FEBRUARY 2025

Beyond Takeoff

Policy Strategies to Build the Infrastructure Future for **Advanced Air Mobility**

COALITION FOR **Reimagined Mobility**

SAFE

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Contents

Glossary of Terms and Definitions

AAM: Advanced Air Mobility, a new and emerging aviation ecosystem that encompasses multiple technologies to transport people or cargo between places underserved or inaccessible by existing aviation modes.

AAM OEM: Original Equipment Manufacturer, a company that designs, obtains airworthiness certificates for, and manufactures a complete AAM aircraft.

AAM Operator: Entity responsible for managing and sustaining an AAM service.

AATF: Airport and Airway Trust Fund, a United States federal fund that supports aviation modernization, expansion, and maintenance, funded primarily by aviation-related excise taxes.

AC: Advisory Circular, a non-binding FAA publication that provides guidance, best practices and acceptable means of compliance with aviation regulations.

AIP: Airport Improvement Plan, a U.S. federal funding program through which Airport and Airways Trust Fund money is distributed to eligible aviation infrastructure including airports, and heliports.

ATM: Air Traffic Management, an operational component of the National Airspace System (NAS) that manages air traffic through air traffic control towers and airspace management.

CAAC: Civil Aviation Administration of China, aviation regulator responsible for certification, funding, and airspace management in China.

CTOL: Conventional Take-Off and Landing aircraft that closely resemble conventional aircraft designs and require a long runway for takeoff and landing.

EASA: European Union Aviation Safety Agency, the E.U. agency responsible for certification, safety, and compliance across all member countries.

eVTOL: Electric Vertical Take-Off and Landing aircraft are powered by electric propulsion and are capable of landing like a helicopter in confined spaces.

FAA: Federal Aviation Administration, the U.S. agency responsible for all aviation certification, safety, and compliance.

FBO: Fixed Base Operator, entity at an airport, heliport or vertiport that provides services like fueling, hangars for storage, maintenance and passenger amenities.

Heliport: Designated area for the takeoff and landing of helicopters, often equipped with facilities for refueling and passenger handling.

Low-altitude Economy: Refers to activities carried out by piloted or autonomous aircrafts in the airspace 1,000 ft–4,000 ft above ground level. This can include drones and vertical take-off and landing aircraft that are electric, hybrid, or gas powered.

ICAO: International Civil Aviation Organization, a United Nations agency with 193 member countries setting global standards for safe air navigation and associated infrastructure, and investigating air accidents.

NAS: National Airspace System, the overarching infrastructure in the U.S. covering all airspace, air navigation facilities, and other infrastructure that supports safe and efficient flight.

NPIAS: National Plan of Integrated Airport Systems, a U.S. plan that identifies public-use aviation infrastructure eligible for federal funding from the AATF and other funds.

STOL: Short Take-Off and Landing aircraft, require short runways like a turboprop or seaplane.

SFAR: Special Federal Aviation Regulation, interim rules to address special aircraft types or operations, issued by the FAA for a specific timeline while they gather data and conduct consultations before a final rulemaking.

Vertiport: Specialized area for vertical take-off and landing aircraft that provide facilities for passenger boarding, refueling or recharging, cargo handling, parking, and maintenance.

Vertiport Developer: An entity that designs, builds, and operates AAM facilities, including passenger terminals, cargo handling, landing, takeoff, and refueling operations.

VTOL: Vertical Take-Off and Landing aircraft capable of taking off, hovering, and landing vertically without requiring a runway.

UAS: Unmanned Aircraft Systems, consist of drones and remotely piloted aircraft, used for deliveries, surveillance, or other applications.

UTM: Unmanned Aircraft System Traffic Management, digital framework that enables safe and efficient integration of drones into the NAS through real-time coordination and data sharing.

Executive Summary

Advanced Air Mobility (AAM) represents a transformative leap in aviation, reimagining traditional aircraft, airspace systems, and operational models. With the potential to reach a global market value of $500 billion by 2040, AAM holds the promise of safer, more efficient and accessible air transportation for people and goods while unlocking new business opportunities.[1]

While widespread passenger AAM adoption may take time, logistics applications are advancing rapidly. Companies like Amazon, Walmart, Wing and Zipline already perform drone deliveries, fueled by innovations in energy storage, battery chemistry, lightweight materials and automation software. These developments also signal AAM's capacity to deliver lasting benefits across industries.

However, the sector's success depends on access to critical infrastructure, particularly vertiports where AAM aircraft can take off, land, refuel or recharge. By 2028, an estimated 620 vertiports will be operational worldwide, though most are expected to be private and located in urban areas or near airports. While private ownership can facilitate faster installation and tailored operations, and face fewer regulatory hurdles, relying solely on private vertiports risks creating exclusivity which can limit access and broader public benefits. An emphasis on private ownership has the potential to stifle innovation, hinder integration with other modes and restrict access, as seen in other transportation sectors like railroads and bikeshare services.[2] Publicly funded and accessible vertiports can support widespread infrastructure development to ensure a competitive, efficient, and open AAM network.

[1] Robin Ridel and Shivika Sahdev, "Taxiing for Takeoff: The Flying Cab in your Future," *Perspectives on Advanced Air Mobility,* McKinsey. Summer 2022 at 5-6.

[2] Richard White, "For Tech Giants, a Cautionary Tale from 19th Century Railroads on the Limits of Competition," The Conversation. March 6, 2018; Constantin Vermoere, "Backroom Monopolies in Bikeshare Systems: How Exclusive Deals Stifle Innovation and Limit Access for All," April 6, 2023.

Globally, AAM is at a pivotal moment. China's aggressive state-led and supported push to establish itself as a global AAM leader underscores the urgency for U.S. action. Leveraging its leadership in high-speed rail, unmanned air systems, electric vehicles and battery production, China aims to quadruple its low-altitude economy by 2025.[3] This rapid progress contrasts with fragmented U.S. efforts. Without a robust national AAM infrastructure strategy, we risk falling behind in an industry with significant civilian and military applications.

The Coalition for Reimagined Mobility (ReMo) emphasizes the need for forward thinking policy strategies to build a scalable and resilient AAM ecosystem. Drawing on lessons from other transportation sectors, ReMo identified three critical recommendations to foster a scalable and resilient AAM ecosystem.

ReMo Recommendations for Advanced Air Mobility

ESTABLISH USE, OWNERSHIP, AND ACCESS OF FINITE REAL ESTATE

Local governments aligning with statewide efforts must take lead under the FAA's guidance to ensure open-access requirements for public vertiports, integrate dual-use infrastructure, and implement clear zoning policies shaped by community consultation.

FAA SHOULD PRIORITIZE DIGITAL VERTIPORT INFRASTRUCTURE

Develop interoperable information frameworks and digital tools and robust cybersecurity protocols to enable real-time communication and secure multi-modal connections, leveraging global frameworks like U-Space, General Transit Feed Specification (GTFS) and the Mobility Data Specification (MDS).

INITIATE NEW AND SUSTAINING FUNDING MECHANISMS

Establish a National AAM Infrastructure Fund tapping alternative funding streams, introduce tax incentives, and foster public-private partnerships (PPPs) to finance physical and digital vertiport development.

By addressing challenges of resource allocation, standardization, and competition, the United States can secure its leadership in AAM and pave the way for sustainable growth and innovation in this dynamic sector.

[3] Chen Zishuai, et al. "Low-altitude Economy Takes Off, as eVTOL Aircraft Producers Tap Growing Demand in Greater Bay Area," Global Times. August 14, 2024.

Building the Skies of Tomorrow

A Brief Introduction to Advanced Air Mobility

Advanced Air Mobility (AAM) encompasses new and emerging aviation technologies that transport people or cargo between places not currently served by existing aviation modes.[4] Early visions of rooftop landing pads and personal flying crafts, popularized by futurists and cartoons like The Jetsons, captured the imagination of what air travel could become.[5] However, while commercial aviation gained popularity and expanded after World War II and became widely accessible following the Airline Deregulation Act of 1978, its core infrastructure and aircraft designs changed little over the decades.

A Transformative Opportunity for Aviation

AAM signals a transformative shift with new aircraft types, propulsion systems, use cases and supporting infrastructure in development. Aviation, one of the hardest sectors to decarbonize, still relies heavily on fossil-fuels.[6] As shown in Graphic 1: Aviation Decarbonization (page 10), jet engine efficiency has improved by 25 percent, and Nox emissions have dropped by 40 percent, yet rising global demand for air travel has offset these gains. Moreover, by 2025, global passenger travel is expected to double, with Asia and Latin America leading this growth.[7]

[4] The International Civil Aviation Organization, “Working Paper WP/245,” *41st ICAO Assembly*, 2022, at 2.

[5] Eugène Hénard’s Cities of the Future (1911) and Fritz Lang’s silent film Metropolis (1927)

[6] International Council on Clean Transportation, “The Steep Descent to Net-Zero Aviation,” March 8, 2022

[7] Airports Council International, “The Trusted Source for Air Travel Demand Updates,” February 13, 2024.

Graphic 1: Aviation Decarbonization.

Aviation is classified as a "hard-to-abate" sector.

Efficiency in aviation has increased tremendously, but passenger travel continues to surge.

Global CO2 Emissions

Aviation accounts for about 2.5% of global CO_2 emissions and makes up 12% of transportation-related emissions, the second-largest source of CO_2 globally.[i]

- Aviation's environmental impact is even greater when factoring in non-CO_2 effects, such as methane, aerosols, soot, and contrails, which contribute to climate variability.
- The industry is "hard to abate" since most aviation emissions come from aviation fuel. While technological advancements have increased jet engine efficiency by almost 25% and reduced emissions like NOx by 40%, the rising demand for air travel has offset these gains.[ii]

  For example, modern aircraft like the Airbus A220 or Boeing 737 Max are far more efficient than previous-generation models like the Embraer E195, but the global demand for air travel continues to grow.

