AAM: On-Airport Infrastructure and Land Use Considerations

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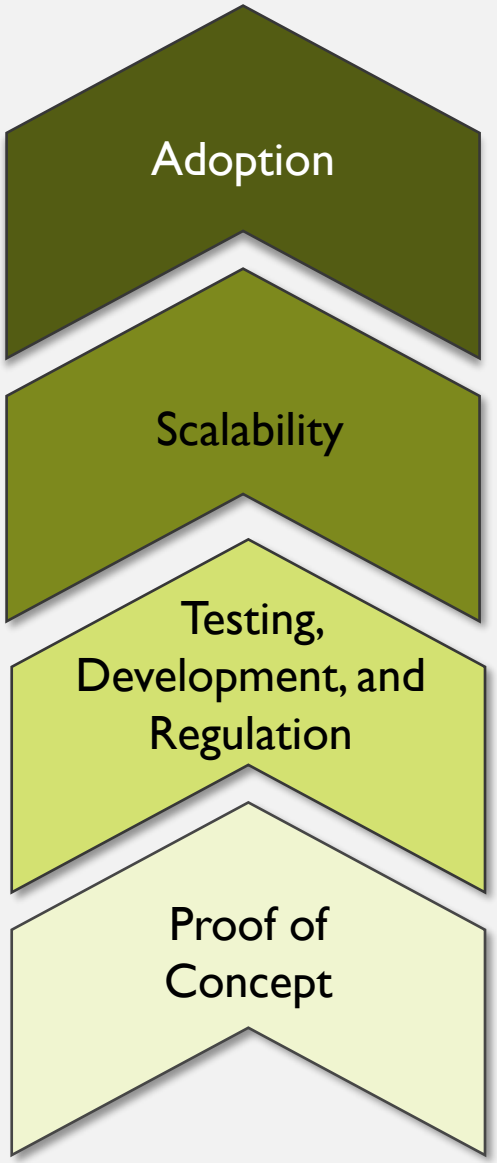
Agenda

- Introduction to AAM and Emerging Aircraft
- National Guidance and Publications
- On-Airport Considerations
- Land Use Considerations
- Conclusion and Questions

