Advanced Air Mobility in Vancouver

How an emerging sector could take off in the region

VANCOUVER ECONOMIC COMMISSION

Economic Transformation Lab

Acknowledgements

Territorial Acknowledgement

This report was commissioned by the Vancouver Economic Commission (VEC), working on the unceded territory of the xʷməθkʷəy̓əm (Musqueam), Skwx̱wú7mesh (Squamish), and səl̓ilw̓ ətaʔɬ (Tsleil-Waututh) Nations.

These Nations have cared for the lands and waters of "Vancouver" since time immemorial, sustaining strong economies while thriving in balance with the natural world. Vancouver is a City of Reconciliation, and VEC – an agency of the City – commits to forming long-lasting relationships of mutual respect and understanding with host First Nations and other local urban Indigenous communities.

VEC pledges to better understand the full breadth of truth and reconciliation and to work alongside local Indigenous communities to support and collaborate on building economic prosperity for all.

About us

The Vancouver Economic Commission's (VEC) mandate is to build a prosperous, inclusive, zero-carbon and resilient economy in Vancouver.

VEC fulfils this mandate by working on the economic transition towards a just and economically resilient future for Vancouver, in which there is prosperity for all. VEC's work is anchored in collecting and sharing research and information; providing expert insights to relevant policymakers; engaging stakeholders and rights holders in the business, academic and investor communities; and leading, partnering and overseeing strategic initiatives, programs and events in the local economy oriented to VEC's four pledges for issues-based economic development.

An Economic Transformation Lab (ETL) Initiative

vancouvereconomic.com/lab

VEC delivers this report in partnership with UBC Sauder School of Business and MITACS through the Economic Transformation Lab, a research program developed by the VEC to prepare Vancouver's economy for global trends anticipated to impact the region within the next 15 years.

By leveraging academic and industry collaborations, ETL aims to produce research that results in actionable goals, best practices, and insights that inform policy advocacy or programs to build Vancouver's economic resilience.

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Executive Summary

The Vancouver region is a promising site for the deployment of advanced air mobility (AAM) applications within the next 10-15 years. This is due to its proximity to major markets, hubs, robust innovation ecosystem, and the presence of a major intermodal transportation hub and many other potential beneficiary sectors, such as agritech, cleantech, resource management, health sciences and other frontier technologies.

However, AAM is a still-evolving space with regulatory challenges, new technologies, and a dynamic slate of numerous potential uses, values and opportunities. If advanced air mobility's full benefits are to be realized and equitably distributed among the region's residents and business communities, it will be necessary to take a whole-of-government approach and foster extensive private–public partnerships. These will be crucial to fill in the regulatory gaps, align the region's investment and development efforts to its values, and unite them in pursuit of a unified social, sustainable and economic vision.

This report is a cluster analysis best suited for an audience of advanced air mobility stakeholders or regulatory policymakers already interested in exploring advanced air mobility deployment. The project focuses on identifying the composition and strengths of Metro Vancouver's existing advanced air mobility sector and does not include a comprehensive cost-benefit analysis. As it does not incorporate an economic impact assessment or other quantifiable benefits, this report will not make a recommendation on whether stakeholders should accelerate the development of the advanced air mobility cluster in the Vancouver region, or lay out a strategy or action plan.

This report instead assumes its audience's interest in learning more about AAM deployment; highlights relevant developments, successes and pitfalls seen in global AAM hubs; and focuses its insights and recommendations on the most promising and priority areas necessary to leverage the Vancouver region's strengths to maximize local economic, environmental and social benefits.

Potential AAM benefits for Metro Vancouver[i]

What is Advanced Air Mobility?

Advanced air mobility (AAM) describes the emergence of transformative airborne technology to transport goods and people in new, environmentally beneficial, and socially responsible ways, using cost-effective aircraft in rural and urban environments. In this paper, AAM refers to both non-passenger and passenger air mobility (PAM), comprising urban air mobility (UAM) and regional air mobility (RAM).

If fully deployed, potential AAM benefits for the Vancouver region include, but are not limited to:

- **Environmental** – particularly decarbonizing transportation via zero-emissions aviation using clean electric and hydrogen fuel cell technology
- **Public health and safety** – for instance, delivering medical supplies, blood, organs, and plasma quickly to and between hospitals, and inspecting bridges, high-rise buildings, and horizontal infrastructure (power/water/gas supply lines) safely and efficiently
- **Regional transportation and tourism** – for example, the regional transportation of passengers and delivery of goods, or supporting the visitor economy and economic self-determination among British Columbia's more remote Indigenous communities, subject to the participation of Indigenous-led tourism associations and travel services

[i] Mentions of Metro Vancouver refer to the census metropolitan area, while Metro Vancouver Regional District refers to the regional government of the same name. We make similar distinctions between the city of Vancouver (the municipality inclusive of its residents) and the City of Vancouver (the municipal government).

Methods

Researchers conducted interviews with members of the Vancouver region's AAM ecosystem, a literature review, and an analysis of AAM global clusters. These findings were tested with representatives from relevant local industry and government agencies to verify the researchers' findings and the implications of the shortlisted recommendations.

The regions analyzed in the benchmarking of global advanced air mobility clusters are Australia; the United Kingdom; Seattle–Washington state and Los Angeles in the US; South Korea; Singapore; and Paris and other cities in Europe. The team chose Seattle due to its proximity to Vancouver and for its aerospace manufacturing prowess. The other regions are either leaders in AAM development or have initiatives the project team felt worth examining.

Key findings from global cluster analysis:

- Regions progressing quickly in the development of AAM have outlined a clear vision and objectives (e.g. Paris' objectives of environmental transition in air transport, economic recovery, and urban densification)
- Public trust and acceptance are a critical prerequisite for the success of AAM adoption
- Successful whole-of-government partnerships encourage investment by working with local authorities to jointly set policy commitments for AAM commercialization
- Leading AAM regions benefit from policy consistency, with a well-communicated roadmap and government-wide approach encompassing coordination and complementary investment or relief programs across public agencies
- Hydrogen energy has promising applications in longer-range or higher-payload AAM, so aviation clusters with heavy AAM presences have already begun to invest in hydrogen power ecosystems
- Scaling up of advanced air mobility as integrated airspace with passenger air mobility and uncrewed aircraft systems is only likely to occur after 2030

Key findings from Metro Vancouver cluster analysis

Vancouver's assets include sectors complementary and even foundational to advanced air mobility and its most promising applications: conventional aircraft and port operators; hydrogen power systems; agritech; and aerospace manufacturing.

Metro Vancouver's drone cluster is particularly robust and includes companies supplying drones, counter-drone and detect-and-avoid technologies, and those providing delivery services and monitoring for the real estate, construction, agriculture, silviculture, industrial and film sectors. Drones have also been deployed for wildfire management with hotspot mapping and land management for landslide risk assessment and geological surveys. However, the remotely piloted aircraft systems research capacity in BC still lags behind Ontario.

BC's AAM cluster at a glance

This project identified or otherwise references 91 AAM-related organizations, 49 of which are active in British Columbia:

- 2 research and development – universities
- 4 finance – government entities providing grants and incentives
- 6 infrastructure – developing communications, fuel cell or energy
- 16 manufacturing – of aircraft, fuel cells or other trade groups
- 15 operations – service providers and those providing operator training
- 2 regulators – standardizing aviation or with market and legal insights for other transportation sectors
- 4 end-users – identified in health, public responders, wildfire services, or geologic exploration

Regional strengths and potential focus areas:

Hydrogen energy and infrastructure. As hydrogen energy is a leading asset in the future of aviation, Vancouver and BC's strengths in this area give it an edge in developing hydrogen-powered AAM aircraft and infrastructure.

