Federal Aviation Administration

FAA AEROSPACE FORECAST

Fiscal Years 2019-2039

TC19-0002

Table of Contents

Forecast Highlights (2019–2039)

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 have been impressive: 2018 marks the tenth consecutive year of profitability for the U.S. airline industry. Looking forward, there is confidence that U.S. airlines have finally transformed from a capital intensive, highly cyclical industry to an industry that generates solid returns on capital and sustained profits.

Fundamentally, over the medium and long term, aviation demand is driven by economic activity, and a growing U.S. and world economy provides the basis for aviation to grow over the long run. The 2019 FAA forecast calls for U.S. carrier domestic passenger growth over the next 20 years to average 1.8 percent per year. The uptick in passenger growth since 2014 will continue into 2019 driven by generally positive economic conditions in the U.S. and the world. Oil prices averaged $64 per barrel in 2018 edging down to $61 in 2019, and our forecast assumes they will increase beginning in the early 2020s to reach $98 by the end of the forecast period. After a year of solid economic growth in 2018 for the U.S. and generally around the world, conditions are beginning to gradually ease. Some headwinds that have been present over the past few years remain, such as the uncertainty surrounding “Brexit” and the difficulty China faces in managing the slowdown of its economy. Meanwhile, new headwinds have developed, including a broad slowdown in global trade, political tensions in several countries, and economic slumps in Italy and Germany. The U.S. economy is showing signs of moderating from the above-trend pace in 2018 as the expansion is poised to become the longest on record. Growth is expected to ease back towards trend with domestic demand supported by positive financial conditions, a strong labor market, and continuing effects of the 2017 Tax Cuts and Jobs Act.

System traffic in revenue passenger miles (RPMs) is projected to increase by 2.2 percent a year between 2019 and 2039. Domestic RPMs are forecast to grow 1.9 percent a year while International RPMs are forecast to grow significantly faster at 3.0 percent a year. System capacity as measured by available seat miles (ASMs) is forecast to grow in line with the increases in demand. The number of seats per aircraft is growing, especially in the regional jet market, where we expect the number of 50 seat regional jets to fall to just a handful by 2030, replaced by 70-90 seat aircraft.

Although the U.S. and global economies saw solid growth in 2018, a combination of higher energy prices and labor cost increases resulted in profits for U.S. airlines falling further from 2016's record levels. The FAA expects U.S. carrier profitability to remain steady or increase as solid demand fed by a stable economy offsets rising energy and labor costs. 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 inflation, reflecting over the long term a growing U.S. and global economy.

The long-term outlook for general aviation is stable to optimistic, as growth at the high-end offsets continuing retirements at the traditional low end of the segment. The active general aviation fleet is forecast to remain relatively level between 2019 and 2039. 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 continues to shrink over the forecast. Against the stable fleet, the number of general aviation hours flown is projected to increase an average of 0.8 percent per year through 2039, as growth in turbine, rotorcraft, and experimental hours more than offset a decline in fixed wing piston hours.

With increasing numbers of regional and business jets in the nation's skies, fleet mix changes, and carriers consolidating operations in their large hubs, we expect increased activity growth that has the potential to increase controller workload. Operations at FAA and contract towers are forecast to grow 0.9 percent a year over the forecast period with commercial activity growing at five times the rate of non-commercial (general aviation and military) activity. The growth in U.S. airline and business aviation activity is the primary driver. Large and medium hubs will see much faster increases than small and non-hub airports, largely due to the commercial nature of their operations.

Review of 2018

An improving economy at home and solid growth abroad translated into another good year for U.S. aviation in 2018. Airlines posted their tenth consecutive year of profits as they boosted revenue growth at the fastest rate since the recession. Revenues grew as the U.S. airline industry continues to shift its emphasis from gaining market share to seeking returns on invested capital. U.S. airlines are continually updating their successful strategies for capturing additional revenue streams such as charging fees for services that used to be included in airfare (e.g. meal service), charging for services that were not previously available (e.g. premium boarding and fare lock fees), as well as for maximizing fare revenue with more sophisticated revenue management systems. At the same time, the U.S. airline industry has become nimbler in adjusting capacity to seize opportunities or minimize losses, helping to raise yields for the first time in four years. These efforts secured industry profitability in 2018 even as energy prices and new labor contracts lifted costs higher.

Demand for air travel in 2018 picked up again after cooling in 2017 as economic growth in the U.S. accelerated. In 2018, system traffic as measured by revenue passenger miles (RPMs) increased 4.8 percent while system enplanements grew 4.7 percent. Domestic RPMs were up 5.4 percent while enplanements were up by 5.0 percent. International RPMs increased 3.4 percent and enplanements grew by 2.8 percent. The system-wide load factor was 83.8 percent, up three tenths of a percent from the 2017 level.

System yields increased for the first time since 2014. In domestic markets, expansion by ultra-low cost carriers such as Spirit and Allegiant, as well as by mainline carriers such as United, helped to keep a lid on fare increases despite rising energy and labor costs as yields were unchanged. International yield rose a strong 5.6 percent as both the Atlantic and Latin regions gained sharply and the Pacific region reversed course after years of declines and posted a solid gain. Despite rising energy and labor costs, U.S. airlines remained solidly profitable in FY 2018. Data for FY 2018 show that the reporting passenger carriers had a combined operating profit of $17.6 billion (compared to a $21.5 billion operating profit for FY 2017). The network carriers[1] reported combined operating profits of $12.5 billion while the low cost carriers[2] reported combined operating profits of $4.5 billion as all carriers posted profits.

The general aviation industry recorded an increase of 9.2 percent in deliveries of U.S. manufactured aircraft in 2018, with pistons up by 5.5 percent and turbines up by 12.8 percent. As the higher priced turbine deliveries improved significantly (as opposed to a

[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, Sun Country Airlines.

flat performance last year), U.S. billings increased 9.0 percent to $11.6 billion. General aviation activity at FAA and contract tower airports recorded a 3.3 percent increase in 2018 as local activity rose 5.2 percent, more than offsetting a 1.8 percent decline in itinerant operations.

Total operations in 2018 at the 518 FAA and contract towers were up 2.9 percent compared to 2017. This marks the first time since FY 1997-2000 that operations at FAA and funded towers have increased for four consecutive years. Air carrier activity increased by 4.3 percent, more than offsetting a decline in air taxi operations, while general aviation rose 3.3 percent and military activity decreased 2.1 percent. Activity at large hubs rose by 1.9 percent, while medium hub activity increased by 3.5 percent and small hub airport activity was up 1.5 percent in 2018 compared to the prior year.

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
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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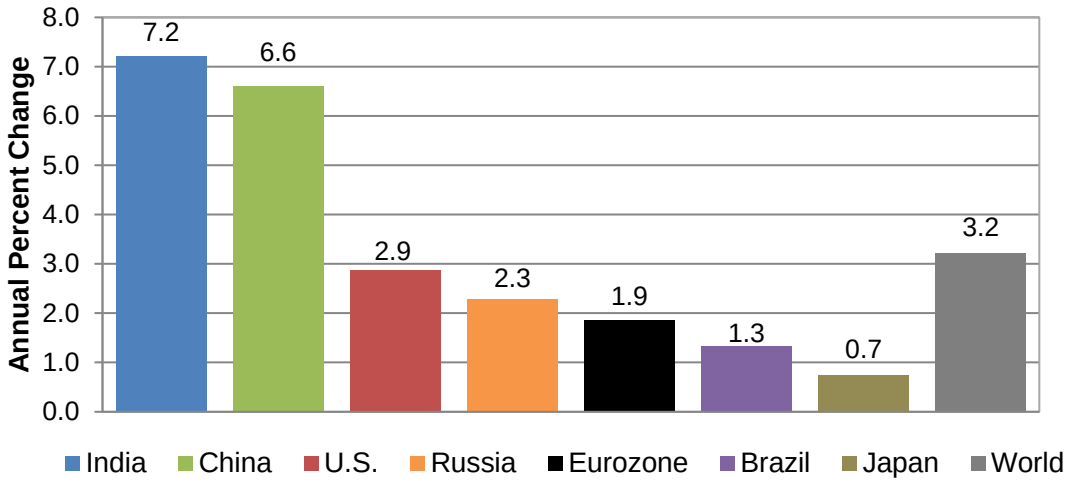
FAA Aerospace Forecasts
Fiscal Years 2019-2039

Economic Environment

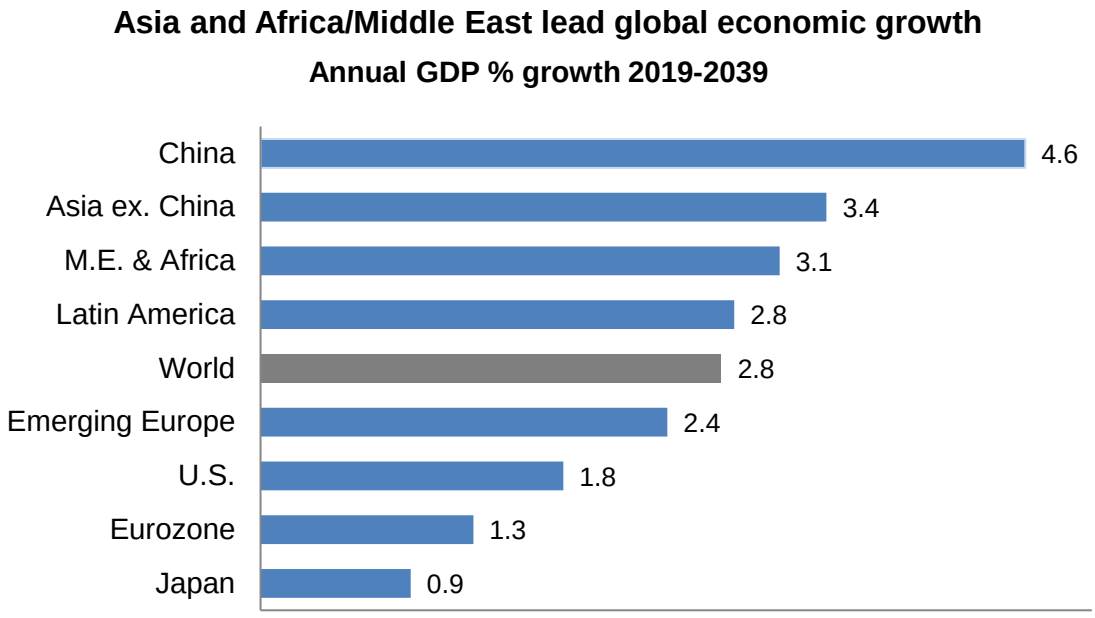
In the near term, IHS Markit projects that world economic growth will ease slightly from its 2018 rate of 2 percent as economies return to their long-run trend growth rates. Growth is projected at 2.9 percent in 2019 and 2.8 percent in 2020. The U.S. economy is forecast to be supported by improved financial conditions but restrained by reduced government spending while European growth is pressured by weakness in manufacturing and widespread political uncertainty. Japan's economic growth is projected to suffer from trade concerns and an increase in the consumption tax later in 2019. In emerging markets, China's growth rate continues to gradually decelerate through 6 percent, though supported by government stimulus, while other countries such as Brazil and Russia suffer from political uncertainties and relatively weak export demand. India is expected to post growth rates of about 7 percent as consumer spending slows and fiscal stimulus is reduced.

India and China led World Economic Growth in 2018



Source: IHS Markit

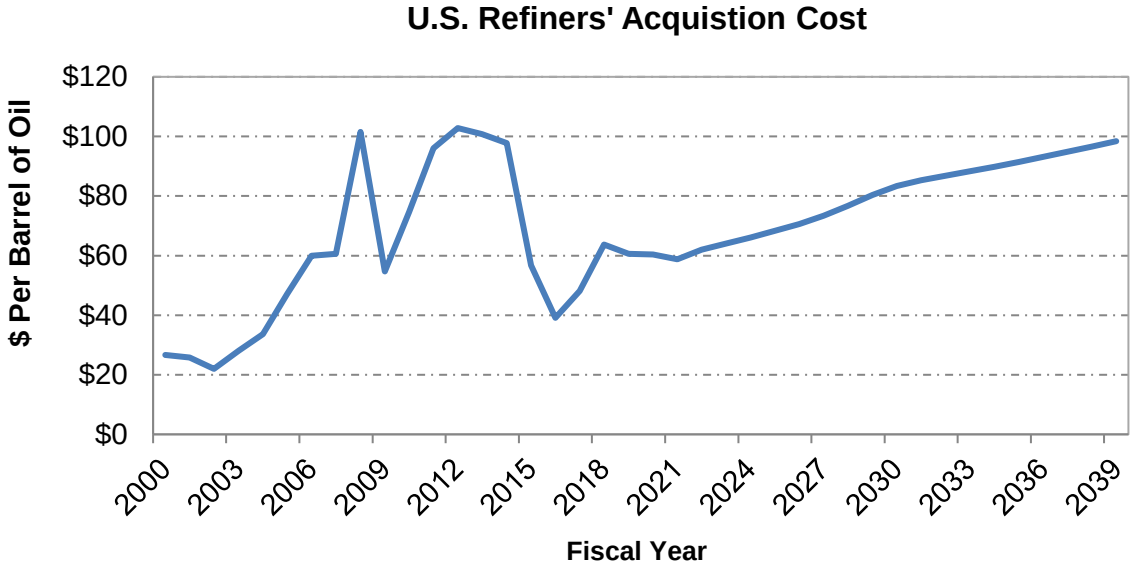
IHS Markit forecasts world real GDP to grow at 2.8 percent a year between 2019 and 2039. Emerging markets, at 4.1 percent a year, are forecast to grow above the global average but at lower rates than in the early 2000's. Asia (excluding Japan), led by India and China, is projected to have the fastest growth followed by Africa and Middle East, Latin America, and Eastern Europe. Growth in the more mature economies (1.6 percent a year) will be lower than the global trend with the fastest rates in the U.S. followed by Europe. Growth in Japan is forecast to be very slow at 0.9 percent a year reflecting deep structural issues associated with a shrinking and aging population.



Source: IHS Markit, Feb 2019 World Forecast

The average crude oil price in 2018 was up 28 percent from the year before to about $65 per barrel, continuing the increase seen in 2017. IHS Markit is projecting slight moderation in prices in 2019 and 2020 due to supply growth, particularly in the U.S., followed by gradual increases in subsequent years.

The price of oil is projected to increase over the long run due to growing global demand and higher costs of extraction. IHS Markit forecasts U.S. refiner's acquisition cost of crude to remain just shy of $100 per barrel by the end of the forecast horizon in 2039.



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.

The commercial air carrier industry in 2019 will respond to four trends already underway: (1) selective capacity expansion; (2) steady growth of seats per aircraft, whether through up-gauging or reconfiguring existing aircraft; (3) increasing competitive pressure due to ultra-low-cost carrier expansion; and (4) increasing price discrimination[4] through ancillary revenues and revenue management systems.

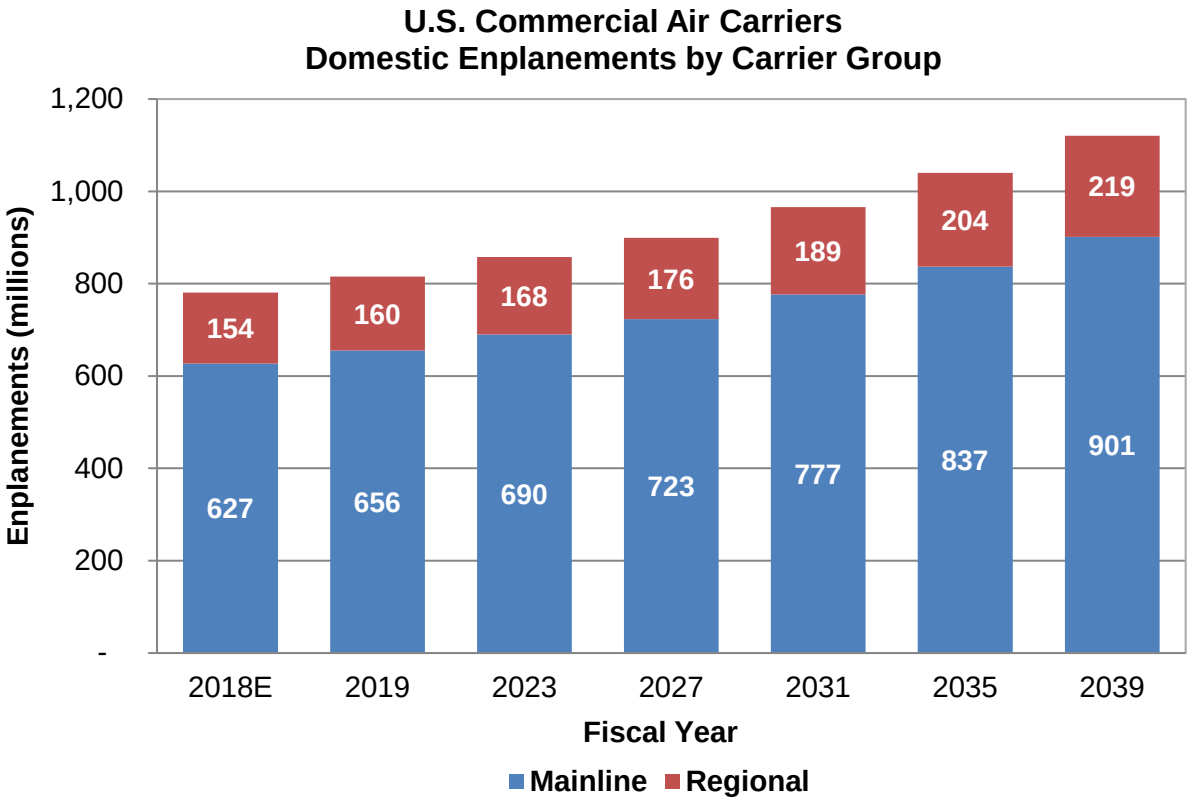
Following the 2007-09 recession, the U.S. airline industry underwent considerable restructuring that has resulted in an unprecedented period of capacity discipline, especially in domestic markets. Between 1978 and 2000, ASMs in domestic markets increased at an average annual rate of 4 percent a year, recording only two years of decline. Even though domestic ASMs shrank by 6.9 percent in FY 2002, following the events of September 11, 2001, growth resumed and by 2007, domestic ASMs were 3.6 percent above the FY 2000 level. Since 2009, U.S. domestic ASMs have increased at an average rate of 2.5 percent per year while RPMs have grown 3.1 percent per year. Although those average rates of growth since the recession are modest, they conceal the fact that growth has been picking up over the period (4.6 percent and 4.7 percent a year since 2014, respectively). ASM growth has risen due to a variety of factors including upgauging and the expansion of ultra-low-cost carriers and the competitive response by major carriers, driven in large part by low fuel prices. Looking ahead to the near-term, that earlier restraint in ASM growth is likely to continue easing as some carriers have indicated plans to open new routes. As new service begins, competitors may respond by adding their own new routes, thus further boosting ASM growth.

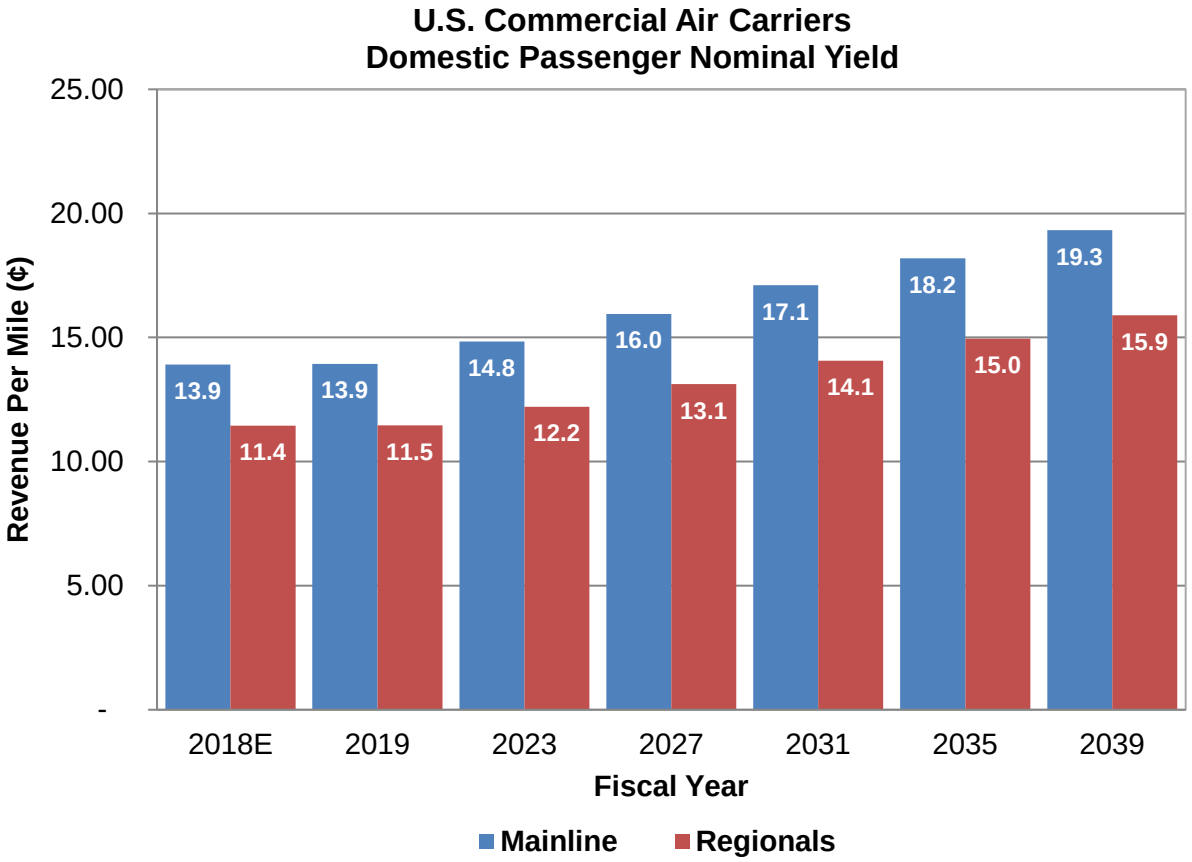
The period of domestic capacity restraint since 2007 has not been shared equally between the mainline carriers and their regional counterparts. In 2018, the mainline carrier group provided 14.8 percent more capacity than in 2007 while carrying 17.8 percent more passengers. Capacity flown by the regional group has risen just 0.5 percent over the same period (with passengers carried down 1.5 percent).

[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 less seats and whose routes serve mainly as feeders to the mainline carriers.

[4] Simply defined as the business strategy of selling largely similar products to different customers at different prices.

The regional market has continued to shrink as the regionals compete for even fewer contracts with the remaining dominant carriers; this has meant stagnant growth in enplanements and yields.





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, the regional airlines are facing some pilot shortages. Their labor costs are increasing as they raise wages to combat the pilot shortage while their capital costs have increased in the short-term as they continue to replace their 50 seat regional jets with more fuel-efficient 70 seat jets. The move to the larger aircraft will prove beneficial in the future, however, since their unit costs are lower.

Growing seats per aircraft has been a longstanding trend for regionals that saw this measure rise by more than 55 percent over the decade from 1997 to 2007. The trend has slowed more recently, however, as regional seats per aircraft rose 28 percent over the ten years ending in 2018.

Mainline carriers have also been increasing the seats per aircraft flown although the trend has been accelerating – the reverse of regionals' behavior. From 1997-2007, mainline seats per aircraft expanded just one-half of one percent. Since 2007, this measure has grown 9 percent.