Introduction to AAM and Emerging Aircraft

AAM Overview



Aircraft Overview

Joby S4

Passengers: 4
Range: 150 miles

Lilium Jet

Passengers: 5
Range: 185 miles

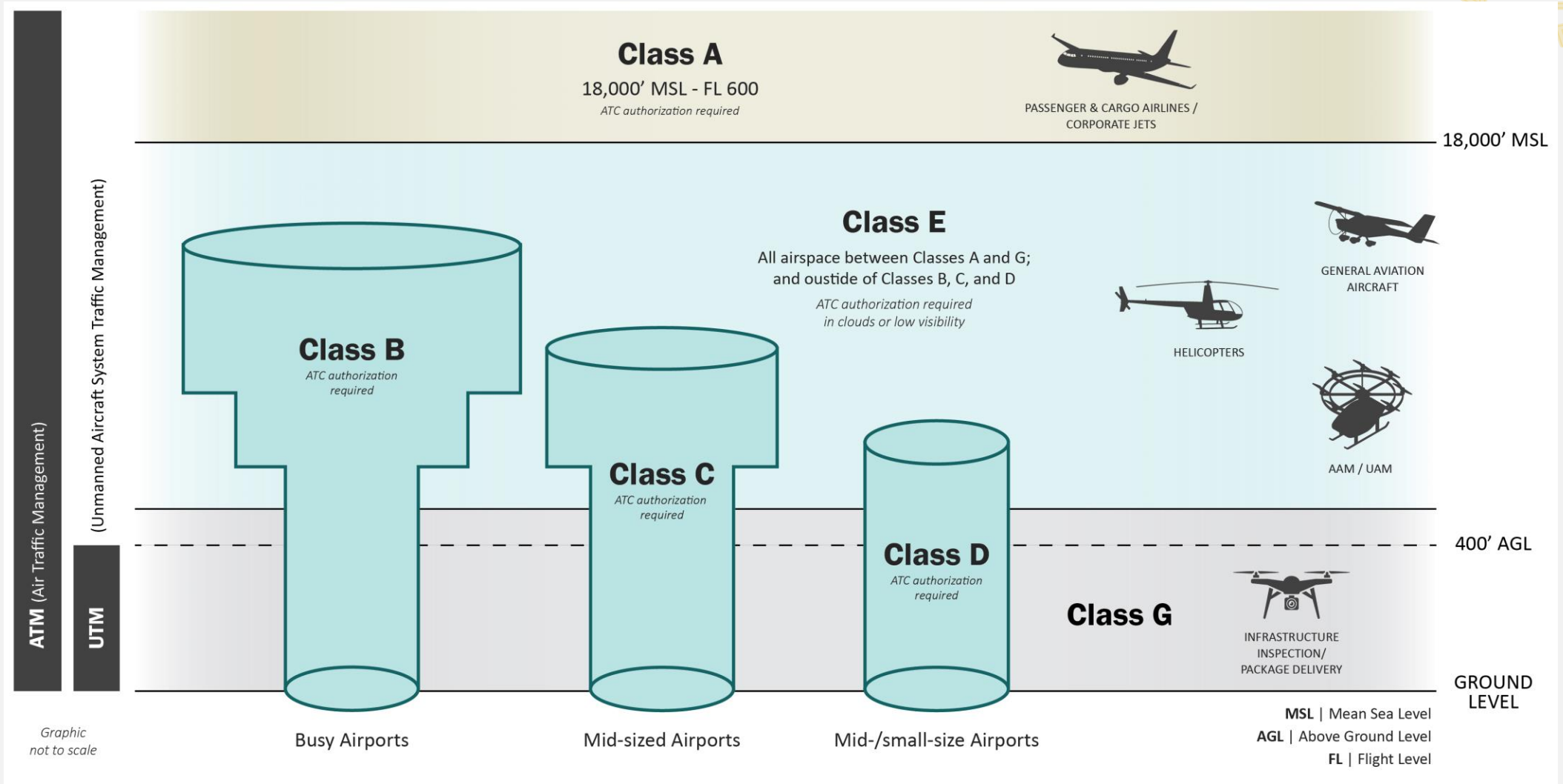
Volocopter 2X

Passengers: 2
Range: 22 miles

EHang 216

Passengers: 2
Range: 22 miles

Airspace Integration

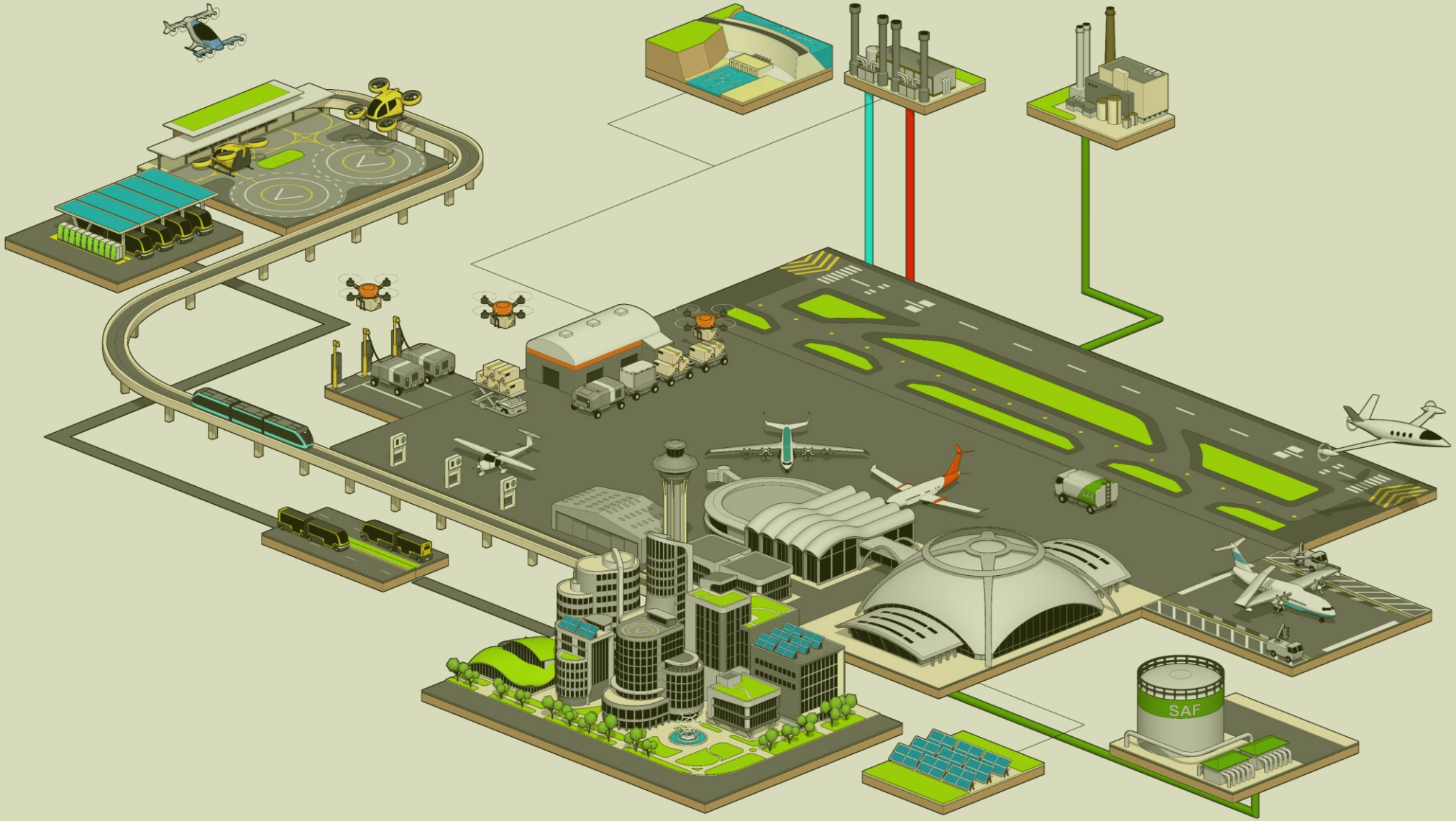


Roles and Responsibilities

Stakeholder Group	Roles and Responsibilities
Federal Agency - NASA	Supports public-private engagement while conducting research to foster the growth of AAM and UAM.
Federal Agency - FAA	Governs aircraft certification, national airspace system, and infrastructure requirements.
Federal and State Legislators	Promote policy development to enable and regulate the AAM industry such as those related to the infrastructure, safety, and investment needed to bolster an AAM ecosystem.
Local Governments	Promote local policy and planning decisions—especially zoning, land use, and transportation planning efforts—to foster an efficient, sustainable, and equitable AAM ecosystem. Develop proactive community engagement strategies to promote public perception of AAM.
OEMs and Private Industry	Drive eVTOL aircraft and market development while ensuring the safety of AAM users and the public.

Source: Kimley-Horn, 2022

