Georgia Department of Transportation

ADVANCED AIR MOBILITY STUDY

COMMUNITY GUIDEBOOK

APRIL 2024

1. Community Guidebook and Toolkit

1.1 Introduction

A new era of aviation is emerging that promises to transform how, where, and when we fly. Known as Advanced Air Mobility (AAM), it represents the next great achievement for humankind in the world of flight. The State of Georgia recognizes the potential benefits of AAM in transportation, including improved transportation mobility, environmental sustainability, efficiency, and increased economic growth. To foster AAM's safe and effective integration into the state's transportation system, the GDOT Aviation Program understands the need to assist communities as they prepare for this aviation revolution. This guidebook is intended to help local governments, urban and rural alike, start planning for AAM as part of their broader mobility plans. It includes information on exactly what AAM is, the roles and responsibilities of AAM stakeholders, community best practices, and tools to assist with its successful integration into Georgia communities. By being proactive and planning for this disruptive technology now, a community can better harmonize AAM with its existing land uses, thus increasing the likelihood of public acceptance of the aircraft and their operations.

1.2 What is AAM?

AAM is the umbrella term for Urban Air Mobility (UAM), which focuses on transporting people and cargo at low altitudes within urban and suburban areas, and Regional Air Mobility (RAM), which builds upon the concept of UAM by expanding its range to inter-city and regional travel. AAM also includes other use cases such as air ambulance, firefighting, law enforcement, and special events.

Technological Advancements

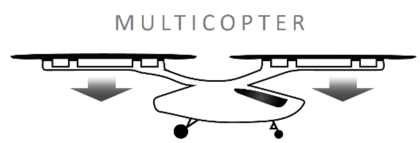
AAM is not a single technology, but rather a collection of new and emerging technologies being applied to the aviation system, particularly in new aircraft types. The advent of distributed electrical propulsion (DEP) is the key element behind many of the major advancements in air mobility, especially vertical flight. "Distributed electric propulsion technology is based on the premise that closely integrating the propulsion system with the airframe and distributing multiple motors across the wing will increase efficiency, lower operating costs, and increase safety" (Clarke, 2021). AAM is becoming an all-encompassing acronym for aircraft and services that use DEP, especially electric vertical takeoff and landing (eVTOL) aircraft.

Broadly, AAM includes Uncrewed Aerial Systems (UAS), a term that refers to uncrewed aerial vehicles (UAVs, sometimes referred to as drones) and the supporting software and systems that enable those vehicles. UAS operations include, among many others, package delivery, aerial photography, infrastructure inspections, surveying, and agriculture. These vehicles can be operated privately or commercially, with most commercial operations falling under the FAA's FAR Part 107 Certificated Remote Pilot license.

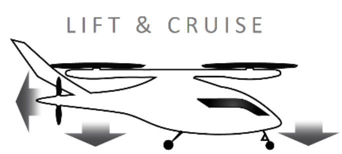
Generally, UAVs must be flown at or below 400 ft. above ground level (or 400 ft. above the structure the UAV is flown over), within the pilot's visual line of sight, and cannot be flown over non-participating individuals. Advancements in UAS can enable widespread, complex beyond-visual-line-of-sight operations. However, because small/lightweight UAVs do not require dedicated landing facilities, there is little role for state or local governments because UAS airspace is largely the jurisdiction of the FAA. For this reason, the guidebook focuses on eVTOL aircraft and the infrastructure associated with enabling those operations. More information about FAA policy on UAS can be found at their website, here: [Unmanned Aircraft Systems (UAS) | Federal Aviation Administration (faa.gov)].

Unconventional Design

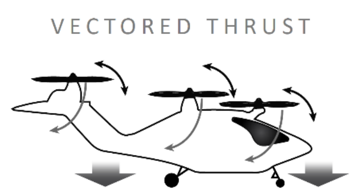
An eVTOL aircraft takes off and lands vertically; it flies horizontally on wings, or like a helicopter with multiple fixed propellers rather than just one rotor. An eVTOL may share some design and operational characteristics between the following categories:



1. Multicopter: This eVTOL aircraft is similar to a helicopter. It uses the same set of fixed propellers in a vertical position for vertical and forward flight.



2. Lift and Cruise: This eVTOL aircraft uses completely independent propellers for vertical lift versus forward flight. The vertical propellers are turned off and feathered for flight on the wings.



3. Vectored Thrust: This is the most complex of the three types with the same propellers changing position for vertical versus forward flight. The thrust is "vectored" based on the desired direction and uses conventional wings when in forward flight.

Photo courtesy of Archer Aviation


Photo courtesy of Lift


Photo courtesy of BETA Technologies

There are more than 600 designs in the Vertical Flight Society database of eVTOL aircraft, which can be found here: https://evtol.news/aircraft.

Several are defunct, and many more will follow. No one knows with certainty which designs will eventually land in Georgia, but with an estimated cost of over $1 billion to certify a new eVTOL aircraft (Head, 2023), the list will likely be small, at first. Archer Aviation, in the vectored thrust category, is counting on being one that makes it to market. In the first quarter of 2023, the company began construction of a site to manufacture their eVTOL aircraft in Covington. The 350,000-square-foot facility is expected to produce up to 650 aircraft per year, and the site is capable of being expanded to 550,000 square ft. to support the production of up to 2,300 aircraft per year (Bristow, 2023). With 2024 as their target date for FAA Type Certification, the company is planning for early operations beginning in 2025 and moving to the mass market in 2028+ (Archer Aviation, 2023).

BETA Technologies also has an eVTOL they believe will make it through certification and operate in Georgia (Georgia Aerospace: World-Class Expertise, 2023). Their lift and cruise design, the Alia-250, is targeted for certification in 2026 (Brinkmann, 2023). The company has also spun off a conventional electric aircraft that takes off and lands horizontally—the CX300—which they are working to certify by 2025. In the first quarter of 2023, BETA Technologies installed an airside charging station at the Augusta Regional Airport that supports fast charging up to 350kW (Bristow, 2023). This station will charge the Alia-250 and the CX300, in addition to other electric aircraft.

Lift Aircraft's Hexa, a multicopter eVTOL, also has connections to Georgia. Qarbon Aerospace, which has a facility in Georgia, "is a provider of large, complex composite and metallic structural components, and assemblies such as fuselages, wings, flight control surfaces and engine nacelles and components" Qarbon produced the first Hexa eVTOL for Lift (Lee, 2022). Lift is seeking operations under FAR Part 103 for "ultralight" vehicles for the Hexa, which is a limited FAR for use by a single occupant in an aircraft not exceeding 254 pounds while empty and not capable of more than 55 knots airspeed at full power in level flight. An ultralight certification significantly limits the use of the aircraft in populated areas.

Those that are certified with the FAA under the ultralight vehicle category will not require a pilot certificate (e.g., Lift Hexa, Rotro X Dragon, Opener Blackfly) but they will not be permitted to fly over any congested area of a city, town, or settlement, or any open-air assembly of persons, nor will they be able to transport passengers or cargo for hire and are for recreational purposes only. Consequently, these aircraft are not the focus of this guidebook.

