UTAH ADVANCED AIR MOBILITY INFRASTRUCTURE AND REGULATORY STUDY

Executive Summary

The Utah Legislature requested the Division of Aeronautics conduct a study of the development and implementation of advanced air mobility (AAM) in the state through Senate Bill 218 (2021) and Senate Bill 122 (2022). The Legislature indicated that the study should:

- Identify potential benefits and limitations of implementing advanced air mobility;
- Identify current state assets and state assets in development that support advanced air mobility;
- Identify assets required for full implementation of advanced air mobility;
- Assess the feasibility of options for the future implementation of a statewide advanced air mobility system, including a potential timeline to incorporate critical elements; and
- Review infrastructure funding mechanisms employed or under consideration by other states.

The Legislature also requested a review of current state laws and the identification of potential changes to state law necessary to facilitate the development of advanced air mobility operations in the state.[1] [2] It examines federal programs and regulatory frameworks, discusses AAM efforts in other states and provides a high-level summary of implementation efforts in other countries.

Through leadership foresight, from the Legislature to state agencies, Utah has positioned itself to embrace AAM. The state already has significant assets in place that could be utilized in early implementation of advanced air mobility. Through the guidance of the Division of Aeronautics, airports are already starting to prepare for vertiport design and electrification, and the Department of Transportation is a national innovation leader with its statewide fiber optics and Road Weather Information Systems.

The technology exists and is available to augment Utah's in place infrastructure. Mechanisms to acquire the money needed to pay for the new technologies are already in place, and more funding is anticipated from the federal government. Most importantly, Utah's preparation allows the state the flexibility to start at a methodical, yet efficient, pace. Everything does not have to be in place on day one. The prudent approach is to follow a phased implementation plan that allows government and markets to grow one step at a time and adjust as appropriate to shifting market demands.

Benefits and Limitations

AAM presents clear and compelling economic and environmental benefits. Economic impact studies and industry operators project thousands of high paying jobs associated with vehicle manufacturing, maintenance and vertiport operations.[3] In Utah, Zipline hires FAA certificated drone pilots out of high school to help the students pay for college. Since electric aircraft do not produce any carbon emissions, Utahns will be able to move people, goods, and services without adding to air quality concerns.

AAM also faces limitations. Inaction by the state creates limitations on advanced air mobility companies to operate within our airspace collectively. Also, most municipalities do not include "drone package delivery" or "aerial taxi operations" as part of their "permitted use" list.

[1] SB122 - https://le.utah.gov/~2022/bills/static/SB0122.html
[2] SB218 - https://le.utah.gov/~2021/bills/static/SB0218.html
[3] Ohio - https://uas.ohio.gov/initiatives/flyohio-initiative/ohio+aam+economic+impact+report

Current Assets

The State of Utah has many existing infrastructure elements that are capable of future utilization for advanced air mobility operations, including current aviation infrastructure, under-utilized parking facilities, foundational electrical grid, robust communications network, and weather monitoring and reporting equipment.

Airports

Airports are prime locations for initial advanced air mobility operations as they are already built to support aerial operations. Local urban general aviation airports such as South Valley Regional in West Jordan, Skypark in Bountiful, and Spanish Fork Airport in Spanish Fork are potential locations for urban air mobility hubs. Local rural airports such as Logan, Richfield, Nephi, Vernal and Price can be especially viable as regional air mobility hubs or drone package delivery service centers.

Under the leadership of the Division of Aeronautics, many of Utah's airports are already preparing for electrification and vertiports within their footprint.[4]

Parking Lots

The Wasatch Front Regional Council provided data[5] on underutilized parking facilities. Initial off-airport vertical take-off and landing facilities, which are called vertiports, could potentially be introduced in under-utilized parking facilities simply by rearranging paint and lighting in large shopping center parking lots. Thus, communities without airports could participate and benefit from advanced air mobility.

Electric Grid

Most first-generation advanced air mobility aircraft will be powered by electric motors. The existing electrical grid in Utah has over 9,000 megawatts (MW) of total generating stations, producing over 37,000 MWh per year.[6] Utah has a shared grid system and there is some ability to draw additional power as demand increases. Electric substations may need upgrades as demand increases beyond the current capacity of these local facilities. Local substation capacity to support aircraft charging is a critical component for consideration of future vertiport placement.

Communications Network

The Utah communications network will play a critical role in the advancement of AAM as the FAA Remote Identification rule requires unmanned aircraft systems to broadcast and connect to operating systems either via wireless internet, radio frequency, Bluetooth, or cell tower signal for flights beyond visual line of sight.[7] Utah has excellent fiber optic and cellular network coverage with two primary systems; (1) the UDOT fiber optic system[8] and (2) the AT&T and Verizon cellular networks.[9]

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[4] Aeronautics - https://udot.utah.gov/connect/employee-resources/uas/
[5] PDF - https://wfrc.org/Studies/UtahParkingModernizationPhase1Report_WithAppendices.pdf
[6] EIA.gov - https://www.eia.gov/electricity/data/browser/#/topic/0?agg=1,0,2&fuel=g&geo=00000000000g&sec=vvs&linechart=ELEC.GEN.ALL-UT-99.A&columnchart=ELEC.GEN.ALL-UT-99.A&map=ELEC.GEN.ALL-UT-99.A&freq=A&ctype=linechart&ltype=pin&rtype=s&maptype=0&rse=0&pin=
[7] FAA Remote ID - https://www.faa.gov/uas/getting_started/remote_id
[8] UDOT - https://www.fhwa.dot.gov/utilities/pdf/hif22040.pdf
[9] FCC Maps - https://fcc.maps.arcgis.com/apps/webappviewer/index.html?id=6c1b2e73d9d749cdb7bc88a0d1bdd25b

Weather

Utah has made significant investments in Automated Surface Observation Systems and Road Weather Information Systems.

The Road Weather Information System provides robust coverage across the state but will only identify surface observations. These stations could be augmented to measure cloud ceiling heights and visibility, which will be essential for advanced air mobility aircraft operations.[10]

Workforce Development

Advanced air mobility is an opportunity for high-paying job creation and the development of a diverse and specialized workforce able to operate and maintain the vehicles and infrastructure for this new transportation system. The Division of Aeronautics has partnered with universities and industry across the state to begin the development of curriculum and standards.

Required Assets

The successful implementation of advanced air mobility will require Utah to explore ways to build "hard" infrastructure and develop accompanying "soft" infrastructure.

Hard Infrastructure

Several new infrastructure components will be required or current components augmented to accommodate AAM uses. For example, Utah will need to investigate establishing an unmanned traffic-management system and an aerial traffic operations center, as well as making improvements to cellular/internet broadcast receivers.

Soft Infrastructure

Utah will also need to consider "soft" infrastructure components, such as personnel, man hours, and skill sets. For example, the state must develop aerial corridor planning, adapt land-use planning, and enact policies and processes to support AAM. In addition, extensive public outreach at the local levels is essential to the state's success.

Phased Implementation Timeline

The proposed implementation plan[11] has been divided into four segments based on current industry projections:

- *Phase One*: This phase is anticipated to span two to three years, and its primary component will be community outreach and public engagement. Initial infrastructure includes unmanned traffic management software and some weather equipment enhancements;
- *Phase Two:* This phase is anticipated to span three to five years, and its primary component will be expanded unmanned traffic management capacity and initial vertiport site development. Community outreach and public engagement should continue in a significant way;
- *Phase Three*: This phase is anticipated to span seven to 15 years, and its primary component will be comprehensive unmanned traffic management, including a fully operational Aerial Traffic Operations Center. Vertiport infrastructure and operations should reach commercially viable levels and daily commuting capacity; and

[10] UDOT RWIS - https://staging.udottraffic.utah.gov/RoadWeatherForecast.aspx

[11] All implementation phases are original content.

- *Phase Four*: This phase is anticipated to span 15 to 30 years, and its primary component will be the development of a fully electric/hydrogen hybrid aviation and integrated ground transportation system to connect urban and rural communities across the state.

Financing and Funding

Municipalities wishing to finance vertiport infrastructure might consider utilizing a State Infrastructure Bank loan. Municipalities may also consider issuing general or revenue obligated bonds if they project collecting revenues from operating a vertiport within their jurisdiction.

The state may also consider issuing bonds, appropriating general revenues, or utilizing green revolving funds. Federal financing is becoming available through the Infrastructure Investment and Jobs Act[12] as well as the Advanced Aviation Infrastructure Modernization Act[13] and more is expected through the FAA reauthorization process imminent in 2023.

Several companies and governments are looking to Public Private Partnerships to implement initial infrastructure – the upshot of this approach is that governments may need to invest relatively little to initiate the first steps of drone package delivery and vertiport construction.

There are a variety of potential funding mechanisms including fees, sales taxes and excise taxes. Potential fees to consider include landing fees, airspace usage fees, parking fees, access fees, aircraft registration fees and permitting fees. Tax revenues to consider will be aircraft sales tax, taxes on electricity as aviation fuel, passenger facility charges and customer facility charges.

Actions the Legislature Might Consider

Definitions

The Legislature has previously taken action in Senate Bill 166 (2022) to define “advanced air mobility system” and retain state preemption of local laws regarding advanced air mobility systems. The Legislature could consider defining related terms, such as “aerial transit corridor”, “vertiport” and “unmanned traffic management”.

Regulating Advanced Air Mobility

It is important to better define roles of government and three-dimensional property rights. The Legislature might consider several steps, including establishing avigation easements within the state, enacting formal processes for licensing vertiports and registering AAM aircraft, or creating an Advanced Air Mobility Program Office.

Local Municipal Processes

One major hurdle for advanced air mobility operators is the lack of local permitting and business licensing approvals. To more readily prepare for and embrace advanced air mobility across the state, the Legislature might consider requiring all municipalities to add “drone package delivery” and “aerial taxi operations” to approved conditional use permit lists, or enacting zoning language for take-off and landing sites, as well as “vertiport overlay zones.”

[12] IIJA Act - https://www.congress.gov/bill/117th-congress/house-bill/3684/text
[13] AAIM Act - https://www.congress.gov/bill/117th-congress/house-bill/6270/text

Final Thoughts

Advanced air mobility is an entirely new transportation system and presents new opportunities and challenges never before encountered by Departments of Transportation. However, national-scale solutions for the entirety of the system do not need to be resolved prior to Utah implementing the first steps and phases toward active operations. This report provides interim steps and a phased approach Utah can take to be pioneers in advanced air mobility.

Chapter 1: Benefits and Limitations

Adoption of advanced air mobility (AAM) can serve as an important driver of equity improvements between urban and rural counties in the State of Utah. AAM can offer more general access and be more cost-effective than road vehicles and conventional aircraft. This will provide rural communities with the opportunity to connect with each other, to the metropolitan center and to global markets more readily.

AAM can potentially support an increase in the quality of health for Utahns, as well. Utilizing zero emissions vehicles means cleaner air, but quicker ambulatory response times in rural communities and the ability to receive medical supplies through drone package delivery also contribute to quality of health. Shorter shipping times for all products can improve rural enterprises' productivity and their contributions to their local economies as they can receive raw materials and export goods with greater efficiency.

AAM could augment public transportation in some areas of the State by supporting first-and-last-mile trips. Although Utah's overall rural connectivity and access to intercity transportation is above the national average, according to the 2020 version of the Bureau of Transport Statistics' Access to Intercity Transportation in Rural Areas, the area around Southeast Utah has little to no access to public transportation.

There is no doubt that the AAM industry will have positive workforce development and economic impact benefits by creating high-paying job opportunities. Direct job creation will happen through AAM flight operations and support (including maintenance and ground crews). Additional jobs will be created to assist with vertiport management and clean-energy production facilities.

AAM implementation can also provide transportation and quality-of-life improvements to and around Native American reservations – especially in Utah, where the two largest reservations by area (Navajo Nation, and Uintah and Ouray (Ute)) are located. AAM's entry as an emerging technology could be a valuable source of economic and social development for communities that are early adopters. This deployment, including the infrastructure, may need to be coordinated with Tribal leadership, including their transportation and planning leaders, as applicable.

It is important to note that AAM may also create negative social consequences in the state and may face unforeseen risks. This is true with any emerging technology. Utah's leadership can counter this through an early and comprehensive outreach approach to communities, which can foster public acceptance, reduce risks and dispel negative perceptions. The Airport Cooperative Research Program (ACRP) Research Report 243 identified these as possible causes of community integration issues with AAM:

- Public safety concerns from aerial vehicle overflight of residential areas;
- Visual disturbances from increased sightings of aircraft overhead;
- Perceived privacy issues associated with aerial photography and potential surveillance;
- Environmental impacts on local or migrating biodiversity;
- Economic accessibility of advanced air mobility;
- Vertiport traffic overflying specific neighborhoods; and
- Potential for terrorist acts (hijacking, explosives, or cyberwarfare).

AAM has the capacity to bring forward quality-of-life, equity and economic improvements. Community involvement is key in creating an AAM ecosystem that serves the people of Utah, fosters social acceptance, and enables the successful implementation of a complete transportation network. AAM planning and design efforts must apply strategies to gain community acceptance.

Chapter 2: Existing and Required Infrastructure Assets

Multiple foundational elements in Utah may be utilized for AAM infrastructure, including current aviation infrastructure, parking facilities, an essential electrical grid for charging electric vehicles, a robust communications network and weather monitoring/reporting systems. Understandably, investments in new infrastructure will be needed to reach full operational capacity.

Existing infrastructure may be leveraged to form a stronger business case for advanced air mobility markets. Geographic Information Systems (GIS) was used to provide geo-coded datasets of locations of current assets within the state. The business case starting point is a geospatially based analysis of the geo-coded datasets. The datasets include the sources of information necessary to perform demand and costing analysis and to aid in estimating capital and operating costs for AAM ground facilities and traffic management facilities.

Using data on Utah consumers' habits, demographic data and the necessary data on aviation infrastructure, policy makers and investors can identify high demand travel routes while simultaneously identifying existing infrastructure that can be used for advanced air mobility expansion.

To determine potential passenger demand specifically tailored to Utah, 10 factors were used:

- Airport origin and destination traffic;
- Mobility substitutes;
- Per capita GDP;
- Distances and congestion;
- CIMI human capital indicator;
- Population density;
- Livability;
- Fortune 1000 company presence;
- Business aviation activity; and
- Existing heliports.

The demand analysis for AAM use cases estimates over 6.4 million travelers in the Salt Lake City region through 2045.

The importance of geocoding accuracy stems from the need of every user, whether business or individual, to correctly identify a location that is important to a business process. In this case, identifying optimal locations of future vertiports and the infrastructure necessary to create the aerial corridors between them will be key to business case viability.

Existing Aviation Infrastructure

Airports can be prime locations to start AAM operations, primarily because they are built to support aerial operations. Utah has 46 public airports, of which eight host commercial flight operations, and 38 serve as general aviation airports. With the advent of electric aircraft, general aviation airports may now be commercially viable as regional air mobility and package delivery service hubs, given that 94% of Utah communities are within a 30-minute drive of an airport. In addition, 37 existing heliports could also be candidates for AAM services.