Aviation's Impact

of global CO_2 emissions

of transportation-related emissions

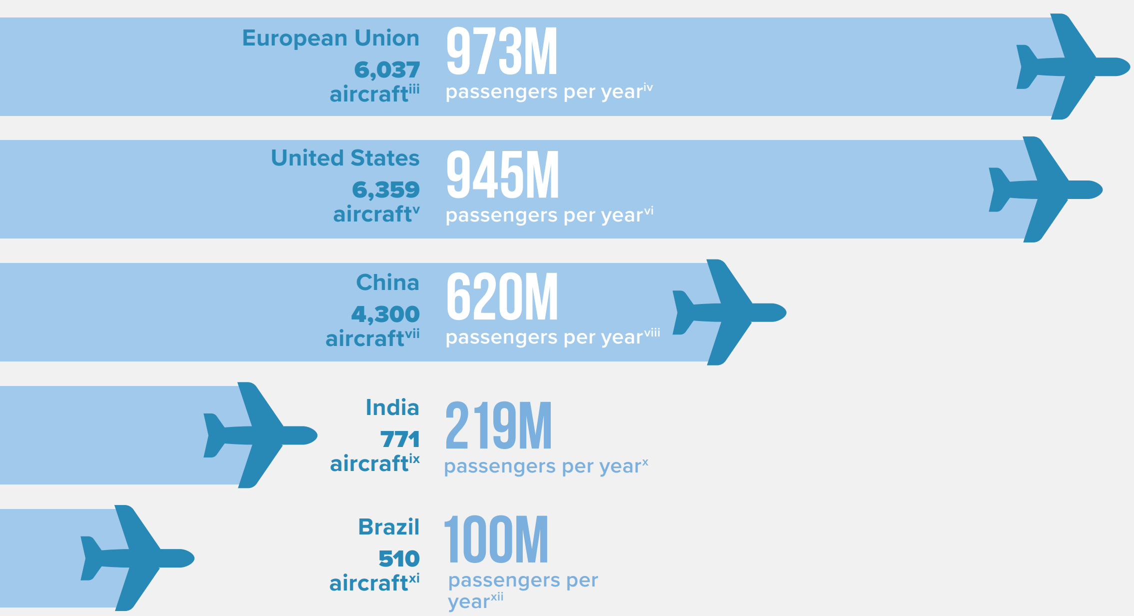
Progress in Efficiency

increase in jet engine efficiency

reduction in emissions like NOx

Growing Demand

Global aviation markets are experiencing rising demand and significant growth potential, especially in rapidly expanding regions outside the Western Hemisphere. The graphic below displays the total number of commercial aircraft and air passengers per region in 2023.



Global passenger travel is expected to double by 2050, *underscoring the need for cleaner solutions.*

eVTOLs offer a promising path forward for reducing aviation emissions, especially for short hops. With lower emissions (assuming a clean energy grid), reduced noise pollution, and the potential to bridge short distances, eVTOLs can complement existing transportation modes while addressing key sustainability challenges.

Innovations Shaping AAM

Over three hundred AAM aircraft designs are currently being developed by incumbent aerospace manufacturers and startups backed by automotive OEMs, drawn by the opportunity to expand into a lucrative emerging mobility market and the opportunity to share synergies in electrification and manufacturing at scale.[8] Among these, vertical take-off and landing (VTOL) aircraft are particularly popular due to their ability to take off, hover, and land vertically without runways, making them ideal for space-constrained urban or inaccessible remote areas.[9]

AAM propulsion systems stand apart in their potential to reduce or eliminate direct emissions. Innovations include fully electric aircraft powered by Lithium-ion batteries and hybrid-electric aircraft nearing deployment as well as sodium-ion, solid state batteries and hydrogen fuel cells still in early stages of development.[10] Significant challenges remain in optimizing battery technology to increase range, manage weight and ensure safety, while keeping pace with industry demands and regulatory requirements.[11] In 2024, California-based electric VTOL (eVTOL) company, Joby Aviation, completed a milestone 523-mile hydrogen-electric VTOL test flight in under five hours, producing only water as a by-product.[12] Vermont-based, Beta Technologies developed an interoperable and multimodal plug-and-charge device, while Charge Cube offers high-power fast charging for electric cars, trucks and aircraft with universal compatibility and real time monitoring features.[13]

Investments Driving Change

The AAM sector has attracted significant investment, with 70 percent of the top 25 automakers, including Hyundai, Toyota, Honda, Volkswagen, Suzuki and Fiat Chrysler involved in AAM companies, an indication of the opportunity to shape an integrated ground and air mobility ecosystem.[14] Aircraft under development are primarily eVTOLs with battery capacities ranging between 300 to 600 kW — similar to Class 8 electric trucks, and designed for two to seven passengers or equivalent cargo weight, typically falling within regulatory limits of 7000 to 12,500 pounds, akin to light or medium helicopters.[15] The potential use cases include:

- **Urban Air Mobility (UAM)**
  Short flights or airport transfers in dense cities.
- **Rural Air Mobility (RAM)**
  First- and last-mile connections in suburban or rural areas.
- **Cargo and Emergency Delivery**
  Supporting logistics and critical medical services.
- **Recreational and Private Use**
  Offering new modes of personal transportation.

Military applications also drive innovation, highlighting an AAM aircraft's dual use. The United States Department of Defense leverages programs like Agility Prime, an initiative under AFWERX, the innovation arm of the United States Air Force to test and fund AAM technologies for logistics transport and disaster response. It builds on the Department's historical track record of advancing and accelerating new technologies like the internet, satellite navigation, and autonomous systems.[16]

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[8] ReMo analysis based on data from the Vertical Flying Society's AAM aircraft database.

[9] The VTOL typology also include helicopters.

[10] Asian Sky Group, "The Key Things to Know about eVTOL Batteries," September 14, 2022.

[11] Quinn Foster, "Expanding AAM Range with Better Batteries Part Two," Thought Leadership Blog, Siemens Digital Industries Software. October 11, 2024.

[12] Joby Aviation, "Joby Demonstrates Potential for Emissions-free Regional Journeys with Landmark 523-mile Hydrogen Electric Flight," Press Releases, Newsroom. July 11, 2024.

[13] Beta Technologies, "Charging," 2024.

[14] Adam Cohen, et al. "Urban Air Mobility: History, Ecosystem, Market Potential, and Challenges," Institute of Electrical and Electronics Engineers. September 9, 2021, at 15.

[15] Ibid

[16] Note: Technology development includes designing and refining propulsion systems, batteries and airframes, while certification involves rigorous testing, safety compliance and regulatory approvals; Coalition for Reimagined Mobility, Unlocking a 21st Century Mobility System: How to Rethink the Future of Mobility and Restore Leadership in Transportation Innovation, January 8, 2024, at 31.

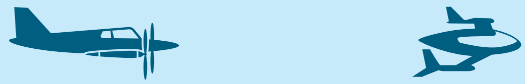
Graphic 2: AAM Typology of Aircraft.

Advanced Air Mobility: Aircraft and Fuel Types

Aircraft configurations[xiii]

Conventional Take-off and Landing (CTOL)
Standard fixed wing aircraft with runway requirements

Short Take-off and Landing (STOL)
Like CTOL, but with shorter runway requirements



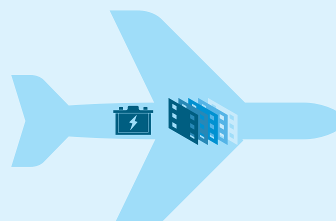
Vertical Take-off and Landing (VTOL)
Can take off and land vertically, and hover. Includes eVTOLs, powered by an electric propulsion system.

Unmanned Aircraft Systems (UAS)
Consists of an unmanned aircraft and the equipment necessary for the safe and efficient operation of that aircraft. Defined by FAA statute as an aircraft operated without the possibility of direct human intervention.

Fuel types

Electric propulsion system
Fully electric propulsion. Uses lithium-ion, solid-state, or sodium-ion batteries to store energy and provide lift or thrust.

Hybrid-electric propulsion
Combines a lithium-ion battery pack with a conventional petroleum-based fuel or sustainable aviation fuel to extend travel range.



Hydrogen fuel cells
All-electric, using a hydrogen fuel cell plus a buffer battery to drive the motors for greater range and payload.

Challenges Ahead: Technology, Cost, Regulation and Public Acceptance

Despite these technological advances and high-profile investments, AAM faces significant hurdles. Aviation is highly regulated and capital-intensive, with technology development and VTOL certification costing approximately $1–2 billion and taking a decade or more, underscoring the long path to commercial viability and profitability.[17] From an infrastructure perspective, vertiport developers must accommodate different VTOL designs and charging types while adhering to aviation guidelines that require robust infrastructure, adaptable and scalable systems for future readiness. Public acceptance is equally critical — AAM global media coverage has more than doubled in the last five years, putting a spotlight on concerns like noise, safety, costs, privacy and visual impact.[18] Without community buy-in and affordability, infrastructure investments risk underutilization and challenges to achieving widespread adoption.

As the world envisions the skies of tomorrow, AAM represents a bold opportunity and a formidable challenge, requiring collaboration, innovation, education, and new policy to make it a reality and truly redefine air travel.