Simplified Vehicle Operations

eVTOL aircraft are based on a paradigm shift away from pilots with manual flying skills to ones who rely more on automation. This is similar to the evolution of automobiles and their drivers. As cars went from manual to automatic transmissions, many young drivers today have never driven a vehicle with a gear shift and clutch pedal. They have never "push started" a car or "downshifted" to brake. Like their counterparts on the road, AAM aircraft are highly automated and use simplified vehicle operations (SVO) or are uncrewed altogether. SVO aims to reduce the pilot workload by using technology to automate elements of the control of the aircraft. By reducing workload in the cockpit, pilots increase

Photo courtesy of Beta Technologies

their situational awareness and thereby increase the safety of the flight. Most eVTOL aircraft will initially be certified with pilots on board with SVO playing a major part in aircraft control. This represents a change from the onboard, 2:1 pilot-to-aircraft ratio airline passengers are used to, and instead more closely models smaller, fixed-wing and helicopter commuter, on-demand, and air tour operations in existence today.

Other eVTOLs will come out of the gate totally automated with no pilot in the aircraft at all, but a "supervisor" on the ground overseeing multiple flights. This represents a significant change from the pilot-on-board model passengers are used to and would require a significant shift in the passengers' trust—they will have to go from an established history of faith in a system of having experienced flight crew on every flight, to a blind trust and acceptance of self-flying aircraft. It is important to reiterate that the eVTOLs found in the earliest entrants – the companies looking to launch in the middle of the 2020-2030 decade—will have a pilot on board. Remotely piloted and autonomous aircraft are longer-term targets by OEMs entering service at a later date.

New Uses

AAM has the potential to change the way people and cargo move from point to point. eVTOL OEMs purport their aircraft will be less expensive to buy, operate, and maintain, due to the electric propulsion systems on board. Instead of a complex combustion engine to maintain, electric propulsion simplifies this system by replacing that engine with electric motors that are cheaper and easier to maintain or replace. OEMs also claim the aircraft will be quieter than helicopters and more environmentally sustainable.

eVTOL aircraft could make it easier to reach places in highly congested areas. The term air taxi is often used when talking about eVTOL aircraft as they may operate much like taxis and ridesharing companies today. While helicopters have long been able to provide air taxi services throughout history, they are very expensive to operate and maintain, so widespread use by the general public has never been mainstream. eVTOLs, if quieter and less expensive than helicopters, may be able to popularize air taxi services that are otherwise out of reach for the general population. Aside from air taxi services, there is potential for eVTOLs to enhance air cargo and emergency/public service missions. Air cargo use cases for eVTOL aircraft would cover the middle-mile of the logistics supply chain, connecting factories or airports to distribution centers. This leg of the transportation journey is currently typically accomplished with cargo vans and box trucks. Increasing the efficiency of this part of the logistics chain could enable more homes to be serviced by same-day delivery.

Public service agencies may be one of the first sectors to embrace eVTOL aircraft. Rapid first response to any emergency adds value, and AAM is viewed as more cost-efficient compared to traditional aircraft. In areas like the Atlanta metro highways, eVTOLs could expedite access to emergency lifesaving care when ground transport is limited by road congestion.

Even with the widespread adoption of eVTOLs, there will still be restrictions on how these aircraft can operate. eVTOLs that are certified as aircraft under other categories can act as air taxis or personal vehicles. The air taxis will likely operate under CFR Title 14, Part 135. Under this regulation, the FAA grants a certificate to a service provider to operate on-demand, unscheduled air service providing certain conditions are met, including strict training and maintenance requirements. Those acting as personal vehicles will have slightly less stringent operating requirements.

Regardless of the type of use, all eVTOL aircraft will need a place to take off and land, which will require infrastructure across Georgia. Most existing airports can accommodate eVTOLs immediately with little to no modification, save for the electric demands from installing charging stations onsite. Early operations will likely utilize airports as they have existing infrastructure and procedures for aeronautical use.

New vertiports will need to be built to accommodate high-tempo and high-volume operations in areas where airports do not exist. Who will build, operate, and maintain this infrastructure remains to be seen, but several caveats come into play depending on who that is. If a vertiport is built with grants from the FAA Airport Improvement Program or Georgia's Airport Aid Program, it must be publicly owned and open to the public for use, which means personal use eVTOL can land there. If the facility is privately-owned and constructed, the operator can place restrictions on its use.

Characteristics and Alliances

The eVTOL aircraft surging the advanced air mobility movement vary in payload, range, and speed, which makes them useful in different mission scenarios. Most aircraft have a wingspan or diameter of 50 ft. or less and weigh approximately 7,000 pounds. The number of eVTOL aircraft designs is in the hundreds and changing daily. Given the high cost of bringing an eVTOL through the FAA certification process, the number of these aircraft that reach operations is likely much more limited. Every news cycle brings new information on hurdles overcome and new obstacles. While only a snapshot in time and a small sampling, **Table 1-1** provides a partial listing of the characteristics and alliances of several OEMs.

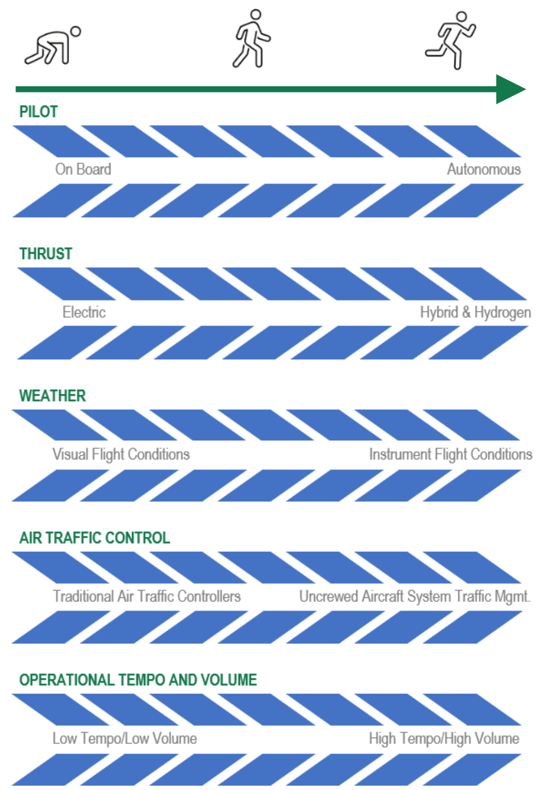
Table 1-1: Early Entrants into eVTOL

OEM	Platform	Mission	Passengers	Range	Airspeed MPH	Key Alliances
Archer Aviation	Vectored Thrust	Air Taxi, Cargo	4 + pilot	100	150	Stellantis, United, US Military, Boeing, Wisk Aero
BETA Technologies	Lift and Cruise	Air Taxi, Cargo, EMS	4 + pilot	250	100	UPS, Amazon, US Military
HEXA	Multicopter	Personal/Recreational	1 pilot or 1 passenger	60	63	
Joby Aviation	Vectored Thrust	Air Taxi	4 + pilot	150	200	Toyota, US Military, Delta, United
Eve Air Mobility	Lift and Cruise	Air Taxi	4 + pilot	60	125	Embraer, Porsche, Blade, United
Vertical Aerospace	Vectored Thrust	Air Taxi, Cargo, Public Services (EMS)	4 + pilot	100	150	American, Virgin Atlantic
Lilium Air Mobility	Vectored Thrust	AT, Regional	6 + pilot	155	155	NetJets
Supernal	Vectored Thrust	Air Taxi	4 + pilot	60	180	Hyundai
Wisk Aero	Vectored Thrust	Air Taxi	4 + no pilot	90	138	Archer, Boeing, Japan Airlines, Air New Zealand
VOLOCOPTER	Multicopter	AT	1 + 1 pilot	22-40	56	Japan Airlines

All values are approximate. Range is in miles. Sources: OEM websites, eVTOL.news, AAM Reality Index, and other misc.

