Emerging Aviation Entrants: Unmanned Aircraft System and Advanced Air Mobility

New Entrants: Analysis and Forecasts

This section of the Aerospace Forecast summarizes the drone forecasts. Additional details and accompanying analysis can be found in the UAS compendium.

https://www.faa.gov/data_research/aviation/aerospace_forecasts/Unmanned_Aircraft_Systems

Unmanned aircraft systems (UAS or drones) have been experiencing healthy growth in the United States and around the world over the past decade. The last few years have been no exception despite the profound impact of COVID-19 on the overall economy. A UAS consists of a remotely-piloted aircraft and its associated elements—including the ground control station and the associated communication links—that are required for safe and efficient operation in the national airspace system (NAS). The introduction of drones in the NAS has opened numerous possibilities, especially from a commercial perspective, such as package deliveries. That introduction has also brought operational challenges including safe and secure integration of drones into the NAS. Despite these challenges, the UAS sector holds enormous promise; potential uses range from individuals flying solely for recreational purposes to small businesses carrying out focused missions to large companies delivering commercial packages, infrastructure inspections and delivering medical supplies. Public service uses, such as conducting search and rescue support missions following natural disasters, are proving promising as well.

This section provides a broad overview covering recreational and commercial unmanned aircraft[11] of various sizes and their recent trends, as gathered from trends in registration, surveys, tracking overall market, and operational information. Using these trends and insights from the industry, the FAA produces several forecasts. Forecasts reported in the following sections are driven primarily by the assumptions of the continuing evolution of the regulatory environment, the commercial ingenuity of manufacturers and operators, persistent recreational uses, and underlying demand for drone services. The analyses in each section are enhanced by discussion of recent survey findings, data on imported equipment, remote pilots and waiver and exemptions of small UAS. Finally, an analysis of the new and emerging sector of Advanced Air Mobility (AAM) is provided together with some initial projections drawn

[11] These are also called, interchangeably, hobby or model and non-hobby or non-model UAS, respectively. On October 5, 2018, the President signed the FAA Reauthorization Act of 2018 (Pub. L. 115-254). Section 349 of that Act repealed the Special Rule for Model Aircraft (section 336 of Pub. L. 112-95; Feb. 14, 2012) and replaced it with new conditions to operate recreational sUAS without requirements for FAA certification or operating authority. The Exception for Limited Recreational Operations of Unmanned Aircraft established by section 349 is codified at 49 U.S.C. 44809 [see https://bit.ly/30tUf1Z for more details]. Recreational flyers, under Section 349, are referred to as “recreational flyers or modeler community-based organizations” [see https://bit.ly/2PUhMCI]. In previous notes including other documents of the Agency, these terms are often interchanged.

from FAA-sponsored and other research, government, and industry reports.

Small Recreational UAS

Given trends in recreational UAS registration and market developments, the FAA forecasts that the recreational small UAS market, which includes all UAS with weights greater than 0.55lbs and less than 55lbs operated for enjoyment, will saturate at around 1.88 million units over the next five years.[12],[13] However, there is still some upside uncertainty due to further changes in technology, including battery life, faster integration from a regulatory standpoint, and the likely event of continued decreasing prices. This leads to upside possibilities in the forecast of as many as 1.92 million units by 2028. In contrast, there are some low-side uncertainties, chief among them is the lack of renewals in the FAA's recreational registry (i.e., before and after the expiration dates), followed by expirations and cancellations in the registry.[14] The inertia, loss of interest, regulatory framework including implementation of remote ID requirements, or lack of recreational opportunities may be key factors leading to an observed decreasing trend in renewals. Nevertheless, if renewals are kept up over time, effective/active fleet would likely converge to the base-case forecast, i.e., derived from cumulative new registrations combined with estimates of aircraft ownership per registrant.

In the presence of slower renewal tendency, as registration data indicates, it is likely that the effective/active fleet will be lower than that derived from the base forecast. This provides the FAA with an opportunity to derive low-side forecasts using effective/active fleet calculations. Nonetheless, low-side uncertainty growth trajectory (i.e., annual growth rates) tracks closer to the base-case forecast in the outer years of 2027-2028. The base-case forecast (i.e., likely), together with high and low scenarios, is provided in the table below:[15]

[12] These forecasts have two dimensions worth emphasizing. When looked at from the cumulative base, "total" captures the number of drones that are reported to be in the system (i.e., base and high case); while "effective/active fleet" refers to aircraft that are presently operating in the system (i.e., low).

