

THE LEADING EDGE: INNOVATION IN U.S. AEROSPACE

(117-14)

REMOTE HEARING

BEFORE THE
SUBCOMMITTEE ON
AVIATION
OF THE
COMMITTEE ON
TRANSPORTATION AND
INFRASTRUCTURE
HOUSE OF REPRESENTATIVES
ONE HUNDRED SEVENTEENTH CONGRESS

FIRST SESSION

APRIL 27, 2021

Printed for the use of the
Committee on Transportation and Infrastructure



Available online at: [https://www.govinfo.gov/committee/house-transportation?path=/
browsecommittee/chamber/house/committee/transportation](https://www.govinfo.gov/committee/house-transportation?path=/browsecommittee/chamber/house/committee/transportation)

U.S. GOVERNMENT PUBLISHING OFFICE

45-132 PDF

WASHINGTON : 2021

COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE

PETER A. DeFAZIO, Oregon, *Chair*

ELEANOR HOLMES NORTON, District of Columbia	SAM GRAVES, Missouri
EDDIE BERNICE JOHNSON, Texas	DON YOUNG, Alaska
RICK LARSEN, Washington	ERIC A. "RICK" CRAWFORD, Arkansas
GRACE F. NAPOLITANO, California	BOB GIBBS, Ohio
STEVE COHEN, Tennessee	DANIEL WEBSTER, Florida
ALBIO SIRES, New Jersey	THOMAS MASSIE, Kentucky
JOHN GARAMENDI, California	SCOTT PERRY, Pennsylvania
HENRY C. "HANK" JOHNSON, JR., Georgia	RODNEY DAVIS, Illinois
ANDRÉ CARSON, Indiana	JOHN KATKO, New York
DINA TITUS, Nevada	BRIAN BABIN, Texas
SEAN PATRICK MALONEY, New York	GARRET GRAVES, Louisiana
JARED HUFFMAN, California	DAVID ROUZER, North Carolina
JULIA BROWNLEY, California	MIKE BOST, Illinois
FREDERICA S. WILSON, Florida	RANDY K. WEBER, Sr., Texas
DONALD M. PAYNE, JR., New Jersey	DOUG LaMALFA, California
ALAN S. LOWENTHAL, California	BRUCE WESTERMAN, Arkansas
MARK DeSAULNIER, California	BRIAN J. MAST, Florida
STEPHEN F. LYNCH, Massachusetts	MIKE GALLAGHER, Wisconsin
SALUD O. CARBAJAL, California	BRIAN K. FITZPATRICK, Pennsylvania
ANTHONY G. BROWN, Maryland	JENNIFFER GONZALEZ-COLON, Puerto Rico
TOM MALINOWSKI, New Jersey	TROY BALDERSON, Ohio
GREG STANTON, Arizona	PETE STAUBER, Minnesota
COLIN Z. ALLRED, Texas	TIM BURCHETT, Tennessee
SHARICE DAVIDS, Kansas, <i>Vice Chair</i>	DUSTY JOHNSON, South Dakota
JESÚS G. "CHUY" GARCÍA, Illinois	JEFFERSON VAN DREW, New Jersey
ANTONIO DELGADO, New York	MICHAEL GUEST, Mississippi
CHRIS PAPPAS, New Hampshire	TROY E. NEHLS, Texas
CONOR LAMB, Pennsylvania	NANCY MACE, South Carolina
SETH MOULTON, Massachusetts	NICOLE MALLIOTAKIS, New York
JAKE AUCHINCLOSS, Massachusetts	BETH VAN DUYNE, Texas
CAROLYN BOURDEAUX, Georgia	CARLOS A. GIMENEZ, Florida
KAIALII KAHELE, Hawaii	MICHELLE STEEL, California
MARILYN STRICKLAND, Washington	
NIKEMA WILLIAMS, Georgia	
MARIE NEWMAN, Illinois	
VACANCY	

SUBCOMMITTEE ON AVIATION

RICK LARSEN, Washington, *Chair*

STEVE COHEN, Tennessee	GARRET GRAVES, Louisiana
ANDRÉ CARSON, Indiana	DON YOUNG, Alaska
SHARICE DAVIDS, Kansas	THOMAS MASSIE, Kentucky
KAIALI'I KAHELE, Hawaii	SCOTT PERRY, Pennsylvania
NIKEMA WILLIAMS, Georgia	JOHN KATKO, New York
HENRY C. "HANK" JOHNSON, JR., Georgia	BRIAN J. MAST, Florida
DINA TITUS, Nevada	MIKE GALLAGHER, Wisconsin
SEAN PATRICK MALONEY, New York	BRIAN K. FITZPATRICK, Pennsylvania
JULIA BROWNLEY, California	TROY BALDERSON, Ohio
DONALD M. PAYNE, JR., New Jersey	PETE STAUBER, Minnesota
MARK DeSAULNIER, California	TIM BURCHETT, Tennessee
STEPHEN F. LYNCH, Massachusetts	JEFFERSON VAN DREW, New Jersey
ANTHONY G. BROWN, Maryland	TROY E. NEHLS, Texas
GREG STANTON, Arizona	NANCY MACE, South Carolina
COLIN Z. ALLRED, Texas	BETH VAN DUYN, Texas
CONOR LAMB, Pennsylvania, <i>Vice Chair</i>	CARLOS A. GIMENEZ, Florida
ELEANOR HOLMES NORTON, District of Columbia	MICHELLE STEEL, California
EDDIE BERNICE JOHNSON, Texas	SAM GRAVES, Missouri (<i>Ex Officio</i>)
JOHN GARAMENDI, California	
PETER A. DeFAZIO, Oregon (<i>Ex Officio</i>)	

CONTENTS

	Page
Summary of Subject Matter	vii
STATEMENTS OF MEMBERS OF THE COMMITTEE	
Hon. Rick Larsen, a Representative in Congress from the State of Washington, and Chair, Subcommittee on Aviation, opening statement	1
Prepared statement	3
Hon. Garret Graves, a Representative in Congress from the State of Louisiana, and Ranking Member, Subcommittee on Aviation, opening statement	5
Prepared statement	6
Hon. Eddie Bernice Johnson, a Representative in Congress from the State of Texas, prepared statement	87
Hon. Sam Graves, a Representative in Congress from the State of Missouri, and Ranking Member, Committee on Transportation and Infrastructure, prepared statement	93
WITNESSES	
Hon. Eric Garcetti, Mayor, City of Los Angeles, California, accompanied by Seleta Reynolds, General Manager, Department of Transportation, City of Los Angeles, California, oral statement of Mr. Garcetti	9
Prepared statement of Mr. Garcetti	11
James L. Grimsley, Executive Director of Advanced Technology Initiatives, Choctaw Nation of Oklahoma, oral statement	18
Prepared statement	20
Adam Bry, Chief Executive Officer, Skydio, Inc., oral statement	31
Prepared statement	32
Pierre F. Harter, Director of Research and Development, National Institute for Aviation Research, and Associate Vice President for Industry and Defense Programs, Research Operations, Wichita State University, oral statement	39
Prepared statement	41
Roei Ganzarski, Chief Executive Officer, magniX, oral statement	48
Prepared statement	50
Blake Scholl, Founder and Chief Executive Officer, Boom Supersonic, oral statement	57
Prepared statement	58
APPENDIX	
Questions from Hon. Rick Larsen to Hon. Eric Garcetti, Mayor, City of Los Angeles, California	95
Questions from Hon. Rick Larsen to James L. Grimsley, Executive Director of Advanced Technology Initiatives, Choctaw Nation of Oklahoma	96
Question from Hon. Steve Cohen to Adam Bry, Chief Executive Officer, Skydio, Inc.	100
Question from Hon. Rick Larsen to Pierre F. Harter, Director of Research and Development, National Institute for Aviation Research, and Associate Vice President for Industry and Defense Programs, Research Operations, Wichita State University	101
Questions to Blake Scholl, Founder and Chief Executive Officer, Boom Supersonic, from:	
Hon. Rick Larsen	102
Hon. Greg Stanton	102



Committee on Transportation and Infrastructure
U.S. House of Representatives
Washington, DC 20515

Peter A. DeFazio
Chairman

Katherine W. Dedrick, Staff Director

Sam Graves
Ranking Member

Paul J. Sass, Republican Staff Director

APRIL 22, 2021

SUMMARY OF SUBJECT MATTER

TO: Members, Subcommittee on Aviation
FROM: Staff, Subcommittee on Aviation
RE: Subcommittee Hearing on “The Leading Edge: Innovation in U.S. Aerospace”

PURPOSE

The Subcommittee on Aviation will meet on Tuesday, April 27, 2021, at 11:00 a.m. (EDT) in 2167 Rayburn House Office Building and virtually via Zoom to hold a hearing titled, “The Leading Edge: Innovation in U.S. Aerospace.” The hearing will explore the recent advances in U.S. aerospace and the National Airspace System (NAS), including emerging airspace entrants (such as drones, advanced air mobility, electric aircraft, and supersonic planes). The hearing will examine how these new aerospace users and technologies will affect the economy, transportation system, local communities, environment, and public good; their visions for and possible barriers to deployment in the United States; and the federal government’s role in ensuring the safe integration of these users and technologies into the NAS. The Subcommittee will receive testimony from the City of Los Angeles; the Choctaw Nation of Oklahoma; Skydio; the National Institute for Aviation Research at Wichita State University; magniX; and Boom Supersonic.

FUTURE OF U.S. AEROSPACE

Civil aviation plays a central role in the United States, supporting more than \$1.8 trillion of economic activity and nearly 11 million jobs, according to the Federal Aviation Administration (FAA).¹ While the COVID-19 pandemic devastated the U.S. aerospace industry, with commercial air travel and aviation manufacturing plummeting in 2020 as coronavirus cases surged, the sector is projected to recover in the years ahead.² In fact, civil aviation’s economic role will only grow with the introduction of new airspace users (such as unmanned aircraft systems (UAS), advanced air mobility (AAM), electric aircraft, and supersonic planes) and the development of other new aerospace technologies that change the way we travel and transport goods and services. The FAA—the federal agency responsible for ensuring the safe and efficient operation of the NAS—along with the National Aeronautics and Space Administration (NASA), aerospace industry, and labor continue to explore

¹ FAA, *The Economic Impact of Civil Aviation on the U.S. Economy: State Supplement*, Nov. 3, 2020, available at https://www.faa.gov/about/plans_reports/media/2020_nov_economic_impact_report.pdf.

² Leslie Josephs, *New Planes, Training and Hiring: Airlines are Planning for a Rebound After Dismal Pandemic Year*, CNBC, Mar. 2, 2021, <https://www.cnbc.com/2021/03/02/how-airlines-are-preparing-for-a-travel-rebound-covid-19.html>.

ways to make current airspace operations safer and more efficient, and to prepare for the integration of new technology.

UNMANNED AIRCRAFT SYSTEMS

UAS—ranging in size from handheld to those weighing more than 50,000 pounds—are proliferating in the NAS.³ In fact, in its most recent aerospace forecast, the FAA estimates that the hobbyist (recreational) UAS fleet will grow to nearly 1.5 million units by 2024 and the commercial UAS fleet will increase to more than 800,000 units by that same year.⁴ UAS are continuously maturing with advanced software, automation, and artificial intelligence skills, and can be equipped with various technologies, such as cameras and infrared or thermal sensors, offering a virtually unlimited number of potential applications.⁵ UAS can perform work that manned aircraft cannot, such as close inspections of bridges, pipelines, railroad tracks, airport runways, and other critical infrastructure, and can enhance the safety of conditions for those performing such work. UAS can also be used for disaster and emergency response, precision agriculture, and delivery of packages such as medicine, medical supplies, and other consumer goods, to name just a few of their possible uses.

UAS INTEGRATION

The FAA is conducting a phased approach to safely integrate UAS operations into the NAS. There are also ongoing efforts within the FAA and coordination between the agency and its federal partners to address the continuing safety and security risks posed by unsafe or unlawful UAS operations, including risk of collision with manned aircraft and unauthorized operations over national security facilities and assets. These are some of the challenges that must be addressed to allow full integration of these users into the NAS.

In 2012, Congress directed the FAA to develop a comprehensive plan to accelerate the safe integration of civil UAS into the NAS⁶ and to issue regulations applicable to the operation of small commercial UAS.⁷ In June 2016, the FAA issued a final rule on commercial operations of small UAS (14 C.F.R. part 107), which significantly expanded and standardized the ability for operators of small UAS to conduct commercial activities.⁸ For these commercial UAS operations, part 107 imposes requirements on UAS pilots⁹ and aircraft,¹⁰ as well as operational limitations. Most notably, the UAS must remain within the visual line of sight (VLOS) of the remote pilot in command and must not fly over people not involved in the operation.¹¹ Operations outside of the defined limitations may require an FAA—waiver or additional certification or approval signifying the FAA finds the proposed operation can be performed safely.¹² In the FAA Reauthorization Act of 2018 (Pub. L. 115–254), Congress enacted provisions authorizing the FAA to fully regulate hobby and recreational UAS in order to ensure the safety and security of U.S. airspace; advancing the safe and efficient integration of UAS through the development and testing of new UAS technologies; and directing the FAA to move forward with authorization of certain advanced operations (e.g., package delivery).

³THE HILL, *The World's Biggest Drone Debuts, and It Weighs Nearly 28 Tons*, Dec. 3, 2020, <https://thehill.com/changing-america/resilience/smart-cities/528691-the-worlds-biggest-drone-debuts-and-it-weighs-nearly>.

⁴FAA, *FAA Aerospace Forecast Report Fiscal Years 2020 to 2040: Unmanned Aircraft Systems*, available at https://www.faa.gov/data_research/aviation/aerospace_forecasts/media/Unmanned_Aircraft_Systems.pdf.

⁵See, e.g., Skydio, <https://www.skydio.com/>.

⁶FAA *Modernization and Reform Act of 2012*, Pub. L. 112–95, § 332(a).

⁷*Id.* § 332(b).

⁸FAA, *Operation and Certification of Small Unmanned Aircraft Systems*, 14 C.F.R. § 107 (2016).

⁹A pilot must be at least 16 years old, obtain a remote pilot airman certificate (or be under the direct supervision of a certificate holder), demonstrate aeronautical knowledge in order to obtain such a certificate, and pass vetting by the Transportation Security Administration.

¹⁰An aircraft must weigh less than 55 pounds, and any aircraft that weighs more than 0.55 pounds must be registered with the FAA online. The aircraft must undergo a pre-flight check to ensure it is in a safe operating condition.

¹¹FAA, *Summary of Small Unmanned Aircraft Rule (Part 107)*, https://www.faa.gov/uas/media/Part_107_Summary.pdf. The UAS must also fly under 400 feet and at or below 100 miles per hour, during the day, yield right of way to manned aircraft, and not from a moving vehicle.

¹²See FAA, *Advanced Operations*, https://www.faa.gov/uas/advanced_operations/.

Recent FAA Activities and Programs

In late 2020, the FAA finalized two rules to advance the integration of UAS into the NAS. The first rule requires the remote identification (remote ID) of UAS and the second rule allows more routine operations over people and at night under certain circumstances.¹³ The requirement that UAS operating in the NAS have remote ID capability—the ability of a UAS to provide certain identification and location information that can be received by other parties, such as the FAA and law enforcement—is described as a necessary foundational element for more complex and routine commercial UAS operations and the FAA’s overall UAS integration efforts.¹⁴

In 2020, the FAA also issued various planning documents, including the third edition of its UAS integration roadmap, which sets forth a five-year strategy for integration.¹⁵ In its roadmap, the FAA provides an update on its activities and rulemakings, as well as a description of and a status update on complex challenges to UAS integration, including remote ID implementation, technological hurdles (e.g., maturity of UAS detect-and-avoid technology), airspace management, UAS noise levels, and societal acceptance.¹⁶

In 2020, the FAA completed its UAS Integration Pilot Program (IPP). The IPP is a program designed to accelerate the testing of UAS operations currently restricted (such as beyond-VLOS operations and flights over people) and to provide a forum for meaningful dialogue with state, local, and tribal governments on the development of federal UAS guidelines and regulations.¹⁷ The FAA then transitioned the IPP to the BEYOND program, through which the FAA is “tackling the remaining challenges of UAS integration,” by studying beyond-VLOS operations, leveraging industry operations to better analyze the benefits of UAS operations, and focusing on community engagement efforts to collect, analyze, and address community concerns.¹⁸

The FAA, NASA, other federal agencies, and industry are also working closely on the development of UAS Traffic Management (UTM).¹⁹ Similar to how air traffic systems manage manned aircraft operations today, UTM is envisioned to include the systems necessary to manage UAS traffic in low-altitude airspace, allowing the FAA to communicate real-time airspace status and constraints to operators, and provide services to prohibit UAS from operating in certain airspace or colliding with other aircraft.²⁰ Thus, UTM will enable complex UAS operations, such as beyond-VLOS operations, which will be critical to the full integration of UAS into the NAS.

State and Local Participation

State and local governments may not enforce requirements regarding civil aviation, including safety regulations, the use of navigable airspace, and aircraft certification, because the federal government has pervasively occupied the field of civil aviation regulation through statutes and regulations.²¹ “While FAA states that it has authority to create a comprehensive regulatory system addressing UAS operations at ground level as part of ensuring aviation safety and the efficient use of airspace, some state and local governments and legal commentators, in addition to [a] . . . federal district court . . . have questioned FAA’s authority to regulate UAS operations at low altitudes, at least those conducted purely intrastate and over private

¹³ FAA, *Remote Identification of Unmanned Aircraft*, Final Rule, 86 Fed. Reg. 4390 (Jan. 15, 2021), available at <https://www.govinfo.gov/content/pkg/FR-2021-01-15/pdf/2020-28948.pdf>; FAA, *Operation of Small Unmanned Aircraft Systems Over People*, Final Rule, 86 Fed. Reg. 4314 (Jan. 15, 2021), available at <https://www.govinfo.gov/content/pkg/FR-2021-01-15/pdf/2020-28947.pdf>.

¹⁴ FAA, *UAS Remote Identification Overview*, https://www.faa.gov/uas/getting_started/remote_id/.

¹⁵ FAA, *Integration of Civil UAS in the NAS Roadmap, Third Edition* (2020), available at https://www.faa.gov/uas/resources/policy_library/media/2019_UAS_Civil_Integration_Roadmap_third_edition.pdf.

¹⁶ See *id.* at 15–16, 20–22.

¹⁷ FAA, *Research and Development*, https://www.faa.gov/uas/research_development/; FAA, *UAS Integration Pilot Program*, https://www.faa.gov/uas/programs_partnerships/uas_integration_pilot_program.

¹⁸ FAA, *BEYOND*, https://www.faa.gov/uas/programs_partnerships/beyond/. According to the FAA, BEYOND “will focus on operating under established rules rather than waivers, collecting data to develop performance-based standards, collecting and addressing community feedback and understanding the societal and community benefits, and to streamline the approval processes for UAS integration.”

¹⁹ FAA, *UAS Traffic Management*, https://www.faa.gov/uas/research_development/traffic_management/.

²⁰ *Id.*; See also NASA, *UAS Traffic Management*, <https://utm.arc.nasa.gov/index.shtml>.

²¹ See, e.g., *City of Burbank v. Lockheed Air Terminal, Inc.*, 411 U.S. 624, 638–39 (1973) (recognizing the need for a “uniform and exclusive system of federal regulation if the congressional objectives underlying the Federal Aviation Act are to be fulfilled”).

property.”²² In the UAS context, states and cities have sought to enact laws and regulations that control or restrict UAS operations, potentially in contradiction to federal law.

In recognition of the issues related to UAS regulation, Congress directed the Government Accountability Office (GAO) to study and report on key legal issues. Specifically, section 373 of the FAA Reauthorization Act of 2018 directed a GAO study on the relative roles and authorities of the federal, state, local, and tribal governments in the regulation and oversight of low-altitude UAS operations. Section 358 of the FAA Reauthorization Act of 2018 called for a study of UAS-related personal privacy issues and the federal, state, and local laws that currently address them. The GAO issued its report in September 2020 and presented “substantial information and analysis regarding these UAS legal jurisdiction and privacy issues.”²³ The GAO concluded that “[t]he law regarding a number of UAS jurisdiction and privacy matters is in a state of flux, both because the federal government is still developing key aspects of its UAS safety and security requirements and because there have been relatively few court decisions to date addressing whether these requirements are consistent with statutory authorities. . . .”²⁴ Defining and delineating federal, state, and local responsibilities with respect to small UAS will continue to be topics of discussion and need to be addressed as these operators are safely integrated into the NAS.

ADVANCED AIR MOBILITY AND ELECTRIC AIRCRAFT

In 2019, Americans lost an average of 99 hours due to traffic congestion in the United States, costing them nearly \$88 billion, according to a recent industry report.²⁵ These gridlocks not only affect drivers, but also have harmful effects on local businesses and the environment.²⁶ With recent advances in aerospace technology, new aircraft designs—including flying cars, passenger air vehicles or taxis, and electric aircraft—have the potential to reduce traffic congestion on U.S. roads, improve mobility options for commuters and cargo (in urban and rural environments), and lessen the current burden on surface infrastructure.²⁷

Vertical Takeoff and Landing. AAM aircraft will be small and lightweight when compared to conventional aircraft, so many concepts rely on batteries and electric propulsion systems. While some concepts are designed to drive short distances before transitioning to flight mode with airplane-like wings, others are designed to operate as electric vertical takeoff and landing (eVTOL) aircraft, with multiple small helicopter-like rotors.²⁸ As such, eVTOL aircraft will be able to lift off from existing physical infrastructure (e.g., modified parking garage rooftops or retrofitted heliports) instead of airports or long runways.²⁹ To support this effort, several AAM operators have released various vertiport designs and are partnering with federal agencies and local governments to develop and deploy these concepts.³⁰

Anticipated Operations. Unlike conventional aircraft, AAM aircraft are intended to fly at low altitudes and across short to medium distances, often in heavily congested areas. A recent industry report projects AAM growth of up to hundreds or even thousands of simultaneous operations within a region at altitudes reaching nearly 5,000 feet.³¹ Some eVTOL concepts include plans to fly more than 150 miles

²² *Huerta v. Haughwout*, 2016 WL 3919799 (D. Conn. 2016); GAO Report, *Unmanned Aircraft Systems: Current Jurisdictional, Property, and Privacy Legal Issues Regarding the Commercial and Recreational Use of Drones*, GAO-B-330570 (Sept. 16, 2020), <https://www.gao.gov/assets/b-330570.pdf>.

²³ See GAO Report, *supra* note 22.

²⁴ See *id.*

²⁵ INRIX, *Congestion Costs Each American 100 Hours, \$1,400 A Year* (Mar. 9, 2020), <https://inrix.com/press-releases/2019-traffic-scorecard-us>.

²⁶ See *id.*

²⁷ See FAA, *UAM Concept of Operations (Volume 1.0)*, at 2–4, https://nari.arc.nasa.gov/sites/default/files/attachments/UAM_ConOps_v1.0.pdf.

²⁸ See, e.g., Terrafugia, *The Transition*, <https://terrafugia.com/transition/>; see also Joby Aviation, *Joby Aviation Generates First Revenue, Takes Key Step Towards Certifying Aircraft* (Feb. 9, 2021), <https://www.jobyaviation.com/news/joby-aviation-generates-first-revenue-takes-key-step-towards-certifying-aircraft>.

²⁹ See Gideon Lichfield, *When Will We Have Flying Cars? Maybe Sooner Than You Think*, MIT TECH. REV. (Feb. 13, 2019), <https://www.technologyreview.com/s/612891/when-will-we-have-flying-cars-maybe-sooner-than-you-think/>.

³⁰ See e.g., Liliium, *Designing a Scalable Vertiport*, <https://liliium.com/newsroom-detail/designing-a-scalable-vertiport>; see also, Urban Movement Labs, *The Urban Air Mobility Partnership*, <https://www.urbanmovementlabs.com/programs-projects>.

³¹ Brock Lascara, *Urban Air Mobility Airspace Integration Concepts*, THE MITRE CORP. (June 2019), <https://www.mitre.org/sites/default/files/publications/pr-19-00667-9-urban-air-mobility-air-space-integration.pdf>.

per hour and cover nearly 150 miles on a single battery charge.³² Currently, proposed aircraft can seat anywhere from one to seven passengers.³³ Additionally, some companies are retrofitting small commuter aircraft with electric propulsion technology to carry passengers up to 1,000 miles.³⁴

Ownership and Access. While some of these concepts contemplate personal ownership and use, other companies' models rely on ridesharing (i.e., air taxis) to reduce operational costs and improve accessibility. Although these companies anticipate that their AAM concepts will be an affordable option for the traveling public, especially in urban areas, questions have been raised about how to ensure equitable access to these technologies for low-income and underserved communities.³⁵

AAM INTEGRATION

Safety and Security. Unlike small UAS, which generally weigh less than 55 pounds, AAM concepts are heavier and typically have a pilot and one or more passengers on board. Not unlike other small manned aircraft, a mid-flight event, such as a failed battery or structural failure, could pose significant safety risks to the vehicle's occupants and to people and property on the ground, particularly in congested urban areas. AAM concepts, like small UAS, will fly in low-altitude airspace, and will need to be safely integrated with conventional airspace users, especially around airports.

Air Traffic Management. Like small UAS, AAM aircraft would access and generally operate in low-altitude airspace; however, some may fly as high as 5,000 feet above ground level. Technologies currently in development such as UTM—a system that can provide airspace design, dynamic geofencing, conflict avoidance, and separation and sequencing for small UAS—may assist the FAA in safely separating AAM aircraft from other aircraft.³⁶

Pilot Training and Certification. The FAA is charged with ensuring aviation safety, which includes establishing the requirements for a pilot's license and the standards for the design, production, and maintenance of aircraft. In many cases, the FAA's current regulatory framework does not contemplate AAM concepts and their anticipated business models.³⁷ The FAA must provide the framework necessary to allow the safe integration of these new technologies and operations. In partnership with the U.S. Air Force, the FAA and other agencies launched the Agility Prime program to support the certification of commercial and defense AAM concepts.³⁸ Recently, the FAA reached a "G-1" certification agreement for an AAM concept, detailing the specific requirements for commercial operation under the FAA's Part 23 certification framework.³⁹

Noise and Emissions. Many AAM concepts rely on electric propulsion technology to operate and as a result, these aircraft contribute no direct pollutant emissions and produce little noise relative to conventional airplanes and large trucks. Developments in onboard energy storage, full and hybrid-electric engines, and resilient charging infrastructure will be critical to AAM deployment.⁴⁰ Low noise and pollutant emissions will also be necessary for community acceptance and utility of these aircraft across the nation, especially in residential areas.⁴¹

³² See Joby Aviation, *supra* note 28.

³³ See Andrew J. Hawkins, *Flying Taxi Startup Lilium Goes Public via SPAC, Unveils its New Electric Aircraft*, THE VERGE (Mar. 30, 2021), <https://www.theverge.com/2021/3/30/22358027/lilium-flying-taxi-evtol-spac-electric-aviation-gm-engle>.

³⁴ See Dominic Gates, *Electric Aviation Startup MagniX Opens New Headquarters and Production Facility in Everett*, THE SEATTLE TIMES (Jan. 19, 2021), <https://www.seattletimes.com/business/boeing-aerospace/electric-aviation-startup-magnix-opens-new-headquarters-and-production-facility-in-everett>.

³⁵ See MIT, *supra* note 29; see also Adam Cohen, *Advanced Air Mobility: Community Integration and Public Acceptance*, UC BERKLEY (Mar. 4, 2021), <https://aam-cms.marqui.tech/uploads/aam-portal-cms/originals/542db455-f781-4109-8d43-94521d2e6553.pdf>.

³⁶ See Lillian Gipson, *UTM 101*, NASA (June 26, 2020), <https://www.nasa.gov/aeroresearch/utm-101>.

³⁷ See MIT, *supra* note 29.

³⁸ U.S. Air Force, *AFWERX Agility Prime Announces, "Flying Car" Military Airworthiness, Infrastructure Milestones* (Dec. 20, 2020), <https://www.af.mil/News/Article-Display/Article/2452683/afwerx-agility-prime-announces-flying-car-military-airworthiness-infrastructure>.

³⁹ See Joby Aviation, *supra* note 28.

⁴⁰ See Robin Lineberger et al., *Advanced Air Mobility: Can the United States Afford to Lose the Race?*, DELOITTE INSIGHTS (Jan. 26, 2021), <https://www2.deloitte.com/us/en/insights/industry/aerospace-defense/advanced-air-mobility.html>.

⁴¹ See Mark Huber, *Noise Critical Issue for eVTOL Acceptance*, AVIATION INT'L NEWS (Jan. 29, 2020), <https://www.ainonline.com/aviation-news/general-aviation/2020-01-29/noise-critical-issue-evtol-acceptance>.

State and Local Participation. As stated previously, state and local governments may not enforce requirements regarding civil aviation, including safety regulations, the use of navigable airspace, and aircraft certification, because the federal government has pervasively occupied the field of civil aviation regulation through statutes and regulations.⁴² The supremacy of federal authority has led to a consistent regulatory structure for all airspace users, ensuring safety and efficiency across the NAS.⁴³ However, as noted earlier, in the UAS context, states and cities have sought to enact laws and regulations that control or restrict UAS operations.⁴⁴ Additionally, according to GAO, the law in this area is in a state of flux.⁴⁵ Therefore, defining and delineating federal, state, and local responsibilities with respect to both small UAS and AAM will continue to be topics of discussion and need to be addressed as these operators are safely integrated into the NAS.

SUPERSONIC AIRCRAFT

Supersonic flight is any flight faster than the speed of sound, which, depending on altitude and ambient conditions, exceeds 750 miles per hour.⁴⁶ The Concorde aircraft, the product of a state-subsidized joint venture between Aerospatiale of France and the British Aircraft Corporation, performed the first commercial trans-oceanic supersonic passenger flight in 1976, flying at twice the speed of sound and at a cruising altitude of 65,000 feet. Concorde flights could cut the duration of a subsonic trans-Atlantic flight in half. During its lifetime, more than 2.5 million passengers flew at supersonic speeds between New York and London and Paris, as well as some other routes from time to time, until fuel prices and a fatal accident resulted in the Concorde's retirement from passenger service in 2003. No supersonic passenger aircraft have flown since that time.⁴⁷

According to the FAA, several factors contributed to the Concorde's retirement, including high operating costs, such as high fuel consumption and the high cost of meeting environmental restrictions on sonic booms.⁴⁸ Unlike traditional subsonic flight, the Concorde created a shock wave when traveling at supersonic speeds, experienced by people on the ground as a "sonic boom" as it passed overhead. This aircraft noise led to many countries banning supersonic flights from their airspace, limiting the ability for the Concorde to travel at supersonic speeds and thus the number of practical Concorde routes.⁴⁹

There has been a revival of interest in supersonic flight since the end of the Concorde. In addition to the time that can be saved traveling at supersonic speeds, the advancement of technology, materials and composites, aircraft design, and manufacturing can make the aircraft lighter, improve fuel efficiency, and reduce noise impacts. Several domestic and foreign airlines have already purchased options for supersonic aircraft in design and testing, and there is interest at state and local levels to establish designated airspace corridors for the testing of civilian supersonic aircraft over land in the United States.⁵⁰

SUPERSONIC AIRCRAFT INTEGRATION

There are several challenges to the integration of supersonic aircraft into U.S. airspace, beyond aircraft design and public acceptance. Today, there are no internationally agreed upon certification, noise, or emission standards for supersonic aircraft under development.⁵¹ As such, there is concern that varying operational stand-

⁴² See, e.g., City of Burbank, *supra* note 21.

⁴³ See GAO Report, *supra* note 22.

⁴⁴ See *id.*

⁴⁵ See *id.*

⁴⁶ CRS, *Supersonic Passenger Flights*, 1 (Nov. 14, 2018), available at <https://fas.org/sgp/crs/misc/R45404.pdf>.

⁴⁷ *Id.* at 1–3.

⁴⁸ See *id.* See also FAA, *Fact Sheet—Supersonic Flight* (Nov. 25, 2020), https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=22754.

⁴⁹ See CRS, *supra* note 46 at 1–3.

⁵⁰ See, e.g., Thomas Black, *Buffet's NetJets to Buy 20 Supersonic Luxury Planes from Aerion*, BLOOMBERG, Mar. 3, 2021, <https://www.bloomberg.com/news/articles/2021-03-03/buffett-s-netjets-to-buy-20-supersonic-luxury-planes-from-aerion> and Ankit Ajmera, *Japan Airlines Invests \$10 Million in Supersonic Jet Company Boom*, REUTERS, Dec. 5, 2017, <https://www.reuters.com/article/us-boom-japan-airlines/japan-airlines-invests-10-million-in-supersonic-jet-company-boom-idUSKBN1DZ1N2>; see also Office of the Governor of Kansas, *Governor Laura Kelly Announces Kansas, FAA Sign Deal for Supersonic Flight Corridor* (Dec. 17, 2020), <https://governor.kansas.gov/governor-laura-kelly-announces-kansas-faa-sign-deal-for-supersonic-flight-corridor/> and Supersonic Flight Alliance, <https://ssfa.aero/> (declaring its mission to "[c]reate a 800-mile civilian supersonic and hypersonic corridor over Eastern Washington in partnership with the FAA, State government and the aerospace industry").

⁵¹ CRS, *supra* note 46 at 7.

ards from country-to-country will prohibit many routes at the start. For instance, FAA regulations currently prohibit supersonic flight in the continental United States that cause a sonic boom.⁵²

Congress sought to address some of these issues in the FAA Reauthorization Act of 2018. The law requires the FAA to exercise international leadership in the creation of federal and international policies and standards regarding the certification and operation of supersonic aircraft. The law also requires that the FAA issue notices of proposed rulemaking to update noise standards for supersonic aircraft and to modernize the application process to operate supersonic aircraft.⁵³

Responding to the 2018 law, the FAA issued a proposed rulemaking in March 2020 to set takeoff and landing noise certification standards for new supersonic aircraft, and in January 2021, to facilitate supersonic flight testing and safe development of such aircraft, the FAA issued a final rule “modernizing the procedure for requesting a special flight authorization to operate in excess of Mach 1 over land.”⁵⁴ However, “[o]utside the context of special flight authorizations under this final rule, the FAA continues generally to prohibit civil supersonic flight over land in the United States.”⁵⁵

OTHER FUTURE AEROSPACE TECHNOLOGIES

As the aerospace sector continues to innovate, there are several promising technologies, designs, and operational concepts with the potential to transform U.S. transportation. Advances in fully automated aircraft, commercial space transportation launch vehicles, engine designs, hydrogen-propulsion technology, and light-weight composite wings and parts are under development and promise more efficient and sustainable operations. Additionally, the industry is embracing alternative fuels and fuel sources as part of a comprehensive effort to reduce aviation’s environmental footprint. Technologies to improve air traffic management and space situational awareness will need to meet the demands of new airspace entrants, aerospace technologies, and business models. In the upcoming decades, American innovation and ingenuity will propel the aerospace sector in the global landscape and improve the safety, availability, and efficiency of transportation for future generations.

WITNESSES

- The Honorable Eric Garcetti, Mayor, City of Los Angeles, California, *accompanied by* Ms. Seleta Reynolds, General Manager, Los Angeles Department of Transportation
- Mr. James L. Grimsley, Executive Director, Advanced Technology Initiatives, Choctaw Nation of Oklahoma
- Mr. Adam Bry, Chief Executive Officer, Skydio
- Mr. Pierre Harter, Director of Research and Development, National Institute for Aviation Research, Wichita State University
- Mr. Roei Ganzarski, Chief Executive Officer, magniX
- Mr. Blake Scholl, Founder and Chief Executive Officer, Boom Supersonic

⁵² 14 C.F.R. § 91.817.

⁵³ See Pub. L. 115-294, § 181.

⁵⁴ FAA, *Noise Certification of Supersonic Airplanes*, Proposed Rule, 85 Fed. Reg. 20431 (Apr. 13, 2020), available at <https://www.govinfo.gov/content/pkg/FR-2020-04-13/pdf/2020-07039.pdf>; FAA, *Special Flight Authorizations for Supersonic Aircraft*, Final Rule, 86 Fed. Reg. 3782 (Jan. 15, 2021), available at <https://www.govinfo.gov/content/pkg/FR-2021-01-15/pdf/2021-00113.pdf>. See also FAA, *Press Release—FAA Announces Final Rule to Facilitate the Reintroduction of Civil Supersonic Flight* (Jan. 6, 2021), https://www.faa.gov/news/press_releases/news_story.cfm?newsId=25581.

⁵⁵ *Id.*

THE LEADING EDGE: INNOVATION IN U.S. AEROSPACE

TUESDAY, APRIL 27, 2021

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON AVIATION,
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE,
Washington, DC.

The subcommittee met, pursuant to call, at 11:01 a.m., in 2167 Rayburn House Office Building and via Zoom, Hon. Rick Larsen (Chair of the subcommittee) presiding.

Members present in person: Mr. Larsen.

Members present remotely: Mr. Carson, Ms. Davids, Mr. Kahele, Ms. Williams of Georgia, Mr. Johnson of Georgia, Ms. Titus, Ms. Brownley, Mr. Payne, Mr. Lynch, Mr. Stanton, Ms. Norton, Ms. Johnson of Texas, Mr. Garamendi, Mr. Graves of Louisiana, Mr. Massie, Mr. Balderson, Mr. Van Drew, and Mrs. Steel.

Mr. LARSEN. The subcommittee will come to order. And I ask unanimous consent the chair be authorized to declare a recess at any time during today's hearing.

Without objection, so ordered.

I also ask unanimous consent that Members not on the subcommittee be permitted to sit with the subcommittee at today's hearing and ask questions.

Without objection, so ordered.

And as a reminder, please keep your microphone muted unless speaking. And should I hear any inadvertent background noise, I will request that the Member, by name, please mute their microphone.

And a reminder as well for Members: to insert a document into the record, please have your staff email that document to DocumentsT&I@mail.house.gov.

I will now follow with an opening statement.

Good morning and welcome to today's witnesses joining the Aviation Subcommittee's hearing titled: "The Leading Edge: Innovation in U.S. Aerospace."

This is a long overdue discussion to explore promising opportunities for U.S. aerospace, including emerging aerospace entrants and new aviation technologies with potential societal, safety, and environmental benefits.

Today's hearing is also a great opportunity to examine challenges in making those concepts a reality, and what Congress and the Federal Aviation Administration, or FAA, can do to ensure the safe and efficient integration of new entrants and technologies into the National Airspace System, or what we call the NAS.

Fostering innovation is one of my top priorities as chair, because it will help bolster U.S. jobs and grow the Nation's leadership in the aerospace industry.

Today's witnesses represent a range of emerging aerospace entrants, from small, unpiloted aircraft systems to electric aircraft and supersonic airplanes. I am also pleased to have representatives from city and Tribal governments at the table to highlight why new aerospace entrants and technologies are important to their communities and how to build public acceptance.

Once only seen in science fiction or dropping Judy and Elroy off at school, flying cars and air taxis will soon be a reality with over 70 advanced air mobility, or AAM, concepts in development. Electric vertical takeoff and landing, or eVTOL, vehicles could reduce traffic congestion and improve mobility options, particularly in dense urban environments. However, Congress and the FAA must consider infrastructure, how new entrants will be integrated into an already busy U.S. airspace, and impacts on local communities.

To that end, I do want to welcome Los Angeles Mayor Eric Garcetti to today's panel. Mayor Garcetti, when we get to you, I know the city of L.A. is a leader in helping get AAM options deployed. So I am interested in hearing more about the city's efforts to prepare for AAM operations in the region, including accounting for community views, ensuring equitable access across the city, and promoting sustainability.

New advancements in aerospace technologies are arriving as U.S. aviation works to address the pressing challenges, such as greenhouse gas emissions and aircraft noise. That is why I am pleased today, as well, to welcome Mr. Roei Ganzarski, CEO of magniX, an electric propulsion system manufacturer leading the charge in the development of more sustainable and energy-efficient aircraft. magniX is another in a long line of innovators in aviation that are based in Washington State. In this case, in my hometown of Everett, Washington, in my district.

Mr. Ganzarski, I look forward to your thoughts on how the Federal Government can help U.S. manufacturing in this increasingly competitive space and help meet environmental goals as well.

I want to turn now to unmanned aircraft systems, another area of tremendous growth. The FAA projects the use of drones will reach up over 2 million units by 2024, combining both private and commercial use. Drones are used today to perform critical infrastructure inspections, assist in recovery efforts following natural disasters, and deliver critical medical supplies during the pandemic.

Mr. Grimsley is here from the Choctaw Nation. I look forward to learning more about the nation's ongoing project under the FAA's BEYOND Program to test advanced drone operations and analyze the impact of this technology on Tribal and rural communities. Inherent in the growth of new entrants are the potential risks posed to existing airspace users and people and critical assets on the ground.

So in December 2020, the FAA issued two long-awaited UAS final rules which took effect last week: one requiring the remote identification, or ID, of UAS, and another permitting more routine UAS operations over people under certain conditions. So not only

do I hope that Mr. Grimsley can address those issues, but Mr. Bry from Skydio is here, and I would like to hear more about the drone industry's reaction to these new rules as well.

