U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, DC 20591

August 3, 2022

The Honorable Patrick Leahy
Chairman, Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Chairman Leahy:

Enclosed is a Federal Aviation Administration (FAA) report to Congress in response to a request in House Report 115-750 that accompanied the Consolidated Appropriations Act 2019 (Pub. L. 116-6).

The House Report requested FAA to submit to Congress a report on the anticipated economic benefits of large, unmanned aircraft in both cargo and passenger applications, the need for performance-based standards to integrate these new systems into our airspace safely, and FAA's recommendations for accelerating its regulatory approach, to keep pace with technological developments and industry demand in this emerging sector of the Unmanned Aircraft Systems market.

We have sent identical letters to the Vice Chairman of the Senate Committee on Appropriations and the Chair and Ranking Member of the House Committee on Appropriations.

Sincerely,

Billy Nolen
Acting Administrator

Enclosure

U.S. Department
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**Federal Aviation
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Office of the Administrator

800 Independence Ave., S.W.
Washington, DC 20591

August 3, 2022

The Honorable Richard Shelby
Vice Chairman, Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Vice Chairman Shelby:

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We have sent identical letters to the Chairman of the Senate Committee on Appropriations and the Chair and Ranking Member of the House Committee on Appropriations.

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800 Independence Ave., S.W.
Washington, DC 20591

August 3, 2022

The Honorable Rosa DeLauro
Chair, Committee on Appropriations
House of Representatives
Washington, DC 20515

Dear Chair DeLauro:

Enclosed is a Federal Aviation Administration (FAA) report to Congress in response to a request in House Report 115-750 that accompanied the Consolidated Appropriations Act 2019 (Pub. L. 116-6).

The House Report requested FAA to submit to Congress a report on the anticipated economic benefits of large, unmanned aircraft in both cargo and passenger applications, the need for performance-based standards to integrate these new systems into our airspace safely, and FAA's recommendations for accelerating its regulatory approach, to keep pace with technological developments and industry demand in this emerging sector of the Unmanned Aircraft Systems market.

We have sent identical letters to the Ranking Member of the House Committee on Appropriations and the Chairman and Vice Chairman of the Senate Committee on Appropriations.

Sincerely,

Billy Nolen
Acting Administrator

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Office of the Administrator

800 Independence Ave., S.W.
Washington, DC 20591

August 3, 2022

The Honorable Kay Granger
Ranking Member, Committee on Appropriations
House of Representatives
Washington, DC 20515

Dear Ranking Member Granger:

Enclosed is a Federal Aviation Administration (FAA) report to Congress in response to a request in House Report 115-750 that accompanied the Consolidated Appropriations Act 2019 (Pub. L. 116-6).

The House Report requested FAA to submit to Congress a report on the anticipated economic benefits of large, unmanned aircraft in both cargo and passenger applications, the need for performance-based standards to integrate these new systems into our airspace safely, and FAA's recommendations for accelerating its regulatory approach, to keep pace with technological developments and industry demand in this emerging sector of the Unmanned Aircraft Systems market.

We have sent identical letters to the Chair of the House Committee on Appropriations and the Chairman and Vice Chairman of the Senate Committee on Appropriations.

Sincerely,

Billy Nolen
Acting Administrator

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FAA
Aviation Safety

REPORT TO CONGRESS:

Large Unmanned Aircraft Systems

2019 House Appropriations (Report 115-750)

Executive Summary

The Federal Aviation Administration (FAA) submits this report as requested by the 2019 House Appropriations (Report 115-750).

Large unmanned aircraft systems (UAS) are expected to affect the U.S. economy in four areas: the manufacturing of large UAS; passenger services; air ambulance services; and services related to parcel delivery. The transportation of goods and people by large UAS is considered to be a subset of a bigger ecosystem commonly referred to as Advanced Air Mobility (AAM).