Local urban general aviation airports, such as South Valley Regional in West Jordan, Skypark in Bountiful, and Spanish Fork Airport in Spanish Fork, can be especially viable as urban air mobility hubs. Urban air mobility operations[14] using short-range vertical take-off and landing vehicles could see their initial flights connect these urban general aviation airports.

Local rural airports, such as Logan, Richfield, Nephi, Vernal and Price, would be especially viable as regional air mobility hubs or drone package delivery service centers. Regional air mobility operations[15] using longer-range conventional take-off and landing electric aircraft could see their initial flights connect these rural airports and urban airports. Someone living in Richfield could reasonably expect to commute to an office in downtown Salt Lake City in about an hour.

General aviation airports often have available and developable land adjacent to or on airport property. The east side of South Valley Regional Airport in West Jordan is a prime candidate for AAM facilities. The location on the east side of the airport also allows direct flight paths from West Jordan to downtown Salt Lake City, the major Intermountain Healthcare hospital in Murray, ski resorts in Big and Little Cottonwood canyons, and Silicon Slopes in Lehi and Orem.

Someone in West Jordan ready to hit the slopes could reasonably expect to be at Snowbird in 9 minutes on an AAM flight, and they wouldn't have to worry about parking their car.

Parking Facilities

It is highly likely that AAM operations would be near population centers that support travel demands. Cities may have limited options for large vertiport real estate, but existing underutilized areas, such as parking facilities, may be an untapped resource for vertiport development. In some United States cities, parking lots cover more than a third of the land area.[16] As cities continue to grow at a steady rate, new integration techniques will be required to meet the demand with limited space. The Wasatch Front Regional Council's Utah Parking Modernization Initiative Phase 1 Report found that parking occupancy was generally low for retail land uses, where only 30% of the parking was being used at peak hours for the cities studied.[17] Downtown Ogden had an overall parking occupancy of 51%.

With the availability of space in these locations, parking lots can become ideal sites to build drone package delivery hubs and vertiports to assist with transporting people close to where they want to travel. A vertiport with a single landing/take-off pad might displace a space as small as twelve parking spaces and the feeder lane between them.

Additionally, integrating AAM into other multimodal options through "Park & Fly" solutions can further increase transportation efficiency. Furthermore, the implementation of connected and automated vehicles in the future will affect parking lots and parking garage utilization. Increased use of autonomous

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[14] In this case, uban air mobility operations are defined as trips within the major Salt Lake City metropolitan area.
[15] In this case, regional air mobility operations are defined as trips connecting rural communities with each other and with the Salt Lake City metropolitan area.
[16] Rethinking a Lot: The Design and Culture of Parking. Eran Ben-Joseph https://doi.org/10.2747/0272-3638.33.6.915
[17] Utah Parking Modernization Initiative Phase 1 Report https://wfrc.org/Studies/UtahParkingModernizationPhase1Report_WithAppendices.pdf

cars and a downward trend of parking facilities could favorably bolster the case for both surface and parking garage rooftop vertiports.

This adapted usage, like many current parking facilities, will need charging stations for surface and air vehicles.

Electrical Grid and Power Generation

Cleaner transportation is an important element of AAM operations. Electric motors and batteries will be a primary source of propulsion for many first-generation AAM aircraft. The existing electrical grid in Utah has over 9,000 megawatts (MW) of total generating stations, producing over 37,000 MWh per year.[18] Utah's electrical grid has been getting cleaner, with solar and wind power increasing up to 10% of production, while coal has slipped from 75% to 61% in the past few years.

Aviation fuel prices in Utah are, on average, higher than in the majority of other states. However, average prices for electricity in Utah are quite a bit lower than the national average, and average costs to consumers were 8.27 cents per kilowatt-hours (kWh). Utah continues to innovate with alternative fuels and will experience continued changes to the electrical system, including the impact of hydrogen production and usage for electricity production.

Due to Utah being a shared-grid system, there is some ability to draw additional power from other places as demand increases. However, augmentation may be needed at the substation level because substations will likely need upgrades as electrical demand increases beyond the current capacity of these facilities. This can be a critical component for consideration of vertiport placement to ensure that the infrastructure can support the charging of vehicles and adjacent infrastructure. Additionally, collaboration with other electric vehicle (EV) efforts may be complementary to lower construction costs and minimize impacts to residents. Finally, innovative approaches focused on energy resilience, such as on-airport generation and micro-grids, could address the growing electricity demand especially at smaller airports serving rural areas.

Utah Communications Network (Fiber Optic, Cellular)

Reliable high-speed communications will be critical to monitor AAM aircraft operations and facilitate two-way communications. The FAA's Remote ID rule stipulates that aircraft must broadcast their identity, position, speed, altitude and safety messages (and disseminate real-time weather reporting, if possible). The ability to receive that broadcast will be necessary.

Utah has excellent fiber optic and cellular network coverage in key locations prime for AAM's beginning phases. A dual complementary network also ensures redundancy and addresses risk mitigation issues in case of connectivity loss.

The density of fiber optic lines across the state allows these networks to assist in connecting key infrastructure elements and diversify locations for the installation of AAM monitoring equipment, including radar, LiDAR and weather reporting systems. As operations expand and additional sites are added for regional air mobility operations, further development of the fiber optic network in the more rural areas of the state may be necessary.

[18] Utah Annual Electric Power Industry Report, Energy Information Administration. https://www.eia.gov/

One of only two 5G testbed sites nationally is already up and running in Salt Lake City – the other is in New York City. The Salt Lake City testbed is sponsored by the National Science Foundation's Platforms for Advanced Wireless Research through the POWDER project at the University of Utah. 5G Alliance Utah is a public-private partnership of wireless network providers, government organizations and offices, universities, industry associations, capital sources, and individual enthusiasts and experts working together to ensure that Utah remains on the technological leading edge.[19]

These communications networks will also help report real-time micro-regional and low-altitude weather conditions.

Weather Monitoring and Reporting Systems

The State of Utah has made significant investments in Automated Surface Observation Systems (ASOS) and Road Weather Information Systems (RWIS) to improve transportation safety on the ground and in the air. To support future AAM operations, continued investments in weather infrastructure will significantly increase knowledge of micro-weather at the surface and in key air corridors. The RWIS is robust for coverage across the state but identifies only surface observations. To provide the necessary weather data, these stations could be augmented to measure cloud ceiling heights and visibility, which are essential data for AAM operations.

Hot desert temperatures, icing, low cloud layers, inversion and wind shear directly affect flight operations and passenger comfort. Due to the low usage of helicopters safe operations have been sufficiently supported through current weather information collection methods.

As regulations for Beyond-Visual-Line-of-Sight (BVLOS) operations for UAS evolve and the operations themselves become more common, the risk of an unmanned aircraft flying into undetected weather hazards increases the probability of mid-air incidents or loss of aircraft control. This risk will drive more conservative decisions without greater weather and wind certainty in the airspace. Today, 30% of manned aviation flights that are delayed or canceled due to weather could have flown with better weather reporting systems.[20] The uncertainty in weather conditions causes groundings until it is certain that no undetectable hazards exist. The current aviation system depends on crewed aircraft taking off and landing in well-instrumented airspace cylinders near airports. Airports have wind shear alert systems, terminal Doppler weather radar and Automated Weather Observation Systems (AWOS) to measure conditions within the aerodrome to keep crewed takeoffs and landings safe until they can get above the weather to safely fly routes.

Workforce Development Efforts

AAM presents an excellent opportunity to create good-paying jobs, and it calls for the development of a diverse and specialized workforce that can operate and maintain the AAM transportation system. Over the next decade, advanced vertical flight alone might need 10,000 engineers across the United States.[21]

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[19] 5G Alliance Utah - https://5gallianceutah.org/f/5g-wireless-testbed-operating-in-utah?blogcategory=5G+Testbed
[20] TruWeather Solutions US Air Force Study - https://truweathersolutions.com/2002-chief-of-staff-team-excellence-award/
[21] McLean, D. 2022 Vertical Flight Workforce Report: Diversity, Equity & Inclusion is Vital, Vertical Flight Society, October 2022, p. 5

Extensive workforce development efforts are underway in Utah, including:

- **Utah Rotor Pathway Program** (URPP) serves as a first-in-the-nation model for education and training programs preparing high school students for STEM careers in rotary-wing aviation. The program provides students with an avenue to earn college credits and learn skills specific to rotary-wing aviation while participating in technical classes and hands-on learning experiences at the secondary-school level. The program connects rotorcraft industry professionals with high schools, flight schools and universities to offer benefits such as mentoring, internships and job interviews upon students' completion of their rotary-wing aviation programs.
- **Utah Valley University** is integrating AAM operational requirements and concepts into its curriculum through individual learning modules within courses. Courses include AVSC 1120 Basic Aircraft Systems, AVSC 4500 Aerospace Aftermarket Support Services, AVSC 4550 Aerospace Vehicle Certification, Reliability and Maintainability Systems, AVSC 4950 Aerospace Technology Management Capstone Project, and AVSC 475R Research Topics in Urban Air Mobility & Autonomous UAS.
- **Jordan Academy for Technology and Careers** developed a curriculum for training the next generation of UAS pilots to help them prepare for FAA written exams to obtain their licenses.
- **Davis County School District** has also developed UAS curriculum for their classes.

The Utah Division of Aeronautics is actively providing educational grants to schools and institutions for developing aviation programs.

Utah is in a good position to be able to initiate the first steps of AAM with its current infrastructure assets. Airport planning, parking lot usage data, the high-speed fiber optic and cellular network and the weather reporting systems will need some augmenting or adjusting, but those assets are already in place. Those assets do not exist in other states and will need to be designed and built. It will be far more expensive and prohibitive to build new systems than to augment infrastructure that is already in place. This puts Utah in a desirable position for early implementation.

Required Infrastructure

To properly outline the infrastructure required to make AAM a reality, it is beneficial to start with a good understanding of the vehicles and use cases utilizing the infrastructure.

Types of Aircraft

As shown in Figure 1, AAM aircraft can be divided between three main categories based on their capabilities:

- VTOL – vertical takeoff and landing;
- STOL – short takeoff and landing; and
- CTOL – conventional takeoff and landing.

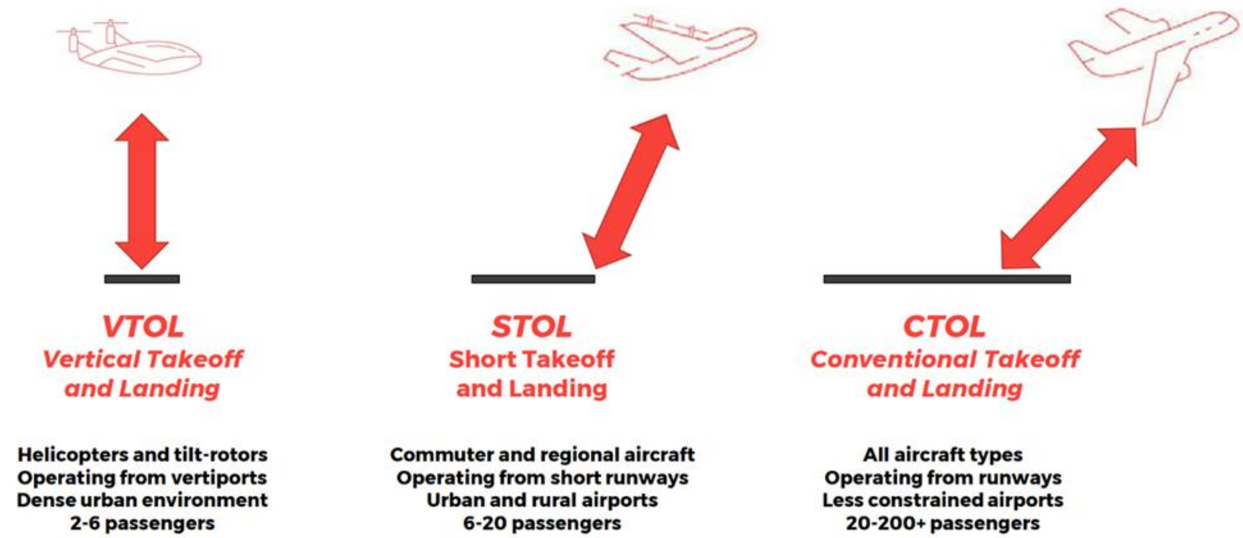

Figure 1: Advanced Air Mobility Aircraft

Although passenger carrying air taxis are the primary market target, secondary markets include package delivery drones, heavy freight drones, small electric training and commuter aircraft, and larger hybrid electric passenger and cargo aircraft. In Utah, a good example of the difference in these aircraft is the Zipline and the DroneUp aircraft. Both are used for package delivery, but Zipline is a STOL drone and DroneUp is a VTOL drone.

As these aircraft evolve, the potential use cases for these aircraft are also evolving.

Use Cases

Three initial use cases were clearly identified for Utah:

1. Cargo Logistics: Cargo drones can support and/or replace local trucks and regional manned aircraft for the bulk transport of freight and mail between cities. Small UAS can then be used for last-mile parcel delivery. Zipline and DroneUp are doing this in Utah today.
2. Passenger transport: Passenger carrying aircraft include:
    a. Fleet service, which is scheduled service by electric regional commuter aircraft and intercity on-demand vertical airlift services, and
    b. Personal aircraft for individual owner operators.
3. Emergency medical support: The speed at which small UAS can operate with respect to ground vehicles can make a life-saving difference when transporting blood, organs and other medical supplies between hospitals and other medical facilities across the state. Electric vertical takeoff and landing aircraft are also good candidates for getting an emergency responder to an incident scene in rural areas more quickly than a conventional ambulance.

The majority of these aircraft and their associated use cases will require airspace management. This entails the development of aerial corridors and lane-based scheduling.

Aerial Corridors

Aerial corridors can be thought of as “highways in the sky”, playing a similar role to airways for traditional aircraft routes. AAM corridors are predetermined blocks of airspace located in the lower altitudes. These corridors allow lower altitude aircraft traffic to maneuver in a more orderly, efficient and secure manner. Determining corridor pathways for AAM operations will require coordination with FAA air traffic control (ATC). Air traffic controllers are focused on airline operations at major airports. Corridor coordination should alleviate them of the burden of additional AAM operations. AAM corridors also offer an additional layer of safety for both conventional and advanced air mobility aircraft while enabling high frequency operations in the lower airspace.

AAM corridors are expected to require more complex air traffic management tools than today's conventional aircraft routes. AAM corridors will feature specific urban air traffic management (UATM) rules in combination with equipment and/or performance requirements to enable communication and coordination between aerial vehicles and a central control hub.

In the Government Accountability Office (GAO) Report 22-105020: Transforming Aviation: Stakeholders Identified Issues to Address for 'Advanced Air Mobility',[22] an advanced air mobility corridor is described as "a defined geographic area within FAA's controlled airspace where [advanced air mobility] services could operate without the need for traditional air traffic control services and would instead rely on a set of technologies for [advanced air mobility] aircraft that would allow the aircraft to navigate and maintain appropriate separation from one another."

