Independent Study Report on Advanced Air Mobility (AAM)

Atasi Roy Malakar
Department of Civil & Environmental Engineering,
University of Wisconsin-Madison, Madison, Wisconsin, 53706
Email: roymalakar@wisc.edu

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ABSTRACT

Advanced Air Mobility (AAM) represents a rapidly emerging aviation ecosystem that integrates electric and hybrid-electric aircraft-including eVTOL, eSTOL, lift-plus-cruise, and hybrid fly-drive designs-into low-altitude airspace for passenger, cargo, and regional mobility applications. This report aims to synthesize the current state of practice using regulatory publications from FAA and EASA, NASA's AAM National Campaign, GAO oversight documents, and recent industry program disclosures. Key findings indicate that tilt-prop and tilt-rotor eVTOL architectures (e.g., Joby S4, Archer Midnight) are the most mature pathways toward near-term commercial operations, supported by the FAA's powered-lift rule, updated vertiport standards, and evolving performance-based certification frameworks. Parallel advances in Europe continue under EASA's SC-VTOL and CS-23 rules. University research networks-including Michigan's AAM corridor, Georgia Tech autonomy projects, and ERAU anomaly-detection initiatives-are accelerating safety modeling, acoustics research, and airspace integration. Persistent challenges include infrastructure readiness, battery energy density, mixed-airspace deconfliction, workforce training, and multi-level governance gaps highlighted by the GAO. With FAA's Innovate28 initiative targeting initial at-scale operations by 2028, early deployments are expected to begin with luxury or demonstration flights before expanding to regional connectors and urban air-taxi shuttles. Sustained regulatory clarity, community acceptance, and cross-sector collaboration remain the most essential for AAM's long-term scalability.

Keywords: Advanced Air Mobility, eVTOL, Powered-Lift, SC-VTOL, Vertiport Design, Certification Frameworks

INTRODUCTION

This report synthesizes latest developments in Advanced Air Mobility (AAM) across aircraft typologies, certification frameworks, regulatory initiatives, academic research, and market readiness, focusing on US and EU regulators -Federal Aviation Administration [1-10] and European Union Aviation Safety Agency [11-12], specifically.

It was found that eVTOLs dominate early development in this field- with its variants like tilt-rotor, multicopter, ducted-fan, and lift-plus-cruise architectures serving urban and regional target markets. Regulatory frameworks like FAA powered-Lift rule and EASA SC-VTOL/CS-23 define the basis for near-term entry-into-service of several representative programs like Alef Model A (experimental fly-drive), AeroMobil 4.0 (CS-23), Joby S4 & Archer Midnight (powered-lift), Lilium Jet (ducted-fan), Volocopter 2X (multirotor), BETA ALIA-250 (lift+cruise), and Wisk Gen-6 (autonomous) [13-18].

FAA's Innovate28 aims at integrating operations at multiple key sites in US by 2028, while NASA's AAM National Campaign focuses on community noise thresholds, detect-and-avoid, and contingency systems [19-20]- all these being supported by university consortia with test data and modeling [21-24].

Constraints that could create obstacles in high target market penetration are vertiport design, infrastructure readiness, workforce training and community acceptance [3,7]. There are also several ongoing governance and liability gaps that Government Accountability Office (GAO) has identified and inter-agency coordination at multiple scales are required to resolve this [25].

AAM's expected evolution and inclusion from early operations as luxury demonstrators to regional connectors to urban shuttles, indicates a gradual, scalable adoption [3,19]. The objective of deployment of limited commercial flights by 2028 appear achievable and realistic with sustained collaboration among regulators, industry, and academia- setting the stage for an even broader, sustainable mobility integration by the first part of the next decade [1,3].

SCOPE

Building on this background, the following section will be used to define the scope of AAM within current aviation frameworks. Commercial and general aviation traditionally encompass airliners, helicopters, and other aircraft operating within the structured National Airspace System (NAS) under established flight regulations [3]. In contrast, Advanced Air Mobility (AAM) represents a new aviation ecosystem that can be traced back to the early 2000s and integrates electric or hybrid-propulsion aircraft capable of operating in both controlled and uncontrolled airspace at low altitudes [3, 19]. These aircraft serve a variety of missions-air taxis, personal aerial mobility vehicles, cargo transport, and drones-with the urban-focused segment commonly referred to as Urban Air Mobility (UAM) and the other component referred as Regional Air Mobility (RAM) [3, 19].