The FAA is committed to the use of performance-based standards to integrate large UAS into the National Airspace System (NAS) safely. Instead of prescriptive design requirements, performance-based standards can maintain a consistent and acceptable level of safety while providing greater flexibility to applicants seeking aircraft certification. Performance-based standards also facilitate certification of new and novel technology, reduce regulatory time and cost burdens, and spur innovation and technology adoption. The FAA anticipates the use of performance-based standards as a means of compliance to meet performance-based rules. Performance-based rules can remain stable while industry develops means of compliance to substantiate the safety and capabilities of new technology.

The FAA believes that continuing to enable operations through the existing authority and regulatory framework is the best way to accelerate increased safe operations. The FAA recommends continuing its current "operations-first" regulatory approach, which focuses on repeatable and scalable operations in order of operational risk and complexity rather than size or type of vehicle. Using applicable rules and aircraft certification, the current UAS integration strategy enables operations through an ecosystem that considers the evolution and safety of the aircraft, the framework for operations, access to airspace, infrastructure development, and community engagement.

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Introduction

The Federal Aviation Administration (FAA) submits this report as requested by the 2019 House Appropriations (Report 115-750). In composing this report, the FAA used multiple data sources, including a November 21, 2018, Booz Allen Hamilton Urban Air Mobility (UAM) Market Study; a McKinsey & Company UAM Market Study, which was commissioned by the National Aeronautics and Space Administration (NASA); and estimates of total parcel deliveries in the United States from Pitney Bowes.

Legislative Request

House Report 115-750 (June 12, 2018), Large Unmanned Aircraft Systems (page 17), states:

> *Large Unmanned Aircraft Systems.—While most of the FAA's attention to date has focused on the integration of small unmanned aircraft into our airspace, the Committee is aware of the economic potential of larger certifiable classes of unmanned aircraft operating at higher altitudes and with longer range and persistence.*
>
> *While the Committee understands the integration of large UAS will not be an overnight transformation, it is time for the FAA to recognize and respond to the near-term arrival of technologies that usher in this next phase of UAS integration. The Committee, therefore, directs the FAA to submit a report to the House and Senate Committees on Appropriations, not later than 120 days after enactment of this act, on the anticipated economic benefits of large unmanned aircraft in both cargo and passenger applications, the need for performance-based standards to safely integrate these new systems into our airspace, and the agency's recommendations for accelerating its regulatory approach, to keep pace with technological developments and industry demand in this emerging sector of the UAS market.*

Background

Unmanned aircraft weighing 55 pounds or more are considered large UAS. Title 14 of the Code of Federal Regulations (14 CFR) part 107, one of the FAA's regulations related to safely integrating UAS into the National Airspace System (NAS), is not applicable to large UAS. Large UAS are subject to the general operating requirements of 14 CFR part 91, as well as other operating requirements that may be applicable depending on the specific nature of the UAS operation. The safe and timely integration of large UAS is critical to the U.S. aviation industry and the American public because the number of operations of large UAS in the NAS continues to

increase.[1] As the large UAS industry continues to mature, the commercial demand will continue to rise.[2] The FAA agrees it must keep pace with those developments while maintaining a safe and secure airspace system that serves as a model to the world.

The FAA's existing UAS integration plan enables the FAA to meet this challenge through a regulatory approach that focuses on repeatable, scalable operations in order of operational risk and complexity. This regulatory approach uses performance-based standards to ensure that safety objectives spur innovation and technology adoption while maintaining a consistent level of safety.

Response

Anticipated Economic Benefits

Large UAS are expected to affect the U.S. economy in four areas: the manufacturing of large UAS, passenger services, air ambulance services, and services related to parcel delivery. The transport of goods and people by large UAS is considered a subset of a bigger ecosystem commonly referred to as Advanced Air Mobility (AAM). To give a sense of the scale of the economic impact, the FAA estimates that:

- $1.6 billion worth of large UAS is expected to be manufactured in the U.S. over the coming decade, with $316 million worth of UAS projected to be manufactured in 2030;[3]
- $2.5 billion per year is expected to be generated from passenger services by 2030;[4]