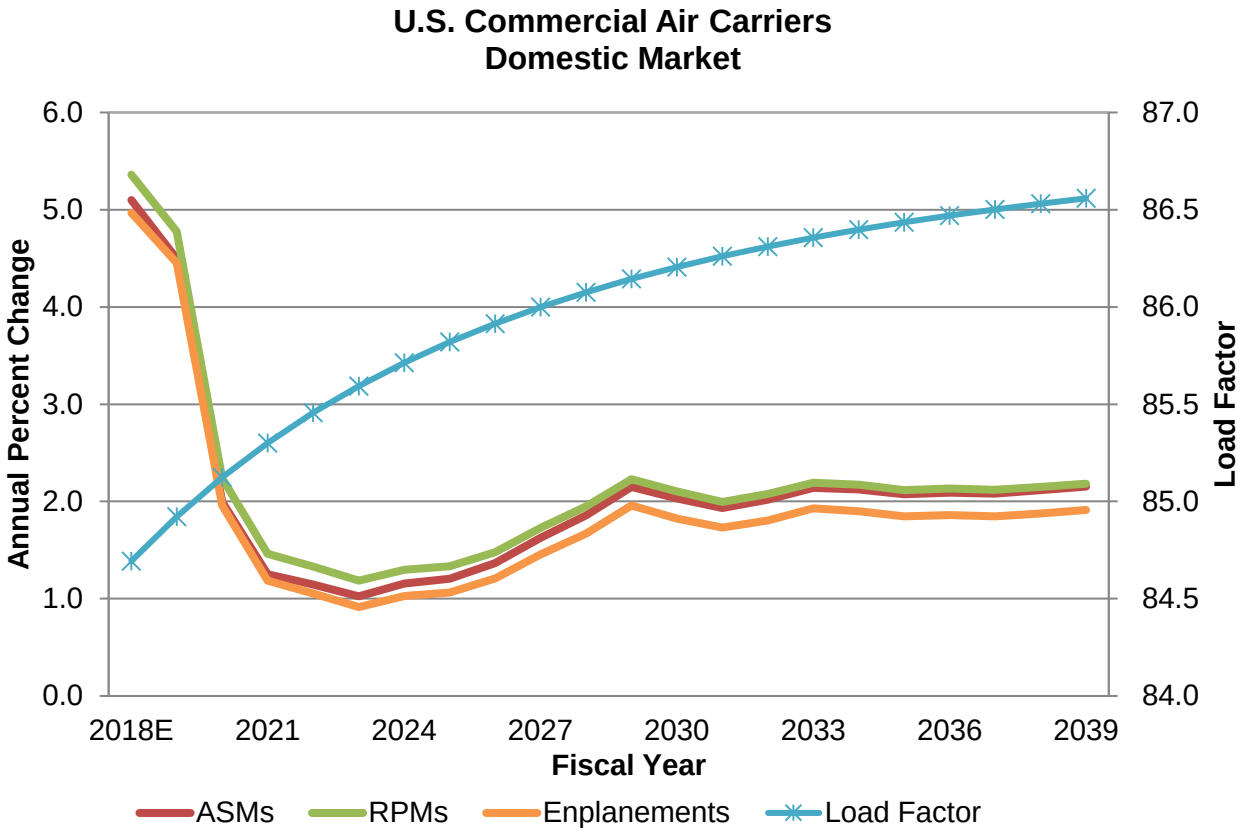
Another continuing trend is that of ancillary revenues. Carriers generate ancillary revenues by selling products and services beyond that of an airplane ticket to customers. This includes the un-bundling of services previously included in the ticket price such as

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 2016, U.S. passenger carrier profits declined in the subsequent three years on rising fuel and labor costs, and flat yields. Nevertheless, profits remain solid and supported by ancillary revenues and the implementation of increasingly sophisticated revenue management systems. These systems enable carriers to price fares optimally for each day and time of flight and minimize foregone revenue. Besides this method of price discrimination, airlines are continuing to implement plans to further segment their passengers into more discreet cost categories based on comfort amenities like seat pitch, leg room, and access to social media and power outlets. In 2015, Delta introduced "Basic Economy" fares that provided customers with a main cabin experience at lower cost, in exchange for fewer options. By the end of 2017 these fares were available in 100% of Delta's domestic network. In February 2017 American began offering its version in February 2017, and had expanded to the entire domestic network by September. United deployed its version of Basic Economy fares across its domestic network in May, but quickly pulled back the scale of deployment across its domestic network as negative revenue impacts were more than anticipated.

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. While mainline enplanements have increased almost 18 percent since 2007, and regionals' have shrunk 1.5 percent, low cost carrier enplanements have grown by 36 percent. RPMs over the same period show a similar pattern with mainline RPMs up almost 22 percent, regional RPMs up 6 percent and LCC RPMs fully 46 percent higher.

U.S. commercial air carriers' total number of domestic departures rose in 2016 for the first time since 2007 but then pulled back in 2017 and rose again in 2018 leaving them about 17 percent below the 2007 level. ASMs, RPMs and enplanements all grew in each of the past eight years; these trends underlie the expanding size of aircraft and higher load factors.[5] In 2018, the domestic load factor returned to 84.7 percent -- the historic high first reached in 2016. Load factor is forecast to rise and peak around 86.6 percent in the future due to the logistical difficulties inherent in matching supply perfectly with demand.

[5] Commercial air carriers encompass both mainline and regional carriers.



System (the sum of domestic plus international) capacity increased 4.4 percent to 1.194 trillion ASMs in 2018 while RPMs increased 4.8 percent to 1.001 trillion. During the same period system-wide enplanements increased 4.7 percent to 880.5 million. In 2018, U.S. carriers continued to prioritize the domestic over the international market in terms of allocating capacity as domestic capacity increased 5.1 percent while international capacity was up just 2.9 percent. U.S. carriers' domestic capacity growth will exceed their international capacity growth in 2019 but carriers will start expanding capacity in international markets faster than domestic markets beginning in 2020 and this trend is projected to continue through 2039 as the domestic market continues to mature.

U.S. mainline carrier enplanement growth in the combined domestic and international market was 5.0 percent in 2018 while regional carriers carried 3.3 percent more passengers.

In the domestic market, mainline enplanements increased for the eighth consecutive year, up 5.4 percent, marking the first time since 2000 that the industry recorded eight consecutive years of passenger growth in the domestic market. Mainline passengers in international markets posted the ninth year of growth, up 2.9 percent. Domestic mainline enplanement growth is forecast to remain solid, increasing at 4.6 percent in 2019 before slowing as economic activity cools and averaging 1.6 percent annually over the forecast. After slowing during the early part of the forecast, international enplanements are

expected to accelerate to an average of 3.1 percent through the forecast horizon.

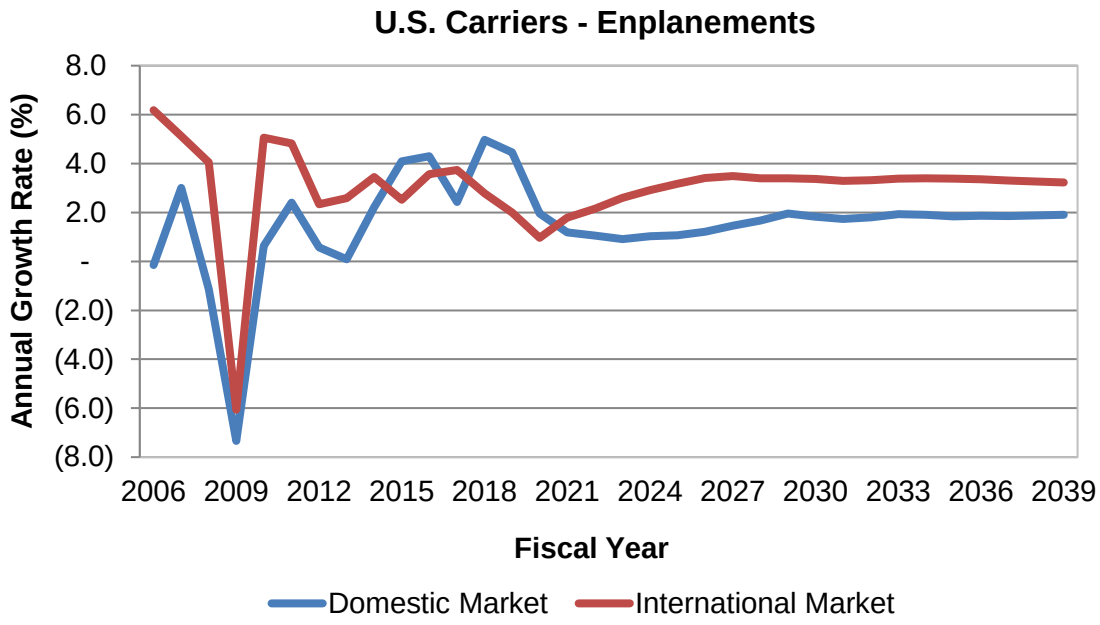
With relatively robust demand, industry capacity growth was up 4.4 percent in 2018 after a 2.9 percent increase in 2017. The increased passenger volume and traffic offset declining yields and along with higher ancillary revenues and relatively low fuel prices, U.S. carriers were solidly profitable in 2018. Domestic mainline capacity is expected to match the pattern of enplanements with solid 4.5 percent growth in 2019, followed by a few years of slower growth before returning to trend. International mainline enplanements are forecast to slow somewhat over the next two years before returning to growth of about 3.4 percent through the remainder of the forecast.

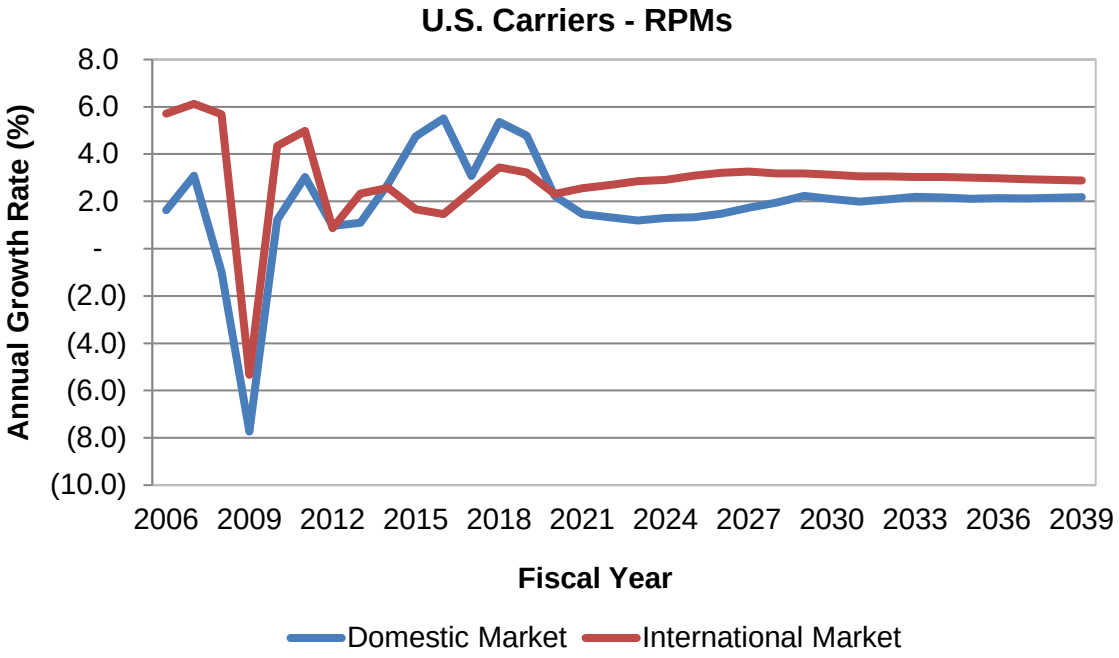
System load factor rose by four tenths of a percentage point while trip length increased 1.1 miles (0.1 percent) in 2018, even as seats per aircraft mile increased by 1.2 percent; again reflecting the trend towards using larger aircraft. Seats per aircraft mile system-wide increased to 156.2 seats (up 1.8 seats per aircraft mile), the highest level since 1990.

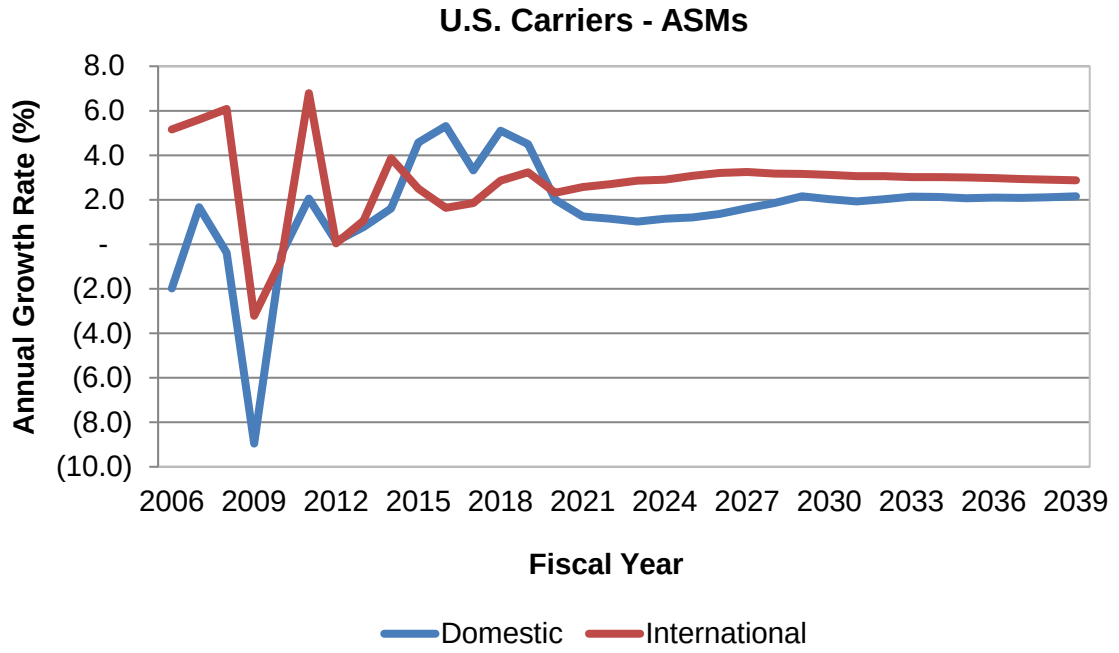
International Market

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. Domestic enplanement growth is expected to outpace that of international markets for the next few years when longer term economic trends begin to reassert themselves. Average annual growth rates (FY 2019-2039) of the international market (comprised of mainline and regional carriers) for enplanements, RPMs and ASMs are all forecast at 3.0 percent.

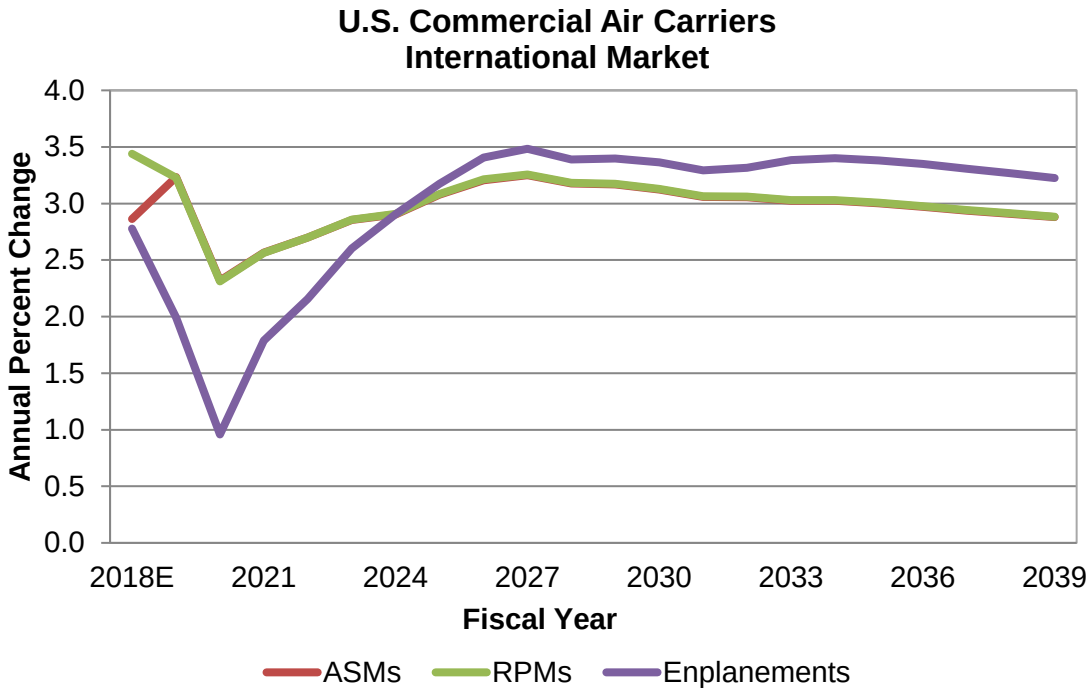
Growth of major global economies has begun to slow from the above-trend rates of recent years. Several moderating factors are at work, including dampened credit growth, reduced global trade, political stresses, and tighter U.S. monetary policy. The European and Japanese economies are generally seeing slow but positive growth, in part due to weak trade with Asia. In turn, this has been driven by China's continuing gradual slowdown which has been managed by the government and is unlikely to decline sharply. Overall, global conditions appear to be on a stable path but one with growth rates that are closer to long-term trends than the higher rates of the recent past. Combined with moderate oil prices, this presents a supportive environment for air travel demand.







The next two years will see some reduction in growth rates of international demand for the U.S. carriers with growth averaging around 1.5, 2.8, and 2.8 percent a year for enplanements, RPMs, and ASMs, respectively. Subsequently, demand picks up to average 3.0 percent throughout the forecast for each measure. Airlines will continue to match capacity growth with traffic growth and load factor is expected to stabilize around 81.5%. Load factors this high were last seen in 2014.

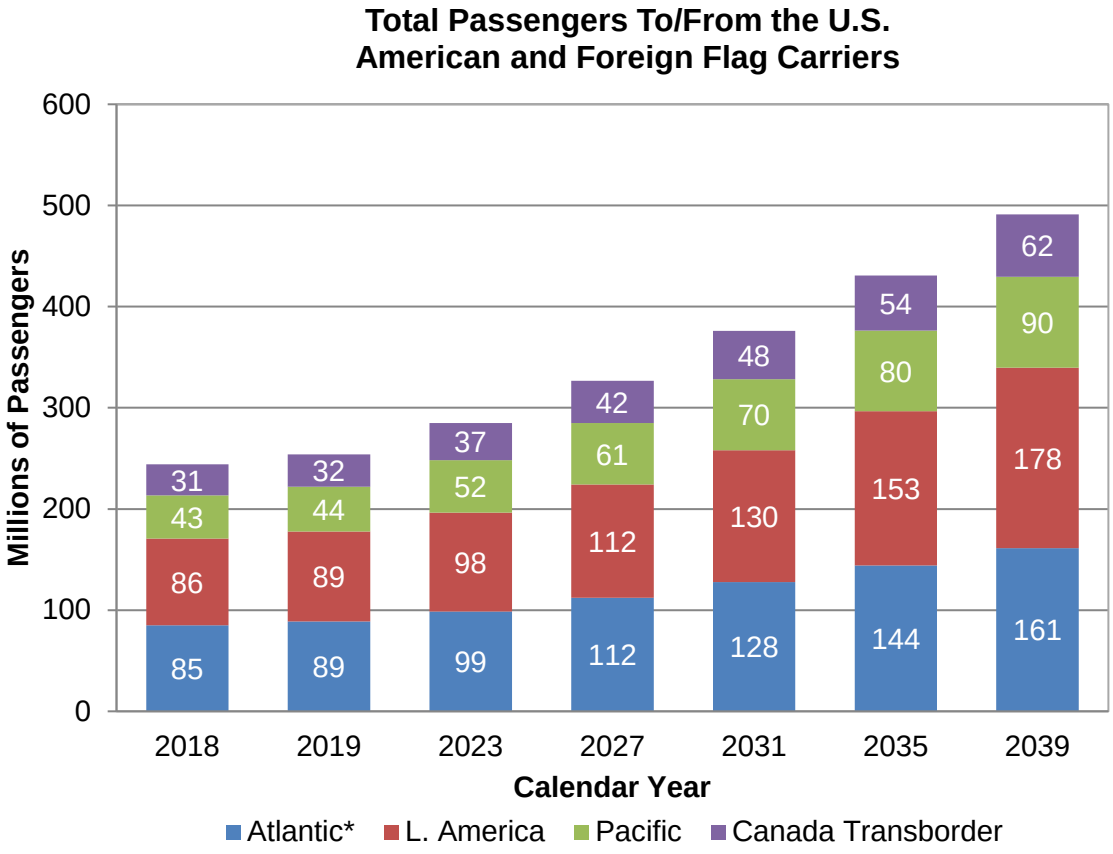


For U.S. carriers, Latin America remains the largest international destination despite the recent economic and political crises in Venezuela and Brazil. Enplanements in 2018 grew an estimated 3.9 percent while RPMs increased 4.0 percent. Growth is projected to ease considerably in 2019 and 2020 as U.S. carriers trim capacity expansion to help stabilize yields. Enplanements and RPMs are forecast to increase 1.1 and 1.6 percent, respectively, in 2019. Over the twenty-year period 2019-2039, Latin America enplanements are forecast to increase at an average rate of 3.5 percent a year while RPMs grow 3.8 percent a year.

The Pacific region is the smallest in terms of enplanements despite the economic growth and potential of air travel to China and India. In 2018, U.S. carriers saw enplanements decline 4.4 percent from their 2017 levels, mainly due to declining enplanements to and from Japan, the region's largest market. Meanwhile, traffic (RPMs) increased by just 0.4 percent. Although the region is forecast to have the highest economic growth of any region over the next 20 years, led by China and India, U.S. carrier enplanements and RPMs for the Pacific region are forecast to grow a modest 2.2 and 2.4 percent a year, respectively. Traffic growth is relatively moderate in part because U.S. carriers continue to have a majority of their service in the region to Japan as opposed to faster growing markets.

After slowing in 2015 and 2016, the Atlantic region saw a strong increase in enplanements of 4.9 percent as well as an increase in RPMs of 5.4 percent in 2018. However, the European economies are beginning to cool and with them enplanement and RPM growth will slow in coming years. Over the twenty-year period from 2019 to 2039, enplanements in the Atlantic region (including the Middle East and Africa) are forecast to grow at an average annual rate of 2.3 percent a year while RPMs grow 2.6 percent a

year. 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.



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 increased an estimated 5.3 percent in 2018 (244.2 million) as all regions posted gains led by a 7.1 percent increase in the Atlantic region.

FAA projects total international passenger growth of 3.9 percent in 2019 as global economic growth eases with the highest growth expected in the Pacific region. Moderate global economic growth averaging 2.8 percent a year over the next 20 years (2019-2039) is the foundation for the forecast growth of international passengers of 3.4 percent a year, as levels double from 244 million to 491 million.

The Latin American region is the largest international market and is projected to grow at

the fastest rate (3.5 percent a year) of any region over the forecast period. Within the region, Mexico and Dominican Republic are the two largest markets and are expected to post average annual growth rates of 3.3 percent and 4.3 percent, respectively.

Powered by economic growth and rising incomes in China, India and South Korea, total passengers in the Pacific region are forecast to more than double to 90 million by 2039. From 2019 to 2039, passengers between the United States and the Pacific region are forecast to grow 3.6 percent a year.

Both the Atlantic and Canada regions are more mature markets and are projected to have somewhat slower growth than the Latin or Pacific regions. The Atlantic region is forecast to grow at an average rate of 3.0 percent a year as an increasing share of the passengers in this region come from the Middle East and Africa markets. Though sizable and comparable to Mexico in passenger traffic, the Canadian transborder market is considerably smaller than the Atlantic region. With solid North American economic growth, Canada transborder passengers are forecast to grow at an annual average of 3.3 percent a year over the next 20 years.

Cargo

Air cargo traffic contains 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.

U.S. air carriers flew 42.8 billion revenue ton miles (RTMs) in 2018, up 9.1 percent from 2017 with domestic cargo RTMs increasing 7.7 percent to 15.8 billion while international RTMs rose 10.0 percent to 27.0 billion. Air cargo RTMs flown by all-cargo carriers comprised 78.7 percent of total RTMs in 2018, with passenger carriers flying the remainder. Total RTMs flown by the all-cargo carriers increased 9.5 percent in 2018 while total RTMs flown by passenger carriers grew by 6.7 percent.

