Federal Aviation Administration

FAA Aerospace Forecast

Fiscal Years 2021-2041

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Forecast Highlights (2021–2041)

Since its deregulation in 1978, the U.S. commercial air carrier industry has been characterized by boom-to-bust cycles. The volatility that was associated with these cycles was thought by many to be a structural feature of an industry that was capital intensive but cash poor. However, the great recession of 2007-09 marked a fundamental change in the operations and finances of U.S Airlines. Since the end of the recession in 2009, U.S. airlines revamped their business models to minimize losses by lowering operating costs, eliminating unprofitable routes, and grounding older, less fuel-efficient aircraft. To increase operating revenues, carriers initiated new services that customers were willing to purchase and started charging separately for services that were historically bundled in the price of a ticket. The industry experienced an unprecedented period of consolidation with three major mergers in five years. The results of these efforts were impressive: 2019 marked the eleventh consecutive year of profitability for the U.S. airline industry.

The outbreak of the COVID-19 pandemic in 2020, however, brought a rapid and cataclysmic end to those boom years. Airline activity and profitability tumbled almost overnight and without the financial and competitive strength built up during the boom, airlines would have faced even greater challenges. As it was, they were able to slash capacity and costs, and then, relying on their balance sheets, credit ratings and value inherent in their brands, to raise capital through borrowing and restructuring fleets allowing them to withstand the period of losses into 2021. Although several small regional carriers ceased operations in 2020, no mainline carriers did.

The business modifications necessitated by the downturn will shape the industry for years to come. Primarily, airlines will be smaller having retired aircraft and encouraged voluntary employee separations. Fleets, however, become younger and more fuel-efficient as retirements targeted the oldest and the least efficient aircraft. As airlines carry high levels of debt, capital spending and investment will be restrained which in turn holds back future growth. And even the unbundling of services took a small step backwards as carriers eliminated change fees for all but Basic Economy tickets.

In the medium-term, airlines will be focused on trying to foretell the recovery in demand and position themselves to meet it. To date, that demand recovery has been extremely uneven, driven by COVID-19 case counts, vaccinations, governmental restrictions and the degree of pent-up demand experienced by consumers. As expected, domestic leisure traffic has led the recovery and domestic business travel should begin to pick-up later in 2021. International activity will lag somewhat as individual country experience with the pandemic is varying so widely. As a result, airlines have initially shifted flights and routes to outdoor recreation areas but as the recovery progresses, their focus will gradually return to traditional markets and segments.

Long-term, the strengths and capabilities developed over the past decade will become evident again. There is confidence that U.S. airlines have finally transformed from a capital intensive, highly cyclical industry to an industry that can generate solid returns on capital and sustained profits.

Fundamentally, over the long-term, aviation demand is driven by economic activity, and a growing U.S. and world economy provides the basis for aviation to grow. The 2021 FAA forecast calls for U.S. carrier domestic passenger growth over the next 20 years to average 4.9 percent per year. This average, however, includes three double-digit growth years during the recovery from a very low base in 2021. Following the recovery period, trend rates resume with average growth through the end of the forecast of 2.3 percent. Domestic passengers are forecast to return, on an annual basis, to 2019 levels in early 2024. Oil prices averaged $43 per barrel in 2020 and are forecast to fall to $36 per barrel in 2021 before rising steadily to $94 by the end of the forecast period.

Just as U.S. economic activity drives domestic demand for air transport, foreign economic activity affects international travel demand. And as virtually all countries have taken actions to contain COVID-19, those same actions have resulted in economic patterns that are similar to those in the U.S. with sharp declines in 2020 followed by strong rebounds forecast as the recovery begins in 2021. The variation of economic performance across countries depends on their relative strength at the beginning of 2020 but is also dependent on the severity of their experience with COVID-19 as well as the stringency of their responses. Europe saw sharp economic declines in 2020, consistent with its relatively high level of infections and numerous lockdowns that overwhelmed a tepid level of baseline economic growth. Many Asian countries, on the other hand, saw only mild downturns as they took swift and strong actions to control the virus early in the pandemic but also began the year with relatively strong economic growth. Most countries are expected to vaccinate their populations and bring the virus under control by 2022 and economic growth rates settle back to their long-run trends in about 2023.

System traffic in revenue passenger miles (RPMs) is projected to increase by 5.5 percent a year between 2021 and 2041. Domestic RPMs are forecast to grow 5.1 percent a year while International RPMs are forecast to grow significantly faster at 6.6 percent a year. These figures are, of course, boosted by several years of high growth rates during the recovery after which the annual rates return to more moderate long-term trends. The strong growth rates return system RPM, on an annual basis, to 2019 levels in 2024, with domestic RPM returning early that year but international RPM recovering a year later in 2025. System capacity as measured by available seat miles (ASMs) is forecast to grow somewhat slower than RPM during the recovery period as airlines seek to restore load factors but, subsequently, ASM grow in line with the increases in demand.

The FAA expects U.S. carrier profitability to remain under pressure for several years due to depressed demand and competitive fare pressures. As carriers return to levels of capacity consistent with their fixed costs, shed excess debt, and see rising yields, profitability should gradually return. Over the long term, we see a competitive and profitable aviation industry characterized by increasing demand for air travel and airfares growing more slowly than overall inflation, reflecting growing U.S. and global economies.

The general aviation (GA) sector was less affected by the COVID-19 crisis than the airlines. There are new comers in the high-end business jet segment as a result of flying privately due to concerns of the virus. At the lower end new comers included student, private and commercial pilots, joining the existing GA pilot population. They are flying piston aircraft in and out of small airports as well as larger airports that do not have as many commercial flights due to the pandemic. The long-term outlook for general aviation thus is more promising than before, as growth at the high-end offsets continuing retirements at the traditional low end of the sector. The active GA fleet is forecast to increase slightly by 0.1 percent between 2021 and 2041, after recording a decline of 2.8 percent in 2020 from the year before (active fleet shrinks 1 percent by 2041 from its 2019 level). Turbine aircraft, including rotorcraft is estimated to not experience a decline between 2019 and 2020, while the total of piston fleet is estimated to have decreased by 1.1 percent in 2020 from the previous year. While steady growth in both GDP and corporate profits results in continued growth of the turbine and rotorcraft fleets, the largest segment of the fleet – fixed wing piston aircraft will continue to shrink over the forecast period. Against the marginally declining active GA fleet between 2019 and 2041, the number of GA hours flown is projected to increase by a total of 14.8 percent from 2019 to 2041 (an average of 0.6 percent per year), as growth in turbine, rotorcraft, and experimental hours more than offset a decline in fixed wing piston hours. When the period of 2021 to 2041 is compared, the total hours flown by the GA aircraft is forecast to increase by an average of 1.0 percent per year, after declining by 9.7 percent between 2019 and 2020, and recovering partially, with a growth of 4.9 percent in 2021 from the previous year.

With the expected robust air travel demand growth between 2022 and 2026 due to the U.S. economy recovering from the impact of COVID, we expect increased activity growth that has the potential to increase controller workload. Operations at FAA and contract towers are forecast to grow 1.9 percent a year over the forecast period (FY2021-41) with commercial activity growing at approximately five times the rate of non-commercial (general aviation and military) activity. The COVID recovery growth in U.S. airline activity is the primary driver. The U.S. commercial aviation sector has been hit by the pandemic much harder than the non-commercial sector. The pent-up demand is expected to drive the commercial operations back to the pre-COVID level, hence leading to the stronger growth in the commercial sector. In particular, large and medium hubs will see much faster increases than small and non-hub airports, largely due to the commercial nature of their operations.

The estimates for U.S. airline traffic contained in the FY 2021 Aerospace Forecast document were developed between October 2020 and January 2021 and factored in the latest traffic data, economic forecasts, the status of COVID-19 infections and availability of COVID-19 vaccinations at that time. Since the completion of the analysis, subsequent data on the outlook for economic growth—which includes the effects of President Biden's American Rescue Plan and the two prior COVID-19 relief bills, as well as current indicators of U.S. airline traffic and the rapid rate of vaccinations across the country due to the Biden-Harris Administration's efforts—suggest a potential pace of aviation travel recovery that is faster than is depicted in the FY 2021 Aerospace Forecast. April 2021 data shows this report is likely conservative in its estimates for 2021: Flights operated in April 2021 (471,375) were more than double the flights operated in April 2020 (194,390) and 72% of the flights operated in April 2019 (652,533).

Review of 2020

All sectors of the aerospace industry suffered from the devastating impacts of COVID-19 and while every sector bore those costs, the operational and financial consequences were felt most by U.S. commercial aviation. As an exception, UAS activity and Commercial Space launches *increased* during the year.

U.S. commercial aviation started the year on very strong footing, but in March the virus had crossed the Atlantic and efforts to contain it brought a sharp decline to aviation. TSA checkpoint throughput plummeted from 105 percent of year ago levels in February to 45 percent in March and then just 5 percent in April. Lockdowns, stay-at-home orders, testing and quarantine requirements, border closures and, of course, people's own concerns about being in close proximity to dozens of strangers while travelling, all led to the drop-off in traffic. While leisure traffic showed some signs of life around holidays, business and international traffic was moribund. As revenue collapsed, airlines worked to aggressively cut expenditures but were constrained by competitive factors including a desire to not just survive until the eventual recovery but to have the capacity at that point to meet demand and then return to previous levels of operation. Airlines slashed flights and routes, parked and retired aircraft, entered into sale-leaseback agreements, halted investment spending, sought labor concessions, reduced management compensation and offered voluntary leave and early retirement programs. While the Payroll Support Program (PSP) portion of the Coronavirus Aid, Relief, and Economic Security (CARES) Act forestalled furloughs through September, its expiration led to 37,000 layoffs the following month. According to the Bureau of Transportation Statistics (BTS), airline employment was 86,000 jobs lower than a year earlier, and marked the lowest level of employment dating back to the beginning of BTS records in 1990. Even with the aggressive cost cutting, expenses exceeded revenues during the year, and airlines were forced to incur debt to cover the cash outflow. By September, long-term debt had reached $107 billion, or more than twice its level at the same point in 2019.

As difficult as the year was, there were a few tailwinds. The PSP and two extensions that keep it active through September 2021 are enabling airlines to maintain staffing levels in anticipation of the recovery and direct cash to other expenses. Fuel prices dropped in 2020 to levels well below those of the past 15 years. And the very large U.S. domestic market meant that the leisure segment could travel without fear of shifting foreign entry or quarantine requirements – factors that, combined with outright border closures, depressed most international demand.

As reflected by the TSA throughput figures, demand for air travel in 2020 contracted sharply. In 2020, system traffic as measured by revenue passenger miles (RPMs) contracted 47.3 percent while system enplanements fell 44.2 percent. Domestic RPMs were 43.9 percent lower while enplanements were down 43.1 percent. International RPMs fell 56.0 percent and enplanements by 53.2 percent. The system-wide load factor was 69.5 percent, down 15 percentage points from the 2019 level.

System nominal yields fell in 2020. In domestic markets, all carriers, whether they normally targeted the leisure segment or not, focused on that price-sensitive segment, adding capacity and lowering fares to attract revenue. The result was a 20.7 percent drop in nominal yields. International yield, however, declined just 0.6 percent as demand was generally less price-sensitive.

Not surprisingly, the sharp, unanticipated fall off in demand pushed U.S. airlines into the red. Data for FY 2020 show that the reporting passenger carriers had a combined operating *loss* of $32.1 billion compared to an average profit over the previous five years of $22.1 billion. The network carriers[1] reported combined operating losses of $24.0 billion while the low-cost carriers[2] reported combined operating losses of $6.6 billion as all carriers posted losses.

The general aviation industry experienced a decline of 12.4 percent in deliveries of U.S. manufactured aircraft in 2020, with pistons slightly down by 0.1 percent (in fact, fixed-wing single engine piston aircraft deliveries were up by 3.2 percent) and turbines down by 24.5 percent. With the effect of the pandemic in new deliveries, global billings decreased by 14.8 percent to $20 billion, nearly the same level as they were in 2018 (Statistics for the U.S. billings were not available as of the publication date of this report).

Total operations in 2020 at FAA and contract towers fell by 16.7 percent compared to 2019. This was the first annual decline in activity since 2015. Air carrier activity decreased by 27.5 percent, while air taxi operations decreased by 24.4 percent. General aviation activity fell 8.9 percent and military activity decreased 10.9 percent. Activity at large and medium hubs fell by 29.9 percent and 22.9 percent, respectively, while small and non-hub airport activity declined by 10.9 percent in 2020 compared to the prior year.

[1] Network carriers are: Alaska Airlines, American Airlines, Delta Air Lines, and United Air Lines.

[2] Low cost carriers are: Allegiant Air, Frontier Airlines, JetBlue Airways, Southwest Airlines, Spirit Air Lines, and Sun Country Airlines.

Glossary of Acronyms

Acronym	Term
ANG	FAA Office of NextGen
ARP	FAA Office of Airports
ASMs	Available Seat Miles
AST	FAA Office of Commercial Space Transportation
ATO	FAA Air Traffic Organization
ATP	Air Transport Pilot
AUVSI	Association for Unmanned Vehicle Systems International
BVLOS	Beyond Visual Line of Sight
CAPS	COA Application Processing System
CBP	Customs and Border Patrol
CFR	Code of Federal Regulations
COAs	Certification of Authorizations
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CRS	Commercial Resupply Services
CY	Calendar Year
DARPA	Defense Advanced Research Projects Agency
DHS	Department of Homeland Security
DoD	Department of Defense
DoE	Department of Energy
DoI	Department of Interior
FAA	Federal Aviation Administration
FY	Fiscal Year
GA	General Aviation
GAMA	General Aviation Manufacturers Association
GC	Grand Challenge
GDP	Gross Domestic Product
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IMF	International Monetary Fund
ISS	International Space Station
LAANC	Low Altitude Authorization and Notification Capability
LCC	Low Cost Carriers
LSA	Light Sport Aircraft
lUAS	Large Unmanned Aircraft System(s)
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NDAA	National Defense Authorization Act
NOTAM	Notices to Airmen
NPRM	Notice of Public Proposed Rulemaking
PCE	Personal Consumption Expenditure
PDARS	Performance Data Analysis and Reporting Systems
RAC	Refiners' Acquisition Cost
RLV	Reusable Launch Vehicle
RP	Remote Pilot
RPA	Remote Pilot Authorization
RPMs	Revenue Passenger Miles

RTMs	Revenue Ton Miles
sUAS	Small Unmanned Aircraft System(s)
SpaceX	Space Exploration Technologies Corp.
TRACON	Terminal Radar Approach Control
TRB	Transportation Research Board
TSA	Transportation Security Administration
UAM	Urban Air Mobility
UAS	Unmanned Aircraft System(s)
UASFM	UAS facility maps
USD	United States Dollar
VFR	Visual Flight Rules

Acknowledgements

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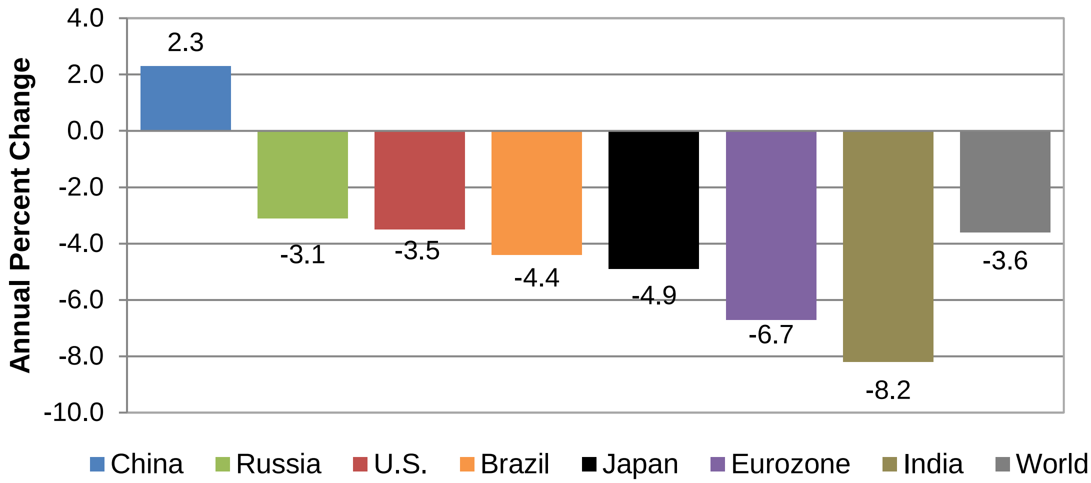
FAA Aerospace Forecasts
Fiscal Years 2021-2041

Economic Environment

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.

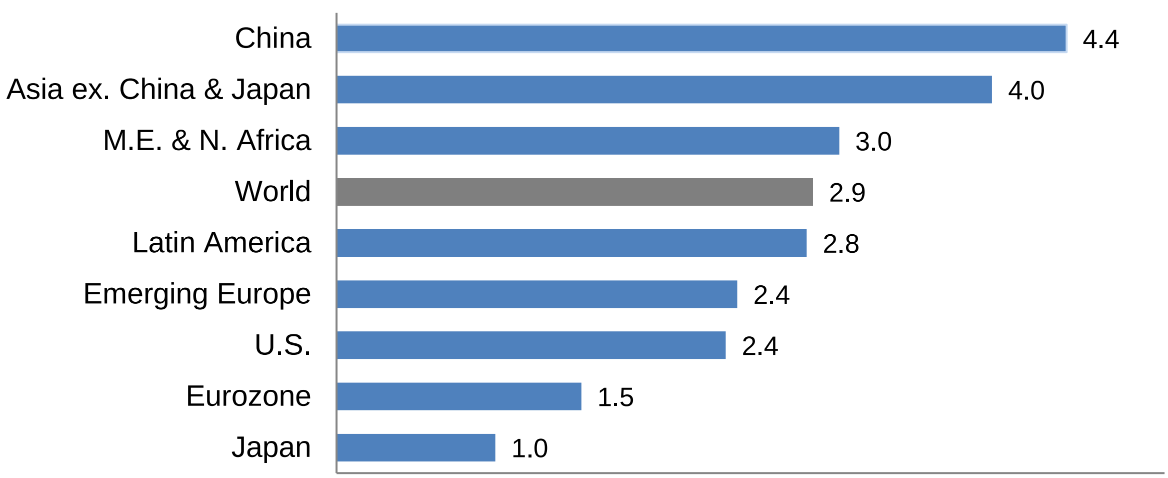
World Economic Growth in 2020



Source: IHS Markit

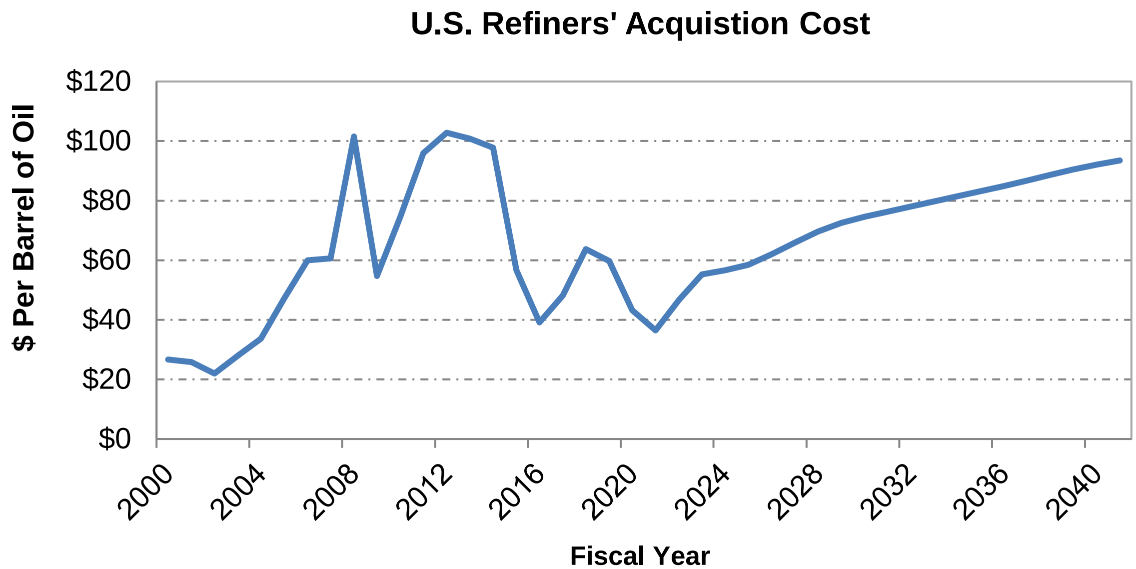
IHS Markit forecasts world real GDP to grow at 2.9 percent a year between 2021 and 2041. Emerging markets, at 3.9 percent a year, are forecast to grow above the global average but at lower rates than in the early 2000's. Asia (excluding Japan), led by India and China, is projected to have the fastest 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.



Source: IHS Markit

U.S. Airlines

Domestic Market

Mainline and regional carriers[3] 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.

[3] 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.

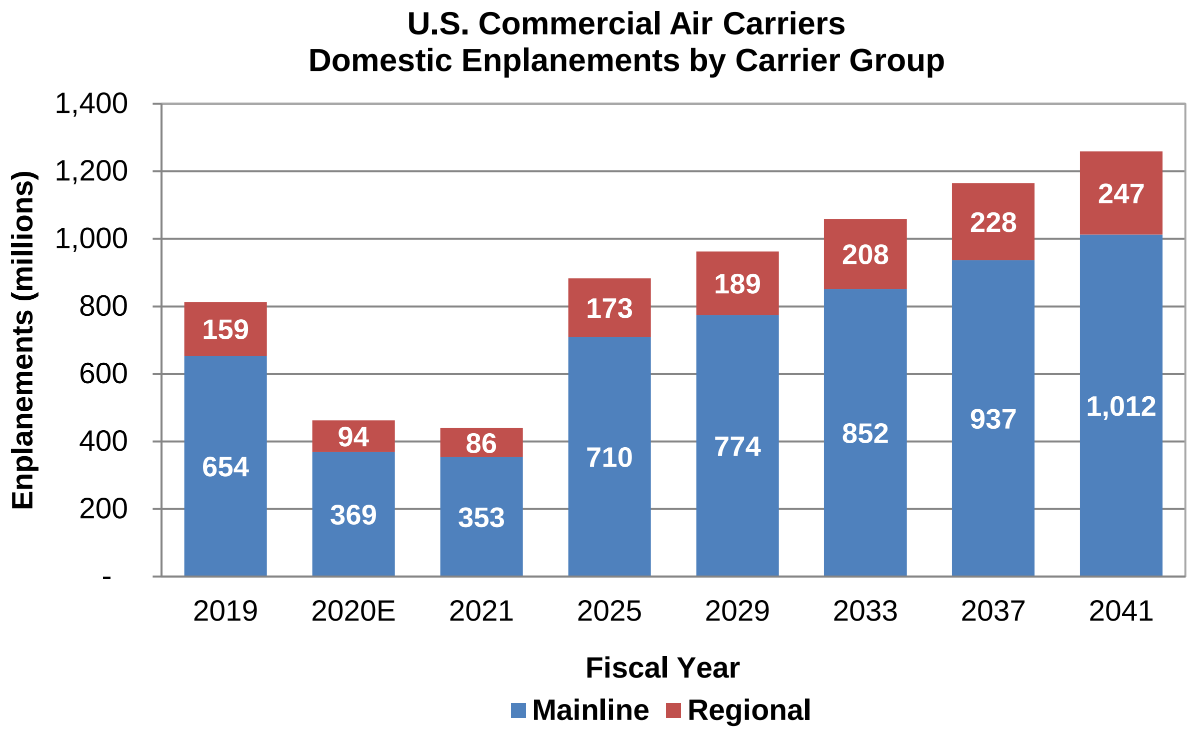
The growing and increasingly predictable activity will allow carriers to return capacity to typical markets, and reduce reliance on purely recreational destinations. Utilization rates will rise and carriers will bring parked and stored aircraft back online. Activity grows slowly, however, as it is restrained 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.

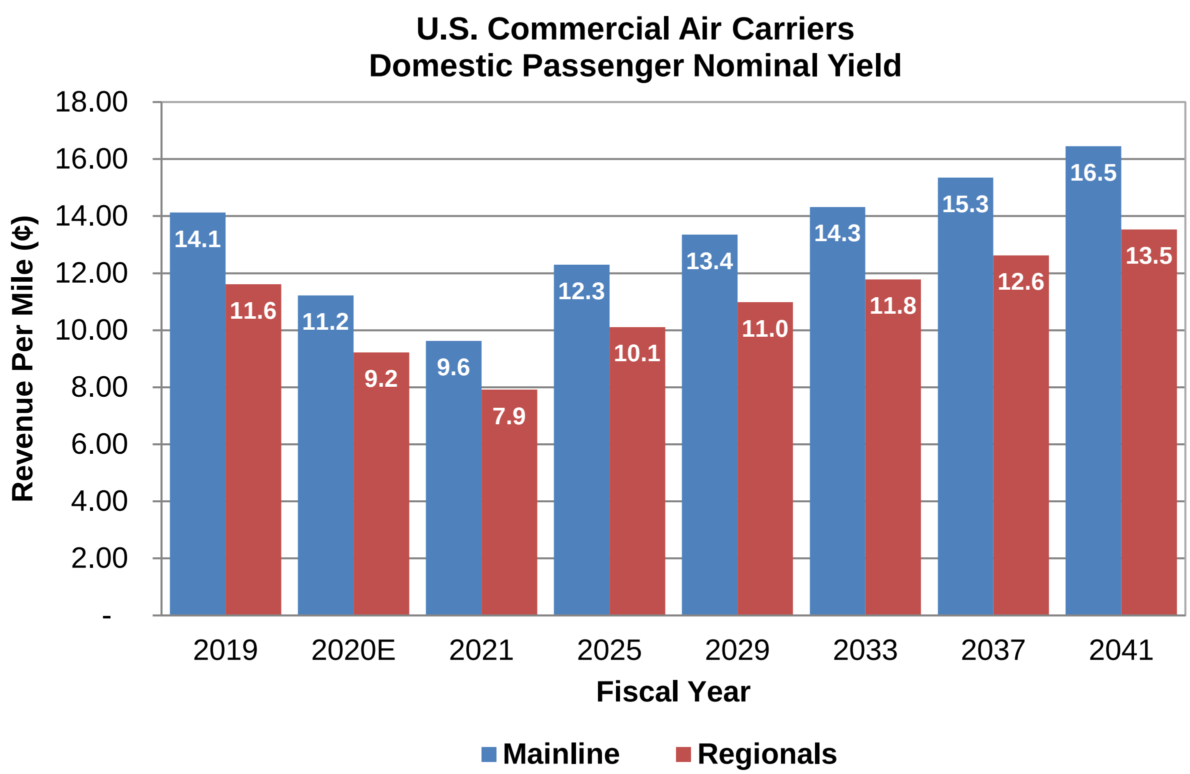
In the third phase, activity begins to approach 2019 levels and industry conditions begin to normalize. Leisure travel has largely returned to pre-pandemic levels and business travel is steadily catching up. Carriers remain somewhat constrained by debt incurred to survive the crisis and forgo some capital 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
Enplanements (millions)
1,400
1,200
1,000
800
600
400
200
-
159
654
94
369
86
353
173
710
189
774
208
852
228
937
247
1,012
2019
2020E
2021
2025
2029
2033
2037
2041
Fiscal Year
Mainline
Regional


U.S. Commercial Air Carriers
Domestic Passenger Nominal Yield
Revenue Per Mile (¢)
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
-
14.1
11.6
11.2
9.2
9.6
7.9
12.3
10.1
13.4
11.0
14.3
11.8
15.3
12.6
16.5
13.5
2019
2020E
2021
2025
2029
2033
2037
2041
Fiscal Year
Mainline
Regionals

The regionals have less leverage with the mainline carriers than they have had in the past as the mainline carriers have negotiated contracts that are more favorable for their operational and financial bottom lines. 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.

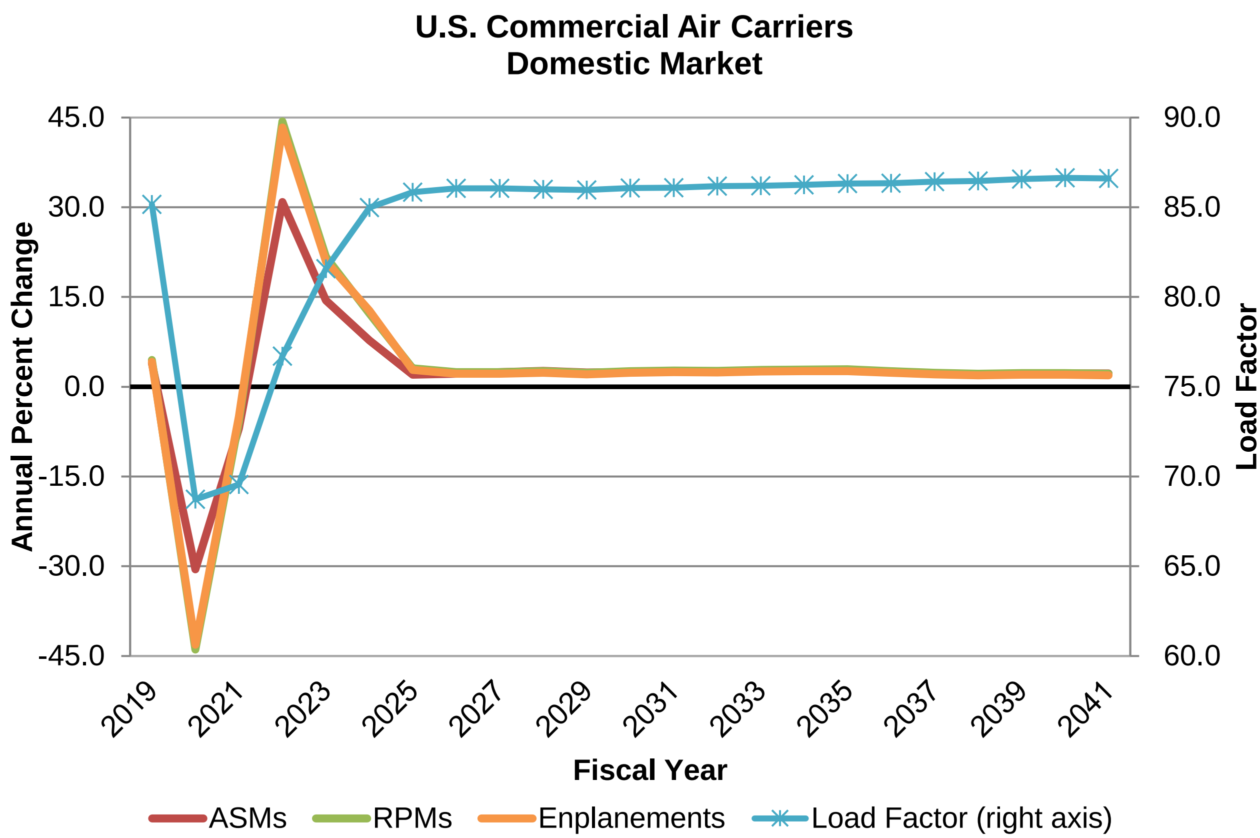
While revenue management systems will regain their important role once travel demand returns to more normal rhythms, one source of ancillary revenue, change fees, was broadly scrapped in 2020. As traveler plans were forced to change due to COVID-19-related restrictions, airlines began dropping fees for 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.[4] 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.

[4] 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.

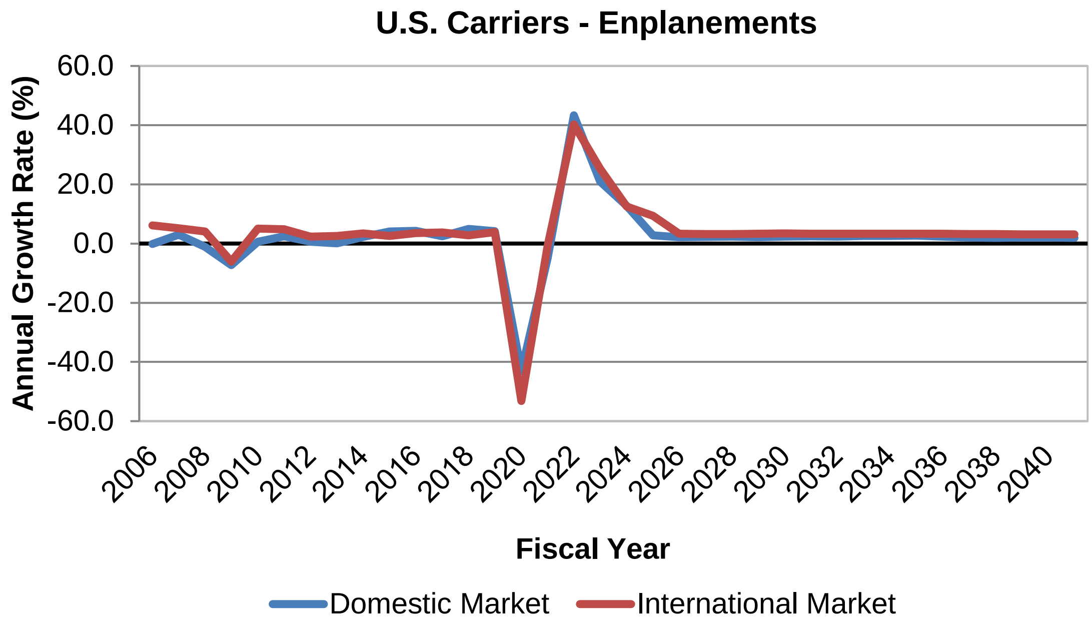
Domestic mainline enplanement growth is forecast to drop further in 2021, falling 4.2 percent before beginning a recovery in 2022 with a 43.3 percent increase. The two subsequent years, 2023 and 2024, also see strong rates of growth and domestic mainline enplanements return to 2019 levels in early 2024. 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 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.