Timeline

AAM has often been described as being implemented in phases—a crawl, walk, run timetable. The initial aircraft certified will have a pilot on board. They are expected to be all-electric and fly only in visual meteorological conditions (good weather). Traffic will be managed by traditional air traffic controllers and operate at a low tempo and volume. Over time, the aircraft are expected to become autonomous, expand to hybrid and hydrogen power systems, and fly in instrument meteorological conditions. As the tempo and volume of operations increase, new air traffic management tools and capabilities may be necessary.



eVTOL are the predominant aircraft utilizing AAM technology. The Vertical Flight Society Aircraft Directory is tracking hundreds of concepts for electric and hybrid-electric VTOL aircraft, though many of these are in extremely early conceptual stages. (Vertical Flight Society, 2023) Many of the leading OEMs are targeting the middle of 2020 to 2030 for entrance into service. (AAM Reality Index, 2023) In general, these aircraft hold somewhere between four and eight passengers. The early entrants will be piloted, while later entrants plan to start out autonomously. Early eVTOL flight ranges are typically 60-150 miles and cruise speeds are typically 100-200 miles per hour.

The Vertical Flight Society Aircraft Directory can be found at the following link: https://evtol.news/aircraft.

Potential Community Benefits and Impacts

AAM's impact on a community may be far-reaching, especially when accepted by the public as a viable alternative to ground transportation. If successful, it can reduce travel times, increase the acceptable range of a commute, enable same-day delivery, reduce emergency response time and cost, improve disaster or law enforcement responses, and better connect rural areas to urban centers. It could reduce vehicular traffic and pollution if operated at a large scale and tempo in congested areas. AAM could also have a positive economic impact by improving the efficiency of air cargo routes and promoting commerce between regional cities.

In addition to those benefits, there are also secondary benefits. AAM will require engineers and manufacturing jobs to construct the aircraft, pilots to fly them, and vertiport operators to manage the vertiports. Furthermore, there will be job opportunities for producing and recycling batteries.

For all of this to happen, landing sites—vertiports—must be readily available in multiple locations with multimodal connections. These vertiports may bring traffic to previously uncrowded areas, impact the ability for development and land uses around the facility, and add noise and visual pollution to the skyline. Preparing for AAM now with conscientious and circumspect policies and plans will aid in successful community integration.

1.3 Roles & Responsibilities

The identification of specific roles and responsibilities is necessary for AAM services to integrate into the National Airspace System (NAS), especially when flight routes and networks increase in complexity and volume. An integrated AAM ecosystem allowing flight through different airspace classes with other airspace users will be dependent on such. The following roles and responsibilities, summarized in **Table 1-2**, make up the foundational network needed to successfully implement AAM in the State of Georgia.

Table 1-2: AAM Roles and Areas of Responsibility

Entity	Area of Responsibility
Federal Aviation Administration	Certification of Aircraft, Vertiport Standards, Airspace, Air Traffic Control, Operational Regulations
Georgia DOT	Statewide AAM Coordination, Vertiport Standards, Inspections
Local Government	Zoning Protection, Land Use Compatibility Planning
Infrastructure Developers and Operators	Vertiports, Utility Providers
Service Providers	Aircraft Operations, Flight Scheduling, Aircraft Maintenance, Pilot Training
Stakeholders	Public Engagement

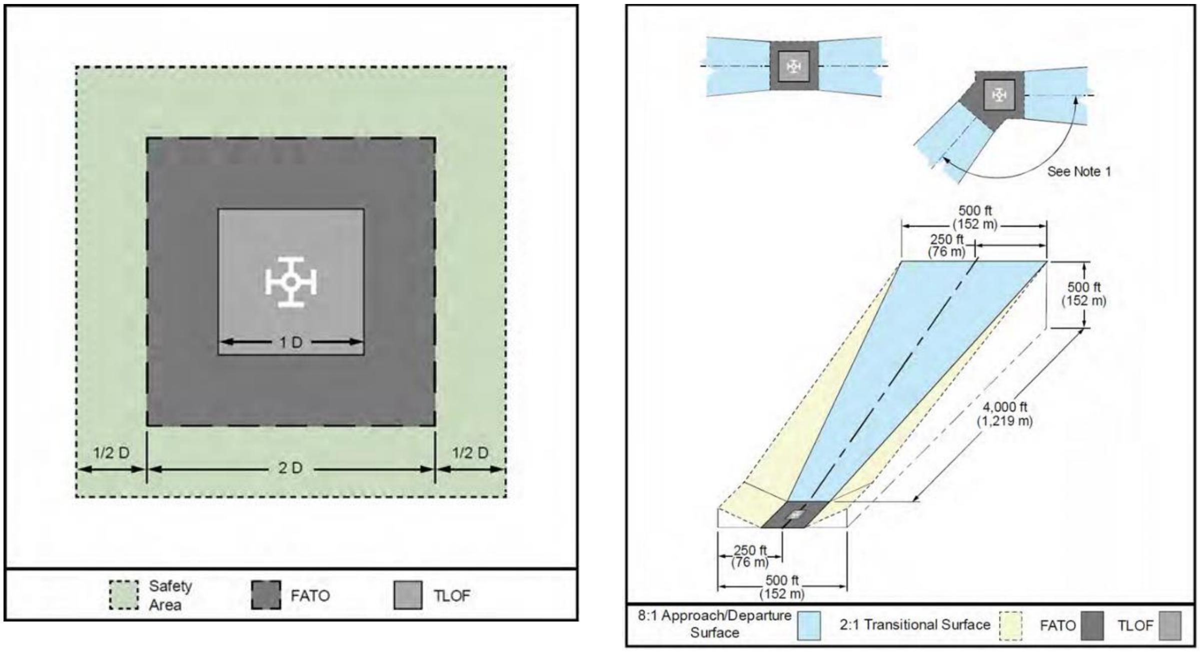
Federal Government

The FAA is the federal agency responsible for the regulation and oversight of the National Airspace System (NAS), where AAM service providers will operate. The FAA's role includes certifying emerging eVTOL aircraft, providing design standards for vertiport infrastructure, defining air traffic management procedures for service providers, and ensuring that operations comply with all applicable federal regulations. Engineering Brief 105, Vertiport Design, is the FAA’s interim guidance on vertiport design standards while a full advisory circular is developed. The Engineering Brief can be found here:

https://www.faa.gov/airports/engineering/engineering_briefs/engineering_brief_105_vertiport_design

The basic landing geometry and considerations for approach and departure paths are illustrated in the figures below.