[1] Two sources of data indicate continuing growth in overall large UAS operations. First, flight thread tracking data, which tracks the broadcasted identification of an aircraft as it passes through the NAS, has shown a 9 percent average increase per year in the flights of large UAS over the past 7 years, when this data collection started, and is expected to grow 15 percent per year over the next 5 years. Note that the thread tracking data does not capture all flight, only a subset of flights operating in the NAS. Second, civil and commercial large UAS must register with the FAA's public aircraft registry to obtain a tail number, which is required to operate in the NAS. The number of large UAS in the public aircraft registry has increased almost 50 percent per year over the last 7 years and is expected to increase at a similar rate over the next 5 years. This data suggests that large UAS operations are increasing and should continue to increase into the future.

[2] Unlike military or civil large UAS, the commercial operation of large UAS requires a section 44807 exemption. Since the exemptions started in 2018, on average almost 10 exemptions were granted per year. However, in 2021, 52 exemptions were granted, a fivefold increase. This suggests a rapid increase in the commercial use of large UAS, which should continue until the section 44807 exemption sunsets or is replaced.

[3] The estimate are derived from the large UAS forecast from the FAA's Aerospace Forecast 2021-2041 (www.faa.gov/data_research/aviation/aerospace_forecasts/), and reduced by the portion of large UAS manufactured in the United States estimated from 44807 exemptions. The fleet estimate is multiplied by the assumed cost of large UAS. See section "Estimates of Economic Output from Large UAS Manufacturing – Unit-Based Direct Value Estimates" for additional details.

[4] Estimated by multiplying the potential market for UAS passenger services ($500 billion) by the projected share of the potential market (0.5 percent) in Booz Allen Hamilton, Urban Air Mobility (UAM) Market Study, Nov. 21, 2018; ntrs.nasa.gov/citations/20190001472. See section "Estimates of Economic Output from the AAM Ecosystem" for details.

- $3.3 billion per year is expected to be generated from air ambulance services by 2030;[5] and
- $2.1 billion per year is expected to be generated from parcel delivery services by 2030.[6]

Large UAS-related manufacturing and services are nascent industries with few data sources available to provide reliable estimates of value-added or spill-over effects on other sectors of the economy. As statistical agencies and international organizations separate UAS manufacturing and services from other portions of the economy, more informed forecasts of the economic impact of large UAS on the U.S. economy will be possible. Currently, federal agencies, including the Departments of Defense, Homeland Security, Interior, Energy, and Agriculture, as well as NASA, operate many of these aircraft. In addition, state governments, local governments, and academic institutions conduct operations with large UAS. Furthermore, there is an increase in commercial operations of large UAS for a number of purposes.[7]

UAS Economic Impact Limitations

The International Trade Administration notes: "Comprehensive data on the UAS market is difficult to obtain because most UAS manufacturers are not publicly traded and few research firms cover the sector extensively; therefore, it is difficult to quantify the overall UAS market."[8] In the past, trade data did not distinguish UAS from other aircraft parts but in January 2022 tariff codes specific for UAS at the international level have been introduced. Until the Census Bureau's North American Industry Classification System (NAICS) and North American Product Classification System (NAPCS) recognize UAS as an explicit industry or product class, economic data on UAS from public sources (such as the Economic Census) will continue to be difficult to find.

[5] AAM air ambulance market is estimated by multiplying the projected cost ($9,000 per trip) of an air ambulance trip using AAM technology – see pg. 112 of Urban Air Mobility (UAM) Market Study, Booz Allen Hamilton – by 1/2 of the estimated roughly 700,000 U.S. air ambulance trips - Wang, Sherry, Duffy, Reinhardt, and Vitagliano, 2020; catsr.vse.gmu.edu/pubs/AMT_RWOPs_JournalPaper_Wang_Sherry_07-29-21.pdf. The 1/2 estimate is assumed to be a reasonable split of manned and unmanned air ambulances in 2030. See section "Estimates of Economic Output from the AAM Ecosystem" for details.

