

Planning for Advanced Air Mobility (AAM)



September 2023

The What and Why of AAM

- AAM is an air transport system concept that integrates new aircraft designs and flight technologies into existing and modified airspace operations
- Small passenger movements (2-6) within/between urban areas and regional areas making flights to smaller markets a possibility
- This presentation does not include drones or UASs



Possible Benefits of AAM



Decongest road traffic



Improve mobility



Reduce transport time



Lower air pollution



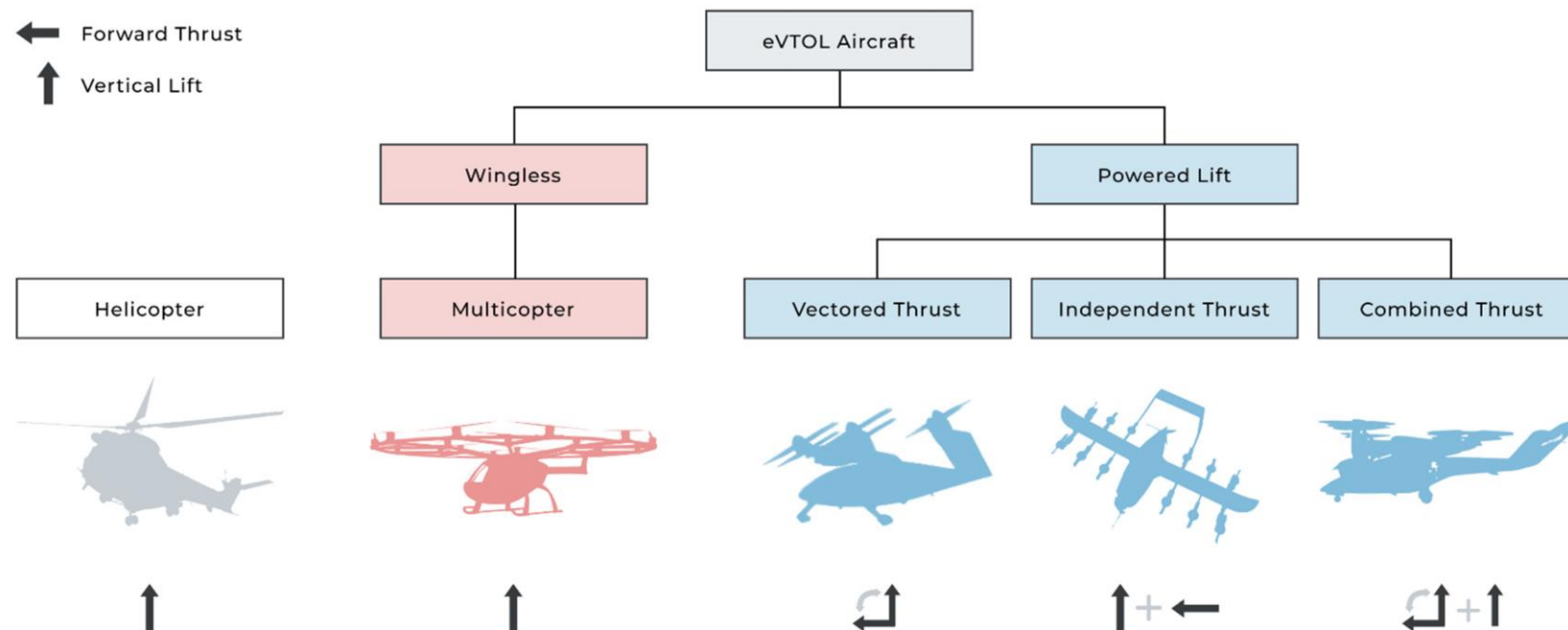
Less strain on existing networks



Improve connectivity

AAM Vehicle Types

- Electric vertical takeoff and landing (eVTOL) is the most discussed and reported segment of AAM to date
- First eVTOL operations will likely include cargo and medical transport services, with passenger transport following



Leading Manufacturers (OEMs)

								
	Archer Aviation	BETA Technologies	Joby Aviation	EVE Urban Air Mobility	Lilium	Vertical	Volocopter	Wisk
Headquarters	California, US	Vermont, US	California, US	Melbourne, FL	Germany	Bristol, UK	Germany	California, US
Funding Amt	\$1.1B	\$800M	\$2.3B	\$400M	\$1.3B	\$300M	\$800M	\$450M
Number of Passengers	4	5	4	4	6	4	1	2
Operation	Piloted	Piloted	Piloted	Piloted/ Autonomous	Piloted	Piloted	Piloted	Autonomous
Range, speed	60 miles, 150 mph	250 miles, NA	150 miles, 200 mph	60 miles, NA	155 miles, 175 mph	100+ miles, 200+ mph	25 miles, 70 mph	62 miles, 110 mph
Entry into service	2025	2025	2025	2026	2026	2027	2026	2028

Source:
AAM Reality Index, 2023.