[17] "Infrastructure for AAM Present and Futures," Paris Air Show, YouTube Video. July 19, 2023.
[18] Kolin Schunck, "Navigating the 2024 Advanced Air Mobility Landscape," TNMT Insights. February 8, 2024.

Current State and Global Outlook for Advanced Air Mobility

Industry Investment Trends

Over the past two decades, AAM has attracted significant investment, comparable to emerging sectors like micromobility, automated driving systems, and mobility data analytics. Between 2017 and 2021, more than $11 billion flowed into the global AAM sector, slightly trailing the $14 billion invested in micromobility but far below the $127 billion invested in autonomous vehicle technology.[19] However, funding has slowed since its 2021 peak, with some manufacturers like Lilium, Volocopter and Vertical Aerospace declaring financial struggles or insolvency.[20]

Despite these growing pains, the AAM ecosystem — including logistics, emergency deliveries, drones and military applications — is projected to grow substantially with market estimates ranging from $115 to $500 billion USD by 2040.[21] Achieving this growth will require collaboration across manufacturers, operators, investors, and regulators to address barriers related to technology, regulation, cost, and public acceptance.

[19] Florian Brummer, et al, “Final Approach: How Airports can Prepare for Advanced Air Mobility,” McKinsey & Company. November 19, 2021; ReMo analysis based on data from CB Insights, “Micromobility Revolution: Startups, Companies & Market Solutions,” October 13, 2021, and McKinsey, “Mobility’s future: An Investment Reality Check,” April 14, 2021.

[20] Jens Flottau, “Volocopter May Have to Consider Insolvency in Foreseeable Future,” Aviation Week Network. April 24, 2024; Robin Riedel et al. “Bridging the Gap: How Future Air Mobility Can Adapt to Decreased Funding.” McKinsey & Company. October 1, 2024.

[21] Robin Ridel and Shivika Sahdev, “Taxiing for Takeoff: The Flying Cab in your Future,” *Perspectives on Advanced Air Mobility,* McKinsey. Summer 2022 at 5-6; Aijaz Hussain and David Silver, “Advanced Air Mobility: Can the United States Afford to Lose the Race,” Deloitte Insights. January 26, 2021.

Near and Long-Term Applications

Cargo and logistics transportation are expected to drive adoption, with passenger services initially focusing on niche markets like airport shuttles and rural-exurban connections. Widespread adoption in dense urban areas will depend on overcoming challenges related to community acceptance, local regulations and availability of infrastructure.

Like airports, infrastructure such as vertiports for take-off, landing and charging, are poised to enhance regional connectivity and generate significant economic benefits. Worldwide, 620 vertiports are expected to be operational by 2028, ranging from modular, low-cost facilities to complex, multimodal hubs subsidized by public funding.[22] The European Union anticipates an AAM market contributing $5 billion to the region by 2030, creating 90,000 associated jobs and achieving time savings of up to 70 percent on travel commutes and emergency deliveries.[23] In the United States, the AAM market is estimated to reach between $115 and $500 billion by 2040, employing approximately 280,000 people.[24] In contrast, the People's Republic of China's low-altitude economy is designated a strategic national initiative and could contribute up to $700 billion USD to the country's economy by 2025, driving advancements in battery technology, autonomous systems and aircraft manufacturing.[25]

Regulatory Developments and Global Leadership

Since the early 2000s, rapid innovation has outpaced regulatory frameworks, leading to fragmented global approaches to AAM. The International Civil Aviation Organization (ICAO), a United Nations agency, provides a baseline for harmonized certification systems and operational standards across its member states, enabling international operations while ensuring aviation safety.[26]

Recent regulatory milestones include the U.S. FAA's Special Federal Aviation Regulation (SFAR) in October 2024, which established a new power-lift aircraft category of civil aircraft and operational rules for the first time in 80 years.[27] This action provides a pathway for commercial operations of AAM in the United States and advances the Innovate 28 timeline to integrate AAM into the national airspace by 2028.[28] Similarly, the European Union Aviation Safety Agency (EASA) pioneered the world's first vertiport design standards in 2022, followed shortly by the FAA. EASA also launched an Innovative Air Mobility Hub, a digital platform to exchange data on air taxis and drones between multiple stakeholders.[29] Meanwhile, the Civil Aviation Administration of China (CAAC) issued the world's first production certificate to mass produce and pilot air taxi services in 2024.[30] And in the Middle East, Saudi Arabia and UAE civil aviation agencies released roadmaps to reduce aviation emissions while fast-tracking trials for passenger air travel.[31]

[22] Philip Butterworth-Hayes, "The Global Vertiport Market Map and Forecast 2024-28," Unmanned Publications Ltd. September 26, 2024.

[23] European Union Aviation Safety Agency, "What are the Benefits for the EU?" What is UAM, EASA. 2022.

[24] Aijaz Hussain and David Silver, "Advanced Air Mobility, Can the United States Afford to Lose the Race?" Deloitte Insights. January 26, 2021.

[25] Staff Reporters. "China Speeds Up Low-Altitude Progress to Support Economy." Global Times. August 4, 2024; , Yi Wu and Giulia Interesse, "China's Futuristic Industries: Investment Prospects in the Emerging Low-Altitude Economy," China Briefing, Dezan Shira and Associates. July 24, 2024.

[26] There are 193 member states except for Vatican City and Liechtenstein.

[27] Federal Aviation Administration, "With New Rule, FAA is Ready for Air Travel of the Future," October 22, 2024.

[28] Note: Innovate 28 is the FAA's implementation plan to enable and integrate AAM operations into the national airspace in time for the Los Angeles Olympics in 2028.

[29] European Union Aviation Safety Agency, "What are the Benefits for the EU?" What is UAM, EASA.

[30] TechNode. "China's EHang Secures World's First Production Certificate for Flying Taxis," April 9, 2024.

[31] Sergio Cecutta, "The Middle East: Future Capital of eVTOL," Vertiflite. July - August, 2024; Alon Dron, "Saudi Mobilises its AAM Roadmap," Times Aerospace. August 9, 2024; Treena Hein, "AAM in the UAE," Vertical Magazine. June 21, 2021.

The Global Race for AAM Leadership

Countries like China have taken bold steps to position themselves as AAM leaders through aggressive industrial policies, significant state investments, and accommodating regulatory environments.[32] For instance, China's low-altitude economy demonstrates the nation's commitment to infrastructure, production, and policy integration. Its advancements contrast with slower progress in the United States and other regions, underscoring the intensifying competition for dominance in this transformative sector. China's increasing lead is highlighted in Graphic 3: China vs. U.S. Leaderboard (page 16).

China's Growing Low-Altitude Economy: A Competitive Edge

Over the past three decades, China has leveraged ambitious state-led industrial policies to emerge as a transportation technology powerhouse. It dominates all aspects of the critical supply chain, from mining and processing to manufacturing and recycling, giving it a decisive advantage in developing advanced transportation technologies like electric and autonomous vehicles, drones, 5G infrastructure, and high-speed rail.[33] Unlike nations taking more cautious steps to enable emerging mobility solutions, China has prioritized sectors, including AAM, in its 2021-2025 Five-Year Plan, accelerating its transformation into a high-tech manufacturing leader.[34]

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[32] Coalition for Reimagined Mobility, *Unlocking a 21st Century Mobility System: How to Rethink the Future of Mobility and Restore Leadership in Transportation Innovation*, January 8, 2024, at 11-16.

[33] Ibid. Id., at 16

[34] Note: A 19 federal agency working group, led by the U.S. Department of Transportation, is developing a national AAM strategy by 2024 under the Advanced Air Mobility Coordination and Leadership Act.

Graphic 3. China vs. U.S. Leaderboard.

China is far ahead of the United States when it comes to AAM development, growth and implementation.

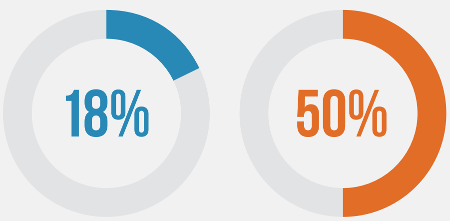
National strategy for AAM growth

United States
2025-26 (Expected Completion)

National Interagency working group created in 2023 per the AAM Coordination and Leadership Act

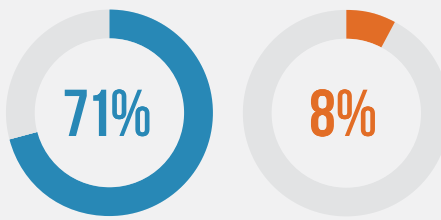
China **2019**
Launched Outline for Building China's Strength in Transport, which details a Low-Altitude Economy[xiv]

Global share of eVTOL aircraft models[xv]



United States | China

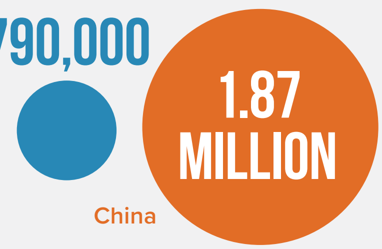
AAM-related patent filings[xvi]



United States | China

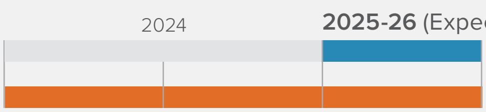
Unmanned aerial vehicles registered (including drones and autonomous eVTOLs)[xvii]

United States
790,000



China

First aircraft certified for mass production



United States
2025-26 (Expected from leading AAM OEMs)

China **2023**
Ehang two-seater eVTOL

Certified Drone Pilots

United States
420,000+[xviii]

China
225,000[xix]

Average cost of a drone completely designed and manufactured in the respective country

China
$250

United States
$1,200

Chinese government-subsidized companies dominate U.S. drone markets[xx]

U.S. consumer drone market | U.S. enterprise/ industrial market | U.S. state and local first responder drones

In December 2023, Chinese policymakers designated low-altitude economy and commercial aerospace innovation as strategic priorities for state regulatory and funding support.[35] Focused on autonomous and piloted AAM aircraft for passenger travel, cargo delivery, military applications and emergency services, this sector is projected to more than quadruple from $70 billion in 2023 to $278 billion in 2025.[36] The Ministry of Industry and Information Technology is deploying local funding to support general aviation, unmanned aircraft and low-altitude economy enterprises while granting local governments control over airspace below 2000 feet.[37] Policies like expedited aircraft certification and the creation of 20 national pilot zones for test AAM flights, have prompted 70 percent of China's provinces to adopt comprehensive plans to integrate AAM-allied industries and use cases.[38] These plans promote regional and recreational commuting, workforce development, battery innovations, autonomous navigation and urban infrastructure.