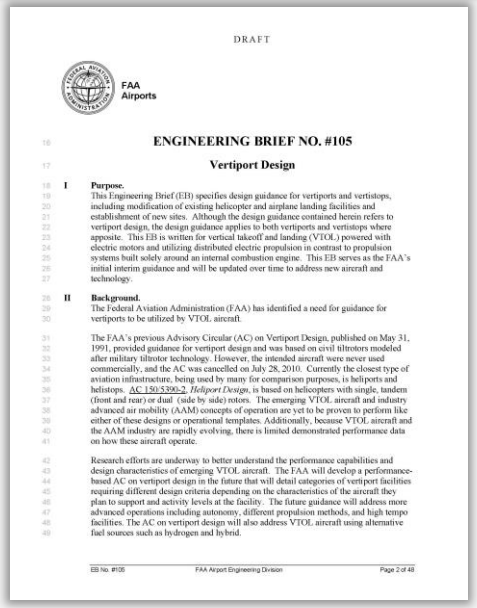
National Guidance and Publications



Industry Publications and Guidance

FAA – Engineering Brief No. 105, Vertiport Design

- First draft released September 2022
- Final version yet to be released
- Guidance for Airport Owner Operators
- For Vertical takeoff and landing (VTOL) operations
- Significant design details



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FAA Airports

ENGINEERING BRIEF NO. #105

Vertiport Design

I Purpose.
This Engineering Brief (EB) specifies design guidance for vertiports and vertistops, including modification of existing helicopter and airplane landing facilities and establishment of new sites. Although the design guidance contained herein refers to vertiport design, the design guidance applies to both vertiports and vertistops where apposite. This EB is written for vertical takeoff and landing (VTOL) powered with electric motors and utilizing distributed electric propulsion in contrast to propulsion systems built solely around an internal combustion engine. This EB serves as the FAA's initial interim guidance and will be updated over time to address new aircraft and technology.

II Background.
The Federal Aviation Administration (FAA) has identified a need for guidance for vertiports to be utilized by VTOL aircraft.