Major Orders of eVTOLs

- Over \$11 billion in capital has been invested in the AAM sector since 2018
- Major airlines and aircraft operators have already placed orders for eVTOLs
- More than two-thirds of the 25 largest AAM companies have stated that airports are among their initial target markets

Examples of Major Orders

UNITED 

400

American Airlines 

250

NETJETS®

150

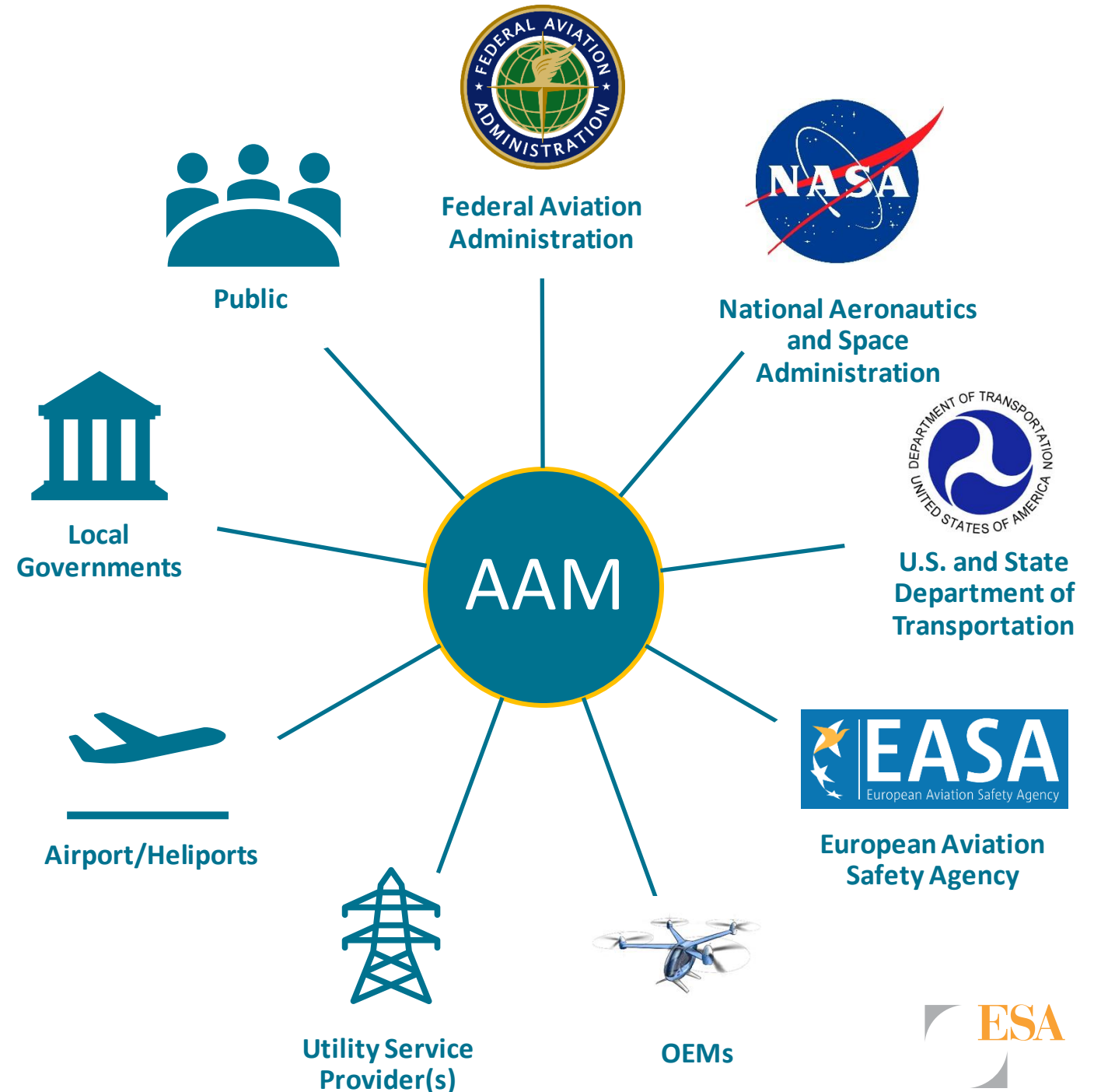


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Source:
Advanced Air Mobility Reality Index, 2022.