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, and globalization.

The forecasts of Revenue Ton Miles (RTMs) 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 9.1 percent in 2018, total RTMs are expected to grow 5.8 percent in 2019. Because of steady U.S. and world economic growth, FAA projects total RTMs to increase at an average annual rate of 3.3 percent for the balance of the forecast period (from 2019 to 2039).

Following a 7.7 percent increase in 2018, domestic cargo RTMs are projected to grow 4.5 percent in 2019 as the U.S. economic recovery slows. Between 2019 and 2039, domestic cargo RTMs are forecast to increase at an average annual rate of 1.6 percent. In 2018, all-cargo carriers carried 90.0 percent of domestic cargo RTMs. The all-cargo share is forecast to grow modestly to 91.4 percent by 2039 based on increases in capacity for all-cargo carriers.

International cargo RTMs rose 10.0 percent in 2018 after posting a 9.7 percent increase in 2017. Faster economic growth in the U.S. helped to fuel a pickup in worldwide trade. Growth in international RTMs remain strong in 2019 at 6.6 percent as global trade growth continues to be robust. For the forecast period (2019-2039) international cargo RTMs are forecast to increase an average of 4.0 percent a year based on projected growth in world GDP with the Other International region having the fastest growth (5.1 percent), followed by the Pacific (4.3 percent), Atlantic (3.1 percent), and Latin America regions (0.8 percent), respectively.

The share of international cargo RTMs flown by all-cargo carriers is forecast to increase from 72.1 percent in 2018 to 78.4 percent by 2039.

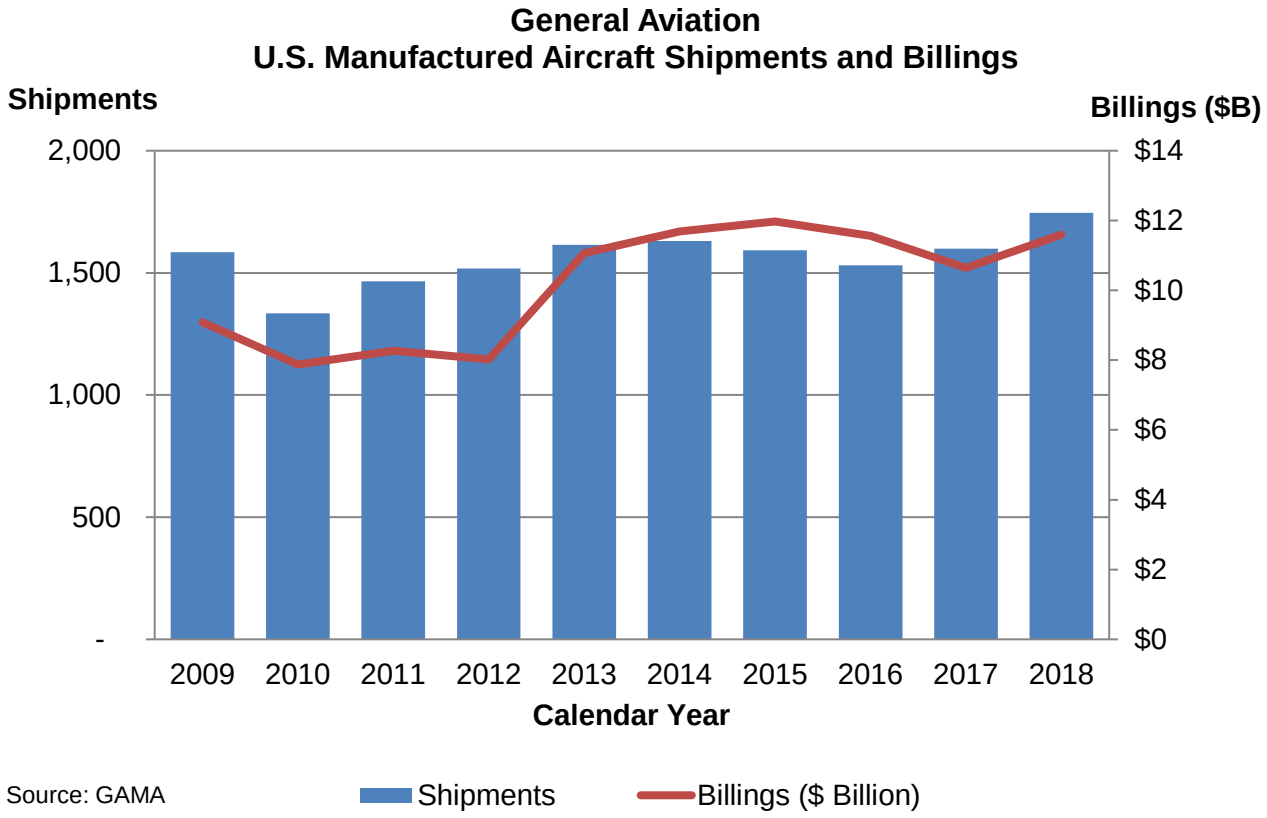
General Aviation

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. Forecasts of new aircraft deliveries, which use the data from General Aviation Manufacturers Association (GAMA), together with assumptions of retirement rates, produce 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,"[6] 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 May and January.

The results of the 2017 GA Survey, the latest available, were consistent with the results of surveys conducted since 2004 improvements to the survey methodology. The estimate of the GA active fleet was in decline between 2007 and 2013, especially between 2011 and 2013, primarily due to the impact of the 2010 Rule for Re-Registration and Renewal of Aircraft Registration, which removed cancelled, expired or revoked records from the Registry. In 2014, the GA fleet recorded its first increase since 2008, which continued till 2016, and remained stable in 2017. The active GA fleet was estimated as 211,757 aircraft in 2017 (0.0 percent change from 2016), with 25.2 million hours flown (up 1.5 percent from 2016).

In 2018, deliveries of the general aviation industry increased in both piston and turbine segments. Single engine piston deliveries of the U.S. manufactured aircraft were up 3.5 percent, while the smaller category of multi-engine piston deliveries went up by 41.5 percent. Business jet deliveries were up by 17.1 percent, and turboprop deliveries were up by 8.6 percent. Based on figures released by GAMA, U.S. manufactured general aviation aircraft deliveries were 1,746 in CY 2018, 9.2 percent more than CY 2017. They amounted to $11.6 billion in factory net billings. Overall piston deliveries were up 5.5 percent while turbine shipments were up by 12.8 percent.

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



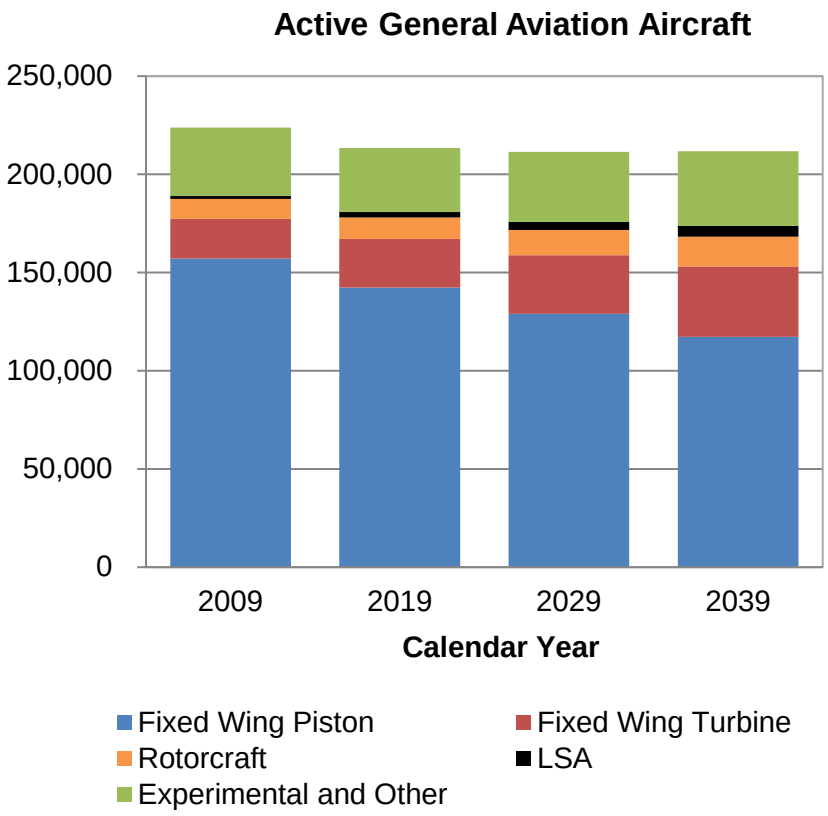
GAMA and industry experts also reported the previous slow increase in rotorcraft deliveries improved in 2018 in both piston and turbine segments.

Against these current conditions, the long-term outlook for general aviation, driven by turbine aircraft activity, remains stable. The active general aviation fleet is projected to remain around its current level, with the declines in the fixed-wing piston fleet being offset by increases in the turbine, experimental, and light sport fleets. The total active general aviation fleet changes from an estimated 212,875 in 2018 to 211,575 aircraft by 2039.

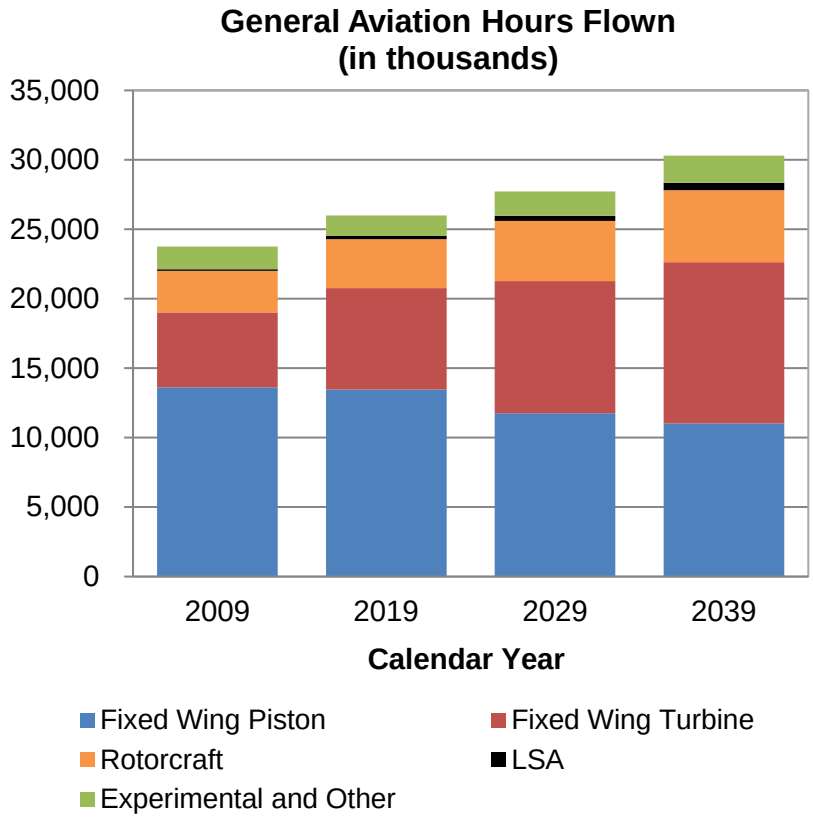
The more expensive and sophisticated turbine-powered fleet (including rotorcraft) is projected to grow by 15,255 aircraft -- an average rate of 2.0 percent a year over the forecast period, with the turbojet fleet increasing 2.2 percent a year. The growth in U.S. GDP and corporate profits are catalysts 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 25,645 aircraft (an average annual rate of -0.9 percent). Unfavorable pilot demographics, overall increasing cost of aircraft ownership, coupled with new aircraft deliveries not keeping pace with retirements of the aging fleet are the drivers of the decline.

On the other hand, the smallest category, light-sport-aircraft, (created in 2005), is forecast to grow by 3.6 percent annually, adding about 2,890 new aircraft by 2039, more than doubling its 2017 fleet size.



Although the total active general aviation fleet is projected to remain stable, the number of general aviation hours flown is forecast to increase an average of 0.8 percent per year through 2039 from 25.2 million in 2017 to 30.3 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 2.4 percent yearly over the forecast period. Jet aircraft are expected to account for most of the increase, with hours flown increasing at an average annual rate of 3.1 percent from 2017 to 2039. 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 previous economic downturn as other aircraft and rebounded earlier, faces the challenges brought by lower oil prices, a trend which has been stabilizing. 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. However, significant use in other activities such as air medical and training continues. Rotorcraft hours are projected to grow by 2.0 percent annually over the forecast period.

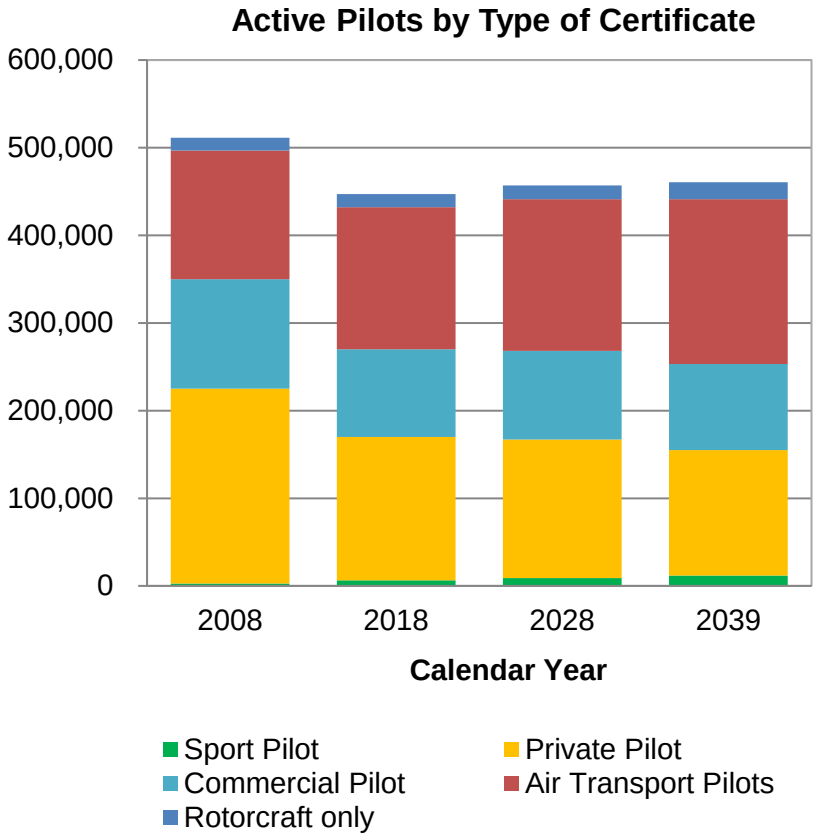
Lastly, the light sport aircraft category is forecasted to see an increase of 4.4 percent a year in hours flown, primarily driven by growth in the fleet.

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 633,317 active pilots certificated by FAA at the end of 2018. All pilot categories, with the exception of rotorcraft only and recreational only certificates, continued to increase. The FAA has currently suspended the student pilot forecast for the second year in a row. The number of student pilot certificates has been affected by two recent regulatory changes; first, the 2010 rule that increased the duration of validity for student pilot certificates for pilots under the age of 40 from 36 months to 60 months. The second one, which went into effect in April 2016 removed the expiration date on the new student pilot certificates. The number of student pilots increased from 72,280 in 2009 to 119,119 in 2010. By the end of 2016 they totaled 128,501 and with no

expiration of the new student certificates, jumped to 149,121 by the end of 2017 and 167,804 by the end of 2018. 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. Because the change is new, there is not 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. Commercial pilot numbers have been increasing for the last two years, as well as the ATP numbers.

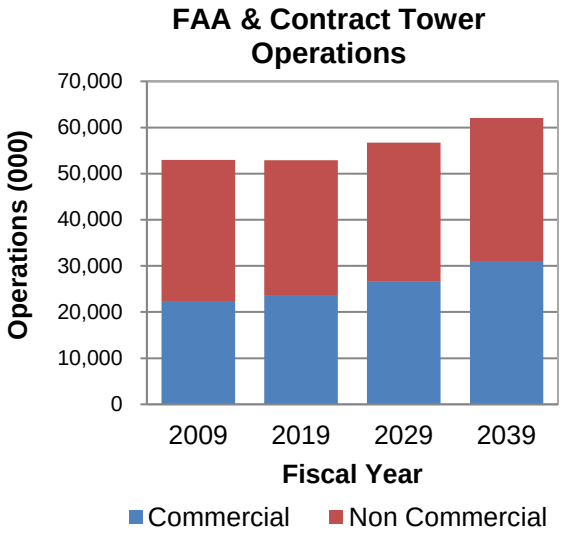
The number of active general aviation pilots (excluding students and ATPs) is projected to decrease about 13,250 (down 0.2 percent yearly) between 2018 and 2039. The ATP category is forecast to increase by 25,755 (up 0.7 percent annually). The much smaller category of sport pilots are predicted to increase by 3.0 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 0.6 and 0.1 percent, respectively until 2039.


Active Pilots by Type of Certificate
600,000
500,000
400,000
300,000
200,000
100,000
0
2008
2018
2028
2039
Calendar Year
Sport Pilot
Private Pilot
Commercial Pilot
Air Transport Pilots
Rotorcraft only

FAA Operations

The growth in air travel demand and the business aviation fleet will drive growth in operations at FAA facilities over the forecast period. Activity at FAA and Contract towers is forecast to increase at an average rate of 0.9 percent a year through 2039 from 51.8 million in 2018 to close to 62 million in 2039. Commercial operations[7] at these facilities are forecast to increase 1.5 percent a year, five times faster than non-commercial operations. The growth in commercial operations is less than the growth in U.S. airline passengers (1.5 percent versus 2.0 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 51.2 percent of operations in 2018) are forecast to increase an average of 0.4 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[8] is commercial in nature, given that these are the airports where most of the passengers, about 88 percent in 2018, in the system fly to.



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[9] and FAA contract towers[10]. The forecasted annual growth is 1.6 percent at large hubs,

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

[8] Large hub is defined to have 1 percent or more of total U.S. revenue passenger enplanements in FY 2018. There are 30 airports in this category. Medium hub is defined to have at least 0.25 percent but less than 1 percent of total U.S. revenue passenger enplanements in FY 2018. There are 31 airports classified as medium hubs.

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

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

1.3 at medium hubs, 0.5 percent at small FAA towers and FAA contract towers between 2019 and 2039.

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[11] 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 1.1 percent a year between 2018 and 2039. Commercial operations accounted for approximately 59 percent of Tracon operations in 2018 and are projected to grow 1.5 percent a year over the forecast period. General aviation activity at these facilities is projected to grow only 0.4 percent a year over the forecast.

The number of IFR aircraft handled is the measure of FAA En-Route Center activity. Growth in airline traffic and 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 1.4 percent a year. Activity at En-Route centers is forecast to grow faster than activity at towered airports because more of the activity at En-Route centers is from the faster growing commercial sector and high-end (mainly turbine) general aviation flying. Much of the general aviation activity at towered airports, which is growing more slowly, is local in nature, and does not impact the centers.

[11] 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.

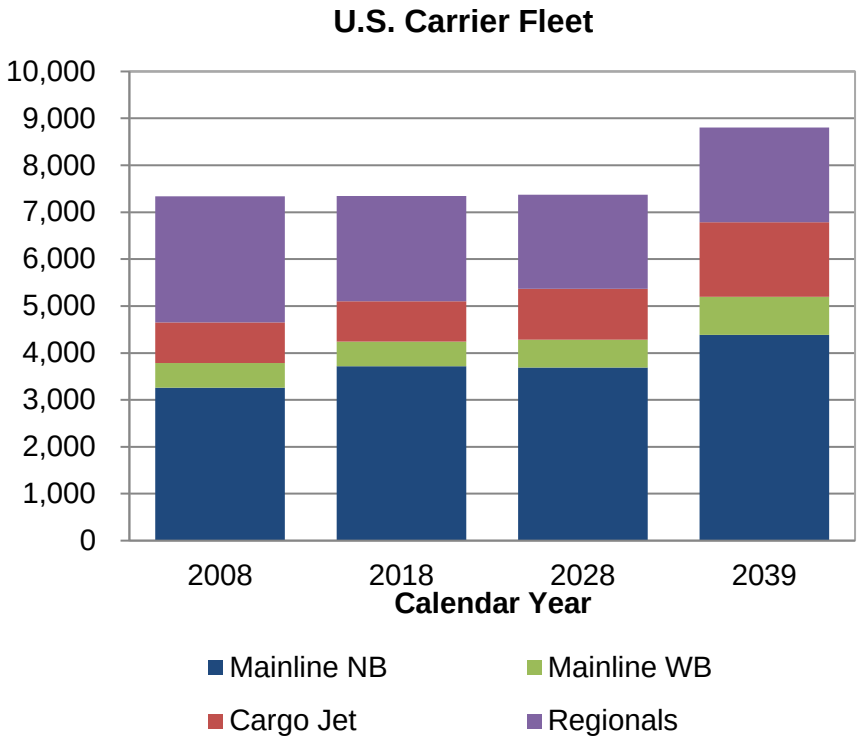
U.S. Commercial Aircraft Fleet

The number of aircraft in the U.S. commercial fleet is forecast to increase from 7,397 in 2018 to 8,806 in 2039, an average annual growth rate of 0.9 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 2018 and 2039 the number of jets in the U.S. mainline carrier fleet is forecast to grow from 4,241 to 5,197, a net average of 51 aircraft a year as carriers continue to remove older, less fuel efficient narrow body aircraft. The narrow body fleet (including E-series aircraft at JetBlue and A220-series at Delta) is projected to grow 46 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 14 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 3 percent over the forecast period.

The regional carrier fleet is forecast to decline from 2,298 aircraft in 2018 to 2,022 in 2039 as the fleet shrinks by 12.0 percent (276 aircraft) between 2018 and 2029. 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 2020. By 2031 only a handful of 50 seat regional jets remain in the fleet. By 2039, the number of jets in the regional carrier fleet totals 1,877, up from 1,795 in 2018. The turboprop/piston fleet is forecast to shrink by 71% from 503 in 2018 to 145 by 2039. These aircraft account for just 7.2 percent of the fleet in 2039, down from 21.9 percent in 2018.

The cargo carrier large jet aircraft fleet is forecast to increase from 858 aircraft in 2018 to 1,587 aircraft in 2039 driven by the growth in freight RTMs. The narrow-body cargo jet fleet is projected to increase by 7 aircraft a year as 757's and 737-800's are converted from passenger use to cargo service. The wide body cargo fleet is forecast to increase 28 aircraft a year as new 747-800, 777-200, and new 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
2008
2018
2028
2039
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. With its dual mission of regulating and also promoting the emerging commercial space transportation industry, FAA faces unique challenges.

The FAA licenses launches or reentries carried out by U.S. persons 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 operated for and by NASA or the Department of Defense). FAA does not license or grant permits for amateur-class rockets, which are unmanned rockets that have less than 200,000 pound-seconds of total impulse and cannot reach an altitude greater than 150 kilometers above the Earth's surface.

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

- Maintains an effective regulatory framework for commercial space transportation activities by developing regulations and guidance,
- 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 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 the National Airspace System (NAS) by coordinating airspace use and regulatory oversight with air traffic management and Federal launch ranges,
- Coordinates research into the safety, environmental, and operational implications of new technologies and the evolving commercial space transportation industry,
- Conducts outreach to the commercial space industry by hosting working groups and conferences,

- Collaborates with Government partners, such as NASA, Defense Advanced Research Projects Agency (DARPA), and the U.S. Air Force to assure consistent approaches to regulation, 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 field offices 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 four field offices in close proximity to: Kennedy Space Center in Florida, Johnson Space Center in Texas, and Vandenberg Air Force Base and the Mojave Air and Space Port in California. Due to industry expansion, FAA is considering additional field offices to accommodate the anticipated increase in launch and reentry operations in other parts of the United States. 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 enforcement 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 important activities performed by FAA during this cycle. The most notable activities are described here.