On to supersonic aircraft. Recent advancements in propulsion technology, materials, and domestic manufacturing have also made supersonic flight more of a reality. Traveling faster than the speed of sound, these flights are projected to significantly reduce transoceanic travel times and open new gateways to support international commerce. However, challenges persist to full deployment of supersonic flight, most notably the lack of internationally recognized certification, noise, or emission standards for supersonic aircraft.

So in response to the 2018 FAA reauthorization law, the FAA recently issued a final rule to help facilitate supersonic flight testing and the safe development of such aircraft. And we are joined today by Mr. Blake Scholl, CEO of Boom Supersonic, a U.S. manufacturer at the forefront of developing supersonic passenger aircraft.

Mr. Scholl, when we get to you, I am interested in learning more about Boom's XB-1 concept, your experience with navigating the current regulatory process for supersonic flight, and what is needed, both U.S. and internationally, to realize the vision.

The subcommittee is also joined by Mr. Pierre Harter with the National Institute for Aviation Research at Wichita State University, a leader in aerospace research and development.

Mr. Harter, when we get to you, I look forward to your thoughts on the importance of Federal investment in research on these technologies and ways to support the next generation of aviation innovators, scientists, and engineers.

As the Nation works towards long-term economic recovery, this subcommittee will continue its forward-looking agenda on the future of U.S. aerospace, and how Congress and the FAA can ensure the U.S. remains the global aviation leader.

Congress, the new administration, and the industry and its workforce must work together as we embark on this next generation of U.S. aerospace and ensure that as nascent operations and technologies are integrated into the complex airspace system, the safety of all who fly and those on the ground remain the top priority.

So I want to thank you all again, today's witnesses, ahead of time. I look forward to our discussion.

[Mr. Larsen's prepared statement follows:]

Prepared Statement of Hon. Rick Larsen, a Representative in Congress from the State of Washington, and Chair, Subcommittee on Aviation

Good morning and welcome to today's witnesses joining the Aviation Subcommittee's hearing titled "The Leading Edge: Innovation in U.S. Aerospace."

This is a long overdue discussion to explore promising opportunities for U.S. aerospace, including emerging airspace entrants and new aviation technologies with potential societal, safety, and environmental benefits.

Today's hearing is also a great opportunity to examine challenges in making these concepts a reality, and what Congress and the Federal Aviation Administration (FAA) can do to ensure the safe and efficient integration of new entrants and technologies into the National Airspace System (NAS).

Fostering innovation is one of my top priorities as Chair because it will help bolster U.S. jobs and grow the nation's leadership in the aerospace industry.

Today's witnesses represent a range of emerging airspace entrants, from small unmanned aircraft systems to electric aircraft and supersonic airplanes.

I am also pleased to have representatives from city and tribal governments at the table to highlight why new airspace entrants and technologies are important to their communities and how to build public acceptance.

Once only seen in science fiction or dropping Judy and Elroy off at school, "flying cars" and "air taxis" will soon be a reality, with over 70 advanced air mobility (AAM) concepts in development.

Electric vertical takeoff and landing (eVTOL) vehicles could reduce traffic congestion and improve mobility options, particularly in dense urban environments.

However, Congress and the FAA must consider infrastructure, how new entrants will be integrated into an already busy U.S. airspace, and impacts on local communities.

To that end, I would like to welcome Los Angeles Mayor Eric Garcetti to today's panel. Mayor Garcetti, I know that the City of Los Angeles is a leader in helping get AAM options deployed. I am interested in hearing more about the City's efforts to prepare for AAM operations in the region, including accounting for community views, ensuring equitable access across the City, and promoting sustainability.

New advancements in aerospace technologies are arriving as U.S. aviation works to address pressing challenges, such as greenhouse gas emissions and aircraft noise.

Which is why I am pleased to welcome Mr. Roei Ganzarski, CEO of magniX, an electric propulsion system manufacturer leading the charge on the development of more sustainable and energy-efficient aircraft.

magniX is another in a long line of innovators in aviation that are based in Washington state, in this case in Everett in my district.

Mr. Ganzarski, I look forward to your thoughts on how the federal government can help grow U.S. manufacturing in this increasingly competitive space and help to meet environmental goals.

Another area of tremendous growth is in UAS, or drones.

The FAA projects the use of drones will reach up over 2 million units by 2024, combining both private and commercial use.

Drones are used today to perform critical infrastructure inspections, assist in recovery efforts following natural disasters, and deliver critical medical supplies during the pandemic.

Mr. Grimsley, I look forward to learning more about the Choctaw Nation's ongoing project, under the FAA's BEYOND program, to test advanced drone operations and analyze the impact of this technology on tribal and rural communities.

Inherent in the growth of new entrants are the potential risks posed to existing airspace users and people and critical assets on the ground.

In December 2020, the FAA issued two long-awaited UAS final rules, which took effect last week: one requiring the remote identification (ID) of UAS and another permitting more routine UAS operations over people under certain conditions.

Mr. Bry, I would like to hear more about the drone industry's reaction to these new rules.

Recent advancements in propulsion technology, materials, and domestic manufacturing have also made supersonic flight more of a reality.

Traveling faster than the speed of sound, these flights are projected to significantly reduce trans-oceanic travel times and open new gateways to support international commerce.

However, challenges persist to full deployment of supersonic flight. Most notably, the lack of internationally recognized certification, noise, or emission standards for supersonic aircraft.

In response to the 2018 FAA reauthorization law, the FAA recently issued a final rule to help facilitate supersonic flight testing and the safe development of such aircraft.

We are joined today by Mr. Blake Scholl, CEO of Boom Supersonic, a U.S. manufacturer at the forefront of developing supersonic passenger aircraft. Mr. Scholl, I am interested in learning more about Boom's XB-1 concept, your experience with navigating the current regulatory process for supersonic flight, and what is needed both in the U.S. and internationally to realize your vision.

The Subcommittee is also joined by Mr. Pierre Harter with the National Institute for Aviation Research at Wichita State University, a leader in aerospace research and development. Mr. Harter, I look forward to your thoughts on the importance of federal investment in research on these technologies and ways to support the next generation of aviation innovators, scientists, and engineers.

As the nation works toward long-term economic recovery, this Subcommittee will continue its forward-looking agenda on in the future of U.S. aerospace, and how

Congress and the FAA can ensure the United States remains the global aviation leader.

Congress, the new Administration, and the aerospace industry and workforce must work together as we embark on this next generation of U.S. aerospace and ensure that as nascent operations and technologies are integrated into the complex airspace system, the safety of all who fly and those on the ground remain the top priority.

Thank you again to today's witnesses. I look forward to our discussion.

Mr. LARSEN. With that, I want to turn now to the ranking member of the subcommittee, Mr. Garret Graves of Louisiana, for an opening statement.

Representative Graves.

Mr. GRAVES OF LOUISIANA. Thank you, Mr. Chairman. Mr. Chairman, about 2 years ago, back in 2019, we had a hearing that you had scheduled called, "Looking Forward: Aviation 2050," where we were looking at the future of aviation over the next 30 years to try and depict and project what that would look like, and what we needed to do during our time to help facilitate that aviation industry in the United States.

I do not think any of us anticipated the amazing challenges that we had during that 2-year period. Now obviously the pandemic, the 737 MAX, and other challenges in our community. My home State of Louisiana: five named hurricanes just last year.

We cannot rest on our laurels in regard to the aviation future or being able to maintain the top position globally in regard to aviation. We must continue to work to strive to facilitate that innovation and that growth.

Although it is not the title of this hearing, I think "Aviation 2030" may be perhaps a better title for this hearing, looking at the aerospace innovation that we can explore and that we can expect to come online over the next decade or so. It seems clear that in the next 10 years, aerospace is going to evolve: an ever-increasing number of drones, the introduction of electric vertical takeoff and landing, reintroduction of civil supersonic aircraft, as you noted; and expanded use of commercial space transportation vehicles.

Other nations may choose one or two technologies to try to excel at or facilitate in their countries. But in the United States, it is our aim—and Mr. Chairman, I believe we share this goal—it is our aim and our intention to lead in all of the above technologies. That means making investments upfront, laying the statutory and regulatory foundation for these cutting-edge technologies as was done in the last FAA reauthorization bill. But obviously, we need to hear from these witnesses on what needs to be done, even beyond.

In fact, year after year, reauthorization after reauthorization, the committee and the FAA have worked to ensure that our foundation is solid, and it enables rather than stifles innovation, and that it is always laid on the bedrock of safety.

For example, last week, rules for UAS remote identification and drone operations over people took effect, which will enable more advanced use of drones. While these rules do represent a major step forward, we know that a true regulatory foundation for drones must include a way for regular, beyond visual line of sight operations.

And with these pieces in place, however, it is time to show some progress and reap the benefits of our investment. The economic and

societal benefits of UAS promise to be enormous, and industry and communities are quickly finding ways to utilize the foundation that we did lay in these laws.

I look forward to hearing from Skydio about the great American-made products they are developing, and from the Choctaw Nation about the innovative use of this technology, and the drones that they have in place now.

Moving forward, we must take some of the lessons learned from our efforts on drone integration as the chairman noted, and apply them to advanced air mobility, to supersonic aircraft, and to electric aircraft. [Inaudible] certification and operations, allowing the industry to move forward and the FAA to ensure safety without spending years drafting overly specific regulations.

For example, I am pleased the FAA has adopted this approach for electric aircraft using the performance-based part 23 regulations to efficiently measure the safety of proposed electric aircraft. But more broadly, I am excited by the expansive vision of companies like magniX, which sees a future where aircraft can be both cleaner and less costly, and Boom, which aims to shrink the world and unlock opportunities that are unavailable at subsonic speeds. I look forward to hearing how our cities and communities are working to integrate these new transportation concepts into their planning.

I know that Mayor Garcetti, the last time he was before our committee, noted that Republicans are Democrats that haven't been through a NEPA process, so I cannot wait to hear his new description of our political parties.

But to all witnesses, I want to know where the foundation really needs to work and what you need from us to help you build on it. These technologies are not just innovation for innovation's sake, they are going to drive real benefits and improvements in the lives of our constituents and the well-being of our communities. They will provide employment for tens of thousands of workers and help stitch together our cities and towns.

With the work the subcommittee is doing, our witnesses, and the thousands of others like them, American aerospace will remain at the leading edge of our Nation's future and success.

So thank you, Mr. Chairman. And I yield back.

[Mr. Graves of Louisiana's prepared statement follows:]

Prepared Statement of Hon. Garret Graves, a Representative in Congress from the State of Louisiana, and Ranking Member, Subcommittee on Aviation

Mr. Chairman,

About two years ago back in 2019, we had a hearing that you had scheduled called "Aviation 2050" where we were looking at the future of aviation over the next 30 years, to try and depict and project what that would look like and what we would need to do during our time to help facilitate that aviation industry in the United States.

I don't think any of us anticipated any of the amazing challenges we had during that two-year period. Obviously, the pandemic, the 737 Max, and other challenges in our community. In my home state of Louisiana, we had five named hurricanes just last year.

We can't rest on our laurels in regard to the aviation future or being able to maintain the top position globally in regard to aviation. We must continue to work to strive to facilitate that innovation and that growth.

Although it is not the title of this hearing, I think "Aviation 2030" maybe perhaps a better title for this hearing, looking at the aerospace innovation we can explore and we can expect to come online over the next decade or so. It seems clear that in the next 10 years aerospace is going to evolve and there will be an increase in the number of drones, the introduction of electric vertical takeoff and landing, re-introduction of civil supersonic aircraft as you noted, expanded use of commercial space transportation vehicles.

Other nations may choose one or two technologies to try to excel at or facilitate in their countries. But in the United States it is our aim, and Mr. Chairman I believe we share this goal, it is our aim and our intention to lead in all of the above technologies. That means making investments upfront, laying the statutory and regulatory foundation for these cutting-edge technologies as was done in the last FAA reauthorization bill. But obviously, we need to hear from these witnesses on what needs even beyond.

In fact, year after year, reauthorization after reauthorization, the committee and FAA have worked to ensure that our foundation is solid and it enables, rather than stifles, innovation and that it is always laid on the bedrock of safety.

For example, last week, rules for UAS remote identification and drone operations over people took effect, which will enable more advanced use of drones.

While these rules do represent a major step forward, we know that a true regulatory foundation for drones must include a way for regular—beyond visual line of sight operations. With these pieces in place, however, it is time to show some progress and reap the benefits of our investment.

The economic and societal benefits of UAS promise to be enormous and industry and communities are quickly finding ways to utilize the foundation that we did lay in these laws. I look forward to hearing from SKYDIO about the great American-made products they are developing, and from the Choctaw Nation about the innovative use of this technology and the drones that they have in place now.

Moving forward, we must take some of the lessons learned from our efforts on drone integration, as the Chairman noted, and apply them to advanced air mobility, supersonic aircraft, and electric aircraft. We need to allow the industry to move forward and the FAA to ensure safety without spending years drafting overly specific regulations.

For example, I am pleased that the FAA has adopted this approach for electric aircraft, utilizing the performance-based part 23 regulations to efficiently measure the safety of proposed electric aircraft.

But more broadly, I am excited by the expansive vision of companies like magniX, which sees a future where aircraft can be both cleaner and less costly to operate, and Boom, which aims to shrink the world and unlock opportunities that are unavailable at subsonic speeds.

To all our witnesses, I want to know where the foundation we've laid needs work, and what you need from us to help you build on it. These technologies are not innovation for innovation's sake, they are going to drive real benefits and improvements in the lives of our constituents and the well-being of our communities. The technology will employ tens of thousands of workers and help stitch together our cities and towns. With the work the subcommittee, our witnesses and the thousands of others like them are doing, American aerospace will remain at the leading edge of our nation's future and success.

Mr. LARSEN. Thank you, Representative Graves, very much. I want to now welcome the witnesses on our panel. Just list the witnesses. And then we have introduction to be made by one of our Members.

First, we will hear from the Honorable Eric Garcetti, mayor, the city of Los Angeles, California, accompanied by Ms. Seleta Reynolds, who is the general manager of the L.A. DOT. Mr. James Grimsley, the executive director of advanced technology initiatives, Choctaw Nation of Oklahoma; Mr. Adam Bry, the chief executive officer of Skydio; Mr. Pierre Harter, director of research, National Institute for Aviation Research, Wichita State University; Mr. Roei Ganzarski, chief executive officer of magniX; and Mr. Blake Scholl, founder and chief executive officer of Boom Supersonic.

I want to thank you all for joining us today. We all look forward to your testimony. We have a lot of Members, although they are not here in the hearing room, they are live with us online, and I know they have a lot of questions for all of you.

So without objection, the witnesses' full statements will be included in the record. And since your written testimony has been made part of the record already, the subcommittee does request that you limit your oral testimony to 5 minutes. You will become familiar with this gavel at 5 minutes, and we try to keep things moving pretty quickly at officially the 5 minutes in order to deal with some of the limitations of technology.

But before we begin, I want to recognize Representative Brownley of California to introduce our first witness.

Representative Brownley, you are recognized.

Ms. BROWNLEY. Thank you, Mr. Chairman, and thank you for allowing me to be here this morning to introduce the mayor of Los Angeles, Eric Garcetti.

Los Angeles has always been at the forefront of the ever-evolving and ever-growing aviation and aerospace industry. In fact, many of the cities, communities, and suburbs were built around aviation companies, assembly factories. Coupled with factors like Angelenos' pioneering spirit, the aviation and aerospace industry has continued to thrive in the region.

For these reasons, you could not have chosen a better witness for today's hearing. Since he became mayor of Los Angeles in 2013, Mayor Garcetti has harnessed the city's sense of optimism and innovation. His forward-thinking and entrepreneurial spirit is especially evident in the city's embrace of advancement air mobility systems.

The southern California metroplex, encompassing the airspace of most of southern California and six major airports, is among the most complex aviation systems in the world. Yet, Mayor Garcetti has not let that deter him from tackling this new frontier in aviation head on, including, by working to integrate urban air mobility, and to the fabric of the city's transportation networks, to provide new options for city residents and visitors.

Along with other forms of zero-emission transportation, urban air mobility has the potential to help our region address its myriad of transportation challenges from lessening congestion on our roads to reducing noise from older model helicopters, and to eliminating carbon emissions from transportation sources.

Mayor Garcetti understands that the United States must lead the way in developing this new technology so that our Nation benefits from the incredible job growth that this emerging transportation sector will yield. He understands the incredible opportunities that urban air mobility can provide, not only for moving people, but for improving the movement of goods.

As we examine this new frontier in aviation and aerospace, our region continues to lead the way. I thank the committee for inviting Mayor Garcetti to share his innovative aviation vision for Angelenos and for the Nation.

Thank you, Mr. Chairman, and I yield back.

Mr. LARSEN. Thank you, Representative Brownley.

Mayor Garcetti, you are recognized for 5 minutes.

TESTIMONY OF HON. ERIC GARCETTI, MAYOR, CITY OF LOS ANGELES, CALIFORNIA, ACCOMPANIED BY SELETA REYNOLDS, GENERAL MANAGER, DEPARTMENT OF TRANSPORTATION, CITY OF LOS ANGELES, CALIFORNIA; JAMES L. GRIMSLEY, EXECUTIVE DIRECTOR OF ADVANCED TECHNOLOGY INITIATIVES, CHOCTAW NATION OF OKLAHOMA; ADAM BRY, CHIEF EXECUTIVE OFFICER, SKYDIO, INC.; PIERRE F. HARTER, DIRECTOR OF RESEARCH AND DEVELOPMENT, NATIONAL INSTITUTE FOR AVIATION RESEARCH, AND ASSOCIATE VICE PRESIDENT FOR INDUSTRY AND DEFENSE PROGRAMS, RESEARCH OPERATIONS, WICHITA STATE UNIVERSITY; ROEI GANZARSKI, CHIEF EXECUTIVE OFFICER, MAGNIX; AND BLAKE SCHOLL, FOUNDER AND CHIEF EXECUTIVE OFFICER, BOOM SUPERSONIC

Mr. GARCETTI. Thank you so much, Chair Larsen and Ranking Member Graves, all the members of the subcommittee, and others who are here. And thank you to my dear friend, Julia Brownley, a Congress Member. My mother should have been there for that introduction, it was so kind.

And I am really pleased to be joined today in my testimony by Seleta Reynolds, who is the general manager of the Los Angeles Department of Transportation. You know, we have the second largest metropolitan economy in the country and now the third largest metropolitan economy in the world in southern California. Home to the Nation's busiest cargo complex, we boast the third busiest passenger airport in the world, one of those six that was mentioned.

But as you know, we are also a creative capital, an innovation capital, and the manufacturing capital of America. Our success is tied to America's strength and America's success is tied to our strength. But L.A. also occupies another role, which is why it is such a treat to testify before you.

We have become the transportation infrastructure investment capital of America, pouring \$14 billion, the most of any airport in America, into LAX; which, if you have been through in the last decade, you know needs it. Investing \$120 billion—you heard that right—for 15 new public transit lines in preparation for the American Summer Olympic Games that will come to Los Angeles in 2028, part of the largest local transportation measure ever passed in American history times two.

And so we are trying to drive the future of transportation locally through investment and beyond as a testing ground for America's new innovation in transportation. And thanks to that, the history, geography, and ingenuity that Representative Brownley mentioned, representatives and companies from everywhere are coming to southern California to develop, to test, to build new transportation solutions, and that includes advanced aerial mobility or AAM.

For this technology, the sky is literally the limit. And it has the potential to reduce emissions, to connect communities, and to grow our economies. But as policymakers, I know that this hearing today is about our responsibility to step back to assess the challenges and to keep our focus on equity as this market takes off.

We need to make sure that AAM does not create flyover highways accessible only to those with the economic means, but how we can explore AAM—estimated to travel between 50 and 200 miles

at more than 150 miles an hour—could tie people to jobs and opportunity without creating more sprawl. We know that well in Los Angeles, where the traffic is among the worst in the country, and our air quality traditionally has been, too, even though we have made huge strides.

In the L.A. region, only one-quarter of jobs are accessible within 90 minutes to people using public transit. AAM could offer a solution, but only if we build affordability, both into the private- and public-sector planning around this technology. So it needs to be safe, zero emissions, and low noise. We will meet that standard industry experts say, and be safer and cleaner than driving a car, and quieter than a helicopter. And while there is no shortage of room in the air for AAM, there are far fewer spots available for takeoff and landing.

So as we build out the infrastructure, we do not need to just think about the sky, but the buildings and the vertiports, and connect density and better connections to walking, cycling, and transit where those vertiports are.

L.A. is already engaging Angelenos in our plans for AAM infrastructure because we want the public to be the coauthors of this. I am proud that L.A. and our sister cities are leading on AAM, but we need your help at the Federal level. Don't let us have a thousand standards in a thousand cities.

Let's develop a national standard—clear roles for managing low-altitude airspace that recognize the responsibility, though, of local governments around land use, density and development.

Two, the FAA needs to prioritize research and to safely integrating AAM into congested airspace, as well as research into how takeoffs and landings will weave into the flightpaths of traditional commercial aircraft operations.

Three; industry, the FAA, and local governments have to start sharing data on the safety, sustainability, equity, noise, and energy infrastructure impacts of AAM with one another, as well as members of the public, academic partners, and others.

And four, the FAA needs to speed up the pace of its data gathering and invest more resources in reliable communications, detect and avoid systems, and remote identification systems. And airports like LAX should be allowed to conduct pilot programs to test these types of systems.

Last, we need funding to plan for and connect AAM infrastructure into our existing and future transportation networks. At its core, infrastructure isn't about a single mode of transportation, it is about innovation and jobs and human beings. It is about connecting communities. Whether it is AAM or encouraging more Americans to walk, ride, or take public transit, we have the tools to forge the next generation of transportation. L.A., with cities around the world, is trying to develop this standard when it comes to AAM, and we simply need your partnership to arrive at that destination together.

Thank you all so much. I look forward to our discussion.
[Mr. Garcetti's prepared statement follows:]



**Prepared Statement of Hon. Eric Garcetti, Mayor, City of Los Angeles,
California**

Chair Larsen, Ranking Member Graves, and Members of the Committee—my name is Eric Garcetti, and I serve as Mayor of Los Angeles, the second-largest city in the country; home to four million residents and Los Angeles International Airport, which in 2019 was the second busiest passenger airport in the United States, and third busiest airport in the world. Prior to the COVID-19 pandemic, we saw the throughput of more than 88 million annual passengers. During the pandemic, we processed a near record of 2,329,348 tons of cargo at LAX alone. This activity at our airports generates 620,600 jobs with a labor income of \$37.3 billion, and an economic output of \$126.6 billion.

I am honored to appear before you and this Committee on behalf of my city to discuss our role as an epicenter of aviation and aeronautics, a field that has rapidly evolved in a little over 100 years, and is poised for continued rapid advancement in the coming years. With a rich history in aeronautics, Los Angeles and the greater Southern California region is currently looking toward the future to plan for a safe, efficient, and integrated advanced air mobility (AAM) system. Our location within the FAA-designated Southern California Metroplex and a growing urban core makes this no easy task. Yet, this is why we are doing it. Effecting change within the transportation system has proven to be an arduous and time-consuming task. With multiple electric vertical take-off and landing (eVTOL) manufacturers (OEMs) announcing intentions to launch service within our city by 2024, it is imperative that we plan now.

Last month, I testified before the Senate Committee on Environment and Public Works. There I described the devastating climate change impacts that threaten Angelenos every year. I told them about my commitment to modernize L.A.'s electric grid to support the decarbonization of our transportation system. It is in this same spirit that I am here, once again.

We have an opportunity to effect significant positive change within my jurisdiction, and within the aviation industry as a whole. New electric aircraft of all types are announced every month. Progress in battery technology, acoustical engineering, and operational milestones are taking place weekly. This emerging market is pushing aviation through a metamorphosis and cities need to be ready. It is my duty to ensure that any new technology, particularly within transportation, is planned for and implemented in a way that improves our constituents' quality of life.

We do not need another mode of transportation that layers new problems onto our existing ones. We need solutions that provide Angelenos with choice. The choice to travel in the most efficient and cost effective way. This means something different for everyone, which means that we must remain flexible in our approach, and we cannot levy new burdens on our neighborhoods that have historically been underserved. We must provide transportation choices to those who need it most.

Doing this requires that we leverage every mode of transportation in an integrated system that benefits all Angelenos. When new technology emerges, we must be ready to help new providers adapt to what our residents need. Within the complex system of systems that is transportation, this often creates ripple effects across to other modes. AAM is no different and we are uniquely positioned and experienced to handle this task.

This work unlocks massive opportunities to foster a new job market, to bring opportunities for upward economic mobility to struggling communities; all while keeping our nation in a leadership position within the global economy. This work will also benefit from strong Federal support, and I will close these remarks today with specific requests to support the planning and deployment of AAM in Los Angeles and across the country.

I appreciate the opportunity to share our work and insights. I hope that it inspires you with the same optimism and innovative spirit that I have shared with all who are undertaking this work to deliver a resilient, equitable, just, and sustainable transportation system.

First, allow me to share a little about L.A.'s rich aerospace history to demonstrate how fitting it is for us to take this leadership role.

A BRIEF HISTORY OF AEROSPACE IN L.A.

The histories of the Los Angeles region and aerospace industry in the United States are closely intertwined. From a quarter million people observing aviation technology at the Los Angeles International Air Meet in 1910, to the agglomeration of aviation manufacturers that led to 300,000 aircraft built by two million workers to support an Allied victory in World War II, the region and industry grew together for much of the 20th century.

As the Cold War came to a close, the region's role in the industry was temporarily disrupted as manufacturers merged and new technology companies drew workers from aerospace to new fields. However, that disruption was short-lived as aerospace industry employment rose by 64 percent and manufacturing increased by 24 percent between 2004 and 2014 to meet the demands of our nation's military and space exploration efforts. With \$15.7 billion in contracts awarded by the U.S. Department of Defense in 2014 to 120 aerospace-related companies in the region, and long-standing educational pipelines between industry leaders and local aerospace engineering programs, these trends are expected to continue.

Today, the aerospace industry invests more than \$24 billion in production costs and \$11.1 billion in wages and benefits in the region annually. Of the 85,500 aerospace industry workers in the Southern California region (about 14% of the national aerospace workforce), most (63%) are employed in Los Angeles County. This provides access to well paying jobs, as average wages in the industry are nearly twice the average wage across other job sectors.

The impact of the industry in our region is even broader when considering jobs indirectly related to aerospace. Direct and indirect aerospace jobs amount to 300 thousand; 300 thousand jobs that support 300 thousand individuals, households and families in Southern California.

LAYING THE FOUNDATION FOR THE FUTURE OF MOBILITY

Los Angeles is leading the way for safe, equitable, and zero-emission mobility options. Our efforts to develop a transportation network of complementary mobility options puts our City in a unique position to guide the integration of Advanced Air Mobility in our communities.

We have planned and documented our approach for building a transportation network that provides our community with safe options. The Los Angeles Mobility Plan 2035 establishes a framework for reimagining transportation within the city, with a focus on creating streets that are safe and accessible for all community members. Paired with our recently adopted Los Angeles Department of Transportation (LADOT) 2021 Strategic Plan, outlining a framework for our transportation department to meet its goals, Los Angeles is poised to be flexible and meet the transportation needs of Angelenos today and in the future.

We embrace transparency and data-driven solutions in Los Angeles, allowing for a flexible and proactive approach to integrating new mobility services. Merging data and the lived experiences of our communities has allowed us to serve Angelenos in new ways, including the provision of micro-transit services and shared scooter devices to wide and diverse audiences. This includes shifting the paradigm of how cities deliver policy in the 21st century from an analog world of signs and curb painting to a digital world of application programming interfaces (APIs). The development of tools, such as the mobility data specification (MDS), both protect constituent and company privacy and allow for the sharing of essential operational data between mobility operators and departments of transportation. These tools also enable our city departments to keep pace with the innovations of the technology sector, while delivering safe, sustainable, and accessible mobility options to Angelenos who need them.

We collaborate with neighboring jurisdictions and agency partners to create paths to alternative mobility options. Working closely with the Los Angeles County Metropolitan Transportation Authority, Angelenos voted to approve Measure M, which will bring \$120 billion in transit projects, bicycle infrastructure, and pedestrian safety improvements.

Finally, we put equity at the forefront of all planning decisions. Recognizing that past decisions created disparate levels of mobility access, safety, emissions exposure, and opportunities, we are working with community members to understand their needs and provide the infrastructure needed to thrive.

To continue our progress and make due on our promise for a more equitable Los Angeles, we must be at the forefront of integrating new mobility options in our City. While new mobility technology presents challenges for cities, we see opportunity:

- An opportunity to engage with community members and industry stakeholders to guide the introduction of Advanced Air Mobility.

- An opportunity to plan and design facilities that reduce dependence on automobile ownership and realize a multimodal transportation system.

- An opportunity to live in a future where our youngest Angelenos are served by a network of accessible, safe, and sustainable, mobility options and where they have clear pathways to jobs that align with our equity and justice imperatives.

ADVANCED AIR MOBILITY EMERGES

As defined by the Federal Aviation Administration (FAA), Advanced Air Mobility (AAM) is a safe and efficient aviation transportation system that will use highly automated aircraft to transport people and goods at lower altitudes. Urban Air Mobility (UAM) recognizes use cases within populated areas.

The FAA acknowledges that community engagement is critical for guiding the development of the UAM ecosystem, along with access to airspace and infrastructure development. This is where Los Angeles thrives—at the intersection of community engagement and guiding multimodal priorities.

So what does UAM look like? Why do we need resources to allow our cities to guide these new services?

UAM adds a third dimension for moving people. OEMs have described aircraft capable of carrying one to five passengers flying at speeds of 150 to 200 miles per hour, over a range of 60 to 200 miles. With these capabilities, UAM has the potential to add a new option for connectivity and accessibility throughout the Southern California region, particularly for difficult commutes where non-auto options are lacking.

UAM adds a third dimension for moving cargo. With an ever increasing demand for goods movement, UAM can benefit logistics operators with high-value parcel movements to support the medical, aerospace, and defense industries across Southern California.

Before being able to see UAM in our cities, we must be able to work with community members and industry partners to create a clear path to implementation that benefits all residents. This includes planning and design efforts that integrate communities, infrastructure, and policy to guide future decisions associated with UAM. This requires public-private partnerships to delineate clear lines of responsibility, accountability, and information exchange. We have already begun this work in Los Angeles.

With numerous OEMs announcing their intent for launching UAM service in Los Angeles by 2024, the time to act is now. We must allocate resources for our local governments, community members, and service providers to collaborate and shape these services to work not simply in our communities, but for our communities. We have made the mistake of being reactionary to transportation technologies in the past, most recently with Transportation Network Companies, such as Uber and Lyft, or the influx of electric scooters in urban communities. Today, Los Angeles is leading the way in proactively partnering with service providers to guide business models in a way that brings solutions to transportation challenges, instead of creating new challenges. But we cannot do it alone.

THE PRINCIPLE OF THE URBAN SKY

Developed in partnership with the World Economic Forum, the Principles of the Urban Sky were adopted by Los Angeles in September 2020. Today, my office is working closely with the Los Angeles Department of Transportation (LADOT) to develop the building blocks to guide UAM implementation in Los Angeles.

The Principles of the Urban Sky are fundamentally important to the short and long-range success of UAM. Shaped with feedback from leaders across the industry, Los Angeles is applying and understanding these lessons to introduce a new mode of transportation.

The Principles of the Urban Sky are:

- *Safety*—UAM operations are aiming for safety performance consistent with commercial aviation. In other words, very safe. To achieve this, the industry will need to adopt similar regulatory requirements and standards.
- *Sustainability*—Sustainability will need to encompass the effects of UAM on the community, which includes people, as well as the animals and vegetation that inhabit the impacted environment. Mobility and public benefits must outweigh negative externalities, particularly when evaluated as a part of a multimodal system.
- *Equity of Access*—Planning early for equitable access is required for public acceptance and long term success. While UAM will initially be operated as a premium service, providers must work with local governments to plan for affordable consumer pricing as the scale of operations increases. Further, take-off and landing areas offer opportunities to serve as hubs for a wide variety of mobility options, ensuring that people who use UAM services or work in supporting functions will not need to rely on personal automobiles to access these facilities.
- *Low Noise*—Noise acceptance thresholds must be established with stakeholders, including city planners, community advocate groups, OEMs, service providers,

and vertiport operators. All stakeholders must understand all negative impacts of noise and plan to mitigate them to the maximum extent.

- *Multimodal Connectivity*—Creating a siloed option for wealthier travelers is the path to failure. Instead, UAM should seamlessly connect with existing modes of transportation to create a high-quality transportation network for everyone to enjoy.
- *Local Workforce Development*—UAM must create new employment opportunities, especially for residents where operations are supported. Accessible education and training should be available to meet the demand for future employment.
- *Purpose-Driven Data Sharing*—Data sharing enables authorized stakeholders to respond to community, passenger, and market needs. To facilitate success, individual privacy must be protected. The availability of relevant data allows for optimized airspace usage, efficient vertiport operations, and intermodal connectivity.

Working collaboratively with our partners, these principles will help us develop policies that can help weave UAM into the fabric of our transportation systems.

URBAN AIR MOBILITY PARTNERSHIP

To properly implement the Principles of the Urban Sky, last December, I announced the Urban Air Mobility Partnership. This unique initiative makes Los Angeles the unmistakable leader in the nation on Urban Air Mobility, and leverages one of the primary tools for our mobility future: a public-private partnership, in this case formed between LADOT and the newly formed Urban Movement Labs (UML).

Urban Movement Labs is a first-of-its-kind mobility-innovation organization that brings together public agencies, businesses, and community members to match technology solutions to mobility problems and test them in Los Angeles' urban contexts. UML brings together different stakeholders to facilitate accelerators and pilot projects to collaboratively find ways of meeting Los Angeles' transportation needs. UML is well-positioned to facilitate a productive dialogue between public and private stakeholders. I am extremely proud of this small team of experts and excited to see their work unfold.

The UAM Partnership leverages new aviation technologies as part of a clean, safe, and equitable transportation system. UML will integrate this through a public education and outreach program, and thoughtful vertiport infrastructure (e.g., places where UAMs will take off and land) planning which will unlock new levels of connectivity, while mitigating negative externalities.

To bring these efforts to fruition, with my support, Urban Movement Labs hired an Urban Air Mobility Fellow. The first position of its kind in the nation. An Air Force veteran, our Fellow brings more than 20 years of diverse aviation experience (including airport, heliport, and airspace planning) and an urban planning and design background to L.A.'s planning toolbox. Prior to joining UML, our fellow worked in statewide aviation planning for a western state Department of Transportation.

Our Urban Air Mobility Fellow is leading the integration of the "Principles of the Urban Sky" into Los Angeles' transportation landscape over the course of this year. Upon completion of the fellowship, our Fellow will collaborate on a policy toolkit that can be utilized by cities, counties, and tribal governments nationwide. A primary goal of this policy toolkit will be to lay the foundation for a safe, sustainable, equitable, and efficient new mobility system that will overlay the already complex transportation infrastructure of the City of Los Angeles and beyond.

ADVANCED AIR MOBILITY POTENTIAL

A study published by Deloitte earlier this year highlighted the potential of AAM. In the United States alone, the AAM market is estimated to produce \$17 billion annually by 2025, and \$115 billion annually by 2035. This is equivalent to 30 percent of 2019's commercial aviation market. Additionally, NASA expects the passenger movement market to be commercially viable by 2028, and the package delivery market soon after in 2030.

As a new economic opportunity, AAM is expected to generate 280,000 new jobs by 2035, adding \$30 billion in wages and benefits. Like current trends in aerospace employment, I expect these jobs will provide higher above average wages. Creating training opportunities to support this new industry, particularly within communities struggling with upward economic mobility, realizes AAM's potential to add value as a transportation option and by developing the next generation aviation workforce.

AAM can also serve as an accelerator in shifting the aviation industry towards greener fuels, lower greenhouse gas emissions, and a more sustainable future. A

study published in *Nature* concluded that carbon emissions associated with a three passenger eVTOL were 52 percent lower, per passenger kilometer, than a fossil-fueled automobile.

UAM will come with the highest expectations for safety, with the goal for eVTOL trips to be as safe as a commercial airline flight. The aviation industry boasts an incredible safety record in the US, with only 0.07 deaths per billion passenger miles—or about 3,000 times safer than travelling by car or motorcycle, which causes 220 deaths per billion passenger miles.

Angelenos are no stranger to noise from aircraft, particularly from daily helicopter flights over urban neighborhoods and the broader noise issues faced by people who live near our various airports. OEMs, like Joby, Jaunt, and Volocopter, are targeting noise levels less than 70 decibels at cruising altitude. This is comparable to the higher range of a normal conversation. Joby Aircraft, for example, has publicly made it known that its aircraft's acoustical characteristics are just as important as other performance characteristics. Communities demand quieter vehicles, and the industry is responding.

UAM will require a new transportation network in order to provide a viable business model and travel mode. In contrast to the traditional hub and spoke airline networks, or the linear networks of roads and rail, UAM's benefits are realized through a nodal network that provides new opportunities for connectivity within a region. Often underutilized infrastructure, like small general aviation airports, now become nodes that are connected to jobs and other areas of economic activity. Like adding other modes of transportation, UAM can help access career opportunities in new parts of the region, particularly for those with limited transportation options today.

AAM is currently enabled through the relatively small footprint of existing infrastructure of airports and heliports, and will be augmented by strategically planned vertiport infrastructure. Maintaining road networks exceeds \$145 billion annually, and despite this cost, congestion continues to worsen causing billions in lost productivity. Maintaining existing aviation infrastructure costs only \$4.1 billion to maintain, revealing aviation infrastructure's high efficiency.

CHALLENGES

The UAM Fellowship is a year-long program, after which, AAM planning will have to compete for traditional urban planning staff and capacity. While it's feasible for new partnerships to fund a dedicated planning position, the City cannot rely on this mechanism to continue its efforts into perpetuity.

Another challenge that I see being faced by growing urban areas is density. Density is often recognized as a solution for creating healthy jobs to housing balance and reducing commuting times. Safety zones contained in current heliport design guidance serve to protect navigable airspace for flight safety, as well as to ensure ground areas are free of high density land uses and gathering areas such as parks or plazas. This imposes land use and height restrictions around vertiports, which limit a city's ability to develop high density areas of housing and employment directly surrounding a vertiport.

Cost is a big barrier to access and equity. Current entry costs will limit AAM access to those with higher expendable incomes. While I understand that cost is expected to eventually be on par with higher end surface ride-sharing options, we need to understand how populations that are unable to afford a trip will be impacted, and what indirect benefits may be shared, such as investing in connected infrastructure. We have been here before in Los Angeles, with the implementation of our ExpressLanes system over a decade ago. While the initial concerns centered on potential disparities created when a transportation mode that is faster and more efficient is provided for a premium fee, ultimately our ExpressLanes system developed a model where revenue generated from use of the ExpressLanes was used to improve public transportation options for other commuters, resulting in an overall improved multimodal transportation system.

While I know that AAM alone cannot resolve congestion and related emissions issues within the city, we must leverage all tools possible to move towards a more sustainable future. AAM can be one of many options in a suite of mobility solutions to move our cities towards a more sustainable future. We look forward to working with the industry to meet sustainability goals.

Most critically, we understand the inequitable consequences of our past planning decisions now more than ever. It is imperative that we take proactive action to ensure we do not repeat these mistakes. The industry is showing interest in joining us in this battle, and we look forward to having them as our allies.

RECOMMENDATIONS

This brings me to my recommendations to this committee.

First and foremost, we need funding to continue to lay the groundwork for planning and preparing our city for UAM for operations by 2024. AAM eligibility under existing USDOT grant programs needs to be added, or expanded. I was pleased to see that the Notice of Funding Opportunity for the RAISE program included eligibility for intermodal facilities at airports. I encourage that we continue to expand these types of programs. At the same time, I also know how competitive projects are for these grants and AAM may not compete well.

I support the creation of other funding options to plan for AAM, especially for programs that are specific to AAM planning and construction. These grants should be available to all providers of local and regional transportation, across all modes who wish to incorporate AAM into their mobility programs, and should take into consideration that not all jurisdictions will have existing resources to use as a local match. Doing so will afford us the dedicated staff time and resources to engage community members, service providers, and other stakeholders in the collaborative process that integrates UAM with other modes of transportation.

These funding options should also make clear that AAM needs to be planned with and connected to other modes of transportation, as well as powered by zero emissions fuels. With transit, personal, and shared mobility moving towards electricity as the primary fuel source, we must think critically about the electricity infrastructure at mobility hubs, as UAM introduces another electric vehicle that requires charging. Fostering collaboration between OEM's across services can facilitate interoperability of chargers and ensure enough electricity is available where needed. My approach is one of collaboration, which requires future grant programs and clearly written planning and engineering guidance.

We need transportation leadership, and not just from the aviation community; from the transit, street design, and regional rail communities as well. To plan for intermodal connectivity, they need a voice in our discussions at all levels. We need a strategic effort alongside transit, active transportation and accessibility programs to reduce single occupancy vehicle trips, establish safe and complete streets, and foster a complete and integrated transportation network for all users, including communities of color. The Advanced Air Mobility Coordination and Leadership Act introduced by U.S. Senators Sinema and Moran is a great start, but is missing these key details. Constituents need to see these efforts codified.