Key Stakeholders Involved

- Local and regional stakeholders will vary, but the following are those considered fundamental
- May 2023 - the USDOT published RFI for a national strategy on AAM
- 2023 FAA Reauthorization Act is expected to provide global leadership in AAM
 - Currently, there are over 20 sections related to AAM in House and Senate Bills



Vertiport Siting

- Possible vertiport locations include urban, suburban, and rural areas
- Vertiports can be categorized as vertihubs, vertiports, and vertistops
- Draft FAA Engineering Brief No. 105, *Vertiport Design*, specifies interim design guidance for vertiports and vertistops

Vertihub



Vertiport



Vertistop

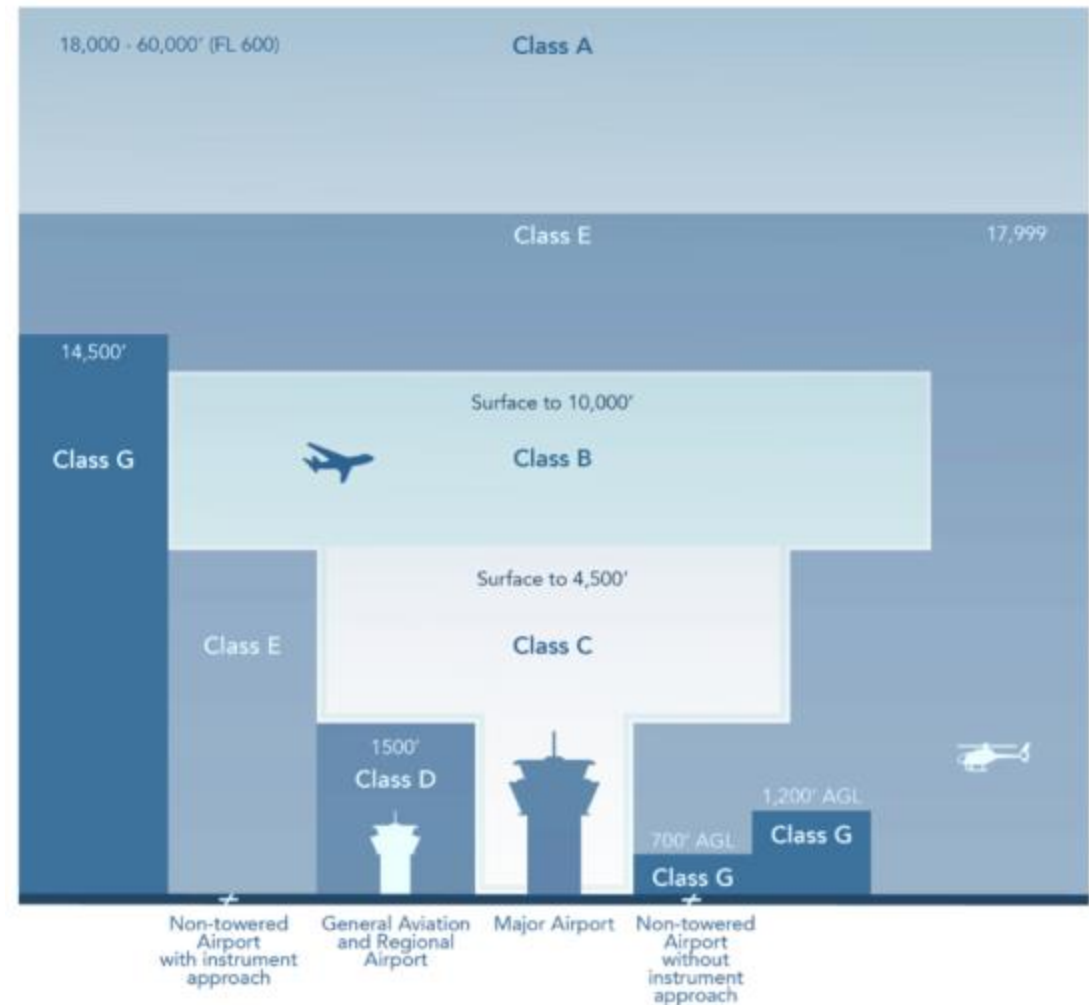


Source:
NASA, *High-Density Automated Vertiport Concept of Operations*, 2020.