AAM aims to democratize access to the sky by enabling point-to-point connectivity between areas underserved by conventional aviation, while addressing key transportation challenges such as congestion, sustainability, safety, and equitable mobility [19]. It encompasses both piloted and, in the future, autonomous aircraft supported by advanced technologies in energy storage, navigation, and airspace integration [3, 19].

The Federal Aviation Administration (FAA) leads U.S. efforts to integrate these systems safely into the NAS, developing regulatory frameworks and community engagement strategies that support industry scalability [1,3]. The FAA's Innovate28 initiative exemplifies this effort, targeting safe and routine AAM operations at select sites across the United States by 2028 [1,2]. Parallel efforts by NASA, European Union Aviation Safety Agency (EASA), and academic research partners contribute to vehicle design, certification readiness, and operational modeling [11,12,19,20,21-24].

This report explores the current state of practice in AAM, synthesizing findings from regulatory publications (FAA, EASA), federal agency programs (NASA, GAO), academic research, and verified media sources [1-5, 7-12, 19, 20, 21-25]. The discussion covers vehicle typologies and technologies, certification progress, federal and university initiatives, market and infrastructure readiness, and emerging challenges and opportunities shaping the path toward early AAM deployment.

TYPOLOGY & TECHNOLOGICAL LANDSCAPE

AAM systems comprise an integrated ecosystem that combines fleet management, airspace management, and vertiport/airport operations supported by technologies such as the FAA's Aircraft Network Security Program, In-Time Aviation Safety Management System (IASMS), and resilient infrastructure for communication, navigation, surveillance, and weather data [9,10]. Together, these systems aim to ensure safe, efficient, and economically sustainable operations-even under contingency or emergency conditions [9].

Within this ecosystem, several aircraft typologies have emerged based on their lift and propulsion configurations [3,19]:

- eVTOL (Electric Vertical Takeoff and Landing): fully electric or hybrid-electric aircraft capable of vertical lift.
- eSTOL (Electric Short Takeoff and Landing): aircraft designed for high-lift short-field performance using minimal runway length.
- Hybrid Fly-Drive Vehicles: dual-use concepts like Alef and AeroMobil that require both aviation and road certification under FAA/EASA and national highway authorities.

The eVTOL category further branches into sub-architectures, each with unique operational trade-offs [3,19]:

- Tilt-rotor/tilt-prop systems (e.g., Joby S4, Archer Midnight) balance range and cruise efficiency but generate transient noise during transition.
- Multicopters (e.g., EHang 216) offer simplicity and vertical agility but limited endurance due to the absence of wing lift.
- Ducted-fan configurations (e.g., Lilium Jet) enhance acoustic shielding but face higher hover power demands.
- Lift+cruise designs (e.g., Wisk Generation 6) use distinct lift and cruise propulsors for stable hover and efficient cruise flight.

Following is a comparative overview of these classes, summarizing their power source, lift/control architecture, advantages/trade-offs, and primary use cases [3].

TABLE 1 Comparative Overview of AAM Aircraft Typologies

Class	Power Source	Lift Type/ Control Architecture	Advantages/ Trade-offs	Primary Use Cases	Examples
eVTOL - tilt-rotor/ tilt-prop	Battery-electric or hybrid-electric	Tilting rotors/props + wing-borne cruise	No runway needed; efficient cruise; transient noise in transition	Urban air taxi; inter-airport shuttle	Joby Aviation
eVTOL - multicopter	Battery-electric	Multiple fixed rotors; no wings	Simplest control; high hover stability; limited range	Urban inspection; medium cargo delivery	EHang 216
eVTOL - ducted fan	Battery- or Hybrid Electric	Ducted fans; some tilt capability	Reduced noise footprint; complex thermal/energy load in hover	Urban shuttle where acoustic limits are strict	Lilium Jet
eVTOL - lift+cruise	Battery- or Hybrid Electric	Dedicated lift rotors + separate cruise propulsor	Efficient in cruise; good redundancy; heavier structure	Urban/suburban air taxi; light cargo	Wisk Aero Generation 6
eSTOL	Battery- or Hybrid Electric	Fixed wing + high lift systems	Higher payload and range. Needs short runway, less suitable for dense urban cores	Regional mobility	VoltAero Cassio
Hybrid fly-drive	ICE or Hybrid	Gyroplane/fixed wing with convertible chassis	Convertible configuration. Complex dual certification	Niche personal travel	Alef Model A