Digital Technology Supercluster opportunities. The deployment of fully autonomous drones for agritech applications is another potential focus area that could be supported by BC's Digital Technology Supercluster (DTS); the DTS can also provide opportunities in smart-city applications (e.g. uncrewed traffic management).

Demonstration and deployment logistics. Vancouver provides a realistic test environment for commercial deployment; its busy airspace results in a complex operating environment that is balanced by surrounding water bodies, which mitigate ground safety risks that are a major concern for trials.

Values-aligned leaders. Existing Vancouver aerospace operators – HeliJet, Harbour Air and Vancouver International Airport – are key players that have expressed support for AAM, are in a position to benefit from and facilitate its deployment, and are already closely aligned with the region's strategic values of sustainability and social and economic responsibility.

There are presently no local passenger air mobility or vertiports[ii] operators in Metro Vancouver, although existing local operators could soon fill the space. Relevant players, such as trade commissioners or entities like Invest in Canada or Invest Vancouver, may also make this the subject of strategic investment attraction initiatives.

The full list of 91 organizations referenced in the report may be found in Appendix B.

High-level Recommendations for Metro Vancouver

These recommendation highlights are subjectively categorized by the project team, and their selection is based on the collective insights from all research methods and industry reviews. They are comprised of a non-exhaustive list of actions that could be collectively taken by a government-industry consortium, public-private partnerships, not-for-profit organizations or government agencies with an interest in coordinating and catalyzing efforts to deploy advanced air mobility in the region.

Establish vision and values

- Create an AAM vision to align deployment with the values of the region, and subsequently drive investment, successfully coordinate and prioritize efforts, and align all policy, industry and investing stakeholders from the outset.
- Build public trust and education through community engagement by involving the public while formulating Vancouver's AAM vision.
- Build upon existing studies and initiatives conducted by the Canadian Advanced Air Mobility consortium (CAAM), Canadian Drone Advisory Council (CanaDAC) and TransLink.

Policy and planning

- Consult a wider section of industry while highlighting the economic prospects of AAM development.
- Institutionalize the process for AAM projects. Metro Vancouver would gain from having a regional office to coordinate with public agencies to clarify their responsibilities and policy requirements, and provide planning, regulatory and industrial development support.
- Fill regulatory and policy gaps. Beyond the federal government, there is a policy vacuum in dealing with AAM, effectively leaving Transport Canada as the only regulator.
- Effective policy and planning requires a whole-of-government approach to align deployment with provincial and regional priorities.

Tactics

- Active AAM demonstrations and public engagement to maintain community, investor and industry engagement when Vancouver hosts major global events; an event of note where Vancouver can seize this opportunity is the upcoming FIFA World Cup 2026.

[ii] A vertiport is an area of land, water, or structure used or intended to be used for the landing and take-off of VTOL aircraft. **https://www.easa.europa.eu/en/light/topics/vertiports-urban-environment**

- Formulate and convey Vancouver's regional AAM vision, roadmap and challenges with clear sequential performance outcome milestones and regulatory commitments, so the AAM industry and investors can monitor their progress and plan accordingly.
- Launch consolidated one-stop service – possibly via a regional AAM office – for the industry by compiling AAM ecosystem resources and existing general support schemes and streamlining them across the various jurisdictions into a user-friendly package.

Market opportunities and use-case prioritization:

The largest projected market for advanced air mobility is the use of uncrewed non-passenger aircraft for commercial inspection, maintenance and operational applications (or "non-delivery" functions). Proponents of advanced air mobility deployment may wish to prioritize the development of these use cases and functions, particularly any that receive broad support during public consultation.[iii, iv]

Suggested Phasing of AAM Use Cases

Timespan	High-Level Use Cases

Near (3 years)	• Medical supplies delivery (high-value, time sensitive), such as:
	  • Organs
	  • Radioisotopes
	• Geological & marine (e.g. mapping land and seascapes)
	• Agritech (e.g. crop monitoring, pest control and data management)
	• Wildfire services
	• Marine port and ship-to-shore operations
	• Defense and border or remote area enforcement
	• Infrastructure and mining
	• Municipal services (exploratory): concepts such as those from Portugal's Omniflow

Medium (6 years)	• Municipal services
	• B2B deliveries through drone corridors over public urban areas
	• Substitution and expansion of existing air passenger services, including:
	  • Medivac and air ambulance
	  • Tourism (low carbon)

Long (>6 years)	• Remote access passenger air mobility (PAM)
	• Regional air travel
	• Review services with selected conditions:
	  • B2C, retail drone deliveries
	  • Air taxi (within Metro Vancouver, between municipalities)

These use cases have potential high-value and synergistic applications for the Vancouver region's strengths in agritech and maritime services. Medium- and long-term goal applications should be directed towards the commercial development of hydrogen-powered AAM aircraft, regional passenger air mobility services, and B2B drone deliveries.

[iii] Porsche Consulting. (2018). *The Future of Vertical Mobility: Sizing the market for passenger, inspection, and goods services until 2035.* https://www.porsche-consulting.com/fileadmin/docs/04_Medien/Publikationen/TT1371_The_Future_of_Vertical_Mobility/The_Future_of_Vertical_Mobility_A_Porsche_Consulting_study__C_2018.pdf

[iv] Drones in this report refers to remotely piloted aircrafts that do not carry passengers.

Summary

Fleets of advanced electric aircraft hum through their designated lanes above the region's waterways, providing vital connections between urban, suburban and rural areas. Some autonomously maintain or monitor infrastructure in locations too costly or dangerous to send human workers; some remotely piloted drones speed life-saving cargo between hospitals; others sow fields with crops or maintain tireless vigil over the health of growing food, urban canopies and regional parks. In the distance, above it all, an electric seaplane carrying out-of-region visitors begins its graceful descent toward the harbour.

According to advanced air mobility (AAM) experts, this vision is already beginning to materialize in numerous AAM hubs around the world – and that includes Vancouver. Given Metro Vancouver's advantageous physical geography and industrial capabilities for AAM applications, and the increased deployment of the technology in jurisdictions around the world, the literature and interview insights of this study suggest that the wider adoption of AAM technologies locally is inevitable.

It would therefore be prudent to create an environment that proactively identifies and understands any negative impacts or pitfalls while maximizing and equitably distributing AAM's benefits for the social and public good – all while aligning to the values and vision aligned to the values and vision of the Vancouver region's economic development priorities.

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1. Introduction and Methodology

1.1 Overview

Advanced Air Mobility (AAM) describes the emergence of transformative airborne technology to transport goods and people in new, environmentally and socially responsible ways, using cost-effective aircraft in rural and urban environments.

AAM builds upon the recent development of electric battery and hydrogen fuel cell technologies to create aircraft and autonomous uncrewed aircraft (drones) that operate with zero emissions. In 2021, the passenger air mobility (PAM) sector globally attracted CA$9.1 billion in new investment, more than doubling the total disclosed investments made over the previous decade. Momentum for AAM is building quickly, and this report seeks to provide a high-level analysis of how the Vancouver region can position itself to harness the technology.

The objective of this study is to conduct an industry cluster analysis of the Vancouver region's existing strengths to:

- Identify potential sectors, organizations and other entities that could benefit from or feed into advanced air mobility innovations;
- Highlight potential gaps in the region's cluster, and provide potential solutions to fill those gaps; and
- Broadly outline any potential economic, environmental and social benefits that advanced air mobility applications could deliver to the city and region.

This report was developed for an audience of advanced air mobility stakeholders or regulatory policymakers already interested in exploring advanced air mobility deployment.

As the project did not include an economic impact assessment or other detailed cost-benefit analysis for the local cluster, this report will not make a recommendation on whether stakeholders should accelerate the development of the advanced air mobility cluster in Vancouver. This report instead assumes its audience's interest in learning more about AAM deployment; spotlights developments, successes and pitfalls found in global AAM hubs; and focuses its recommendations on the most promising and priority actions necessary to leverage the Vancouver region's strengths to maximize local economic, environmental and social benefits.

