



COMPENDIUM TO
FAA AEROSPACE FORECAST
FY 2025-2045
EMERGING AVIATION ENTRANTS:
UNMANNED AIRCRAFT SYSTEMS
AND ADVANCED AIR MOBILITY

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Introduction

Technological advancements in materials, avionics, airframes, fuel types, and engines have created new types of aircraft and enabled novel operations in the National Airspace System (NAS) over the past decade. These new entrants are enhancing the productivity of the United States, creating high-skilled jobs, and reshaping the future of aviation. President Trump issued Executive Orders (EO) 14305 and 14307, directing Federal agencies to enhance integration of Unmanned Aircraft Systems (UAS) into the NAS.¹ Congruent with and in support of Unleashing American Drone Dominance (EO 14307), this compendium analyzes data, provides context, and extrapolates the potential future of these new entrants. The findings and analyses provided within empower decision makers and American industry to accelerate the safe commercialization and integration of these new aviation entrants into the NAS and continue to scale up domestic production to strengthen UAS supply chains.

Although many new technologies are emerging in aviation, this document focuses on two maturing categories: UAS and Advanced Air Mobility (AAM). Both new entrants have shown maturing operations or significant market potential. As such, forecasts and supporting analyses have been developed to help prepare air traffic controllers, regulators, and the aviation industry for UAS and AAM's increased demands on the NAS.

An abridged version of the Emerging Aviation Entrant Compendium is available in the Emerging Aviation Entrant section of the FAA Aerospace Forecast.² The Compendium, however, includes more detailed forecasts, additional supporting research, and further industry context compared to the FAA Aerospace Forecast. In addition, the Compendium includes novel and developing forecasts for segments of aviation that are not addressed in the FAA Aerospace Forecast. As such, the Compendium can be viewed as an expanded analysis of and conversation about the forecasts presented in the Emerging Aviation Entrant section of the FAA Aerospace Forecast.

Unmanned Aircraft Systems

1.1 Analysis and Forecasts

Unmanned aircraft systems (UAS or drones) have been experiencing healthy growth in the United States and around the world over the past decade. A drone 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 NAS.³ The introduction of drones in the NAS offers numerous potential benefits, especially from a commercial perspective

¹ Unleashing American Drone Dominance (EO 14307; June 6 2025); Restoring American Airspace Sovereignty (EO 14305; June 6 2025)

² FAA Aerospace Forecast, Fiscal Years 2025-2045, Jun. 2025, https://www.faa.gov/data_research/aviation/aerospace_forecasts/FY-2025-2045-Full-Forecast-Document-and-Tables.pdf

³ The terms “unmanned aircraft system” and “drone” have the meaning given to the term “unmanned aircraft system” in 49 U.S.C. 44801(12).

e.g., package deliveries. However, this also introduces operational challenges, including the safe and secure integration of drones into the NAS. Despite these challenges, the drone sector holds enormous promise; potential uses range from individuals flying for recreational purposes to individual businesses carrying out infrastructure inspections to large companies delivering medical supplies. Public service uses, such as conducting search and rescue following natural disasters, are proving promising as well.

Growth trends for recreational and commercial unmanned aircraft⁴ are discussed below and are demonstrated in registrations, surveys, tracking of the overall market, and operational information. The reporting period examines data up to the end of 2024. FAA produces several forecasts using these UAS industry insights. Forecasts reported in the following sections are influenced by the continuing evolution of the regulatory environment, the commercial ingenuity of manufacturers and operators, persistent recreational uses, and underlying demand for drone services.

Recreational and commercial drone use is discussed below, enhanced by discussion of recent survey findings and data on imported equipment, remote pilots, waivers, and exemptions of small UAS (sUAS). This is followed by analysis and forecasts of large UAS (referred to as LUAS in this document). Finally, an analysis of the new and emerging sector of Advanced Air Mobility is provided with some initial projections drawn from FAA-sponsored research, other research, and government and industry reports.

1.2 Recreational/Model UAS

The FAA's online registration system for recreational/model small drones went into effect on December 21, 2015. This required all drones weighing more than 0.55 pounds (or 250 grams) and fewer than 55 pounds (or 25 kilograms) to be registered using the on-line system or the existing (paper-driven) aircraft registry. Registration was free for the first 30 days and \$5 thereafter. Following a temporary halt in registration due to an order from the US Appeals Court in Washington, DC, in May 2017 (Taylor v. Huerta), the registration requirement for all model aircraft was reinstated in December 2017 with the National Defense Authorization Act (NDAA) [Pub. L. 115-91, Sec. 1092]. The NDAA extended the registration for three years for those registered prior to December 2017. New registration resumed after the temporary halt was removed. On May 16, 2024, the FAA Reauthorization Act of 2024 (Public Law 118-63) was enacted, which formalized new conditions for recreational use of drones.⁵

⁴ These are also called, interchangeably, hobby or model and non-hobby or non-model UAS, respectively. See the Exception for Limited Recreational Operations of Unmanned Aircraft codified at 49 U.S.C. 44809 for more details [<https://www.federalregister.gov/documents/2019/05/17/2019-10169/exception-for-limited-recreational-operations-of-unmanned-aircraft>]. Recreational flyers, under Section 349, are referred to as "recreational flyers or modeler community-based organizations" [see <https://www.federalregister.gov/documents/2019/05/17/2019-10169/exception-for-limited-recreational-operations-of-unmanned-aircraft>]. In previous notes including other documents of the Agency, these terms are often interchanged.

⁵ See <https://www.faa.gov/about/reauthorization> for more details.

At the end of 2024, over 1.61 million recreational drone owners were registered with the FAA.⁶ On average, new owner registration stood at around 5,810 per month with some expected peaks during the holiday seasons and summer. In 2023, the average new owner registration was 6,053 per month compared to 7,866 per month in 2022.

As evident, the current pace of new registration (and, presumably, sales of drones requiring registration) has decreased compared to last year in the same period; average new monthly owner registration during 2024 stood at 243 less than observed the year before in 2023. In comparison to the year before, in 2023, the number stood at 1,813, which was also less than the year before, in 2022. This trend has been continuing over the last few years. We expect this trend to continue over the forecast horizon for the next five years.

However, cumulative registrations may overstate the current fleet of sUAS in the United States by ignoring registrants who have cancelled or let their registrations expire. If the cancelled and expired registrations are removed, we obtain the effective or active number of registrants. This estimate of effective/active registrations is a theoretical lower bound to the number of operators, given that a portion of the expired registrations was not intentional, and the operator is flying their drones or model aircrafts. A comparison chart (Figure 1) capturing the difference between cumulative new registrations and effective/active registrations is provided below covering the entire period of 2022-2024:⁷

⁶ For our estimate and projections using the registration database, applied to recreational, commercial/Part 107 and remote pilots, we use only those who are registered in the US and the territories for the period January – December 2024.

⁷ The effective/active registrations estimate is calculated using the cumulative net gain/loss process detailed in the appendix of this document. There are two important aspects making the difference between cumulative new registrations and cumulative net gain: (a) the base; and (b) the rate of change in the two lines. For cumulative net gain/loss, the base is highly influenced by substantial expiry and cancellations implemented in December 2020, as discussed above; the rates of change (or slope) of the cumulative net gain/loss line are influenced by these two elements plus new registrations and Renew+ re-registrations. In comparison, new registration counted cumulatively has a substantial base, thus accounting for the difference between the two lines, while new monthly registrations are the primary factor driving the rate of change (or slope) for the cumulative new registrations line.

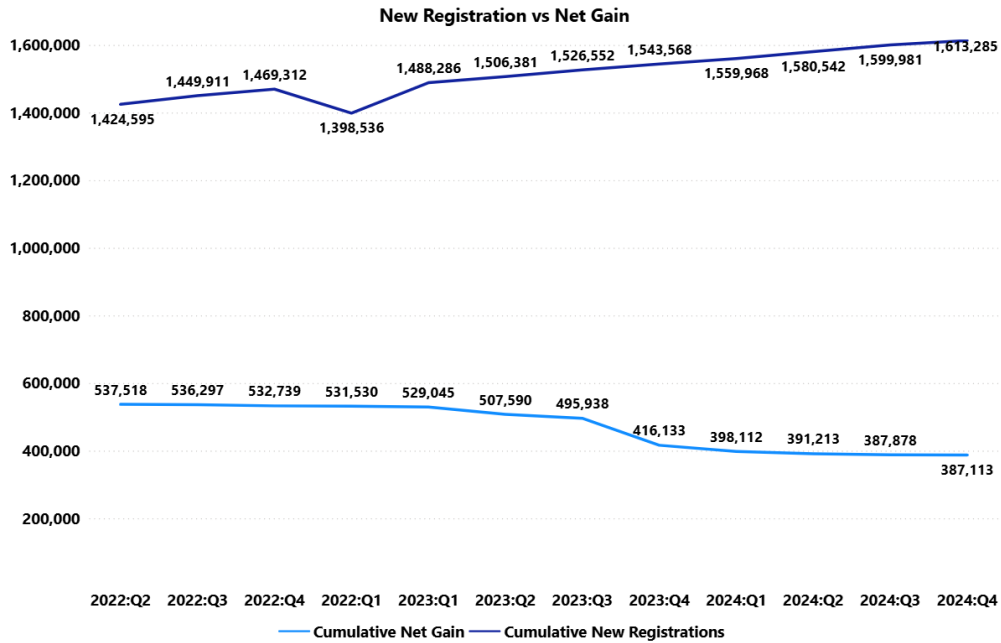


Figure 1

Using the data available in December 2024, the spatial distribution of recreational ownership by zip code (Figure 2) demonstrates that small drones continue to be distributed throughout the US, with denser ownership mapping closely to the population centers or densities of the zip codes, as expected.

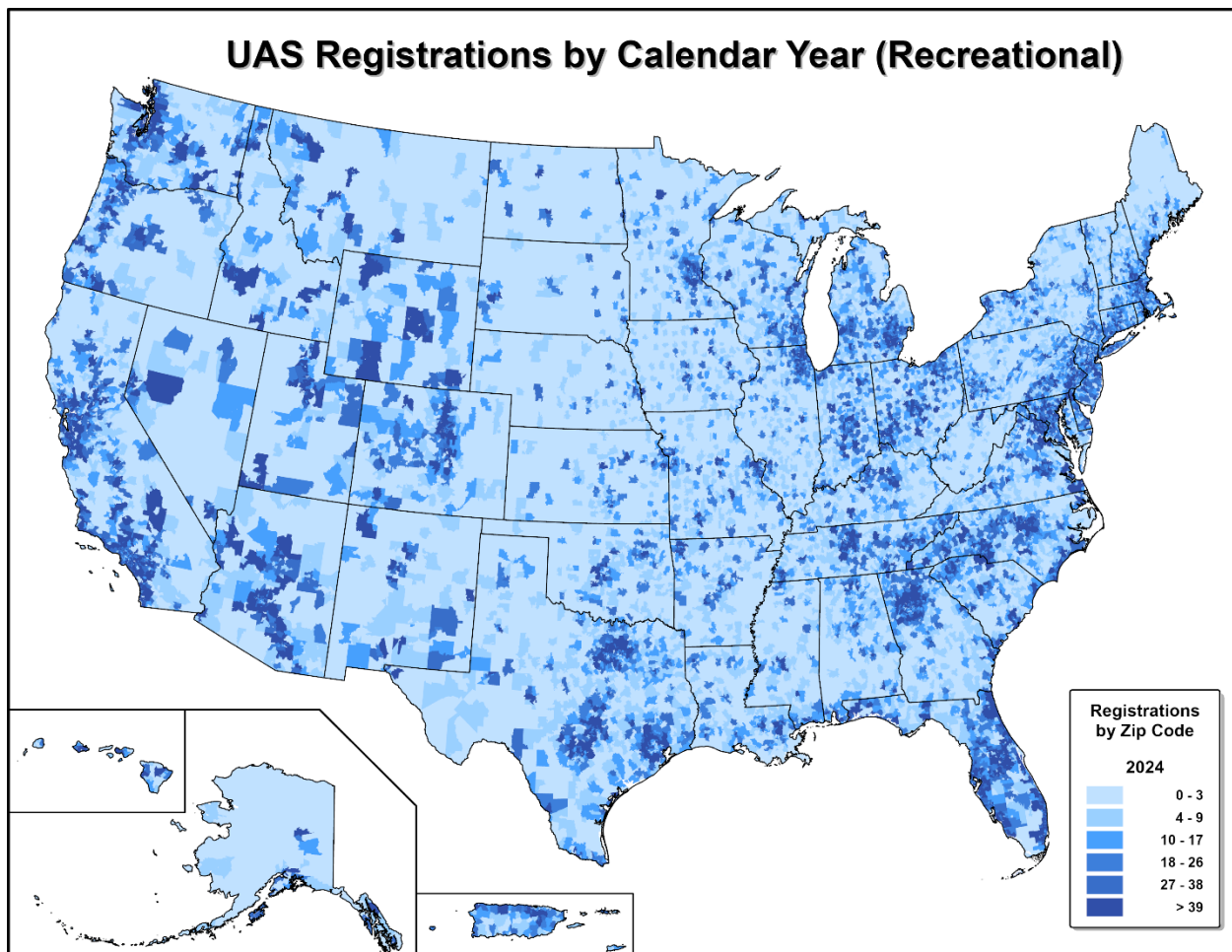


Figure 2

At present, recreational drone ownership registration does not correspond one-to-one with individual drones. Unlike their commercial non-model counterpart, the registration rules for recreational operators do not require owners of recreational small drones to register each individual aircraft; only operators are registered.⁸ For each registration, therefore, one or more aircraft may be owned. In some instances, there is no equipment associated with registration. Notwithstanding these challenges, there is information available, from industry, academia, and surveys, allowing us to understand aircraft ownership. Furthermore, because of robust strategic drone research planning, the FAA has launched various research projects to understand the size and scope of the sector, implications for aircraft that may be used for recreational flying, as well as the potential safety impacts of drone integration into the NAS. Finally, the agency has incorporated outside analyses and launched surveys⁹ to understand the magnitude of the sector including forecasting efforts.

Previous forecasts for small drones were based primarily on new registrations without considering the effective/active fleet. Now that data elements (i.e., expiry, cancellations, new registration and

⁸ https://www.faa.gov/uas/getting_started/register_drone

⁹ Survey and results are reported below.

renewals) are available, more granular forecasts can be made, particularly the lower estimates, using the calculation of effective or active fleet.¹⁰

With over 1.61 million new recreational operators cumulatively registered at the end of 2024, the FAA estimates that there are approximately 1.87 million sUAS in the fleet distinctly identified as recreational aircraft, i.e., equipment is 16% higher than the total new registrations. Compared with industry sales and other data noted earlier, it is concluded that the number of recreational aircraft is almost 16% higher than ownership registration.¹¹ Applying cumulative net gain/loss calculations, the effective/active fleet is estimated to be around 455,106.¹² This provides us with the lower bound of the effective/active fleet of recreational small drones in the NAS.

A comparison of the 2023 data with 2024 data shows the annual growth rate for new registrations to be a little over 4.5%, a slight drop from 4.9% in 2023, continuing the trend from 2022 of 6.7%. As such, there continues to be a growth trend for new registrations, albeit at a decreasing rate. The recreational drone market has experienced decreasing equipment prices (e.g., average price of \$750 or less), improved technology such as built-in cameras and higher capability sensors, and relatively easy maneuvering. Nevertheless, like all technologies fueling growth of hobby or recreational items (e.g., cell phones and video game consoles), the trend in recreational small drone ownership registration has been slowing. It is likely to slow down further as the pace of falling prices diminishes and the early adopters begin to experience limits in their experiments, or simply because the market reaches saturation.

Given trends in registration and market developments, the FAA forecasts that the recreational small drone market will saturate at around 1.93 million units over the next five years.^{13,14} However, there is still some uncertainty regarding the upper potential due to further changes in technology including battery life, faster integration from a regulatory standpoint, and the likely event of continued decreasing prices. By 2029, we may have as many as 1.97 million units. If registration renewals are kept up over time, effective/active fleet would likely converge to base forecasts, i.e., derived from cumulative new registrations combined with multiplicity of craft ownership. In the presence of slower renewal tendency, as data presently indicates, it is likely that the effective/active fleet will be lower than that derived from base forecasts. This provides the FAA with an op-

¹⁰ See appendix for net gain/loss calculation methodology.

¹¹ This calculation involves taking into account retirement, redundancy, and loss of aircraft corresponding to ownership registration. As aircraft become sturdier and operators more situationally aware, this rate has been changing, and we expect it to change dynamically over time. Assumptions tying ownership to aircraft holding and issues related to compliance have been discussed [see <https://napawash.org/academy-studies/federal-aviation-administration-assessment-of-compliance-with-and-effective> for a recent study by the National Academy of Public Administration on these issues.]

¹² See appendix for cumulative net gain/loss calculation details.

¹³ These forecasts have two dimensions worth emphasizing. When looking at the cumulative base, “total” captures the number of drones that are reported to be in the system (i.e., base and high); while “effective/active fleet” refers to aircraft that are presently operating in the system (i.e., low).

¹⁴ As we extend the forecast period by a year from 2028 to 2029 for rolling five-year projections, the recreational small drone sector is expected to expand by around 63,000 from what we forecasted last year: 1.88 million in 2028 to 1.93 million in 2029. This trend is likely to continue.

portunity to derive the potential lower bound of the forecast which tracks closer to the base forecast in the outer years of 2027-2029. Table 1 (below) shows a forecast base (i.e., likely scenario), together with high and low scenarios:¹⁵

Timeline	Low ⁺	Base ⁺⁺	High ⁺⁺
Historical			
2024	0.46	1.87	1.87
Forecast			
2025	0.46	1.89	1.90
2026	0.48	1.91	1.93
2027	0.50	1.92	1.95
2028	0.51	1.93	1.96
2029	0.51	1.93	1.97

+ : Effective/active fleet counts combined with multiplicity of craft ownership

++ : New registration counts combined with multiplicity of craft ownership

Table 1

Last year, the FAA forecasted that the recreational small drone sector would have 1.83 million drones in 2024 in the base case (i.e., new registrations). Actual data for 2024 came in higher by around 41,000 with around 1.87 million units accounted for by the end of 2024. Thus, our forecast of recreational small drones last year undershot by around 2.2% for 2024 (or 1.87 million actual aircraft in 2024 vs. 1.83 million aircraft projected last year). In contrast, our 2024 forecasted low scenario stood at around 555,719. Actual data came to be 455,106 (or around 100,000 lower). Thus, our forecast for a lower range last year overshot the actual by over 22%.

Using the trends observed in registrations, the FAA forecasts that the recreational small drone fleet (i.e., base scenario) will likely maintain its peak with average or trend growth over the next five years. Currently, there are 1.87 million units forecasted to grow to approximately 1.93 million units by 2029, thus attaining a cumulative annual growth rate of 0.66% during 2024-2029 down from the previous forecast of 1.2% for 2023-2028.

The low forecast for recreational/model small drones is approximately 507,237 active/effective small drones (or 52,131 more than what was observed during 2024) over the next five years in 2029. This suggests a cumulative annual growth rate of 2.2% during 2024-2029. Active/effective fleet count is derived and projected based on the net gain/loss calculation from using the five underlying components discussed above; hence, the rate influencing lower forecast growth is different than the base forecast which is derived using new registrations.¹⁶ The high scenario, on the other hand, may reach as high as 1.97 million units (or, 1.1% cumulative annual growth rate). High scenario projection is based on the trends in base forecast.

¹⁵ As noted earlier, low scenario reports effective/active fleet using a net gain/loss calculation. By definition, the low scenario differs from base and high scenarios, which are based on new registrations only. Hence, a low scenario counting of fleet for the year 2024 is markedly different than the baseline and high scenarios for the same year.

¹⁶ For additional information on the net gain/loss calculations, see the appendix.

Notice that eventual saturation at somewhat higher levels in comparison to last year's projections reflects continued new registrations, albeit at a slower rate, by recreational flyers observed during 2024 and extension of the forecast projection by a year. The increased new registration trend may or may not continue in the long run. In comparison, forecasts of the lower bound assume the present trend in renewals combined with new registrations followed by similar expiry 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 drone fleet parallels other consumer technology products and the agency's projections from the last few years, particularly with respect to base and high forecasts. However, both the numbers and the growth trajectory for the low scenario (i.e., effective/active fleet) are fundamentally different than the past couple years (for reasons described above). It provides a lower bound that is likely to be closer to reality in terms of small drones that are in use and operationally active in the NAS.

1.3 The Recreational UAS Safety Test (TRUST)

TRUST is the safety test for recreational/model small drone operators. It provides training and testing for recreational flyers on important safety and regulatory information. All recreational flyers must pass an aeronautical knowledge and safety test and provide proof of test passage – the TRUST completion certificate — to the FAA or law enforcement upon request.^{17,18}

¹⁷ See https://www.faa.gov/uas/recreational_flyers/knowledge_test_updates for more details.

¹⁸ Under the 2024 reauthorization bill (See <https://www.govinfo.gov/content/pkg/BILLS-118hr3935enr/pdf/BILLS-118hr3935enr.pdf>), requirements for recreational pilots have been maintained from earlier [See Section 928 of P.L. 118-63].