Figure 1-1: Vertiport Landing Area Dimensions



The size of the landing area for vertiports is based on the aircraft's "controlling dimension", or "D." This is the longest/widest part of the eVTOL. Most early entrant eVTOLs will have a controlling dimension of 40-50 feet. The approach, departure, and transitional surfaces are areas that must be free of penetrations surrounding a vertiport.

EB 105 refers to the FAA Advisory Circular for Heliports to fill in many gaps for vertiport development in the absence of a full advisory circular. The Heliport Design Advisory Circular can be found here:

https://www.faa.gov/airports/resources/advisory_circulars/index.cfm/go/document.current/documentNumber/150_5390-2.

Title 14 Code of Federal Regulations Part 157 requires that the FAA be notified at least 90 days before construction, alteration, activation, deactivation, or change to the status or use of a civil or joint-use (civil/military) takeoff and landing area. This notification serves as the basis for the FAA's evaluation of how the proposed site affects the safe and efficient use of airspace by aircraft, as well as the safety of persons and property on the ground. A link to this form can be found here:

https://www.faa.gov/documentLibrary/media/Form/faa-form-7480-1-notice-for-construction-2020.pdf.

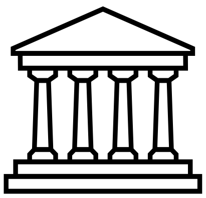
Questions regarding this process can be made to the FAA Atlanta Airports District Office at 404-305-6799. A link to their website follows: https://www.faa.gov/airports/southern/.

State Government

The State of Georgia is responsible for working with AAM developers and operators to establish a framework for the safe and efficient integration of AAM into the state's transportation system. Georgia Department of Transportation (GDOT) is the primary agency responsible for coordinating aviation activities at the state level, and as such, carries much of the weight for fostering the successful integration of AAM into Georgia's transportation system. This includes establishing state-level regulations and licensing processes for AAM infrastructure. GDOT may also work with local communities and stakeholders to promote public acceptance of AAM. Georgia State Code O.C.G.A. § 32-9-8 outlines the regulatory framework requiring GDOT to license public takeoff and landing area facilities in the state of Georgia. Georgia Administrative Code 672-09-.03 establishes the licensing minimum standards for those facilities.

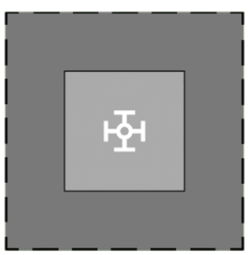
GDOT Division of Intermodal can be contacted at (404) 631-1990.

Local Government



The local governing body of a community i.e., municipality, county commission, or unified government, will need to prepare for the development of vertiports in their jurisdiction by enacting local ordinances covering zoning, building permits, and compatible land uses. Once built, local governments will be responsible for addressing potential noise impact mitigation, restricting tall structures and landfill development nearby, and deterring wildlife attractants near aviation activity at these locations. Without oversight, any public benefit may be compromised from encroachment by incompatible land uses. Zoning protection must be in place to protect airspace in and around vertiports while also protecting the public from potential noise impacts.

Infrastructure Developers and Operators



eVTOL aircraft must have safe areas for takeoff and landing. AAM developers and operators are the entities involved in the design, construction, financing, and operation of these facilities, known as vertiports, and their supporting infrastructure including terminals, charging stations, parking, etc. Infrastructure developers and operators may be involved in developing greenfield vertiport sites in a community but may also work with local publicly owned public-use airports to develop on-airport sites to accommodate eVTOL operations.

Utility providers play a crucial role in providing sufficient electricity to greenfield sites and improving existing power infrastructure at airports. It is important to involve these providers early in planning and development to ensure that adequate power supply is available. Depending on the site, it can take several years before an adequate supply can be provided. This further establishes that it is critical to engage with utility providers early so that an assessment of the timeline and supply can be completed. The availability of electricity can determine the feasibility of a site and should be given high priority.

Service Providers

These entities are responsible for the overall management and execution of AAM operations. They plan the flights, operate the eVTOL aircraft, schedule flights and share flight information, and ensure infrastructure, equipment, and services are in place for the safe execution of a flight. They manage all the AAM services, from flight schedules to charging and maintenance on the aircraft. Service providers may also be involved in the development of infrastructure or may contract with developers to use their infrastructure.

Stakeholders

Aviation is a complex industry that includes a wide range of stakeholders with differing areas of expertise, as well as goals and objectives. Each stakeholder's needs should be considered while planning for AAM to succeed in the State of Georgia. Knowing who the stakeholders are, and where they fit in the development of vertiports and deployment of services is an essential underpinning to success. By understanding stakeholders and their issues, communities will be prepared to engage and effectively address stakeholder concerns and manage expectations.

Applicable stakeholders and their specific roles will vary from local jurisdiction to local jurisdiction, but the following entities are considered fundamental to the vertiport siting decision-making process:

- Aviation facilities within 5 miles (public and private airports, heliports, navigational aids, hospital heliports, etc.)
- City and County Governments, as well as metropolitan and regional planning organizations
- Utility Service Providers (e.g., electric, water, communications)
- Community Members (e.g., businesses, residents)
- FAA
- GDOT Division of Intermodal Aviation Program
- OEM/operators
- Special interest groups (e.g., environmental, commerce, and neighborhood groups)

1.4 Community Preparedness

Whether AAM will be a game changer for the average American or a high-speed mobility option available only to high-net-worth individuals is still uncertain. Regardless, it should not hinder any current form of public transportation. Integrating AAM into local transportation, land use, and comprehensive plans can assist in a logical and methodical rollout of the technology that does not discriminate or unfairly impact any segment of the community or tangential planned development. Connecting surface transportation options to vertiports and reducing congestion should be at the forefront of planning, not an afterthought that tries to bridge gaps and correct problems. Engaging with the community, OEMs, and regulatory agencies will need to happen early and continuously for Georgia's citizens to reap the benefits of AAM.

1.5 Best Practices

The successful and sustainable implementation of AAM in the State of Georgia relies on societal acceptance and integration of eVTOL aircraft, their operations, and the vertiports they use. While the passenger-carrying segment of AAM necessitates the highest level of safety, infrastructure complexities, and public acceptance for a community, many of the same issues are also relevant to AAM cargo operations. Maximizing the likelihood of success for AAM in a community, be it passenger or cargo, requires establishing consistent processes, adopting progressive policies, and thoughtfully engaging the public from the early stages of implementation. By doing so, local governments can proactively address potential challenges and concerns, ensuring the likelihood of a successful transition. These consistent processes, progressive policies, and public engagement embody what is commonly referred to as best practices, which can serve as a valuable resource for Georgia municipalities, counties, and unified governments aiming to incorporate AAM into their communities.

