



AUVSI Research Presents

# THE 2023 QUARTERLY INSIGHT

Q3



We're entering the fourth quarter of the year and AUVSI is maintaining the momentum we've built this year to bring you new insights and perspectives. This is your chance to get up to speed and make the most of the last few months of 2023.

In this Q3 report, we include major announcements and in-depth analyses that show how uncrewed systems are being used by a variety of sectors:

- **The big picture:** Our Advocacy update gives the latest context on FAA Reauthorization, BVLOS exemptions, and new partnerships and certifications that are speeding up industry adoption.
- **By the numbers:** Our analysis of Part 107 waivers reveals which small UAS uses are gaining the most traction.
- **The bottom line:** Identify major shifts in the DoD's FY 2024 budget analysis reveals major trends and shifts in defense spending around uncrewed systems.

The AUVSI team is already preparing for major initiatives through the end of the year and into 2024 including:

- New and expanded advocacy campaigns
- Additional research and industry reports
- Programming to convene critical stakeholders
- Industry training and educational opportunities

Thank you for your continued engagement with AUVSI as we work together to achieve the acceptance and adoption of uncrewed autonomous technologies. If you have any questions about our work or the initiatives included in this report, please reach out to [membership@auvsi.org](mailto:membership@auvsi.org).

**BRIAN WYNNE**  
President &  
CEO, *AUVSI*

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**2024 DoD Budget for  
Uncrewed Systems**

# ADVOCACY

*Author: Michael Robbins, Chief Advocacy Officer, AUVSI*

AUVSI's advocacy team works at every level of government, including at the federal, state, local, and tribal levels. Our goal is to remove barriers to innovation and chart a clear path for the integration of uncrewed, robotic, and autonomous systems and technologies across the commercial and defense sectors.

- In Q3 2023, we made progress on a number of fronts:
- We continued to promote several priorities for the FAA reauthorization bill.
- We formed a new Defense Advocacy Committee (DAC) to advance the adoption of uncrewed and autonomous systems in the Department of Defense.
- Four AUVSI member organizations were granted exemptions to conduct commercial drone operations beyond visual line of sight.
- We launched the Partnership for Drone Competitiveness to support a stronger U.S. drone industry.
- We awarded the first-ever Green UAS certification.

## 2023 FAA Reauthorization Updates

For the first time in five years, Congress must reauthorize key authorities and funding for the Federal Aviation Administration (FAA). The 2018 FAA Reauthorization was a five-year bill and first multi-year FAA Reauthorization bill in quite some time. The expiration date of that bill was September 30, 2023.

Earlier this year, the U.S. House of Representatives [passed](#) its version of the FAA reauthorization bill – H.R. 3935, the Securing Growth and Robust Leadership in American Aviation Act. However, the U.S. Senate Committee on Commerce, Science, and Transportation has not held a hearing on their [version](#) of the bill. Ultimately, the two chambers must resolve the vast differences between the two versions and produce one comprehensive bill for the President to sign into law.

With the legislative process on FAA Reauthorization having stalled in Congress ahead of the September 30 deadline, Congress passed legislation to temporarily extend the FAA's authorities until December 31, 2023 and provide more time to

work through points of disagreement. The full FAA Reauthorization bill is still pending before Congress and work continues on moving it forward in the Senate.

**Why it matters:** The bill provides direction from Congress to the FAA on issues relating to the safety of the national airspace system, including the integration of uncrewed systems and Advanced Air Mobility (AAM) aircraft. AUVSI secured several priorities in both the House and Senate versions of the legislation that would help our members in a myriad of ways.

**What's next:** AUVSI will continue to closely monitor the status of the FAA Reauthorization bills and provide regular updates to members of our Air Advocacy Committee.

**[Learn more about AUVSI's legislative priorities for FAA Reauthorization.](#)**

## BVLOS Exemptions Granted

The Federal Aviation Administration granted exemptions to four organizations to conduct commercial drone operations beyond visual line of sight (BVLOS): Phoenix Air Unmanned, uAvionix, UPS Flight Forward, and Zipline. All four are AUVSI member organizations, and we previously submitted comments to the FAA encouraging the Agency to approve their requests.

**Why it matters:** To fully realize normalized BVLOS operations, a solution must consider both the safety benefits of these operations and the full

spectrum of risk mitigations available. This is essential to realize the societal potential of drones and for Americans to benefit from drones' expanded use. The more operations are enabled, the clearer the safety picture is.

**The Big Picture:** These approvals demonstrate the significant progress the drone industry is making toward scalable commercial drone operations beyond visual line of sight in data and inspection services. Successfully enabling BVLOS operations at scale throughout the NAS and across the spectrum of uncrewed aircraft is essential for the United States to retain a global leadership role in aviation.



## Partnership for Drone Competitiveness Launched

This quarter, AUVSI Advocacy launched our Partnership for Drone Competitiveness – a coalition built to support a stronger U.S. drone industry, enable greater security for customers and end users, forge American leadership in advanced aviation, and effectively level the playing field for domestic and allied drone manufacturers against foreign subsidized competition.

**Why it matters:** Incentivizing U.S. leadership in the drone industry represents a strategic imperative in a market long characterized by state-subsidized companies based in China. AUVSI believes it is essential to advance security and competitiveness in a thoughtful way that respects existing investments while building toward a more secure, sustainable future that puts U.S. interests first.

**What's next:** The coalition will advocate for targeted investments and common-sense policies that level the playing field against state-subsidized competitors and reduce dependence on foreign supply chains for components and rare earth materials.

[Download our whitepaper](#) detailing challenges facing the drone industry, [learn more](#) about policy recommendations for U.S. lawmakers and regulators, and [see AUVSI members](#) supporting the Partnership.

## Defense Advocacy Committee Formed

At the AUVSI Defense event, we announced the formation of a new Defense Advocacy Committee (DAC). The DAC joins AUVSI's existing government affairs work to champion the uncrewed systems industry and serve as a bridge across advocacy initiatives in the air, maritime, ground and cyber domains.

**Why it matters:** The Committee will advance policies and funding for uncrewed and autonomous systems in the Department of Defense, ensuring the U.S. remains at the forefront of autonomous defense technologies.

**The big picture:** The current global condition of strategic competition demonstrates that uncrewed systems are absolutely critical tools in the hands of warfighters. The U.S. cannot afford to fall behind in the innovation and

integration of uncrewed systems at scale. The DAC will champion a strong defense industrial base for uncrewed systems and work with both Department of Defense and Congress to increase necessary investments in these critical capabilities.

**What's next:** The DAC will provide members with opportunities to engage service branches at the Pentagon, key committees and lawmakers on Capitol Hill and experts in academia and the commercial sector. AUVSI is also working to secure opportunities for members to showcase their uncrewed and autonomous systems capabilities to program managers at the DoD.

[Learn more about DAC membership and specific areas of focus.](#)



## First platform receives Green UAS certification

During Q3, AUVSI's Trusted Cyber Certification program awarded the first-ever Green UAS certification to the Skyfront Perimeter 8 and 8+ UAS.

**Why it matters:** The 'Green UAS cleared' designation assesses and verifies commercial drones meet the highest levels of cybersecurity and National Defense Authorization Act (NDAA) supply chain requirements.

**The big picture:** Customers in the commercial, civil and non-defense government sectors – including federal and state agencies, law enforcement and first responders, and industrial enterprise – are increasingly relying on commercial, off-the-shelf drones to conduct critical operations.

[Learn more about Green UAS frameworks and other companies progressing through the program.](#)

# ADS-B

*Author: David Ambrozic, Junior Analyst - Operations, Safety and Workforce, AUVSI*

In this report we provide an update on ADS-B equipage rates in general aviation. The latest october 2023 data release by the FAA, signals a positive trend, showing a rise in equipage rates in General aviation.



# ADS-B GENERAL AVIATION EQUIPAGE UPDATE

## ADS-B Equipage heading in the right direction

Automatic Dependent Surveillance-Broadcast (ADS-B) is an essential tool in aviation safety. The FAA's October 1st data release<sup>1</sup> indicates a slight rise in General Aviation aircraft equipped with ADS-B, but somewhat offset by the increase in Non-Performing Equipment (NPE). Equipped aircraft have risen from 79% in October 2022 to a current level of 80.9% of registered aircraft while equipped and functioning systems have risen from 74.9% in October 2022 to 76.3% in October 2023.

### Key takeaways

- 3,983 new ADS-B equipages since October 2022
- In the fixed-wing category, since October 2022 ADS-B equipage has increased by 910
- FAA Reauthorization bill to include \$2,000 rebates for ADS-B equipage

### What is ADS-B?

Automatic Dependent Surveillance-Broadcast (ADS-B) is a surveillance technology that combines aircraft's positioning source, avionics, and ground infrastructure to provide an aircraft with its own location and that of other aircraft. ADS-B Out broadcasts an aircraft's location, ground speed, and data to ground stations and other aircraft, while ADS-B In provides equipped aircraft with weather and traffic positions of other aircraft. ADS-B equipage plays a pivotal role in aviation safety by broadcasting an aircraft's location, thereby reducing the risk of midair collisions.

### ADS-B GA Equipage Statistics as of October 1st, 2023:

Type	Aircraft Count	Rate
Equipped	165,351	80.9%
Equipped and functioning	155,906	76.3%
Equipped and non-functioning	9,445	4.6%
Non-equipped	39,054	19.1%
Non-equipped or non-functioning	48,499	23.7%

Source: FAA, BTS, AUVSI Research

### ADS-B equipage by system

ADS-B System	Equipage count
1090 ES	123,934
978 UAT	40,117
Dual	1,300
Total	165,351

Source: FAA, BTS, AUVSI Research

## ADS-B equipage by aircraft type

Aircraft	Equipage count
Fixed wing	110,038
Other	55,313
Total	165,351

Source: FAA, BTS, AUVSI Research

## Opportunity to increase ADS-B equipage

While the numbers indicate a significant percentage of equipped aircraft, there is still an opportunity to increase equipage rates. Recognizing this, the United States House of Representatives has included \$2,000 rebates for ADS-B equipage in the new FAA reauthorization bill<sup>2</sup>. This amount is four times the previously authorized amount by Congress, underscoring the importance of this issue. If this provision is included in the final version that is signed into law, there will be no reason not to equip an aircraft with ADS-B.

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1 [https://www.faa.gov/air\\_traffic/technology/equipadsb/installation/current\\_equipage\\_levels](https://www.faa.gov/air_traffic/technology/equipadsb/installation/current_equipage_levels)

2 [https://transportation.house.gov/uploadedfiles/sgrlaa\\_act\\_ans.pdf](https://transportation.house.gov/uploadedfiles/sgrlaa_act_ans.pdf)



an **AUVSI** database

## **UNCREWED SYSTEMS & ROBOTICS DATABASE (USRD)**

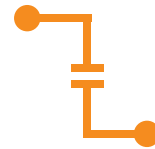
USRD provides technical data on over 8,000 uncrewed vehicle and mobile robot system operating in the air, ground and maritime domains.



**Development since 2010 with updates applied daily**



**Global coverage of uncrewed systems**



**Comprehensive coverage of domains, industries & development status**



**Comprehensive statistics & capabilities for each system**



**Data exports available in Excel & PDF formats**



**Integrated SQL-based search functionality**

Please reach out to [research@auvsi.org](mailto:research@auvsi.org) with any questions!

[auvsi.org/usrd](http://auvsi.org/usrd)

# SMALL UAS WAIVER TRENDS AND ANALYTICS

*Author: Aaron Bull, Senior Analyst - Economics, AUVSI*

Part 107 waivers cover a wide range of small UAS operations. They represent an important interim solution that allows the industry to function without long-term advanced regulation. By examining trends in the number and types of waivers being requested, we can better understand the demand for sUAS use cases in specific industries and across the country.

- This report quantifies our observations over the past 7+ years, including:
- A rise in overall waiver demand
- A drop in waiver duration
- The impact of the elimination of daylight waivers
- A marked increase in VLOS and visual observer waivers

## Intro: The shift in activity following waiver policy changes

To operate a small UAS (<55 lbs) in ways beyond what is covered in 14 CFR Part 107, a waiver from the limitation(s) in Part 107 must be requested and received from the Federal Aviation Administration (FAA). These sUAS, often referred to as drones, are used for a wide variety of applications. By looking at the types of relief requested, information on the prevalence of desired use cases can be inferred. Changes in the nature and frequency of requests over time are also illustrative of industry activity. One key regulatory change has had a dramatic impact on the nature of Part 107 waiver activity: in 2021, the FAA eliminated the need for most daylight operations waivers<sup>2</sup>. Up until that point, daylight waivers were by far the largest category of waivers accounting for roughly 85% of all waivers issued since 2016. Elimination of this need was a noteworthy boost to the industry by allowing for significantly improved capabilities for commercial operation and greatly reducing the petition processing burden on the FAA.

While eliminating the need for daylight operations waivers has resulted in a decline in the total number of waivers needed, there has been simultaneous and significant growth in the number of waivers requested in other areas, such

as beyond visual line-of-sight (BVLOS), visual observer requirements, flights over people, and other waiver categories. Non-daylight category waiver issuances have been growing at roughly 30% per year since 2020 with current demand for waivers at over 12x the number of waivers being issued. While waivers are only an interim solution and not a viable long-term solution to regulatory gaps, they serve as a critical resource to allow the industry to operate until more advanced regulation, including the anticipated Part 108 rule, comes into place. This document analyzes the current waiver landscape by category; the resulting data may be used to infer industry activity, potential next-step regulatory focus areas, and other key indicators of the UAS industry.

While we acknowledge the importance and landscape of waivers to enable expanded operations, we must also highlight recent exemption grants for Phoenix Air Unmanned, UPS Flight Forward, and uAvionix. The BVLOS operations are flown outside of part 107, and thus are not broadly captured within waiver statistics and analysis, nonetheless, they are a significant step forward for unlock value and access with drones.

**[AUVSI Statement on Phoenix Air Unmanned BVLOS Exemption](#)**

## Key points:

- Despite an overall decline in the volume of waivers, requests in most waiver categories are on the rise
- Waiver demand represented by the total number of waiver applications is rising and is currently over 12x the number of waivers issued
- Average waiver duration has fallen in the past two years potentially adding more red tape
- Visual line of sight (VLOS) and visual observer waivers are the fastest growing categories of major waiver issuance
- Waiver types and usage varies by industry and reflects idiosyncratic industry drivers

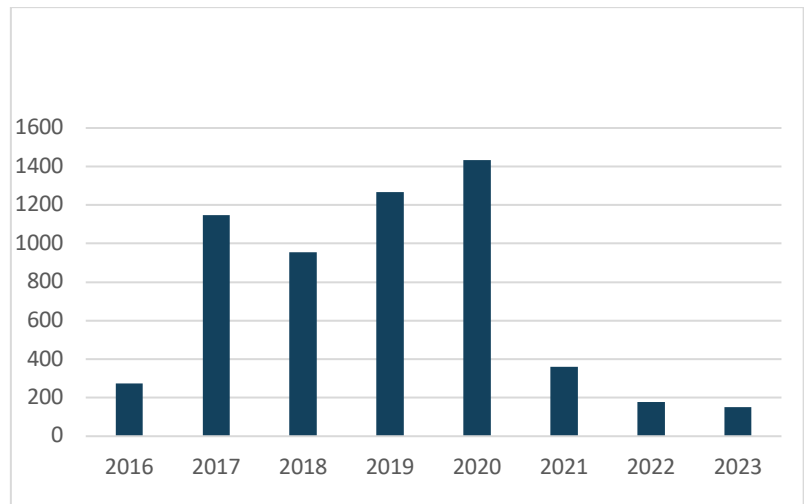
Rule Paragraph	Activity Permitted with Waiver
§ 107.25 – Operation from a Moving Vehicle or Aircraft	Fly a small UAS from a moving aircraft or a vehicle in populated areas
§ 107.29(a) – Operation at Night	Fly a small UAS at night without anti-collision lighting
§ 107.25 – Operation from a Moving Vehicle or Aircraft	Fly a small UAS during periods of civil twilight without anti-collision lighting
§ 107.31 – Visual Line of Sight Aircraft Operation	Fly a small UAS beyond your ability to clearly determine the position, altitude, attitude, and movement of the sUAS, with unaided vision.
§ 107.33 – Visual Observer	Use a visual observer without following all visual observer requirements
§ 107.35 – Operation of Multiple Small UAS	Fly multiple small UAS with only one remote pilot
§ 107.39 – Operation over human beings.	Fly over a person with a small UAS which does not meet conditions of operational categories 1, 2, 3, or 4
§ 107.51 – Operating limitations for Small Unmanned Aircraft	<p>Fly a small UAS:</p> <ul style="list-style-type: none"> <li>Over 100 miles per hour groundspeed (limitation a)</li> <li>Over 400 feet above ground level (AGL) (limitation b)</li> <li>With less than 3 statute miles of visibility (limitation c)</li> <li>Within 500 feet vertically or 2000 feet horizontally from clouds (limitation c)</li> </ul>
§ 107.145 – Operations Over Moving Vehicles	Fly over moving vehicles with a small UAS which does not meet conditions of operational categories 1, 2, 3, or 4

**All Sources:** Federal Aviation Administration

## Overall new waivers issued have declined but relevant waivers have seen substantial growth

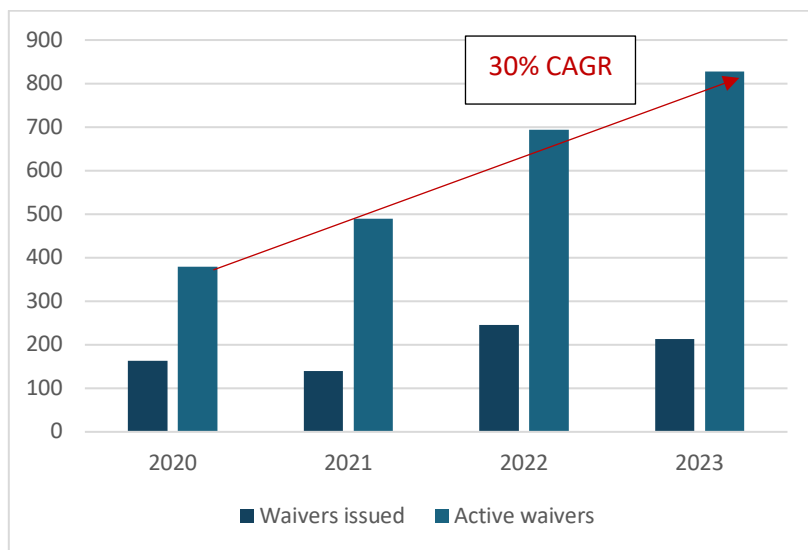
2016 through 2020 saw a major increase in the number of companies and individuals being granted waivers, peaking in 2020 with just over 1,400 new issues. Beginning in April 2021, waivers for most daylight operations were no longer required and the industry saw a steep decline in individuals and companies being issued waivers extending from 2021 through 2023. However, this decline in the headline number is misleading as it reflects the removal of the requirement for daylight waivers, which allow for operations at night, and does not reflect the economics of waivers within the industry which has seen steady and consistent growth.