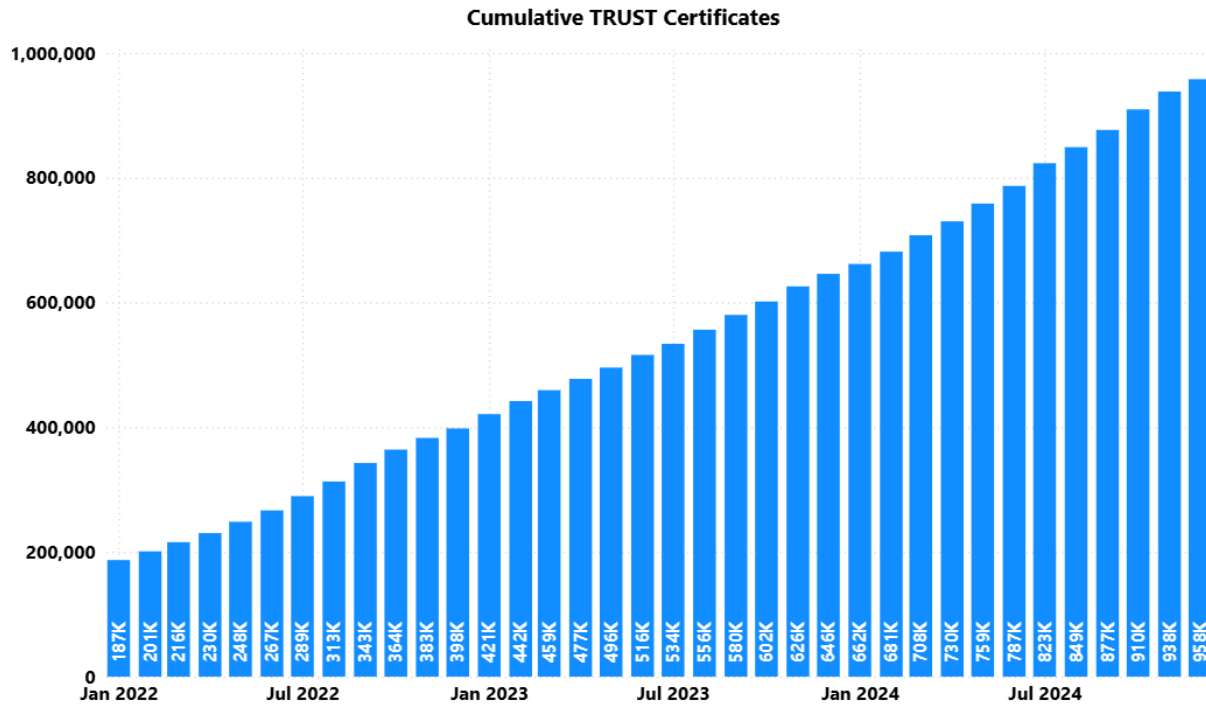


Figure 3

TRUST completions have increased by 48% from 646,000 in December 2023 to 957,890 in December 2024.

1.4 Commercial/Non-Model UAS

Online registration for commercial/non-model small drones went into effect on April 1, 2016. Unlike recreational/model ownership, rules for commercial registration require owners to register each small drone, thus creating a one-to-one correspondence between the number of registrations and the number of aircraft. During the period of January – December 2024, more than 124,000 commercial operators registered their equipment. In comparison, during the 2023 period, more than 115,000 commercial operators registered their new equipment. The pace of monthly new registrations in 2024, at around 10,370, is higher than monthly registrations of 9,627 during 2023, which was higher than those observed during 2022, at 8,750. As the pace of recreational registration has slowed somewhat, the pace of new registrations for commercial/non-model small drones is picking up speed slightly in comparison to earlier years, reaching 965,524 commercial drones cumulatively registered since April 2016.

For each month the registration has been available, over 4,600 new aircraft per month were registered until December 2017. This pace accelerated to 14,600 new registrations per month during 2018. During 2019, average monthly new registrations stood at approximately 10,100. During the year 2020, average monthly registration dropped to 7,850, while during 2021, average monthly registrations jumped by 650 to around 8,500. During the year 2022, average monthly registration again jumped by 250 to around 8,750 while, during the year 2023, this further jumped to 9,627, an increase of 877 from the year before. During 2024, average monthly registration stood at

10,370 which is 743 more than the year before, 2023. The commercial small drone sector is dynamic and appears to be at a turning point, as evident from the monthly registrations, demonstrating powerful stages of growth. Unlike the recreational small drone sector, the FAA anticipates that the growth rate in this sector will remain high over the next few years. This is primarily driven by the regulatory clarity that Part 107 continues to provide for the industry.

The Remote Identification (Remote ID) rule became effective on April 21, 2021. Remote ID (i.e., digital license-plate) of remotely piloted aircraft is necessary to ensure public safety and efficiency of US airspace. The rule applies to all operators of small drones that require FAA registration (i.e., both recreational and Part 107). There are three ways to comply with the Remote ID rule: (a) operate a standard Remote ID small drone broadcasting identification and location information of both the aircraft and control station; (b) operate a small drone with a Remote ID broadcast module attached to it that broadcasts identification, location and take-off information; or (c) operate a small drone without Remote ID at specific FAA-recognized identification areas (FRIAs). FAA extended enforcement of Remote ID implementation until March 16, 2024, when the rule became effective.¹⁹

FAA rules provide much-needed regulatory clarity and have reduced the need for waivers under Part 107. With enhancement of operational efficiencies under increasingly well-defined concepts of operations (CONOPS)—which ensure safety and transparent information flow across the community—more and more commercial uses will become likely, fueling even further growth. Notably, as a central location for receiving all operational information, including registration, authorization, and accident report logs, the FAADroneZone has helped further facilitate this growth.

Similar to Recreational/Model sUAS registrations, cumulative registrations may overstate the current fleet of sUAS in the United States by ignoring registrants who have cancelled or let their registrations expire. If the cancelled and expired registrations are removed, we obtain the effective or active registrations. This estimate of effective/active registrations is a theoretical lower bound to the fleet, given that a portion of the expired registrations was not intentional, and the operator still has and may operate the registered drone. A comparison chart capturing the difference between cumulative new registrations vs. effective/active registrations is provided below (Figure 4):²⁰

¹⁹ See https://www.faa.gov/uas/getting_started/remote_id. For public access to Remote ID compliance, see <https://uasdoc.faa.gov/listDocs>.

²⁰ The effective/active fleet using net gain/loss calculations for Part 107 registration, which is detailed in this document's appendix.

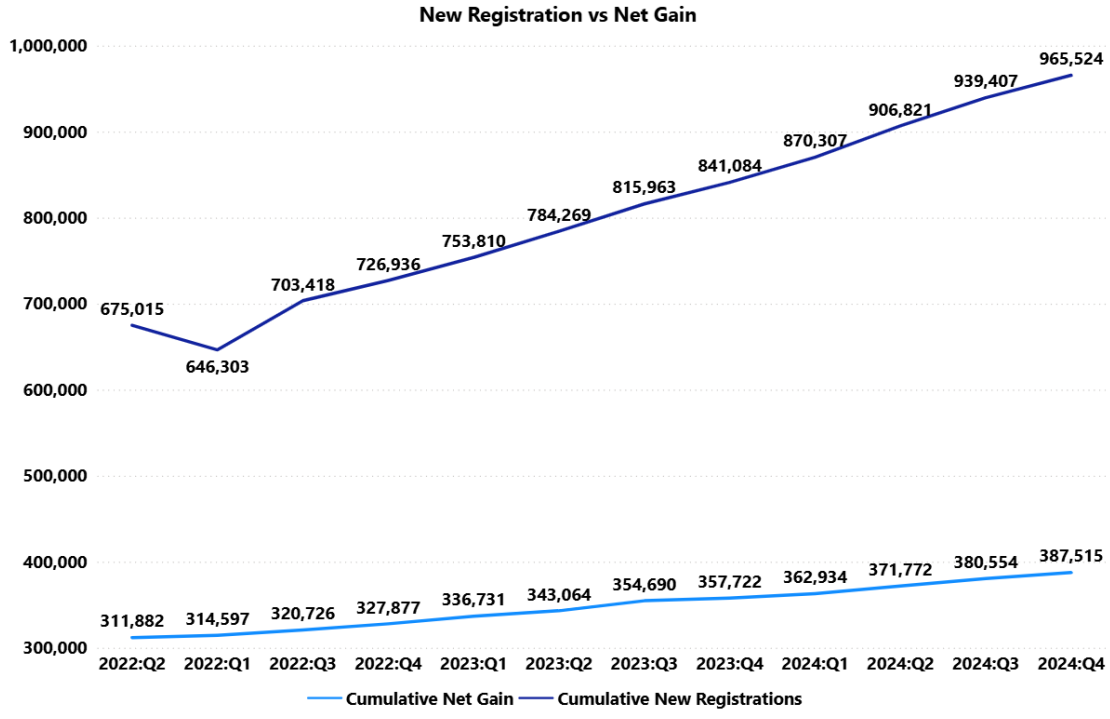


Figure 4

A spatial distribution of commercial/non-model equipment registration by zip code (using data through December 2024) demonstrates that commercial small drones are distributed throughout the country, with denser activity mapping closely against the economic or commercial activities of the geographic areas.

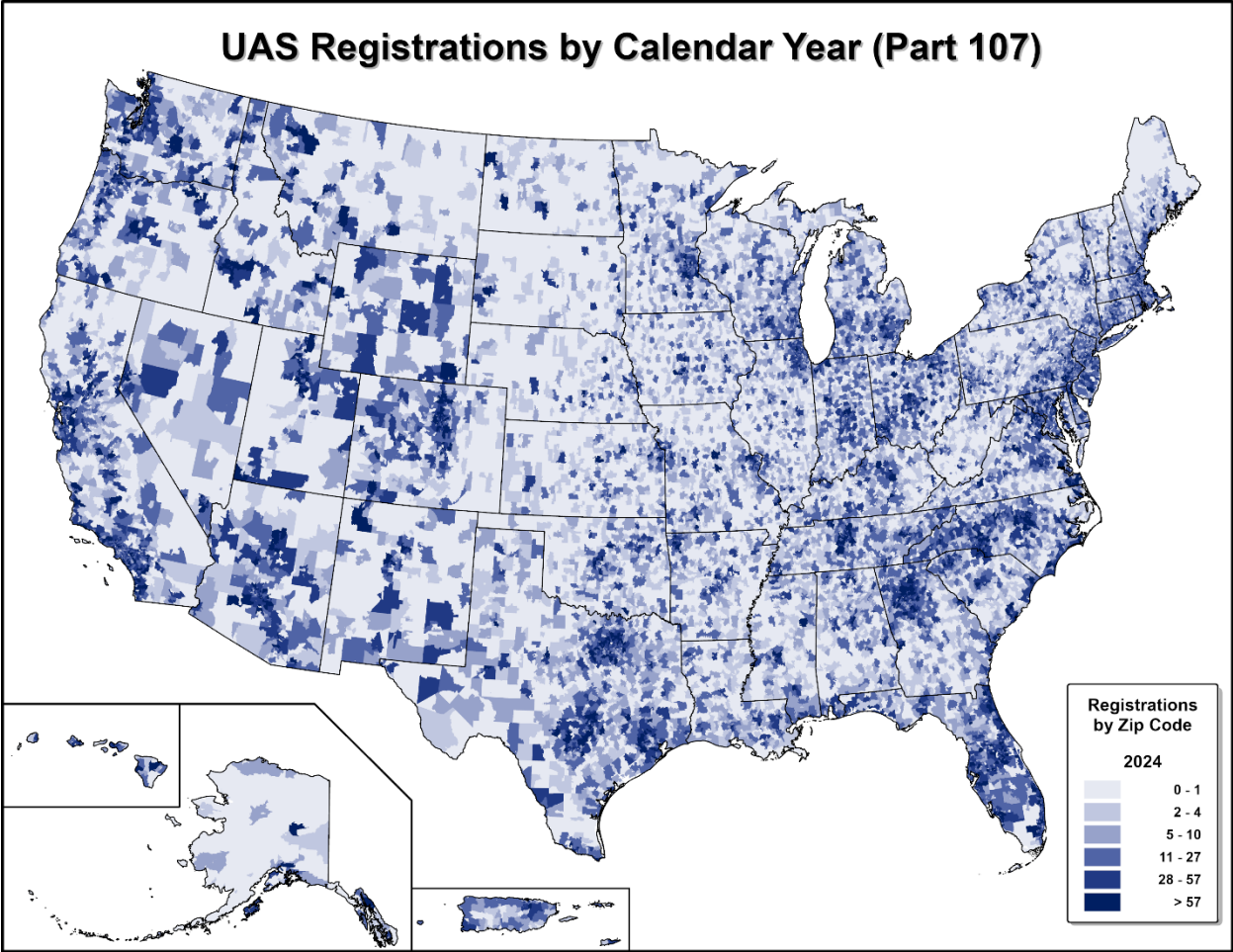


Figure 5

Last year, the FAA forecasted that the commercial drone sector would include over 951,000 small drones in 2024 in the base case, a growth rate of almost 13% over 2023. Actual data came in at over 966,000 commercial small drones by the end of 2024. Our forecast thus undershot by around 1.5%, or 965,524 aircraft (vs 951,283 projected aircraft). In the low case, the FAA had forecasted that 369,000 units would be effective/active for the year 2024; in reality, the number came to be around 395,000, thus undershooting the lower case by 6.6%. Nevertheless, our forecast errors for both recreation and commercial small drones appear to be within the bounds of reasonableness.

Timeline	Low ⁺	Base ⁺⁺	High ⁺⁺
Historical			
2024	388	966	966
Forecast			
2025	395	1030	1035
2026	402	1089	1099
2027	408	1135	1151
2028	411	1165	1187
2029	413	1180	1209

⁺: Effective/active fleet counts

⁺⁺: New registration counts based on fleet counts

Table 2

The FAA forecasts that the commercial drone fleet will likely (i.e., base scenario) exceed the one million mark with around 1.11 million by 2029. This is 1.22 times larger than the current number of new commercial small drones. These values are based on the trends observed in registration during previous years, calculation of net gain/loss, information from the annual survey, a review of available industry forecasts/workshops and past FAA Drone Symposiums, and FAA-sponsored research.²¹

Using low or effective/active fleet, the FAA forecasts an expansion of the commercial small drone fleet by 25,000, 1.07 times larger than the currently calculated effective/active fleet of around 388,000 units.²² As the present base (i.e., the cumulative total) increases, the FAA anticipates the growth rate of the sector will slow down, 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.

Unlike recreational small drones, it is extremely difficult to put a floor on the growth of the commercial small drone sector due to its composition (i.e., consumer vs. professional grades) and the varying business opportunities and growth paths. As commercial small drones become operationally safer and more efficient, battery life expands, and rules such as Normalizing Unmanned Aircraft Systems Beyond Visual Line of Sight Operations become enacted²³, their use is expected to continue to grow. Forecasts for the “high” scenarios show cumulative annual growth rates of 4% and 5%, respectively (lowered by a percentage point from last year). Low scenarios are driven by two positive factors (i.e., new registration and renew+) and two negative factors (i.e., cancellations and expiry).²⁴ The average annual growth rate corresponding to the low scenario is thus determined by the combined effect of both positive and negative factors and presently calculated

²¹ See https://www.faa.gov/sites/faa.gov/files/2022-05/UAS_Fact_Sheet_2021.pdf; for additional information on the net gain/loss calculations, see the appendix.

²² This is driven by the combined effects of projected underlying growth rates of cancellations, expiry, new registrations, and renewals.

²³ See <https://www.federalregister.gov/documents/2025/08/07/2025-14992/normalizing-unmanned-aircraft-systems-beyond-visual-line-of-sight-operations> for more details.

²⁴ See appendix for more details.

to be approximately 1.3%, an increase from last year boosted by early growth. This is much smaller than both base (4.1%) and high scenarios (4.6%) because the effective/active count is driven to catch up with the new registrations trend.^{25,26}

As the commercial sector grows, the FAA anticipates there will be many more uses for, and much more use of, commercial small drones. This growth is evident in the implementation of UAS traffic management (UTM, a collaborative ecosystem that manages drone activity),²⁷ the successful completion of phase one of the BEYOND project,²⁸ and package delivery activity by Part 135 operators.²⁹ The following section provides a brief analysis of recent developments in the commercial package delivery sector.

1.5 Remote Pilot Forecast

An important final metric in commercial small drones is the trend in Part 107 remote pilot (RP) certifications. A remote pilot certificate is required to pilot a UAS operating under Part 107.³⁰ The certificate ensures the pilot has the prerequisite knowledge to safely operate the UAS in the NAS. As such, commercial and public use (i.e., law enforcement and first responder) small drone flights are constrained by the availability of RPs, as discussed in the preceding section. As of December 2024, a total of 405,682 RP certifications had been issued, an increase of a little over 38,000 from the same time in 2023.

The FAA classifies RPs into two categories:

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

Part 107 certifications require completing a multi-step process, for further details see FAA's Become a Certificated Remote Pilot.³¹

The chart below (Figure 6) provides distribution of these two types of RPs who presently have certificates.

²⁵ Findings from our survey, discussed last year and this year in a later section, also support this observation.

²⁶ See prior footnotes for a similar explanation pertaining to effective/active count for recreational registration.

²⁷ See https://www.faa.gov/uas/advanced_operations/traffic_management.

²⁸ See https://www.faa.gov/uas/programs_partnerships/beyond. We provided a detailed analysis of the BEYOND program in last year's document.

²⁹ See https://www.faa.gov/uas/advanced_operations/package_delivery_drone for more details.

³⁰ In our accounting of RPs, we take pilots who passed the initial knowledge test (or Part 107.65), plus current traditional pilots who took online training in lieu of the knowledge test (or Part 61).

³¹ See https://www.faa.gov/uas/commercial_operators/become_a_drone_pilot.

Distribution of Remote Pilots

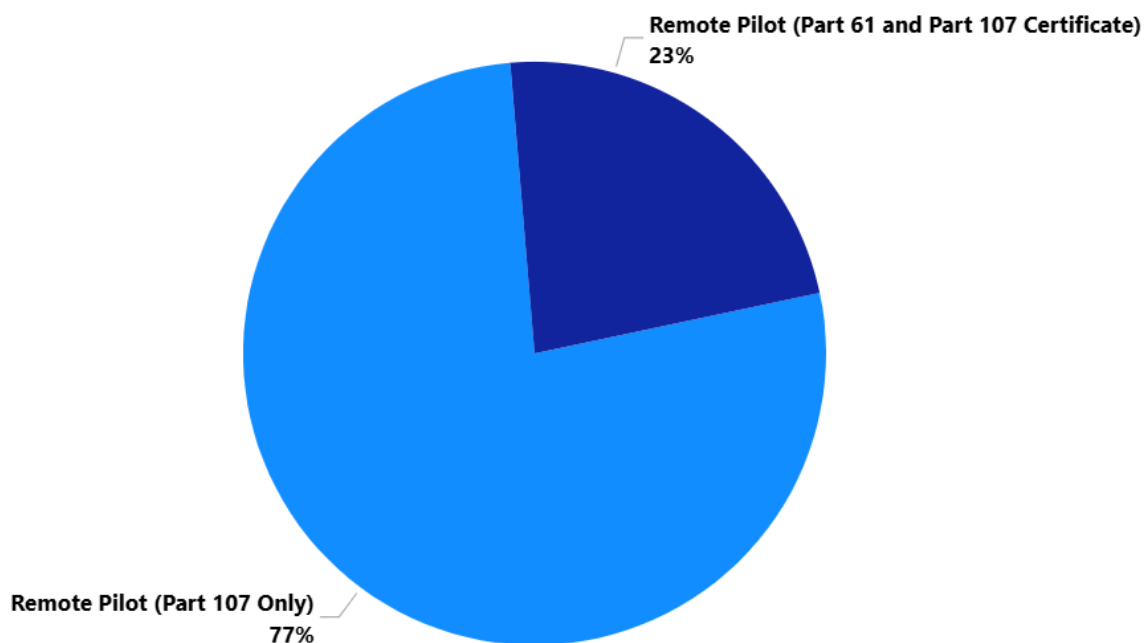


Figure 6

Around 77% of the RPs are Part 107 RPs only. Over 90% of those who took the exam passed and obtained RP certification.³² A cumulative density distribution of remote pilots by zip code in 2024 is provided in the map below (Figure 7).

³² Comparing data from last year, we notice that RP numbers have been revised downwards, by around 4,000 (or around -2%), over the entire program period. This is due to data clean up, throwing out duplicate data and wrong data entry noticed during renewal.