[6] This estimate combines the expected cost of AAM parcel delivery ($4.20 per delivery) from the NASA commissioned Urban Air Mobility (UAM) Market Study, McKinsey & Company; pg. 12, Nov. 2018, ntrs.nasa.gov/api/citations/20190026762/downloads/20190026762.pdf; and the estimates of total parcel deliveries in the United States from Pitney Bowes (https://www.pitneybowes.com/us) weighted by the population of cities with infrastructure constraints. See section "Estimates of Economic Output from the AAM Ecosystem" for details.

[7] In addition to being used in cargo and passenger operations, many of these new commercial large UAS are used in agricultural aircraft operations.

[8] www.trade.gov/unmanned-aircraft-systems

Moreover, the way in which UAS markets will mature is uncertain. Rapid technological development and determined regulators will help these UAS markets to develop by 2030, but many hurdles still lie ahead. As such, the timing of when these markets are established, and their path to maturity, is difficult to determine. Additional research, ideally involving participation from the U.S. aviation industry, would be required for a reliable estimate. Given these uncertainties, most of the estimates presented in this report are for the economic output of the UAS markets in the year 2030.

Estimates of Economic Output from Large UAS Manufacturing – Unit-Based Direct Value Estimates

Over the next 10 years, the FAA estimates commercial purchases of 6,524 large UAS manufactured in the United States.[9] These sales are expected to gross $1.63 billion over a 10-year period.[10]

Roughly 80 percent of large commercial UAS are produced by U.S. manufacturers.[11] Although prices can vary widely, the FAA assumes the average price of a large UAS is $250,000.[12] However, UAS used for more advanced services, such as air ambulance and passenger services, likely will cost from $1.4 to $4 million per aircraft.[13]

Year	Total Estimated Large UAS Produced in the U.S.	Total (Million US$)
2021	268	$67
2022	303	$76
2023	335	$84
2024	364	$91

[9] The U.S. manufactured, commercial large UAS is calculated by using the large UAS forecast from the FAA Aerospace Forecast: 2021-2041 (www.faa.gov/data_research/aviation/aerospace_forecasts/), which is a 5-year forecast, and extending it to a 10-year forecast by extrapolation. The 10 year forecast is then reduced by the portion of large UAS manufactured abroad.
[10] The gross sales of large UAS by U.S. manufactures to U.S. operators is calculated by multiplying the U.S. manufactured, commercial large UAS by the assumed average price of a large UAS.
[11] The estimate for the portion of large UAS manufactured within the U.S. is calculated by tracking exemption granted under Title 49 United States Code section 44807 and the unmanned aircraft reported in the exemption. The portion of granted exemptions citing large UAS manufactured by U.S. companies is assumed to be the portion of large UAS manufactured within the United States. The FAA assumes this portion of large UAS manufactured in the United States for U.S. consumers is static and does not change over the time horizon of the forecast.
[12] For example, the Yamaha Fazer agricultural drone costs $130,000 (New Atlas, *Yamaha's latest unmanned helicopters ready to spray or survey*, (last visited November 2, 2021) https://newatlas.com/yamaha-uav-fazer-r-g2/45846/), while small, manned helicopters (which have the same relative size of a large UAS, such as the Robinson R22) are priced around $230,000 (Aircraft Cost Calculator, *ROBINSON R22 Beta II Price and Operations Costs* (last visited November 2, 2021) www.aircraftcostcalculator.com/AircraftOperatingCosts/633/Robinson+R22+Beta+II), and military UAS sold by Kratos are priced around $3 million (Forbes, *The Quiet Billionaires Behind America's Predator Drone That Killed Iran's Soleimani*, (last visited November 2, 2021) www.forbes.com/sites/denizcam/2020/01/07/the-quiet-billionaires-behind-americas-predator-drone-that-killed-irans-soleimani/?sh=5bb1b75f5cb0).
[13] See L.E.K., *Advanced Air Mobility-Cost Economics and Potential* (last visited November 2, 2021) http://www.lek.com/insights/ei/advanced-air-mobility-cost-economics-and-potential for an estimated range of prices.