The FAA's previous Advisory Circular (AC) on Vertiport Design, published on May 31, 1991, provided guidance for vertiport design and was based on civil tiltrotors modeled after military tiltrotor technology. However, the intended aircraft were never used commercially, and the AC was cancelled on July 28, 2010. Currently the closest type of aviation infrastructure, being used by many for comparison purposes, is heliports and helistops. AC 150/5390-2, *Heliport Design*, is based on helicopters with single, tandem (front and rear) or dual (side by side) rotors. The emerging VTOL aircraft and industry advanced air mobility (AAM) concepts of operation are yet to be proven to perform like either of these designs or operational templates. Additionally, because VTOL aircraft and the AAM industry are rapidly evolving, there is limited demonstrated performance data on how these aircraft operate.

Research efforts are underway to better understand the performance capabilities and design characteristics of emerging VTOL aircraft. The FAA will develop a performance-based AC on vertiport design in the future that will detail categories of vertiport facilities requiring different design criteria depending on the characteristics of the aircraft they plan to support and activity levels at the facility. The future guidance will address more advanced operations including autonomy, different propulsion methods, and high tempo facilities. The AC on vertiport design will also address VTOL aircraft using alternative fuel sources such as hydrogen and hybrid.

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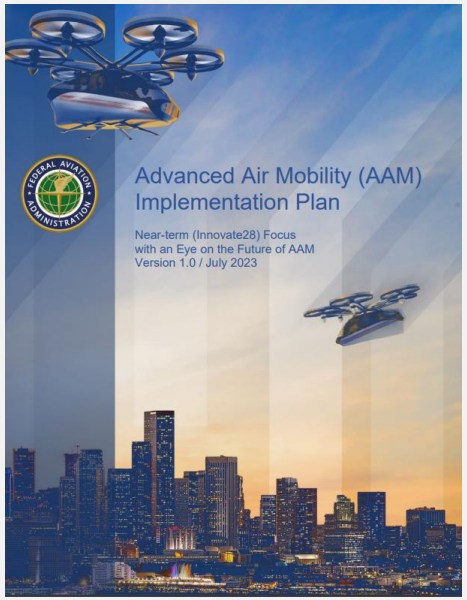
FAA – Advanced Air Mobility (AAM) Implementation Plan – Near Team Focus (Innovate 28)

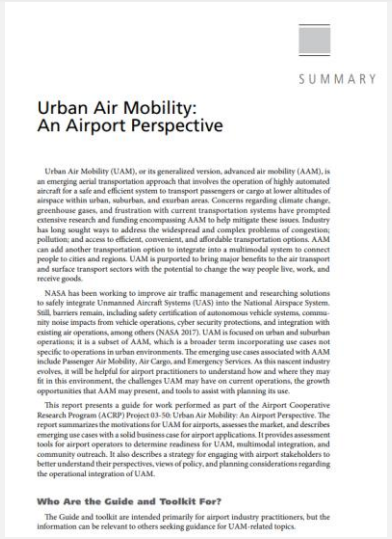
- Integrate AAM operations with OEMs
- Identify key locations and use cases for AAM operations
- Identify a repeatable processes for AAM integration



Industry Publications and Guidance

ACRP Report 243 – Urban Air Mobility: An Airport Perspective

- Focuses on impacts and opportunities for airports
- Assessment tool to determine AAM readiness, multimodal integration, and community outreach
- Offers strategy for engaging with stakeholders



SUMMARY

Urban Air Mobility:
An Airport Perspective

Urban Air Mobility (UAM), or its generalized version, advanced air mobility (AAM), is an emerging aerial transportation approach that involves the operation of highly automated aircraft for a safe and efficient system to transport passengers or cargo at lower altitudes of airspace within urban, suburban, and exurban areas. Concerns regarding climate change, greenhouse gases, and frustration with current transportation systems have prompted extensive research and funding encompassing AAM to help mitigate these issues. Industry has long sought ways to address the widespread and complex problems of congestion; pollution; and access to efficient, convenient, and affordable transportation options. AAM can add another transportation option to integrate into a multimodal system to connect people to cities and regions. UAM is purported to bring major benefits to the air transport and surface transport sectors with the potential to change the way people live, work, and receive goods.

NASA has been working to improve air traffic management and researching solutions to safely integrate Unmanned Aircraft Systems (UAS) into the National Airspace System. Still, barriers remain, including safety certification of autonomous vehicle systems, community noise impacts from vehicle operations, cyber security protections, and integration with existing air operations, among others (NASA 2017). UAM is focused on urban and suburban operations; it is a subset of AAM, which is a broader term incorporating use cases not specific to operations in urban environments. The emerging use cases associated with AAM include Passenger Air Mobility, Air Cargo, and Emergency Services. As this nascent industry evolves, it will be helpful for airport practitioners to understand how and where they may fit in this environment, the challenges UAM may have on current operations, the growth opportunities that AAM may present, and tools to assist with planning its use.