Furthermore, in the 2020 FAA Urban Air Mobility Concept of Operations, an urban air mobility corridor is described as "an airspace volume defining a three-dimensional route segment with performance requirements to operate within or cross where tactical [Air Traffic Control] separation services are not provided." Per the Concept of Operations, an urban air mobility corridor is a performance-based airspace of defined dimensions in which aircraft abide by urban air mobility specific rules, procedures and performance requirements.

While AAM corridors can be thought of as "highways in the sky," aerial transit corridors could be considered "interstates in the sky."[23]

Unmanned Traffic Management

Much like FAA's air traffic control, unmanned traffic management (UTM) will support operations for UAS operating in low altitude airspace. Unmanned traffic management utilizes the industry's ability to supply services under FAA's regulatory authority where these services do not currently exist. It is a community-based, cooperative traffic management system, where the operators and entities providing operations support services are responsible for the coordination, execution and management of operations, with the FAA establishing the rules of the road.

Unmanned traffic management is predicated on layers of information sharing and data exchange – from operator to operator, vehicle to vehicle, and operator to an aerial traffic operations center. Operators share their flight intent with the central aerial traffic operations center and with each other to de-conflict and separate trajectories. The primary means of communication and coordination between operators, the aerial traffic operations center and other stakeholders is through a distributed information network – not between pilots and air traffic controllers via voice.

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[22] GAO - https://www.gao.gov/products/gao-22-105020

[23] A comprehensive discussion of aerial transit corridors can be found in the full Utah Advanced Air Mobility report.

In 2018, the FAA's NextGen Office released an initial overarching Concept of Operations for Unmanned Aircraft Systems Traffic Management that presented a vision and described the associated operational and technical requirements for developing a supporting architecture and operating within an unmanned traffic management ecosystem. This federated set of services enables cooperative management of operations between UAS operators and is facilitated by third-party support providers through networked information exchanges. UTM, through an innovative and competitive open market of service suppliers, is designed to support the demand and expectations for a broad spectrum of operations with ever-increasing complexity and risk. The services provided are interoperable to allow the UTM ecosystem to scale to best meet the needs of the UAS Operator community.

The FAA updated this Concept of Operations (ConOps) to document the continued maturation of unmanned traffic management and to share the vision with government and industry stakeholders. Unmanned traffic management Concept of Operations V2.0 continues to focus on operations below 400 feet above ground level (AGL), but also addresses increasingly more complex operations within and across both uncontrolled (Class G) and controlled (Classes B, C, D, E) airspace environments.

V2.0 updates and expands the set of operational scenarios, describing more complex operations in denser airspace, including beyond visual line of sight (BVLOS) operations in controlled airspace. V2.0 includes updated descriptions of/approaches to several unmanned traffic management components, including UAS Volume Reservations,[24] performance authorizations, data archiving and access, USS service categories, UTM/ATM contingency notification and security aspects associated with automated operations.

V2.0 also introduces new topics, including Airspace Authorization for flight beyond visual line of sight within controlled airspace, UTM architecture support to remote identification of UAS Operators and standards development efforts, with industry as an integral part of enabling UTM operations.

FAA UTM ConOps documents do not prescribe solutions or specific implementation methods, unless for purposes of providing examples. Rather, these documents describe the essential conceptual and operational elements associated with UTM operations that will serve to inform development of solutions across the many actors and stakeholders involved in implementing UTM. They also support a spiral implementation approach—maturing the concept through analysis of more complex airspace environments, tested and validated by field demonstrations—including National Aeronautics and Space Administration (NASA) Technology Capability Level (TCL), FAA UTM Pilot Program (UPP), and UAS Integration Pilot Program (IPP) demonstrations. Future versions will continue to be developed as needed to reflect the progress of research and continued concept maturation resulting from collaboration with the FAA, NASA, and industry partners.

The unmanned traffic management systems operate through the previously mentioned aerial traffic operations center.

Aerial Traffic Operations Center

An Aerial Traffic Operations Center (ATOC) will be a central facility to house personnel and system monitoring software that would be complementary to the FAA's Air Traffic Management System. A fully functioning unmanned traffic management system would not require human operators to continuously

[24] UAS Volume Reservations were previously referred to as Dynamic restrictions.

monitor every vehicle but would use innovative software solutions. The personnel would use data to make strategic decisions regarding airspace access, airspace density thresholds, weather reporting, safety messages (e.g., TFRs, Automated NOTAMS), performance requirements, emergency services coordination and overall systems monitoring (i.e., monitor health, redundancy checks, fault detection, failure mitigation) for low altitude airspace operations.

Detect and Avoid Censors

Aircraft Monitoring and Tracking Systems will be necessary to mitigate risk and safely manage aircraft in the National Airspace System (NAS) as operations scale. Multiple monitoring solutions exist and continue to evolve, including ground and air-based solutions. Solutions are primarily categorized into two categories: active or passive configurations.

Active sensors (e.g., Radar, LiDAR) can be both ground- and air-based and function well in day or night operations because they aren't dependent on lighting conditions. Active sensors can use time-of-flight information to provide accurate distance measurements to obstacles, which is extremely useful for rapid collision detection. However, they tend to be larger, heavier and require more power, making them unsuitable for integration into smaller, more SWaP (size, weight, and power)-limited drones. Ground based radar can be a viable solution where infrastructure exists to support network and power requirements but have limited range and need multiple sensors to provide coverage over an area.

LiDAR based solutions are being used in a variety of applications from 3D vision for robots to Connected Automated vehicles. These solutions have applications for aircraft LiDAR mixed with advanced analytics to provide the ability to detect and identify objects and movement patterns. This would help to detect birds or other aircraft.

Passive Sensors (e.g., Optical, Acoustic) are a cost-effective solution but are limited in their operations in limited visibility or high noise environments. Passive sensors such as EO/IR (electro-optical/infrared) sensors are typically smaller, lighter and consume less power, and they can offer a very fast scan rate and high resolution. However, due to the lack of reflected signal measurement and time-of-flight data, their estimation of obstacle distances is less accurate. Weather conditions may also affect their performance.

Sense and Avoid or Detect and Avoid

Detect and avoid technologies allow unmanned aerial vehicles (UAVs) and drones to integrate safely into civilian airspace, avoiding collisions with other aircraft, buildings, power lines, birds and other obstacles. Unmanned aerial vehicles sense and avoid systems may combine data from several sensors, using sensor fusion algorithms, image recognition and artificial intelligence to provide the best outcome.

A combination of ground and air based active and passive sensors may prove the most beneficial as a mixed approach will be needed for operations in different environments. Radar may prove cost prohibitive for the entire State yet could be supplemented by other sensors or on-aircraft solutions.

Weather Reporting Systems

Operations in urban areas will pose unique challenges, especially for smaller aircraft, such as package delivery UAS, that may operate near ground and/or building level. Wind tunnel effect – a situation where wind traversing the space between two buildings abruptly gains speed and becomes turbulent – is a possibility in downtown Salt Lake City. A likely location where this can occur is near Main and State

Streets, where most of the State's high-rise buildings are located. A system of micro-weather monitoring stations can be installed to provide UAS operators with additional situational awareness when flying near urban centers.

A common issue with most built-up areas, irrespective of building height, is the creation of urban heat islands. Natural land cover can either use heat as energy or reflect it, but built-up areas tend to absorb this heat, warming the area around them. Urban areas are also more likely to exhibit temperature inversion phenomena, where air temperature increases – not decreases – as altitude increases. This phenomenon, aside from trapping pollutants at ground level, also creates a mass of unstable, turbulent air that can cause safety and comfort issues for low-altitude operations in urban locations. Fog conditions during the winter season may necessitate an increase of separation between advanced air mobility aircraft due to decreased visibility.

When conducting operations between Utah's two major urban areas (the Wasatch Front and St. George) and the mostly rural eastern half of the state, crossing mountain ranges may be a common occurrence. Operations near high terrain will encounter turbulence due to the uneven and sharp variations in topography, which gives rise to both anabatic (daytime updraft) and katabatic (nighttime downdraft) winds. Narrow valleys in the eastern half of the state can also affect operations because of their increased propensity for fog and downdrafts. AAM operations should be conducted with additional terrain clearance in this area, lowering the range of suitable operating altitudes.

Wind measuring issues can be resolved with augmented Road Weather Information Systems. It is not uncommon for 50% to 200% wind speed errors at 200 feet to 400 feet above ground compared to weather model estimates. Errors of this magnitude cause significant uncertainty to operators flying battery-powered vehicles, affecting operations efficiency, travel time and distance. The uncertainty is a concern to drone delivery companies seeking to build a highly precise delivery service to meet 30-minute client delivery expectations

The uncertainty of eVTOLs flying into vertiports in built-up areas is also a concern due to building-induced wind tunnels and wind shear not detectable today. It will be necessary to install a diverse set of wind sensors to collect wind data above the ground ubiquitously. A possible example is Scanning Wind Lidar — a device that "sees" particulates like dust in the sky, and using Doppler technology, can provide a 3D picture of winds that covers a 20 kilometer to 30-kilometer area coverage, to 6,000 feet AGL at 75-meter grid space resolution.

Wind measuring equipment, like electric aircraft will need power to operate continuously.

Electric Capacity and Power Generation

Although most of the infrastructure already exists, additional facilities are needed before beginning AAM operations in this phased approach. AAM vehicles would likely function with electrical propulsion, so the state's airports and heliports will need to offer recharging facilities to support advanced air mobility. Providing the necessary power supply to support electric aircraft operations can be addressed by connecting these chargers to utility power grids, or through on-airport power generation, according to Airport Cooperative Research Program Research Report 236 and the National Renewable Energy Laboratory's (NREL) *Electrification of Aircraft: Challenges, Barriers, and Potential Impacts*.

On-airport generation requires additional capital investment, but it can help solve part or all the growing electricity needs of airports transitioning systems and equipment to electricity[25], especially in rural and remote communities. This would also bring additional value to airports as local assets that can be leveraged for the benefit of the local communities. For example, ACRP Research Report 236 suggests that on-airport generation can provide power resilience to the communities they serve when broader grids are deficient. To minimize the greenhouse gas emissions and air quality impact of AAM operations and supply chains, the electrical energy generated should arise from net-zero energy sources.

AAM vehicles may also be powered by hydrogen fuel cells. The Intermountain Power Agency has announced that it will replace its coal-fired power plant in Delta, Utah, with a hybrid natural gas-green hydrogen facility[26]. This new facility is part of the *Western Inter-States Hydrogen Hub*, a regional initiative for green hydrogen generation that also comprises the states of New Mexico, Colorado and Wyoming. Utah will be able to construct this facility, in part, with federal assistance, as the 2021 Bipartisan Infrastructure Law allocates $8 billion for funding four or more of these hubs. Utah could look at this facility as a primary fuel producer for hydrogen-powered mobility.

These required assets don't all have to be in place on day one. Building these out in a coordinated effort with industry partners is an effective way to mirror market demand trends. Using currently projected timelines we can deduce a natural phased approach.

[25] This trend, that is not aviation-specific, is also known as the "Electrification of Everything" (EoE).
[26] Green hydrogen implies production of hydrogen gas through non-polluting processes, such as the electrolysis of water with zero-carbon electricity. The hydrogen share of energy production is projected to rise steadily over the coming decades to 100% by 2045.
Source: Metz, Sam. Can green hydrogen save a coal town and slow climate change? The Associated Press, July 20, 2022.

Chapter 3: Phased Implementation Timeline

Implementation phases have been broken into four sections, as shown in Figure 2, to create a realistic timeline based on current industry projections. Phase One would start the preparations, planning and infrastructure development to meet current demand in the Salt Lake City Metropolitan area. Phase Two would expand infrastructure capacity and see the creation of initial vertiport infrastructure along with an expansion of infrastructure capacity for traffic monitoring/advisories. Phase Three consists of expanding services over the entire Wasatch front, including Brigham City to Payson. Phase Four would be the final phase for statewide implementation and would focus on connecting urban and rural communities through regional air mobility to begin a seamless efficient multimodal transportation system.

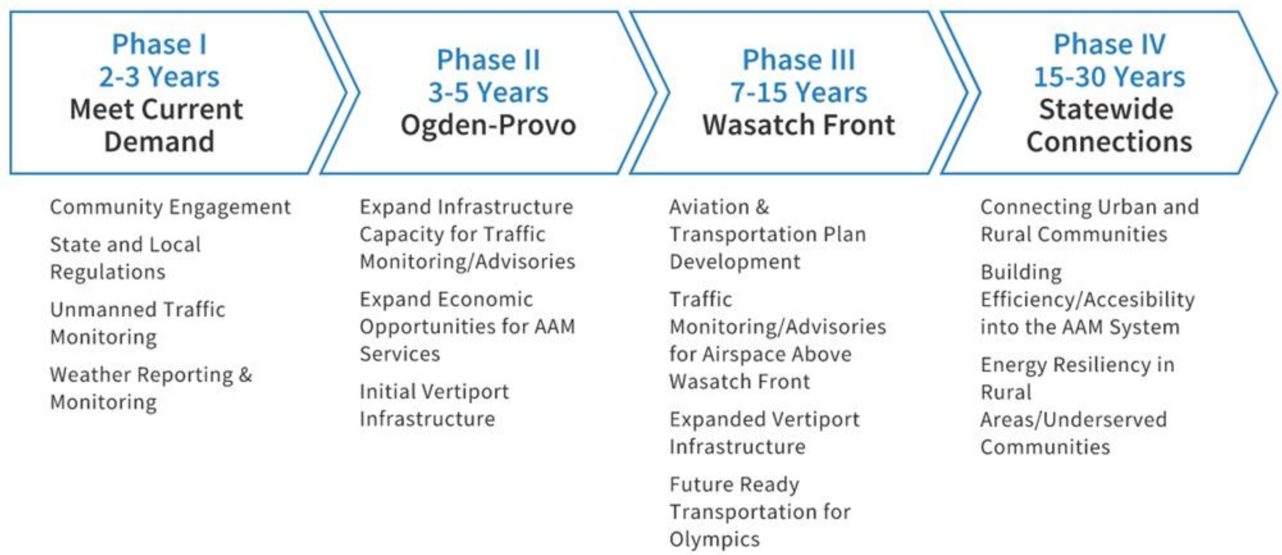

Figure 2: Advanced Air Mobility Phased Implementation

Phase One

Phase one is expected to take two to three years for full implementation, which includes primary steps to meet the current demand and create a foundation for future phases to evolve and to facilitate an organized statewide implementation.

In partnership with Intermountain Healthcare, Zipline has built a UAS/drone package delivery facility in the Salt Lake Valley and has started providing medical deliveries to residents. Zipline's initial operations encompass a 2 nautical mile initial operation area surrounding its facility, with plans to expand to a 26 nautical mile operating area.

DroneUp, in partnership with Walmart, plans to begin package deliveries to homes in the near future. Initial operations are planned to operate within 1 nautical mile of selected Walmart locations, with plans to extend to a 10 nautical mile range from multiple locations in future phases.

Similar services are sure to follow in the near future as additional companies obtain certifications from the FAA or expand their current operations. Considerations to meet the current demand and plan for future operations for Phase One include community engagement, unmanned traffic monitoring, and weather reporting.