Year	Total Estimated Large UAS Produced in the U.S.	Total (Million US$)
2025	390	$97
2026	628	$157
2027	850	$212
2028	991	$248
2029	1,132	$283
2030	1,263	$316
Total	6,524	$1,631

Given the lack of NAICS or NAPCS categories for UAS, as noted above, the FAA is unable to estimate the international sales of domestically manufactured UAS.

Estimates of Economic Output from the AAM Ecosystem

The development of electric vertical takeoff and landing aircraft and increasing levels of flight automation has opened up the possibility of using airspace around cities for within-metropolitan-area transport. This additional mode of transportation, often considered an important element of the AAM ecosystem, could open new opportunities for commuters, tourism, ambulances, and parcel delivery.[14] This is particularly the case where land is scarce or where transportation infrastructure is prohibitively expensive (e.g., over water). The FAA expects the market for some AAM services, which include passenger, parcel delivery, and ambulance services, to be $7.9 billion per year for the industry by the end of the decade.[15]

In a study commissioned by NASA, the potential market for AAM passenger-related services was estimated at $500 billion annually.[16] Even though the potential demand for these services is large, the report notes that these AAM services only capture 0.5% of the potential market or $2.5

[14] The vast majority of AAM services are expected to be performed by large UAS in the long run. Some stakeholders (e.g. Amazon) believe that in the long run, most parcel services could continue to be fulfilled by small UAS, but parsing out what portion of the parcel services are likely to be performed by small UAS (<55lb of gross takeoff weight) vs. large UAS (>55lb of gross takeoff weight) is not feasible. Assuming all AAM services will be completed by large UAS is likely the most reasonable forecast given the current data constraints.
[15] The $7.9 billion per year estimate for AAM services is the sum of the estimates for parcel services, passenger services, and air ambulance services. Sources: Booz Allen Hamilton, Urban Air Mobility (UAM) Market Study, Nov. 21, 2018; and Urban Air Mobility (UAM) Market Study, McKinsey & Company; pg. 12, Nov. 2018.
[16] Booz Allen Hamilton, Urban Air Mobility (UAM) Market Study, Nov. 21, 2018; ntrs.nasa.gov/citations/20190001472.

billion per year by the end of the decade.[17] The lower estimates are based on risks from several unknowns, including infrastructure, regulatory climate, and public perceptions. Given changes in commuting patterns due to the impact of the COVID-19 pandemic and the current economic forecast, $2.5 billion per year within the decade is optimistic for the industry. It also is important to note that AAM passenger-related services are most likely to have a pilot on board in the initial phase of operations and, therefore, might not be classified as UAS. However, once the AAM ecosystem has matured, a large part of AAM vehicles likely will be remotely piloted or fully automated, which would classify these aircraft as UAS.[18]

The FAA has determined that the $500-billion-per-year potential market for AAM passenger services cited in the NASA survey might be overly optimistic. The competition from advanced ground-based transportation (e.g., automated) might limit the market size of AAM passenger services. However, cities with infrastructure constraints are likely to include AAM services in their transportation systems to relax demands on costly infrastructure. The NASA study selected ten such cities as case studies that fit this description. Using the infrastructure-constrained number of trips for the ten cities in the NASA study, the FAA estimates that the market potential for AAM passenger services is $160 billion per year by the end of 2030.[19] However, as stated above, it is possible that only a fraction of this potential market is realized.

The NASA study also suggests that AAM is expected to replace the majority of the current air ambulance market, which would be a $3.3-billion-per-year industry when using AAM technology.[20] Similar to AAM passenger services, infrastructure-constrained cities are more likely to invest in AAM ambulance services. Converting ground ambulances to AAM ambulances in infrastructure-constrained cities would create a $104-billion-per-year industry by

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[17] Estimated by multiplying the potential market for UAS passenger services ($500 billion) by the projected share of the potential market (0.5 percent) projected by 2030 by the Urban Air Mobility (UAM) Market Study, Booz Allen Hamilton.