CERTIFICATION & REGULATORY FRAMEWORK

The Federal Aviation Administration (FAA) continues to lead regulatory development and community engagement for Advanced Air Mobility (AAM) in the United States [1,3]. Its framework spans aircraft type certification, vertiport and ground infrastructure standards, and pilot and operational rules for powered-lift aircraft [5,7]. Historically, powered-lift designs such as tiltrotor, tilt-prop eVTOLs, or hybrid fly-drive models like the Alef Model A have not fit neatly under existing airplane or rotorcraft categories because they derive lift variably from rotor or propeller thrust (like helicopters) and from fixed wings (like airplanes) [5].

To accommodate these new configurations without forcing them into outdated rules, the FAA issued a Final Rule and Special Federal Aviation Regulation (SFAR) establishing a tenyear alternate framework for pilot certification and operational qualification [5,6]. This SFAR clarifies that powered-lift aircraft capable of vertical landing along their route must meet helicopter minima for visibility, altitude, and fuel reserves. Those unable to maintain vertical landing capability must instead satisfy airplane minima for reserves and requirements [5]. In essence, vertical-capable vehicles follow helicopter visual flight rules (VFR) when operating in lift mode at speeds allowing adequate collision avoidance, while others default to airplane criteria. When certified for autorotation or equivalent descent maneuvers, powered-lift aircraft may also operate at altitudes lower than conventional airplane minima [5,6].

In parallel, the FAA Vertiport Design Standards (Engineering Brief 105A, 2024) updated earlier 2022 proposals to better match emerging eVTOL needs [7]. Key revisions include the adoption of a "VTL" marking on touchdown and liftoff areas, modified geometry reducing safety-area dimensions, expanded parking zones for hover-taxi operations, new guidance for aircraft with three or more propulsors, and an explicit downwash/outwash caution area. Together, these updates provide clearer physical design standards to support both air-taxi and personal AAM operations.

Across the Atlantic, the European Union Aviation Safety Agency (EASA) serves a parallel role, publishing Means of Compliance (MOC) packages that define certification criteria under the Special Condition for VTOL (SC-VTOL) [11]. The MOC Issue 2 emphasizes continued safe flight and landing, controlled emergency descent, and survivable emergency landings, with detailed provisions for energy reserves, redundancy, and continued airworthiness. These performance-based objectives allow diverse configurations to demonstrate equivalent safety outcomes rather than adhere to fixed hardware prescriptions.

Distinct from eVTOLs governed by SC-VTOL, the AeroMobil 4.0 is certified under EASA CS-23, which regulates airworthiness, energy storage and distribution, and structural durability for conventional or short takeoff and landing (STOL) aircraft [12]. In contrast, the Alef Model A, although holding an FAA Special Airworthiness Certificate, remains in a prototype testing phase [8]. This authorization permits experimental flight demonstrations but does not constitute a type certificate for commercial passenger operations as would be required under CS-23 or SC-VTOL frameworks [8, 11, 12].

Overall, AAM certification today reflects a spectrum between performance-based and prescriptive regulatory philosophies [5,11,12]. Performance-based systems such as EASA CS-23 and SC-VTOL define safety outcomes-continued safe flight, redundancy, energy reserves-and allow applicants to prove compliance through approved MOCs, fostering innovation and long-term design flexibility, albeit with higher upfront engineering effort [11,12]. In contrast, prescriptive legacy rules for airplanes and rotorcraft specify fixed design parameters and test methods, yielding predictable short-term pathways but greater risk of later redesign when technology diverges from legacy standards [5]. Additionally, experimental certifications, such as the FAA's Special Airworthiness category, provide a pragmatic bridge enabling flight testing and data collection prior to full type certification [8].