China's rapid development of the low-altitude economy poses ***significant national and economic security challenges for the United States.***

China's dominance is evident. It accounts for 50 percent of the world's eVTOL models, compared to 18 percent from the United States and 8 percent that are German.[39] Though the CAAC's AAM rules currently are not harmonized with FAA or EASA standards, in 2024, it issued the world's first production certificate to Ehang's two-seater, 22-mile range eVTOL and is fast-tracking approvals for other domestic players like Autoflight and Xpeng.[40] China's strong supply chain of critical minerals and advancements in battery technology solidifies its leadership across many transportation sectors and places it in a good position to pull ahead in the AAM race.[41]

National and Economic Security Risks of China's Low-Altitude Economy

China's rapid development of the low-altitude economy poses significant national and economic security challenges for the United States. While FAA regulations and the Airline Deregulation Act of 1978 currently block OEMs from selling uncertified aircraft and foreign AAM operators from entering U.S. markets, existing bilateral agreements

[35] Yi Wu and Giulia Interesse, "China's Futuristic Industries: Investment Prospects in the Emerging Low-Altitude Economy," China Briefing, Dezan Shira and Associates. July 24, 2024.

[36] CGTN. "China Develops New Growth Engine through Low-Altitude Economy." August 10, 2024

[37] Mia Nulimaimaiti, "China's Low-Altitude Economy Is All the Buzz, so Where Are the Tangible Results?" South China Morning Post. November 20, 2024; Global Trade Alert, "China: Shenzhen State Aid for the Development of Low-Altitude Economy," December 28, 2023; Huaxia, "China Promotes Low-Altitude Economy to Boost Innovation and Economic Growth," XinhuaNet. December 18, 2024.

[38] Kashif Anwar, "China's High Ambition for the Low-Altitude Economy," The Lowy Institute. April 22, 2024.

[39] The Economist, "It's a Bird, It's a Plane… It's a Chinese Flying Car," June 6, 2024.

[40] Dr. Steve Wright, "The Real Future of Flying Cars," Time Magazine. July 31, 2024; Ashish Dangwal, "China's Flying Cars Could Be Launched by End of 2024." The EurAsian Times. April 23, 2024.

[41] Zubeyde Oysul, et al, "Trading Tensions: Navigating Policy Tools for a Diverse Critical Minerals Supply Chain." Center for Critical Minerals Strategy, SAFE. October 2024.

between the CAAC and the FAA allow reciprocal recognition of certification standards, enabling Chinese OEMs to secure FAA certification. If achieved, this would permit the production and sale of cheaper, technologically advanced Chinese AAM aircraft in the U.S., potentially disrupting the domestic aviation industry — America's second largest manufacturing sector, contributing 5 percent of the GDP. From a national security perspective, Beijing's history of enabling coercive practices to acquire intellectual property, particularly in transportation technology, raises concerns.[42] Attempts by the state-owned, Commercial Aircraft Corporation of China (COMAC) to form joint ventures and technology transfers with McDonnell Douglas and Airbus led to accusations of IP theft in developing the C919 jetliner and the ARJ21 regional jet.[43] Despite these allegations, China's aviation industry continues to grow, fueled by a strong domestic market and strategic investments.

> ***From a national security perspective,*** *Beijing's history of enabling coercive practices to acquire intellectual property, particularly in transportation technology, raises concerns.*

China's dominance in drone manufacturing further highlights the risk. As of the publishing of this report, American-made drones are a tiny portion of the consumer market, with the largest American drone maker, Skydio, exiting this segment in mid-2023. Chinese drone companies, led by Da Jiang Innovations (DJI) and Autel, control nearly 90 percent of the global consumer market and 95 percent of the U.S. market, offering technologically superior drones at significantly lower costs than U.S. counterparts.[44] Both companies feature on the U.S. Department of Commerce's Entity List for national security concerns, which restricts their access to U.S. technology and components. Moreover, the American Security Drone Act of 2023 that was approved in the 2024 National Defense Authorization Act will ultimately prohibit federal agencies and funded programs from purchasing or using drones manufactured by adversarial nations like China or Russia.[45] NDAA-compliant drones on the DoD's Blue UAS safe list are mostly used for enterprise and industrial purposes, but will gain consumer share over time. DJI drones were also used by Russia and Ukraine despite DJI's stated position against any military use of its drones.[46] The dual-use nature of drones — suitable for civilian and military applications — raises concerns about data security, especially in a potential conflict involving China, such as with Taiwan. With AAM technologies playing an increasingly role in modern warfare, securing supply chains and fostering domestic innovation are critical for the U.S. and its allies.

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[42] Coalition for Reimagined Mobility, *Unlocking a 21st Century Mobility System: How to Rethink the Future of Mobility and Restore Leadership in Transportation Innovation*, January 8, 2024, at 65.

[43] Robert Hackett, "Chinese Hacking: The Plane Made from Stolen Tech?" Fortune Magazine. October 19, 2019; Crowdstrike Global Intelligence Team, "How Turbine Panda and China's Top Spies Enabled Beijing to Cut Corners on the C919 Passenger Jet," October 2019

[44] Matthew Kroenig and Imran Bayoumi, "A Global Strategy to Secure UAS Supply Chains," Atlantic Council. June 25, 2024.

[45] United States Congress. "H.R.2670 - National Defense Authorization Act for Fiscal Year 2024," 2024.

[46] David Hambling, "DJI's New Drone Could Change War — But It's Not Supposed to Be a Weapon." Forbes Magazine. January 16, 2024.

Current Frameworks for AAM Regulations, Standardization, and Financing

The United States stands as a global leader in aviation, boasting a vast and intricate system that has long been a cornerstone of economic strength and technological innovation.[47] As the aviation landscape evolves to incorporate advanced air mobility (AAM) technologies, the National Airspace System (NAS) — all U.S. infrastructure encompassing airspace, navigation facilities and systems that support safe and efficient flight — faces the critical challenge of integrating new types of aircraft and supporting infrastructure. The frameworks for regulating and standardizing this infrastructure, and the financing to support this transformation, will require careful coordination. Achieving this vision requires understanding the current environment and navigating a complex web of existing regulations and standards to mobilize the necessary financial resources.

Regulatory Structures

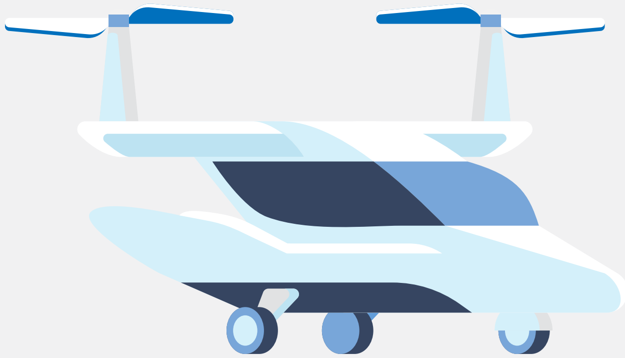
At the core of the regulatory framework for AAM is the Federal Aviation Administration (FAA), the agency tasked with overseeing the safe and efficient operation of the NAS, based on authority from Title 14 of the Code of Federal Regulations (14 CFR). Historically, the FAA has managed regulations designed for conventional aircraft, pilots, and aviation infrastructure. However, AAM introduces aircraft with novel designs and propulsion systems, like the powered-lift category introduced in the 2024 SFAR. The FAA has been adapting its processes to meet these needs, particularly in the areas of aircraft certification, air traffic management, and infrastructure development.[48]

[47] Seth Young and Alexander Wells, *Airport Planning and Management, Seventh Edition.* New York City, NY: McGraw-Hill Education, 2019, at 7.

[48] Ibid. Id., at 15.

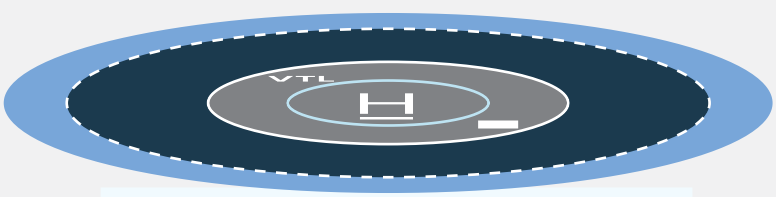
Graphic 4. The Long Road to FAA Certification.

Achieving certifications to start an eVTOL taxi or logistics service is a lengthy and expensive process in this highly regulated industry.