[18] Given that AAM is a nascent industry – as well as evolving technologically, it would be misleading to estimate the portion of each type of command and control system that will be used in the future. However, labor costs for pilots are statistically growing faster than inflation, which should incentivize introducing more capital per laborer to reduce costs. In other words, AAM businesses are able to increase profits when remote pilot and fully automated UAS are available.

[19] See pg. 156 of the Urban Air Mobility (UAM) Market Study, Booz Allen Hamilton for daily number and the portion which qualify to be replaced by AAM services. Long-run market size was calculated with average commute distances based on the report from the Metropolitan Policy Program at Brookings, *The Growing Distance Between People and Jobs in Metropolitan America, March* 24, 2015; www.brookings.edu/research/the-growing-distance-between-people-and-jobs-in-metropolitan-america/ and revenue maximizing prices per mile for each city for AAM services on pg. 96 of Urban Air Mobility (UAM) Market Study, Booz Allen Hamilton. Due to a lack of data on Honolulu in the Brookings report, Seattle was substituted into the 10 cities with the data from the Booz Allen Hamilton study assumed to be the same as San Francisco.

[20] AAM air ambulance market is estimated by multiplying the projected cost ($9,000 per trip) of an air ambulance trip using AAM technology – see pg. 112 of Urban Air Mobility (UAM) Market Study, Booz Allen Hamilton – by 1/2 of the estimated roughly 700,000 U.S. air ambulance trips - Wang, Sherry, Duffy, Reinhardt, and Vitagliano, 2020; catsr.vse.gmu.edu/pubs/AMT_RWOPs_JournalPaper_Wang_Sherry_07-29-21.pdf. The 1/2 estimate is assumed to be a reasonable split of manned and unmanned air ambulances in 2030.

the end of the decade.[21] However, as with AAM passenger services, only a fraction of this potential market is likely to be realized.

Another report commissioned by NASA suggests that the market for AAM parcel delivery could be $2.1 billion per year by the end of the decade.[22] This market is expected to grow rapidly as logistics for last-mile parcel delivery by air mature. However, similar to other AAM services, competition from other modes of transportation may limit AAM parcel delivery to cities with infrastructure constraints. Using the demand for parcel delivery in the ten infrastructure-constrained cities, the market potential for AAM parcel delivery likely is $84.5 billion per year by the end of the decade, but only a small portion of the potential market is likely to be realized.[23]

Sales of AAM Services by 2030 (million USD)

	Passenger Services	Ambulance Services	Parcel Delivery	Total
NASA Estimates (Sponsored Studies)	$2,500	$3,304	$2,100	$7,904
Potential Market	$160,259	$103,852	$84,503	$348,614

Need for Performance-Based Standards

The FAA is committed to the use of performance-based standards to safely integrate UAS into the NAS. In accordance with the reauthorized National Technology Transfer and Advancement Act of 1995 and Office of Management and Budget Circular A-119, dated January 2016, the FAA is consulting with standards-developing organizations and is participating in the

[21] The $104 billion estimate combines the projected cost ($9,000 per trip) of an air ambulance trip using AAM technology – see pg. 112 of Urban Air Mobility (UAM) Market Study, Booz Allen Hamilton – with the number of ground ambulance trips in urban areas from pg. 41 of the Report to Congress Evaluations of Hospitals' Ambulance Data on Medicare Cost Reports and Feasibility of Obtaining Cost Data from All Ambulance Providers and Suppliers (www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AmbulanceFeeSchedule/Downloads/Report-To-Congress-September-2015.pdf).

[22] This estimate combines the expected cost of AAM parcel delivery ($4.20 per delivery) from the NASA commissioned Urban Air Mobility (UAM) Market Study, McKinsey & Company; pg. 12, Nov. 2018, ntrs.nasa.gov/api/citations/20190026762/downloads/20190026762.pdf; and the estimates of total parcel deliveries in the United States from Pitney Bowes (https://www.pitneybowes.com/us) weighted by the population of infrastructure constrained U.S. cities.