To build the necessary infrastructure, we need to develop vertiport design guidance that reflects the unique needs associated with bringing UAM into urban spaces. This guidance must be scalable to provide flexibility for integration into different urban contexts, and clearly identify risks associated with specific criteria. Guidance should provide practitioners clear direction for a multitude of use cases including private (part 91) facilities, on-demand charter facilities (part 135), and scheduled operations facilities (part 121). Additionally, steps should be outlined for establishing intermodal facilities, converting buildings to support UAM (e.g., parking garage), bringing services to surface brownfield sites with existing surrounding development, and facilities housed within small, medium, and large airports.

This guidance must acknowledge the crucial rule that local governments play in managing the land use, development, and density of urban areas. Between October 2021 and 2029, the City of Los Angeles will be responsible for adding 456,643 housing units, about a third of the metropolitan planning organization's five-county goal and almost a third of which will be for very low income households. L.A. cannot afford to jeopardize density, including through the construction of vertiports with safety zones that might imperil surrounding future development. Any guidance that the FAA releases must take into consideration this key point.

Existing infrastructure at airports and heliports also needs to evolve. This presents a unique opportunity for these critical pieces of infrastructure to take on a new role in communities as mobility and communications hubs. Accessibility at these points can be enabled by intermodal connectivity or through land use changes that bring more opportunities to the airport/heliport itself. The more seamless we can make the journey to the final destination, the better our chances for success. Strategically bringing new surface connectivity, land uses, and activity to airports and heliports should be encouraged across all modes, highway, transit, and aviation. Grant programs must allow us to jump on this opportunity.

Back to our airport—LAX in 2019 was the world's number one origin and destination airport. More passengers started or ended a trip at LAX than any other airport, many of them driving on our freeways to get there. Someday that 45-minute (or more) trip on freeways from LAX to downtown LA might be a five-minute trip in

a zero emissions Electric Vertical Takeoff and Landing (eVTOL) aircraft. AAM companies have told us that major airports fit prominently in their business plans.

We have to start planning now. The Federal Aviation Administration (FAA) needs to prioritize the study of how AAM will integrate safely into the very congested airspace around the nation's busiest airports, such as LAX, and how takeoff and landings will weave into the flight paths of traditional commercial aircraft operations.

Critical to the safety of our airspace is purpose-driven data sharing across levels of government and across dimensions of transportation. The UAM Concept of Operations ("ConOps") Version 1.0 published by NASA and the FAA in June 2020 starts to address the increasing number of aircraft in our urban airspaces, and how operators and government entities might share data dynamically to allow for both safety and scaling of services. However, this initial version of the UAM Concept of Operations only notionally includes local governments and the people they represent. A second version of the ConOps should more clearly outline the jurisdiction local governments hold with regards to managing low-altitude airspace, such as permitting operations that ensure sustainability, accessibility, and low-noise are achieved. It should also define how local governments might participate in both receiving and providing data, particularly in the case of emergency situations.

That planning also needs to include unmanned aircraft systems—or drones—both being used for societal benefits, safety and security, as well as those that could cause major disruptions to our airports. Drones are in our airspace now—and have the ability to cause great impact. According to FAA statistics, since April of 2016, there have been more than 260 reported cases of unauthorized drone activity near LAX alone, and I know that all airports are concerned about drone incursions in their airspace.

That is why I have been advocating for LAX to be able to test sophisticated systems that can help detect and mitigate drones around the airport to keep our airline passengers and communities under flights paths safe from unauthorized incursions—and to protect our local economy from the devastating impacts that would occur if the airport needed to shut down because of a drone incursion.

The FAA needs to increase the pace of gathering data and to invest more resources in reliable communications, detect-and-avoid systems, and remote identification systems. The FAA should allow large airports like LAX to conduct pilot programs to test these types of systems to gather crucial information on how these technologies will work in a high air traffic airport environment. Without these pilots, airports are limited in being able to effectively respond to and plan for the safety and future implementation of AAM for cargo and mass transit solutions. I also support looking at common sense uses for drones that can help bring additional safety, security and efficiency to our airports and the movement of goods.

AAM will not be successful if it happens without our people. My duty first and foremost as Mayor of Los Angeles is to the people who live and work in our City of Angels.

To build public trust, I need to show my constituents how AAM will serve them while meeting the same level of safety that is associated with commercial flight. Commercial airline operators achieve this level of safety through a comprehensive system of checks, balances, and redundancies. UAM operators will have to operate similarly, and OEM's must work with the FAA to adapt existing regulations to new technology.

We also need to know how these technologies can operate without placing a burden on communities neighboring airports in terms of noise and other potential annoyances. The FAA plans to continue to apply its current noise certification standards to eVTOL aircraft. NASA recognizes that community acceptance around noise is more dynamic than these standards can measure. Communities need a framework to better assess community annoyance and health impacts to fully understand and mitigate new aircraft noise.

To protect disadvantaged communities, I need a framework that allows me to work with the FAA to prevent new burdens from being levied upon these residents. I need to be able to protect schools, outdoor gathering spaces, and recreation facilities from new noise and/or increased greenhouse gas emissions. To effectively accomplish this, I need to have a certain level of authority in how low altitude airspace is managed.

AAM also needs to meaningfully contribute to our regional economy, and to create jobs with good wages. Academic departments and programs need support to create the education and training necessary to meet the demand of the future workforce. These programs need to target institutions that are more accessible to a diverse student body. Community colleges and vocational schools—like Los Angeles Trade Tech—should receive top priority. Ongoing job training and skills development are

also crucial, as it typically requires approximately 10 years of experience to develop capable aeronautical maintenance and operations staff.

CONCLUSION

We are at a critical juncture in the history of transportation. The decisions that we make today can change the trajectory away from our past mistakes when we planned for a single mode of transportation. This is not just an opportunity for aviation, but for all of transportation, to unite and collectively create the transportation system of tomorrow. The work that we have in front of us will not be easy, and it will be necessary to drive change throughout the system. We owe it to the historically neglected communities. We owe it to our health. And we owe it to our children, to do everything in our power to keep them from having to correct these types of mistakes.

Thank you once again, Chair Larsen and Ranking Member Graves, for allowing me to be here today. I look forward to partnering with you to bring forth a new frontier in aviation and transportation. We are ready to lead alongside you.

Mr. LARSEN. Thank you, Mayor Garcetti, I appreciate your testimony.

And now I will turn to Mr. Grimsley. Mr. Grimsley, you are recognized for 5 minutes.

Mr. GRIMSLEY. Chairman Larsen and Ranking Member Graves, thank you for inviting me to testify today. It is an honor to speak with you about the historic and exciting work underway within the Choctaw Nation to help safely advance strong technology into our National Airspace System.

In addition to serving as the executive director of Advanced Technology Initiatives with the Choctaw Nation, I also serve on the board of directors of the Commercial Drone Alliance. The efforts of our team have clearly demonstrated some of the quantifiable benefits to our own communities in using drone technology. Public safety and agriculture are particularly impactful applications for us. We are also finding that drones can reduce the risk of injury to workers, improve productivity, and assist first responders.

In 2018, the Choctaw Nation made history by becoming the first and only Tribal government to be selected by the U.S. Department of Transportation to participate in the Drone Integration Pilot Program, or IPP, as well as the first Tribal government to be recognized by the FAA as a public aircraft operator.

Last year, the Choctaw Nation was invited to continue our collaboration with the FAA as part of the BEYOND Program, which is focused on advancing beyond visual line of sight drone operations, as well as cargo delivery by drone. As part of these programs, we have been focused on community engagement with public stakeholders, which has been both productive and insightful.

Our Tribe has an interest in emerging technologies as a potential equalizer for rural and underserved communities. These advancements help communities such as ours make dramatic strides in improving overall quality of life. The technology that supports drones will continue to advance rapidly and in ways that enable the safe, efficient, secure, and environmentally responsible use of the airspace.

The U.S. safety regulatory system for civil aviation has an enviable record of stewardship over the busiest and most complex aviation system in the world. But in order to sustain this vibrancy, our regulatory system needs to evolve to enable and support emerging technologies and new entrants into the airspace. Although we have

made progress in the IPP and BEYOND in understanding how our regulatory system needs to evolve to integrate drones, our policies lag behind the pace of technological advances. This hinders the industry unnecessarily.

Notwithstanding the best efforts of regulators today, drone operations remain highly limited and reliant on a patchwork of unwieldy, one-off regulatory waivers, rather than a stable and standardized regulatory foundation. Without regulatory modernization, the drone industry faces uncertainty that discourages investment and threatens the survival of innovative companies here in the United States.

Unfortunately, our Nation is at risk of losing our aviation leadership role in the world unless we take bold action to move into the better future that awaits. Drone technology continues to develop, but it is ready now to safely do more than it has been able at this time.

For communities like ours that have already made investments in safety infrastructure, drones can offer a more economical, cleaner, and safer alternative to surface transportation for mobility needs with occupations such as cargo delivery by drone. Moreover, we have a relatively less busy and complex airspace for drone traffic to traverse. Since our geography and others like it is of relatively more benefits and relatively less air traffic complexity, regulators should be amenable to broadly enabling drone operations in locations such as ours.

Our Nation has long led the world in developing and safely deploying aviation technology. We are at risk of losing that leadership role with drones. A more conducive regulatory environment that enables the U.S. drone industry to scale would help build a stronger U.S. manufacturing base and research ecosystem serving our country's economic, safety, and security interests.

We simply cannot afford to have U.S.-based companies move offshore to develop their technologies in more accommodating regulatory environments. We need continuing action and oversight by Congress to move forward so that communities such as ours can fully benefit from emerging transportation technologies. Our safety regulatory system needs specific mandates that clearly reflect the intent of Congress, and we need accountability of our safety regulatory system to achieve those mandates.

Congress can begin by codifying and funding the FAA's BEYOND Program. We must ensure that the lessons we collectively learn from these pilot programs translate efficiently into permanent reform to our regulatory system. We believe the future is bright and that our quality of life can be enhanced by responsibly harnessing drone technology, but we need the Federal Government's support to ensure that these technologies flourish and provide the benefits to society that we know are possible.

Thank you again for having me with you today, and I will be happy to answer any questions that you may have.

[Mr. Grimsley's prepared statement follows:]

Prepared Statement of James L. Grimsley, Executive Director of Advanced Technology Initiatives, Choctaw Nation of Oklahoma

Chairman Larsen and Ranking Member Graves:

Thank you for inviting me to testify before the House Committee on Transportation and Infrastructure, and Subcommittee on Aviation. It is an honor to speak with you today about the historic and exciting work underway within The Choctaw Nation of Oklahoma to help safely advance commercial drone operations into our national airspace system. Our efforts have thus far clearly demonstrated some of the quantifiable benefits to society from drones, with agriculture and public safety being examples of impactful applications for us. Among other benefits, we are finding that drones can reduce the risk of injury to workers, improve productivity, and assist first responders.

I currently serve as the Executive Director of Advanced Technology Initiatives with the Choctaw Nation. The Choctaw Nation of Oklahoma is the third largest federally-recognized Native American Tribe, and the Choctaw Nation reservation is comprised of approximately 11,000 square miles in southeastern Oklahoma. I was fortunate to grow up in the heart of the Choctaw Nation, and both sides of my family have lived in that area for multiple generations. I have great respect and appreciation for the Choctaw people and Choctaw culture.

My professional career has revolved around transportation technology, and I have a fascination and passion for both the technology and policy aspects of transportation. I serve as a Transportation Commissioner with the Oklahoma Department of Transportation, and in that role I'm involved in the oversight and governance of our state transportation network of highways and bridges. I also serve on the Board of Directors of the Commercial Drone Alliance. My degrees are in aerospace and mechanical engineering, and for the first twenty years of my career I was a technologist, but I became actively involved in policy about fourteen years ago. During my career I have also been a university research administrator, an executive in the defense industry, an entrepreneur, and an engineer with the federal government.

BACKGROUND ON THE CHOCTAW NATION OF OKLAHOMA DRONE INTEGRATION EFFORTS

In 2018, the Choctaw Nation made history by becoming the first and only tribal government to be selected by the U.S. Department of Transportation to participate in the Drone Integration Pilot Program—or “IPP”. The Choctaw Nation of Oklahoma was selected as part of a group of lead participants consisting of tribal, state and local governments to focus on safely accelerating the integration of drones into our national airspace system. This was historic for the Choctaw Nation since, prior to the IPP, tribal governments had not been eligible to participate in many technology-related federal government-sponsored pilot programs. The Choctaw Nation of Oklahoma is also the first tribal government to be recognized by the FAA as a public aircraft operator or “PAO”. We are proud to have an active role in the safe integration of drones into the national airspace system to support important applications for rural and tribal communities, where we believe that drone technology can improve our quality of life, health, and safety.

In 2020, the Choctaw Nation was invited to continue our collaborative relationship with the FAA as part of the FAA BEYOND program, which is focused on advancing beyond visual line of sight—or “BVLOS”—drone operations, as well as cargo delivery by drone. As part of both the IPP and BEYOND, we are also focused on community engagement with public stakeholders. It has been exciting to be part of the Choctaw Nation team as we have accomplished many historic firsts for tribal governments in this exciting area of emerging aviation technology.

Although we have made progress in the IPP and BEYOND in understanding how the aviation safety regulatory system needs to evolve to integrate drones into our national airspace, overall our regulatory system is lagging behind the pace of technological advances, hindering the industry unnecessarily. Notwithstanding the best efforts of regulators to date, many advanced drone operations remain highly limited and highly reliant on a patchwork of unwieldy, one-off regulatory waivers rather than a stable and standardized regulatory foundation. Obtaining these limited waivers can be very time-consuming, and getting a waiver once will not necessarily make it easier to get the next waiver. Absent regulatory modernization, industry faces regulatory uncertainty that discourages investment and threatens the survival of companies attempting to innovate here in the United States. Sadly, we have witnessed very well-organized companies that were staffed with very qualified technologists abruptly close and cease operations, defeated by the lack of a clear regulatory path that enables regular operations.

IMPORTANCE OF EMERGING AVIATION TECHNOLOGIES

The Choctaw Nation of Oklahoma has an interest in emerging technologies because we see technology as a potential equalizer for opportunities in rural and underserved communities. As we have seen in the past, technology advancements can often help rural and remote areas make dramatic strides in improving the quality of life for communities. In my own lifetime, I have witnessed this with telecommunication technology, where today even the most remote areas of the globe can be connected through technology, and access to knowledge has expanded immeasurably.

Drones are the result of technological advancements in many areas. Distributed electric propulsion allows us to design drones that can weigh less than a pound as well as drones that weigh thousands of pounds, and virtually any size in between. Advances in electronics and onboard avionics allow an ever-improving level of safety, controllability, and reliability of these systems. Advances in machine learning and image processing can allow the development of systems that can analyze and respond to a physical environment in ways that a human physically cannot. The technology that supports drones continues to advance quickly, and in ways that can be harnessed to advance the safe, efficient, secure, and environmentally responsible use of the airspace.

The U.S. safety regulatory system for civil aviation has an enviable record of stewardship over the busiest and most complex aviation and airspace system in the world. To sustain this vibrancy, however, that regulatory system needs to evolve to enable and support emerging technologies and new entrants into the national airspace system. Our aviation safety regulatory framework is premised in large part on human eyesight as well as humans communicating with each other one at a time to safely coordinate flight activities. When humans are no longer in the aircraft, and the aircraft flies beyond the line of sight of a remote operator or pilot, then our safety regulatory system is simply not yet accommodating. Modernizing the regulatory framework is crucial in order to fully avail ourselves of the many potential benefits of emerging drone technology.

We are also at a time in our history when there is an increasing level of overlap between advanced ground transportation technology and emerging aviation technology. The growing prevalence of electric propulsion in both ground and aerial vehicles means that we will have common infrastructure challenges related to power availability, battery technologies, and charging stations. This will directly impact areas such as airport construction and modernization. Low-altitude aviation operations with drones will also benefit from broadband buildouts similar to the ways that advanced ground vehicles will leverage inter-connectiveness to achieve constantly improving levels of safety and operational efficiencies.

OVERVIEW OF THE ECONOMIC AND SOCIAL BENEFITS OF DRONE TECHNOLOGY FOR TRIBAL COMMUNITIES

Remote and rural areas within the United States—including Native American tribal lands and surrounding regions—have unique challenges that may be addressed by the use of small drones. The three primary areas where drones show promise are improving efficiencies with agricultural production, improving public safety, and enabling efficient infrastructure inspections.

It is important to note that there are also overlaps among these three areas. For example, not only can small drones be used to improve efficiency for agricultural operations, but they can also be used to address emergency response challenges for rural agricultural applications such as responding to medical emergencies that may occur involving large agricultural operations.

Some aspects of using small drones for public safety applications will also directly benefit scientific research, particularly in our understanding the atmosphere at lower altitudes and studying the lower atmospheric boundary layer to improve understanding of severe storms and ultimately improving severe storm prediction and forecasting capabilities. This improved understanding can in turn benefit the development of UAS Traffic Management (UTM) systems by creating drone management and safety systems that can accommodate dynamic weather conditions and flight conditions at low altitudes and at finer resolutions than is currently possible.

ADDRESSING RURAL AND REMOTE INFRASTRUCTURE INSPECTION

Traditionally, piloted helicopters have been used to inspect power lines as part of maintenance programs. These types of inspections can sometimes cost \$1,000 or

more¹ per hour, and can put the lives of the pilot and crew at risk of serious injury or death (an inspection typically requires both a pilot and also an observer/inspector within the helicopter). Drones can cut costs of inspections and also reduce risks to human life since the operations are “low, slow and near the live wire”.

Tribal governments are also growing increasingly reliant on small drones for a variety of GIS-related tasks to support tribal government operations and needs. Within The Choctaw Nation of Oklahoma GIS operations currently, a small drone flight operation can cost \$500 each (including costs for transportation, labor, supplies, etc.). When operated under a visual line of sight, or VLOS scenario, a typical GIS mapping or inspection mission can require multiple flights. For example, a single beyond visual line of sight (BVLOS) flight with a range of 2.5 miles could replace as many as five (5) or more VLOS flights, resulting in as much as a 5-to-1 cost saving. When BVLOS operations are enabled for GIS operations, higher productivity and lower operational costs can be achieved.

ADDRESSING DELAYS IN MEDICAL RESPONSE IN RURAL AREAS

In 2017, Reuters Health reported on the results from a study² published in the *Journal of the American Medical Association (JAMA) Surgery* that analyzed the differences in wait times for emergency medical services between urban and rural areas. Whereas wait times averaged 7 minutes in urban settings, rural settings had wait times of 14.5 minutes or more (and some wait times could be up to 30 minutes or more for rural areas). For very large agricultural operations in very remote areas, wait times could be significantly more than 30 minutes.

In the case of heart attacks, extended wait times can prove fatal. For example, it has been reported that access to automatic external defibrillators (AEDs) when used swiftly in the first 3–5 minutes of a person collapsing have been shown to dramatically increase the survival rate of people suffering from cardiac arrest³, since brain cells begin to die after 4–6 minutes of oxygen deprivation. Unfortunately, wait times in rural areas more often prove problematic and fatal in these situations.

Another important health challenge in rural and remote areas is emergency delivery of insulin, epinephrine, or related drugs and medications that can be critical for treating emergency medical conditions. Even if medical professionals and first responders are on the scene of a medical emergency, their response can be hindered by lack of available equipment or supplies.

Small drones can fly in direct paths and arrive on scene much faster than ground vehicles such as ambulances. Assuming a 30 second preparation time before launch, a small drone can easily reach any location within a 4.5 mile radius of launch within 5 minutes (or less), providing more than a 63 square mile area that can have a response of 5 minutes or less. However, these scenarios would typically require beyond visual line of sight (BVLOS) and also possibly night operation capabilities.

ADDRESSING FARMING AND RANCHING OCCUPATIONAL HAZARDS

According to the 2016 Census of Fatal Occupational Injuries⁴, farming and agricultural operations ranked 8th in the list of “most dangerous jobs” in 2016, with an average of 23.1 fatal injuries per 100,000 workers. Additionally, the CDC reports that every day about 100 agricultural workers suffer a “lost-work-time” injury⁵.

In 2017, the National Children’s Center for Rural and Agricultural Health and Safety released a report card and estimated that every three days a child dies in agricultural-related incidents⁶. Around 17% of those deaths involved motor vehicles, including all-terrain vehicles (ATVs). For “working youth”, tractors were the leading source of fatalities followed by ATVs.

Livestock and herd-based agricultural operations have unique occupational hazards. These types of operations typically require a significant amount of surveillance activities and travel/movement on the ground, including:

- Visual inspection/observation/surveillance using ground transportation (ATVs, farm trucks, etc.) to assess complete inventory status and overall health

¹ https://ac.els-cdn.com/S2212827113006823/1-s2.0-S2212827113006823-main.pdf?_tid=ca7d5d82-8ba4-4144-9f45-c2533115c2c4&acdnat=1527878253_f77e8b4ca794b4b5e553a30add32eb53

² <https://www.reuters.com/article/us-health-emergency-response-times/be-prepared-for-ambulance-wait-times-idUSKBN1A42KQ>

³ <http://www.cprandfirstaid.net/cpr/aed-guidelines.html>

⁴ <https://www.bls.gov/news.release/pdf/cfoi.pdf>

⁵ <https://www.cdc.gov/niosh/topics/aginjury/default.html>

⁶ <https://agfax.com/2017/04/24/farm-and-kids-every-3-days-a-child-dies-in-ag-related-accident/>

- Locating animals that are separated from the herd that make them vulnerable to attacks by predators or other potential risks
- Periodic inspection of very long fence lines to ensure the integrity of the fencing system
- Identification and tracking of dangerous predators and/or invasive species such as wild feral hogs
- Surveillance and inspection of water sources and feedstocks to ensure integrity
- Assessment and management of grazing patterns and plans to ensure healthy use of land and resources

Searches for lost animals that have separated from the herd can be time-consuming, disruptive to ongoing operations, and expensive. For example, a cow may separate from the herd when she is about to give birth, which can put the cow and calf at risk of attack and death by predators. Complications with the birth can also put both animals at risk. The loss of a cow/calf combination can result in a financial loss of \$4,000 or more for the agricultural producer based on beef prices. Cattle producers can spend a significant amount of time searching for a lost herd animal, many times at night, which increases the risk of injury or death to the agricultural workers that are involved. There are additional costs due to the depreciation of ground vehicles used in these searches, since often times farm trucks or ATVs are used to cover remote rough terrain.

Many agriculture-related injuries and deaths occur in remote rural locations. As noted earlier, rural and remote locations have much longer emergency management response times, since it physically takes longer for an ambulance or first responder to arrive at the scene of an accident or injury. Injuries that occur with livestock and herd operations can have even worse response times since in addition to limited roads and highways in the rural locations, the actual scene of the injury or accident may be at a significant distance from any roadways and not easily accessible by vehicle. For example, depending on the location within the Choctaw Nation's own 44,000+ acre ranch operation, it could take up to an hour or more to reach a remote site within the ranch boundaries using ground vehicles. As noted earlier, these types of delayed response times can prove fatal in some situations.

IMPACTS ON STEM AND WORKFORCE PREPARATION

A very positive impact of the IPP and BEYOND on The Choctaw Nation of Oklahoma has been with science, technology, engineering and mathematics (STEM) and future workforce development. The visibility of our drone research and testing activities has stimulated interest for our K-12 students and our STEM educators. The Choctaw Nation of Oklahoma has leveraged this interest to create drone camps for our Choctaw youth as well as other opportunities to support STEM activities within our region and to work to ensure a future workforce pipeline to support emerging aviation technologies.

Many of the public schools within our region are in historically impoverished areas that have been underserved. The visibility of our IPP and BEYOND activities coupled with the heightened interest in STEM as a result of those activities, is enabling us to reach students at an early age where positive STEM experiences and exposure to STEM opportunities can help instill confidence and strengthen interest in future STEM careers. STEM outreach and future workforce development will remain a priority of our emerging aviation efforts within The Choctaw Nation of Oklahoma.

ENHANCING WEATHER RESEARCH AND FORECASTING

A major challenge for improving the predictions and forecasts for severe storms is achieving a better understanding of the lower altitudes of the atmosphere, particularly the lower atmospheric boundary layer. In 2009, the National Research Council⁷ stated the following:

“The vertical component of U.S. mesoscale observations is inadequate. Assets required to profile the lower troposphere above the near-surface layer (first 10) are too limited in what they measure, too sparsely or unevenly distributed, sometimes too coarse in vertical resolution, sometimes limited to regional areal coverage, and clearly do not qualify as a mesoscale network of national dimensions. Likewise, vertical profiles below the Earth's surface are inadequately measured in both space and time. The solutions

⁷ <https://www.nap.edu/download/12540>

to these particular deficiencies require leadership and infrastructure investments from each of the pivotal federal agencies.”

For the past several years, researchers at Oklahoma State University (OSU) and the University of Oklahoma, in collaboration with National Oceanographic and Atmospheric Administration (NOAA) and the National Science Foundation (NSF) have conducted research to determine the feasibility of using small drones to “profile” and observe atmospheric conditions at low altitudes in a repeated manner. The Choctaw Nation of Oklahoma is proud to be a collaborative partner with these institutions as part of this research. The results have been very promising thus far, and it is believed that this improved data collection could have a profound impact on the accuracy of weather models and our overall understanding of the atmosphere at the lowest altitudes (which are most critical for understanding severe weather phenomena). The potential benefits of monitoring and measurement of the lower altitude atmospheric conditions could result in extended warning times for severe weather, including tornadoes, and also improved accuracy when issuing severe storm warnings. On average, dozens of deaths occur in the United States each year from tornado outbreaks⁸.

In addition to public safety benefits arising from improved understanding of lower altitude weather conditions, it is also likely that this information and understanding will improve path planning and routing for low altitude drone operations, particularly when operating within a future UTM framework. Smaller drones are more susceptible to lower-intensity weather events like gustiness. Current weather models utilize grids that are too coarse for practical benefit to UTM systems. Improved observations and monitoring can assist in developing more refined and accurate weather models for low altitude observations, which ultimately can enhance safety and reliability of small drone operations.

In order to utilize small drones for observation and monitoring of the lower boundary layer in a meaningful way, it will be necessary to move away from visual line of sight (VLOS) operations with ground crews and toward “one-to-many” and “unattended” operational scenarios. Therefore, “one-to-many” and BVLOS challenges are the significant regulatory hurdles to enabling widespread use of small drones for regular atmospheric vertical profiling on a scheduled and recurring basis. These “vertical atmospheric profiling” operations will represent a unique type of BVLOS mission and operation, since the small drones will often be tightly-constrained within a cylindrical volume of the lower altitudes, and the operations will occur on known intervals and schedules (such as regularly every half-hour or hour).

Improved weather observations will have two potentially quantifiable impacts: 1) potential reduction in lives lost due to severe weather (when wide-scale monitoring and observations are in practice and use and data can be successfully ingested into predictive weather models); and 2) improvement in planning and routing for operations like drone deliveries (reduction in the loss of platforms and payloads due to gustiness and low-intensity weather phenomena).

SPECIFIC RECOMMENDATIONS FOR CONGRESS

In conclusion, we need support and mandates from Congress to more efficiently transition the lessons that we learn from initiatives like the IPP and BEYOND into permanent reform to our regulatory system. We simply cannot remain in a regulatory state where operations are only enabled by limited case-by-case exemptions and waivers, since this is not a long-term practical approach to managing regular expanded aviation operations.

To accomplish this, I offer two specific recommendations for consideration to enable a safe acceleration of drones into the national airspace system. For additional recommendations, please see the Commercial Drone Alliance’s 2021 UAS and AAM policy priorities documents, included as an appendix to this statement.

First Recommendation: Codify the BEYOND Program and Provide Funding. The first recommendation that I offer is for Congress to codify the BEYOND program, and to provide a statutory foundation for the program with clear congressional direction and oversight. The BEYOND lead participants have made—and are making—substantial investments of resources, money and time to support research and testing to safely integrate drones into the national airspace. Any legislation addressing BEYOND should include provisions for reporting and accountability of the FAA directly to Congress. Although the legacy FAA drones test sites are eligible for grant funding from NASA and the FAA, the BEYOND lead participants are often excluded from consideration for funding from programs such as the UTM Pilot Program

⁸ <https://blog.nssl.noaa.gov/nsslnews/2009/03/us-annual-tornado-death-tolls-1875-present/>

(UPP). The BEYOND lead participants should also be eligible to receive funding from the FAA and NASA to support more generalized integration efforts and be allowed to fully participate in these initiatives. The BEYOND lead participants are making important contributions to a critical national policy challenge, and it is important that these entities be eligible for federal funding and support.

Second Recommendation: Enable Site-Specific Regular Operations. The second recommendation that I offer is to mandate that the FAA accelerate opportunities for communities and sites that can demonstrate the ability to safely scale regular operations, such as drone delivery. Some sites, such as The Choctaw Nation of Oklahoma, have already made significant investments in ground-based radar and other safety infrastructure and mitigations to support safe drone operations today. This can serve as an opportunity for industry to innovate and demonstrate economic viability by allowing these sites to move forward and scale their low-risk low altitude drone operations.

The Choctaw Nation of Oklahoma has made significant investments based on our own bold and ambitious vision and plans. We believe the future is bright, and that our quality of life can be enhanced by responsibly harnessing emerging aviation technologies. But we need the federal government's full support to ensure that these technologies flourish and provide the benefits to society that we strongly believe are possible.

APPENDIX

COMMERCIAL DRONE ALLIANCE'S 2021 UAS AND AAM POLICY PRIORITIES DOCUMENTS

POLICY PRIORITIES FOR 2021

PROPOSED EXECUTIVE ACTIONS FOR THE FIRST 100 DAYS OF THE BIDEN-HARRIS ADMINISTRATION

In January 2021, the Biden-Harris Administration will have a significant opportunity to leverage and enable the fast-growing commercial drone industry for the benefit of all Americans. The Commercial Drone Alliance¹ has identified several concrete actions the White House and Executive Branch can take on Day 1 or within the first 100 days of 2021 that will support the continued revitalization of the U.S. economy, keep Americans healthy, and enable a safe return to work—all while ensuring America's continued leadership in aviation innovation and enhancing the growth and development of the U.S. commercial drone industry.

Drones can provide extensive benefits and essential services to American citizens, consumers, and businesses, such as:

- Delivering critical supplies, life-saving medical equipment, and medicines;
- Assisting with fire, accident, public safety and natural disaster response, crop assessments, search and rescue missions, and newsgathering;
- Inspecting and monitoring railroad tracks, bridges, power lines, energy facilities, industrial equipment, wind turbines, communications towers, parked aircraft, and other critical infrastructure.

The commercial unmanned aircraft systems (UAS or drone) industry has been operating safely for years and has a strong history of working closely in collaboration with the federal government to safely and securely integrate drones into our National Airspace System (NAS). The executive actions proposed below will provide vast benefits to the American public while promoting safety and security, fostering the continued growth of the U.S. economy, enabling the U.S. to continue to lead the world in aviation innovation, and supporting the advancement of critical UAS, Urban Air Mobility (UAM) and other Advanced Air Mobility (AAM) technologies here in the United States. The actions we propose here are actions that can be taken by the Executive Branch in the short term focused on UAS industry growth; a separate CDA document proposes short-term executive actions to promote the UAM and broader AAM industry. CDA will follow up with longer term legislative priorities separately.

¹The CDA is an independent non-profit organization led by key leaders in the commercial drone industry. The CDA brings together commercial drone end-users, manufacturers, service providers, advanced air mobility companies, drone security companies, and vertical markets including oil and gas, precision agriculture, construction, security, communications technology, infrastructure, newsgathering, filmmaking, and more. The CDA works with all levels of government to collaborate on policies for industry growth and seeks to educate the public on the safe and responsible use of commercial drones to achieve economic benefits and humanitarian gains. Learn more at www.commercialdronealliance.org.

SUPPORT AMERICA'S COVID-19 RESPONSE

- *Enable Drone Delivery Operations at Scale.* Beyond vaccines and medical supplies, Americans are increasingly seeking contact-free delivery service. Industry is evolving quickly to meet these needs—but the regulatory frameworks struggle to keep pace. The Federal Aviation Administration (FAA) should accelerate efforts to integrate routine Beyond Visual Line of Sight (BVLOS) operations into the National Airspace System. To safely and broadly enable UAS delivery operations to communities in need, the White House should direct the FAA to provide a scoring matrix system that identifies criteria and assigns point values in order to create a transparent, predictable process for UAS operators to attain air carrier status. If necessary, the White House should direct the Office of Information and Regulatory Affairs to fast-track regulatory changes. Streamlining of UAS-critical processes will promote innovation while ensuring that technological and safety advances are implemented efficiently.
- *Broadly Enable Expanded Commercial Drone Operations.* Broadly enabling flights over people, BVLOS, and at night in a safe and secure manner is critical to unlocking the benefits of using drones for many commercial and public safety tasks, including buttressing the nation's COVID-19 response. This will also foster new job opportunities within the industry. The White House should require the FAA to enable a safe and workable framework for operations over people, including over moving vehicles. The White House should also direct the FAA to expeditiously prioritize expansion of true BVLOS operations by providing guidance and a detailed framework for building an acceptable safety case for such operations that do not require visual observers.
- *Unlock High-value, Low-Altitude Operations.* The Administration should unlock the airspace by starting from the ground up—literally. On Day 1, the President should issue an Executive Order directing the FAA to enable low-altitude BVLOS operations to inspect critical infrastructure across the country, such as bridges, energy facilities, and railroads. Low-altitude BVLOS operations would offer incredible value, enabling state DOTs and commercial operators to inspect infrastructure more effectively, at a lower cost, while maintaining social distancing requirements that have impacted inspection crews. BVLOS flights would be limited to a low altitude within close proximity of the operator. Authorizing commercial operators to conduct these operations within a framework designed to ensure safety would buttress our nation's COVID-19 response, propel innovation and efficiency and advance U.S. leadership in aviation.
- *Launch Vaccine Delivery UAS Rapid Response Task Force.* Once the nation has access to a vaccine to combat COVID-19, it will be critical to immediately distribute the vaccine to the vast majority of all Americans, including those in hard-to-reach areas. The Administration should launch a UAS Vaccine Delivery Rapid Response Task Force with a focus on the areas hardest hit by the coronavirus to enable UAS delivery of vaccines and other critical supplies to vulnerable and difficult-to-reach populations, including to remote, rural, and tribal areas. To ensure success of the program, the FAA must provide clear benchmarks for UAS vaccine delivery approvals to enable rapid response efforts.

PUT AMERICANS BACK TO WORK

- *Promote State/Local Planning for UAS Activities.* To put Americans back to work and enable innovation to prosper safely here at home, we must support state and local governments as they undertake strategic planning for “next-generation” infrastructure systems. As air transportation needs evolve, vertiports, dronepads, and digital systems will become increasingly necessary. Direct NASA and the FAA to work with industry to provide guidance to enable states and cities to plan for UAS/UAM activities. In addition, match funding and provide logistical support for state and local governments to pilot UAS/UAM infrastructure and other programs that promote innovation.
- *Grow U.S. UAS Manufacturing Capabilities and the Supply Chain System.* In an effort to put Americans back to work and promote American competitiveness, the White House should work with NASA, DOD, DOT, FAA, DOC and other agencies to immediately grow and fast-track UAS manufacturing capabilities in the United States. Relatedly, in order to stimulate the UAS marketplace, the White House should support NASA's ongoing efforts to build a reliable U.S. UAS supply chain system and to identify gaps and vulnerabilities in the current supply chain system for unmanned vehicles, as well as downstream components. Collaboration between the federal government and industry on these important issues is critical to open the industry safely and securely.

- *Launch Workforce Initiative to Transition Veterans into the Commercial Drone Sector.* Direct the FAA, Veterans Administration (VA), and White House to coordinate with private industry on the development of a program aimed at recruiting experienced veterans into jobs within the civil drone industry. This initiative would help put experienced veterans back to work and leverage their skills and knowledge to benefit the American public and the UAS industry.
- *Promote Diversity in the UAS Industry.* Work with and incentivize private industry to attract diverse talent to the fast-growing and emerging UAS industry. Ensuring a wide range of experiences, perspectives, and skills in the industry will grow the economy while providing better solutions and driving innovation and creativity for the benefit of the American public.

ENHANCE SAFETY

- *Empower the FAA's UAS Integration Office.* Empower the UAS Integration office to become the office of primary responsibility for most UAS-related waivers and approvals. The UAS Integration Office is a champion for safe and secure UAS integration, but currently lacks the internal authority necessary to maximize its effectiveness. The White House should immediately empower the UAS Integration Office to "own" certain regulatory approvals.
- *Implement a Comprehensive Remote Identification Framework.* Remote Identification (remote ID) is a crucial step towards expanded and scalable drone operations, which is the key to unlocking the enormous potential of commercial UAS operations here in the U.S. Implementation of a comprehensive remote ID framework that supports all airspace users will enable future development and commercialization of UAS operations.
- *Enhance UAS Industry Access to Spectrum.* The successful realization of the public benefits of UAS operations requires access to spectrum to ensure the full integration of UAS into the NAS, and the corresponding public benefits. The White House should direct the FCC to work quickly to enable all available communications technology for the industry, for the benefit of American society.
- *Prioritize UAS Experience in the Executive Branch.* In considering new political appointments, hire into senior positions within the White House and relevant executive branch agencies personnel that understand and appreciate the value and safety benefits of UAS operations to government, industry, and the American public.
- *Promote Global Standardization and Harmonization on UAS Regulations.* Global standardization and harmonization of requirements and approvals for the commercial drone industry will enhance safety and promote the ability of U.S. companies to operate and sell UAS-related products and/or technology abroad. Global standardization will also support U.S. companies in the global UAS industry supply chain.
- *Streamline FAA Processes Governing UAS Operations.* Streamline FAA processes to promote transparency, enhance regulatory accountability and consistency, and improve communication around regulatory approvals, which will promote safety and enable expanded operations that benefit the American public. The FAA's review process must recognize that small UAS (those below 55 pounds) present far lower levels of risk than manned aircraft. Indeed, many drones used to conduct highly valuable inspections of critical infrastructure weigh less than five pounds. Even so, the FAA continues to apply incongruous standards and approaches designed for manned aircraft to very small drones performing safe and highly effective operations. That must change. U.S. leadership in aviation and Artificial Intelligence hangs in the balance.
- *Appoint a Domestic Drone Interagency Coordinator.* Appoint a Domestic Drone Interagency Coordinator to coordinate, streamline, and improve efficiencies around interagency processes related to UAS integration. UAS is a fast-growing, high-value sector of the economy. At present, interagency disagreements sometimes linger longer than necessary. Although these disagreements are part of the governing process, a Domestic Drone Interagency Coordinator could help to forge consensus, respond to concerns, and drive the regulatory system and the industry forward. Creating such a position would advance innovation and maintain U.S. leadership in the rapidly expanding drone economy.
- *Implement UAS Traffic Management.* Direct the FAA to expeditiously implement UAS traffic management (UTM), which will safely enable new types of UAS operations in low altitude airspace. UTM is a critical safety and security tool comprised of services and protocols offered by qualified providers to drone operators, and it will enable advanced drone operations by digitalizing current air traffic control procedures. These services will help the drone industry to con-

duct operations Beyond Visual Line of Sight, deliver packages, inspect infrastructure, and conduct life-saving humanitarian missions. Early successes by the FAA and NASA have yielded globally-recognized UTM services and form the basis for international adoption. The United States should continue to support efforts to validate and operationalize the development of UTM capabilities and standards.

FOSTER INNOVATION AND COMPETITION

- *Enable Data Sharing to Lift Barriers to Commercial Drone Industry Growth.* Open the resources of the federal government to spur innovation, including by sharing radar and other relevant data collected by the federal government while maintaining appropriate privacy and security measures. Data-sharing will lift critical barriers to industry growth and enable the UAS industry to help respond to the COVID-19 crisis. Lack of access to federal government data has inhibited the ability to identify trends and leverage the collective experience of the UAS industry to drive innovation and commercialization. The White House should direct FAA to launch a joint working group with industry to identify key information needs, data priorities, and recommended access processes.
- *Enable Large UAS.* Large UAS have tremendous potential to conduct operations safely and economically with significant public benefits—from agricultural operations to natural disaster assessments, public safety activities to commercial delivery, to passenger transportation and much more. However, to enable these significant benefits, clarity is needed. The White House should therefore direct the FAA to expeditiously establish a clear regulatory roadmap and provide regulatory certainty for certification and operation of large UAS.