While overall waiver requirements have declined, active waivers excluding daylight waivers have increased at 30% per year over the past three years. While the largest jump was in 2022, the steady growth of the waiver requirement has remained constant and in-line with our calculations for growth of the commercial industry. As the uncrewed aircraft industry grows, we expect the requirement for waivers to continue to grow in-line with commercial industry development and continued advancements in technology with more complex capabilities and operations. These



**Chart 1: New waivers issued**  
\*Excludes compounding for multiple waivers applications

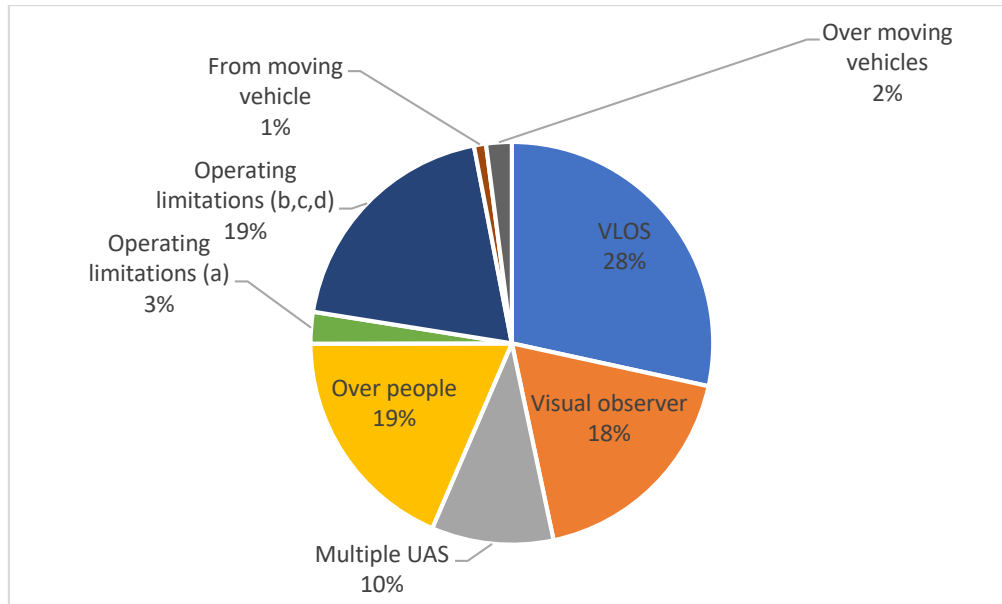
waivers are an essential tool for industry to move forward and gain critical operational experience and realize commercial value; ultimately these topics would be covered in a normalized regulatory environment, but until that point these exemptions are vital to the industry. Currently, waivers are the only tool available to the FAA to keep up with the pace of industry advancements.



**Chart 2: Waivers excluding daylight operations waivers and waivers by type over time**  
\*Compounded for multiple-waiver applications

Among active waivers in 2023, VLOS waivers which allow for operations beyond the visual line of sight, accounted for 28% of active waivers. Operating limitations b, c and d which allow for operations at higher altitudes, lower visibility and in closer proximity to clouds, and flights over people waivers accounted for 19% each. Visual observer waivers, which waive the requirement for a visual observer, accounted for 18% of active waivers; multiple UAS waivers, which allows one operator to fly multiple aircraft, accounted for 10%; operating limitation, which restricts

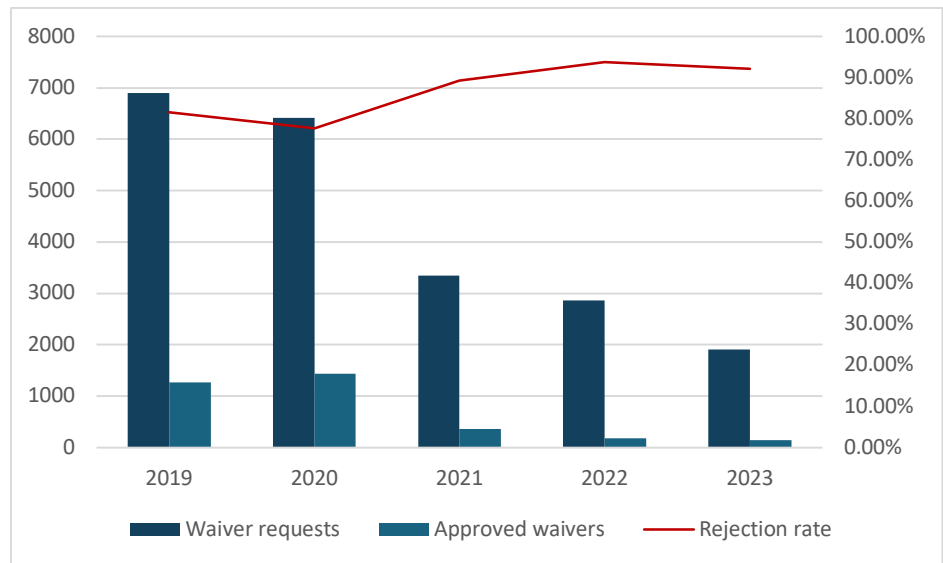
ground speed, accounted for 3%; and waivers for operations from moving vehicles accounted for 1% of active waivers. Overall, this represents a relatively balanced distribution of regulations for which waivers are requested, but with an overweight to sectors such as VLOS where risks can be overcome with increased capabilities in autonomy.



**Chart 3:** Active waivers by type

## Waiver demand is roughly 12.6x the number of waiver approvals

Waiver acceptance rates can give us key insights into demand for activities beyond the current set of restrictions for drone operations. To evaluate waiver acceptance rates, we looked at waiver request numbers and waiver approvals. Since we can see the request number of each issued waiver, which resets at the end of each year, we can look at the last waiver approved and determine roughly how many waivers were requested. While this methodology is imperfect and tends to slightly understate the percentage of rejections, it is a good proxy for rough waiver approval rates. Overall,



**Chart 4:** Waiver approvals  
\*Includes multiple-waiver applications

waiver requests have continued to trend down since 2019, but the rejection rate has increased from a low of 78% in 2020, to 92% in 2023. While part of this can likely be attributed to the reduction in daylight waivers, which appear to have had a higher chance of approval, the low overall acceptance rate is highly indicative of significant demand and capability for operations in excess of current regulatory allowances. The FAA however has strict safeguards in place with respect to safety, and complex waivers have more complicated approval requirements. We do not factor rejection rationale in our analysis and the low acceptance rate of waivers may also be indicative of safety concerns on the side of the FAA over some proposals.



## Waiver durations have fallen steadily since 2018

Waiver duration peaked in 2018 when over 99% of waivers granted were four-year waivers. Since then, the average waiver duration has fallen to 2.8 years with only 49% and 48% of waivers granted being four-year waivers in 2022 and 2023 respectively. The average waiver length in 2022 and 2023 fell to 3.0 years and 2.8 years. While the shortened waiver duration may reflect changes in waiver mix, it also requires additional processing resources if waivers expire and need to be renewed.

Waiver duration (y)	<1	1	2	3	4	Average (y)
2016	2	6	20	0	246	3.8
2017	14	6	65	1	1,061	3.8
2018	0	0	3	1	951	4.0
2019	0	4	7	1	1,255	4.0
2020	12	5	29	5	1,382	3.9
2021	9	1	27	5	318	3.7
2022	8	10	46	26	88	3.0
2023	13	11	46	8	73	2.8

**Table 2:** Duration of approved waivers



**green uas™**

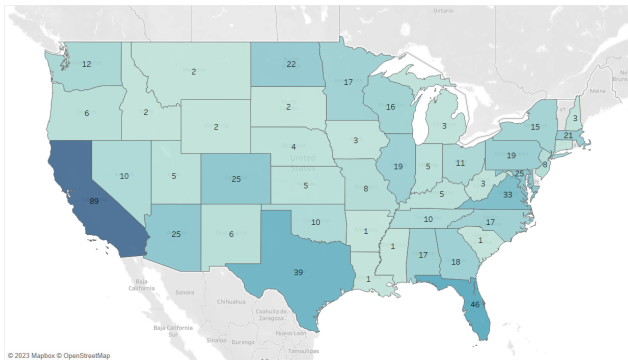
**Green UAS vets and validates commercial drones with a cybersecurity penetration test and ensures NDAA supply chain compliance.**

[Learn More](#)

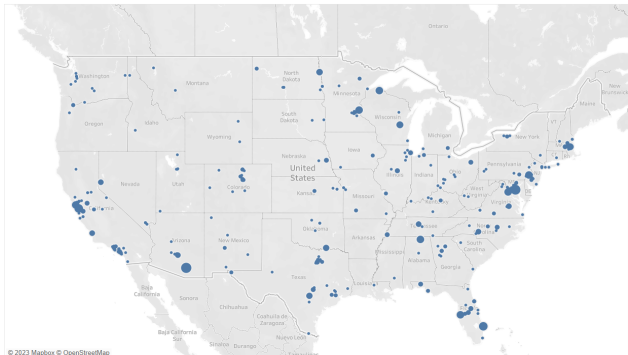
# Tech and defense centers and urban population centers dominate waiver demand

As of 2023, active waiver geography was dominated by California, Florida, Texas, and Virginia with California having by-far the most active waivers at 89, followed by Florida at 46, Texas at 29, and Virginia at 33. Technology centers around San Francisco and Boston as well as the greater Washington DC area including Maryland and Northern Virginia which acts as a hub for defense and aerospace technology, tended to be waiver hotspots across most waiver types. Among waiver categories, VLOS waivers stood out for being more dispersed and less concentrated in urban tech centers indicating a greater relative use in less-populated areas. This makes sense given the higher likelihood of greater operational distance requirements for operations in lower-density areas.

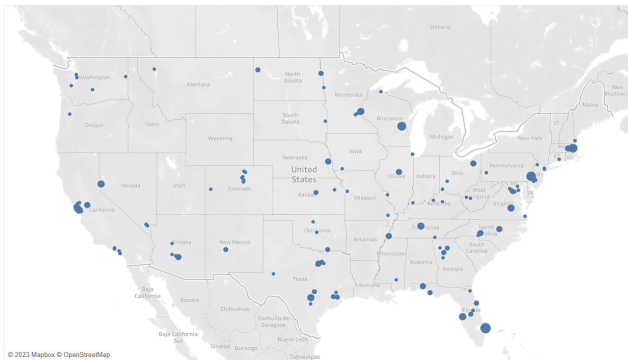
Waivers by state



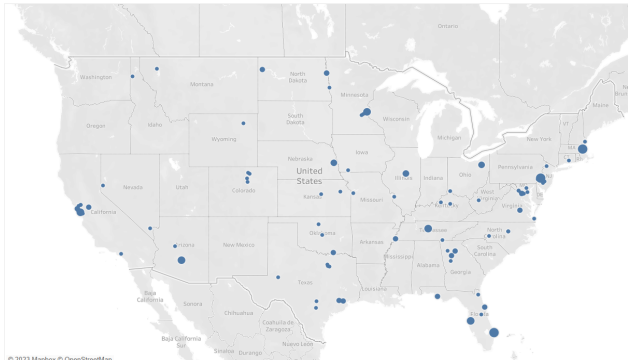
2023 Waivers



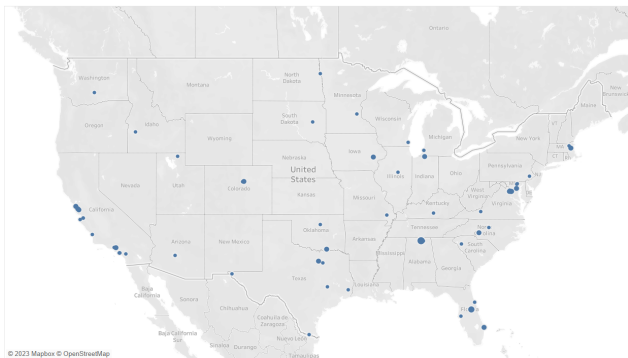
VLOS Waivers



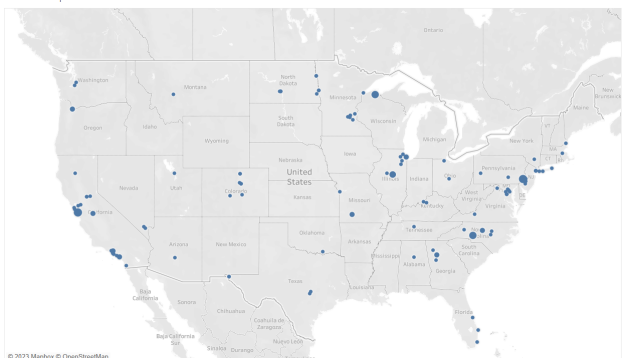
Visual Observer



Multiple UAS



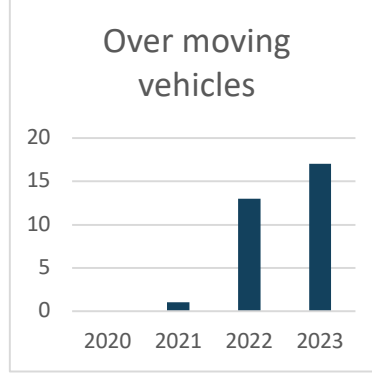
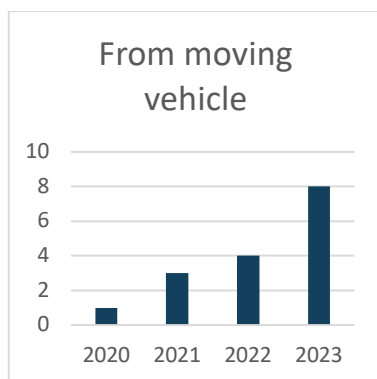
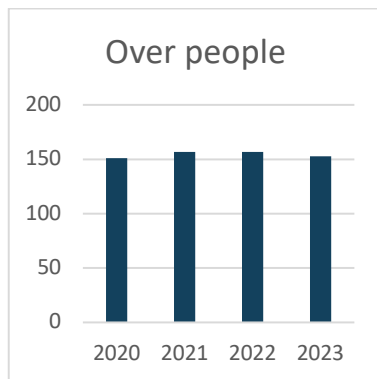
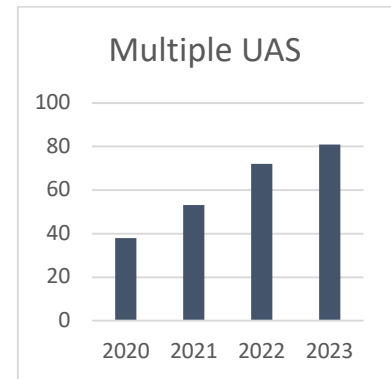
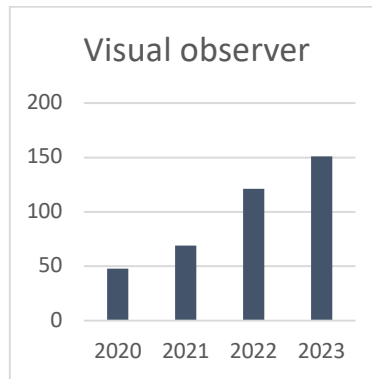
Over People



Source: AUVSI Research, Federal Aviation Administration

## Steady increase in demand for most waivers

While approvals for daylight waivers and waivers for operations in certain airspace are no longer necessary and have all but disappeared, approvals for waivers in nearly every other category have increased significantly. In particular, VLOS, visual observer, multiple UAS and operating limitations b, c and d have seen a steady increase in approvals. High-use waiver categories that have seen the highest growth include VLOS waivers which have grown at 57.6% per year since 2020, visual observer waivers which have grown at 46.5% per year, multiple UAS waivers which have grown at 28.7% per year, and operating limitation b, c and d waivers which have grown at 27.9% per year.