[23] The 10 cities' portion of U.S. population was used to proportion the national deliveries (see above) to the 10 cities. Delivery rates from Urban Air Mobility (UAM) Market Study, McKinsey & Company (see above) for the expected price per delivery using AAM parcel delivery. It is important to note here that all estimates reported in the table for AAM markets per year are expressed in 2020 (or current) dollars.

development of performance-based industry consensus standards that facilitate this goal. Specifically, the FAA is engaged with the Radio Technical Commission for Aeronautics Special Committees 228 and 147 to develop "detect and avoid," "command and control," and "airborne collision avoidance systems" performance-based industry consensus standards for UAS operating in controlled airspace. The use of such performance-based standards serves to establish minimum performance requirements with safety at the center, helps to sustain innovation, and fosters scalability. It also enhances U.S. job growth and competitiveness as well as ensures nondiscrimination. Additionally, the National Environmental Policy Act requires the FAA to ensure that environmental considerations are factored into its decision-making process by performing reviews which could cause reasonably foreseeable effects on the human environment.

The use of performance-based standards, rather than prescriptive design requirements, can maintain an acceptable level of safety while providing greater flexibility to applicants seeking aircraft certification. Applicants prefer performance-based industry consensus standards because these standards specify required safety outcomes rather than dictating limited or specific design solutions. Performance-based industry consensus standards spur innovation, facilitate certification of new and novel technology, and may reduce regulatory time and cost burdens for the UAS industry and the FAA.

The FAA anticipates the use of FAA-accepted performance-based standards as a means of compliance to meet performance-based regulations. Performance-based industry consensus standards serve to clarify how industry can meet safety objectives by specific designs and technologies. Such standards also provide a collaborative framework for standards development and help leverage the experience of technical experts outside the traditional aerospace industry as well as the experience of those within the FAA to develop standards for new technologies. In addition to providing an entity with the option to propose its own means of compliance, implementation of performance-based regulations allow for the acceptance of industry consensus standards as another way of establishing compliance.

Agency's Recommendations for Accelerating its Regulatory Approach

The FAA recognizes the desire to accelerate the integration of large UAS. Broadly integrating UAS into the NAS will require new regulations or updates to existing regulations to accommodate unmanned aircraft better. The FAA believes continuing to enable operations through existing regulatory authority is the best way to gather the information necessary to

accelerate its regulatory approach and to keep pace with technological developments and industry demand. As UAS integration evolves, the FAA is looking to integrate these operations by the risk and complexity of the operation, not by the size of the aircraft. The FAA's regulatory strategy is consistent with this approach. The FAA remains focused on identifying repeatable and scalable operations and on categorizing these operations by operational risk and complexity. The knowledge gained through the currently authorized operations is integral to this approach.

The lowest risk operations are those conducted within visual line-of-sight (VLOS). Many commercial VLOS operations using small UAS have been integrated into the NAS as a result of the FAA's recent rulemakings. Such rulemakings include promulgation of 14 CFR part 107, and the recent expansion of part 107 under the Operations of Small Unmanned Aircraft Systems Over People rule, which permits small UAS operations at night or over people under certain conditions, as well as the Remote Identification of Unmanned Aircraft Rule, which paves the way for future operations beyond visual line-of-sight (BVLOS).

The FAA considers BVLOS operations to be higher risk than VLOS operations. The FAA must make significant updates to existing regulations before BVLOS operations can occur routinely. As a result, the FAA adopted an "Operations First" approach by using an individualized safety review to enable safe BVLOS operations in the near term by granting exemptions, waivers, and deviations from existing rules. Currently, several companies are conducting commercial BVLOS operations. These limited operations today will inform the regulatory updates needed to make these operations routine in the coming years. The FAA expects that the knowledge learned from these discrete operations ultimately will result in generalized performance-based, technology-agnostic rules.