Collectively, these evolving frameworks by the FAA and EASA mark a transition from traditional aircraft regulation toward adaptable, evidence-driven systems essential for integrating AAM safely into national and regional airspace [1,3,11,12].

STATE OF PRACTICE: VEHICLE PROGRAMS (AS OF 2025)

According to FAA Aerospace Forecast FY 2025-2045 (Emerging Aviation Entrants: Unmanned Aircraft System and Advanced Air Mobility), AAM is emerging as a major new entrant to the NAS besides Drones [3]. Based on regulator-sponsored demand modeling (MITRE

2025), AAM operations are expected to grow from roughly 40000 annual trips in Year 1- also known as Entry Into Service (EIS) year, to about 2.8 million by Year 6 with corresponding fleet sizes increasing from 4 to 283 [4]. In its Compendium, we see AAM services like Airport shuttle, Urban air taxi and Air medical are expected to be started in Metropolitan Statistical Areas like, Chicago, Dallas, Houston, Orlando etc [3,4]. Building on these regulator-derived projections, the following table summarizes current vehicle programs that represent the State of Practice within the domain of AAM. Each entry lists propulsion type, lift configuration, certification pathway, and anticipated entry-into-service, cross referenced wherever possible with FAA and EASA documentation before citing company disclosures [3-5,11,12].

TABLE 2 Overview of Current Vehicle Programs within the Domain of AAM

Company	**Model**	**Architecture/Powertrain**	**Seats**	**Range**	**Certification Stage**	**Target Market**	**Region**
Alef	Model A	Roadable Electric VTOL / fly-drive	1+1	≈110 mi (flying); 200 mi (driving)	FAA Special Airworthiness (test authorization)	Luxury/ personal	USA
AeroMobil	4.0	Hybrid STOL / fly-drive (CS-23 basis)	1+1	≈450-750 mi (program claims vary)	EASA CS-23 testing	Luxury/ personal	EU
Joby	S4 (JAS4-1)	eVTOL (tilt-prop)	4+1	≈150 mi (OEM claim; demonstrated 154.6 mi test flight)	FAA special-class powered-lift under 21.17(b) - final airworthiness criteria issued; Type Cert in process	Air taxi	USA, UAE (Dubai 2026 target)
Archer	Midnight	eVTOL (tilt-rotor)	4+1	≈100 mi (OEM positioning; optimized 20-50 mi stage length)	FAA special-class powered-lift under 21.17(b) - final airworthiness criteria issued; Type Cert in process	Air taxi	USA, UAE (Abu Dhabi program)

Lilium	Jet	Ducted-fan eVTOL “electric jet”	Up to 6+1 (configurable cabin)	≈300 km (2019 OEM claim; current configs vary)	EASA Design Organisation Approval (DOA); EASA type cert program in process	Air taxi/Shuttle	EU
Volocopter	2X (demo)	Multirotor eVTOL	1+1	~27 km / 27 min (spec sheet)	Company holds EASA DOA; 2X is a demonstrator (VoloCity is the cert target)	Tech demo / UAM trials	EU
BETA	ALIA-250 (eVTOL) / CX300 (eCTOL)	Lift-plus-cruise eVTOL; fixed-wing eCTOL (shared systems)	4+1	≈250 mi (claimed by program)	CX300: FAA Part 23 type cert program (G-1 set). ALIA-250: powered-lift path under §21.17(b) in parallel	Regional cargo/ passenger	USA
Wisk	Cora (Gen 5 demo; Gen-6 go-to-market)	Lift-plus-cruise Autonomous eVTOL	Gen-5: 1+1; Gen-6: 4 (no pilot onboard)	≈90 mi (Gen-6 OEM spec)	First FAA candidate for type cert of an autonomous, passenger-carrying eVTOL; NZ Gov’t MoU for Cora trials	Air taxi (autonom -ous)	USA/ NZ