Community Engagement

Comprehensive public engagement early in the process is essential to help communities understand what AAM is and what it is not. Many misconceptions surround AAM, such as classifying it as "the Jetsons" or "flying cars." Such misconceptions cast AAM as an overwhelming topic or a thing that is exclusive to some communities. Community engagement will be critical to support community buy-in to the definition of AAM as the next generation of aviation, integrated into a holistic, multimodal transportation system of the future. Giving the public the opportunity to engage in the process will foster collaborative relationships as advanced air mobility grows, help mitigate problems early on and allow for operations to grow dynamically.

Community engagement will require significant investment, planning and coordination across a coalition of stakeholders. Education and engagement strategies should include meaningful discussions with stakeholders to gauge demand, interest and concerns. Stakeholders may include local communities, local and metropolitan planners, the aviation industry, public transit, residents, businesses, disadvantaged communities, manufacturers and suppliers, among others. Initial community outreach efforts may range in cost from $500,000 to $1 million, depending on internal resources, contracted third-party consultants, or a hybrid approach.

Unmanned Traffic Monitoring

As operations increase in frequency, UTM will be essential to provide de-confliction and monitoring for operations. Due to the limited operations expected in Phase One, early stages of UTM may be accomplished solely with traffic monitoring integration software monitored by staff at the Division of Aeronautics. The software is an essential initial investment that would scale in further phases toward building a full monitoring system that includes active and passive sensors, capacity management, tracking and monitoring, and interfacing with the FAA systems.

Estimates of initial costs for a UTM platform include:

- Annual UTM license – $150,000/year;
- One time integration fee – $50,000; and
- Surveillance Fusion: $75,000/year.

Weather Reporting

Advanced air mobility and unmanned aerial systems flying beyond visual line of sight will generally fly in a low altitude below 5,000 feet AGL. Ensuring safe, sustainable, cost-effective and accessible UAS and AAM operations require accurate weather data and a diverse system of local micro-weather monitoring stations. Without new weather infrastructure investments, a lack of weather data below 5,000 feet will ground aircraft 30% to 40% of the time during marginal weather conditions when they could have flown.

As shown in Figure 3, Utah can leverage the existing, surface-based RWIS weather infrastructure by augmenting capabilities to measure cloud ceiling heights and visibility, which are critical to meeting FAA weather standards. Enhancing existing RWIS with cloud measurement devices and visibility sensors will close gaps in measurement coverage between ASOS located at airports. Ground-based weather stations are required to provide a complete suite of aviation weather data in gaps between ASOS and RWIS locations.

Phase 1

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UAS and AAM Infrastructure Plan

Sensor	Cost	Quantity	Total
Wind Scanning LiDAR MRI winds aloft over 25 Mile area *(5 years Mx)*	$450,000 ea.	2	$900,000
Sited Ultra-Accurate Wind Sensors	$3,500 ea.	4	$14,000
Ultra-Accurate Wind Sensors –on Drones (not including drone)	$2,600 ea.	5	$13,000
Sited Micro-Weather Stations	$35,000 ea.	5	$175,000
Sited cost-effective weather	$600 ea.	20	$12,000
Upgrade RWIS with Ceiliometers	$15,000 ea.	5	$75,000
TOTAL			**~$1.2M**

ASOS has 5NM acceptable coverage. With no FAA weather standard change, would require 15-20 ASOS stations @$3-4M

Costs are estimated and include configuration, system integration, and multi-year replacement/maintenance plan

TRUWEATHER

Figure 3: Phase One Upgrades to Existing Weather Reporting Infrastructure

Private Investment and Development

Private companies have begun infrastructure and staffing for current operations. During Phase One, the following are actual and projected quantities of private investment and development costs:

- Medical Delivery Air Cargo Hub – $1 million;
- Medical Air Cargo Delivery Payroll – $600,000;
- Air Cargo Goods Delivery (three hubs, $500,000 each) – $1.5 million; and
- Air Cargo Payroll – $500,000.

Phase Two

Phase Two would build on the work completed in Phase One to provide the infrastructure to support passenger air mobility, emergency services and expansion of air cargo deliveries from Ogden to Provo. Phase Two anticipates the first operations of aerial taxis at vertiports and would further develop supporting infrastructure to support aerial transit corridor monitoring. The timeline for Phase Two is expected to span between three and five years. Phase Two elements include expanding infrastructure, such as detect and avoid and sense and avoid hardware, for traffic management/advisories and increased development of weather reporting to support increased operations.

Community Engagement

Continued community engagement will be necessary as operations grow and AAM services are available for more residents. A minimum of $500,000 is recommended for stakeholder outreach to facilitate comprehensive stakeholder and community engagement efforts. This estimate may need to be adjusted depending on the source of funds and scope of work determined by a communications firm.

Unmanned Traffic Management Censors

Multiple aircraft would be competing for airspace at this stage, which would require a robust monitoring solution. Remote ID is one solution for aircraft in compliance with FAA rules but would not account for nefarious actors or hobbyists not in compliance with FAA regulations for remote identification devices on small UAS. Monitoring all aircraft in the airspace may require supplemental sensors in the form of active and passive sensors. Active sensors would include radar or LiDAR; passive sensors would include acoustic, radio frequency receivers, or visual sensors. For this report's purposes, radar was selected for cost estimates. A Fortem TrueView R40 radar panel was selected for review due to its use at other test sites and to Fortem being a Utah-based company.

The Fortem TrueView R40 radar panel will detect and track small single engine aircraft such as ultralights or Cessnas at a distance of at least five nautical miles, and small UAS such as DJI Phantom 4 at a distance of at least two nautical miles.

The Fortem TrueView R40 radar is a small, distributed radar system that has all the processing at the edge for the aggregated system to track and classify tens of thousands of flying objects simultaneously. Conversely, one long-range radar has limited central processing capability. The TrueView R40 makes use of multiple networked and intelligent small, distributed radar panels to provide superior coverage, accuracy, tracking and timely decision-making for low flying aircraft near ground obstacles or terrain, as opposed to single, large long-range radars. A distributed network is also able to track and analyze far more flying objects due to the distributed processing provided by each radar panel.

Four radar panels on a pole create a hemispherical dome of protection from the ground to 10,000 MSL, with a radius as noted. Current software allows each panel to track at least 500 flying objects, and the software aggregates tracks of flying objects as they pass from the field of view of one panel to the other throughout the entire network.

The Fortem TrueView single unit list price in September of 2022 is $78,500. Annual support and upgrade costs average around 20% per radar panel or $15,700. Prices may be negotiated for volume and long-term purchase and maintenance contracts.

Aerial Traffic Operations Center (ATOC)

As infrastructure is built to support advanced air mobility operations, a central location to monitor and integrate sensors will be necessary. An aerial traffic operations center can serve to apply UTM policies and enforce rules as necessary. As Utah looks toward a lane-based approach for unmanned traffic management, most operations can be automated. However, monitoring will be required due to inevitable unexpected events. For initial operations, existing infrastructure in the Division of Aeronautics building may be sufficient, but additional staff and hardware may be required.

The estimated costs for an aerial traffic operations center include:

- Two part-time staff members (salary and benefits at $60,000 each) – $120,000;
- Hardware (computers, monitors, software) – $230,000;
- Facilities Modification – $50,000; and
- System Redundancy and Monitoring Software – $100,000.

Unmanned Traffic Management Software

The software costs for UTM are projected to be the same as for Phase One:

- Annual UTM license – $150,000/year; and
- Surveillance Fusion – $75,000/year.

Weather Reporting and Monitoring Services

As shown in Figure 4, Phase Two expenditures would further expand the infrastructure developed in Phase One to include the density needed to support operations from Ogden to Provo.

Phase 2

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UAS and AAM Infrastructure Plan

Sensor	Cost	Quantity	Total
Wind Scanning LiDAR MRI winds aloft over 25 Mile area *(5 years Mx)*	$450,000 ea.	3	$1,350,000
Sited Ultra-Accurate Wind Sensors	$3,500 ea.	8	$28,000
Ultra-Accurate Wind Sensors –on Drones (not including drone)	$2,600 ea.	10	$26,000
Sited Micro-Weather Stations	$35,000 ea.	10	$350,000
Sited cost-effective weather	$600 ea.	40	$24,000
Upgrade RWIS with Ceiliometers	$15,000 ea.	10	$150,000
TOTAL			**~$1.928M**

ASOS has 5NM acceptable coverage. With no FAA weather standard change, would require 15-20 ASOS stations @$3-4M

Costs are estimated and include configuration, system integration, and multi-year replacement/maintenance plan

TRUWEATHER

Figure 4: Phase Two Upgrades to Existing Weather Reporting Infrastructure

Private Investment and Development

Significant private development is projected for Phase Two as demand grows from the certification of aircraft, relocation of business to Utah and public engagement efforts. NEXA Advisors forecast that within Salt Lake City proper, not counting the adjacent cities, eight vertiports can be potentially developed within the city limits to support demand. As a conservative approach for Phase Two, we assumed the creation of a vertihub, two vertiports and a vertipad to support operations in the Salt Lake Valley, Ogden and Provo.

Estimated infrastructure development costs for vertiport infrastructure as referenced from Airport Cooperative Research Program report 243 are shown in Figure 5.

Cost component	Comments	Vertipad	Vertiport	Vertihub
Pad material costs, $	▪ Constructed of reinforced concrete [1] ▪ **Vertipad**: 1-pad, FATO area[2] 4500 sq-ft, total area 20,000 sq-ft ▪ **Vertiport**: 2-pad, 7-10 parking spots, FATO area[2] 4500 sq-ft, total area 165,000 sq-ft ▪ **Vertihub**: 1 to 2-pad, 20 parking spots, FATO area[2] 4500 sq-ft, total area 380,000 sq-ft	$66,000	$500,000	$1.25M
Time for pad construction, Manhours	▪ .055 manhours per sq-ft ▪ Anchored in surveys of helipad development projects with published timelines	1,100	9,075	20,900
Flight deck labor cost, $	▪ Labor rate of $25 per person hour ▪ **Vertipad**: Crew of 10 working 8-hour days, completion time ~14 days ▪ **Vertiport**: Crew of 15 working 8-hour days completion time ~2.5 months ▪ **Vertihub**: Crew of 25 working 8-hour days, completion time ~3.5 months	$28,000	$228,000	$625,000
Charging station cost, $	▪ Mean cost of an analogous electric vehicle charging station (equipment and install) **Vertipad**: Single charging station, as a backup for emergency or atypical events ▪ **Vertiport**: 8 charging stations assumed ▪ **Vertihub**: 20 charging statins assumed	$52,000	$416,000	$1M
Terminal cost, $	▪ Average rate of $197 / sq-ft4 ▪ **Vertipad**: Likely not to exceed 3000 sq-ft[3] ▪ **Vertiport**: Assumes 35,000 sq-ft terminal ▪ **Vertihub**: Assumes 80,000 sq-ft terminal	$591,000	$6.9M	$15.8M
Site and operational capex, $	▪ Land procurement and preparation (survey, grading, soil treatment) ▪ Safety and security (barricades, lighting, cameras, *etc.*) ▪ Regulatory compliance assurance and inspection	$500,000	$4.1M	$9.5M
Total cost, $/location	▪ **Vertipad**: Costs may range from $1 – 2.5M ▪ **Vertiport**: Miscellaneous costs may lead to cost variance of $2 - $5M ▪ **Vertihub**: Miscellaneous costs may lead to cost variance from $5 – 10M	**$1.2M**	**$12.1M**	**$28.1M**

1 Reinforced concrete priced at $3.30 per sq. ft. (ConcreteNetwork.com)
2 FATO area (1.5 x rotor diameter)^2 uses assumed 'rotor diameter' of 45 ft.
3 Terminal space has been scaled based on occupancy and capacity assumptions
4 Facility development cost reflects average rate for total construction cost, including labor

SOURCES: Federal Aviation Administration, Heliport advisory circular; Compass International, Airport costs; and US DOE electric vehicle equipment cost

Figure 5: Estimated Infrastructure Development Costs for Vertiport Infrastructure

Referencing the above information, the following costs can be derived for infrastructure investment:

- Vertihub – $28.1 million;
- Two (2) Vertiports ($12.1 million each) – $24.2 million; and
- Vertipad – $1.2 million.

The private industry forecast of $53.5 million is a conservative estimate and accounts only for the investment costs associated with vertiport development. Additional investment in drone package delivery expansion, and maintenance and operations can also be expected, but is not presented in the economic forecast.

Phase Three

Aviation and Transportation Plan Development

AAM should be included in the long-range transportation planning efforts of state and local governments at this stage. A clear network and authority will also need to be established for aerial traffic management and advisory communications with autonomous aircraft systems.

Full plan development for aviation and transportation plans can exceed $1 million; however, minimal edits to existing plans to incorporate AAM elements may average $500,000 if full redevelopment is not possible.

Community Engagement

Continued community engagement will be necessary as operations grow and AAM are available for more residents. To facilitate continued engagement efforts, $500,000 is recommended unless otherwise defined in a scope of work or funding sources.

Expansion of Traffic Management

It is anticipated that operations will grow extensively in the airspace during this phase to accommodate further adoption of e-commerce and air cargo delivery operations based on the demands of residents and businesses. AAM and air cargo will be a more commonplace and expected option for expedited delivery. Effective monitoring of the airspace will require additional equipment to monitor the expanses of the Wasatch Front, instead of only corridor-based monitoring.

Unmanned Traffic Management Software

The software costs for UTM are projected to be similar to Phase Two:

- Annual UTM license – $150,000/year; and
- Surveillance Fusion – $75,000/year.

Detect and Avoid and Sense and Avoid Equipment

The Wasatch Front is approximately 110 nautical miles long. To provide a manned aviation tracking zone of approximately 40 nautical miles wide (i.e., four sets of four radar panels on poles to provide the width), would require 52 poles with 4 radars each, or a total of 208 radars ($16.6 million). To provide a similar corridor for tracking small UAS, would require 10 sets of four radar panels to provide the width, multiplied by 34 in length, or a total of 1360 radars ($106 million).

- Cost to track manned aviation: $ 16,642,000;
    - Support: $ 3,328,400/year
- Cost to track sUAS aviation: $106,760,000;
    - Support: $ 21,352,000/year.

Weather Reporting Equipment

As shown in Figure 6, Phase Three costs would further expand the infrastructure developed in Phases One and Two to include the density needed to support operations for the Wasatch Front.

Phase 3

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UAS and AAM Infrastructure Plan

Sensor	Cost	Quantity	Total
Wind Scanning LiDAR MRI winds aloft over 25 Mile area *(5 years Mx)*	$450,000 ea.	2	$900,000
Sited Ultra-Accurate Wind Sensors	$3,500 ea.	4	$14,000
Ultra-Accurate Wind Sensors –on Drones (not including drone)	$2,600 ea.	5	$13,000
Sited Micro-Weather Stations	$35,000 ea.	5	$175,000
Sited cost-effective weather	$600 ea.	20	$12,000
Upgrade RWIS with Ceiliometers	$15,000 ea.	5	$75,000
TOTAL			**~$1.2M**

ASOS has 5NM acceptable coverage. With no FAA weather standard change, would require 15-20 ASOS stations @$3-4M

Costs are estimated and include configuration, system integration, and multi-year replacement/maintenance plan

TRUWEATHER

Figure 6: Phase Three Upgrades to Existing Weather Reporting Infrastructure

Aerial Traffic Operations Center

Phase Three projected expenditures and support for the Aerial Traffic Operations Center:

- Four full-time staff members (salary and benefits at $90,000 each) – $360,000;
- Additional hardware and upgrades – $30,000; and
- System Redundancy and Monitoring Software – $100,000.