Terminology

The project team uses Porter's definition of industry clusters in his paper on "Clusters and the New Economics of Competition," namely, "critical masses – in one place – of unusual competitive success in particular fields." Report recommendations are based on an examination of the status of the Vancouver region's AAM cluster and potential benefits from AAM deployment.

The project team has included a complete list of abbreviations and definitions of technical terminology after the conclusion of this report. However, readers should know the following:

- **Advanced air mobility (AAM)** refers to both non-passenger and passenger air mobility, comprising urban air mobility (UAM) and regional air mobility (RAM).
- **Non-passenger systems** are typically in the form of remotely piloted aircraft systems (RPAS) sometimes referred to as drones. They are used mostly for goods delivery, monitoring and inspection applications, which are also collectively referred to in the industry and in published literature as "surveillance," a term we try to avoid using due to its conventional meaning and associated provocation of concerns related to privacy.
- **Passenger air mobility (PAM)** includes passenger transportation using electric vertical take-off and landing (eVTOL) aircraft, and electric short take-off and landing (eSTOL) aircraft.
- Mentions of **Greater Vancouver** or **Metro Vancouver** refer to the geographic region comprising Vancouver's census metropolitan area. To eliminate confusion, we refer to the regional government of the same name as Metro Vancouver Regional District.

We make similar distinctions between the **city of Vancouver** (the municipality inclusive of its residents) and the **City of Vancouver** (the municipal government).

Please note this report otherwise provides the bare minimum level of technical explanations required for business analysis. Readers may refer to the Canadian Advanced Air Mobility (CAAM) website or Porsche Consulting's 2018 report for additional details on AAM technology.[3] [4]

1.2 Potential benefits of AAM for Vancouver

Environmental, social, and economic benefits could be delivered through the deployment of AAM in Vancouver.[v]

For the environment:

- Decarbonizing transportation with zero emission aviation using clean electric and hydrogen fuel cell technology
- Eliminating other fossil fuel pollutants, such as volatile organic compounds, particulate matter, sulphur dioxide, nitrous oxides, and unburned fuel
- Improvements in agriculture and silviculture efficiencies by minimizing fertilizer and pesticide use through prescriptive farming techniques
- The ability to better monitor wildfires, marine life, forests, and coastal health

For public health and safety:

- Taking injured and critically ill patients to hospitals more efficiently and quietly than Medevac helicopters; eVTOLs will be easier to maneuver and are more capable of landing close to accident sites
- Providing crucial supplies, medicine, and transportation to underserved Indigenous communities in the north of the province that are difficult to serve with fixed-wing aircraft
- Delivering medical supplies, blood, organs, and plasma quickly to and between hospitals
- Assisting firefighters and law enforcement personnel by providing no-risk early assessments of potentially dangerous situations
- Inspecting bridges, high-rise buildings, and horizontal infrastructure (power/water/gas supply lines) safely and efficiently

For the region's residents and workforce:

- Providing regional transportation of passengers and delivery of goods between city pairs such as downtown Vancouver to Greater Seattle (Kent, Renton, etc.), Whistler, Kamloops, Abbotsford, Osoyoos, and Kelowna
- Complementing and diversifying public transportation operations. For example, providing metropolitan transportation options for commuters between heavily populated suburban communities, such as Surrey, the Gulf Islands, the North Shore of Vancouver, and the Lower Mainland, to the outermost Skytrain stations
- Supporting the Vancouver region and British Columbia's visitor economy through tourism in clean, green, quiet aircraft to the province's breathtaking natural wonders
- Supporting the visitor economy and economic self-determination among British Columbia's more remote Indigenous communities, subject to the participation of Indigenous-led tourism associations and travel services

In addition to these, findings suggest there is a significant (though not yet quantifiable) degree of potential economic benefits in terms of the creation of new businesses, jobs and systems efficiencies, along with less tangible economic value, depending on the type and magnitude of AAM deployment.

[v] https://assets.evtol.com/wp-content/uploads/2020/09/Vancouver-AAM-White-Paper-Fall-2020.pdf

1.3 Method

This report uses four research and analysis methods:

1. A broad literature review of AAM technologies and commercialization;
2. A targeted location-specific literature review and analysis of AAM industry developments – the main sources of information are academic journals and publicly accessible information online;
3. Interview-based survey of relevant local and national AAM experts and potential stakeholder representatives, with location-specific research completed concurrently and iteratively with the survey. The general approach was to identify the practices and circumstances of regions that have made the most progress as a benchmark to Metro Vancouver; and
4. A ground-truth interview survey to verify the researchers' findings and implications of their recommendations.

The project team consolidated all findings into the findings and recommendation section. Researchers anonymized and aggregated the insights to promote candour and maximize insights from the interview process.

The research team created a shortlist of interviewees for the surveys to cover a broad range of potential stakeholders and perspectives within the AAM ecosystem. The questions and discussion were semi-structured, with questions customised to the expertise and role of the interviewee. The team conducted a total of 12 interviews, with interviewees hailing from the following groups:

- Three from academic institutes or consultancies with expertise in AAM;
- Five from industry or trade organizations with interest and/or expertise in AAM; and
- Four from public agencies with a mandate or responsibilities related to AAM.

The ground-truth survey involved a follow-up interview with a public agency previously interviewed, and another from an industry/trade organization. The questions were customized on a per-interview basis to verify the researchers' findings and tease out the interviewees' views of the best possible options among the report recommendations. Further details on the interview surveys may be found in Appendix A.

1.4 Rationales for global clusters

The second component of the methodology benchmarked Vancouver's AAM development by strategically selecting regions around the world.

Table 1 lists the regions and corresponding rationales for their selection. More detailed research was performed for Australia, the United Kingdom (UK), Seattle–Washington State and Los Angeles. Paris and selected cities in Europe, South Korea and Singapore were analyzed as thematic leaders.

Table 1: Selected global clusters and the rationales for their selection

Region	Rationales
Australia with Brisbane and Melbourne	• Similar to Canada in population, population density and GDP/capita • Similar industry profile to Canada; development state of clusters is attainable by Canada • Early adopter, particularly for drones • Melbourne was Uber Air's first international city[5]
UK with Coventry and London	• Thriving vertiports cluster • Progressive programs support research and development (R&D) to revitalize existing aviation cluster • Clear vision and plan for AAM development and deployment • Similar regional regulatory position – UK with EU, Canada with US
US with Seattle–Washington State and LA	• Seattle: Geographical proximity and similar climate • Seattle: Established aerospace manufacturing cluster • LA: Among the leading contenders for first adoption in the US
Paris and other cities in Europe	• Paris: Commitment to be among the first to launch air taxi services, for the 2024 Summer Olympics showcase • Airport-led AAM adoption
South Korea with Seoul	• Among the leading developers of hydrogen-powered drones • Government-led development and enthusiasm for technological innovation and adoption
Singapore	• Projected to be first location in Asia for commercialized urban air mobility (UAM) operations • City-state with limited land and surrounded by sea

2. Findings

"Public acceptance is the most important component and yardstick for the success of AAM."

2.1 General

Based on the literature review and survey, the main components of the AAM ecosystem are summarized in Table 2, which includes examples of organizations belonging to the component's cluster. The interview survey results show that public acceptance is the most important component and yardstick for the success of AAM. Many interviewees also suggested targeted policy and investment as being vital for building and maintaining a thriving AAM ecosystem.

The literature reported that most funding has been channelled towards aircraft manufacturers, although the development of AAM infrastructure also requires substantial investment.[1,6,7] For regulatory policies, a desirable feature mentioned by interviewees is a region that is supportive of AAM innovation and has a conceptual understanding of how AAM can best integrate with its existing aviation system. Another asset is having clear AAM policies that work effectively for all stakeholders, including regulatory bodies, and a clearly defined scope of responsibilities.