Alef Aeronautics’ Model A roadable electric VTOL has received an FAA Special Airworthiness Certificate (Experimental) for limited flight testing (PR Newswire) [8]. The AeroMobil 4.0 hybrid fly-drive aircraft is progressing toward certification under EASA CS-23 (Normal Category Aeroplanes), with details available on the AeroMobil site and the EASA CS-23 framework, and flight-test coverage from AIN Online [12]. Joby Aviation’s S4 tilt-prop eVTOL is being certificated under the FAA special-class powered-lift rule (§ 21.17 b) with final criteria published in March 2024 [13]. Archer’s Midnight tilt-rotor follows the same path, with criteria issued May 2024 and an ADIO partnership to launch service in Abu Dhabi (2025) [14]. Lilium holds EASA Design Organisation Approval (DOA) and is advancing type certification for its ducted-fan “electric jet,” as shown in its DOA release and product page [11,15]. Volocopter likewise holds EASA DOA and targets type certification of its VoloCity multicopter eVTOL, supported by its newsroom announcement and 2X spec sheet [11,16]. BETA Technologies is certifying its CX300 eCTOL under FAA Part 23 while pursuing a powered-lift (§ 21.17 b) path for the ALIA-250 eVTOL (official site; Aviation Week report) [4,17]. Finally, Wisk Aero's Gen-6 autonomous lift-plus-cruise eVTOL-the successor to Cora-is the first FAA type-certification candidate for an autonomous passenger aircraft, detailed in the Wisk Gen-6 release and the New Zealand Government MoU covering its Cora trial program[18].

Among the ones mentioned in the above table, Tilt architecture (Joby S4, Archer Midnight) are clearly near-term workhorses- hovering on thrust, cruising on wings and on FAA's special-class powered-lift path under 21.17 (b) with published airworthiness criteria [5,13,14]. Lift-plus-cruise designs (Wisk Gen-6, BETA ALIA-250) are simpler but have drag/energy penalties, certification cases are mostly SC-VTOL (EASA) or powered-lift (FAA) [5,11,17,18]. Multicopters like Volocopter are for short urban hops and demos with VoloCity type-cert target backed by EASA [11,16]. Then there are STOL/eCTOL (BETA CX300) and hybrid fly-drive concepts (AeroMobil 4.0 under CS-23; Alef Model A under experimental test authority) illustrating divergent pathways [8,12,17].

All these vehicle programs representing the State of Practice within the domain of AAM gives an indication towards a rapid ramp-up of vertiports/charging, procedure design, powered-lift pilot/ops implementation and certification workloads expanding across SC-VTOL (EASA), CS-23 (STOL/eCTOL, road-air), and FAA powered-lift programs [3,5,7,11,12]. The most regulator-mature combinations among these programs (tilt architectures and powered lift; CS-23 STOL) are best positioned for near term EIS, with autonomous lift-plus-cruise and multicopter demos following as standards harden [3,5,11,12,16-18].

FEDERAL & AGENCY EFFORTS

FAA's "Advanced Air Mobility (AAM) Implementation Plan" talks about its near-term programmatic portfolio Innovate28 (I28)- a joint government and industry initiative aiming at culminating in a nationally scaled up integrated AAM operations, including full NAS touchpoints, operator, O/D pairs, at multiple key site locations in USA by 2028 [1,2]. Workstreams coming under this cross-agency-efforts towards user initial entry into service goals range from Certification & Ops Enablement to Airspace/ATC integration and Infrastructure & Community.

Similarly, NASA's AAM Project: National Campaign has a primary objective of de-risking AAM operations and informing FAA/EASA standards and community acceptance by running multi-partner flight tests and simulations [20]. It has been putting efforts into acoustics/noise characterization for regulatory models and community acceptance, Detect-and-Avoid (DAA) for safety in dense and mixed airspace, contingency management to validate procedures and automation, among others to ensure compliance and interoperability across vehicles, airspace tech and infrastructure [19,20].

As AAM scales up, authorities across different scales - federal, state, tribal and local entities feel the increasing need to coordinate and have their role clarity gaps resolved. In this context, GAO comes in highlighting calls for intergovernmental roles, data-sharing and strategies for privacy, security, and community impacts -focusing on certification and safety of aircraft, pilot and mechanic training, airspace management, vertiport construction and noise management [25].