Source: AUVSI Research, Federal Aviation Administration

## Waiver types for issued and active waivers

Newly issued waivers, excluding daylight waivers, have seen a steady increase since 2020. Among newly issued waivers, operations over moving vehicles, visual observer waivers and visual line of sight waivers have seen a significant jump in proportional representation. Operational waivers b, c, and d have continued to represent a high proportion of new waivers over time while new waivers for flights over people have declined significantly.

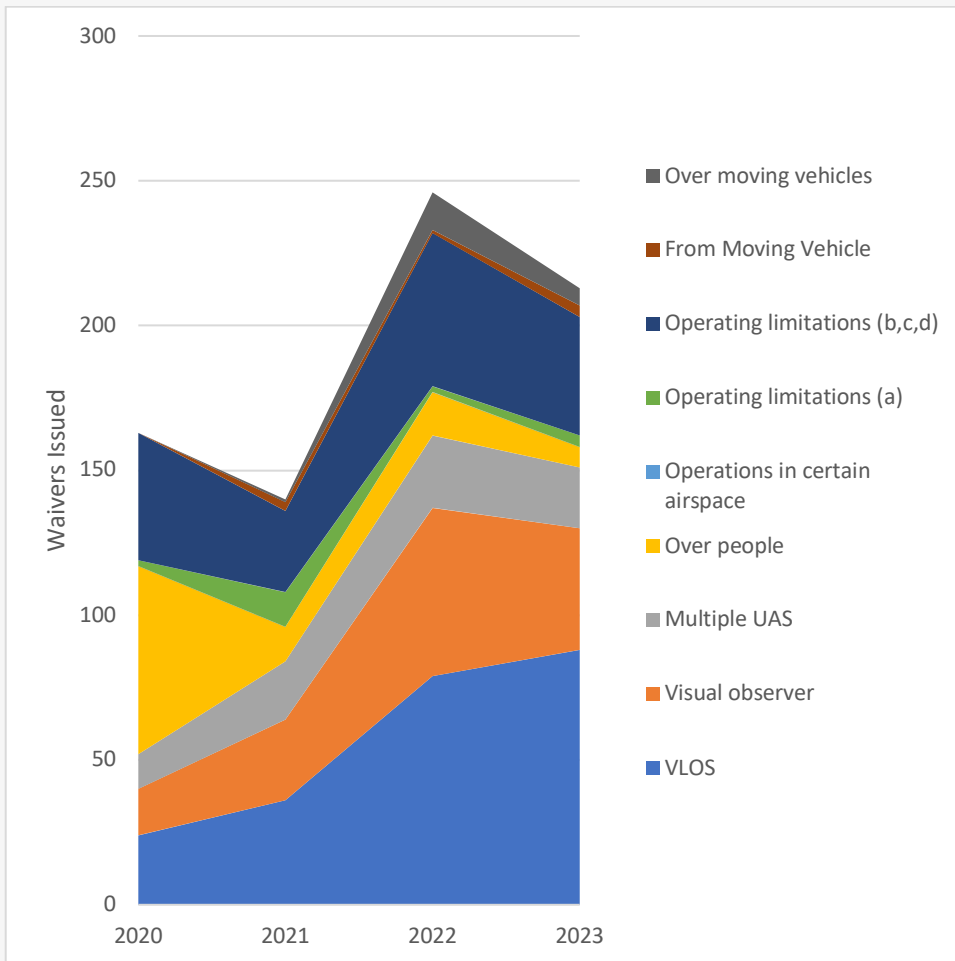
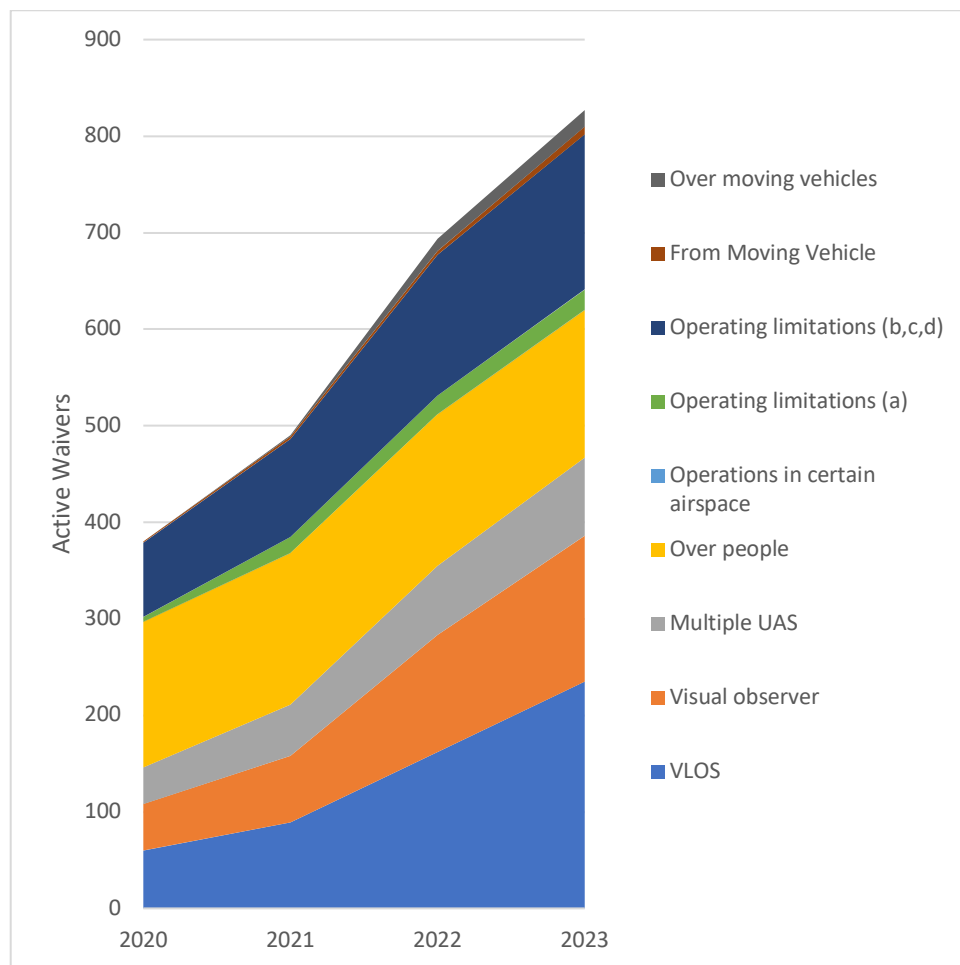


Chart 7: New waivers issued by category

Despite some year-to-year inconsistency, active waivers for most categories have been consistent and generally well distributed. Among categories, VLOS and visual observer waivers have contributed the most to the growth in active waivers. This relatively steady split of active waivers over time demonstrates that despite the volatility of annual renewals by sector, demand for capabilities allowed by waivers has grown relatively constantly and has not significantly diminished in any sector.

Among new waiver issuances, aerospace and defense, technology and telecommunications, natural resources, energy and utilities, and education have seen the largest jumps in usage, details of which can be found in our sector waiver breakdown below.



**Chart 8:** Active waivers by category

## Industries demanding new and active waivers

New waiver issuances across industries have seen similar volatility to waiver type but a few clear trends have emerged. New waiver issues for technology and telecommunications, defense, and energy and utilities have increased significantly. Meanwhile, new waivers for agriculture, construction and engineering, and services applications have declined, also detailed in our sector breakdown.

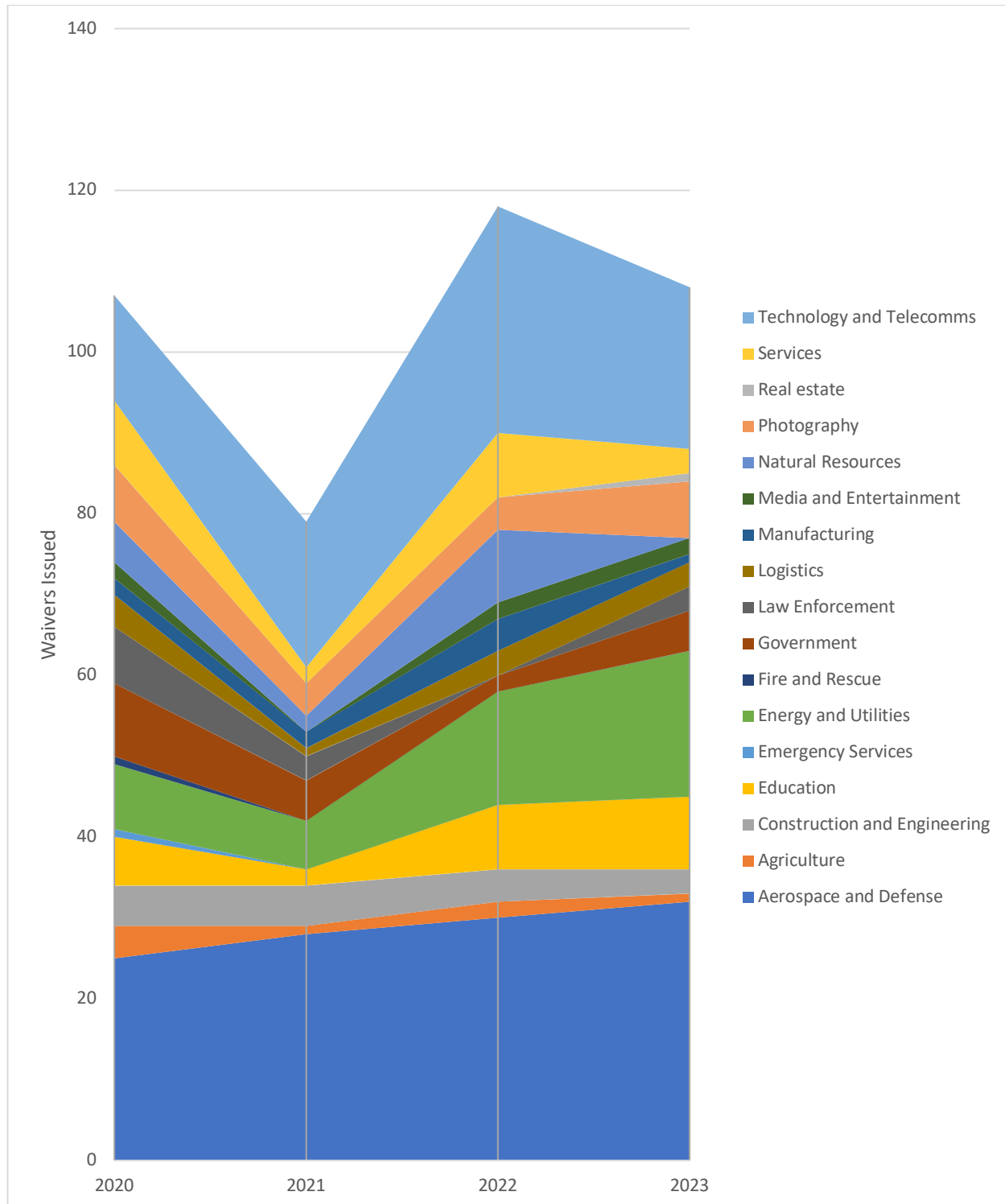


Chart 9: New waivers issued by industry

## Active waivers by Industry

Looking at active waivers, we see a similar trend. Aerospace and defense and technology and telecommunications make up the largest industries with active waivers and are increasing proportionally. Energy and utilities join that group with the highest growth. Despite the reduction in waiver approvals on a yearly basis for some industries, active waivers have been steady or increasing in every major industry demonstrating continued and sustained demand growth across the economy.

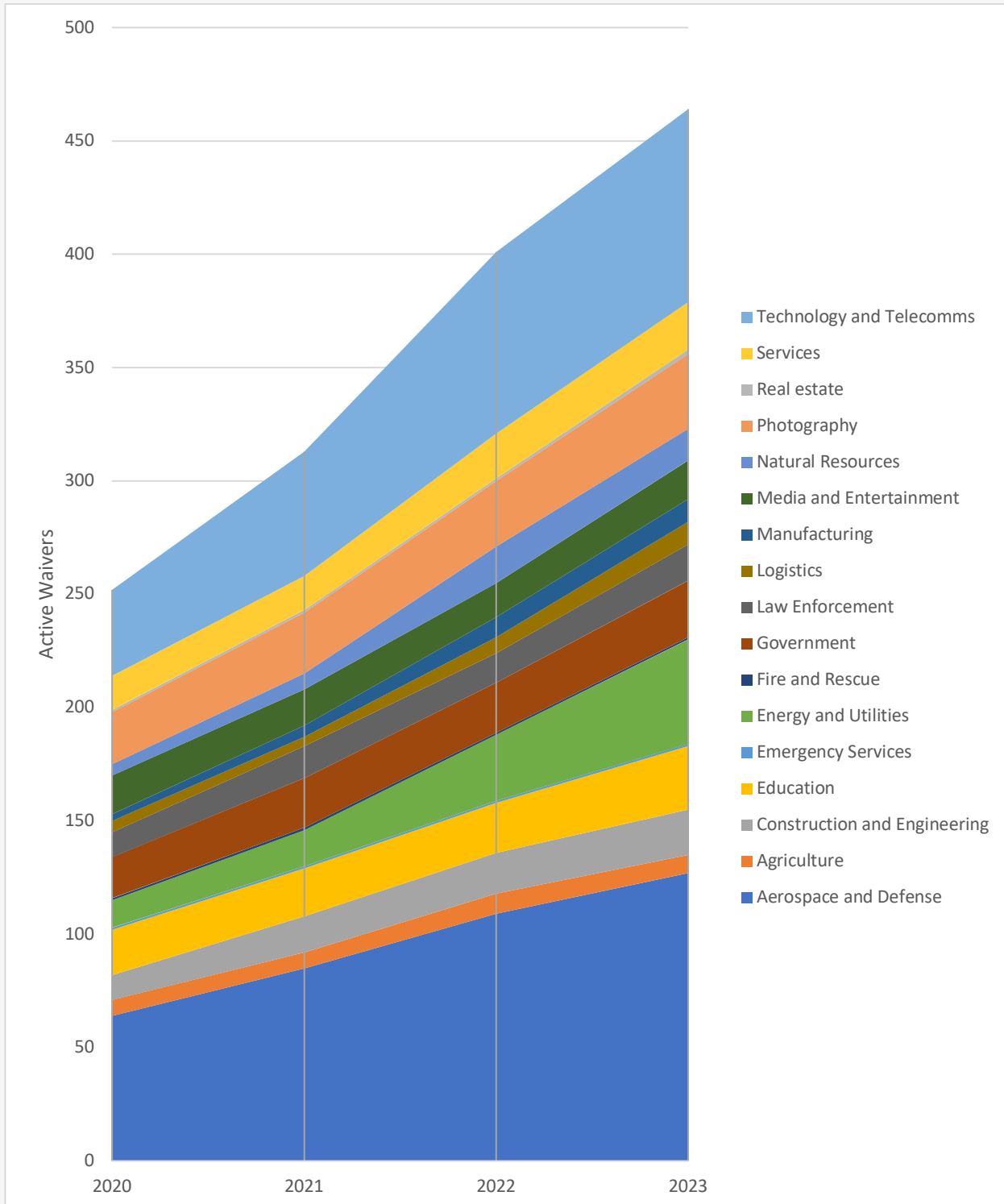


Chart 10: Active waivers by industry

## 2023 Snapshot: New and active waivers by type

Pairing newly issued and active waivers, we can see the impact of new operations in 2023, relative to ongoing operations. While VLOS, visual observer, flights over people, and operating limitations (b), (c), and (d) waivers make up the bulk of active waivers, new issues in 2023 were dominated by VLOS, visual observer and operating limitations waivers. VLOS had a high volume of new issues relative to active waivers indicating a substantial bump in both the demand for operations and technical capabilities for operations on the supply side.