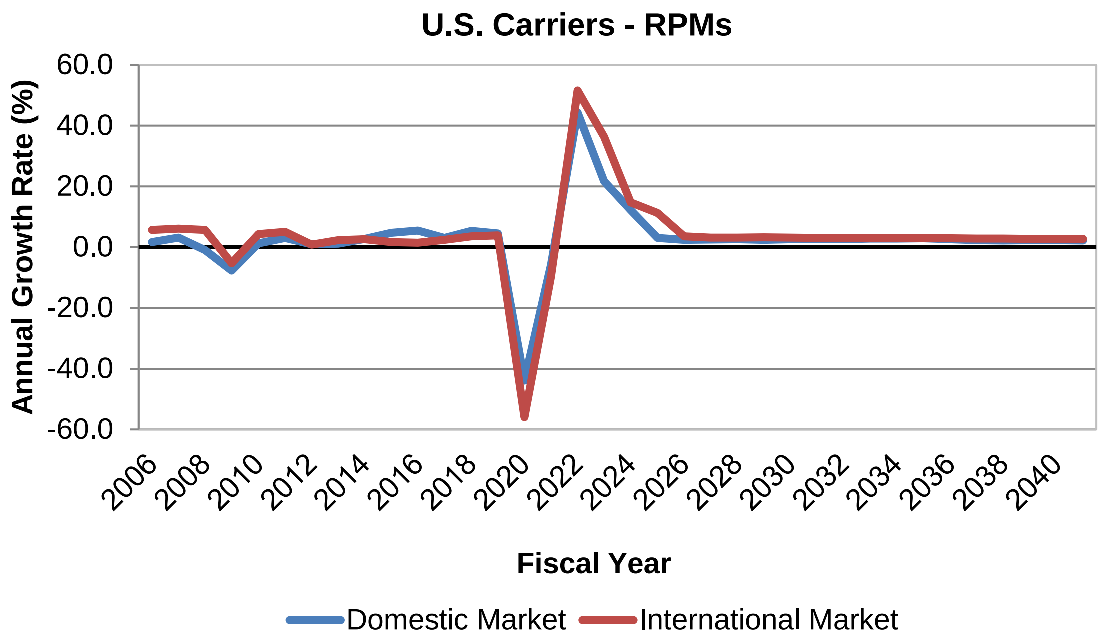
Although carriers cut capacity, the drop in traffic was even greater and system load factor fell from 84.5 percent in 2019 to 69.5 in 2020 – a drop that far exceeded those following both 9/11 and the Great Recession. Load factor gradually recovers, returning to its 2019 level in 2025.

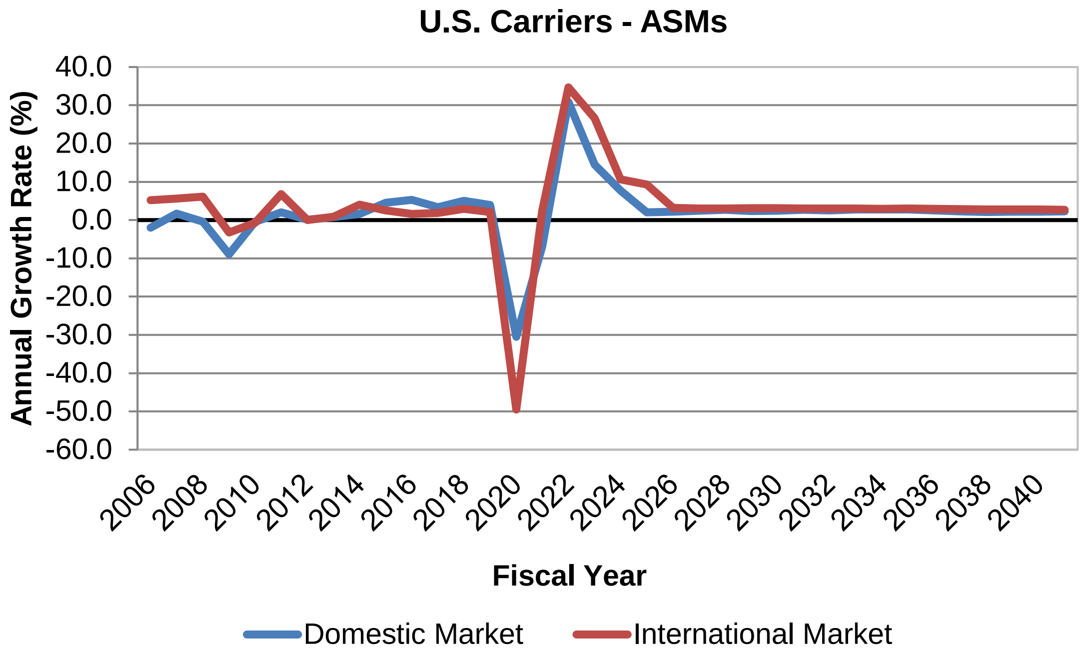
International Market

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 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.

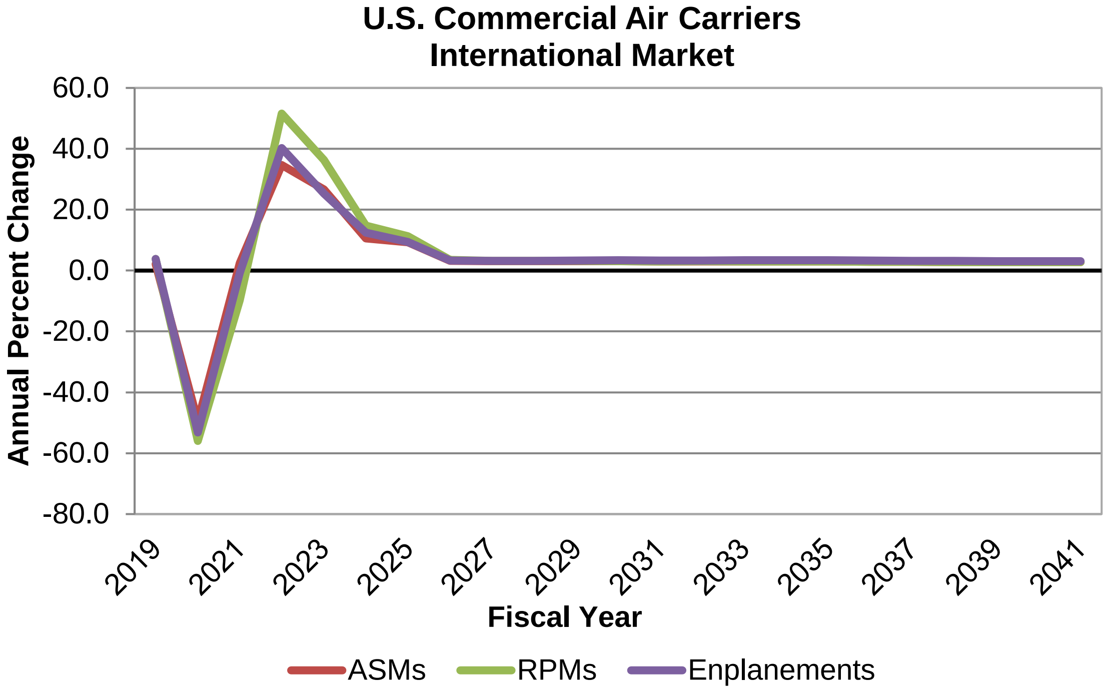
In the long-run, growth of major global economies will slow from the above-trend rates of recent, pre-pandemic years. Several moderating factors are at work, including dampened credit growth, reduced global trade, and political stresses. The European and Japanese economies are generally seeing slow but 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.



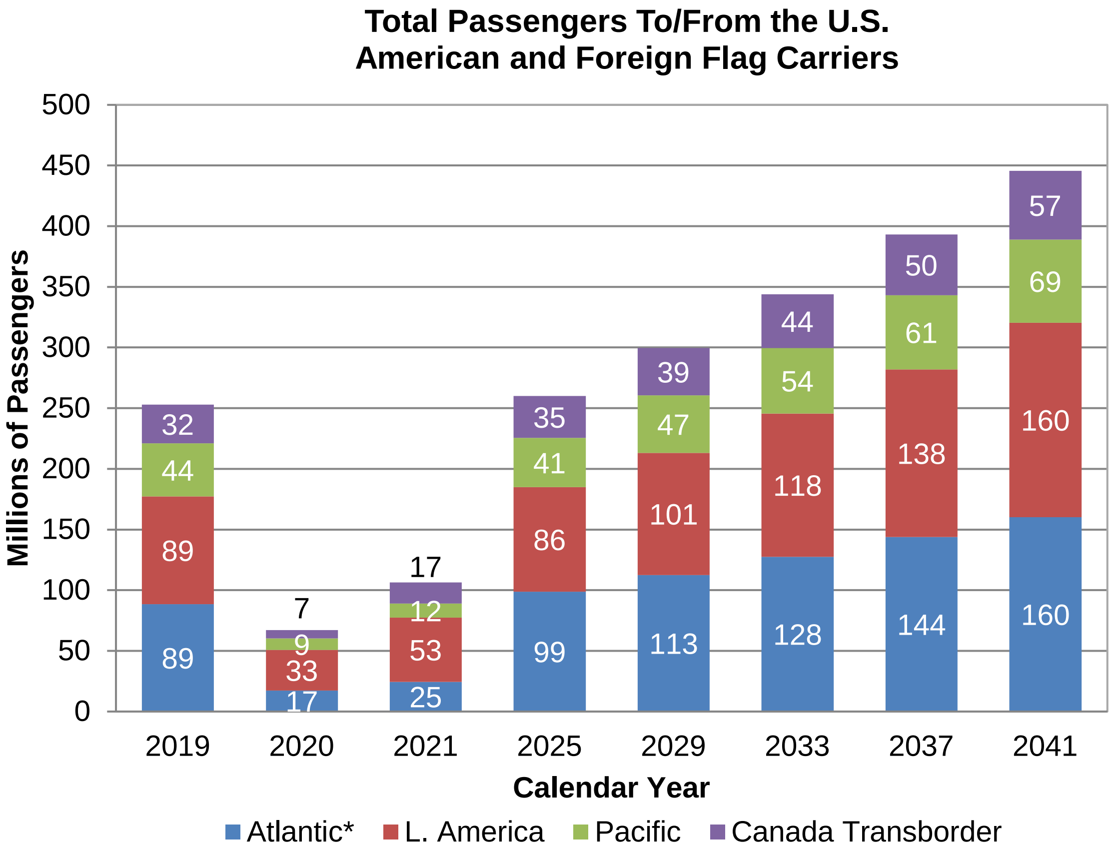
The impact of COVID-19 on travel by region has varied somewhat, as will the recovery paths. Factors affecting the responses by market are similar to those affecting travel as a whole: COVID-19 case counts, governmental restrictions, predominant traveler segments, and macroeconomic conditions. In 2020, 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.



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.

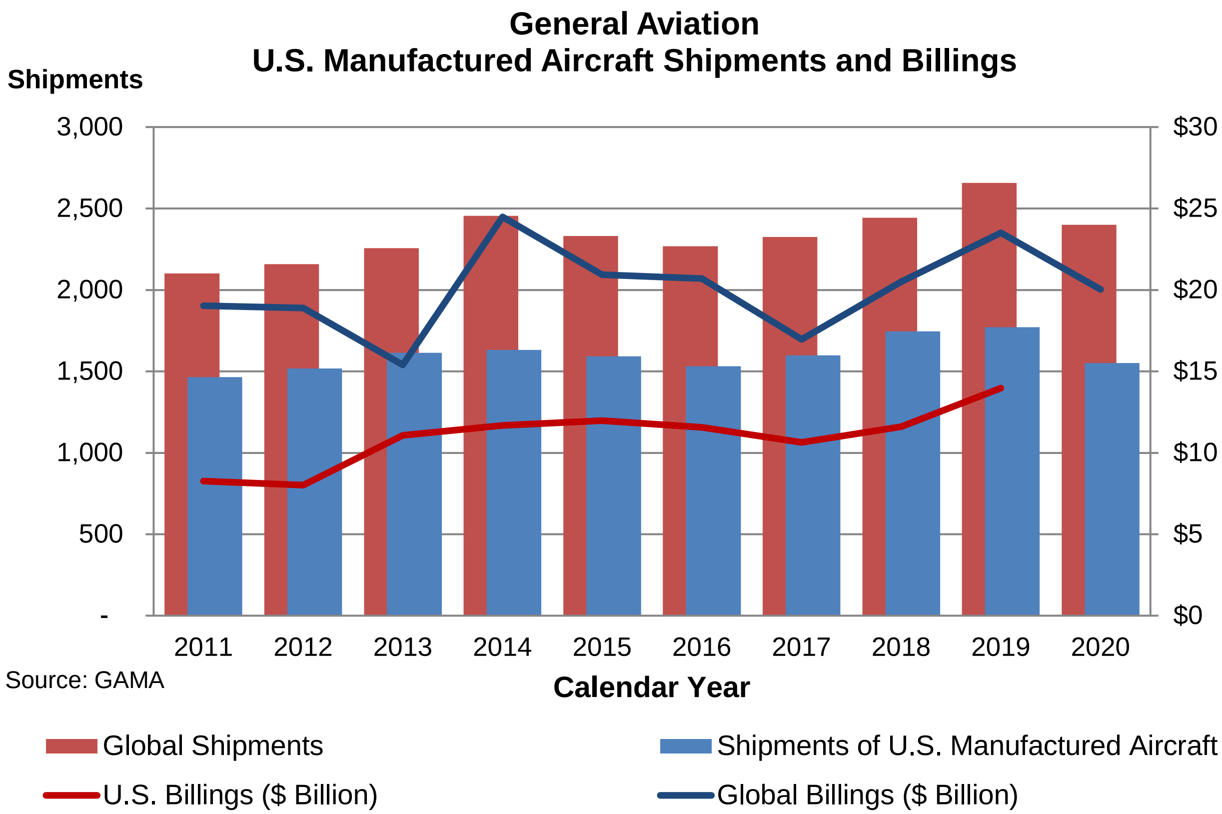
General Aviation

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,"[5] 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.

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



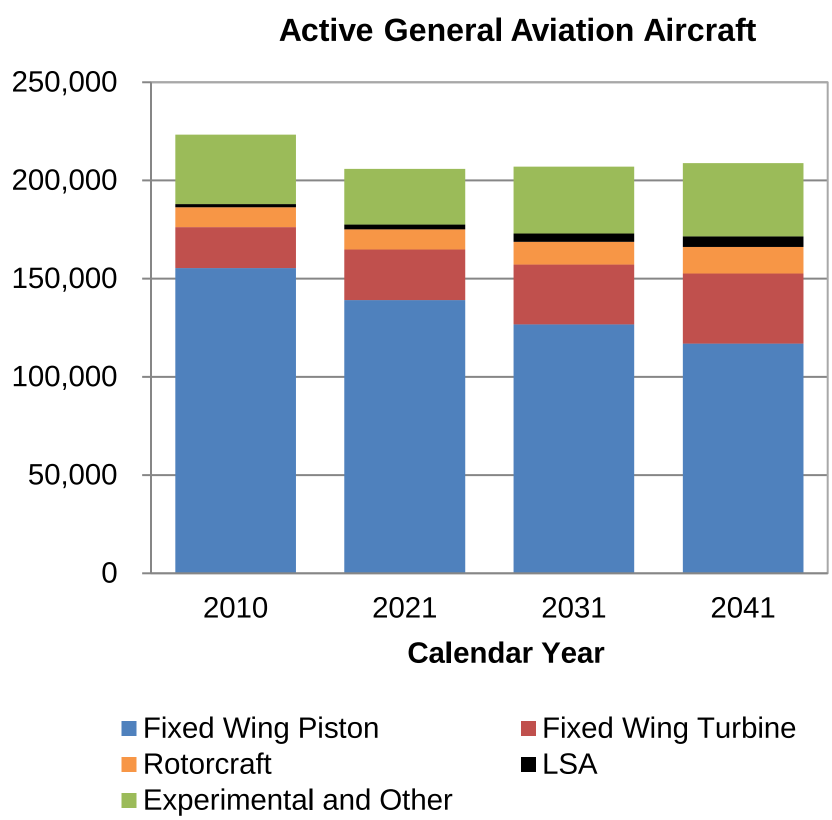
GAMA also reported the rotorcraft deliveries declined at a global level in 2020 in both piston and turbine segments by 20.7 percent and 16.9 percent, respectfully.

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.

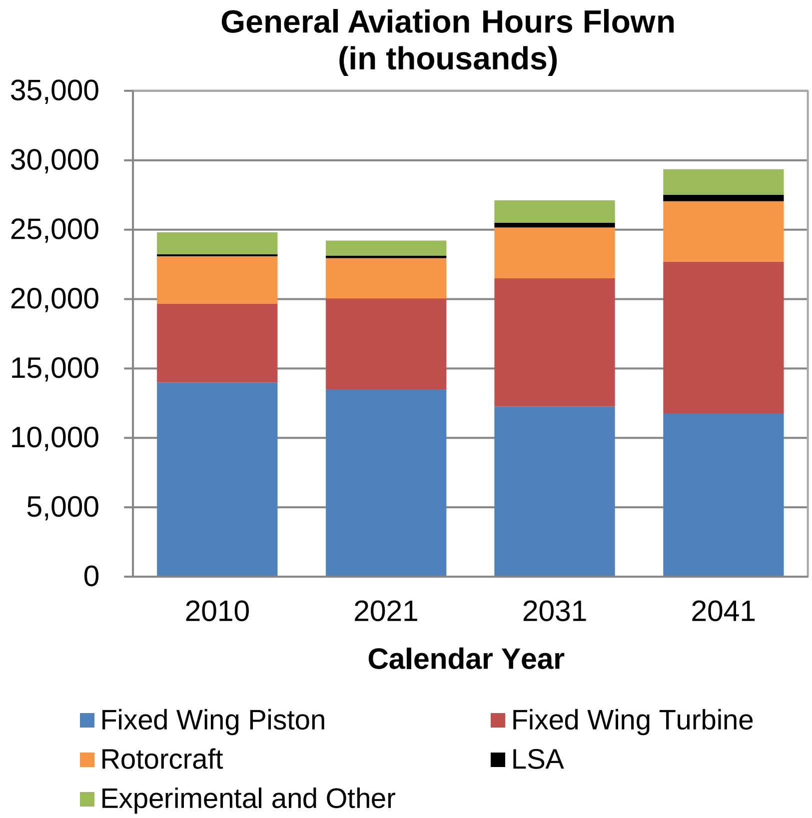
The more expensive and sophisticated turbine-powered fleet (including rotorcraft) is projected to grow by 12,990 aircraft between 2020 and 2041 to total 45,530 in 2041, an average rate of 1.6 percent a year during this period, with the turbojet fleet increasing 2.3 percent a year. When measured from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



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.

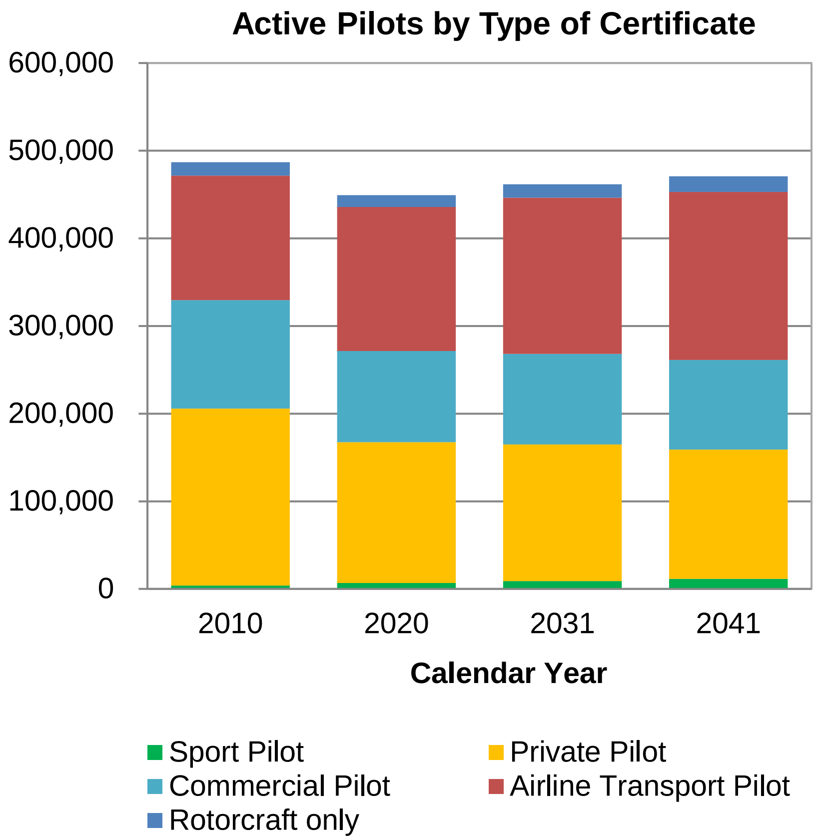
The FAA also conducts a forecast of pilots by certification categories, using the data compiled by the Administration's Mike Monroney Aeronautical Center. There were 691,691 active pilots certificated by FAA at the end of 2020. The number of certificates in some pilot categories continued to increase, 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.


Active Pilots by Type of Certificate
600,000
500,000
400,000
300,000
200,000
100,000
0
2010
2020
2031
2041
Calendar Year
Sport Pilot
Private Pilot
Commercial Pilot
Airline Transport Pilot
Rotorcraft only

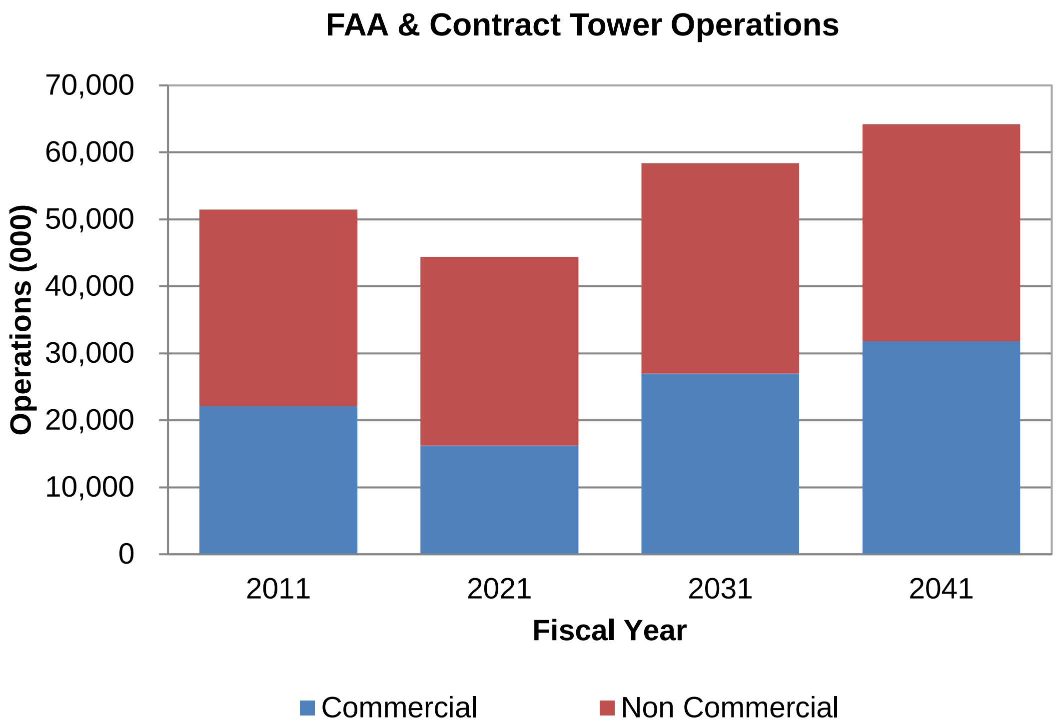
FAA Operations

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[6] 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[7] 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.

[6] Sum of air carrier and commuter/air taxi categories.

[7] 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[8] and FAA contract towers[9]. 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. 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[10] 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

[8] Small FAA towers are defined as towered airports that are neither large or medium hubs nor FAA contract towers.
[9] FAA contract towers are air traffic control towers providing air traffic control services under contract with FAA, staffed by contracted air traffic control specialists.

[10] 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.

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.[11] 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.

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

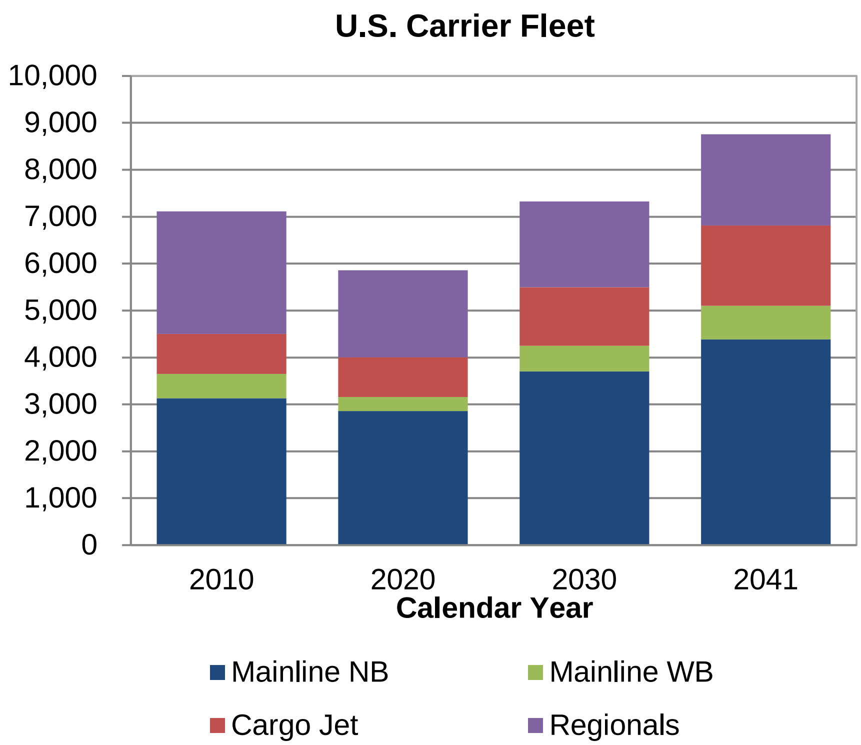
U.S. Commercial Aircraft Fleet

After 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.


U.S. Carrier Fleet
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2010
2020
2030
2041
Calendar Year
Mainline NB
Mainline WB
Cargo Jet
Regionals

Commercial Space

The FAA's Office of Commercial Space Transportation (AST) licenses and regulates U.S. commercial space launch activities including launch and reentry of vehicles and operation of non-federal launch and reentry sites authorized by Executive Order 12465 and Title 51 U.S. Code, Subtitle V, Chapter 509 (formerly the Commercial Space Launch Act). Title 51 and the Executive Order also direct the U.S. Department of Transportation to encourage, facilitate, and promote U.S. commercial launches. The FAA's mission is to license and regulate commercial launch and reentry operations and non-federal launch sites to protect public health and safety, the safety of property, and the national security and foreign policy interests of the United States.

The FAA licenses launches or reentries carried out by U.S. persons (which includes U.S. corporations) inside or outside the United States. The FAA does not license launches or reentries the U.S. Government carries out for the Government (such as those owned and operated by National Aeronautics and Space Administration (NASA) or the Department of Defense). Amateur-class rockets do not require a FAA license or permit[12].

To accomplish its mission, the FAA performs the following major functions:

- Maintains an effective regulatory framework for commercial space transportation activities,
- Provides guidance to prospective commercial operators on how to comply with regulatory requirements for obtaining an authorization and operating safely,
- Evaluates applications for licenses, experimental permits, and safety approvals for launch and reentry operations and related commercial space transportation activities,
- Evaluates applications for licenses for launch and reentry site operations,
- Monitors and enforces regulatory compliance through safety inspections of launches, reentries, sites, and other regulated commercial space activities,
- Provides U.S. Government oversight of investigations associated with the mishap of an FAA authorized launch or reentry,
- Facilitates the integration of commercial space launch and reentry operations into other modes of transportation including the National Airspace System (NAS) by establishing appropriate hazard areas and limits to ensure the protection of the public,
- Coordinates research into the safety, environmental, and operational implications of new technologies and the evolving commercial space transportation industry,

[12] Per 14 CFR Chapter 1, Part 1, section 1.1: Amateur rocket means an unmanned rocket that is propelled by a motor or motors having a combined total impulse of 889,600 Newton-seconds (200,000 pound-seconds) or less; and cannot reach an altitude greater than 150 kilometers above the earth's surface.

- Conducts outreach to the commercial space industry by hosting working groups and conferences,
- Collaborates with Government partners, such as the Department of Defense and NASA to assure consistent approaches to regulations, policy, and standards, and
- Conducts outreach to international counterparts to promote the U.S. regulatory framework across the world.

In addition to AST headquarters offices in Washington, D.C., AST maintains staff with assigned duty locations near active launch ranges to facilitate communication with space launch operators and to implement FAA's regulatory responsibilities more efficiently. AST personnel are currently assigned to duty locations in close proximity to: Kennedy Space Center and Cape Canaveral Space Force Station in Florida; Johnson Space Center in Texas; and, Vandenberg Air Force Base and the Mojave Air and Space Port in California. FAA also directly supports NASA's commercial space initiatives by providing on-site staff at both the Johnson Space Center and Kennedy Space Center to coordinate the FAA's regulatory and compliance activities with NASA's development and operational requirements for commercial space.

Regulatory Safety Oversight Activities of FAA

The business cycle from the time a firm first contacts FAA until the last launch of a licensed operation can be several years. There are many activities performed by FAA during this cycle. The most notable activities are described here.

Pre-Application Consultation for Licenses, Experimental Permits, and Safety Element Approvals

Prospective applicants seeking commercial space transportation licenses, experimental permits, or safety approvals are required by regulation to consult with FAA before submitting their applications. During this period, FAA assists them in identifying potential obstacles to authorization issuance and determining potential approaches to regulatory compliance. In addition, many new operators are seeking to incorporate new technologies, vehicle types, or operational models creating opportunities for FAA to assist in determining the applicable regulations or approach to regulatory compliance.

Licenses, Permits, and Safety Element Approvals

FAA authorizes commercial space transportation activities via the issuance of licenses, permits, and safety element approval. Though many licenses authorize multiple launches (for mature launch systems), the need remains for FAA to also issue individual launch licenses for systems that are still maturing towards a high level of reliability. Furthermore, with the dynamic commercial space industry, FAA often evaluates launch and reentry systems and operations that are evolving and changing, which may ultimately require license modifications or issuance of new licenses.

Inherent in the review process is the requirement to conduct policy reviews and payload reviews. When conducting a policy review, FAA determines whether the proposed launch, reentry, or site operation presents any issues that would jeopardize public health and safety or the safety of property, adversely affect U.S. national security or foreign policy interests, or be inconsistent with international obligations of the United States. If not otherwise exempt from review, FAA reviews a payload proposed for launch or reentry to determine whether the payload would jeopardize public health and safety, the safety of property, U.S. national security or foreign policy interests, or the international obligations of the United States. The policy and/or payload determination becomes part of the licensing record on which FAA's licensing determination is based.

FAA reviews and issues launch and reentry site operator licenses and license renewals. FAA also reviews and evaluates launch site license applications for launch sites located in foreign countries but operating with U.S.-licensed launch or reentry systems. FAA coordinates range planning among Federal, state, and local governments and with the commercial range operators or users. As part of the evaluation of applications for launch licenses, reentry licenses, and site operator licenses, FAA also conducts environmental reviews consistent with its responsibilities under the National Environmental Policy Act.

FAA anticipates issuing a growing number of safety element approvals for space launch systems equipment, processes, technicians, training and other supporting activities. FAA reviews, evaluates, and issues safety approvals to support the continued introduction of new safety systems, safety operations applications, and safety approval renewal applications.

Safety Analyses

FAA conducts flight safety, system safety, maximum probable loss, and explosive safety analyses to support the evaluation and issuance of licenses and permits. FAA also evaluates and analyzes the performance of safety-critical space flight personnel to determine how they affect public safety risk. In the near future, as commercial firms become more involved with human space flight activity, AST and the FAA's Office of Aerospace Medicine may evaluate, analyze, and determine the health risks to the space flight participants (crew and space flight participants) due to natural and flight-induced launch and reentry environments, as well as any hazardous ground operations directly associated with the flight.

Inspections and Enforcement

FAA currently conducts as many as 330 preflight/ reentry, flight/ reentry, and post-flight/ reentry safety inspections per year. Inspections often occur simultaneously at any of the 12 licensed U.S. and international commercial space launch sites, as well as at 4 Federal launch ranges and 3 exclusive-use launch sites. The establishment of non-federal launch sites requires additional inspections in areas such as ground safety that have traditionally been overseen by the U.S. Air Force (now the U.S. Space Force) at Federal ranges. At spaceports and launch sites with high launch rates (e.g., Cape Canaveral Space Force Station, Vandenberg Air Force Base, the Mid-Atlantic Regional Spaceport, and Spaceport America), at least 80 percent of inspections are typically conducted by locally-based field inspectors. Additionally, as a result of the COVID-19 pandemic, many inspections in fiscal year (FY) 2020 were handled remotely. FAA will leverage this approach in the upcoming years in order to respond to a dynamic operational tempo, minimize cost, and increase efficiency.