Commercial viability is a key determinant of the financial sustainability of AAM. According to Porsche Consulting, the non-delivery drone market (sometimes called surveillance, and which deals with inspection, maintenance and operational monitoring activities) is the largest AAM segment, followed by passenger transport and goods delivery.[4] Costs can be reduced through beyond visual line-of-sight (BVLOS) operations, which is still uncommon in developed or urbanized societies.[vi] Passenger air mobility (PAM) will be initially costly and only affordable to niche markets or the affluent.[8] Scaling up to general public access and necessary regulatory reforms will require reductions in costs, public interest, and significant regulatory support.

Market studies of potential AAM demand in a number of countries have been conducted by National Aeronautics and Space Administration (NASA), Goyal et al. and other studies cited in Straubinger et al.[9,10,11] Factors identified as influencing potential AAM market shares can be grouped into four categories:

- **Demand-related:** The demand-related factors are the market's total population in a study area, population density, rate of population growth, gross domestic product (GDP) per capita, distributions of income and wealth, aviation activity, and the presence of large corporations and economic clusters.
- **Supply-related:** The supply-related factors are the market's geography, number of airports, infrastructure for take-off and landing and battery charging, capacity of the electricity grid, time-of-day flight restrictions, weather, surface transportation congestion, air traffic management capability, interoperability of communication standards, and regulatory challenges. Availability of capital and venture investment may be important for developing all four links in the AAM supply chain: ground infrastructure, traffic management, aircraft manufacturing, and aircraft operation.
- **Relationship to other transport modes:** In some markets, AAM will compete with existing air, ground and water transport modes. The scope for AAM to gain market share will depend on the quality of service it offers relative to competitors in terms of cost, access time, service frequency, speed, reliability, safety, comfort and compatibility with social equity ideals. AAM may also complement (or compete with) existing services by providing multimodal transport.
- **Public attitudes:** Widespread deployment of AAM will be contingent on allaying public concerns about safety, noise, privacy, visual or aesthetic drawbacks, and social equity.

[vi] Beyond visual line-of-sight (BVLOS) operations refers to operations where the drone operator(s) cannot physically see their drone for at least a portion of the flight. This contrasts with visual line-of-sight (VLOS) operations where the drone can be physically seen by the drone operator(s) throughout its full flight duration. VLOS could entail having a visual observer or drone operator for every 1-2 km of the flight path.

Some interviewees referenced the environmental benefit of zero-emissions air transportation as another determinant of sustainability. The following are findings to clarify the technical environmental sustainability potential of AAM:

- Typically less energy-efficient than ground or marine transport, with the exception of more direct routes, due to obstacles such as water bodies or passageway closures.
- Emissions depend on the source of fuel; for example, not all drones are electrified.
- Carbon intensity depends on the fuel used for energy generation.
- Main sustainable AAM power technologies are battery electric, hydrogen fuel cell (H2FC) and certain biofuels.
- Only very lightweight eVTOL aircraft can be more sustainable than fossil fuel-powered road vehicles under specific conditions.[12]
- Multi-modal deliveries with trucks and drones can reduce emissions substantially compared to truck-only deliveries.[13]

Some interviewees have cautioned against overhyping the benefits of AAM and its counter-productiveness to public engagement. Thus, policies should also be cognizant of the following limitations and risks of AAM:

- AAM will not be effective for congestion alleviation [1,14]
- Limited eVTOL aircraft and vertiport capacity and scalability cannot match mass transit modes such as rail. [1]
- There is no door-to-door mobility in most cases. [1]
- In the context of commuting, AAM is likely to only benefit higher-income individuals[15]
- Human pilots will eventually be replaced by autonomous technology, which may discourage employment in the industry.[16]
- Risk of market consolidation.[17]

Photo: Heart Aerospace

Table 2: Main components of the Vancouver AAM ecosystem, with a sample of organizations belonging to the corresponding cluster

Cluster	Description	Cluster Members
Research and development	• Academic: workforce development and technology adoption • Industry: commercialization and regulatory	• British Columbia Institute of Technology (BCIT) • MéridaLabs at UBC
Finance (investment)	• Public • Private: venture capital, bonds, equities • Public–private partnership (PPP)	• National Research Council Canada • PacifiCan • Vertiko Mobility

Infrastructure	• Vertiports
	• Energy and compatible technology
	• Communications (AI, 5G) and geospatial navigation systems:
	  • Detect-and-Avoid (DAA)
	  • Counter-drone systems (for airspace regulation and detection)
	  • Dynamic geofencing
	  • Reliable urban transmission of signals while addressing potential interferences (network management)
	  • Severe weather management and urban wind
		• Urban-Air Port
		• BC Hydro
		• AerialX

Manufacturing	• Aircraft original equipment manufacturer (OEM) • Energy systems • Communications and geospatial navigation systems	• Volocopter • InDro Robotics

Operations	• Air traffic management and concept of operations (ConOps):
	  • Route planning and airspace congestion
	  • Compatibility with infrastructure and aircraft systems
	  • Contingency procedures
	• Service provider: aircraft and non-aircraft
	• Maintenance, repair and overhaul (MRO), and fleet management
	• Operator and pilot training
	• Insurance
		• Nav Canada
		• OneSky
		• HeliJet
		• Vancouver International Airport (YVR)
		• CAE

Public acceptance	• Safety and risk management • Noise • Privacy • Social equity • Visual disamenity • Cybersecurity	• Transport Canada • Provincial government • TransLink • Municipalities • Communities
Regulations (policy)	• Addressing each dimension of public acceptance • Applied to infrastructure, manufacturing and operations • Market and non-market (certification, standards and approvals) • Policies on research and development and finance can spur industry development and improve regulatory outcomes	• Transport Canada • Provincial government • TransLink • Municipalities • Communities
Market demand	• By use cases and industry of end-user	• Vancouver Coastal Health • BC Wildfire Services

2.2 International Case Studies

2.2.1 Australia: Melbourne and Brisbane

AAM developments

Melbourne can expect to have air taxi services in 2026, according to air mobility platform provider Ascent when it entered a partnership with Eve.[18] Brisbane has been attracting investors and original equipment manufacturer (OEM) interest recently – a notable outcome of its status as a host city of the 2032 Summer Olympics. The latest development comes from Wisk Aero, which has expanded its business to display its Cora eVTOL technology demonstrator.[19] At the Singapore Airshow 2022, Eve received a potential pre-order of up to 90 eVTOL aircraft from an Australian operator partnership of Microflite, Aviair, and HeliSpirit. Swoop Aero will also establish a remote command centre at its Melbourne headquarters for worldwide BVLOS operations, supported by Amazon Web Services (AWS) infrastructure.[20] It expects to obtain BVLOS approval for drone logistics in Queensland and Victoria by the end of 2022. Swoop Aero drones are already undertaking shark spotting and bushfire detection, as well as delivering essential medical supplies.[21] As of 2022, drone delivery is relatively well-established in Australia, with Wing operating since 2019 and completing more than 50,000 deliveries of coffee and snacks in 2021 alone.[22]

Initial trials by Wing in Bonython in 2018 raised concerns about noise, safety, privacy and lack of community consultation.[23] Nonetheless, the Australian government has caught up quickly with AAM development, completing its first study on the economic impact of drones in 2020.[24] This was followed by a policy statement for National Emerging Aviation Technologies and a Memorandum of Understanding (MoU) between federal government departments and the state government of Victoria to jointly develop AAM in 2021.[25,26] The policy statement identified 14 key whole-of-government initiatives with an implementation timeline up to 2024 and a federal funding commitment of AU$35.7 million. Among these initiatives is the provision of a best-practice guide to promote the consideration of AAM within government procurement processes.

