot certificates, created in 2005, kept their steady increase since their inception to reach 6,801 by December 31, 2021. Rotorcraft pilots continued their decline since 2016 to end up with 13,191 by the end of 2021.

The number of active general aviation pilots (excluding students and ATPs) is projected to remain flat between 2021 and 2042 at around 306,400. The ATP category is forecast to increase by 30,360 (up 0.8 percent annually). The much smaller category of sport pilots are predicted to increase by 2.7 percent annually over the forecast period. Commercial pilot certificates, which has been on an increase for five consecutive years, are projected to increase at an average annual rate of 0.1 percent between 2021 and 2042. On the other hand, private pilot certificates are projected to decrease at an average annual rate of 0.6 percent over the forecast horizon.



FAA Operations

The traffic at FAA facilities underwent drastic changes during the period of 2019 and 2020 from the COVID-19 impact. Activity recovered a modest 7.4percent from 44.4 million in 2020 to 47.7 million in 2021, following the 16.7 percent decline from 53.3 million in 2019 to 44.4 million in 2020. The limited recovery was partially due to the fact that FY 2020 includes 5 months of pre-pandemic data. Going forward, the pace of recovery accelerated starting in early spring of CY 2021, and continued in the winter months of CY 2021 and CY 2022 despite the fourth wave of COVID-19 driven by the Delta variant. Elevated growth is predicted to last until around 2023 and 2024 as the unemployment rate is forecast to reach the pre-pandemic level around that time.

After operations return to pre-pandemic levels, 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. Activity at FAA towers and contract towers is forecast to increase at an average rate of 1.5 percent a year through 2042 from 50.7 million in 2022 to close to 68.4 million in 2042. The 1.5 percent annual growth forecast is lower than the 1.9 percent forecast for 2021-2041 last year mainly due to the shorter recovery time from COVID-19. Commercial operations⁵ at these facilities are forecast to increase 2.7 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 (2.7 percent versus 3.8 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 0.6 percent a year as increases in turbine powered activity more than offset declines in piston activity. General aviation operations accounted for 57 percent of operations in 2021. The share has been increasing since the pandemic, from 51 percent in 2019 to 56 percent in 2020, and 57 percent in 2021. This occurs because the decline of general aviation traffic was relatively mild during the pandemic and the recovery speed has been very swift.

The growth in operations at towered airports is not uniform. Most of the activity at large and medium hubs⁶ is commercial in nature, given that these are the airports where most of the passenger enplanements in the U.S., about 87 percent in 2021, are reported.

least 0.25 percent but less than 1 percent of total U.S. revenue passenger enplanements. In the 2021 TAF there were 29 large hub airports and 34 medium hub airports.

⁵ Commercial operations include air carrier and commuter/air taxi operations.

⁶ A large hub is defined to have 1 percent or more of total U.S. revenue passenger enplanements in FY 2021. A medium hub is defined to have at



FAA & Contract Tower Operations

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 towers⁷ and FAA contract towers⁸. The forecasted annual growth is 3.0 percent at large hubs, 2.4 percent at medium hubs, 0.9 percent at small FAA towers, and 0.7 percent at FAA contract towers between 2022 and 2042.

Among the 29 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, the airports forecast to have slower long term annual growth tend to be located in the middle of the country. 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) Operations⁹ are forecast to grow slightly

⁷ Small FAA towers are defined as towered airports that are neither large or medium hubs nor FAA contract towers.

⁸ FAA contract towers are air traffic control towers providing air traffic control services under contract with FAA, staffed by contracted air traffic control specialists.

⁹ 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.

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 1.9 percent a year between 2022 and 2042. Commercial operations accounted for approximately 52 percent of Tracon operations in 2021 and are projected to grow 2.6 percent a year over the forecast period. General aviation activity at these facilities is projected to grow only 0.5 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 busi-

ness aviation sector recovers. Over the forecast period, aircraft handled at En-Route centers are forecast to increase at an average rate of 2.7 percent a year from 2022 to 2042, with commercial activity growing at the rate of 3.1 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.¹⁰ In 2021, the share of commercial IFR aircraft handled at FAA En-Route centers is about 78 percent, which is greater than the 52 percent share at Tracons or the 38 percent share at FAA and Contract Towers.

¹⁰ 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

After arresting the Pandemic shrinkage and posting a very moderate -1.2% in 2020-21 (a decrease of 69 aircraft), the number of aircraft in the U.S. commercial fleet is forecast to increase from 5,815 in 2021 to 8,894 in 2042, 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 2021 and 2042 the number of jets in the U.S. mainline carrier fleet is forecast to grow from 3,132 to 5,532, a net average of 114 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 152 aircraft per year) out to 2026 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 91 aircraft a year as carriers replace current technology 737 and A320 family aircraft with the next generation MAX and Neo families. The widebody fleet grows by an average of 24 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 5.0 percent a year over the forecast period.

The regional carrier fleet is forecast to increase from 1,807 aircraft in 2021 to 2,187 in 2042 as the fleet expands by 0.9 percent a year (18 aircraft) between 2021 and 2042. 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 2030 only a handful of 50 seat regional jets remain in the fleet. By 2042, the number of jets in the regional carrier fleet totals 1,979, up from 1,406 in 2021. The turboprop/piston fleet is forecast to shrink by 48% from 401 in 2021 to 208 by 2042. These aircraft account for 9.5 percent of the fleet in 2042, down from 22.2 percent in 2021.

The cargo carrier large jet aircraft fleet is forecast to increase from 876 aircraft in 2021 to 1,959 aircraft in 2042 driven by the growth in freight RTMs. The narrow-body cargo jet fleet is projected to increase by 19 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 32 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