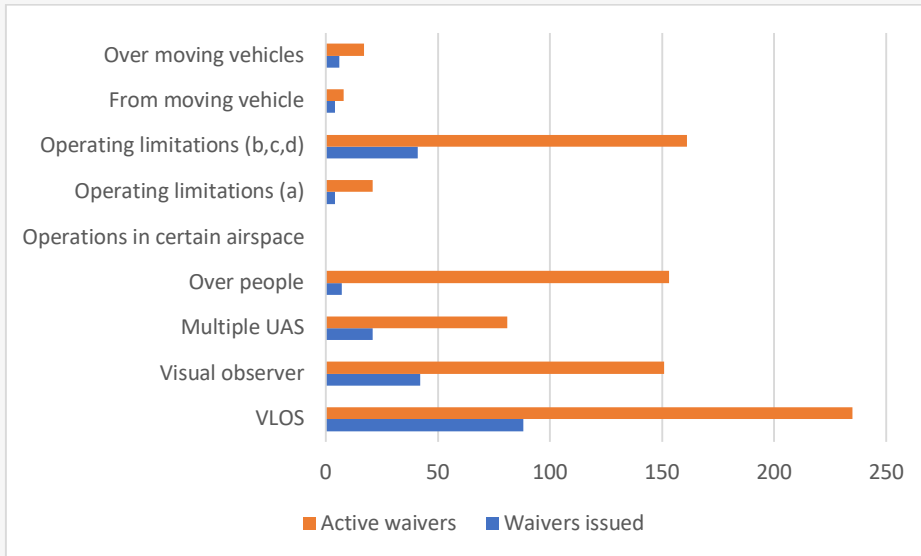
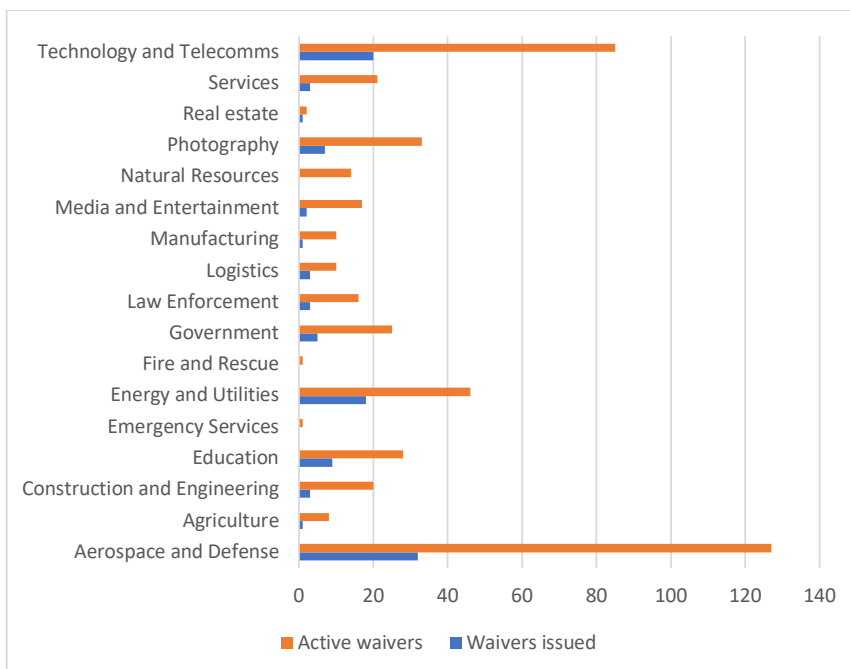


Chart 11: New and active waivers by type

## New and active waivers by industry

Breaking down waivers by industry, excluding individual (no company identified) waivers, we are able to identify hotspots for waiver usage, or industries where technical capabilities and drone operations exceed current regulatory frameworks. Industry concentration for active waivers was highly focused on aerospace and defense, technology, and telecommunications companies.



Energy and utilities had a disproportionately high number of new waivers relative to active waivers indicating growing usage within the industry, while natural resources, photography, and media and entertainment held a high degree of legacy waivers relative to new issuances indicating slower demand for waiver growth in these sectors.

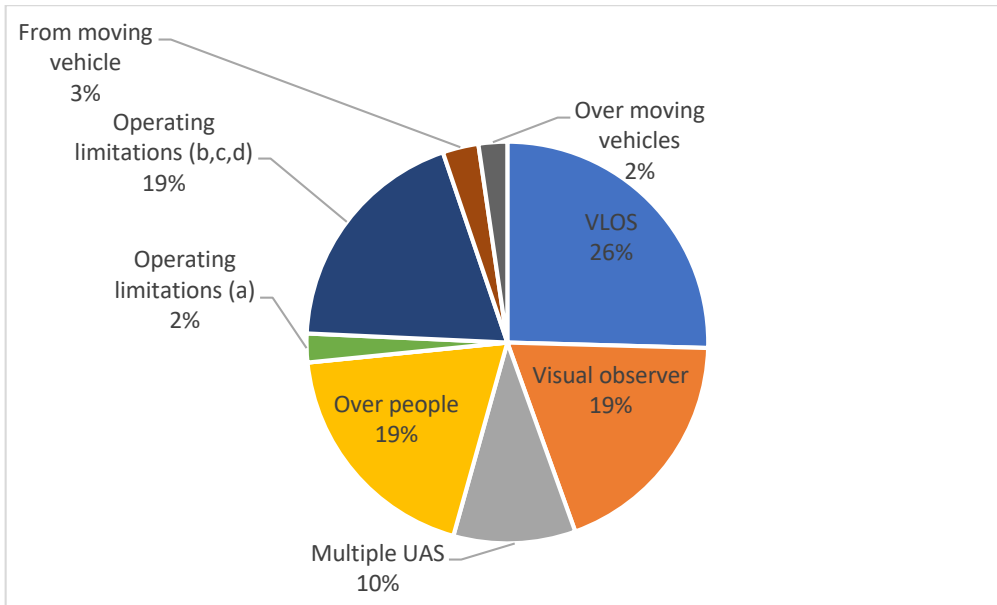
Chart 12: New and active waivers by industry



# SECTOR SNAPSHOTS

## Aerospace and Defense

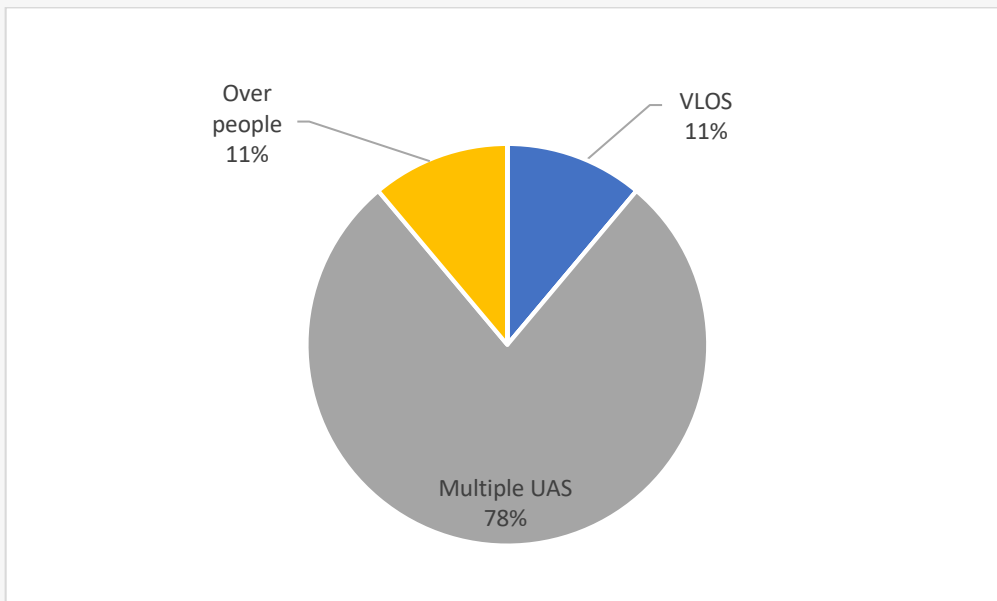
Aerospace and defense had a balanced exposure to waiver categories with roughly equal distribution across VLOS (26%), visual observer (19%), flights over people (19%), and operating limitations b, c and d, also (19%) waivers. Classification of some aerospace and defense-related drone companies within aerospace and defense likely contributed to the diversification of waiver requirements.



**Chart 13:** Aerospace and Defense active waivers

## Agriculture

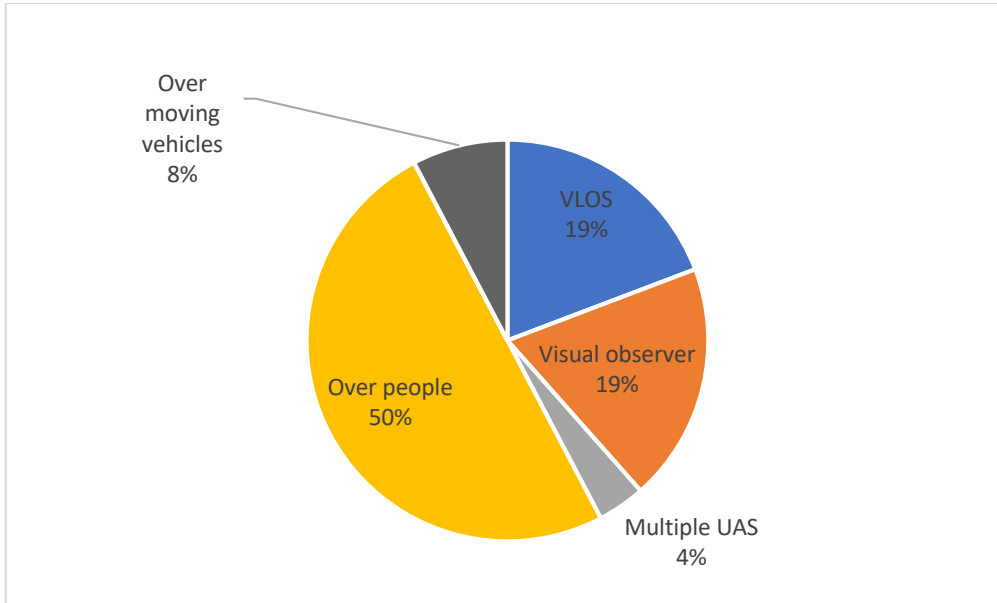
Agricultural waiver requirements were highly concentrated with 78% of active waivers being multiple-UAS, with 11% for flights over people and VLOS. This likely can be attributed to the large areas of farmland that are being serviced and the requirement of more than one UAS to efficiently apply pesticides or fertilizers to these properties while being controlled by a single operator.



**Chart 14:** Agriculture active waivers

## Construction and Engineering

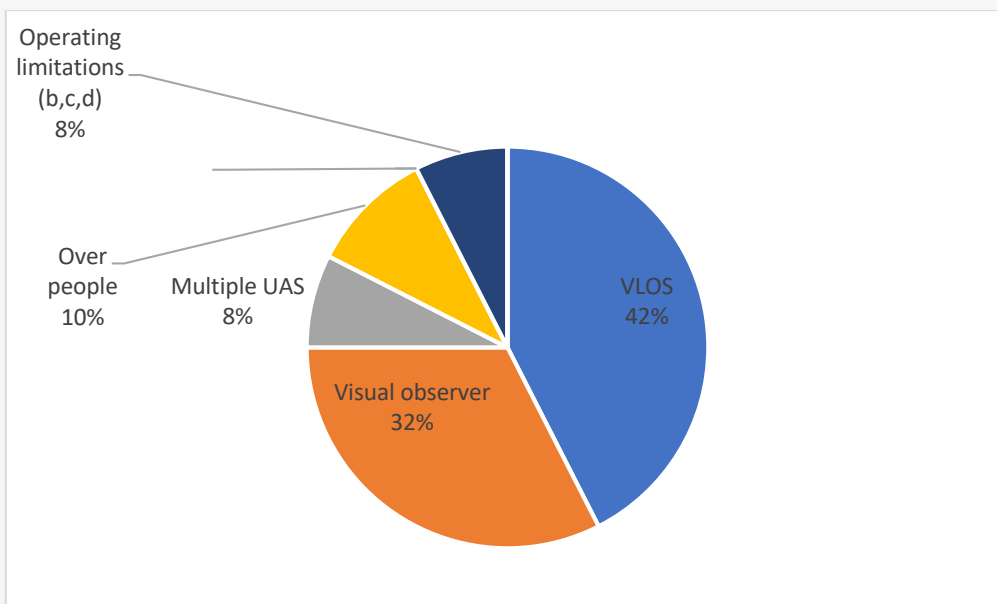
Construction and engineering waivers were highly concentrated in drones over people waivers, which accounted for 50% of waivers, but also had high exposure to visual observer and VLOS waivers at 11% each respectively. This is consistent with the need for operations over construction crews, vertical assessments and assessment of projects at range and in inaccessible locations.



**Chart 15:** Construction and Engineering active waivers

## Education

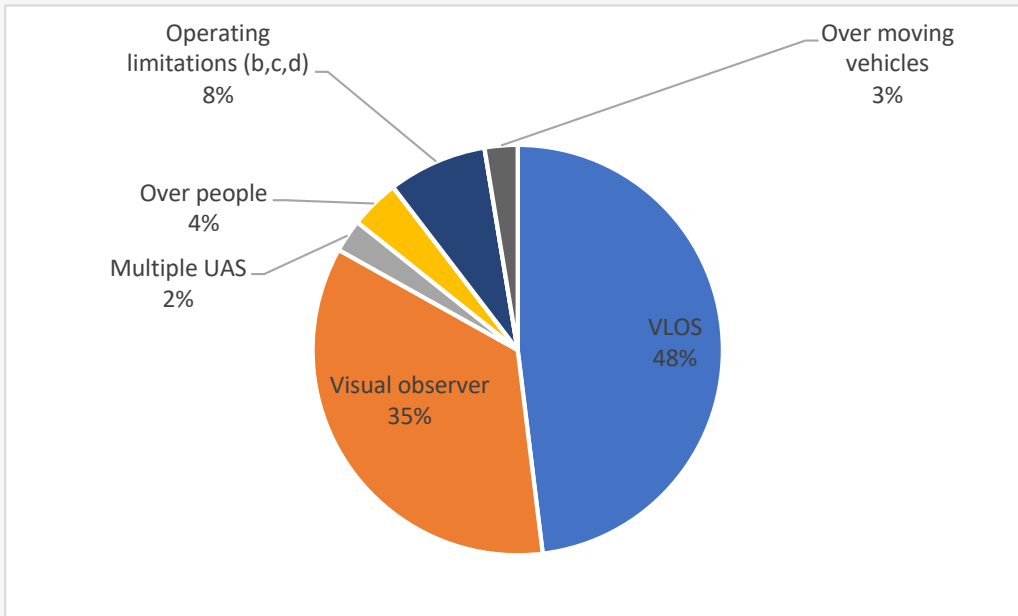
The education industry (academic institutions and research facilities) predominantly utilized VLOS and visual observer waivers with 42% and 32% in these sectors respectively. This may be attributed to increases in long-range flight testing, or scientific/academic research being conducted over long distances such as environmental research or wildlife surveys.



**Chart 16:** Education active waivers

## Energy and Utilities

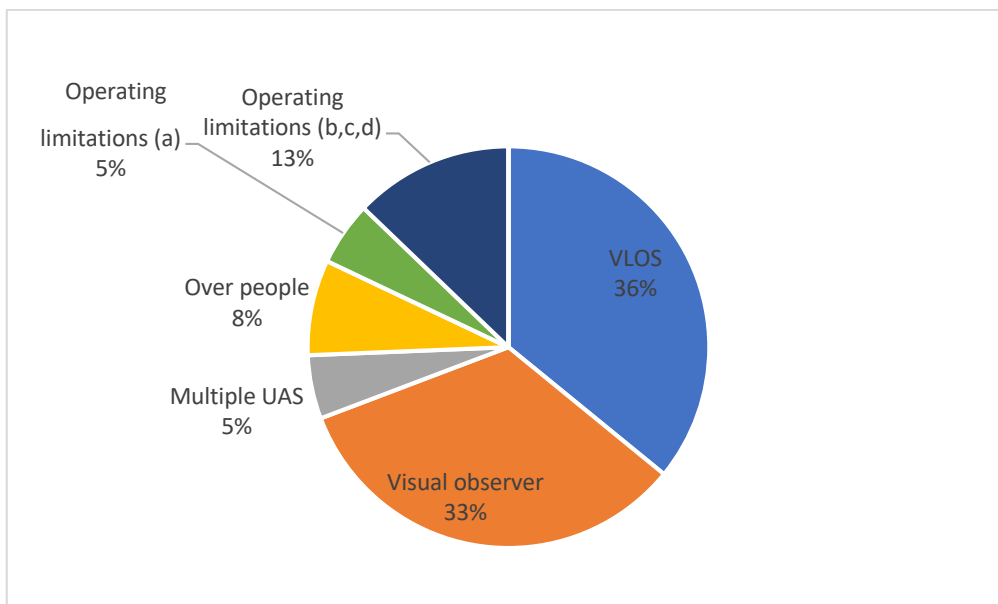
The energy and utilities industry used almost exclusively visual observer (35%) and VLOS (48%) waivers. This is consistent with the long-range flight requirements associated with infrastructure assessments and electrical grid inspections, which are characteristically long linear flight paths along electrical easements or when flying in proximity around and behind buildings that can take advantage of infrastructure shielding in their BVLOS operations.