In 2022, Australia's Civil Aviation Safety Authority (CASA) released the remotely piloted aircraft system (RPAS) and AAM Strategic Regulatory Roadmap for public consultation.[27] It covers definitions, goals, and the provisional processes to meet them over the next 15 years, across different AAM ecosystem components and stakeholders. The City of Melbourne has also stated its goal to protect amenities, privacy and equity in the review of airspace regulations in its Transport Strategy 2030. [28]

Australia's AAM cluster

Australia's AAM cluster is well-rounded with an established drone sector; a local eVTOL aircraft developer, AMSL Aero; an AAM vertiports network developer, Skyportz; and existing rotorcraft operators.[29] Similar to HeliJet in BC, Microflite provides premium tours, charter flights, pilot training, and emergency services using helicopters, while Aviair and HeliSpirit operate aerial tours to attractions in Western Australia. Australia also hosts the Greenbird consortium, whose objective is to foster collaboration between industry partners, research institutions and government to advance the commercialization of AAM.[30] Members include Brisbane's Archerfield Airport, Griffith University, ground infrastructure group Skyports[vii], aircraft operators Nautilus Aviation and Aviator Group, planning specialist Aviation Projects, electric charging specialist Electro.Aero and AMSL Aero.

In 2017, Australian telecommunications company Telstra's muru-D incubator founded the

[vii] Note that Skyports is a different company than Skyportz.

Photo: Heart Aerospace

eVTOL aircraft developer AMSL Aero. Since its inception, AMSL Aero has received additional funding totalling at least AU$7 million: from London-based IP Group; the Australian federal government, via a two-year innovation grant; and the New South Wales regional government. The project grants support AMSL Aero's aim to create the world's most efficient and longest-range eVTOL aircraft for passenger and medical use.[31]

Skyportz is a real estate-based company that develops vertiports networks. Its approach is to facilitate infrastructure planning and investment with a focus on regulatory change and securing properties. In the words of CEO Clem Newton-Brown, Skyportz is doing "the hard work in gathering together the property partners while at the same time engaging in the political process for regulatory change to activate these sites." Newton-Brown is the former deputy lord mayor of Melbourne and former assistant minister in the state of Victoria, and therefore well-acquainted with the local regulatory landscape. Skyportz is also collaborating with several eVTOL aircraft developers and Electra.aero, an eSTOL aircraft developer, to investigate potential concept of operations (ConOps) in Australia. In Newton-Brown's view, vertiport network development will start with the retrofitting of existing airports and helipads, followed by building new vertiports on industrial and retail land for passengers and B2B heavyweight drone deliveries.[32] Newton-Brown has announced that Skyportz will build its first local vertiport at the Australian Advanced Manufacturing Centre of Excellence in Brisbane in 2023.[33] Skyportz has already obtained brand protection in all emerging markets worldwide in anticipation of expansion overseas.[34]

Relevant takeaways

- After completing a study on drone economic benefits, the federal government introduced and adopted swift and decisive policy measures across departments and levels
- A concise yet comprehensive policy statement for near-term targets and actions engaged the industry as active participants
- Regional and local governments proactively work to advance AAM, both as an industrial development policy and to maximize its net benefits for local deployment
- Skyportz has ameliorated local infrastructure investment uncertainty
- 2032 Summer Olympics carries the potential to showcase local AAM adoption
- The region boasts favorable weather for AAM and early-stage adoption

2.2.2 United Kingdom (UK): Coventry and London

AAM developments

Based on the UK Research and Innovations (UKRI) roadmap, the UK will be among the first to launch AAM demonstration services in 2024.[35] In 2021, the UK Air Mobility Consortium, working with reviewers from the UK Civil Aviation Authority's (CAA) Innovation Hub, completed the London-centric ConOps for airspace integration of UAM.[36] The comprehensive ConOps includes proposals for different time horizons to address key regulatory challenges for safe and scalable zero-emissions UAM operations. The study is part of Innovation Hub's sandbox for UKRI's Future Flight Challenge (FFC).

UK authorities became actively involved in AAM relatively early in 2018 with the Aviation 2050 green paper by the Department for Transport (DfT).[37] The paper highlighted the risks and opportunities of drones and introduced the Aerospace Sector Deal to support its development. In the same month, UK CAA published its Airspace Modernisation Strategy.[38] It documents UK CAA's end goals for airspace functions, methods and requirements, gaps in policy and regulations, and execution plans involving NATS, UK's analogue of NAV Canada, subsidiary NATS (En Route) plc and other public agencies.

Also in 2018, PwC issued a report looking at projected drone applications, their potential productivity and cost-savings and resulting economic impacts, as well as high-level guidance on the requirements to realize them.[39] This was followed up with the Flying High project in 2019, commissioned under the Nesta Challenges program, that engages city leaders, regulators, public services, businesses and industry to focus on public use cases in cities, and outlines the main steps to realizing these opportunities.[40] In the same year, CAA launched the Innovation Hub to "create a regulatory environment where innovation in aviation can flourish in line with CAA principles."[41]

The Innovation Hub serves three purposes: 1) it is a gateway point of contact for innovators to access CAA's expertise and guidance; 2) it provides regulatory sandboxes to test innovative concepts in safe environments and address regulatory challenges of new technologies – either the Innovation Hub or industry may propose these regulatory challenges concerning safety, security, and consumer protection; and 3) it anticipates regulatory challenges of new technologies, thereby accelerating the development of relevant new policies.

On the research and commercialization front, UKRI's FFC initiated a series of research studies in 2021. UKRI's Future Flight Challenge provides £125 million in public funding, matched by industry with £175 million, to develop greener ways to fly by advancing electric and autonomous flight technologies. Many research projects were born out of FFC, including:

- Socio-economic assessment of the potential costs and benefits, and their associated key drivers and impacted parties, of six use cases selected by FFC[42]
- Study to understand the safety challenges posed by the future use cases of AAM and devise a list of prioritized recommendations required to evolve the aviation system to address them. [43]
- AAM vision and roadmap for UK[35]
- Forward strategy paper analyzing the social-economic research dimension of AAM to identify five priority research themes, as well as next steps[44]
- Investigation of hydrogen as a zero-emissions fuel source for future aircraft and understanding the infrastructure requirements[45]

Concurrent with UKRI's FFC research studies, DfT launched the Connected Places Catapult (CPC) to develop and trial an open-access uncrewed traffic management (UTM) framework based on the national framework previously developed by the industry and DfT with CAA.[46] The program is designed to inform further research and demonstration activity on integrated UTM for drones and other aircraft within the FFC, and guide the evolution of policy and regulations. It also proves the concept of a federated UTM architecture with a set of open application programming interfaces (APIs) that enables interoperability of UTM service providers. Field trials were initially conducted for delivery, fire response, and wind farm inspection. Subsequently in 2022, FFC formed a cross-sector

Future Aviation Industry Working Group on Airspace Integration to help inform policy for future airspace integration of AAM technologies and enable commercial services by 2025.[47] Shortly after, the government released its vision and plans for commercial drones.[48]

UK's AAM cluster

UK has a thriving AAM cluster that comprises several domestic and overseas companies and has generated significant investment interest from the private sector. The UK Air Mobility Consortium is led by Eve and joined by NATS, Heathrow Airport, London City Airport, Skyports, Atech, Volocopter and UK-based Vertical Aerospace. It also boasts the most recognizable vertiport startups: Skyports and Urban-Air Port.