Like any emerging technology, the challenges and concerns associated with AAM are continuously evolving. It is essential to recognize that each local government within the State of Georgia possesses its own distinct characteristics, and the specific issues related to AAM implementation will vary accordingly. However, certain fundamental steps can be identified at a high level, which, if implemented, will foster the success of AAM initiatives. These actions must be undertaken before an AAM service provider shows interest in a community.

Appoint an AAM Lead Staff Member

As AAM continues to develop and garners increasing attention, communities must cut through the industry noise and separate fact from fiction regarding the transformative technology that eVTOL aircraft represent. Local governments should proactively identify a dedicated point-person or division to spearhead AAM dialogue within their community. This individual can assume the role of the principal spokesperson, responsible for staying well-informed about AAM advancements and effectively representing the community's requirements and best interests. By assigning a knowledgeable and proactive lead staff member or division, local governments can ensure that the community's perspectives and concerns are appropriately considered throughout the AAM integration process.

Coordinate Early with Stakeholders

A key role for the AAM lead staff member is to identify points of contact at each of the stakeholder organizations listed in the **Roles & Responsibilities** section. Reaching out to each of these organizations early in the planning process will allow the AAM lead staff member to understand and evaluate concerns and opportunities from these groups. Reaching out to the FAA early on will help identify airspace conflicts. Reaching out to utility providers early will help to identify supply chain and timeframe constraints on expanding electrical capacity at a given site. Bringing these and other stakeholders together early will ultimately result in a greater understanding of AAM in the community and increase the likelihood of successful integration.

Review Zoning Ordinances

It is essential to incorporate airspace overlay zoning within local zoning ordinances for vertiports to ensure the safe and sustainable operation of AAM and to protect any public investments and benefits associated with it. This proactive approach will prevent incompatible land uses and obstructions to air navigation from arising over time.

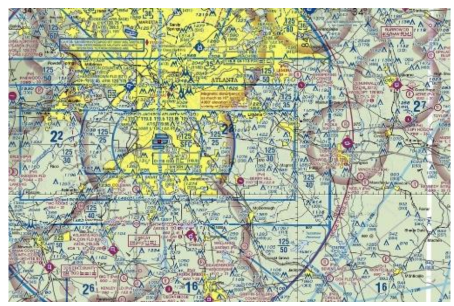
The responsibility for land-use zoning and control normally rests with local planners and elected officials, who develop comprehensive plans, zoning ordinances, and land-use regulations tailored to their community's specific needs and priorities. These local plans and regulations should consider the impact of community development on local aviation facilities and aviation activities, as well as the reciprocal effects of aviation on the community. Consequently, it is necessary to expand the scope of aviation facilities beyond traditional airports and heliports to encompass vertiports and AAM services. Local plans and regulations should place particular emphasis on identifying potential noise impacts and mitigation measures, regulating the placement of tall structures which can adversely impact airspace and aircraft operations, and ensuring municipal solid waste landfill development is not allowed within 5 statute miles of an airport or vertiport, and addressing wildlife attractants in close proximity to aviation facilities and activities.

Conversely, local comprehensive plans can offer opportunities to identify optimal locations for vertiports. By reviewing existing transportation hubs, local governments can incorporate vertiports and connect multiple modes of transportation, including buses, rail, ride-sharing, and micro-mobility options will help to connect people on the “first mile” and “last mile” of their travel.

Outlining permitted and prohibited land uses, vertiport development standards, airspace requirements, and other criteria will ensure vertiports fit into the community’s comprehensive land use plans while comprehensive land use plans for the community while also protecting them from future noncompatible land uses. By considering these factors, communities can balance accommodating AAM development and preserving the integrity, safety, and compatibility of their local airspace and surrounding areas.

Map Aeronautical Use Facilities, 14 C.F.R. Part 77 Surfaces

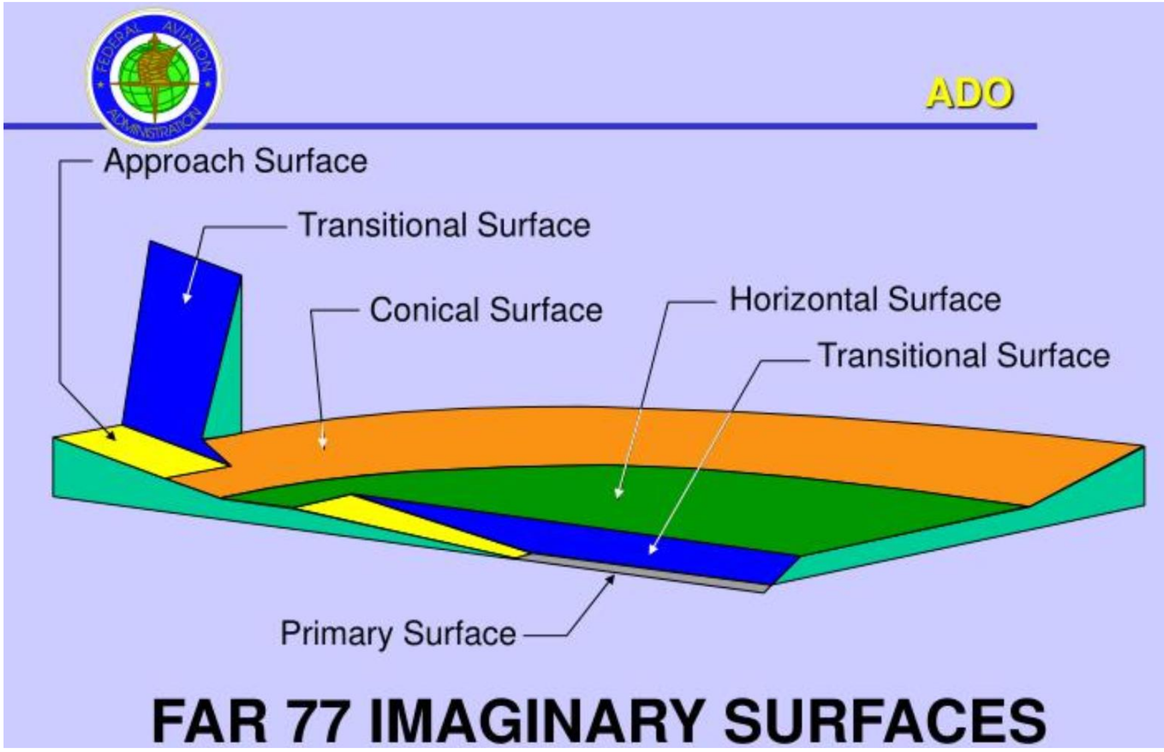
Embracing the emergence of new forms of air mobility should not be done at the expense of existing aviation infrastructure. While AAM brings new technology and opportunity to the aviation industry, its capabilities and use cases should serve to complement rather than compromise traditional aviation operations. By identifying a community’s current aviation infrastructure and airspace, local planners can integrate new AAM facilities without encroaching on the facilities already established for existing aviation users.