PROMOTE SECURITY

- *Protect Critical Sites.* UAS security is an issue of national importance. Section 2209 of the FAA Extension, Safety and Security Act of 2016 requires the FAA to establish a procedure by which operators or proprietors of fixed site facilities can prohibit or restrict the operation of UAS in close proximity to such facilities. Once implemented, this important requirement will enhance UAS security efforts, yet the deadline for rulemaking has come and gone. The White House should require the FAA to implement Section 2209 immediately.
- *Implement a “Known Operator” Program for UAS.* While innovation has moved quickly forward, policymaking has lagged behind. The White House should direct the FAA or DHS to implement a “Known Operator” program to enhance safety and security protocols, promote regulatory compliance and incentivize authorized commercial operators (or public safety operators) to proactively gain the trust of public officials and the public. This program will enable positive use cases for commercial UAS while prioritizing safety and security. Such a program could be similar in concept to the TSA Precheck system and the TSA Known Shipper Program.
- *Enhance Drone Security.* It is a national security problem that, notwithstanding security issues around rogue drone use at sensitive sites, private industry and state and local public safety agencies do not have the legal ability to broadly test various counter-UAS technologies here in the United States. The White House should seek authority to enable the safe expanded testing of counter-UAS technology. In doing so, the White House should direct the FCC to issue experimental licenses to counter-UAS providers to allow them to test radio frequency (RF) based counter-UAS systems in areas that will not interfere with the public.
- *Streamline Drone Security Efforts.* The national security agencies should publicly share a UAS Security National Plan to develop and review the federal government’s counter-drone capabilities with an implementation timeline, as well as relevant goals over the next five years. The National Plan would document counter-UAS and air domain awareness requirements, and provide an implementation plan inclusive of funding, programs, and support for appropriate expanded counter-UAS authorities.

PROMOTE U.S. LEADERSHIP IN AVIATION

- *Demonstrate Leadership in Global Aviation.* The United States must swiftly implement enabling UAS regulations, which are necessary to allow innovation to safely scale and to regain U.S. leadership in aviation innovation. It has been five years since there has been any significant regulatory action to enable drone use in the U.S., while other countries have raced ahead, including the European

Union, Canada, Australia, and many others. The White House can also demonstrate continued U.S. leadership in global aviation and UAS integration specifically by immediately appointing a U.S. representative to the International Civil Aviation Organization, a specialized agency of the United Nations which supports a safe, efficient, secure, economically sustainable and environmentally responsible civil aviation sector.

- *Integrate Drones into the NASA STEM Engagement Program.* Direct NASA to incorporate drones into its STEM Engagement Program, which is designed to build a diverse future STEM workforce by engaging students in authentic learning experiences with NASA people, content, and facilities. Work with industry to identify unique educational opportunities (such as university apprenticeships) and public outreach initiatives that will enhance public understanding of UAS operations and support the federal government’s ongoing efforts to enable safe and secure UAS integration.

URBAN AIR MOBILITY POLICY PRIORITIES FOR 2021

PROPOSED EXECUTIVE ACTIONS FOR THE FIRST 100 DAYS OF THE BIDEN-HARRIS ADMINISTRATION

In January 2021, the Biden-Harris Administration will have a significant opportunity to advance the adoption of new aviation technologies that add to our transportation solutions, reduce congestion along heavily burdened corridors, and demonstrate U.S. leadership in sustainable aviation technologies and innovation. Together these innovations unlock a new industry that can spur regional growth and U.S. jobs creation.

The Commercial Drone Alliance (CDA)¹ has identified several concrete actions the White House and Executive Branch can take on Day 1 or within the first 100 days of 2021 that will ensure America’s continued leadership in aviation innovation and facilitate the development of Urban Air Mobility (“UAM”) technology in the U.S. and shape the global policy and regulatory approach.

Electric vertical takeoff and landing aircraft (eVTOL) and other emerging clean-fuel aircraft technologies promise many benefits, including but not limited to:

- Reducing passenger travel times, surface congestion and overall transportation emissions through air taxi passenger flights in urban centers
- Connecting smaller communities to urban centers through new regional air mobility and complementing existing surface transportation systems by providing linkages to transit and intercity rail facilities
- Promoting economic development and local jobs through greater use of existing heliports and airports
- Improving mobility by integrating existing transit and regional commuter systems into multi-modal and multi-dimensional transportation platforms
- Additional applications including supporting emergency response during natural disaster emergencies and supplementing package delivery applications

Executive Branch actions that promote U.S. investment and leadership in UAM will advance a growing U.S. industry and sustain U.S. leadership in aviation. CDA recommends the following focused executive branch initiatives to continue to drive this innovation.

ESTABLISH UAM LEADERSHIP & GOVERNANCE

To enhance accountability and promote innovation, the Administration should immediately:

- *Create FAA Leadership Position and Office Dedicated to Urban Air Mobility.* Immediately establish an executive-level leadership position and office with responsibility for promoting UAM policy development and addressing UAM-specific considerations including aircraft and operator certification pathways, battery standards, infrastructure standards, airspace integration and management, and community engagement.

¹The CDA is an independent non-profit organization led by key leaders in the commercial drone industry. The CDA brings together commercial drone end-users, manufacturers, service providers, advanced air mobility companies, drone security companies, and vertical markets including oil and gas, precision agriculture, construction, security, communications technology, infrastructure, newsgathering, filmmaking, and more. The CDA works with all levels of government to collaborate on policies for industry growth and seeks to educate the public on the safe and responsible use of commercial drones to achieve economic benefits and humanitarian gains. Learn more at www.commercialdronealliance.org.

- *Prioritize UAM activities within the Office of Science and Technology Policy (OSTP).* Appoint a dedicated UAM Senior Advisor within OSTP to act as a liaison between industry and federal agency UAM leads. Create regular forums to advance public-private partnership initiatives.
- *Establish UAM Advisory Panel for DOT.* Direct the Secretary of Transportation to assemble a UAM Advisory Panel composed of a diverse group of industry, local, state and Federal stakeholders to examine the state of the industry, identify gaps in relevant policy/regulations, and make recommendations on ways DOT can advance progress.
- *Pursue Public-Private Partnerships and Flexible Regulatory Pathways.* Demonstrate continued commitment to U.S. investment and leadership in emerging aviation technologies through industry-government collaboration. Advance UAS/UAM integration in the National Airspace System through support for initiatives such as the U.S. Air Force's Agility Prime.
- *Demonstrate Leadership in Global Aviation.* Appoint a U.S. representative to the International Civil Aviation Organization (ICAO) to demonstrate global leadership in developing standardized and harmonized approaches for airspace and infrastructure.

SUPPORT INFRASTRUCTURE DEVELOPMENT

Especially in the era of COVID-19, the Administration can spur job growth in state and local communities, and support the UAM/aviation industry, by taking the following steps:

- *Expand Federal Financing Eligibility to Aviation.* Expand Transportation Infrastructure Financing Improvement Act (TIFIA) financing program eligibility to airports, cities and developers seeking to build out physical infrastructure to support UAM operations.
- *Promote R&D by Enabling eVTOL Aircraft Testing at Federal Facilities.* Sponsor access to FAA, NASA and DOD flight test facilities for eVTOL aircraft test programs to unlock data collection and research opportunities.
- *Launch a National Vertiport Demonstration Challenge.* Establish a National UAM Vertiport Development Challenge through a joint FAA-industry-localities working group that supports early identification of sites and the development of prototype vertiport facilities through a competitive process.
- *Provide Grant Funding for Innovative Multi-Modal Infrastructure Projects.* Expand the US DOT's Better Utilizing Investments to Leverage Development ("BUILD") discretionary grant program (previously the TIGER grant program) eligibility to support State and local innovative multi-modal infrastructure projects that would provide facilities to serve transit, commuter rail, and/or intercity rail, and air transportation in a combined facility. Consider a specific carve out of annual BUILD awards to support multi-modal advanced aerial mobility projects (passenger or freight) to enable UAS infrastructure.
- *Ensure Data Communications Access.* Support the safe and scalable integration of UAM into the National Airspace through equitable access to both refarmed and new Spectrum licenses.
- *Fund FAA eVTOL Noise Research.* Resource and initiate collaborative research to define appropriate noise metrics and methodologies for use in assessing community impacts associated with electric aircraft.
- *Grow U.S. UAM Manufacturing Capabilities and the Supply Chain System.* In an effort to put Americans back to work and promote American competitiveness, the White House should work with NASA, DOD, DOT, FAA, DOC and other agencies to grow and fast-track UAM manufacturing capabilities in the United States. Relatedly, in order to stimulate the UAM marketplace, the White House should support NASA's ongoing efforts to build a reliable U.S. UAM supply chain system and to identify gaps and vulnerabilities in the current supply chain system for unmanned vehicles, as well as downstream components. Collaboration between the federal government and industry on these important issues is critical to open the industry safely and securely.

INVEST IN FUTURE UAM WORKFORCE

To create good-paying jobs here in the United States and support the workforce, the Administration should:

- *Promote STEM Programs in Emerging Aviation Technologies.* Promote STEM initiatives focused on UAM infrastructure, battery technology, vertical flight, autonomy, and more to advance interest in emerging technologies and provide diverse workforce opportunities.

INSTITUTE UAM SAFETY STANDARDS

Safety is always paramount when promoting innovation. To that end, the Administration should work right away to:

- *Implement Recommendations on Safety Management Systems (SMS)*. Implement recommendations of the Special Committee Report on Aircraft Certification that were delivered to the Secretary of U.S. DOT earlier this year.² Establish a formal mechanism for government-industry collaboration to develop voluntary safety programs specific to UAM based on those that have delivered proven safety benefits to traditional aviation operations.

Mr. LARSEN. Mr. Grimsley, thank you for your testimony.

I will now turn to Mr. Adam Bry of Skydio. Mr. Bry, you are recognized for 5 minutes.

Mr. BRY. Chairman Larsen, Ranking Member Graves, and members of the subcommittee, thank you for the opportunity to be here today.

We meet at the dawn of a new era in flight. Electric propulsion and autonomy will transform aviation, and small drones are at the forefront. This new class of small, electric drones will have a profound impact on our economy and our national security. The countries that lead the way will help to define this new era. Even though the drones are small, the stakes are high.

For the recent past, the drone industry has been dominated by manually controlled drones that are hard to fly and easy to crash. Eighty percent of these drones are made by companies based in China and come with a slew of cybersecurity concerns. Many have assumed it will always be this way, but much like the shift from flip phones to smart phones, the drone market is ripe for a transition from hardware-defined products to software-enabled solutions. And just as with phones, there is an opportunity for U.S. companies to lead the way with the potential to create tens of thousands of jobs here in the U.S.

I believe drones hold the promise of making our world dramatically better: safer, more creative, and more productive. And that the key to realizing that promise is making drones smart enough to fly themselves. That is why my cofounders and I started Skydio in 2014.

Skydio is a software and artificial intelligence company. Our drones use computer vision and AI to build a real-time 3D map of the environment, avoid obstacles, and automate complex tasks. Thanks to an incredible team, we are now the largest U.S. drone manufacturer and a world leader in autonomous flight. We have grown to employ hundreds of people across the country, but we are still small compared to the total opportunity.

Having a strong domestic drone industry is important for our security, economy, and values. Once viewed as consumer toys, drones have become essential tools for a wide range of applications including national defense and inspecting critical infrastructure. Our customers include roof inspectors that use drones to assess damage after storms, rather than them climbing the roof and putting themselves in danger.

Telecom inspectors use drones to create digital twins of cell phone and transmission towers while remaining safely on the ground. As one of our customers put it, "When you use a drone for

²<https://www.transportation.gov/sites/dot.gov/files/2020-01/scc-final-report.pdf>

these inspections, you're not reducing an injury, you're reducing a death."

We manufacture our drones in the U.S., building thousands per month. This gives us the fastest development times, the highest quality, and the highest levels of supply chain security. The more the market relies on American companies, the more jobs we will create in the United States, and the more we will be able to trust drones to keep our data secure. We should also ensure that taxpayer funds support U.S. jobs. For example, DoD's Blue UAS Program has boosted the industry by relying on domestic drone companies like Skydio to equip our soldiers with the most advanced drone technology.

Most importantly, the stronger the domestic drone industry, the more this technology will reflect democratic values. In 2020, Skydio became the world's first drone company to issue a set of ethical principles to guide our work. We consider the holistic impact of our products with particular focus on privacy and civil liberties.

This committee is considering a generational investment in America's infrastructure. In addition to investing in the infrastructure itself, this committee has a profound opportunity to improve the way we maintain it. To ensure the safety of America's infrastructure, inspectors put themselves in harm's way by climbing towers, repelling from bridges, and riding in gas-guzzling bucket trucks, which sometimes tip over.

Drones revolutionize infrastructure inspection, getting better data with a fraction of the cost, risk, and carbon footprint. That is why almost every State department of transportation has started a drone program. Congress has an opportunity to capitalize on those benefits, including by enacting a grant program for infrastructure inspection. The program would enhance safety and efficiency by providing grants to State and local agencies to inspect America's highways and bridges with drones. It can also offer grants to educate workers on drone technology.

Whether this new era of aviation is led by the U.S. or other nations will depend on a regulatory approach. The key is to unlock the airspace from the ground up, enabling workers to inspect America's infrastructure with small, light drones flying low to the ground and beyond line of sight. These operations can be conducted safely now as demonstrated by North Carolina DOT's groundbreaking statewide waiver to inspect bridges using Skydio drones.

I am grateful to the committee for holding this hearing. Working together, we can ensure the United States leads this new era of aviation, providing extraordinary benefits for our economy, our security, and our infrastructure. Thank you.

[Mr. Bry's prepared statement follows:]

Prepared Statement of Adam Bry, Chief Executive Officer, Skydio, Inc.

Chairman Larsen, Ranking Member Graves, members of the Subcommittee, thank you for the opportunity to appear before you today. We meet at the dawn of a new era in flight. Electric propulsion and autonomy are transforming aviation as we know it. Small drones are at the forefront of both of these trends. The technologies, regulations, companies, and countries that lead the way with small drones will help to define this new era. Even though the drones are small, the stakes are large.

I am the co-founder and CEO of Skydio, an American company on the front lines of this transformation. Founded in 2014, Skydio is now the largest U.S. drone manufacturer by volume and a world leader in autonomous flight. Our customers include consumers creating amazing videos, construction companies tracking project progress, state departments of transportation inspecting infrastructure, energy utilities monitoring transmission lines, public safety agencies responding to emergencies, and U.S. and allied soldiers observing battlefield threats. In each of these applications, drones are helping to make our world more productive, creative, and safe.

My own aviation journey began 20 years ago when I began building and flying remote controlled (R/C) aircraft, eventually winning a national championship in R/C aerobatics. This hobby fueled a passion for engineering. I studied mechanical engineering at Olin College, and received my master's in aerospace engineering at MIT. There, I helped to pioneer autonomous flight for drones, transferring my skills as an R/C pilot into software that enables drones to fly themselves. After graduating, I co-founded Google's drone delivery program.

In 2014, my co-founders and I started Skydio. We saw the potential of drones to transform a wide range of industries and applications. We believed that autonomy—the ability for a drone to fly itself and perform complex tasks on its own—is essential to realizing the promise of drones. Skydio is a software and Artificial Intelligence (AI) company at heart. Skydio drones use advanced computer vision and AI to build a real-time, 3D map of the environment, plan collision-free paths around obstacles, and automate complex tasks. We build hardware that embodies and accentuates our software.

The drone industry has long been defined by manually controlled drones manufactured at low cost in China. But this is not the future. In the early 2000s, Nokia held a dominant position in the global cell phone market. In 2007, Apple released the iPhone, a software-centric device that made phones infinitely more useful by making them more intelligent. Apple not only captured market share, but dramatically grew the market for phones globally. We believe the drone industry is ripe for a similar transition, and there is an opportunity for U.S. companies to once again lead that revolution.

Today we consider how to capture the benefits of this transformation. This Committee will play a profoundly important role in setting the conditions for U.S. leadership in aviation and safety. To assist the Committee, I will outline my views on the strategic importance of the domestic drone industry, how to harness the full potential of drones to keep America's aging infrastructure safe and resilient, and how to shape a regulatory system designed to ensure U.S. competitiveness and safety.

I. PLAYING TO AMERICA'S STRENGTHS: THE STRATEGIC IMPORTANCE OF THE DOMESTIC DRONE INDUSTRY

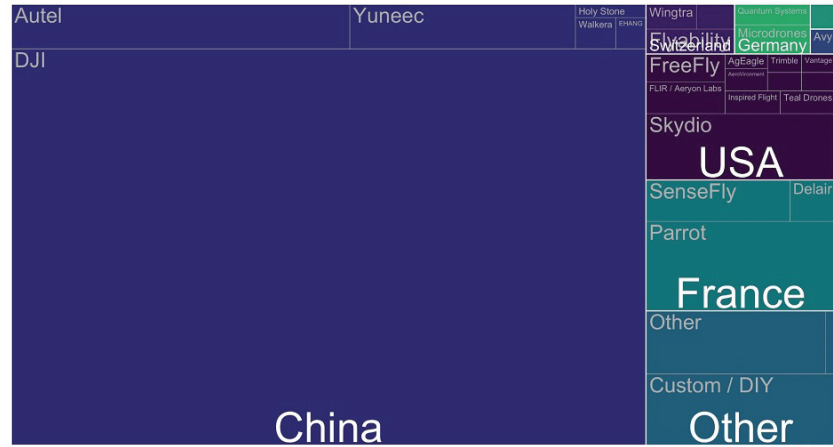
The story of the domestic drone industry has been defined by struggle. For example, GoPro, a multi-billion-dollar company, launched a consumer drone to great fanfare. Then their drones started falling out of the sky. GoPro soon shuttered their drone business. Sensational headlines followed. "The dream of an American drone may be dead," one headline speculated. Analysts suggested that when it came to "engineering [drones] in the US," we should "forget about it."

That advice appeared well-founded. Before GoPro exited the market, another U.S. company, 3D Robotics, launched a drone called the Solo that sold thousands of units with features similar to Chinese drone company DJI. Then DJI began to "turn the screw," massively lowering the prices of its own products," and "dropping the bottom out of the market." 3D Robotics stopped making drones, deciding instead to design software for use on the very Chinese drones that pushed them out of the market. PrecisionHawk, another promising company that once testified before this committee, also left the hardware market to make software for use on DJI drones (and drones made by other companies).

Today, companies based in China dominate the U.S. market with more than 80% of the market share. DJI alone accounts for approximately 70% of the market. As the following graphic reveals, the domestic drone market is unlike almost any other.

2020 Drone Hardware Landscape

Brand market share, by country of origin



Source: DroneAnalyst 2020 Drone Market Sector Report



a. America's Advantage

However unhealthy the market may be, reports of the death of the domestic drone industry are greatly exaggerated.

The way to build a sustainable and secure domestic drone industry is to embrace areas of natural advantage. In the past, domestic drone companies sought to beat foreign competitors at their own game: producing commodity hardware devices, sometimes even making them in China and selling them here.

In today's crowded and competitive marketplace, dominated by foreign firms, homegrown companies will succeed when they focus on areas where the U.S. holds an advantage, such as AI. As graduate students, my co-founders and I studied at MIT's Computer Science and Artificial Intelligence Lab (CSAIL)—one of the world's leading centers for AI research. Our research in advanced navigation was funded, in part, by the Army Research Laboratory and the Office of Naval Research. CSAIL's roots trace back to the early days of the U.S. space program, where America led the way in sensor fusion software and navigation computers that enabled us to land on the moon. At MIT, we built a fixed-wing aircraft capable of flying itself autonomously through a parking garage. Skydio's technology grew out of that early research and experimentation. We hope to be another success story in the tradition of our nation's commitment to basic research.

Today, Skydio has experienced incredible growth based on the demand for our AI-powered drones. From state departments of transportation, to fire departments, to federal agencies, we are fortunate to have hundreds of public sector customers that are excited to have an American drone alternative to DJI, and even more excited about getting more powerful products with the benefits of autonomy. Our customers are at the center of our success.

Skydio is also proud to support our service members. The Defense Innovation Unit and other forward-leaning government initiatives have helped us connect with military end users, in whose hands our products can save lives. The U.S. Army, for example, recognized that consumer and commercial drone products were racing ahead of traditional defense systems. Rather than acquire expensive and outdated technology from traditional defense contractors, the Army launched a new effort, the Short Range Reconnaissance Program, to equip soldiers with world-leading technology produced here at home.

On the strength of that demand, we have grown from employing three people to hundreds of people across the country. We design and assemble thousands of drones a month in the United States. And we are expanding rapidly around the world. With every drone we sell, and every new employee we hire, we disprove the myth that American companies cannot compete in the domestic drone market. American companies can compete—and win. The key is to focus on areas of asymmetric advantage—and no area provides more of an advantage than AI.

b. *The Strategic Importance of the Domestic Drone Industry*

Maintaining a viable domestic drone manufacturing base matters for three reasons.

Creating Good-Paying Jobs, Benefiting the Economy: The small drone market has a big economic impact. According to Levitate Capital, “The global drone economy will grow from \$15B to \$90B by 2030.” The U.S. represents the largest share of that market, with an overall size of \$8B in 2020, growing to \$16B in 2025, and \$34B in 2030.

Right now, more than 70% of the true value of that market is held by foreign companies. *The more the market relies on American companies that produce their products at home, the more high-skill, good-paying domestic manufacturing jobs we can bring back to the United States.* That goal deserves bipartisan support.

In addition to hiring U.S. workers, U.S. drone manufacturers support domestic component suppliers. For example, the Skydio X2 uses a breakthrough carbon fiber component produced by Arris, a U.S. startup based in California, that would have otherwise required 17 separate parts. Skydio is proud to be the first commercial customer of Arris, which manufactures its components in the U.S.

Protecting National Security: Once viewed as little more than consumer toys, drones have become essential tools for a wide range of applications, including national defense and inspecting critical infrastructure. Depending on a strategic competitor to meet the nation’s technology needs is neither healthy nor prudent.

To be clear, the Chinese government represents the central threat, not Chinese companies. The Chinese government has the legal ability to demand data from Chinese companies operating anywhere in the world—without due process and the rule of law. DJI officials have acknowledged, under oath, the company’s obligation to comply with those requests. Basic cybersecurity standards cannot buy down that risk.¹ That is why Congress prohibited DOD, in the Fiscal Year (FY) 2020 National Defense Authorization Act (NDAA), from procuring drones manufactured in China. We support legislation extending that common-sense approach to other federal agencies.

Ultimately, the only way to trust a digital device is to trust the company that developed it and the legal framework in which they operate. That is something Skydio takes seriously. We design, assemble, and support all of our products in the U.S. We develop our software in-house and source our processors from U.S. companies. The result is a homegrown aircraft that reflects the best of American innovation, trustworthiness, and craftsmanship.

As a result of Skydio’s commitment to supply chain and cyber security and high level of product performance, the U.S. Defense Department named Skydio one of a handful of “Blue sUAS” companies in 2020. DOD also determined that Skydio’s flagship enterprise product, the Skydio X2, complies with the rigorous supply chain security restrictions in the FY20 NDAA provision mentioned above.

Our Values: Most importantly, the stronger the domestic drone industry, the more this critical area of emerging technology will reflect democratic ideals and values.

The final report of the National Security Commission on AI recognizes that the U.S. finds itself in an “AI competition” with an emboldened China. According to the Commission, “The AI competition is also a values competition. China’s domestic use of AI is a chilling precedent for anyone around the world who cherishes individual liberty. Its employment of AI as a tool of repression and surveillance ... is a counterpart to how we believe AI should be used.”

Months before the release of the Commission’s report, the U.S. Commerce Department placed DJI on the entity list for supporting China’s suppression of the Uighur people in Xinjiang. The listing noted the nexus to “widescale human rights abuses within China ... or high-technology surveillance, and/or ... the export of items by China that aid repressive regimes around the world.”

¹In characterizing the risks presented by DJI drones, the former Undersecretary of Defense for Acquisition, Ellen Lord, acknowledged that the Defense Department “know[s] that a lot of the information is sent back to China.” Billy Mitchell, *Pentagon plans drone event for new VC, startup matchmaker program*, Fedcoop, Aug. 28, 2019, <https://www.fedcoop.com/dod-uas-drones-trusted-capital-marketplace-program-ellen-lord/>. See also Frank J. Cilluffo (Auburn University), Testimony to the U.S. House of Representatives Committee on Transportation and Infrastructure, Hearing on the Impacts of State-Owned Enterprises on Public Transit and Freight Rail Sectors, p. 3–4, May 16, 2019, <https://transportation.house.gov/imo/media/doc/Testimony%20-%20Cilluffo.pdf> (“Chinese [drone] companies, for example, may be legally required to help advance the mission and goals of China’s security and intelligence services. The use of UAS also raises the prospect of cyber/physical convergence, whereby cyber tools and operations may be invoked (particularly by an adversary with hostile intent) to generate kinetic or real-world consequences.”).

That underscores the importance of U.S. leadership in the drone industry. If we want this technology to align with our values, we must lead the way. At Skydio, we believe companies that make the world's most advanced products have a responsibility to shape the norms and standards that govern their use. That is especially true with respect to AI. In 2020, Skydio became the world's first drone company to issue a set of policy and ethical principles—the Skydio Engagement and Responsible Use Principles—to guide our work and move the industry forward. These principles capture our commitment to considering the holistic impact our products will have on communities and countries. They also convey Skydio's core values of accountability, transparency, and the protection of privacy and civil liberties.

II. HARNESSING THE POWER OF DRONES TO KEEP AMERICA'S INFRASTRUCTURE SAFE AND RESILIENT

This Committee is considering a generational investment in America's infrastructure. In addition to investing in the infrastructure itself, this Committee has a profound opportunity to reimagine the way to maintain it.

America's infrastructure is aging. Although examples of crumbling infrastructure are not in short supply, the nation's bridges have become the symbol of infrastructure decay. According to the American Society of Civil Engineers, "Currently, 42% of all bridges are at least 50 years old."

We cannot rebuild our way out of this crisis. The President's American Jobs Plan is ambitious in scope, but it calls only to replace approximately 10,000 of the 46,154 bridges that America's civil engineers consider structurally deficient. A serious maintenance backlog makes the problem more pernicious.²

The way to reimagine our infrastructure is to make our existing infrastructure more *resilient*. As recommended by ASCE, we must prioritize "existing deterioration" and "focus . . . on preventive maintenance." Inspections are at the heart of preventive maintenance. The older the infrastructure, the more it must be inspected, and the more accurate and efficient the inspections must become.

That is exactly why 49 of 50 states have adopted drone programs primarily to inspect critical infrastructure. Drones offer three critical benefits in the journey to infrastructure resilience.

a. Drones Protect Workers, Drive Efficiency, and Slash Carbon Emissions

Protecting Workers: Inspecting infrastructure can be a dangerous job. To ensure the safety of America's infrastructure, inspectors "put themselves in harm's way by climbing towers, rappelling from bridges, and riding in bucket trucks" (which sometimes tip over).

By contrast, inspectors equipped with drones can examine every part of an infrastructure asset—including areas not visible to the naked eye—without exposing themselves to danger. Capitalizing on that capability, state departments of transportation have begun to equip their bridge inspectors with drone technology.

North Carolina Department of Transportation (DOT), a partner and customer of Skydio, has become a national leader in the employment of drone technology for bridge inspection and other purposes. Eric Boyette, North Carolina's Secretary of Transportation, has stated that, "Drones are a fantastic new tool for our Bridge Inspection Units. Safety is our top priority at NCDOT, and this new system helps improve the safety of not only our bridges and other infrastructure, but of our inspectors as well."

The American Society of Mechanical Engineers has observed that "drones can perform hazardous inspections and maintenance scans much more quickly and with greater ease, lessening the perils on the American worker." To that end, Sundt Construction uses Skydio's autonomous drones to inspect "very tight, claustrophobic, and dangerous areas where you wouldn't want to put a human," such as "high-pressure, high-temperature systems." According to Dean Miller, Sundt's Virtual Construction Engineer,

When you use a drone for these inspections, you're not reducing an injury, you're reducing a death. With human inspections, the construction industry has been able to reduce the injury rate over the years, but the death rate has stayed the same—when something explodes in these environments, there is no coming out of that. Because the Skydio can fly into these areas that would be impossible with other drones and capture that data for us,

²According to ASCE, "A recent estimate for the nation's backlog of bridge repair needs is \$125 billion. Estimates show that we need to increase spending on bridge rehabilitation from \$14.4 billion annually to \$22.7 billion annually, or by 58%, if we are to improve the condition. At the current rate of investment, it will take until 2017 to make all of the repairs that are necessary."

we can effectively reduce that death rate. A drone is around \$1,000, but a human life is priceless.

Driving Efficiency: According to a 2019 AASHTO survey, 29 state departments of transportation have found that drones are “helping them save money.” Drones drive extraordinary levels of efficiency—empowering existing workers to be more productive while creating an entirely new career field of drone operators.

In the case of a freeway bridge inspection, AASHTO estimates that the average manual inspection costs \$4,600, takes 8 hours, and imposes \$14,600 in social costs while the bridge is closed. Drone inspections of the same bridge cost an average of \$1,200, take only 1 hour, and impose far lower social costs. Along those lines, Ohio estimates that its drone bridge inspection program could save almost \$1.7 million in state funds over four years.

Consider “as-built” inspection of construction sites, which is critical to ensuring that construction projects do not require rework. As Danielle Gagne recently discussed in *Commercial UAV News*, rework can account for 4–9% of the cost of the average construction project.³ Drones—and especially autonomous drones—offer high levels of value, automating a process that can be time-consuming, complex, and costly. Accurate Drone Solutions, a drone service provider specializing in construction, has found that switching from manual drones to Skydio’s autonomous drones allowed them to perform as-built assessments 66% faster and increase the frequency of cost-saving inspections on their clients’ job sites.

As automation increases, it will become possible to create and maintain full “digital twins” of every piece of infrastructure, and update them frequently as drones autonomously capture imagery of entire structures. This will enable early detection and tracking of potential issues with preventative maintenance, further increasing efficiency.

Slashing Carbon Emissions: Reliant on electric propulsion, drones significantly reduce carbon emissions compared to traditional methods. Helicopters “burn more fuel and emit far more CO₂ emissions than cars do over the same distance.” Under-bridge inspection vehicles fare only slightly better, achieving around 5 mpg. Drones shatter this paradigm. *If a state with 14,000 bridges could inspect 5,000 of them using drones, the carbon savings would be equivalent to removing 1,000 cars from the road.*⁴

The environmental benefits of drones will compound over time: as drone use becomes more common, the benefits for our air and environment will increase.

b. Drone Infrastructure Inspection Grants (DIIG)

To capitalize on these benefits, Congress should enact a Drone Infrastructure Inspection Grants program. Administered by the Secretary of Transportation, the program would consist of two pillars:

- *Promoting Infrastructure Resilience:* The first pillar would provide grants to state and local agencies allowing them to capture these benefits by implementing advanced drone technology for infrastructure inspection. State DOTs could apply for funding necessary to scale the use of drones—purchasing equipment and standing up program management capability—to inspect America’s highways and bridges, handing inspectors a powerful new tool to drive safety and efficiency.
 - With 49 of 50 state DOTs already using drones to inspect infrastructure, state DOTs understand the value of drone technology. But, in the face of budgetary shortfalls, state DOTs have had trouble scaling their programs. By enacting the DIIG program, Congress would ensure that state and local inspection personnel have access to the transformative technology and talent necessary to protect workers, our environment, and provide new levels of infrastructure safety and efficiency—while promoting U.S. leadership in emerging technology.
- *Education and Training:* The second pillar would offer grants to community colleges and other public educational institutions to educate workers on drone technology. The program would position a new generation of workers to capitalize on new economic opportunities created by drones.

³ Gagne, Danielle, *Why America’s Infrastructure Needs the Drone Industry*, Commercial UAV News, April 21, 2021, <https://www.commercialuavnews.com/infrastructure/why-america-s-infrastructure-needs-the-drone-industry>.

⁴ Internal analysis. Key factors: Snooper trucks achieve approximately 5 mpg fuel economy; average round trip inspection distance estimated at 225 miles; drones are fully electric.

This program could form the foundation of an approach to infrastructure that prioritizes long-term resilience by making inspection easier and more effective than ever.

III. LEADING THE SECOND CENTURY OF AVIATION: ENABLING U.S. COMPETITIVENESS, ENSURING SAFETY

When asked what is holding the drone industry back, the answer is often “regulations.” There are elements of the regulatory framework that should be improved, some of which I will discuss today. But, overall, the arc of regulations bends in the direction of integration and progress, and is reasonable given the state of manual drone technology. Most encouragingly, we are seeing signs of regulators recognizing the benefits of autonomy for unlocking safe, reliable operations.

As an example, last year the FAA granted NCDOT a breakthrough waiver to fly Skydio drones beyond visual line of sight (BVLOS) to inspect bridges. Unlike past waivers, this one applies statewide and does not require the use of visual observers. Skydio’s autonomy technology enables bridge inspectors to fly BVLOS more confidently than when piloting manual drones, which cannot avoid obstacles on their own. That waiver demonstrates the important role that industry plays in advancing regulations. If we want the FAA to permit drone operations beyond line of sight, we should build drones capable of navigating complex environments safely and efficiently.

As technology improves, we should ask how the regulatory system can improve alongside it. To answer that question, we need to understand that we have entered a new century of aviation. The first century of flight was defined by crewed aviation. From the windy hills of Kitty Hawk to the airliners that criss-cross our sky today, our aviation system has revolved around the notion of a pilot onboard and at the controls.

We have now entered the second century of aviation. This century will be defined by uncrewed, and increasingly autonomous operations. The nations that embrace this new paradigm will experience massive economic and societal benefits—from safer work environments to more efficient infrastructure. But other nations are not content to let the United States lead the second century of aviation in the same way we led the first.

There are two principles necessary for the U.S. to continue its historical leadership role and take our economy and society to new heights. Those principles are symbolized in the acronym, “UP.”

1. Unlocking the Airspace from the Ground Up: The vast majority of commercially valuable drone operations occur at very low altitudes in close proximity to infrastructure. When inspecting infrastructure, operators generally need to fly *just* beyond line of sight and *behind* the object under inspection. Recognizing that reality, the first principle calls for regulatory changes designed to unlock the airspace *from the ground up*—enabling the low risk, low altitude, high-value BVLOS operations necessary to inspect America’s infrastructure at scale.
 - a. *America risks falling behind*: When it comes to enabling BVLOS operations, the European Union has created a regulatory pathway, known as the “specific category,” designed to enable routine commercial BVLOS operations. The “specific category” intends to fill the gap between the general regulation that allows flights within visual line of sight, on the low end, and the type certification of large drones for more complex operations, such as the transport of passengers, on the high end. In addition, Europe has proposed “standard scenarios” designed to permit BVLOS operations that fall within certain, low-risk parameters. Australia has also released “standard scenarios” to enable BVLOS operations, including low-altitude infrastructure inspection. However in the US, we have yet to fill the “missing middle” between Part 107 (which allows flights only within visual line of sight) and type certification.
 - b. *These operations are safe*: These operations can be safely conducted today, as demonstrated by NCDOT’s statewide bridge inspection waiver in the U.S. Along those lines, global regulators have recognized that drone operators are very unlikely to encounter crewed aircraft at low altitudes, such as the “atypical airspace” in the vicinity of natural or artificial obstacles (e.g. within 100 feet of structures or terrain).⁵ That is where we should start: enabling

⁵ See, e.g., Joint Authorities for Rulemaking of Unmanned Systems, *JARUS Guidelines on SORA* (Specific Operational Risk Assessment), Annex I: Glossary of Terms, p. 5, definition of “atypical airspace,” http://jarus-rpas.org/sites/jarus-rpas.org/files/jar_doc_06_jarus_sora

small, smart, low-weight, drones to fly BVLOS while remaining close to the ground and structures. After mastering those operations, we can begin to enable more complex operations with larger aircraft at higher altitudes and longer range.

2. Promoting pathways for increasing levels of autonomy while protecting safety: The second principle calls for regulators to provide pathways for drones to exercise increasing levels of autonomy.
 - a. *Why:* First, autonomy is critical to safety. Trustworthy autonomy enables drones to conduct complex operations while avoiding obstacles that even the most proficient pilots may miss. Second, autonomy is critical to scalability. The same trustworthy autonomy technology that today allows drones to fly inside bridge trusses and transmission towers will one day enable Advanced Air Mobility (AAM) vehicles to shuttle cargo and people safely between cities. Without autonomy, the AAM revolution risks becoming a tool for the wealthy few, rather than an enabling technology for the many.⁶
 - b. *How:* In order to maintain U.S. leadership in emerging technology and aviation, we must enable autonomous operations. We can start small—but we have to start somewhere. If we fail to act, autonomy pioneers will take their talent and investments overseas. Congress could begin by directing the FAA to enable limited autonomous operations within the context of a pilot program that would bring together public and private partners, much like the current FAA BEYOND program, but focused on autonomy. Operations could begin at low altitude in remote areas, and scale up from there. The most important thing is to get started—soon.

IV. CONCLUSION

I am grateful to the Committee for focusing on the future of U.S. leadership in aviation. This Committee deserves great credit for helping to cultivate a regulatory system that promotes both safety and innovation. Working together, we can ensure the United States leads the second century of aviation—providing extraordinary benefits for our economy, workers on the front lines of the infrastructure crisis, and all Americans.

Mr. LARSEN. Thank you, Mr. Bry. I appreciate that very much. I now want to turn to Mr. Harter. Mr. Harter, you are recognized for 5 minutes.

Mr. HARTER. Mr. Chairman and members of the subcommittee, I would like to thank you for the opportunity to testify today.

My name is Pierre Harter, and I am director of research and development for the National Institute for Aviation Research at Wichita State University. I will start with some background.

After dominating in the 20th century, the U.S. aerospace industry continues to be a world leader in this century as well. The gap has closed significantly in the commercial aviation sector, hastened by the pandemic and the MAX grounding. Significant competition remains and is growing. U.S. general aviation continues to slowly recover from the shock of the 2009 financial crisis and other factors with significant consolidation in the sector and continued pressure from international competition.

In the defense industry, the U.S. continues to maintain air dominance. The global arms race for unmanned aerial systems and hypersonics is well underway, spurring innovation that will impact the aerospace industry for years to come.

annex_i_v1.0.pdf#page=5. JARUS, a consortium of global regulators, recognizes that drone operations within “atypical airspace” in close proximity to structures and terrain generally do not require additional airspace risk mitigation measures.

⁶Skip Descant, *Flying Taxis: Experts Balance Enthusiasm Against Reality*, Government Technology, Sept 11, 2020, <https://www.govtech.com/fs/Flying-Taxis-Experts-Balance-Enthusiasm-Against-Reality.html> (quoting Dan Dalton, VP of Global Partnerships, Wisk) (“In order for this industry to scale, we really believe that this has to be a self-piloted aircraft.”).

The U.S. aerospace supply chain is still in a precarious position, recovering from multiple recent global shocks.

In aerospace manufacturing, transformation is well underway and will accelerate as we emerge from the pandemic. This transformation has been both physical and digital, across existing production lines, as well as sustainment of legacy fleets, incorporating new technologies and innovations in areas such as automation, digital engineering, Industrial Internet of Things, artificial intelligence and other technologies.

Now let's focus on the importance of innovation. Aviation has always been a source of innovation and inspiration going back to the Wright brothers' first flight in 1903. In many ways, the next two decades hold the promise to transform our daily lives as significantly as that event did for the 20th century.

Advanced aerial mobility and supersonic flight will create new travel paradigms and provide us with unprecedented global and local connectivity. Unmanned aerial systems technology will provide new and faster methods for delivering goods and services, transforming business-to-business and business-to-consumer transactions.

Electric technologies will provide cleaner, quieter, and more efficient propulsion systems. Continued advancements in composite materials, added to manufacturing and production system technologies, will increase efficiency and reduce costs across all of aerospace.

Safety must of course remain at the core of all aviation related innovations but must be balanced by enabling new technologies to enter the market efficiently, which inherently enhances safety.

To remain the world leader in aerospace, the United States must continue to evolve and execute a strategic plan to create an environment that allows U.S.-based companies to innovate and be first to market with these new technologies while maintaining safety and security. We must continue to embrace strong public-private partnerships to establish the strategic framework and shape the regulatory environment. In addition, we must invest in research and development that enables new designs, products, materials, and manufacturing technologies that enable U.S. businesses to efficiently design, certify, and manufacture the most advanced air vehicles of the future.

Wichita State University's National Institute for Aviation Research has a proven track record for supporting industry and Government agencies in developing, certifying, and bringing new technologies to market, as well as preparing the workforce for the future.

Since its inception in 1985, NIAR has made a name for itself as the most capable university-based aviation research center in the United States, providing research, design, testing, certification, and training to the aviation manufacturing industry, Government agencies, education entities, and other clients that can benefit from our services. Because of NIAR's research efforts, Wichita State University currently ranks fourth among all U.S. universities in aeronautical R&D expenditures, and first in industry funding for aeronautical expenditures according to the National Science Foundation.

NIAR's mission is to conduct research, transfer technology, and enhance education for the purpose of advancing the Nation's aviation industry, and to assist nonaviation industries that may benefit from aviation-related technologies.

Some of NIAR's areas of expertise are its additive manufacturing and prototyping, advanced manufacturing, composites and advanced materials, digital twinning, engineering design and modification, reverse engineering, robotics, and virtual engineering.

NIAR also runs several centers and participates in initiatives that are strategically aligned with the institute's capabilities and mission. NIAR centers promote the safety, research, manufacturing, and design elements of today's aviation industry. They strengthen airworthiness assurance in the short term and long term.