To fly commercially, an eVTOL must comply with multiple parts of the 14 CFR (Title 14 of the FAA's Code of Federal Regulations).[xxi] For example:

- **Part 21:** Obtaining necessary certificates covering design, engines, propellers, production and airworthiness
- **Part 23:** Meeting airworthiness standards (eVTOLs are treated as a special class of powered lift aircraft)
- **Part 135:** Operational requirements for commuter and on-demand operations
- **Part 91:** General operating rules
- **Part 43:** Maintenance and pilot certification requirements
- **Part 61:** Certification of pilots, cabin or ground crew, flight and ground instructors



From initial design to mass production and operations is expected to take about ***10 years and $1 billion.***

Aircraft certification has been one of the most pressing challenges for the FAA. Graphic 4 shows the rigor and meticulous process an aircraft undergoes before it can commence commercial flight.[49] Traditional certification procedures were designed for airplanes and helicopters, but VTOL aircraft require a rethink on applying safety and performance standards. For instance, fuel reserve requirements to ensure flight safety in conventional aircraft will need reconsideration for an eVTOL with an electric propulsion system. The FAA is working closely with manufacturers and international aviation authorities to adapt its certification framework while maintaining the rigorous standards that underpin public trust in aviation safety.[50]

Air traffic management poses another significant challenge as AAM aircraft operate at lower altitudes over densely populated areas, face micro-weather systems and must coordinate with other aircraft operations. The increasing use of unmanned aerial vehicles (UAVs) has led to the development of new systems like Unmanned Aircraft System Traffic Management (UTM) to manage airspace effectively.[51] These systems will need to ensure that large numbers of AAM aircraft can operate safely and efficiently while integrating seamlessly with existing air traffic control infrastructure.

Table 1 outlines the most recent legislative and regulatory actions shaping the future of AAM in the United States. As industry continues to evolve, these regulations and guidelines will play a crucial role in facilitating the growth and widespread adoption of AAM technologies and infrastructure, ensuring they are safely integrated into national and global airspace systems.

Infrastructure Standards and Development

Equally important to the success of AAM is the creation of physical infrastructure, particularly vertiports — specialized hubs designed for the take-off, landing,

[49] Phil Coyle, "The Airspace Opportunity," Wisk Aero Blog. September 24, 2020.

[50] Federal Aviation Administration, "Certification Reform Efforts," November 14, 2024.

[51] Federal Aviation Administration, "Unmanned Aircraft System Traffic Management (UTM)," November 19, 2024.

and maintenance of VTOL aircraft. Just as multiple 14 CFR rules and Advisory Circulars (non-binding FAA publications) guide the design and operations of airports and heliports; efforts are underway to streamline vertiport design through Engineering Brief 105A.[52] The FAA aims to consolidate heliport and vertiport standards into a single Advisory Circular enhancing regulatory consistency across these facilities.[53] Non-regulatory guidance documents like Advisory Circulars and Engineering Briefs provide flexibility and allow for faster updates to keep up with rapid innovations without a lengthy rulemaking process.

[52] Note: An Engineering Brief is a non-regulatory FAA document that provides technical information and interim design or engineering guidance which serves as a precursor to updated standards or regulations.

[53] Dominic Mathew, "Shaping the Future of Aviation: How VTOL Standards Can Keep the U.S. at the Forefront of Advanced Air Mobility," Coalition for Reimagined Mobility. October 21, 2024.

Table 1. AAM-related Regulations & Guidelines in the United States.

YEAR	NAME OF REGULATION	DESCRIPTION
2024	**FAA Special Federal Aviation Rule (SFAR) for Powered-Lift Aircraft**	Creates a framework for pilot and instructor qualifications and operational requirements for powered-lift aircraft, the first new aircraft category in 80 years. Sets standards for training, flight operations, and safety for powered-lift operations like air taxis.
2024	**Engineering Brief 105A, Vertiport Design**	Updated the 2022 vertiport design standards. Key revisions include the classification of vertiports as a type of heliport, futureproofing for diverse aircraft operations, the addition of aircraft parking spaces, and the creation of a protection area to mitigate the effects of aircraft downwash and outwash.
2024	**FAA Reauthorization Act**	Sunsets the FAA NextGen program, defines AAM, includes vertiports in airport energy assessments, and introduces a 5-year pilot program for 10 airports to install electric charging for eVTOLs.
2022	**Advanced Aviation Infrastructure Modernization Act (AAIM), HR 6270**	Helps state and local governments prepare for AAM operations and plan vertiports. Includes a 2-year, $25 million pilot program for vertiport development.
2022	**Advanced Air Mobility Coordination and Leadership Act**	Establishes an interagency working group under USDOT, with 19 federal agencies coordinating to integrate AAM technologies into national airspace. Focus areas include safety, infrastructure, workforce development, and public acceptance.

Ownership, Operational Models, and Financing for AAM Infrastructure

The development of AAM infrastructure presents unique opportunities and challenges as the industry matures. Ownership and operational structures of critical infrastructure like vertiports will significantly impact flexibility of use, community access and market competition in the AAM ecosystem.[54] The National Plan of Integrated Airport Systems (NPIAS) lists aviation facilities that are eligible for federal funding and development. Publicly funded or supported vertiports would feature here to be eligible for federal funding and require compliance with FAA regulatory oversight and existing safety, operational, and land use planning standards.

Current management models of public airports provide a useful blueprint for vertiports. Public airports are governed through public or quasi-public agencies such as municipal or county governments, port authorities, or state agencies, often under federal regulatory oversight. While fully private airports are rare, the most common authority structure model provides financial flexibility, allowing airports to issue bonds, charge fees, levy taxes, and operate independently.[55] Regardless of operational or ownership structures, ensuring vertiport access to multiple operators and use cases is key to a successful AAM network.[56]

On the financing side, U.S. aviation infrastructure is supported by three primary sources including federal grants for NPIAS-listed facilities, passenger fees and revenue from tenants and user fees.[57] Large commercial airports like Hartfield-Jackson Atlanta International (ATL) generate substantial operational funding through terminal concessionaires, parking, landing fees, rents and other user charges.[58] Smaller airports and heliports rely heavily on external funding to cover both operations and capital investments.[59]

The Airport and Airway Trust Fund (AATF), subsidized by excise taxes on tickets and fuel, provides critical support through programs like the Airport Improvement Program (AIP), which in 2023 alone generated $17 billion for projects such as runway construction, rehabilitation, noise control, and safety enhancements.

For AAM, infrastructure and new aircraft certification has largely been driven by private investment, with significant contributions from the U.S. military. The Air Force's Agility Prime program, for example, has invested over $100 million to accelerate air mobility system development through industry partnerships, including the only all-electric passenger aircraft program in the U.S. government, in collaboration with industry and academic partners.[60] As AAM services expand, financing models for vertiport infrastructure will likely evolve, blending public and private investments to balance community needs and commercial interests.

No single policy or funding mechanism will address all the challenges associated with AAM. A combination of robust infrastructure, enabling regulations, and diversified funding models will be essential to integrate new technologies into the National Airspace System (NAS). Collaborative efforts among industry, government, and stakeholders are already laying the groundwork for a system that meets the demands of air mobility.

Strategic investment, thoughtful planning and supportive public policy can ensure that AAM becomes a safe, efficient, and reliable mode of transportation for generations to come. The following section explores key strategies and policy actions to foster the growth of this transformative and emerging sector.

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[54] Adam Cohen, et al, "Planning for Advanced Air Mobility," PAS Report 606, American Planning Association and Mineta Transportation Institute. March 8, 2024, at 47-49

[55] Seth Young and Alexander Wells, *Airport Planning and Management, Seventh Edition.* New York City, NY: McGraw-Hill Education, 2019, at 30-31.

[56] Adam Cohen, et al, "Planning for Advanced Air Mobility," PAS Report 606, American Planning Association and Mineta Transportation Institute. March 8, 2024, at 47.

[57] Airports Council International, "Airport Infrastructure Funding," 2024.

[58] Seth Young and Alexander Wells, *Airport Planning and Management, Seventh Edition.* New York City, NY: McGraw-Hill Education, 2019, at 295-300.

[59] Ibid.

[60] AFWERX, The United States Department of Air Force, *Annual Report*, 2023.

Advancing Vertiport Infrastructure

Policy Recommendations for a Scalable and Interoperable AAM Ecosystem

Policy can play a pivotal role in advancing vertiport infrastructure by establishing regulatory and funding frameworks that clarify access, foster innovation, and promote standardization and collaboration. The AAM industry is at a critical turning point, as it starts passenger and cargo flights that require open, secure, and interoperable vertiport infrastructure. At its foundation, vertiport infrastructure standardization is essential for broad sector scalability, integration within the multimodal transportation network, and efficient coordination across the AAM ecosystem's stakeholders, benefiting both industry and consumers.

Three key strategies and supporting policy actions to achieve a reimagined future of flight and for policymakers to consider are outlined on the pages that follow.

1 Establish Use, Ownership, and Access of Finite Real Estate

This strategy is aimed at establishing clear guidelines for long-term success and fair use of public resources to support a widespread and efficient AAM ecosystem. Public vertiports resemble shared public infrastructure like parking, curb spaces, and air or rail terminals, in the need to balance competing demand for limited space with open access. In July 2018, private companies deployed hundreds of e-scooters on St. Louis (Missouri) sidewalks without approval, causing accidents and injuries, leading to a temporary ban until regulations were established. Effective management of finite land is critical for the optimal utility of shared spaces, to minimize inefficiencies, prevent monopolization, and foster competition between AAM operators.

Policy actions to consider in achieving this strategy include:

State and Local Governments under FAA Guidance Should Safeguard Open-Access Requirements for Public Vertiports.