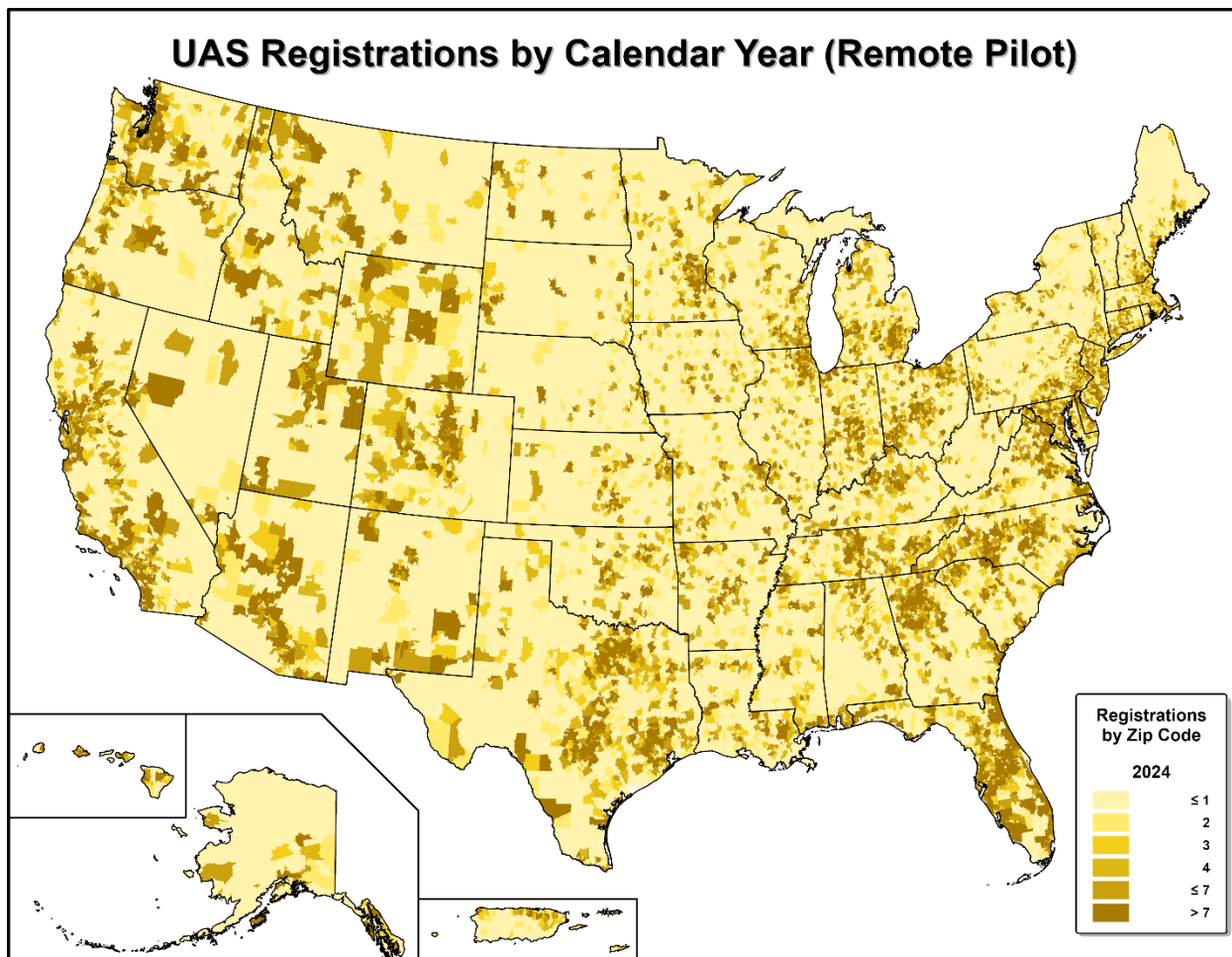


Figure 7

The RP forecast presented below (Figure 8) is based on three primary data sources: (a) trends in total RPs; (b) renewal trends; and (c) trends in commercial small drone registration, or Part 107 and forecasts of fleet. In this context, it is important to note that the empirical relationship between trends in RP and commercial/Part 107 small drone registration, particularly new registration, appear to hold steady despite expiry, cancellations and renewal.³³ Given the trends in registration and our forecast of the commercial small drone fleet (i.e., base forecasts), the FAA assumes that one pilot is likely to handle 2.38 units of commercial small drone aircraft, the same as the previous five years.

Using these assumptions and combined with the base scenario of the commercial/Part 107 small drone forecast, we project RPs in the figure below. Last year, the FAA projected RPs to be a little over 400,000 by the end of 2024. Actual registrations by the end of 2024 totaled 405,682 (or over 5,400 more than the 2023 projection), exceeding last year's projection by 1.35%.

³³ See the appendix for more details.

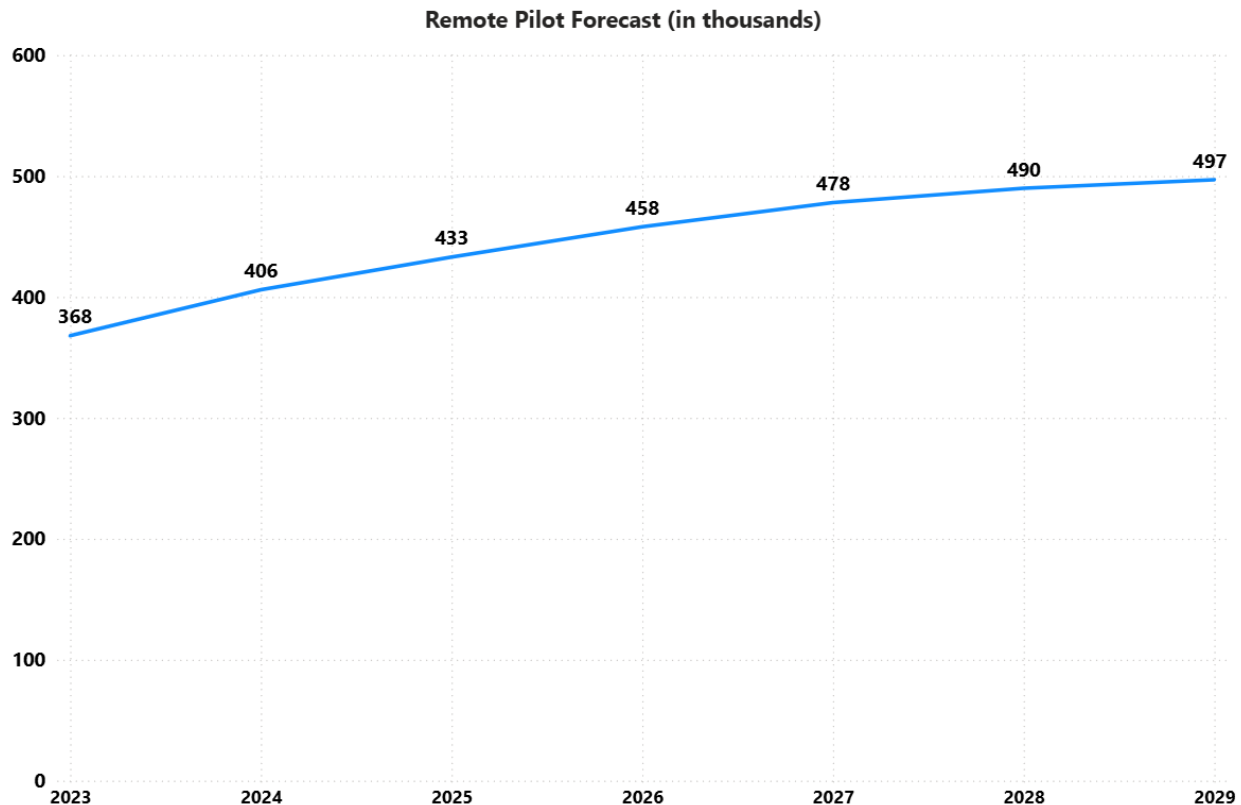


Figure 8

Given the actual numbers at the end of 2024, RPs are set to experience tremendous growth following the growth trends of the commercial (or Part 107) small drone sector. Starting from the base of 405,682 RPs in 2024, commercial activities may require over 496,689 RPs in five years, a 1.2-fold increase that may provide opportunities for growth in employment—over 91,000 new RP opportunities—associated with commercial and public use activities of small drones. Potential for RPs may be enhanced even more if larger drones are used in commercial activities and advanced air mobility (AAM) becomes a reality in the near future, two topics discussed in the sections below.

1.6 Commercial Package Delivery: Analysis and Forecast

Parcel delivery via drone has become a viable alternative to manned traditional delivery options. The sheer volume of parcel deliveries as well as the opportunity to reduce delivery cost per unit have been key forces driving growth of drone delivery adoption.

Drones pose a potential safety risk, such as a malfunction or communication failure that could cause a threat to both people and/or property. In addition, some local communities are uneasy with the growing threat to privacy as many drones are equipped with cameras.

Currently, drone delivery operations are conducted under either Part 107 or Part 135 with waivers. FAA's BEYOND program replaced the earlier effort known as the Integration Pilot Program (IPP). These programs include the effort of testing, attaining operation flexibility, and gaining regulatory approvals including waivers. FAA evaluates and approves these operations following a six month to year-long assessment. Under current regulatory arrangements, a visual observer (VO) is required to monitor the airspace, making drone delivery more expensive than the traditional delivery methods. To reduce per unit operations cost, some operators have been developing detect and avoid (DAA) sensors onboard drones to avoid the requirement of VO on the ground. Research continues into 'beyond visual line of sight' (BVLOS) operations, which will allow more opportunities for commercial operators.

FAA is studying the nature, scope, location, extent, and growth of commercial package delivery processes by drone. Measuring demand for drone package delivery relies upon a few important metrics. This analysis focuses on several factors that are the driving forces for drone delivery demand, including airspace analysis, socioeconomic variables, urban structure, and drone delivery readiness.³⁴

There is an assumption that the level of acceptance and comfort with drone delivery will increase over time.³⁵ The growth in drone package delivery will increase consistently over the period 2025 to 2031. More than half of the total daily package delivery will be contributed by nineteen Metropolitan Statistical Areas (MSAs) and combined MSAs (CMSAs). Estimates of package deliveries for MSAs provide us with further insights into (a) distribution of these flights by months of the year; (b) duration in minutes of flights; and (c) types of aircraft that are likely to carry out package delivery missions.

At the national level, more flights were conducted during Spring/Summer months compared to Winter months. Building on the seasonal aspect observed in flight distribution, the average minutes of flight under Part 107 Survey is twice as long as data in the BEYOND program data. This discrepancy is due to BEYOND data solely measuring package deliveries and Part 107 Survey data measuring a broader range of operation types.

1.7 2024 Survey and Preliminary Results

Unlike most traditional commercial aviation, most drone operations do not have statutory reporting requirements. UAS operate mostly outside of airports and are free to operate in uncontrolled airspace without reporting activities to aviation authorities. As such, little is known about the general operations of UAS.

The FAA has developed and conducted a survey of UAS operators to improve its understanding of UAS activities within the NAS.³⁶ Information collection for the survey started in 2021 with a

³⁴ Drone delivery readiness is based on GDP per capita, Class G air space and congestion, and public and private investment/Unmanned Traffic Management (UTM).

³⁵ See <https://www.mckinsey.com/industries/aerospace-and-defense/our-insights/future-air-mobility-blog/consumer-views-of-drone-delivery-how-soon-can-you-get-here>.

³⁶ The survey has been approved by the Office of Management and Budget (OMB).

baseline of UAS activities and has continued annually through 2024. The survey design is a stratified random sample of registered UAS operators with type of operator, recreational or Part 107, and geography, U.S. County, as the strata. The survey frame is constructed from the recreational UAS and Part 107 registries.³⁷ A total 97,857 invitations were sent to UAS registrants: 54,634 recreational registrants and 43,223 Part 107 registrants.³⁸ The survey for 2024 UAS activity was opened on January 17th, 2025, and closed on March 31st, 2025. Follow-up reminder emails were sent out periodically to those who had not yet responded up until the final week of collection.

Overall, 24.3% of invited registrants responded to the 2024 survey. The response rate varied marginally by registration type with a 26% response rate for recreational registrants and a 22% response rate for Part 107 registrants. This difference in response rate by registration is consistent with the previous two years and the survey baseline.³⁹ Of the invited registrants who did not respond, 4.2% had unreachable email addresses, an additional 4.2% opted out of receiving emails from the approved survey platform, and the reasons for the remainder of the non-responses are unknown.

The survey of UAS operators used a questionnaire distributed by the approved survey platform to collect responses from selected, registered UAS operators.⁴⁰ The questionnaire consisted of as few as six questions or as many as 40 questions based on the respondents' answers and the registry from which they were recruited.⁴¹ Some questions had multiple response options and the average time to complete the survey was approximately 10 minutes. Given that many operators use their UAS for several purposes, selected Part 107 registrants reported primarily about their non-recreational activity while selected recreational registrants reported on their recreational activity. Of those that accessed the survey, 94% agreed to participate, 2.8% opted out of the survey for 2024, and 3.5% requested that the FAA permanently remove them from the FAA's survey list.

All respondents were asked about their total number of flights conducted in 2024, defined as a takeoff and a subsequent landing. Respondents from the Part 107 registry were asked to report

³⁷ As noted earlier, 49 U.S. Code § 44809 requires recreational UAS aircraft systems operators to register with the FAA. In addition, 14 CFR Part 107 requires non-recreational operators to register with the FAA. UAS operators must register with one of these registers at FAA's <https://faadronezone-access.faa.gov/#/> and paper forms are no longer available.

³⁸ The survey design is a stratified random sample of registered operators. The strata are the registries and the U.S. County in which the operator is domiciled. Each county had 30 registrants randomly selected to receive an invitation to the survey. If the number of registrants in the county are fewer than 30, all registrants in the county were sent an invitation. For more information, a survey supplement is available upon request.

³⁹ The baseline survey was an initial survey design and questionnaire to establish a baseline understanding of the UAS community. The baseline was used to determine if test surveys, controlled deviations in the survey design and questionnaire from the baseline design had a significant effect on responses to the questionnaires. More information is available via survey supplement.

⁴⁰ The survey platform [see <https://www.surveymonkey.com/>] is approved by the Government Services Administration (GSA) and provides a fast and cost-effective method for designing, deploying, and organizing a questionnaire. Given the internet-based registration for UAS operators, an internet-based questionnaire was best suited for this population. More information is available via survey supplement.

⁴¹ The language used in the survey was tailored to recreational and non-recreational operators. Most questions provided for optional responses, required responses were rare. Periodically, the survey asked an open-ended question soliciting general feedback about the survey and specific questions. Some questions were unique to specific groups, such as emergency responders. More information is available via survey supplement.

their total number of non-recreational flights and their total number of recreational flights conducted in 2024. Respondents from the recreational registry were asked to report their total number of recreational flights and how many of these flights were conducted in a FAA-Recognized Identification Areas (FRIAs).⁴² The question of flights conducted within a FRIA was added in 2024 in response to findings in 2023 showing differentiation of flight and fleet characteristics as a function of self-identification and free responses indicating the use of FRIAs. Both suggest that model aircraft operators are functionally different from drone operators. The data presented here bear this supposition out and reveal relationships between the level of operations within a FRIA to aircraft types owned, number of flights, and other operational factors.

Respondents from the Part 107 registry reported an average of 75.4 nonrecreational flights (median of 2) and an average of 34.9 recreational flights (median of 5) in 2024. Respondents from the recreational registry reported an average of 46.2 recreational flights (median of 10) with an average of 18.0 of those flights conducted in a FRIA (median of 0). This difference between mean and median is a result of non-normally distributed data. In this case, there are a subset of operators with high annual flight numbers although the majority have low annual flight numbers.

Annual Flights	Recreational-only Part 107 Operators	Nonrecreational Part 107 Operators
Recreational	40.5	36.2
Nonrecreational	0	135.6

Table 3

The FAA sought to better differentiate operators by classifying them into groups based on their response to their flight activity. Respondents from the Part 107 registry were classified into three categories (see Table 4). Inactive Part 107 operators received a truncated survey that skipped irrelevant questions, while non-recreational Part 107 operators and recreational Part 107 operators received subsequent survey questions that targeted their non-recreational or recreational activity.

⁴² A FAA-Recognized Identification Areas (FRIAs) is a defined geographic area where drones can be flown if they don't have Remote ID equipment. FRIAs are often used by community organizations and educational intuitions. [see https://www.faa.gov/uas/getting_started/remote_id/fria]

Part 107 Operator Classification	Category Definition	Percent; Count of Operators Classified
Nonrecreational Part 107	At least one nonrecreational flight	55.6%; n=4537
Recreational-only Part 107	Zero nonrecreational and at least one recreational flight	36.4%; n=2966
Inactive Part 107	Zero total flights in 2024	8.0%; n=654

Table 4

Respondents from the recreational registry were similarly differentiated into groups by their percentage of activity in a FRIA and those who were inactive. FRIA activity displayed a bimodal distribution with 75.9% (n=8182) of active operators conducting 0% of flights in a FRIA and 15.9% (n=1716) conducting 100% of flights in a FRIA. Three FRIA groups were defined. First, we defined Low FRIA activity recreational respondents (77.8%; n=8391) as those who conducted 10% or less of their operations in a FRIA. Second, we defined Mixed FRIA activity recreational respondents (5.4%; n=582) as those who conducted greater than 10% and less than 90% of their operations in a FRIA. Third, we defined High FRIA activity recreational respondents (16.8%; n=1812) as those who conducted 90% or more of their operations in a FRIA. Fourth, we defined the Inactive recreational operators (14.8% of all recreational respondents; n=1592) as those who reported no flight activity in 2024. Inactive Part 107 and recreational operators are beyond the scope of this preliminary data and are explored later in the survey supplement.

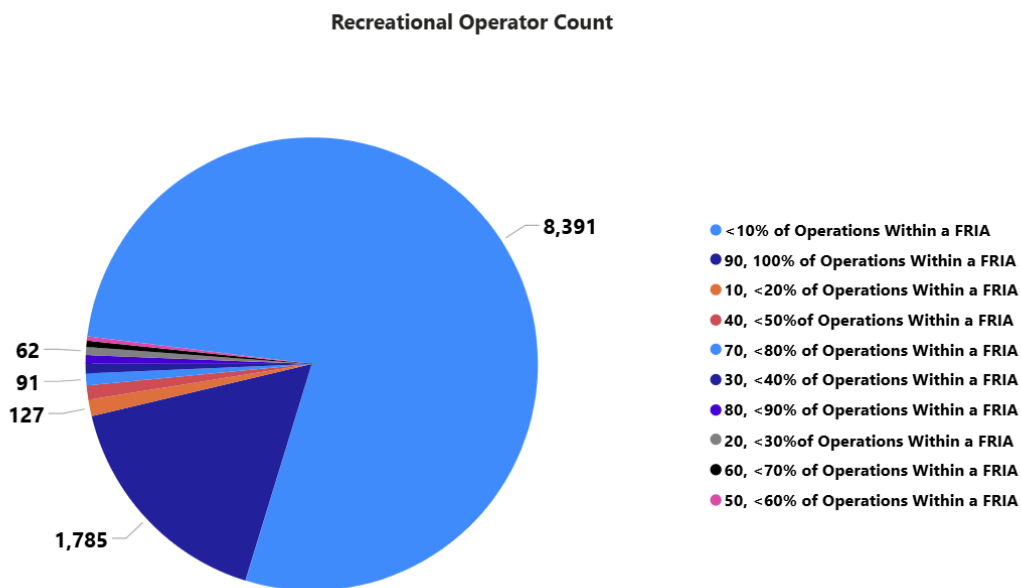


Figure 9

To further parse operators and develop meaningful differentiations, the survey contained a self-report question on the type of UAS operator the respondent considered themselves. Respondents were given the multiple-selection options of: (a) commercial, business, or pilot for hire; (b) emergency response, public safety, or law enforcement; (c) other government (non-emergency); (d) university, research institution, or non-profit; (e) recreational or hobby: drone; (f) recreational or hobby: model aircraft; and (g) a fill-in “other” category. For respondents from the recreational registry, 98.3% self-identified as a recreational operator with 85.6% identifying as drone operators and 21.0% identifying as model aircraft operators. Despite 8.3% of respondents identifying as both recreational drone and model aircraft operators, 77.2% identified as drone and not model aircraft operators, and 12.7% identified as model aircraft and not drone operators. A minority of 1.8% of operators did not self-identify as recreational and instead self-identified with a use better suited for Part 107 or selected “other”.

For respondents from the Part 107 registry who self-identified, almost one half of respondents (43.4%) identified exclusively as recreational operators. Of those, 95.0% self-identified as recreational drone operators and 10.0% as recreational model aircraft operators. Over half (56.7%; n=3444) identified as a nonrecreational category. Of those, 71.6% reported operating their UAS for commercial, business, or pilot for hire reasons, 18.5% for emergency response, public safety, or law enforcement, 9.9% for other government (non-emergency) purposes, and 8.5% for university, research institution, or non-profit purposes.

The self-identification question suggests that the vast majority of UAS operators who register in the recreational registry are using their UAS for personal enjoyment. However, Part 107 registrants have more diverse uses for their UAS. With over 40% of Part 107 registrants using their UAS exclusively for personal enjoyment, defining all of Part 107 operators as non-recreational or non-hobby is not accurate. This finding is consistent with the previous two years of findings.

To better differentiate types of recreational operators, the analysis considered operational activity within a FRIA, using the new question added to the 2024 survey. Annual flights conducted by recreational operators varied by flight categories with Low FRIA operators conducting an average of 38.2 annual flights with 0.2 of those flights in a FRIA. Mixed FIRA operators conducted an average of 98.6 annual flights with 49.1 of those flights in a FRIA while High FRIA operators conducted an average of 107.2 annual flights with 106.3 of those flights in a FRIA. One particularly interesting finding is that the High FRIA group is conducting 2.8 times as many flights as the Low FRIA group.

The recreational categories, Low FRIA, Mixed FRIA, and High FRIA, varied with the self-identification question as well. Looking at those who identified as recreational operators, three groups emerge--those who identified as a drone but not model aircraft operator (Drone not Model), those who identified as a model aircraft but not drone operator (Model not Drone), and those who identified as both drone and model aircraft operators (Drone and Model). The Low FRIA group was dominated with Drone not Model operators (87.1%). The Mixed FRIA group was more balanced with 55.6% Drone not Model operators, 18.9% Drone and Model operators, and 23.5% Model not Drone operators while the High FRIA group is 48.2% Model not Drone operators, 37.5% Drone

not Model operators, and 8.3% Drone and Model operators. These data reveal a, perhaps predictable, trend that model aircraft operators favor FRIAs while Drone operators favor operating outside FRIAs.