[13] As we extend the forecast time period by a year from 2027 to 2028 for rolling 5-year projections, the sector is expected to expand by around 60,000 from what we forecasted last year for 1.8234 million in 2027 to 1.8830 million in 2028. This trend is likely to continue due to secular growth in the sector.

[14] Recreational UAS operators are required to register with the FAA under 49 U.S.C § 44809. The code requires recreational flyers to register but does not require the registration of each aircraft flown by the recreational flyer.

[15] As noted earlier, low scenario reports effective/active fleet using a net gain/loss calculation. By definition, low-case scenario differs from base and high-case scenarios, which are based on new registrations only. Hence, a low scenario counting of fleet for the year 2023 is markedly different than the baseline and high-case scenario for the same year.

	Total Recreation/Model Fleet (Million sUAS units)			
	Calendar Year	Low*	Base**	High**
Historical	2023	0.5573	1.7768	1.7768
Forecast	2024	0.5557	1.8264	1.8308
	2025	0.5832	1.8470	1.8674
	2026	0.6092	1.8673	1.8913
	2027	0.6213	1.8787	1.9075
	2028	0.6288	1.8830	1.9208
'*': effective/active fleet counts combined with multiplicity of craft ownership;				
'**': new registration counts combined with multiplicity of craft ownership;				

Last year, the FAA forecasted that the recreational small UAS sector would have around 1.75 million drones in 2023 in base case (i.e., new registrations), a growth rate exceeding 3.7% from the year before (2022). Actual data for 2023 came in higher by 26,613 units with around 1.78 million units accounted for by the end of 2023. Thus, our forecast of recreational small UAS last year undershot by around -1.50% for 2023, (1.78 million aircraft observed in 2023 vs the 1.75 million aircraft forecasted in the previous Aerospace Forecast). In contrast, our last year's forecast of the low-case scenario stood at around 620,472 for 2023. In reality, actual data came to be 557,300 (or around 63,000 lower). Thus, our previous forecast of the lower-range scenario overshot the actual data by over 11%.

The FAA uses the observed trends in registrations, particularly over the past year; the calculation of net gain/loss of registrants this year; information collected from a survey conducted in 2018 and the Survey of UAS Operated conducted in 2023; expert opinions distilled from Transportation Research Board annual workshops; review of available industry forecasts; market/industry research; and time-series models fitted on monthly data underlying annual data reported in the above table. These apply to all three elements reported above: low, base, and high-case forecasts. Using these, the FAA forecasts that the recreational small UAS fleet will likely (i.e., base-case scenario) maintain its peak with average or trend growth over the next five years, from the present 1.78 million units now to approximately 1.88 million units by 2028 thus attaining a cumulative annual growth rate of 1.2% during 2023-2028. In the previous Aerospace Forecast, the cumulative annual growth rate for small recreational UAS was reported to be 1.6% for 2022-2027.

Following somewhat different growth trajectory than the base or high growth scenarios, there will likely be approximately 628,800 active/effective small UAS (or, 71,500 more than what was observed during 2023) over the next five years in 2028, which is now the low-case scenario forecast for recreational/model small UAS. This ensures a cumulative annual growth rate of 2.4% during 2023-2028. Active/effective fleet count is derived and projected based on the net gain/loss of recreational registrants; hence, the rate influencing lower forecasts growth is different than the base-case forecast, which is derived using new registrations. The high-case scenario, on the other hand, may reach as high as 1.92 million units (or, 1.6% cumulative annual growth rate). The high-case scenario projection is based on the trends in the base-case forecast.

Notice that the saturation of the market is at a higher level in comparison to the previous Aerospace Forecast, reflects continued new registrations, *albeit* at a slower rate, by recreational flyers observed during 2023 and the shift of the forecast horizon by a year. The increased new registration trend, in partly driven by COVID-19, may or may not continue in the longer run.[16] In comparison, the low-case scenario forecast assumes the present trend in renewals combined with new registrations followed by similar expirations and cancellations trends. Nevertheless, the growth rates underlying these numbers are fairly steady in the initial years but fade faster in the last two to three years. The gradual saturation that is projected in five years and beyond in the recreational small UAS fleet parallels other consumer technology products and the Agency's projections from the last few years, particularly with respect to base and high-case forecasts. However, both the numbers and the growth trajectory for the low-case scenario (i.e., effective/active fleet) are fundamentally different than years earlier compared to the past couple years for reasons described above. Nevertheless, it provides a lower bound that is likely to be closer to reality in terms of small UAS that are in use and operationally active in the NAS.