Mishap Investigations

Mishap events have demonstrated that FAA needs to have the capacity to oversee the investigation of at least two space launch or reentry mishaps or accidents simultaneously anywhere in the world, and to lead/oversee as many as nine investigations during a single year. FAA anticipates an increase in mishaps with new operators coming online. FAA should have the capabilities and resources to efficiently review all applicant mishap plans and accident investigation procedures as part of the license and permit evaluation process.

NAS Integration

AST works in partnership with all FAA lines-of-business, notably the Air Traffic Organization (ATO) and Office of Airports (ARP) to support the safe and efficient integration of commercial launch and reentry operations through the NAS and its system of airports and air traffic managed by the ATO. AST expects an increased level of interaction with the ATO, ARP, and the FAA Office of NextGen (ANG). Further, AST works with the ATO as FAA develops technologies to facilitate safe and efficient integration of commercial launch and reentry operations into the NAS, including technologies to improve the integration of launch and reentry data into FAA air traffic control systems and technologies to improve the timely and accurate development and distribution of notices of aircraft hazard areas.

FAA's Launch and Reentry Operations Forecast

To improve its workforce planning process, in 2014, FAA adopted an approach to estimate its future staffing needs based on the ratio of regulatory safety oversight staff to a forecast of launch and reentry operations within the purview of the FAA mission. Although it was a modest improvement, this change set the groundwork for FAA to implement a more objective and transparent process for projecting staffing requirements and also necessitated development of credible operations forecasts. Since 2014, FAA has made several important improvements to its operations forecast:

- In 2015, FAA began using planned launch and reentry data collected from operators and prospective applicants as the starting point for its launch and reentry forecasts. This change enabled FAA to simplify and improve its forecasting methodology by tying launch and reentry forecasts directly to anticipated operations by commercial space transportation firms known to FAA, rather than to aggregate industry demand.
- Because commercial spaceflight is a highly dynamic and rapidly evolving industry, it was quickly determined that operator-provided data alone were not sufficient to reliably predict future activity. Consequently, a primary pillar of FAA's forecasting methodology is to take a conservative view of industry growth in the near term. Therefore, in 2016, FAA began refining its forecasting methodology by using observations about historical launch activity to establish better forecasting parameters for both new applicants and existing operators.

There are several factors that magnify the challenges associated with predicting the number of launches and reentries to expect in a given year. They include:

- list of firms intending to launch or actually launch is dynamic,
- continued development of new technologies,
- launch rates for reusable launch vehicles,

- commercial human spaceflight by both government astronauts and private citizens,
- dynamic nature of flight test programs, and
- mishaps.

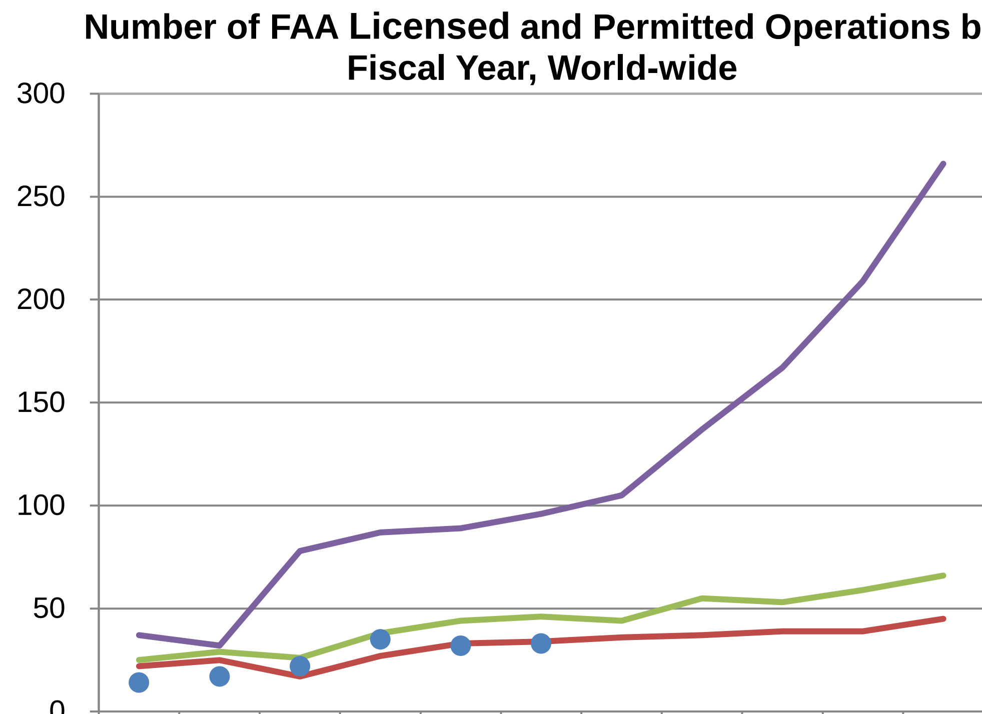
For example, the number of firms actively communicating with FAA increased from 14 in 2014 to 68 in 2020, an increase of more than 380 percent. New technologies [e.g., reusable launch vehicles (RLVs)] allow a faster operational tempo, and at the same time, early use of these technologies can increase the probability of a mishap. A mishap can drastically impact launch plans for one or more firms. Investigations and subsequent “return to flight” for firms impacted by a mishap can take months. It is also important to note that the FY2021 number is best described not as a forecast but rather a mid-year correction on previous forecast numbers, considering this forecast is published six months into FY2021.

Taking these factors into account, the following table and graph provide industry’s and FAA’s forecast through 2025, as well as historical activity.

Fiscal Year	Industry Forecast	FAA Forecast	Actual
Historical			
2015	37	22 - 25	14
2016	32	25 - 29	17
2017	78	17 - 26	22
2018	87	27 - 38	35
2019	89	33 - 44	32
2020	96	34 - 46	33
Forecast			
2021	105	36 - 44	
2022	137	37 - 55	
2023	167	39 - 53	
2024	209	39 - 59	
2025	266	45 - 66	

Notes:

1. FAA Forecast entries represent the Low to High estimate.
2. Industry Forecast for 2015 follows COMSTAC methodology from 2014. Industry forecasts for all other years follow the same methdology: FAA-authorized launch and reentry operators provide to FAA the number of FAA-authorized operations (launches, reentries, orbital and suborbital) that industry expects to occur per fiscal year.



	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025
Actual	14	17	22	35	32	33					
Forecast High	25	29	26	38	44	46	44	55	53	59	66
Forecast Low	22	25	17	27	33	34	36	37	39	39	45
Industry Forecast	37	32	78	87	89	96	105	137	167	209	266

It is important to note all FAA-authorized commercial space operations are included in this forecast, regardless of where they occurred in the world. That is, not all launch and reentry activity occurs at one location, for example, at Cape Canaveral, Florida. In the past year, FAA licensed launches and reentries throughout the NAS and beyond, including multiple reentries in the Pacific and Atlantic Ocean and six licensed launches from New Zealand. This forecast, however, does not include launch activity not authorized by the FAA (e.g. U.S. Department of Defense or non-commercial NASA launches), launch activity for other nations, and this forecast is not tied exclusively to satellite demand.

Additional Factors Affecting Forecast Accuracy

Commercial space transportation is a rapidly evolving industry. The industry's growth through technological innovation and the development of new markets increases the challenges associated with forecasting commercial space transportation operations.

New Commercial Launch Technologies and Operations are Emerging on an Accelerated Basis

The commercial space transportation industry is exploring a variety of new technologies and new approaches to space launch and reentry. In late 2015, both Blue Origin and

Space Exploration Technologies Corp. (SpaceX) successfully demonstrated the reusability of their vertically launched rockets. Both companies are now developing a new generation of much larger orbital vehicles that will launch and land in a vertical configuration. In 2020, Rocket Lab successfully recovered a flown booster, and announced plans to re-fly it in 2021. While these new orbital-class vehicles are unlikely to lead to a significant increase in the number of annual launch and reentry operations over the next three years, they may cause a greater increase further in the future, as the upper end of the forecast shows in fiscal years 2024 and 2025. Other U.S. commercial entities are also pursuing the development of reusable launch vehicles (RLVs). At the same time, state and local governments are joining with commercial firms to promote additional launch and reentry sites, and some firms are seeking to establish launch sites for their exclusive use. This added launch capacity sets the stage for simultaneous operations and an increase in the number operations per year.

New Markets for Commercial Space Transportation are Emerging

The continuing development of commercial space transportation technology has spurred new markets for commercial space transportation services. As private industry continues to develop and test new vehicles capable of taking space flight participants and government astronauts on suborbital and orbital flights, companies and organizations are proposing to offer human space flight training and several organizations have already begun to provide this service. States and municipalities have sought to open new spaceports to attract commercial space transportation and associated high-tech firms and create technology hubs for research and development. Since 2008, NASA has managed the Commercial Resupply Services (CRS) program, which acquires transportation services from commercial providers to deliver cargo to and from the International Space Station (ISS). In 2020, SpaceX successfully transported NASA astronauts to the International Space Station under the auspices of a Commercial Crew Transportation Capabilities contract – the first time humans have traveled to orbit under an FAA-license. Boeing is expected to do the same for NASA in 2021. The commercial vehicles used by NASA for cargo and crew transportation will have other commercial applications that increase the capabilities of the commercial space transportation industry as a whole.

Looking further afield, there are several companies in the regulatory pipeline seeking authority to land commercial vehicles on the Moon, establish private-sector space stations, service satellites on-orbit, and establish launch sites using non-traditional technologies like railguns and tube launchers. Additional FAA resources may be needed to determine how these unprecedented commercial space ventures will impact public safety and U.S. national interests.

Unmanned Aircraft Systems

Unmanned aircraft systems (UAS) have been experiencing healthy growth in the United States and around the world over the past few years. Last year has been no exception despite the profound impact of COVID-19 on the overall economy. A UAS consists of an unmanned aircraft and its associated elements—including the aircraft, the control station, and the associated communication links—that are required for safe and efficient operation in the national airspace system (NAS). While introduction of UAS in the NAS has opened up numerous possibilities, commercial in particular, it has brought operational challenges including safe integration into the NAS. Despite these challenges, the UAS sector holds enormous promise; potential uses include modelers flying for recreational purposes to delivering packages on a commercial basis; including the delivery of medical supplies; and provision of support for search and rescue missions following natural disasters and other public service uses.

This section provides a broad overview covering recreational and commercial (or Part 107) unmanned aircraft[13] and their recent trends as gathered from trends in registration, surveys, overall market, and operational information. Using these trends and insights from industry, the FAA has produced a number of forecasts. Forecasts reported in the following sections are driven primarily by the trends in registrations, assumptions of the continuing evolution of the regulatory environment, the commercial ingenuity of manufacturers and operators, persistent recreational uses, and underlying demand for UAS services.

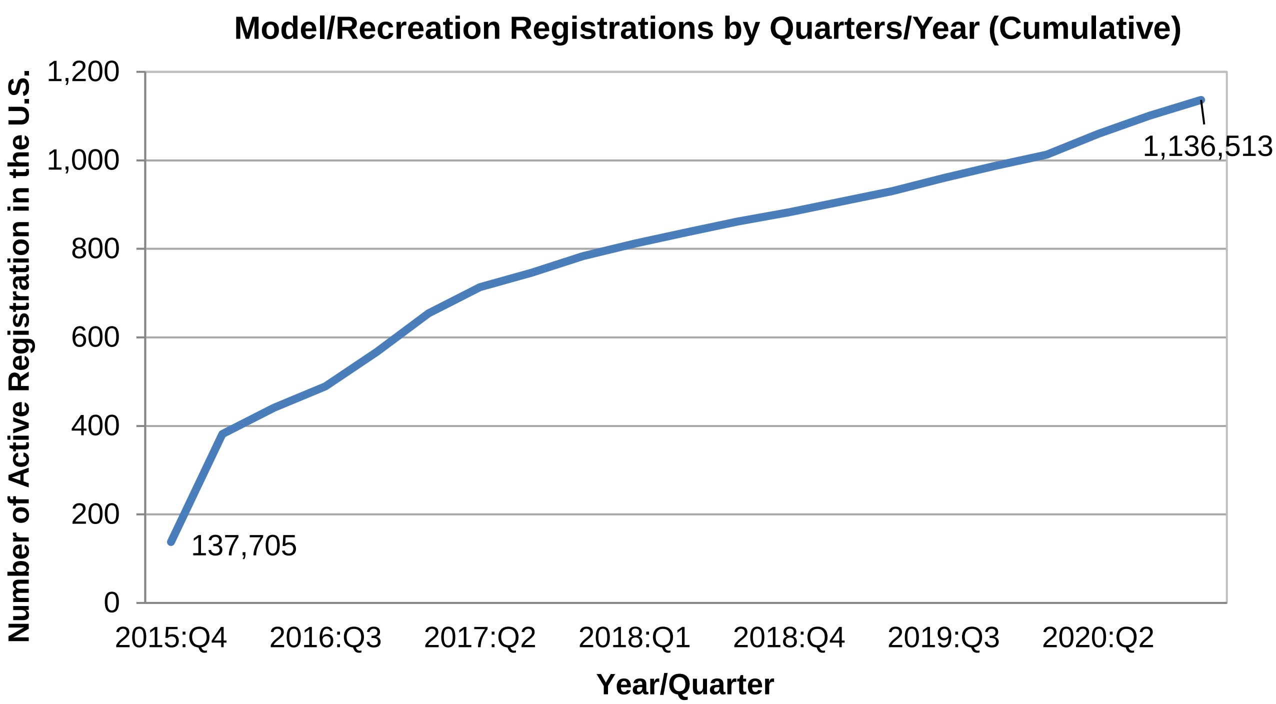
Trends in Recreational/Model Aircraft and Forecast

FAA's online registration system for recreational/model sUAS went into effect on Dec. 21, 2015. This required all UAS weighing more than 0.55 pounds (or 250 grams) and fewer than 55 pounds (or 25 kilograms) to be registered using the on-line system (https://www.faa.gov/uas/getting_started/registration/) or the existing (paper-driven) aircraft registry. Registration was free for the first 30 days, and $5 thereafter. Following a temporary halt in registration due to an order from the US Appeals Court in Washington, D.C. in May, 2017 (i.e., *Taylor v. Huerta*), the registration requirement for all model aircraft was reinstated in December, 2017 with the National Defense Authorization Act (NDAA) [Pub. L. 115-91, Sec. 1092]. NDAA extended the registration for three

[13] These are also called, interchangeably, hobby and non-hobby UAS, respectively. On October 5, 2018, the President signed the FAA Reauthorization Act of 2018 (Pub. L. 115-254). Section 349 of that Act repealed the Special Rule for Model Aircraft (section 336 of Pub. L. 112-95; Feb. 14, 2012) and replaced it with new conditions to operate recreational sUAS without requirements for FAA certification or operating authority. The Exception for Limited Recreational Operations of Unmanned Aircraft established by section 349 is codified at 49 U.S.C. 44809 [see https://www.federalregister.gov/documents/2019/05/17/2019-10169/exception-for-limited-recreational-operations-of-unmanned-aircraft for more details]. Recreational fliers, under Section 349, are referred to as "recreational fliers or modeler community-based organizations" [seehttps://www.faa.gov/uas/recreational_fliers/]. In previous notes including other documents of the Agency, these terms are often interchanged.

years for those registered prior to December, 2017. Registration pace continued after the temporary halt was removed. On October 5, 2018, the President signed the FAA Reauthorization Act of 2018 that formalized new conditions for recreational use of drones [See https://www.faa.gov/news/updates/?newsId=91844 for more details].

With the continuing registration, almost 1.14 million recreational UAS owners had already registered with the FAA by end of November, 2020.[14] On average, owner registration stood at around 12,400 per month during January-December, 2020 with some expected peaks during the holiday seasons and summer.

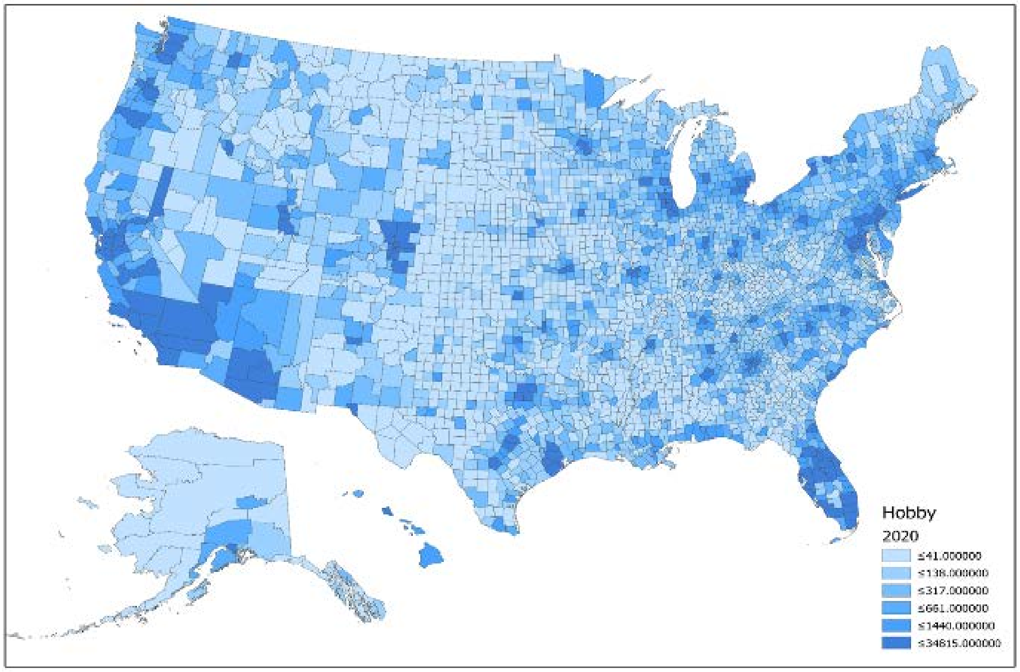


The current pace of registration has increased compared to last year in the same period; average monthly owner registration during 2020 stood 3,000 more than the level observed in 2019.

Recreational registration, and thus ownership of sUAS, is distributed throughout the country. Using the data available in December 2020, a spatial distribution of ownership by zip code below demonstrates that sUAS continue to be distributed throughout the country with denser ownership mapping

[14] For our estimate and projections using the registration database, applying to recreational, commercial (Part 107) and remote pilots, we use only those who are registered in the U.S. and the territories. Furthermore, we use those registrants who are "active;" i.e., those whose registrations have been canceled or withdrawn are not part of the data we report in this document. Finally, using the trends for the prior months in 2020 and years before, we extrapolate it to December, 2020 for completion of annual data.

closely against the population centers of the country, as expected.



At present, recreational ownership registration does not correspond one-to-one with aircraft. Unlike their commercial non-model counterparts, the registration rules for recreational operators do not require owners of recreational sUAS to register each individual aircraft; only operators are registered. For each registration, therefore, one or more aircraft are possibly owned. In some instances, there is no equipment associated with registration. Free registration at the initial phase may have incentivized some to create registration without any equipment to report. Notwithstanding these challenges, there is information available, both from industry and academia, allowing us to understand aircraft ownership. Furthermore, under the sponsorship of the UAS Integration Research Plan, the Agency has launched various research activities to understand the possible magnitude of the sector as well as implications on likely aircraft that may be used for recreational flying and safety implications of the sUAS fleet from gradual integration into the NAS. Finally, the Agency has incorporated outside analysis to aid forecasting efforts.

With around 1.14 recreational operators registered as of December, 2020, we estimate that there are around 1.44 million fleet distinctly identified as recreational aircraft. Comparing with industry sales and other data noted above, we conclude that the number of recreational aircraft is almost 30% higher than ownership registration.[15]

[15] This calculation involves taking into account retirement, redundancy, and loss of aircraft corresponding to ownership registration. As aircraft become sturdier and operators situationally aware, we expect this rate to change dynamically over time. Assumptions tying ownership to aircraft holding and issues related to compliance have

A comparison of last year's data (2019) with this year's (2020) shows the annual growth rate to be approximately 8.5%. This was possible due to continuation of drones playing dominant roles in recreation that is facilitated by decreasing equipment prices (e.g., average price around $750 or less), improved technology such as built-in cameras and higher capability sensors, and relatively easy maneuvering. Furthermore, it appears that COVID-19 had a positive impact on recreational registration (see below for more details). Nevertheless, similar to all technologies fueling growth of hobby items (e.g., cell phone and video game consoles; and prior to that, video cameras and video players), the trend in recreational sUAS has been slowing. It is likely to slow down further as the pace of falling prices diminishes and the early adopters begin to experience limits in their experiments, or recreational eagerness plateaus.

Given the trend in registration and market developments, we forecast that the recreational sUAS market will saturate at around 1.55 million units. However, there is still some upside uncertainty due to further changes in technology including battery, faster integration from a regulatory standpoint, and the likely event of continued decreasing prices. This leads to upside possibilities in the forecast. In contrast, there is relatively less low-side uncertainty. Low-side uncertainty tracks closer to the base forecast. We provide a forecast base (i.e., likely) with high and low scenarios, provided in the table below.

Last year, we forecasted that the recreational sUAS sector would have around 1.38 million sUAS in 2020, a growth rate exceeding 4.5% from the year before (2019). Actual data overshot the projection by a little over 53,000 with over 1.44 million aircraft already accounted for by the end of 2020. Thus, our forecast of recreational sUAS last year undershot by 3.7% for 2020; or 1.4365 million actual aircraft vs 1.3833 million aircraft that we projected last year.

Total Recreation/Model Fleet (Million sUAS Units)

Fiscal Year	Low	Base	High
Historical			
2020	1.4365	1.4365	1.4365
Forecast			
2021	1.4544	1.5022	1.5417
2022	1.4668	1.5303	1.5935
2023	1.4708	1.5415	1.6157
2024	1.4719	1.5455	1.6237
2025	1.4724	1.5510	1.6347

been discussed elsewhere [see https://www.napawash.org/studies/academystudies/federal-aviation-administration-assessment-of-compliance-with-and-effective for a recent study by the National Academy of Public Administration on these issues].

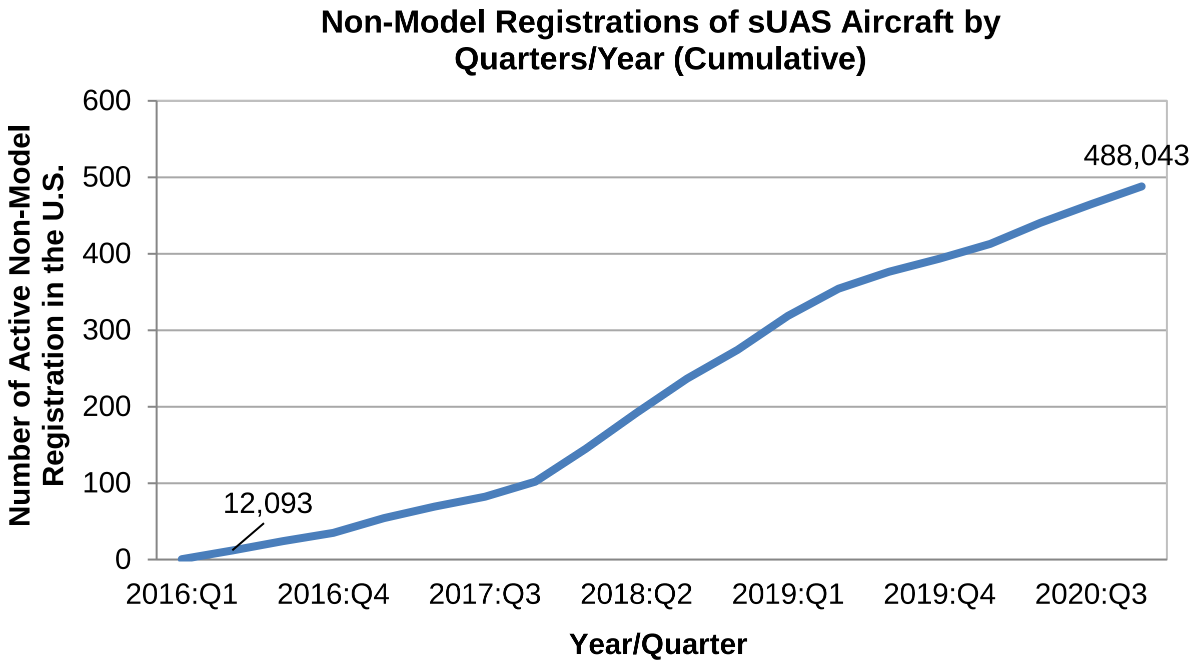
The FAA uses the trend observed in registrations, particularly over the past year; expert opinions distilled from TRB annual workshops; review of available industry forecasts; market/industry research; and a time-series model on registration trends fitted on monthly data. Using these, we forecast that the recreational sUAS fleet will likely (i.e., base scenario) attain its peak over the next 5 years, from the present 1.44 million units to around 1.55 million units by 2025. The high scenario may reach as high as 1.63 million units with low-side scenario yielding around 1.47 million units over the next 5 years. Notice that eventual saturation at somewhat higher levels, in comparison to last year's projections, reflects relatively higher registration by recreational flyers observed during 2020. This increased registration trend, in part driven by COVID-19, may or may not continue in the longer run[16]. Nevertheless, the growth rates underlying these numbers are fairly steady in the initial years, but fade faster in the last 2-3 years. The gradual saturation that is projected in 5 years and beyond in the recreational sUAS fleet parallels other consumer technology products and the Agency's projections from last year.

Trends in Commercial/Non-Model Aircraft and Forecast

Online registration for commercial/non-model sUAS went into effect on April 1, 2016. Unlike recreational/model ownership, rules for commercial registration require owners to register each sUAS, thus creating a one-to-one correspondence between registration and aircraft. During the period of January – December, 2020[17], more than 94,000 commercial operators registered their equipment. The pace of monthly registration, slightly above 7,800, is still relatively high but lower than the same period in 2019 (around 10,000). It appears that the pace of registration is slowing down in comparison to 2019 and comparable historically (i.e., April 2016 – November 2019 roughly 8,500 per month). While the pace of recreational registration ownership has increased somewhat, particularly last year, the pace of registration remains somewhat dampened for their commercial counterparts. By the end of 2020, there were more than 488,000 commercial UAS registered since the registration opened.

[16] It is quite likely that many people are buying and experimenting with recreational sUAS given the COVID-19 public health emergency and a substantial portion of the workforce is presently working from home. This may or may not continue once regular work patterns are resumed.

[17] As noted in fn. #2, using actual registrations until November, 2020, trends for the prior months in 2020 and years before, we extrapolate it to December, 2020 for completion of yearly data.

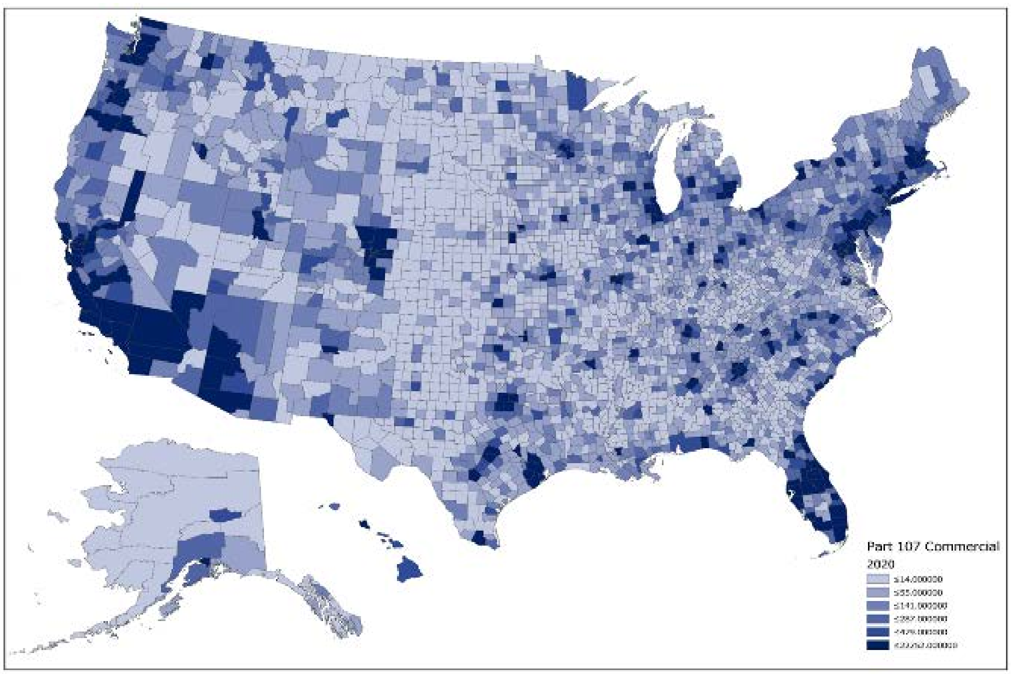


For each month the registration has been available, over 4,600 aircraft/month were registered until December, 2017. This pace accelerated to 14,600 registered per month during 2018. During 2019, average monthly registration stood at around 10,100. In the past year of 2020, average monthly registration dropped to 7,850. Despite this slowdown, the commercial sUAS sector is dynamic and appears to be at an inflexion point demonstrating powerful stages of growth. Unlike the recreational sUAS sector, the FAA anticipates that the growth rate in this sector will remain high over the next few years. This is primarily driven by the regulatory clarity that Part 107 has, and continues to provide, to the industry. In particular, the Operation Over People final rule, published on December 28, 2020, is the latest incremental step towards further integration of sUAS into the NAS. This final rule allows routine operations over people and routine operations at night under certain circumstances and eliminates the need for individual Part 107 waivers [seehttps://www.faa.gov/news/media/attachments/OOP_Executive_Summary.pdf for more details].

The Remote ID rule was announced on December 28, 2020 [seehttps://www.faa.gov/news/media/attachments/RemoteID_Final_Rule.pdf] as well. Remote ID (i.e., digital license-plate) of unmanned aircraft is necessary to ensure public safety and efficiency of the airspace of the United States. The rule applies to all operators of drones that require FAA registration (i.e., both recreational and Part 107). Remote ID provides airspace awareness to the FAA, national security agencies, law enforcement entities, and other government officials. Under the present rule guidance, unmanned aircraft in flight is to provide, via broadcast, certain identification, location, and performance information that interested parties on the ground and other airspace users can receive.

There are three ways to comply with the Remote ID rule: (a) operate a standard remote ID sUAS broadcasting identification and location information of both the aircraft and control station; (b) operate a sUAS with a remote ID broadcast module attached to it that broadcasts identification, location and take-off information; and (c) operate a sUAS without Remote ID but flying at specific FAA-recognized identification areas (or FRIAs) [see https://www.faa.gov/uas/getting_started/remote_id/]. The final rule was been published in Federal Register on January 15, 2021, and almost all of the final rule goes into effect on April 21, 2021[seehttps://www.federalregister.gov/documents/2021/01/15/2020-28948/remote-identification-of-unmanned-aircraft as amended byhttps://www.federalregister.gov/documents/2021/03/10/2021-04882/remote-identification-of-unmanned-aircraft-delay].

These two rules together provide much-needed regulatory clarity and reduce the need for waivers under Part 107. With enhancement of operational efficiencies under increasingly well-defined concepts of operations (CONOPS)—which ensures safety and transparent information flow across the community—more and more commercial uses will become likely, fueling even further growth. Notably, one such place for receiving all operational information, including registration, authorization, and logging accident reports, helps facilitate this growth further [https://faadronezone.faa.gov/#/].



As in the case of recreational UAS ownership, commercial sUAS are distributed across the country. A spatial distribution of equipment registration (using data for December 2020) demonstrates that commercial sUAS are distributed throughout the country with denser activities mapping closely against the economic or commercial activities of the country.

Last year, the FAA forecasted that the commercial UAS sector would have around

507,000 sUAS in 2020, a growth rate exceeding 32% over the year before (2019). Actual data came close to that projection with a little over 488,000 aircraft by the end of 2020. Our forecast of commercial sUAS last year thus overshot by 3.7% for 2019 (or 488,043 actual aircraft vs 506,776 projected last year). Forecasting in a time of tremendous uncertainty is indeed challenging, especially given the economic slowdown during COVID-19 and its impact on the UAS sector. The commercial sUAS sector's fast growth and adjustments during the pandemic is a demonstration of that fact. Nevertheless, our forecast errors for both recreation and commercial appear to be within the bounds of reasonableness.

Total Commercial/Non-Model Fleet (Thousand sUAS Units)

Fiscal Year	Low	Base	High
Historical			
2020	488	488	488
Forecast			
2021	543	589	691
2022	569	665	871
2023	583	729	1,028
2024	601	784	1,094
2025	614	835	1,144

We use the trends observed in the registration during the years past, information from the survey conducted in 2018, review of available industry forecasts/workshops and past FAA UAS Symposiums, and internal research together with market/industry research. Using these, the FAA forecasts that the commercial UAS fleet by 2025 will likely (i.e., base scenario) be at around 835,000; 1.7 times larger than the current number of commercial sUAS.[18] As the present base (i.e., the cumulative total) increases, the FAA anticipates the growth rate of the sector will slow down over time. Nevertheless, the sector will be much larger than what was only a few years earlier.