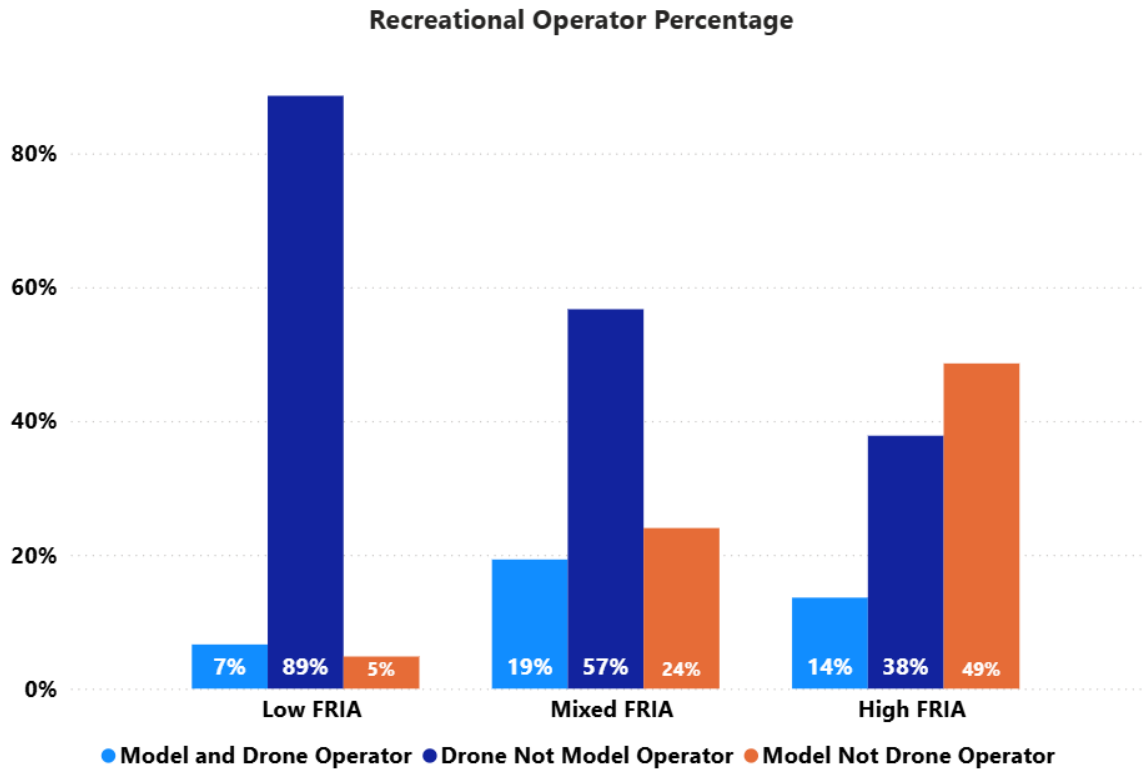


Figure 10

These categories also revealed differences in the number of aircraft owned, number of aircraft operated, and airframe type operated in 2024. Low FRIA operators owned an average of 2.5 aircraft and operated 2.0, while High FRIA operators owned an average of 9.6 aircraft and operated 6.5. Additionally, Low FRIA operators operated 1.5 quadcopters and 0.4 fixed wing aircraft while High FRIA operators operated 0.8 quadcopters and 7.8 fixed wing aircraft on average.

When considering the multitude of cross tabs for these categories, two groups emerge and demonstrate a stark contrast in operational characteristics: the Low FRIA and Drone not Model group (n=5550) and the High FRIA Model not Drone group (n=660). The Low FRIA and Drone not Model group flew an average of 29.5 times in 2024 with 0.1 flights in a FRIA while the High FRIA Model not Drone group flew an average of 153.4 flights in 2024 with 152.6 occurring in a FRIA. The Low FRIA and Drone not Model group owned an average of 1.8 aircraft, operated 1.6 and reported operating 1.5 quadcopters and 0.02 fixed wing aircraft on average in 2024. In contrast, the High FRIA and Model not Drone group owned an average of 14.7 aircraft, operated 10.0 and reported operating 0.1 quadcopters and 14.4 fixed wing aircraft on average in 2024. It is evident that the degree to which a recreational operator conducts flights within a FRIA correlates to how they self-identify, how many and what type of aircraft they operate, and multiple other fleet

and flight factors. This finding allows the FAA to better articulate the nature of UAS operations and forecast use.

Nonrecreational Part 107 Operator Self-Identification Type	Percent
Commercial, Business, or Pilot for Hire	65
Recreational or Hobby: Drone	46
Emergency Response, Public Safety, or Law Enforcement	17
Other Government (Non-emergency)	9
University, Research Institution, or Non-Profit	7
Recreational or Hobby: Model Aircraft	4

Table 5

Part 107 operators were categorized into Recreational-only Part 107 operators and Non-recreational Part 107 operators. The survey reveals that non-recreational Part 107 operators are operating to a greater extent compared to the recreational-only Part 107 operators. Table 5 shows the self-identification responses from the non-recreational Part 107 operators, while Table 6 compares those operators who identified as Commercial, Business, or Pilot for Hire to those who identified as Other Government (Non-emergency). This suggests that those who identify as Commercial, Business, or Pilot for Hire, though having fewer drones compared to those identifying as Other Government (Non-emergency), have much higher utilization of their aircraft.

	Non-recreational Part 107 operators who identified as Commercial, Business, or Pilot for Hire (n=1960)	Non-recreational Part 107 operators who identified as Other Government (Non-emergency) (n=284)
Annual Recreational Flights	25.5	17.3
Annual Non-recreational Flights	195.8	53.4
Drones Owned	2.3	4.4
Drones Operated	1.9	3.4

Table 6

One group of particular interest in the Part 107 respondents are the emergency response organizations. A total of 385 Part 107 respondents answered yes to operating drones for an emergency response organization that has a drone program. Uses are shown in Table 7.

Percent of Emergency Response Organizations	UAS Uses
47	crime scene documenting
35	traffic crash reconstruction
57	tactical support
86	search and rescue
55	search of wanted persons
51	firefighting support
59	natural disaster response
7	explosive ordnance disposal
77	training
50	public demonstrations

Table 7

These emergency response organizations conducted an average of 72.7 flights in 2024 with a median of 25 and max of 2000 flights. They reported 4.5 drones owned on average with a maximum of 500 and 3.6 drones operated on average with a maximum of 250 operated. Quadcopters were the favored operated airframe type with an average of 3.1 quadcopter drones operated in 2024; the second most common airframe type was rotary wing with an average of 0.25 operated per organization. These groups have an average age of 3.6 years with the longest running at 15 years. Additionally, 337 of these operators responded to the question asking what type of airspace they operated in for 2024. Most (85%) indicated operating in class G, 33% in class E, 26% in class D, 15% in class C, 5% in class B, and 1.2% in class A airspace.

In general, these data illuminate meaningful differences with respect to fleet and flight characteristics between distinguishable groups of registrants within both the Recreational Registry and the Part 107 Registry.

Of note in this year’s survey was the inclusion of activity within FRIAs for recreational operators. The number of active FRIAs in the United States reached 2,481⁴³ at the end of 2024 and the extent of their use has not been quantitatively measured until now. We have identified that recreational operators are either all-in on FRIAs or not, operating nearly entirely within or outside their boundaries. In addition, 17% of recreational registrants are High FRIA operators who, when compared to Low FRIA operators, conduct 2.8 times as many annual flights with different airframes (in particular, more fixed wing).

⁴³ See https://udds-faa.opendata.arcgis.com/datasets/c7ad6f733cce47b9a653e12010742361_0/explore?location=38.732240%2C-77.118017%2C8.28&showTable=true

These data also reveal new commercial use cases for the use of drones. Part 107 emergency response organizations offer a unique window into the uses and implementations of drone operations in the NAS. Drones are not limited simply to use of their cameras but are also being used to quickly deliver lifesaving flotation devices to drowning persons and safely disarm potential explosives.

This preliminary analysis of the 2024 survey reveals operating groups that are varied, unique, and more differentiable. With these activities and groups identified, the FAA can better serve the people and make more informed decisions that improve the safety of the NAS.

1.8 Large UAS

Part 107 limits the gross takeoff weight of small unmanned aircraft (sUAS) to below 55lbs. Thus, unmanned aircraft with gross takeoff weights above 55lbs must operate under separate rules and are thus considered a separate category of UAS, which we refer to as large UAS (LUAS) for this analysis. Since these LUAS are not type certified and do not fall under the Part 107 operating rules, operation of these aircraft requires a section 49 U.S.C § 44807 exemption or a public aircraft operator (PAO) certification.⁴⁴ In addition, the FAA requires LUAS operating under a 44807 exemption or PAO to receive a tail number by registering the unmanned aircraft in the Part 47 aircraft registry.⁴⁵ As such, the LUAS fleet and operations are not contained in or correlated with the sUAS discussed in previous sections.

The FAA has been granting 44807 exemptions since their introduction in the FAA Reauthorization Act of 2018. Both applications for a 44807 exemption by individuals and organizations and the decisions by the FAA are publicly available. Since 44807 exemptions are required to operate a LUAS for commercial purposes, these exemptions are a leading indicator of both the purchases, which increase the fleet, and the operations of non-military LUAS. The 44807 exemption was slated to sunset in May of 2024, but the FAA Reauthorization Act of 2024 extended the 44807 exemption's sunset to the end of September 2033.⁴⁶

The FAA granted 1,114 new exemptions for LUAS in 2024, a 13% increase from 2023.⁴⁷ Almost 97% (1,079) of the new exemptions granted were for large agriculture unmanned aircraft. Just under 12% (156) of all exemptions granted (1,270) were extensions or amendments.

⁴⁴ See https://www.faa.gov/uas/advanced_operations/certification/section_44807 for more details.

⁴⁵ See https://www.faa.gov/licenses_certificates/aircraft_certification/aircraft_registry.

⁴⁶ See <https://www.congress.gov/bill/118th-congress/house-bill/5860/actions>.

⁴⁷ Changes in count methodology.

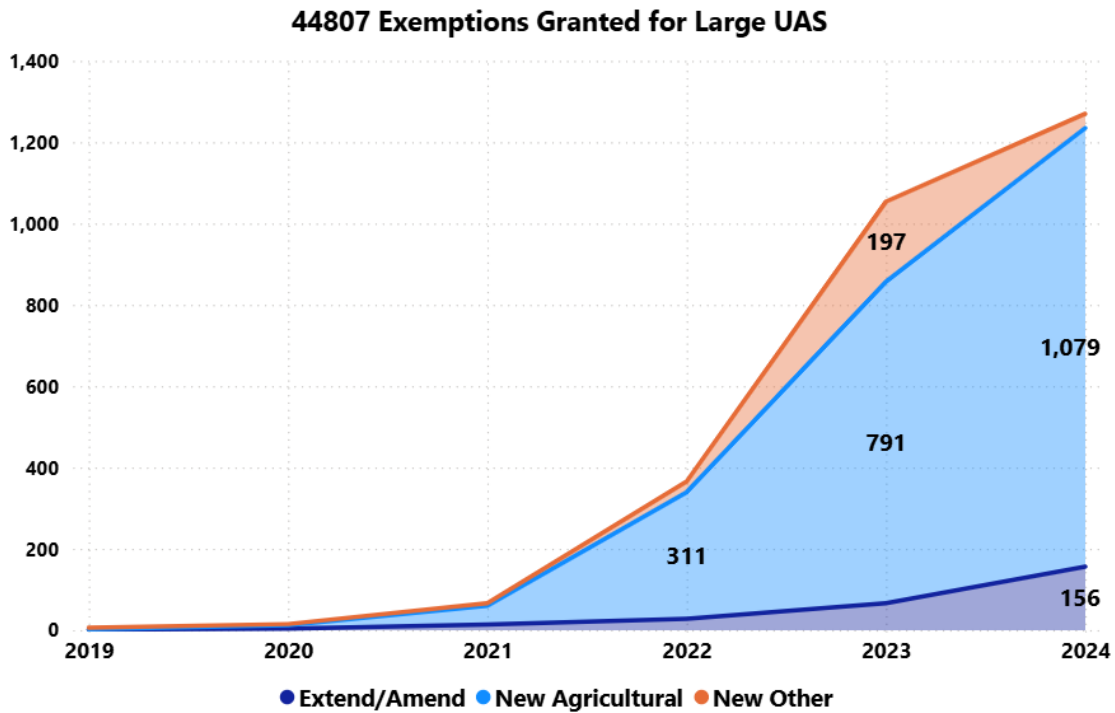


Figure 11

The increased number of exemptions granted in 2023 and 2024 suggests that granting exemptions by regulators has become routine, particularly for LUAS used in agricultural operations. While agricultural exemptions granted per year continue to grow, exemptions for other LUAS operations, such as package delivery or long-range infrastructure inspection, have slowed. This suggests that, although agricultural LUAS exemptions are routine, the safety cases for other LUAS operations have not been sufficiently proven for these exemptions to become routine. Since 44807 exemptions are only valid for two years, the extensions and amendments should be a function of the new exemptions granted over the previous two years. The portion of the existing LUAS exemptions that were extended or amended has fallen each year from 66% in 2021 to 11% in 2024.

Since LUAS are required to register with the Part 47 Aircraft Registry (PAR), the PAR can be used to estimate the LUAS active fleet. Using the Aircraft Reference file from the publicly available PAR, we identify the LUAS in the Aircraft Registration Master file and the Deregistered Aircraft file from which we calculate the active fleet of LUAS.⁴⁸ In 2024, 2,800 new LUAS aircraft were

⁴⁸ The Public Aircraft Registry data for 2022 is available at https://www.faa.gov/licenses_certificates/aircraft_certification/aircraft_registry/releasable_aircraft_download. Unmanned aircraft are separated from crewed 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 they 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 LUAS fleet.

added to the PAR, a 156% increase from 2023. Of aircraft registered at the end of 2023, 21% (409) were delisted in 2024, producing an active fleet of 4,314 LUAS by the end of 2024.

With robust demand for LUAS operations indicated by 44807 exemptions, we expect the growth of new LUAS over the next five years to keep pace with the growth observed in 2024. However, assuming 44807 exemptions remain the primary authority by which LUAS are operated, we expect an inflection point in 2027 or 2028 after which the new LUAS added to the PAR are expected to decrease in the following years. As such, we expect 14,896 new LUAS will be added to the PAR in 2029, with a total active LUAS fleet of 44,740 aircraft by the end of 2029.

Although the active fleet can be observed from the PAR, the operations of LUAS are more difficult to observe. The majority of registered LUAS in the PAR are agricultural spraying aircraft from just three manufacturers.⁴⁹ Moreover, the portion of new LUAS registered in the PAR has increased from 40% in 2022 to 59% in 2023. We expect this proportion to increase to around 80% of new LUAS registered in the PAR until a new class of 44807 exemptions, or the equivalent, are issued in similar numbers to the agricultural spraying exemptions. As such, the vast majority of LUAS operations will be conducted close to the ground with only a few organizations operating LUAS in the NAS, let alone in the controlled airspace.

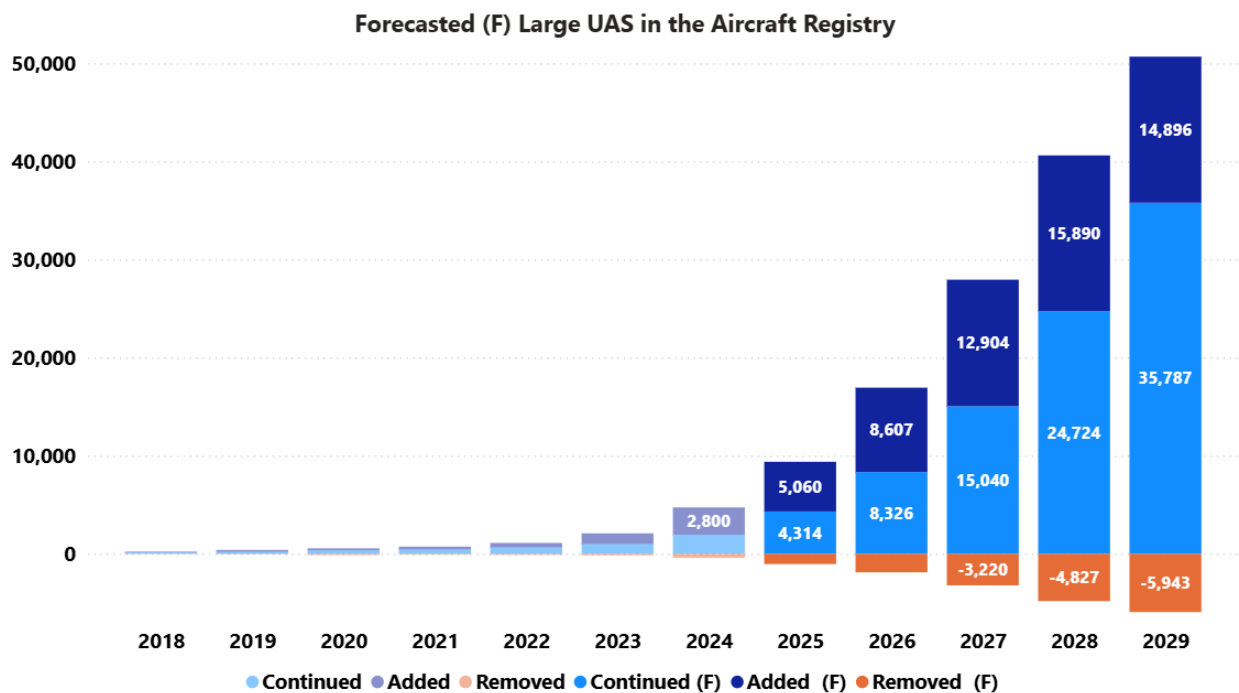


Figure 12

⁴⁹ DJI, Hylio, and Yamaha's agricultural-spraying UAS account for just over 50% of the registered large UAS in the Part 47 aircraft registry.

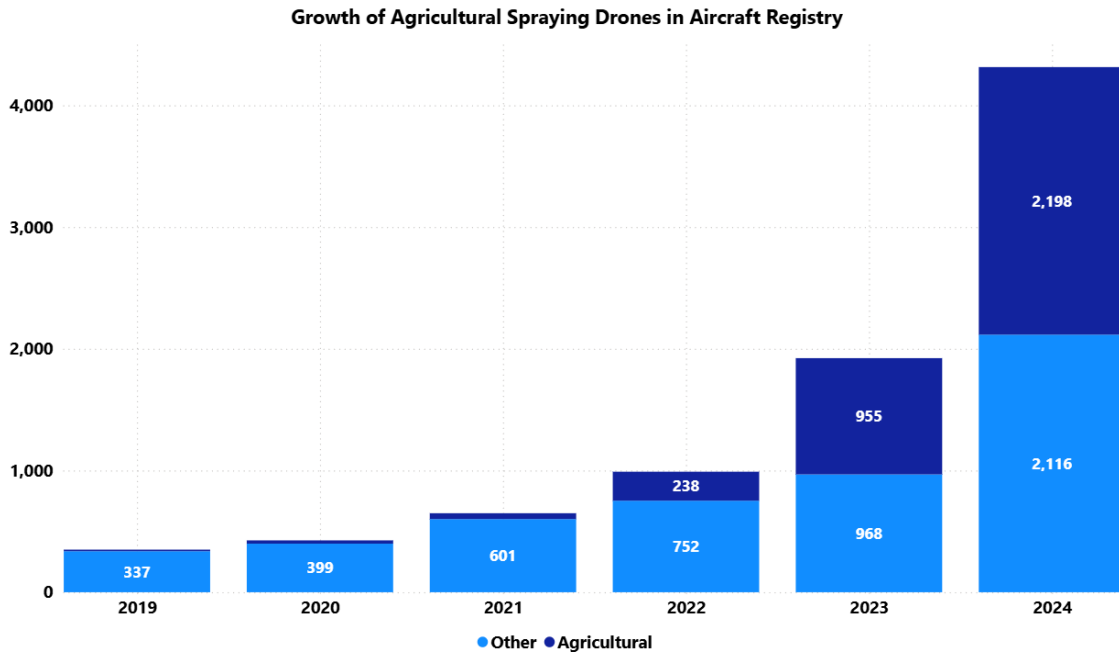


Figure 13

1.9 Micro UAS

Part 107 and section 44809 both specify that UAS weighing under 0.55lbs are exempt from requirements to register. The fleet of this category of UAS, which this report refers to as micro UAS (mUAS), has been difficult to estimate given the lack of data related to the number of aircraft, such as registry data. However, on January 27th, 2022, the White House issued a proclamation to update the Harmonized Trade Schedule of the United States (HTSUS) to match recommendations by the World Customs Organization.⁵⁰ The new categories added to the HTSUS included a category for UAS with weights less than 0.25kg or 0.55lbs, which has allowed Customs and Border Patrol (CBP) to track both the declared values and number of mUAS entering the United States from foreign ports. Given that almost all mUAS sold in the United States are manufactured abroad, this data from CBP is a reasonable approximation of the total mUAS added to the U.S. fleet of mUAS each year.⁵¹

Although the trade data gives us a reasonable estimate of the flow of mUAS into the United States, the fleet or stock of mUAS requires some additional data and assumptions to estimate. First, data from the Survey of UAS Operators suggest that the average life of a UAS is around three years with many lasting only weeks and months while others last up to a decade. As such, we estimate the economic depreciation of mUAS is around 0.33 per year. Second, given that the recreational sUAS fleet has almost saturated the market and the Part 107 sUAS fleet is trending toward a saturation, we also assume the mUAS are trending toward or already saturating the market. As

⁵⁰ See the U.S. President's proclamation: <https://www.govinfo.gov/content/pkg/FR-2021-12-28/pdf/2021-28334.pdf>; World Customs Organization's amendments: <https://www.wcoomd.org/en/topics/nomenclature/instrument-and-tools/hs-nomenclature-2022-edition/amendments-effective-from-1-january-2022.aspx>.

⁵¹ The data collected by CBP is housed in Census at <https://usatrade.census.gov/>.

such, the flow of imported mUAS are replacing the lost mUAS from depreciation, and thus the imported mUAS (investment) divided by the depreciation rate provides the stable state fleet of mUAS.