Commercial/Non-Model Aircraft

Last year, the FAA forecasted that the commercial UAS sector, which includes all UAS with weights greater than 0.55lbs and less than 55lbs operated for non-recreational purposes, would include over 805,000 small UAS in 2023 for the base case, a growth rate exceeding 11% over the previous year (2022). Actual data came in over 842,000 aircraft by the end of 2023. Our forecast of commercial small UAS in the previous Aerospace Forecast thus undershot (around -4.4%) for 2023 (or 842,460 actual aircraft vs 805,448 projected aircraft). In the low-case scenario, the FAA forecasted 349,000 units to be effective/active for the year 2023 in the previous Aerospace Forecast; but in reality, the number was around 361,000 thus undershooting the lower-case scenario by -3.3%. Forecasting in a time of tremendous uncertainty is indeed challenging, especially given the economic slowdown during COVID-19 and its impact on the UAS sector. The commercial small UAS sector's fast growth and adjustments during the pandemic demonstrate this fact. Nevertheless, the errors of our forecast for both recreational and commercial small UAS appear to be within the bounds of reasonableness.

[16] It is quite likely that many users were buying and experimenting with recreational small drones given the COVID-19 public health emergency and the substantial portion of the workers presently working from home. This trend may or may not continue once regular work patterns resume.

Total Commercial/Non-Model Fleet (Thousand sUAS units)				
Calendar Year		**Low***	**Base****	**High****
Historical	2023	361	842	842
Forecast				
	2024	369	951	960
	2025	371	1032	1050
	2026	372	1083	1113
	2027	373	1110	1152
	2028	374	1122	1176
'*': effective/active fleet counts.				
'**': new registration counts based fleet counts.				

The FAA uses the trends observed in part-107 registrations during previous years, calculation of net gain/loss from the part-107 registry, information from the survey conducted in 2018 and again this year, a review of available industry forecasts/workshops, and past FAA Drone Symposiums, and FAA-sponsored research.[17] Using these data sources and with the help of a time series model fitted onto the monthly data, the FAA forecasts that the commercial UAS fleet will likely (i.e., base-case scenario) exceed the million aircraft mark with around 1.12 million by 2028. This is 1.3 times larger than the current number of new commercial small UAS.[18]

Using low-case scenario or effective/active fleet, the FAA forecasts an expansion of the small UAS fleet by 12,800, 1.03 times larger than the currently calculated effective/active fleet of around 361,000 units.[19] As the present base-case scenario (i.e., the cumulative total) increases, the FAA anticipates the growth rate of the sector will slow down over time, and the effective/active fleet will likely catch up with the growth trajectory of new registrations. Nevertheless, the sector will be much larger than what was understood only a few years earlier.

In order to understand the growth trajectory of the sector better, this report makes use of two categories of commercial UAS: consumer grade and professional grade aircraft. Consumer-grade commercial UAS have a wide range of prices, below $10,000 with an average unit price of approximately $1,500.[20] The professional grade, on the other hand, is typically priced above $10,000 with an average unit price assumed to be around $30,000.[21] For both consumer-grade and

[17] See https://bit.ly/432Gxn5.

[18] Last year, the ratio of end-year forecast to base-year forecast was 1.31-times. That is, the FAA forecasted end-year to be 1.31 time base year's (2022) numbers in 5-year (2027). Higher forecasts are often the result of improved regulatory environments, as noted below, and environments following the process of rule-making evaluation (See fn. #30-33 for these).

[19] This is driven by the combined effects of projected underlying growth rates of cancellations, expiry, new registrations, and renewals.

[20] See https://tinyurl.com/5dswkz6b for more details.

[21] Because of this wide range in prices between types of small drones in commercial activities, start-up costs for a business may vary between $2,500 and $30,000.