It is important to recognize that the FAA has sole authority over airspace regulation and control. Their oversight ensures the safe and efficient operation of all aviation activities, including AAM. Protecting airspace for vertiport operations is achieved by local zoning utilizing 14 CFR § Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace, which defines height restrictions and obstruction evaluation criteria as its basis.

Below is a visual representation of the surfaces in Part 77. Each of these surfaces has varying slopes, distances, and restrictions.

Figure 1-2: FAR 77 Imaginary Surfaces



Source: FAA Office of Airports

By considering these regulations as they relate to existing and future landing facilities and collaborating with the FAA and nearby airports, local planners can effectively provision for airspace considerations and support AAM development in concert with existing aviation infrastructure. A link to Part 77 can be found here: [eCFR :: 14 CFR Part 77 -- Safe, Efficient Use, and Preservation of the Navigable Airspace (FAR Part 77)].

Ensure Land Use Compatibility

Certain land uses as identified by the FAA are inherently incompatible with airports and vertiports. Wetlands, landfills, and nature preserves can attract birds, which can be dangerous if flying near AAM aircraft, especially in the operations' take-off or landing phase. Wildlife collisions with aircraft present a serious safety problem. FAA AC 150/5200-33C, *Hazardous Wildlife Attractants on or near Airports*, is the industry standard for guidance on certain land uses that have the potential to attract hazardous wildlife on or near public-use airports.

Incompatible land uses near airports and vertiports that are sensitive to noise include but are not limited to residential, educational, health, and religious structures, parks, recreational areas, and cultural and historical sites. Vertiports should not be sited in noise-sensitive areas where noise could interfere with the normal activities associated with these sites. FAA has published an advisory circular, AC 150/5190-4B, *Airport Land Use Compatibility Planning,* for use by local governments and planning commissions to help guide considerations for local land use planning relative to airports and their operations. This information is also relevant for vertiports and their operations. A link to this AC can be found here:

https://www.faa.gov/airports/resources/advisory_circulars/index.cfm/go/document.current/documentNumber/150_5190-4.

As noted earlier under 14 C.F.R. § Part 77, tall structures can obstruct aircraft approach and departure paths and are therefore incompatible land uses. Antenna towers, high-rise buildings, power lines, and even flag poles among other structures have the potential to adversely impact the safety of aircraft approach and departure paths. Vertiport landing areas will have at least one approach and departure path in reciprocal directions. Anything penetrating a slope of 8 ft. rise to 1 foot of run on that path can be considered an obstruction to the final approach and takeoff area of the vertiport. Vertiports should be planned for and sited such that there are no penetrations to the 8:1 reciprocal approach paths.

Finally, vertiports should also be sited to be compatible with the traffic patterns of existing airports and heliports. As stated earlier, airports and heliports have approach and departure paths with "imaginary surfaces" under 14 CFR § Part 77. These surfaces represent the minimum altitudes and dimensions of airspace that must be protected for the safe arrival and departure of aircraft from a runway. When planning for a new vertiport its location should not infringe upon existing airport approach and departure paths.

Identify Existing Ambient Noise Levels

AAM features aircraft design concepts that are significantly different from traditional airplanes and helicopters. The most significant of these differences is the implementation of distributed electric propulsion versus traditional piston-powered engine propulsion. These emerging electric aircraft also tout a variety of design configurations and operational characteristics including multiple propellers for vertical and forward flight as compared to helicopters with minimal configurations. As a result, accurately predicting the precise noise signature of these aircraft poses challenges.

While AAM has generally been publicized as quieter than conventional aircraft, the presence of electric motors and multiple propellers introduces a different noise profile not typically encountered in traditional aviation. Considering that AAM operations will involve multiple blades moving within urban and confined environments, careful consideration must be given to sound propagation. Understanding the existing ambient noise levels in areas where vertiports are proposed, particularly in urban settings, will help communities evaluate the potential impact of AAM noise, thus helping them make informed decisions regarding the optimal placement of vertiports.

It is also essential to stay abreast of developments in AAM noise metrics, as ongoing research and advancements will provide valuable insights into the specific impacts of AAM noise on local communities. By remaining informed, stakeholders can effectively address concerns related to noise and strategically determine the most suitable locations for vertiports to ensure a harmonious integration of AAM within urban and rural environments.

Establish an Electric Aircraft Fire Safety Protocol

Emergency preparedness is just as important for AAM as it is for traditional aviation. First-generation eVTOLs will likely include lithium-ion batteries and the fires associated with these batteries are extremely difficult to extinguish and can reignite even after being extinguished. Firefighting efforts to combat a potential eVTOL fire will require specific planning and reliance on guidance from fire safety officials. It should not be assumed that traditional ARFF or local firefighting departments have existing capabilities to manage these fires. The firefighting departments who will be responding to electric aircraft fires should develop a protocol for such fires and coordinate with the vertiport operators on that matter. The National Fire Protection Association (NFPA) has completed revising **NFPA 418: Standard for Heliports** to include considerations for vertiports. This guidance should be adopted.

Create Community First AAM Policies

Policy planning that prioritizes the community's interests as it relates to the AAM ecosystem will maximize the public benefit of AAM. This entails careful consideration of vertiport locations, flight paths, and compatible land uses. Given that AAM operations are initially expected to occur at low altitudes within urban areas, community-first policies that foster positive interaction between the eVTOL aircraft and the community are crucial for the successful integration of AAM.

AAM policy planning should begin with defining the purpose and need of AAM in a community. Guiding principles for policy planning may include the following:

- Promoting equitable mobility choices for all segments of society.
- Supporting community-friendly flight routes and operation times.
- Encouraging the co-location and integration of AAM with existing transportation network options to maximize benefits.
- Fostering positive economic growth.

In addition to these principles, AAM policies should incorporate a public notification and engagement process for vertiport proposals. Given the potential impact of AAM on numerous stakeholders, resources, and locations, a notification requirement is prudent to ensure all relevant parties are appropriately informed. Early public notification and outreach policies enhance transparency in the decision-making process. They should strive to maximize community outreach to all nearby residents through various channels such as on-site signs, electronic media, and postal services.

It is possible that vertiport development could be perceived as controversial and generate significant public interest from neighboring residents, businesses, and the community at large, therefore notification and outreach should occur early in the application process, allowing stakeholders to provide meaningful input to the project applicant and planning staff. One component for AAM to be successful is it must first be accepted by the public—those who are customers and those who are neighbors alike. Public acceptance and community engagement go hand in hand. Accordingly, the local policies on AAM should also include requirements that serve to foster and improve public acceptance. The following are general guidelines for AAM policy as it relates to achieving public acceptance:

- AAM service providers should meet or exceed existing safety criteria from the FAA.
- AAM noise should not exceed existing ambient noise levels or mitigation strategies should be developed to minimize noise disturbances and ensure compatibility with the surrounding community.
- The location of vertiports should not exacerbate existing transportation disparities but rather provide affordable and accessible options for all communities.

By prioritizing community interests, fostering transparency, and promoting meaningful stakeholder engagement, AAM policies at the local level can effectively address public concerns, enhance acceptance, and facilitate the integration of AAM within the fabric of the community.