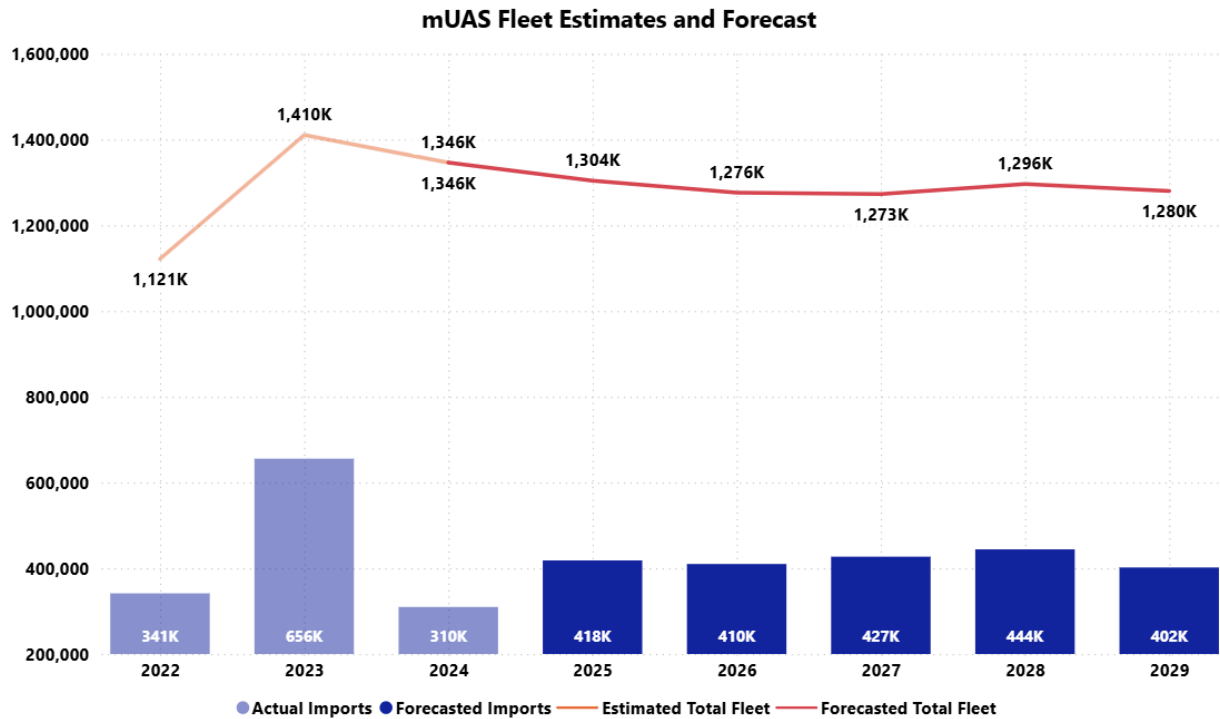


Figure 14

In Figure 14, the steady state fleet estimate is used to establish the initial mUAS fleet in 2022. After which, a standard dynamic approach is applied to estimating the stock of mUAS. For the forecast portion of the graph, we use a moving average to forecast the imports of mUAS and apply the predicted imports to the dynamic approach to estimate the mUAS fleet over a five-year horizon. In 2024, we estimate the U.S. fleet of mUAS to be 1.35 million aircraft. From 2025 to 2029, the U.S. fleet of mUAS is expected to fall from 1.35 million to 1.28 million. This is driven by over 400 thousand imported mUAS per year.

The forecast for mUAS depends on import data to estimate the current stock of mUAS and the future growth of mUAS. As such, the forecast assumes the current rules regarding imports remain the same over the five year time horizon. However, a change in the import rules would likely change the mUAS imported and the growth path of the mUAS fleet. Thus, if the US import rules regarding mUAS change significantly, the mUAS forecast will require adjustments.

1.10 UAS Imports

On January 27th, 2022, the White House issued a proclamation to update the Harmonized Trade Schedule of the United States (HTSUS) to match recommendations by the World Customs Organization.⁵² As part of the update, UAS received their own categories, separating UAS from crewed aircraft or toys. The new schedule splits UAS into several categories based on weight and a special category for UAS capable of passenger services (See Table 3).⁵³ The new HTSUS has given the FAA additional information regarding the number of UAS purchased in the United States. This is particularly useful given that the vast majority of UAS operators' equipment within the United States are imported.

To map the HTSUS categories onto the categories commonly used in the Aerospace Forecast, we used the category of small UAS as defined by Part 107 as the divider.

HTSUS Code	Type	Weight	FAA Code
8806.1	Rc Unmanned Aircraft Carriage of Passengers	Unspecified	
8806.21	Rc Unmanned Aircraft	Not Over 250g	mUAS
8806.22	Rc Unmanned Aircraft	250g - 7kg	sUAS
8806.23	Rc Unmanned Aircraft	7kg - 25kg	sUAS
8806.24	Rc Unmanned Aircraft	25kg - 150kg	LUAS
8806.29	Rc Unmanned Aircraft	>150kg	LUAS

Table 8

In 2024, the United States imported over 470,000 UAS with a declared value of US\$421 million.⁵⁴ The number of aircraft imported decreased by almost half from 2023 to 2024 while the value of UAS imports decreased by a third.⁵⁵ Given that mUAS accounted for around three-quarters of all UAS imported in 2022 and 2023, the vast majority of the reduction in imported unmanned aircraft was from the mUAS category, with a 53% reduction in imported mUAS in 2024 compared to 2023. In addition, sUAS imports fell from 187,000 aircraft in 2023 to 156,000 in 2024, an almost 17% reduction. However, LUAS grew from 3,100 in 2023 to 5,145 in 2024, a 66% increase, but since LUAS are only half a percent of total UAS imported, the increase had little effect on total UAS imports.

⁵² See the U.S. President's proclamation: <https://www.govinfo.gov/content/pkg/FR-2021-12-28/pdf/2021-28334.pdf>; World Customs Organization's amendments: <https://www.wcoomd.org/en/topics/nomenclature/instrument-and-tools/hs-nomenclature-2022-edition/amendments-effective-from-1-january-2022.aspx>

⁵³ The categories also included "Not Elsewhere Specified or Included (NESOI)" and "duplicate category" for each of the sub-category codes.

⁵⁴ All import numbers are for the values and units of UAS for consumption and exclude units in bonded warehouses. Values exclude duties, insurance, and freight.

⁵⁵ Total declared value of UAS imports.

US Imports of UAS by Value and Units

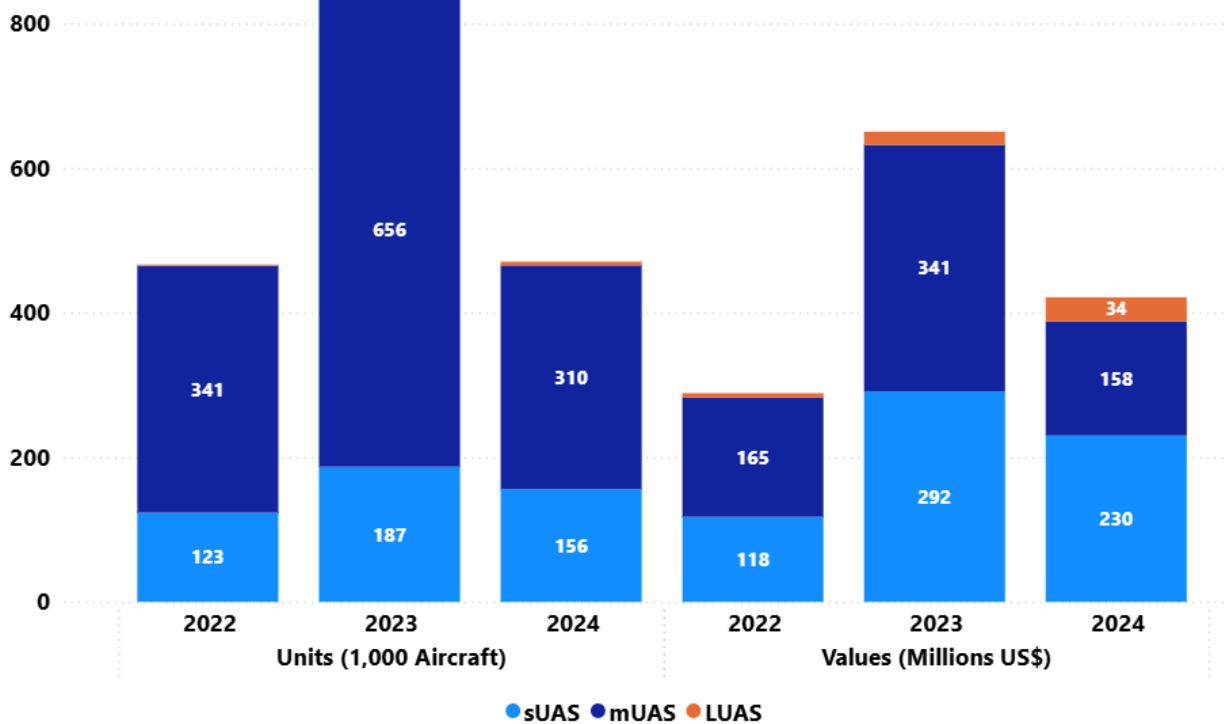


Figure 15

Corresponding to the change in units imported, the average price per unit has followed the change in units imported for each category.⁵⁶ For mUAS and sUAS, the price per unit imported decreased by 2.0 and 5.3%, respectively, while prices for LUAS increased by 11.2%. The changes in price suggest that markets for mUAS and sUAS are likely saturated while LUAS continues to grow. This conclusion is supported by the forecasts for sUAS and LUAS in the previous sections.

⁵⁶ Average price is calculated as the total declared value divided by the number of units imported.

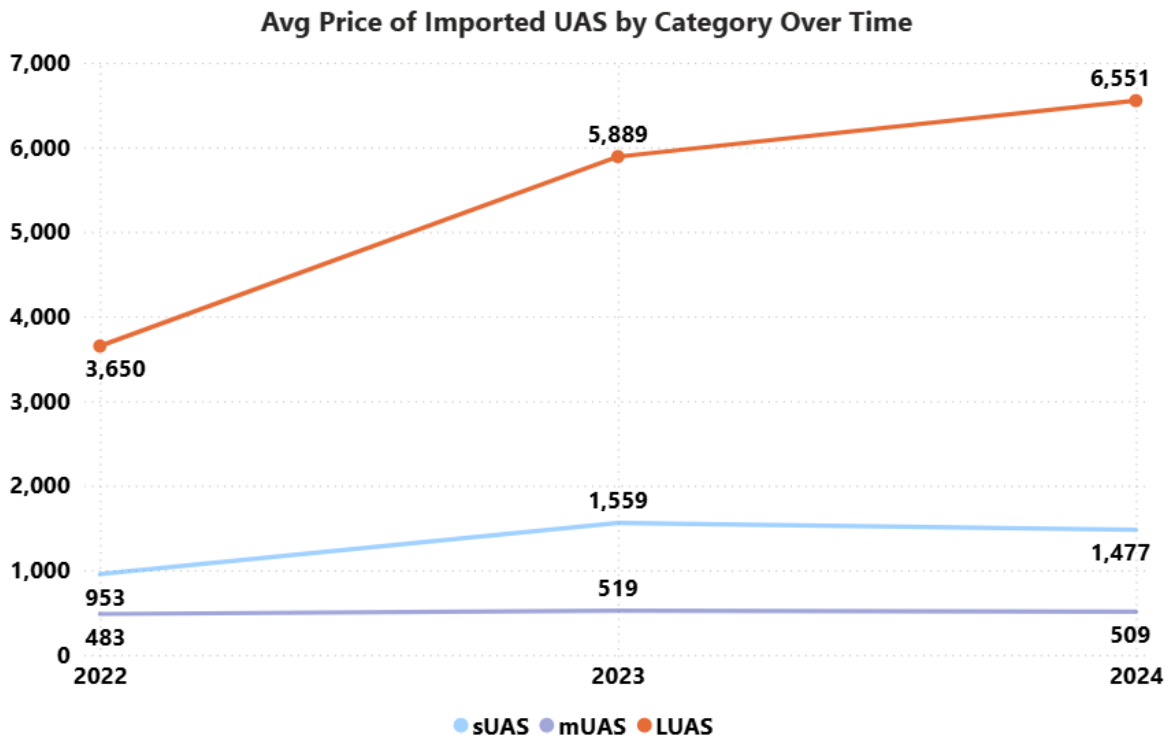


Figure 16

The vast majority of UAS imports, both in terms of value and units, originate in either China or Malaysia. On average, both China and Malaysia are exporting low value UAS compared to other countries, with Malaysia having the lowest average price of a UAS.

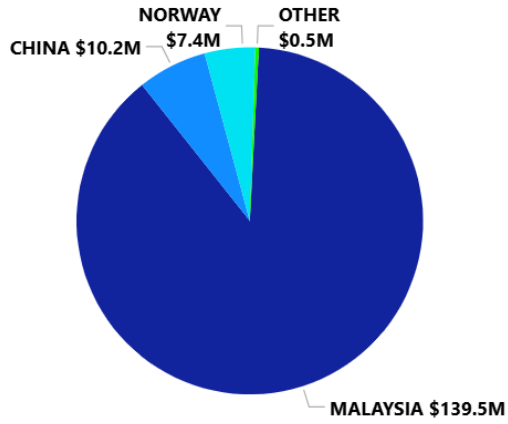
A total of just under 310,000 mUAS were imported into the United States in 2024 with a value of over \$158 million, a 53% decrease from 2023.⁵⁷ China and Malaysia dominated this segment of the UAS market, exporting 34,800 and 260,200 units to the United States worth \$10.2 million and \$139.5 million, respectively. Between the two countries, their exports of mUAS to the United States made up 95% of the mUAS imported.⁵⁸ However, Malaysia’s portion of mUAS imported into the United States has been increasing each year from 66% in 2022 to 84% in 2024 while imports from China fallen from 34% in 2022 to 11% in 2024.⁵⁹ This suggests that Malaysia is dominating the overall production of mUAS destined for the U.S. market. Norway is a notable exception to the two large exporters of mUAS. Norway’s exports of mUAS to the United States made up five percent of imports in terms of value and had one of the highest average values per unit of any category of UAS at over US\$27,000 per aircraft.

⁵⁷ All graphs of mUAS import values and units bundle all countries with less than 2% of the market into the OTHER category.

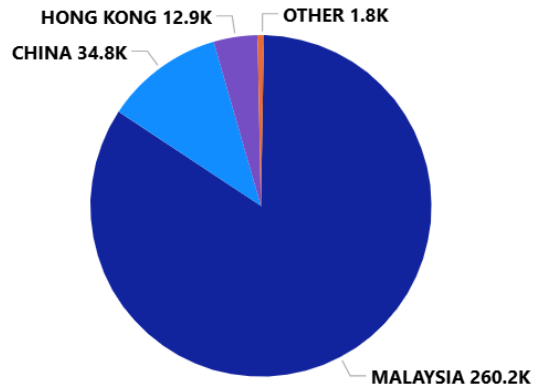
⁵⁸ If Hong Kong, which is administered by China, is included in the Chinese mUAS import numbers, then 99% of the mUAS imported into the U.S.A. are from just two countries: China and Malaysia.

⁵⁹ If Hong Kong, which is administered by China, is included into the U.S. imports from China, then imports from China consist of 15% of mUAS imports into the U.S.A.

Value of mUAS Imports (Millions of US\$)



mUAS Imported (Thousands of Aircraft)



	Value (Millions of US\$)	Aircraft (Thousands)	Average Price (US\$)
CHINA	10.2	34.8	294
HONG KONG	0.0	12.9	3
MALAYSIA	139.5	260.2	536
NORWAY	7.4	0.3	27,725

Figure 17

Portion of mUAS Aircraft Imported into U.S.A. by Country

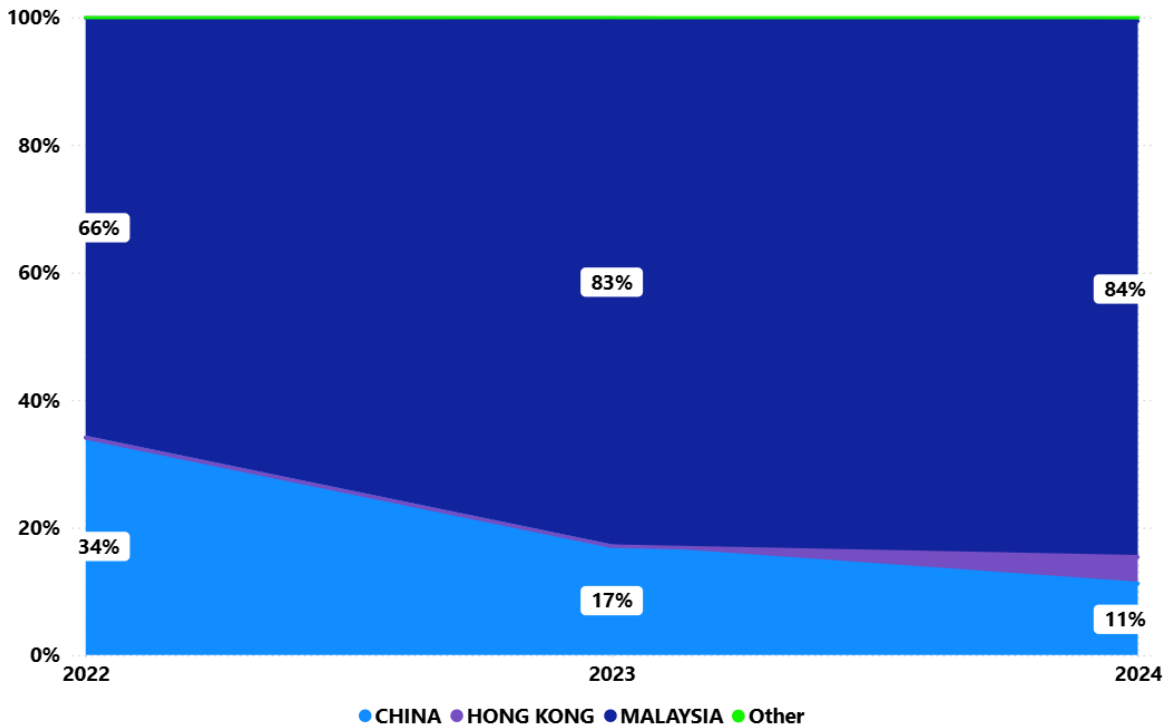


Figure 18

The United States imported a total of 155,800 units of sUAS in 2024 valued at \$230.1 million.⁶⁰ Imports from China, Malaysia, and Vietnam dominate this segment of the UAS market with 92% of all imported sUAS originating in these three countries. Both Malaysia and Vietnam have grown their share of sUAS imports into the United State each year from 11% and less than one percent in 2022 to 57% and seven percent in 2024. Conversely, China’s share of sUAS imports into the United States has decreased each year from 84% in 2022 to 28% in 2024. South Korea has become the newest entrant in the significant sUAS manufacturers with their share of sUAS imported into the United States growing from less than a percent in 2023 to 4.5% in 2024. Small UAS from China, Malaysia, and South Korea had an average price of around \$1,200 while those from Vietnam had more than twice the price of around \$3,100. Small UAS from Canada, Israel, and Switzerland made up less than a percent of the sUAS imported into the United States but consisted of 11% of the value. This is because the average price of the sUAS imported from these countries was 16 times higher than the average price of the other four countries, suggesting that these sUAS are more likely for commercial than recreational use.

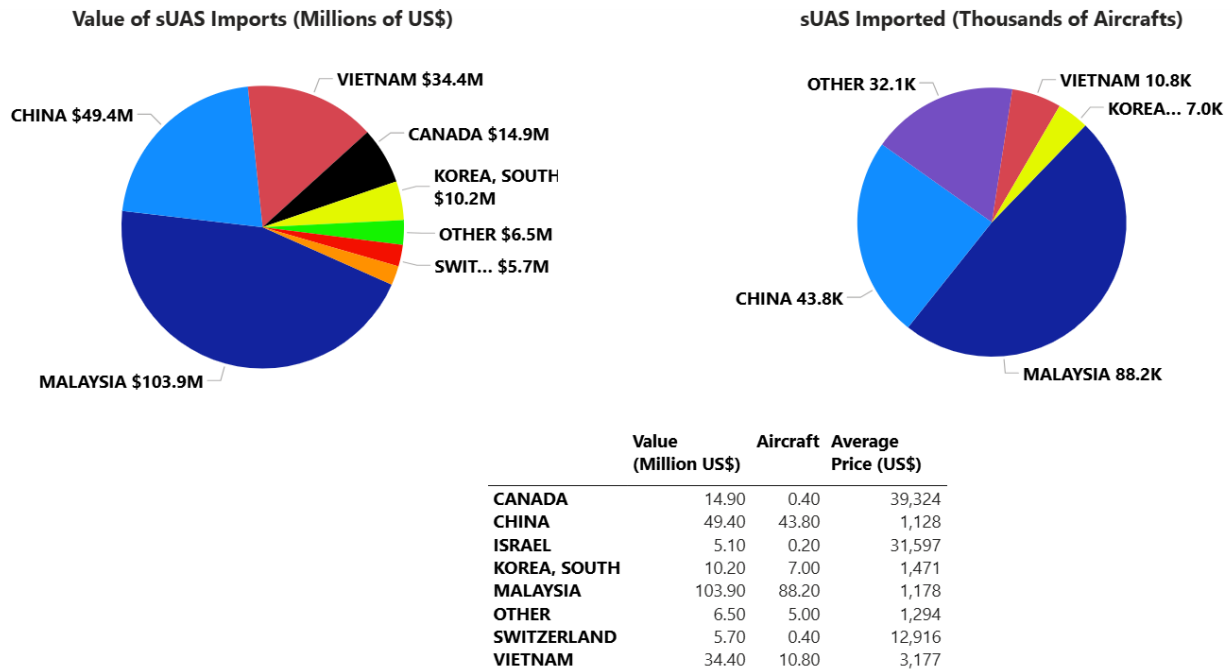


Figure 19

⁶⁰ All graphs of sUAS import values and units bundle all countries with less than 2% of the market into the OTHER category.