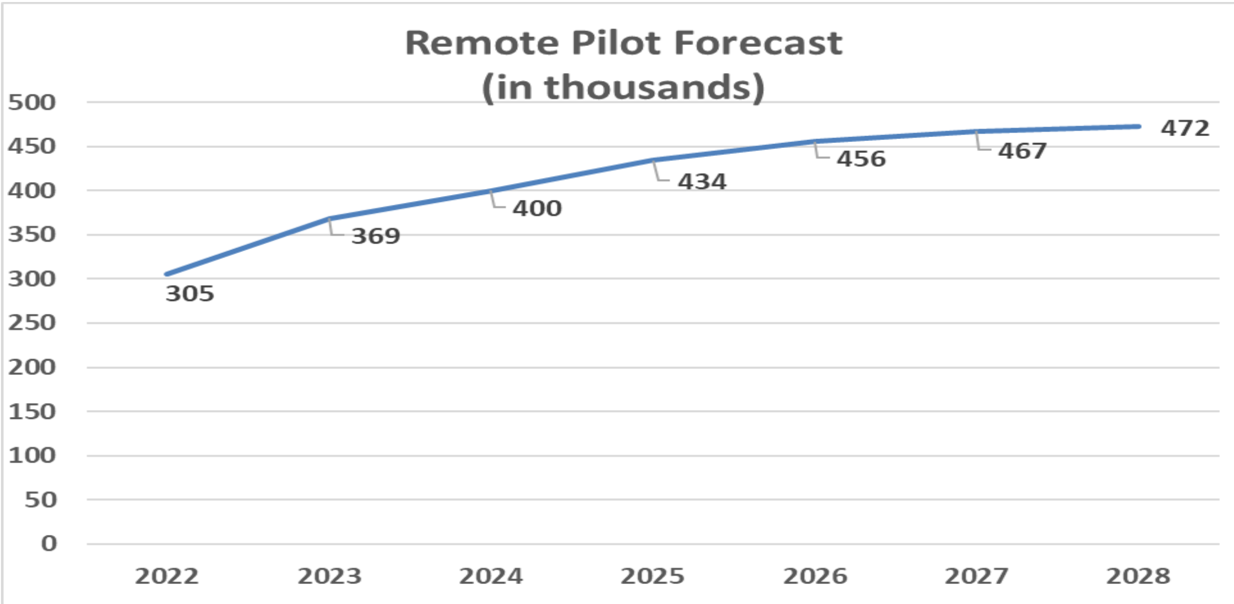
professional-grade UAS, the average price has fallen over time, particularly over the last few years. Currently, the consumer grade dominates the commercial UAS sector, with a market share approaching 90%. However, as the sector matures and the industry begins to consolidate, the share of consumer grade commercial UAS is likely to decline, though it will still be dominant.

At present, the sector has numerous uses, primary among them is the general photography and real estate. While real estate draws chiefly from the Part 107 registrants, general photographers are often drawn from recreational registrations. Despite this difficulty in using strict definition, it is instructive to note that the distribution of industries/businesses reported by Part 107 operators, and to some extent, recreational flyers, match the distributions reported by the Teal Group[22]

US Commercial Market (Units)		
Units (Air Vehicles) in 2023	Total	Percent-ages
Construction	29,000	3.96%
Energy	22,220	3.03%
Agriculture	43,000	5.86%
Communications	300	0.04%
Insurance	10,250	1.40%
Gen. Photography/Real Estate	600,300	81.88%
Other Industrial Inspection	7,600	1.04%
Entertainment	20,000	2.73%
Delivery	500	0.07%
Total	733,170	100.00%

[22] https://tinyurl.com/5dswkz6b

Remote Pilots



An important final metric in commercial small UAS is the trend in remote pilot (RP) certifications. RPs[23] are used primarily to facilitate commercial and public use small UAS flights, as discussed in the preceding section. As of December 2023, a total of 368,883 RP certifications had been issued, an increase of almost 64,000 from the same time last year (2022) and almost 120,000 higher than the year before in 2021.

Given the actual numbers of RPs at the end of 2023, RPs are set to experience tremendous growth following the growth trends of the commercial small UAS sector. Starting from the base-case scenario of 368,883 RPs in 2023, commercial activities may require over 472,269 RPs in five years, a 1.3-fold increase that may provide tremendous opportunities for growth in employment—over 103,386 new RP opportunities—associated with commercial and public use activities of small UAS. Potential for RPs may enhance even more if larger UAS are used in commercial activities.

Large UAS

Part 107 limits the gross takeoff weight of unmanned aircraft to below 55lbs, which categorizes these aircraft as small UAS. Thus, UAS with gross takeoff weights above 55lbs must operate under separate rules and are thus considered a separate category of UAS for this forecast, which we refer to as simply large UAS (lUAS). Since these lUAS are not type certified and do not fall under the Part 107 operating rules, operation of these aircraft require a section 49 U.S.C § 44807 exemption or a public aircraft operator (PAO)

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

certification.[24] In addition, the FAA requires IUAS operating under a 44807 exemption or PAO to receive a tail number by registering the unmanned aircraft in the part-47 aircraft registry.[25] As such, the IUAS fleet and operations can be separated from the forecast of small UAS, which utilizes the recreational and part-107 registries.