In conclusion, it is apparent that U.S. dominance in aerospace is a critical economic driver and a national security imperative. The next two decades promise exciting new aerospace innovations and products that will transform the way we live and work, enhancing the quality of life for Americans and the rest of the world.

As in the past, the Government must continue to support innovation by incorporating these new technologies into its strategic framework. Investment in R&D and capitalizing on industry, academia, and Government partnerships will enable safe, secure, and efficient introduction of these new technologies and products.

WSU and NIAR look forward to continue working with industry and Government to conduct research, transfer technology, and enhance education for the purpose of advancing the Nation's aerospace industry. I appreciate the opportunity to testify and would be happy to answer any questions you may have.

[Mr. Harter's prepared statement follows:]

Prepared Statement of Pierre F. Harter, Director of Research and Development, National Institute for Aviation Research, and Associate Vice President for Industry and Defense Programs, Research Operations, Wichita State University

THANK YOU

Mr. Chairman and Members of the Subcommittee, I would like to thank you for the opportunity to testify today. My name is Pierre Harter, and I am Director of Research and Development for the National Institute for Aviation Research and Associate VP for Industry and Defense Programs, Research Operations at Wichita State University.

BACKGROUND

After dominating in the 20th century, the U.S. aerospace industry continues to be the world leader in this century as well. The gap has closed significantly in the commercial aviation sector, hastened by the pandemic and the MAX grounding. Significant competition remains and is growing, with major world powers (e.g. China, Russia, Japan, India, Brazil) working to introduce new indigenous commercial platforms (with some being nationalized) to capture the economic and trade benefits associated with this industry and its products.

U.S. general aviation continues to slowly recover from the shock of the 2009 financial crisis, with significant consolidation in the sector and continued pressure from international competition.

In the defense industry, the U.S. continues to maintain air dominance in traditional manned aircraft, although the competition is stiff. Widely reported cybersecurity/espionage threats in the 21st century have tightened the gap. The global arms

race for unmanned aerial systems (both autonomously and remotely flown) and hypersonics is well underway, spurring innovation that will impact the aerospace industry for years to come—and in some cases, the military relies on innovation coming from commercial industry sectors like aerospace.

The U.S. (and international) aerospace supply chain is still in a precarious position recovering from multiple recent global shocks¹. The aerospace supply chain is an essential component of the U.S. economy that provides a competitive edge. It must remain a strategic asset as well as national defense priority, as much of it serves the civil, commercial, and military sectors.

In the aerospace supply chain (civil, commercial and defense), as well as the original equipment manufacturers (OEMs), transformation was well underway and will accelerate as we emerge from the pandemic. This transformation has been both physical and digital across existing production lines as well as sustainment of legacy fleets—incorporating new technologies and innovations in areas such as robotics, automation, digital engineering, additive manufacturing, Industrial Internet of Things (IIoT), data science, artificial intelligence and other technologies (aka “Industry 4.0” and “Advanced Manufacturing”).

Technological advances in hardware, software, composites, and other advanced materials have spurred innovation in recent years in several new areas that are within the focus of this hearing:

- Unmanned Aerial Systems (UAS), also referred to as “drones” or unmanned aerial vehicles (UAV) with some nuances
- Advanced Aerial Mobility (AAM), also referred to as Urban Air Mobility (UAM)
- Supersonic (Mach 1–5) and hypersonic (greater than Mach 5) transportation
- Electric propulsion

INNOVATION

Aviation has always been a source of innovation and inspiration going back to the Wright Brother’s first flight in 1903. In many ways, the next two decades hold the promise to transform our daily lives as significantly as that event did for the twentieth century.

Advanced aerial mobility (AAM) and supersonic flight will create new travel paradigms and provide us with unprecedented global and local connectivity. Unmanned aerial systems (UAS) technology will provide new and faster methods for delivering goods, transforming business-to-business and business-to-consumer transactions, similar to how ecommerce has transformed our daily lives. Electric technologies will provide cleaner, quieter, and more efficient propulsion systems that will drive a variety of these new air vehicle platforms. Continued advancements in composite materials, additive manufacturing, and production system technologies will increase efficiency and reduce costs for these new entrants, as well as the “traditional” general aviation and commercial aircraft designs of the future.

I would also like to highlight the importance of advanced air mobility as an emerging sector of the aviation industry. We need broader thinking to facilitate industry growth within this realm, and we are pleased to see both House and Senate legislation working to address this important topic through the Advanced Air Mobility (AAM) Coordination and Leadership Act. This legislation will facilitate collaboration between federal agencies and civil aviation industry leaders to develop policies regarding advanced air mobility, ensuring we advance United States global leadership and competitiveness within this growing sector.

It certainly is an exciting time in aviation history, with so much innovation underway and on the horizon. And the stakes are high—as these technologies will transform how we do business domestically and internationally, and even more fundamentally, how we live and interact with each other on a daily basis.

It is imperative that we recognize, as this hearing is, the promise that these new innovations will bring. Safety must of course remain at the core of all aviation-related innovations, but must be balanced by enabling new technologies to enter the market efficiently, which inherently enhances safety. The United States must maintain its competitive advantage in aerospace, as it will continue to remain a dominant economic driver and a national defense imperative.

To remain the world leader in aerospace, the United States must develop and execute a strategic plan to create an environment that allows U.S.-based companies to innovate and be first to market with these new technologies, while maintaining

¹Robin Lineberger, John Coykendall, Alan D. Faber, Steve Shepley. Deloitte. “2021 aerospace and defense industry outlook”. <https://www2.deloitte.com/us/en/pages/manufacturing/articles/global-aerospace-and-defense-industry-outlook.html>

safety and security². To do this, we must continue to embrace strong public-private partnerships to help establish the strategic framework and shape the regulatory environment. In addition, we must invest in research and development that enables new designs/products, materials and manufacturing technologies that enable U.S. businesses to efficiently design, certify, and manufacture the most advanced air vehicles of the future.

Wichita State University's National Institute for Aviation Research has a proven track record for supporting industry and government agencies in developing, certifying and bringing new technologies to market. An excellent example of this is composite technology.

COMPOSITES—CASE STUDY

Composites have transformed aerospace since their introduction in the late 1970s and 1980s. Early on, adoption was limited to OEMs with deep pockets to invest in proprietary structural material databases and analytical tools for certification. In many cases, identical materials were used by multiple OEMs, each having to create their own database at their own cost. This created a barrier to entry, and hence stifled innovation.

Recognizing this barrier, a partnership was formed in the 1990s with the FAA, NASA, academia and industry. The partnership was successful in transforming the way new composite material databases were created and approved for use on aircraft utilizing a shared database methodology. This collaboration between the FAA, NASA, NIAR and industry reduced the "time required for certification of new composite materials by a factor of four and the cost of certification by a factor of ten"³.

Over the last two decades, NIAR's relationship with government and industry has evolved significantly. NIAR is the world's only non-OEM entity that the FAA, and its counterpart in Europe (EASA), accept for developing new composite materials and specifications⁴. NIAR partners with OEMs, as well as sub-tiers and material suppliers, to test and create certified material databases. Adoption has been broad, starting with general aviation and quickly moving into commercial and defense applications. Recognizing this expertise and experience, NIAR now oversees the Composite Materials Handbook (CMH-17, formerly MIL-HDBK-17) and works with industry and government to continuously amend and add new content to this handbook that provides methods and guidance material for certifying composite structure. NIAR also provides research and guidance to government agencies for policy and regulatory guidance material for composite structures as well as other certification areas (e.g. crash worthiness).

In recent years, this composite expertise has extended into the additive manufacturing field. In 2019, working with government and industry, NIAR provided new guidance for how to certify non-metallic additive manufacturing materials and added the first AM material system to its shared database—ULTEM 9085. NIAR is now working with government agencies (FAA and DoD) as well as respected industry advisory groups (America Makes, SAE International, ASTM International, Metallic Material Property Development and Standardization (MMPDS), and others) to create guidance material and create shared databases for metallic AM materials. The first effort is with a titanium alloy, which is a critical structural material for civil and military air vehicles.

New epoxy composite material systems continue to evolve, providing higher strength and stiffness, lower costs, and higher operating temperatures. Many companies are investigating and deploying new thermoplastic polymer matrix composite (TP PMC) materials into structure. These materials offer the ability to drastically reduce composite manufacturing times down to the automotive-like efficiencies, while offering higher temperature capabilities required for primary structure and supersonic applications where skin friction at supersonic speeds creates significant heat on the structure.

The hypersonic regime (speeds greater than Mach 5), creates a new challenge for materials and manufacturing based on the intense heat generated by skin friction at these speeds. Efforts are already underway at NIAR, and industry partner Spirit AeroSystems Inc., to build the infrastructure needed to create and test these new

²Source: Robin Lineberger, Aijaz Hussain and David Silver. Deloitte Insights. "Advanced air mobility: Can the United States afford to lose the race?". <https://www2.deloitte.com/us/en/insights/industry/aerospace-defense/advanced-air-mobility.html>.

³Source: Statement of John Tomblin, Ph.D. before the U.S. Senate Commerce Committee Subcommittee on Science, Technology and Space. February 27th, 2003. https://www.globalsecurity.org/space/library/congress/2003_h/030227-tomblin.pdf

⁴Sources: AIR100-2010-120-003.pdf (faa.gov) and Certification Memorandum_v2 (europa.eu)

ultra-high temperature materials. See Figure 1 for more details on the evolving advanced material landscape applicable across all sonic speed zones.

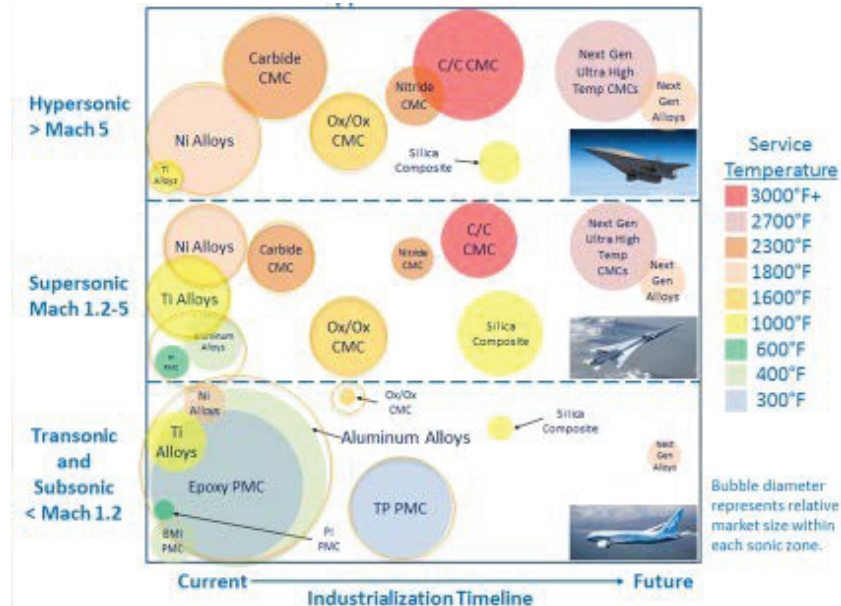


Figure 1: Material Application in Aerostructures. Source: Spirit AeroSystems Inc.

All of this was made possible via strategic decisions by the U.S. government in the 1990's to fund R&D efforts in this area and embrace public and private collaborations to create new policy, guidance and regulations to enable innovation that has carried through to present day. It is this successful model of investment in R&D and public-private collaboration that will continue to enable innovation in U.S. aerospace allowing U.S. companies to be first-to-market and maintain the leading edge.

WICHITA STATE UNIVERSITY AND THE NATIONAL INSTITUTE FOR AVIATION RESEARCH

Since its inception in 1985, National Institute for Aviation Research (NIAR) at Wichita State University has made a name for itself as the most capable university-based aviation research center in the United States, providing research, design, testing, certification and training to the aviation manufacturing industry, government agencies, educational entities and other clients that can benefit from our services. NIAR has a \$125 million annual budget, a staff of over 875, and over one million square feet of laboratory and office space in six locations across the city of Wichita, the Air Capital of the World.

The Brookings Institution ranks:

- Wichita #1 in manufacturing jobs as a percentage of all jobs.
- South Central Kansas as the most manufacturing-specialized region in the United States with 17.7 percent of regional jobs in manufacturing, more than half of which are engaged in making some of the world's most sophisticated aircraft.
- Wichita has the highest concentration of aerospace manufacturing employment in the nation.
- Wichita is ranked #3 nationally as an advanced industry hotspot.
- Wichita ranks # 1 in percentage of jobs involving stem occupation.
- Wichita ranks #3 among metros for highest concentration of engineers per 1,000 employees (22.4/1000)

A key contributor to these rankings, the NIAR mission is to conduct research, transfer technology and enhance education for the purpose of advancing the nation's aviation industry, and to assist non-aviation industries that may benefit from aviation-related technologies. NIAR's areas of expertise are:

- Additive Manufacturing & Prototyping
- Advanced Coatings
- Advanced Manufacturing
- Aerodynamics
- Ballistic and Impact Dynamics
- Composites and Advanced Materials
- Crash Dynamics
- Digital Twin
- Engineering Design & Modification (WERX)
- Environmental and Electromagnetic Testing
- Extended Reality
- Flight Simulation
- Full-Scale Structural Testing
- Nondestructive Testing
- Sustainability
- Reverse Engineering
- Robotics and Automation
- Virtual Engineering
- Wind Tunnel Testing

NIAR also runs several centers and participates in initiatives that are strategically aligned with the institute's capabilities and mission. NIAR's centers promote the safety, research, manufacturing and design elements of today's aviation industry. They strengthen airworthiness assurance in the short and long term. They make the concerns of the general aviation industry their own. And they make dreams of a reality. This happens not only through NIAR's own research, but through the exchange of knowledge with researchers in other centers.

Those centers include:

ATLAS Advanced Technologies Lab for Aerospace Systems (ATLAS)

NIAR's ATLAS is a multi-disciplinary manufacturing environment and engineering education program to prepare engineers and educators for the Factory of the Future and to aid the current workforce in seamlessly adapting to advancements in the workplace. ATLAS's mission is to provide a neutral ground for advanced manufacturing research and development with state-of-the-art machines, software and processing options.

Aircraft Structural Test & Evaluation Center (ASTECC)

NIAR's ASTEC encompasses 130,000 square feet (39,000 square meters). The facility features include a 30x70-foot hangar door, a clear span of 265 feet (80 meters) and ceiling height of 48 feet (14 meters). ASTEC is a secure site designed to perform proprietary client research and testing. The facility is currently home to the institute's Full-Scale Structural Test Lab, Aging Aircraft Lab, Mechanical Test Lab and Ballistics Lab.

3DEXPERIENCE Center

The 3DEXPERIENCE® Center, a partnership with Dassault Systemes, involves an interconnected community of top researchers, corporations and laboratories to accelerate innovation. The 22,000 sq. ft. facility at Wichita State University offers the expertise and technology for companies to accelerate their innovation. Aerospace and other industries can target improvements from concept to production and extend to operations—all while facilitating certification. The 3DEXPERIENCE Center enables companies to engage in advanced product development and the manufacturing of next-generation materials and technologies.

Jerry Moran Center for Advanced Virtual Engineering & Testing

The Advanced Virtual Engineering and Testing Lab (AVET) was opened in 2019. It was dedicated to Kansas Senator Jerry Moran in 2020 as tribute to Moran's commitment to helping WSU fulfill its vision and mission to provide impactful student experiences that drive prosperity in our region. AVET is home to NIAR's Virtual Engineering and Crash Dynamics Labs. The facility features additional client prep bays, which will allow multiple clients to be in the lab at the same time, while maintaining privacy during testing. It also includes workspace for 40+ virtual engineering staff, three collaboration rooms and secured areas for restricted projects; and a space for related technologies such as material/component testing and virtual reality.

National Center for Advanced Materials Performance (NCAMP)

The National Center for Advanced Materials Performance (NCAMP), located at WSU-NIAR provides the nation's commercial and military aviation industry with a center for the validation and quality assurance of composites and advanced materials.

Composite Materials Handbook-17 (CMH-17)

The CMH-17 organization, administered by Wichita State University, provides information and guidance necessary to design and fabricate end items from composite materials. Its primary purpose is the standardization of engineering

data development methodologies related to testing, data reduction, and data reporting of property data for current and emerging composite materials. In support of this objective, the handbook includes composite materials properties that meet specific data requirements. CMH-17 works closely with NCAMP to approve composite specification and design values.

FAA Center of Excellence for Composites and Advanced Materials (CECAM)

CECAM is an FAA-sponsored consortium of universities competent in advanced materials research. CECAM is led by Wichita State University, which interacts directly with the FAA to support its advanced materials safety programs.

FAA ASSURE Center of Excellence for UAS Research

WSU is one of 24 core research institutions within the FAA's Alliance for System Safety of UAS through Research Excellence (ASSURE). ASSURE's mission is to provide high-quality research and support to autonomy stakeholders both within the US and beyond to safely and efficiently integrate autonomous systems into the national and international infrastructure, thereby increasing commerce and overall public safety and benefit.

Kansas Aviation Research & Technology Growth Initiative (KART)

The Kansas Aviation Research & Technology Growth Initiative uses funds provided by the Department of Commerce and the Kansas Legislature with the goal of strengthening a variety of aircraft industry technologies and marketing them to other areas outside the State of Kansas and the United States. The Kansas Aviation Research & Technology Growth Initiative will help retain and grow the aviation cluster in Kansas and help Kansas aviation companies remain competitive throughout the 21st century.

FirePoint Innovations Center

Established in 2018, FirePoint partners with the U.S. Army's Combat Capabilities Development Command, Aviation and Missile Center (DEVCOM AvMC) to accelerate the delivery of innovative capabilities to the warfighter. FirePoint creates a collaborative and networked environment of national scope to investigate, collaborate and produce courses of action to solve technology and equipment challenges identified by the Army.

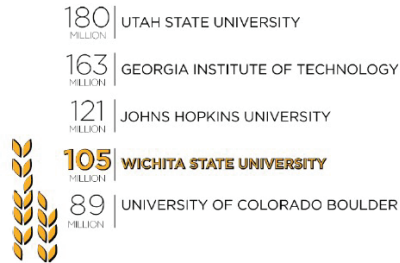
National Institute for Research and Digital Transformation (NIRDT)

The newly created (2019) National Institute for Research and Digital Transformation at Wichita State focuses on diversifying and growing the economy while providing an important platform for creating new academic and applied learning programs for students. NIRDT is based on the model and strengths of NIAR, but focused on developing technology that can transform other industries, including aviation, to drive economic development and support new ventures in Kansas and the United States.

Kansas's leadership in aerospace research and development and its strong aerospace manufacturing presence is reflected in Wichita State University. Because of NIAR's research efforts, Wichita State University currently ranks fourth among all U.S. universities in aeronautical R&D expenditures according to the National Science Foundation. WSU ranks first in industry funding for aeronautical expenditures. See Figure 2. WSU and NIARs R&D expenditures have steadily increased over the last two decades, a testament to its unique capabilities and ability to collaborate successfully with government and industry as shown in Figure 3.

AERO R&D EXPENDITURES

Source: National Science Foundation Higher Education Research and Development survey 2019



INDUSTRY FINANCED AERO R&D

Source: National Science Foundation Higher Education Research and Development survey 2019

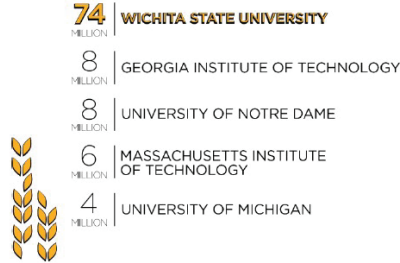


Figure 2: WSU aeronautical R&D expenditures 2019 rankings (Source: National Science Foundation survey 2019)

WSU R&D EXPENDITURES | 2012-2020

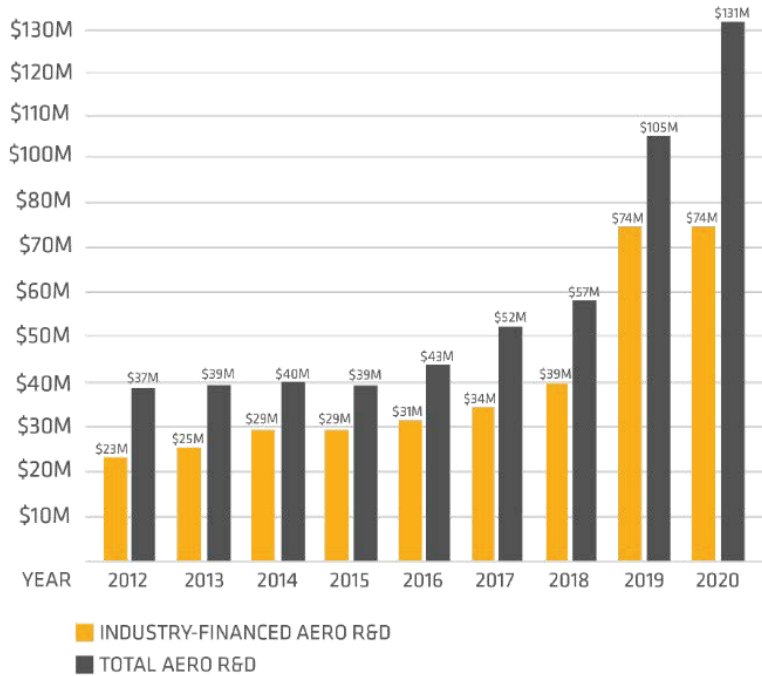


Figure 3: WSU aeronautical historical R&D expenditures (Source: National Science Foundation Surveys 2012–2020)

SUMMARY

In conclusion, it is apparent that U.S. dominance in aerospace is a critical economic driver and national security imperative. The next two decades promise exciting new aerospace innovations and products that will transform the way we live and work—enhancing the quality of life for Americans and the rest of the world. As in the past, the government must continue to support innovation by incorporating

these new technologies into its strategic framework. Investment in R&D and capitalizing on industry/academia/government partnerships will enable safe, secure and efficient introduction of these new technologies and products. WSU and NIAR look forward to continue working with industry and government to conduct research, transfer technology and enhance education for the purpose of advancing the nation's aviation industry.

I appreciate the opportunity to testify today and would be happy to answer any questions you may have.

Mr. LARSEN. Thank you. Thank you, Mr. Harter, for your testimony.

I will now turn to Mr. Roei Ganzarski from the great State of Washington and what some say is the best district in the country: the Second Congressional District of Washington State. About 700,000 people say that in fact.

So Mr. Ganzarski, I will recognize your 5 minutes. And good to see you.

Mr. GANZARSKI. Good morning, Chairman Larsen, Ranking Member Graves, and esteemed committee members.

My name is Roei Ganzarski, and I am the CEO of magniX. Headquartered in the great city of Everett, Washington, we design and manufacture all-electric propulsion systems for commercially focused aircraft.

Before I begin, I wanted to express what an honor this is for me to be testifying here. I came to this country 24 years ago in pursuit of an education and found a home, a haven to raise a family, and a flourishing environment to work in. The American dream is alive and well and I thank you for that.

Accessible, affordable, equitable, environmentally clean, quieter—this is the future of aviation we should be striving for in the United States. A future that offers all Americans the ability to fly in convenient door-to-door fashion without causing harm.

In this future, the average American only drives a short distance to an airport, arrives 15 minutes before their flight, boards without hassles, and flies up to a few hours. This sounds like a utopia, but for the most part, the technologies and infrastructure to do this exist or are being developed and flight proven as I speak. It is called the electric age of aviation.

On the world stage, the U.S. has always been a leader. Be it economics, culture, or technology, the world looked to the U.S. as a beacon for the future. However, with aviation, our country is falling short of our reputation for pioneering innovation and leading industry.

In Europe, countries are pledging domestic flights be electric by 2030, banning short flights that produce emissions, and providing hundreds of millions of dollars to advance carbon-free aviation.

As the home of the Wright brothers and *Apollo 11*, our legacy of asking "Why not?" demands ambitious, aspirational, and forward-thinking action. Electric aircraft will have significantly lower operating costs, stemming from cheap electricity, and significantly less maintenance needs. This means operators can provide much more affordable services using smaller aircraft flying from and to smaller airports, all with significantly lower noise and zero emissions. We can truly connect all of America by air and do so cleanly.

Doing this will require us to be bold. As bold as President Kennedy was when he announced the dramatic and ambitious goal of

sending an American safely to the moon. But like conquering the moon, commercial electric aviation is an audacious goal; one that will require determination, focus, and grit, and that will compel us to put our best minds to work and make sacrifices as we make advances.

We have everything we need here in the United States. magniX, for example, has been flying all-electric, commercially focused aircraft since December of 2019. And our FAA certification, part 33, is on track for 2022, which means there is a real possibility that smaller, all-electric aircraft can start flying with people and packages on short routes within the next 4 years. It will not be easy. But let's not forget that we did not reach the moon in one attempt or one stage.

Expecting electric aviation to power a 737-sized aircraft as it flies across the country is not reasonable at this stage. We must start with smaller aircraft flying shorter routes from, and to, smaller airports.

As investments are made, policies are set, incentives introduced, and technologies progress, we will advance to larger and longer distances. With the current state of technology, our President and Congress can set a bold and ambitious goal of having all-electric aircraft start to perform commercial flights up to 250 miles by the end of 2024 and up to 1,000 miles by 2030. Doing this will also lead to thousands of clean jobs across the country.

Congress needs to provide incentives for operators to adopt electric aircraft for existing and new routes, incentives for airports who invest in charging capabilities, and incentives for manufacturers to develop all-electric aviation solutions. These incentives can include grants, tax credits, and more. I also propose amending the Essential Air Service, a taxpayer-funded program, by adding an environmental performance criterion to be awarded subsidies.

Separately I will share that the FAA is doing an amazing job working with the right attitude and approach with these new technologies, but they are lacking in resources. I highly recommend more funding for the FAA to hire and train more people in electric aviation.

I will conclude by shamelessly paraphrasing President Kennedy, because his words are as relevant and accurate today as they were for the Space Race in 1962: We choose to transition to electric aviation within the next 4 years, not because it is easy, but because it is hard. Because that goal will serve to organize and measure the best of our energies and skills. Because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win.

Thank you for the opportunity to share my insight. The United States must seize the moment and lead. magniX is proud to be a part of returning the American aviation industry to preeminence and global leadership with the electric age of aviation.

Thank you.

[Mr. Ganzarski's prepared statement follows:]

Prepared Statement of Roei Ganzarski, Chief Executive Officer, magniX

Good morning Chairman Larsen, Ranking Member Graves, and esteemed members of the Aviation Subcommittee. My name is Roei Ganzarski and I am the CEO of magniX. magniX, headquartered in Everett, WA, designs and manufactures all-electric propulsion systems for commercially focused aircraft. I am also the executive chairman of Eviation. Headquartered in Arlington, WA, Eviation designs and manufactures electric aircraft starting with the Alice, a 9-passenger all electric commuter aircraft. Thank you for giving me the opportunity to provide my insights on the future of aviation in the United States.

Before I begin, I wanted to express what a personal honor this is for me to be testifying here in front of you. I came to this country 24 years ago from Israel, in pursuit of a graduate education at the University of Washington. In addition to a great education, I found a home; a haven to start a family and raise three amazing children; and a flourishing environment to expand my career, grow companies, and create jobs. The American Dream is alive and well. I thank you for that.

Accessible, affordable, equitable, environmentally cleaner, and quieter—this is the future of aviation we should be striving for in the United States. An aviation system that offers and promotes the ability to travel, send and receive packages, and commute in a low-cost, sustainable, quick, and convenient door-to-door fashion. This is the future of aviation that I, and the entire team at magniX and Eviation, are working towards.

In this future aviation system, the average American, including in more rural areas, should be able to drive no more than 15 minutes to their nearest airport (most likely not a large metropolitan hub airport), arrive there only 15 minutes ahead of their flight, walk onboard without hassles or waiting in lines since the airport is smaller, fly for up to a few hours, land, and arrive at their destination in another 15 minutes, because their smaller arrival airport (most likely not a large metropolitan hub airport) is closer to their final destination. While this may sound like an unrealistic utopia, for the most part, the technology and infrastructure to provide such an aerospace environment is being developed, flight-proven, and on the path to FAA certification today.

It is called the “Electric Age of Aviation.”

It will happen. The question is: will the United States lead or lag?

On the world stage, the United States has always been a leader. Whether it is economics, culture, or technology, the world looked to the US to see and understand the future. In aviation, the United States will always be remembered and respected for that magical Wright Brothers’ first powered flight in Kitty Hawk, North Carolina.

However, I am afraid our country is now falling short. We are falling short of our reputation for pioneering innovation; falling short of our track record in leading an industry; and in particular, falling short for not embracing two major cultural shifts that are happening both globally and domestically: a shift to democratize demand-driven aviation in a way that makes it available and accessible to all, and a shift to propel clean energy in aviation.

Sweden and Norway are increasing their commitments to curb emissions by pledging that all domestic flights will be electric—in other words, emission-free—by 2030 and 2040, respectively. France is right now passing legislation that will ban short-haul flights as long as they produce emissions. The United Kingdom is directly providing its aviation industry with hundreds of millions of dollars to advance carbon-free technology. In fact, the UK is attracting U.S. companies to move across the pond.

As the home of the Wright brothers, Benjamin Franklin, Thomas Edison, and Apollo 11, our legacy as leaders, inventors, innovators, and a country that asks “why not” demands ambitious, aspirational, and forward-thinking policies to spur immediate and bold action, and encourage behavioral change on a grand scale. We must use the power of pro-active government policy and incentives to help propel progress.

Some positive movement has recently started. Congressman Graves (Louisiana) and Representative Davids (Kansas) introduced the Advanced Air Mobility Coordination and Leadership Act. The legislation focuses on development of new transportation options, moving goods, amplifying economic activity and jobs, advancing environmental sustainability and new technologies, and supporting emergency preparedness and competitiveness.

Reps. Larsen (Washington), Schrier (Washington), and Davids (Kansas) introduced the National Evaluation of Aviation and Aerospace Solutions to Climate Change Act, instructing the U.S. Department of Transportation to partner with the National Academies of Sciences, Engineering and Medicine to study, catalogue and

report on technologies, processes, materials or practices that contribute to the reduction of greenhouse gas emissions.

With that said, much more must happen. The United States must act in unity and continue to move rapidly, aggressively, intentionally and with focus, if we want to lead this global electric aviation revolution that is happening.

This global electric aviation revolution, promises significantly lower costs of aircraft operations, significantly reduced noise pollution, and zero carbon (CO₂) emissions. The hourly operating costs of all-electric aircraft are 40 to 80 percent lower than using traditional fuel-based technologies. These savings stem from two main elements. The first is the much cheaper price of electricity when compared to fuel. For example, a ninety-minute flight on a nine-passenger fossil-fuel powered aircraft will burn about \$424 in fuel. The all-electric version of the same aircraft will only use \$24 in electricity. The second reason for the lower operating costs is maintenance. Current engine technology is very complex, requires many parts working in unison turning at thousands and tens of thousands of revolutions per minute, at very high temperatures under substantial friction. This requires significant, regular, time consuming, and expensive maintenance. An electric propulsion system only has one moving part, turning at very low revolutions per minute, and operating at relatively low temperatures. The simplicity of electric propulsion means dramatically reduced maintenance costs.

Transitioning to all-electric aviation means airline operators gain efficiency, can better respond to increasing demand with smaller aircraft flying from and to smaller airports, and offer more affordable pricing for travelers and cargo alike. And this transition means lower noise and zero emissions. Moreover, with the country's electric grid becoming cleaner and more renewable every year, we are on a clear pathway for an entirely clean electric value chain.

By incentivizing the move of the aviation industry to electric flight by using small to mid-sized aircraft, we will be creating affordable access to and from more rural areas and we can better connect all of America. We can fulfill the vision this country had for the aviation industry in the 1930s, '40s, and as late as the '60s, when the massive number of small regional airports we have today in this country were built.

Doing this will require us all to be bold. I would like to take you back to a time our country and our leadership had the intestinal fortitude to make courageous investments, take decisive action, and lead the world. On September 12, 1962 President John F. Kennedy told an audience at Rice University:

“... So it is not surprising that some would have us stay where we are a little longer to rest, to wait ... but this country of the United States was not built by those who waited and rested and wished to look behind them. This country was conquered by those who moved forward ... We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win, and the others, too. It is for these reasons that I regard the decision last year to shift our efforts in space from low to high gear as among the most important decisions that will be made during my incumbency in the office of the Presidency ... To be sure, we are behind, and will be behind for some time in manned flight. But we do not intend to stay behind, and in this decade, we shall make up and move ahead.”

Like conquering space and the moon, commercial electric aviation is an audacious goal. A goal that will require determination, focus, and grit. A goal that will compel us to put our best minds to work and make sacrifices as we make advances. A goal that will require the US government to make changes in our policies, regulations, and funding.

We have all the ingredients we need right here in the United States to lead us on this tough journey. Companies like magniX and Eviation are doing this work right now. We have been designing, building, and flight testing the required technologies and solutions, and as companies, we are currently in a global pole position to lead the industry. In 2019, magniX retrofitted and flew the first-ever all-electric commercially-focused aircraft—a five-passenger de Havilland Beaver (eBeaver) in partnership with Harbour Air—that took flight on December 10, 2019 in Vancouver, BC. It has been flying ever since, collecting data, testing performance, measuring noise, and more.

A few months after the eBeaver's flight, in Moses Lake, WA, magniX started flying the world's largest all-electric commercially-focused plane—the magnified 9-12 passenger Cessna 208B Grand Caravan, now known as the eCaravan. With this air-

craft flying at 8,000 feet, new heights were literally and figuratively achieved in terms of electric aircraft power and performance.

Both of our aircraft flew without creating emissions. That is right—not one ounce of CO₂ was emitted from these flights. Later this year, the nine passenger, all-electric Eviation Alice, the first aircraft to be designed from the ground up as an electric commuter, will be taking flight for the first time in Arlington, WA. This will be a monumental watershed moment for our industry. And it too, will fly without emissions.

Our all-electric flight test aircraft measured that electric aircraft noise energies are 100 times lower than those of traditional fossil-fuel-based engines. In practical terms, when one of these aircraft is taking off 300 feet away from you, it sounds like people having a regular conversation next to you versus what it is today—noise levels of a vacuum cleaner operating next to your ears.

This topic is not, well, simply noise. Noise pollution is an important yet often sidelined pollutant from aircraft. The Harvard School of Public Health and Boston University School of Public Health found that people exposed to aircraft noise may face increased risk of being hospitalized for cardiovascular disease. And the number one cause of death in the US is heart disease. At significantly reduced noise levels, all-electric aircraft will also have far reaching impacts to our society and health.

The Environmental Protection Agency reports that aircraft contribute 12 percent of U.S. transportation emissions and account for three percent of the nation's total greenhouse gas production. In the United States alone, 45,000 flights carrying three million airline passengers take off every single day. If we continue down this path, by 2050, commercial aircraft emissions could triple, given the projected growth of passenger air travel and freight. This is not sustainable. Rapidly introducing electric aircraft that produce zero carbon emissions is absolutely essential to a clean-energy and healthy future.

In addition to flying electric aircraft to prove out the technology and its benefits, magniX has also been working closely with the Federal Aviation Administration (FAA) on certification. The FAA has already published the Special Conditions by which it will evaluate magniX's electric propulsion and magniX is on a path to FAA certification before the end of 2022.

Based on my experience, I believe the FAA is doing a great job and is working with the right attitude and approach. The agency is making every effort to learn about the new technologies and their benefits, while maintaining the utmost integrity when it comes to safety, reliability, and quality. As I plan to have my own children and, eventually, grandchildren fly on these new aircraft, I appreciate the work the FAA are doing and expect them to continue to uphold the utmost safety and reliability standards.

With that being said, I think the FAA lacks the resources it needs for the enormity of the task ahead. They do not have enough staff to adequately support the new entrants and new technologies being introduced at a lightning pace. The resource shortage at the FAA is already creating delays; I fear that it will only get worse. I highly recommend that additional funding be provided to the FAA so that it can hire and train experienced staff and support the timely entry of new companies and technologies into the marketplace. This will also position the FAA to be the most knowledgeable and experienced regulator on this new technology, and enable them to teach and lead other regulatory agencies worldwide.

With electric propulsion certification on track for 2022, that means there is a real possibility for smaller all-electric aircraft to start flying people and packages on short routes within the next four years—within this current Administration's first term. This is an audacious—but realistic—goal for our industry.

The feasibility and benefits of electric aviation are clear and proven. I know the naysayers, many of them within the ranks of the incumbents of the industry's current antiquated technology, will provide many reasons why electric aviation is not feasible, why risks are not worth taking, why more time should be spent researching, analyzing, and debating, while the world moves ahead. Most of those reasons stick to a familiar theme: energy density of batteries and/or hydrogen fuel cells. Indeed, as I testify before you today, batteries and fuel cells are not powerful enough for a large-scale aircraft, also known in industry as a single isle or twin isle aircraft, carrying 100 people or more, to fly 2,327 miles non-stop from Seattle to Washington, D.C. Batteries are only good enough today, in 2021, to power a passenger aircraft carrying five to nine passengers up to 500 miles.

However, the question we should be asking is not “can an electric aircraft fly as far as a fossil-fuel based aircraft?” Instead, we should ask “does today's electric aircraft meet the demands of the flying public?”

In the United States, half of all airline flights are less than 500 miles. This speaks loudly to the need and opportunity for middle-mile regional electric flight.

Moreover, only 1.6 percent of all 50–500 mile-trips in the United States are made by air. Travel for these distances is clearly in high demand, but the aviation industry has yet to provide customers a viable, affordable, and widely accessible option.

What's more, access and equity are real issues for the future of aviation. Electric aviation, with lower-cost flights at ranges of up to 500 miles, will enable affordable access even in the most rural of areas in the United States. Electric aviation will connect our communities like never before.

On the topic of energy sources, I would like to point out that electric aircraft can be powered by multiple sources of electricity. As long as the propulsion system, i.e., the technology creating the thrust, is electric, it is deemed an electric aircraft. The source of energy can be batteries, including lithium-ion, lithium-sulfur, lithium-metal, solid state, and other battery technologies currently being developed. The source of energy can also be hydrogen fuel-cells. These fuel cells create electricity that then flows to the electric propulsion systems. In the future, there might also be new sources of electricity, fully renewable and recyclable, that are developed to provide the electrons needed.

Today, given the state of development, the majority of electric aircraft are battery-electric and specifically using lithium-ion batteries. I believe this is temporary, as better and better battery chemistries are being proven, as well as advances in the development of hydrogen fuel-cells.

While the source of energy is indeed the biggest challenge for mass adoption of electric aviation, I parallel this to where electric cars were less than ten years ago. When Tesla, the company that we attribute the democratization of electric cars started, it was with an electric propulsion system developed for cars, rudimentary batteries, and the conversion of the Lotus car. Mainstream car manufacturers, as well as battery manufacturers, discounted and disregarded Tesla and their idea of electric cars. The claims were similar to what we in aviation are hearing today—batteries are not good enough and there will not be enough range. But once Tesla started to prove that its converted cars were real, battery technology started to progress, and Tesla began to develop cars that were designed to be electric. Once it became clear this solution was real, other car manufacturers followed suit.

Today, in 2021, seeing an electric car drive on our streets is no longer a novelty, and seeing a car charger at the entrance to a shopping mall is no longer an anomaly. Tesla had to start somewhere to lead the electric car revolution. Similarly, that focus, intentionality, and patience is required in aviation. magniX started with propulsion and retrofits. Now companies like Eviation are designing aircraft to be electric. And battery companies and fuel-cell developers are starting to realize that the potential is real and are making investments to improve the sources of energy.

However, many of these companies are outside of the United States. Be it China, France, Germany, Norway, or the United Kingdom, these countries have created ecosystems that stimulate, incentivize, and financially support the rapid and aggressive development of carbon-free aviation. If the United States chooses to lead the electric aviation future, we'll see a significant number of jobs created across the nation. From advanced research jobs to aircraft assembly jobs to electronics manufacturing jobs—these jobs can support diverse workforces across the country.

A paradigm shift in our mindsets must occur for this to happen. We did not reach the moon in one attempt or one stage. The journey to the moon started with low-altitude rockets, then higher altitude ones, then low orbit, then high orbit, until eventually we could fly to and land on the moon. Expecting electric aviation to immediately be able to power a 737 sized aircraft as it flies across the country is not reasonable. In fact, it only deters and defers the inevitable. The American people want a low-cost, accessible, equitable, sustainable, quiet, and demand-driven aviation transportation system. Electric aircraft can enable that. We must start with the correct vision—with smaller aircraft flying shorter distances from and to smaller airports. And as investments are made, policies are set, incentives introduced, and technology progresses, we will be able to advance to larger aircraft flying longer distances—a pattern that should be familiar across most evolving industries.

To reach this audacious goal within the next four years, we need our President and Congress to take bold action to support and incentivize the move to electric aircraft and to provide the boost needed for the technology to really take flight. I recommend a holistic flight ecosystem approach: set aspirational goals, provide incentives, and set bold policies.