Major Operational Challenges

- Operating Airspace (e.g., Class B, C, D, E)
- Airspace Capacity
- Entry and Exit into FAA Controlled Airspace
- Wildlife Impacts (e.g., bird strikes)
- eVTOL Performance Differences
- Route Planning and Integration within the National Airspace System
- Airport Siting

Controlled Airspace



Source:
FAA Aeronautical Information Manual.

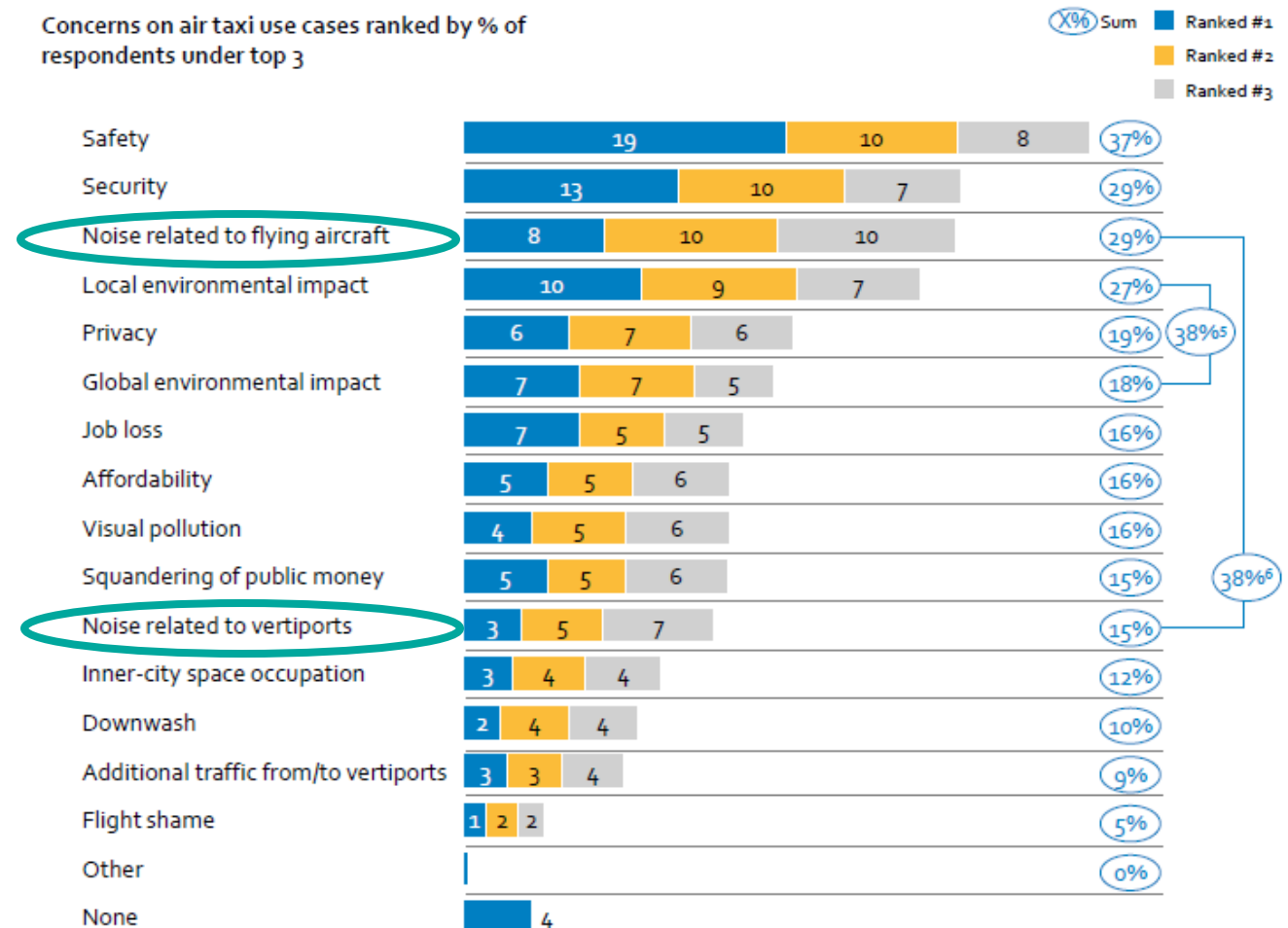
Community Integration

- Several surveys indicate that the public is generally receptive of AAM
- However, public is concerned about safety, security, noise, and environmental impact (mostly noise-related)
- Other studies by NASA in the U.S. have also confirmed that noise is the highest concern among survey participants¹
- Vertiport siting and routes are going to be key to community acceptance

¹ NASA, AAM Ecosystem Community Integration Working Group: Vertiport Siting Survey, 2022.