In order to understand the growth trajectory of the sector better, this report divides the commercial UAS sector into two types of sUAS aircraft: consumer grade and professional grade. The consumer grade commercial UAS have a wide range of prices, below US $10,000 with an average unit price of approximately $2,500. The professional grade, on the other hand, is typically priced above US $10,000 with an average unit price assumed to be around $25,000.[19] For both consumer grade and professional grade UAS, the average price is falling over time, particularly over the last few years. Currently, the consumer grade dominates the commercial

[18] Last year, the ratio of end-year forecast to base year forecast was 2-times; i.e., we forecasted end-year to be twice the base year's (2019) numbers in 5-year (2024).

[19] Because of this wide range in prices between types of sUAS in commercial activities, start-up costs for a business may vary between $2,500 and $25,000.

UAS sector with a market share approaching 92%. However, as the sector matures and the industry begins to consolidate, the share of consumer grade commercial UAS is likely to decline though it will still be dominant. By 2025, FAA projects this sub-sector will have approximately 87% of the overall commercial sUAS sector.

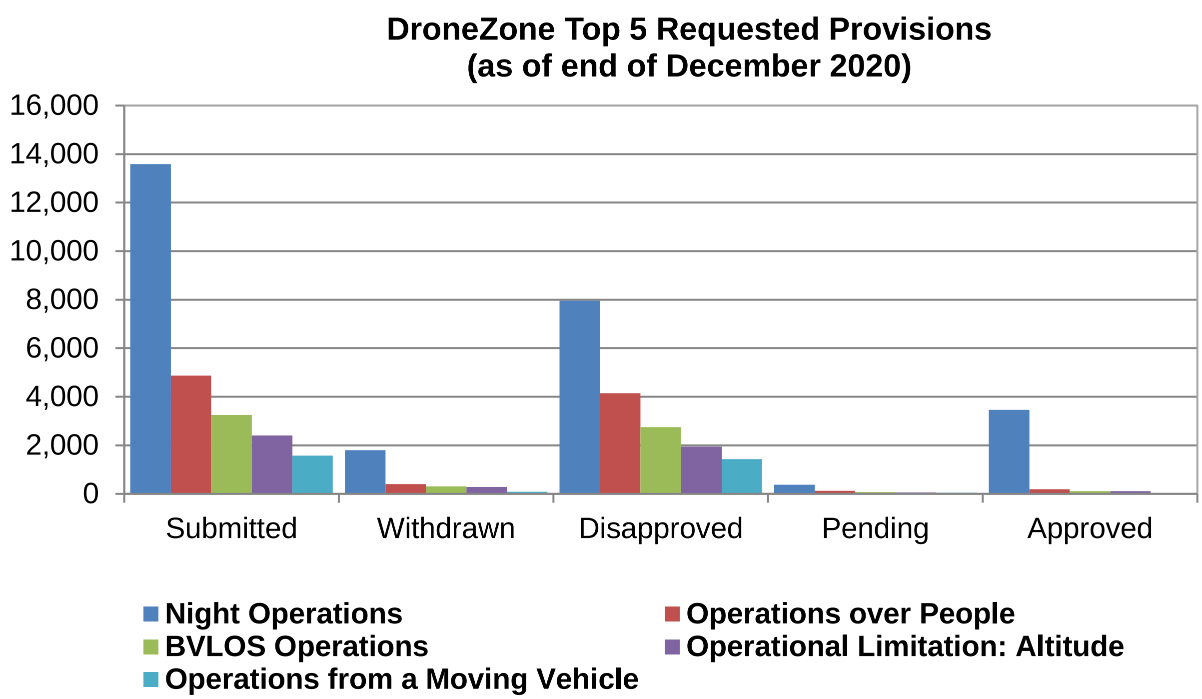
Starting from a lower base of approximately 40,000 aircraft in 2020, the professional grade commercial sUAS sub-sector stands to expand rapidly over time reaching 105,000 in 2025, especially as newer and more sophisticated uses are identified, designed, and operationally planned and flown. If, for example, professional grade sUAS meet criteria of operations, safety, regulations, and satisfy economics and business principles and enter into the logistics chain via small package delivery, the growth in this sector will likely be phenomenal. On the other hand, starting from a base of 448,000 in 2020, consumer grade sUAS is likely to grow over 730,000 by 2025. These growth trajectories could be even further enhanced by expanding operations in controlled airspaces, e.g., the Low Altitude Authorization and Notification Capability (LAANC) system[20], which began authorization in May, 2017. LAANC is designed to facilitate sUAS use of controlled airspace in the NAS. While most of the near-term growth in commercial sUAS will continue to come from consumer-grade units (over 90%), the FAA anticipates a significant part will come from professional-grade sUAS as well.

Unlike its recreational sUAS counterpart, it is extremely difficult to put a floor on the growth of the commercial sUAS sector due to its composition (i.e., consumer vs. professional grades) and the varying business opportunities and growth paths. As commercial sUAS become operationally more efficient and safe, battery life expands, and regulatory constraints are gradually relaxed (e.g., recent final rule involving operations over people; and Remote ID), new business models will begin to develop, thus enhancing robust supply-side responses. These responses, in turn, will pull demand forces (e.g., consumer responses to receiving commercial packages; routine blood delivery to hospitals, search-and-rescue operations, just to name a few) that are somewhat latent and in the experimental stages at present. Unlike a developed sector such as passenger air transportation, it is impossible to put a marker on “intrinsic demand” (or core demand) primarily driven by economic and demographic factors underlying this sector. Nevertheless, in this year’s forecast the FAA makes a provisional attempt to provide a “low” side for now, essentially capturing the intrinsic demand. In addition, we provide the likely or base scenario together with the enormous potential embodied in the “high” scenarios, representing cumulative annual growth rates of 11% and 19%, respectively. Average annual growth rate corresponding to the low scenario, on the other hand, is around 5%.

[20] Low Altitude Authorization and Notification Capability [https://www.faa.gov/uas/programs_partnerships/uas_data_exchange/] or LAANC automated the application/approval process for airspace authorizations. Requests submitted via FAA approved UAS Service Suppliers (USS) are checked against airspace data in the FAA UAS Data Exchange such as temporary flight restrictions (TFRs), Notice to Airmen (NOTAMS), and the UAS Facility Maps (UASFM). Approved requests thus provide the FAA/ATO visibility into where and when planned drone operations will take place.

Commercial sUAS are currently used for numerous purposes. As the sector grows, the FAA anticipates there will be many more uses for, and much more use of, commercial sUAS as is increasingly evident, for example, from the successful implementation of the UAS Integration Pilot Program (IPP) [see https://www.faa.gov/uas/programs_partnerships/integration_pilot_program/ for more details].

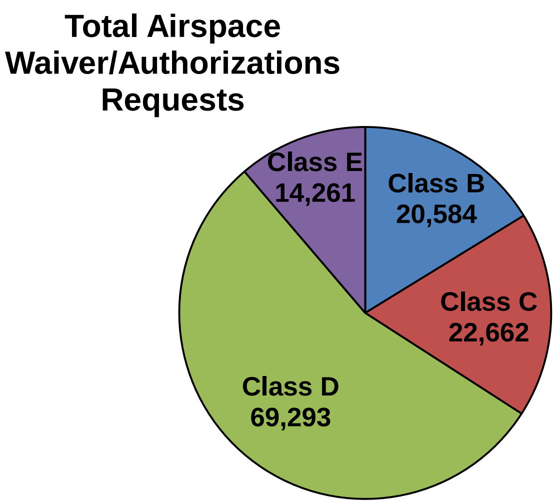
One way of identifying early trends in commercial sUAS use is to analyze the waiver applications granted to sUAS operators. Both the magnitude and relative composition of waiver types may indicate the direction of the commercial sUAS sector as a whole. A breakdown of the waiver requests granted in December, 2020 is shown in the chart below:

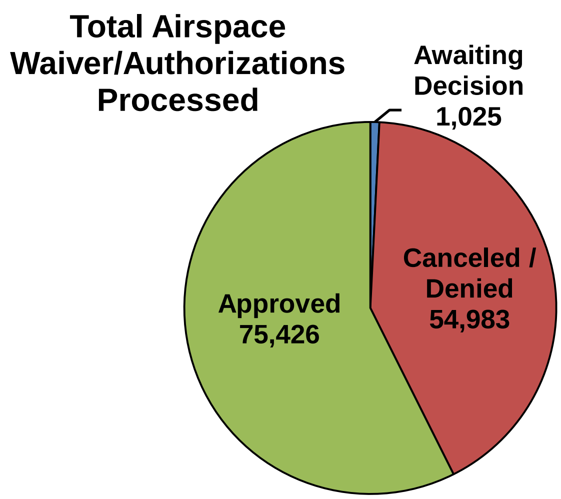


Beyond the daytime operation that is presently allowed under existing Part 107 rules, expanding applications further requires waivers, to a large extent, for night operations as distinct from daylight operations (around 9 in 10 approved waivers), and operations over people (around 1 in 20 approved waivers). As noted earlier, approved rules will now allow night operations and some operations over people as part of routine operations no longer requiring waivers. There are also BVLOS waiver requests (around 13% of total requests) and limitations on altitude (around 9% of total requests), for which waiver approvals are given at rates of 2.8% and 2.9%, respectively. Many of these waivers are combined, and thus total waiver approvals (i.e., full + partial) granted (over 3,890 by December, 2020) exceed 100%.

The Agency issues these waivers to facilitate business activities by sUAS while preparing for the next round of regulations that will enable routine, more complex drone operations. Now that night operations and operations over people have been finalized[21] [see https://www.faa.gov/news/media/attachments/OOP_Final%20Rule.pdf] amending Title 14 of the Code of Federal Regulations Part 107 (14 CFR Part 107) by permitting the routine operation of sUAS at night[22] or over people under certain conditions[23], the Agency is turning its focus on long-term solutions that will eventually enable routine BVLOS fights without waivers. Analysis of the waiver applications allows us to understand industry trends, one of many metrics essential for understanding and projecting the trajectory, course corrections, and growth trends of the sector.

On the airspace authorizations and waivers, almost 50% of requests were approved for controlled airspace at the end of December, 2020. While over half were for class D airspace (i.e., smaller airports with control towers), other classes were also requested and regularly flown.





Finally, LAANC has been routinely providing auto-approval since its inception in May, 2017, and now covers 726 airports. It has provided 289,749 auto-approvals for airspace access requests from Part 107 users

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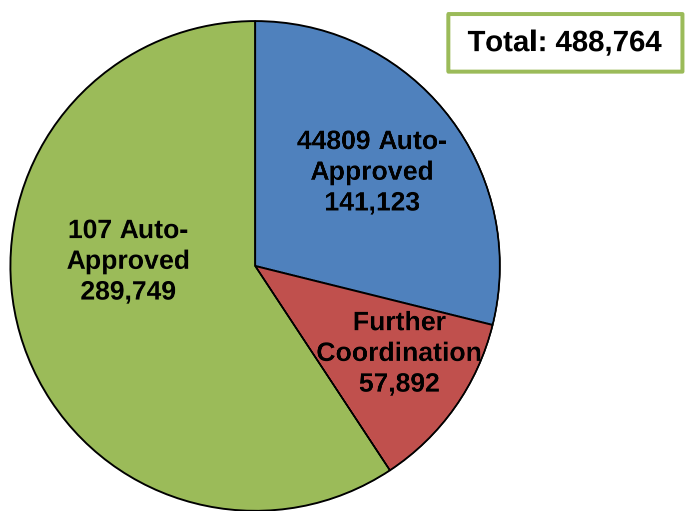
[21] The rule has been sent to the Office of the Federal Register and will become effective 60 days after the publication date in the Federal Register. Publication was expected in January 2021 but effective dates were delayed [See: https://www.federalregister.gov/documents/2021/03/10/2021-04882/remote-identification-of-unmanned-aircraft-delayandhttps://www.federalregister.gov/documents/2021/03/10/2021-04881/operation-of-small-unmanned-aircraftsystems-over-people-delay-withdrawal-correction.

[22] *See* § 107.29. An operation at night was defined as an operation conducted between the end of evening civil twilight and the beginning of morning civil twilight, as published in the Air Almanac, converted to local time (*ibid*).

[23] *See* § 107.39. An operation over people was established as one in which a small unmanned aircraft passes over any part of any person who is not directly participating in the operation and who is not located under a covered structure or inside a stationary vehicle.

and 141,123 requests from recreational operators as defined by 49 U.S.C. §44809[24]. Approvals thus total over 430,000 (see below); over 200,000 more since this time last year, while sending almost 58,000 requests for further coordination. LAANC authorizations are facilitated by the use of UAS facility maps (UASFM) [https://faa.maps.arcgis.com/apps/webappviewer/index.html?id=9c2e4406710048e19806ebf6a06754ad] that provide maximum allowed altitudes around airports where the FAA may authorize Part 107 UAS operations without additional safety analysis. The UAS facility maps are used to inform requests for Part 107 airspace authorizations and waivers in controlled airspace.

LAANC Airspace Requests



Status of Survey

The FAA is expected to conduct a nationwide survey of UAS operators in the summer of 2021, titled *Survey of UAS Operators*. The survey would ask commercial, recreational, and safety-agency operators in the United States about flight behavior, fleet characteristics, and commercial activities. To achieve this goal, all UAS operators who have registered with the FAA and have a valid email address will be invited to participate in the survey. The responses to the survey are intended to help the FAA make more informed decisions regarding UAS policy, investment in UAS infrastructure, and public safety in local communities

In general, the survey will ask all operators about flight behavior and their sUAS fleet. Questions about flight behavior include how often they fly their sUAS, the duration of each flight, how high they fly, and which days of

[24] Strictly for recreational uses [see https://www.faa.gov/uas/recreational_fliers/new_changes_recreational_uas/media/44809_authorization.pdf].

the week and months of the year they are the most active. The questions about operators' sUAS fleets includes propulsion type, weight of aircraft, and number of aircraft. The survey responses will allow the FAA to develop models of sUAS activity in the NAS, which should inform both policy and investment.

In addition to the general flight and fleet questions, two additional sections are included for respondents who self-identify as commercial or safety-agency operators. The commercial operator's section asks questions about industry of operation and intentions to apply for waivers. The safety-agency operator's section asks questions about intra-agency cooperation and training activities.

The new information collect request (ICR) for the survey is in the final stages of approval from the Office of Management and Budget (OMB). Both the 60-day notice and comment (www.regulations.gov/document?D=FAA-2020-0488-0001) and the 30-day notice and comment (www.regulations.gov/document?D=FAA-2020-0488-0003) have been completed. In addition, the ICR has received approvals from both the FAA's Paperwork Reduction Act (PRA) office and the Office of the Secretary of Transportation (OST). The FAA expects OMB approval before the summer of 2021.

Once the ICR is approved, the FAA will initiate an awareness campaign for the survey. The awareness campaign will include emails to operators registered with the FAA and social media posts through FAA social media accounts.
In addition, a webpage with information about the upcoming survey will be published on the FAA website.

After the survey closing, the responses to the survey will be compiled and appropriately weighted. The statistics developed from the survey will be published in the Aerospace Forecast, like in the past, the year after the survey has been completed. We expect to publish those results in the near future.

Remote Pilot Forecast

An important final metric in commercial sUAS is the trend in remote pilot (RP) certifications. RPs are used primarily to facilitate commercial sUAS flights. As of December 2020, approximately 206,347 RP certifications have been issued[25], an increase of around 47,000 from the same time last year.

Part 107 certifications require completing a multi-step process beginning with obtaining an FAA tracking number via the creation of an Integrated Airman Certification and Rating Application (IACRA) profile prior to registering for a knowledge test. Following this initial step, scheduling and passing the initial aeronautical knowledge test at a Knowledge Testing Center is required. Provided that one has passed this test, the applicant is required to fill out FAA Form 8710-13 in IACRA. A confirmation email is sent when an applicant

[25] In our accounting of RPs, we take pilots who passed the initial knowledge test (or Part 107) plus current manned pilots who took online training in lieu of the knowledge test (or Part 61).

has completed the necessary TSA security background check. This email contains instructions for printing a copy of the temporary remote pilot certificate from IACRA. A permanent remote pilot certificate is sent via mail once all other FAA-internal processing is complete. A RP certificate is valid for two years, and certificate holders must pass a recurrent knowledge test every two years at a Knowledge Testing Center. It is required that RPs carry their certificate whenever flying a sUAS.

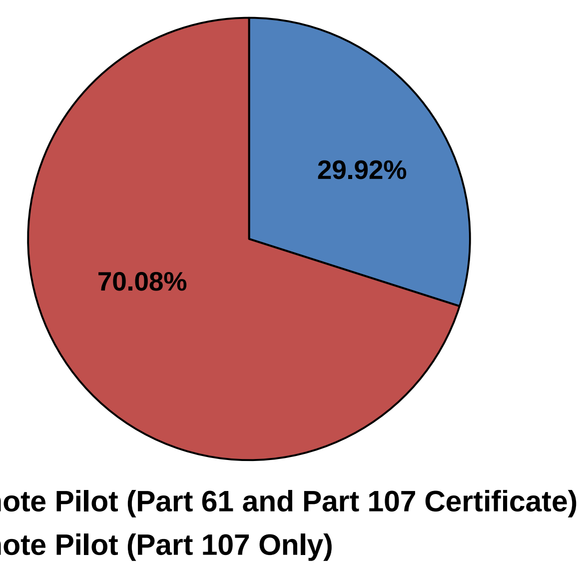
Certifications for Part 61 operators, on the other hand, require that an applicant must hold a pilot certificate issued under 14 CFR Part 61, and must have completed a flight review within the previous 24 months. Since Part 61 airmen already have IACRA profiles established, they are required to complete, like part 107 operators, FAA Form 8710-13 in IACRA. Upon completion of this form, proof of current flight review, and proof of online course completion, part 61 operators are required to meet with FAA representatives at the FAA Flight Standards District Office (FSDO), or with an FAA-designated pilot examiner (DPE), or an airman certification representative (ACR) or an FAA-certificated flight instructor (CFI) who issues the RP certificate to the Part 61 operator. Like their Part 107 counterparts, certificates for Part 61 operators are valid for 2 years and require renewal. (See https://www.faa.gov/uas/commercial_operators/become_a_drone_pilot/ for more details).

Following the process above, the FAA classifies RPs into two categories:

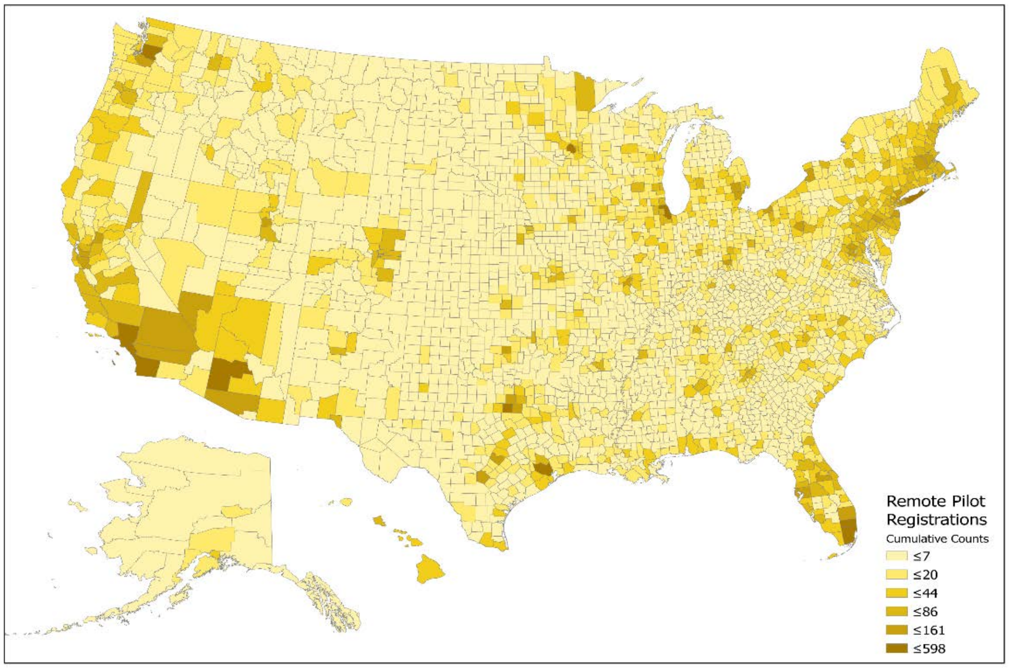
- those who do not hold any pilot certificate other than the Part 107, or Remote Pilot only; and
- those who hold a Part 61 certificate and a Part 107 certificate, or Part 61 and Remote Pilot.

The chart below provides a distribution of these two types of RPs who presently have certificates.

Distribution of Remote Pilots

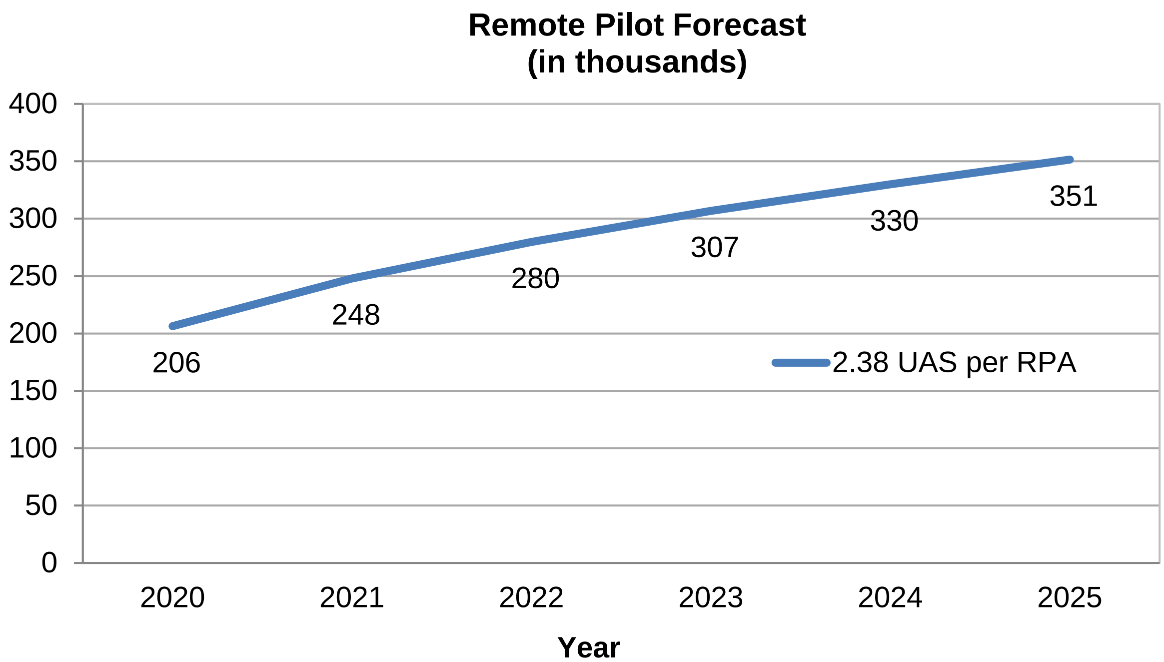


Over 70% of the RPs are part 107 RPs only. Over 90% of those who took the exam passed and obtained RP certification. A cumulative density distribution of remote pilots by zip code in 2020 is provided in the map below.



The RP forecasts presented below are based on three primary data sources: (a) trends in total RPs; (b) renewal trends; and (c) trends in commercial sUAS registration and forecasts of fleet. Given the trends in registration and our forecast of the commercial UAS fleet, the FAA assumes that one pilot is likely to handle 2.38 units of commercial sUAS aircraft, same as last year.

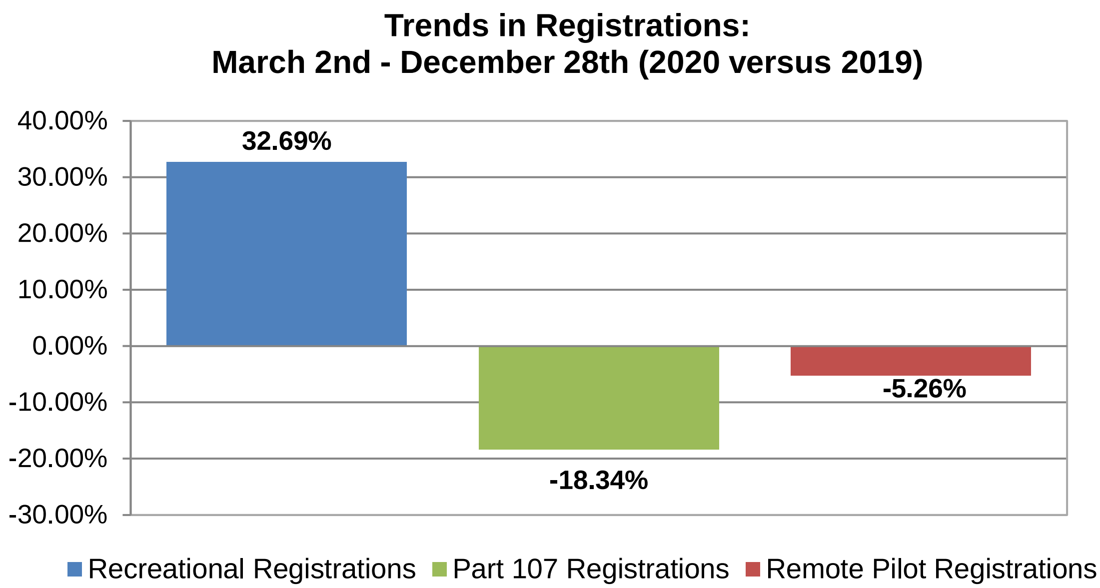
Using these assumptions and combined with the base scenario of the commercial sUAS forecast, we project RPs in the graph below. Last year, the FAA projected RPs to be around 213,200 by the end of 2020. Actual registrations came to be 206,347 or falling short of 3.21% from the projection last year.



Given the actual numbers at the end of 2020, RPs are set to experience tremendous growth following the growth trends of the commercial sUAS sector. Starting from the base of 206,347 RPs in 2020, commercial activities may require almost 350,000 RPs in 5 years, a 1.7-fold increase, providing tremendous opportunities for growth in employment associated with commercial activities of sUAS. Potential for RPs may enhance even more if larger UAS are used in commercial activities and advanced air mobility (AAM) becomes a reality in the near future.

COVID-19 and Its Impact on sUAS

Before we turn our attention onto areas of further expansion of sUAS, the chart below summarizes how COVID-19 may have impacted three areas of registration. During the prolonged shut-down (i.e., March-Dec, 2020) of numerous parts of the economy, we notice that commercial facets of sUAS, i.e., Part 107 and RP registrations, were impacted negatively.

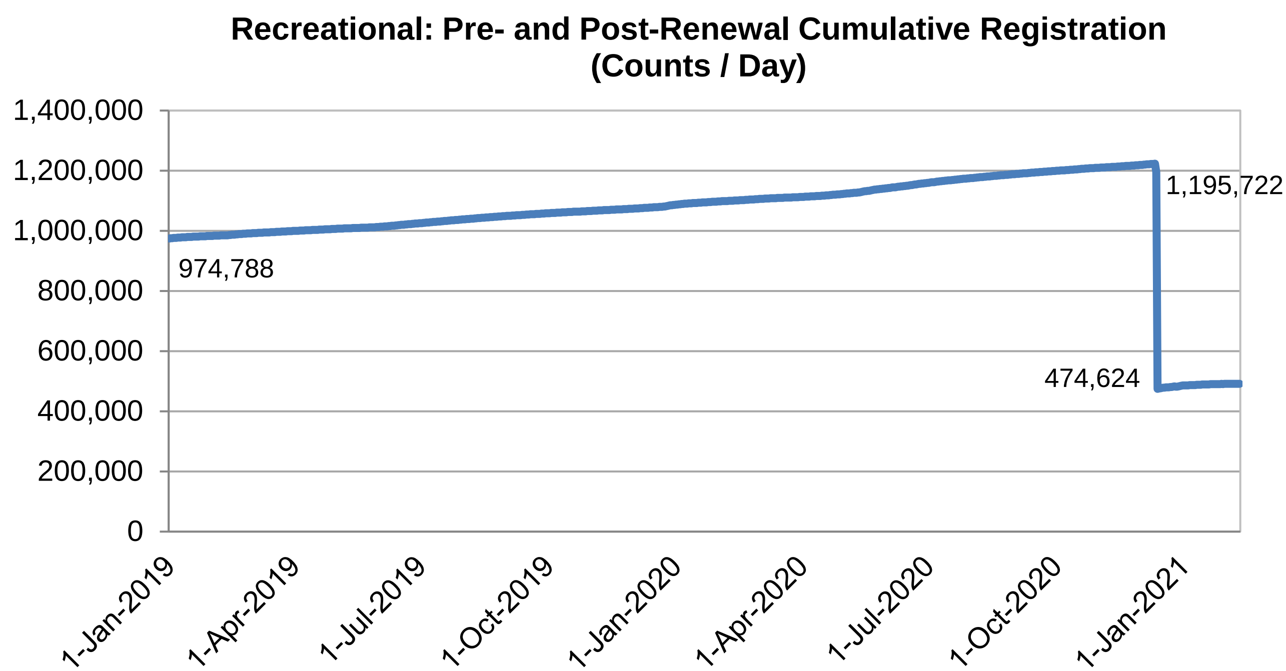


As evident, Part 107 registrations dropped by over 18% during this long period of partial shut-down in 2020 in comparison to the year before. RP registrations, on the other hand, dropped by around 5%. Interestingly, the registrations of recreational users went up by almost 33% during this past year in comparison to the year before. While it is quite possible that these drops/increases were led by sectoral progression, we believe that at least parts of the observed drops/increase were caused primarily by COVID-19. As the economy slowed down considerably, use of commercial sUAS and correspondingly the use of RPs, may have dropped as a result. On the other hand, economic slowdown may have afforded more time to people working from home; consequently, leading to increased experiment of recreational uses of sUAS thus causing higher registration in this past year in comparison to the year before.

Effective/Active Fleet via Renewal

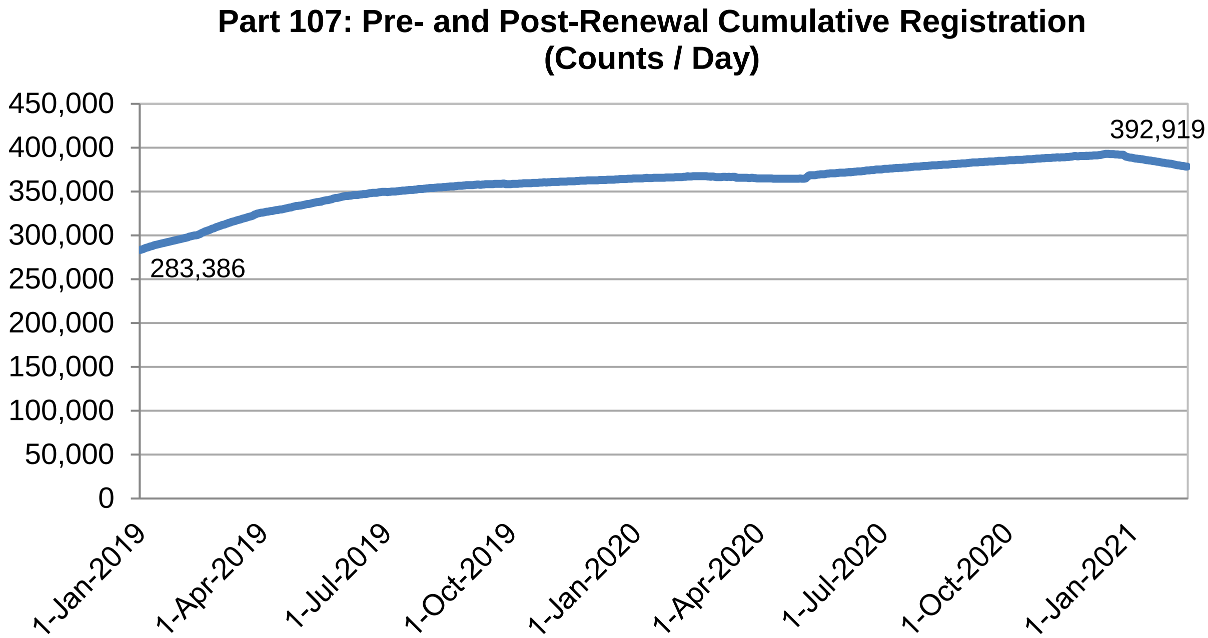
sUAS are registered for 3 years [see https://www.faa.gov/uas/getting_started/register_drone/] while RP certifications are valid for 2 [seehttps://www.faa.gov/uas/commercial_operators/become_a_drone_pilot/]. As noted earlier, rules adopted by the FAA in the matter of registration and marking requirements for sUAS aircraft [see FAA-2015-7396; published on December 16, 2015] were vacated by the United States Court of Appeals for the District of Columbia Circuit in *Taylor v. Huerta* [No. 15-1495; decided on May 19, 2017]. However, Section 1092(d) of the NDAA for Fiscal Year 2018 (Pub. L. 115-91), signed by the President on December 12, 2017, overruled the decision in *Taylor v. Huerta* and reestablished FAA's authority over registration. The FAA elected to extend the registration period, for all drones registered prior to December 12, 2017, for three years. Thus, December 12, 2020 marked the first effective renewal date for both recreational and Part 107 registrations. As a result of this sequence of events, approximately 800,000 sUAS registrations were due for renewal in December 2020.