Aspirational Goals. In 1961, President John F. Kennedy announced before a special joint session of Congress the dramatic and ambitious goal of sending an American safely to the Moon before the end of the decade. This goal was achieved on July 20, 1969. With the current state of technology, our President and Congress could set a dramatic and ambitious goal of having all-electric aircraft start carrying pas-

sengers and packages for up to 250 miles in range by the end of 2024 and up to 1,000 miles by 2030.

Incentives. Congress needs to provide incentives for airlines and operators to adopt electric aircraft and use them on existing or new routes. In many ways, this would follow the same pattern as electric cars. When buying or leasing an electric car, the buyer gets a significant income tax credit against the car, sales tax exemptions on the purchase or lease, and more.

Following the same analogy, Congress needs to provide incentives for airports investing in charging capabilities and sourcing renewable energy from solar, wind, and hydro—just as installing an electric car charger at home provides a financial grant for the installation, incentivizing people to do so and eliminating a barrier in purchasing an electric car.

Finally, Congress needs to provide incentives for manufacturers developing electric propulsion systems for commercially focused aircraft, retrofitting conventional aircraft to electric, and designing and building new fully electric aircraft. Using an existing model familiar to automobile manufacturers, aviation carbon credits should be introduced in which manufacturers of fossil fuel-based aviation technology would be required to offset their environmental impact by buying carbon credits from all-electric aviation manufacturers.

These incentives can take the shape of budget allocations, financial grants, tax credits, rebates, exemptions, reduced registration fees, reduced utility rates, and other innovative proposals. We should also consider changes to the Essential Air Service—a taxpayer-funded program that subsidizes rural air connections. By simply adding an environmental-performance criterion to qualify for and be awarded such subsidies, operators will be encouraged to increase service to these underserved areas by using aircraft with lower operational costs and zero emissions. This will result in gaining additional clean and quieter routes without any increase in federal investment.

Set Bold Policies. Policies drive behavior and right now our behavior is lacking. Congress should set bold policies that require a certain percentage of domestic middle-mile flights be emission-free by a certain date. It could also require government officials fly a certain percent of their flights on zero-emission aircraft by a certain date. Similarly, the Department of Defense could operate short transport flights using emission-free technology by a certain date. Policies like this will set a clear line in the sand and send a message that this Administration and Congress—and the country, take this issue with the seriousness it deserves.

As this new electric aviation industry grows and flourishes, there is a significant opportunity to bring new jobs and training across the United States while meeting the goal of creating a more sustainable economy. Investing in electric aviation will create thousands of jobs, from manufacturers to suppliers to operators to airports and peripheral servicing companies, right here in the United States. Moreover, it will enhance the economies of smaller and rural towns by connecting them with low-cost and cleaner flights, enabling access to new markets.

It is my sincere hope that Congress provides all modes of transportation, and specifically electric aviation, the critical support needed to accelerate our country and provide good-paying jobs. Electric aviation will reduce our reliance on fossil-fuels, lower our carbon footprint, decrease aircraft operating costs, and create greater accessibility and connectivity to all areas in our country.

I will conclude by shamelessly paraphrasing President Kennedy, because his words are as relevant and accurate today for electric aviation, as they were for the Space Race in 1962:

We choose to transition to electric aviation within the next four years, not because it is easy, but because it is hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win. And while it is not surprising that some would have us stay where we are a little longer to rest—to wait—this country of the United States was not built by those who waited and rested and wished to look behind them. It was conquered by those who moved forward. I truly hope that as a country, we make the decision to shift our efforts in aviation towards electric. To be sure, we are behind, and will be behind for some time. But we do not intend to stay behind, and in the next four years, we shall make up and move ahead.

Thank you for giving me the opportunity to provide my insights. magniX and Eviation are proud to be a part of the solution that returns the American aviation industry to preeminence and global leadership. We can do this by continuing to build upon the innovative, environmentally sustainable technology that is already here and can soon be commercially available. With the right investment and incentives, electric aviation can and will be our reality starting within four years. We are

on the cusp of the “Electric Age of Aviation;” the United States must take advantage of it.

PHOTOS



Some of the magniX team members in the Everett, WA facility
magniX includes 23% women and 27% minorities Photo taken in 2021



The eBeaver powered by magniX all-electric propulsion flying in Vancouver, BC
Photo taken in 2021



The eCaravan powered by magniX all-electric propulsion flying in Moses Lake, WA
Photo taken in 2020



The magniX facility in Everett, WA
Photo taken in 2020



The magniX logo

Mr. LARSEN. Thank you, Mr. Ganzarski. I appreciate that very much.

And now I want to turn to Mr. Blake Scholl, founder and CEO of Boom Supersonic.

Mr. Scholl, you are recognized for 5 minutes.

Mr. SCHOLL. Good morning. I would like to start by recognizing and reflecting on why flying is so moving. Even though air travel has now become routine, it affords opportunities and experiences that were just unfathomable a few generations ago. And we get to enjoy all of this while miles up in the air, at hundreds of miles an hour, while having a breathtaking view of the Earth.

Sixty years before the early jets, crossing the Atlantic took 6 days. And the jet shrank that to just 7 hours. But today, we cannot travel any faster than we could 60 years ago. So Chair Larsen, Ranking Member Graves, and members of the subcommittee, I am grateful for the opportunity today to discuss the coming renaissance of safe, sustainable, and affordable supersonic flight.

Since the 1950s, the jet airplane has defined so much of our modern lives. Thanks to the speed of the jet, places like Hawaii are now major tourist destinations. Musicians think of world tours, and entrepreneurs can reach customers around the globe. And our leaders can gather frequently in person to build relationships and defuse crises.

At Boom, we want to unlock new possibilities for human connection and for business. We have three guiding principles: safety, sustainability, and speed. Our first supersonic commercial airplane, Overture, is designed to facilitate net-zero carbon travel. Aboard Overture, London would be just 3½ hours from New York, and Sydney becomes as accessible as Honolulu is today.

Overture, along with the other emerging technologies represented here today, are going to be pillars of the future transportation ecosystem. Some day you might take an electric taxi to the airport, board a supersonic jet, and then cross the planet at twice today's speeds.

More seamless point-to-point travel makes for a more connected world. At Boom, we have been building a strong safety culture from day one. Developing our piloted supersonic demonstrator, the XB-1, has helped us build a safety-first mindset early on, and to develop our safety management system well ahead of Overture's assembly.

We are also taking great care to ensure that speed and sustainability are compatible goals. This is a deep part of our culture, and our team is working diligently to maximize efficiency and minimize noise in Overture's design.

Crucially, Overture will meet the same stringent noise levels that are applicable to the latest generation subsonic jets. We understand the importance of community engagement, and we plan to undertake such outreach well ahead of Overture's entry into service. And because Overture will fly at supersonic speeds over water only, we will not be creating sonic booms over communities.

Sustainable aviation fuels, or SAF, are key to Overture's sustainability. And we are designing Overture from the ground up to run on 100 percent SAF, enabling net-zero carbon flight.

Lastly, we plan to use and support high-quality carbon offsets, including new generation carbon removal technologies where necessary, to meet our net-zero commitments.

Additionally, we are excited to be working with the United States Air Force, on potential military applications of our aircraft. For example, carry leaders across the world in half the time, evacuating wounded soldiers to medical care in time to save lives, and transporting lifesaving emergency supplies to where they are urgently needed.

And of course I would be remiss if I did not thank Congress and especially this committee, for your leadership in passing the bipartisan FAA Reauthorization Act of 2018. Through this act, Congress helped drive important regulatory work in support of new innovation. And indeed, the FAA's work at the International Civil Aviation Organization is critical. Regulatory certainty is vital to our success, and ICAO must continue to advance economically reasonable, technologically feasible, and environmentally beneficial standards for supersonic aircraft.

In the field of SAF, policy incentives will also be critical to accelerating production and adoption. At Boom, we support measures such as blender tax credits to accelerate SAF production, and we are working with a broad coalition of SAF stakeholders to advance that policy. Boom is proud that Overture will be designed and assembled in the United States, leveraging the formidable talent, entrepreneurial spirit, and tradition of innovation in our workforce.

Faster travel will offer many benefits to society, and I am grateful that Congress continues to show leadership in aviation innovation.

Thank you for having me here today, and of course, I am happy to answer your questions.

[Mr. Scholl's prepared statement follows:]

**Prepared Statement of Blake Scholl, Founder and Chief Executive Officer,
Boom Supersonic**

Good morning, Chair Larsen, Ranking Member Graves, and Members of the Subcommittee. My name is Blake Scholl, Founder and CEO of Boom Supersonic. Thank you for having me here today to talk about innovation in U.S. aerospace and our efforts to ensure the safe, sustainable reintroduction of commercial supersonic air travel.

At Boom, we believe in a world where more people can go more places more often, and we want our children to grow up in such a world. Today, the barriers of time and inconvenience limit us from experiencing more of what Earth has to offer. By building transportation that is faster, more affordable, more convenient, and more sustainable, we can unlock new possibilities for human connection and for business.

Boom is redefining what it means to travel long distances beginning with Overture, our first supersonic commercial airplane. We envision a future in which any-

one can buy a ticket and enjoy the benefits of high-speed travel. Aboard Overture, London would be just 3.5 hours from New York, and Sydney becomes as accessible as Honolulu is today. With Overture, three-day business trips could be done in just one day—you could attend meetings across an ocean and be home in time to tuck your children into bed. Speed powers growth and transformation, and increasing the speed of travel would foster greater human connection. And Overture is about more than just speed—we are also raising the bar for safety and sustainability.

Traditional wisdom says that supersonic flights are expensive, uncomfortable, noisy, and unsustainable. Thanks to key breakthroughs at Boom and to innovations across the industry, supersonic flight can now be not just faster, but also more comfortable, more affordable, and sustainable. For example, our whole-lifecycle approach to sustainability will facilitate net-zero-carbon Overture flights. Overture will also fly at supersonic speeds only over water, so communities will not experience sonic booms. Overture is already a massive leap forward from Concorde—the only supersonic commercial airplane to see lasting service—but Overture is only our first airliner. Ultimately, we want the fastest flight to be the most accessible, too.

WHY NOW IS THE TIME FOR A PARADIGM SHIFT IN TRAVEL

Until the middle of the twentieth century, people could expect continued innovation in travel speeds. Railroads, steamships, piston-powered airliners, and jets each represented a significant improvement in how we got around. But in 2021, we're flying no faster than we were in 1960. The world has gone more than sixty years without a meaningful improvement in travel speeds. Limited by 1960s technology, Concorde was loud, costly, and fuel hungry. Concorde was a technological marvel in its time, but it was neither economical nor sustainable.

Over the subsequent decades, aviation saw steady improvements in efficiency and safety. Fundamental advancements and key breakthroughs allow Boom to bring back supersonic travel—this time, economically and sustainably. Overture will be a brand-new airliner optimized to run on 100% sustainable aviation fuels, facilitating net-zero carbon flights. It will leverage state-of-the-art computational design methods, advanced composite materials, and modern turbofan engines to increase efficiency and reduce noise. These technologies represent sixty years of advancement, but supersonic commercial aviation is still in its early days. Over time, we expect continued investment and innovation to lead to supersonic airliners that are even more efficient and less expensive—reducing ticket costs, fuel burn, and emissions. Overture, along with other emerging technologies represented on this panel including advanced air mobility and electric propulsion, will be key pillars of the future transportation ecosystem. Someday, you might take an electric air taxi to the airport, board a supersonic jet, and fly across the planet at twice today's speed. Together, these modes will enable easier, more seamless point-to-point travel and a more connected world.

SAFETY

At Boom, we have been working diligently to build both a strong safety culture and safety technology from day one. The U.S. aviation industry has an exceptional safety record, and we are committed to build on that legacy. However, we are also mindful of recent tragic accidents, and we have been proactively incorporating learnings and program governance best practices to ensure Overture is designed and built with safety in mind at every step. At Boom, we have involved pilots in the design and development of our airplane programs since the beginning.

Our piloted supersonic demonstrator, XB-1, is a critical element of our safety culture. Designing, building, and testing XB-1 has given us the opportunity to build a safety-first mindset from day one and start to develop our safety management system well ahead of Overture assembly. XB-1 has helped mitigate risk from the Overture program.

In addition, our goal is that Overture will be the first clean-sheet airliner to seek certification in the aftermath of the COVID-19 pandemic. The global health crisis has brought significant changes to how we go about our lives—and in the context of air travel, it has shown all of us that passenger and crew health is a critical component of safety. We plan to incorporate state-of-the-art air filtration systems and other health-promoting innovations, ensuring that flying aboard Overture is both safe and healthy.



ENVIRONMENT AND SUSTAINABILITY

Air travel offers many benefits to society—facilitating cross-cultural understanding, fostering new trading relationships, and supporting millions of jobs. But it also creates externalities, including community noise and climate effects, that the aviation industry is working diligently to minimize. As a new company designing a new airplane from a clean sheet of paper, Boom has the opportunity to optimize our products for sustainability. We have built this mentality into our culture from the beginning, and we are committed to making supersonic flight something communities welcome. Our team is working to maximize efficiency and minimize noise in Overture’s design, and we plan to engage with airports and communities well ahead of Overture’s entry into service to understand their concerns and help develop noise-reducing flight procedures. Key for airport communities, Overture will meet the same stringent noise levels set for subsonic jets. Because Overture will fly at supersonic speeds only over water, Overture will not create sonic booms over communities.

Because Overture is a new airplane, Boom is able to take a whole-lifecycle approach to sustainability. This includes designing for clean manufacturing at our future final assembly line, where we plan to incorporate waste-minimizing production practices and leverage on- and off-site renewable energy, and it also includes planning for end-of-life recycling.

At the core of this whole-lifecycle approach is facilitating net-zero-carbon Overture flights. In the development phase, we are reducing tailpipe CO₂ emissions through airframe and engine design optimization. This step aligns economic and environmental goals. Next, we are ensuring that Overture can operate on up to 100% sustainable aviation fuels (SAF), a key strategy for more sustainable long-haul aviation, which will continue to rely on carbon-based fuels for some time. Current-generation SAF enables up to 80% reductions in life-cycle carbon emissions when compared with conventional petroleum-based jet fuels, and emerging SAF technologies could offer even greater reductions in net CO₂. We believe the fastest and most comfortable flight should also be sustainable—and our goal is a net zero carbon future.

Beyond the carbon reduction benefits, SAF also reduces emissions of particulate matter, helping mitigate the non-CO₂ climate effects of aviation. SAF is currently only permitted to comprise up to 50% of a blend with petroleum-based fuels, but the clean-sheet nature of Overture allows Boom and our suppliers to design the airplane to use 100% SAF, capturing the fuel’s full potential to reduce CO₂ and non-CO₂ effects. In the coming years, we will continue to engage with SAF producers to ensure adequate supply for Overture operations, and we expect to power Overture’s engine test, certification, production test, and delivery flights using SAF. Lastly, we support and plan to use high-quality carbon offsets, including new-generation carbon removal technologies, where necessary to meet our net-zero pledges. Sustainability is at the core of Boom’s mission to make the world dramatically more accessible.

U.S. GLOBAL LEADERSHIP IN AVIATION

Boom is proud that Overture will be designed *and* assembled in the United States, leveraging the formidable talent, entrepreneurial spirit, and tradition of innovation in our workforce. And we are fortunate to draw on the expertise of a variety of partners—including Collins Aerospace, Amazon Web Services, Rolls-Royce, and others. We are a growing team, and over the next several years, we will continue to create well-paying engineering and manufacturing jobs to support the Overture program.

Beyond the immediate economic impacts of Boom and its partners, commercial supersonic manufacturing will have a sizable global economic impact. Leading investment bank UBS recently estimated the commercial supersonic market could be worth \$255 billion by 2040.¹ Undoubtedly, the promise of this market will spur international competition, and the United States must lead the charge.

The benefits of Overture go beyond commercial applications—for the United States government, supersonic travel represents a significant expansion in capabilities: conveying leaders across the world in half the time to resolve crises and build international connections; evacuating wounded soldiers to medical care in time to save lives; and rapidly carrying life-saving emergency supplies where they are needed. Boom is excited to be working with the United States Air Force to adapt Overture for executive transport. Overture could offer the Air Force a unique combination of passenger capacity, speed, cabin space, and power to accommodate requirements of multiple missions, enabling accelerated diplomacy and greater responsiveness to crises. Beyond USAF missions, Overture could also become part of the Civil Reserve Air Fleet and enable humanitarian and other critical airlifts in half the time.

The United States has long been a global leader in aviation. To ensure that this leadership endures, the federal government must continue to encourage innovation and facilitate the integration of new entrants into the National Airspace System. I would be remiss if I did not thank this Committee and Congress for your leadership in passing the bipartisan FAA Reauthorization Act of 2018, which helped drive important regulatory work to support new innovation. We are grateful for the direction Congress provided to the Federal Aviation Administration, which has exercised global leadership in developing economically reasonable, technologically feasible, and environmentally beneficial standards for supersonic aircraft—helping ensure that U.S. industry remains the leader in this field.

Regulatory certainty is critical to our success in bringing Overture to market. The FAA has also shown great leadership both domestically and at the International Civil Aviation Organization promoting the global standards necessary to develop, certify, and operate supersonic aircraft. The FAA has set up an office to deal with new entrants such as advanced air mobility vehicles. These processes will be extremely helpful to facilitate the introduction of supersonic aircraft—and to wider U.S. efforts to support emerging technology in aviation. I ask that Congress continue to provide resources to support this important work.

Government also plays a key role providing policy incentives and resources for common infrastructure. We are grateful for the leadership role that this Committee has played in authorizing the FAA's Continuous Lower Energy, Emissions and Noise (CLEEN) program. CLEEN has been a successful public-private partnership to help advance sustainable technologies and we support expanding the program to include technologies applicable to new entrants. The technology behind SAF is well understood, but policy incentives will play a critical role in accelerating production and adoption. Boom supports measures such as blender tax credits to accelerate production of SAF, and we are working with a broad coalition of fuel producers, operators, airports, and manufacturers to advance this key policy.

Thank you for having me here today, and I am happy to answer any questions.

Mr. LARSEN. Thank you, Mr. Scholl.

And I want to thank all the witnesses for sticking to 5 minutes or under. I appreciate that. It might be a record. We are going to go back and spend some staff time and look at that. So I appreciate that very much from folks.

I also want to thank the staff on both sides of the aisle for putting together an excellent panel for us. I did think this was going

¹“The need for speed—How will supersonic jets transform the travel industry?” UBS Q-Series, 01 December 2020.

to be a fairly interesting and somewhat exciting hearing based what I had planned to hear, and I think I can say ahead of time, before we get to questions, that this is giving us a lot to think about on the committee as we move forward in aviation. So I really want to thank the panelists for that.

We are now going to move to 5 minutes each for Member questions. I am going to start by recognizing myself for questions. And next, if Mr. Graves—he had to step away. If he is not back, I think Mr. Massie will be next. He will be the first Republican up unless Mr. Graves comes back. So if Mr. Massie can be ready.

So I recognize myself for 5 minutes. The first question is for Mayor Garcetti. Can you elaborate, specifically, on the elements FAA should include in vertiport standards to meet the needs of densely populated areas? This is the question that we are taking a look at on the committee. So specific elements the FAA should look at in terms of vertiport standards to meet the needs of densely populated areas.

Mayor?

Mr. GARCETTI. Yeah, absolutely.

First, I just think you have to coauthor this and write it with the community. Access is critically important, especially when it comes to private buildings. And looking at ways that the FAA can create a national standard, but also respect local zoning, local land use, and figure out a way to give that sort of flexibility on the ground and listen to the coauthorship of this with local communities as well.

Seleta, I don't know if you want to add anything to that real quick, because I know the Members do not have a lot of time; but anything else you would add?

Ms. REYNOLDS. I would just say consideration for integration with existing transit systems, as well as noise and redundancy. So do we have a large enough footprint to make sure that there are alternate landing and takeoff locations if something happens with the first one.

Mr. LARSEN. Yeah.

And a follow up, Mayor Garcetti, how are you thinking about equitable access for residents using AAM?

Mr. GARCETTI. Well you know, we have developed something called Principles of the Urban Sky, or the other POTUS, as I call it. But Principles of the Urban Sky really looks at the ways that we can make sure that whatever we do in Los Angeles, that we have a public process to kind of coauthor that. That we look at links with our public transit system so that it is seen as connecting to a system, rather than existing above it.

And making sure that there are stakeholders from underrepresented communities: lower income communities, commuter communities that often have been bypassed when it comes to cutting-edge technology. They should be the first to benefit, as well as folks of other communities.

So we are looking at putting that together and probably having a task force while we develop a standard that wouldn't be just good for Los Angeles, but a playbook that hopefully folks from around the world can do. And doing that together with the World Economic Forum.

Mr. LARSEN. OK. Yeah, great. Thank you very much; it is great food for thought.

Mr. Ganzarski, regarding magniX, you talked about in your testimony, you got the eBeaver and eCaravan 5 to 6 person and 9 to 12 person. What is the limiting technological challenge to get to a platform that is larger, say, than a 12-seater caravan?

Mr. GANZARSKI. You are right. Right now, the limiting factor is sources of energy, meaning batteries and/or hydrogen fuel cells. With that said, today's batteries are enough, as you mentioned, to take a six to nine-passenger aircraft up to 500 miles. And hydrogen fuel cells are good enough to take a 40-passenger aircraft up to 500 miles. That is a project we are doing with Universal Hydrogen, converting at Dash 8.

And so in the next 10 to 15 years, I would say that 40 to 70 passengers will be the max size you see, and up to about 500 miles in range. By the time we get to 2030, having 1,000-mile ranges with a 100-passenger aircraft should not be a problem.

Mr. LARSEN. Oh, we will make a note of that and check up in 9 years with you on that one. You noted in your testimony, Mr. Ganzarski, that 23 percent of your workforce are women, 27 percent are minorities. Is magniX doing anything specific to attract and hire a workforce that is more reflective of the Nation's diversity?

Mr. GANZARSKI. Yes. We intentionally and with purpose look for both women and minorities in the roles that we have. This is a challenging industry. Aerospace is a tough, tough industry to find good diversity in because they just do not exist. And that starts at middle school and high school; not enough women go into engineering. Not enough minorities go into engineering. And so when you want to hire someone today in 2021, the pool is much smaller.

So you have to intentionally do that starting at middle school and high school programs. We go to campuses to look for women. We do internships, and then when we look at resumes, we specifically try to focus on minorities and women in this industry so that we can propel them up; but it is not an easy task.

Mr. LARSEN. Thank you. I want to touch on that with Mr. Grimsley.

Given your focus on improving visibility of drone research and testing among the K to 12 Choctaw Nation students, how can the Federal Government—or should the Federal Government support the Choctaw Nation's efforts to encourage the students to pursue STEM and aerospace careers?

Mr. GRIMSLEY. Well thank you very much for that question. It is a very important question, and I agree with what the previous witness said. We need to reach the children at younger ages. That is when they develop the passion and when they have the ability to have a sense of confidence that STEM is something that they could do a career in, engineering is something they can do.

I believe the things that Congress is doing right now in terms of broadband buildout, including STEM education as part of things like the FAA reauthorization, are all important. But I think more opportunities for partnerships. We have a great partnership with NASA where we do a lot of STEM-related camps for our Choctaw youths. So more opportunities where we can work with agencies so

that we can reach some of these underserved students in some of these areas.

The Choctaw Nation has really historically been an impoverished area. The Tribe has made a huge impact on the quality of life and economic opportunity. But we are still an emerging area. So one of the big things that we are working on: STEM at that younger age. We are looking at middle school and all the way through high school as something very important to us, even as part of BEYOND and our previous IPP efforts.

So I think that—

Mr. LARSEN. OK.

Mr. GRIMSLEY. Thank you, appreciate it.

Mr. LARSEN. Yeah, thank you. I need to cut myself off.

And with that, I will just doublecheck that Mr. Graves is available.

[Pause.]

Mr. LARSEN. OK. Then we will move to Representative Massie of Kentucky.

You are recognized for 5 minutes.

Mr. MASSIE. Thank you, Chairman Larsen, for having this hearing.

Mr. Bry, since we share an alma mater, I want to start with you. Also, I was very disturbed by the state of our drone manufacturing and the small market share that we have. What are the biggest challenges that you see for drone manufacturers in the United States? Why is China so dominant and what can we do, if anything, in Congress to sort of change the playing field or level it out?

Mr. BRY. Well thank you, Representative, for that question. I think it is a really important issue.

So there is some history to this. I grew up flying radio-controlled airplanes, which is kind of my on-ramp into the industry. And the U.S. had a thriving, and still has a thriving, obvious community, which I think is really important. But most of those RC airplanes, RC toys, were manufactured in China. And I think that is actually one of the reasons why China got out to an early lead, because there has kind of been this blending of the hobbyist industry into what is now the drone industry.

I think the most important thing to recognize is that we are still very early. The technology is in its infancy, so there is tremendous opportunity. Ultimately, the way that we win is by having better products. And I think the way that we have better products is by focusing on the stuff that we are good at.

So at Skydio, we focused on autonomy and AI. We think that is the future of the industry. And we are winning head-to-head with customers across basically every segment based on the strength of that AI and autonomy.

From Congress' standpoint, I think there is a few things to consider. The U.S. public sector represents a really significant customer base for drones: from State departments of transportation to DOT to public safety. And the more the taxpayer dollars are going to support U.S. companies, the stronger the U.S. industry is going to be. So legislation like the American Security Drone Act, which is primarily concerned with security of drones, will also help promote U.S. industry.

And I also think doubling down on the stuff that is working. So using drones for infrastructure inspection—and this is a use case that has tremendous public good. There is an opportunity to provide grant funding to increase that and help State departments of transportation stand up stuff that is working. You have heard this in a number of the opening statements as well: the regulatory environment matters a huge amount. We need to have regulations that support autonomous flight because that is really the future of the industry.

Mr. MASSIE. Well let me ask you about that. As you well know, I am sure there were 50 UAS provisions in the last FAA authorization. How is that going at the FAA? We need a robust domestic end-user market for drones in order to have robust manufacturing, I believe.

So how are they doing on that and what can we do?

Mr. BRY. Again, I very much appreciate the question. I mean, I think there is a lot of good stuff in there.

So one of the things that we have really benefitted from, from the last FAA reauthorization, was what is called the 44807 provision. So there is kind of this, you know, small—part 107 if you have a pilot, if they are flying within visual line of sight. That is one end of the spectrum.

The other end of the spectrum is full type certification, which is designed primarily for crewed aircraft at a much larger scale. And there is kind of this missing middle, which 44807 begins to fill where it is a lighter weight, faster process to certify autonomous aircraft for routine operation. I think we need a lot more of that. The FAA seems to be kind of backing away from this. I think we need to double-down on things like that.

And one of the other areas that was called out in the reauthorization, which I think is really important to continue with, is investment in education. Because that is really where all of this starts. We are hiring from the pool of talent that comes from our educational system. And I think that is ultimately the future.

Mr. MASSIE. Mr. Scholl, I am really excited about the prospect of civilians flying supersonic again, and especially if those routes will start from the United States. Can you tell us how far away we are, Mr. Scholl, from civilians flying supersonic? And what is the first route you are going to focus on?

Mr. SCHOLL. Yeah, thank you.

Yes. Super exciting. We are going to have passengers on board before the end of the decade. To give you a little bit of a sense of the timeline, our XB-1 supersonic demonstrator—which is history's first independently developed supersonic jet and the first new civil supersonic aircraft since the Soviets did it in 1968—that airplane is going to fly around the end of this year, early next year, start to set some speed records.

We are breaking ground next year on the factory for our Overture airliner. We are going to start building the first one in 2023; it is going to roll out of the factory in 2025, and begin flight tests in 2026. So we are just 5 years away from having the first American-made supersonic airliner in our skies, and that is tremendously exciting.

As far as which routes we are going to focus on, that is really up to our airline customers. But you are going to see supersonic first on the routes that are transoceanic. Think New York to London in 3½ hours. Think L.A. to Sydney in 8 hours. Think being able to get from the U.S. to Asia an entire day faster than it takes today. You can leave a day later, sleep at home before you have to leave, it is super, super exciting.

Mr. LARSEN. Thank you.

Mr. MASSIE. Thank you, Chairman Larsen. Has my time expired?

Mr. LARSEN. I am sorry, your time has expired.

Mr. MASSIE. OK. Thank you very much.

I yield back.

Mr. LARSEN. Thank you, Representative Massie.

And next up, we have Representative Carson, who will be followed by Representative Mast.

Representative Carson of Indiana, you are recognized for 5 minutes.

[Pause.]

Mr. LARSEN. I was waiting for a hint from the staff about sound.

[Pause.]

Mr. LARSEN. You seem to be muted, Mr. Carson.

Representative Carson.

Mr. CARSON. Yes, sir.

Mr. LARSEN. There you go. Representative Carson is recognized for 5 minutes.

Mr. CARSON. All right. Thank you. You know, I'm preparing to reintroduce my bipartisan bill with Don Young, the National Center for the Advancement of Aviation Act. It would effectively support and promote collaboration among civil, commercial, and military aviation sectors to address the demands and challenges associated with ensuring a safe and vibrant national aviation system through research, education, and training.

To the panel, what do you think about this kind of center that would effectively go across silos of so many different aviation sectors and build up our American aviation industry. Is this too ambitious? What are your thoughts?

Mr. LARSEN. Mr. Carson, this is the chair. Could you identify a specific person to ask that of, please?

Mr. CARSON. Let's start with the good mayor. I think he's passionate about aviation.

Mr. GARCETTI. Absolutely. I would welcome it, Congressman. I think it's absolutely critical, and as we look at infrastructure packages that you'll be considering, having these national centers to both test and develop, I think of the high desert where the B2 bomber, Northrop Skunk Works, others have for a long time helped develop the aerospace innovation that's helped us win wars and keep the peace.

Right now where there's drone technology and transportation technology being focused, I think for all of us it would be welcome to see that sort of investment. We can't take for granted that it will just happen. I think the best of public-private partnerships are the public funding to see this research be accelerated and then the private sector to spin it off as we've seen in this country from everything from the internet to the aerospace breakthroughs we've made

in the past. So I would absolutely welcome it, and I'd probably lobby to put it here, but since my wife's from Indiana, I'd settle for Indiana too.

Mr. CARSON. Those Hoosiers ties run deep. Thank you, sir.

Mr. GARCETTI. You bet.

Mr. SCHOLL. I can throw in a couple cents here. I am not familiar with this specific proposal but I think we're really onto something here with the importance of innovation at the intersection of different technologies. Especially as we think about the future of advanced air mobility, supersonic flight, how that intersects with our infrastructure, bringing together airports, airlines, aircraft manufacturers including new kinds, and thinking about how we can more fluidly move around the planet. This can be a major opportunity for innovation.

Mr. CARSON. Thank you.

Mr. GANZARSKI. I'd be happy to add to that as well in that I think the center would really have to focus on what is the deliverable and what do you call success. Is it about R&D? Is it about bringing practical solutions to market? How do you know the sector has been successful and how do you measure it?

Mr. CARSON. That's good, very good. Thank you all. I yield back, Chairman. Thank you.

Mr. LARSEN. Thank you. I recognize Representative Mast for 5 minutes, who will be followed by Representative Davids. Representative Mast for 5 minutes from Florida. Sorry. We're going to skip ahead, and I apologize. Representative Balderson, you're recognized for 5 minutes.

Mr. BALDERSON. Mr. Chairman, thank you very much. I appreciate everyone joining us today. My first question is going to go to Mr. Scholl. Mr. Scholl, I have had the opportunity to visit NASA's Glenn Research Center, which is located in Cleveland, Ohio, outside of my district, but within a 2-hour drive.

So one of the many great projects they're working on with their state-of-the-art wind tunnels is developing a prototype quiet boom supersonic aircraft. Has your company collaborated with NASA or other Federal agencies on researching this technology or delivering a commercial product?

Mr. SCHOLL. Thank you very much for the question. To be clear, with Overture 1, we are starting focusing on routes that are over water only for supersonic flight. So the question of quiet boom and sonic boom over communities is not something we're addressing in Overture 1. However, I am very excited with the work happening at NASA Glenn with the QueSST program and elsewhere about developing the technologies that will ultimately enable supersonic flight unrestricted everywhere, and I think that is certainly part of the future.

Mr. BALDERSON. Thank you. Is there anything Congress can do to ensure some of the Federal research to help commercial air-space?

Mr. SCHOLL. I think that's a great question. I think we're on a good track with QueSST. I think one of the things that would be important, sort of guidance in the regulatory process, is balancing sustainability, balancing affordability, and balancing what is an appropriate, acceptable noise level for communities. Sometimes, those

goals can be intention, and having to balance on making supersonic flight acceptable for everybody, affordable for everybody, is going to be huge to enabling that next generation of high-speed flights everywhere for everybody.

Mr. BALDERSON. Thank you very much. My next question is for Mr. Harter. Mr. Harter, thank you for joining this morning also. What do you believe the best practices are for Federal research collaboration with entities like your university and how can Congress best support your work and ensure that Federal agencies are collaborating with researchers on the university level?

Mr. HARTER. Thank you for the question, sir. I appreciate the opportunity. So I think NIAR has a long history of being able to process intersections and bring together all the different stakeholders; the Government, the industry, academia to collaborate on different research projects as well as to inform and help write the regulations and policies.

So I think the Federal Government should continue to invest in research opportunities as well as policy and guidancemaking in centers that create those intersections, and I think Wichita State is very well poised to do that as are other institutions in the U.S.

Mr. BALDERSON. OK, thank you very much. Mr. Chairman, I will yield back my remaining time. Thank you all very much.

Mr. LARSEN. Thank you, Representative. I now recognize Representative Davids, after which it will be Representative Van Drew. Representative Davids from Kansas, you are recognized for 5 minutes.

Ms. DAVIDS. Thank you, Chairman. And thank you to all our witnesses for taking the time to join us today, especially Mr. Harter, who is coming from the Sunflower State and serving on today's panel. Thank you so much.

I also really want to just kind of note how much I appreciate the chairman and ranking member for holding the hearing that we're having today. This is a chance for us to look forward and evaluate the opportunities that exist that are frankly really exciting in the U.S. aerospace sector.

Of course, one area of particular interest for me is advanced air mobility, or AAM, as folks often refer to it as. Because these air transportation systems hold a lot of potential to integrate into existing aerospace operations, whether we're talking about local and regional, rural, urban, passenger, cargo. I think we're hearing about all of that today. And I think a lot of folks would love to imagine a future where you can hop onboard a small electric vertical takeoff vehicle in the middle of an urban environment or city environment like Kansas City and then fly a really manageable distance. What would normally take maybe 45 minutes to commute now only would take 10 or 15 minutes. And it's obvious that that future is not really that far off.

And I've had the chance to visit with some of the companies that are working on this exciting technology, and I know that now is the time for us to be engaged in this from the congressional level. And this is actually one of the reasons that Ranking Member Garret Graves and I have introduced H.R. 1339, the Advanced Air Mobility Coordination and Leadership Act. We're going to come up with a nice little acronym for that for everybody.

But you know, this is a simple bill that's got some pretty commonsense stuff in it directing the DOT to establish an advanced air mobility interagency working group. That includes executive agencies, labor, public and private stakeholders, which we've heard are going to be so important to this.

And then, of course, there's obviously the infrastructure, security, cybersecurity, but when we're talking about an industry that's predicted to be a \$1.5 trillion industry, we need to make sure that we're taking this really seriously here. And that's for everybody here in States like Kansas and all across the country.

So I want to start off actually with a question to Mayor Garcetti. Mayor, I know you all have already started to prepare for an AAM-enabled future with your Mobility Plan 2035. You have a working group established, and I'm just curious, what questions and answers do you think that other cities need to be looking at when they're evaluating the future of AAM?

Mr. GARCETTI. Well, thank you, Representative Davids, and thank you to you and to Ranking Member Graves for the AAM Coordination and Leadership Act. I think it's a really important piece of legislation to have introduced.

We're looking at a few different things and trying to do this in conjunction, not just with other cities but rural Tribal areas, as well as having this conversation outside the United States to see what sort of global standards might be developed, though I think America should lead on these.

Obviously, it's the sharing of data in a way that's open-sourced as much as possible for stakeholders to be able to see that and understand the space that we all own collectively. We're looking at things like affordability, how much do these rides actually cost if they were in an urban area. Of course, the planning issues that I mentioned about land use, but also the distribution of vertiports. Are they equal in different communities? It's like broadband; this will be something for rural communities to consider as well as poorer neighborhoods in urban areas, the noise and visual pollution.

And then lastly, the jobs from the manufacturing all the way to the passenger experience. What sort of standards do we want to establish for these jobs and opportunities for folks who are underserved and economically don't have as many advantages.

Ms. DAVIDS. Yeah, I appreciate the—particularly when it comes to the up and down stream. Both the jobs and also making sure that our suppliers are taken care of, and in Kansas where we've got both up and down stream suppliers, I'm keenly aware of how important that can be.

And one last thing I wanted to just—

Mr. LARSEN. If the Representative could wrap? Your 5 minutes is up.

Ms. DAVIDS. OK, OK. Sorry. I just wanted to—thank you to the Choctaw Nation for all the innovative work that you all have been doing. I meant to say that earlier.

Mr. GRIMSLEY. Thank you.

Mr. LARSEN. Thanks. A little change-up here. We're going to recognize Ranking Member Garret Graves from Louisiana for 5 minutes.

Mr. GRAVES OF LOUISIANA. Great. Thank you, Mr. Chairman. Mr. Chairman, I love that we're talking about advanced technologies and found my internet was not solid in the first opening statement, but I think we got that fixed.

In any case, I want to follow up on a question I believe Mr. Massie asked, and if I could ask Mr. Bry. We've seen a lot of problems with supply chain and perhaps dependence upon supply chain from China that's problematic. We've seen the percentage of the drone market share. Could you talk a little bit, you know, Congress is especially concerned about this increased reliance upon them for batteries for technology for components. Can you talk a little bit about the current status of domestically sourced components and supply lines and why you think that's important?

Mr. BRY. Yeah, I very much appreciate the question, Representative Graves. I think this is a really, really important issue, and it's something that we think a lot about at Skydio. So most of the most critical components on our drones are coming from U.S. companies. The two major processors that we use are coming from Embedia and Qualcomm, both U.S. companies. Wherever we can, we're sourcing stuff from U.S. companies or allied nations. And there are a lot of great components out there.

We were actually the first commercial customer for a company called Arris Composites that has a really innovative composite technology, a critical component for our latest enterprise drone. So I think there's a lot of good stuff happening. It's also important to recognize that these things take time, and there are certainly areas where there just are not U.S. alternatives. I think there's a lot of innovation and a lot of good things happening. I think everybody kind of recognizes that there's opportunity and need here. It's just going to take a little bit of patience to get there. But I think a lot of positive things are happening.

Mr. GRAVES OF LOUISIANA. Great. Thank you. I appreciate it.

Mr. Harter, one of the things the subcommittee has been focusing a good bit of time on, and I know the chairman shares concerns, is on cybersecurity threats as it relates to aerospace. And certainly with new generations of technologies before us, this whole threat evolves. Could you talk a little bit about how you see the current threat and what we need to be thinking about as policy-makers and some of those on the Zoom in terms of innovators?

Mr. HARTER. Yes, certainly. Thank you for the question. Cybersecurity is a paramount concern in all of new technologies. Aerospace, of course, is getting more and more connected. Not only in the technology of the aircraft or the air vehicles themselves, but in the technology that helps those air vehicles navigate our pathways. So we need to spend a lot of time and have a lot of concern and research and make sure our workforce is ready to support the cybersecurity of not just the air vehicle itself, but the systems that support those and help them fly around our Nation and across the world. Does that answer your question, sir?

Mr. GRAVES OF LOUISIANA. It does. Thank you. And I think this is an area where we need to continue being very thoughtful and vigilant, ensure that we keep it on the front burner.

Mr. Bry, if I can go back to you, the FAA has done a number of rulemakings and a number of initiatives to integrate drones into

the national airspace, IPP, BEYOND, unmanned traffic management systems and others. Can you talk a little bit? Again, I know the chairman mentioned this. I mentioned it in the opening as well. We've got to make sure that all of these efforts are coming together to ensure that we are efficiently and safely integrating drones into the national airspace.

Could you just talk a little bit about how you see these things coming together?

Mr. BRY. Yeah. Again, I think it's a great question, and I think this committee and the FAA deserve a lot of credit for the work that's been done. We've benefited quite a bit from the integration pilot program, the IPP. It's gotten us connected to end users. We've gotten some breakthrough waivers for low-altitude beyond visual line of sight.

The most important thing I think is using that momentum to create repeatable operational stuff that goes beyond these pilot programs and gets codified into actual scalable regulations. And thanks to the pilot programs I think we now have a lot of data that suggests and shows the kinds of operation that can be done safely. So I think we've got a lot of the pieces we need. We just need to make sure that we keep the momentum and turn those into actual scalable operational standards.

Mr. GRAVES OF LOUISIANA. Great. Thank you. Yield back, Mr. Chairman.

Mr. LARSEN. Thank you, Representative Graves.

I now recognize for 5 minutes Representative Kahele of Hawaii. Representative Kahele.

Mr. KAHELE. OK. Thank you so much, Chair, and aloha, everyone. It's great to be on this hearing today. As a pilot, a lifelong pilot, I'm really excited about some of the really innovative things that we're talking about.