2021 EASA Study on the Societal Acceptance of UAM

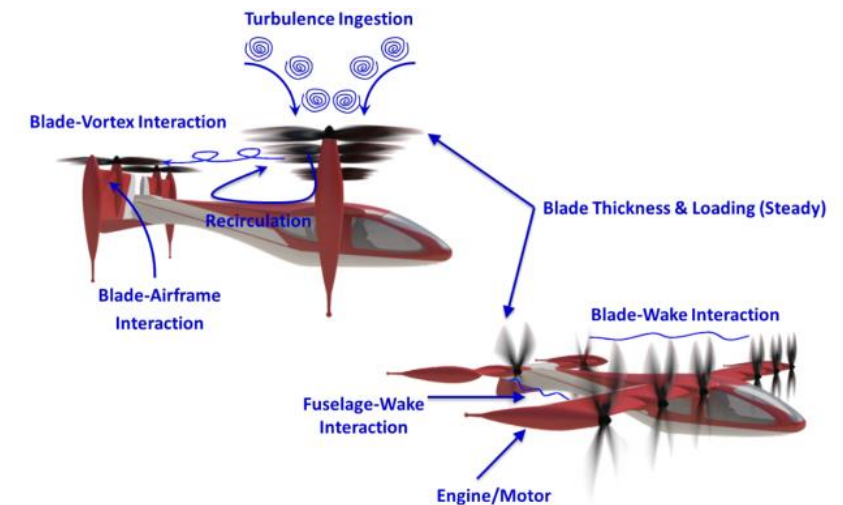
Concerns on air taxi use cases ranked by % of respondents under top 3



Noise Levels

- Noise levels will vary by vehicle type and largely depend on manufacturer design
 - Distributed propulsion systems, optimized rotor designs, and active noise reduction techniques can further decrease noise
- Most vehicles are still in development and noise data proprietary
- FAA's AEDT model does not yet contain noise data for these types of vehicles
- The overall noise level of AAM vehicles is expected to be much lower than traditional aircraft and helicopters
 - In 2022, acoustic testing of Joby's aircraft with NASA registered the equivalent of 45.2 dBA from an altitude of 1,640 feet at 115 mph¹
- Frequency of operations and flight path concentration anticipated to be largest community concern

Potential Noise Sources



Notes:

Aircraft noise sources are highly design-dependent and may vary by model. Figure is for graphical purposes only.

Source:

NASA, Urban Air Mobility Noise: Current Practice, Gaps, and Recommendations, 2021.

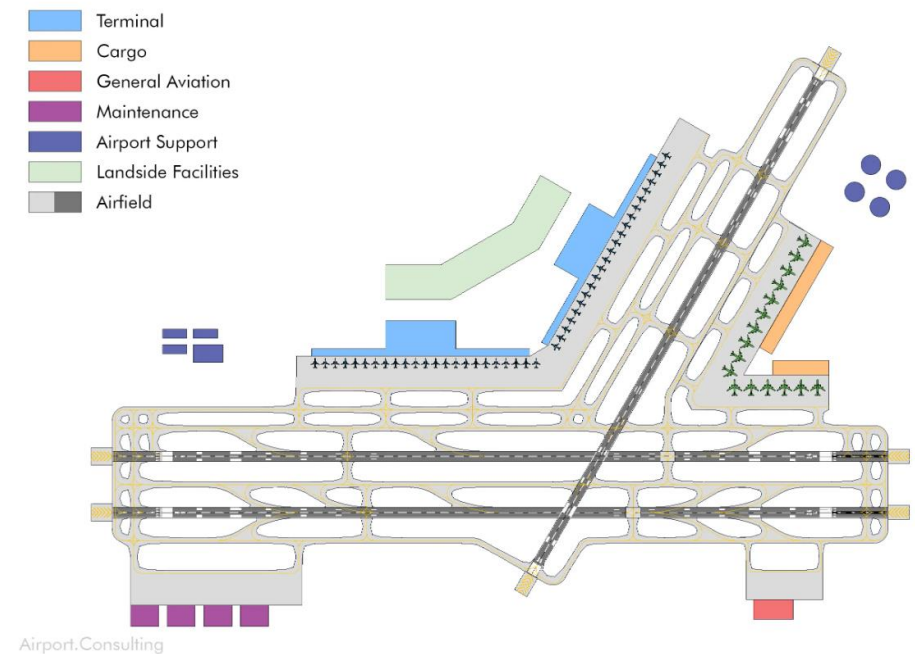
¹ Aerospace Testing International, *Joby and NASA Test Noise Levels of its eVTOL Aircraft*, 2022

Potential Implications to Airport Operations

- Airports will likely be key linkage in initial AAM rollout
- Capacity impacts
 - Potential sequencing challenges and airspace and airfield congestion
- Change in noise environment
 - Aircraft hovering over populated areas while waiting to land or cross the traffic flow
 - Changes in runway use and operational flows for fixed wing aircraft

FAA trend away from active management of aircraft could increase operational impacts

Generic Airfield Layout



Source:
Jean-Christophe Dick, 2023.