The beginning of the registration renewal affords the FAA an opportunity to review the data, i.e., duplicates and unnecessary registrations removed, and make the registration database cleaner and more compact. Following this process, a preliminary examination of the data reveals that renewal of registrations appears to be slower perhaps due to inertia, an informational awareness gap, confusion about registration duration, and/or lack of operational opportunities. This is particularly true for recreational registrations. For example, a comparison of the latest period for which preliminary data is available against the earlier periods, i.e., December 13-February 10 for 2019-2021, show renewal and data clean-up led to a significant decline, over 60% (or over 721,000) in cumulative recreational registration trends.



This decline occurs due to renewal/data and validation starting on December 13, 2020. Average daily registrations, taking into account renewal, for the latest period shows a decline of 11,934 compared to over 300 daily registrations in the two years prior during the same periods (see the figure above). Further examination will occur during the upcoming year.

Part 107 renewal trends, on the other hand, leading to restating of registrations show similar trends but declines are much less prolific compared to its recreational counterpart.



Average daily registrations taking into account renewals dropped to -248, as opposed to earlier positive numbers, during the same periods of Dec. 13 – February 10 in different years since the registry began. Renewal/data clean up beginning on December 13, 2020 led to a reduction of over 14,600 from the cumulative registration counts by February 10 this year. We do not observe similar trends in RP registrations following renewals.

Given the uncertainty underlying these numbers (e.g., effect of undecideds/late decision by registrants to renew, role of registrations initiated by third -party services), this opens up a great need for communications about the registration renewal requirement, which the Agency already initiated. Furthermore, FAA's decision to defer the registration renewal process for 800,000 registrants, collected over approximately a year and a half period, created a unique data anomaly with regard to the renewal process. This data anomaly may be further skewed by confusion about registration requirements and practices of third-party registration services that occurred during this period. Now that registration is expiring on a routine basis, FAA will begin to monitor this data point carefully.

While removal of registrations that have been entered in error may reduce the total number of registrations, it is likely that renewals by late deciders may significantly alter cumulative numbers and upward. As noted earlier, the Agency uses registration as the primary basis for forecasting. Upon careful review of these data, which appear to be transitory, we decided not to use these changes in data to drive forecast for this year. We are examining these numbers carefully and will report the renewal-driven registrations and forecasts based on the stabilized numbers in the near future. For this year, we continue reporting registration trends prior to Dec. 12 and extrapolated data for forecasts (see fn. #s 2 and 5). Provided that this slow pace is indeed due to inertia, and not due to changed opportunities or lost interests, renewal trends may have significant impact on effective fleet in the NAS and thus remaining integration challenges and opportunities.

IPP to BEYOND

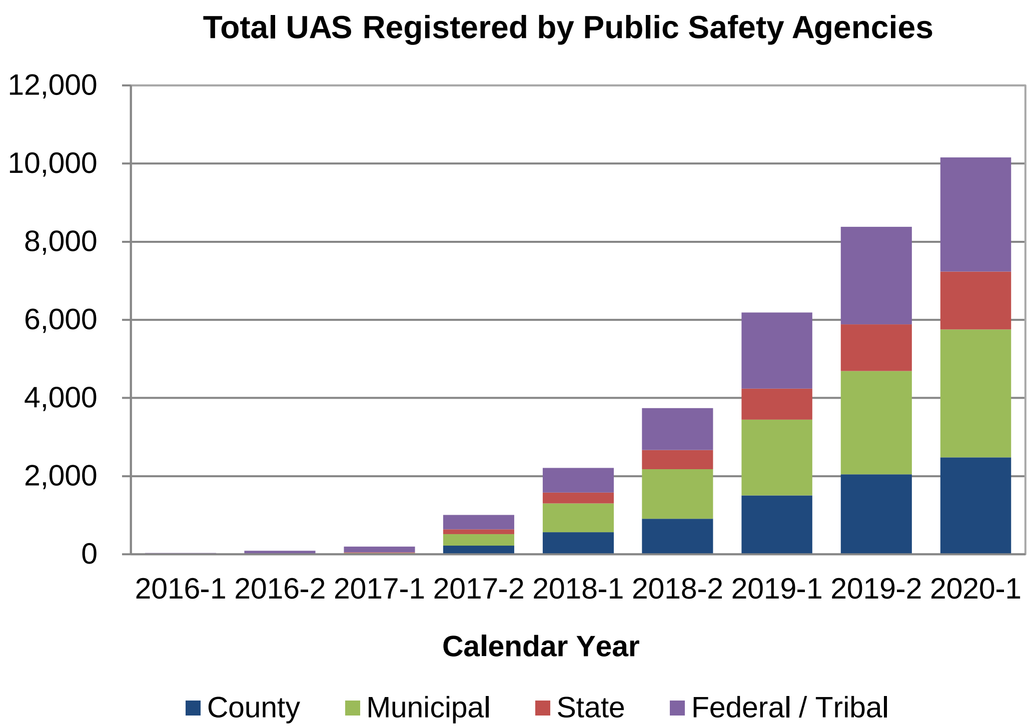
One such integration challenge was addressed under the Unmanned Aircraft System (UAS) Integration Pilot Program (IPP). Beginning in 2017, the IPP brought state, local, and tribal governments together with private sector entities, such as UAS operators or manufacturers, to test and evaluate the integration of civil and public drone operations into the NAS. The IPP program [see https://www.faa.gov/uas/programs_partnerships/integration_pilot_program/ for more details] concluded on October 25, 2020. The FAA launched a new program called BEYOND to continue working on specific challenges of UAS integration:

- Beyond Visual Line of Sight (BVLOS) operations that are repeatable, scalable and economically viable with specific emphasis on infrastructure inspection, public operations and small package delivery;
- Leveraging industry operations to better analyze and quantify the societal and economic benefits of UAS operations; and
- Focusing on community engagement efforts to collect, analyze and address community concerns.

BEYOND started on October 26, 2020 to continue the partnerships with eight of the original nine IPP participants. [see https://www.faa.gov/uas/programs_partnerships/beyond/ for more details].

sUAS use by Public Entities

Public safety agencies' use of sUAS has grown over time and will continue to grow. Public safety agencies' roles in the United States include law enforcement, firefighting and response to natural disasters, and emergency medical services. Additionally, these agencies are at different levels of government: federal, state, and local including tribal and territorial. Examples include the Department of the Interior monitoring wildlife with sUAS; California Fire using sUAS for firefighting operations; and local police departments using them for search and rescue in missing person instances. Figure below shows the historical growth of sUAS. By mid-year 2020, 2,399 public safety agencies had an active fleet size of 10,156 based on FAA Part 107 registrations [see Figure below].



Future growth of public safety agencies' sUAS fleet size will continue to be strong. Table below outlines the different growth paths for the next five years. The expectation is that the sUAS fleet size will be over 30,000 by 2025. This reflects a compound annual growth rate of 24 percent. The strength of growth will depend on multiple factors. One factor is changes in FAA regulations for sUAS, such as allowing tactical beyond visual line of sight. Another factor is budgetary constraints at local and state levels of government. These factors have the possibility of increasing or decreasing the growth of sUAS adoption from public safety agencies as shown in Table below with High and Low forecasts.

Fiscal Year	Low	Middle	High
Forecast			
2021	11,733	14,127	15,604
2022	13,022	18,098	21,313
2023	14,112	22,069	27,497
2024	15,056	26,040	34,106
2025	15,888	30,011	41,102
CAGR*	9%	24%	32%

Note: Based on extrapolation of registrations of Part 107 UAS by public safety agencies 2018-2020.

*Compound Annual Growth Rate

Large UAS

UAS weighing 55 pounds or greater cannot be operated under part 107 or as recreational unmanned aircraft. These larger UAS (lUAS) must be registered using the existing aircraft registration process and operated with an exemption under the Special Authority for Certain Unmanned Systems (49 U.S.C. §44807) or a public aircraft operator (PAO) certification. At present, many of these aircraft fly within the NAS by federal agencies including the Departments of Defense (DoD), Homeland Security (DHS), Interior (DOI), Energy (DOE), and Agriculture, as well as NASA, state governments, local governments, and academia. However, commercial operators are on the rise, many of which are operating agricultural lUAS. In order to calculate active lUAS in the NAS, we employ multitudes of data from various sources: the COA Online system and its successor CAPS or COA Application Processing System; MITRE's Threaded Track infusing data from different sources, FAA's Performance Data Analysis, FAA's Aircraft Registry and Reporting Systems or PDARS; and Notices to Airmen (NOTAM).

Combining these data sources, the FAA estimates that 195 lUAS are operating in 2020, with the bulk of these aircraft operated by the DoD and other government agencies. However, these estimates are likely the lower bound since a growing number of agricultural lUAS are operating in close proximity to the ground (i.e., likely below 400ft AGL) and are not captured by this data. These agricultural lUAS are likely to grow rapidly over the next 5 years but will have very little effect on air traffic in the NAS given their locations away from busy manned air traffic and low altitude. lUAS operated by military and civilian agencies in the NAS are expected to grow at a steady pace over the next 5 years. DoD is expected to remain the largest operator of lUAS in airspace above 400ft AGL over the forecast.

However, commercial operators are expected to overtake government operators as a whole over the next 5 years. As the industry for agricultural UAS matures, farmers are expected to switch from manual or manned aircraft spraying to lUAS for their specialty crops. This switch should drastically increase the number of lUAS operated for commercial reasons, but unlike the lUAS operated by the government, these lUAS are operating well below 400ft AGL.

In 2020, 14 exemptions were granted by the FAA for commercial UAS with weights above 55lbs while 21 exemptions expired. There are approximately 30 active exemptions to operate a lUAS. One-third of the active exemptions are for agricultural uses, mostly with UAS weighting above 55lbs. The exemptions for agricultural spraying is likely to increase as the technology and the industry matures.

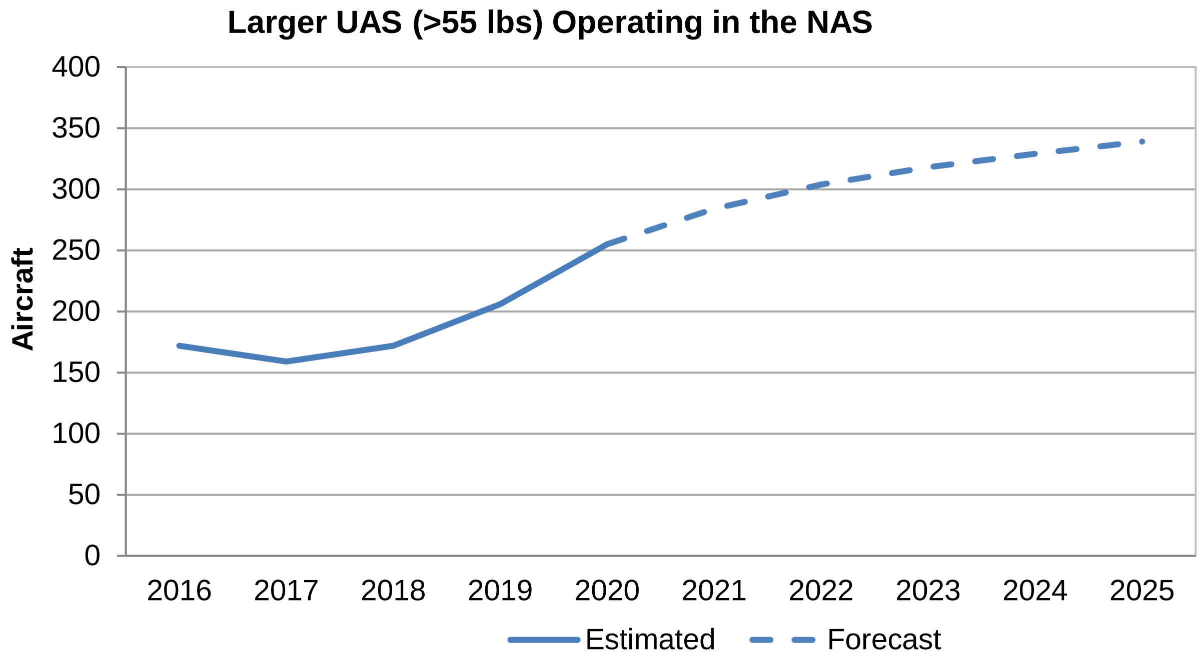
The unmanned aircraft over 55lbs registered in the public aircraft registry has increased by 63 percent, from 322 at the end of 2019 to 510 at the end of 2020. Three hundred and nine lUAS registered or renewed in 2020, up 21 percent from 2019. However, the delisted and expired registration almost tripled in 2020 from 47 deregistration in 2019 to 121 deregistration in 2020. Around 10 percent of the lUAS registered are directly connected to agricultural uses.

Although 510 lUAS are registered in the public aircraft registry, only a portion of these aircraft are currently operating commercially. A sizable portion of the lUAS operators are not operating their aircraft in the NAS due to safety or regulatory concerns or only operating close to the ground. As such, the number of registered lUAS which are likely to come in contact with ATC is small. The forecast for the lUAS is only for aircraft operating in airspace where contact with other lUAS or manned aircraft is possible.

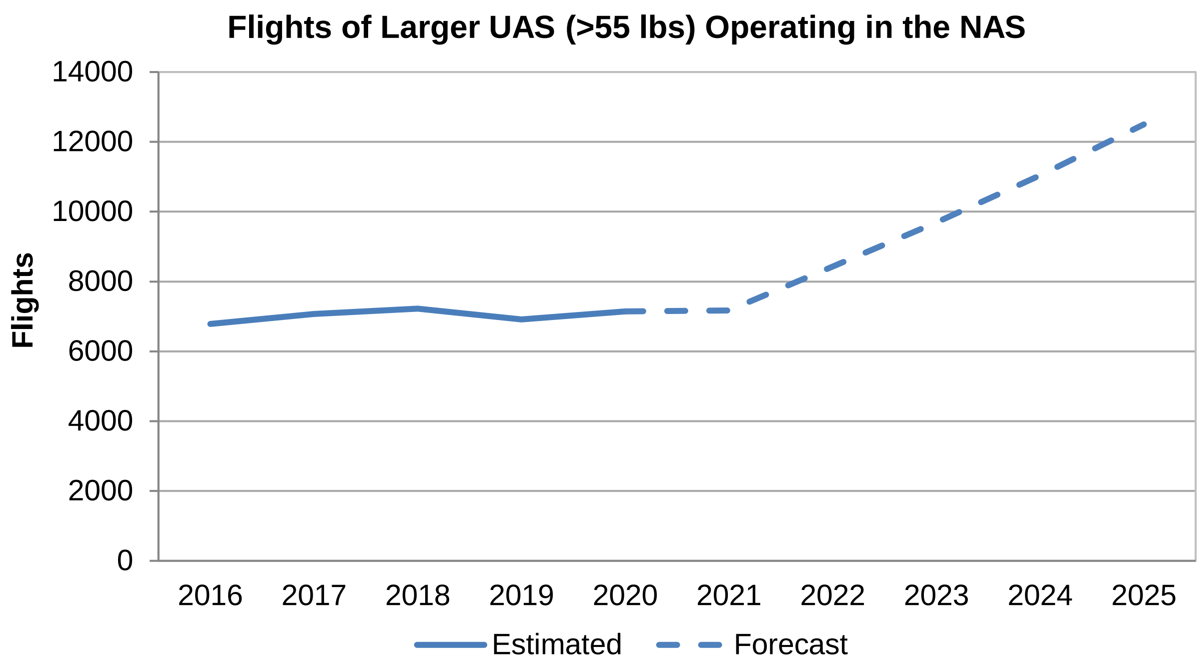
Larger UAS (>55 lbs) Forecast - 5 Years

Year	Active L-UAS	Number of Flights
Historical		
2016	172	6,785
2017	159	7,066
2018	172	7,223
2019	206	6,914
2020	255	7,144
Forecast		
2021	284	7,171
2022	304	8,426
2023	318	9,696
2024	329	11,038
2025	339	12,500

Combining the baseline from military and civilian agencies and projections of commercial exemptions from the FAA, lUAS are estimated to increase from 209 in 2019 to 255 in 2020, and are expected to increase by 29 aircraft in 2021 due to an acceleration in commercial applications. As commercial and advanced military lUAS are introduced over the next half decade, lUAS are projected to increase to 339 aircraft by 2025. The flattening of the forecast from previous years is partially due to the sunset of UAS exemptions under 49 U.S.C. §44807 in September of 2023, which is expected to reduce the fleet of lUAS after 2024, and partially due to the economic impact from Covid-19, which has drastically reduced the utilization of these aircraft.



Despite 49 additional aircraft detected operating in the NAS in 2020, only 230 additional flights were observed. This suggests that the utilization of each lUAS had decreased since the beginning of the Covid-19 pandemic recession. Even though the lUAS fleet is expected to increase in 2021, lower utilization of each aircraft is expected to keep flights relatively unchanged. As economic activity recovers and planned lUAS accusation are fulfilled, flights are expected to grow rapidly, despite fewer new lUAS. As such, the number of lUAS flights are expected to increase from the estimated 7,144 in 2020 to 12,500 by 2025, even as the growth of the lUAS fleet stabilizes.



Advanced Air Mobility

In September 2017, NASA launched a market study for a segment crossing over some functions of UAS discussed above. This segment of autonomous vehicles broadly called Advanced Air Mobility[26] (or AAM) is defined as "a safe and efficient system for air passenger and cargo transportation, inclusive of small package delivery and other urban UAS services, which supports a mix of onboard/ground-piloted and increasingly autonomous operations" (See https://www.nasa.gov/aero/nasa-embraces-urban-air-mobility). AAM technology presents considerable opportunities for economic growth over the coming decades. Markets for AAM services, such as delivering packages by drone or larger unmanned cargo or unmanned passenger shuttles or air taxis, have huge potentials both in the United States and globally. For example, package or larger cargo delivery is the AAM service that is most likely to experience economic growth in the next decade. By 2030, for example, package delivery is likely to be profitable at a price point of $4.20 per delivery with a fleet of 40,000 vehicles completing 500 million deliveries per year.[27]

[26] The community is in the process of deciding on a nomenclature. Only recently, the community-at-large has moved onto coining earlier-used urban air mobility (UAM) as advanced air mobility (AAM) to broaden its operational scope, technical characteristics, economic opportunities and regulatory framework. Under this broad characterization, UAM is considered a subset of AAM.

[27] Urban Air Mobility (UAM) Market Study, Nov. 2018, NASA. (See https://www.nasa.gov/uamgc.)

Passenger services, on the other hand, promise larger markets for AAM services, but safety challenges and evolving technology leading to market uncertainties may slow the pace of AAM's penetration into this segment of the market. It appears that initial AAM operations will be more likely helicopter operations with pilots onboard leading to some form of automation as vehicles mature. Due to perceived uncertainties, market estimation for the overall sector has been quite wide. The total available market for passenger services is estimated to be $500 billion in the United States, but AAM is unlikely to garner more than $2.5 billion of this market in the near term, as one study estimates.[28] On the upside of the estimation, a recent study conducted by Deloitte and the Aerospace Industries Association (AIA) estimates[29] the AAM market in the US to reach approximately US$115 billion by 2035, equivalent to 30% of the present US commercial air transportation market. Of that total, US$57 billion is expected to originate in passenger air mobility while an equivalent amount is expected to come from the cargo market.

Airport shuttles and other fixed-route passenger services are the AAM passenger services most likely to gain economic traction in the coming decade. Optimistic reports project the AAM passenger industry to have 23,000 aircraft with 740 million enplanements per year at a price of around $30 per trip by 2030.[31] However, several other stud-

Market dynamics underlying AAM are complex, dynamic and numerous. Although COVID-19 has led to an increased adoption of virtual work versus commuting and business travel[30], persistence of this trend in the long-run is mired in uncertainty. Socioeconomic changes such as population shifts from urban to suburban or rural areas (i.e., de-urbanization) could also affect the various AAM use cases differently. AAM services, i.e., both cargo and passenger, may appear to be unprofitable in the near future, like many other services in the beginning, the AAM passenger industry is likely to expand due to an inflow of venture capital and experimental services exploring market opportunities.

ies have reported more conservative estimates, arguing the market penetration is likely limited to a handful of major metropolitan areas where geography and economic conditions are conducive to AAM market development. As such, estimates by KMPG predict 60.4 million enplanements by 2030 and a much smaller industry size.[32] Similarly, Roland Berger estimates a fleet of only 12,000 passenger UAS by 2030.[33] However,

[28] UAM Market Study – Technical Out Brief, Oct. 2018, Booz-Allen-Hamilton and NASA. (See https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20190001472.pdf.)

[29] https://www2.deloitte.com/us/en/insights/industry/aerospace-defense/advanced-air mobility.html?id=us:2el:3pr:4diER6839:5awa:012621:&pkid=1007244

[30] Road congestion and associated opportunity cost in commuting around metros provided the most powerful boon for economic and financial justifications for AAM passenger services. However, changed working pattern and home location due to COVID19 puts a damper on that earlier economic trade-off, at least in the near-term.

[31] Urban Air Mobility (UAM) Market Study, Nov. 2018, NASA. (See https://www.nasa.gov/uamgc.)

[32] Getting Mobility Off the Ground, 2019, KPMG (see https://institutes.kpmg.us/manufacturing-institute/articles/2019/getting-mobility-off-the-ground.html).

[33] Urban Air Mobility: The rise of a new mode of transportation, Nov. 2018, Roland Berger (see https://www.rolandberger.com/en/Publications/Passenger-drones-ready-for-take-off.html).

given the current safety and technology challenges, even these projections may likely to be optimistic.

Given the enormous economic potentials underlying the AAM sector, coordination led by the Agency with close collaborations of NASA and the industry, numerous activities are presently taking place. This is leading to flight testing of AAM vehicles (e.g., https://www.nasa.gov/centers/armstrong/features/nasa-begins-air-mobility-campaign.html), regulatory coordination for safety, traffic management and on issues related to international harmonization with other agencies, e.g., European Union Aviation Safety Agency (EASA) leading to type certifications (e.g.,https://www.faa.gov/uas/advanced_operations/certification/). In order to accelerate this process, the Agency created an internal AAM Executive Council [see https://www.faa.gov/uas/advanced_operations/urban_air_mobility/] and is actively working with the internal and external stakeholders to understand the nature, scope and likely evolutions of AAM. The FAA also issued a concept of operations (CONOPS) in June last year [see https://nari.arc.nasa.gov/sites/default/files/attachments/UAM_ConOps_v1.0.pdf] and likely to publish a strategic implementation framework in the near future. NASA also launched a national campaign (NC) to promote public confidence and accelerate the realization of emerging aviation markets for passenger and cargo transportation in urban, suburban, rural, and regional environments [see https://www.nasa.gov/aeroresearch/aam/description/ for more details]. Furthermore, NASA issued AAM CONOPS corresponding to slightly advanced maturity levels (i.e., Urban Air Mobility Maturity Level 4) recently [see https://ntrs.nasa.gov/citations/20205011091 for more details].

These pro-active steps are positioning the AAM industry positively towards realizing market opportunities. In December 2020, for example, Joby Aviation received the first ever airworthiness approval by the US Air Force (USAF) for an eVTOL aircraft under Agility Prime and recently reached an agreement with the FAA to certify its aircraft using the FAA's Part 23 requirements along with special conditions for the eVTOL aircraft.[34] Joby Aviation plans to launch air taxi services in the US by 2023. Lilium GMBH, a German company, is developing an eVTOL transport network centered around Lake Nona, Orlando, Florida. It has partnered with the City of Orlando and a real estate development company to develop a vertiport hub in Lake Nona for regional, inter-city air mobility services by 2025 with travel distances of up to 186 miles in 60 minutes with Lilium Jet aircraft under development.[35]

The trend is somewhat similar at the international level as well. For example, EHang, a Chinese manufacturer of autonomous aerial vehicles (AAVs), established a strategic partnership with UAM pilot cities in Spain, Austria, and China in 2020.[36] It also conducted demonstration flights in South Korea with its two-passenger autonomous aerial vehicle, the EHang 216. German AAM companies,

[34] https://www.aviationtoday.com/2021/02/09/joby-agrees-evtol-certification-requirements-faa/

[35] https://lilium.com/newsroom-detail/lilium-partners-with-tavistock-and-orlando

[36] https://www.ehang.com/news/617.html

Lilium and Volocopter, are also working to launch passenger air transport services in the next few years. Volocopter completed demonstration air taxi flights in Singapore in 2019 and began to sell tickets for commercial service, expected to start in Singapore by 2023.[37] Volocopter has also announced plans to introduce air taxi services in the US.

AAM services are likely to face stiff competition from technological advances in industries with close substitutes, such as ground transportation (i.e., emerging automated solutions on increasingly electric-powered vehicles). Furthermore, economic and financial trade-offs underlying emergence of AAM may have changed following COVID-19, changed travel patterns and perhaps long-term living arrangements. Finally, the high costs of urban infrastructure, community acceptance, associated noise and environmental issues pose considerable challenges for AAM type certification, wide production certification, and eventual community acceptance leading to greater adoption. Future AAM operators must also prepare to comply with new operating requirements and other regulations yet to come.

Despite these challenges, regional governments are aligning themselves with the manufacturers and likely operators. For example, the city of Los Angeles announced the creation of its Urban Air Mobility Partnership in December 2020. It is a public-private partnership that will evaluate barriers and solutions to launching air taxi services in Los Angeles by 2023.[38] Other entities including the Canadian AAM Consortium (CAAM) have also studied the impacts of AAM on regional economies.[39]

As the sector grows and new initiatives are undertaken, the Agency, together with numerous stakeholders, is keeping a keen eye on understanding the overall trends in AAM. As more information becomes available, the FAA will likely provide emerging trends and forecast ds-in the near future.

[37] https://www.bloomberg.com/news/articles/2020-12-09/first-electric-air-taxis-set-to-fly-in-singapore-by-2023

[38] https://www.lamayor.org/mayor-garcetti-announces-first-nation-urban-air-mobility-partnership

[39] http://www.pnwer.org/uploads/2/3/2/9/23295822/economic_impact_assesment_-_caam_-_v1.0.pdf

Forecast Uncertainties

The forecasts in this document are forecasts of aviation demand, driven by models built on forecasts of economic activity. There are many assumptions in both the economic forecasts and in the FAA models that could affect the degree to which these forecasts are realized. This year's forecast is driven, at least in the near-term, by the pace of recovery from the impacts to the U.S. and global economies and the aviation industry resulting from the novel coronavirus (COVID-19). Shifting international dynamics and impacts resulting from the U.S. administration's economic policies could drive further changes. Also, as numerous incidents in the past few years remind us, terrorism remains among the greatest world-wide risks to aviation growth. Any terrorist incident aimed at aviation could have an immediate and significant impact on the demand for aviation services that could be greater than its impact on overall economic activity.

The rapid spread of the novel coronavirus (COVID-19) that began in early 2020 resulted in the largest decline in aviation activity since the jet era began in the late 1950's. Although the FAA forecast is a long-term trend forecast, there is great uncertainty about the path of aviation's recovery from the 2020 downturn. This uncertainty arises from a variety of factors including the speed at which infection rates are brought down to a minimal level, the willingness of consumers to resume air travel as infection rates are reduced, the pace at which vaccinations of the population take place, the success of the strategies U.S. and foreign carriers are employing to recover from the downturn in demand, the stability of consumer attitudes and behaviors towards aviation in a post-COVID environment, as well as the breadth and depth of the economic recession and the speed and nature of the economic recovery, all of which apply both domestically and globally.

Although oil prices moved lower in 2020 from the previous year, recent volatility reminds us there is still considerable uncertainty as to the future direction of oil prices. The FAA's baseline forecast (derived from economic assumptions in IHS Global Insight's November 2020 U.S. macro forecast and 30-Year Focus released during August 2020) calls for oil prices to decrease to $36 per barrel in 2021 and rise gradually thereafter. By 2030, oil prices are projected to reach $75 per barrel and reach $94 per barrel by the end of the forecast period in 2041. Some forecasters are calling for a more gradual rebound in the price of oil. In October 2020, the World Bank released its latest commodity price forecast. The forecast calls for oil prices to rise gradually from a low of $41 per barrel in 2020 to just under $57 per barrel by 2025. After 2025 prices continue to rise and reach $70 per barrel by 2030. However, there are other oil price forecasts that are considerably more aggressive than the FAA base forecast. The latest Energy Information Administration (EIA) Annual Energy Outlook released in January 2021, sees oil prices rising approximately 5.9% per year between 2020 and 2041. By 2041, the spot price of oil ranges from $133 per barrel (West Texas Intermediate) to $138 per barrel (Brent), considerably above the FAA base forecast of $94. Over the long run, lower oil prices give consumers an impetus for additional spending, including air travel, and should enhance industry profitability. In the case where oil prices turn out to be higher than the FAA forecast, we would expect lower spending on air travel by consumers, higher costs for fuel to airlines and reduced industry profitability.

The baseline forecast incorporates additional infrastructure spending in 2021 and beyond. However, there is considerable uncertainty as to the magnitude, timing, and nature of these programs that ultimately determines the impact on the future growth of the U.S. economy. In addition, how the U.S. will engage with the rest of the global economy over the next several years continues to evolve. Under the right conditions, a period of sustained high and more inclusive growth along with increased financial stability could occur but there is also the possibility of an outcome that leads to greater global economic fragmentation, slower growth, and increased financial instability.

The baseline forecast assumes that the global economic recession that occurred in 2020 will be short lived with recovery beginning in the end of 2020. By the end of 2021 global GDP will be back to pre-COVID (2019) levels led by China and the United States. Thereafter, the baseline forecast assumes that China and India will be growth engines for emerging economies as China successfully transitions the economy from heavy reliance on manufacturing and resource industries to one more oriented towards the services and technology sectors and India continues to implement reforms to make its economy more competitive. In the United States, economic growth will rebound strongly in 2021 as the impacts from the latest round of COVID-19 stimulus flow through the economy. The combination of direct payments, extension of unemployment benefits, and direct federal spending will provide money into consumer's wallets boosting their spending. However later on in the decade, the forecast assumes some measure of fiscal restraint will be implemented as the impact of the 2017 tax cuts and the huge increase in federal spending to combat the economic impacts of COVID-19 have pushed the government debt as percent of GDP to levels that were last seen at the end of World War 2. In Japan, the United Kingdom, and the European Union economic growth over the next few years will be well above rates seen over the past decade as these regions recover from the COVID-19 recession. However, over the forecast horizon, demand growth will remain slow in these regions as they continue to be constrained by structural economic problems (high debt, slow population growth, weak public finances, for example) and political instability. In most of the major advanced economies, governments need to shore up their finances and many are concerned that policy makers will not take the necessary actions. There exists a non-trivial possibility that authorities will either act prematurely or be excessively timid and late in taking necessary steps to maintain a healthy global economy. The current forecasts call for strong passenger growth for travel between the United States and other world regions, especially over the next five years. Further slowing of worldwide economic activity could seriously inhibit the growth in global passenger demand.

Although U.S. airline finances have been decimated as a result of COVID-19 and the fall in demand, the outlook for further consolidation either through mergers and acquisitions (M&A) or bankruptcy appears to be rather limited. Based on FY 2020 data, the top 6 (American, Delta, United, Southwest, Alaska and JetBlue) accounted for almost 81% of the U.S. airline industry capacity and traffic. For the large network carriers, the steps they have taken to increase their liquidity have reduced the risk of bankruptcy in the next few years. However, if the demand recovery is slower than expected, the increase in debt that these carriers are servicing may be a burden and increase the possibility of a bankruptcy or liquidation. Low cost carriers and ultra-low cost carriers also took steps to increase their liquidity (stock issuances, debt financing) that when combined with the size of any merger transaction has increased the amount of risk associated with a merger making further merger activity unlikely.

The forecast assumes the addition of sizable numbers of large regional jets (70 to 90 seats) into the fleets of regional carriers. While the recovery in air travel demand from the COVID downturn is projected to be robust, we are not projecting a uniform recovery across all segments. As network carriers continue to adjust the size and breadth of their networks in anticipation of the post-COVID environment, they are continuing to move forward with plans to significantly reduce the numbers of small regional jets they will need. Prior to the COVID downturn in 2020, strong air travel demand has not ensured financial stability for regional carriers, as the bankruptcy filings of Republic Airways in 2016, Great Lakes Airlines in 2018 and Trans States Airlines in 2020 have shown. Financially strong and well positioned regional carriers may see increased opportunities for regional flying as a result of the network carrier actions, but the overall impact will most likely reduce opportunities for many regional carriers, increasing financial pressures on these carriers, and may lead to further consolidation in the regional airline industry.

The general aviation sector did suffer a downturn in activity in 2020 due to the impacts of COVID-19, but the magnitude of the decline was much less than the decline in commercial aviation. However, within the sector, the impacts of the COVID-19 downturn have varied widely, as some segments recovered quickly and by the end of 2020 were already exceeding pre-COVID activity levels. Corporate and business aviation on the other hand saw activity fall significantly after the economy came to a near-halt in March 2020. We project a return to pre-COVID levels of activity in the GA segment will be sooner than for commercial airlines. Once returning to pre-COVID levels of activity, future growth in business and corporate aviation is based largely upon the prospects for economic growth and corporate profits. Uncertainty in these leading indicators poses a risk to the forecast, but the risk is not limited to these factors. Other influences, such as potential environmental regulations and taxes do not seem to be as much of a concern in the short term, but over the long term, uncertainties about the direction of these influences may place downward pressure on the forecast.