UNIVERSITY RESEARCH LANDSCAPE

The research landscape surrounding AAM looks rather promising with University of Michigan standing up an air-mobility research corridor to enable drones and electric aircraft trials along with a netted flight lab for weather-proof testing [21,22], Georgia Tech expanding AAM Safety & autonomy and urban airspace modeling to develop learning-based safety-aware autonomy [23], Embry-Riddle leading a NASA project to build real-time abnormal event detection and response for intelligent autonomy/adaptive control AAM vehicles [24], Virginia Tech advancing foundational technologies and policy work for scaled AAM, Purdue University outlining AAM scopes in autonomous vertiport operations and secure comms, University of Maryland focusing on NAS integration research and rulemaking-informed testing while also tackling UAM routing and scheduling, Ohio state working on vertiport site selection and state AAM frameworks for network siting and policy, among many others. Our very own University of Wisconsin-Madison is also a methods contributor in this area working on vertiport siting and environmental modeling and network effects in VISSIM. These academic efforts feed data into FAA I28 and NASA NC, hence accelerating near-term EIS and operations that will be welcome and accepted by community [1,2,19,20].

MARKET, INFRASTRUCTURE & PUBLIC READINESS

The target market is already clearly split into two main niches, viz., luxury/personal and urban air-taxi or shuttle [3]. As described in earlier sections, while the former (e.g., Alef, AeroMobil) is a roadable/STOL concept with experimental test authorizations to carry smaller volumes and subject to local road as well as air regulatory crossover, the latter (e.g., Joby, Archer) are commercial powered-lift air-carrier models aiming for scheduled airport shuttle rides and fulfilling the airworthiness criteria and EB-105A infrastructure [5,7,13,14].

Readiness to be accepted into these target markets and community is mainly dictated by constraints like compatibility of siting or zoning of vertiports with local code touchpoints; grid upgrades to ensure proper load sizing, on-site storage, and phased adoption of vertiport electrical infrastructure; compliance with noise thresholds of the community; resolution of coordination gaps across federal, state and local bodies in the areas of land use, policing, emergency response, etc., establishment of foundations of training pipelines and air-carrier operations manuals in near term, among others [3,7,20,25].

CHALLENGES & OPPORTUNITIES

In addition to the previously discussed constraints, like, infrastructure upgradation and readiness, safety validation, and authority fragmentation, other major challenges this emerging field faces are, certification uncertainty for new category air-carriers, battery energy density and turnaround impacting fleet utilization, airspace integration for mixed-traffic choreography, services needed for upscaling, etc [3,5,25].

Along with challenges also lie the opportunity to grow if there is a will to mitigate the problems. Battery energy management can be done by pairing battery-dominant designs with hybrid or staged charging strategies; infrastructure readiness can be facilitated by installing temporary modular vertiports, helicopter-site conversions and phased deployment; build towards digital UAM/UTM services to make way for tactical deconfliction and maintain strategic demand/capacity balance for the airspace, among others [7,9,20].

Three main bottlenecks AAM is likely to face are- infrastructure and grid readiness affecting throughput and turnaround, certification path clarity and community acceptance of noise and local authority rules, which could be respectively mitigated by adopting modular vertiports (EB-105A), leverage FAA powered-lift rule to lock pilot or operations assumptions, and use NASA acoustic methods for route/scheduling design [3,5,7,20].

CONCLUSION & FUTURE OUTLOOK

Driven by FAA's I28 goal of "At-scale at one or more sites", it is expected that AAM will transition from prototype to limited commercial operation around 2028 [1,2]. It is very likely that initial services will begin as luxury or demo flights (Alef, AeroMobil) and then gradually regional cargo and STOL connectors (BETA CX300), and urban air-taxi shuttles (Joby, Archer, Lilium, Volocopter) will be introduced, as infrastructure and certification procedures evolve [3,13-18]. But this transition will not be easy, as the main challenge behind that would be lack of coordination among agencies at different scale [25]. As other challenges like battery performance, noise threshold violation, etc. are mitigated more efficiently, AAM has the potential to supplement, and not replace, existing modes to create a cleaner, equitable and accessible mode of mobility [3,19]. However, all these expected future progresses will hinge on regulatory clarity, community acceptance and academic-industry collaboration to sustain evidence -based growth of this promising field [1,3,21-24].

Overall, the regulatory and technological trajectories suggest that AAM is set to transition from niche demonstrations to structured, safety-validated mobility services within the next decade.

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