Public agencies must prioritize the value of vertiports situated on public lands or developed with public funds, ensuring they serve the broader public interest. While the management and development of public vertiports primarily rest with local and regional governments, alignment with statewide planning efforts and adherence to federal oversight will be essential. Establishing clear guidelines for who can access and operate these facilities — while upholding open-access principles — enables many operators to utilize publicly funded vertiports safely, fairly, and efficiently. For example, the creation of open-access smart zones in Omaha, Austin, Seattle and other cities addresses growing congestion and inefficiencies using real time monitoring and flexible scheduling, ensuring the efficient use of limited public space like curbs while balancing the needs of multiple private operators.[61] In 2023, Omaha introduced twenty Smart Zones that feature AI cameras to identify vehicles, charge drivers for parking and analyze curb traffic trends. The city aims to improve parking turnover, curbside pickup, and safety while optimizing curb use. Digital infrastructure like the Curb Data Specification (CDS) enable this dynamic curb management by standardizing and allowing data exchange between public agencies and private operators.[62]

Public-private partnerships (PPPs) also provide a viable model, blending public ownership with regulated private operation. To prevent operator lock-ins, contractual obligations can maintain open access, encourage private investment, and support a competitive and resilient vertiport network. For instance, since 1997, Terminal 4 at the publicly owned, John F. Kennedy International Airport is operated under a PPP between the Port Authority of New York and New Jersey, which manages the airport, and JFK International Air Terminal, LLC (JFKIAT), a private operator. The PPP agreement includes contractual provisions called use and lease agreements that ensure access to gates, ticket counters and terminal facilities for multiple airlines through a competitive bidding process to facilitate fair competition.[63]

By balancing public interest with operational flexibility, agencies can ensure that publicly funded vertiports foster a sustainable, and well-integrated AAM ecosystem.

Develop Clear Vertiport Zoning and Land Use Policies Aligned with Local Government Structures and Community Input

Local governments play a crucial role in crafting zoning and land-use policies for vertiports, with support from federal and state agencies to ensure coordinated efforts among developers, local planners, and regional stakeholders. These governance structures can vary, requiring tailored approaches to align with local regulatory frameworks and community needs. While airspace is regulated by the FAA, scalability of AAM services will need comprehensive local laws tailored to AAM's unique operational needs. Establishing a dedicated zoning category for vertiports allows their distinct operational needs

[61] Mary Hammon, "Manage the Curb with Smart Loading Zones." Planning Magazine, American Planning Association. March 1, 2021.

[62] Open Mobility Foundation, "About CDS," 2024.

[63] Sheri Ernico, et al. "Considering and Evaluating Airport Privatization," Report 66, Airport Cooperative Research Program, Transportation Research Board, 2012, at 84.

to be addressed without the constraints of traditional zoning frameworks.

These policies should align vertiport placement with community priorities, protecting sensitive areas like schools and hospitals through conditional permits, noise mitigation and environmental safeguards. Overlay zones, a special zoning layer added on top of base zoning regulations with additional rules addressing specific local concerns, can further encourage vertiport development near transit hubs, promoting multimodal connectivity while preserving airspace access with aviation easements and height restrictions.[64] An example of this is the Los Angeles Department of Transportation (LADOT) which in 2021 developed a proactive urban air mobility policy brief to guide local agencies in determining vertiport zoning and land use considerations.[65] The Florida Department of Transportation's 2024 AAM Land Use Compatibility and Site Approval Guidebook provides a step-by-step checklist and relevant zoning ordinances for local government partners to utilize for vertiport development.

By implementing these targeted zoning and land use measures, informed by community consultation, local governments can balance operational demands with national interests, supporting an efficient, competitive and well-integrated vertiport network.

The FAA Should Fully Optimize Cross-Functional Vertical-Lift Infrastructure.

Current FAA regulations reduce the distinction between heliports and vertiports and treat these facilities as part of a unified vertical-lift infrastructure. This integration represents a significant opportunity to fully optimize the limited real estate that is conducive for vertiport development.

The FAA's Engineering Brief No. 105A, Vertiport Design, classifies vertiports as a type of heliport and aims to incorporate these guidelines in the Heliport Design Advisory Circular by end of 2025. By adopting comprehensive unified standards for vertical-lift infrastructure — weight limits, aerodynamic parameters, and operational protocols — public agencies and private operators can adapt existing heliport infrastructure to accommodate VTOL aircraft as they enter the market.

This approach maximizes the utility of existing facilities, reduces the need for new construction, and minimizes environmental impact and financial costs. Unified infrastructure standards provide a practical and sustainable solution to support the evolving needs of the AAM ecosystem.

The FAA Should Facilitate Regulatory Sandboxing Across Multiple Governance Levels.

This strategy is designed to assess and optimize the use of public vertiport infrastructure through standardized knowledge capture and stakeholder collaboration across federal, state and local governments. Regulatory sandboxing allows mobility innovations to be tested within a controlled regulatory framework.[66] It allows stakeholders to evaluate opportunities and risks associated with emerging technology and generate data critical for evidence-based policymaking. Standardized reporting and integration of findings in the regulatory

> *Local governments can balance operational demands with national interests,* ***supporting an efficient, competitive and well-integrated vertiport network.***

[64] Adam Cohen, et al, "Planning for Advanced Air Mobility," PAS Report 606, American Planning Association and Mineta Transportation Institute. March 8, 2024, at 70.

[65] Los Angeles Department of Transportation, "Urban Air Mobility: Policy Framework Considerations," September 13, 2021.

[66] Coalition for Reimagined Mobility, "A Policy Path to Achieving Europe's Green Digital Revolution with Sustainable, Smart and Seamless Mobility," April 2023.

process can amplify its impact and inform future policy development.[67]

Create an AAM Infrastructure Sandbox Grant Program within the FAA.

Infrastructure regulatory sandboxes can foster collaboration between public agencies, vertiport developers, AAM operators, and technology providers to fund and test vertiport designs, operational protocols and integration with existing transportation modes. Such a program could evaluate critical factors like site layout, landside operations, access for multiple operators, charging infrastructure, noise impacts and airspace management in a controlled environment.

A comparable example is the Federal Transit Administration's Mobility on Demand Sandbox Program (2016), which allocated $8 million to test multimodal policies and assess their community, operational and financial impacts to inform future projects. A proposed Advanced Aviation Infrastructure Modernization Act (2022) sought $25 million over two years to fund construction of public-use vertiports but remains stalled in Congress. Building on past FAA efforts like the Unmanned Aircraft Systems (UAS) Integration Pilot Program, which advanced drone technologies, and the NextGen modernization program, an AAM Infrastructure Sandbox could fill this gap, generating critical data and stakeholder alignment to guide scalability of AAM infrastructure.

Standardize Knowledge Capture and Dissemination to Inform Long-Term Planning.

Systematic data collection and dissemination are essential for codifying best practices and guiding future programs. A centralized data pipeline maintained by the FAA in collaboration with state DOTs, tracking real-time insights can help policymakers and operators make informed decisions on public vertiport siting, charging requirements, and determining peak and non-peak demands. The FTA's MOD Sandbox Program, referenced above, generated program-level insights to inform mobility system integration.[68] Similarly, an AAM Infrastructure Sandbox Grant Program can result in a playbook for planning, operating and managing public vertiport infrastructure. The program can establish protocols to engage multiple stakeholders, evaluate economic viability and generate empirical evidence on vertiport planning and airspace integration that can be used to inform FAA, state and local regulations.

2 Prioritize Standardized and Interoperable Frameworks for Digital Vertiport Infrastructure

This strategy provides a robust digital framework to support AAM in the United States. Standardized interoperable frameworks that support the flow of information among vertiport developers, AAM operators, public agencies and users can ensure efficient vertiport operations and seamless multimodal integration. Advanced data analytics can provide real-time updates, enhance coordination, and strengthen cybersecurity, mitigating risks and building confidence in digital vertiport infrastructure.

Policy actions to consider in achieving this strategy include:

The FAA Should Facilitate Interoperable and Secure Information Standards to Achieve Seamless Multimodal Integration.

Work with industry to develop information frameworks and digital tools that ensure interoperability across data formats and communication protocols. Coordinated APIs connecting AAM operators, vertiport developers, ground mobility systems and public agencies can support regulatory compliance. The FAA should leverage its guidance documents like the Advisory Circulars and Engineering Briefs, and partnerships with standards bodies, to establish comprehensive, technology-neutral standards with clear adoption timelines. Accelerating standards processes and defining stakeholder roles can further streamline coordination and integration of AAM solutions across the transportation system.

[67] Coalition for Reimagined Mobility, "A Policy Path to Achieving Europe's Green Digital Revolution with Sustainable, Smart and Seamless Mobility," April 2023.

[68] Federal Transit Administration, "Mobility on Demand Sandbox Program," May 28, 2024.

While the current FAA Reauthorization runs through to 2028, ***proactive planning is essential to address future AAM infrastructure funding gaps.***

In 2024, Switzerland launched its U-Space digital infrastructure for drone operators that enables safe and efficient real-time flight planning, airspace updates and automated flight authorizations and traffic alerts via mobile apps.[69] Additionally, existing standards frameworks like the Mobility Data Specification (MDS), enable the location sharing of vehicles on public rights of way between public agencies and private mobility providers like e-scooter and bikeshare companies, to track and allocate transportation resources and needs efficiently and can be used in new markets, like AAM.[70]

The FAA Should Implement Robust Cybersecurity Protocols for Vertiport Infrastructure.

Ensure compliance with the National Institute of Standards and Technology (NIST) Cybersecurity Framework standards for all digital systems connected to vertiports and AAM operations.