Private Investment and Development

Expectations of continued growth in private development are expected during Phase Three as demand grows across use cases. As a conservative approach for Phase Three, we assumed the creation of eight additional vertiports to support demand across the Wasatch Front as forecast by NEXA Advisors.

Referencing the previous graphic, the following costs can be derived for infrastructure investment:

- Eight Vertiports ($12.1 million each) – $96.8 million.

The private industry forecast of $96.8 million is a conservative estimate and accounts only for the investment costs associated with vertiport development. Additional investment in drone package delivery expansion, and maintenance and operations can also be expected, but is not presented in the economic forecast.

Phase Four

AAM operations expand in Phase Four to connect multiple communities across the state and evolve beyond the “hub and spoke” model with the Wasatch front as the central point.

Statewide Connections

Phase Four is anticipated to span 15 years to 30 years. Operations will expand statewide during this period to facilitate efficient transportation options and connect urban and rural communities. The use cases discussed previously will be fully functional across the state. Electric conventional aircraft will service airports between the larger population density markets. eVTOL aircraft will also provide commuter service within multiple communities. Additional electricity infrastructure in rural communities will allow recharging for aircraft and increase these communities’ resiliency for energy and sustainability. Efficiencies between multimodal transportation networks will likely evolve collaboratively during this phase to provide rapid options for transportation and goods delivery. The following elements will facilitate the needs to support Phase Four operations.

System Planning

Further system planning for expanding operations will be required as operations move to additional service areas. Additional planning efforts during Phase Four are projected at $500,000.

Community Engagement

Community engagement will be organic and advanced air mobility should be commonplace by Phase Four. No additional funding is projected for community engagement through the years in phase four.

Unmanned Traffic Management

The software costs for UTM are projected to remain steady throughout Phase Four:

- Annual UTM license – $150,000/year; and
- Surveillance Fusion – $75,000/year.

Detect and Avoid Equipment

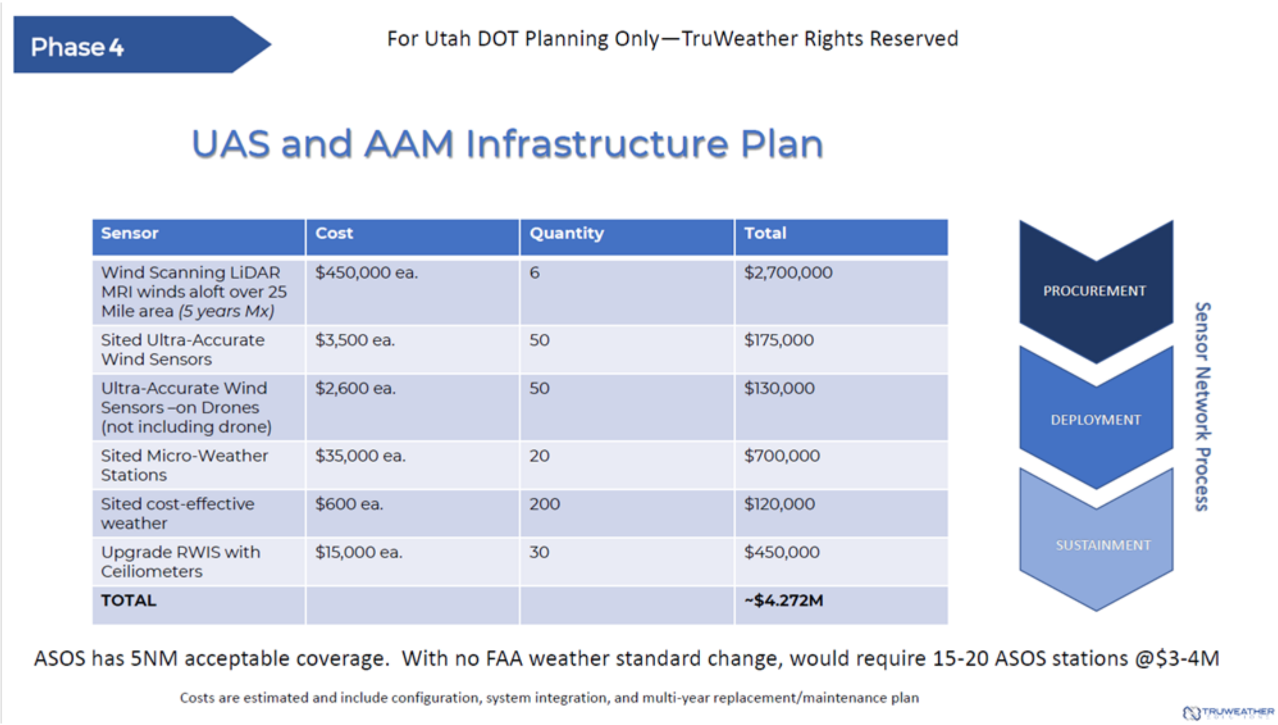
A massive expansion of sensor equipment will require greater resources. However, by this time the per unit price of equipment can be projected to decrease as the technology becomes more readily purchasable. Phase Four implementation is projected to range between $16.6 million and $106 million. Adding narrow spurs of routing as desired and calculating costs in the same manner as Phase Two, the cost of about $44,500 per mile of extra coverage of manned aviation, or $120,000 per mile of extra coverage for small UAS are projected.

If, for example, an assumption of 20 spurs with an average of 100 nautical miles each, or a total of 2,000 nautical miles in length, plus the previous Phase Three cost projections might conclude:

- Cost to track manned aviation – $105,642,000;
    - Support – $ 21,128,400/year
- Cost to track UAS aviation – $346,760,000;
    - Support – $ 69,352,000/year.

Weather Reporting Equipment

Phase Four costs would further expand the infrastructure developed in Phases One through Three to include the density needed to support operations statewide. Figure 7 illustrates statewide coverage for weather reporting and monitoring systems.



Sensor	Cost	Quantity	Total
Wind Scanning LiDAR MRI winds aloft over 25 Mile area *(5 years Mx)*	$450,000 ea.	6	$2,700,000
Sited Ultra-Accurate Wind Sensors	$3,500 ea.	50	$175,000
Ultra-Accurate Wind Sensors –on Drones (not including drone)	$2,600 ea.	50	$130,000
Sited Micro-Weather Stations	$35,000 ea.	20	$700,000
Sited cost-effective weather	$600 ea.	200	$120,000
Upgrade RWIS with Ceiliometers	$15,000 ea.	30	$450,000
TOTAL			**~$4.272M**

Figure 7: Phase Four Upgrades to Existing Weather Reporting Infrastructure

Aerial Traffic Operations Center

Phase Four support for ATOC assumes a central ATOC to support statewide operations. As operations grow statewide, multiple ATOC nodes may be considered:

- Multiple staff members – salary and benefits at $120,000 each;
- Additional hardware and upgrades – $130,000; and
- System Redundancy and Monitoring Software – $150,000.

Private Investment and Development

Expectations of continued growth in private development are expected during Phase Four as demand grows across use cases. As a conservative approach for Phase Four, we assumed the creation of two additional vertihubs to support demand across the Wasatch Front. Ten vertiports will support rural communities across the state and augmentation of the Wasatch Front. Additionally, 100 vertipads may be expected to support lower volume operations statewide.

Referencing the previous graphic, the following costs can be derived for infrastructure investment:

- Two (2) Vertihubs ($28.1 million each) – $56.2 million;
- Ten (10) Vertiports ($12.1 million each) – $121 million; and
- One hundred (100) Vertipads ($1.2 million each) – $120 million.

The private industry forecast of $297.2M is a conservative estimate and accounts only for the investment costs associated with vertiport development. Additional investment in drone package delivery expansion, and maintenance and operations can also be expected, but is not presented in the economic forecast.

Chapter 4: Financing and Funding

Financing discussions refer generally to methods of raising initial capital to purchase and/or construct the necessary infrastructure.

State Financing

One option available to Utah municipalities and agencies is the State Infrastructure Bank.[27] The State Infrastructure Bank (SIB) offers a source for low-cost infrastructure loans and assistance for public entities. Interest rates of 0.5% above bond market interest rates are available public entities. The purpose of the State Infrastructure Bank Loan Fund is to provide loans and assistance to improve transportation infrastructure in Utah. The program is intended to be an innovative financing tool that will offer financing options not previously available in meeting infrastructure needs.

The fund consists of money generated from the following six revenue sources:

1. Appropriations made to the fund by the Legislature;
2. Federal money and grants that are deposited in the fund;
3. Money transferred to the fund by the commission from other money available to the department;
4. State grants that are deposited in the fund;
5. Contributions or grants from any other private or public sources for deposit into the fund; and
6. All money collected from repayments of fund money used for infrastructure loans or infrastructure assistance.

Utah Administration Rule R940-3-4 requires, "A public entity must submit a request for an infrastructure loan or infrastructure assistance using an application form provided by the department. The public entity must complete and submit the application according to the application instructions."

As of May 2022, the unobligated balance of the Utah State Infrastructure Loan Fund is $5.3 million, if all applications are approved.

Municipal Bonds

Municipal bonds are another financing strategy to consider. Municipal bonds are debt securities issued by states, counties, municipalities or local districts, often used to support the building of infrastructure.

Often, the projects being funded by bonds produce a stream of revenue in which the interest and principal are paid directly from the revenue stream of completed projects. This is known as a revenue bond. In this case, the users of a project, rather than taxpayers, generally pay the cost of the project. Projects funded with revenue bonds often include toll roads, hospitals, bridges, water, sewer or electrical infrastructure projects and airports – or in this case, vertiports.[28]

The State of Utah has used lease revenue bonds to finance building projects. For lease revenue bonds, rent that would be paid to private owners is, instead, used as the revenue stream to pay off the debt.

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[27] https://le.utah.gov/xcode/Title72/Chapter2/72-2-P2.html?v=C72-2-P2_1800010118000101

[28] Funding a vertiport project with a bond would be similar to using General Airport Revenue Bonds to fund an airport terminal project, such as the 10-year terminal redevelopment of the Salt Lake City International Airport.

These bonds are often referred to as "appropriation risk bonds" because the Utah State Legislature must appropriate funds to pay the "lease" every year.

In Utah, revenue bonds are more commonly issued by local governments. Revenue bonds are an attractive option because local entities usually do not need to pass a referendum to authorize the projects, and the revenue stream is often generated by the users of the projects. Local entities can also alternatively pledge their sales tax as a revenue stream for the bonds. Revenue bonds in Utah are typically used for water, sewer and electric projects.

General obligation bonds, which are backed by the general revenue of the issuing entity, usually achieve lower interest rates than revenue bonds. As of November 2022, Utah had a AAA bond rating, the highest rating a state can receive. Because Utah has such a great bond rating, it allows the state to borrow at lower interest rates than most other entities.

Apart from facilities on state property, the state itself may never need to finance the construction of a vertiport. However, the state may need to finance unmanned traffic management and detect and avoid infrastructure. Cities typically are sponsors (owners) of airports and may find an opportunity to finance and construct a vertiport on occasion.

Federal Financing

Currently, the FAA Airport Improvement Program does not permit funding for AAM infrastructure of any type. However, the current administration has been signaling significant investment in AAM. There is much anticipation for additional funding measures in the upcoming 2023 FAA Reauthorization Bill.

Until then, House Bill H.R. 6270 was introduced on December 21, 2021, and titled the "Advanced Aviation Infrastructure Modernization (AAIM) Act." The Act states that "not later than 180 days after the date of enactment of this Act, the Secretary shall establish a pilot program to provide grants that:

- Assist an eligible entity to plan for the development and deployment of infrastructure necessary to facilitate AAM operations in the United States;
- Make funding available for costs directly related to construction of public use vertiports or associated infrastructure; and
- IN GENERAL. The Secretary shall provide grants to eligible entities to develop comprehensive plans under paragraph (2) related to AAM infrastructure."[29]

This bill makes funds available for states and cities that are ready and able to put them to use.

Private Financing

Public-private partnerships (PPP or P3) and tax-exempt Private activity Bonds (PAB) are two resources to consider incorporating in any finance initiative.

With public-private partnerships, high-level conversations are needed at the outset to consider how a partnership could be structured and formed. In addition, some original equipment manufacturers may want to build their own vertiports and infrastructure and restrict usage. This presents questions regarding grant assurances and requirement for full public usage. Manufacturers have indicated that fully private funding is a viable option to begin operations in areas/regions that fit their business needs.

[29] AAIM Act - https://www.congress.gov/bill/117th-congress/house-bill/6270

It is imperative to consider legal and other implications, as well as state compliance rules when entering into these agreements.

Local or state government can issue Private Activity Bonds to attract private investment from corporations and enable them to execute projects for public benefits by offering special financial benefits. Private Activity Bonds (PAB) are issued for the benefit of private individuals or entities and are issued on a tax-exempt basis if the private individuals or entities are "qualified."[30] Tax-exempt bonds tend to have lower interest rates than bank loans or taxable bonds. This lower borrowing cost is passed directly to the borrowing entity. The Department of Workforce Services (DWS) oversees Utah's PAB program.

Funding

Funding discussions refer generally to methods of paying for the ongoing operating costs and maintenance of the advanced air mobility system.

User Fees

There are a variety of user fees.

Landing Fees: Landing fees come in two basic varieties: (1) a per-landing fee and (2) a fee based on gross landing weight. The per-landing fee is the simplest and is typically a flat fee. These fees are often lower than the weight-based fees. Weight-based fees come with a formula that aircraft operators must calculate based on their maximum landing weight and sometimes actual landing weight. This formula is intended to compensate the airport for the increased amount of impact and wear that heavier planes have on runway asphalt. Weight-based fees may not be as applicable for AAM aircraft since they do not land with the same impact as conventional aircraft.

Aircraft Parking Fees: Aircraft parking fees, known at airports as "ramp" fees, are often flat rates and the rate schedule is posted and available. However, for special occasions, special events or high demand seasons, airports and vertiports can charge market rates for leasing parking areas or charge premium parking fees per time use.

Airspace Fees: Airspace usage fees are utilized in Europe but have been adamantly opposed in the United States. Attempting to implement an airspace user fee for AAM may meet with the same pushback. These fees can be a flat fee for each operation, or a per-mile use fee. These fees are seen as revenue to pay for the cost of air traffic and air space management.

Access Fees: Access fees pertain less to aircraft and more to peripheral access of the vertiport itself. These fees come in many forms and could be associated with vehicle permits, security badges, one-time gate card fees to access facilities and ride-sharing fees.