Ongoing Noise Research

- April 2018 - NASA formed UAM Noise Working Group to identify, discuss, and address potential noise issues
- April 2023 – FAA provided ~\$1M funding to universities via ASCENT¹
 - MIT and Penn State to develop noise models for various vehicles
 - Georgia Tech to evaluate potential noise exposure
- July 2023 – FAA released “Innovate28” implementation plan providing steps to take to safely enable operations in near term
- ASCENT continues to conduct research on noise characteristics of vehicles under various flight conditions²
- Summer 2024 – NASA to perform a human response study to provide insights on how individuals may or may not respond to AAM noise
- November 2023 – NASA’s Urban Air Mobility Noise Working Group will meet to speak with OEMs regarding noise levels



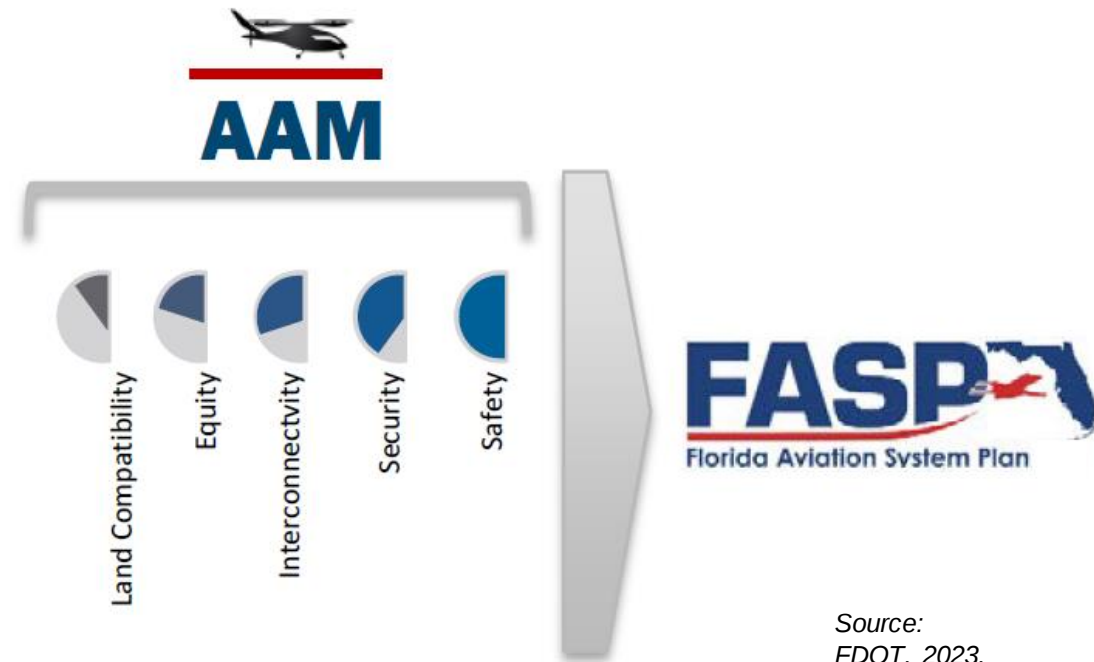
¹ FAA, *Quiet Skies: Universities to Research Way to Reduce Aviation Noise*, 2023

² ASCENT, *Modeling of Urban Air Mobility Noise to Enable Innovative Means of Noise Reduction*, 2022

Florida Department of Transportation (FDOT) AAM Leadership

- The FDOT Aviation Office (AO) has taken a leading role in AAM and has completed numerous work products to build a foundation of knowledge within the state to advance the industry
- FDOT has completed the following:
 - FDOT AAM Roadmap
 - FDOT Minimum Standards and Gap Analysis
 - FDOT Airport Compatibility Considerations
 - FDOT AAM Working Group (WG) Report
- FDOT's *Implementation and Public Outreach Plan* will outline the execution of recommendations from the AAM WG Report

AAM Relationship to the Florida Aviation System Plan (FASP)



Source:
FDOT, 2023.