The FAA applies the NIST Risk Management Framework and the Cybersecurity Framework to structure their approach to information security. Yet, a mature AAM ecosystem is unique because it requires the facilitation of secure and anonymized data exchange between mobility operators and public agencies to ensure system-wide resilience and seamless integration. Drawing from the FAA's existing frameworks, vertiports must implement cybersecurity protocols including encryption, real-time threat detection, and the secure storage of sensitive data.

3 Initiate New and Sustaining Funding Mechanisms

This strategy catalyzes public and private sector investment in the fast-growing AAM sector and supports both physical and digital vertiport infrastructure development. Traditional aviation contributes significantly to the Airport and Airway Trust Fund (AATF) and benefits from federal assistance for capital costs. The nascent AAM industry lacks similar funding support. Robust funding mechanisms are critical to turning private sector innovation into an operational reality and establishing a cohesive, national AAM infrastructure network.

Policy actions to consider in achieving this strategy include:

Establish a National AAM Infrastructure Fund.

A dedicated fund, supported by a combination of federal grants, state-level contributions, and private sector matching funds, can create and maintain critical vertiport infrastructure. Changing airline ticketing practices like ticket unbundling have resulted in lower base fares that reduce taxable revenues for the Airport and Airway Trust Fund (AATF). The AATF could face significant shortfalls in the future, impacting its ability to finance public vertiport infrastructure. While the current FAA Reauthorization runs through to 2028, proactive planning is essential to address future AAM infrastructure funding gaps. A National AAM Infrastructure Fund can fill these gaps while using the AAM Sandbox Program, as referenced previously, to develop shovel-ready projects that can transition into scalable vertiport infrastructure.

Congress Should Design Tax Incentives to Leverage Private Sector Investments in AAM Infrastructure.

AAM specific tax incentives initiated by Congress can attract targeted private sector investments to develop essential vertiport infrastructure to support AAM operations. Tax credits could apply to development costs, land acquisition, operating or installation expenses of vertiports and must meet requirements around open

[69] Swiss Federal Council, "Implementing U-Space Airspace," Swiss Federal Administration. June 14, 2024.
[70] Open Mobility Foundation, "How Cities are Thinking About Air Mobility, Data and Digital Infrastructure," 2024.

access to foster competition and create a network. In 2017, the Tax Cuts and Jobs Act created the Opportunity Zones program to stimulate economic development and job creation in distressed communities by offering tax benefits to investors. By 2020, nearly $48 billion was invested in designated Opportunity Zones, in real estate, housing, infrastructure or the startup ecosystem, that will leverage progressively increasing tax benefits over a 5- to 10-year period.[71] This program demonstrated that targeted tax incentives could attract private investment to underfunded regions and sectors while addressing broader social goals.

Encourage Public Private Partnerships (PPP).

PPPs with built-in contractual obligations could be pivotal in developing public vertiport infrastructure that enforces open-access criteria and future proofing to account for market changes in the AAM industry. The NoMa-Gallaudet Metrorail station in Washington, D.C. was one of the first stations to be developed using a PPP model in 2004 and leveraged innovative financing mechanisms and strategic partnerships to overcome municipal budget constraints. The $104 million project cost was funded through a combination of public and private funding, land donations and financing from a special assessment district comprised of increased property taxes from owners within 2,500 feet of the station.[72] This effective model can be adapted to the AAM industry to build a nationwide vertiport network that supports open-access, innovation and public benefits. The district committed to covering cost overruns incentivizing private sector participation, while federal agencies relocated key agencies to contribute to the area's redevelopment. Within a decade, the project generated $4.7 billion in economic benefits, created nearly 30,000 jobs and quadrupled property values in the area. This PPP approach offers valuable lessons for vertiport development, which similar to metro stations will require strategic placement to maximize economic potential and connection to multiple modes.

The policy actions highlighted above set the foundation for an integrated public AAM physical and digital infrastructure that can support mature AAM operations. To illustrate their practical applications and potential impact, the following case studies highlight successful models from other transportation sectors and offer valuable lessons for the AAM industry.

[71] Tax Policy Center, Urban Institute and Brookings Institutions, "What are Opportunity Zones and How Do They Work?" 2022.

[72] Jason Hobbs, Daniel Pecina-Lopez, "Keys for a Successful Public-Private Partnership: The Case of Washington, D.C." Sustainable Cities, Inter-American Development Bank. March 23, 2023

Lessons from Ground Transportation for AAM

Enabling Public AAM Infrastructure: Optimizing a Finite Resource

Pickup/Drop-off (PUDO) Zones: Managing Washington, DC's Curbs for Greater Efficiency and Safety

In 2017, the District Department of Transportation (DDOT) addressed curbside congestion in Washington, DC's Golden Triangle Business Improvement District by piloting Pickup/Drop-off Zones. High parking occupancy, combined with increased ride-hailing and delivery traffic led to congestion and unsafe behaviors like double parking, illegal U-turns, and haphazard passenger loading.[73] To address these challenges, DDOT's Parking and Ground Transportation Division piloted a specialized curbside management effort by creating and designating Pickup/Drop-Off (PUDO) Zones. The new PUDO zones were dedicated spaces for rideshare, taxi, and delivery vehicles to legally and safely load and unload passengers and goods.

The pilots resulted in significant improvements in traffic flow and safety. Double parking and illegal U-turns dropped by an estimated 64 percent in areas near PUDO Zones, while curbside operations became significantly more efficient.[74] According to a study done in partnership with on-demand curb management software company curbFlow, rideshare and taxi vehicles used PUDO zones for under 2.5 minutes on average, while on-demand and freight deliveries took 7 to 11 minutes per stop.[75] The successful pilot led to nearly 40 additional PUDO zones in the District across 47 neighborhoods.

[73] District Department of Transportation, "Nightlife to Network: Piloting "PUDO" Zones in the District of Columbia," September 13, 2019.

[74] Intelligent Transportation Systems Joint Program Office, "Double parking and Illegal U-turns in Washington, DC Decrease by 64 Percent with Curbside Delivery Reservation System," November 25, 2019.

[75] District Department of Transportation," DDOT, curbFlow Research Project Finds High Demand for Pickup, Dropoff Zones,"
November 13, 2019.

The PUDO Zone network is a forward-thinking model for cities grappling with curbside congestion, offering best practices for efficient curbside management of ground transportation that improves safety and streamlines urban mobility. D.C.'s successful curbside strategy provides a structured framework to design public vertiport infrastructure.

Curbs and vertiport infrastructure both involve managing access to scarce public resources, balancing competing demands such as parking, deliveries, or ridesharing at curbs, and takeoff or landing opportunities at vertiports. In both cases, optimizing usage requires fair policies, dynamic allocation, and technology-driven solutions to maximize efficiency and benefit for all users.

Dallas Fort Worth (DFW) International Airport: Curb Utilization

An airport curb serves as a high-demand and limited space for various modes including rideshare vehicles, taxis, transit, hotel and car-rental shuttles. Unlike urban curb management which emphasizes parking behavior, policy and pricing strategies, airport curb management must address unique challenges like shorter dwell times, constrained terminal lengths and variable passenger peaks. An airport curb's balancing of operational efficiency, revenue goals and equitable access provides a parallel for designing public vertiports that can cater to multiple operators.

Dallas Fort Worth (DFW) is the third-busiest airport in the world, handling nearly 80 million passengers annually. Spanning 27 square miles, it operates like a small city with its own zipcode and police, fire and emergency services. In 2018, increasing congestion and idling at the curb prompted DFW to rethink its curb strategy, transitioning all terminal curbside areas exclusively into active loading and unloading zones. In addition, licensing and operating conditions and expectations for drivers and customers were established.[76] This discouraged idling and improved vehicle turnover. Now parking and ground transportation access fees are the largest revenue generators at DFW. In parallel, designated zones for various modes on upper and lower levels of each of the five terminals minimized conflict and streamlined traffic between the 100+ public and private service providers. More than 1,200 one-hour parking spaces and a cellphone lot also provide short-term parking alternatives.[77]

With support from the North Central Texas Council of Governments' Automated Vehicle 2.0 Program, DFW is testing the feasibility of an autonomous ecosystem that includes automated valet parking, dedicated self-parking for autonomous buses and cars, and active digital curb management. An initial step in assessing curb limitations is underway with a digital mapping of the airport in progress.[78] DFW's dual role as a public utility and its aim to monetize the curb provides a parallel for regions looking to develop a comprehensive public vertiport network.

DFW's approach to a finite resource like curbside access in a constrained airport environment offers takeaways for planners and policymakers who are making decisions on who can build, operate and access vertiports and where these should be built, particularly when a region is looking to balance its multimodal and revenue generation goals.

European Union's (EU) Rail Open-Access Mandate

Between 1991–2016, the EU established a framework for open access to rail networks across a thirty-three country region, aiming to dismantle monopolies, increase competition and create an integrated and efficient railway system. Historically, national rail systems were vertically integrated and monopolized by state entities, limiting private competition and cross-border interoperability. The mandate required member states to allow private and international operators to access domestic rail infrastructure under non-discriminatory and transparent conditions, overseen by an independent regulatory body to ensure fair competition.[79] This policy enabled a separation between essential infrastructure functions like track access, scheduling and charging, from train operations, enabling multiple operators to compete within the same network. It also resulted in infrastructure upgrades to facilitate cross-border rail operations. This included the standardization of platform heights, track gauges and electrification systems to accommodate trains from different European operators like TGV, ICE and AVE.

[76] DFW Airport, "DFW Airport to Change Pick-Up and Drop-Off Rules at Terminals," July 17, 2018.

[77] DFW Airport, "Transportation at DFW Airport," 2024.