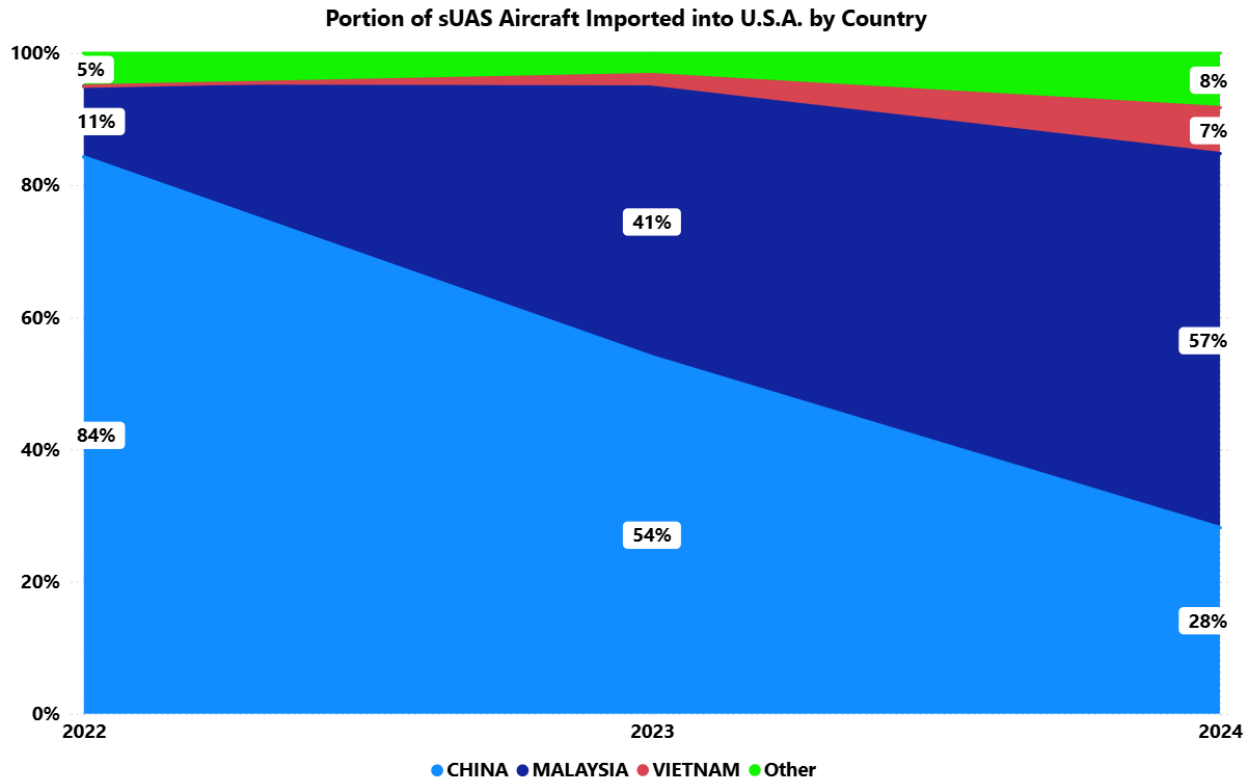


Figure 20

In 2024, the United States imported 5,145 LUAS valued at \$33.7 million, a 66% increase in imported LUAS and an 85% increase in value between 2023 and 2024.⁶¹ Once again, China was the dominant exporter to the United States, both in terms of units and value. European countries are notable producers of LUAS with Norway, Switzerland, and the U.K. exporting 34, 23, and 105 aircraft to the United States valued at US\$1.6 million, US\$1.2 million, and US\$4.0 million, respectively. Taiwan and Vietnam have emerged as new entrants for LUAS. Both countries have started to export low value but high volumes of LUAS to the United States, most likely airframes. Over the past two years, China has increased its share of LUAS imports to the United States from 44% in 2022 to 73% in 2024. At the same time, Spain’s share of LUAS imports to the United States has dropped from 26% in 2022 to less than a percent in 2024. Part of Spain’s market share was absorbed by Taiwan in 2024. Taiwan accounted for less than one percent of LUAS imports in 2023 but made up 12% in 2024.

⁶¹ Like in the case of mUAS and sUAS, all graphs of LUAS import values and units bundle all countries with less than 2% of the market share into the OTHER category.

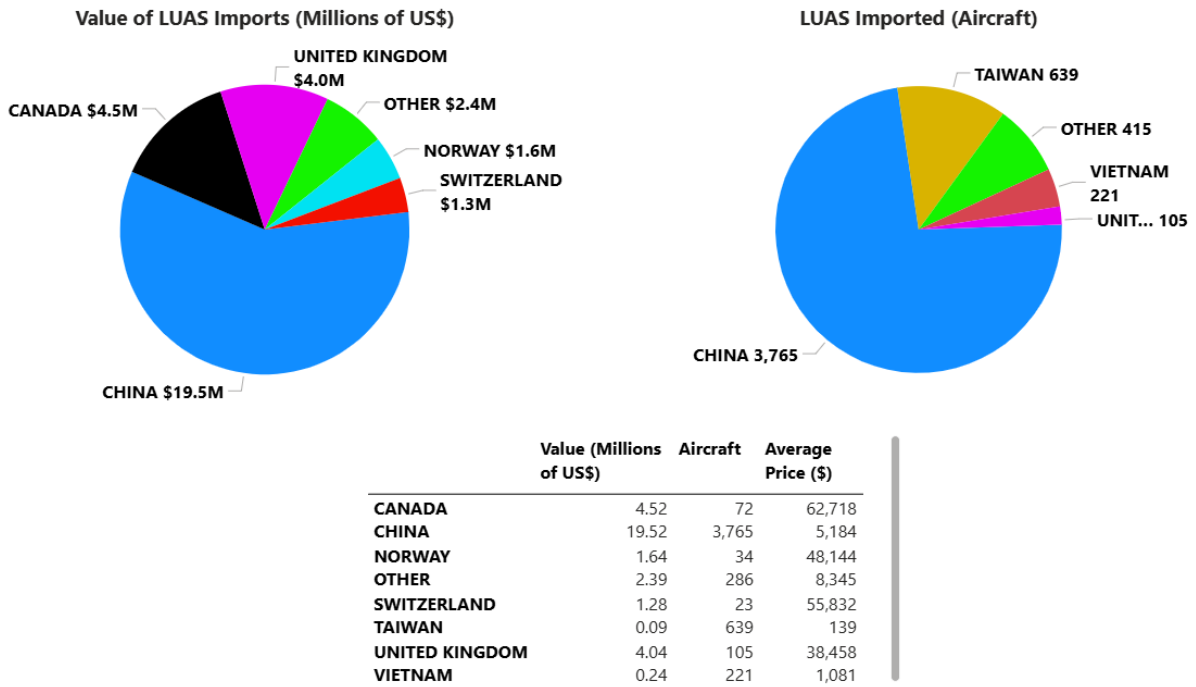


Figure 21

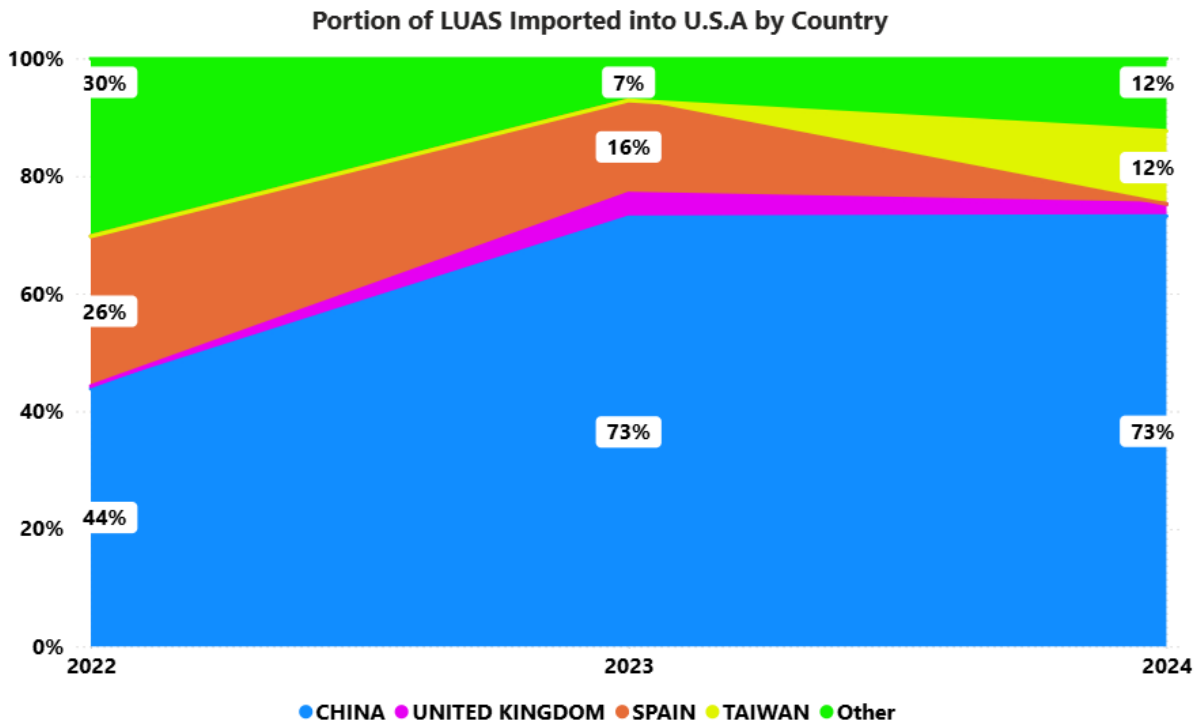


Figure 22

Overall, UAS imports have fallen in 2024. Micro UAS and sUAS have seen a reduction in total aircraft imported, while LUAS have seen continued growth, although from a low basis. These import trends seem to follow projected fleet growth trends introduced in previous sections. The

sUAS fleet continues to grow but at an ever-decreasing rate, requiring fewer aircraft to replace and sustain the growth. The LUAS fleet continues to grow exponentially, requiring a greater number of imports to sustain the rapid growth. We expect these trends to continue, which should drive up the price of LUAS as demand continues to grow, while decreasing the price of mUAS and sUAS as manufacturers seek to grab dwindling new consumers. Imports could continue to shift between countries or additional domestic manufacturers could emerge. Thus, uncertainty in the UAS supply chain is likely a risk to the UAS forecasts over the five year time horizon.

Advanced Air Mobility

Advanced Air Mobility (AAM) is an umbrella term for aircraft that are typically highly automated, electrically powered, and have vertical take-off and landing capability. AAM consists of two sub-groups: Regional Air Mobility (RAM) and Urban Air Mobility (UAM). UAM involves increasingly automated, cooperative air transportation services in and around urban areas. Many of these aircraft fall into the powered-lift category and are often referred to as air taxis or electric vertical takeoff and landing (eVTOL) aircraft. Several proposed use cases for UAM aircraft include passenger transport and the provision of emergency services. Conversely, RAM involves highly automated air transportation with advanced propulsion systems operating outside of urban environments. These aircraft range from heavy unmanned-aircraft cargo delivery to electric-propulsion passenger aircraft. Although both segments of AAM are developing, UAM markets are more defined and provide better data for estimating demand for services. As such, for the purpose of this forecast, the estimates of AAM rely entirely on UAM related services. As RAM markets become more defined and data becomes available, the FAA will consider expanding the AAM forecast to include RAM related services.

To prepare for the safe and efficient integration of AAM operations into the NAS, the FAA led several initiatives including the release of the FAA UAM CONOPS Version 2.0 in April 2023, as well as the publication of the FAA AAM Implementation Plan and the issuance of the final rule that adds the “powered-lift” definition to the regulations covering certain air carrier and commercial operations, both in July 2023. More recently, in November 2024, the FAA issued the final rule establishing the requirements for pilot certification and powered lift operations and published an updated engineering brief for vertiport design standards in December 2024.

During late 2024 and the beginning of 2025, the AAM industry saw a wave of consolidation and divestment activities, including:

- Lilium, a German aerospace company developing electric vertical take-off and landing (eVTOL) aircraft, first filed for insolvency in October 2024 but later entered into an asset purchase agreement with an investor group. In February 2025, Lilium filed for insolvency again as the transaction did not progress as expected.
- Volocopter, another German aircraft manufacturer, filed for insolvency in December 2024 and is currently seeking investors.

- Airbus announced in January 2025 that it will suspend plans to bring its CityAirbus NextGen eVTOL aircraft to the market.
- Ferrovial Airports, a global airport developer and operator, announced in November 2024 it was pausing its vertiport investments. In January 2025, Ferrovial Airports sold off its Ferrovial Vertiports unit to Atlantic Aviation, a fixed-base operator (FBO) based in the U.S.
- Eviation, a U.S.-based aircraft manufacturer, in February 2025, halted development of its electric aircraft, Alice, and laid off most of its staff as it seeks additional funding.

Nevertheless, several AAM Original Equipment Manufacturer (OEMs) including Joby Aviation, Archer Aviation, and Beta Technologies have made significant progress toward entry into service (EIS) and are planning to launch operations in the 2025-2026 timeframe. Archer Aviation plans to launch air taxi services in Abu Dhabi by late 2025, and Joby Aviation plans to launch air taxi services in Dubai by early 2026. In the U.S., these OEMs have applied for FAA aircraft certification. They intend to launch operations as soon as possible.

Considering the recent regulatory advancements and operator progress toward EIS, it is essential to incorporate the latest available information into AAM demand estimates. These estimates will aid in the development of vertiports and other infrastructure, airspace design and procedures, spectrum availability, workforce considerations, and safety assessments and other analyses. Drawing from FAA-sponsored AAM demand research conducted by The MITRE Corporation (MITRE) in March 2025,⁶² we present a NAS-wide AAM potential demand forecast starting from Year 1 (defined as the EIS year⁶³ for the first expected AAM use case in the U.S.) through Year 6 (five years after EIS) in the table below (Table 4):

NAS-Wide AAM Demand Forecast

	Year 1 (EIS)	Year 2	Year 3	Year 4	Year 5	Year 6
Annual Trips	42,405	323,038	616,115	1,029,883	1,826,525	2,820,956
Daily Trips	116	885	1,688	2,822	5,004	7,729

Table 9

Unconstrained demand for AAM departures across the NAS is estimated to be 42,405 departures in its first full year, growing to over 600,000 departures annually by Year 3. As technology adoption and community acceptance continue to increase, the NAS-wide demand could continue to accelerate and reach 2.8 million departures annually by the end of Year 6 (or around 7,700 daily flights).

This NAS-wide AAM demand forecast was developed by MITRE using a data-driven, bottom-up approach. The approach starts by assessing and ranking the top 100 most populous core-based

⁶² “Advanced Air Mobility Demand Forecast for the National Airspace System”, The MITRE Corporation, MP250135, Mclean, VA, March 2025.

⁶³ Year 1 does not have a definitive calendar year assigned as the timing for AAM operations to be granted EIS in the U.S. is still uncertain and is dependent on several external factors beyond the scope of the AAM demand research.

statistical areas (CBSAs) in the U.S. in terms of their suitability for deployment of three AAM use cases:

- **Airport Shuttle:** Transport of passengers between an airport and a central business district (CBD) area, or between airports within the metro area.
- **Urban Air Taxi:** Transport of commuters from a location near their home to a location near their work, and vice versa.
- **Air Medical:** Transport of people and supplies for medical reasons. Within the six-year forecast horizon, only scheduled missions between medical facilities (interfacility transport) are expected.⁶⁴

For each of the three AAM use cases, the suitability assessment compared and ranked the relative market demand and readiness of the top 100 CBSAs using demand driver and site readiness variables (with assigned weights) deemed relevant and appropriate for each use case based on literature review. Several demand driver variables for Airport Shuttle and Urban Air Taxi include population density, individual purchasing power, number of travelers, and peak-hour drive time between origin and destination. Several site readiness variables include existing numbers of take-off and landing areas (TOLAs), FBO sites, battery charging sites, as well as the presence of AAM operator go-to-market plans, partnerships, state/local initiatives, etc. For the Air Medical use case, different demand driver variables such as distance between hospitals, number of people lacking timely access to hospitals, and existing number of interfacility transport flights were used. Note that the information captured by the research was current as of February 2025.

A map of the top 100 CBSAs by population included in the suitability assessment is shown below. All of these CBSAs are also MSAs which have 50,000 or more inhabitants.

⁶⁴ Researchers have found that the range and the very limited hover capability for eVTOL aircraft could mean they are more suitable for planned interfacility transport services rather than emergency scene response.

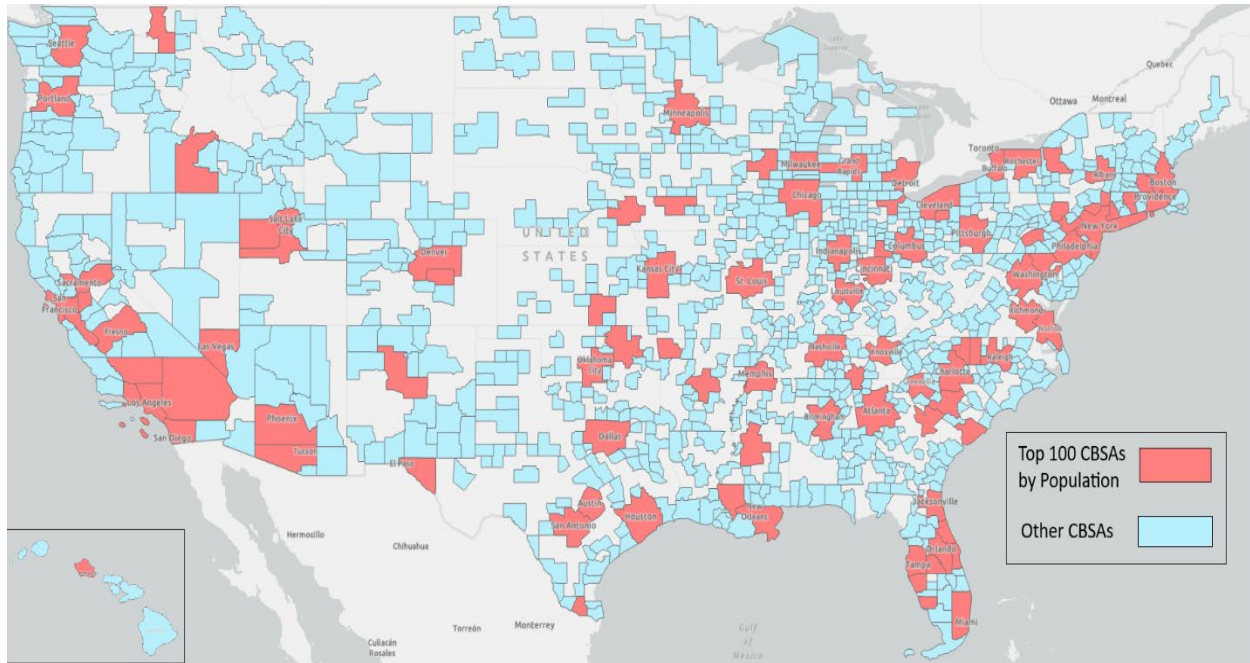


Figure 23

The next step in the bottom-up forecast approach was to generate AAM passenger and departure forecasts for the top-ranked MSAs from the suitability assessment, by use case.

In developing the use case and MSA-specific forecasts, several assumptions were made. First, only piloted eVTOL operations were assumed within the forecast horizon (i.e., up to five years after initial EIS operations). Additionally, the forecasts reflect unconstrained demand, as they do not account for factors like air traffic requirements, airspace limitations, vertiport capacities and locations, aircraft performance, fleet size, regulations, and other similar considerations.

Among the three AAM use cases, it is projected that initial operations in the U.S. will commence with airport shuttles, followed by air taxis, and then air medical missions. This is because airport shuttles will have the most robust passenger demand traveling between fixed and concentrated points of interest (i.e., airports and downtown areas). Urban air taxi flights for commuters, on the other hand, will be spread across more routes depending on where commuters live and work. Lastly, air medical missions are expected to lag behind airport shuttle and air taxi services due to lower level of operator interest currently, as well as potential requirements for retrofitting aircraft for medical-use, additional time needed for aircraft certification, and deployment of charging infrastructure to support air medical missions.

The figure below (Figure 24) shows the anticipated AAM departures for each forecast year, by use case.