Overall activity at FAA and contract towers decreased 16.7 percent in 2020, while activity at large and medium hub airports (61 in total) fell 29.9 percent and 22.9 percent in 2020. While FAA's baseline forecast calls for operations at FAA and contract towers to return to pre-COVID levels of activity by 2025, the uneven nature of the demand recovery results in operations at large and medium hub airports growing faster than the overall national trend and congestion and delays could become critical limits to growth over the forecast period. FAA's forecasts of both demand and operations are unconstrained in that they assume that there will be sufficient infrastructure to handle the projected levels of activity. Should the infrastructure be inadequate and result in even more congestion and delays, it is likely that the forecasts of both demand and operations would not be achieved.

Not only is the volume of aircraft operating at most large hubs expected to increase over the next 20 years, but the mix of aircraft is changing for this same period. The expected increases in the numbers of larger regional jets and business jets as well as the anticipated widespread deployment of UAS and Advanced Air Mobility (AAM) vehicles into the national airspace system will make the FAA's job more challenging. This change in the mix of aircraft will most likely add to workload above and beyond the increasing demand for aviation services resulting from the growth in operations over the forecast period.

Increasing concerns about aviation's environmental impacts could potentially limit or delay the ability of the aviation sector to grow to meet national economic and mobility needs. Airspace modernization and airport expansion or new construction are often contentious because of concerns over noise, air quality, and water quality. Climate change is also of concern and could limit aviation growth. In Europe, concerns about climate change are leading to restrictions on airport expansion activities and proposals to limit short-haul domestic flights. Community concerns across the U.S. about aviation noise have led to increasing levels of public debate, political interest, and even litigation. Without effective measures to mitigate and abate aviation noise, the infrastructure projects and airspace redesign efforts needed to achieve aviation growth may be delayed.

In addition to providing economic benefits, technologies to improve aircraft fuel efficiency and reduce fuel consumption provide benefits in terms of reduced emissions that impact air quality and climate change; many technologies that improve fuel efficiency also result in reduced noise. Airlines are increasing their use of sustainable aviation fuels, which provides benefits in terms of reduced impacts of aviation on climate change and air quality. The implementation of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), a global market-based measure for international carbon dioxide emissions, will help ensure an approach that is economically preferable to a patchwork of State or Regional-level regulations around the world is used, and will help to further address the impacts of aviation on climate change. Continued advancements and fleetwide uptake of sustainable aviation fuels and new aircraft and engine technologies that result in improved fuel efficiency, reduced fuel consumption, noise reduction and reduced emissions are required to ensure that access restrictions or operating limitations are not imposed on the in-service fleet, which in turn may depress growth.

Appendix A: Alternative Forecast Scenarios

Uncertainty exists in all industries, but especially in the commercial air travel industry. As volatility in the global environment has increased, the importance of scenarios for planning purposes has increased. In order to help stakeholders better prepare for the future, the FAA provides alternative scenarios to our baseline forecasts of airline traffic and capacity.

To create the baseline domestic forecast, economic assumptions from IHS Markit's 10-year and 30-year U.S. Macro Baselines were used. To develop the alternative scenarios, assumptions from IHS Markit's 30-year optimistic and pessimistic forecasts from their August 2020 *US Economy: The 30-Year Focus* were utilized. Inputs from these alternative scenarios were used to create "high" and "low" traffic, capacity, and yield forecasts.

International passengers and traffic are primarily driven by country specific Gross Domestic Product (GDP) forecasts provided by IHS Markit. Thus, the alternative scenarios use inputs based on ratios derived from IHS Markit's Major Trading Partner and Other Important Trading Partners optimistic and pessimistic forecasts in order to create high and low cases.

Scenario Assumptions

The FAA's domestic baseline forecast assumes that economic growth rebounds moderately in 2021 and then remains slightly above trend in the medium-term, supported primarily by consumer spending and in particular, some catch-up in services spending that were most impacted during 2020. The forecast assumes no fiscal stimulus in the fourth quarter of 2020 which negatively affects GDP growth in 2021. The unemployment rate retreats gradually, reaching its pre-pandemic rate in 2024. Oil prices remain moderate by historic standards and there are no external shocks.

The FAA's high case forecast uses IHS Markit's optimistic forecast. The optimistic scenario is characterized by a quicker recovery in the near term than in the baseline but shows only slight improvement over the balance of the forecast. Near-term differences include a fiscal stimulus package which boosts consumer spending as well as personal savings in 2021. Accelerated COVID-19 vaccinations lead to a more rapid decline in case counts and an earlier return of consumers to their pre-COVID spending patterns. The unemployment rate also falls faster than in the baseline, reaching the pre-pandemic rate about a year sooner. And the price of oil is lifted slightly above the baseline as stronger economic activity generates increased oil demand.

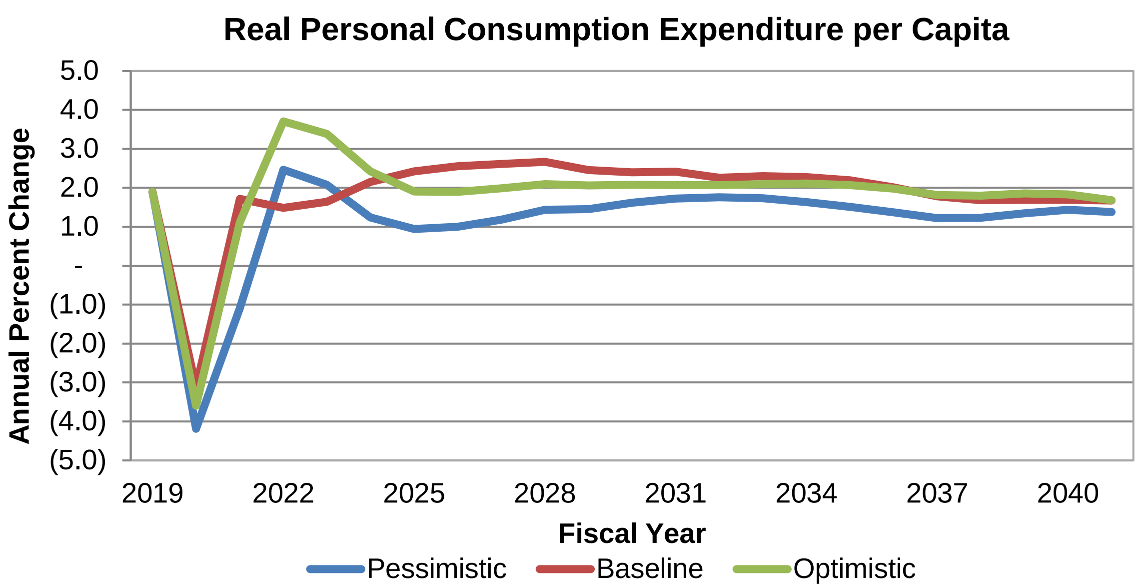
In this scenario, real personal consumption expenditure (PCE) per capita growth over the entire forecast is similar to that in the baseline and unemployment averages 0.15

points lower on a fiscal year basis than the baseline.[40]

Conversely, FAA's low case forecast uses IHS Markit's pessimistic scenario. In this forecast, an upturn in new COVID-19 cases, hospitalizations, and deaths, slows the pace of "opening up" and results in some retrenchment in consumer spending which falls below the baseline path, removing support from the economic recovery. The economy slows with negative GDP growth in both 2020 and 2021 and recovery rates below the baseline. GDP growth averages 0.8 percentage points lower than in the baseline over the forecast horizon.

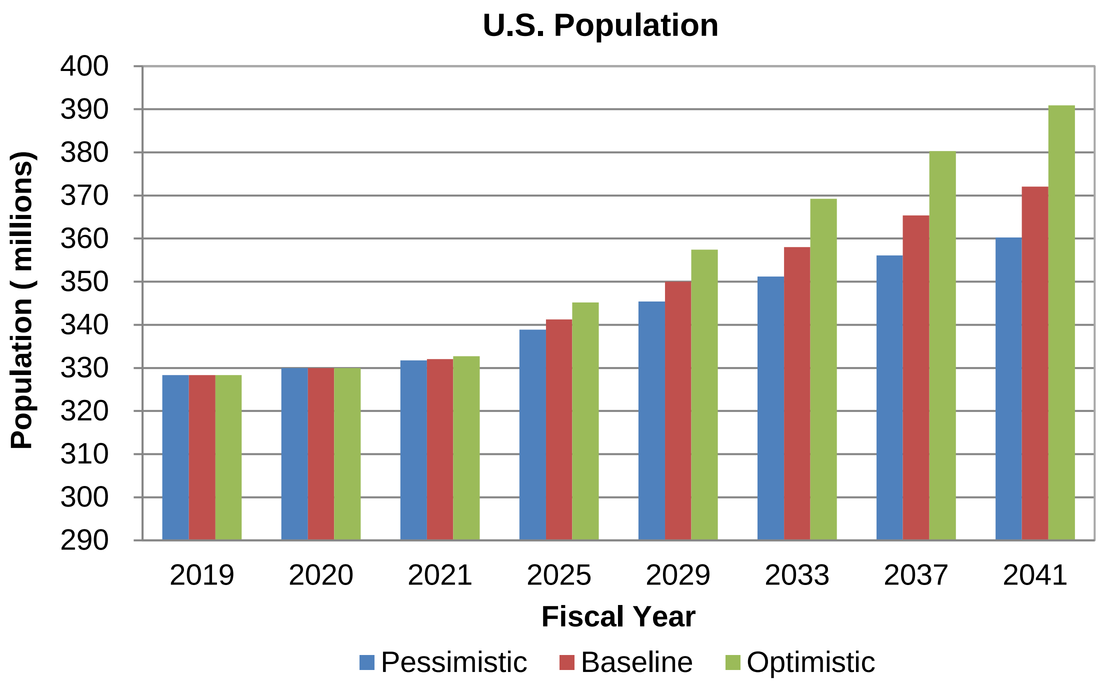
In addition to slower GDP growth in this scenario, productivity, the labor force and capital investments also grow more slowly than in the baseline. Personal income growth is pressured leading to depressed consumer confidence and spending, with durable goods consumption, particularly of housing and motor vehicles, impacted the most. Financial conditions are tight and the higher interest rates reflect concerns about the inflationary outlook, given the Fed's accommodative monetary policy and accelerating inflation. Inflation is fanned by higher commodity prices and rising energy prices, wages, and import prices combine to push consumer price inflation above the baseline.

Oil prices rise faster than the baseline throughout the forecast and are $63 per barrel higher by 2041. Real PCE per capita in this scenario grows 0.7 percentage points slower per year than in the baseline; and unemployment, on average, is 1.0 points higher on an annual basis than in the baseline.

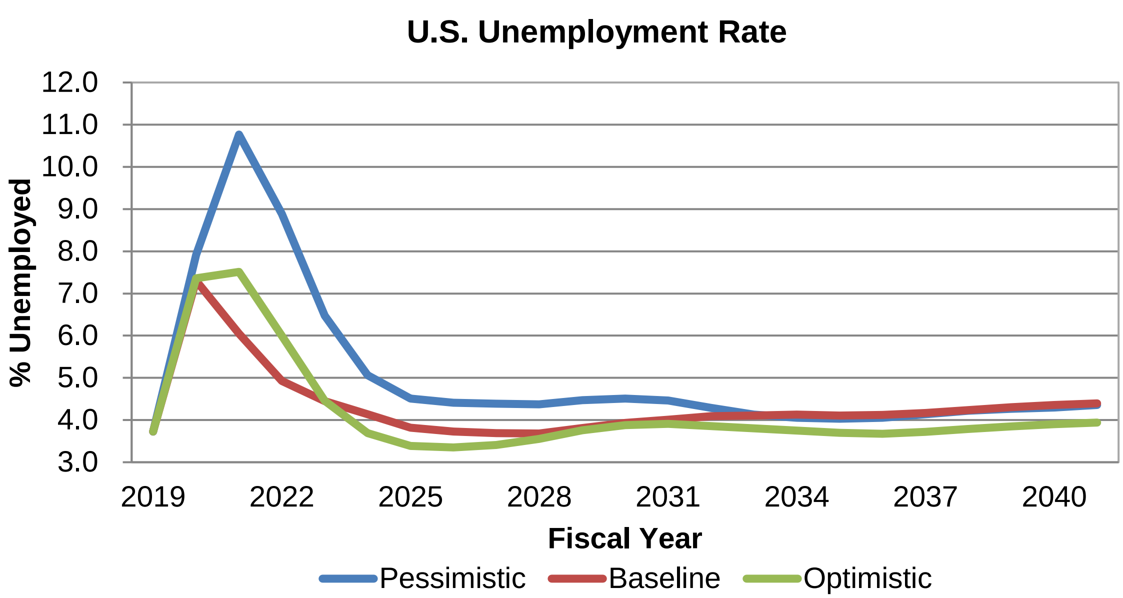


Source: IHS Markit

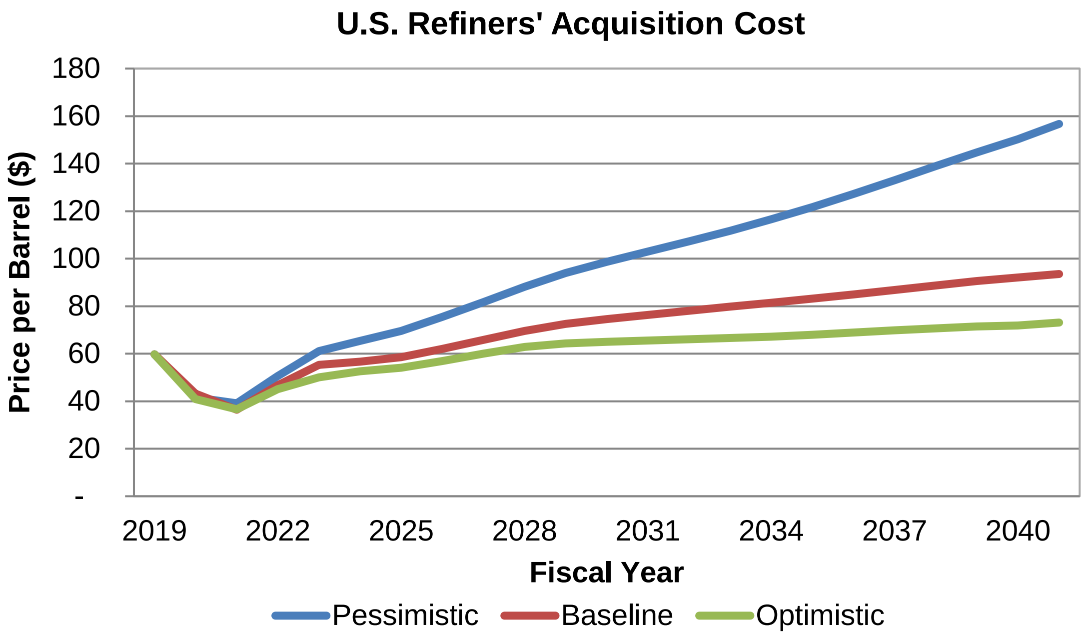
40 Real personal consumption expenditure per capita and unemployment are used as input variables to the FAA's base, high and low forecasts of enplanements.



Source: IHS Markit

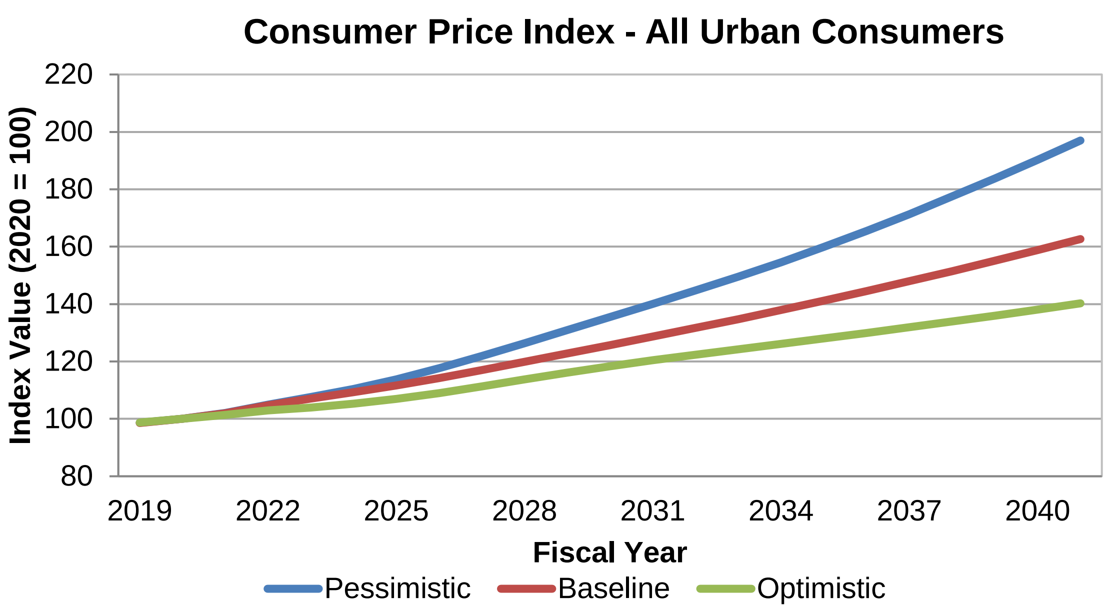


Source: IHS Markit



Source: IHS Markit

The price of energy is one of the drivers in the growth of consumer prices over the forecast period. In the optimistic case, slow growth of energy prices and import prices counteracts faster growth of other consumer goods prices causing the optimistic CPI to rise somewhat slower than the baseline. In the pessimistic case, energy prices, wages and import prices all rise more rapidly compared to the baseline.



Source: IHS Markit

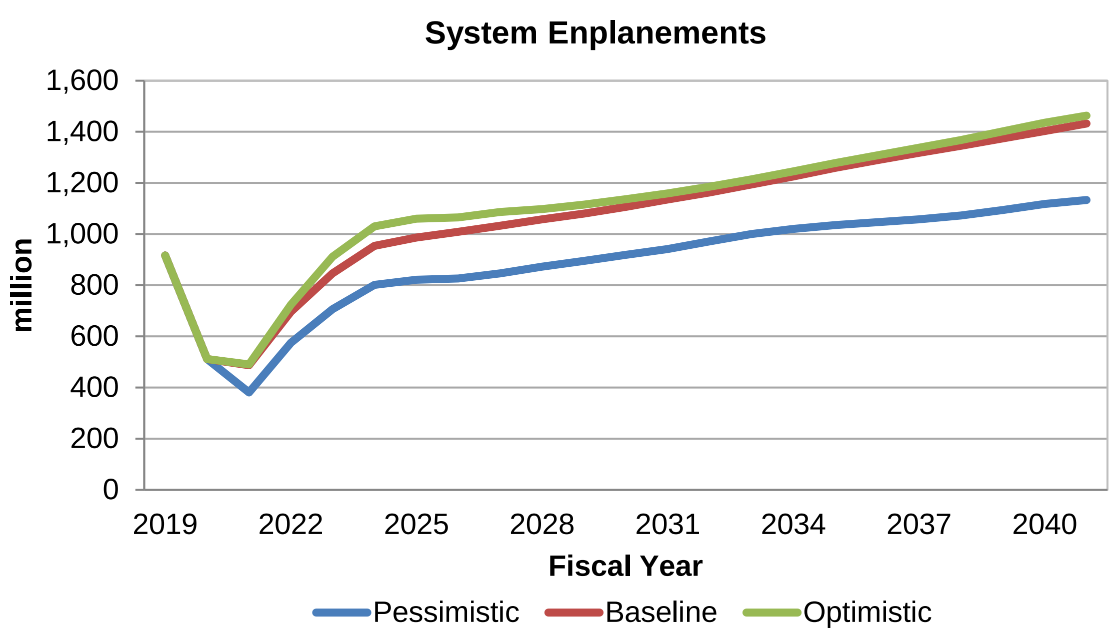
Alternative Forecasts

Enplanements

In the baseline forecast, system enplanements are forecast to grow at an average annual rate of 5.0 percent a year over the forecast horizon of 2021-2041 (with domestic and international passengers increasing at rates of 4.9 and 6.3 percent, respectively).

In the optimistic case, enplanements grow at a slightly quicker pace, averaging 5.1 percent per year (up 5.0 percent domestically and 6.5 percent internationally). This scenario is marked by a more favorable business environment and lower fuel prices which make the price of flying more affordable to business and leisure travelers. By the end of the forecast period in 2041, system passengers in the optimistic case are 1.8 percent above the baseline, totaling 1.5 billion, 26 million greater than in the baseline.

The pessimistic case is characterized by a period of weakened personal income growth and consumer confidence combined with a contraction in financial asset markets, leading to higher interest rates, and curtailed investment and consumer spending. In this scenario, enplanements grow an average of 3.9 percent per year (domestic up 3.6 percent and international up 5.8 percent). In the pessimistic case, system passengers in 2041 are 21.2 percent below the baseline case, totaling 1.1 billion, or 303 million fewer than in the baseline.

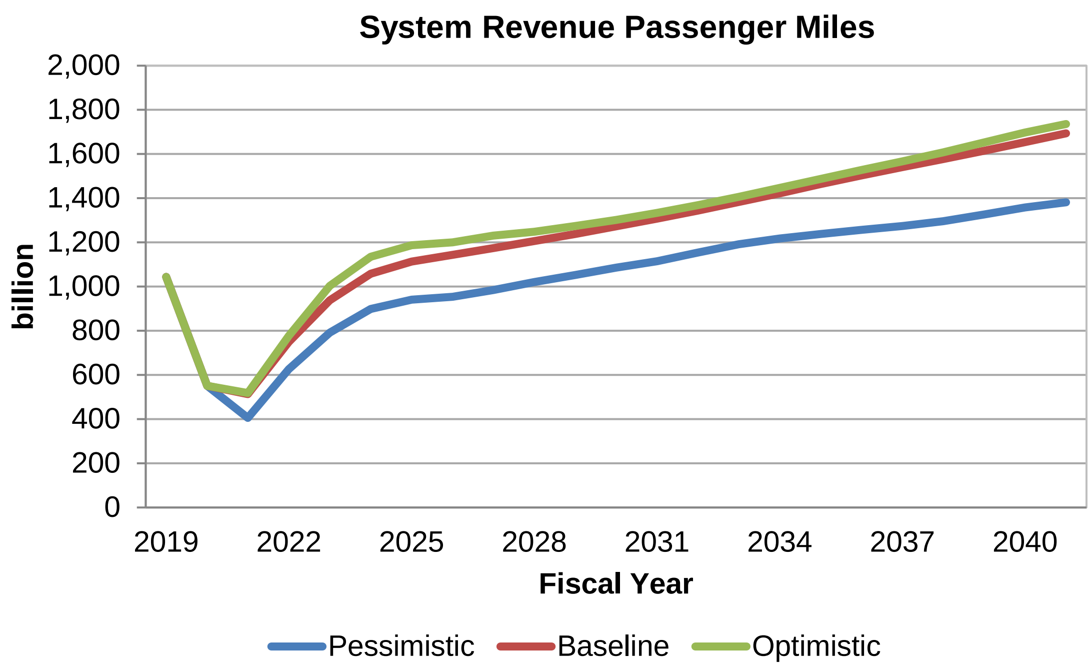


Revenue Passenger Miles

In the baseline forecast, system RPMs grow at an average annual rate of 5.5 percent a year over the forecast horizon (2021-2041), with domestic RPMs increasing 5.1 percent annually and international RPMs growing 6.6 percent annually.

In the optimistic case, the faster growing economy coupled with lower energy prices drives RPMs higher than the baseline, with growth averaging 5.6 percent per year (domestic and international RPMs up 5.2 and 6.8 percent, respectively).

In the pessimistic case, the combination of a slower growing economy and higher energy prices result in RPM growth averaging 4.5 percent annually with domestic markets growing 3.8 percent a year while international traffic grows 6.2 percent annually.

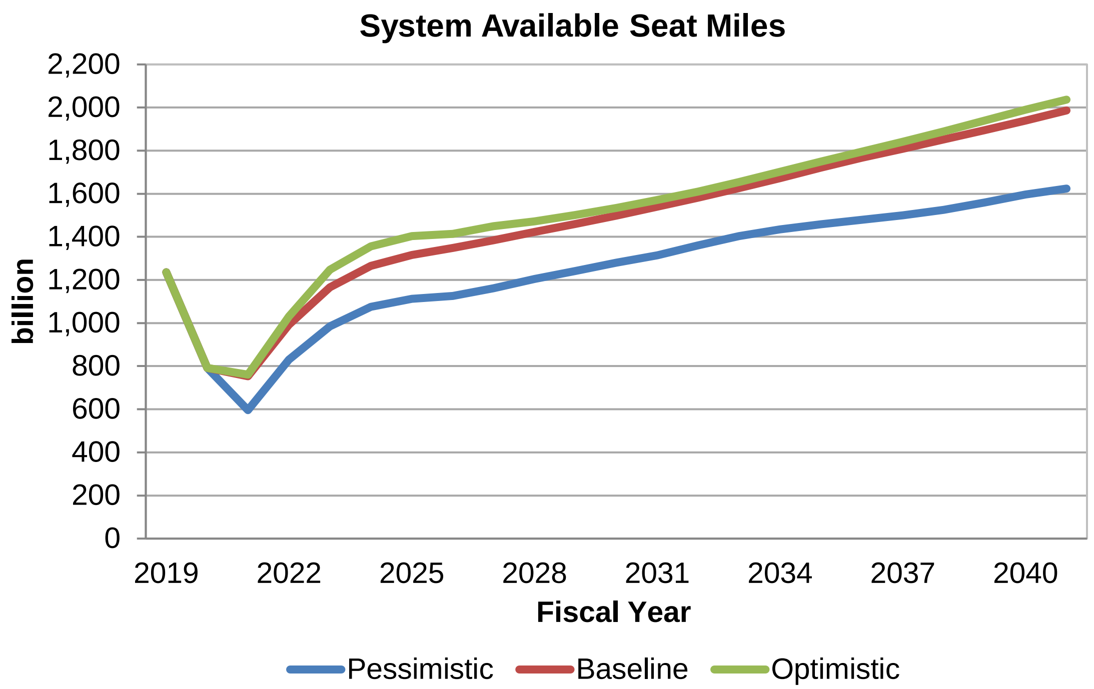


Available Seat Miles

In the base case, system capacity is forecast to increase an average of 4.5 percent annually over the forecast horizon with growth averaging 4.0 percent annually in domestic markets and 6.0 percent a year in international markets.

In the optimistic case, capacity grows slightly faster than in the baseline forecast, averaging 4.6 percent annually system-wide (4.1 and 6.2 percent for domestic and international markets, respectively). Carriers increase capacity compared to the baseline forecast to accommodate increased travel demand brought about by a more favorable economic environment.

In the pessimistic case, demand for air travel is lower than in the baseline, thus system capacity grows at a slower pace of 3.5 percent annually (domestic growth of 2.7 percent annually and international up 5.5 percent annually).



Load Factor

System load factors over the 20-year forecast period are similar for all three forecast scenarios. System load factor rises from 69.5 percent in 2020 to 85.2 (optimistic), 85.1 (pessimistic), and 85.3 (baseline) percent in 2041.

In all three scenarios it is assumed that carriers will keep load factors on the high side by actively managing capacity (seats) to more precisely meet demand (passengers).

The domestic load factor increases over the forecast horizon from 68.7 percent to 86.6 percent in the baseline, optimistic and pessimistic scenarios.

The international load factor is forecast to rise to 82.1 throughout the period in the baseline and pessimistic scenarios and rise slightly to 82.2 percent in the optimistic scenario. This reflects in part the relative growth in demand and capacity in the three (Atlantic, Latin, and Pacific) international regions under each scenario.

Yield

In the baseline forecast, nominal system yield increases 1.8 percent annually, rising from 11.54 cents in 2020 to 16.95 cents in 2041. In domestic markets, yield in the baseline forecast rises from 11.00 cents in 2020 to 16.15 cents in 2041. International yield rises from 13.33 cents in 2020 to 18.93 cents in 2041.

System yield rises in the optimistic case at a slower rate than in the baseline, up 1.2 percent annually to 14.92 cents by 2041. Domestic yield increases to 13.78 cents while international yield increases to 17.66 cents. The modest growth in yield in both cases is due to advancements in technology, gains in productivity, and relatively favorable fuel prices.

In the pessimistic case, nominal yields rise more rapidly than in the baseline, growing an average of 2.7 percent annually, reaching 20.14 cents by 2041 (20.17 cents domestically and 20.09 cents internationally). This scenario reflects higher general domestic inflation and higher energy prices than in the baseline, forcing carriers to increase fares in order to cover the higher costs of fuel, labor, and capital.

TABLE A-1

FAA FORECAST ECONOMIC ASSUMPTIONS

FISCAL YEARS 2020-2041

		Historical	FORECAST					PERCENT AVERAGE ANNUAL GROWTH				
Variable	Scenario	2020E	2021	2026	2031	2036	2041	2020-21	2021-26	2021-31	2021-36	2021-41
Economic Assumptions												
Real Personal Consumption	Pessimistic	38,831	37,987	41,014	44,145	47,792	51,038	-2.2%	1.5%	1.5%	1.5%	1.5%
Expenditure per Capita	Baseline	38,831	39,496	43,717	49,488	55,198	60,070	1.7%	2.1%	2.3%	2.3%	2.1%
(2012 $)	Optimistic	38,831	39,073	44,552	49,327	54,638	59,727	0.6%	2.7%	2.4%	2.3%	2.1%
Refiners Acquisition Cost -	Pessimistic	43.2	39.1	75.5	103.0	127.2	156.7	-9.5%	14.1%	10.2%	8.2%	7.2%
Average - $ Per Barrel	Baseline	43.2	36.4	62.0	76.4	85.0	93.5	-15.7%	11.2%	7.7%	5.8%	4.8%
	Optimistic	43.2	36.6	56.9	65.5	68.9	73.1	-15.3%	9.2%	6.0%	4.3%	3.5%
Consumer Price Index	Pessimistic	2.58	2.63	3.04	3.62	4.27	5.08	2.1%	2.9%	3.2%	3.3%	3.3%
All Urban, 1982-84 = 1.0	Baseline	2.58	2.63	2.95	3.32	3.73	4.20	2.0%	2.3%	2.4%	2.4%	2.4%
	Optimistic	2.58	2.62	2.81	3.11	3.35	3.62	1.3%	1.5%	1.7%	1.7%	1.6%
Civilian Unemployment Rate	Pessimistic	7.3	10.8	4.4	4.5	4.1	4.4	47.4%	-16.3%	-8.4%	-6.3%	-4.4%
(%)	Baseline	7.3	6.0	3.7	4.0	4.1	4.4	-17.2%	-9.2%	-4.0%	-2.5%	-1.6%
	Optimistic	7.3	7.5	3.4	3.9	3.7	3.9	2.9%	-14.9%	-6.3%	-4.7%	-3.2%

Source: IHS Markit

TABLE A-2

FAA FORECAST OF AVIATION ACTIVITY*

FISCAL YEARS 2020-2041

		Historical	FORECAST					PERCENT AVERAGE ANNUAL GROWTH				
Variable	Scenario	2020E	2021	2026	2031	2036	2041	2020-21	2021-26	2021-31	2021-36	2021-41
System Aviation Activity												
Available Seat Miles	Pessimistic	791.4	595.9	1,126.4	1,315.1	1,479.5	1,623.9	-24.7%	13.6%	8.2%	6.2%	5.1%
(BIL)	Baseline	791.4	753.1	1,348.4	1,539.8	1,766.8	1,986.5	-4.8%	12.4%	7.4%	5.8%	5.0%
	Optimistic	791.4	760.6	1,414.4	1,571.2	1,795.0	2,036.6	-3.9%	13.2%	7.5%	5.9%	5.0%
Revenue Passenger Miles	Pessimistic	550.3	405.5	954.5	1,114.9	1,256.5	1,381.5	-26.3%	18.7%	10.6%	7.8%	6.3%
(BIL)	Baseline	550.3	513.2	1,143.8	1,307.6	1,503.5	1,693.6	-6.8%	17.4%	9.8%	7.4%	6.2%
	Optimistic	550.3	518.1	1,200.2	1,334.2	1,527.2	1,735.8	-5.9%	18.3%	9.9%	7.5%	6.2%
Enplanements	Pessimistic	511.0	380.9	827.2	941.1	1,046.8	1,133.5	-25.5%	16.8%	9.5%	7.0%	5.6%
(MIL)	Baseline	511.0	487.5	1,009.3	1,135.1	1,289.8	1,432.6	-4.6%	15.7%	8.8%	6.7%	5.5%
	Optimistic	511.0	490.6	1,065.5	1,159.8	1,307.6	1,463.5	-4.0%	16.8%	9.0%	6.8%	5.6%
Psgr Carrier Miles Flown	Pessimistic	5,158.7	3,744.7	6,960.1	7,952.3	8,807.3	9,504.0	-27.4%	13.2%	7.8%	5.9%	4.8%
(MIL)	Baseline	5,158.7	4,761.9	8,407.4	9,442.2	10,674.7	11,806.6	-7.7%	12.0%	7.1%	5.5%	4.6%
	Optimistic	5,158.7	4,801.0	8,846.1	9,640.3	10,835.4	12,086.6	-6.9%	13.0%	7.2%	5.6%	4.7%
Psgr Carrier Departures	Pessimistic	6,443.7	4,609.5	8,010.5	8,895.2	9,635.6	10,142.9	-28.5%	11.7%	6.8%	5.0%	4.0%
(000s)	Baseline	6,443.7	5,902.3	9,768.9	10,735.5	11,869.8	12,802.8	-8.4%	10.6%	6.2%	4.8%	3.9%
	Optimistic	6,443.7	5,944.6	10,329.8	10,963.2	12,015.3	13,057.7	-7.7%	11.7%	6.3%	4.8%	4.0%
Nominal Passenger Yield	Pessimistic	11.54	10.33	13.21	15.11	17.38	20.12	-10.5%	5.0%	3.9%	3.5%	3.4%
(cents)	Baseline	11.54	10.21	12.93	14.24	15.52	16.95	-11.5%	4.8%	3.4%	2.8%	2.6%
	Optimistic	11.54	10.24	12.51	13.56	14.22	14.92	-11.3%	4.1%	2.9%	2.2%	1.9%

* Includes domestic and international activity.