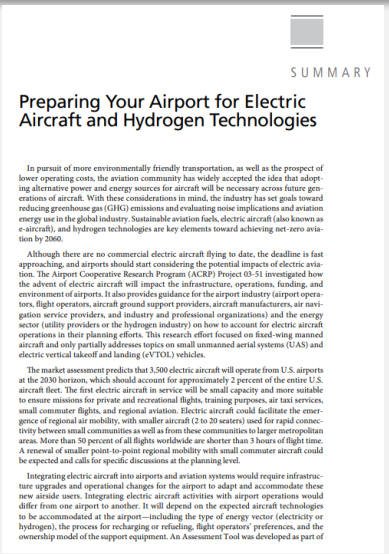
This report presents a guide for work performed as part of the Airport Cooperative Research Program (ACRP) Project 03-50: Urban Air Mobility: An Airport Perspective. The report summarizes the motivations for UAM for airports, assesses the market, and describes emerging use cases with a solid business case for airport applications. It provides assessment tools for airport operators to determine readiness for UAM, multimodal integration, and community outreach. It also describes a strategy for engaging with airport stakeholders to better understand their perspectives, views of policy, and planning considerations regarding the operational integration of UAM.

Who Are the Guide and Toolkit For?

The Guide and toolkit are intended primarily for airport industry practitioners, but the information can be relevant to others seeking guidance for UAM-related topics.

ACRP Report 236 – Preparing Your Airport for Electric Aircraft and Hydrogen Technologies

- Provides estimates for market growth
- Provides guidance to help airports estimate impact of electric aircraft on their facilities
- Accompanied by an electronic toolkit



SUMMARY

Preparing Your Airport for Electric Aircraft and Hydrogen Technologies

In pursuit of more environmentally friendly transportation, as well as the prospect of lower operating costs, the aviation community has widely accepted the idea that adopting alternative power and energy sources for aircraft will be necessary across future generations of aircraft. With these considerations in mind, the industry has set goals toward reducing greenhouse gas (GHG) emissions and evaluating noise implications and aviation energy use in the global industry. Sustainable aviation fuels, electric aircraft (also known as e-aircraft), and hydrogen technologies are key elements toward achieving net-zero aviation by 2060.

Although there are no commercial electric aircraft flying to date, the deadline is fast approaching, and airports should start considering the potential impacts of electric aviation. The Airport Cooperative Research Program (ACRP) Project 03-51 investigated how the advent of electric aircraft will impact the infrastructure, operations, funding, and environment of airports. It also provides guidance for the airport industry (airport operators, flight operators, aircraft ground support providers, aircraft manufacturers, air navigation service providers, and industry and professional organizations) and the energy sector (utility providers or the hydrogen industry) on how to account for electric aircraft operations in their planning efforts. This research effort focused on fixed-wing manned aircraft and only partially addresses topics on small unmanned aerial systems (UAS) and electric vertical takeoff and landing (eVTOL) vehicles.

The market assessment predicts that 3,500 electric aircraft will operate from U.S. airports at the 2030 horizon, which should account for approximately 2 percent of the entire U.S. aircraft fleet. The first electric aircraft in service will be small capacity and more suitable to ensure missions for private and recreational flights, training purposes, air taxi services, small commuter flights, and regional aviation. Electric aircraft could facilitate the emergence of regional air mobility, with smaller aircraft (2 to 20 seaters) used for rapid connectivity between small communities as well as from these communities to larger metropolitan areas. More than 50 percent of all flights worldwide are shorter than 3 hours of flight time. A renewal of smaller point-to-point regional mobility with small commuter aircraft could be expected and calls for specific discussions at the planning level.

Integrating electric aircraft into airports and aviation systems would require infrastructure upgrades and operational changes for the airport to adapt and accommodate these new airside users. Integrating electric aircraft activities with airport operations would differ from one airport to another. It will depend on the expected aircraft technologies to be accommodated at the airport—including the type of energy vector (electricity or hydrogen), the process for recharging or refueling, flight operators' preferences, and the ownership model of the support equipment. An Assessment Tool was developed as part of

On-Airport Considerations

Why Airports for Early AAM Integration?