Registration Fees

Currently, aircraft registration fees in Utah are calculated using the average wholesale value of the aircraft as published in the Aircraft Bluebook Price Digest (Utah Code § 72-10-110). However, unmanned aircraft are exempt from this fee. An option to revise Utah Code to implement a registration fee for smaller drones can be modeled after FAA 14 CFR Part 107. Under this federal regulation, Small Unmanned Aircraft Systems registration costs $5 per drone and is valid for three years. Registration fees

[30] Qualification is based on

can be implemented on a flat-rate basis, a gradual scale, or a scaled fee (i.e., registration scaled against wholesale value).

Another method is a UAS commercial and government permitting program. North Carolina has already deployed this method, and UAS/drone operators are required to have an UAS Operator Permit if they fly for commercial purposes or are a government organization.

The Utah Division of Aeronautics is already capable of processing aircraft registration fees.

Tax Revenue

Tax revenue is generated through several avenues in Utah. The primary sources of revenue for the state aviation system are the aviation fuel tax and aircraft registration fees. The fuel flowage fee is one of the primary sources of revenue for airports.

Fuel Tax: With the advent of electric aircraft, a new method for calculating tax on electricity that is used as aviation “fuel” will be needed. For reference, tax rates on electricity in Utah range from 0.0% to 6.0% depending on the rate levied by each city. This raises several questions: Should there be a special “aviation” rate, similar to liquid aviation fuel? Is this rate equivalent to, or at least similar to, the rate on aviation fuel?

Flowage Fee: In addition to the tax rate, airports and vertiports may consider instituting a power flowage fee, akin to the fuel flowage fee. Fuel flowage fees are typically paid on a “cents per gallon” basis and range from $0.05-$0.40 per gallon. Aircraft powered by electricity are anticipated to consume a tenth of the cost of traditional fuel for operating expenses. Due to the lower operating costs, fees should be balanced to ensure end-user operational price equity, while supporting infrastructure needs. Fee structure may also consider on-peak versus off-peak costs, as on-peak charging costs may be double that of off-peak rates.[31]

Sales and Use Tax: Aircraft sales taxes, including sales and use taxes for aircraft-related purchases and aviation maintenance labor are open for discussion as sources of revenue to maintain the AAM system. Some states, such as South Carolina, have exempted the sales and use tax on aircraft parts and labor. Other states channel taxes from aircraft sales into their aeronautics-restricted accounts. Taxes from the sale of advanced air mobility aircraft, and parts and labor, could be channeled into an AAM-restricted account to help cover the cost of maintaining the system. This ensures the system is paid for by the users.

Restricted Accounts: Utah Code § 72-2-126 establishes the Aeronautics Restricted Account within the Transportation Fund. The account consists of money generated from the following revenue sources:

- Aviation fuel tax allocated for aeronautical operations deposited into the account in accordance with Utah Code § 59-13-402;
- Aircraft registration fees deposited into the account in accordance with Utah Code § 72-10-110;
- Appropriations made to the account by the Legislature;
- Contributions from other public and private sources for deposit into the account; and

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[31] Costs from Rocky Mountain Power in June through September 2022 for on-peak usage is 5.8282 cents/kWh, while off-peak usage is 2.9624 cents/kWh

- Interest earned on account money.

Revenues generated from aviation fuel tax and aircraft registration fees are highly regulated by federal revenue-diversion mandates. Money in those accounts may not be used for any purposes outside of the benefit of the aviation system. By state statute, money in the account may be used for:

- The construction, improvement, operation and maintenance of publicly used airports in this state;
- The payment of principal and interest on indebtedness incurred;
- Operation of the division of aeronautics; and
- The promotion of aeronautics in this state.

In addition to the Aeronautics Restricted Account, a new restricted account known as the State Aircraft Restricted Account, was created in 2022 for specific aircraft operations uses. Utah Code § 72-2-132 states that the money in the account is generated from the following revenue sources:

- Fees the department receives for use of state-owned aircraft;
- Appropriations to the account by the Legislature;
- Contributions from other public or private sources for deposit into the account; and
- Interest earned on money in the account.

Using these two accounts as precedent, the Legislature can potentially create an AAM-restricted account. The separation of these aviation monies will provide a clear delineation between airport-generated funds (used only at airports), aircraft-operations-generated funds (used only for state owned aircraft), and AAM-generated funds (used only for AAM infrastructure). This delineation ensures money generated from AAM-related revenue sources is used on detect and avoid sensors and unmanned traffic management systems.

Aviation has always considered itself a self-funded transportation system that is paid for by those using it. These financing and funding considerations will help ensure that tradition continues and places no additional burden on taxpayers.

Chapter 5: Legislative Considerations

The Utah Legislature might consider taking several first steps to create a foundation for the phases of enabling advanced air mobility. Many of these steps require little or no fiscal note. The following outlines the potential legislative actions.

Defining Advanced Air Mobility (AAM)

Utah Code § 72-10-104 Definitions – Regarding definitions, the Legislature might consider:

Aerial Transit Corridor

As defined in the FAA Urban Air Mobility Concept of Operations (2020) – "an airspace volume defining a three-dimensional route segment with performance requirements to operate within or cross where tactical ATC separation services are not provided."

Vertiport

The FAA defines vertiports as identifiable ground or elevated areas, including any buildings or facilities thereon, used for the takeoff and landing of tiltrotor aircraft and rotorcraft.

As an alternative option, EASA defines a vertiport as an area of land, water, or structure used or intended to be used for the landing and take-off of VTOL aircraft.

Unmanned Traffic Management

UTM as defined by the FAA is a "traffic management" ecosystem for uncontrolled operations that is separate from, but complementary to, the FAA's Air Traffic Management (ATM) system.

Regulating Advanced Air Mobility

Utah Code § 72-10-103 and 109 – Regarding a regulatory framework, the Legislature might consider several options, as discussed below.

Avigation Easements

The Legislature might consider one of several avigation easement definitions such as:

"A surface and overhead avigation easement consists of an agreement with property owners to cede air rights over their property to the government. These easements restrict the property owners from building or having obstacles (e.g., trees) above specific heights, or elements (e.g., ponds that may attract birds) that may prevent safe flight paths for aircraft. It conveys rights for aircraft to cause noise, vibrations, fumes, deposits of dust, and fuel particles (incidental to the normal operation of aircraft)."

or,

H.B. 327 (2022) defined "avigation easement" as an easement permitting unimpeded aircraft flights over the property subject to the easement, and includes the right:

> (a) to create or increase noise or other effects that may result from the lawful operation of aircraft; and
>
> (b) to remove any obstruction to such overflight.

The Legislature might also consider ensuring that avigation easements exist in the airspace above all state property, all roads, rails and rivers, and all rights-of-way and easements currently existing within the state or other political subdivisions; and shall apply to all future property, roads, rails, rights-of-way, and easements.

H.B. 327 (2022) provided examples of easement attainment mechanisms:

Utah Code § 72-10-413. Purchase or condemnation of air rights or avigation easements.

A political subdivision owning a vertiport, whether the vertiport is located within or without the territorial limits of the political subdivision, or a political subdivision that is served by the vertiport may acquire, by purchase, grant, or condemnation in the manner provided by the law under which political subdivisions are authorized to acquire real property for public purposes, an air right, an avigation easement, or other estate or interest in the property or nonconforming structure or use in question if:

> (1) it is desired to remove, lower, or otherwise terminate a nonconforming structure or use;
>
> (2) the approach protection necessary cannot, because of constitutional limitations, be provided by vertiport land use regulations under this part; or
>
> (3) it appears advisable that the necessary approach protection be provided by the acquisition of property rights rather than by vertiport zoning regulations.

Licensing of Vertiports

After "airports" add "and vertiports" to Utah Code § 72-10-103 1a – regulate the use, licensing, and supervision of airports and vertiports.

Aircraft Registration

Utah Code § 72-10-109 (3) – The Legislature might consider replacing "Unmanned aircraft as defined in Section 72-14-102 are exempt from the state registration requirement under Subsection (1)." with "All commercial UAS and advanced air mobility aircraft must register with the state."

The Legislature might also consider basing registration fees on aircraft weight and utility category.

For example, Code of Federal Regulations Part 107 commercial operators, such as real estate agents, would pay $5 per year, theirs being the lightest drones; drone package delivery operators with heavier aircraft would pay $20 per year; and aerial taxi service providers, being the largest and heaviest aircraft, would pay $100 per year in registration fees.

Advanced Air Mobility Restricted Account

The Legislature might consider establishing an Advanced Air Mobility Restricted account, which would have purposes similar to the Aeronautics Restricted Account and the Aircraft Operations Restricted Account.

Example language might include:

> (1) There is created a restricted account known as the Advanced Air Mobility Restricted Account.
>
> (2) The account consists of money generated from the following revenue sources:
>
> > (a) Fees the department receives from;
> >
> > > i. Aerial corridor user fees

ii. Advanced air mobility alternative fuel tax, (electricity, hydrogen, etc.)

iii. Landing fees

iv. Vertiport related property taxes

v. UAS aircraft sales tax

vi. Advanced air mobility aircraft registration fees

(b) Appropriations to the account by the Legislature;

(c) Contributions from other public or private sources for deposit into the account; and

(d) Interest earned on money in the account.

(3) Upon appropriation by the Legislature, the department may use money in the account for the operation and maintenance of the state Advanced Air Mobility system.

State Preemption

The Legislature might consider broadening the preemption rule in state code by changing “unmanned aircraft” to “advanced air mobility” aircraft.

Utah Code § 72-14-103. Preemption of local ordinance, might be changed to state:

(1) A political subdivision of the state, or an entity within a political subdivision of the state, may not enact a law, ordinance, or rule governing the private use of an advanced air mobility aircraft unless:

(a) Authorized by this chapter; or

(b) The political subdivision or entity is an airport operator that enacts the law, rule, or ordinance to govern:

(i) The operation of an advanced air mobility aircraft within the geographic boundaries of the airport over which the airport operator has authority; or

(ii) The takeoff or landing of an advanced air mobility aircraft at the airport over which the airport operator has authority.

(2) This chapter supersedes any law, ordinance, or rule enacted by a political subdivision of the state before July 1, 2022.

Advanced Air Mobility Program Office

It will be necessary to engage, collaborate and coordinate regulations and management of this new transportation system in a more deliberate and formal manner as advanced air mobility operations grow and additional transportation options evolve across communities.

Utah Code § 72-10-103 establishes the Division of Aeronautics to govern the regulation of air navigation and airport facilities. The Legislature might consider creating a formal advanced air mobility program office under the jurisdiction of the Division of Aeronautics.

To mitigate any confusion, the Legislature might consider it beneficial to add language to Utah Code § 72-10-103 to specifically address advanced air mobility program office responsibilities. Responsibilities may include:

- General oversight of the advanced air mobility system;
- Aerial corridor planning and management;
- Vertiport facility approval and permitting;
- Advanced air mobility/UAS aircraft registration;
- Management of funds within an Advanced Air Mobility restricted account; and
- Development and management of an aerial traffic operations center.

Multiple states are proactively approaching this space by setting up an advanced air mobility program office and starting to build the initial infrastructure to support operations and foster economic growth.

Sandbox

To catalyze initial aerial taxi utilization, the Legislature might consider providing portions of land at public facilities (Trax stations, Frontrunner stations, parking decks, rooftops, rest areas, etc.) to be transitioned into simple initial vertiports. These will provide multi-modal public access to airspace and aerial corridors and will incentivize the industry to begin offering aerial taxi services.

Local Municipal Processes

Permitting and Business Licensing Processes

The Legislature might consider ensuring that municipalities include drone package delivery, aerial taxi services and personal aerial vehicles to their list of approved uses, and develop a clearly defined process through which AAM service providers may apply for the necessary use permits and business licenses to begin conducting operations.

Zoning and Vertiport Overlay Zones

The Legislature might consider ensuring that municipalities develop language inclusive of take-off and landing operations within their zoning ordinances. The Legislature might also consider ensuring that political subdivisions adopt vertiport overlay zones to ensure cooperative integration between vertical infrastructure and future development.

Taking an example from H.B. 327 (2022):

"Vertiport overlay zone" means a secondary zoning district designed to protect the public health, safety, and welfare near a vertiport, that:

> (a) Applies land use regulations in addition to the primary zoning district land use regulations of property used as a vertiport and property within a vertiport influence area;
>
> (b) May extend beyond the vertiport influence area;
>
> (c) Ensures vertiport utility as a public asset;
>
> (d) Protects property owner land values near a vertiport through compatible land use regulations as recommended by the Federal Aviation Administration, local Metropolitan Planning Organization, or Government Association Organization; and

(e) Protects aircraft occupant safety through the protection of navigable airspace.

Utah Code § 72-10-403 Vertiport land use regulations

Regarding land use regulations for vertiports, the Legislature might consider requiring municipalities to adopt language to protect the navigable airspace around vertiports such as:

(1) [(a)] In order to prevent the creation or establishment of vertiport hazards, every political subdivision having a "vertiport hazard area" within the political subdivision's territorial limits, and each political subdivision located within a vertiport influence area shall adopt, administer, and enforce, under the police power and in the manner and upon the conditions prescribed in this part, Title 10, Chapter 9a, Municipal Land Use, Development, and Management Act, and Title 17, Chapter 27a, County Land Use, Development, and Management Act, vertiport land use regulations for the vertiport influence area, including a vertiport overlay zone.

(2) (a) Each political subdivision located within an airport influence area shall notify a person building on or developing land within a vertiport influence area of aircraft overflights and associated noise.

(b) To promote the safe and efficient operation of the vertiport, a political subdivision located within a vertiport influence area shall:

(i) As a condition to granting a building permit or a requested zoning change within a vertiport influence area, require a person building or developing land to grant or sell to the vertiport owner, at fair market value, an avigation easement;

(ii) Adopt a vertiport overlay zone conforming to the requirements of this chapter and 14 C.F.R. Part 77; and

(iii) Require any proposed development within a vertiport influence area to conform with 14 C.F.R. Part 77

Land-Use and Transportation Planning

The Legislature might consider ensuring that any long-range transportation planning process undertaken within the state incorporates land-use plans for future potential vertiport sites and aerial corridor planning.

The land-use planning for AAM should also coordinate with zoning laws and be developed in a complementary manner to balance acceptable uses without stifling innovation. Land uses for AAM will need to address and differentiate between public, recreational, commercial, residential and transportation uses. Considerations for each may include:

Public Use – Setting aside areas for general public use for AAM, which may include hospitals, multimodal transportation hubs, municipal buildings, parks or areas for the general public good.

Recreational Use – Areas for recreational uses of advanced air mobility vehicles that could facilitate improved capacity in areas of State or National parks within the State. Recreational areas could also include parks, stadiums, golf courses, scenic mountain retreats, lakes or other open spaces to facilitate recreation.

Commercial Use – Facilitate commutes for employees, air cargo delivery hubs, inland ports, restaurants or other commerce-type buildings where AAM in the form of passenger air mobility or air cargo is beneficial.

Residential Use – AAM services close to where people live and would need to be balanced with benefits to the community versus impacts. Residential areas would need to consider land use for air cargo, passenger air mobility and emergency services. Planning should consider the density of the housing in the area, noise impacts and acceptable uses.