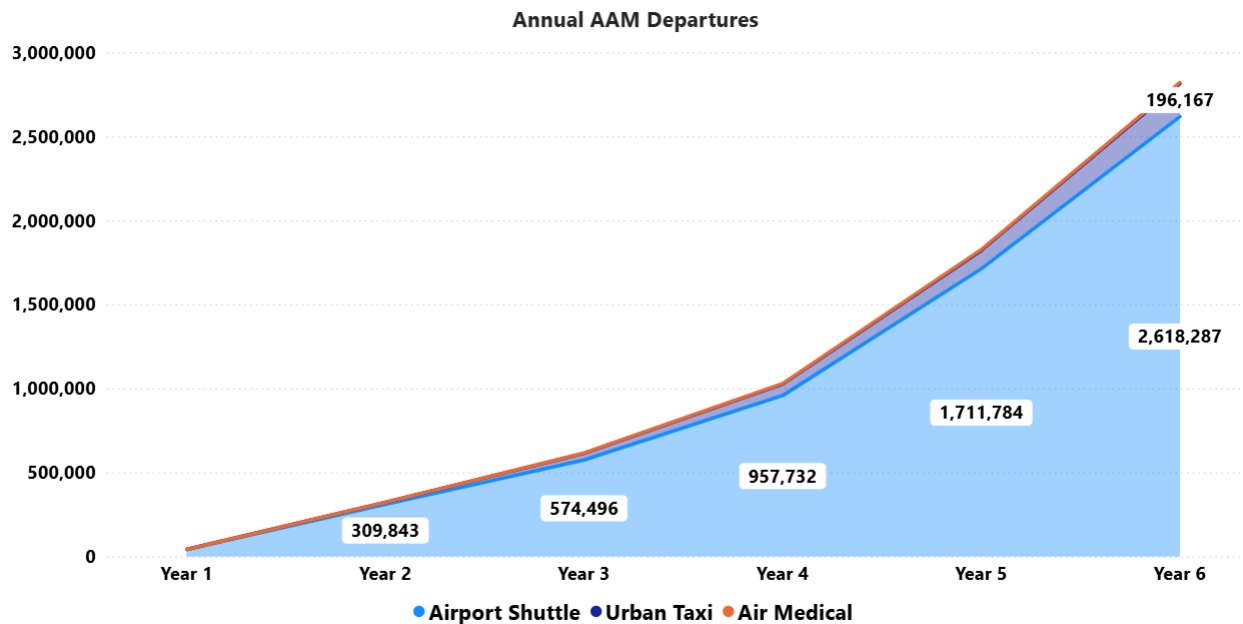


Figure 24

The Airport Shuttle projections constitute the largest portion of the overall AAM forecasts for a couple of reasons. First, the Airport Shuttle is anticipated to be the initial AAM use case to be implemented, with demand increasing annually in tandem with the rise in airline passengers from a growing number of MSAs that could adopt an AAM airport shuttle service. Secondly, the number and proportion of commuters likely to consider AAM are generally lower than the estimates for airline passengers.

In the MITRE AAM demand research, the Airport Shuttle and Urban Air Taxi passenger demand for the top 20 MSAs were derived from benchmark forecasts available for a single MSA. The benchmark forecasts were used to calibrate the passenger demand estimates for the other 19 MSAs in the forecast.

For the Airport Shuttle use case, the benchmark forecast was that 2% of the dominant air carrier passengers would take AAM in a benchmark MSA.⁶⁵ For the Urban Air Taxi use case, the benchmark forecast was based on an FAA-sponsored study for a site-specific AAM demand forecast.⁶⁶ Since the benchmark forecasts represent when AAM operations have scaled and matured (as opposed to initial operations), they were used to benchmark passenger demand for Year 6, the final year in the forecast horizon.

⁶⁵ This was based on a statement from Joby Aviation and Delta Air Lines regarding anticipated passengers at John F. Kennedy International Airport (JFK) which is in the New York-Newark-Jersey City, NY-NJ MSA as reported by the Washington Post. The Washington Post estimated that approximately 1,000 passengers per day would opt for AAM instead of driving to the airport, representing about 2% of Delta's passengers at JFK. (<https://www.washingtonpost.com/technology/interactive/2024/need-get-airport-soon-you-can-take-an-air-taxi/>)

⁶⁶ "Urban Air Mobility Demand Forecast for the Los Angeles Metropolitan Area", The MITRE Corporation, MP240376, Mclean, VA, June 2024.

The benchmark was compared to the other 19 MSAs within the respective use cases in terms of the demand driver variables from the suitability assessment. If the demand driver variables for an MSA signaled stronger/weaker demand than the benchmark MSA, then the benchmark forecast (e.g., 2% of air carrier passengers, 0.98% of commuters) would be scaled up/down proportionally. The calibration step was repeated for all non-benchmark MSAs to obtain different estimates of the percentages of passengers expected to take AAM. These estimates were then applied to their respective MSAs' Year 6 (assumed year for the benchmark) daily passenger counts to derive the number of passengers who would take airport shuttle or urban air taxi, depending on the use case. Finally, the study assumed an average load factor of 60% for a four-seater aircraft (2.4 passengers per departure)⁶⁷ and divided the Airport Shuttle passenger forecasts and Urban Air Taxi commuter forecasts by 2.4 to arrive at the number of departures.

For the Air Medical use case, MSA-specific demand was estimated using event-level data on ambulance trips from the National Emergency Medical Services Information System (NEMSIS) database. A prior MITRE study⁶⁸ used this data to derive national-level proportions of air ambulance rotorcraft trips by complaint group (heart, stroke, accident, or other⁶⁹), age group (0-24, 25-49, 50-64, or 65 and over), and mission type (interfacility transport or scene response). Over time, changes to the proportions of population by age group at the MSAs will lead to changes to the MSAs' expected frequency of air ambulance trips. This is because some demographics, such as the older population which is more susceptible to heart and stroke-related health events, demand more air medical transport. The MITRE research used the NEMSIS proportions augmented with age group-specific population forecasts, by MSA, to estimate expected changes to the baseline air medical flight counts, also determined in the research using flight surveillance data.

The MITRE AAM demand research obtained MSA-level population data and forecast for 2023-2035 to compute year-over-year population growth rates by age group, for each MSA. These population growth rates translated into changes to the proportions of complaint groups and led to changes to the expected frequencies of air medical flight departures from one year to the next, starting with the baseline year 2023.

Additionally, the fleet sizes required to support the projected departures for three use cases were estimated by assuming each AAM aircraft would conduct 28 trips per day on average (two trips per hour over a 14-hour operating day) for the Airport Shuttle and Urban Air Taxi use cases and 2.5 trips a day for the Air Medical use case. The assumption of the 28 trips per day per aircraft is similar to the assumption used in the prior ASSURE A36 study and is in line with estimates for the eVTOL annual utilization assumptions for Joby Aviation. The projected NAS-wide AAM daily trips and the estimated fleet sizes to support those trips are shown in the table below (Table 5). Based on announcements of expected fleet production capacities from several AAM OEMs, the

⁶⁷ Los Angeles International Airport Shuttle forecast study conducted by Rimjha et al. (M. Rimjha, S. Hotle, A. Trani, N. Hinze and J. C. Smith, "Urban Air Mobility Demand Estimation for Airport Access: A Los Angeles International Airport Case Study," *2021 Integrated Communications Navigation and Surveillance Conference (ICNS)*, Dulles, VA, USA, 2021, pp. 1-15, doi: 10.1109/ICNS52807.2021.9441659).

⁶⁸ "Demand Forecasting Frameworks and Case Studies for Advanced Air Mobility Air Ambulance Operations", The MITRE Corporation, MP230616, Mclean, VA, September 2023.

⁶⁹ This group includes all other dispatch-reported complaints not related to heart issues, stroke, or accidents, such as: abdominal pain, animal bite, falls, assault, and unknown problems.

fleet sizes needed to support the number of trips should be attainable and not be a constraining factor.

NAS-Wide AAM Demand Forecast

Year 1 (EIS) Year 2 Year 3 Year 4 Year 5 Year 6

Daily Trips	116	885	1,688	2,822	5,004	7,729
Fleet Size	4	32	62	104	184	283

Table 10

In addition to determining the demand for AAM departures and fleet sizes, the site readiness variables from the suitability assessment were assigned weights to rank the top MSAs by their EIS readiness scores. The MSAs with higher EIS readiness scores could expect to see operations sooner.

After the initial ranking, the EIS year assignments were further adjusted. The table below (Table 6) shows 15 MSAs with high potential to see AAM operations within the forecast horizon (Years 1 to 6).

Expected AAM Services in Select Metropolitan Statistical Areas

MSA	Airport Shuttle	Urban Air Taxi	Air Medical
Atlanta	*		*
Boston		*	
Chicago	*	*	*
Dallas	*	*	*
Denver	*		
Houston	*	*	*
Los Angeles	*	*	
Miami	*	*	
New York City	*	*	
Orlando	*	*	*
Phoenix			*
Pittsburgh			*
San Francisco	*	*	
Seattle	*		
Tampa			*

Table 11

The FAA will continue to refine the forecast assumptions as more information becomes available, specifically, details related to proposed AAM operations, use cases, and vertiport locations. In addition, further research can incorporate constraints such as airspace access, vertiport locations and capacities into the forecasts. Comparing constrained forecasts against the unconstrained forecasts could yield estimates of the opportunity cost of investments affecting the emergence of AAM services.

Appendix

A.1 Forecasts Using New Registrations vs. Effective/Active Fleet for Recreational/Model Operators

An examination of the registration renewal data provides an opportunity for the FAA to discern the effective/active fleet more succinctly using the following five elements: **Cancellations**, defined as the number of registrations canceled by user; **Expiry**, defined as the number of registrations expired (i.e., effectiveness of expiry); **New**, defined as the number of brand new registrations (i.e. new registration number) that are reported in the preceding section; **Renew**, defined as the number of registrations renewed prior to expiration; and **Renew+**, defined as the number of registrations renewed after expiration.



Figure A. 1

Cumulative cancellations were, on average, 26,234/month for the period of January 2024 – December 2024 (or averaging around 218 new cancellations, the average gaps between two bars in the graph below, for each month during the January – December 2024 timeframe). For the year 2022-2023, the numbers for cumulative cancellations and average new monthly cancellations stood at 21,379/month and 508, respectively:

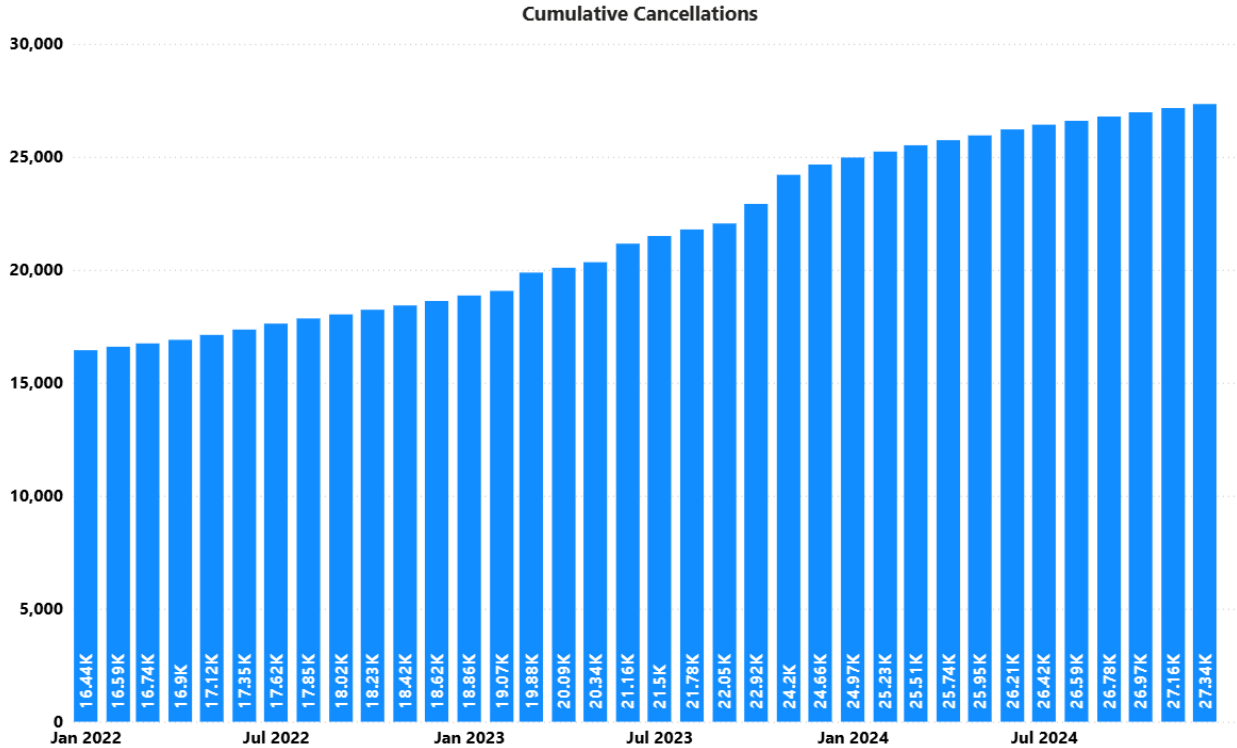


Figure A. 2

We extended the data by one more year in this year’s forecast, to 2024, while shortening a year from last year, to 2022, and observe that the trend in cancellations accelerated from an average of 500/month last year to 218/month this year; cumulative cancellations, on average, stood at around 26,234 with new monthly cancellations at 218 during January-December 2024. Trends in cancellations are decelerating as the numbers during 2024 and the prior year of 2023 indicate.

Likewise, cumulatively expired registrations reached over 1.23 million during 2024 following the immediate and substantial adjustment in December 2020, as noted earlier and shown below (Figure A.3). In comparison, during 2023, cumulative expirations stood at around 1 million. New average expirations for each month during January-December 2024 were around 9,529; during the years 2022-2023, it was calculated to be 12,356/month.

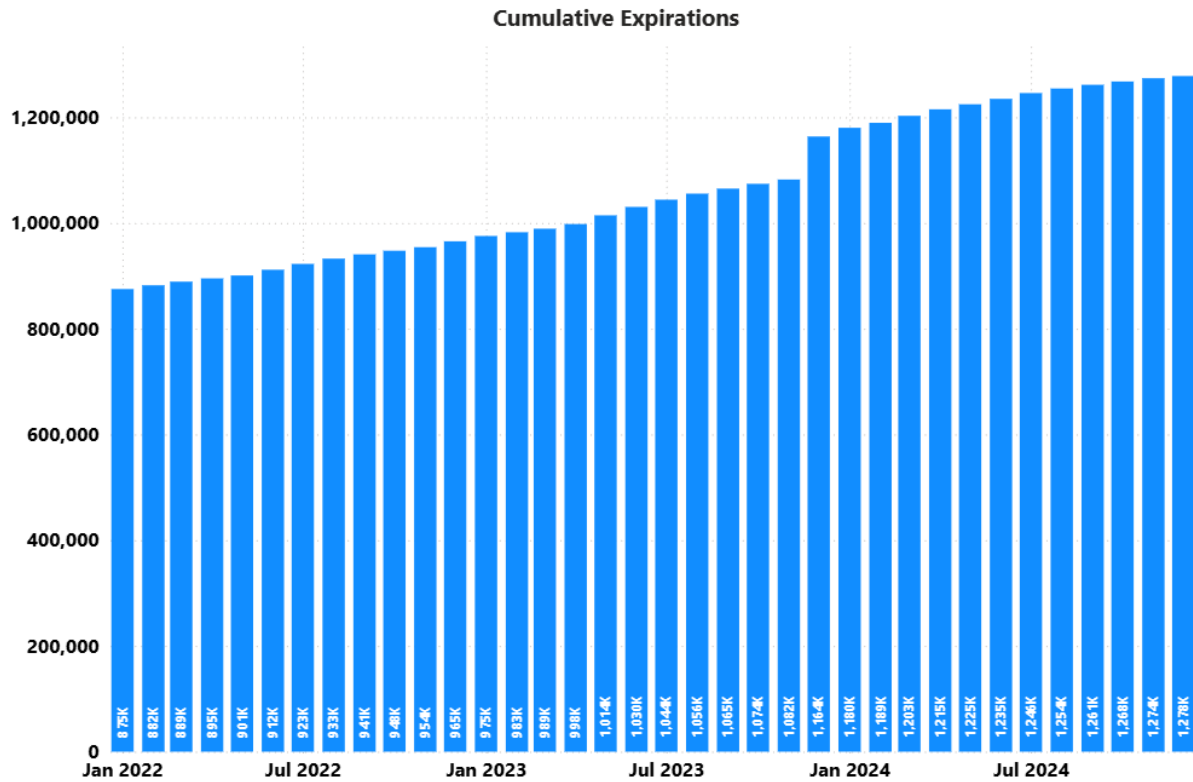


Figure A. 3

While cancellations and expirations had been accelerating over the last three years prior to this immediate past year's (2024) deceleration, renewal or re-registrations prior to expiry date have been picking up speed as well. In comparison to last year's (2023) observed 142,000 renewals (or 5,059 new average monthly renewals), this past year's (January-December 2024) renewals further climbed up to 196,885 (or 2,458 new average monthly renewals, in comparison to 5,059 the year before for each month during January – December 2023). For the past two years (2023-2024) as a whole, 149,547/month renewed on a cumulative basis while new average renewals correspondingly stood at around 3,823/month. This was a little over twice the Renew+ on a cumulative basis, as reported below (Figure A.4):

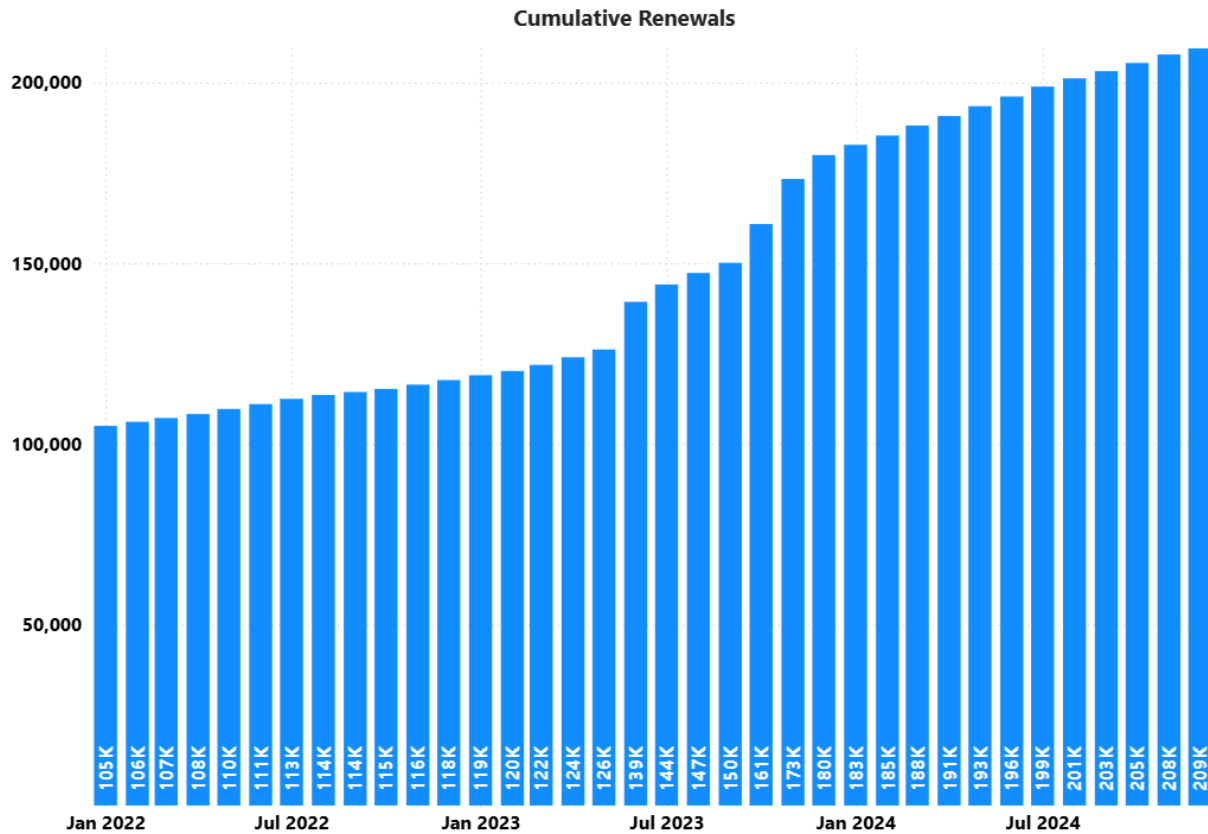


Figure A. 4

Renew+, re-registrations after the expiry date, logged a cumulative average of 71,958/month during January-December 2024. This is equivalent to 1,524 new average Renew+ registrations for each month during January – December 2024 and are reported in the below figure:

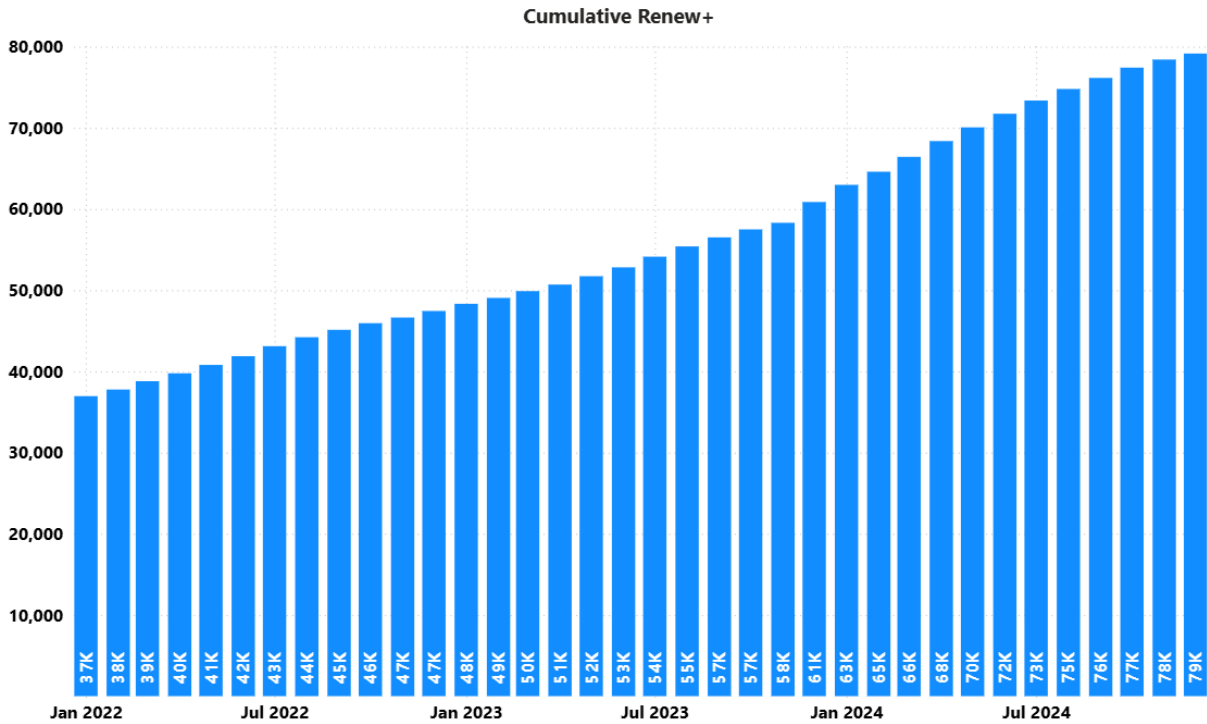


Figure A. 5

For the three years (2022-2024) in aggregate, cumulative renewal+ stood a little over 56,000/month with new Renew+ at almost 1,200/month.