**Chart 17:** Energy and utilities active waivers

## Government

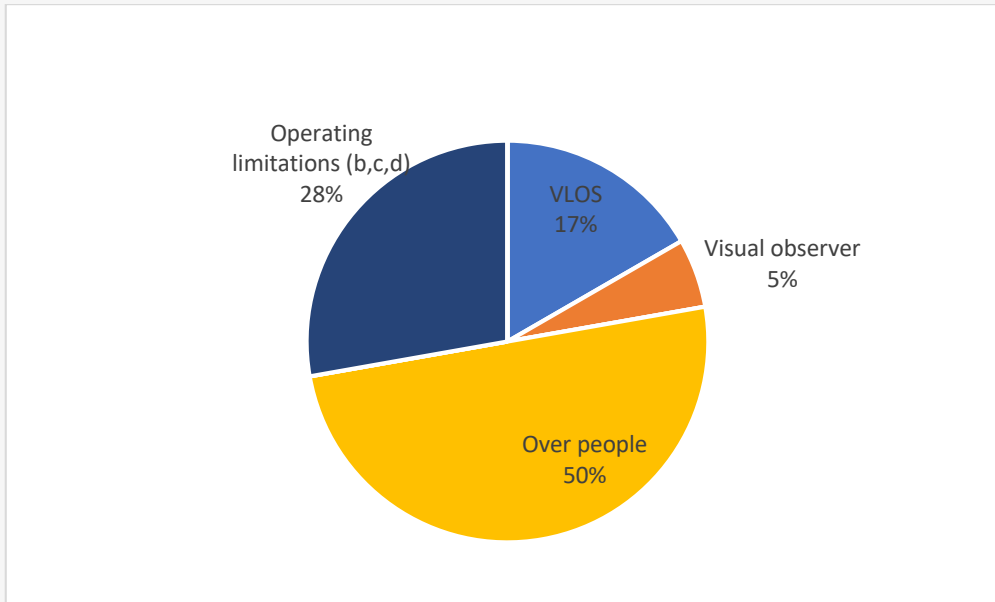
Government had a generally broad use of waivers, but VLOS and visual observer waivers had the highest use of waivers at 36% and 33% of active waivers in the sector respectively. The sector is dominated by municipal governments which can use drones for a wide array of purposes, including monitoring of public parks and forests, assisting local civil departments and economic development photography, traffic monitoring and accident response.



**Chart 18:** Government active waivers

## Law Enforcement

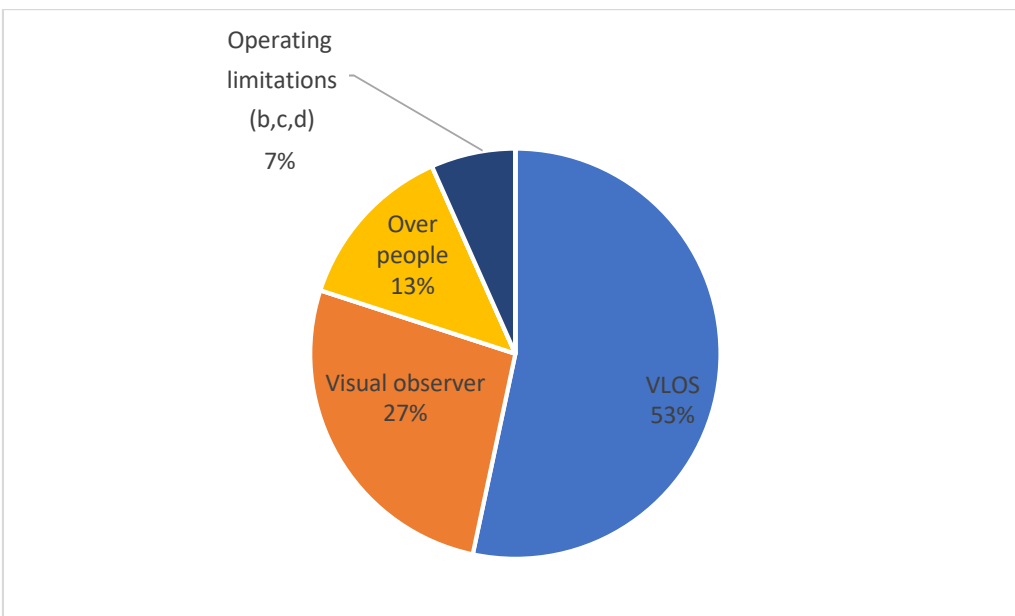
Law enforcement used predominantly flights over people waivers which accounted for 50% of active waivers. They also had a high exposure to operating limitations (b), (c), and (d) waivers at 28%, and VLOS waivers at 17%. This is consistent with law enforcement and DFR operations in urban and semi-urban environments where drones may be used for incident monitoring or for a drone first responder program where the drone may be deployed to a potential crime scene prior to officers arriving on the scene for overwatch, situational assessment, or de-escalation.



**Chart 19:** Law Enforcement active waivers

## Logistics

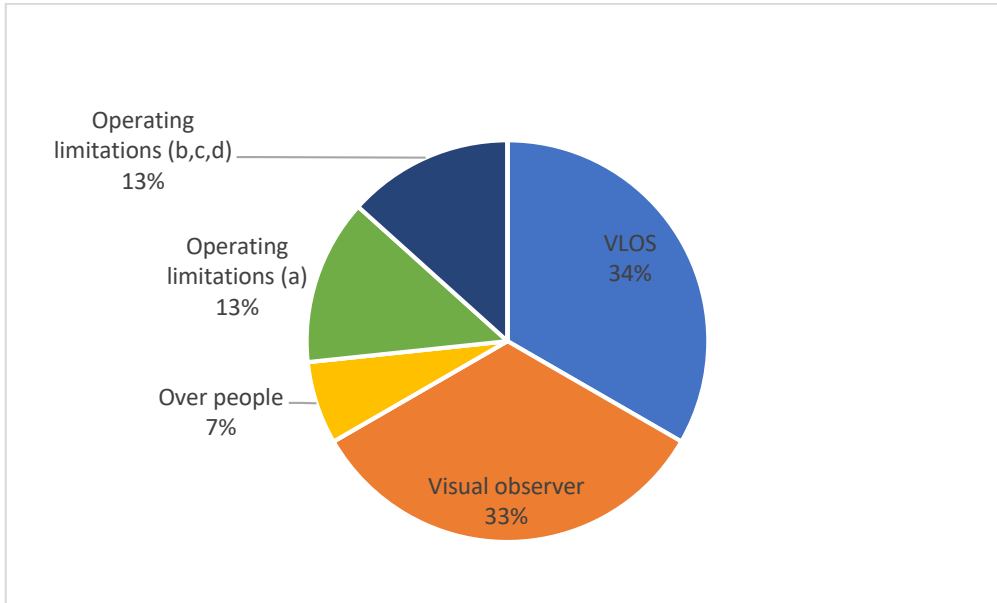
The logistics industry used predominantly VLOS (53%), visual observer (27%), and flights over people waivers (13%). This is consistent with delivery and logistics operations. It is important to note that most delivery operations are limited to short-range deliveries and covered under Part 135. VLOS waivers are likely being used by ground package delivery companies for testing, and numerous rail companies and other transit companies, for transit or infrastructure inspections.



**Chart 20:** Logistics active waivers

## Manufacturing

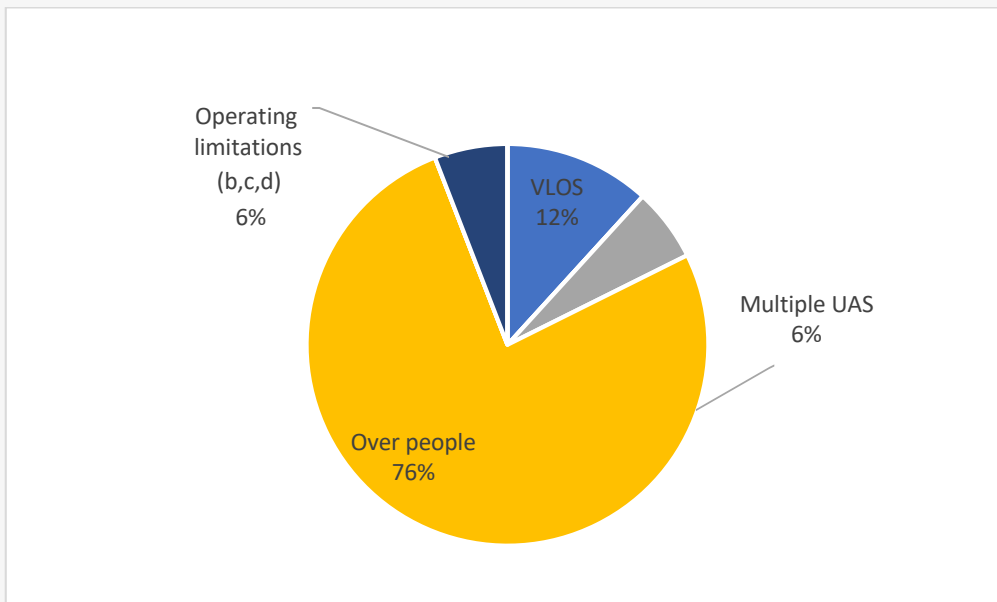
The manufacturing sector had a relatively even split of waiver usage. VLOS and visual observer were the largest categories with 34% and 33% of waivers in these categories respectively.



**Chart 21:** Manufacturing active waivers

## Media and Entertainment

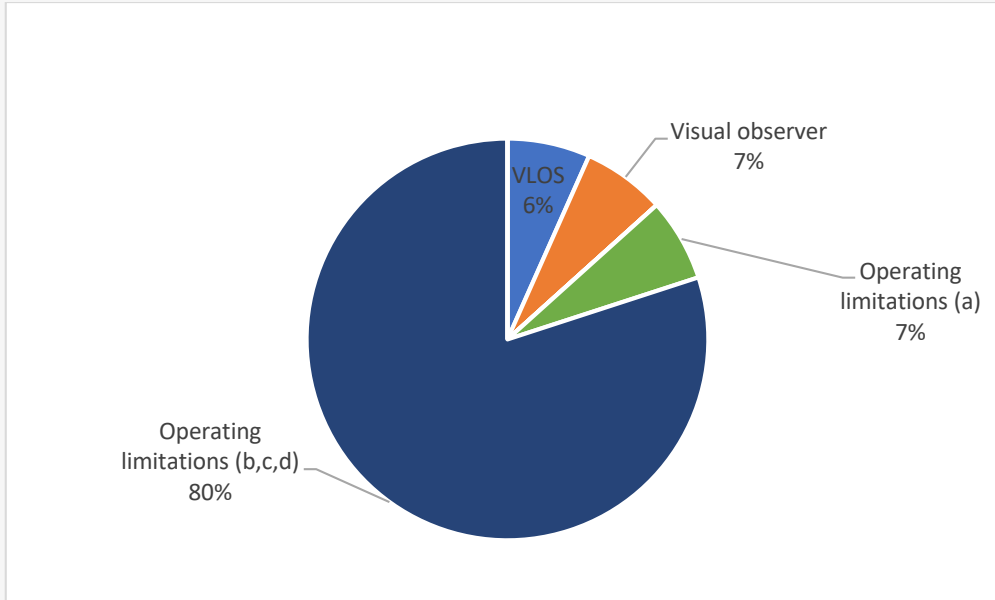
The media and entertainment industries were dominated by flights over people waivers, which accounted for 76% of active waivers. Relative to other industries, they made almost no use of VLOS (12%) or visual observer waivers. This can likely be attributed to industry requirements including news and event coverage, which would be more likely to involve crowds, urban settings and where drones may need to be used over a crowd for media or event coverage.



**Chart 22:** Media and Entertainment active waivers

## Natural Resources

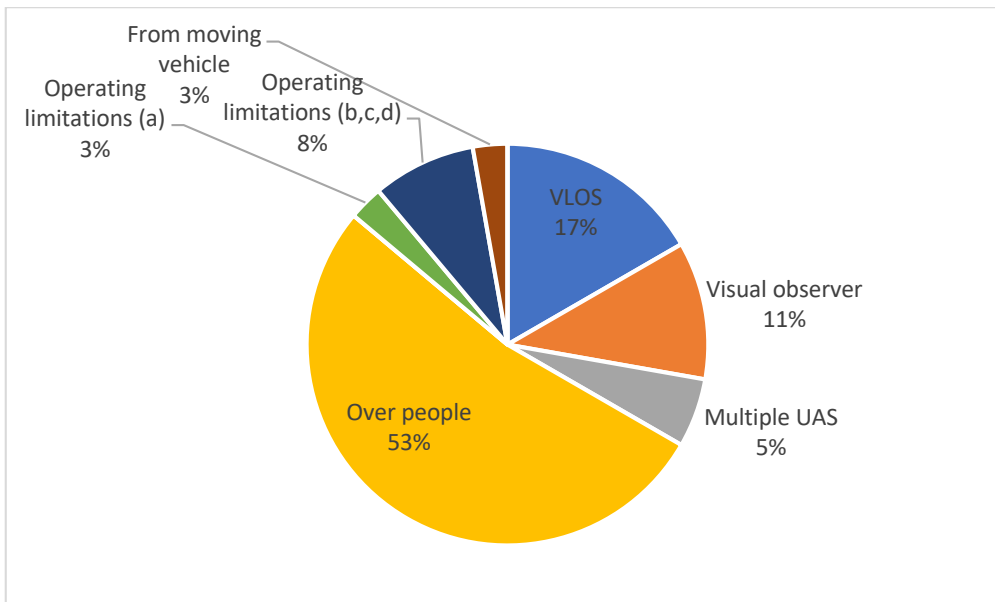
The natural resources industry, which includes oil and gas, metals, and mining made almost exclusive use of waivers for exceptions to operating limitations b, c and d, which accounted for 80% of waivers in these industries. We attribute the high volume of operating limitation b, c and d waivers to inconsistency of terrain and potential altitude requirements around resource extraction and transportation sites such as mines, or pipelines.



**Chart 23:** Natural Resources active waivers

## Photography

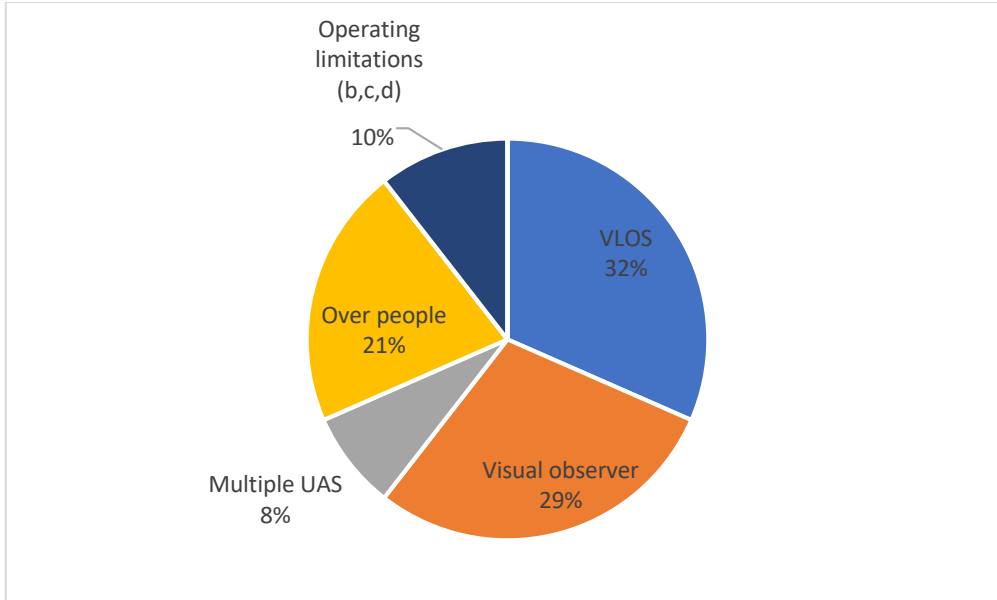
The photography industry, which includes both photography and inspections, was highly tilted towards waivers for flights over people accounting for 53% of active waivers and can be used for event photography. VLOS and visual observer waivers were minor categories, which we attribute to longer-distance flight requirements that may be present for some inspection services or photography needs for larger projects that would not be contained within visual line-of-sight.