And my first question goes to Mr. Scholl from Boom. I had a great opportunity to read your testimony and I had something that popped out at me and I wanted to ask you a question on it.

You mentioned in your testimony that Overture, the supersonic aircraft which looks very similar to the Concorde, but obviously from your testimony, there's much greater technological advancement in this type of aircraft. But you noted that the Overture will—due to noise—only fly supersonic speeds over the water.

And so my question was, that makes a lot of sense when you're flying from New York to London or Japan to Hawaii, but how would that work flying from Los Angeles to New York if we're limited to flying right under the speed of sound?

Mr. SCHOLL. Great question, really appreciate it. The reality is we're going to see supersonic travel coming to market in a couple phases, and that first phase is going to be focused on supersonic flight over water. So fortunately, Hawaii is one of those places to get a super benefit from it since it's right in the middle of a lot of water.

Of course we want to get from, say, Seattle to Washington, DC, faster than we get from Seattle to Tokyo. And so there is going to be, I think, a second generation here, possibly some supersonic corridors that would allow high-speed flight over land.

And then what we really need to have this be mainstream everywhere is global standards for supersonic flight over land, understanding what's going to be an acceptable level of noise over communities that doesn't create disruption.

And then once we have those standards, once you have that certainty, we know we can build aircraft that meet it, but we can't do that in phase 1 because we don't know what we need to do. So it's that regulatory uncertainty that's really holding it back.

Mr. KAHELE. All right. Thank you for that. Second question is in regards to the SAF reductions in carbon emissions and the types of fuels and technology and research we're doing to build aircraft that are more energy efficient, more carbon neutral and the ones that help us contribute to a cleaner environment.

Can you talk a little bit about that part of your testimony and what Boom is doing and Overture is doing to do R&D into that?

Mr. SCHOLL. Yeah. It's a great question. It's super, super important to us, and we believe deeply that the airplane that you most want to be on from a comfort perspective, from a convenience perspective, from a speed perspective, also needs to be the one that's best for the planet. And, you know, historically we've seen those things in conflict, but they really don't need to be.

And I think there is great inspiration that we can take from what Tesla has accomplished in automotive. You know, before Tesla you didn't want an electric vehicle. They were slow. They didn't go very far. They weren't fun to drive. And then they showed us that we could build an electric car that's great to drive and is best for the planet.

And so that's the kind of vision that inspires us in Overture. And so the question is well, how do you do it? You can't do it with electricity, not anytime soon, because batteries are simply too heavy for a long-range flight. You'll run out of charge before you get to your destination.

So what you need is sustainable aviation fuel, which is chemically very similar to today's jet fuels, but can come from completely carbon-neutral sources. So there are a bunch of ways we can do this. There are biofuels. There are fuels that are based out of municipal waste. There are fuels that are based in carbon sequestration. And we're designing Overture from the ground up to be the first commercial airliner that's going to run on 100 percent SAF, and that's super important to us as a design goal.

Now, the biggest challenge, and I think this is where there is an opportunity for this committee and for Congress to provide some leadership, is that the supply chain for sustainable aviation fuel, for SAF, needs to be scaled. And today the technologies exist, but they're not scaled up yet.

So we need things like producer tax credits, R&D around SAF and how we scale that so that it is not just technologically feasible, but available in large quantities and available on terms that are economically competitive.

Mr. KAHELE. Thank you so much for that. And mahalo, Chair, and I yield back.

Mr. LARSEN. Thank you, Representative, and I'm going to recognize Representative Steel of California. And just a heads-up that

Representative Williams from Georgia will follow Representative Steel.

Representative Steel, you're recognized for 5 minutes.

Mrs. STEEL. Thank you, Chairman Larsen and Ranking Member Graves. I'm happy to have the opportunity today to hear from the witnesses about the advances that aerospace industries are making through research and innovation for the future of American air transportation.

I have the honor of representing coastal Orange County, California, in Congress. My district is home to John Wayne Airport. The airport is located between the cities of Costa Mesa, Irvine, and Newport Beach, and serve more than 3 million people within 34 cities and unincorporated areas of Orange County.

In 2019, approximately 10.7 million passengers flew through John Wayne Airport. The residents of Orange County and of my district care a lot about our airport. In addition to the convenience of having a world-class airport close to home, my constituents are also deeply concerned about the impacts noise and pollution have on our community.

I'm very encouraged by the innovations that the witnesses have presented today. They show that private-sector innovation is the driver for a new, cleaner, and quieter air travel. But I know the new technology such as electric airplanes have been part of the discussion for quite some time.

I believe the Federal Government has an important role to play in cutting redtape and providing a regulatory environment where new technology can be approved for use safely yet avoid the pitfalls of using taxpayers' dollars to pick winners and losers. I'm happy to be a member of the Quiet Skies Caucus and to work here in Congress to help reduce noise and pollution from air travel.

I believe the best way to do this is to create a fair playing field where innovation can flourish and airlines, manufacturers, and travelers can make the best choice for their businesses, and most importantly for the health and wellbeing of their passengers and the communities in which they operate.

So having said that, I want to ask Mr. Ganzarski, can you share more about the current market for electric aircraft and about what the barriers are to transitioning to this more clean and more efficient technology?

Mr. GANZARSKI. Thank you very much. John Wayne Airport is a great example of a regional airport in the middle of a dense population. Imagine being able to fly in and out of John Wayne Airport with an aircraft that produces 100 times less noise energy, 20 percent less decibels, and do so at zero emissions. That completely changes the landscape. Now imagine that aircraft costs 40 to 80 percent less per hour to operate. How many more people in and around John Wayne Airport can now have access to flying?

The fact is that most flights in the United States are less than 500 miles in range, which means that battery-electric or hydrogen fuel cell electric aircraft, even small ones, can today serve a large amount of demand.

Because of battery density and fuel cell density, we will start with small aircraft, 6, 9, 12, 40 passengers flying to and from smaller airports in distances of 250 to 500 miles. But that will open

up access and equity at costs and cleanliness of levels that have never existed before, and so the market is very strong for it. Now we have to incentivize the move forward.

Mrs. STEEL. So your testimony includes a request for incentives for manufacturers that make electric aircraft. So can you share how to see electric aircraft competing without taxpayer subsidies?

Mr. GANZARSKI. So it wouldn't have to be even taxpayer subsidies. Imagine carbon credits. So there is now the discussion about having carbon credits for synthetic aviation fuels. What if it was also for electric? If you use an aircraft or are manufacturing an aircraft that pollutes the environment, you can offset those with credits towards an aircraft or a propulsion system manufacturer that does so with completely clean technology.

And so those types of incentives and subsidies, if we call them that, will encourage other manufacturers in other aerospace companies to go more electric.

Mrs. STEEL. Thank you very much. Thank you for all the witnesses and I yield back.

Mr. LARSEN. Thank you, Representative.

The Chair now recognizes Representative Williams of Georgia for 5 minutes.

Ms. WILLIAMS OF GEORGIA. Thank you, Chairman Larsen for convening this hearing, and thank you to all of our witnesses today. It's critical that we make investments into aeronautics research. We have some of the best scientists and researchers at NASA working with the FAA on advanced air mobility. What was once thought of as futuristic or something from "The Jetsons" will be our reality in no time. With all of the forms of transportation, safety is one of the top things that we need to ensure.

Mayor Garcetti, I represent the city of Atlanta, and we're similar to the city of Los Angeles in many ways. Both cities are urban areas. Both have very large, busy airports, some of the busiest in the world, and have extreme vehicle congestion.

As we move to implement AAM, what safety regulations and standards do you believe the Federal, State, and local government should have in place to ensure that residents in urban areas that are high density are safe?

Mr. LARSEN. Mayor Garcetti, you seem to be on mute.

Mr. GARCETTI. Sorry. Thank you so much, Representative Williams. We have a real expert here, who not only serves on the FAA Drone Advisory Committee, but who has been trying to help us hear what some of these things might even sound like in an urban environment. So I'm going to ask Seleta Reynolds to answer that with your indulgence if that's OK.

Ms. WILLIAMS OF GEORGIA. Yes, thank you.

Ms. REYNOLDS. Thank you so much, Representative Williams, for the question. And I was born in Atlanta, so it has a place in my heart forever. I just want to share that like Atlanta, Los Angeles is a city that has suffered a legacy impact of where freeways are and how they really box Black and Brown neighborhoods and low-income neighborhoods out of opportunity.

And as we consider where we are going to locate vertiports, we want to consider equity of impacts. We want to make sure that we don't double down on those same legacy impacts of the past. And

that means we have to consider safety, which means that while the industry wants to innovate and lean forward, that probably should not happen over urban areas.

But we also want to consider noise impacts. And in Los Angeles, we've actually built a sound lab where residents can come in and stand on the corner of a different part of Los Angeles; touch, feel, and hear what it might sound like, so we can really start to get their reactions about how they might like to see these things come into their community.

We want everybody to benefit, but we want to make sure that we do not continue the harms of the past. And so that sound lab research is something that we hope we can share with other cities, especially cities like Atlanta that share so much in common with Los Angeles.

Ms. WILLIAMS OF GEORGIA. Thank you, Ms. Reynolds. And going more into that, AAM aircraft will still require landing areas, so thinking about the equity and the concerns from the past, how do you propose we build this infrastructure in cities that currently have limited space and land like L.A. and Atlanta?

Mr. GARCETTI. Go ahead, Seleta. Yeah.

Ms. REYNOLDS. So I think that we need to come up with a tiered policymaking, so there may be regional hubs where larger or louder aircraft can take off and land, maybe near existing airports or other regional hubs like Union Station.

But then at smaller distributed hubs throughout our neighborhoods, we want to have a higher bar and make sure that those aircraft are quieter. Maybe they're more appropriate for aircraft that are carrying cargo that are delivering things to restaurants and other sort of retail establishments, or even residents in those arenas.

And so I think there is a thoughtful approach to policymaking where we really can come up with some creative ideas that directly address the needs of communities. We don't need another solution in search of a problem, and I think that's where sort of thoughtful city voices at the table can make the difference between success and failure for this industry as it scales.

Ms. WILLIAMS OF GEORGIA. Thank you. And Mr. Bry, in your testimony, you mentioned that companies based in China currently dominate the U.S. market share of drones by 80 percent. What would it take for the United States-based companies to manufacture drones at the same rate or faster than what is currently being manufactured by these other companies?

Mr. BRY. Thank you, Representative, for the question. I think this is an incredibly important issue and topic, and something that we think a lot about at Skydio and we're proud of the progress that we've made. I think just a few years ago, people thought it wasn't possible for a U.S. company to build a competitive product, and we're showing now on the strength of our artificial intelligence and autonomy that we can build a product that is winning just on the strength of its capabilities for a really wide range of customers.

And I think that's really the most important thing, is using the things that the U.S. is good at. We've led the way in cell phones with the transition to software-defined devices with the iPhone, with Android. I think there's a similar opportunity with drones as

AI and autonomy become more important. So I think getting the product piece right is most important.

And anything that's good for domestic manufacturing is also going to be good for the U.S. drone industry, so we started building our drones in the U.S. because it was the way to get the best product the fastest with the fastest development times. Drones are really like other aerospace products where there's tight integration between hardware and software manufacturing.

Mr. LARSEN. Thank you, Mr. Bry. Thank you, Representative Williams. The time is expired.

I'll now recognize Representative Johnson of Georgia, followed by Representative Brownley of California. So I recognize Representative Johnson for 5 minutes.

Mr. JOHNSON OF GEORGIA. Thank you, Mr. Chairman. I would like to ask Mr. Harter, how has the COVID-19 pandemic illuminated the need for greater innovation in the aerospace industry, and how can Congress amplify its role in incentivizing greater innovation in the aerospace industry?

Mr. HARTER. Thank you, Congressman Johnson, for the question. So how has COVID illuminated innovation in aerospace? That was the question. Correct?

Mr. JOHNSON OF GEORGIA. Yeah, the—how has the pandemic illuminated the need for greater innovation in the industry?

Mr. HARTER. I can't say that I've thought about that particularly, but let me try and, let me try and shed some light on that. So I think what we've seen is a big impact in air travel. We've certainly seen the airlines and OEMs respond with innovation in ensuring that air is clean inside their vehicles as we fly, and we've seen great innovation there and very good progress.

There's been a lot of research and effort spent in ensuring that the way that we clean the aircraft doesn't damage them. And I think we're going to see a lot of innovation in the way seats are configured, the way people board airplanes, and continued innovation in the way air is cleaned on board the airplanes as well. I think—

Mr. JOHNSON OF GEORGIA. OK. All right. Well, thank you. Does anyone else care to respond to that question?

Mr. GANZARSKI. Yes. This is Roei Ganzarski. I'll be happy to add, COVID has showed us that people can work from home regularly. Many companies have already said that even post-COVID, people can continue working from home because it saves costs and increases productivity.

What that means is—and we saw an article today in CNBC saying that younger generations are now moving out of the cities. Where once people were afraid of gentrification, of city costs going up, now it's the opposite. People are moving more to the suburbs, more into rural areas. That means now that low-cost aviation can connect them when they do need to come to the office, once a week, once every 2 weeks. They can come with low-cost, clean energy electric aircraft from a small airport nearby.

The second thing—

Mr. JOHNSON OF GEORGIA. OK. All right.

Mr. GANZARSKI [continuing]. COVID—

Mr. JOHNSON OF GEORGIA. OK. Go ahead, go ahead.

Mr. GANZARSKI. The second thing is with COVID, maybe people don't want to come an hour ahead to their flight, stand in line with hundreds and thousands of other people at a large, congested airport. Maybe they would prefer to come 15 minutes ahead of time with only 10 or 15 other people to a smaller airport. So both those aspects are making changes.

Mr. JOHNSON OF GEORGIA. OK. Anyone—

Mr. GRIMSLEY. I'd like to comment on—yes, on behalf of the Choctaw Nation, in a way that we were not ready with regulation. We had communities when the pandemic started reaching out to us because they wanted to do contactless delivery. They said, is there anything we can do to do drone delivery now to get supplies to assisted living centers, basically to reduce that contact, human to human. And the regulatory system was not ready.

So we saw a lot of other technologies, businesses that were using things like curbside delivery and online ordering, app ordering. They were able to shift, and society was able to adjust very quickly.

On the side of things like drone delivery, where society could have benefitted, the regulatory system was not ready. We could not get anything in place to do any sort of meaningful missions or to help the public, specifically because the regulatory system has been so slow to get to where we are now.

So I'd say our regulatory system actually delayed our ability to respond, in my opinion, very proactively or very constructively to the pandemic response.

Mr. JOHNSON OF GEORGIA. OK. Anyone else?

Mr. SCHOLL. Yeah. I have a couple of things to throw in here. I think we're going to see that one of the effects of the pandemic is it's going to actually accelerate the adoption of supersonic flight, and that's for a couple reasons. First is the more we're able to do things over Zoom, the less tolerance people are going to have for the time inconvenience and hassle that air travel takes today, and the more attractive the faster, speedier flights are going to be. So that's thought number one.

And thought number two is the way the aircraft fit into the airline fleets is changing. Airlines, as we know, have downsized their subsonic fleets, many retiring aircraft 10, 15 years ahead of when they otherwise would have. And as we exit the pandemic and we see that air travel starts to recover, there's going to be a new generation of fleet plans made at airlines and supersonic for the first time is going to be baked into those from day one, and that's going to result in a much faster adoption of high speed than what we would have seen otherwise.

Mr. JOHNSON OF GEORGIA. Thank you. I'm sorry I'm not going to be able to ask you a question, Mr. Bry, but technology is very interesting. I wanted to ask about weaponized drones. You don't produce those, do you?

Mr. BRY. We do not. We're focused on—

Mr. JOHNSON OF GEORGIA. Thank you, and I yield back.

Mr. LARSEN. All right. Thank you, Representative Johnson. We'll have Representative Brownley, followed by Representative Payne.

Representative Brownley, you're recognized for 5 minutes.

Ms. BROWNLEY. Thank you, Mr. Chairman, and thank you very much for having this very interesting hearing. My first question is

to Mr. Mayor, and you've sort of already touched upon this question, but I wanted to ask it anyway. So can you kind of explain how your city is engaging with the community to determine these vertiport locations for UAM, and how UAM is really being integrated into an extraordinary transit system being developed and in progress right now in Los Angeles?

Mr. GARCETTI. Yeah. It's actually very exciting, Representative, to engage the community. There's a lot of excitement and a lot of fear. I think human beings are either totally horrified by this or totally excited by this, and there's not a lot of people in between, and sometimes human beings can contain both of those emotions together.

But for instance, I chair a Metro system for Los Angeles County, the third busiest transit system in the country. When we were just changing our bus service or looking at new rail lines in anticipation of the Olympics, we engaged with as many as 20,000 people. It's been tougher to engage people around this, and so we're looking for creative ways with the FAA and others. And FAA has done a great job of putting safety first, though we need to have the ability maybe to test some of this stuff a little bit more real-time.

We are looking at those conversations, but we're trying to engage people with things like what Seleta Reynolds has done with our Department of Transportation is you can go someplace and listen to the difference between a helicopter, a drone, you can look at some of the AAM options, and hear that. In most neighborhoods in Los Angeles, for instance, you don't really hear much of the electric drone noise because it's already louder than that. We don't have, as you know, a lot of rural areas where there's a lot of quiet.

So we're looking at ways to engage people where it's not just: What do you think of the boogeyman or are you excited about "The Jetsons"? It's more like: Listen to this, how do you move from place to place, where would you want a vertiport if one was here, and how would you use it? Would you want it mostly to deliver packages in this area, or would it be something that human beings should be able to use, and how do you get accessibility through a private building for a public good?

So those are some of the things and—but I think it's going to be a challenge for us across the country to engage people on the technology they don't really know anything more than a caricature about at this point.

Ms. BROWNLEY. What are two or three things at the top of your list that Congress should be doing to integrate UAM into the transportation systems?

Mr. GARCETTI. Absolutely. I mean, first, just with drones in general and UAM, I think it's very important. As I said, FAA has done a great job of putting safety first, whether it's NASA and the Grand Challenge or the Agility Prime in the Air Force.

But at LAX, for instance, we have, I think, 260 reported cases of unauthorized drones in the area since 2016, and we can't test some of the kind of defensive work that we need to do to detect and to mitigate and have remote IDs. I think that would be a critical thing that Congress could help us, and the FAA could help us do in the short term.

I think also it's very important that Congress, like I said, establish national standards and allow the local flexibility, especially when it comes to land use so that we're not overruled on things. We're often overruled, as we know, about the flightpaths, and people complain about them that are under them. When it comes to land use, people get even more intense.

So I think that automation deconfliction, helping work with planning departments, and then finally, working together to understand the technical requirements of aircraft, but also their impacts on the noise, the density, environment, and privacy, those would be the main things that I would—and how do you fund the infrastructure?

Is this something that cities pay for, or are Tribal areas, are areas in cities going to be potentially left behind if they're not higher income parts of America, and again we create that two-class transportation system?

Ms. BROWNLEY. And do you think FAA is hearing your message regarding Federal standard but local control?

Mr. GARCETTI. There's been some—I think they're hearing it, for sure, and we look forward to actually the implementation of that as well, and that's tough. I know FAA doesn't want 10,000 local standards, but a standard to allow local flexibility, especially when it comes to what gets built in cities and even rural areas, I think that's absolutely critical.

Ms. BROWNLEY. Thank you so much.

And Mr. Scholl, I wanted to just comment to you. I have very limited time now, but you had mentioned SAF, and what the Federal Government needs to do to increase its supply and supply chain. And I just wanted to let you know that I have a bill, a great bill to do just that, and I would hope that you take a hard look at it and join many in the aviation industry in supporting the bill in terms of moving forward for cleaner fuels for all of aviation, so I appreciate your interest.

And with that I will yield back. Thank you, Mr. Chairman.

Mr. LARSEN. Thank you, Representative Brownley.

The Chair, before recognizing Representative Payne, will note that Representatives Stanton and Norton are next in order after Representative Payne, who is now recognized for 5 minutes.

[Pause.]

Mr. LARSEN. Sorry. We'll just move on and then we'll come back to Representative Payne. Representative Stanton from Arizona is recognized for 5 minutes.

Mr. STANTON. Thank you very much, Mr. Chairman. Can you hear me OK?

Mr. LARSEN. Hear you fine. Go ahead there, Greg.

Mr. STANTON. All right, great. What a fascinating hearing and an important hearing, so thank you for holding it. The aviation industry played such a critical role in Arizona's economy, supporting good jobs, making it easier for travelers and workers to get to our region, shaping local communities and impacting our environment. We already see how technology and innovative practices can transform every aspect of our lives, and it's no surprise that the aviation industry is evolving as well.

In Arizona, we're committed to being at the forefront of transportation innovation. That includes the latest in aerospace and defense, clean public transit, autonomous vehicle testing, and drones.

The common thread is that these innovations are strengthening our economy and our local communities, and as Government leaders, we're here today to explore how innovations in aviation can improve policymaking and the way we invest in infrastructure.

My first set of questions are for Mr. Bry, CEO, Skydio. Drones play an increasingly important role in the way we inspect infrastructure such as roads and bridges. It's a job that when done by humans can be incredibly dangerous, and you addressed this during your testimony, but I want to hear a little bit more. How can the FAA help to promote safe and effective use of drones to inspect America's aging infrastructure?

Mr. BRY. Thank you, Representative Stanton. It is a great question, and it is something that we are really excited to be working on at Skydio. I think the first thing is just recognizing the benefits, as you alluded to. There is incredible safety benefits for the workers doing these inspections. And it is also a positive transformation for the inspections themselves. You get a full digital record of the structure. Makes it easy to track changes over time. So we really think this is the future of this industry.

From the FAA's perspective, from a regulatory perspective, I think the most important thing is unlocking autonomous operations from the ground up. We have the data now with our customers, and there are other companies doing similar things to know there is the potential for safe operations very close to the ground where drones pose no risk to manned aircraft. They pose no risk to people on the ground, and there is tremendous benefits for the people operating them. And I think that is really the place to start. We can scale up in size and altitude from there.

Mr. STANTON. OK. That is great. And then I know you have talked a little bit, and I want to hear a little bit more about how the use of drone technology can help the environment. How can drones help mitigate carbon emissions and play a role in reducing climate change?

Mr. BRY. Yeah. Thank you for the question. This is another really important area and, I think, an area of tremendous opportunity. So in basically every industry where our customers are using drones, the kind of status quo technology is some piece of heavy machinery. It could be a snooper truck for bridge inspection. These trucks actually get about 5 miles to the gallon. They have to drive them all over the country to perform bridge inspections.

It could be a crewed helicopter which burns hundreds of gallons of fuel per hour. And a drone uses negligible energy. It is all electric. So the general story is the more that we are using drones to perform this work, the smaller the carbon footprint is going to be. We have done some analysis on this with our customers that finds that using drones for bridge inspection—just a fraction of the bridges in a State is equivalent to removing thousands of cars from the road. And the more that we do that across the country, the more that we are going to see the benefits.

Mr. STANTON. That is great. And my next question is for Mayor Garcetti. Great to see you. Thank you for your outstanding testi-

mony today. The balancing act between Federal jurisdiction and the role of local governments as it relates to drones. When I was mayor of Phoenix, I expressed some frustration when the FAA was trying to regulate airspace over the city and didn't really understand the full context in my city, particularly desert preserves and the importance of protecting desert preserves in my city. Maybe you can talk a little bit about your thoughts about the balancing act between the role of the FAA in drone regulation and what is the role of local governments in managing low-altitude airspace over cities.

Mr. LARSEN. I am sorry. This is the chair. Before you answer that—and I will give you a few extra seconds here, Greg—reminding Members to mute yourselves if you are not questioning because your talking is interrupting the questioner and the answers. Mute yourself if you are not currently asking questions.

Mr. GARCETTI. Well, thank you, Mayor. I mean, Representative Stanton. It is great to see you. And I know that experience you have had. Certainly, I think at some lower level, on the lowest level, that you have to have some local ownership, some local power, some local jurisdiction because it does become the city itself, not just the airspace above it. But we have been working with Google and others to—kind of how to even map three-dimensionally the space above a city and what's the basic unit of that, something that Seleta Reynolds has been the cutting edge of. And I think making sure that we can—again, around that, planning land use in transit connections.

This isn't something that is autonomous—no pun intended—from the rest of the way we get around cities. It has to be integrated in, and that has to be a fundamental understanding. So I think that is the best way to approach that and to empower local governments, whether it is at a certain altitude or certainly not mandating how and where—unless it is around equity. I would welcome some sort of Federal mandates where cities have to make sure this is done equitably and affordably, but then we can figure out exactly how to hit that standard.

And finally, from your previous question, as chair of our L.A. Metro, we use drones right now to inspect our rail infrastructure. And our fire department uses them all the time for hotspots. So we are already seeing that from a public safety perspective, not just transportation.

Mr. STANTON. All right. Thank you for that excellent answer, and I yield back.

Mr. LARSEN. Thank you. Thank you, Representative Stanton.

We are going to flip back again to Representative Payne, and then after that, go to Representative Norton.

Representative Payne, you are recognized for 5 minutes.

Mr. PAYNE. Thank you, Mr. Chairman. And, you know, sorry for not being there when called on. It was a bit of a dilemma. The Uber Eats guy came right at the same time you called on me, so I had to go pick up the Uber Eats, so I am back, though. Thank you.

Mr. LARSEN. We understand. Go ahead.

Mr. PAYNE. Let's see. Mr. Grimsley, emerging aviation technology such as unmanned systems have the potential to greatly as-

sist underserved communities. Businesses that have been historically discriminated against should not be left out of the process of developing these new technologies and bringing them to consumers. Can you explain why it is important that disadvantaged businesses be given a fair shot to implement emerging aviation technology?

Mr. GRIMSLEY. Yeah. That is a very good question. Thank you very much for that. I am an optimist when it comes to technology. I see technology as always a potential equalizer, an opportunity where we can see communities actually change the way they have access to quality of life through technology.

I could give an example. I also serve as an Oklahoma transportation commissioner. So I have some oversight responsibility over our roadways and our bridges. And in our area, it is very historically impoverished and a very poor area historically. The roads are not that great. And so your life, your access to healthcare or just the risk of safety of driving around is at risk because these roads are not always up to the standards that they need to be for the traveling public.

I see technology such as drones and even AAM as being able to allow us to leapfrog, to allow communities that don't quite have that infrastructure in place in roadways to get access to health services or get access to emergency healthcare or to get access to other things that improve the quality of life by leapfrogging very quickly. So I think it is very important that we ensure equity in what we are doing.

We are seeing some tremendous things happening within the Choctaw Nation. And that is an area that traditionally has not had access to a lot of things. But it is happening very quickly now because of technology. Thank you.

Mr. PAYNE. Thank you. And Mr. Chairman, that—I wish I had picked up on the topic for today a bit earlier. I work with several minority drone companies in Maryland, the consortium of four African-American companies that have gotten together that are in the drone space. So maybe one day, we can look at people, minorities in that space, and what they are doing, so just as potentially a topic in the future.

Mayor Garcetti, it is good to see you here once again. Unmanned aircraft systems, or UAS, have opened the doors to numerous practical applications that improve lives and benefit communities. However, they must be used in a responsible manner, especially when used in dense urban areas near major airports such as Los Angeles or Newark, where I am from. How have you been engaging with your community to educate them on the responsible use of UAS, and what advice do you have for other cities who wish to do the same?

Mr. GARCETTI. It is a great question, Representative Payne. And I hope Uber Air delivered your food. I know they are talking about aerial delivery. I think it is a really good question because you really have a bunch of hobbyists right now. And trying to get to them is like trying to find your tweezers in the haystack and pull out the people that are engaged in this. The rest of us are kind of watching it and wondering about it.

But I think what I would advise is kind of traditional community organizing, going into communities and putting together—we have

a system of neighborhood councils, folks who are already interested in traffic and transportation issues and empowering them to be the voices and then provide them not just what do you think of X, but give a curriculum. Give them an experience, which is why our Department of Transportation is actually going and inviting community members to listen to what these things hear about, mapping and going around the city to see where noise is variable.

Those things can empower you beyond just the particular issue of UAS. I think it is for all of us to be able to look at ways of empowering ourselves in the system. And that equity of access, that availability and affordability of services—for instance, we are trying to make transit free in Los Angeles, a bold pilot to make our Metro lines, which we already do with our city bus lines, free for everybody.

But what does that mean when it comes to aerial transportation as well? And giving them the choice of weighing in on themselves being moved by these vehicles versus the goods that they need or the supplies for the businesses they go to. But it is a tough one. I think really there should be some funding that goes into that community capacity and organizing or else this will be a conversation among a lot of geeky experts like us, but it won't engage the public at large.

Mr. PAYNE. Well, thank you for that answer, Mr. Mayor.

And I yield back, Mr. Chairman.

Mr. LARSEN. Thank you, Representative Payne, and your suggestion is so noted by the staff, so we will follow up with you, Representative Payne, on meeting with some of these folks in the drone business and minority-owned drone businesses.

Next up will be Congresswoman Norton from the District of Columbia. You are recognized for 5 minutes.

Ms. NORTON. Thank you very much, Mr. Chairman. This is really not a futuristic hearing because the future is now. I want to begin with Mr. Garcetti. I am interested in jobs and economic opportunity, particularly when you say there are 280,000 new jobs coming by 2035. I am interested in the wages and opportunities. Are there existing pipelines to ensure a diverse talent pool, particularly of underrepresented minorities, or is this going to be an all-White matter?

Mr. GARCETTI. Well, that is an important question. We are trying to make that be reflective of our city and our Nation. Los Angeles is kind of the face of the Nation, I think, tomorrow, in many ways. And we are doing everything from setting up transportation schools that are focused on children who have experienced homelessness, been in the foster care system, live in our lowest income communities of color and getting them from the seventh grade into a public school that will prepare them for transportation careers as engineers and investors and builders, people who will be operators and maintainers of systems as well as people who can run agencies.

New York had one of these, and we looked at it. And Phil Washington, the head of our Metro system, and I at the time—Supervisor Mark Ridley-Thomas are building this school. And we are going to our community colleges, which I think is absolutely critical saving some of those aerospace maintenance programs that have

existed through our public schools, our adult schools, and our community colleges.

And that is absolutely critical because if we get this wrong, then there will be a backlash, I think, against this. People won't see those jobs. In L.A., 50,000 people in L.A. County are in aerospace jobs, 300,000 indirect and direct jobs in the southern California region. So it is an immense manufacture. We are also going straight to those companies and asking them to make pledges to hire more diversely and to train more diversely because that is the pipeline of what is coming.

I say don't wait for the pipeline to produce. Build it ourselves, and I think Federal funds that would go into those sorts of job training and, last piece, local hire. Please let us hire locally when we are investing our money in local transportation to support this and any transportation measures, something that was allowed in the Obama administration and taken away.

Ms. NORTON. That is encouraging, though, Mayor.

Mr. Scholl, I am a cochair of the Quiet Skies Caucus. I am particularly concerned particularly here in the District about noise, aircraft noise.

Mr. LARSEN. Congresswoman Norton, would you—Congresswoman Norton, would you just suspend for a moment? There is some background noise. If everyone could mute yourselves, please. Thank you. No, thank you. Please mute yourselves.

Ms. NORTON. If I could—if my time—

Mr. LARSEN. Go ahead, Congress—

Ms. NORTON [continuing]. Could begin again, sir—

Mr. LARSEN. No. We stopped your clock. Don't worry about it.

Ms. NORTON. OK.

Mr. LARSEN. Go ahead. Go ahead.

Ms. NORTON. My question was for Mr. Scholl because here in the Nation's capital, we have been particularly concerned about aircraft noise. And supersonic flights were once infamous for that. I am a cochair of the Quiet Skies Caucus. I understand that Overture will only fly supersonic speeds over water to avoid creating supersonic booms. Still, even flying at normal speeds, aircraft generate a significant amount of noise. Is there research that would allow these aircraft to mitigate noise?

Mr. SCHOLL. Thank you for the question. And we share your view and concern that aviation impacts to communities need to be minimized and continue to make forward progress. And you are right. Supersonic flight over water only so sonic boom isn't a consideration at all. And secondarily, we are using the latest generation propulsion technology, optimizing the airplane.

So Overture is going to meet the same most stringent noise levels that apply to latest generation subsonic aircraft, so completely different than the last generation of supersonics. You were asking about R&D that could further advance that. There are opportunities that are kind of on the drawing board today, something called variable cycle engines, for example, that are going to allow us and next generations to push to even higher speeds while being even quieter at the same time. So we have got even more to look forward to here, and supersonics, going forward in the future.

Ms. NORTON. Can I ask you, Mr. Scholl, will Overture follow the same routes as current aircrafts over the same communities, or will it need new routes for its flight speed?

Mr. SCHOLL. So over airport communities, it will take off and land just like every other airplane today. No need for special integration of the airspace.

Ms. NORTON. Thank you. I have a final question for Mr. Bry.

Mr. Bry, drones interest me, and you mention education and training as some of the programming that Congress should enact in order to build a workforce. Let me ask you, drones with artificial intelligence cameras and sensors pose serious concerns for privacy that only grows as these technologies become more ubiquitous.

How are you as a company building in safeguards for privacy as you build your technology?

Mr. LARSEN. Mr. Bry, we will give you 30 seconds to answer that, please.

Mr. BRY. Yes, thank you, Representative, for that question.

I think this is an incredibly important topic and something that we think a lot about at Skydio. So the most important thing that we do is only send customer data back to us if they explicitly choose to do so. So our app makes this very clear. If customers want to, they can say "share flight logs with Skydio." There are all kinds of reasons why somebody might want to do that, to help us debug an issue or improve their experience. But it is totally transparent to customers and it is up to them.

And we are actually the first drone company in the world to announce a set of ethical principles that guide our work. Privacy, civil liberties, transparency are at the forefront for us. I think this is—

Mr. LARSEN. Thank you.

Mr. BRY [continuing]. Companies and lawmakers—

Mr. LARSEN. Thank you. Thank you, and thank you, Congresswoman Norton.

The Chair now recognizes Representative Johnson from Texas for 5 minutes, and Representative Garamendi will follow Representative Johnson. Representative Johnson from Texas, 5 minutes.

[Pause.]

Mr. LARSEN. Just waiting for Representative Johnson maybe to return. We will put her in the queue and we will go to Representative Garamendi for 5 minutes.

Sorry, Representative Garamendi, to catch you in mid-lunch there, sorry about that.

Mr. GARAMENDI. Hello, Mr. Larsen.

Mr. LARSEN. You are good.

Mr. GARAMENDI. Fascinating hearing. Thank you very much for the opportunity to ask a couple of questions.

Mayor Garcetti, you seem to be a very busy person this morning. You seem to be the focus of a lot of attention. Perhaps that is because L.A. is such an important city with such an awesome mayor. But I have a question for you, Mayor.

Mr. GARCETTI. Sure.

Mr. GARAMENDI. The upgrading of your airports requires a pile of money. We have a financing program at the Federal Government for transportation, mostly for highways, it is called TIFIA.

Mr. GARCETTI. Yes.

Mr. GARAMENDI. We have been trying to expand TIFIA to include other modes of transportation, particularly airports, so that the investment in those airports could be made using Government financing. Federal Government can borrow money now 20 years, maybe in 30 years, somewhere around 2 percent. It seems to me to make enormous sense for us to take advantage of that, make that money available through the TIFIA program for airports such as yours and others from around the Nation so that they can meet the requirements of much of what Mr. Larsen has put on the table today.

So what do you think about going with TIFIA? And do you think it is a cool idea that you would support? If you think it is a bad idea, just don't say anything. What do you have for us, Mayor?

Mr. GARCETTI. Well, the feeling is mutual towards you. Thank you for your excellent service to our State and our country.

As I mentioned, it is the third busiest airport in the world, second busiest in the United States, and the biggest airport improvement program in America, \$15 billion. In my state of the city address just last week, I greenlit three more terminals.

We have essentially, as folks put it, done open-heart surgery on somebody while they are running a marathon, because we had to keep this going while building every terminal out as well as three new terminals, four now, that we have greenlit.

We would love, in anticipation of the 2028 Olympic and Paralympic Games returning to American soil, and we would take advantage of TIFIA funds if they were available for airports, together with the long overdue increase to the PFC cap and added flexibility for AIP funding. We would absolutely welcome it. I think it is a brilliant idea.

Mr. GARAMENDI. Well, thank you. We do share brilliant ideas. It is good to work with you. I don't know how many years we have been at it, but it has been a good, long while and a good run.

Mr. GARCETTI. Thank you; you, too.

Mr. GARAMENDI. Hang in there and we will see what we can do. I think we got a good shot at this. If you could talk to the other mayors, other airport folks around—

Mr. GARCETTI. You got it.

Mr. GARAMENDI [continuing]. Many of whom are on this, I think we can push this thing through.

The other question goes, if I might, to Mr. Harter. And this has to do with my work on the Armed Services Committee. We are trying to green the military. We are trying to see if we can really force them to reduce their consumption of carbon fuels, particularly hydrocarbons, petroleum products.

Conservation is one of the best ways of doing that, but beyond conservation and they are going to battery-powered vehicles, including Abrams tanks, so that would be hybrid, the fuel is still petroleum based. And what I am looking for here is really what we can do, how we can move the military to be an early starter on biofuels of all kinds.

And so if you can comment on that, and if any of your colleagues want to jump into it, that would be cool, too. So what do you think here? Can we do that?

Mr. HARTER. Thank you, Representative. Yes, I think there is already a lot of work being done in that area. I think Mr. Scholl addressed that earlier with some of his comments on sustainable aviation fuels. And I think all of that research that is underway on sustainability of fuels is applicable to the military. I certainly think it helps with your work on the Armed Services Committee to make that a focal point for the military and have them emphasize that more in their research.

I also think a lot of the other technologies we are talking about here today are going to help with that greenifying. So, drones being able to deliver equipment and supplies to the soldier on the front lines, not just the last mile but part of the last 100 miles of delivery.

Electric aircraft, as Mr. Ganzarski has talked about, is going to evolve and we will eventually be able to carry our soldiers and equipment into battle and replace some of those fixed-wing and nonfixed-wing aircraft that we have flying today.

Mr. GARAMENDI. Thank you very much. I am going to ask all of you to lobby your Congress Members about the military and going green in the military and going to biofuels, using the military to bring into the market these new fuels.

With that, I am going to yield back my remaining 13 seconds. Thank you very much, Mr. Chairman. Take care.

Mr. LARSEN. Thank you, Representative Garamendi. I will now recognize—I think Representative Johnson is back—Representative Johnson of Texas is recognized for 5 minutes.

Ms. JOHNSON OF TEXAS. Thank you very much, Mr. Chairman. And let me thank you for this very interesting and needed hearing, and all of our witnesses. I would also like to ask unanimous consent to put my opening statement in the record.

Mr. LARSEN. Without objection.

[Ms. Johnson of Texas' prepared statement follows:]

**Prepared Statement of Hon. Eddie Bernice Johnson, a Representative in
Congress from the State of Texas**

Thank you, Chairman Larsen and Ranking Member Graves for holding today's hearing, which delves into the intricate and truly awe-inspiring ideas behind "innovation in U.S. aerospace." I would like to thank our outstanding witnesses for testifying today, and my colleagues on the Aviation Subcommittee for engaging in today's thought-provoking discussion into the future of aviation and novel modes of transportation.

As a nearly 30-year member of the House Committee on Transportation and Infrastructure, I have witnessed first-hand the astounding technological advancements and transformations in the aviation arena. As Dean of the Texas Congressional Delegation, I represent the city of Dallas, a critical and vital metropolitan area for the airline industry. In fact, Dallas Love Field, based in my congressional district, is home to Southwest Airlines' corporate headquarters. Southwest also operates a key base at Love Field Airport. Just outside my congressional district lies Dallas-Ft. Worth International Airport (DFW), which is the largest hub for American Airlines, and whose headquarters is nearby in Ft. Worth. By all measures, DFW is one of the busiest airports in the world and, according to The Texas Commercial Airports Association, generates a \$37 billion impact for the North Texas region each year.

Certainly, as the Chairwoman of the House Committee on Science, Space and Technology, the rapid advancements in U.S. aerospace are issues of primary importance, as reflected by the attention that the Science Committee has given to aerospace innovation. We have been examining the role that both NASA and the private sector play in promoting innovation in aerospace, whether in the areas of low boom

supersonic flight, sustainable aviation, urban air mobility, and drones. We recently held a Subcommittee hearing looking at R&D pathways to sustainable aviation, an important avenue for innovation in cleaner, more efficient aircraft and aviation systems. We're also interested in understanding how aviation and aircraft operations can contribute to efficiencies in the aviation system.

The role of academia, students, and the workforce is integral to our advances in U.S. aerospace innovation. In that light, we also are considering opportunities for further university involvement and ways to increase the diversity of professionals in aeronautics and aerospace. We need to include all of our talented students and professionals to remain on the cutting-edge.

The Science Committee has and will continue to focus on innovation in our NASA Authorization and standalone bills. The testimony from today's witnesses will be helpful in illuminating the impact that innovation in U.S. aerospace will have on the operation of the National Airspace System, and I look forward to today's discussion.