FDOT AAM Working Group

- FDOT AO utilized a Working Group (WG) format to ensure focused and deliberate discussions on the steps necessary for a successful integration of AAM into the State Transportation System
- AAM WG consisted of FAA, OEMs, airports, local governments, FDOT, MPOs/TPOs, and other industry stakeholders
- AAM WG met four times between 2022-2023
- Focus Areas for discussion included:
 - Public Education and Community Engagement
 - Infrastructure and Zoning
 - System Planning and Access
 - Airspace and Safety
- AAM WG made 18 legislative, advisory, and regulatory recommendations to assist FDOT in the integration of AAM within the State Transportation System



Current Initiatives in Florida

Florida, due to its weather and robust aviation infrastructure network and traveling public, is poised to lead the nation in operations by the first entrants

AIR

- AAM vehicle showroom and dealership in Palm Beach
 - Focusing on personal market with a vehicle that can be operated from residence

Skyports

- Planned construction of vertiport at VRB
- Partnered with EVE to develop global AAM ecosystem

Archer Aviation and Joby Aviation

- Partnered with Miami based Reef (country's largest parking operator)
 - Convert tops of parking structures in Miami to vertiports



Source: Skyports, 2023.

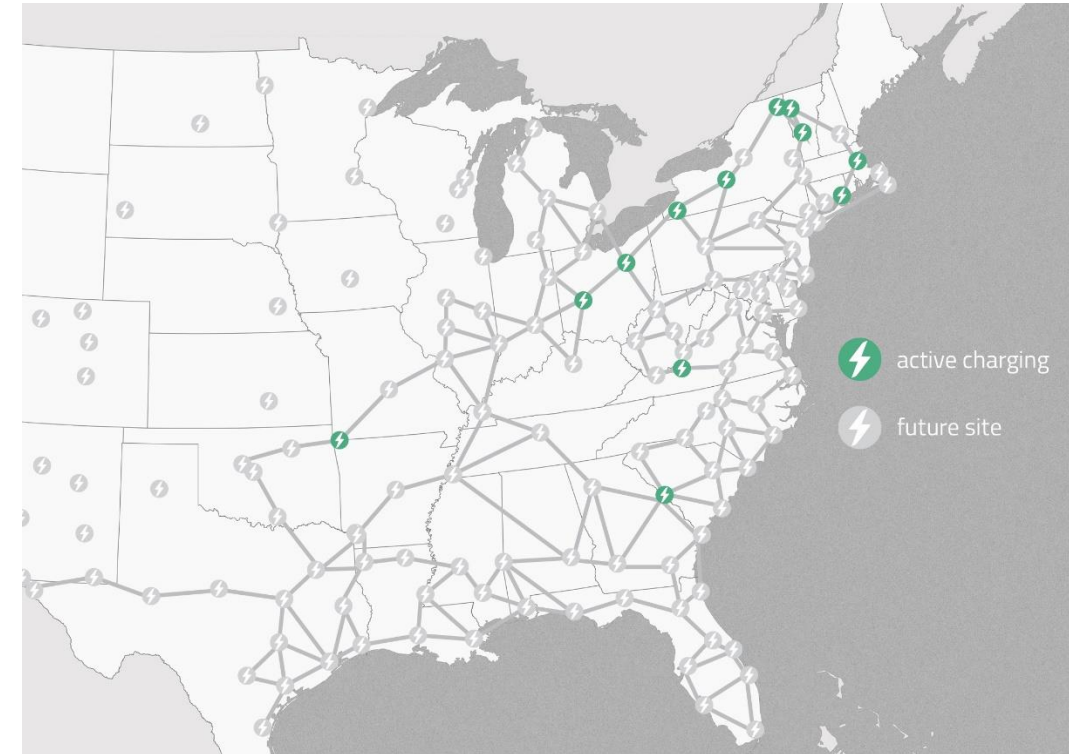
Current Initiatives in Florida (continued)

BETA

- Vertiports with charging planned for 10 Florida stations
 - Also, an agreement with CAE, a major aviation training company out of Orlando International

Eve

- Headquarters in Melbourne, FL and affiliated with Embraer
 - Intend to operate urban air taxis to be competitive with surface rideshares
 - Teamed with Global Crossing Airlines to provide AAM flights to/from MIA and FLL, as well as local flying within the Keys, Palm Beach, and Naples



Source: BETA Technologies, 2023.

Current Initiatives in Florida (continued)

Supernal (Hyundai)

- Signed a MOU with city of Miami to create a framework to look at innovative opportunities to introduce its aircraft in Miami
- In April 2023, Governor met with Hyundai Motor Group President to discuss expanding their businesses in Florida, including possibilities for eVTOL



Source: Supernal, 2022.