TABLE A-3

FAA FORECAST OF DOMESTIC AVIATION ACTIVITY

FISCAL YEARS 2020-2041

		Historical	FORECAST					PERCENT AVERAGE ANNUAL GROWTH				
Variable	Scenario	2020E	2021	2026	2031	2036	2041	2020-21	2021-26	2021-31	2021-36	2021-41
Domestic Aviation Activity												
Available Seat Miles (BIL)	Pessimistic	613.8	442.4	778.6	887.0	991.3	1,076.2	-27.9%	12.0%	7.2%	5.5%	4.5%
	Baseline	613.8	571.1	961.0	1,089.1	1,244.6	1,387.5	-7.0%	11.0%	6.7%	5.3%	4.5%
	Optimistic	613.8	573.4	1,018.3	1,113.9	1,259.8	1,413.3	-6.6%	12.2%	6.9%	5.4%	4.6%
Revenue Passenger Miles (BIL)	Pessimistic	421.8	307.7	669.9	763.5	855.8	931.9	-27.1%	16.8%	9.5%	7.1%	5.7%
	Baseline	421.8	397.2	826.9	937.6	1,074.7	1,201.6	-5.8%	15.8%	9.0%	6.9%	5.7%
	Optimistic	421.8	398.8	876.2	958.8	1,087.6	1,223.7	-5.5%	17.0%	9.2%	6.9%	5.8%
Enplanements (MIL)	Pessimistic	462.6	340.4	730.7	821.7	908.9	976.5	-26.4%	16.5%	9.2%	6.8%	5.4%
	Baseline	462.6	439.4	902.0	1,009.1	1,141.3	1,259.1	-5.0%	15.5%	8.7%	6.6%	5.4%
	Optimistic	462.6	441.2	955.8	1,031.9	1155.0	1,282.3	-4.6%	16.7%	8.9%	6.6%	5.5%
Psgr Carrier Miles Flown (MIL)	Pessimistic	4,340.8	3,038.6	5,416.0	6,065.8	6,670.2	7,121.5	-30.0%	12.3%	7.2%	5.4%	4.4%
	Baseline	4,340.8	3,924.7	6,688.7	7,454.2	8,383.1	9,190.8	-9.6%	11.3%	6.6%	5.2%	4.3%
	Optimistic	4,340.8	3,940.0	7,088.6	7,623.5	8,484.3	9,361.1	-9.2%	12.5%	6.8%	5.2%	4.4%
Psgr Carrier Departures (000s)	Pessimistic	6,066.9	4,257.3	7,365.8	8,105.6	8,732.8	9,125.4	-29.8%	11.6%	6.7%	4.9%	3.9%
	Baseline	6,066.9	5,484.7	9,052.3	9,901.3	10,895.1	11,674.5	-9.6%	10.5%	6.1%	4.7%	3.8%
	Optimistic	6,066.9	5,515.1	9,596.6	10,117.2	11,012.9	11,877.6	-9.1%	11.7%	6.3%	4.7%	3.9%
Nominal Passenger Yield (cents)	Pessimistic	11.00	9.55	12.90	15.10	17.39	20.17	-13.1%	6.2%	4.7%	4.1%	3.8%
	Baseline	11.00	9.44	12.31	13.58	14.80	16.15	-14.1%	5.4%	3.7%	3.0%	2.7%
	Optimistic	11.00	9.45	11.69	12.59	13.17	13.78	-14.0%	4.3%	2.9%	2.2%	1.9%

TABLE A-4

FAA FORECAST OF INTERNATIONAL AVIATION ACTIVITY*

FISCAL YEARS 2020-2041

		Historical	FORECAST					PERCENT AVERAGE ANNUAL GROWTH				
Variable	Scenario	2020E	2021	2026	2031	2036	2041	2020-21	2021-26	2021-31	2021-36	2021-41
International Aviation Activity												
Available Seat Miles	Pessimistic	177.7	153.5	347.9	428.1	488.2	547.7	-13.6%	17.8%	10.8%	8.0%	6.6%
(BIL)	Baseline	177.7	182.0	387.4	450.7	522.2	599.1	2.5%	16.3%	9.5%	7.3%	6.1%
	Optimistic	177.7	187.2	396.1	457.3	535.3	623.3	5.4%	16.2%	9.3%	7.3%	6.2%
Revenue Passenger Miles	Pessimistic	128.5	97.8	284.6	351.4	400.7	449.6	-23.9%	23.8%	13.6%	9.9%	7.9%
(BIL)	Baseline	128.5	116.0	316.9	370.0	428.8	492.0	-9.7%	22.3%	12.3%	9.1%	7.5%
	Optimistic	128.5	119.3	324.0	375.4	439.6	512.1	-7.2%	22.1%	12.1%	9.1%	7.6%
Enplanements	Pessimistic	48.4	40.5	96.5	119.4	137.9	157.0	-16.3%	18.9%	11.4%	8.5%	7.0%
(MIL)	Baseline	48.4	48.0	107.3	126.0	148.5	173.4	-0.8%	17.4%	10.1%	7.8%	6.6%
	Optimistic	48.4	49.4	109.8	127.8	152.6	181.2	2.0%	17.3%	10.0%	7.8%	6.7%
Psgr Carrier Miles Flown	Pessimistic	817.9	706.1	1,544.1	1,886.5	2,137.2	2,382.5	-13.7%	16.9%	10.3%	7.7%	6.3%
(MIL)	Baseline	817.9	837.2	1,718.7	1,988.0	2,291.6	2,615.7	2.4%	15.5%	9.0%	6.9%	5.9%
	Optimistic	817.9	861.0	1,757.5	2,016.8	2,351.1	2,725.5	5.3%	15.3%	8.9%	6.9%	5.9%
Psgr Carrier Departures	Pessimistic	376.8	352.2	644.7	789.6	902.9	1,017.5	-6.5%	12.9%	8.4%	6.5%	5.4%
(000s)	Baseline	376.8	417.6	716.5	834.2	974.7	1,128.3	10.8%	11.4%	7.2%	5.8%	5.1%
	Optimistic	376.8	429.5	733.3	846.0	1,002.5	1,180.1	14.0%	11.3%	7.0%	5.8%	5.2%
Nominal Passenger Yield	Pessimistic	13.33	12.79	13.96	15.13	17.34	20.03	-4.1%	1.8%	1.7%	2.0%	2.3%
(cents)	Baseline	13.33	12.84	14.56	15.89	17.33	18.93	-3.7%	2.5%	2.2%	2.0%	2.0%
	Optimistic	13.33	12.87	14.73	16.05	16.82	17.63	-3.5%	2.7%	2.2%	1.8%	1.6%

*Includes mainline and regional carriers.

Appendix B: Forecast Tables

TABLE 1

U.S. SHORT-TERM ECONOMIC FORECASTS

	FISCAL YEAR 2020				FISCAL YEAR 2021				FISCAL YEAR 2022			
ECONOMIC VARIABLE	1ST. QTR.	2ND. QTR.	3RD QTR.	4TH. QTR.	1ST. QTR.	2ND. QTR.	3RD QTR.	4TH. QTR.	1ST. QTR.	2ND. QTR.	3RD QTR.	4TH. QTR.
Real Personal Consumption												
Expenditure per Capita												
(2012 $)	40,543	39,789	35,928	39,070	39,325	39,408	39,550	39,702	39,856	40,006	40,160	40,314
Year over year change	2.0%	-0.3%	-10.7%	-3.4%	-3.0%	-1.0%	10.1%	1.6%	1.4%	1.5%	1.5%	1.5%
Refiners' Acquisition Cost - Average												
(Dollars per barrel)	58.00	47.29	26.68	40.88	34.35	34.81	35.92	40.56	44.09	45.23	46.82	50.42
Year over year change	-2.7%	-17.3%	-58.0%	-30.3%	-40.8%	-26.4%	34.6%	-0.8%	28.3%	29.9%	30.3%	24.3%
Consumer Price Index												
(1982-84 equals 100)	257.8	258.6	256.3	259.5	261.0	262.1	263.8	265.7	267.7	269.3	271.0	272.6
Year over year change	2.0%	2.1%	0.4%	1.3%	1.2%	1.3%	2.9%	2.4%	2.5%	2.7%	2.7%	2.6%

Source: IHS Markit

TABLE 2

U.S. LONG-TERM ECONOMIC FORECASTS

FISCAL YEAR	REAL GROSS DOMESTIC PRODUCT (Billions 2012 $)	REAL PERSONAL CONSUMPTION EXPENDITURE PER CAPITA (2012 $)	CONSUMER PRICE INDEX (1982-84=1.00)	REFINERS' ACQUISITION COST AVERAGE (Dollars per barrel)
Historical				
2010	15,500	34,165	2.17	74.61
2015	17,339	36,940	2.37	56.69
2018	18,574	39,337	2.50	63.72
2019	18,982	40,082	2.54	59.77
2020E	18,538	38,831	2.58	43.21
Forecast				
2021	18,895	39,496	2.63	36.41
2026	21,576	43,717	2.95	62.05
2031	24,285	49,488	3.32	76.36
2036	27,025	55,198	3.73	84.96
2041	29,648	60,070	4.20	93.53
Avg Annual Growth				
2010-20	1.8%	1.3%	1.7%	-5.3%
2020-21	1.9%	1.7%	2.0%	-15.7%
2021-31	2.5%	2.3%	2.4%	7.7%
2021-41	2.3%	2.1%	2.4%	4.8%

Source: IHS Markit

TABLE 3

INTERNATIONAL GDP FORECASTS BY TRAVEL REGION

	GROSS DOMESTIC PRODUCT (In Billions of 2015 U.S. Dollars)				
CALENDAR YEAR	CANADA	EUROPE / AFRICA / MIDDLE EAST	LATIN AMERICA / CARIBBEAN / MEXICO	JAPAN / PACIFIC BASIN / CHINA / OTHER ASIA / AUSTRALIA / NEW ZEALAND	WORLD
Historical					
2010	1,400	21,290	4,613	19,000	64,363
2015	1,557	23,205	5,174	24,463	74,528
2018	1,659	24,863	5,344	28,339	81,764
2019	1,690	25,229	5,384	29,514	83,842
2020E	1,593	23,508	4,993	29,064	80,413
Forecast					
2021	1,666	24,356	5,179	30,721	84,042
2026	1,885	27,511	5,870	38,163	98,758
2031	2,045	30,121	6,753	46,276	113,482
2036	2,225	32,889	7,790	54,972	129,288
2041	2,427	35,811	8,988	64,275	145,888
Avg Annual Growth					
2010-20	1.3%	1.0%	0.8%	4.3%	2.3%
2020-21	4.6%	3.6%	3.7%	5.7%	4.5%
2021-31	2.1%	2.1%	2.7%	4.2%	3.0%
2021-41	1.9%	1.9%	2.8%	3.8%	2.8%

Source: IHS Markit website, GDP Components Tables (Interim Forecast, Monthly)

TABLE 4

INTERNATIONAL GDP FORECASTS – SELECTED AREAS/COUNTRIES

	GROSS DOMESTIC PRODUCT (In Billions of 2015 U.S. Dollars)				
CALENDAR YEAR	NORTH AMERICA (NAFTA)	EUROZONE	UNITED KINGDOM	JAPAN	CHINA
Historical					
2010	18,731	11,189	2,655	4,220	7,490
2015	20,966	11,662	2,934	4,446	10,961
2018	22,465	12,435	3,075	4,580	13,366
2019	22,915	12,597	3,113	4,592	14,186
2020E	22,017	11,661	2,754	4,346	14,484
Forecast					
2021	22,952	12,084	2,849	4,460	15,567
2026	26,265	13,332	3,249	4,696	20,144
2031	29,304	14,171	3,515	4,914	25,094
2036	32,593	15,011	3,791	5,122	30,374
2041	35,818	15,868	4,082	5,310	35,841
Avg Annual Growth					
2010-20	1.6%	0.4%	0.4%	0.3%	6.8%
2020-21	4.2%	3.6%	3.5%	2.6%	7.5%
2021-31	2.5%	1.6%	2.1%	1.0%	4.9%
2021-41	2.3%	1.4%	1.8%	0.9%	4.3%

Source: IHS Markit website, GDP Components Tables (Interim Forecast, Monthly)

TABLE 5

U.S. COMMERCIAL AIR CARRIERS[1]

TOTAL SCHEDULED U.S. PASSENGER TRAFFIC

	REVENUE PASSENGER ENPLANEMENTS (Millions)			REVENUE PASSENGER MILES (Billions)		
FISCAL YEAR	DOMESTIC	INTERNATIONAL	TOTAL	DOMESTIC	INTERNATIONAL	TOTAL
Historical						
2010	635	77	712	555	231	786
2015	696	90	786	629	261	889
2018	781	100	880	720	281	1,001
2019	813	103	917	752	292	1,044
2020E	463	48	511	422	128	550
Forecast						
2021	439	48	487	397	116	513
2026	902	107	1,009	827	317	1,144
2031	1,009	126	1,135	938	370	1,308
2036	1,141	148	1,290	1,075	429	1,503
2041	1,259	173	1,433	1,202	492	1,694
Avg Annual Growth						
2010-20	-3.1%	-4.6%	-3.3%	-2.7%	-5.7%	-3.5%
2020-21	-5.0%	-0.8%	-4.6%	-5.8%	-9.7%	-6.8%
2021-31	8.7%	10.1%	8.8%	9.0%	12.3%	9.8%
2021-41	5.4%	6.6%	5.5%	5.7%	7.5%	6.2%

Source: Forms 41 and 298-C, U.S. Department of Transportation.

[1]Sum of U.S. Mainline and Regional Air Carriers.

TABLE 6

U.S. COMMERCIAL AIR CARRIERS[1]

SCHEDULED PASSENGER CAPACITY, TRAFFIC, AND LOAD FACTORS

FISCAL YEAR	DOMESTIC			INTERNATIONAL			SYSTEM		
	ASMs (BIL)	RPMs (BIL)	% LOAD FACTOR	ASMs (BIL)	RPMs (BIL)	% LOAD FACTOR	ASMs (BIL)	RPMs (BIL)	% LOAD FACTOR
Historical									
2010	679	555	81.7	281	231	82.1	961	786	81.8
2015	744	629	84.5	323	261	80.7	1,067	889	83.4
2018	850	720	84.7	345	281	81.5	1,195	1,001	83.8
2019	883	752	85.2	352	292	82.9	1,235	1,044	84.5
2020E	614	422	68.7	178	128	72.3	791	550	69.5
Forecast									
2021	571	397	69.5	182	116	63.7	753	513	68.1
2026	961	827	86.0	387	317	81.8	1,348	1,144	84.8
2031	1,089	938	86.1	451	370	82.1	1,540	1,308	84.9
2036	1,245	1,075	86.3	522	429	82.1	1,767	1,503	85.1
2041	1,387	1,202	86.6	599	492	82.1	1,987	1,694	85.3
Avg Annual Growth									
2010-20	-1.0%	-2.7%	-1.7%	-4.5%	-5.7%	-1.3%	-1.9%	-3.5%	-1.6%
2020-21	-7.0%	-5.8%	1.2%	2.5%	-9.7%	-11.9%	-4.8%	-6.8%	-2.0%
2021-31	6.7%	9.0%	2.2%	9.5%	12.3%	2.6%	7.4%	9.8%	2.2%
2021-41	4.5%	5.7%	1.1%	6.1%	7.5%	1.3%	5.0%	6.2%	1.1%

Source: Forms 41 and 298-C, U.S. Department of Transportation.

[1]Sum of U.S. Mainline and Regional Air Carriers.

TABLE 7

U.S. COMMERCIAL AIR CARRIERS[1]

TOTAL SCHEDULED U.S. INTERNATIONAL PASSENGER TRAFFIC

	REVENUE PASSENGER ENPLANEMENTS				REVENUE PASSENGER MILES			
FISCAL YEAR	ATLANTIC (Mil)	LATIN AMERICA (Mil)	PACIFIC (Mil)	TOTAL INTERNATIONAL (Mil)	ATLANTIC (Bil)	LATIN AMERICA (Bil)	PACIFIC (Bil)	TOTAL INTERNATIONAL (Bil)
Historical								
2010	25	40	13	77	109	63	59	231
2015	25	52	14	90	107	83	71	261
2018	26	60	13	100	112	94	75	281
2019	28	62	13	103	121	96	75	292
2020E	11	32	6	48	48	49	31	128
Forecast								
2021	8	37	4	48	36	59	21	116
2026	32	63	13	107	140	99	78	317
2031	36	76	14	126	158	122	90	370
2036	40	93	16	148	177	150	101	429
2041	44	112	18	173	197	182	112	492
Avg Annual Growth								
2010-20	-7.8%	-2.2%	-8.1%	-4.6%	-7.8%	-2.5%	-6.2%	-5.7%
2020-21	-28.7%	14.7%	-36.0%	-0.8%	-25.4%	20.0%	-32.2%	-9.7%
2021-31	16.5%	7.6%	14.8%	10.1%	16.0%	7.6%	15.5%	12.3%
2021-41	9.1%	5.7%	8.3%	6.6%	8.9%	5.8%	8.7%	7.5%

Source: Forms 41 and 298-C, U.S. Department of Transportation.

[1]Sum of U.S. Mainline and Regional Air Carriers.

TABLE 8

U.S. AND FOREIGN FLAG CARRIERS

TOTAL PASSENGER TRAFFIC TO/FROM THE UNITED STATES

	TOTAL PASSENGERS BY WORLD TRAVEL AREA (Millions)				
CALENDAR YEAR	ATLANTIC	LATIN AMERICA	PACIFIC	U.S./CANADA TRANSBORDER	TOTAL
Historical					
2010	56	53	27	22	158
2015	70	75	36	27	207
2018	85	86	42	31	244
2019	89	89	44	32	253
2020E	17	33	9	7	67
Forecast					
2021	25	53	12	17	106
2026	102	89	42	36	270
2031	120	109	51	42	321
2036	140	133	59	49	381
2041	160	160	69	57	446
Avg Annual Growth					
2010-20	-11.0%	-4.5%	-10.0%	-10.8%	-8.2%
2020-21	41.5%	57.9%	24.8%	147.2%	58.3%
2021-31	17.2%	7.5%	15.7%	9.2%	11.7%
2021-41	9.8%	5.7%	9.2%	6.1%	7.4%

Source: US Customs & Border Protection data processed and released by Department of Commerce; data also received from Transport Canada.

TABLE 9

U.S. COMMERCIAL AIR CARRIERS' FORECAST ASSUMPTIONS[1]

SEATS PER AIRCRAFT MILE AND PASSENGER TRIP LENGTH

	AVERAGE SEATS PER AIRCRAFT MILE			AVERAGE PASSENGER TRIP LENGTH		
FISCAL YEAR	DOMESTIC (Seats/Mile)	INTERNATIONAL (Seats/Mile)	SYSTEM (Seats/Mile)	DOMESTIC (Miles)	INTERNATIONAL (Miles)	SYSTEM (Miles)
Historical						
2010	121.9	216.4	139.7	874.8	2,988.0	1,104.2
2015	131.6	214.8	149.1	902.8	2,892.6	1,131.1
2018	140.0	219.1	156.3	922.1	2,820.1	1,136.9
2019	141.3	221.5	157.6	925.0	2,821.1	1,139.0
2020E	141.4	217.2	153.4	912.0	2,653.2	1,077.0
Forecast						
2021	145.5	217.4	158.2	903.9	2,414.5	1,052.7
2026	143.7	225.4	160.4	916.7	2,954.3	1,133.3
2031	146.1	226.7	163.1	929.1	2,935.9	1,151.9
2036	148.5	227.9	165.5	941.6	2,887.6	1,165.6
2041	151.0	229.0	168.3	954.3	2,836.8	1,182.2
Avg Annual Growth						
2010-20	1%	0%	1%	0%	-1%	0%
2020-21	3%	0%	3%	-1%	-9%	-2%
2021-31	0%	0%	0%	0%	2%	1%
2021-41	0%	0%	0%	0%	1%	1%

Source: Forms 41 and 298-C, U.S. Department of Transportation.

[1]Sum of U.S. Mainline and Regional Air Carriers.

TABLE 10

U. S. MAINLINE AIR CARRIERS

SCHEDULED PASSENGER TRAFFIC

	REVENUE PASSENGER ENPLANEMENTS (Millions)			REVENUE PASSENGER MILES (Billions)		
FISCAL YEAR	DOMESTIC	INTERNATIONAL	SYSTEM	DOMESTIC	INTERNATIONAL	SYSTEM
Historical						
2010	473	75	548	480	230	710
2015	543	87	630	556	259	815
2018	627	96	723	645	279	924
2019	654	100	754	674	290	963
2020E	369	47	416	375	127	502
Forecast						
2021	353	46	400	356	115	471
2026	725	104	829	741	315	1,055
2031	811	122	934	840	368	1,207
2036	918	144	1,062	963	426	1,389
2041	1,012	169	1,181	1,076	489	1,565
Avg Annual Growth						
2010-20	-2.5%	-4.6%	-2.7%	-2.5%	-5.7%	-3.4%
2020-21	-4.2%	-0.5%	-3.8%	-5.1%	-9.7%	-6.2%
2021-31	8.7%	10.2%	8.9%	9.0%	12.3%	9.9%
2021-41	5.4%	6.7%	5.6%	5.7%	7.5%	6.2%

Source: Form 41, U.S. Department of Transportation.

TABLE 11

U.S. MAINLINE AIR CARRIERS

SCHEDULED PASSENGER CAPACITY, TRAFFIC, AND LOAD FACTORS

	DOMESTIC			INTERNATIONAL			SYSTEM		
FISCAL YEAR	ASMs (BIL)	RPMs (BIL)	% LOAD FACTOR	ASMs (BIL)	RPMs (BIL)	% LOAD FACTOR	ASMs (BIL)	RPMs (BIL)	% LOAD FACTOR
Historical									
2010	581	480	82.7	279	230	82.2	860	710	82.5
2015	653	556	85.1	321	259	80.8	973	815	83.7
2018	756	645	85.3	342	279	81.6	1,098	924	84.1
2019	785	674	85.8	349	290	83.0	1,134	963	84.9
2020E	543	375	69.0	176	127	72.4	719	502	69.8
Forecast									
2021	508	356	70.1	180	115	63.7	688	471	68.4
2026	854	741	86.7	385	315	81.8	1,239	1,055	85.2
2031	968	840	86.8	448	368	82.1	1,416	1,207	85.3
2036	1,106	963	87.0	519	426	82.1	1,625	1,389	85.5
2041	1,233	1,076	87.3	595	489	82.1	1,828	1,565	85.6
Avg Annual Growth									
2010-20	-0.7%	-2.5%	-1.8%	-4.5%	-5.7%	-1.3%	-1.8%	-3.4%	-1.7%
2020-21	-6.5%	-5.1%	1.6%	2.6%	-9.7%	-12.0%	-4.3%	-6.2%	-2.0%
2021-31	6.7%	9.0%	2.2%	9.5%	12.3%	2.6%	7.5%	9.9%	2.2%
2021-41	4.5%	5.7%	1.1%	6.1%	7.5%	1.3%	5.0%	6.2%	1.1%

Source: Form 41, U.S. Department of Transportation.

TABLE 12

U.S. MAINLINE AIR CARRIERS

SCHEDULED INTERNATIONAL PASSENGER ENPLANEMENTS

	REVENUE PASSENGER ENPLANEMENTS (MIL)			
FISCAL YEAR	ATLANTIC	LATIN AMERICA	PACIFIC	TOTAL
Historical				
2010	24.5	37.2	12.9	74.6
2015	24.6	48.6	14.0	87.2
2018	26.0	56.9	13.3	96.2
2019	27.9	59.2	13.2	100.2
2020E	10.8	30.3	5.6	46.7
Forecast				
2021	7.7	35.2	3.6	46.5
2026	31.9	59.6	12.6	104.1
2031	35.6	72.7	14.2	122.4
2036	39.7	88.8	15.9	144.4
2041	43.9	107.4	17.7	169.0
Avg Annual Growth				
2010-20	-7.8%	-2.0%	-8.1%	-4.6%
2020-21	-28.7%	16.0%	-36.0%	-0.5%
2021-31	16.5%	7.5%	14.8%	10.2%
2021-41	9.1%	5.7%	8.3%	6.7%

Source: Form 41, U.S. Department of Transportation.

TABLE 13

U.S. MAINLINE AIR CARRIERS

SCHEDULED PASSENGER CAPACITY, TRAFFIC, AND LOAD FACTORS BY INTERNATIONAL TRAVEL REGIONS

	ATLANTIC			LATIN AMERICA			PACIFIC			INTERNATIONAL		
FISCAL YEAR	ASMs (BIL)	RPMs (BIL)	% LOAD FACTOR	ASMs (BIL)	RPMs (BIL)	% LOAD FACTOR	ASMs (BIL)	RPMs (BIL)	% LOAD FACTOR	ASMs (BIL)	RPMs (BIL)	% LOAD FACTOR
Historical												
2010	131	109	82.9	78	62	79.2	70	59	84.1	279	230	82.2
2015	133	107	80.0	101	81	80.3	86	71	82.5	321	259	80.8
2018	138	112	81.0	111	92	82.2	92	75	81.7	342	279	81.6
2019	146	121	82.9	112	94	83.5	91	75	82.6	349	290	83.0
2020E	69	48	69.3	63	48	76.2	44	31	71.8	176	127	72.4
Forecast												
2021	60	36	59.4	86	58	67.0	34	21	63.0	180	115	63.7
2026	172	140	81.4	117	97	82.8	96	78	81.3	385	315	81.8
2031	194	158	81.4	145	120	82.8	109	90	82.4	448	368	82.1
2036	218	177	81.4	178	148	82.8	122	101	82.4	519	426	82.1
2041	242	197	81.4	217	179	82.8	136	112	82.4	595	489	82.1
Avg Annual Growth												
2010-20	-6.1%	-7.8%	-1.8%	-2.1%	-2.5%	-0.4%	-4.7%	-6.2%	-1.6%	-4.5%	-5.7%	-1.3%
2020-21	-12.9%	-25.4%	-14.3%	37.3%	20.8%	-12.0%	-22.7%	-32.2%	-12.2%	2.6%	-9.7%	-12.0%
2021-31	12.4%	16.0%	3.2%	5.3%	7.6%	2.1%	12.4%	15.5%	2.7%	9.5%	12.3%	2.6%
2021-41	7.2%	8.9%	1.6%	4.7%	5.8%	1.1%	7.2%	8.7%	1.4%	6.1%	7.5%	1.3%

Source: Form 41, U.S. Department of Transportation.

TABLE 14

U.S. MAINLINE AIR CARRIER FORECAST ASSUMPTIONS

SEATS PER AIRCRAFT MILE

		INTERNATIONAL				
FISCAL YEAR	DOMESTIC (Seats/Mile)	ATLANTIC (Seats/Mile)	LATIN AMERICA (Seats/Mile)	PACIFIC (Seats/Mile)	TOTAL (Seats/Mile)	SYSTEM (Seats/Mile)
Historical						
2010	152.0	231.7	171.7	287.2	220.9	169.2
2015	157.7	237.0	173.9	272.1	219.5	173.8
2018	164.2	247.5	178.1	265.2	223.2	178.9
2019	166.0	251.6	177.9	269.9	225.6	180.7
2020E	166.8	256.2	178.5	256.5	221.8	177.5
Forecast						
2021	171.0	267.6	184.8	275.7	221.4	181.8
2026	168.8	253.8	180.2	270.0	228.7	183.8
2031	171.7	256.2	182.7	273.9	229.9	186.6
2036	174.4	258.7	185.2	277.8	230.9	189.2
2041	177.4	261.1	187.7	281.6	232.0	192.1

Source: Form 41, U.S. Department of Transportation.

TABLE 15

U.S. MAINLINE AIR CARRIER FORECAST ASSUMPTIONS

AVERAGE PASSENGER TRIP LENGTH

		INTERNATIONAL				
FISCAL YEAR	DOMESTIC (Miles)	ATLANTIC (Miles)	LATIN AMERICA (Miles)	PACIFIC (Miles)	TOTAL (Miles)	SYSTEM (Miles)
Historical						
2010	1,015	4,433	1,660	4,587	3,077	1,296
2015	1,023	4,336	1,669	5,080	2,969	1,292
2018	1,029	4,299	1,610	5,638	2,895	1,277
2019	1,030	4,330	1,582	5,709	2,890	1,278
2020E	1,016	4,442	1,577	5,634	2,725	1,208
Forecast						
2021	1,007	4,648	1,642	5,972	2,474	1,177
2026	1,021	4,383	1,631	6,193	3,025	1,273
2031	1,035	4,440	1,651	6,318	3,002	1,293
2036	1,049	4,471	1,662	6,343	2,950	1,307
2041	1,063	4,493	1,670	6,353	2,894	1,325

Source: Form 41, U.S. Department of Transportation.

TABLE 16

U.S. MAINLINE AIR CARRIER FORECAST ASSUMPTIONS

PASSENGER YIELDS

	REVENUE PER PASSENGER MILE					
	DOMESTIC		INTERNATIONAL		SYSTEM	
FISCAL YEAR	CURRENT $ (Cents)	FY 2020 $ (Cents)	CURRENT $ (Cents)	FY 2020 $ (Cents)	CURRENT $ (Cents)	FY 2020 $ (Cents)
Historical						
2010	12.62	14.98	12.84	15.24	12.69	15.06
2015	14.79	16.12	14.16	15.43	14.59	15.90
2018	13.92	14.38	13.58	14.04	13.82	14.28
2019	14.12	14.33	13.47	13.66	13.92	14.13
2020E	11.22	11.22	13.37	13.37	11.76	11.76
Forecast						
2021	9.62	9.44	12.87	12.62	10.41	10.21
2026	12.54	10.98	14.59	12.77	13.15	11.52
2031	13.84	10.75	15.92	12.37	14.47	11.25
2036	15.08	10.44	17.37	12.02	15.78	10.92
2041	16.45	10.11	18.97	11.66	17.24	10.60
Avg Annual Growth						
2010-20	-1.2%	-2.8%	0.4%	-1.3%	-0.8%	-2.4%
2020-21	-14.2%	-15.9%	-3.8%	-5.6%	-11.5%	-13.2%
2021-31	3.7%	1.3%	2.2%	-0.2%	3.3%	1.0%
2021-41	2.7%	0.3%	2.0%	-0.4%	2.6%	0.2%

Source: Form 41, U.S. Department of Transportation.

TABLE 17

U.S. MAINLINE AIR CARRIER FORECAST ASSUMPTIONS

INTERNATIONAL PASSENGER YIELDS BY REGION

	REVENUE PER PASSENGER MILE							
	ATLANTIC		LATIN AMERICA		PACIFIC		TOTAL INTERNATIONAL	
FISCAL YEAR	CURRENT $ (Cents)	FY 2020 $ (Cents)	CURRENT $ (Cents)	FY 2020 $ (Cents)	CURRENT $ (Cents)	FY 2020 $ (Cents)	CURRENT $ (Cents)	FY 2020 $ (Cents)
Historical								
2010	12.73	15.12	13.33	15.83	12.50	14.84	12.84	15.24
2015	14.64	15.95	14.38	15.67	13.20	14.39	14.16	15.43
2018	14.38	14.86	14.13	14.60	11.73	12.12	13.58	14.04
2019	14.04	14.25	14.20	14.41	11.63	11.80	13.47	13.66
2020E	13.42	13.42	14.56	14.56	11.48	11.48	13.37	13.37
Forecast								
2021	13.38	13.12	13.14	12.88	11.27	11.05	12.87	12.62
2026	15.11	13.23	15.70	13.75	12.25	10.72	14.59	12.77
2031	16.54	12.85	16.98	13.19	13.42	10.43	15.92	12.37
2036	18.11	12.53	18.27	12.64	14.73	10.19	17.37	12.02
2041	19.88	12.22	19.70	12.11	16.20	9.96	18.97	11.66
Avg Annual Growth								
2010-20	0.5%	-1.2%	0.9%	-0.8%	-0.8%	-2.5%	0.4%	-1.3%
2020-21	-0.3%	-2.2%	-9.7%	-11.5%	-1.8%	-3.7%	-3.8%	-5.6%
2021-31	2.1%	-0.2%	2.6%	0.2%	1.8%	-0.6%	2.2%	-0.2%
2021-41	2.0%	-0.4%	2.0%	-0.3%	1.8%	-0.5%	2.0%	-0.4%

Source: Form 41, U.S. Department of Transportation.