Since IUAS are required to register with the Part-47 Aircraft Registry (PAR), we can use the PAR to estimate the IUAS active fleet. Using the Aircraft Reference file from the publicly available PAR, we identify the IUAS in the Aircraft Registration Master file and the Deregistered Aircraft file from which we calculate the active fleet of IUAS.[26] In 2023, 1,066 new IUAS aircraft were added to the PAR, a 174 percent increase from 2022. Sixteen percent of aircraft registered at the end of 2022 (173) were delisted in 2023, producing an active fleet of 2,311 IUAS by the end of 2023.

With robust demand for IUAS operations indicated by a rapid increase in the 44807 exemptions granted, we expect the growth of new IUAS over the next five years to keep pace with the growth observed in 2023. As such, we expect 14,859 new IUAS will be added to the PAR in 2028, with a total active IUAS fleet of over 24,000 aircraft by the end of 2028. This forecast assumes that 44807 exemptions, or an equivalently permissive rule, remains in place until 2028. However, the uncertainty regarding the availability of the 44807 exemptions presents a headwind for the expansion of the IUAS sector.

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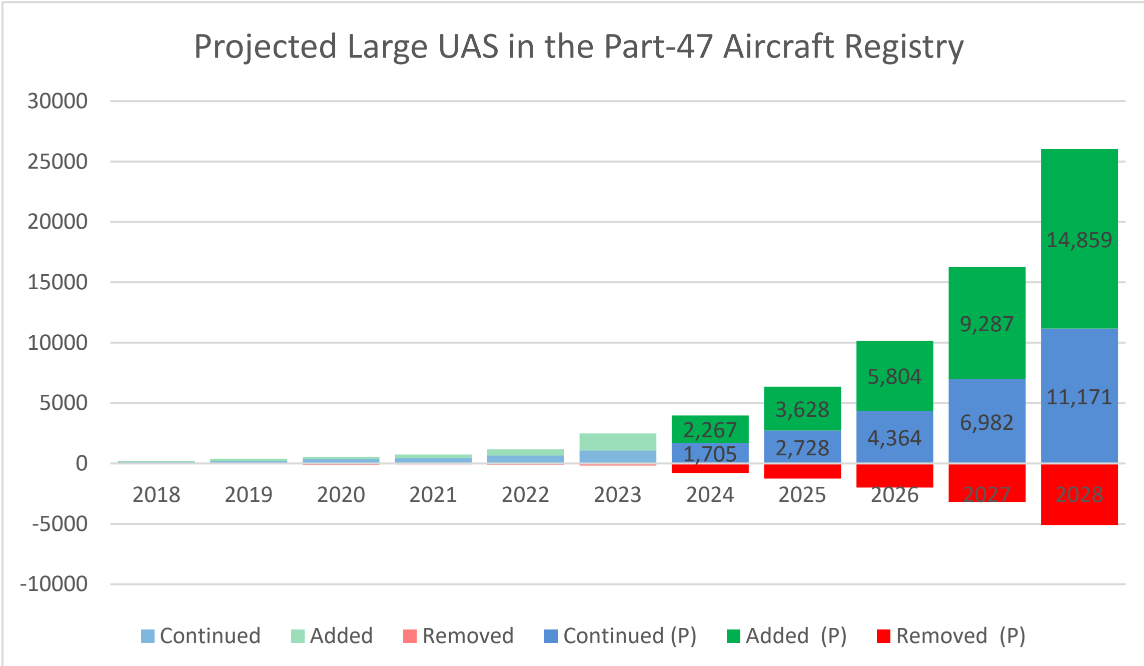
24 See bit.ly/3KxiuVX for more details.
25 See bit.ly/3ZIcCxJ.
26 The Public Aircraft Registry data for 2022 is available at https://bit.ly/433iqET. Unmanned aircraft are separated from manned aircraft using the “NO-SEATS” field in the Aircraft Reference file. The “AC-WEIGHT” field is used to remove all small unmanned aircraft, and the “TYPE-ACFT” field is used to remove all lighter-than-air aircraft, including blimps and balloons. The remaining codes – held within the “CODE” field – are matched with the “MFR MDL CODE” in the Aircraft Registration Master file and the Deregistered Aircraft file, and adjusted based on the “STATUS CODE” field. The remaining aircraft are sorted for the year the registered using the “CERT ISSUE DATE” or “LAST ACTION DATE”. The count of new registration, older registrations, and delisted registrations are used to construct the active IUAS fleet.