**Chart 24:** Photography active waivers

## Services

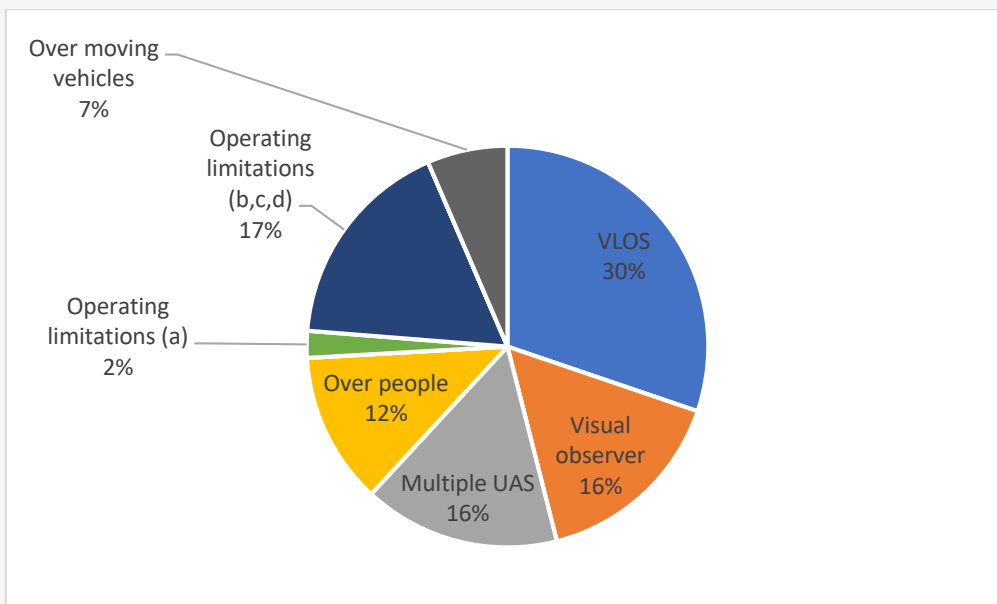
The services industry which captures commercial services had a generally balanced distribution requirement for waivers requested. VLOS accounted for 32% of active waivers, while visual observer waivers accounted for 29% and flights over people accounted for 21%. Operating limitations b, c and d waivers, and multiple UAS waivers accounted for 10% and 8% respectively. This balanced profile reflects a broader and non-uniform requirement across the services industry.



**Chart 25:** Services active waivers

## Technology and Telecommunications

Technology and telecommunications also had a very balanced split of active waivers. Operating limitations b, c, and d waivers and multiple UAS waivers stood out relative to other industries. We may be able to attribute some of this to infrastructure inspections, Cell on Wings services, and coverage mapping; and we believe that some of the requirements for waivers may reflect the technology industry working with systems that are at the forefront of the capabilities frontier.



**Chart 26:** Technology and Telecommunications active waivers

# FY 2024 DOD BUDGET FOR UNCREWED SYSTEMS RDT&E

*Author: David Klein, Analyst - Technology and Defense, AUVSI*

As the Department of Defense enters a new fiscal year, innovators of uncrewed and autonomous vehicles have an opportunity to align their work with military priorities. In this budget analysis, our research team identifies major trends for FY 2024, including:

- A major shift toward air programs with autonomous capabilities
- Key growth areas for air, ground, maritime, and C-UAS operations
- Congressional priorities for the research, development, test, and evaluation of uncrewed vehicles
- Increased interest in low-cost, air-launched, and VTOL UAS systems



## Key Takeaways

- **New initiatives in FY 2024 shift a major focus toward air programs** especially with respect to the development, maturation, and integration of autonomous capabilities. Investments in these programs will improve capabilities supporting sensors, communication systems, navigation systems, and simulation environments for uncrewed vehicles.
- **Significant growth areas are identified across all domains of operation** for uncrewed vehicles. Noteworthy projects from each of the core services include:
  - **The Air Force's Collaborative Combat Aircraft (CCA) project** which is developing autonomous loyal wingmen for fighter jets.
  - **The Army's Tactical Unmanned Ground Vehicle (UGV) project** developing hardware and software upgrades to improve autonomous off-road mobility, safety architectures, and vehicle perception.
  - **The Navy's range of Unmanned Surface Vehicle (USV) programs** which provide improved battlespace awareness and lethality.
  - **A range of Counter-UAV (C-UAV) capabilities** that will protect infrastructure and assets from emerging threats in combat scenarios.
- **Congressional priorities involve the development and countering of next-generation automation.** Congressional priorities are identified which offer insight into technologies that are of high importance to the DoD and inform future technology developments, acquisition strategies, potential technology gaps, and risks. Investigations into these priorities have revealed increased interest in low-cost, air-launched, and VTOL UAS; advanced technologies to counter emerging threats posed to U.S. forces; additional investment in commercially available maritime platforms; continued emphasis on common control systems for ground robotics.

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Appendix: Budget Release Schedule

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Appendix: Structure and Terminology

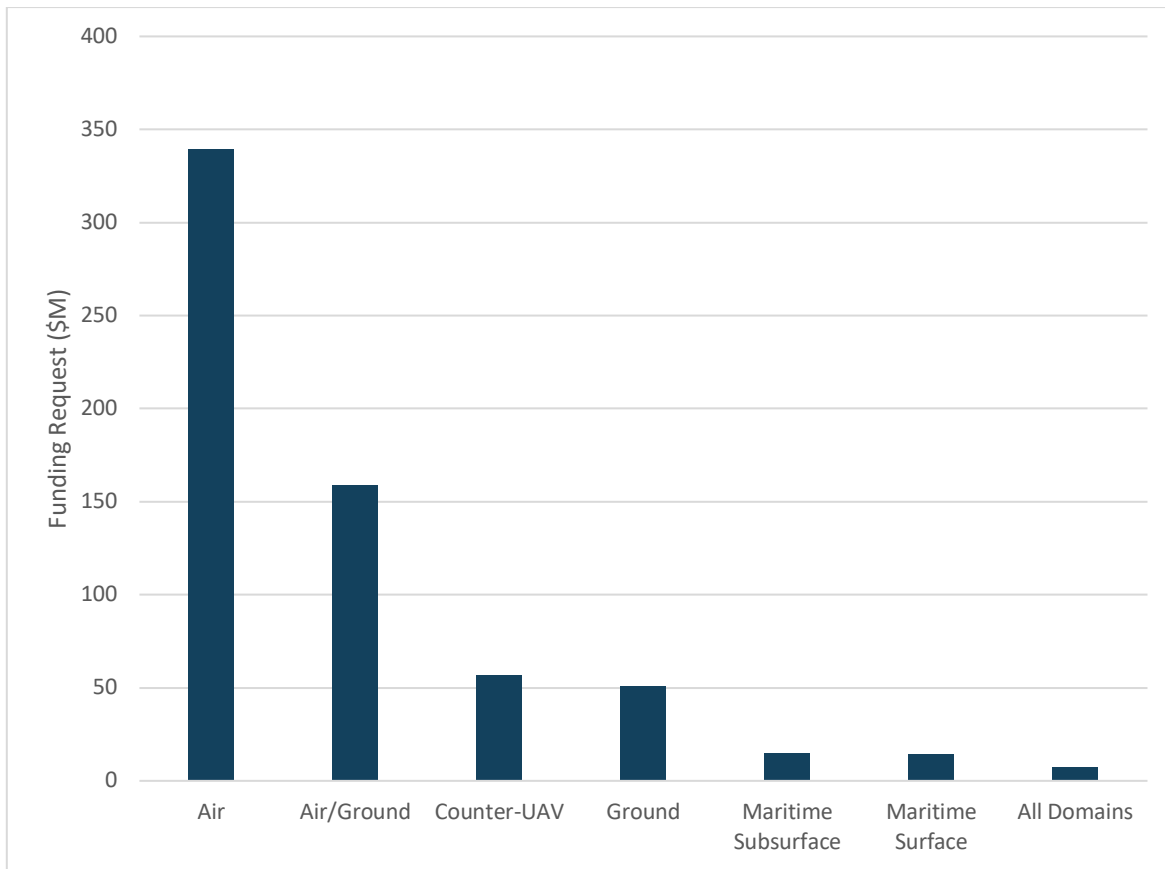
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## Congress is targeting 10 major uncrewed projects

In FY 2024, ten new projects and 58 new sub-projects were established which involve the support of uncrewed systems. The new projects are as follows:

Organization	Program Element	Project Name	FY24 Funding (\$M)
Navy	Rapid Prototyping, Experimentation & Dem	Rapid Prototype Development	214.1
Air Force	Autonomous Collaborative Platforms	Experimental Operations Unit (EOU)	68.956
Air Force	Autonomous Collaborative Platforms	Viper Experimentation and Nextgen Operations Model (VENOM)	49.87
OSD	AUKUS Innovation Initiatives	AUKUS	25
Army	Weapons and Munitions - Eng Dev	30mm MMPA M-SHORAD INC 3	18.936
Navy	UAS Integration & Interoperability	Architecture and Capabilities for Autonomy in the Naval Enterprise (ARCANE)	16.409
Air Force	University Affiliated Research Center (UARC) - Tactical Autonomy	HBCU University Affiliated Research Center (UARC)	8.018
Army	Army Agile Innovation and Development-Applied Research	Sci & Analysis for Autonomous Sys & Counter-Auton	2.133
Air Force	Lethality Technology	Fire Control Lethality Technology	1.462
Army	Network C3I Advanced Technology	Pathfinder 3D Advanced Technology	1.045

At the sub-project level, the 58 initiatives represent an estimated funding of more than \$640 million with the breakdown by domain charted in Figure 1. This shows significant emphasis on air-related efforts followed by those that include support for both air- and ground-related uncrewed platforms. New sub-projects are also created for counter-uncrewed air vehicles (C-UAV) and ground robotics technologies representing about \$50 million in funding each. And finally, a handful of sub-projects are initiated to aid in the development of maritime systems and research associated with all domains in which uncrewed systems are deployed.



**Figure 1:** New FY 2024 sub-projects support all domains with a primary focus on air.

## Funding for autonomy in the air takes center stage

Further investigations into these sub-projects offer insight into the current DoD priorities with respect to technology advancements and areas of particular interest in the coming fiscal year. A common theme for FY 2024 involves autonomy integrations with 85% of the air-related sub-project funding for new initiatives including support for innovations in autonomy. These investments will support a range of capabilities including resilient communication systems, data analytics, modeling, simulation, sensing, teaming, and swarming. Employing autonomous systems will serve as a force multiplier in military operations by enhancing the efficiency of uncrewed vehicles. For example:

- Sensor systems will enable more accurate detection, identification, targeting, tracking, and engagement of adversaries.
- Communication systems can deliver and process larger quantities of data collected by sensors, especially as the volume of data continues to increase with employment of

advanced technologies like hyperspectral imaging units.

- As uncrewed vehicles shift from remotely controlled platforms to teammates on the battlefield, autonomy integrations as well as the use of artificial intelligence and machine learning (AI/ML) will enable more effective collaboration and coordinated behaviors, including swarming.
- Enhanced navigation systems aid in uncrewed vehicle mobility and maneuverability in complex, unstructured environments, especially in situations where access to GPS is not available.
- Modeling and simulation techniques will be employed to ensure that advancements are properly evaluated prior to further testing and integration.
- These developments will also serve to unburden soldiers from tasks that traditionally required high levels of training and oversight.
- Outside of those efforts relating to autonomy, some other notable investments established in FY 2024 are being applied to vehicle platforms, weaponry, energy, and propulsion systems.

## **Innovative research on advanced platform designs and CONOPs**

From the platform perspective, the Army's Small Unmanned Aircraft System (6.5) project is completing an Acquisition Shaping Panel in FY 2023 for the Long Range Reconnaissance (LRR) UAS and will initiate development and system integration of these aircraft in FY 2024 at a requested funding of nearly \$20 million. LRR will be a rugged small UAS with the ability to conduct Reconnaissance, Surveillance, and Target Acquisition (RSTA) missions using Electro-Optical and Infrared (EO/IR) sensors as well as a laser targeting device. LRR should be capable of autonomous or manual launch with a minimal ground footprint, training, and support requirements. The original request for information on the LRR was published in January 2022.

FY 2024 also funds initial planning and preparation for testing of Optionally Manned Fighting Vehicle (OMFV) designs from up to three vendors. The OMFV is intended to replace the Bradley Infantry Fighting Vehicle and will be capable of both crewed and uncrewed missions in support of combat missions by employing improved lethality, protection, mobility, range and survivability. OMFV will also be capable of deploying and controlling other robotic and semi-autonomous platforms. The projected value of this program from FY 2022 to FY 2028 is \$3.4 billion. In the maritime domain, a new project utilizing surface vessels has requested \$5.6 million to equip Wave Glider (from the Boeing subsidiary Liquid Robotics) and TRITON (from Ocean Aero) USVs with payloads and autonomy to provide maritime decoy and deception capabilities.

## **Novel technologies supporting energy and propulsion systems**

Moving on to new efforts related to propulsion and energy, an interesting development is initiated by DARPA in FY 2024 with \$16.38 million requested to investigate a concept

involving an airborne power relay system using a distributed network of high-altitude persistent UAS equipped with lasers. Additionally, DARPA is looking to design a vertical takeoff and landing (VTOL) UAS with "leap-ahead" long endurance performance capable of launch and recovery from small ships in adverse weather using an investment of \$13.2 million.

A new effort is established to develop propulsion systems for small USVs under the sub-project Allied & Partnered/Expeditionary Asymmetric Industrial Warfare (APEX-AIW). This Navy effort will leverage technologies developed under the Manufacturing Autonomous System at Scale (MASS) Innovative Naval Prototype (INP) effort at the Office of Naval Research (ONR) and demonstrate the ability to produce useful prototypes in relevant quantities.

## **Advanced weapon systems to counter emerging threats**

With respect to research in novel weapon systems associated with uncrewed vehicles, the Office of the Secretary of Defense (OSD) is establishing the Swarming Prototype Attack Unmanned Aerial Systems with a requested investment of \$15.771 million to develop and test three prototype payloads that aid in find, fix, track, target, engage, and assess missions. FY 2024 also includes the creation of three Counter-UAV efforts with a total funding request of \$48.798 million. These include:

- Development and testing of Marine Air Defense Integrated System (MADIS) to protect installations and other assets from adversarial aircraft.
- An Army project that develops, demonstrates, and qualifies a 130-millimeter munition with proximity airburst to engage UAS and other targets.
- Maturation of a Solid State-High Powered Microwave (SS-HPM) prototype capable of defeating UAS groups and swarms.

## DoD projects with potential growth

The next three figures show projects with potential growth in each of the core services of the DoD. Potential growth was identified by comparing average funding from FY 2022 to FY 2024 to the average funding in outlook years of FY 2025 to FY 2028.

### Rapid growth for Air Force loyal wingman efforts

By far the most significant initiative relative to funding is the Collaborative Combat Aircraft (CCA) project. In the next five years, CCA has projected funding of nearly \$6 billion dollars with the intended deployment of autonomous uncrewed aircraft in large volumes to serve as loyal wingmen for manned fighter aircraft and act as an agile force multiplier in combat situations. These systems represent a cost-effective solution that address a growing threat posed to U.S. forces by hostile stealth fighters.

Also displayed on this graph but barely visible due to the relatively low funding in comparison to CCA are:

- The Next Generation Sensors (NGS) Technology Maturation/Risk Reduction project which is developing sensors that address warfighter needs. NGS is employing an acquisition strategy that sources commercial and national developments through competitive and sole source contracts. While no funding is currently detailed after FY 2027, the next four years will see a total estimated investment of more than \$90 million.
- The HBCU University Affiliated Research Center (UARC) project which is created in FY 2024 to fund tactical autonomy developments supported by Howard University. Plans for the next fiscal year include research into tools that enable autonomous systems to act with delegated and bounded authority of humans. Funding in the next five years totals an estimated \$41.9 million.