- High demand for last-mile connections, particularly in the congested environment of airports in urban areas
- Some of the basic infrastructure is already in place, including airside and landside facilities
- Time-saving benefits for passengers, with AAM flights saving 40-60% of travel time

More than two-thirds of the 25 largest AAM companies have announced that airports are among their initial target markets

Siting and Other Considerations

Siting Considerations

- Future Expansion
- Airspace Ingress/Egress
- Utility Infrastructure/Electrical Supply
- Proximity to Operations (ATC)
- Vertiport Site Access
- Surface Constraints (Obstructions)

Other Considerations

- Aircraft Storage
- Multi-Modal Connectivity
- Business Uses and Market Demand
- Passenger Demand
- Community Buy-in

Vertiport Types

Vertipad or Vertistation

- Smallest and simplest design
- One takeoff/landing site
- One or two parking spots
- Suburban connection point
- No MRO or repair services on-site
- No passenger accommodations
- Likely not staffed

Vertiport or Vertibase

- Key urban area sites (center)
- 2-3 FATO/TLOF and some aircraft parking
- Basic maintenance crew
- Requires a charging station (quick charge or battery swap)
- Passenger waiting areas and security screening required

Vertihub

- Largest facility
- Multiple aircraft parking locations (overnight)
- Full functioning MRO
- Passenger amenities
- Charging facilities

A Holistic Approach to AAM Integration on Airports

- Integrate AAM into existing airspace operations
- Identify potential vertiport sites early
- Work with utility providers to develop charging infrastructure
- Identify opportunities to integrate AAM operations into existing terminal operations

Land Use Considerations

5 Land Use Compatibility Factors

Tall Structures	Visual Obstructions	Population Density	Wildlife Attractants	Noise
				
• Buildings • Powerlines • Smokestacks • Trees	• Glare • Dust • Steam • Smoke	• Multi-family homes • Hospitals • Churches • Arenas	• Landfills • Water bodies • Dense shrubbery • Wetlands • Golf courses	• Schools • Hospitals • Residential

AAM Corridor Planning

- Serves a similar purpose as transit corridor planning
- Includes a market-based and technical analysis
- Addresses business opportunities for AAM services within and between regions or communities
- Inventories relevant aviation and non-aviation assets that could be used for AAM operations
- Proposed alternatives for implementing the corridor
- Should consider policy, land use, environmental, and safety impacts

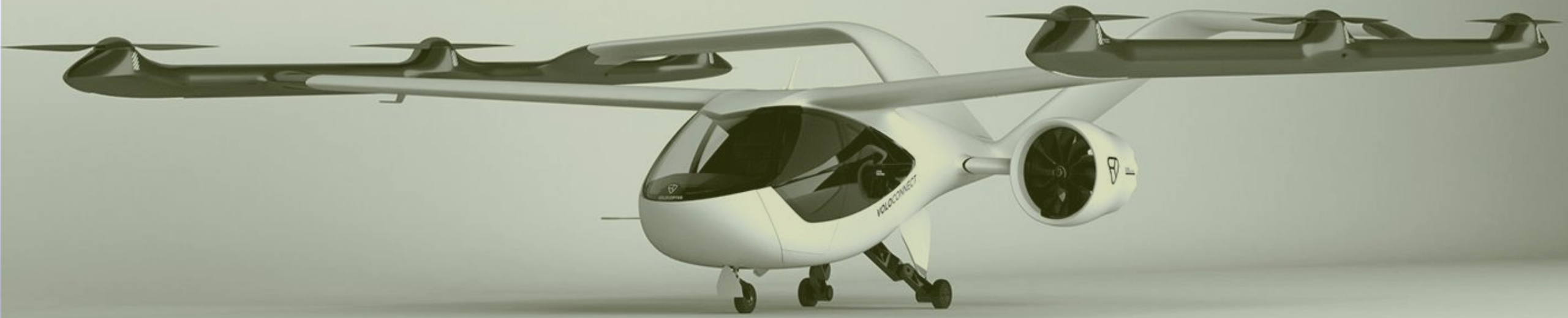
Community Engagement

- Multi-dimensional approach
  - Combining traditional public outreach with innovative approaches
- Tailored to the community
- Specific to the message being conveyed
- Dynamic and flexible
  - Room for new technologies and methods as years progress
- Identify opportunities for AAM working groups

What Can Airports Do Now?

- Engage with WSDOT
- Review Master Plans and ALPs
- Reach out to OEMs or Industry Groups
- Evaluate the Electric Grid and Coordinate with Utility Companies
- Research the Market
- Connect with Community Members
- Coordinate with Local Land Use Authorities

THANK YOU
Any questions?



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