Skyports, founded in 2018, is an end-to-end vertiport provider and operator that has partnerships with major OEMs worldwide.[49] In 2019, it built the world's first vertiport in Singapore, and is currently working on the Cergy Pontoise demonstrator with Volocopter for the 2024 Summer Olympics in Paris. Skyports is also a drone operator, and has chosen to set up its command center for its global BVLOS remote operations at the Westcott Space Cluster.[50] To date, Skyports has received a total of US$30.9 million in funding over three rounds. Its first investors were from European transport operators via Deutsche Bahn Digital Ventures (DBDV) and Groupe ADP.

In 2022, Urban-Air Port with Hyundai's Supernal (a smart mobility service provider) opened the world's first fully operational eVTOL hub, Air-One, in Coventry.[51] The Air-One project is a public–private partnership (PPP) where 20 percent of seed funding comes from FFC with the project site provided by the municipality of Coventry.[52] Demonstrations conducted at the site are intended to help gain public acceptance. Urban-Air Port designed its vertiports to be highly flexible and deployable at short notice for the air transport of emergency supplies, equipment and people.[53] It will serve four markets in a variety of situations: passenger air taxis, autonomous delivery drones, emergency management, and defence and logistics operations. A critical aspect of Urban-Air Port's offerings is zero-emissions, off-grid power, supplied by AFC Energy's H2FC generator for Air-One.[54]

Urban-Air Port has also developed a travel retail e-commerce app-within-an-app for passengers as part of its infrastructure-as-a-service business model.[55] The operating finance is similar to airports where 40 percent of total revenue of Airports Council International members comes from non-aeronautical sources.[56] Urban-Air Port raises capital by selling its stake to investors, the first of which is Supernal. The latest investment interest comes from European real estate fund M7 and Canada's Dymond Group. Dymond Group is planning to open two vertihubs in Canada, one of which will be in the west.[57,viii]

Relevant takeaways

- Progressive governance embraces innovation and creates a set of complementary schemes that build upon each other – effectively a government-wide approach to foster a conducive development ecosystem
- Accessible and well-structured channels support close collaboration with industry down to the technicalities; for example, Innovation Hub and Connected Places Catapult
- Future Flight Challenge and Innovation Hub are sufficiently flexible to encourage holistic, system-level solutions involving consortiums
- The region is home to a strong research and applications ecosystem – private, public and non-governmental

[viii] A vertihub is a stand-alone structure and the largest form of vertiport. It has infrastructure for maintenance, repair, and overhaul (MRO) operations for the fleet, parking spaces for longer-haul vertical takeoff and landing (VTOL) aircraft, and a centralized operations control system (NUAIR, 2021).

[141] Northeast UAS Airspace Integration Research Alliance (NUAIR). (2021, March 5). *High-density automated Vertiport concept of Operations - NASA Technical Reports Server (NTRS)*. NASA. Retrieved May 12, 2022, from https://ntrs.nasa.gov/citations/20210010603

2.2.3 United States: Seattle–Washington State and Los Angeles

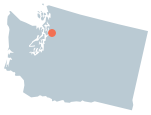
AAM developments

The main federal organizations overseeing aviation development in the US are NASA and Federal Aviation Administration (FAA). NASA undertakes research with the industry, while FAA is the regulator of civil aviation.

NASA has been quick to commence AAM research. The first of its documented AAM studies dates to 2013; it also commissioned UAM market studies in 2018, which remain the only such comprehensive studies publicly accessible.[58] NASA's UTM project, an advanced stage of drone development, started in 2015.[59] In 2019, NASA launched the UAM Grand Challenge. The following year, this was upgraded to the AAM Project National Campaign (AAMPNC) in collaboration with FAA.[60] AAMPNC seeks to accelerate the adoption of AAM and promote public confidence.[61] Its findings will also be used to inform FAA policies on AAM safety, certification, operations, and airspace integration. Apart from these, NASA Aeronautics Research Institute (NARI) regularly initiates information exchange with the industry, public agencies and academia via workshops and working groups. For instance, it has regularly held workshops to share and build on extensive experience in the US with wildfire management using aviation technologies.[62,63,64]

The Federal Aviation Administration intends to certify eVTOL technology by 2024.[65] It issued its UAM ConOps in 2020 and draft interim guidance for vertiports in 2022.[66] Also in 2022, FAA revised its certification process for eVTOL deployment, which has led to concerns in some quarters of the industry.[67] FAA's rationale was to accommodate the novel pilot certification requirements with a predictable framework without special conditions or exemptions. It assured that its process "for certifying the aircraft themselves remains unchanged. All of the development work done by current applicants remains valid and the changes in our regulatory approach should not delay their projects."[67] Interestingly, FAA has conceded that it has lost the lead on drone adoption due to its tardiness in creating rules to accommodate drone applications.[65]

FAA's drone program began in 2017 with the Unmanned Aircraft Systems (UAS) Integration Pilot Program and was extended via the BEYOND program in 2020.[68] BEYOND will tackle the remaining regulatory challenges of UAS integration, notably scalable BVLOS. These programs comprise partnerships with local authorities that will work with the private sector; it's important to note that the extent of local development is highly dependent on the interest of local authorities.



AAM in Seattle–Washington State

Interest in Seattle around PAM was high in 2019, when Voom, an on-demand helicopter booking platform, and Uber Elevate hinted that they were contemplating the provision of on-demand urban air service around Seattle.[69] However, Voom shut down in 2020 due to the COVID-19 pandemic; Uber Elevate was sold off later that year. Nonetheless, the Puget Sound region, which includes Seattle, is still home to the Community Air Mobility Initiative (CAMI) as of 2022. CAMI was founded in 2019 by mostly industry members and aims to promote UAM deployment through education, communication, and advocacy. The lukewarm atmosphere for AAM in Seattle comes despite Washington State's competitive and established aerospace manufacturing cluster.[70] Seattle also has a sizeable cluster of helicopter and seaplane operators, including the largest in North America, Harbour Air (which is headquartered in Vancouver, BC) and Washington-founded Kenmore Air.[71]

When asked why Seattle lags in the local development of AAM, interviewees offered two possible explanations. The first is that there are more suitable cities in terms of climate and demand: for example, Seattle experiences colder winters than other hubs like LA. It's also not among the top US cities for projected market demand by various measures.[72,73]

The second reason is community hesitation due to lack of trust in localized air mobility operations. This can be traced back to the 2014 KOMO News helicopter crash near downtown Seattle, which left two people dead and led to calls for stricter regulations. The lack of sufficient public acceptance of helicopter operations has persisted.[75] Since 2019, there has been tension between aircraft operators and the community over sea space.[76,77] This could also be attributed to poor community engagement.[ix]

The AAM policy environment is proactive and supportive at the state and regional levels. Authorities at these levels regularly review their aviation needs and developments for policymaking; a notable example is the Puget Sound Regional Council (PSRC) Regional Aviation Baseline Study.[78] The Washington State Department of Transportation (DoT) began preparing for AAM adoption in 2017 and conducted a feasibility study of electric aircraft in 2018. The Washington State Transportation Commission is planning to include aerial drone highways in Washington State's future transportation plans.[79]

On AAM development, PSRC acts as a regional platform to boost economic development by securing federal funding and collaborating on state initiatives. One notable initiative is NMA (New Mid-Market Airplane) Choose Washington Council, which promotes Washington State as the most competitive site for Boeing's NMA design and production.[80,81,82] In 2022, Washington State created an Innovation Cluster Accelerator Program (ICAP) that provides cluster promotion and management support.[83] It comes in the form of cluster management funding, cluster strategy and leadership development, cluster expert advisory, and global networking. ICAP currently has nine clusters, three of which are particularly relevant to the AAM ecosystem: Pacific Northwest Aerospace Cluster (PNAC), Sustainable Aerospace Technologies and Energies (SATE) Cluster, and Consortium for Hydrogen and Renewable Generated E-Fuels (CHARGE).