A summary of the above 4 charts (Figures A.2-A.5) is provided below (Figure A.6) to narrate the relative contributions of cancellations, expiry, renew and Renew+:

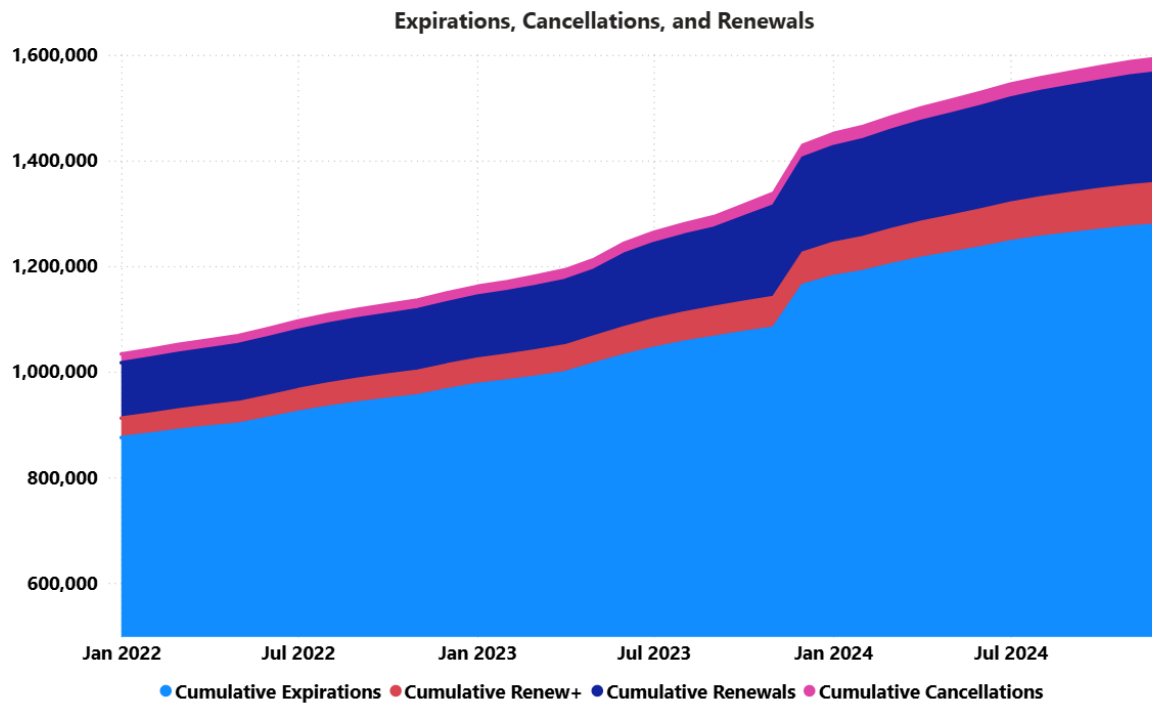


Figure A. 6

As noted from the above discussion, relative contributions of individual elements remain the same over the past two years with cumulative expiry having the largest impact on the effective/active registration as discussed below.

We calculate active/effective fleet using the five elements. Calculating active/effective registrations for a particular day requires calculating the “net gain/loss” of registrations for each preceding day and then adding them to the given day (i.e. calculating the running sum).

The following are the contributions of each element to the day's net gain/loss calculations:

- **Cancel:** (-1 for each registration);
- **Expire:** (-1 for each registration);
- **New:** (+1 for each registration);
- **Renew:** (0); and
- **Renew+:** (+1 for each registration).

An example of this calculation may be constructed as follows: calculating the net gain/loss for recreational registration for August 9, 2024 (an arbitrary date, same as reported last year), where Cancel = 3; Expiry = 292; New = 210; Renew = 75; and Renew+ = 43 were reported for recreational operators/modelers.

Thus, Net Gain/Loss for August 9, 2024 =

$$\begin{aligned}
 & 3 \times (-1) + 292 \times (-1) + \\
 & 210 \times (1) + 75 \times (0) + \\
 & 43 \times (+1) = -42
 \end{aligned}$$

A.2 Forecasts Using Registrations vs. Effective/Active Fleet for Commercial/Non-Model Aircraft

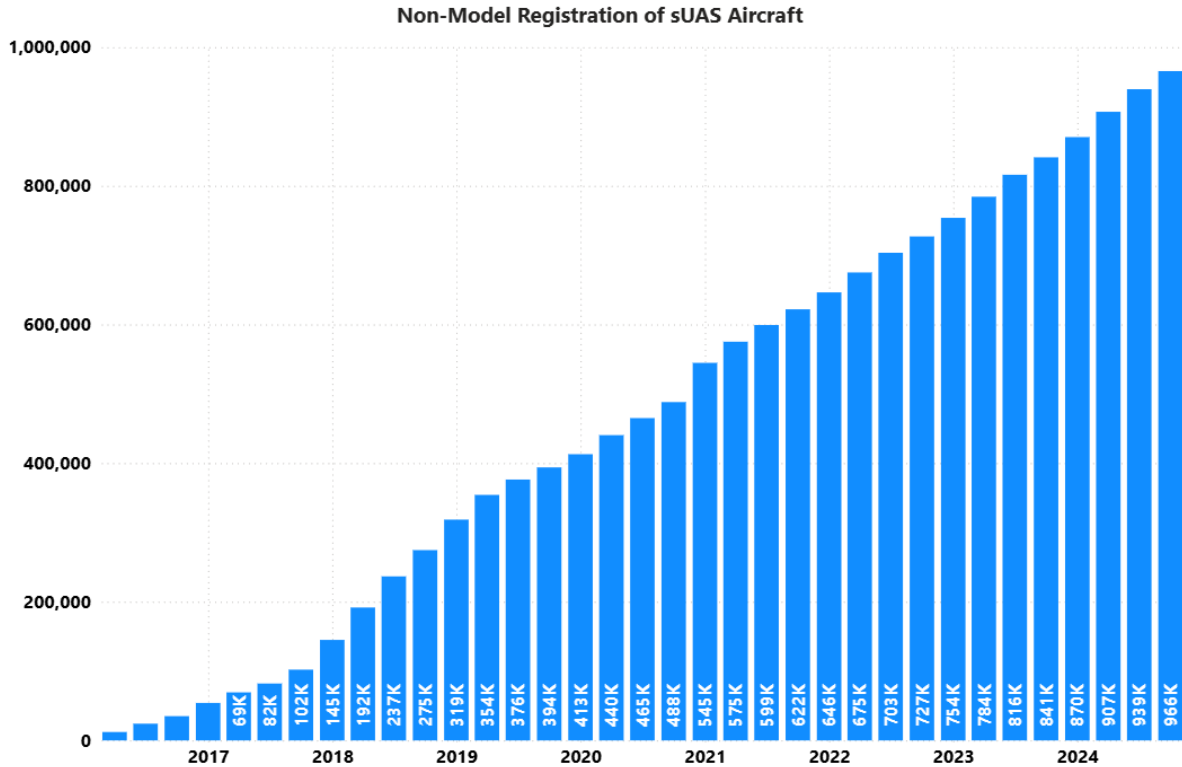


Figure A. 7

As in the case of recreational/model aircraft, an examination of the data provides an opportunity to discern the effective/active fleet more accurately using the following five elements introduced earlier: Cancellations; Expiry; New; Renew; and Renew+. It is worth mentioning that, prior to having access to these five elements, forecasts in the past were based only on new registration trends.

An average of 128,315 cancellations per month, on a cumulative basis, were reported during January – December 2024, as shown below (Figure A.8). The trend in cumulative cancellations went up by almost 29,000 from the year before. This is an average of approximately 2,319 (2,280 the year before) new cancellations for each month of 2024.

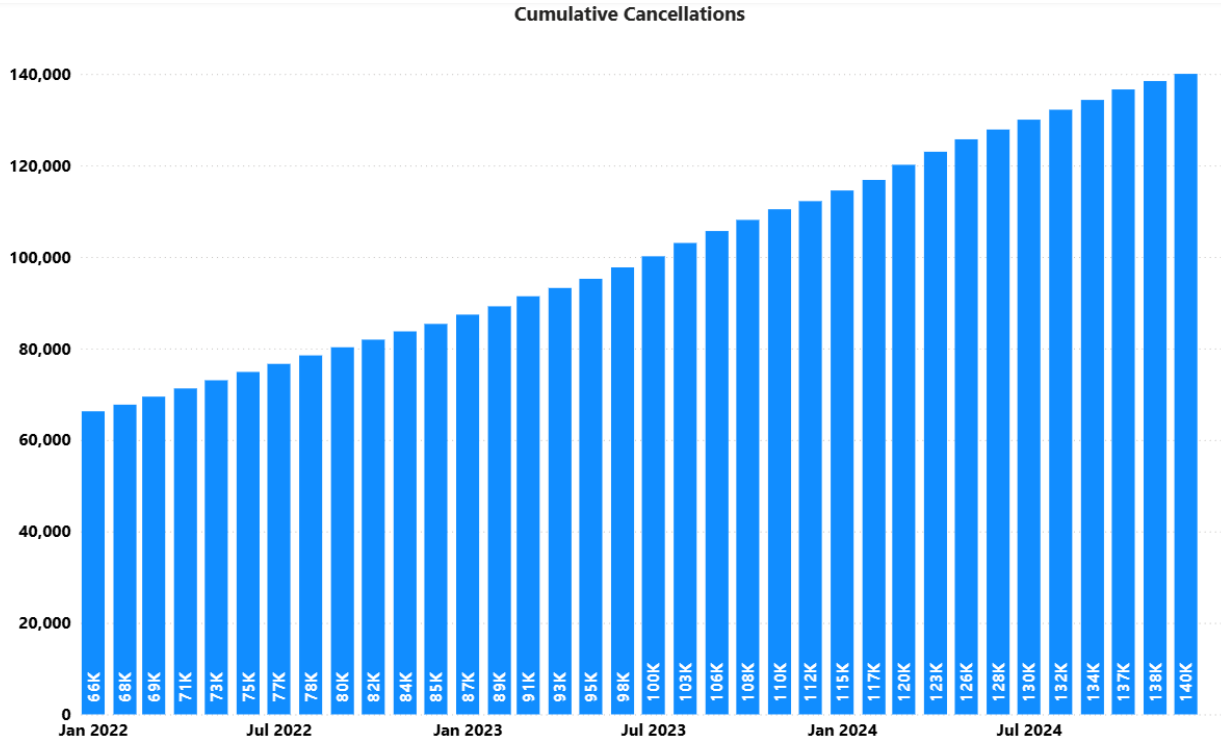


Figure A. 8

An average of over 450,000 (374,000 the year before) expirations per month was reported on a cumulative basis between January–December 2024 as shown below (A.9). This equals approximately 6,420 new average expiries for each month during January– December 2024:

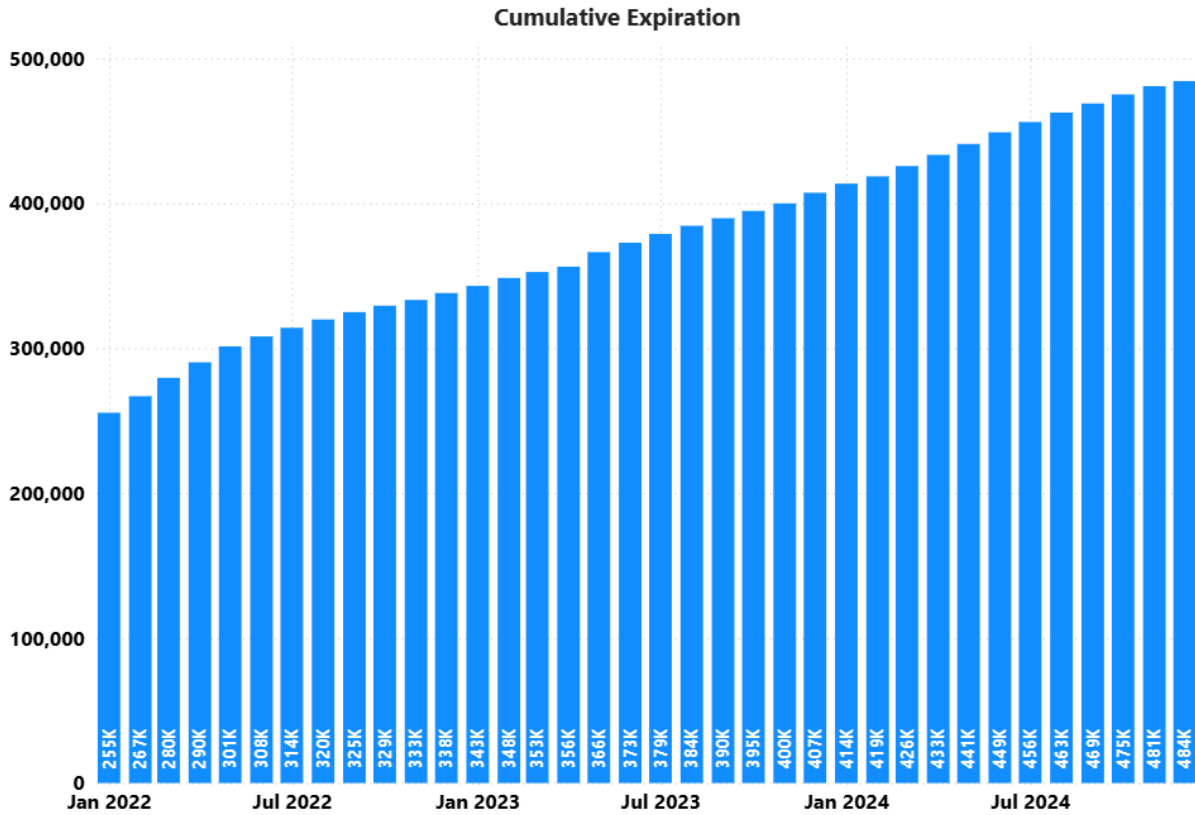


Figure A. 9

Renew, or re-registration prior to expiry date, continue to accelerate, on average, to over 76,000 (52,000/month the year before) on a cumulative basis (or a one and half time increase from the year before) during January–December 2024 (or 2,216 new average renewals/month):

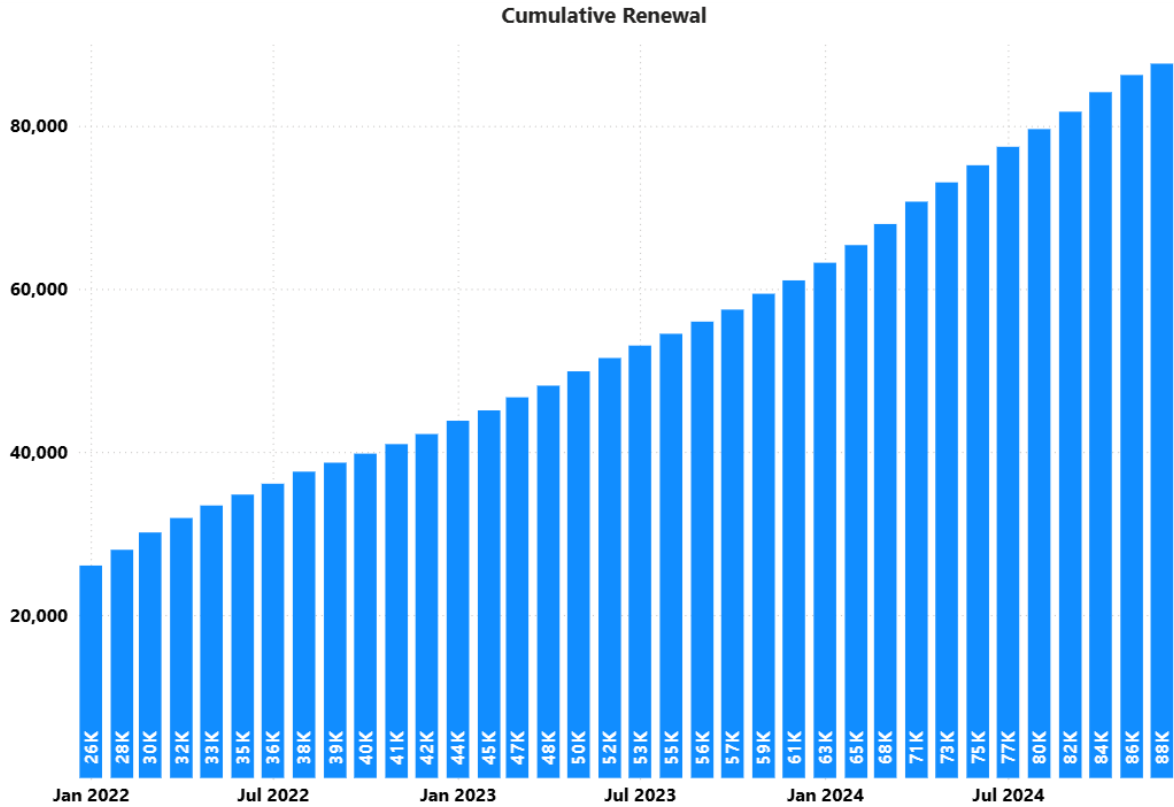


Figure A. 10

Like renewals, “Renew+” (i.e., re-registrations after expiry) logged at a rate much higher than last year with an average 41,858 during the months of January–December 2024 (compared to 30,772/month on a cumulative basis the year before). This is an average of 856 new Renew+ each month during January–December 2024 (1,016 from the year before), as reported below (Figure A.11):



Figure A. 11

As in the case of recreational/model registrations, calculating active/effective registrations for a particular day requires calculating the “net gain/loss” of registrations for each preceding day and adding them to the particular day (i.e. calculating the running sum). Using the formulation described in the example in the preceding section, we can derive the net gain/loss for Part 107 data as well.

A summary of the above 4 charts (Figure A.7-A.11) is provided below (Figure A.12) to relate the relative contributions of cancellations, expiry, renew and renew+:

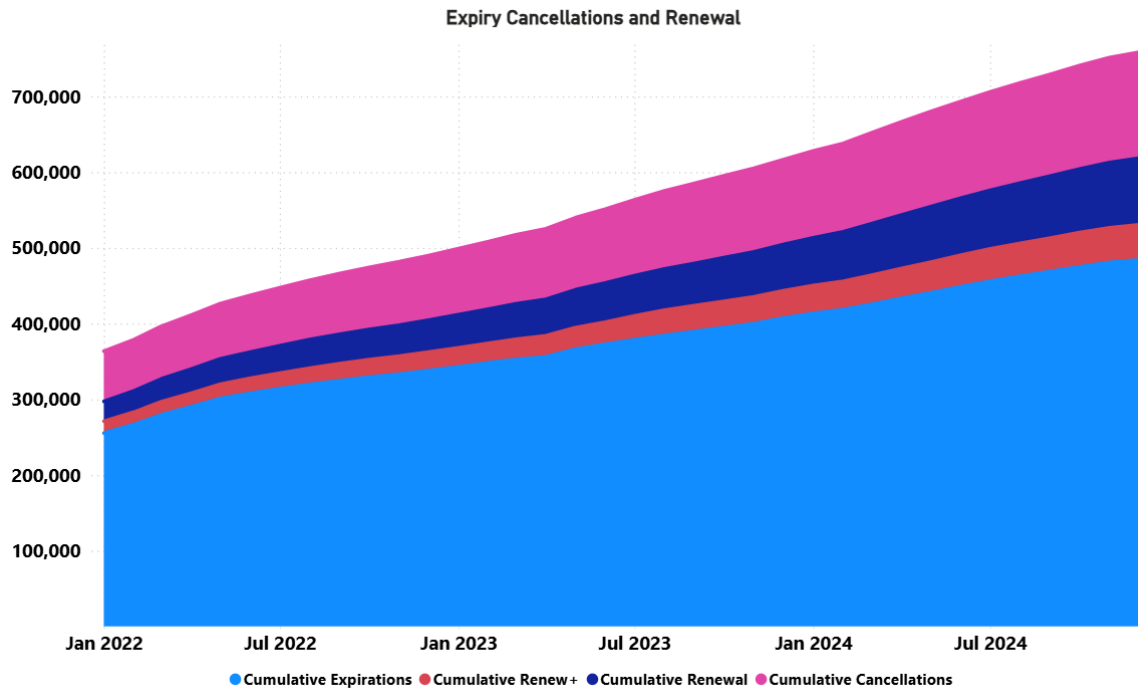


Figure A. 12