Transportation Use – Transportation land-use planning should consider the integration of AAM services into the current transportation system on the streets and railways as well as buildings that may be associated with rooftop take-off and landing operations.

It will be essential to coordinate with city planners and Metropolitan Planning Organizations to ensure that new AAM developments don't conflict with future development plans.[32]

Phase One Implementation

Aerial Traffic Operations Management

As requested in the committee hearing on September 21, 2022, the Legislature might consider directing the Division of Aeronautics to establish an aerial traffic operations center for monitoring and reporting on airspace traffic and, as appropriate, managing airspace for AAM purposes not currently managed or controlled by FAA air traffic control operations.

Public Outreach and Education Campaign

As recommended in the committee hearing on September 21, 2022, the Legislature might consider directing the Division of Aeronautics, or another agency or organization such as the Governor's Office of Economic Opportunity or Deseret UAS, to conduct a public outreach campaign targeted to communicate the facts and realities of an AAM system and its accompanying aircraft operations to municipal stakeholders and the general public.

Stakeholder Innovation Task Force

Effectively integrating advanced air mobility operations into existing transportation solutions will require collaboration across diverse groups that have not traditionally worked together.

To encourage and initiate effective collaboration, the Legislature might consider establishing a statewide mobility innovation task force. This task force might be housed and organized within Deseret UAS, ASPIRE the Governor's Office, or another appropriate agency or organization.

The task force could assist in fostering innovation by integrating key stakeholders to identify emerging solutions that assist with the freedom of movement across the state. Stakeholders may include members of the Legislature, transportation departments, airport managers, city planners, economic development teams, MPOs, OEMs, service providers, public safety, rail administration, shared mobility providers, the manufacturing community and academia.

[32] For example, coordination is needed for the creation of a vertiport next to a site with the planned development of tall buildings or other tall obstructions.

Conclusion

Advanced air mobility is coming. The proverbial train is leaving the station. The only question is: Will Utah be in the pilot’s seat, or waiting in the wind?

Utah already has a plethora of assets in place that could be utilized in early implementation of advanced air mobility. Because of the leadership of the Division of Aeronautics, airports are already starting to prepare for vertiport design and electrification. And the Department of Transportation has been a national innovation leader with their statewide fiber optics and Road Weather Information Systems.

The technology exists and is available to augment Utah’s in place infrastructure. Mechanisms to acquire the money needed to pay for the new technologies are already in place and more are anticipated from the federal government.

Most importantly, Utah has the ability to start simple; not everything needs to be in place on day one. Following a phased implementation allows government and markets to grow one step at a time and adjust appropriately to shifting market demands.

Proactive legislative action to enable this new industry has clear benefits to air quality, quality of life and healthcare access, and increased equality and access to global markets. Conversely, inaction can limit or slow growth, and, in some cases, can completely stymie implementation of this new system.

With a second Olympic games imminent and the world looking for innovative leadership in technology, environmental stewardship and human equality, Utah’s pioneer spirit can be that beacon of light leading the world in advanced air mobility.

This project completed under the direction of the Utah Division of Aeronautics, Jared Esselman Director, WSP USA, Inc as prime contractor, and a multi-disciplinary team with NEXA Advisors, and UAM Geomatics as a subcontractors.

Appendix A: United States Federal Programs and Regulatory Efforts

The United States is at the forefront of advanced air mobility implementation worldwide. U.S.-based aircraft design and manufacturing projects are among the most mature in the world. Congress is taking legislative action to encourage and provide funding for the implementation of advanced air mobility. Also, the Federal Aviation Administration (FAA) and the National Aeronautics and Space Administration (NASA) are conducting extensive research into aircraft standards, electric propulsion standards, manufacturing standards, vertiport standards and airspace management.

To date, Congress is considering two major bills.

Advanced Air Mobility Coordination and Leadership Act

In 2021 and 2022, the United States Senate and House of Representatives passed independent versions of the Advanced Air Mobility Coordination and Leadership Act. This legislation is designed to encourage the U.S. Department of Transportation to bolster the advanced air mobility ecosystem by creating an interagency working group of over 10 departments and agencies.

Introduced by Rep. Sharice Davids (D-KS) and cosponsored by five Democrats and five Republicans, the House version, H.R. 1339[33], passed on November 11, 2021. The Senate version, S.516[34], was introduced by Senator Jerry Moran (R-KS) and cosponsored by Senator Kyrsten Sinema (D-AZ) and passed on March 23, 2022.

The two bills feature similar language and provide for the establishment of a working group comprised of representatives from key federal agencies, tasked with identifying ways of maturing advanced air mobility operations and the relevant federal programs for doing so. The working group is intended to plan and coordinate efforts related to the safety, operations, infrastructure, physical security, cybersecurity and federal investment necessary to support the advanced air mobility ecosystem in the United States. The Senate and the House of Representatives will need to take further action to reconcile the two versions, which harbor minor differences, prior to it being signed into law.

Advanced Aviation Infrastructure Modernization Act

House Bill H.R. 6270 was introduced on December 21, 2021, and is titled the "Advanced Aviation Infrastructure Modernization (AAIM) Act." The Act states that "not later than 180 days after the date of enactment of this Act, the Secretary shall establish a pilot program to provide grants that:

- Assist an eligible entity to plan for the development and deployment of infrastructure necessary to facilitate advanced air mobility operations in the United States;
- Make funding available for costs directly related to construction of public use vertiports or associated infrastructure; and

[33] H.R. 1339, Advanced Air Mobility Coordination and Leadership Act, Nov. 2021. Available at: https://www.congress.gov/bill/117th-congress/house-bill/1339

[34] S.516, Advanced Air Mobility Coordination and Leadership Act, Mar. 2021. Available at: https://www.congress.gov/bill/117th-congress/senate-bill/516/text

- IN GENERAL. The Secretary shall provide grants to eligible entities to develop comprehensive plans under paragraph (2) related to AAM infrastructure."[35]

FAA Unmanned Aircraft Systems Test Site Program

The FAA Modernization and Reform Act of 2012 directed the FAA Administrator to select six UAS test sites to support the administration in the integration of UAS into the national airspace system. The six selected sites became operational in 2014, and a seventh site was added in 2016. The six sites selected are:

- Griffiss International Airport, New York;
- New Mexico State University, New Mexico;
- North Dakota Department of Commerce, North Dakota;
- State of Nevada, Nevada;
- Texas A&M University Corpus Christi, Texas; and
- Virginia Polytechnic Institute & State University, Virginia.

The main objective of the UAS Test Site Program is to provide verification of the safety of public and civil UAS operations and related navigation procedures before their integration into the national airspace system (NAS). Other program requirements include supporting the FAA during the development of certification standards, air traffic requirements, coordinating research, and other work with NASA, FAA NextGen, the Department of Defense, and other federal agencies. The original five-year program has been extended twice and is scheduled to continue until September 30, 2023.

The UAS Test Sites support the FAA advancement of the following technologies and concepts through research and demonstration operations:

- Air traffic control operational and communications procedures;
- Airworthiness;
- Beyond Visual Line of Sight (BVLOS) operations;
- Command and Control (C2);
- Counter UAS;
- Detect and Avoid (DAA);
- Environmental impacts;
- Multiple UAS operations;
- Standards for the safe operation of UAS in various airspace classes;
- Test and evaluation of proposed UAS standards, processes and procedures;
- UAS Traffic Management (UTM); and
- Urban Air Mobility (UAM).

To assist in research development at the test sites, the FAA has provided "blanket" authorizations to fly public aircraft operations throughout the national airspace system (NAS) at or below 200 feet. These new authorizations are called Certificates of Waiver or Authorization (COAs) and allow for small UAS (under 55 pounds) to be operated by the test sites, to fly up to 200 feet above ground level anywhere in the United States except restricted airspace and close to airports or heliports. It also allows test sites to

[35] AAIM Act - https://www.congress.gov/bill/117th-congress/house-bill/6270

fly various types of UAS under a single Certificate of Authorization. People who hold a recreational or sport pilot certificate may conduct test site operations under the Certificate of Authorization.

Under the new rules, a third-class medical certificate is no longer required; only a valid driver's license. Flights must be done during daytime, under visual flight rules.

Definitive funding for the UAS Test Site Program is not readily available. However, the FY2022 FAA President's Budget Submission allocated the below listed funding requests:

- $23.1 million for advanced UAS integration and address the need for enhanced security related to UAS (Operations);
- $59.3 million to support integration into the national airspace (Facilities and Equipment);
- $6.5 million to support integration into commercial airspace (Facilities and Equipment); and
- $22 million to support continued research to support safe integration of UAS operations, examine counter UAS technologies, and evaluate potential impacts on airport operations (Research, Engineering and Development).

In addition to these funding requests, a Grants-in-Aid for Airports request of $40.9 million for the Airport Technology Research program was included in the budget submission. The Airport Technology Research program targets funding specifically related to or impacting the airport environment, and UAS was explicitly included for funding support. Although it cannot be definitively stated, it is likely that funding for the UAS test site program is allocated from the funding requested for research, engineering, and development.

FAA Urban Air Mobility Concept of Operations

The FAA 2020 Concept of Operations (ConOps) on Urban Air Mobility describes the FAA vision of how urban air mobility may evolve and be integrated into the national airspace. This concept of operations envisions urban air mobility and advanced air mobility will initially operate with helicopter facilities, regulations and air traffic management. These will gradually be replaced by "advanced air mobility"-specific equivalents. The concept of operations also calls for the gradual increase levels of automation over time, up to the point where piloting would occur remotely. Urban air mobility and advanced air mobility would operate in three different environments:

- Air Traffic Management within all other airspace subject to FAA Air Traffic Control;
- UAS Traffic Management at or below 400 feet Above Ground Level, outside Urban Air Mobility/Advanced Air Mobility corridors; and
- Urban Air Mobility and Advanced Air Mobility within designated UAM/AAM corridors.

FAA UAS Traffic Management Concept of Operations

The FAA 2020 Concept of Operations on Unmanned Aircraft System (UAS) Traffic Management (UTM) presents the FAA's perspective on the ongoing integration of unmanned aircraft systems into the national airspace. The previous version of this concept of operations dealt mostly with UAS operations up to 400 feet AGL in uncontrolled airspace, revision 2.0 introduces a vision for operations beyond visual line-of-sight and/or in controlled airspace (Classes B through E).

As the FAA does not believe that the existing Air Traffic Management system can be adequately scaled to handle large numbers of UAS operations in controlled airspace, the agency proposes that UAS operations in this airspace and/or beyond visual line-of-sight should be handled through Unmanned Traffic Management that will provide identification, route monitoring, and collision avoidance, among other services.

NASA Advanced Air Mobility National Campaign

NASA's vision for the Advanced Air Mobility (AAM) Mission is to help emerging aviation markets to safely develop an air transportation system that moves people and cargo between places previously not served or underserved by aviation.

The Aeronautics Research Mission Directorate (ARMD) initiated the AAM Mission Integration Office during the 2020 fiscal year. The objective is to promote flexibility and agility while fostering advanced air mobility mission success and to promote teamwork across aeronautics research mission directorate projects contributing to the AAM Mission.[36]

NASA's goals for advanced air mobility are that it:

- Is safe, sustainable, accessible, and affordable aviation for transformational local and intraregional missions;
- Includes the transportation passengers and cargo as well as aerial work missions, such as infrastructure inspection or search and rescue operations; and
- Includes local missions of about 50-mile radius in rural or urban areas, and intraregional missions of up to a few hundred miles that occur between urban areas, between rural areas, or between rural and urban areas.

Additional Federally Funded Research Efforts

The Airport Cooperative Research Program (ACRP) is an FAA-sponsored initiative of the Transportation Research Board (TRB) providing practice-ready research products to the broader aviation community. The Transportation Research Board is a division of the National Academies of Sciences, Engineering, and Medicine.

Airport Cooperative Research Program (ACRP) Report 236: Preparing Your Airport to Electric Aircraft and Hydrogen Technologies – investigates the impacts of the emergence of electric aviation on the infrastructure, operations, funding, and environment of airports and aviation systems. It explores how to account for electric aircraft and hydrogen technologies in aviation and utility (electric power) planning. This guidance document provides tools for planning and design purposes, including a database of electric aircraft characteristics for airport and vertiport planning, and a long-term electric demand assessment tool. The study proposes extensive discussions on policies, technical standards, and the safety implications of operating electric aircraft at airports and vertiports.

ACRP Research Report 243: An Airport-Centric Study of the Urban Air Mobility Market – discusses the introduction of advanced air mobility at airports, and provides a market assessment, as well as emerging use cases with a solid business case for airport applications. The guidebook, primarily intended for airport industry practitioners, defines the major technological and regulatory uncertainties. It also describes a strategy for engaging with airport stakeholders to better understand their perspectives and views of policy and planning considerations regarding the local implementation of advanced air mobility.

[36] NASA - https://www.nasa.gov/aam/overview/

Finally, it provides guidance on how to plan for vertiports and STOLports, including at existing aviation facilities, and features discussions on flight operations and aviation security. The report is accompanied with assessment tools for airport operators to determine readiness for advanced air mobility, multimodal integration, and community outreach.

ACRP Synthesis 11-03: Airport Centric Advanced Air Mobility Market Study – an ongoing project that aims to summarize, compare, and contrast existing advanced air mobility market studies, and analyze and identify research gaps for information that airports may need. The audience for the research report will be airport operators, transportation planners, state and local governments, policy makers, and other key stakeholders.

PARAS 0041: Security Considerations for Urban Air Mobility Operations at Airports – an ongoing research project of the Program for Applied Research in Airport Security (PARAS). PARAS is a similar FAA-funded research program that develops near-term practical solutions to security problems faced by airport operators. PARAS is managed by the National Safe Skies Alliance, Inc., a non-for-profit modeled after the ACRP.

Appendix B: Advanced Air Mobility Efforts in Other States

Several states are starting to take an interest in facilitating the emergence of advanced air mobility locally. To better understand both the opportunities and potential challenges associated with the deployment of advanced air mobility, working groups are being formed and studies are being conducted, especially to evaluate the potential benefits of advanced urban and regional air mobility for the local economy and communities. As a part of these studies, states are starting to explore options for policies that could enable or facilitate the development of advanced air mobility, and to integrate advanced air mobility considerations into statewide transportation system planning.

Arkansas

Arkansas announced the creation of the Arkansas Council on Future Mobility, an advisory board tasked with helping Arkansas serve as a hub for next-generation mobility, including advanced air mobility. According to Flying Magazine, Governor Asa Hutchinson has tasked this committee to review current legislation, design programs to expeditiously adopt these technologies, secure federal funding and establish education and workforce initiatives that can create jobs in the state. Twenty percent of Arkansas' exports are already part of the aviation and aerospace supply chains. An initial report is expected by December 2022.

In terms of funding smart-mobility research in the state, in July 2022, the University of Arkansas received a $412,000 planning grant from a charitable support foundation to support the college's efforts and pilot research studies in smart mobility including unmanned aerial mobility (Arkansas Business, 2022).