PNAC is led by the Pacific Northwest Aerospace Alliance, which is also open to organizations from British Columbia and Alberta. SATE works to advance sustainable aviation fuels (SAF), and electrified and hydrogen-powered aviation, by building critical hydrogen ecosystem and electric charging infrastructure, performing commercial flights with SAF, implementing clean fuel standards, and developing a qualified workforce. CHARGE aims to grow the green hydrogen and low carbon e-fuel economy by facilitating hydrogen value chain commercialization and inbound investment.

AAM in Los Angeles (LA)

LA is often cited as one of the most promising US cities for AAM.[72,73,84,85] The primary reasons are its extensive network of heliports, high willingness-to-pay, large market, severe road congestion and mild winters. The Los Angeles Department of Transportation (LADOT) is planning to introduce electric air taxi services by 2028, when the Summer Olympics Games will be hosted in the city.[86] One concern that surfaced from the planned introduction of air taxi services was visual disamenity. In this context, the Urban Movement Labs (UML) was spun out of the mayor's Office of Economic Development in 2020 and has since become a key player in LA's AAM ecosystem.[87]

The UML is leading the UAM Partnership (UAMP) to integrate AAM into LA's mobility network in a safe, equitable and sustainable way. A key product of UAMP is the collaboration between the mayor's office and LADOT to define the roles, vision, goals and challenges for the city in adopting AAM.[88] UAMP is partly funded by industry, and one of its main functions is community engagement; it has concluded its first phase with interviews, outreach and a review of a draft UAM Policy Toolkit.[89] Beyond UAMP, Supernal and NREL are collaborating with the City of Los Angeles to take a holistic look at AAM for vertiports and energy network planning by analyzing their energy costs, market viability, public acceptance, station distribution, accessibility, and environmental sustainability.[90]

[ix] According to Roberts (2019), a long-time resident highlighted that in 1989, "seaplane companies, neighborhood groups, city officials and others came together to hammer out an agreement that saw seaplane companies change the way they operated."

Relevant takeaways

- Policy certainty and communications are important; major revisions to regulations need to be deliberated and communicated in advance
- Preserving public trust and constant community engagement is critical to achieve a successful AAM ecosystem
- A suitable weather climate is advantageous for early-stage AAM adoption
- Forward-looking regional and state planning ranges from aviation to multimodal integration and aerial highways; note that the City of Los Angeles is more than 10 times the area of the City of Vancouver and closer in size to Metro Vancouver
- The Urban Movement Labs initiative clarifies and advances the city's vision and policymaking for AAM
- Seattle–Washington's well-organized business ecosystem includes partnerships between industry and the enterprising state government to secure external (private investors and federal) funding for industrial and economic development; BC can follow suit by leveraging its ties with Pacific Northwest Aerospace Alliance and Cascadia
- The 2028 Summer Olympics in Los Angeles could serve as an showcase for local AAM adoption

2.2.4 Other thematic leaders

AAM in Europe: Paris and selected cities

In 2020, airport operator Groupe ADP, transit operator RATP Group, and Choose Paris Region came together with a plan to develop a UAM industry that fits with **Paris'** objectives of environmental transition in air transport, economic recovery, and urban densification. Their focus was on conducting sandbox experiments with eVTOL aircraft and ultimately showcasing the technology at the 2024 Olympic and Paralympic Games in Paris. The collective aimed to create an ecosystem of large groups, SMEs, startups, laboratories, and universities in the Paris region over the long term. It launched a worldwide call for applications offering the test area at the Pontoise airfield and access to the €4 billion French smart mobility market, one of Europe's largest, and also to the developing AAM ecosystem.[91]

In preparation for the Olympic Games showcase, in 2022 Volocopter and local partners conducted noise emissions flight trials at Pontoise Airport to understand how aircraft can be flown with the lowest possible noise profile.[92] These trials saw RATP take a step closer to its ambitions in the air taxi sector, as they prepared noise maps around potential routes and vertiport sites across the city. A complementary scheme offered by Choose Paris Region and Groupe ADP, this time with Air France-KLM and Airbus, is the H2 Hub Airport, which explores the use of hydrogen to boost air transport decarbonization in anticipation of Airbus' hydrogen aircraft planned for 2035.[93]

In **Rome**, airport operator Aeroporti di Roma is embracing AAM due to its alignment with its primary goals for sustainable operations and zero emissions by 2030.[94] The airport is developing a startup incubator, Fiumicino's Innovation Hub, to encourage innovation towards new sustainable mobility models. Also, in conjunction with the airports in **Venice**, **Bologna**, and the **French Riviera**, Aeroporti di Roma founded Urban Blue to study, design, build and operate vertiports.[95] Of special note is the way Aeroporti di Roma issues sustainability-linked bonds to raise capital, which is unique to the airport sector.[94]

In **Germany**, Munich Airport takes centre stage in AAM development. In 2021, it agreed to purchase at least one full-scale operational Urban-Air Port and jointly develop vertiports that will be ready by mid-decade.[96] In 2022, Munich Airport teamed up with Airbus to work on offering a full range of AAM solutions encompassing options for aircraft, navigation, vertiports and operations services in simplified packages.[97] The collaboration is part of the €86 million Air Mobility Initiative, introduced in 2022, which involves leading companies, research institutions, municipalities and organizations in Munich jointly funded by the Bavarian and federal governments, and industry.[98]

AAM in South Korea: Seoul

In South Korea, the Ministry of Land, Infrastructure and Transport (MOLIT) leads the development of AAM. In 2020, MOLIT selected Goheung's state-run aircraft performance

test centre to be the test bed for UAM commercialization. In 2022, MOLIT launched the K-UAM Grand Challenge with the goal of commercializing UAM in its major cities by 2025. The initial use cases planned will be air medical services provision and replacement of military helicopters, followed by the use of tourism and UAM theme parks to raise public awareness.[99]

For drones, MOLIT embarked on regulatory reform in 2019, with the goal of setting regulatory standards by 2023 and commencing drone deliveries by 2025.[100] In 2022, it selected seven operators to run a test demonstration of an urban drone traffic control tower system, K-Drone system, for BVLOS facilities maintenance and blood deliveries.[101] An interesting application adopted by **Seoul** is the use of smart city light poles as drone stations for traffic and incident monitoring and enforcement.[102] This innovative concept originated from Portugal-based Omniflow and can be used as swift deployment of first responder drones or en-route drone charging stations.

A key highlight of South Korea's AAM development is its hydrogen-powered drones. The government remains a major player via its Defence Acquisition Program Administration (DAPA), which intends to extend the range of South Korea's indigenous drones to match global leaders from Israel and the US. DAPA signed a contract to purchase low-noise H2FC (hydrogen fuel cell) drones in 2021.[103] The Drone Show Korea 2022 was centred on new domestic long-range or high payload military drones powered by hydrogen, products of eco-fuel company SK E&S, missile maker LIG and Korean Air. Furthermore, Doosan Mobility Innovation is behind the world's first mass-produced H2FC drone, DS30, which was first sold in 2020 for industrial surveillance purposes.[104] It received ₩27 billion in private capital in early 2022, mostly for H2FC cargo drones' development.[105] Doosan Group holds one of the world's largest H2FC companies by market capitalization, and has prioritized the H2FC business as part of its restructuring between 2020 and 2022.[106]

AAM in Singapore

Through the use of Memorandums of Understanding (MoU)s, Calls-for-Proposal (CfP) and Proof-of-Concept (PoC) trials, the Singapore authorities have been collaborating with industry to develop AAM incrementally. Development started relatively early with the 2016 Skyways UAS PoC between Airbus and Civil Aviation Authority of Singapore (CAAS), which led to an urban-focused UAS sharing and development agreement with the European Union Aviation Safety Agency (EASA).[107] Another MoU between Airbus and CAAS to develop initial UAS services followed the Singapore Airshow 2020. In 2021, OneSky and Nova Systems concluded a Ministry of Transport (MOT)/CAAS UAS call for proposal with a demonstration of UTM system scalable BVLOS operations that will be used to inform their UAS roadmap.[108]