In closing, I want to again thank Chairman Larsen for holding today's hearing. Our nation is clearly at a decisive turning point with respect to innovation, specifically in the arenas of advanced air mobility, electric aircraft, drones, and supersonic plane exploration. And as we move forward and examine the federal government's role in these scientific advances, we need to make sure that our progress is inclusive of all Americans, and that no one, irrespective of race, income or ethnicity, is marginalized and left out of the tremendous benefits that have already been, and will continue to be produced by aviation innovation.

Ms. JOHNSON OF TEXAS. And let me say, Mayor Garcetti, I really like your attitude about preparing staff. I chair the Science, Space, and Technology Committee and we are very concerned about the lack of diversity in our STEM careers. And across the board here as we talk about this future, and it sounds exciting, but I want all of the people to comment on where they are getting talent, and what are they doing to expand the talent in trying to reach all of these goals that we have in this technology, and especially at home in the United States.

So let me start with you, Mayor, to see if you have any other comments on producing more talent, on diversity, both by gender, whatever, and then move to the other witnesses.

Mr. GARCETTI. So we have what I think is a national model for going to technology companies, including aerospace technology companies as well as digital and biotech and other technology companies, something called PledgeLA with the Annenberg Foundation. It is voluntary but it has been highly successful and uses peer pressure.

It started with kind of an equity framework we are using on ourselves hiring in the city of Los Angeles. But it essentially has two aspects. It goes to companies, over 100 of them, and their funders. So it goes to private equity, venture capital, other funders, and ask them to sign a pledge to look at the hiring of more women, of more people of color, and other disenfranchised communities, as well as then, second, applying some of their brilliance to problems that our communities face.

I have an Italian last name because of an Italian who went through Mexico, but my father's whole side of the family is Mexican American. Looking at the Latino community, for instance, the STEM careers were greatly lagging. African-American communities as well; many Pacific Islander communities and some Asian-American communities, our Native communities.

So it starts with that, and over 100 companies have signed off on kind of self-imposing that. And that becomes very collaborative. It becomes: If you are not doing that, you are not an excellent com-

pany here in Los Angeles anymore. And I think that is a great model building on some of the other things I mentioned, like the schools and community colleges before.

Mr. BRY. I just want to jump in here. Thank you, Representative, for raising this issue. It has come up a couple of times. I think it is incredibly important and it is one that I am incredibly excited about. And I think drones can actually be one of the most valuable tools, not just for the drone industry but for all of aviation and all of aerospace because it is one of the few aerospace devices that people can actually use themselves and see how it works and benefit from.

And so at Skydio we are doing a few things. We are donating drones to underrepresented communities, or groups that focus on underrepresented communities, to get them exposed to the technology. In our own recruiting efforts, we engage with college and campus groups that focus on diversity. And I think there is an opportunity for Congress here as well.

So I have more details on this in my written statement, but something like a drone infrastructure inspection grant program could not only provide funding to State departments of transportation for using drones for inspection, but could provide funding to educate folks on how to use drones and really empower a new generation of workers with very diverse backgrounds.

Mr. GRIMSLEY. I would like to—

Mr. SCHOLL. I would like to comment as well. Your core principle for building our culture here at Boom is to make the company the place where the most talented people on the planet can be inspired and enabled to do the best and most meaningful work of their careers. And today, many of the most talented, best people on the planet don't even consider careers in aerospace. And so this is a problem that runs deep, and you have to solve it at many levels.

We focus on diversity at every level of the company at Boom. I am proud to have a very diverse leadership team with me. But we have to go much further beyond that. We need to do things that inspire the next generation of people to think about what they can do and to take on more challenging careers.

But even more than that, we have to reach all the way back into early childhood and make sure that people have the opportunity and the education that they need to go off and do great things, and that everybody from every walk of life can look in the mirror and say "I am somebody who can do something great. I am somebody who can change the world. I am somebody who can take on a tough challenge." And that is a very tall order. But if we inspire people and we focus on education, we can make it happen.

Ms. JOHNSON OF TEXAS. Thank you.

Mr. GRIMSLEY. And on behalf of the Choctaw Nation, I can say, just like the other witnesses here, we are focusing on that middle school and even younger age because that is when students develop a sense of confidence, when they develop their passions.

An observation I have had on the IPP and BEYOND is some of our biggest champions within our region within the reservation, are school superintendents and our STEM educators, because the kids hear about what we were doing, they ask questions, they kind of get interested and excited about it, but it gives the STEM edu-

cators an opportunity to talk to them about STEM opportunities and so we have made it a priority. The pipeline that you are talking about, we have to start building it at that middle school level to make sure that it propagates all the way through the university level. So that is very important to us. So thank you for the question.

Ms. JOHNSON OF TEXAS. Thank you very much, Mr. Chairman. I yield back.

Mr. LARSEN. Thank you, Representative Johnson. And next is Representative Titus of Nevada. Representative Titus, you are recognized for 5 minutes.

Ms. TITUS. Thank you very much, Mr. Chairman. It is a very interesting hearing this morning.

I would like to change the subject a little bit. We have heard a lot about the technological developments of the aircraft itself, but not too much about the impact it is going to have on infrastructure.

What is going to be needed at our airports to accommodate these new kind of aircraft? Are the air traffic controllers engaged? How are we going to be able to provide some of these alternative, sustainable fuels?

Could Mr. Ganzarski or Mr. Scholl talk about those kinds of changes that they see coming, or that we need to be considering as we take up an infrastructure bill that looks at modernizing our airports?

Mr. GANZARSKI. Yes, I would be happy to address that.

Mr. SCHOLL. I would like to comment. So I think there are a couple things here that are important to emphasize. When it comes to sustainable aviation fuels, the technologies all exist. The biggest challenge is how do we scale them up.

So finding ways to make investments in the SAF supply chain is going to be critical for making sure those fuels not just exist in laboratories in small quantities, but actually go into aircraft. And today, the SAF capacity for planned projects is just about 6 percent of what we're going to need in 2030, so there is a lot of work to do there to scale things up.

The other piece of this is airports, and when we think about the ways transportation is going to get faster, the advanced urban mobility with vertical takeoff and landing, as well as supersonic, all of a sudden our airports can start to become a bottleneck. And so I think there is an opportunity there to say how can we think differently about how we build and operate airports such that these can also come up to the experience that we are going to see in the transportation itself.

Mr. GANZARSKI. And I would like to add to that that, and I will even oversimplify it, in the next 5 years you will see electric aircraft, traditional fixed-wing aircraft that take off from airports and land at airports, start to fly in the country. This country has over 10,000 airports that these aircraft can fly in and out of. So you don't need to invest in infrastructure. You do need electrical power, which lo and behold most of these airports have. Most of the States are now going to renewable energy, so we can even perhaps install the renewable energy sources at the airports themselves.

The beauty of small aircraft going to and from airports is that we change the way we think about aviation. As long as we think

about hub and spoke, everyone having to go to one large airport, then yes, airports get condensed and the costs go up. But if you think of most Americans and where they travel, it's locally, which means 200, 300, 400 miles. They would rather fly to and from an airport next to them, which means less flights per each of those airports.

So the infrastructure challenge, while there, can be solved easier than we think. But having incentives from the Government to these small airports to help is critical.

Ms. TITUS. Thank you, that is interesting. Thank you very much.

I would also like to ask Mayor Garcetti, or anybody, about the interconnectivity regionally. We are not nearly so connected in the Southwest as they are in the Northeast, and part of that is geography, part of it is demographic patterns, part of it is people just like to get in their car out here and drive wherever they want to go.

But as we develop this kind of aircraft, how are we looking at regional approaches, so you can start in Los Angeles and come and see me in Las Vegas and you won't run into different kinds of regulations or barriers to getting here?

Mr. GARCETTI. Well, I will jump in, because whether it is high-speed rail or the highway that we are constantly trying to improve between our cities, we essentially are part of one State in two States, you know, we have more in common sometimes than we do with folks who are "in our State" than with each other.

Seleta, do you want to address that a little bit? Because we were talking about regional work and making sure with rural and urban areas we can develop these standards and create that. So let me toss that over to Seleta for a couple words, if you don't mind.

Ms. REYNOLDS. I really appreciate the question, Representative Titus, and just want to flag that when we talk about not wanting a patchwork of regulations so that industry can scale, what we don't mean is preemption, right? But in order to make sure that we retain our ability to sort of have the community voice heard and control our destiny, we have to collaborate and get together.

So we have been working very closely with different organizations like CAMI and others to try and exercise that convening power of Government to think about a golden triangle of aviation that connects Los Angeles and Las Vegas and Phoenix and how we can all sort of grow together and come up with that policy framework that can be used broadly. Because you are right. The potential for regional interconnectivity is tremendous.

I think one of the things that we can't walk past, though, is the needs for the municipal power grids. An airplane needs to be able to recharge in Los Angeles or recharge in Las Vegas, and our municipal grids, to your question about infrastructure, really need shoring up to enable that future. So whether it is infrastructure or it is questions about land use, I think there is a powerful role for local voices to play at the front end of this technology, and that is where we are now, so it is a perfect time to get together and come up with some great ideas.

Ms. TITUS. Well, thank you so much. Just make it easier for Mayor Garcetti to come over here and see me in Las Vegas.

Mr. GARCETTI. You got it.

Mr. LARSEN. Thank you, Representative Titus. And that actually concludes Member questions.

I want to thank the Members for their attentiveness to this hearing, to the great questions. It is not often we get a chance to have hearings on things that we have to think about for the future, because as Congresswoman Norton said, the future is now in terms of innovation in the airspace. But I really do want to thank the Members for their questions. I want to thank the staff for putting this together.

I want to thank the panel for providing this, a broad spectrum of ideas that we need to think about as we help the FAA sort out the new entrants in the airspace, who they are going to be, what they are going to be, how they are going to be using the airspace, and ways we can help.

So with that, this concludes our hearing.

I want to thank the witnesses for your testimony. Your comments have been informative and very helpful, and I want to ask unanimous consent that the record of today's hearing remain open until such time as our witnesses have provided answers to any questions that may be submitted to them in writing. I also ask unanimous consent that the record remain open for 15 days for any additional comments and information submitted by Members or witnesses to be included in the record of today's hearing.

Without objection, so ordered.

And with that, the subcommittee now stands adjourned.

[Whereupon, at 1:22 p.m., the subcommittee was adjourned.]

SUBMISSIONS FOR THE RECORD

Prepared Statement of Hon. Sam Graves, a Representative in Congress from the State of Missouri, and Ranking Member, Committee on Transportation and Infrastructure

Thank you, Chair Larsen, and thank you to our witnesses for being here today. Just before the COVID-19 pandemic we held a similar hearing, and at that time we were excited about the possibilities for new aircraft, new operators, new business models, new technology, and new and expanding opportunities.

If nothing else, the last year has shown us that opportunities for aerospace innovation are endless.

In fact, some new technologies hit the market much faster during the pandemic due to high demand.

There's no doubt that American innovation can lead the way in changing how we move people and goods across town, around the globe, and into space.

However, during the advancement of new ideas, technology, and careers, we must maintain a high standard for safety.

Today, I am interested to hear about some of the newest users of the airspace, including drone operators; and to hear from those pursuing drone manufacturing, Advanced Air Mobility, electric aircraft technology, and supersonic flight.

I am particularly interested in how innovation will help connect small and rural communities with the rest of the country and world.

I yield back.

APPENDIX

QUESTIONS FROM HON. RICK LARSEN TO HON. ERIC GARCETTI, MAYOR, CITY OF LOS ANGELES, CALIFORNIA

Question 1. In your written testimony, you emphasized that “purpose-driven data sharing” across all levels of government is critical to ensuring the safety of the National Airspace System. What types of data from the Federal government does the City believe it needs?

ANSWER. While the FAA’s record for aircraft and operational safety is nearly unparalleled across the transportation industry, Advanced Aerial Mobility (AAM) presents a new set of challenges—for safety both on the ground and in the sky. Purpose-driven data sharing can help reduce the actual and perceived risk of AAM operations, providing the public with greater confidence whether they are passengers or spectators of AAM. Purpose-driven data sharing is also not just about improving safety: it is about making sure AAM operations are consistent with all of the “Principles of the Urban Sky,” [<https://www.weforum.org/reports/principles-of-the-urban-sky>] including equity of access, multi-modal connectivity, sustainability, low-noise, and local job creation. States, Cities, Local Governments, and Tribal Nations will be held accountable for successfully integrating this mode into their built environments and achieving desired social and environmental outcomes.

Some examples of purpose-driven data sharing include:

- Safety: Cities are places of spontaneity, and while local officials make all efforts to plan for the unplanned, there are often events and emergencies that crop up without notice. To that end, estimated and actual arrival and departure times, flying altitudes, geographic location of aircraft while in flight, number of flights per day and hour are among the data points cities might need to access on a real-time basis. And safety around areas of high traffic in the air, such as airports, is critical. LAX was recently selected by the U.S. Transportation Security Administration to test state-of-the-art technology to detect, track, and identify drones that are encroaching on restricted airspace. Data sharing pilot programs such as these are also critical to ensuring the safe integration of AAM.
- Sustainability: Many cities, including Los Angeles, have set ambitious greenhouse gas (GHG) emissions targets, and are actively implementing programs to improve local air quality. Data such as emissions of aircraft at flight, at take-off and landing; air quality impacts of aircraft at flight, at take-off and landing, and more will ensure that AAM helps cities reach sustainability goals, rather than inhibit progress. With many transportation modes transitioning to electric motors, cities need industry data to properly plan for electric grid enhancements and clean power production. We cannot afford a future where transportation modes compete for limited energy resources. We must search for synergies now to plan for an integrated future. Cities view sustainability comprehensively, and that includes impacts to nature, whether animal or botanical. Impacts to trees, birds, and other urban habitats need to be understood in order to site vertiports and operations sustainably.
- Multi-modal Connectivity: Flight path, origin, and destination, as well as the mode of transportation used to access AAM trips, are critical for transportation agencies to create integrated transportation networks with minimal impact to neighbors and to realize shared outcomes across communities.
- Low-Noise: Aircraft noise characteristics are important for planning low-impact arrival and departure procedures. Real noise data keeps community stakeholders educated and prevents the propagation of misinformation.
- Equity of Access: Where the FAA is concerned with equity of access to airspace, cities and communities are concerned with equity associated with exposure to detrimental impacts. Historically, a relatively small number of neighborhoods have borne the burden of negative externalities induced by new transportation technologies. These neighborhoods are often underserved communities of color.

Cities should work with the FAA and other stakeholders to develop an index to identify both in advance and with operations the equity of impacts of AAM, including on affordability of services, time to reach vertiports, mode of transportation to vertiports, noise impacts, air quality and emissions impacts, connectivity and grid interruptions resulting from AAM, noise, emissions, job creation, and more.

- **Local Job Creation:** Data related to the manufacturing, maintenance, and servicing of future aircraft is critical to ensure our local workforce is prepared. From these data, secondary and tertiary job forecasts can further improve our ability to respond with targeted economic development strategies. Dense cities like Los Angeles cannot afford to develop a system where few are transported over the air at the cost of worsening our jobs to housing imbalances and induce more single occupancy vehicles onto our roadways. Organizations like Los Angeles' Urban Movement Labs [<https://www.urbanmovementlabs.com/>] are well positioned to help shape the job creation and workforce development of the burgeoning AAM industry.

Question 2. How would the City need to enhance its digital infrastructure to accommodate the new frequency and scale of data from AAM operations?

ANSWER. This is a question better suited for industry to answer at this time. Industry has not yet shared with the City the technological underpinnings of AAM operations, including what type or speed of digital infrastructure would be needed to facilitate data sharing, smart charging, connectivity for customers and for aircraft operations, and more.

Understanding these needs is a critical component of planning for AAM, and part of the reason why the City has advocated for federal funding to support local AAM infrastructure planning.

As a foundation, the City of Los Angeles has invested in open-source digital infrastructure called MDS that allows it and other transportation agencies around the world to have a two-way digital relationship between commercial transportation companies operating in the public right of way, and public regulators, planners, and operators. This system is being used today to receive over 4 million anonymous notifications daily from more than 50,000 shared vehicles in the City of Los Angeles and at the LAX Airport. The City of Los Angeles and other city transportation agencies participating in the Open Mobility Foundation [<https://www.openmobilityfoundation.org/>], participants in NASA's National Campaign, and FAA workshops are working to expand the digital infrastructure capabilities to include full-scale AAM operations in the near future.

Without question, major metropolitan areas with existing airspace complexities will need the ability to communicate their policies at scale to the FAA and in turn, private companies. As cities begin to deploy pilots such as emissions-free delivery zones on the ground and invest in infrastructure such as bus-only lanes and protected bike lanes to access major transit hubs, we are relying on a mix of physical and digital methods. Enabling this same continuity of communication in the sky using similar open-source systems will assist the industry in scaling while allowing cities to achieve climate, safety, economic, and equity outcomes that residents expect.

The lessons learned from aviation hubs like LAX in cities is that up-front investment in community outreach, a shared discussion about costs and benefits, and a strong role for cities can save tremendous amounts of time and energy further down the line. As we anticipate the arrival of AAM in the next several years, a timely investment now will avoid or minimize challenges in the future, with a goal of opening up shared wins for both industry and community.

QUESTIONS FROM HON. RICK LARSEN TO JAMES L. GRIMSLEY, EXECUTIVE DIRECTOR OF ADVANCED TECHNOLOGY INITIATIVES, CHOCTAW NATION OF OKLAHOMA

Question 1. As the only tribal government participating in the Federal Aviation Administration's UAS Integration Pilot Program (IPP), what are your main takeaways from the Choctaw Nation's experience in that program?

ANSWER. Thank you for your interest in our experience as a tribal government.

As noted in the question, the Choctaw Nation of Oklahoma made history by becoming the first and only tribal government to be selected by the U.S. Department of Transportation to participate in the UAS Integration Pilot Program—or "IPP". The Choctaw Nation of Oklahoma was selected as part of a group of lead participants that also included state and local governments to focus on safely accelerating the integration of drones into our national airspace system (NAS). This was historic for the Choctaw Nation since, prior to the UAS IPP, tribal governments had not been eligible to participate in many technology-related federal government-spon-

sored pilot programs. Many positive developments and accomplishments were made possible due to the IPP. For example, the Choctaw Nation of Oklahoma became the first tribal government to be recognized by the Federal Aviation Administration (FAA) as a public aircraft operator (PAO).

In 2020, the Choctaw Nation was invited to continue our collaborative relationship with the FAA as part of the FAA BEYOND program, which is focused on advancing beyond visual line of sight—or “BVLOS”—drone operations, as well as cargo delivery by drone. As part of both the IPP and BEYOND, we have also focused on community engagement with public stakeholders. It has been exciting to be part of the Choctaw Nation team as we have accomplished many historic firsts for tribal governments in this exciting area of emerging aviation technology.

As the only tribal government lead participant in the IPP and BEYOND, the Choctaw Nation of Oklahoma did face challenges, due to an outdated regulatory framework as well as to a legacy of exclusion of tribal governments from similar programs in the past. Some of these challenges highlighted some of the inequities that tribal and rural communities still face today.

First, as we mentioned during the hearing, even as an IPP lead participant, we were frustrated by the lack of enabling regulatory progress in areas such as drone delivery, especially during situations such as the COVID-19 pandemic response. We believe that missions such as drone delivery could have possibly helped us to reduce person-to-person contact in our communities and could have been a significant tool for safely managing many parts of daily life during the pandemic response. However, outmoded regulatory frameworks designed for manned aviation did not enable this, nor did the IPP. The purpose of innovative pilot programs is to offer the ability to work around unduly restrictive existing regulatory frameworks. Indeed, that is why the Choctaw Nation was excited to participate in the IPP. Without that ability, the IPP’s success enabling expanded UAS operations was limited.

Relatedly, we are fully committed to safe aviation operations and protecting the safety of the NAS. However, when weighing the social benefits against safety risks, it is important to find ways to ensure that the societal benefits of these types of activities (such as drone delivery) are fully and thoroughly assessed and considered by the FAA. During disruptive events such as a global pandemic, our regulatory system needs to properly balance societal benefits versus safety risks to ensure that potentially groundbreaking changes in technology adoption are not unduly discouraged and prevented, especially when those technology changes could have significant immediate benefits for communities. Congress should require the FAA to account for these factors in its analysis.

We have also experienced challenges associated with the legacy of exclusion from similar pilot programs. The FAA Modernization and Reform Act of 2012 (FMRA 2012) directed the FAA Administrator to initiate a 5-year program to establish six (6) UAS test sites to support the FAA in integrating UAS into the NAS. Unfortunately, tribal governments were excluded and ineligible to participate in the program, and thus unable to seek UAS test site status. Although originally only planned for a 5-year program life, these test sites have been extended and remain active programs today. This initial exclusion has therefore had cascading effects for the Choctaw Nation. Unfortunately, many follow-on pilot program opportunities and activities such as the UAS Traffic Management (UTM) Pilot Program (or “UPP”) were limited to the original UAS test sites, and the Choctaw Nation was ineligible to participate in either the UPP 1 or UPP 2 programs. The history of exclusion of tribes from these types of pilot programs continues to be perpetuated when new pilot program opportunities are restricted to legacy programs, and there are no opportunities for inclusion of tribal governments.

Finally, our activities with the IPP also reinforced our concerns about the historic lack of funding for science, technology, engineering and mathematics (STEM) educational opportunities and resources for tribal and rural communities. The STEM educators in our reservation territory were some of the most vocal supporters of our IPP activities because the visibility of our activities helped generate interest and enthusiasm for aviation and STEM-related topics among their students. However, a general lack of resources to fully support public STEM educators throughout our reservation territory was frustrating and discouraging, and the lack of available resources prevented us from fully exploiting the IPP activities to the maximum extent possible to support and encourage STEM educational opportunities for students in our region.

As a result of the IPP, and now the BEYOND program, we are optimistic about the potential to use drone technology to improve the quality of life and health in our rural and tribal communities. It is our hope that these pilot programs are just the beginning of even more collaborative partnerships between tribal governments

and the FAA, and that these collaborations can yield meaningful advances in regulatory modernization to accommodate emerging aviation technologies.

Question 2. What lessons from the IPP should the FAA apply to the BEYOND program and future UAS integration efforts?

ANSWER. Thank you for your focus on applying lessons learned from UAS pilot programs to support further UAS integration.

In general, we endorse the industry recommendations as set forth in the Commercial Drone Alliance (CDA) policy papers included as an attachment to this document. We also endorse the CDA policy paper for IPP Renewal Recommendations (also attached).

With respect to our experience as an IPP lead participant, we strongly believe there were important lessons learned that can be used to inform both near-term and long-term FAA decision-making and we offer the following suggestions. We believe also that Congress can play a valuable role. As described in my written extended testimony, Congress can provide important support by codifying BEYOND and funding the program (funding for both the FAA and lead participants). Congress can also empower the FAA to make important decisions and hold the FAA accountable for congressional mandates related to aviation regulatory modernization and reform.

We offer the following specific suggestions for how the FAA can better pursue future UAS integration efforts:

First Recommendation: Establish Senior Leadership Positions That Are Empowered to Advance and Enable Emerging Transportation Technologies.

We believe there is a strong need for an Associate Administrator to be appointed within the FAA to focus solely on emerging aviation technologies. The new Associate Administrator should also be empowered to make decisions related to regulatory modernization and reform, and to oversee and enact mandates from Congress. The new FAA Associate Administrator should have responsibility for ensuring that our regulatory system can safely and efficiently integrate new emerging technologies into the NAS.

Ideally, there should also be a counterpart position created within the U.S. Department of Transportation, such as an Assistant Secretary of Emerging Transportation Technologies. This particular office and official should have oversight of both ground and aerial emerging technologies. This is necessary to provide leadership and coordination to related efforts to integrate emerging technologies into existing transportation systems.

Second Recommendation: Enable Site-Specific Regular Operations.

As described in my extended written testimony, we recommend mandating that the FAA accelerate opportunities for particular communities and sites that can demonstrate the ability to safely scale regular operations, such as drone delivery. Some sites, such as the Choctaw Nation of Oklahoma, have already made significant investments in ground-based radar and other safety infrastructure and mitigations to support safe drone operations today. This can serve as an opportunity for industry to innovate and demonstrate economic viability by allowing these sites to move forward and scale their low-risk low altitude drone operations within a safe and managed environment.

The original FAA UAS Test Sites fell short of fully meeting the needs of society and industry since the federal government did not make meaningful accommodations to enable regular advanced operations in the NAS. For many decades, the military and defense communities have benefited from the use of restricted military test ranges to support research, development, testing and evaluation (RDT&E) of emerging aviation technology. Over this same time period, civil aviation was typically the beneficiary of military aviation technology development as the technology moved from the military environment to civil environment. However, with the quick and expansive growth of electric propulsion, innovation in aviation is now occurring much more quickly within the civil market, and within commercial industry, versus the military and defense communities. The lack of fully capable aviation testing locations or "sandboxes" for regularized UAS operations adversely impacts the emerging aviation industries. This also places considerable pressure on the FAA's ability to achieve UAS integration. Overall, this situation is placing the United States at a global competitive disadvantage in these important emerging industry sectors.

Therefore, we recommend that the FAA work with specific sites that have made necessary investments in safety mitigations to enable regular operations for missions such as drone delivery. Many of these missions can be broadly enabled now in those locations where there are sufficient safety mitigations in place. For example, the Choctaw Nation of Oklahoma has already made significant investments to

enable safe operations within a 44,000+ acre test range that has been developed on tribally-owned land in rural southeastern Oklahoma.

Third Recommendation: Proactively Prepare for Important Public Safety Missions.

Many public safety emergency scenarios and disasters have common elements such as disruption of ground transportation, and an urgent need for an immediate pivot to alternative transportation/delivery modes. Given the unique utility and versatility of drone technology, a more proactive response should be taken by the FAA to prepare for—and enable—drone operations for public safety emergency operations. Most often it is not practical or possible to engage in detailed discussions with the FAA after an emergency situation or disaster scenario has commenced. Instead, the FAA should proactively work with emergency management and public safety officials to identify common scenarios and situations, and work to establish guidance for emergency operations during those scenarios. The FAA should not cede authority during these situations but should instead proactively evaluate common scenarios of emergency public safety operations and develop guidelines that can be used by public safety and emergency management personnel during times of emergency. This would enable the FAA to focus on only those elements or factors that are unique to the situation at hand, rather than “starting from scratch” during each and every emergency situation or disaster scenario.

Fourth Recommendation: Establish Pilot Program(s) to Demonstrate Benefits of Drone Delivery to Improving Health in Rural and Tribal Communities.

We enthusiastically support legislative proposals to establish a grant program to fund the use of commercial drones to increase rapid access to medical care in rural and tribal communities. As an example, we enthusiastically endorse the current pending industry proposals for infrastructure from the Commercial Drone Alliance (see attached in the appendix) for Congress to create a \$20 million program for *Advanced Infrastructure Solutions for Rural and Tribal Health Access* to be administered by the Department of Transportation to provide grants to eligible entities to plan for and implement the use of drones to deliver medication or medical supplies to rural and tribal areas. American drone technology is already proven to operate safely at scale through extensive operations abroad and the time is right for it to be used at home to address rural and tribal health access inequities, create high-paying, next-generation jobs in our communities, and bolster American global competitiveness in crucial emerging transportation technology sectors.

Fifth Recommendation: Empower the FAA Regional Administrators to More Actively Support Tribal Governments.

We believe that the FAA Regional Administrators can be more effectively utilized to work directly with tribal governments, and typically these FAA regional offices are more familiar with the uniqueness of the particular regions, including tribal governments. For programs like BEYOND, the FAA should consider designating a regional liaison to work with the tribal government lead participants, and the resources of the regional offices should be fully leveraged.

APPENDIX

COMMERCIAL DRONE ALLIANCE’S POLICY DOCUMENTS

[Editor’s note: The Commercial Drone Alliance’s “Policy Priorities for 2021: Proposed Executive Actions for the First 100 Days of the Biden-Harris Administration” and “Urban Air Mobility Policy Priorities for 2021: Proposed Executive Actions for the First 100 Days of the Biden-Harris Administration” are included as an appendix to Mr. Grimsley’s prepared statement on pgs. 25–31.]

COMMERCIAL DRONE ALLIANCE URGES CONTINUATION OF THE UAS INTEGRATION PILOT PROGRAM

[Editor’s note: This document is retained in committee files and is available online at <https://www.commercialdronealliance.org/letters-comments/commercial-drone-alliance-urges-continuation-of-the-uas-integration-pilot-program>]

DRONE-RELATED INFRASTRUCTURE PROPOSALS OF THE COMMERCIAL DRONE ALLIANCE

[Editor’s note: This document is retained in committee files and is available online at <https://www.commercialdronealliance.org/letters-comments/drone-related-infrastructure-proposals-of-the-commercial-drone-alliance>]

QUESTION FROM HON. STEVE COHEN TO ADAM BRY, CHIEF EXECUTIVE OFFICER,
SKYDIO, INC.

Question 1. Mr. Bry, I've been a longtime advocate for the Stadiums Operating under New Guidance (SONG) Act, which would give the Federal Aviation Administration the authority to issue Temporary Flight Restrictions (TFRs) for concerts and other events held at stadiums across the country. I know that some drone companies have the ability to recognize TFRs through their geo-fencing capability, which helps to keep careless and clueless drone operators out of airspace they shouldn't be in. However, I believe that Skydio does not offer a geo-fencing capability. In light of the FAA's Drone Advisory Committee and Unmanned Aircraft Safety Team, why is your company not implementing/endorsing that drone technology feature?

ANSWER. Thank you for your question. I appreciated the opportunity to testify about the importance of enabling U.S. leadership in the uncrewed aircraft sector. The drone industry plays a critical role in leading the next generation of aviation innovation, creating good-paying domestic jobs, protecting workers who inspect America's aging infrastructure, and slashing carbon emissions.

The safe and secure integration of drones requires a layered approach. Manufacturers have an important role to play, and Skydio takes that obligation seriously. In 2020, Skydio became the world's first and only drone company to issue a set of policy and ethical principles—the Skydio Engagement and Responsible Use Principles [<https://medium.com/skydio/skydio-engagement-and-responsible-use-principles-49c6576eb740>—to guide our work and move the industry forward. These principles capture our commitment to considering the holistic impact our products will have on communities and countries.

Skydio takes a range of measures to promote safety, including education and training. Our safety guidelines advise customers to follow FAA regulations and ensure it is appropriate to fly in a given area by using resources like the FAA's B4UFLY app. New customers acknowledge compliance with our safety guidelines when they first use the Skydio app. Skydio is one of the only drone manufacturers to offer a virtual and in-person flight school, known as Skydio Academy. The educational curriculum for Skydio Academy reinforces the importance of safe operations, including compliance with FAA regulations. In addition to Skydio Academy, Skydio offers flight school videos that teach our customers how to use Skydio drones safely and effectively. The nature of our products also contributes to safety of flight. Both of our drones—the Skydio 2 and Skydio X2—weigh less than three pounds and are not designed to carry cargo.

We take pride in engineering advanced features that provide high levels of safety and efficiency. For example, we recently released Skydio 3D Scan, a transformational product that automates photographic data collection and mapping tasks. Enterprise customers use 3D Scan to produce stunning digital twins of bridges, cell phone towers, and dams. First responders use the product to capture 3D maps of accident scenes in a fraction of the time it takes to snap manual photos. 3D Scan enables the operator to create dynamic limitations on the boundaries of the flight—a feature known as geo-caging.

As for geofencing, the FAA and global aviation regulators promote a layered approach to safety and security and generally have not required geofencing. Among other reasons, geofencing has been less effective than expected and can be easy to defeat.¹ Geofencing also makes it difficult for critical infrastructure operators and commercial drone pilots to use drones for inspection and security purposes, inadvertently grounding authorized drone flights. We will continue to closely monitor developments in this space.

At Skydio, we think safety and security go hand-in-hand. Appropriate security measures support the safe and effective integration of drones into the airspace. For that reason, we support the expeditious implementation of Section 2209 of the FAA Extension, Safety and Security Act of 2016, which directed the FAA to enable flight

¹See, e.g., Ben Heubl, *Conflict Groups Arm Consumer Drones for Terror Attacks*, Engineering & Technology, April 9, 2021, <https://tinyurl.com/j8mejbox> (describing terrorist groups' use of DJI drones to drop explosive devices in Syria and Iraq, notwithstanding geofencing); Alan Levin, *Drone Easily Pierced New York 'No-Fly Zone, Exposing Risk*, December 15, 2017, <https://www.insurancejournal.com/news/east/2017/12/15/474422.htm> (discussing a DJI drone that struck a U.S. Army helicopter 2.5 miles away from the operator, despite Presidential security TFRs); Special Agent Deana M. Jones, Criminal Complaint, *United States v. Henry Alejandro Jimenez*, February 5, 2021, at 5–6, <https://www.justice.gov/usao-mdfl/press-release/file/1365131/download> (supporting federal criminal charges against a drone pilot who flew a DJI drone into restricted airspace surrounding the 2021 NFL Super Bowl in Miami, notwithstanding geofencing). Those anecdotes suggest that layered safety and security measures—from robust training and education to drone detection and enforcement—are important tools in ensuring airspace safety.

restrictions over security sensitive fixed-sites, such as critical infrastructure, refineries, and “other locations that warrant such restrictions.” Along similar lines, the Stadiums Operating under New Guidance (SONG) Act referenced in your letter would direct the FAA to protect sporting events from unauthorized drone overflights. I would welcome the opportunity to learn more about the Act.

Skydio is committed to promoting safe and effective operations. We appreciate your interest in this topic and look forward to working with you and your office.

QUESTION FROM HON. RICK LARSEN TO PIERRE F. HARTER, DIRECTOR OF RESEARCH AND DEVELOPMENT, NATIONAL INSTITUTE FOR AVIATION RESEARCH, AND ASSOCIATE VICE PRESIDENT FOR INDUSTRY AND DEFENSE PROGRAMS, RESEARCH OPERATIONS, WICHITA STATE UNIVERSITY

Question 1. Your written testimony highlights NIAR’s long-standing collaboration with Federal agencies, academia, and the aerospace industry to improve the certification of new composites and additive manufacturing.

What investment in composite technologies do you think is necessary to grow the United States’ leadership in this field?

ANSWER. In my initial testimony, I touched briefly on some areas that I will elaborate on in this response.

Public-private partnerships

We must continue to embrace strong public-private partnerships to help establish the strategic framework and shape the regulatory environment.

We have seen great strides in enabling innovation over the last few decades in aerospace when government agencies have embraced collaboration with industry and academia. Indeed, the FAA has been strongly encouraged to utilize industry-based performance-based standards whenever possible^{1,2}.

Regardless of the origin of the standards, associated guidance and policy material, funding must be provided to enable the creation of material. That can range from convening forums of experts in an effort to collect and create standards based on consensus and experience, to executing on basic science or fundamental research to close knowledge gaps necessary to create new standards.

Research and Development

We must continue to invest in research and development that enables new designs/products, materials and manufacturing technologies. There is strong historical precedence and evidence that strong United States government investment in fundamental research and development creates tailwinds for economic prosperity (including closing the inequality gap), technological dominance, and national security. Some areas of composite technology historically have benefited in part from this investment, as referenced my testimony.

To grow our leadership in this field, there should be continued funding to current composite topics of research funded via the FAA, NASA, DoD, DoE and other federal agencies. Some particular areas of focus are:

- Composite material formulation and characterization for thermosets, thermoplastics as well as higher temperature capable composites like CMCs and Carbon-Carbon (reference Figure 1 in my original testimony)
 - This includes traditional fiber-reinforced composites (e.g. carbon and glass fiber-reinforced) as well as the other materials that are used in composite structures (e.g. honeycomb and other core products, film and paste adhesives, hybrid materials, sealants, fasteners, etc.)
- Composite process development. New materials and new ways to process existing materials need to continue to be developed to decrease costs, increase production rates and increase quality and safety. Process development is especially important in composites, as the processing of composites items can greatly affect the final physical, mechanical and other important properties of the end-use item. Some examples of this are:
 - In-situ curing of composites (to reduce the need on capital intensive ovens and autoclaves)
 - Bonding and welding of composite primary structure (to reduce/eliminate fasteners and decrease weight/cost)
- Fabrication and production-related technologies that focus on reducing manufacturing costs of raw materials as well as finished products. Special focus in this area will help enable US-based manufacturers to compete (via technology)

¹ OMB Circular A-119 Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities

² FAA Reauthorization Act of 2018, SEC. 329. PERFORMANCE-BASED STANDARDS

in this market that has often been out-sourced to low-cost countries. This is especially important to creating a resilient U.S.-based composite supply chain to avoid production disruptions, and to ensure the ability to design and manufacture composites from a national security perspective. There is a broad array of technologies in these areas that are often combined to increase benefits, which adds to development complexity and the need to fund research. Many of these technologies have been matured in other industries, but still need to be developed for composite applications. Some examples are:

- Automation and robotics
- Industrial Internet of Things
- Artificial Intelligence (AI), Machine Learning (ML) and Deep Learning
- New tooling technologies aimed at faster development time, reduce cost, increased tool life, including adaptive and reconfigurable tooling
- Non-destructive inspection, in-process and post-process
- Process control technologies that eliminate or reduce the need to inspect every part
- Analytical tools and techniques that enable virtual design, analysis, certification, and life-cycle management through physics-based modeling and other techniques. With better simulation tools and computational infrastructure, we will be able to drastically reduce the time to market as well as the non-recurring costs associated with extensive testing for certification. These tools and techniques, coupled with large data sources and AI and ML, will also aid in reducing maintenance costs and increasing fleet safety
- Embedded structural health monitoring and other multi-functional hybrid composite technologies

I appreciate the opportunity to answer this question and would be happy to answer any questions you may have in the future.

QUESTION FROM HON. RICK LARSEN TO BLAKE SCHOLL, FOUNDER AND CHIEF EXECUTIVE OFFICER, BOOM SUPERSONIC

Question 1. In your written testimony, you recommend expanding the Federal Aviation Administration's Continuous Lower Energy, Emissions and Noise (CLEEN) program to include technologies applicable to new entrants. Can you please elaborate on this proposal?

ANSWER. The commercial supersonic aircraft industry is nascent, and supersonic technology requires research and development investment. Including an emphasis on new entrants as part of CLEEN would give the U.S. an opportunity to maintain leadership in these areas.

Subsonic jet aircraft technology has matured over the past eighty years. This progress has occurred in part thanks to substantial NASA investment and the ~\$225 million in CLEEN funding committed over the last ten years. These investments have helped improve performance and reduce noise and emissions. Boom recognizes and appreciates the new inclusion of supersonic technologies to the CLEEN III program, but we recognize that supersonic technology is eligible for only one of the program's four goal areas. The program explicitly includes the considerations of LTO noise and NO_x emissions but does not include technologies that could enhance fuel efficiency and reduce other emissions. Certain potential technologies, like variable noise reduction technology, directly benefit the performance of supersonic aircraft but may also ultimately benefit subsonic aircraft. The CLEEN III program also omits other emerging technologies, including advanced air mobility and battery technologies.

An expansion of CLEEN with funding exclusively dedicated to supersonic aircraft and other emerging technologies would help the U.S. maintain leadership in these new industries while also reducing the environmental effects of new technologies. This could come in the form of a mid-cycle expansion in CLEEN funding through direct Congressional appropriations; inclusion in the 2023 FAA reauthorization; or a number of other forms. Should an expansion not be realized by 2025, dedicated funds for supersonic technology in the CLEEN IV program would be beneficial for enhancing the environmental performance of supersonic aircraft.

QUESTION FROM HON. GREG STANTON TO BLAKE SCHOLL, FOUNDER AND CHIEF EXECUTIVE OFFICER, BOOM SUPERSONIC

Question 1. Mr. Scholl, I understand that one challenge in the development of supersonic aircraft is the lack of clear international standards for environmental performance. The Federal Aviation Administration (FAA) plays an important role here on the International Civil Aviation Organization's Committee on Aviation Environ-

mental Protection, which is charged with developing those standards. Ultimately the success of supersonic aircraft will depend on harmonized international rules that allow them to operate across national boundaries.

Why are the development of international environmental standards important to Boom and how would you assess FAA's engagement on these standards at the International Civil Aviation Organization?

ANSWER. Global supersonic standards, including a noise landing and takeoff standard, will facilitate the reintroduction of commercial supersonic air travel. For Boom, global standards would create a path for Overture certification and worldwide operations. Boom is committed to sustainability, including optimizing for reduced emissions and noise. The nuances of supersonic aircraft require alternative certification procedures (including increased takeoff speeds and variable noise reduction systems) to achieve reduced noise levels without significant emissions increases, and these procedures will need to be defined in global certification standards. The FAA has shown strong engagement and global leadership to date. FAA representatives lead noise, emissions, and modelling working groups within the International Civil Aviation Organization's Committee on Aviation Environmental Protection (ICAO/CAEP), and significant investment in research and modelling efforts to support data driven standards. Boom would like this strong engagement to continue. To meet Overture's planned entry into service in 2029, global standards are needed during the next CAEP cycle, which begins in 2022 and ends in 2025. An agreement to develop supersonic standards by 2025 must be reached at the next meeting of CAEP in February 2022, and FAA leadership is essential to achieve this goal.

○