Advanced & Urban Air Mobility Impact and Timing

Significant investment in new technologies is driving the creation of a new and disruptive industry that is poised to transform travel.

A resource prepared by:

The Community Air Mobility Initiative (CAMI)

Supporting the responsible integration of the third dimension at the state and local level.

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How real is Advanced & Urban Air Mobility?

A phased approach means that baby steps are being taken now. The following is a compilation of estimates.

2021 — Development Testing, Urban Planning

2022 — Understanding Public Acceptance, Operational Readiness

2023 — eVTOL Aircraft Certification, Low-Volume Operations

2024 — Increased Volume/Complexity, Airspace Restructuring

2025 — Expanded Vertiport Infrastructure, Mid-Volume Operations

2026 — Expanded Markets, Vertiport Build-out

2027 — Scaled Urban Demo(s), Emergency Use Cases

2028 — Commercially Viable Operations, Increasing Network Sizes

2029 — National Airspace Integration, Increasing Automation

2030 — Frequent, High Volume Operations

2035 ... — Approaching mature operations

Currently, at the end of 2020, there are over 320 public eVTOL concepts, of which around 5% are full size aircraft in flight testing. It is estimated that well over 1,000 flights were conducted over the course of the previous year in the U.S. alone. Several of these concepts are well advanced in their certification programs. Hundreds of other concepts are moving through the development pipeline behind these first movers.

Cargo operations, operations using smaller eVTOL aircraft (sUAS), and operations in low-complexity airspace are already happening today.

Existing general aviation airports and heliports can be used with existing aircraft certification and operational rules during the crawl phase while the industry matures.

Electrification and automation are both critical streams of technology development and certification. They are distinct from one another and should not be assumed to be overly co-dependent.

Joby's full size evTOL protopype

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Financial Impact: Investment & Market

Significant investment today is building the foundation for disruptive operations tomorrow.

Total investment in advanced air mobility, of which urban air mobility and electric aviation are both considered facets, is a challenging figure to measure. There have been a few high profile deals, such as Joby Aviation's $720 million in early 2020 from players like JetBlue Technology, Toyota, and Intel Capital. Additional significant capital has been deployed more organically through established organizations like Boeing NeXt (which was shuttered in Sept 2020 due to COVID-19 impacts) and through smaller deals with startup companies. Secondary investments in supply chain, supporting technologies, and infrastructure are also part of the picture. In 2019 studies show that between $2 and $3.5 Billion USD were invested in the space. This represents an acceleration in capital deployment: estimates are that $5 Billion USD has been invested to this point, but these numbers are very imprecise.

The ultimate potential market for all things A/UAM is also difficult to estimate, in part because of its diversity. In addition to the operational zones and modes described in CAMI's *What is Urban Air Mobility?*, military investment has been catalyzed due to the Air Force's Agility Prime campaign and the mainstream civilian market is multifaceted. Societal benefits extend well beyond market estimates: job creation on the order of 30-50 full time positions for each active vertiport, with 1.5 - 2.2x that number in secondary effects and 1.2x in tertiary job creation, creating 80-100 jobs per vertiport with 10-20 new vertiports expected per metropolitan area as the industry enters its "run" phase*. Beyond this direct job creation, UAM has the potential to connect greater portions of the workforce to economic and educational opportunities that would otherwise be literally out of reach.

It is unclear if COVID-19 will blunt the ongoing trend towards urbanization on more than a transient basis. If remote work does drive a more geographically distributed workforce, UAM still has a role to play in facilitating office visits for mostly remote workers.

$5+ Billion USD Invested to Date

1,000-2,000 Jobs per Metro Area

*Jobs creation estimates from D. Swanson, Swanson Aviation Consultancy Ltd.

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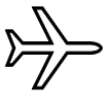
Market Estimates & Common Questions

Initially, the A/UAM market is limited by vehicle availability; as acceptance grows, so does the market

During the crawl phase of the industry, money will still be flowing in to the space. As operations mature and economies of scale are realized, the market for Advanced and Urban Air Mobility is expected to grow exponentially. Estimates for 2040 put the US market around $500 Billion with a total global opportunity of around $1.9 Trillion USD (and possibly as much as $2.9 Trillion). NOTE that these numbers are pre-COVID-19 estimates. Some estimate that COVID could delay market realization by 5-10 years; many others see little long-term negative impact due to the long development cycle of the industry; time will tell.

$1.9+ Trillion USD total 2040 market



With this much at stake, and with so much cutting edge technology involved, it is not surprising that misconceptions and questions abound. One of the biggest sources of confusion is around unmanned aircraft systems (UAS), or drones, and urban air mobility (UAM). eVTOL aircraft may eventually be self- or remotely-piloted, but they are much more similar to manned, certificated general aviation aircraft than they are to drones. This is related to another common area of confusion around the extent of automation (execution of predefined tasks) and autonomy (ability to make decisions) these aircraft employ: eVTOL aircraft do not have to be autonomous.

While stability augmentation, simplified vehicle operations (SVO), and fly-by-wire systems enable more complex aircraft to be flown safely, most eVTOL will initially be flown by a human pilot on board the aircraft with the same operational considerations as general aviation aircraft in the national airspace today. As technology matures, increasing automation and autonomy will be incorporated, enhancing both safety and operational efficiency, but these are likely part of the late "walk" and "run" phases of the industry, not the imminent "crawl" phase. The electric propulsion itself, even including battery technology, is already mature enough for early operations. Operational requirements and technology to support autonomous passenger-carrying eVTOL flights are being developed.

One of the main pacing elements of the development timing for UAM is the aircraft certification and operational regulatory timeline. While significant progress has already been made here, it should be noted that no eVTOL aircraft has yet been certified and the details of operations for UAM remain unsettled between industry and regulators.

Conclusions and Further Reading

As with any fundamentally new industry, uncertainty shouldn't preclude exploration and preparation

As with most disruptive new industries, it remains challenging to quantify predictions about how the Advanced and Urban Air Mobility development timeline and market creation and penetration will progress. Secondary economic impacts are even harder to predict as they will be influenced by behavior patterns and use cases for this new technology that may not yet have been anticipated. The numbers presented herein are at best estimates, some from CAMI and some from the sources below: they should still be sufficient motivation to take A/UAM seriously and to be actively planning for its widespread adoption.

Further Reading and References

- CAMI's online Resource Library: https://www.communityairmobility.org/resources
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