Regent

- Operate regional near-coastal routes, such as from Florida to The Bahamas
- Selected Tampa to test its electric seaglider

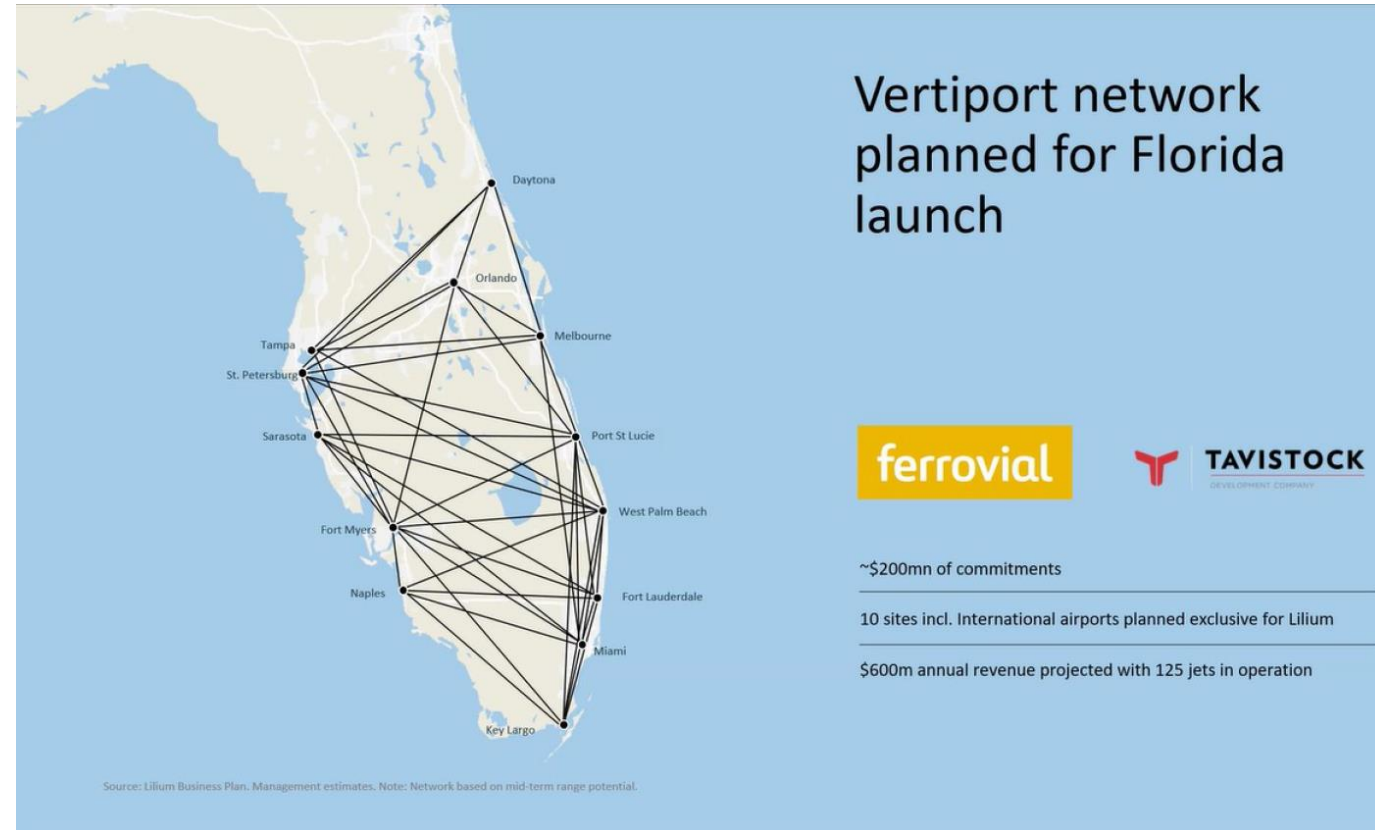


Source: Regent, 2022.

Current Initiatives in Florida (continued)

Lilium/ Ferrovia

- Perhaps most aggressive in Florida
 - Partnerships to develop network of at least 10 vertiports in Florida
 - Also partnered with Reef for parking structure sites in Miami
 - First land lease at Palm Beach International Airport
 - Plan first vertiport in Lake Nona, FL (within Orlando International's Class B Airspace)



Source: Lilium, 2022.

Note: While Naples is shown on Lilium's planned network, they nor any other developer have contacted the NAA about their future plans.