Pre-Application Consultation for Licenses, Experimental Permits and Safety 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. The growth in both the number of commercial space operators and the number of operations will likely increase FAA's pre-application consultation workload over the next five years. Furthermore, many new operators are seeking to incorporate new technologies, vehicle types, or operational models that create challenges for FAA in determining the applicable regulations or approach to regulatory compliance.

Licenses, Permits and Safety Approvals

An increasing number of applicants for licenses, permits, safety approvals, and renewals has a direct impact on the number of launches and reentries at some uncertain point in the future. 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, especially those systems for human space flight missions. 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 or payload determination becomes part of the licensing record on which FAA's licensing determination is based.

FAA also reviews and issues launch and reentry site operator licenses and license renewals. FAA additionally 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 approvals for space launch systems equipment, processes, technicians, training and other supporting activities. FAA reviews 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 and capabilities of space flight crews to determine how human factors affect overall public safety risk. As commercial firms become more involved with human space flight activity, FAA will evaluate, analyze, and determine the health risks to the space flight participants (crew and "passengers") due to natural and flight-induced launch and reentry environments, as well as any hazardous ground operations directly associated with the flight. FAA will also need to evaluate the safety of ground operations at spaceports and exclusive-use sites.

Inspections and Enforcement

FAA currently conducts as many as 400 preflight/ reentry, flight/ reentry, and post-flight/ reentry safety inspections per year, often conducting several inspections simultaneously, at any of the approximately 20 U.S. and international commercial space 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 at Federal ranges. At spaceports and launch sites with high launch rates (e.g., Cape Canaveral Air Force Station, Vandenberg Air Force Base, the Mid-Atlantic Regional Spaceport, and Spaceport America), at least 85 percent of the inspections must be conducted by locally-based field inspectors in order to respond to a dynamic operational tempo, minimize cost, and increase efficiency.

Mishap Investigations

Recent mishap events have demonstrated that FAA must have the capacity to investigate at least two space launch or reentry mishaps or accidents simultaneously anywhere in the world, and to lead/oversee as many as six investigations during a single year. FAA must have the capabilities and resources to

safely perform the investigations lasting as long as 16 weeks at remote sites with limited infrastructure or facilities. FAA must have the capability and resources to efficiently review all applicant mishap plans and accident investigation procedures as part of the license and permit evaluation process.

NAS Integration

The FAA works in partnership across all its organizations to ensure the safe and efficient integration of commercial space operations with aviation activities. This includes an increased presence at the Air Traffic Control System Command Center and other locations to assist in the strategic and tactical planning of launch and reentry operations, as well as to provide support during these operations. Further, FAA will continue the development of 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 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 a reliable indicator of future activity. There is a natural, inherent bias by industry to be optimistic about their business prospects. Consequently, FAA adopts a cautionary view of what industry representatives say will happen versus what may reasonably be expected to happen. A primary pillar of FAA's forecasting methodology is to err on the side of caution and take a conservative view of industry growth. 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.

Based on proprietary information available to FAA, an increase in launch and reentry activities expected in the coming years. 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:

- the list of firms intending to launch or actually launch is dynamic,

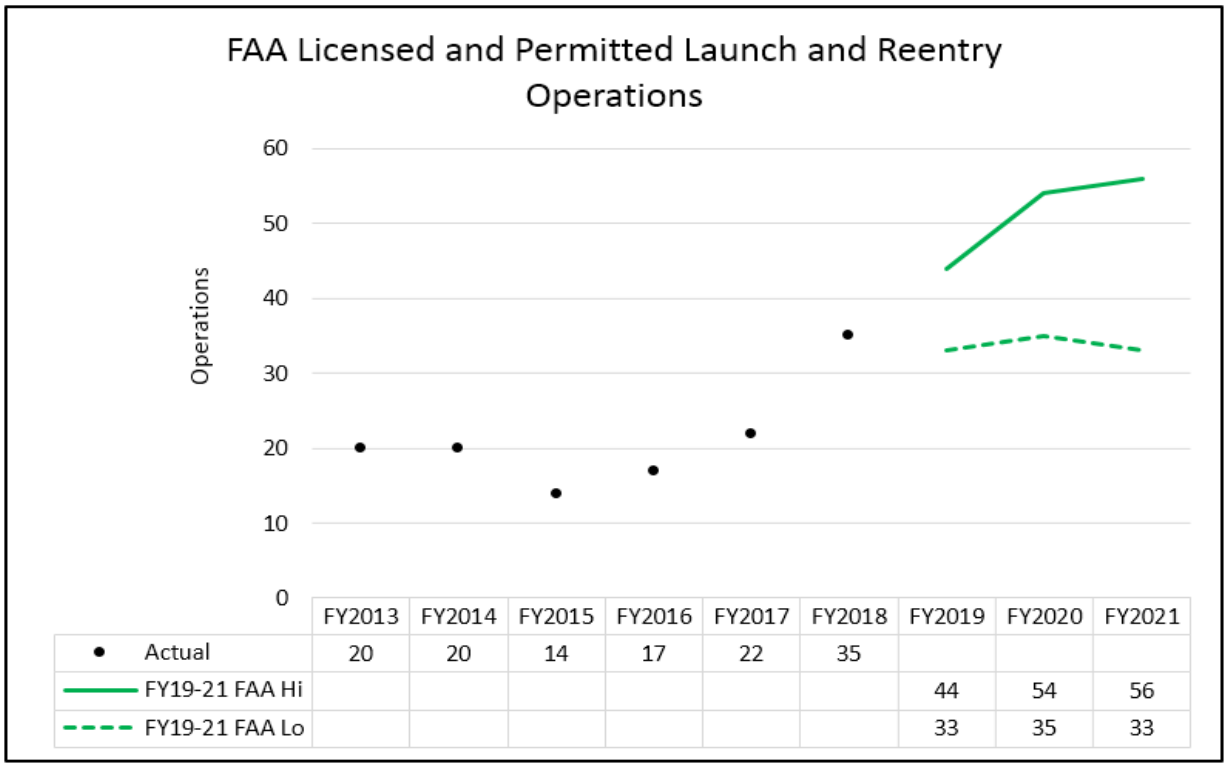
- the continued development of new technologies,
- launch rates for reusable launch vehicles,
- dynamic nature of flight test programs, and
- mishaps.

For example, the number of firms actively communicating with FAA increased from 14 in August of 2014 to 79 four years later, an increase of more than 550 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 derail launch plans for one or more firms. Investigations and subsequent "return to flight" for firms impacted by a mishap can take months to years.

Taking these factors into account, the following table and graph provide historical activity and FAA's forecast through fiscal year 2021.

Fiscal Year	*Actual/Forecast*	*FAA Licensed and Permitted Launches and Reentry Operations*
2013	*Actual*	*20*
2014	*Actual*	*20*
2015	*Actual*	*14*
2016	*Actual*	*17*
2017	*Actual*	*22*
2018	*Actual*	*35*
2019	*Forecast*	*33 – 44*
2020	*Forecast*	*35 – 54*
2021	*Forecast*	*33 – 56*

Notes:
1. *Forecast entries represent the Low to High estimate.*
2. *Six mishaps in 2015 caused the number of launch and reentry operations to fall significantly from the previous year rather than increase as expected.*



Note: Forecasts are finalized the second quarter of the fiscal year.

It is important to note that the operations included in the forecast will occur at a variety of locations throughout the National Airspace System (NAS). 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 Ocean and one licensed launch from New Zealand. Furthermore, the forecast above only accounts for launches and reentries licensed by FAA. It does not include launch activity for the rest of the world, and it 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 rockets, a development that could significantly reduce the cost of operations and lead to an increase in the number of launch and reentry operations per year. 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 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 business hubs for research and development. Since 2008, the 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). NASA is also working with commercial companies under its Commercial Crew Transportation Capabilities contract to develop vehicles that will provide transportation for astronauts and international partners to and from the ISS. Commercial Crew vehicles developed by SpaceX and Boeing are expected to commence test flights during 2019, followed by crewed operational launches licensed by the FAA. NASA is also seeking proposals from industry for a program called Commercial Lunar Payload Services. 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. In 2018, DARPA announced the DARPA Launch Challenge, which incentivizes the commercial space industry to design launch systems with the ability to launch small payloads to orbit on extremely short notice, with no prior knowledge of the payload, destination orbit or launch site, and do it not just once, but twice, in a matter of days. DARPA required launch operators to submit applications in March 2019 and expects the competition launches to occur at the end of 2019. Historically, prizes such as the Ansari X PRIZE and the Northrop Grumman Lunar Lander Challenge have caused a surge in commercial space licensing activity, so we expect the same from the DARPA Launch Challenge.

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. Extensive FAA resources will be needed to determine how these unprecedented commercial space ventures will impact public safety and U.S. national interests.

Unmanned Aircraft Systems

Over the last 5 years, unmanned aircraft systems (UAS) have been experiencing healthy growth in the United States and around the world. UAS consists of the unmanned aircraft platform and its associated elements--including communication links, sensors, software and power supply-- that are required for the safe and efficient operation in the national airspace system (NAS). While the introduction of UAS in the NAS has opened up numerous possibilities, it has also brought operational challenges including safe integration into the NAS. Despite these challenges, the UAS sector holds enormous promise. Uses may include modelers experimenting with small UAS (sUAS), performing numerous functions including aerial photography and personal recreational flying. At the same time commercial operators may be experimenting with package and medical supply delivery and providing support for search and rescue missions.

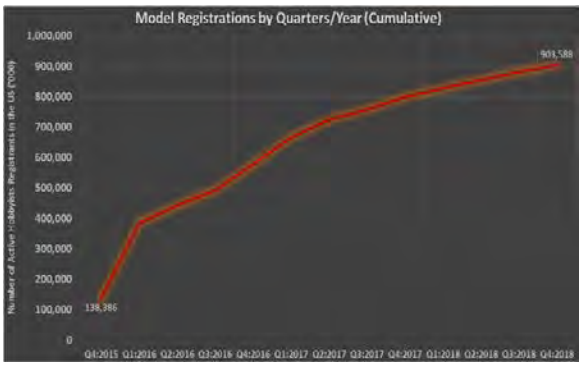
This section provides a broad landscape covering model and non-model aircraft[12] and their recent trends as gleaned from trends in registration, overall market and operational information. Using these trends and insights from industry, the FAA has produced several areas of forecasts for UAS. Forecasts reported in this section are driven primarily by the assumption of continuing evolution of the regulatory environment (i.e., unconstrained environment), the commercial ingenuity of manufacturers and operators and underlying demand, including business models. The FAA will continue to enable the thriving UAS industry, with the safe integration of UAS into the NAS.

Trends in Model Aircraft and Forecast

The FAA's online registration system went into effect on Dec. 21, 2015. This required all UAS weighing more than 0.55 pounds (250 grams) and less than 55 pounds to be registered using the on-line system (https://www.faa.gov/uas/getting_started/registration/) or by using the existing (paper-based) aircraft registry. In May, 2017, a U.S. Appeals Court Order caused a temporary halt in UAS registration. Subsequently, the registration requirement for all model aircraft owners was reinstated in December 2017 with the 2018 National Defense Authorization Act (NDAA). Despite the temporary halt, registration's pace continued beyond May, 2017. The latest FAA reauthorization codifies the requirement [see https://www.faa.gov/news/updates/?newsId=91844 for more details].

With the continuing registration, more than 900,000 owners had already registered with the FAA by Sept. 2018. Monthly owner registration averaged around 8,000-9,000 during Jan.-Dec., 2018, with some expected peaks during the holiday season and summer.

[12] These are also called, interchangeably, hobby and non-hobby UAS, respectively. In previous notes including other documents of the Agency, these terms are often interchanged.



The pace of registration in 2018 slowed considerably compared to 2016 and 2017. Monthly owner registration now stands at half of what was observed a year ago.

Model registration and thus ownership of sUAS is distributed throughout the country. Using the data as available in Sept 2018, a spatial distribution of ownership by zip code below demonstrates that sUAS continue to be distributed throughout the country with denser ownership mapping closely against the population centers of the country, as expected.

Unlike non-model counterparts, the registration rules do not require modelers to register each individual aircraft; only owners are registered. Each owner registers, and each owner might have multiple UAS. Exceptions may be registered modelers with no owned equipment. Notwithstanding these challenges, there is information available for both 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 for likely aircraft that may be used for model flying and safety implications for the UAS fleet from gradual integration into NAS. The forecasts presented use all available resources to analyze and forecast both model and non-model activities in the U.S.

With over 900,000 modelers registered as of December 31, 2018, we estimate that there are around 1.25 million drones distinctly identified as model aircraft. Comparing with industry sales and other data noted above, we conclude that model aircraft is almost 40 percent higher than ownership registration[13]. A comparison of last year's data with this year's (2018) shows that the annual growth rate to be around 13 percent. This continues to be substantial growth as anticipated from the introduction of drones as a recreation activity facilitated by falling equipment prices and improved technology, such as built-in cameras and relatively easy maneuvering.

[13] This calculation involves taking into account retirement, redundancy, and loss of craft corresponding to ownership registration. As craft becomes sturdier and operators situationally aware, we expect this rate to change dynamically over time.

However, like in all other technologies including hobby items, (e.g., cell phones and video game consoles; and prior to that, video cameras, and video players), the trend in model aircraft is likely to slow as the pace of falling prices diminishes and the early adopters begin to experience limits in their experiments or simply eagerness plateaus.

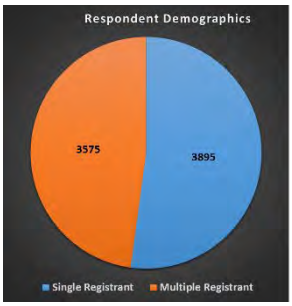
	Total Recreation/Model Fleet (Million sUAS Units)		
year	Low	Base	High
2018	1.25	1.25	1.25
2019	1.29	1.31	1.35
2020	1.31	1.35	1.44
2021	1.31	1.37	1.52
2022	1.32	1.38	1.59
2023	1.32	1.39	1.66

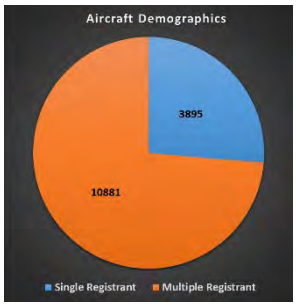
Given the trend in registration and market developments, we forecast that the model aircraft market will saturate at around 1.4 million units. However, there are still some upside uncertainties due to further changes in technology and the likely event of continuously falling prices. This yields to some upside uncertainty in the forecast. We do not anticipate similar symmetry in low side as it parallels to the growth in the base projection. Nevertheless, we provide a forecast base (i.e., likely) with high (or optimistic) and low (or pessimistic) scenarios, provided in the table above. The FAA projects, unlike in previous years, that this sector may have exhausted downside risks; i.e., decline in registration beyond saturation as captured by base forecast.

We use the trend observed in registrations, particularly over the past year, expert opinions collected in TRB annual workshops, review of available industry forecasts, market/industry research, and a time-series model on registration trends. Using these, we forecast that the model fleet will likely (i.e., base scenario) attain its peak over the next 5 years, climbing from the present 1.25 million units to around 1.39 million units by 2023. The high/optimistic scenario may be estimated at 1.66 million units over the next 5 years. As evident, the growth rates underlying these numbers are fairly steady in the initial years but are diminishing faster in the last 2-3 years. The gradual saturation that is projected in 5 years and beyond in the model aircraft fleet parallels other consumer technology products.

Survey of Non-Model Aircraft Owners

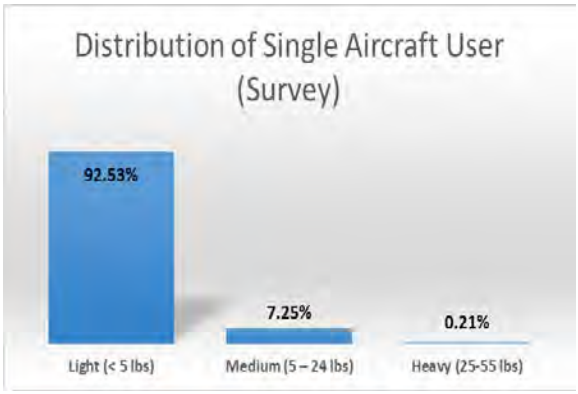
Before we describe non-model sUAS trends and forecasting in the next section, we provide a brief overview of results from a prototype survey that the FAA undertook during June-July, 2018. The results provide likely growth path in the near future. The survey, based on a well-tested questionnaire, was sent by the FAA to individuals registered by December 31, 2017 and conducting activities under Part 107 (i.e., non-model or commercial activities) in that year. The response rate to the survey was approximately 8 percent (7,400 responses from 89,000 contacted). The survey was designed primarily to get a snapshot of non-model/commercial mission characteristics including location, types of aircraft used, and altitude flown. In addition to providing the FAA key data in understanding operational characteristics of non-model activities throughout the country, these key metrics are also important for understanding trends in non-model activities and likely growth trajectory in the near future.



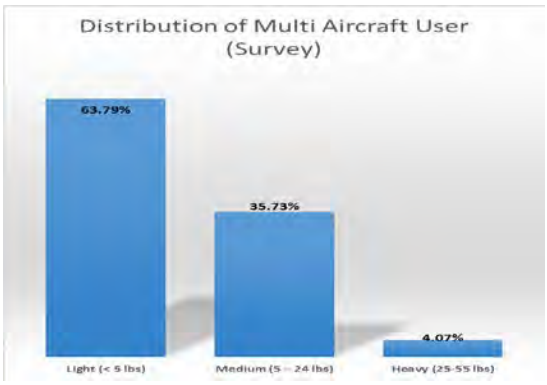


Registrants with one aircraft and those who owned/operated multiple aircraft responded almost equally as the figure above shows. The average number of aircraft among multiple registrants was around 3 with a margin of error of ± 0.2. Survey sample was representative when checked against the population from the Registry.

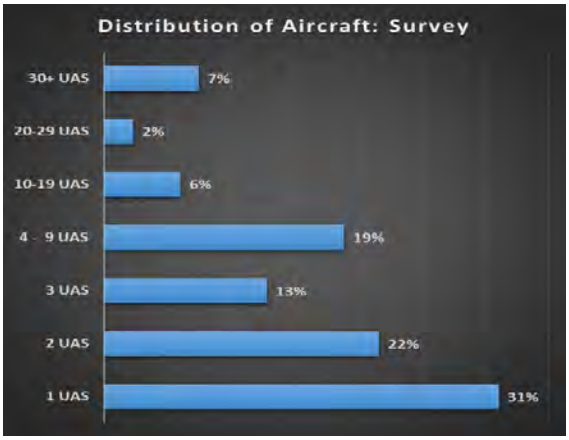
The survey reveals that most of the non-model UAS are light UAS, those weighing 5 lbs or less. This result was the same as in the Registry. The figure below shows the distribution among the responses from single sUAS users:



A similar distribution is reflected in responses from multiple aircraft owners, although the weight of the classes are skewed more towards the medium (5-24 lbs) and heavy (25-55 lbs):



Turning to distribution of ownership, we observe that almost 1 in 3 survey respondents used one sUAS compared to 55 percent from the population (i.e., the Registry). For those who operate multiple sUAS, a large group (54 percent) falls into the category of operating 2-9 sUAS, as compared to only 1 in 3 in that category from the Registry or population counts. For operators with over 10 sUAS, survey response (15 percent) were closer to what we observe in the Registry (12 percent). This distribution provides valuable information regarding the use intensity of sUAS by both single and multiple owners.



Bigger variations are observed between single and multiple sUAS when asked about in-

tensity of operations as captured by the number of missions[14] in 2017. It is apparent from the table below, the more one operates (i.e., multiple owners) sUAS, the more missions they fly during the year; i.e., over twice as many as the single operator. On average, while a single operator flies 32 missions/year, multiple owner/operators flew more than twice that number (82 missions, on average):

		# of Respondents	# of Aircraft	Total Missions	Average Missions per Aircraft
Single Registrant	1 UAS	2,575	2,575	81,827	32
	Total	2,575	2,575	81,827	32
Multiple Registrant	1 UAS	496	496	18,304	37
	2 UAS	1,148	2,296	128,312	56
	3 UAS	458	1,374	101,622	74
	4 - 9 UAS	391	1,961	237,843	121
	10-19 UAS	34	425	52,817	124
	20-29 UAS	9	207	16,183	78
	30+ UAS	9	510	41,336	81
	Total	2,545	7,269	596,417	82
Grand Total		**5,120**	**9,844**	**678,244**	**69**

Trends in Non-Model Aircraft and Forecast

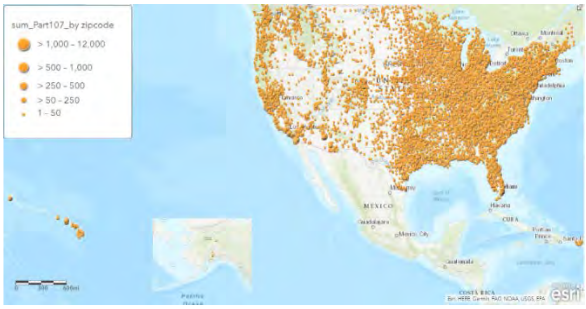
Unlike model ownership, rules for non-model registration require owners to register each sUAS, thus giving a one-to-one correspondence between registration and aircraft. For the calendar year 2018, more than 175,000 non-model owners/operators registered their equipment. The pace of monthly registration, almost 15,000, is nearly 3-times higher than the pace at which non-model aircraft owners registered their craft during the same time last year. While the pace of model registration ownership has slowed down considerably, interestingly, the pace of registration is accelerating for non-model counterparts. By the end of 2018, there were more than 277,000 non-model aircraft registered since registration opened.

Since the registration process has been available through Dec 2017, over 4,600 aircraft per month have been registered. This pace accelerated to 14,600 registrations a month during the last year (2018). The non-model sector is primarily commercial in nature. It is dynamic and appears to be at an inflexion point of demonstrating powerful stages of growth. Unlike the model sector, we anticipate that the growth rate in this sector will continue to accelerate over the next few years. Since initiation of Part 107, there has been proposed rule changes (see https://www.federalregister.gov/documents/2019/02/13/2019-00732/operation-of-small-unmanned-aircraft-systems-over-people. The requirements would address operations over people, operations at night without waivers and possibilities for waivers including enhancement of operational efficiencies. They would also address more commercial uses that will likely facilitate further growth. Notably, a single point for submission of all operational information, including

[14] Missions were described as a job or economic activity consisting of many take-offs/landings.

registration, authorization, and accident logging, helps facilitate this growth further [https://faadronezone.faa.gov/#/].

As in the case of model UAS ownership, non-model sUAS are distributed across the country. A spatial distribution of equipment registration (using data for September 2018) demonstrates that non-model sUAS are distributed throughout the country with denser activities mapping closely against the economic or commercial activities of the country.



Last year, we forecasted that the non-model sector would have around 229,400 sUAS in 2019, a growth rate exceeding 44 percent from the year before (2018). Actual data far exceeds that trend with over 277,000 aircraft already registered by the end of 2018. Our forecast of non-model sUAS last year thus fell short by almost 80 percent for 2018 (or 277,000 actual aircraft vs 158,900 that we projected last year). The significant growth in this sector over the past year demonstrates the uncertainty and potential of the market.

Given the trend observed in the registrations, information from the survey, review of available industry forecasts, and internal research, together with market/industry research, we project that the non-model fleet by 2023 will likely (i.e., base scenario) be three times larger than the current number of non-model aircraft[15]. As the present base (i.e. cumulative total) gets larger, we anticipate the growth rate of the sector will slow down over time. Nevertheless, the sector will be much larger than what we understood as recently as last year. Given the accelerated registration over the last year, we now project the non-model sUAS sector will have over 835,000 aircraft in 2023 (i.e., end of 5-year period). Important to note here is that last year's forecasted sUAS for 2022 (452,000 units) will be surpassed sometime towards the later part of 2019 or early 2020 if the present registration trend continues. This will shorten the forecast outcome period by almost 2-3 years.