TABLE 18

U.S. MAINLINE AIR CARRIER FORECAST ASSUMPTIONS

JET FUEL PRICES

	DOMESTIC		INTERNATIONAL		SYSTEM	
FISCAL YEAR	CURRENT $ (Cents)	FY 2020 $ (Cents)	CURRENT $ (Cents)	FY 2020 $ (Cents)	CURRENT $ (Cents)	FY 2020 $ (Cents)
Historical						
2010	219.19	260.18	220.12	261.29	219.49	260.54
2015	207.29	225.94	211.77	230.82	208.96	227.76
2018	206.63	213.52	208.42	215.37	207.29	214.20
2019	205.67	208.67	207.82	210.84	206.63	209.64
2020E	166.65	166.65	167.19	167.19	166.83	166.83
Forecast						
2021	138.87	136.19	139.32	136.63	139.02	136.33
2026	211.79	185.43	212.48	186.03	212.02	185.63
2031	263.29	204.57	264.14	205.23	263.58	204.79
2036	293.34	202.96	294.29	203.62	293.66	203.18
2041	323.35	198.81	324.40	199.45	323.70	199.02
Avg Annual Growth						
2010-20	-2.7%	-4.4%	-2.7%	-4.4%	-2.7%	-4.4%
2020-21	-16.7%	-18.3%	-16.7%	-18.3%	-16.7%	-18.3%
2021-31	6.6%	4.2%	6.6%	4.2%	6.6%	4.2%
2021-41	4.3%	1.9%	4.3%	1.9%	4.3%	1.9%

Source: Form 41, U.S. Department of Transportation

TABLE 19

U.S. COMMERCIAL AIR CARRIERS

AIR CARGO REVENUE TON MILES[1, 2, 3]

	ALL-CARGO CARRIER RTMS (Millions)			PASSENGER CARRIER RTMS (Millions)			TOTAL RTMS (Millions)		
FISCAL YEAR	DOMESTIC	INT'L.	TOTAL	DOMESTIC	INT'L.	TOTAL	DOMESTIC	INT'L.	TOTAL
Historical									
2010	11,306	15,971	27,276	1,495	6,246	7,742	12,801	22,217	35,018
2015	11,636	16,359	27,995	1,455	6,277	7,733	13,091	22,636	35,727
2018	14,182	19,465	33,647	1,580	7,532	9,112	15,761	26,997	42,759
2019	14,737	19,668	34,405	1,468	6,986	8,454	16,205	26,654	42,858
2020E	16,639	21,958	38,597	1,127	4,135	5,262	17,767	26,093	43,860
Forecast									
2021	17,064	22,673	39,737	1,422	5,094	6,517	18,487	27,768	46,254
2026	18,679	26,238	44,917	1,792	8,909	10,701	20,471	35,147	55,618
2031	20,228	32,208	52,436	1,868	10,225	12,093	22,096	42,433	64,529
2036	21,953	38,827	60,780	1,949	11,497	13,447	23,902	50,324	74,226
2041	23,413	45,691	69,104	1,996	12,586	14,582	25,408	58,277	83,685
Avg Annual Growth									
2010-20	3.9%	3.2%	3.5%	-2.8%	-4.0%	-3.8%	3.3%	1.6%	2.3%
2020-21	2.6%	3.3%	3.0%	26.2%	23.2%	23.8%	4.1%	6.4%	5.5%
2021-31	1.7%	3.6%	2.8%	2.8%	7.2%	6.4%	1.8%	4.3%	3.4%
2021-41	1.6%	3.6%	2.8%	1.7%	4.6%	4.1%	1.6%	3.8%	3.0%

Source: Form 41, U.S. Department of Transportation

[1]Includes freight/express and mail revenue ton miles on mainline air carriers and regionals/commuters.

[2]Domestic figures from 2000 through 2002 exclude Airborne Express, Inc.; international figures for 2003 and beyond include new reporting of contract service by U.S. carriers for foreign flag carriers.

[3]Domestic figures from 2003 and beyond include Airborne Express. Inc.

TABLE 20

U.S. COMMERCIAL AIR CARRIERS

INTERNATIONAL AIR CARGO REVENUE TON MILES BY REGION[1, 2]

FISCAL YEAR	ATLANTIC (MILLIONS)	LATIN AMERICA (MILLIONS)	PACIFIC (MILLIONS)	OTHER INTERNATIONAL (MILLIONS)	TOTAL (MILLIONS)
Historical					
2010	6,786	1,990	7,897	5,545	22,217
2015	6,627	1,639	9,018	5,352	22,636
2018	7,554	1,846	10,422	7,176	26,997
2019	7,426	1,663	10,429	7,135	26,654
2020E	6,670	1,295	10,197	7,931	26,093
Forecast					
2021	6,972	1,424	11,072	8,300	27,768
2026	8,836	1,706	14,445	10,161	35,147
2031	10,329	1,963	17,575	12,566	42,433
2036	11,774	2,229	20,969	15,352	50,324
2041	12,868	2,436	24,468	18,505	58,277
Avg Annual Growth					
2010-20	-0.2%	-4.2%	2.6%	3.6%	1.6%
2020-21	4.5%	10.0%	8.6%	4.7%	6.4%
2021-31	4.0%	3.3%	4.7%	4.2%	4.3%
2021-41	3.1%	2.7%	4.0%	4.1%	3.8%

Source: Form 41, U.S. Department of Transportation

[1]Includes freight/express and mail revenue ton miles on mainline air carriers and regionals/commuters.

[2]Figures for 2003 and beyond include new reporting of contract service by U.S. carriers for foreign flag carriers.

TABLE 21

U.S. MAINLINE AIR CARRIERS

PASSENGER JET AIRCRAFT

	LARGE NARROWBODY				LARGE WIDEBODY						
CALENDAR YEAR	2 ENGINE	3 ENGINE	4 ENGINE	TOTAL	2 ENGINE	3 ENGINE	4 ENGINE	TOTAL	LARGE JETS	REGIONAL JETS	TOTAL JETS
Historical											
2010	3,120	8	1	3,129	470	9	43	522	3,651	71	3,722
2015	3,319	2	0	3,321	492	0	31	523	3,844	99	3,943
2018	3,678	0	0	3,678	541	0	0	541	4,219	98	4,317
2019	3,775	0	0	3,775	553	0	0	553	4,328	60	4,388
2020E	2,860	0	0	2,860	298	0	0	298	3,158	23	3,181
Forecast											
2021	2,828	0	0	2,828	281	0	0	281	3,109	23	3,132
2026	3,560	0	0	3,560	476	0	0	476	4,036	0	4,036
2031	3,762	0	0	3,762	560	0	0	560	4,322	0	4,322
2036	4,092	0	0	4,092	638	0	0	638	4,730	0	4,730
2041	4,387	0	0	4,387	714	0	0	714	5,101	0	5,101
Avg Annual Growth											
2010-20	-0.9%	-100.0%	-100.0%	-0.9%	-4.5%	-100.0%	-100.0%	-5.5%	-1.4%	-10.7%	-1.6%
2020-21	-1.1%	N.A.	N.A.	-1.1%	-5.7%	N.A.	N.A.	-5.7%	-1.6%	0.0%	-1.5%
2021-31	2.9%	N.A.	N.A.	2.9%	7.1%	N.A.	N.A.	7.1%	3.3%	-100.0%	3.3%
2021-41	2.2%	N.A.	N.A.	2.2%	4.8%	N.A.	N.A.	4.8%	2.5%	-99.9%	2.5%

Note: N.A. - Not Applicable

TABLE 22

U.S. MAINLINE AIR CARRIERS

CARGO JET AIRCRAFT

	LARGE NARROWBODY				LARGE WIDEBODY				
CALENDAR YEAR	2 ENGINE	3 ENGINE	4 ENGINE	TOTAL	2 ENGINE	3 ENGINE	4 ENGINE	TOTAL	TOTAL
Historical									
2010	153	104	31	288	265	200	97	562	850
2015	228	22	2	252	309	156	72	537	789
2018	213	11	2	226	392	120	100	612	838
2019	216	10	2	228	419	120	112	651	879
2020E	200	10	0	210	414	115	109	638	848
Forecast									
2021	213	8	0	221	434	111	110	655	876
2026	276	3	0	279	557	104	124	785	1,064
2031	366	0	0	366	681	101	123	905	1,271
2036	439	0	0	439	861	77	113	1,051	1,490
2041	517	0	0	517	1,089	8	97	1,194	1,711
Avg Annual Growth									
2010-20	2.7%	-20.9%	-100.0%	-3.1%	4.6%	-5.4%	1.2%	1.3%	0.0%
2020-21	6.5%	-20.0%	N.A.	5.2%	4.8%	-3.5%	0.9%	2.7%	3.3%
2021-31	5.6%	-100.0%	N.A.	5.2%	4.6%	-0.9%	1.1%	3.3%	3.8%
2021-41	4.5%	-99.9%	N.A.	4.3%	4.7%	-12.3%	-0.6%	3.0%	3.4%

Note: N.A. - Not Applicable

TABLE 23

TOTAL JET FUEL AND AVIATION GASOLINE FUEL CONSUMPTION

U.S. CIVIL AVIATION AIRCRAFT

(Millions of Gallons)

	JET FUEL					AVIATION GASOLINE			
	U.S. AIR CARRIERS[1, 2]								
FISCAL YEAR	DOMESTIC	INT'L.	TOTAL	GENERAL AVIATION	TOTAL	AIR CARRIER	GENERAL AVIATION	TOTAL	TOTAL FUEL CONSUMED
Historical									
2010	12,036	6,315	18,351	1,435	19,786	2	221	223	20,009
2015	12,834	6,541	19,374	1,383	20,757	2	196	198	20,955
2018	14,553	7,121	21,674	1,820	23,494	2	232	234	23,728
2019	14,594	7,043	21,637	1,510	23,148	2	200	202	23,350
2020E	10,504	4,715	15,219	1,269	16,489	2	184	186	16,675
Forecast									
2021	9,677	4,783	14,460	1,475	15,935	2	186	188	16,123
2026	15,493	7,841	23,334	1,894	25,228	2	183	185	25,413
2031	16,706	8,680	25,386	2,085	27,471	2	178	180	27,651
2036	18,165	9,568	27,733	2,246	29,979	2	175	177	30,156
2041	19,267	10,444	29,712	2,393	32,104	2	177	179	32,283
Avg Annual Growth									
2010-20	-1.4%	-2.9%	-1.9%	-1.2%	-1.8%	0.0%	-1.8%	-1.8%	-1.8%
2020-21	-7.9%	1.4%	-5.0%	16.2%	-3.4%	0.0%	1.0%	0.9%	-3.3%
2021-31	5.6%	6.1%	5.8%	3.5%	5.6%	0.0%	-0.4%	-0.4%	5.5%
2021-41	3.5%	4.0%	3.7%	2.4%	3.6%	0.0%	-0.3%	-0.3%	3.5%

Source: Air carrier jet fuel, Form 41, U.S. Department of Transportation; all others, FAA APO estimates.

[1]Includes both passenger (mainline and regional air carrier) and cargo carriers.

[2]Forecast assumes 1.0% annual improvement in available seat miles per gallon for U.S. Commercial Air Carrier

TABLE 24

U.S. REGIONAL CARRIER FORECAST ASSUMPTIONS

	AVERAGE SEATS PER AIRCRAFT MILE			AVERAGE PASSENGER TRIP LENGTH			REVENUE PER PASSENGER MILE**	
FISCAL YEAR	DOMESTIC (Seats/Mile)	INT'L (Seats/Mile)	TOTAL (Seats/Mile)	DOMESTIC (Miles)	INT'L. (Miles)	TOTAL (Miles)	CURRENT $ (Cents)	2020 $ (Cents)
Historical								
2010	56.1	53.2	56.1	464	503	465	15.74	18.68
2015	60.0	62.6	60.1	476	695	480	10.93	11.92
2018	64.1	70.8	64.3	487	680	491	11.32	11.70
2019	64.5	70.8	64.7	492	685	496	11.50	11.67
2020E	65.2	70.6	65.3	502	685	506	9.23	9.23
Forecast								
2021	66.4	70.9	66.5	481	656	484	7.95	7.80
2026	65.6	72.4	65.7	488	665	491	10.31	9.03
2031	66.7	73.9	66.9	495	674	498	11.37	8.83
2036	67.8	75.4	67.9	501	684	505	12.39	8.57
2041	68.9	76.9	69.1	508	693	511	13.50	8.30
Avg Annual Growth								
2010-20	1.5%	2.9%	1.5%	0.8%	3.1%	0.9%	-5.2%	-6.8%
2020-21	1.9%	0.4%	1.9%	-4.2%	-4.2%	-4.2%	-13.9%	-15.5%
2021-31	0.0%	0.4%	0.0%	0.3%	0.3%	0.3%	3.6%	1.3%
2021-41	0.2%	0.4%	0.2%	0.3%	0.3%	0.3%	2.7%	0.3%

Source: Form 41 and 298C, U.S. Department of Transportation.

** Reporting carriers.

TABLE 25

U.S. REGIONAL CARRIERS

SCHEDULED PASSENGER TRAFFIC

(In Millions)

	REVENUE PASSENGERS			REVENUE PASSENGER MILES		
FISCAL YEAR	DOMESTIC	INTERNATIONAL	TOTAL	DOMESTIC	INTERNATIONAL	TOTAL
Historical						
2010	162	3	164	75,029	1,347	76,376
2015	153	3	156	72,737	2,116	74,853
2018	154	3	157	74,852	2,295	77,147
2019	159	3	163	78,468	2,211	80,679
2020E	94	2	95	47,119	1,165	48,284
Forecast						
2021	86	2	88	41,436	1,025	42,460
2026	177	3	180	86,265	2,133	88,398
2031	198	4	201	97,811	2,419	100,230
2036	224	4	228	112,118	2,772	114,890
2041	247	4	251	125,355	3,100	128,455
Avg Annual Growth						
2010-20	-5.3%	-4.4%	-5.3%	-4.5%	-1.4%	-4.5%
2020-21	-8.2%	-8.2%	-8.2%	-12.1%	-12.1%	-12.1%
2021-31	8.7%	8.7%	8.7%	9.0%	9.0%	9.0%
2021-41	5.4%	5.4%	5.4%	5.7%	5.7%	5.7%

Source: Form 41 and 298C, U.S. Department of Transportation.

TABLE 26

U.S. REGIONAL CARRIERS

SCHEDULED PASSENGER CAPACITY, TRAFFIC, AND LOAD FACTORS

	DOMESTIC			INTERNATIONAL			TOTAL		
YEAR	ASMs (MIL)	RPMs (MIL)	% LOAD FACTOR	ASMs (MIL)	RPMs (MIL)	% LOAD FACTOR	ASMs (MIL)	RPMs (MIL)	% LOAD FACTOR
Historical									
2010	98,455	75,029	76.2	1,857	1,347	72.5	100,312	76,376	76.1
2015	90,647	72,737	80.2	2,819	2,116	75.0	93,467	74,853	80.1
2018	93,860	74,852	79.7	3,023	2,295	75.9	96,883	77,147	79.6
2019	98,202	78,468	79.9	2,933	2,211	75.4	101,135	80,679	79.8
2020E	70,621	47,119	66.7	1,742	1,165	66.9	72,363	48,284	66.7
Forecast									
2021	63,494	41,436	65.3	1,567	1,025	65.4	65,061	42,460	65.3
2026	106,842	86,265	80.7	2,636	2,133	80.9	109,478	88,398	80.7
2031	121,088	97,811	80.8	2,987	2,419	81.0	124,076	100,230	80.8
2036	138,380	112,118	81.0	3,414	2,772	81.2	141,794	114,890	81.0
2041	154,263	125,355	81.3	3,806	3,100	81.4	158,069	128,455	81.3
Avg Annual Growth									
2010-20	-3.3%	-4.5%	-1.3%	-0.6%	-1.4%	-0.8%	-3.2%	-4.5%	-1.3%
2020-21	-10.1%	-12.1%	-2.2%	-10.1%	-12.1%	-2.2%	-10.1%	-12.1%	-2.2%
2021-31	6.7%	9.0%	2.2%	6.7%	9.0%	2.2%	6.7%	9.0%	2.2%
2021-41	4.5%	5.7%	1.1%	4.5%	5.7%	1.1%	4.5%	5.7%	1.1%

Source: Form 41 and 298C, U.S. Department of Transportation.

TABLE 27

U.S. REGIONAL CARRIERS

PASSENGER AIRCRAFT

AS OF JANUARY 1	REGIONAL AIRCRAFT											
				31 TO 40 SEATS			OVER 40 SEATS			TOTAL FLEET		
	LESS THAN 9 SEATS	10 TO 19 SEATS	20 TO 30 SEATS	PROP	JET	TOTAL	PROP	JET	TOTAL	NON JET	JET	TOTAL
Historical												
2010	440	92	82	144	28	172	99	1,728	1,827	857	1,756	2,613
2015	346	68	13	32	0	32	57	1,628	1,685	516	1,628	2,144
2018	360	77	20	11	3	14	54	1,795	1,849	522	1,798	2,320
2019	374	72	19	11	0	11	39	1,846	1,885	515	1,846	2,361
2020E	276	74	20	9	0	9	40	1,434	1,474	419	1,434	1,853
Forecast												
2021	246	66	18	6	0	6	42	1,406	1,448	377	1,406	1,783
2026	186	49	14	0	0	0	60	1,670	1,730	309	1,670	1,979
2031	130	35	9	0	0	0	65	1,588	1,653	240	1,588	1,828
2036	73	20	5	0	0	0	70	1,735	1,805	168	1,735	1,903
2041	24	5	2	0	0	0	75	1,838	1,913	106	1,838	1,944
Avg Annual Growth												
2010-20	-4.6%	-2.2%	-13.2%	-24.2%	-100.0%	-25.5%	-8.7%	-1.8%	-2.1%	-6.9%	-2.0%	-3.4%
2020-21	-10.9%	-11.1%	-10.5%	-38.9%	N.A.	-38.9%	5.0%	-2.0%	-1.8%	-10.0%	-2.0%	-3.8%
2021-31	-6.1%	-6.1%	-6.2%	-100.0%	N.A.	-100.0%	4.5%	1.2%	1.3%	-4.4%	1.2%	0.2%
2021-41	-11.1%	-12.0%	-10.1%	-99.9%	N.A.	-99.9%	2.9%	1.3%	1.4%	-6.2%	1.3%	0.4%

Note: N.A. - Not Applicable

TABLE 28

ACTIVE GENERAL AVIATION AND AIR TAXI AIRCRAFT

	FIXED WING						ROTORCRAFT						TOTAL GENERAL AVIATION FLEET		
	PISTON			TURBINE											
AS OF DEC. 31	SINGLE ENGINE	MULTI-ENGINE	TOTAL	TURBO PROP	TURBO JET	TOTAL	PISTON	TURBINE	TOTAL	EXPERI-MENTAL**	LIGHT SPORT AIRCRAFT**	OTHER		TOTAL PISTONS	TOTAL TURBINES
Historical*															
2010	139,519	15,900	155,419	9,369	11,484	20,853	3,588	6,514	10,102	24,784	6,528	5,684	223,370	159,007	27,367
2015	127,887	13,254	141,141	9,712	13,440	23,152	3,286	7,220	10,506	27,922	2,369	4,941	210,031	144,427	30,372
2018	130,179	12,861	143,040	9,925	14,596	24,521	3,082	6,907	9,989	27,531	2,554	4,114	211,749	146,122	31,428
2019	128,926	12,470	141,396	10,242	14,888	25,130	3,089	7,109	10,198	27,449	2,675	4,133	210,981	144,485	32,239
2020E	127,920	12,395	140,315	10,205	15,245	25,450	3,065	7,090	10,155	24,455	2,145	2,460	204,980	143,380	32,540
Forecast															
2021	126,745	12,320	139,065	10,170	15,620	25,790	3,070	7,145	10,215	25,250	2,465	3,085	205,870	142,135	32,935
2026	120,595	11,970	132,565	10,165	17,770	27,935	3,165	7,650	10,815	28,075	3,525	4,160	207,075	135,730	35,585
2031	114,990	11,720	126,710	10,390	20,065	30,455	3,300	8,280	11,580	29,965	4,180	4,180	207,070	130,010	38,735
2036	109,860	11,520	121,380	10,725	22,305	33,030	3,460	8,985	12,445	31,625	4,790	4,215	207,485	124,840	42,015
2041	105,540	11,365	116,905	11,385	24,395	35,780	3,640	9,750	13,390	33,050	5,415	4,250	208,790	120,545	45,530
Avg Annual Growth															
2010-20	-0.9%	-2.5%	-1.0%	0.9%	2.9%	2.0%	-1.6%	0.9%	0.1%	-0.1%	-10.5%	-8.0%	-0.9%	-1.0%	1.7%
2020-21	-0.9%	-0.6%	-0.9%	-0.3%	2.5%	1.3%	0.2%	0.8%	0.6%	3.3%	14.9%	25.4%	0.4%	-0.9%	1.2%
2021-31	-1.0%	-0.5%	-0.9%	0.2%	2.5%	1.7%	0.7%	1.5%	1.3%	1.7%	5.4%	3.1%	0.1%	-0.9%	1.6%
2021-41	-0.9%	-0.4%	-0.9%	0.6%	2.3%	1.7%	0.9%	1.6%	1.4%	1.4%	4.0%	1.6%	0.1%	-0.8%	1.6%

* Source: 2001-2010, 2012-2018, FAA General Aviation and Air Taxi Activity (and Avionics) Surveys.

**Experimental Light-sport category that was previously shown under Sport Aircraft is moved under Experimental Aircraft category, starting in 2012.

Note: An active aircraft is one that has a current registration and was flown at least one hour during the calendar year.

TABLE 29

ACTIVE GENERAL AVIATION AND AIR TAXI HOURS FLOWN

(In Thousands)

AS OF DEC. 31	FIXED WING PISTON SINGLE ENGINE	FIXED WING PISTON MULTI-ENGINE	FIXED WING PISTON TOTAL	FIXED WING TURBINE TURBO PROP	FIXED WING TURBINE TURBO JET	FIXED WING TURBINE TOTAL	ROTORCRAFT PISTON	ROTORCRAFT TURBINE	ROTORCRAFT TOTAL	EXPERI-MENTAL**	LIGHT SPORT AIRCRAFT**	OTHER	TOTAL GENERAL AVIATION FLEET	TOTAL PISTONS	TOTAL TURBINES
Historical*															
2010	12,161	1,818	13,979	2,325	3,375	5,700	794	2,611	3,405	1,226	311	181	24,802	14,773	8,311
2015	11,217	1,608	12,825	2,538	3,837	6,375	798	2,496	3,294	1,295	191	162	24,142	13,623	8,871
2018	12,092	1,694	13,785	2,736	4,592	7,328	601	2,322	2,922	1,153	187	131	25,506	14,386	9,650
2019	12,700	1,731	14,431	2,619	3,926	6,546	628	2,369	2,997	1,269	189	135	25,566	15,059	8,914
2020E	11,768	1,708	13,476	2,624	3,159	5,783	567	2,126	2,693	923	158	50	23,082	14,043	7,909
Forecast															
2021	11,805	1,689	13,494	2,701	3,841	6,542	605	2,303	2,908	1,015	185	73	24,217	14,098	8,845
2026	11,286	1,606	12,892	2,911	5,436	8,346	688	2,617	3,306	1,301	278	141	26,264	13,581	10,964
2031	10,710	1,553	12,263	2,991	6,245	9,236	760	2,896	3,656	1,471	338	140	27,104	13,023	12,132
2036	10,298	1,549	11,847	3,092	6,956	10,048	821	3,169	3,990	1,596	393	142	28,016	12,668	13,217
2041	10,184	1,577	11,761	3,297	7,637	10,935	886	3,465	4,350	1,714	449	144	29,353	12,647	14,399
Avg Annual Growth															
2010-20	-0.3%	-0.6%	-0.4%	1.2%	-0.7%	0.1%	-3.3%	-2.0%	-2.3%	-2.8%	-6.6%	-12.0%	-0.7%	-0.5%	-0.5%
2020-21	0.3%	-1.1%	0.1%	2.9%	21.6%	13.1%	6.7%	8.3%	8.0%	10.0%	17.3%	46.3%	4.9%	0.4%	11.8%
2021-31	-1.0%	-0.8%	-1.0%	1.0%	5.0%	3.5%	2.3%	2.3%	2.3%	3.8%	6.2%	6.7%	1.1%	-0.8%	3.2%
2021-41	-0.7%	-0.3%	-0.7%	1.0%	3.5%	2.6%	1.9%	2.1%	2.0%	2.7%	4.5%	3.4%	1.0%	-0.5%	2.5%

* Source: 2001-2010, 2012-2018, FAA General Aviation and Air Taxi Activity (and Avionics) Surveys.

**Experimental Light-sport category that was previously shown under Sport Aircraft is moved under Experimental Aircraft category, starting in 2012.

Note: An active aircraft is one that has a current registration and was flown at least one hour during the calendar year.

TABLE 30

ACTIVE PILOTS BY TYPE OF CERTIFICATE, EXCLUDING STUDENT PILOTS*

AS OF DEC. 31	RECREA-TIONAL	SPORT PILOT	PRIVATE	COMMERCIAL	AIRLINE TRANSPORT	ROTOR-CRAFT ONLY	GLIDER ONLY	TOTAL LESS STUDENT PILOTS	INSTRUMENT RATED PILOTS[1]
Historical**									
2010	212	3,682	202,020	123,705	142,198	15,377	21,275	508,469	318,001
2015	190	5,482	170,718	101,164	154,730	15,566	19,460	467,310	304,329
2018	144	6,246	163,695	99,880	162,145	15,033	18,370	465,513	311,017
2019	127	6,467	161,105	100,863	164,947	14,248	19,143	466,900	314,168
2020E	105	6,643	160,860	103,879	164,193	13,629	19,753	469,062	316,651
Forecast									
2021	100	6,805	160,750	103,900	166,400	13,350	20,300	471,605	317,000
2026	85	7,710	160,550	103,900	172,000	14,200	21,800	480,245	323,500
2031	70	8,855	155,900	103,500	178,000	15,450	22,500	484,275	330,600
2036	60	10,265	150,700	102,950	185,100	16,700	22,750	488,525	337,400
2041	50	11,615	147,200	102,500	191,600	17,950	22,900	493,815	343,800
Avg Annual Growth									
2010-20	-6.8%	6.1%	-2.3%	-1.7%	1.4%	-1.2%	-0.7%	-0.8%	0.0%
2020-21	-4.8%	2.4%	-0.1%	0.0%	1.3%	-2.0%	2.8%	0.5%	0.1%
2021-31	-3.5%	2.7%	-0.3%	0.0%	0.7%	1.5%	1.0%	0.3%	0.4%
2021-41	-3.4%	2.7%	-0.4%	-0.1%	0.7%	1.5%	0.6%	0.2%	0.4%

** Source: FAA U.S. Civil Airmen Statistics.

*Starting with April 2016, there is no expiration date on the new student pilot certificates. This generates a cumulative increase in the student pilot numbers and breaks the link between student pilot and private pilot or higher level certificates. Since there is no sufficient data yet to forecast the student certificates unter the new rule, student pilot forecast is suspended and excluded from this table.

[1]Instrument rated pilots should not be added to other categories in deriving total.

Note: An active pilot is a person with a pilot certificate and a valid medical certificate.

TABLE 31

GENERAL AVIATION AIRCRAFT FUEL CONSUMPTION

(In Millions of Gallons)

	FIXED WING				ROTORCRAFT				TOTAL FUEL CONSUMED		
	PISTON		TURBINE								
CALENDAR YEAR	SINGLE ENGINE	MULTI-ENGINE	TURBO PROP	TURBO JET	PISTON	TURBINE	EXPERI-MENTAL** / OTHER	LIGHT SPORT**	AVGAS	JET FUEL	TOTAL
Historical*											
2010	133	54	187	1,123	11	125	22	1	221	1,435	1,656
2015	128	40	191	1,063	10	128	15	1	196	1,383	1,578
2018	152	50	234	1,455	9	132	20	1	232	1,820	2,052
2019	131	45	213	1,170	8	127	16	1	200	1,510	1,711
2020E	121	44	214	941	7	114	11	1	184	1,269	1,453
Forecast											
2021	121	44	219	1,133	8	122	12	1	186	1,475	1,661
2026	116	41	233	1,525	9	136	16	1	183	1,894	2,077
2031	109	40	236	1,705	10	144	18	2	178	2,085	2,263
2036	104	39	238	1,852	10	156	19	2	175	2,246	2,421
2041	103	40	247	1,983	11	162	21	2	177	2,393	2,569
Avg Annual Growth											
2010-20	-1.0%	-1.9%	1.3%	-1.7%	-3.9%	-0.9%	-6.6%	-5.1%	-1.8%	-1.2%	-1.3%
2020-21	0.3%	-1.2%	2.7%	20.4%	6.7%	7.3%	11.8%	17.3%	1.0%	16.2%	14.3%
2021-31	-1.1%	-1.0%	0.7%	4.2%	2.2%	1.7%	3.9%	5.8%	-0.4%	3.5%	3.1%
2021-41	-0.8%	-0.5%	0.6%	2.8%	1.9%	1.4%	2.6%	4.2%	-0.3%	2.4%	2.2%

*Source: FAA APO Estimates.

**Experimental Light-sport category that was previously shown under Sport Aircraft is moved under Experimental Aircraft category, starting in 2012.

Note: Detail may not add to total because of independent rounding.

TABLE 32

TOTAL COMBINED AIRCRAFT OPERATIONS AT AIRPORTS WITH FAA AND CONTRACT TRAFFIC CONTROL SERVICE

(In Thousands)

			GENERAL AVIATION			MILITARY				NUMBER OF TOWERS	
FISCAL YEAR	AIR CARRIER	AIR TAXI/ COMMUTER	ITINERANT	LOCAL	TOTAL	ITINERANT	LOCAL	TOTAL	TOTAL	FAA	CONTRACT
Historical											
2010	12,658	9,410	14,864	11,716	26,580	1,309	1,298	2,607	51,255	264	244
2015	13,755	7,895	13,887	11,691	25,579	1,292	1,203	2,495	49,724	264	252
2018	15,686	7,126	14,130	12,354	26,485	1,319	1,155	2,474	51,770	264	254
2019	16,192	7,234	14,245	13,109	27,354	1,349	1,134	2,483	53,264	264	256
2020	11,737	5,472	12,608	12,333	24,941	1,192	1,020	2,212	44,362	264	256
Forecast											
2021	11,219	5,013	13,199	12,744	25,943	1,192	1,020	2,212	44,388	264	256
2026	19,050	5,336	15,139	13,632	28,770	1,192	1,020	2,212	55,368	264	256
2031	21,337	5,646	15,333	13,877	29,210	1,192	1,020	2,212	58,406	264	256
2036	23,490	5,960	15,533	14,131	29,664	1,192	1,020	2,212	61,326	264	256
2041	25,571	6,287	15,738	14,393	30,131	1,192	1,020	2,212	64,201	264	256
Avg Annual Growth											
2010-20	-0.8%	-5.3%	-1.6%	0.5%	-0.6%	-0.9%	-2.4%	-1.6%	-1.4%		
2020-21	-4.4%	-8.4%	4.7%	3.3%	4.0%	0.0%	0.0%	0.0%	0.1%		
2021-31	6.6%	1.2%	1.5%	0.9%	1.2%	0.0%	0.0%	0.0%	2.8%		
2021-41	4.2%	1.1%	0.9%	0.6%	0.8%	0.0%	0.0%	0.0%	1.9%		

Source: FAA Air Traffic Activity.

TABLE 33

TOTAL TRACON OPERATIONS

(In Thousands)

FISCAL YEAR	AIR CARRIER	AIR TAXI/ COMMUTER	GENERAL AVIATION	MILITARY	OVERFLIGHT	TOTAL
Historical						
2010	12,576	8,667	10,839	2,054	4,851	38,987
2015	13,611	7,095	10,399	1,966	4,100	37,171
2018	15,519	6,495	10,805	1,954	4,115	38,888
2019	15,991	6,547	10,871	1,940	3,644	38,993
2020	11,617	5,153	9,691	1,763	3,050	31,274
Forecast						
2021	11,098	4,533	10,160	1,765	2,981	30,535
2026	18,856	4,471	11,872	1,765	3,993	40,957
2031	21,126	4,749	12,008	1,765	4,283	43,931
2036	23,265	5,029	12,147	1,764	4,559	46,764
2041	25,331	5,320	12,289	1,764	4,828	49,533
Avg Annual Growth						
2010-20	-0.8%	-5.1%	-1.1%	-1.5%	-4.5%	-2.2%
2020-21	-4.5%	-12.0%	4.8%	0.1%	-2.3%	-2.4%
2021-31	6.6%	0.5%	1.7%	0.0%	3.7%	3.7%
2021-41	4.2%	0.8%	1.0%	0.0%	2.4%	2.4%

Source: FAA Air Traffic Activity.

TABLE 34

IFR AIRCRAFT HANDLED AT FAA EN ROUTE TRAFFIC CONTROL CENTERS

(In Thousands)

	IFR AIRCRAFT HANDLED			
FISCAL YEAR	COMMERCIAL	GENERAL AVIATION	MILITARY	TOTAL
Historical				
2010	30,965	6,550	2,982	40,498
2015	33,116	7,007	1,795	41,918
2018	35,713	7,403	1,724	44,840
2019	35,682	6,275	1,525	43,483
2020	25,537	5,071	1,297	31,905
Forecast				
2021	23,938	5,425	1,297	30,660
2026	38,056	6,534	1,297	45,887
2031	42,798	6,703	1,297	50,798
2036	47,272	6,880	1,297	55,449
2041	51,593	7,067	1,297	59,956
Avg Annual Growth				
2010-20	-1.9%	-2.5%	-8.0%	-2.4%
2020-21	-6.3%	7.0%	0.0%	-3.9%
2021-31	6.0%	2.1%	0.0%	5.2%
2021-41	3.9%	1.3%	0.0%	3.4%

Source: FAA Air Traffic Activity