[78] Christopher Carey, "Dallas Airport Aims to Launch Air Taxis Ahead of 2026 World Cup," Cities Today. March 14, 2024.

[79] European Commission, "Transport Modes: Rail & Market," 2024.

The resulting competition led to a reduction in ticket prices, efficiency gains, and service improvements across passenger and freight rail services. For example, Italy's open access passenger market saw ticket prices drop by 31 percent, while Austria experienced a 41 percent increase in service frequency.[80] In France, competitive tendering increased service frequency by up to 110 percent on some lines and introduced new locomotives.[81] Freight services also benefited from reduced operational costs and stable growth, particularly in intermodal transport in markets like Germany. The EU's approach to this challenge parallels a potential challenge that can emerge in the AAM industry regarding vertiport access and infrastructure management. Like rail, AAM infrastructure risks monopolization by early entrants or dominant operators. The EU framework shows the importance of creating open-access policies, transparent governance and independent oversight to ensure that competitive vertiport locations owned by public agencies that are near existing mobility hubs and communities can support a diverse range of operators and use cases.

Building an Integrated Mobility Hub: Lessons for Multimodal Integration and MaaS Implementation

A successful AAM market for passengers and logistics depends on a robust and interconnected network. Seamlessly integrating transportation systems physically and digitally can reduce friction for users transitioning between modes, creating an efficient ecosystem. But widespread adoption is hindered by the lack of harmonized regulations, and competitive bottlenecks that restrict transparent sharing of data.[82] Establishing neutral data standards can enable users to switch modes and plan journeys efficiently.

Detroit's Multimodal AAM Aerotropolis

Michigan has positioned itself as an AAM leader by testing and scaling critical infrastructure through the Detroit Region Aerotropolis, a public-private partnership involving two airports- Detroit Metro (passenger hub) and Willow Run (cargo hub)-as well as two counties, seven municipalities and numerous aviation related stakeholders. Leveraging its unique geographic location, strong manufacturing base and existing airport infrastructure, the Aerotropolis implemented the AirHub platform, a cutting-edge airspace management system designed to safely integrate low-altitude drone operations. This initiative aligns low altitude "Highways in the Sky" with community priorities, supported by Michigan's AAM Activation Fund, that has allocated $6.25 million to test AAM projects.[83] In the City of Romulus, FAA-approved airspace changes expanded drone-accessible areas, increasing flight grid ceilings to a minimum of 50 feet across 14 square miles, impacting over 5,500 residents. These changes enhance the potential for diverse use cases like intrastate charging networks, healthcare logistics, maritime operations, and industrial applications.

> *A successful AAM market for passengers and logistics depends on **a robust and interconnected network.***

This effort directly supports the AAM ecosystem by establishing foundational infrastructure for integrating unmanned and eVTOL technologies into regional transportation networks. The dual focus on safety and community alignment highlights the scalability of this model for broader AAM adoption. For example, a 28 square mile area around Michigan Central in the City of Detroit is the first cross-sector, advanced aerial urban initiative in the United States. The two-year project will provide open shared infrastructure and

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[80] Antonio de Rose, et al. "Study on Passenger and Freight Rail Transport Services' Prices to Final Customers," European Commission: Directorate-General for Mobility and Transport. August 2024.

[81] Ibid

[82] Coalition for Reimagined Mobility, "A Policy Path to Achieving Europe's Green Digital Revolution with Sustainable, Smart and Seamless Mobility," April 2023.

[83] Note: The AAM Activation Fund is a collaboration between the Michigan Department of Transportation, the Office of Future Mobility and Electrification and the Michigan Economic Development Corporation.

services that enable commercial drone development while ensuring safety in the air and on ground.[84] The expanded drone airspace in Detroit and the greater Aerotropolis region has already unlocked opportunities for businesses to innovate in areas such as package delivery, infrastructure inspection, and STEM education, while improving public health, safety, and recreational opportunities.

For AAM, the Aerotropolis demonstrates how collaborative regional efforts can lay the groundwork for advanced aviation technologies. As this industry matures, its immense potential spillover and network effects underscore the need to incorporate AAM in long-range planning efforts that involve economic development agencies, regional or metropolitan planning organizations and transportation agencies at the state and federal levels. The development of the semiconductor industry in Silicon Valley is a good example of far-reaching spillover effects that spurred growth in consumer electronics, and telecom. Companies in this region had high learning rates due to increased employee mobility and technology spillovers that eventually led to the creation of new industries in personal computers and smartphones.[85]

The AirHub platform and the region's multimodal infrastructure provide a replicable blueprint for other regions aiming to incorporate AAM into their economic and transportation ecosystems, driving innovation, job creation, and sustainable growth.

From Ground to Air: Leveraging EV Infrastructure Insights to Standardize AAM Charging

Just as vertiports are integral infrastructure to the success of AAM operations, robust interoperable charging standards are essential to inspire customer confidence and enable seamless operations. As AAM aircraft technology advances with lighter batteries and more energy efficient propulsion systems, it is the best time to prioritize standardization and future-proof vertiport charging solutions.

Transition from CCS to NACS: Lessons for AAM Charging Standardization

The electric vehicle (EV) industry's convergence from the Combined Charging System (CCS) to the North American Charging Standard (NACS) represents a move towards one dominant standard. Divergent standards among EVs led to limited compatibility, increased cost for users and consumer frustration which deterred widespread adoption of EVs. Similarly, AAM faces the challenge of integrating diverse aircraft and battery technologies into a unified charging ecosystem. High capacity eVTOLs, designed for quick turnarounds, require scalable and fast charging solutions. The FAA Engineering Brief 105A on vertiport design outlines modular charging recommendations, but broader industry alignment is essential to avoid fragmentation and ensure interoperability.

The EV industry's adoption of NACS as a unifying standard was driven by consumer demand, regulatory incentives, and market pressures for greater interoperability. Tesla set a high benchmark with its superior design, lower setup cost and high reliability. In 2023, Tesla Superchargers accounted for one-third of all fast chargers in the United States, were 20% cheaper to deploy and were functional and available 99.95 percent of the time.[86] Tesla's early investment and innovation were followed by collaborative agreements between manufacturers and support from federal subsidies such as the $5 billion NEVI Formula Program and the $2.5 billion Discretionary Grant Program, that enabled the industry's broader shift to NACS.

The AAM sector currently has divergent charging standards, reflecting the nascent stage of the industry. Major players like Joby Aviation, General Aviation Manufacturers Association (GAMA) and SAE International all advocate for different approaches. This ranges from Joby's proprietary Global Electric Aviation Charging System (GEACS), GAMA's push for CCS charging and SAE's development of aerospace specific charging standards like the ARP6968 for light electric aircraft and AIR7357 for high-capacity charging. Without broad alignment, the AAM industry risks the fragmentation seen early in the EV industry which delayed widespread EV adoption.

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[84] Michigan Department of Transportation, "MI Central, MDOT Launch Advanced Aerial Innovation Region in Detroit to Accelerate Commercial Drone Development," October 25, 2023.

[85] Douglas Irwin, et al. "Learning-by-Doing Spillovers in the Semiconductor Industry," *Journal of Political Economy*, Vol 102, No. 6, December 1994, at 1200-1227.

[86] Hillary Weiss, "The Battle of NACS vs. CCS: Will There Be a Winner?" Automotive Fleet. September 8, 2023.

Conclusion

Advanced Air Mobility (AAM) is at the forefront of reimagining the aviation industry, poised to redefine how people and goods move across our skies. With a wide array of innovative technologies and far-reaching applications, AAM is also set to play a pivotal role in the global race for advanced technologies and transportation leadership. However, realizing its full potential demands strategic collaboration, robust policy frameworks, and a commitment to building accessible and scalable infrastructure.

This report underscores the importance of public vertiports as the foundation of an efficient and competitive AAM ecosystem. To ensure their accessibility, policymakers must prioritize clear zoning laws, open-access principles, and the integration of dual-use infrastructure. By doing so, we can avoid the pitfalls of monopolistic practices and create an environment where multiple operators and use cases thrive. These steps will be essential to address the finite nature of real estate while aligning AAM development with community needs.

The international context of AAM further highlights the urgency of these efforts. With competitors like China aggressively advancing state-backed industrial policies and dominance in technology hardware supply chains that provide a solid foundation to be an AAM leader, the U.S. faces both economic and national security imperatives to assert its leadership in this transformative mobility sector. By leveraging its rich aviation heritage, innovation capacity, and policy ingenuity, the U.S. can position itself as a global leader in AAM, shaping not only the infrastructure of tomorrow but also the principles and values that guide its implementation.

Regulatory innovation, particularly through sandboxing programs, will also play a critical role in testing, refining and standardizing AAM infrastructure and operations. These controlled environments allow stakeholders to evaluate real-world concepts, generate actionable data and inform long-term policymaking. Coupled with this, the prioritization of digital vertiport infrastructure — featuring interoperable information frameworks and digital tools and robust cybersecurity protocols will ensure seamless multimodal integration and operational resilience.

Equally important is the financial architecture underpinning AAM growth. Innovative funding mechanisms like a National AAM Infrastructure Fund, targeted tax incentives for public-private partnerships (PPPs), are critical to mobilizing the capital necessary for this emerging sector's physical and digital infrastructure backbone. By fostering private sector participation and leveraging public investment, the U.S. can build a robust network that supports the evolving needs of the AAM ecosystem while delivering economic benefits.

Ultimately, by embracing the strategies outlined in this report, the U.S. can turn the vision of AAM into a reality, ensuring the skies of tomorrow are built for sustained growth, global leadership, and access to benefit all.

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