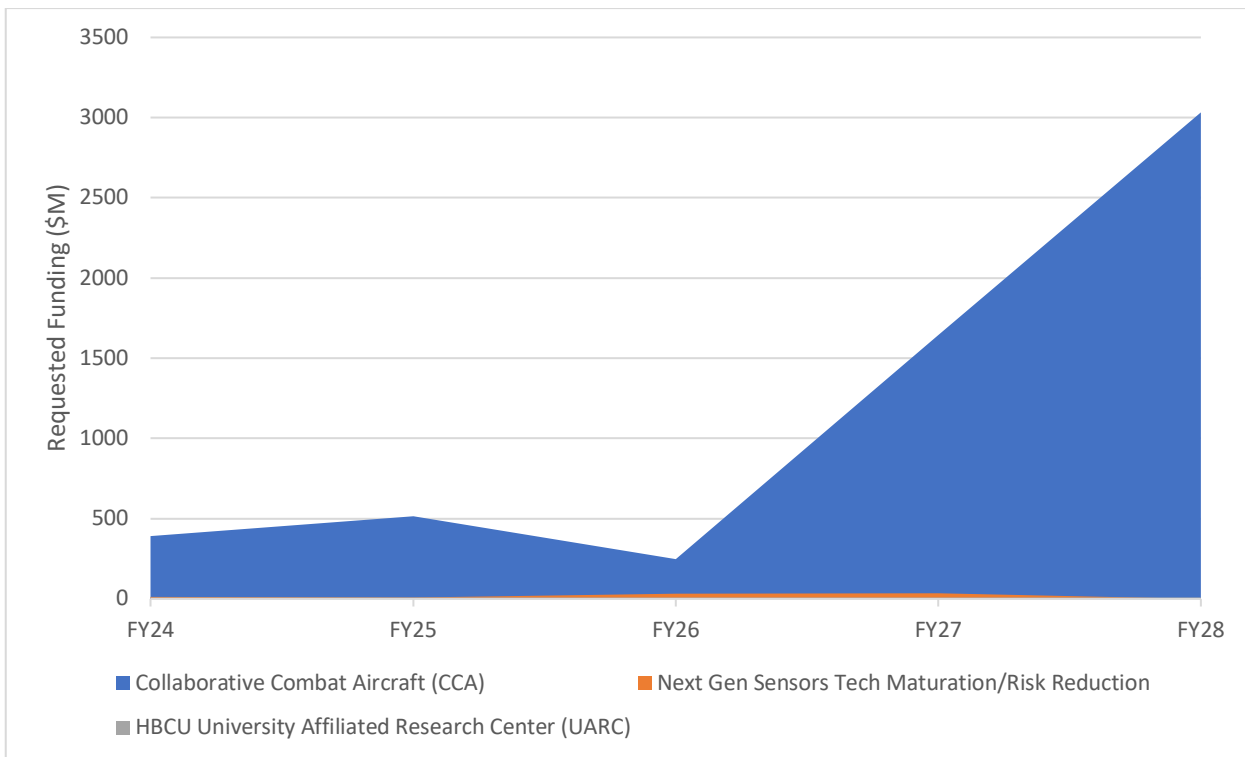


Figure 2: Significant investment in the Air Force's CCA project.

## Army funding growth is anchored by the Robotic Combat Vehicle project

The Army has the highest number of projects showing potential growth, representing almost half of the initiatives that were identified. With a mix of air, ground, and C-UAV related efforts, the top ten relative to funding in FY 2024 are displayed in Figure 3. The project with the highest funding supports the Robotic Combat Vehicle (RCV) with an average of \$137.755 million each year from FY 2023 to FY 2028. In FY 2024, just under \$100 million will be dedicated to:

- RCV-Large Surrogate Prototypes: focus on developing mobility autonomy, safety upgrades, and perception enhancements with support from government centers and contractors (QinetiQ and Textron Systems)
- Autonomous Mobility Development: autonomous mobility software and hardware development with emphasis on off-road capabilities.
- DevSecOps Pipeline Development, Software Integration Lab (SIL) Support, and Data Management Support: maturation of autonomous capabilities for RCV including existing government and commercial software. FY 2024 plans involve autonomous mobility and safety architecture software; simulation environments to test RCV software.

Other noteworthy ground projects include:

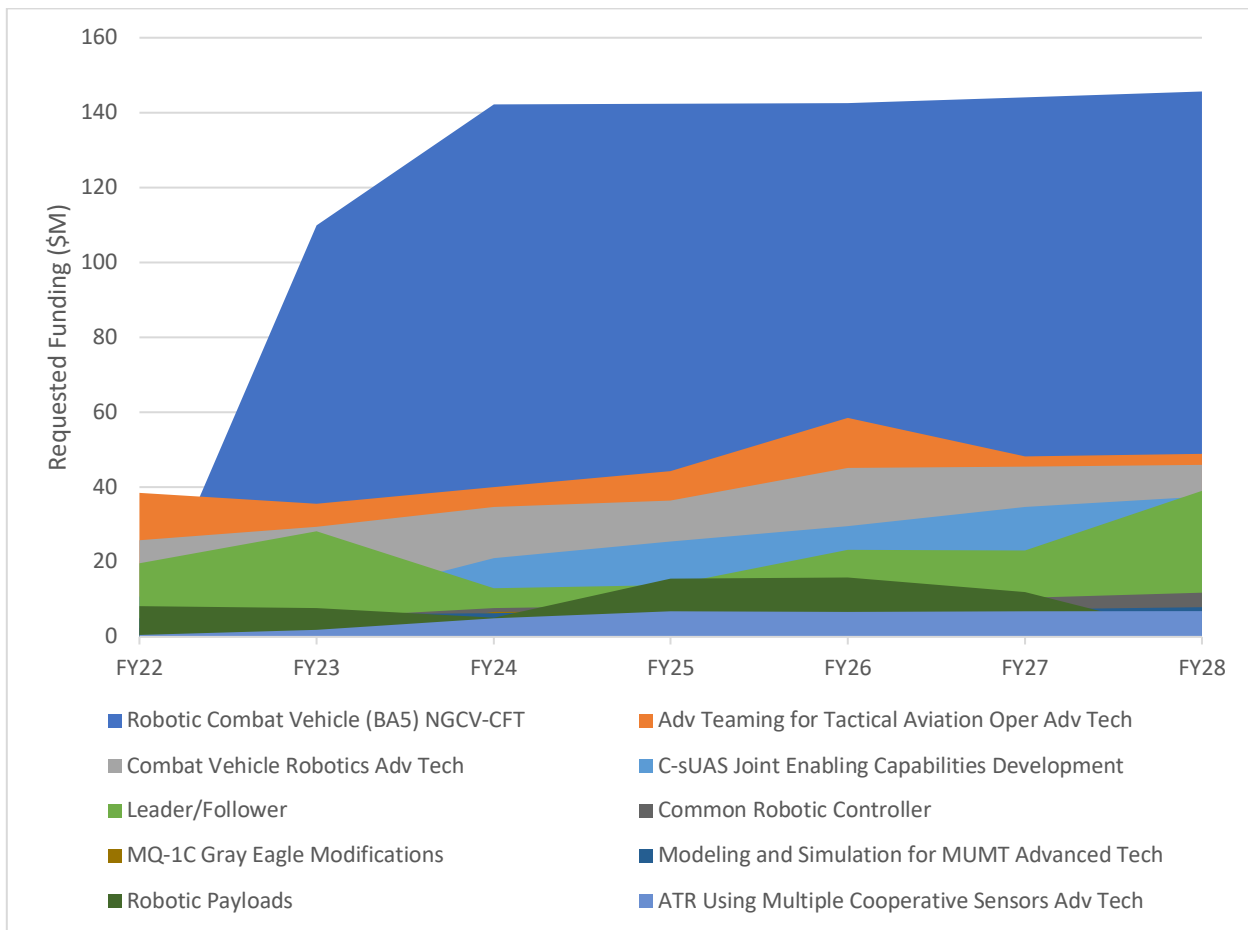
- Combat Vehicle Robotics Advanced Technology: With estimated funding of more than \$260 million from FY 2022 to FY 2028, this project enables teaming of robotics within Army formations in combat scenarios. Plans in the next fiscal year involve improvement and demonstration of autonomous maneuver in degraded and hostile environments with emphasis on manned-unmanned teaming (MUM-T) maneuvers, cybersecurity, collaborative surveillance, autonomous ground vehicle reference architecture (AGVRA), drive-by-wire optimization, and developments associated with the Robot Operating System-Military (ROS-M).
- The Leader/Follower project has estimated funding of nearly \$160 million from FY 2022 to FY 2028 with a primary focus on integration of autonomy on tactical wheeled vehicles to enhance convoy safety.

In the air domain, the Army project with the largest funding is Advanced Teaming for Tactical Aviation Operations Advanced Technology. With nearly \$314 million projected from FY 2022 to FY 2028, current plans for the next fiscal year include two primary efforts:

- Complex Advanced Teaming Operations was initiated in FY 2024 with \$31.574 requested to enhance autonomy and teaming technologies as well as to demonstrate autonomous team of teams synchronized operations facilitating integrated air defense systems.
- Sensors / Multi-Function Imagers for Future Aviation requested \$8.486 million to develop an aircraft-hardened multispectral camera with digital circuit for threat warning data.

Relative to C-UAV efforts, the Army’s C-sUAS Joint Enabling Capabilities Development has an estimated funding of \$167.794 million from FY 2022 to FY 2028 which continues counter small UAS (C-sUAS) technology demonstrations to address capability gaps against new threats. This will inform limited prototyping procurements and assessments through the Joint Counter-sUAS Office’s (JCO) identified threats and C-sUAS Governance process.

While of relatively low funding overall, some other noteworthy projects from the Army showing strong growth potential are Soldier Borne Sensor (SBS) and Pathfinder 3D Advanced Technology. Current priorities for SBS include testing and integration of advanced obstacle avoidance, autonomous behaviors, edge processing, and battery chemistries on small, highly portable UAS. The Pathfinder project is initiated in FY 2024 with a focus on demonstration and integration of Visual Terrain Reference and Navigation algorithms to support semi-autonomous ground robotics.



**Figure 3:** Substantial funding anticipated for the RCV.



## Navy USV programs account for almost \$3 billion from FY22 to FY28

According to funding in FY 2024, the top three maritime projects showing potential growth are associated with uncrewed surface vehicle (USV) developments:

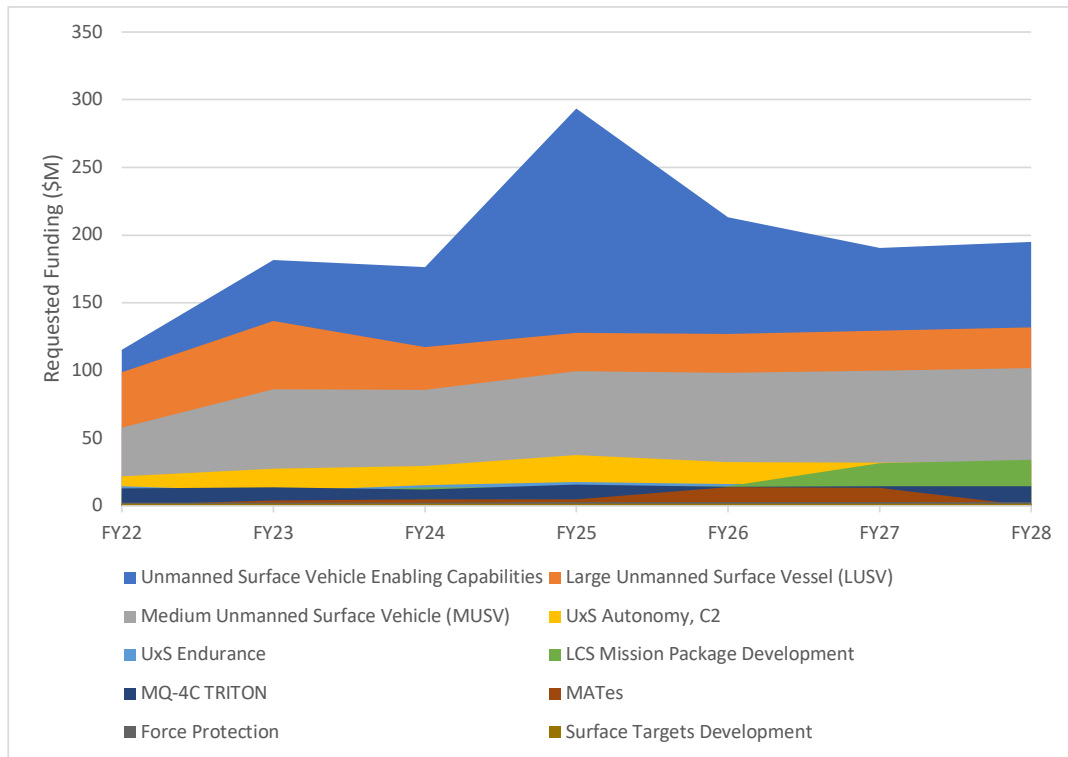
- With approximately \$1.366 billion requested from FY 2022 to FY 2028, the USV Enabling Capabilities project sees a significant increase in FY 2025 with current plans for FY 2024 supporting communication and cryptographic developments; finalizing of autonomy software testing; sensor and perception testing; Containerized Elevated Payload (C-TEP) prototype testing; and procurement and integration of a Next Generation Surface Search Radar on a USV prototype.
- While Large USV procurement has been delayed until 2025, RDT&E associated with these vessels is estimated to be \$868.872 million from FY 2022 to FY 2028. Current plans for FY 2024 include continued machine and electrical distribution qualification and reliability improvements. LUSV will be up to 300 ft long and have a displacement of up to 2,000 tons with the ability to integrate modular payloads for offensive strike missions like anti-surface warfare while employing autonomous navigation and maintaining compliance with

COLREGS.

- The Medium USV project is establishing support and test equipment at a contractor facility in FY 2023 with FY 2024 plans dedicated to software developments and upgraded C4I and autonomy systems tested on Sea Hunter and Seahawk vessels. MUSV will integrate modular payloads with initial capabilities enabling improved battlespace awareness.

The next two “UxS” projects are associated with the UUV Core Technologies program however details were classified as SECRET in the FY 2023 PB request. Based on budget requests prior to this reclassification, this program supports the Navy’s uncrewed underwater vehicle (UUV) family of systems (FoS) by developing, testing, maturing, and demonstrating enabling technologies in critical areas like autonomy, communications, C2, navigation, endurance and energy, payloads, launch & recovery systems, and integration with host platforms.

The MATes project, while requesting relatively low funding in comparison to the other initiatives detailed above at just under \$42 million from FY 2022 to FY 2027, shows the largest growth potential in the coming years with key developments supporting research on autonomy, perception and C2 across a diverse set of domains and missions.



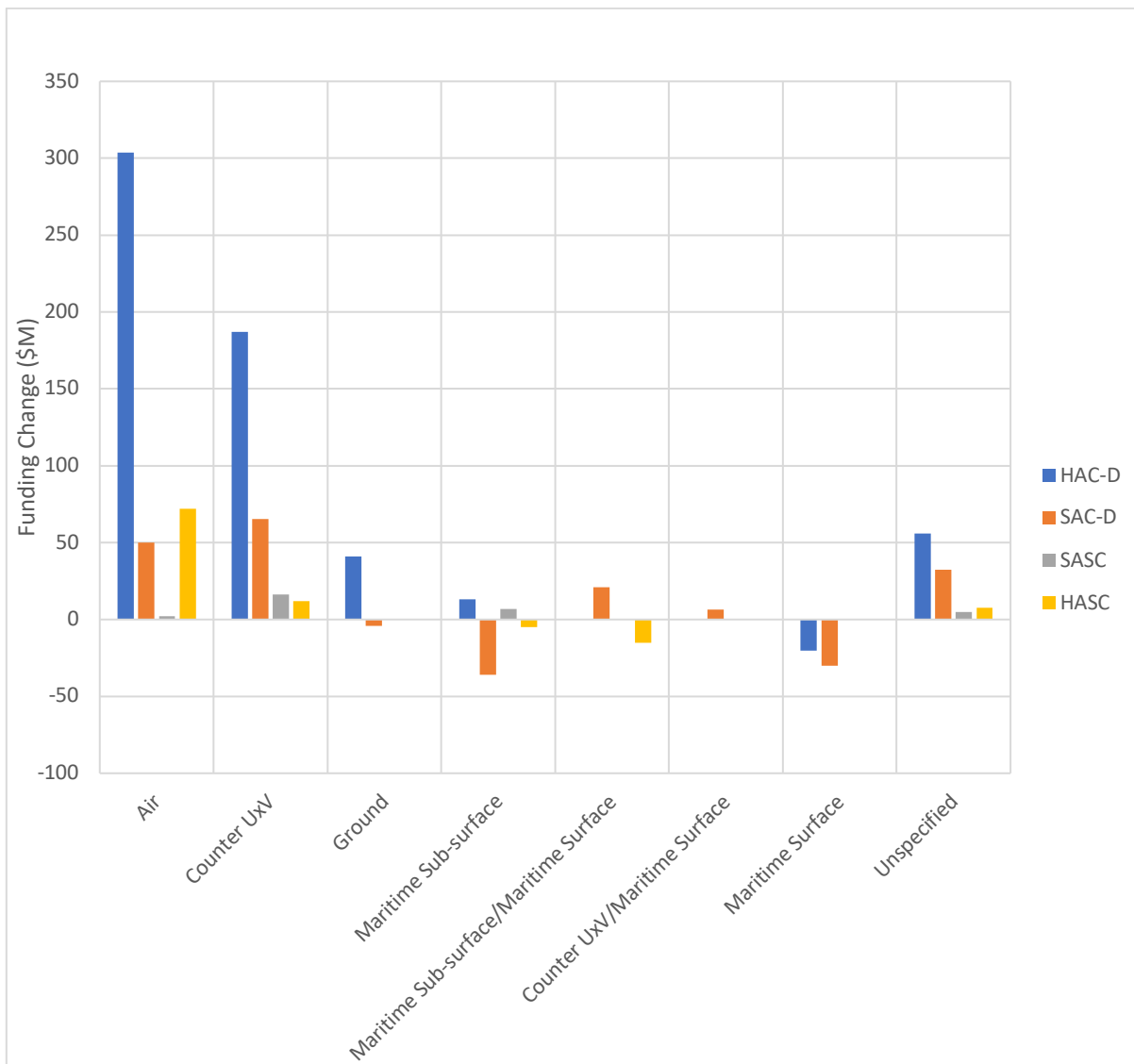
**Figure 4:** Nearly \$3 billion forecasted for RDT&E of USV systems

## How the requested budget is enacted

While the above funding levels for FY 2024 represent initial requests, they must be further reviewed by congressional committees before being enacted. These committees include the House and Senate Armed Services Committees (HASC / SASC) which authorize and the House and Senate Appropriations Committees on Defense (HAC-D / SAC-D) which appropriate funding relative to the initial requests. Funding will either be confirmed, increased, or decreased based on analysis from each committee. Following this review process, a compromise will be established between the House and Senate versions of each bill and will establish the final budget for the DoD. AUVSI has reviewed versions of the defense budget from each of the four committees and collected information on any changes that were suggested. At the time of writing this article, the final bill has not yet been established.