In order to understand the growth trajectory of the sector better, we divide the non-model sector into two types of UAS aircraft: consumer grade and professional grade. The consumer grade non-model aircraft are priced in a wide range, somewhere below US

[15] Last year, this ratio (from base year of forecast to end-year of forecast) was 4-times; i.e., we projected forecast to be 4-times the base year's (2017) numbers in 5-year.

$10,000 with an average unit price of around $2,500. The professional grade is typically priced above US $10,000, with an average unit price assumed to be around $25,000[16]. For both consumer grade and professional grade aircraft, the average price has been falling over time, particularly over the last three years. Currently, the consumer grade dominates the non-model sector with a market share approaching 95 percent. However, as the sector matures and the industry begins to consolidate, the share of consumer grade non-model aircraft is likely to decline but will still be dominant. By 2023, FAA projects this sub-sector will have around 85 percent share of the overall non-model sUAS sector.

Starting from a low base of around 13,000 aircraft in 2018, professional grade non-model sUAS sub-sector stands to expand rapidly over time, especially as newer and more sophisticated uses are identified, designed, and operationally planned and flown. If, for example, professional grade sUAS meets feasibility criteria of operations, safety, regulations, and satisfies economics and business principles and enters into the logistics chain via delivering small packages, the growth in this sector will likely be phenomenal. This growth trajectory may even be further enhanced by, for example, the Low Altitude Authorization and Notification Capability (LAANC) system[17], which began authorization in May, 2018. LAANC is designed to allow considerable flexibility in sUAS operations and facilitate non-modelers' use of the NAS. While most of the near-term growth in non-model sUAS will continue to come from consumer grade (over 90 percent), we anticipate a significant part will come from professional grade non-model sUAS as well.

As non-model aircraft become operationally more efficient and safe, battery life expands and integration continues, 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, etc.) that are somewhat latent and at the experiment stage, 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, an attempt has been made to capture the low-range to the projected demand. Hence, we provide the likely or base scenario together with the enormous potential embodied in the

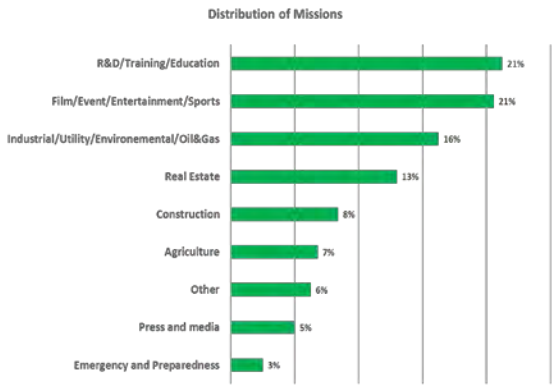
[16] Because of this wide range in prices between types of sUAS in commercial activities, start-up cost for a business may vary somewhere between $2,500 and $25,000.

[17] 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, 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.

"high" scenario, representing cumulative annual growth rates of 25 percent and 36 percent, respectively. In the event of unforeseen slowdown or obstacles, "low" scenario projects a cumulative growth rate of around 17 percent annually.

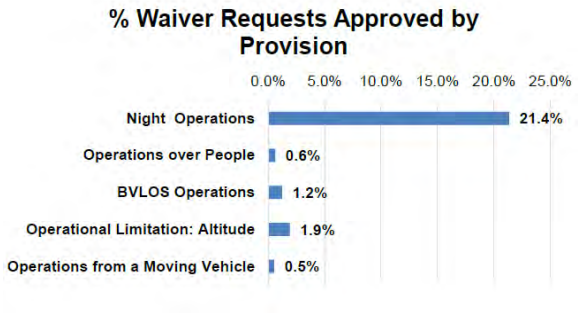
	Total non-Model Fleet (no. of '000 units)		
year	Low	Base	High
2018	277	277	277
2019	369	400	426
2020	460	545	638
2021	552	711	932
2022	588	789	1,112
2023	603	835	1,290

Non-model sUAS are presently used for numerous purposes. The survey of non-model sUAS aircraft owners reveals their present uses as follows:



Non-model sUAS are used extensively in carrying out research and development (R&D), and in training-education missions (21 percent), followed by filming events including weddings, entertainment and sports (21 percent), industrial/utility and in environmental projects such as aerial inspection (16 percent) followed by real estate (13 percent) and in construction activities (8 percent). Agriculture (7 percent) including crop inspection; and press and media (5 percent) come next. Increasingly, state and local governments are using sUAS for emergency services including search-and-rescue operations and presently employ around 3 percent of all non-model sUAS. As the sector grows, we anticipate there will be many more uses of non-model sUAS as they are increasingly evident from the participants' activities, for example, under the Integration Pilot Program (IPP). In May, 2018 the FAA awarded 10 communities, among a pool of 149 applications, [https://www.faa.gov/uas/programs_partnerships/uas_integration_pilot_program/awardees/] to participate in the IPP. IPP applications and preliminary data indicate that awardees overwhelmingly plan to undertake numerous commercial and public interest activities.

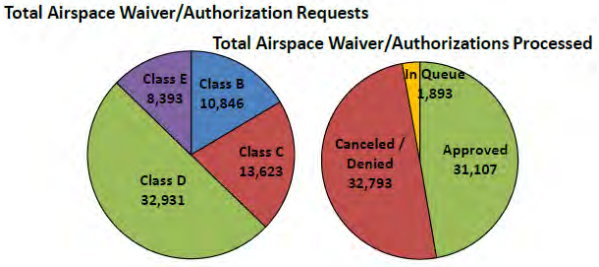
One way of identifying early trends of non-model sUAS uses is to analyze the waiver applications granted to non-model sUAS operators. Both the magnitude and relative composition of waiver types may indicate the direction of the non-model sUAS sector as a whole. A breakdown of the waiver requests granted in December 2018 is shown in the chart below:



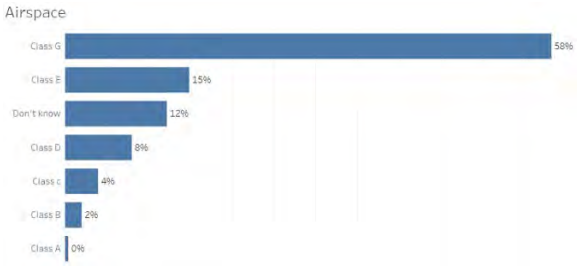
Beyond what is presently allowed under existing Part 107, expanding non-model applications further would require waivers, to a large extent, for night operations, (1 in 5 waivers) and operating limitations of altitude (1.9 percent). Many of these waivers are combined, and hence, total waivers granted

(over 2100 in December 2018) exceed 100 percent. The Agency issues these waivers to facilitate commercial activities by non-model sUAS while preparing for the next round of regulations. New regulations seek to amend the present waiver requirements. (See https://www.federalregister.gov/documents/2019/02/13/2019-00732/operation-of-small-unmanned-aircraft-systems-over-people for current notice of proposed rulemaking (NPRM) on operations of small unmanned aircraft over people in certain conditions and operations of small UAS at night without obtaining a waiver). Analysis of these waiver applications allows us to understand the industry trends, one of many metrics essential for understanding and projecting both the trajectory, course corrections, and growth trends of the sector.

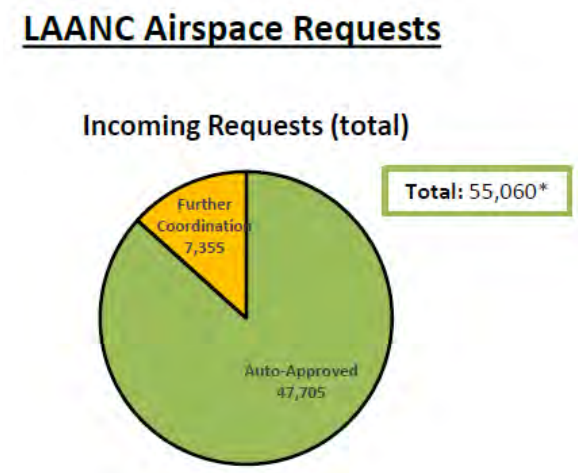
Almost 50 percent of airspace authorizations and waivers were approved for the controlled airspaces at the end of December, 2018. While over half of them were for class D airspace (i.e., smaller airports with control towers), other classes were also requested and regularly flown.



Survey responses show that while most of the respondents routinely fly in Class G airspace (almost 60 percent), there are quite a few users, who fly within controlled airspace facilitated by the airspace waivers.



Finally, LAANC continues to routinely provide auto-approval. It has provided, so far, over 47,000 auto-approvals for airspace access requests, while sending over 7,000 for further coordination. LAANC authorizations are facilitated by combining 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 UASFMs are used to inform requests for Part 107 airspace authorizations and waivers in controlled airspace.

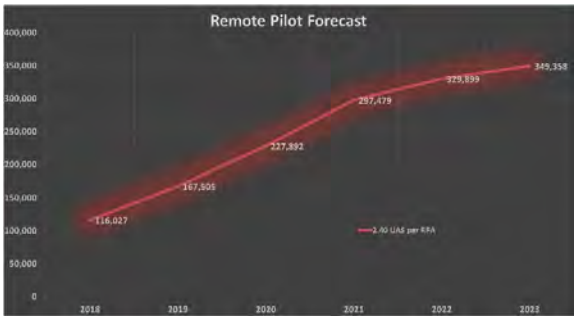


Remote Pilot Forecast

An important final metric in non-model sUAS is the trend in remote pilot (RP) certifications. RPs primarily facilitate non-model sUAS

flights for commercial activities. As of December 2018, more than 116,000 RP certifications have been issued[18]. Over 90 percent of those who took the exam passed and obtained RP certification. The RP forecasts presented below are based on using two data sources: (a) trends in total RPs; and (b) trends in non-model sUAS registration and forecasts of fleet. Given the trends in registration and our forecast of non-model fleet, we assume that one pilot is likely to handle 2.4 units of non-model sUAS.

Using these assumptions and combined with the base scenario of non-model sUAS forecast, we project RPs in the graph below. Last year, we projected RPs to be around 106,000 by the end of 2018; which fell short by 10,000 by the end of 2018. However, the registration of non-model sUAS far exceeded, as noted earlier, what we projected last year.



Given these, we made the adjustment to RPs per non-model aircraft, thus increasing it by one more unit than last year. Despite this adjustment, RPs are set to experience tremendous growth following the growth trends of the non-model sUAS sector. Starting from the base of 116,027 RPs in 2018, non-model activities may require almost 350,000 RPs in 5 years, a three-fold increase, providing tremendous opportunities for growth in employment associated with commercial activities of UAS. Potential for RPs may enhance even more if larger UAS are used in commercial activities and urban air mobility becomes a reality in the near future.

Urban Air Mobility

In Sept 2017, NASA launched a market study for a segment crossing over some functions of UAS discussed above. This segment of autonomous vehicles broadly called Urban Air Mobility (UAM) is defined as "a safe and efficient system for air passenger and cargo transportation within an urban area, inclusive of small package delivery and other urban unmanned aircraft systems (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). Studies sponsored by NASA were undertaken by two consulting firms and are presently under review from expertise within the government and academia. Executive summaries of the two reports suggest (https://www.nasa.gov/uamgc), broadly speaking, the following: (a) UAS may play a significant role in transforming short-haul urban air transportation, e.g., airport shuttle, air taxi, air ambulance, last-mile parcel delivery, etc.; (b) substantial financial and business opportunities exist, but there are significant technological, operational, and regulatory challenges including issues involving public

[18] In our accounting of RPs, we take pilots who passed the initial knowledge test plus current manned pilots who took online training in lieu of the knowledge tests.

perceptions and acceptance; and (c) gradual integration of sUAS into the overall system may facilitate integration of UAM by around 2030.

In order to understand and address the challenges identified by the studies, the new Grand Challenge (GC) has been initiated, under which NASA will host UAM ecosystem-wide challenges in 2020. Under GC, participants will be required to execute system level safety and integration within operationally robust and relevant environments. The goal of the first GC (GC-1), from a series of GCs, will be to "promote public confidence in UAM safety and facilitate community-wide learning while capturing the public's imagination" (see https://www.nasa.gov/uamgc for more details).

As the sector grows and new initiatives are taken, the Agency is keeping a keen eye on understanding the overall trends.

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 short-term, by a number of factors including the strength of the U.S. and global economies. 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 worldwide 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.

Although oil prices remained below $65 per barrel for most of 2018, the 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 February 2019 U.S. macro forecast and 30-Year Focus released during the fourth quarter of 2018) calls for oil prices to decrease to $59 per barrel in 2021 and rise gradually thereafter. By 2031 oil prices are projected to be $85 per barrel and approach $100 per barrel by the end of the forecast period in 2039. Some forecasters are calling for a more gradual rebound in the price of oil. In October 2018, the World Bank released its latest commodity price forecast. The forecast calls for oil prices to rise to $74 per barrel in 2019, but then decline to $69 in 2020. After 2020 prices rise slowly 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 2019, sees oil prices rising approximately 3.5% per year between 2018 and 2050. By 2040, the spot price of oil ranges between $166 per barrel (West Texas Intermediate) to $174 per barrel (Brent), considerably above the FAA base forecast of $98. 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 the December 2017 U.S. tax cuts and some additional infrastructure spending in 2019 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 be 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 global economic growth will slow in 2019-2021 from its 2018 rate, as weakness in Europe and a slowdown in China constrains global growth.

Thereafter, the baseline forecast assumes that China and India will be growth engines for emerging economies as China successfully transitions the economy from reliance on heavy 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 appears to be slowing from 2018's level as the effects of the tax cuts on demand begin to wane, and at the same time there remains concerns about the strength of demand in Japan and in the European Union as these areas continue to be constrained by structural economic problems (high debt, slow population growth, weak public finances for example) and the outcome of political elections. Furthermore, the actions taken to stabilize the global economy during the Great Recession continue to hamper economic policy makers. In some of the major advanced economies, concerns have been expressed by some political leaders that central banks have raised interest rates too quickly and have hampered the recovery. Additionally, governments in these economies need to shore up their finances and recent actions have many analysts concerned that policy makers will not take the steps needed. 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 assume strong passenger growth for travel between the United States and other world regions. Further slowing of worldwide economic activity could seriously inhibit the growth in global passenger demand.

The outlook for further consolidation via mergers and acquisitions (M&A) appears to be rather limited. Based on FY 2018 data, the top 6 (American, Delta, United, Southwest) plus Alaska/Virgin and JetBlue accounted for more than 85% of the U.S. airline industry capacity and traffic. For many low cost carriers, the sheer size of merger transactions or the amount of risk associated with a merger makes further merger activity unlikely. For the network carriers, it is unclear how regulatory authorities will respond to any future proposed mergers.

The forecast assumes the addition of sizable numbers of large regional jets (70 to 90 seats) into the fleet of regional carriers. However, network carrier consolidation and new rules on pilot training have left regional carriers saddled with either excess capacity or a lack of pilots. Although air travel demand continues to recover, the bankruptcy filing of Republic Airlines in February 2016 is a reminder that financial pressures on regional operators have not abated. Network carriers continue to adjust the size and breadth of their networks. In many cases there are not opportunities for regional carriers to backfill the loss of the mainline service. Delta is well along in its plans to reduce its small (read 50 seat) regional jet fleet and brought its total to just 119 at the end of 2018, down from almost 500 at the end of 2009. United has reduced the number of small regional jets flown by its partners from an estimated 380 in 2012 to 304 by the end of 2018. However, it plans to add 9 more small regional jets to its fleet in 2019 as part of its latest expansion plan. Meanwhile American has trimmed its small regional jet fleet by 93 aircraft since the beginning of 2015 from 297 to 204 aircraft and has plans to retire an additional 19 aircraft in 2019, and a further 12 in 2020. At the same time the carrier plans to add 31 larger regional jets to its fleet in 2019, and 13 more in 2020. While these actions may provide

some opportunities for well positioned regional carriers, the overall impact of consolidation so far has been to reduce opportunities for regional flying substantially.

After suffering through a significant downturn in 2009, partial recovery of business and corporate aviation continues. The future pace of the recovery 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. On the other hand, the close relationships between corporate profits and purchase of business jets have been weakened since 2009. Increases of the past few years in real corporate profits have not translated into demand for new business aircraft yet, possibly because of perceived economic and political uncertainties. With the U.S. administration's emphasis on policies designed to stimulate economic growth and limit regulation, and the favorable terms of the new tax law, companies are feeling more optimistic about their future prospects that can translate into additional business jet sales. The impact of fuel price movements on business aircraft demand is also uncertain. Overall, the positive effect of declining fuel prices on corporate profits transforms to increased demand for business aircraft. However, business aircraft demand from energy related industries will be negatively impacted if fuel prices remain low (by historic standards) for an extended period in the future.

Other factors, such as new and more efficient product offerings like supersonic business jets serve to broaden the potential of the industry and can make corporate jet travel look increasingly appealing.

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 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.

While overall activity at FAA and contract towers increased 2.9 percent in 2018, activity at large and medium hub airports (60 in total) increased 2.3 percent in 2018 and delays remained at historically high levels at many U.S. airports. FAA forecasts operations at these airports to grow substantially faster than the overall national trend. As demand continues to grow and workload increases, 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.

Increasing concerns about aviation 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. Community concerns 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. The environmental noise and emissions issues associated with overflight operations also present global challenges. In addition to providing economic benefits, technologies to improve aircraft fuel efficiency and reduce fuel consumption provide benefits in terms of reduced emissions; many technologies that improve fuel efficiency also provide reduced noise. 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. Continued advancements in technologies that result in improved fuel efficiency, reduced fuel consumption, noise reduction and reduced emissions are also 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 10-year optimistic and pessimistic forecasts from their February 2019 Baseline U.S. Economic Outlook were combined with the optimistic and pessimistic forecasts from their Fall 2018 30-year U.S. Macro forecast. Inputs from these alternative scenarios were used to create a "high" and "low" traffic, capacity, and yield forecast.

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 a high and low case.

Scenario Assumptions

The FAA's domestic baseline forecast assumes that economic growth remains close to trend over the next few years as both consumer and business spending provide support. Recent tax cuts result in some near-term stimulus but in the medium term, headwinds result from slower federal government spending. 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 forecast sees stronger overall growth driven mainly by an increase in productivity in a low inflation environment. This results in stronger real wage growth and an improved employment outlook, leading to increased consumer spending. Confidence is high and the stock market sees strong gains while the unemployment rate remains slightly lower than in the baseline scenario. Stronger imports accompany the increased domestic demand but exports rise faster with improving foreign economic conditions.

In this scenario, real personal consumption expenditure (PCE) per capita growth averages 0.5 percentage points faster per year

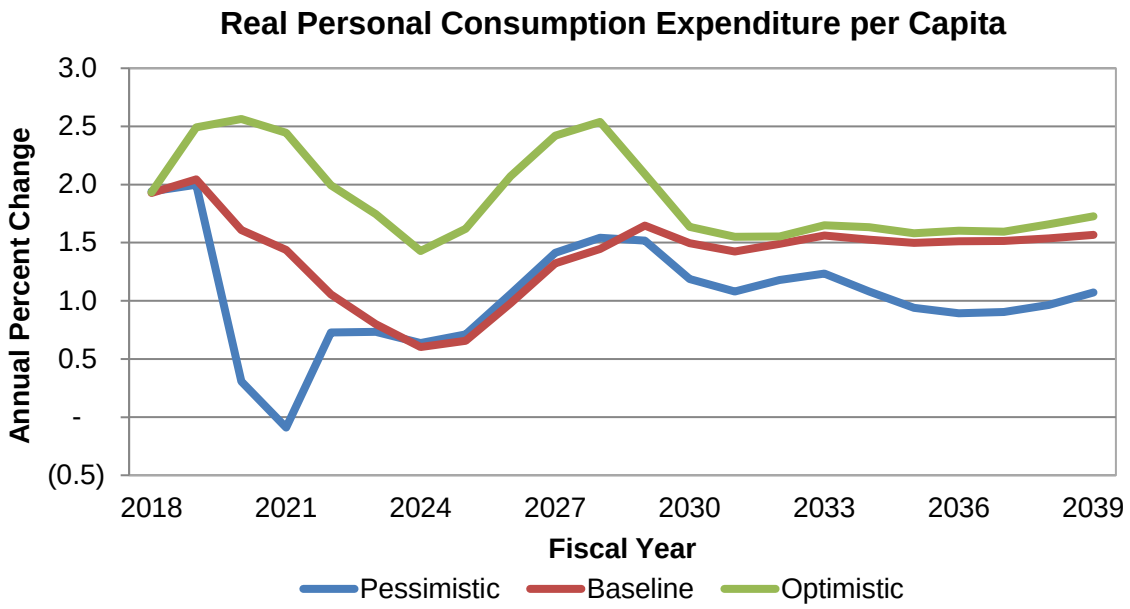
than the baseline forecast and unemployment averages 0.3 points lower on a fiscal year basis than the baseline.[19]

Conversely, FAA's low case forecast uses IHS Markit's pessimistic scenario. In this forecast, a broad loss in confidence and growing aversion to risk leads to drops in a wide range of investment and consumer spending categories to end the expansion in the U.S. The economy suffers a three-quarter recession in 2020 and GDP growth averages 0.2 percentage points lower than in the baseline over the first ten years of the forecast.

Rising housing prices have left the real-estate market vulnerable, and a slowdown turns into a decline, as real-estate prices correct and confidence plunges. Then, a growing sense of unease marked by declines in consumer confidence and an inverted yield curve stresses financial markets, resulting in sharp declines in asset values and broad-based declines in business fixed investment. Negative wealth effects and employment declines lead households to sharply curtail their spending early in 2020. By the end of 2020, housing and consumer spending start to turn back up, but recover only tepidly, while business fixed investment turns up more strongly and leads the recovery. Oil prices rise faster than the baseline throughout the forecast.

Real PCE per capita in this scenario grows 0.4 percentage points slower per year than in the baseline; and unemployment, on average, is 0.6 points higher on an annual basis than in the baseline.