Advanced Air Mobility

In September 2017, NASA launched a market study for a new segment of aviation. This segment of piloted electric and vertical takeoff and landing (eVTOL) vehicles with progressively remote-piloted or automated control options, broadly called AAM, is defined as "a safe and efficient system for air passenger and cargo transportation, inclusive of small parcel delivery and other urban drone services, which supports a mix of onboard/ground-piloted and increasingly-autonomous operations."[27] [28] Urban air mobility (UAM), contained within the broader AAM category, is thus envisioned as a transportation system that is likely to use piloted and progressively automated aircraft to transport passengers and cargo at lower altitude within urban and suburban areas. AAM/UAM aircraft are expected to adopt electric engine and vertical takeoff and landing technologies to improve operability in urban settings.

Despite many regulatory and technological issues and given the fact that the AAM services have not yet begun using this new type of aircraft within the US, projection of AAM demand, at best, is challenging and somewhat hypothetical and arbitrary.[29] Nevertheless, drawing from FAA-sponsored research

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

[28] See https://go.nasa.gov/40Y4hXM.

[29] As reported throughout this document, the FAA routinely forecast sectors (i.e., manned and unmanned air transportation) for which services exist, and therefore, a great deal of data exist. For AAM services using eVTOLs, neither services nor data are available at present. However, a great

and other market analyses, we provide an estimate of a base-case scenario (likely; or potential adjusted by above-discussed risk factors) and lower-range scenario for departure forecasts for the hypothetical years of one through six after these aircraft enter into service[30] in the table below:

	Departure Forecasts*					
	Year1	Year2	Year3	Year4	Year5	Year6
Base	295,530	494,637	827,887	1,385,657	2,319,213	3,881,730
Low	206,871	346,246	579,521	969,960	1,623,449	2,717,211

*': Base (risk-adjusted potential) is based on linear interpolation of ASSURE forecasts;
Low forecast is 30% lower than base forecasts.

In May 2022, the FAA announced that it will certify winged eVTOL aircraft, which suits AAM/UAM operations, as powered-lift aircraft as “special class” under its 14 CFR 21.17(b) regulations, rather than under the 14 CFR Part 23 rules used for small fixed-wing aircraft.[31] This change comes after the FAA has previously accepted several G-1 certification basis issue papers from eVTOL companies with the understanding that Part 23 rules, supplemented by special conditions, were applicable. In December 2022, the proposed airworthiness criteria for the Archer Midnight aircraft were published in the Federal Register by the FAA.[32] These announcements suggest that the regulatory landscape is evolving to accommodate AAM into service. An example of this evolution is that the FAA has proposed a Special Federal Aviation Regulation (SFAR), ‘Integration of Powered-Lift: Pilot Certification and Operations,[33] to establish temporary operating and pilot certification regulations for powered-lift.

However, to account for regulatory uncertainties, only two scenarios that are comparable and drawn from FAA-sponsored research projections, base and low-case forecasts are reported in the table above.[34]

deal of need, particularly for planning and allocation of scarce resources, leading to understanding the sector and its future trends is now essential. To meet these needs, the FAA is providing the forecasts for overall guidance. We plan to update and revise these forecasts once services begin and data become widely available.

[30] Many in the AAM community identifies 2025-2027 as likely point of entry in time [see https://tinyurl.com/5n7yzbvy for an analysis] but it depends on numerous factors, some of which have been outlined above. Depending on resolution of these issues and business case for AAM continues to hold, service may begin in 2025-2027 or soon thereafter. Furthermore, we keep the forecast horizon short to Year 6 afterwards because the industry will undergo rapid changes once it begins service due to inherent dynamism and promises it holds. Hence, we keep the forecast horizon short so that we can learn from the data and revise the projected numbers and growth trajectories annually on a rolling basis, like in case of UAS sector, drawing from concurrent developments.

[31] See https://bit.ly/3UbsyqZ. At present, FAA operating rules apply to five operational categories and associated aircraft: domestic, commuter, flag, on-demand and supplement carriers. Through the powered-lift NPRM, provided it is finalized, the FAA is proposing adding powered-lift to the list.

[32] See https://bit.ly/436vucv for more details.

[33] See https://bit.ly/3Mi3f4O for more details.

[34] Higher scenarios will be determined by many factors including the growth trajectories following EIS, types of missions/services, expansion into many metro areas, number of departures and passengers, commercial success, and success-

Given the Entry Into Service (EIS) in Year 1-2, likely departures may reach a level of 295,530 to begin with to a cumulative 790,000 in the base-case scenario within a couple year. Assuming EIS successful, AAM departures will then likely accelerate and reach almost 3.9 million a year in a very short time (i.e., by the end of Year 6), provided outstanding integration issues involving new entrants have been appropriately addressed and resolved. In the lower-case scenario estimate, the likely departures are expected to be around 207,000 to a level of 553,000 cumulatively by Year 2. It may likely reach around 2.7 million by end of the projection in Year 6.