1.6 Toolkit

While traditional fixed-wing airplanes and helicopters have been around for many years, eVTOLs present unique opportunities and challenges. The following list of resources and tools has been compiled to help municipalities in their efforts to integrate AAM into their communities. Some of these tools were originally created for airports, but they will also be useful for vertiports. The toolkit is organized into five main components of AAM: AAM 101, Land Use Compatibility, Noise, Infrastructure, and Airspace.

AAM 101

1. **FAA Webpage on AAM**
   https://www.faa.gov/air-taxis

The home webpage for the FAA's efforts on AAM. It includes a description of what AAM is, milestones the FAA has achieved, and additional links to resources from the FAA.

2. **FAA Urban Air Mobility Concept of Operations 2.0**
   https://www.faa.gov/air-taxis/uam_blueprint

This document is the second generation of a conceptual framework that puts forward a comprehensive vision of urban air mobility operations as envisioned by the FAA. The document describes a framework with roles and responsibilities for the FAA, Air Traffic Control, UAM Operators, and Infrastructure Operators, among other stakeholders. It is the FAA's most comprehensive document-to-date for AAM.

3. **FAA Advanced Air Mobility Implementation Plan**
   https://www.faa.gov/sites/faa.gov/files/AAM-I28-Implementation-Plan.pdf

Innovate 28 is the FAA's Implementation Plan outlining the necessary steps to enable AAM. The report documents a high-level view to be used as a foundation for AAM. It provides steps for AAM operations to take place, including airspace usage and route structure, air traffic control services, infrastructure, and security. It also includes Workstreams associated with implementing AAM for certification, airspace, and air traffic management, infrastructure, environment, hazardous materials safety, and community engagement.

4. **NASA Advanced Air Mobility National Campaign**
   https://www.nasa.gov/aamnationalcampaign

This webpage is NASA's hub for Advanced Air Mobility. It highlights NASA's mission for AAM, including working groups, AAM industry partners, research efforts, and AAM mission documents. It serves as a launching point for everything NASA is doing in the AAM sector.

5. **NASA Advanced Air Mobility Community Integration Playbook**
   https://ntrs.nasa.gov/api/citations/20230010184/downloads/AAM-Community-Integration-Considerations-Playbook.pdf

This playbook is NASA's community integration playbook for AAM. A valuable tool for local decision-makers, the playbook identifies dozens of relevant stakeholders and then lists out nine different integration challenges, including institutional readiness, equity, community engagement, multimodal integration, economic development, and environmental sustainability. For each challenge, it identifies organizational strategies, research, and policy considerations and concludes that continued research, prudent policy, and stakeholder/community engagement are needed to prepare institutions for AAM.

6. **Vertical Flight Society eVTOL Aircraft Directory**
   https://evtol.news/aircraft

The Vertical Flight Society (VFS) is a non-profit professional organization dedicated to advancing vertical flight technology and its applications. Among other initiatives, the group is tracking eVTOL development by listing and categorizing all known electric and hybrid-electric VTOL concepts. This link directs to the eVTOL aircraft directory, where this list is kept and provides additional links for further research on each aircraft concept.

7. **Center for Urban and Regional Air Mobility**
   https://airmobility.gatech.edu/

The Georgia Institute of Technology's Center for Urban and Regional Mobility directly works to advance AAM in Georgia. The Center leads research and education related to urban air mobility and new forms of regional aviation. The Center develops and curates research products including simulation models, demand forecasts, technology test laboratories, and flight demonstrator testbeds. Recently, a NASA-funded study by the Center indicated significant demand for shorter-distance flights, served by 9-30 electric jets. The study identified demand for over 4,200 origin and destination markets, connecting 980 different airports across the United States.

Land Use Compatibility

1. **AC 150/5190-4B - Airport Land Use Compatibility Planning**
   https://www.faa.gov/airports/resources/advisory_circulars/index.cfm/go/document.current/documentnumber/150_5190-4

This Advisory Circular aims to provide guidance on land use compatibility around airports to ensure safe and efficient airport operations while safeguarding nearby communities from adverse effects. It highlights incompatible land uses that conflict with airport operations, such as residential areas within airport noise contours, hazards to navigation, wildlife attractants, and concentrations of people or property within airport runway protection zones. It also addresses land uses that are compatible with airports and defines them as those that can coexist without compromising airport operations or posing negative environmental or safety impacts to nearby inhabitants. The document emphasizes that local land use planners should understand the implications of such compatibility between airports and communities. These concepts are applicable to vertiports.

2. **Guidebook on Effective Land Use Compatibility Planning Strategies for General Aviation Airports**
   https://nap.nationalacademies.org/catalog/25633/guidebook-on-effective-land-use-compatibility-planning-strategies-for-general-aviation-airports

This guidebook is designed to help general aviation airport managers adopt and implement effective airport compatibility regulations, and it can also apply to vertiport development. It serves as a concise resource for engaging in discussions with local government decision-makers and land use professionals to enhance existing compatibility regulations. Other stakeholders involved in airport land use planning, such as state aviation regulatory agencies, regional and local planning agencies, and industry professionals, can also benefit from this resource. It offers step-by-step guidance on evaluating airport land use compatibility status and developing effective regulations, emphasizing mutually beneficial relationships with airport host communities. Overall, the guidebook aims to facilitate improved airport land use compatibility planning and address key concerns in this domain.

3. **Enhancing Airport Land Use Compatibility, Volume 1: Land Use Fundamentals and Implementation Resources**
   https://www.trb.org/Publications/Blurbs/163344.aspx

This comprehensive research document offers recommendations to address incompatible land use issues, requiring airports and local communities to take an active role in developing and maintaining land use compatibility programs. The report also offers an airport land use compatibility model state legislation as well as an airport land use compatibility model local zoning ordinance. These resources can be used as a starting point for land use compatibility legislation and zoning at the state and local level for vertiports.

Noise

1. **FAA – Noise**
   https://www.faa.gov/about/office_org/headquarters_offices/apl/aee/noise

This links to the FAA Office of Environment and Energy Noise Division's webpage, which provides a variety of FAA resources for aviation noise. It includes links to Noise Standards, Noise Certification of Unmanned Aircraft, and information about Airport Noise Compatibility Planning. This page is a starting point for FAA guidance on noise as it relates to aviation, though the FAA has yet to develop eVTOL noise standards.

2. **U.S. DOT Volpe Center - Advanced Acoustic Modeling of Urban Air Mobility Concept Vehicles**
   https://www.volpe.dot.gov/news/advanced-acoustic-modeling-urban-air-mobility-concept-vehicles

This is the webpage of the Volpe Center at the U.S. DOT. The Volpe Center runs NASA's Advanced Acoustic Model and is working to develop it further. In partnership with NASA, the Volpe Center conducted an acoustic analysis of a NASA UAM concept vehicle to demonstrate the tool's ability to model the noise created by these vehicles. This tool culminated in the development of a white paper found at the link titled "Comparison of Two Community Noise Models Applied to a NASA Urban Air Mobility Concept Vehicle."