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



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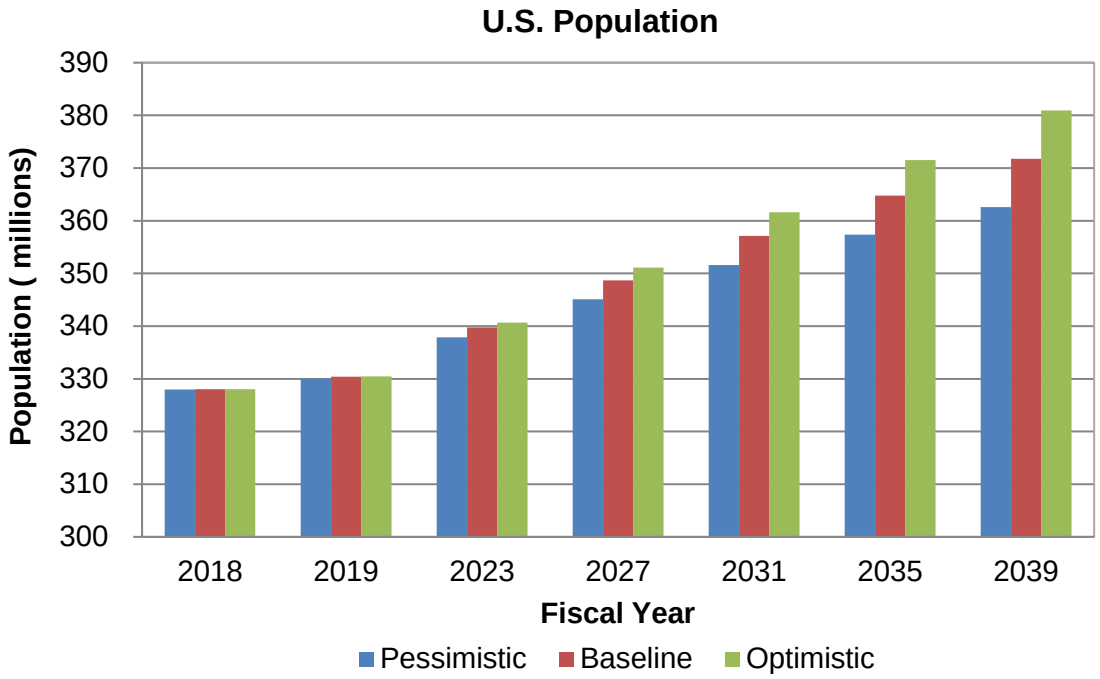

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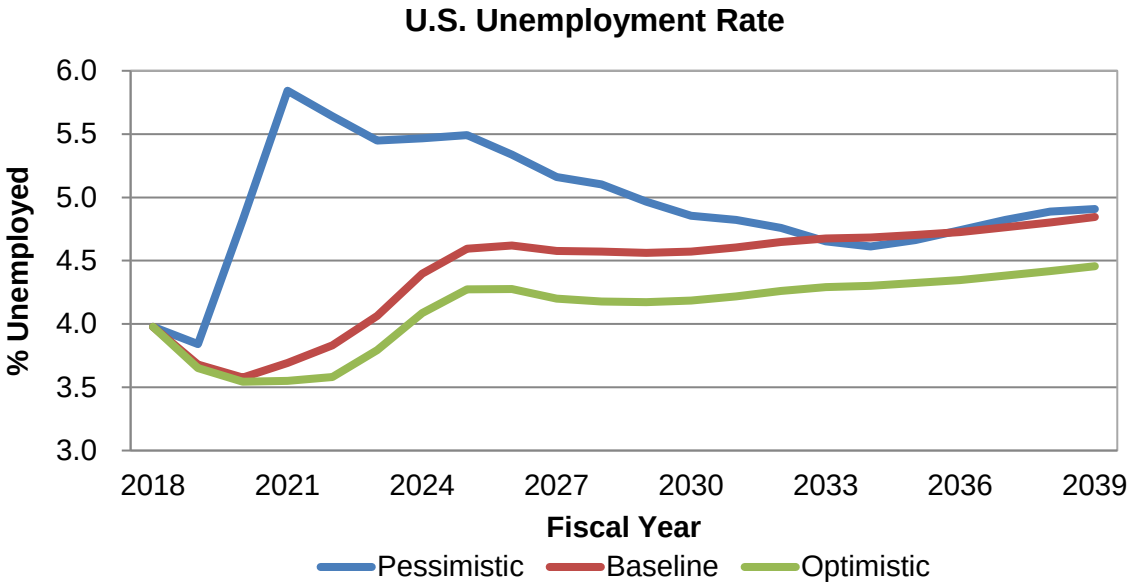

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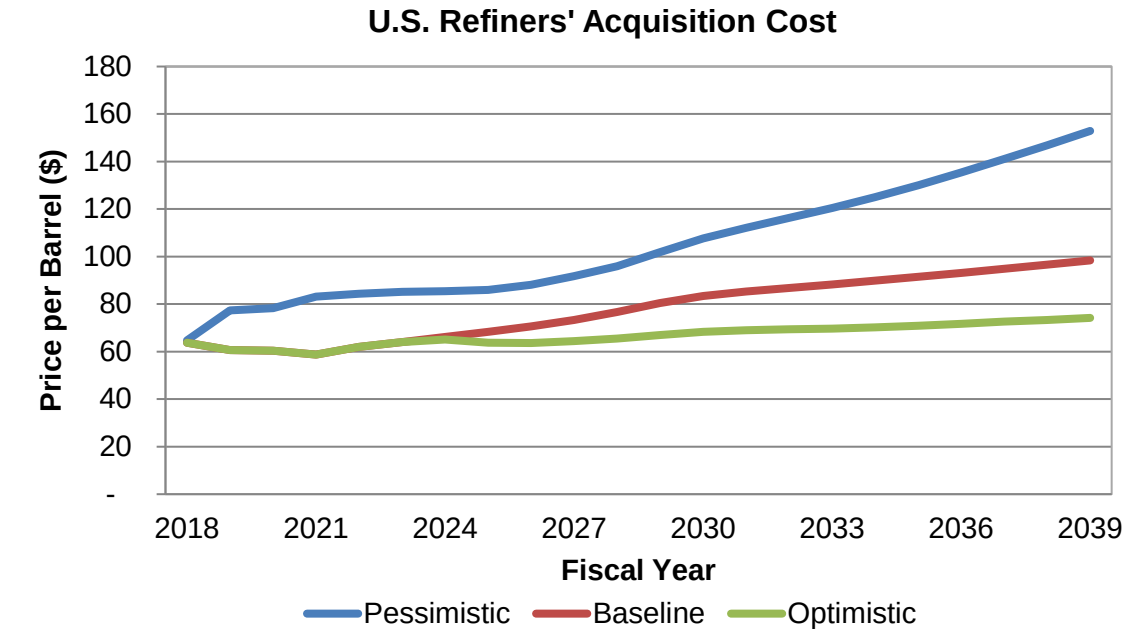
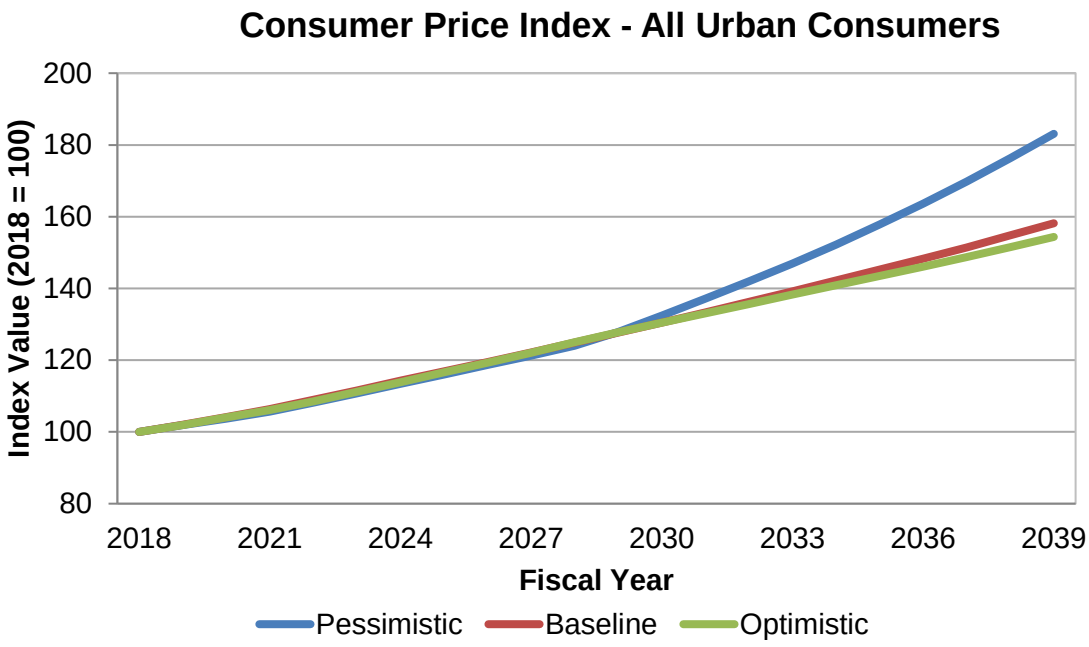


Source: IHS Markit

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 similarly to the baseline. In the pessimistic case, energy prices, wages and import prices all rise more rapidly compared to the baseline.



Source: IHS Markit

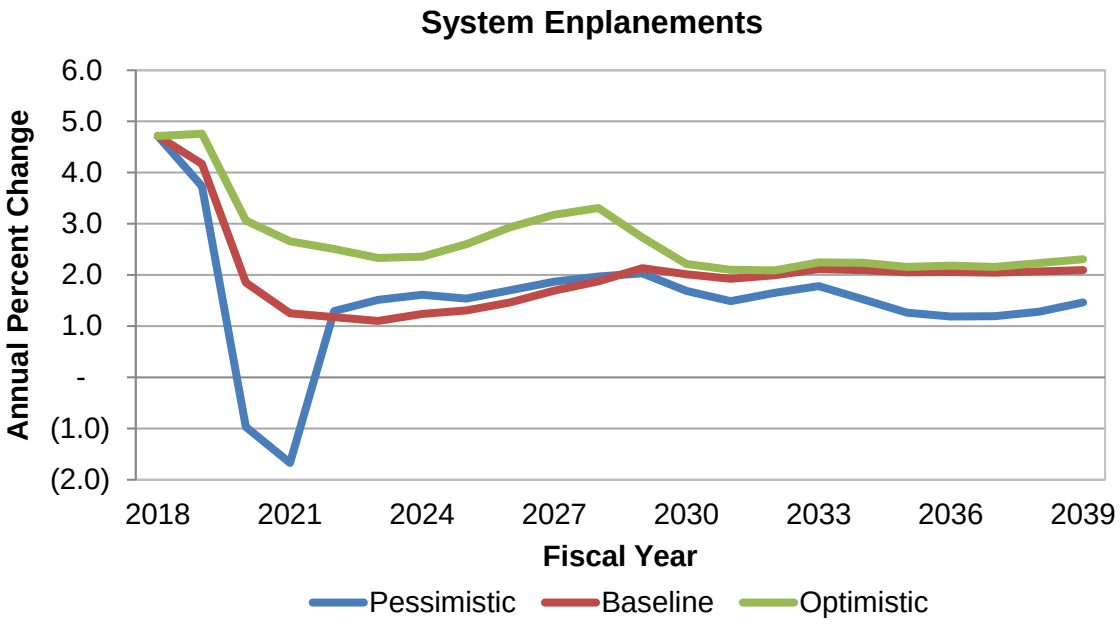
Alternative Forecasts

Enplanements

In the baseline forecast, system enplanements are forecast to grow at an average annual rate of 1.8 percent a year over the forecast horizon of 2019-2039 (with domestic and international passengers increasing at rates of 1.6 and 3.0 percent, respectively).

In the optimistic case, enplanements grow at a quicker pace, averaging 2.5 percent per year (up 2.4 percent domestically and 3.4 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 2039, system passengers in the optimistic case are 15.4 percent above the baseline, totaling 1.5 billion, 201 million greater than in the baseline.

The pessimistic case is characterized by a period of weakened consumer confidence combined with a contraction in real estate and financial asset markets, leading to higher interest rates, and curtailed investment and consumer spending. In this scenario, enplanements grow an average of 1.3 percent per year (domestic up 1.1 percent and international up 2.6 percent). In the pessimistic case, system passengers in 2039 are 9.9 percent below the baseline case, totaling 1.2 billion, or 130 million fewer than in the baseline.

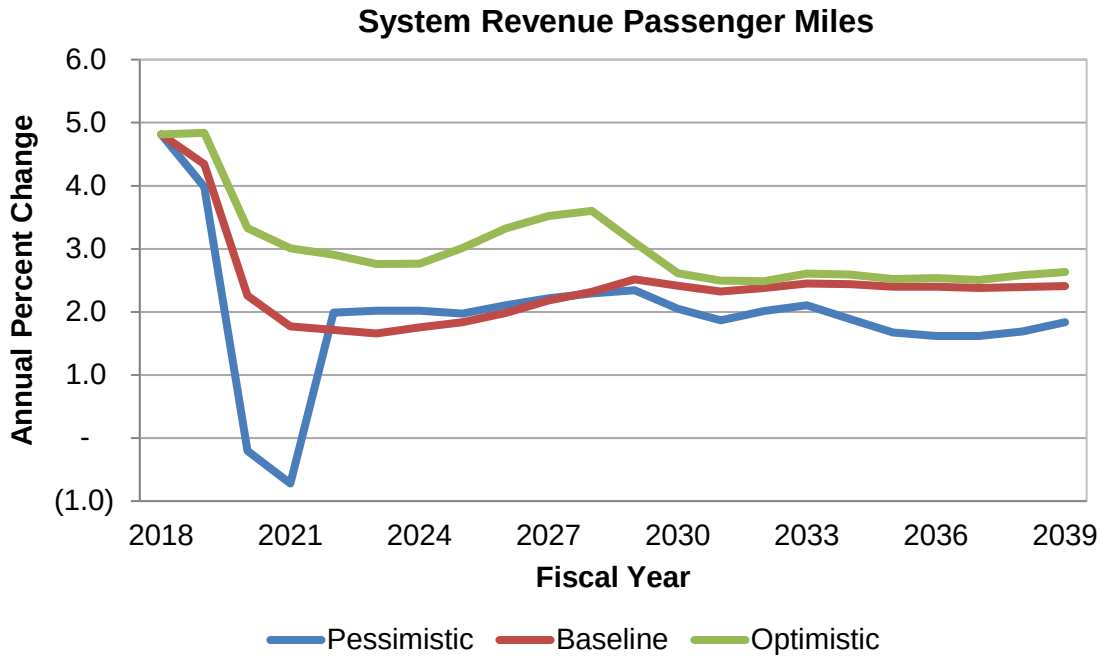


Revenue Passenger Miles

In the baseline forecast, system RPMs grow at an average annual rate of 2.2 percent a year over the forecast horizon (2019-2039), with domestic RPMs increasing 1.9 percent annually and international RPMs growing 3.0 percent annually.

In the optimistic case, the faster growing economy coupled with lower energy prices drives RPMs higher than the baseline, with growth averaging 2.8 percent per year (domestic and international RPMs up 2.6 and 3.4 percent, respectively).

In the pessimistic case, the combination of a slower growing economy and higher energy prices result in RPM growth averaging 1.7 percent annually with domestic markets growing 1.4 percent a year while international traffic grows 2.6 percent annually.



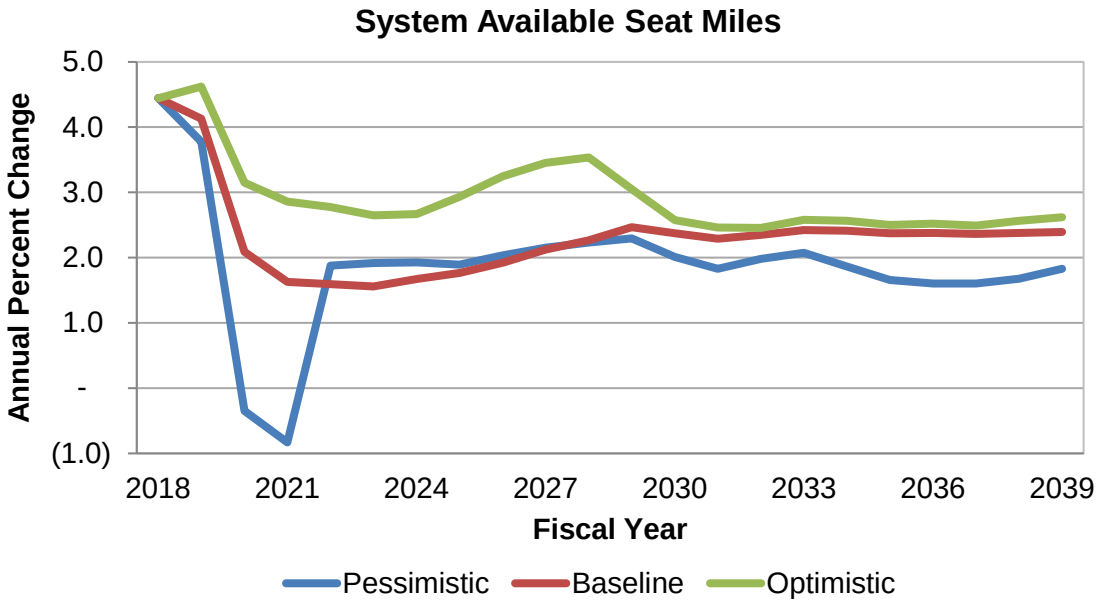
Available Seat Miles

In the base case, system capacity is forecast to increase an average of 2.1 percent annually over the forecast horizon with growth averaging 1.8 percent annually in domestic markets and 3.0 percent a year in international markets.

In the optimistic case, capacity grows at a faster clip than in the baseline forecast, averaging 2.8 percent annually system-wide (2.5 and 3.4 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 1.7 percent annually (domestic growth of 1.3 percent annually and international up 2.6 percent annually).



Load Factor

System load factors over the 20-year forecast period are relatively similar for all three forecast scenarios. System load factor rises from 83.9 percent in 2019 to 85.0 (optimistic), 84.8 (pessimistic), and 84.9 (baseline) percent in 2039, respectively.

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 84.9 percent to 86.6 percent in all three scenarios, optimistic, pessimistic and baseline.

The international load factor is forecast to hold steady near 81.5 throughout the period in the pessimistic scenario and rise slightly to 81.6 percent in the baseline and optimistic scenarios. 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 1.6 percent annually, going from 13.69 cents in 2019 to 18.94 cents in 2039. In domestic markets, yield in the baseline forecast rises from 13.67 cents in 2019 to 18.96 cents in 2039. International yield rises from 13.73 cents in 2019 to 18.89 cents in 2039.

System yield rises in the optimistic case at the same rate as in the baseline, up 1.4 percent annually to 18.20 cents by 2039. Domestic yield increases to 18.08 cents while international yield increases to 18.48 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 2.4 percent annually, reaching 21.92 cents by 2039 (22.05 cents domestically and 21.66 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 2018-2039

		Historical	FORECAST					PERCENT AVERAGE ANNUAL GROWTH				
Variable	Scenario	2018E	2019	2024	2029	2034	2039	2018-19	2019-24	2019-29	2019-34	2019-39
Economic Assumptions												
Real Personal Consumption	Pessimistic	39,042	39,827	40,757	43,365	45,921	48,154	2.0%	0.5%	0.9%	1.0%	1.0%
Expenditure per Capita	Baseline	39,042	39,840	42,079	44,686	48,137	51,924	2.0%	1.1%	1.2%	1.3%	1.3%
(2012 $)	Optimistic	39,042	40,016	44,256	49,215	53,292	57,787	2.5%	2.0%	2.1%	1.9%	1.9%
Refiners Acquisition Cost -	Pessimistic	64.7	77.4	85.4	101.8	125.1	152.9	19.5%	2.0%	2.8%	3.3%	3.5%
Average - $ Per Barrel	Baseline	63.7	60.6	66.1	80.4	89.9	98.4	-4.8%	1.7%	2.9%	2.7%	2.5%
	Optimistic	63.7	60.6	65.1	67.0	70.2	74.2	-4.8%	1.4%	1.0%	1.0%	1.0%
Consumer Price Index	Pessimistic	2.50	2.54	2.83	3.19	3.80	4.57	1.9%	2.2%	2.3%	2.7%	3.0%
All Urban, 1982-84 = 1.0	Baseline	2.50	2.55	2.85	3.19	3.55	3.95	2.0%	2.3%	2.3%	2.2%	2.2%
	Optimistic	2.50	2.55	2.84	3.19	3.52	3.85	1.9%	2.2%	2.3%	2.2%	2.1%
Civilian Unemployment Rate	Pessimistic	4.0	3.8	5.5	5.0	4.6	4.9	-3.5%	7.3%	2.6%	1.2%	1.2%
(%)	Baseline	4.0	3.7	4.4	4.6	4.7	4.8	-7.5%	3.6%	2.2%	1.6%	1.4%
	Optimistic	4.0	3.7	4.1	4.2	4.3	4.5	-8.2%	2.3%	1.3%	1.1%	1.0%

Source: IHS Markit

TABLE A-2

FAA FORECAST OF AVIATION ACTIVITY*

FISCAL YEARS 2018-2039

Variable	Scenario	Historical 2018E	FORECAST 2019	2024	2029	2034	2039	PERCENT AVERAGE ANNUAL GROWTH 2018-19	2019-24	2019-29	2019-34	2019-39
System Aviation Activity												
Available Seat Miles (BIL)	Pessimistic	1,194.7	1,239.8	1,296.7	1,440.2	1,586.4	1,723.7	3.8%	0.9%	1.5%	1.7%	1.7%
	Baseline	1,194.7	1,244.0	1,353.9	1,503.0	1,689.8	1,900.5	4.1%	1.7%	1.9%	2.1%	2.1%
	Optimistic	1,194.7	1,249.9	1,436.3	1,685.0	1,909.0	2,163.9	4.6%	2.8%	3.0%	2.9%	2.8%
Revenue Passenger Miles (BIL)	Pessimistic	1,000.8	1,040.6	1,094.4	1,219.3	1,345.2	1,462.5	4.0%	1.0%	1.6%	1.7%	1.7%
	Baseline	1,000.8	1,044.3	1,143.4	1,272.8	1,433.1	1,613.2	4.3%	1.8%	2.0%	2.1%	2.2%
	Optimistic	1,000.8	1,049.2	1,213.6	1,428.2	1,620.5	1,838.5	4.8%	3.0%	3.1%	2.9%	2.8%
Enplanements (MIL)	Pessimistic	880.5	913.3	929.3	1,017.2	1,102.8	1,175.1	3.7%	0.3%	1.1%	1.3%	1.3%
	Baseline	880.5	917.2	979.5	1,065.5	1,178.2	1,304.9	4.2%	1.3%	1.5%	1.7%	1.8%
	Optimistic	880.5	922.4	1,047.9	1,211.8	1,349.7	1,505.5	4.8%	2.6%	2.8%	2.6%	2.5%
Psgr Carrier Miles Flown (MIL)	Pessimistic	7,649.7	7,893.6	8,005.3	8,715.8	9,426.9	10,044.9	3.2%	0.3%	1.0%	1.2%	1.2%
	Baseline	7,649.7	7,923.9	8,396.9	9,113.0	10,058.3	11,115.8	3.6%	1.2%	1.4%	1.6%	1.7%
	Optimistic	7,649.7	7,965.1	8,944.9	10,288.3	11,438.8	12,735.4	4.1%	2.3%	2.6%	2.4%	2.4%
Psgr Carrier Departures (000s)	Pessimistic	9,161.0	9,425.4	9,172.1	9,716.1	10,222.1	10,567.6	2.9%	-0.5%	0.3%	0.5%	0.6%
	Baseline	9,161.0	9,417.6	9,636.9	10,136.1	10,866.3	11,677.8	2.8%	0.5%	0.7%	1.0%	1.1%
	Optimistic	9,161.0	9,473.5	10,329.7	11,525.1	12,428.3	13,444.4	3.4%	1.7%	2.0%	1.8%	1.8%
Nominal Passenger Yield (cents)	Pessimistic	13.63	13.68	14.78	16.21	18.76	21.92	0.4%	1.6%	1.7%	2.1%	2.4%
	Baseline	13.63	13.69	14.87	16.24	17.57	18.94	0.5%	1.7%	1.7%	1.7%	1.6%
	Optimistic	13.63	13.69	14.81	16.06	17.16	18.20	0.4%	1.6%	1.6%	1.5%	1.4%

* Includes domestic and international activity.