Although there are several aircraft under development for the AAM/UAM market[35] , we assume relatively low load factors (e.g., 2-3 passengers per departures for lower and base cases, respectively).[36] Using this assumption, the number of passengers corresponding to the departure scenarios may be calculated and are reported in the table below:

	Passenger Flow* Corresponding to Departures					
	Year1	**Year2**	**Year3**	**Year4**	**Year5**	**Year6**
Base	**886,590**	**1,483,910**	**2,483,661**	**4,156,972**	**6,957,638**	**11,645,190**
Low	**413,742**	**692,491**	**1,159,042**	**1,939,920**	**3,246,898**	**5,434,422**

*': 3 passengers per departure and 2 passengers per departures corresponding to base and low forecasts, respectively.

Starting from an anticipated 887,000 passengers annually, a cumulative 2.3 million passengers may be reached soon after EIS by Year 2 in the base-case scenario or risk-adjusted potential scenario. In the lower-range scenario, passenger levels may reach a cumulative of 1 million passengers by Year 2 driven by the assumption of lower number of departures and low load factors.

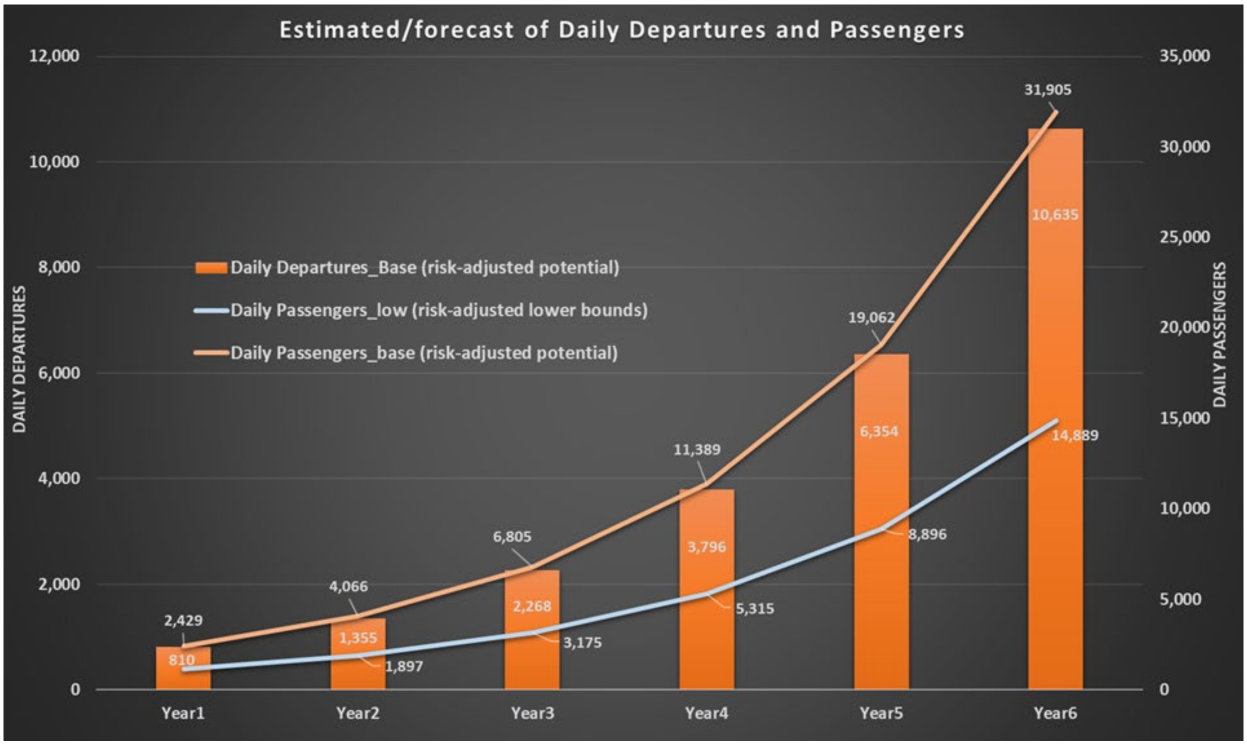
Translating the above annual numbers to daily departures/passengers (e.g., total departures and passengers divided by 365

ful integration into NAS. Due to much higher levels of impending uncertainties on the upside, we are leaving the upper level of forecasts out of these initial projections.