California

In 2022, the California Department of Transportation's (Caltrans) Division of Research, Innovation, and System Information (DRISI) began research on Air Digitization with a primary focus on digitizing corridor airspace for UAS/AAM. The goal of this project is to develop and implement guidelines and best practices for the state and local agencies in the understanding, development and approval of airspace corridors. A second goal of the research is to identify corridor impacts on the community in terms of safety, equity and environmental impacts. The research outcomes will summarize items required for identifying and defining the critical roles and responsibilities of stakeholders involved in the implementation of advanced air mobility.

The research findings will be utilized by Caltrans' Division of Aeronautics to develop a simulation to be used for analysis of proposed siting and development of vertiports and airspace corridors. Additionally, the California State Transportation Agency is working toward coordinating advanced air mobility integration and has released a Request for Information (RFI) on critical components necessary for advanced air mobility integration. The State of California is anticipated to release a Request for Proposals (RFP) in the fall of 2022, which incorporates the knowledge gained from the RFI to perform a study of what elements are needed for advanced air mobility integration in California.

Los Angeles

The Los Angeles Department of Transportation (LADOT), the Los Angeles Department of City Planning and the Mayor's Office are collaborating to develop policies and procedures for the regulation of UAM operations in the city, starting with a report on the UAM Policy Framework Considerations. The implementation strategy to be utilized over the next two decades is to enable relevant stakeholders to analyze and evaluate the UAM trials and partial development. Per the LADOT UAM Policy Framework Considerations report, this approach best informs the construction and scaling of new infrastructure and helps the community benefit from equitable access to multimodal transportation and its land use.

Urban Movement Labs (UML) was formed in December 2020 with the purpose of defining what the future of UAM will look like in Los Angeles. UML was funded through a partnership with the City of Los Angeles that includes eVTOL developers Archer, Supernal Volocopter and others in the advanced air mobility industry. In February 2021, eVTOL developer Archer announced plans to establish an air taxi network in Los Angeles using its four-seat, all-electric butterfly eVTOL design, which is due to be certified for commercial operations by 2024. UML is working to facilitate collaboration between public agencies, mobility technology companies and community members to pilot mobility solutions.

Overair plans to introduce passenger services in the region as early as 2026. The company claims aircraft will be able to transport up to five passengers and a pilot at distances of up to 100 miles and top speeds of 200 mph. The aircraft can also be configured to carry 1,100 pounds of cargo. In April 2022, UML was joined by Helinet, which transports more than 900 medical transplant organs a year and is the primary helicopter provider for Children's Hospital Los Angeles. With experience in parcel delivery, aerial firefighting, chartered passenger services and filming, Helinet will help inform future policy and regulatory decisions related to aerial operations and ground-based infrastructure needs.

San Francisco

The San Francisco Bay Area has been at the forefront of short-haul research over the past four decades. The area is the headquarters of several eVTOL and UAM companies, including air taxi startups, manufacturers (i.e., Cora; Vahana; Kitty Hawk; Archer) and rideshare and passenger companies (i.e., Quick Charter; Gary Air; Meicer Aviación). These have become alternatives to other mobility services in the city. BLADE, a short-distance aviation company, has tested on-demand flights in the Bay Area, connecting San Francisco International Airport to the Oakland International Airport, Palo Alto Airport (PAO), Norman Y. Mineta San Jose International Airport (SJC), Monterey Regional Airport (MRY), and Napa Valley.

Florida

The City of Orlando is a founding member of the World Economic Forum's Advanced and Urban Aerial Mobility Cities and Regions Coalition. The Coalition launched in March 2022 and brings together cities and regions at the forefront of advanced air mobility to collaborate and share expertise, with a goal of developing a range of solutions those other cities and regions can adopt based on their respective needs. Other founding members of the Coalition include Amsterdam (Netherlands); the State of Massachusetts; Los Angeles County; Île-de-France (France), and São Paulo (Brazil). The Coalition will build on work that has taken place in Europe under the Urban Air Mobility Initiative Cities Community (UIC2) of the European Union's Smart Cities Marketplace.

In March 2022, Eve Air Mobility formed a consortium of advanced air mobility companies, tasked with developing a Concept of Operations (ConOps) to explore services that would connect the Miami International Airport (MIA) with the Miami Beach Convention Center – a distance of nine miles.

In November 2020, German eVTOL aircraft developer Lilium announced plans to develop a 2,000-mile air mobility network across the most populous parts of central and southern Florida. Orlando's Lake

Nona community will be the first site for one of 10 or more vertiports expected to launch services in 2025. The Lake Nona vertiport will cost $25 million and cover 56,000 square feet. Most of Florida's population (22 million people) will live within 30-minutes of one of these vertiports, and further demand for flights is expected from visitors to the state, which total more than 125 million annually.

The mayor of Orlando has convened the Orlando Advanced Air Mobility (AAM) Transportation Plan to prepare for new mobility options, including emerging eVTOL technologies. The Orlando AAM Transportation Plan will evaluate anticipated transportation, economic, environmental and community impacts associated with advanced air mobility through a regional connectivity plan.

The City of Orlando is one of five government entities (and the only municipality) selected to participate in NASA's AAM aero-research partnership, an initiative that allows NASA's aeronautical innovators to work with participating governments to define what it means to be a sustainable, resilient community with advanced air mobility as a significant new mode of public transportation. The NASA partnership launched series of workshops in summer of 2022.

Michigan

Michigan has partnered internationally with Ontario (Canada) to collaborate on air mobility corridor development. Governor Gretchen Whitmer initiated a study in 2022 to determine the feasibility of commercial drone skyways in three proposed areas, the Grand Traverse Region, the Michigan Central Impact Area of Corktown Detroit and between Michigan and Ontario. In 2020, two-way goods trade between Michigan and Ontario was valued at $44.8 billion. Detroit-based Airspace Link, with Northern Plains UAS Test Site, Thales USA, CityFi, Grand Sky Development Co. and Aviation Innovations LLC, will lead the support the project with the State of Michigan and Government of Ontario.

Senate Bill (SB 795) titled "Aeronautics: unmanned aircraft systems; advanced air mobility (AAM) task force; establish" was passed in the state Senate on March 17, 2022. It has been read in the House and referred to the Transportation Committee.

The bill requires the AAM committee to:

- Review current laws in this state that could impact the advanced air mobility industry and discuss necessary revisions;
- Identify potential laws in this state that will create jurisdictional consistency for advanced air mobility operations throughout this state;
- Foster public acceptance and awareness by creating an outreach campaign to educate the general public and lawmakers about advanced air mobility technology and its benefits;
- Collaborate with local governments to identify the best ways to integrate advanced air mobility into transportation plans;
- Not later than 2 years after the effective date of the amendatory act that added this section, submit a report regarding the committee's activities described in this subsection that includes recommendations for administrative or legislative action to the governor, the secretary of state, the senate majority leader, and the speaker of the house of representatives.

Senate Bills 795 and 796 address local preemption and amend the Aeronautics Code to prohibit a county, city, village or township from enacting (except as authorized by law) an ordinance, policy or rule that relates to the ownership or operation of an advanced air mobility aircraft or AAM and from otherwise engaging in the regulation or ownership of an AAM aircraft or AAM. Any ordinance, policy, or rule violating these provisions would be void, regardless of whether it was enacted or adopted by the county, city, village or township before or after the effective date of the bill.

North Carolina

The North Carolina Department of Transportation (NCDOT) is one of the few teams selected by the FAA to be a part of the BEYOND initiative, which started in October 2022. This initiative seeks to address the challenges faced with drone integration by:

- Utilizing Beyond Visual Line of Sight (BVLOS) operations that are repeatable, scalable and economically viable with attention given to infrastructure inspection, public operations and small package delivery;
- Leveraging industry operations to better analyze and quantify the societal and economic benefits of UAS operations; and
- Focusing on community engagement efforts to collect, analyze and address community concerns.

The NCDOT Integration Pilot Program (IPP) team, formed to be part of the BEYOND initiative, primarily focused on UAS package delivery (medical and food packages) in rural, suburban, and urban areas. They also investigated UAS for transportation infrastructure inspection. Under the IPP, the team conducted close to 13,000 flights, working with UPS Flight Forward, as well as Flytrex, Matternet, Volansi and Zipline. The operation included the delivery of medical supplies across the Atrium Health Wake Forest Baptist Medical Center campus and received the first waiver for full BVLOS drone operations to be used in bridge inspections.

Another NCDOT initiative was the funding of the North Carolina Transportation Center of Excellence on Connected and Autonomous Vehicle Technology (NC-CAV) in 2020. One of the goals of the center, comprising of researchers from North Carolina A&T State University (NCAT), North Carolina State University (NCSU) and University of North Carolina at Charlotte (UNCC), was to develop flexible and adaptive coordination and control algorithms for UAM.

In November 2021, the North Carolina General Assembly awarded a $5 million grant to AeroX, a nonprofit organization focused on promoting the safe and efficient commercialization of UAS technologies, for the design and development of an urban advanced air mobility system in Winston-Salem and Forsyth County. The NCGA grant allows AeroX to take a major step forward toward building the ATM system that will allow unmanned and manned aircraft to fly safely in the low-altitude air space (below 400 feet) in which UAS operate. Additionally, in 2021, North Carolina created a grant program to offer advanced air mobility startups $50,000 in non-dilutive, non-equity grants to launch Winston-Salem-based ventures for advanced air mobility.

North Carolina is actively planning for UAS integration and has incorporated UAS as part of the innovative future transportation needs in its NC Moves 2050 Plan, the state’s 30-year transportation plan. The state sees over 30,000 recreational use owners of UAS as well as over 5,000 permitted commercial and government operations. The state, in the incorporation of UAS as part of future transportation needs, also focused on the implementation of programs for public education and outreach to expand safe, beneficial drone use. This was conducted through public workshops, social media outreach, pilot programs and other approaches other things to inform residents, businesses and agencies of the benefits of UAS.

North Dakota

One of the FAA seven UAS test sites, the Northern Plains program has received more than $50 million in funding since it launched in 2019. Funding was delivered by the North Dakota Department of Commerce, Office of the Adjunct General of the National Guard, the University of North Dakota and state organizations. The funding supports UAS applications in oil and gas, public safety, law enforcement, and other relevant areas of need.

In October 2021, Vantis, a network to facilitate UAS growth in North Dakota, selected Thales Group USA as its system integrator to build the first statewide system to allow unmanned aircraft to operate BVLOS. Thales is a leader in cybersecurity and technology. Between 2021 and 2022, the program went from green field sites across the state to installing a significant amount of UAS infrastructure. The program installed three radar systems, four ADS-B ground stations and a command and communications network. The program also supported the development of a statewide cloud solution, serving as a backup for the mission-network operation capability, and a missions and operations center. This program is one of the first deployments of its kind in the world.

Ohio

FlyOhio, led by the Ohio Department of Transportation's (ODOT) DriveOhio initiative, is partnering with advanced air mobility leaders; the United States Air Force; NASA; JobsOhio; the Ohio Federal Research Network; the Dayton Development Coalition; the City of Springfield, and corporate partners from across Ohio. Ohio estimates $13 billion in economic impact over 25 years through investing in advanced air mobility, including 15,000 new jobs, $2.5 billion in local, State and federal tax revenues, and 1.6% GDP growth through 2045.

To kickstart advanced air mobility efforts, a $6 million grant was awarded to the City of Springfield. The grant funds were intended for the establishment of a National Advanced Air Mobility Center of Excellence (NAAMCE) at Springfield-Beckley Municipal Airport. The total cost is expected to be $9.35 million and is further supplemented through funding from the City of Springfield and JobsOhio.

Ohio has conducted has four separate research efforts with NASA, focused on (1) community integration; (2) air traffic; (3) command and control; and (4) safety. Ohio also published the Ohio AAM Framework in August of 2022. This framework delves deeper into implementation and integration guidance for advanced air mobility. The target audience is entities needed for successful implementation (MPO, RPO, city governments, etc.).

In 2020, FlyOhio and the Ohio DOT commissioned an in-depth study of advanced air mobility, with a focus on connecting six metropolitan areas — Akron, Cincinnati, Cleveland, Columbus, Dayton and Toledo. The connections between regions were focused on passenger transportation, cargo delivery, and an economic impact forecast through 2045. The jobs, tax revenues and overall economic productivity forecasted have won politicians' interest. In November 2021, Ohio Governor Mike DeWine said, "Just as Ohio led the development of the air age in the 20th century, Ohio will lead the development of the aerospace age in the 21st century."

Springfield-Beckley Municipal Airport near Dayton has become an advanced air mobility epicenter. In 2019, the airport won FAA designation to test drone flights BVLOS. The airport has also attracted several companies developing advanced air mobility capabilities. They include Beta Technologies (Vermont), Moog Inc. (New York), Kitty Hawk and Joby Aviation (California) and Lift Aircraft (Texas).

On August 22, 2022, the state hosted a National AAM Industry Forum. (https://www.aamohio.com/). In September 2022, the 6th AAM Infrastructure Workshop of the Vertical Flight Society was held in Dayton.

*A list of active legislation from all 50 US states can be found in the full Utah Advanced Air Mobility report.

Appendix C: Global Implementation

Global implementation of advanced air mobility has varied in style and purpose. Brazil, Canada, the United Kingdom, France, China and Japan have all approached advanced air mobility from various perspectives and certification processes.

Brazil

The Airport Infrastructure Department (SIA) of the Brazilian national aviation authority (ANAC) established an industry working group in April 2021 to explore the potential development of regulations regarding vertiports.[37] On the aircraft-certification side, ANAC amended several Brazilian Civil Aviation Regulations (RBAC), including airworthiness requirements and noise requirements, to account for novel VTOL aircraft.

Canada

Transport Canada (TC), the federal aviation authority of Canada, is involved with certification of electric aircraft and electric propulsion technologies. Transport Canada has already published technical standards on remotely piloted aircraft system (RPAS).

European Union

In March 2022, the European Aviation Safety Agency (EASA) issued Prototype Technical Specifications for the Design of VFR Vertiports for Operation with Manned VTOL-Capable Aircraft Certified in the "Enhanced" Category. This guidance plays a similar role to the FAA Engineering Brief No. 105, as it presents a first step toward a full regulatory framework for vertiport design and certification.

Japan

Japan developed an ambitious roadmap to enable advanced air mobility nationwide at the 2030 horizon. The first step, before 2025, would feature a few flight areas to perform demonstration flights around specific use cases. Ten more mature UAM flight areas enabling commercial operations would be implemented in 2025. This second milestone would provide for passenger air services during the World's Fair Expo 2025 in Osaka. Several developers are hoping to fly their aircraft at the expo, including the ANA Holdings/Joby and the Japan Airlines/Volocopter coalitions.

* For a full comprehensive report on global advanced air mobility activities, please see the full Utah Advanced Air Mobility Report.

[37] Portaria nº 4917 of April 30, 2021 (SEI 5659455) – "Institui Grupo de Trabalho responsável pelo estudo para a identificação de possíveis intervenções regulatórias relacionadas à infraestrutura aeroportuária necessária para a operação segura de eVTOL (electric and hybrid-electric Vertical Takeoff and Landing aircraft) na mobilidade aérea urbana", ANAC