TABLE A-3

FAA FORECAST OF DOMESTIC AVIATION ACTIVITY

FISCAL YEARS 2018-2039

		Historical	FORECAST					PERCENT AVERAGE ANNUAL GROWTH				
Variable	Scenario	2018E	2019	2024	2029	2034	2039	2018-19	2019-24	2019-29	2019-34	2019-39
Domestic Aviation Activity												
Available Seat Miles	Pessimistic	850.4	884.4	894.0	980.3	1,065.4	1,135.2	4.0%	0.2%	1.0%	1.2%	1.3%
(BIL)	Baseline	850.4	888.6	948.5	1,028.9	1,138.7	1,263.5	4.5%	1.3%	1.5%	1.7%	1.8%
	Optimistic	850.4	894.1	1,020.1	1,181.7	1,317.8	1,473.2	5.1%	2.7%	2.8%	2.6%	2.5%
Revenue Passenger Miles	Pessimistic	720.2	751.1	766.3	844.4	920.4	982.6	4.3%	0.4%	1.2%	1.4%	1.4%
(BIL)	Baseline	720.2	754.6	813.0	886.3	983.8	1,093.7	4.8%	1.5%	1.6%	1.8%	1.9%
	Optimistic	720.2	759.3	874.3	1,018.0	1,138.5	1,275.2	5.4%	2.9%	3.0%	2.7%	2.6%
Enplanements	Pessimistic	780.8	811.8	817.1	888.5	955.7	1,006.6	4.0%	0.1%	0.9%	1.1%	1.1%
(MIL)	Baseline	780.8	815.6	866.9	932.5	1,021.4	1,120.5	4.5%	1.2%	1.3%	1.5%	1.6%
	Optimistic	780.8	820.7	932.3	1,071.1	1182.1	1,306.4	5.1%	2.6%	2.7%	2.5%	2.4%
Psgr Carrier Miles Flown	Pessimistic	6,078.8	6,279.0	6,203.3	6,673.1	7,129.2	7,466.9	3.3%	-0.2%	0.6%	0.9%	0.9%
(MIL)	Baseline	6,078.8	6,308.8	6,583.0	7,005.6	7,621.9	8,314.8	3.8%	0.9%	1.1%	1.3%	1.4%
	Optimistic	6,078.8	6,348.6	7,082.5	8,051.2	8,826.4	9,701.2	4.4%	2.2%	2.4%	2.2%	2.1%
Psgr Carrier Departures	Pessimistic	8,470.1	8,724.7	8,414.9	8,857.2	9,251.0	9,468.0	3.0%	-0.7%	0.2%	0.4%	0.4%
(000s)	Baseline	8,470.1	8,716.5	8,875.3	9,247.8	9,829.4	10,469.7	2.9%	0.4%	0.6%	0.8%	0.9%
	Optimistic	8,470.1	8,771.8	9,546.7	10,581.2	11,316.8	12,138.0	3.6%	1.7%	1.9%	1.7%	1.6%
Nominal Passenger Yield	Pessimistic	13.66	13.66	14.76	16.25	18.85	22.05	0.0%	1.6%	1.8%	2.2%	2.4%
(cents)	Baseline	13.66	13.67	14.85	16.24	17.58	18.96	0.1%	1.7%	1.7%	1.7%	1.6%
	Optimistic	13.66	13.67	14.78	15.99	17.05	18.08	0.1%	1.6%	1.6%	1.5%	1.4%

TABLE A-4

FAA FORECAST OF INTERNATIONAL AVIATION ACTIVITY*

FISCAL YEARS 2018-2039

Variable	Scenario	Historical 2018E	FORECAST 2019	2024	2029	2034	2039	PERCENT AVERAGE ANNUAL GROWTH 2018-19	2019-24	2019-29	2019-34	2019-39
International Aviation Activity												
Available Seat Miles (BIL)	Pessimistic	344.3	355.4	402.6	459.9	521.0	588.5	3.2%	2.5%	2.6%	2.6%	2.6%
	Baseline	344.3	355.4	405.4	474.1	551.1	637.0	3.2%	2.7%	2.9%	3.0%	3.0%
	Optimistic	344.3	355.7	416.3	503.3	591.2	690.7	3.3%	3.2%	3.5%	3.4%	3.4%
Revenue Passenger Miles (BIL)	Pessimistic	280.6	289.6	328.1	374.9	424.7	479.9	3.2%	2.5%	2.6%	2.6%	2.6%
	Baseline	280.6	289.7	330.4	386.4	449.3	519.5	3.2%	2.7%	2.9%	3.0%	3.0%
	Optimistic	280.6	289.9	339.2	410.2	482.0	563.3	3.3%	3.2%	3.5%	3.4%	3.4%
Enplanements (MIL)	Pessimistic	99.6	101.6	112.2	128.7	147.1	168.5	2.0%	2.0%	2.4%	2.5%	2.6%
	Baseline	99.6	101.6	112.6	132.9	156.7	184.4	2.0%	2.1%	2.7%	2.9%	3.0%
	Optimistic	99.6	101.7	115.5	140.8	167.6	199.0	2.1%	2.6%	3.3%	3.4%	3.4%
Psgr Carrier Miles Flown (MIL)	Pessimistic	1,570.9	1,614.7	1,802.0	2,042.7	2,297.8	2,577.9	2.8%	2.2%	2.4%	2.4%	2.4%
	Baseline	1,570.9	1,615.2	1,813.8	2,107.4	2,436.4	2,801.0	2.8%	2.3%	2.7%	2.8%	2.8%
	Optimistic	1,570.9	1,616.5	1,862.5	2,237.1	2,612.4	3,034.2	2.9%	2.9%	3.3%	3.3%	3.2%
Psgr Carrier Departures (000s)	Pessimistic	690.9	700.7	757.1	858.9	971.1	1,099.6	1.4%	1.6%	2.1%	2.2%	2.3%
	Baseline	690.9	701.1	761.6	888.3	1,036.9	1,208.1	1.5%	1.7%	2.4%	2.6%	2.8%
	Optimistic	690.9	701.7	783.0	944.0	1,111.5	1,306.4	1.6%	2.2%	3.0%	3.1%	3.2%
Nominal Passenger Yield (cents)	Pessimistic	13.55	13.72	14.83	16.11	18.57	21.66	1.2%	1.6%	1.6%	2.0%	2.3%
	Baseline	13.55	13.73	14.94	16.22	17.55	18.89	1.3%	1.7%	1.7%	1.7%	1.6%
	Optimistic	13.55	13.73	14.88	16.24	17.41	18.48	1.3%	1.6%	1.7%	1.6%	1.5%

*Includes mainline and regional carriers.

Appendix B: FAA Forecast Accuracy

Forecasts, by their nature, have a degree of uncertainty incorporated in them. They involve not only statistical analyses and various scientific methods, but also judgment and reliance on industry knowledge and the forecaster's experience to incorporate industry trends not yet reflected in recent results. The FAA's annual Aerospace Forecast is no exception. Given the volatile nature of the U.S. airline industry, it is not surprising that each year's forecast would contain a certain degree of forecast variance. Therefore, FAA forecasters have tried to build forecast models that give a consistent and predictable pattern of results. Analysts relying on the forecasts produced by the models would then be able to adjust for the predictable variance from actual results.

The table below presents an analysis of the variance from historical results for a primary forecast assumption along with five key forecast metrics during the FY 2010-2018 forecast period. Although many of the forecasts prepared for the period examined were developed while the U.S. airline industry was going through upheaval, the FAA's forecast methodology remained consistent during this time. For this reason, inclusion of prior periods in an analysis of forecast variance might lead to inconclusive or inaccurate implications about the accuracy of FAA's current forecast methodology.

The table below contains the mean absolute percent errors for the projected values versus the actual results for U.S. carriers' system operations along with the projected values versus actual results for U.S. GDP. Each metric has five values showing the relative forecast variance by the number of years in advance the preparation of the forecast took place. For example, the "3 Years" column for ASMs shows that the mean absolute percent error was 5.0 percent for ASM forecasts prepared 3 years in advance. For the period under examination, preparation of the forecasts for FY 2010 through FY 2018 occurred in FY 2006 through FY 2017. [20]

[20] It should be noted that the first forecasted year for each respective fiscal year is that very same year. Therefore, FY 2010's first forecasted year is FY 2010, and the third forecasted year is FY 2012.

U.S. AIR CARRIERS
SYSTEM SCHEDULED PASSENGER ACTIVITY
FORECAST EVALUATION

Forecast Variable	Mean Absolute Percent Error (Combined FY 2010 - FY 2018) (Forecast Variance from Actual) Forecast Performed Years Prior to Actual				
	1 Year	2 Years	3 Years	4 Years	5 Years
U.S. Real GDP	1.0%	2.8%	5.5%	7.9%	9.5%
ASMs	0.8%	2.1%	5.0%	8.7%	12.3%
RPMs	0.9%	1.7%	4.2%	7.4%	10.2%
Passenger Enplanements	0.7%	1.6%	4.3%	7.6%	10.0%
Mainline Domestic Yield	2.6%	5.3%	7.8%	8.7%	8.7%
Commercial Operations at FAA/Contract Towers	0.8%	2.9%	6.6%	10.9%	16.2%

*Total - scheduled and nonscheduled commercial plus noncommercial

Presenting forecast variances from actual data in such a manner simplifies a review of longer-term trends. Typically, one would expect the variances to increase as the forecast year is moves away from the year the forecast is prepared. Presenting forecast variances in this way allows an examination of changes in the relative variances by time horizon, signaling when dramatic shifts in accuracy occur.

Examination of the forecast variances reveals several items. First, the forecast variances for GDP, a key exogenous variable, are similar to the variances of the key traffic measures, Passenger Enplanements and RPMs. This suggests that a substantial amount of the forecast variance for the traffic variables is attributable to the forecast error in the exogenous variables. Second, all the metrics examined have increasing variances as the forecast time horizon lengthens. Third, the variance in the Commercial Operations at FAA/Contract Towers relative to ASM variance is stable for the 2 to 5 year out horizon. This suggests that beyond a 2 year forecast horizon carriers are able to accommodate changes in capacity by means other than adjusting operations. Many carriers have been systematically reducing the number of smaller regional jets in their fleets, replacing them with larger 70-90 seat aircraft. This has allowed carriers to increase capacity without increasing flights.

Appendix C: Forecast Tables

TABLE 1

U.S. SHORT-TERM ECONOMIC FORECASTS

	FISCAL YEAR 2018				FISCAL YEAR 2019				FISCAL YEAR 2020			
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 $)	38,835	38,828	39,122	39,380	39,663	39,750	39,886	40,060	40,232	40,403	40,562	40,725
Year over year change	3.2%	-0.1%	3.1%	2.7%	2.9%	0.9%	1.4%	1.8%	1.7%	1.7%	1.6%	1.6%
Refiners' Acquisition Cost - Average												
(Dollars per barrel)	56.65	61.88	67.24	69.04	61.25	54.79	62.52	63.95	62.78	60.51	59.71	58.65
Year over year change	87.3%	42.4%	39.4%	11.1%	-38.1%	-36.0%	69.6%	9.4%	-7.1%	-13.7%	-5.2%	-6.9%
Consumer Price Index												
(1982-84 equals 100)	247.3	249.4	250.5	251.7	252.8	253.4	255.3	257.0	258.3	259.5	260.8	262.0
Seasonally Adjusted Annual Rate	3.3%	3.5%	1.7%	2.0%	1.8%	0.9%	3.1%	2.6%	2.1%	1.8%	2.0%	1.9%

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	34,164	2.17	74.61
2015	17,301	36,862	2.37	56.69
2016	17,577	37,618	2.39	39.12
2017	17,941	38,303	2.44	48.16
2018E	18,431	39,042	2.50	63.70
Forecast				
2019	18,917	39,840	2.55	60.63
2024	20,522	42,079	2.85	66.11
2029	22,508	44,686	3.19	80.40
2034	24,689	48,137	3.55	89.85
2039	27,065	51,924	3.95	98.39
Avg Annual Growth				
2010-18	2.2%	1.7%	1.7%	-2.0%
2018-19	2.6%	2.0%	2.0%	-4.8%
2019-29	1.8%	1.2%	2.3%	2.9%
2019-39	1.8%	1.3%	2.2%	2.5%

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	1,396	21,261	4,610	18,846	64,168
2015	1,553	23,165	5,172	24,247	74,225
2016	1,570	23,690	5,163	25,404	76,207
2017	1,617	24,302	5,261	26,710	78,721
2018E	1,650	24,812	5,333	28,028	81,248
Forecast					
2019	1,681	25,185	5,424	29,356	83,578
2024	1,853	27,668	6,094	36,785	96,245
2029	2,035	30,564	7,063	45,558	111,446
2034	2,226	33,664	8,191	54,367	127,315
2039	2,438	36,970	9,514	63,874	144,415
Avg Annual Growth					
2010-18	2.1%	1.9%	1.8%	5.1%	3.0%
2018-19	1.9%	1.5%	1.7%	4.7%	2.9%
2019-29	1.9%	2.0%	2.7%	4.5%	2.9%
2019-39	1.9%	1.9%	2.8%	4.0%	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	18,753	11,201	2,630	4,179	7,468
2015	20,942	11,678	2,915	4,390	10,916
2016	21,276	11,902	2,968	4,417	11,650
2017	21,761	12,202	3,022	4,502	12,436
2018E	22,363	12,428	3,063	4,535	13,257
Forecast					
2019	22,882	12,576	3,091	4,572	14,093
2024	24,849	13,398	3,320	4,765	18,725
2029	27,354	14,320	3,591	5,037	24,175
2034	30,180	15,263	3,878	5,267	29,313
2039	33,201	16,219	4,187	5,473	34,645
Avg Annual Growth					
2010-18	2.2%	1.3%	1.9%	1.0%	7.4%
2018-19	2.3%	1.2%	0.9%	0.8%	6.3%
2019-29	1.8%	1.3%	1.5%	1.0%	5.5%
2019-39	1.9%	1.3%	1.5%	0.9%	4.6%

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	787	629	261	890
2016	726	93	820	663	265	928
2017	744	97	841	684	271	955
2018E	781	100	880	720	281	1,001
Forecast						
2019	816	102	917	755	290	1,044
2024	867	113	980	813	330	1,143
2029	933	133	1,065	886	386	1,273
2034	1,021	157	1,178	984	449	1,433
2039	1,120	184	1,305	1,094	520	1,613
Avg Annual Growth						
2010-18	2.6%	3.2%	2.7%	3.3%	2.5%	3.1%
2018-19	4.5%	2.0%	4.2%	4.8%	3.2%	4.3%
2019-29	1.3%	2.7%	1.5%	1.6%	2.9%	2.0%
2019-39	1.6%	3.0%	1.8%	1.9%	3.0%	2.2%

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	890	83.4
2016	783	663	84.7	329	265	80.6	1,112	928	83.5
2017	809	684	84.5	335	271	81.0	1,144	955	83.5
2018E	850	720	84.7	344	281	81.5	1,195	1,001	83.8
Forecast									
2019	889	755	84.9	355	290	81.5	1,244	1,044	83.9
2024	948	813	85.7	405	330	81.5	1,354	1,143	84.4
2029	1,029	886	86.1	474	386	81.5	1,503	1,273	84.7
2034	1,139	984	86.4	551	449	81.5	1,690	1,433	84.8
2039	1,264	1,094	86.6	637	520	81.6	1,901	1,613	84.9
Avg Annual Growth									
2010-18	2.8%	3.3%		2.6%	2.5%		2.8%	3.1%	
2018-19	4.5%	4.8%		3.2%	3.2%		4.1%	4.3%	
2019-29	1.5%	1.6%		2.9%	2.9%		1.9%	2.0%	
2019-39	1.8%	1.9%		3.0%	3.0%		2.1%	2.2%	

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
2016	24	55	14	93	105	87	73	265
2017	25	58	14	97	106	90	75	271
2018E	26	60	13	100	112	93	75	281
Forecast								
2019	27	61	13	102	117	95	77	290
2024	31	67	15	113	137	106	87	330
2029	35	81	17	133	156	132	98	386
2034	39	99	19	157	176	163	111	449
2039	43	120	21	184	196	199	124	519
Avg Annual Growth								
2010-18	0.8%	5.3%	0.4%	3.2%	0.4%	5.0%	3.0%	2.5%
2018-19	4.2%	1.3%	0.9%	2.0%	4.7%	1.7%	2.9%	3.2%
2019-29	2.5%	2.9%	2.2%	2.7%	2.9%	3.3%	2.4%	2.9%
2019-39	2.3%	3.5%	2.2%	3.0%	2.6%	3.8%	2.4%	3.0%

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	208
2016	75	79	39	28	220
2017	79	82	41	29	232
2018E	85	86	43	31	244
Forecast					
2019	89	89	44	32	254
2024	102	100	54	38	294
2029	120	121	65	45	351
2034	140	147	77	52	416
2039	161	178	90	62	491
Avg Annual Growth					
2010-18	5.4%	6.2%	5.8%	4.5%	5.6%
2018-19	4.6%	3.6%	3.7%	3.4%	3.9%
2019-29	3.0%	3.1%	4.0%	3.4%	3.3%
2019-39	3.0%	3.5%	3.6%	3.3%	3.4%

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	121.8	216.4	139.7	874.8	2,988.0	1,104.2
2015	131.5	214.8	149.0	902.7	2,892.6	1,131.0
2016	134.8	214.8	151.5	913.2	2,833.8	1,132.2
2017	137.8	217.2	154.3	918.9	2,798.6	1,135.6
2018E	139.9	219.2	156.2	922.3	2,816.6	1,136.7
Forecast						
2019	140.8	220.1	157.0	925.2	2,850.7	1,138.5
2024	144.1	223.5	161.2	937.8	2,933.7	1,167.3
2029	146.9	224.9	164.9	950.5	2,907.1	1,194.6
2034	149.4	226.2	168.0	963.2	2,866.6	1,216.4
2039	152.0	227.4	171.0	976.1	2,816.8	1,236.3

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
2016	575	90	665	590	262	852
2017	595	93	689	612	269	881
2018E	627	96	723	645	278	924
Forecast						
2019	656	98	754	676	287	964
2024	697	109	806	728	328	1,056
2029	750	129	879	793	384	1,177
2034	822	152	974	880	446	1,326
2039	901	180	1,081	978	516	1,494
Avg Annual Growth						
2010-18	3.6%	3.2%	3.5%	3.8%	2.4%	3.3%
2018-19	4.6%	1.9%	4.2%	4.8%	3.2%	4.3%
2019-29	1.4%	2.8%	1.6%	1.6%	2.9%	2.0%
2019-39	1.6%	3.1%	1.8%	1.9%	3.0%	2.2%

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
2016	692	590	85.3	325	262	80.7	1,017	852	83.8
2017	718	612	85.2	331	269	81.1	1,049	881	83.9
2018E	756	645	85.3	341	278	81.5	1,098	924	84.1
Forecast									
2019	791	676	85.5	352	287	81.5	1,143	964	84.3
2024	843	728	86.3	402	328	81.5	1,245	1,056	84.8
2029	914	793	86.8	470	384	81.5	1,385	1,177	85.0
2034	1,011	880	87.1	547	446	81.6	1,558	1,326	85.1
2039	1,121	978	87.2	632	516	81.6	1,753	1,494	85.2
Avg Annual Growth									
2010-18	3.4%	3.8%		2.5%	2.4%	-0.1%	3.1%	3.3%	
2018-19	4.5%	4.8%		3.2%	3.2%	0.0%	4.1%	4.3%	
2019-29	1.5%	1.6%		2.9%	2.9%	0.0%	1.9%	2.0%	
2019-39	1.8%	1.9%		3.0%	3.0%	0.0%	2.2%	2.2%	

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
2016	24.4	51.5	14.0	89.9
2017	24.8	54.7	13.9	93.5
2018E	26.0	56.9	13.3	96.2
Forecast				
2019	27.1	57.5	13.4	98.1
2024	31.1	62.9	14.9	108.9
2029	34.8	77.4	16.7	128.9
2034	38.8	94.8	18.7	152.4
2039	43.2	115.5	20.9	179.6
Avg Annual Growth				
2010-18	0.8%	5.5%	0.4%	3.2%
2018-19	4.2%	1.1%	0.9%	1.9%
2019-29	2.5%	3.0%	2.2%	2.8%
2019-39	2.3%	3.5%	2.2%	3.1%

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
2016	134	105	78.0	104	85	81.4	87	73	83.9	325	262	80.7
2017	134	106	79.5	107	88	82.3	91	75	82.2	331	269	81.1
2018E	138	112	81.0	111	91	82.1	92	75	81.7	341	278	81.5
Forecast												
2019	145	117	81.0	113	93	82.1	95	77	81.7	352	287	81.5
2024	170	137	81.0	126	104	82.1	106	87	81.7	402	328	81.5
2029	193	156	81.0	157	129	82.1	121	98	81.7	470	384	81.5
2034	217	176	81.0	194	160	82.1	136	111	81.7	547	446	81.6
2039	242	196	81.0	238	196	82.1	152	124	81.7	632	516	81.6
Avg Annual Growth												
2010-18	0.7%	0.4%		4.5%	5.0%		3.4%	3.0%		2.5%	2.4%	
2018-19	4.7%	4.7%		1.6%	1.6%		2.9%	2.9%		3.2%	3.2%	
2019-29	2.9%	2.9%		3.4%	3.4%		2.4%	2.4%		2.9%	2.9%	
2019-39	2.6%	2.6%		3.8%	3.8%		2.4%	2.4%		3.0%	3.0%	

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
2016	159.9	241.7	174.1	266.6	219.8	175.1
2017	162.3	243.4	176.4	267.5	221.8	177.3
2018E	164.2	247.5	178.2	265.2	223.3	178.9
Forecast						
2019	164.8	248.0	178.7	266.0	224.3	179.5
2024	167.8	250.5	181.2	269.7	227.5	183.3
2029	170.3	253.0	183.7	273.5	228.6	186.4
2034	172.4	255.5	186.2	277.2	229.6	188.9
2039	174.5	258.0	188.7	281.0	230.7	191.3

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
2016	1,027	4,291	1,650	5,176	2,917	1,283
2017	1,028	4,278	1,602	5,373	2,875	1,279
2018E	1,029	4,299	1,603	5,638	2,892	1,277
Forecast						
2019	1,032	4,320	1,611	5,751	2,928	1,279
2024	1,045	4,412	1,648	5,842	3,010	1,310
2029	1,058	4,483	1,669	5,886	2,975	1,339
2034	1,071	4,523	1,685	5,916	2,928	1,362
2039	1,085	4,546	1,693	5,931	2,872	1,382

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 2018 $ (Cents)	CURRENT $ (Cents)	FY 2018 $ (Cents)	CURRENT $ (Cents)	FY 2018 $ (Cents)
Historical						
2010	12.62	14.49	12.84	14.74	12.69	14.58
2015	14.79	15.60	14.16	14.94	14.59	15.39
2016	13.96	14.59	12.88	13.46	13.62	14.24
2017	13.91	14.25	12.89	13.20	13.60	13.93
2018E	13.91	13.91	13.60	13.60	13.82	13.82
Forecast						
2019	13.93	13.66	13.78	13.52	13.89	13.62
2024	15.13	13.24	14.99	13.12	15.09	13.20
2029	16.55	12.96	16.28	12.76	16.46	12.90
2034	17.92	12.60	17.62	12.39	17.82	12.53
2039	19.33	12.22	18.95	11.98	19.20	12.14
Avg Annual Growth						
2010-18	1.2%	-0.5%	0.7%	-1.0%	1.1%	-0.7%
2018-19	0.1%	-1.8%	1.3%	-0.6%	0.5%	-1.4%
2019-29	1.7%	-0.5%	1.7%	-0.6%	1.7%	-0.5%
2019-39	1.7%	-0.6%	1.6%	-0.6%	1.6%	-0.6%

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 2018 $ (Cents)	CURRENT $ (Cents)	FY 2018 $ (Cents)	CURRENT $ (Cents)	FY 2018 $ (Cents)	CURRENT $ (Cents)	FY 2018 $ (Cents)
Historical								
2010	12.73	14.63	13.33	15.31	12.50	14.36	12.84	14.74
2015	14.64	15.44	14.38	15.17	13.20	13.92	14.16	14.94
2016	13.83	14.45	12.72	13.29	11.69	12.22	12.88	13.46
2017	13.58	13.90	13.38	13.70	11.36	11.63	12.89	13.20
2018E	14.38	14.38	14.18	14.18	11.73	11.73	13.60	13.60
Forecast								
2019	14.59	14.31	14.34	14.06	11.89	11.66	13.78	13.52
2024	15.95	13.96	15.43	13.50	12.96	11.34	14.99	13.12
2029	17.39	13.61	16.58	12.98	14.14	11.06	16.28	12.75
2034	18.89	13.28	17.76	12.48	15.39	10.81	17.62	12.38
2039	20.45	12.95	18.89	11.96	16.69	10.57	18.95	12.00
Avg Annual Growth								
2010-18	1.5%	-0.2%	0.8%	-1.0%	-0.8%	-2.5%	0.7%	-1.0%
2018-19	1.5%	-0.5%	1.1%	-0.8%	1.4%	-0.6%	1.3%	-0.6%
2019-29	1.8%	-0.5%	1.5%	-0.8%	1.7%	-0.5%	1.7%	-0.6%
2019-39	1.7%	-0.5%	1.4%	-0.8%	1.7%	-0.5%	1.6%	-0.6%