[35] It is not conclusive to what extent lower overall load factors (e.g., dead-heading back from revenue missions) and lower utilization will impact business cases negatively and thus may jeopardize services altogether. Many assumptions have been made, and at this point, the FAA is not certain how pricing, lower load factors or utilization of aircraft, types of services and market adoption, supply chains, funding, manufacturing and role of operating partners, infrastructure including access to airspaces and airports/vertiports will ultimately impact the business cases of AAM services. As more information become available in the future via research, and information from the industry, we plan to improve on these initial projections going forward.

[36] Generally speaking, eVTOLs are assumed to have, for majority of vehicles that have been presently designed (over 200), one to four passengers with one pilot on board. On average, trips are expected to have a passenger load of three riders for airport shuttle, as reported by market studies accounting for the shared route model of Air Metro [see https://bit.ly/40Wik0t]. The base case reported in the table (i.e., 3 passengers) draws on this recent finding. However, air taxi is expected to have much lower passenger load (1 passenger) due to on-demand nature of services and associated mobility flexibility.

days), in the base-case scenario, we calculate a few hundred departures transporting a few hundreds to around 2,400 passengers daily to begin with in Year 1. Around 2,100 cumulative daily departures transporting around 3,000-6,500 cumulative passengers (i.e., lower to base cases, respectively) may be attained soon after by Year 2. It may reach a level of over 10,000 daily departures in base case transporting around 15,000 daily passengers in lower-range scenario to around 32,000 in base-case scenario in Year 6.



Despite our efforts to provide initial projections of the AAM sector, there are numerous factors that may possibly create a shroud of uncertainty around the numbers discussed above. One of the major challenges of eVTOL entering the AAM marketplace is infrastructure. In a recently published report, GAO (2022)[37] estimates that for smaller metropolitan areas (1.5-2.5 million population), 6 vertiports will be needed while for larger metro areas (7-10 million population), the numbers may go up as high as 77. Total estimated ground cost for smaller metro areas have been estimated to be $50 million while for larger metros, it is almost 5-times higher at $240 million. ASSURE (2022) reported that an estimated 75-300 vertiports will be required for each metro area. In total, ASSURE estimates 2,500-3,500 vertiports will be needed to establish a mature AAM passenger network nationwide in the US. Costs in-

[37] GAO (2022): Transforming Aviation: Congress Should Clarify Certain Tax Exemptions for Advanced Air Mobility; GAO-23-105188.

volving setting up such a network will be expensive as reported in GAO report and elsewhere:[38]

FAA-sponsored research estimated revenues from AAM/UAM operations to be modest; at around $150 million in around 2025-2026 that is likely to reach around $2.7 billion in 2030. Combining these revenue projections with departure and passenger forecasts reported above, average fare per passengers is calculated to be around $80-$120 corresponding to base and lower-range cases, respectively. Recent service announcement[39] implies price (i.e., around $136-$200 for a full cabin of 4 passengers or $34-$50 per person] to be around half that ASSURE-implied prices calculated from revenue estimates.[40]

AAM services are likely to face stiff competition from technological advances in industries with close substitutes, such as ground transportation (i.e., emerging automated solutions on increasingly electric-powered vehicles). Furthermore, economic and financial tradeoffs underlying the emergence of AAM may have changed following COVID-19, changing travel patterns and perhaps long-term living arrangements. Finally, the high costs of urban infrastructure, community acceptance, associated noise, and environmental issues pose considerable challenges to greater adoption.

As eVTOL aircraft enter service for AAM operations, new initiatives will be undertaken with new missions envisioned and operationalized. The FAA, together with numerous stakeholders including the industry, and NASA will be keeping a keen eye on understanding overall trends in AAM. It is likely that AAM services will become a reality in the US by 2025-2027 and will become incrementally available in urban and suburban areas followed by an accelerated growth trajectories targeted to reach farther and distant travel destinations and routes over time. With this anticipated travelscape is imagined and drawn over the next few years as more information becomes available, the FAA will revise emerging trends and forecasts for AAM reported in this section in the near future.

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[38] See ASSURE (2022) for a detailed discussion drawing on the existing literature.

[39] See https://bit.ly/3ZMllPb. Furthermore, Blade with existing services in many parts of the country including the NYC reported first successful completion of a historic piloted test flight of BETA's ALIA-250 electric and vertical aircraft (EVA) at the Westchester County Airport in White Plains, New York on February 14, 2023. Blade reported it to be a significant milestone towards transition from its use of helicopters to EVA in the near future [see https://bit.ly/3lZgAUY for more details].

[40] Research studies, industry reports and analysis tend to suggest a broad range of price estimates with varying effects on AAM demand: $2.25 per seat mile to as much as $11 per seat mile as summarized and reported here: https://bit.ly/3KySwS6.