## Increased investments in UAV and C-UAV technologies

Across the four committees, 154 changes were identified relative to the RDT&E of uncrewed vehicles and associated technologies. The net changes are displayed in Figure 5 which shows a general increase in funding. Similar to the chart that displayed new initiatives in FY 2024, the largest increases are found for the air domain, followed by counter uncrewed vehicle (C-UxV) developments (primarily from HAC-D). By tracking these changes, insight can be gleaned with respect to the technologies that are of high importance to the DoD as they receive suggested increases in funding as well as those initiatives that might be underperforming or experiencing delays.



**Figure 5:** Generally positive changes to the original funding request.

## Increased interest in expendable, air-launched, and VTOL UAS

In the air domain, some of the most significant funding changes suggested by congressional committees include:

- Increases
  - A \$55 million increase from HAC-D for the SOCOM MQ-9 UAV Adaptive Airborne Enterprise (A2E) concept which envisions the development of projecting air power for special operations forces from beyond the horizon, using a family of large UAS and expendable, small UAS. A similar change was also suggested by HASC with an increase of \$15 million.
  - \$50 million and \$23 million increases from HAC-D for the Defense Innovation Unit (DIU) Fielding program to support drones for multi-domain awareness and autonomous VTOL air logistics, respectively.
  - An increase of \$39 million from SAC-D for the Army's Future Tactical Unmanned Aircraft System (FTUAS) program to accelerate developments associated with air launched effects.
  - \$32.5 million and \$21 million increases from HAC-D for the Marine Corps' USMC Advanced Technology Demonstration (ATD) program to fund low-cost attritable aircraft technology extended range high speed aerial loitering munitions, respectively.
  - A \$25 million increase from HAC-D to the SOCOM Intelligence Systems Development program for Multi-Mission Tactical UAS (MTUAS).
- Decreases
  - A \$50.782 million decrease from HAC-D to the Unmanned Carrier Aviation (UCA) program for excess testing funding due to delays in Engineering Development Models (EDM). A similar change was also suggested by SAC-D with a decrease of \$20.403 million as well as a \$25 million cut due to carryover of prior year balances.
  - \$41.3 million and \$41.1 million decreases from SAC-D for the RQ-4 Modernization program due to the Incremental Functional Capability (IFC) 4.4 being ahead of need and due to a classified adjustment, respectively.
  - SASC has recommended a decrease of \$29.047 million to the previously mentioned FTUAS program to slow the associated expenditure rate.

## Further RDT&E required to address evolving threats posed by adversaries

Relative to Counter-UAS programs, three major changes were suggested:

- An increase of \$100 million was recommended by HAC-D to the DIU Fielding program previously noted is actually just a transfer from procurement to RDT&E in support of Counter-sUAS (CsUAS) technologies.
- Both HAC-D and SAC-D suggested a \$40 million increase to the OSD's Combating Terrorism Technology Support program to fund development of C-UAS systems including directed energy and laser technology.
- A \$20 million reduction to the Army's Counter-Small Unmanned Aircraft Systems Advanced Development program is suggested by SAC-D due to an unjustified funding request.

## **Common control is the key to future Army ground robotics**

In the ground domain the largest funding increase of \$10 million was recommended by HAC-D to support investment in the common robotics controller in the Army's Ground Robotics program. In that same program, a decrease of \$17.982 million was also suggested by SAC-D due to the Squad Multipurpose Equipment Transport (S-MET) Increment II being early to need. SAC-D also suggested a cut to the Tactical Unmanned Ground Vehicle (TUGV) program because of historical under-execution of RCV software. In general, ground-related programs were supported at the requested levels of funding by each of the congressional committees.

## **Increased interest in commercially available UUV technologies**

Noteworthy changes in the maritime domain include:

- A \$35 million increase from HAC-D to the Navy's Rapid Prototyping, Experimentation, and Demonstration program which would support investigations into commercially available large diameter UUV technology.
- In the Navy's Small and Medium Unmanned Undersea Vehicles program, delays to the MEDUSA UUV contract award and prototype award dates have caused suggested reductions in funding of \$23.984 million (HAC-D) and \$14.454 million (SAC-D), respectively.
- Program delays and associated basing equipment being ahead of need for the extra large UUV (XLUUV) under the Advanced Undersea Prototyping program brought suggested decreases of \$21.725 million (HAC-D) and \$20.7 million (SAC-D), respectively.

The changes detailed above indicate that the DoD is seeking new, more agile pathways to develop and procure technologies. This includes sourcing low-cost attritable systems as well as investigations into commercially available solutions that can be acquired and adapted to military mission requirements. Additionally, adversarial uncrewed systems are posing a growing threat to U.S. forces in combat situations, and technologies are being researched and developed to counter those threats including both kinetic and non-kinetic effects.

## **Areas requiring further congressional investigation and oversight**

In addition to suggested funding changes, congressional legislation also includes provisions which detail committee-directed briefings, reports, and recommendations. Across all committees, nearly 100 provisions were identified with relevance to uncrewed vehicles. These provisions offer insight into congressional priorities which inform future technology developments, acquisition strategies, potential technology gaps, and risks. Provisions associated with the RDT&E of uncrewed vehicles are provided below.

## Air Force Provisions

Section Title	Summary
Air Force Agility Prime	The committee directs the Secretary of the Air Force to submit a report to the HASC by March 2024, on the Air Force's future acquisition strategy for eVTOL systems to include the status of current and future eVTOL R&D programs; plans and potential locations for testing eVTOLs; summary of acquisition efforts; planned operational use cases; barriers in acquisition at scale for operational use.
Collaborative Combat Aircraft propulsion systems	The committee has emphasized the potential importance of developments related to uncrewed collaborative combat aircraft (CCA). However, there is concern about the lack of a clear plan for funding and operationalizing key technologies, especially attritable (low-cost) engine technologies. Therefore, a report is requested by October 2023 to cover plans for funding and RDT&E of these systems.
Electric Vertical Take-Off and Landing	The committee has directed the Secretary of the Air Force to provide a report NLT 90 days following the enactment of this act on future plans for eVTOLs including current and future R&D programs; planned/potential testing of civilian eVTOLs; planned/programmed funding; expected operational use cases; current/potential barriers of acquisition.
Collaborative Combat Aircraft	The committee supports the requested funding for CCA in FY 2024 and has requested a detailed plan in FY 2025 on how these technologies will be transitioned to an operational program of record among other considerations.

## Army Provisions

Section Title	Summary
Development of small unmanned aircraft system signature management capability	The committee has encouraged the Army to develop a sUAS signature management capability to enable the detection of signature levels and provide material developers and operational units with the needed information to avoid detection and minimize attribution of sUAS platforms. This would assist in ways to mitigate and defeat potential adversarial sUAS swarms.
Heavy-Payload Medium-Range VTOL Aircraft Logistical Support	The committee directs the Secretary of the Army to provide a briefing to the HASC by June 2024 on current and future efforts to utilize unmanned VTOL aircraft to provide low-cost, heavy-payload, medium-range, logistical support in both contested and permissive environments.
Hyperspectral sensors for autonomous operations and survivability	The committee directs the Secretary of the Army to provide a briefing to the HASC by December 2023 on the Army's plans and strategy to incorporate and develop Ultra-Compact Hyperspectral Imaging Systems (UCHIS) capabilities for current and next generation Army platforms (which includes uncrewed ground combat vehicles and UAS).
Medium-Range Reconnaissance Unmanned Aircraft System Modernization	The committee has observed that the Army's Medium-Range Reconnaissance (MRR) program is moving slowly which could compromise the effectiveness of company-level maneuver as threats rapidly evolve and recommends that the Army moves forward with this effort expeditiously. Therefore, a briefing has been requested by April 2024 to include a summary of the most important advances in commercial UAS capabilities; a description of capability gaps for company-level UAS missions including EO/IR-based surveillance.
Next generation hybrid and electric vertical take-off and landing vehicles for Army modernization	The committee encourages the Army to further explore the development of novel VTOL concepts, including hybrid and electric propulsion technologies for UAS that enable Army multi-domain operations (MDO). Therefore the Secretary of the Army has been directed to provide a report to HASC by December 2023 on current and future hybrid electric VTOL R&D efforts. This will include how the Army is incorporating hybrid electric VTOL solutions into FVL modernization efforts; an overview of current and future research on hybrid and electric VTOL energy sources as well as a survey of commercially available solutions; future fielding strategies within the Army; an overview of collaboration between the Army and the Air Force's Agility Prime program.
Ultra-Long Endurance High Altitude Pseudo-Satellites (HAPS)	The committee directs the Secretary of Defense to submit a briefing to the HASC by March 2024, on the ability to increase fixed-wing HAPS secure payload data-backhaul capacity and interoperability with Department of Defense networks. The briefing should include, at minimum, a schedule and costs for fielding HAPS in the 2025 timeframe.
Target Development for Counter-Small Unmanned Aerial Systems	The committee supports investment in domestic class 1-3 UAS among other systems to provide realistic engagement targets for defense against these types of threats from adversaries.
Future Vertical Lift Technologies	The committee has recommended an additional \$2.5 million to continue development of an extended range VTOL UAS platform under the Army's Future Vertical Lift program.

## Navy Provisions

Section Title	Summary
Maritime Domain Awareness	The committee directs the Secretary of the Navy to provide a briefing to the HASC by February 2024, on the Navy's utilization of AI-powered MDA systems and any capability gaps.
Resilient autonomous systems research and workforce diversity	The committee encourages the Navy to partner with academia to develop techniques and automated cybersecurity methods to improve trust and resilience of autonomous systems against cyberattacks.
Support for Future Naval Capabilities research and development programs	Rapid and efficient data processing and synthesis from multiple sensors, aided by robust and capable interconnects, is essential for distributed command, control, communications, computers, and intelligence, surveillance, and reconnaissance. This is particularly the case at extended ranges for unmanned platforms such as Medium/Large Unmanned Surface Vessels, and represents a vital capability to ensure the military maintains its decision-making advantage at the tactical edge in times of conflict. The committee encourages the Navy to continue adequately programming and budgeting for Future Naval Capabilities (FNC) programs.
Unmanned aerial systems degraded environment facility	Expansion of test infrastructure for autonomous platforms like sUAS is necessary to allow for a much larger variety of unmanned systems and autonomy technologies to be tested in additional degraded environments. The committee understands that the Naval Surface Warfare Center has begun to invest in an unmanned systems degraded environment facility to enable testing of autonomous systems in a controlled environment. The committee commends the Navy for establishing a testing infrastructure for this critical mission and encourages the Navy to budget for this facility in future years.
Low-Cost Attributable Aircraft	The committee encourages the Marine Corps to explore novel concepts of operation and employment opportunities for low-cost attributable aircraft to enable reconnaissance, strike, and contested logistics operations.
Marinisation of Long Rang and Long Endurance Systems	The committee recommends investigations into the marinisation of existing uncrewed platforms to meet the needs of future Marine Corps requirements in an expedited timeline to provide ISR and kinetic strikes.

## Defense-Wide Provisions

Section Title	Summary
Neural biosensors	The committee has noted the potential benefits associated with AI-enabled bi-sensors to assess a user's level of alertness with applicability including pilots of uncrewed systems. Therefore, a report to HASC has been requested by December 2023 which discusses plans for the development of these technologies to support broader transition to the military services as well as required steps that can be taken to accelerate their funding and development.
United States Marine Corps development of vertical takeoff and landing systems	The committee recommends that the Navy continues to develop next generation VTOL UAS including hybrid and electric VTOL UAS to address capability gaps, particularly in the Indo-Pacific.
Advanced Air Mobility	The committee commends the DOD on recent milestones reached with respect to Advanced Air Mobility but is concerned that there is still risk associated with maintaining a competitive advantage in this sector. Therefore, the committee has directed a report be submitted within 180 days of enactment of this Act to discuss a collaborative approach for joint interagency developments.

## Appendix: Budget Release Schedule

The Department of Defense (DoD) releases their budget each year in multiple stages.

1. The first version is known as the President's Budget (PB) which provides information on the requested funding from each department and agency. The PB includes detailed justification documents which discuss specific plans for each program as well as requested funding amounts. AUVSI collects data on all programs involved in the procurement as well as the research, development, test, and evaluation (RDT&E) of initiatives supporting uncrewed vehicle systems and associated technologies. Investigations into these initiatives offers insights into current and future developments of uncrewed vehicles across all domains.
2. The next stage of the budget involves the release of legislation from congressional committees that authorize and appropriate funding relative to the initial PB request. The committees will either confirm or suggest changes to the requested amounts. The legislation will also include provisions which detail committee-directed briefings, reports, and recommendations related to uncrewed systems.
3. The final stage of the budgetary process is the release of the National Defense Authorization Act (NDAA) and the Appropriations bill which are then signed by the President and enacted into law.

Using these pieces of information, this article informs stakeholders involved in the research and development of uncrewed systems of current congressional and DoD priorities, how the threat landscape is evolving in military operations, and where investments are being made to counter these threats.

Terminology was used throughout that reference the hierarchical funding structure of DoD's budget (i.e. program elements, projects, and sub-projects). Further details can be referenced in the section below.

Additionally, full access to this data can be acquired using our integrated visualizations resource which offers details on more than 300 program elements, 600 projects, and 1200 sub-projects that offer support for uncrewed vehicles. To learn more, please click [here](#).



## Appendix: Structure and Terminology

DoD RDT&E initiatives are detailed using a hierarchical structure as follows:  
Structure:

- Appropriation (RDT&E, Procurement, Operations & Maintenance, etc.)
  - Budget Activity (1-8)
    - Program Elements (identified using an alpha-numeric code)
      - Project(s) (identified using an alpha-numeric code)
        - Sub-Project (listed under each project which detail specific plans for the current and next fiscal year)

An example for a specific program is provided below for the *Ground Technology* program:

- Appropriation 2040: Research, Development, Test & Evaluation, Army
  - Budget Activity 2: Applied Research
    - Program Element 0602144A: Ground Technology
      - Project BK7: Robotics for Engineer Operations Technology
        - Sub-Project: Beyond-Visual-Line-of-Sight Teleoperated Engr Ops
        - Sub-Project: Semi-Autonomous Engineer Operations
      - Project CA9: Predictive Maintenance
        - Sub-Project: Predictive Maintenance
      - Project CG6: Ground Vehicle Power and Energy Concepts and Tech
        - Sub-Project: Advanced Distributed Power for Autonomous Systems
      - Project CG8: Human Autonomy Teaming
        - Sub-Project: Soldier-AI Team Mission Planning for Dynamic Complex Environments
        - Sub-Project: Dynamic Soldier-AI Team Resource Allocation
        - Sub-Project: Soldier Cognition-Centric Interface Technologies
        - Sub-Project: Enabling Soldier-AI Technology Adaptation
  - Etc.

The DoD provides funding amounts for each of the bullets above at the Program Element and below. AUVSI uses the values at the sub-project level to formulate funding totals for the next Fiscal Year as this offers the most granular funding amounts as well as the specific plans that will be supported by that funding.

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[auvsi.org/research](http://auvsi.org/research)

Association for Uncrewed Vehicle Systems International