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 2017 $ (Cents)	CURRENT $ (Cents)	FY 2017 $ (Cents)	CURRENT $ (Cents)	FY 2017 $ (Cents)
Historical						
2010	219.16	251.78	220.12	252.85	219.49	252.12
2015	207.29	218.65	211.77	223.38	208.96	220.42
2016	146.17	152.77	147.01	153.65	146.47	153.09
2017	162.31	166.22	160.79	164.66	161.76	165.65
2018E	206.63	206.63	208.37	208.37	207.24	207.24
Forecast						
2019	214.75	210.61	216.56	212.39	215.38	211.24
2024	234.57	205.28	236.54	207.01	235.26	205.89
2029	282.87	221.59	285.25	223.46	283.70	222.24
2034	319.33	224.55	322.02	226.44	320.27	225.21
2039	349.16	220.76	352.10	222.62	350.19	221.41
Avg Annual Growth						
2010-18	-0.7%	-2.4%	-0.7%	-2.4%	-0.7%	-2.4%
2018-19	3.9%	1.9%	3.9%	1.9%	3.9%	1.9%
2019-29	2.8%	0.5%	2.8%	0.5%	2.8%	0.5%
2019-39	2.5%	0.2%	2.5%	0.2%	2.5%	0.2%

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	11,243	16,733	27,976	1,580	6,332	7,912	12,823	23,065	35,888
2015	11,636	16,008	27,643	1,455	6,670	8,126	13,091	22,678	35,769
2016	11,998	16,236	28,234	1,373	6,136	7,509	13,372	22,372	35,744
2017	13,062	17,587	30,649	1,579	6,958	8,537	14,641	24,545	39,186
2018E	14,182	19,465	33,647	1,580	7,532	9,112	15,761	26,997	42,759
Forecast									
2019	14,829	20,845	35,674	1,638	7,947	9,585	16,467	28,792	45,259
2024	15,608	26,239	41,847	1,652	9,268	10,920	17,260	35,507	52,766
2029	17,201	33,041	50,243	1,742	10,780	12,523	18,944	43,821	62,765
2034	18,968	40,864	59,832	1,835	12,276	14,111	20,803	53,139	73,942
2039	20,835	49,917	70,752	1,960	13,753	15,713	22,795	63,670	86,465
Avg Annual Growth									
2010-18	2.9%	1.9%	2.3%	0.0%	2.2%	1.8%	2.6%	2.0%	2.2%
2018-19	4.6%	7.1%	6.0%	3.7%	5.5%	5.2%	4.5%	6.6%	5.8%
2019-29	1.5%	4.7%	3.5%	0.6%	3.1%	2.7%	1.4%	4.3%	3.3%
2019-39	1.7%	4.5%	3.5%	0.9%	2.8%	2.5%	1.6%	4.0%	3.3%

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	6,865	1,991	8,348	5,860	23,065
2015	6,669	1,639	9,018	5,352	22,678
2016	6,639	1,565	8,852	5,316	22,372
2017	7,061	1,689	9,939	5,857	24,545
2018E	7,554	1,846	10,422	7,176	26,997
Forecast					
2019	7,894	1,905	11,169	7,825	28,792
2024	9,350	1,867	13,621	10,670	35,507
2029	10,890	1,977	17,193	13,761	43,821
2034	12,591	2,119	21,264	17,164	53,139
2039	14,463	2,245	25,823	21,139	63,670
Avg Annual Growth					
2010-18	1.2%	-0.9%	2.8%	2.6%	2.0%
2018-19	4.5%	3.2%	7.2%	9.0%	6.6%
2019-29	3.3%	0.4%	4.4%	5.8%	4.3%
2019-39	3.1%	0.8%	4.3%	5.1%	4.0%

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]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
2016	3,457	2	0	3,459	490	0	27	517	3,976	97	4,073
2017	3,539	1	0	3,540	517	0	0	517	4,057	98	4,155
2018E	3,616	1	0	3,617	526	0	0	526	4,143	98	4,241
Forecast											
2019	3,597	1	0	3,598	487	0	0	487	4,085	60	4,145
2024	3,656	0	0	3,656	510	0	0	510	4,166	60	4,226
2029	3,729	0	0	3,729	618	0	0	618	4,347	60	4,407
2034	4,013	0	0	4,013	709	0	0	709	4,722	20	4,742
2039	4,387	0	0	4,387	810	0	0	810	5,197	0	5,197
Avg Annual Growth											
2010-18	1.9%	-22.9%	N/A	1.8%	1.4%	N/A	-100.0%	0.1%	1.6%	4.1%	1.6%
2018-19	-0.5%	0.0%	N/A	-0.5%	-7.4%	N/A	N/A	-7.4%	-1.4%	-38.8%	-2.3%
2019-29	0.4%	N/A	N/A	0.4%	2.4%	N/A	N/A	2.4%	0.6%	0.0%	0.6%
2019-39	1.0%	N/A	N/A	1.0%	2.6%	N/A	N/A	2.6%	1.2%	-99.9%	1.1%

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
2016	235	19	2	256	328	149	77	554	810
2017	243	16	2	261	360	149	85	594	855
2018E	246	15	2	263	365	148	82	595	858
Forecast									
2019	233	15	2	250	427	108	104	639	889
2024	232	10	2	244	509	106	113	728	972
2029	291	1	0	292	629	106	112	847	1,139
2034	365	0	0	365	785	103	110	998	1,363
2039	412	0	0	412	1,066	24	85	1,175	1,587
Avg Annual Growth									
2010-18	6.1%	-21.5%	N/A	-1.1%	4.1%	-3.7%	-2.1%	0.7%	0.1%
2018-19	-5.3%	0.0%	N/A	-4.9%	17.0%	-27.0%	26.8%	7.4%	3.6%
2019-29	2.2%	N/A	N/A	1.6%	3.9%	-0.2%	0.7%	2.9%	2.5%
2019-39	2.9%	N/A	N/A	2.5%	4.7%	-7.2%	-1.0%	3.1%	2.9%

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
2016	13,441	6,467	19,908	1,437	21,345	2	206	208	21,553
2017	13,842	6,667	20,509	1,541	22,050	2	206	208	22,258
2018E	14,662	7,081	21,743	1,613	23,356	2	208	210	23,566
Forecast									
2019	15,169	7,238	22,407	1,675	24,081	2	207	209	24,290
2024	15,406	7,855	23,261	1,919	25,181	2	198	200	25,381
2029	15,901	8,739	24,640	2,089	26,729	2	191	193	26,922
2034	16,744	9,665	26,409	2,221	28,630	2	185	187	28,817
2039	17,678	10,630	28,308	2,335	30,643	2	184	186	30,829
Avg Annual Growth									
2010-18	2.5%	1.4%	2.1%	1.5%	2.1%	0.0%	-0.7%	-0.7%	2.1%
2018-19	3.5%	2.2%	3.1%	3.8%	3.1%	0.0%	-0.4%	-0.4%	3.1%
2019-29	0.5%	1.9%	1.0%	2.2%	1.0%	0.0%	-0.8%	-0.8%	1.0%
2019-39	0.8%	1.9%	1.2%	1.7%	1.2%	0.0%	-0.6%	-0.6%	1.2%

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)	2018 $ (Cents)
Historical								
2010	56.1	53.2	56.0	464	503	465	15.74	18.08
2015	59.9	62.6	60.0	475	695	480	10.93	11.53
2016	61.5	68.9	61.8	481	723	487	11.31	11.82
2017	63.0	70.8	63.2	482	718	487	11.27	11.54
2018E	63.8	70.8	64.0	487	680	491	11.32	11.32
Forecast								
2019	64.7	71.1	64.9	489	683	493	11.33	11.12
2024	67.5	72.6	67.7	499	697	503	12.30	10.77
2029	70.1	74.1	70.2	509	711	513	13.45	10.54
2034	72.7	75.6	72.8	519	725	524	14.56	10.24
2039	75.4	77.1	75.5	530	740	534	15.70	9.93
Avg Annual Growth								
2010-18	1.6%	3.6%	1.7%	0.6%	3.8%	0.7%	-4.0%	-5.7%
2018-19	1.5%	0.4%	1.4%	0.4%	0.4%	0.4%	0.1%	-1.8%
2019-29	0.8%	0.4%	0.8%	0.4%	0.4%	0.4%	1.7%	-0.5%
2019-39	0.8%	0.4%	0.8%	0.4%	0.4%	0.4%	1.6%	-0.6%

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	75,030	1,347	76,377
2015	153	3	156	72,754	2,116	74,870
2016	152	4	155	72,964	2,564	75,527
2017	149	3	152	71,715	2,468	74,183
2018E	154	3	157	74,886	2,295	77,181
Forecast						
2019	160	4	164	78,242	2,398	80,640
2024	170	4	174	84,776	2,598	87,374
2029	183	4	187	92,926	2,848	95,773
2034	200	4	204	103,786	3,181	106,967
2039	219	5	224	116,106	3,558	119,664
Avg Annual Growth						
2010-18	-0.6%	2.9%	-0.6%	0.0%	6.9%	0.1%
2018-19	4.0%	4.0%	4.0%	4.5%	4.5%	4.5%
2019-29	1.3%	1.3%	1.3%	1.7%	1.7%	1.7%
2019-39	1.6%	1.6%	1.6%	2.0%	2.0%	2.0%

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	98,461	75,030	76.2	1,857	1,347	72.5	100,318	76,377	76.1
2015	90,681	72,754	80.2	2,819	2,116	75.0	93,500	74,870	80.1
2016	91,158	72,964	80.0	3,519	2,564	72.8	94,677	75,527	79.8
2017	90,938	71,715	78.9	3,380	2,468	73.0	94,317	74,183	78.7
2018E	93,924	74,886	79.7	3,023	2,295	75.9	96,947	77,181	79.6
Forecast									
2019	97,861	78,242	80.0	3,149	2,398	76.1	101,011	80,640	79.8
2024	105,098	84,776	80.7	3,382	2,598	76.8	108,480	87,374	80.5
2029	114,699	92,926	81.0	3,691	2,848	77.2	118,390	95,773	80.9
2034	127,786	103,786	81.2	4,112	3,181	77.3	131,899	106,967	81.1
2039	142,723	116,106	81.4	4,593	3,558	77.5	147,315	119,664	81.2
Avg Annual Growth									
2010-18	-0.6%	0.0%		6.3%	6.9%	0.6%	-0.4%	0.1%	
2018-19	4.2%	4.5%		4.2%	4.5%	0.3%	4.2%	4.5%	
2019-29	1.6%	1.7%		1.6%	1.7%	0.1%	1.6%	1.7%	
2019-39	1.9%	2.0%		1.9%	2.0%	0.1%	1.9%	2.0%	

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

TABLE 27

U.S. REGIONAL CARRIERS

PASSENGER AIRCRAFT

	REGIONAL AIRCRAFT											
				31 TO 40 SEATS			OVER 40 SEATS			TOTAL FLEET		
AS OF JANUARY 1	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
2016	390	55	13	59	0	59	40	1,637	1,677	557	1,637	2,194
2017	367	65	19	26	0	26	65	1,644	1,709	542	1,644	2,186
2018E	351	63	9	25	0	25	55	1,795	1,850	503	1,795	2,298
Forecast												
2019	286	58	8	29	0	29	61	1,745	1,806	442	1,745	2,187
2024	225	45	6	0	0	0	81	1,801	1,882	357	1,801	2,158
2029	160	33	5	0	0	0	86	1,682	1,768	284	1,682	1,966
2034	95	19	3	0	0	0	95	1,727	1,822	212	1,727	1,939
2039	32	6	1	0	0	0	106	1,877	1,983	145	1,877	2,022
Avg Annual Growth												
2010-18	-2.8%	-4.6%	-24.1%	-19.7%	N/A	-21.4%	-7.1%	0.5%	0.2%	-6.4%	0.3%	-1.6%
2018-19	-18.5%	-7.9%	N/A	16.0%	N/A	16.0%	10.9%	-2.8%	-2.4%	-12.1%	-2.8%	-4.8%
2019-29	-5.6%	-5.5%	N/A	-100.0%	N/A	-100.0%	3.5%	-0.4%	-0.2%	-4.3%	-0.4%	-1.1%
2019-39	-10.4%	-10.7%	N/A	-99.9%	N/A	-99.9%	2.8%	0.4%	0.5%	-5.4%	0.4%	-0.4%

TABLE 28

ACTIVE GENERAL AVIATION AND AIR TAXI AIRCRAFT

	FIXED WING												TOTAL		
		PISTON			TURBINE			ROTORCRAFT					GENERAL		
AS OF DEC. 31	SINGLE ENGINE	MULTI-ENGINE	TOTAL	TURBO PROP	TURBO JET	TOTAL	PISTON	TURBINE	TOTAL	EXPERI-MENTAL**	LIGHT SPORT AIRCRAFT**	OTHER	AVIATION FLEET	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
2016	129,652	12,986	142,638	9,779	13,751	23,530	3,344	7,233	10,577	27,585	2,478	4,986	211,794	145,982	30,763
2017	129,833	13,083	142,916	9,949	14,217	24,166	3,270	7,241	10,511	26,921	2,551	4,692	211,757	146,186	31,407
2018E	129,885	13,040	142,925	9,925	14,585	24,510	3,335	7,370	10,705	27,365	2,665	4,715	212,885	146,260	31,880
Forecast															
2019	129,285	13,010	142,295	9,925	14,970	24,895	3,405	7,490	10,895	27,755	2,790	4,745	213,375	145,700	32,385
2024	123,145	12,805	135,950	10,135	17,025	27,160	3,775	8,075	11,850	29,465	3,420	4,820	212,665	139,725	35,235
2029	116,360	12,575	128,935	10,770	19,110	29,880	4,150	8,700	12,850	30,880	4,100	4,865	211,510	133,085	38,580
2034	110,160	12,330	122,490	11,640	21,100	32,740	4,545	9,420	13,965	32,040	4,820	4,880	210,935	127,035	42,160
2039	105,195	12,085	117,280	12,810	23,050	35,860	4,950	10,225	15,175	33,040	5,555	4,890	211,800	122,230	46,085
Avg Annual Growth															
2010-18	-0.9%	-2.4%	-1.0%	0.7%	3.0%	2.0%	-0.9%	1.6%	0.7%	1.2%	-10.6%	-2.3%	-0.6%	-1.0%	1.9%
2018-19	-0.5%	-0.2%	-0.4%	0.0%	2.6%	1.6%	2.1%	1.6%	1.8%	1.4%	4.7%	0.6%	0.2%	-0.4%	1.6%
2019-29	-1.0%	-0.3%	-1.0%	0.8%	2.5%	1.8%	2.0%	1.5%	1.7%	1.1%	3.9%	0.3%	-0.1%	-0.9%	1.8%
2019-39	-1.0%	-0.4%	-1.0%	1.3%	2.2%	1.8%	1.9%	1.6%	1.7%	0.9%	3.5%	0.2%	0.0%	-0.9%	1.8%

* Source: 2001-2010, 2012-2017, 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)

	FIXED WING												TOTAL		
	PISTON			TURBINE			ROTORCRAFT						GENERAL		
AS OF DEC. 31	SINGLE ENGINE	MULTI-ENGINE	TOTAL	TURBO PROP	TURBO JET	TOTAL	PISTON	TURBINE	TOTAL	EXPERI-MENTAL*	LIGHT SPORT AIRCRAFT**	OTHER	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
2016	11,865	1,683	13,548	2,708	3,847	6,554	780	2,348	3,128	1,224	187	193	24,834	14,328	8,902
2017	12,047	1,536	13,583	2,625	4,065	6,690	782	2,538	3,320	1,241	209	168	25,212	14,366	9,228
2018E	12,029	1,568	13,597	2,672	4,294	6,966	808	2,613	3,420	1,274	221	169	25,647	14,404	9,578
Forecast															
2019	11,894	1,578	13,472	2,713	4,528	7,241	832	2,688	3,521	1,305	233	170	25,943	14,305	9,929
2024	10,906	1,577	12,483	2,898	5,571	8,469	946	2,986	3,932	1,445	301	173	26,802	13,429	11,455
2029	10,186	1,563	11,748	3,105	6,417	9,523	1,044	3,279	4,323	1,570	374	175	27,713	12,792	12,802
2034	9,672	1,547	11,218	3,365	7,173	10,537	1,145	3,584	4,729	1,681	456	176	28,798	12,363	14,122
2039	9,483	1,532	11,016	3,707	7,916	11,623	1,249	3,920	5,169	1,784	542	177	30,311	12,265	15,543
Avg Annual Growth															
2010-18	-0.1%	-1.8%	-0.3%	1.8%	3.1%	2.5%	0.2%	0.0%	0.1%	0.5%	-4.2%	-0.8%	0.4%	-0.3%	1.8%
2018-19	-1.1%	0.7%	-0.9%	1.5%	5.4%	3.9%	3.1%	2.9%	2.9%	2.4%	5.6%	0.8%	1.2%	-0.7%	3.7%
2019-29	-1.5%	-0.1%	-1.4%	1.4%	3.5%	2.8%	2.3%	2.0%	2.1%	1.9%	4.8%	0.3%	0.7%	-1.1%	2.6%
2019-39	-1.1%	-0.1%	-1.0%	1.6%	2.8%	2.4%	2.0%	1.9%	1.9%	1.6%	4.3%	0.2%	0.8%	-0.8%	2.3%

* Source: 2001-2010, 2012-2017, 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
2016	175	5,889	162,313	96,081	157,894	15,518	17,991	455,861	302,572
2017	153	6,097	162,455	98,161	159,825	15,355	18,139	460,185	306,652
2018	144	6,246	163,695	99,880	162,145	15,033	18,370	465,513	311,017
Forecast									
2019	140	6,515	164,550	101,650	163,300	14,750	18,550	469,455	314,800
2024	120	7,925	162,800	102,300	168,400	14,650	18,300	474,495	321,400
2029	95	9,360	156,350	101,150	174,200	15,850	17,840	474,845	327,100
2034	80	10,680	149,100	99,650	180,800	17,550	17,420	475,280	332,200
2039	60	11,705	143,400	98,250	187,900	19,450	17,250	478,015	337,300
Avg Annual Growth									
2010-18	-4.7%	6.8%	-2.6%	-2.6%	1.7%	-0.3%	-1.8%	-1.1%	-0.3%
2018-19	-2.8%	4.3%	0.5%	1.8%	0.7%	-1.9%	1.0%	0.8%	1.2%
2019-29	-3.8%	3.7%	-0.5%	0.0%	0.6%	0.7%	-0.4%	0.1%	0.4%
2019-39	-4.1%	3.0%	-0.7%	-0.2%	0.7%	1.4%	-0.4%	0.1%	0.3%

** 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. As the implementation is very new and there is not sufficient data 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								TOTAL FUEL CONSUMED		
	PISTON		TURBINE		ROTORCRAFT						
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
2016	137	42	207	1,117	10	113	17	1	206	1,437	1,643
2017	138	41	198	1,204	10	139	16	1	206	1,541	1,747
2018E	138	41	201	1,270	10	142	17	1	208	1,613	1,821
Forecast											
2019	137	41	203	1,326	11	146	17	1	207	1,675	1,882
2024	125	41	213	1,551	12	155	18	2	198	1,919	2,117
2029	116	40	224	1,700	13	166	20	2	191	2,089	2,280
2034	108	39	238	1,807	14	176	21	3	185	2,221	2,406
2039	104	39	255	1,896	16	183	22	3	184	2,335	2,519
Avg Annual Growth											
2010-18	0.5%	-3.2%	0.9%	1.6%	-0.5%	1.6%	-3.2%	-1.6%	-0.7%	1.5%	1.2%
2018-19	-1.1%	0.3%	1.0%	4.4%	3.1%	2.4%	1.2%	5.6%	-0.4%	3.8%	3.3%
2019-29	-1.7%	-0.4%	1.0%	2.5%	2.2%	1.3%	1.6%	4.5%	-0.8%	2.2%	1.9%
2019-39	-1.4%	-0.3%	1.2%	1.8%	2.0%	1.2%	1.4%	3.9%	-0.6%	1.7%	1.5%

*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	25,578	1,292	1,203	2,495	49,722	264	252
2016	14,417	7,580	13,904	11,632	25,536	1,317	1,145	2,462	49,995	264	252
2017	15,047	7,179	13,838	11,732	25,570	1,326	1,200	2,526	50,322	264	253
2018E	15,686	7,126	14,130	12,354	26,485	1,319	1,155	2,474	51,770	264	254
Forecast											
2019	16,301	7,197	14,223	12,672	26,896	1,319	1,155	2,474	52,868	264	254
2024	19,093	5,484	14,412	12,870	27,282	1,319	1,155	2,474	54,332	264	254
2029	20,772	5,752	14,606	13,081	27,687	1,319	1,155	2,474	56,685	264	254
2034	22,653	6,047	14,806	13,300	28,106	1,319	1,155	2,474	59,281	264	254
2039	24,663	6,361	15,012	13,526	28,538	1,319	1,155	2,474	62,037	264	254
Avg Annual Growth											
2010-18	2.7%	-3.4%	-0.6%	0.7%	0.0%	0.1%	-1.5%	-0.7%	0.1%		
2018-19	3.9%	1.0%	0.7%	2.6%	1.6%	0.0%	0.0%	0.0%	2.1%		
2019-29	2.5%	-2.2%	0.3%	0.3%	0.3%	0.0%	0.0%	0.0%	0.7%		
2019-39	2.1%	-0.6%	0.3%	0.3%	0.3%	0.0%	0.0%	0.0%	0.8%		

Source: FAA Air Traffic Activity.

TABLE 33

TOTAL TRACON OPERATIONS

(In Thousands)

FISCAL YEAR	AIR CARRIER	AIR TAXI/ COMMUTER	GENERAL AVIATION	MILITARY	TOTAL
Historical					
2010	13,174	9,511	13,864	2,438	38,987
2015	13,948	7,861	13,076	2,286	37,171
2016	14,640	7,672	13,090	2,311	37,713
2017	15,276	7,281	13,276	2,254	38,085
2018E	15,900	7,216	13,513	2,260	38,888
Forecast					
2019	16,501	7,288	13,575	2,260	39,623
2024	19,263	5,321	13,777	2,260	40,621
2029	20,972	5,597	14,079	2,260	42,907
2034	22,856	5,903	14,401	2,260	45,419
2039	24,834	6,228	14,737	2,260	48,059
Avg Annual Growth					
2010-18	2.4%	-3.4%	-0.3%	-0.9%	0.0%
2018-19	3.8%	1.0%	0.5%	0.0%	1.9%
2019-29	2.4%	-2.6%	0.4%	0.0%	0.8%
2019-39	2.1%	-0.8%	0.4%	0.0%	1.0%

Source: FAA Air Traffic Activity.

TABLE 34

IFR AIRCRAFT HANDLED
AT FAA EN ROUTE TRAFFIC CONTROL CENTERS
(In Thousands)

	IFR AIRCRAFT HANDLED				
FISCAL YEAR	AIR CARRIER	AIR TAXI/ COMMUTER	GENERAL AVIATION	MILITARY	TOTAL
Historical					
2010	22,342	8,624	6,550	2,982	40,498
2015	25,270	7,847	7,007	1,795	41,918
2016	26,318	7,787	7,301	1,826	43,231
2017	26,074	8,591	7,428	1,765	43,857
2018E	26,692	9,055	7,407	1,726	44,880
Forecast					
2019	27,396	8,864	7,468	1,726	45,454
2024	30,503	7,791	7,671	1,726	47,692
2029	33,987	7,589	7,986	1,726	51,288
2034	37,476	7,725	8,358	1,726	55,285
2039	41,097	8,001	8,767	1,726	59,592
Avg Annual Growth					
2010-18	2.2%	0.6%	1.5%	-6.6%	1.3%
2018-19	2.6%	-2.1%	0.8%	0.0%	1.3%
2019-29	2.2%	-1.5%	0.7%	0.0%	1.2%
2019-39	2.0%	-0.5%	0.8%	0.0%	1.4%
Source: FAA Air Traffic Activity					