3. **Science of Sound: NASA Examines Advanced Air Mobility Noise**
   https://www.nasa.gov/centers/armstrong/features/science-of-sound-aam-noise.html

This is a NASA webpage on Advanced Air Mobility (AAM) noise and the efforts to make future-generation aircraft quiet for safe integration into our skies. It discusses developmental testing with Joby Aviation's (eVTOL) aircraft and gathering data to understand the vehicle's performance and acoustics profiles. The data helps to develop modeling scenarios and design tools for quiet operation in urban and rural areas. This research aims to optimize AAM routes and low-noise flight paths for community needs and assist the FAA in policy creation.

4. **Acoustic Flight Test of the Joby Aviation Advanced Air Mobility Prototype Vehicle**
   https://ntrs.nasa.gov/api/citations/20220006729/downloads/Aeroacoustics2022_Pascioni_STRIVES5.pdf

NASA performed an acoustic flight test on Joby Aviation's pre-production eVTOL prototype. Joby aims to carry a pilot and four passengers up to 150 miles with this aircraft using distributed propulsion and vectored thrust with six tilting propellers. This marked the first full-scale testing of an AAM aircraft by NASA, covering various mission phases. This white paper details the process and results of the flight test.

5. **Joby Aviation Sound Levels Test Shows How Quiet eVTOL Aircraft Can Be – FutureFlight**
   https://youtu.be/itP8-3j2UZI?si=oAZ-LgWJT2N8-HNv

This YouTube video compares the volume of Joby's eVTOL aircraft to five conventional aircraft, including small, piston aircraft, turboprop aircraft, and three separate helicopters. The video demonstrates a significant reduction in noise compared to those aircraft. It is important to note that the noise profiles of other eVTOL aircraft are not fully known, and there is still additional testing and research to be done regarding the noise of these aircraft in their takeoff and landing procedures.

Infrastructure

1. **Vertiport Design Standards**
   https://www.faa.gov/newsroom/faa-releases-vertiport-design-standards-support-safe-integration-advanced-air-mobility

This webpage links to Engineering Brief 105, Vertiport Design. It provides a summary of the safety-critical geometry and design elements; lighting, marking, and visual aids; charging and electric infrastructure, on-airport vertiport guidance, and guidance for elevated vertiport. EB 105 is the current guidance until performance-based vertiport design guidance is published.

2. **EV Infrastructure Funding and Financing for Rural Areas**
   https://www.transportation.gov/rural/ev/toolkit/ev-infrastructure-funding-and-financing

This webpage contains links to support electric vehicle (EV) infrastructure funding and financing for rural areas. It provides an overview of federal funding and financing programs, the federal funding application process, and definitions for funding eligibility. It provides a link to a rural electric vehicle funding matrix which notes the type of EV activities that are eligible for funding under different programs, as well as the eligible entities. This page may be useful for communities in rural areas looking to provide electrical infrastructure for a vertiport.

3. **Charging Forward: A Toolkit for Planning and Funding Urban Electric Mobility Infrastructure**
   https://www.transportation.gov/urban-e-mobility-toolkit

This toolkit is a one-stop resource for local governments to scope, plan, and fund electric charging infrastructure, including electric cars, bikes and scooters, and transit and school buses. It provides an overview of electric mobility, the benefits and challenges of urban mobility electrification, partnership opportunities, infrastructure planning, as well as additional planning support tools. This resource may be useful for communities in urban areas looking to understand electric vehicle charging in an urban environment.

4. **Preparing Your Airport for Electric Aircraft and Hydrogen Technologies**
   https://nap.nationalacademies.org/catalog/26512/preparing-your-airport-for-electric-aircraft-and-hydrogen-technologies

This report provides guidance to help airports incorporate electric aircraft into their operations and long-term planning. It identifies two market segments: air carrier/military and air taxi/commuter/general aviation, and three forecast scenarios with varying degrees of electric aircraft activity. The guidance addresses facility needs, including charging infrastructure, hydrogen supply chain, airside requirements, and passenger terminal facilities. The report also offers advice on accounting for electric aircraft in airport master plans and long-term planning documents. While it is focused on airports, it provides a wealth of information that would be pertinent to vertiports.

5. **Urban Air Mobility: An Airport Perspective**
   https://nap.nationalacademies.org/catalog/26899/urban-air-mobility-an-airport-perspective

This study included a state-of-the-practice review, market assessment, and exploration of various UAM use cases, such as air metro, air cargo, and air medevac. The research considered market growth, regulatory changes, financial aspects, and community and environmental impacts. The report's primary focus is to assist airports and their communities in integrating UAM operations, but it includes information that would be applicable to vertiports. It provides strategies for aligning policies, infrastructure, utility requirements, and corridor planning with UAM activity. To aid airports in assessing their readiness for UAM, an interactive toolkit, and a checklist are available on the National Academies Press website under ACRP Research Report 243: Urban Air Mobility: An Airport Perspective.

Airspace

6. **Safe, Efficient Use, and Preservation of the Navigable Airspace**
   eCFR :: 14 CFR Part 77 -- Safe, Efficient Use, and Preservation of the Navigable Airspace (FAR Part 77)

This is a link to 14 CFR Part 77. It covers the requirements for notifying the FAA about certain proposed construction or alterations to existing structures as they relate to navigable airspace. It outlines the standards and process to determine what is considered an obstruction to air navigation or will impact communication facilities. It also explains the procedure for submitting petitions to the FAA for discretionary review of its airspace determinations.

7. **Obstruction Evaluation / Airport Airspace Analysis (OE/AAA)**
   Obstruction Evaluation / Airport Airspace Analysis (OE/AAA) (faa.gov)

This is a link to the FAA Obstruction Evaluations/Airport Airspace Analysis site. This tool is for users to submit a notification to the FAA of any proposed development that may penetrate the 14 CFR Part 77 surfaces described in the preceding link.

8. **Circle Search for Airports**
   https://oeaaa.faa.gov/oeaaa/external/searchAction.jsp?action=showCircleSearchAirportsForm

This tool, developed by the FAA, allows users to search for airports within a 50-mile radius of a specific latitude and longitude.

1.7 Conclusions

Emerging technology is providing opportunities in aviation mobility that could change how we travel short distances, how packages are delivered, and how emergency responses are conducted. Each community will differ in its approach to AAM depending on its evaluation of the pros and cons. Key best practices, however, remain similar. Appointing a lead staff member to handle AAM, reviewing zoning ordinances and compatible land uses, mapping out aeronautical facilities, considering noise levels, and establishing fire safety protocols.

Ultimately, a community should strive to create community-first AAM policies and plan for AAM in a way that considers the needs of all its community members. A transparent approach to community engagement will be required to integrate it successfully and connect it with the other forms of transportation that will be needed for the last leg of the trip. Beginning this process early will help ensure negative consequences are realized and mitigated before these services are offered.

At the state level, GDOT is leading the way on AAM and stands ready to assist communities as they prepare for AAM. This guidebook is one of many steps that GDOT is taking to advance and integrate AAM into the state transportation ecosystem.

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