Singapore also leveraged its existing aerospace cluster to advance advanced air mobility. Thales conducts UAS and UTM system R&D locally and partners with CAAS to accelerate air traffic management (ATM) digitization.[109] Its government industrial estate developer, JTC, provides space for drone developmental trials and plans for cluster-oriented industrial space supply.[110] JTC, together with Singapore Economic Development Board, has inked an MoU with Skyports and Volocopter to explore the future development of Seletar Aerospace Park to accommodate AAM infrastructure, R&D, maintenance, repair and overhaul (MRO) and operator training activities.[111] The MoU follows up on Volocopter's better-publicized roadmap for Singapore to operate eVTOL tours in 2024 before expanding to regional air taxi services.[112] Lastly, Jurong Port, a multi-purpose cargo port operator, has signed an MoU with Skyports to develop ship-to-shore infrastructure and large-scale drone delivery operations.[113]

Singapore's universities round out its AAM ecosystem, and conduct research on drone safety, third-party risks, and urban flight route optimization..[114,115] It was on the campus of National University of Singapore that Skyways drones completed the first local urban parcel delivery in 2019.[116] An interesting finding from a local public drone perception study is that traffic enforcement – such as Seoul's smart city drone deployment – is considered one of the least acceptable use cases.[117]

Relevant takeaways

- Leadership needs to be taken by airport operators to achieve their sustainable business growth objectives
- Proactive industrial development policies can be a great boost to AAM development and deployment
- Hydrogen technologies present opportunities for the future of aviation and AAM
- The 2024 Summer Olympics can be a valuable showcase for AAM adoption
- Coordination and alignment in policy objectives between different levels of government may be easier in certain cities, such as Seoul and Singapore

2.2.5 Summary

Key Takeaways from Global Clusters

A list of selected attributes of the regions studied is presented in Table 3 on page 22 of this report. The following are key findings drawn from analyzing these clusters:

- Public trust and acceptance are a critical prerequisite for the success of AAM adoption. Various approaches are used to achieve this trust, from public consultation and demonstrations to deployment for public use cases.
- Many regions are piggybacking on their hosting of a major world event to showcase AAM deployments. It serves as an attractive value proposition for investors, a policy commitment, and an opportunity for public engagement; on the latter, Japan explicitly stated its intention for Expo 2025 in its AAM roadmap.[118]
- Regions with more advanced clusters share the trait of having clear, established objectives for AAM development.
- Another feature typical of leading regions is their policy consistency with a well-communicated roadmap and government-wide approach encompassing coordination and complementary schemes across public agencies.
- Successful federal regulators in benchmarked regions have proactively worked with local authorities to expedite the development of AAM and provide guidance to fill local/regional AAM policy vacuums. Successful whole-of-government partnerships could also encourage investment by jointly, with local authorities, setting policy commitments for AAM commercialization based on the satisfaction of performance targets.
- As evident from Table 3, almost all the countries of the regions analyzed are among the top 10 in the world for aerospace manufacturing competitiveness. Except for Canada, these regions or countries have active AAM industrial development policies. Their local AAM cluster developments receive significant government funding based on existing schemes, such as those for aerospace development (i.e. Bell Textron Canada and CAE in Québec).
- Table 3 shows that AAM adoption has been accompanied by a coherent regional effort. It is not feasible for the City of Vancouver, or any municipality in Metro Vancouver, to successfully take on advanced air mobility cluster development alone. For instance, the planning efforts undertaken by the City of Los Angeles are better matched to the scale of Metro Vancouver, in terms of population and geographical area.
- Scaling up of advanced air mobility as an integrated airspace with passenger air mobility and uncrewed aircraft systems is only likely to occur after 2030.
- Hydrogen energy is one of the main options for the future of aviation, including longer-range or higher-payload AAM. Aviation clusters with heavy AAM presences have already begun to invest in hydrogen power ecosystems.[x]
- Neither Metro Vancouver nor other parts of BC are likely to be early-stage AAM adopters due to the risk of icing and poor visibility. However, this has not held back other cities with similar or colder climates (notably Seoul). One possible strategy is to plan for a sustainable AAM ecosystem and invest when the case for scaling up is clear-cut.

[x] A long payback time will require earlier investment to gain a foothold in the market earlier or get positive returns by a target date – i.e. decarbonization timeline. Nonetheless, an interviewee mentioned that the long payback period is holding back investment in BC, likely due to the shorter investment horizon in BC.

- One key interviewee suggested that regions in Asia might be more open than those on other continents to technological innovation. Relatedly, the high-density living in many Asian urban centres may have acclimatized its residents to accept high levels of noise and visual obstruction, and limited levels of privacy. Vancouver will need to invest in greater public engagement efforts to resolve these concerns.

2.3 Metro Vancouver

2.3.1 Regulatory Landscape in Canada

Transport Canada (TC) is the main regulatory agency for AAM in Canada. It is supported by NAV Canada for the development of airspace integration and air traffic management (ATM) with AAM. It also works with the National Research Council Canada (NRC) to set up research and development programs to support drone industry development and evidence-based regulatory evolution.[120] Icing and severe weather impacts is a prioritized area of research identified by TC that is more relevant to Canada than most other countries. TC and NRC have jointly conducted studies on these challenges since 2019. Another study jointly undertaken by TC and NRC aims to advance drone safety centers on urban airflow and operator awareness. TC, together with NRC, Consortium for Aerospace Research and Innovation in Canada (CARIC) and the Consortium for Aerospace Research and Innovation in Québec (CRIAQ), has also been launching calls for proposals since 2018 on other areas, such as detect-and-avoid (DAA) technology.

At present, Transport Canada administers the development of PAM and RPAS separately, instead of adopting a more unified framework with overlapping policies undertaken by some of the benchmarked regions. TC uses a risk-based approach to AAM and, as such, the policy response has been focused on drones due to their lower risk. The priority on RPAS could also be due to a public survey commissioned by TC that showed while almost every participant was comfortable using drones for emergency situations, only a few were comfortable with air taxis.[121] In 2021, TC published its near-term drone strategy and set up the Canadian Drone Advisory Council (CanaDAC), comprising about 35 industry thought leaders and stakeholders to foster the development of RPAS.[122] eVTOL aircraft, on the other hand, have to undergo the national aircraft certification process while TC is still monitoring international developments for their future vertiports policies.

A policy common to both PAM and RPAS is the use of Special Flight Operations Certificate (SFOC) as a permit for flight trials or pilots and higher risk operations. In general, the risk factors for drones are their operating mode in terms of line-of-sight (LOS), their weight, their proximity to people, and the airspace environment.[123] Under the current framework, BVLOS operations typically require an SFOC. Consequently, the development of the larger H2FC drones (hydrogen fuel cell drones) more suitable for beyond visual line-of-sight (BVLOS) will be slower and entails a longer investment gestation. Furthermore, UAM and drone deliveries within denser urban centres will likely occur only at the later stages of AAM development.

Safety was frequently mentioned by interviewees as critical to AAM, and generally there was trust and satisfaction in Transport Canada's work to ensure safety. However, there was some perception of regulatory sluggishness among industry interviewees, even as they acknowledged the need for regulations. A key finding is that, beyond the federal government, there is a policy vacuum in dealing with AAM, effectively leaving TC as the only regulator. In practice, operations and trials for AAM development still must pass through non-AAM procedures by local authorities to manage potential AAM-related public concerns. At the same time, TC's emphasis is on safety for Canada as a whole and therefore relies upon local authorities to form their own vision for AAM applications and leverage TC's expertise for local adaptation. There are localized implications such as noise, privacy, visual disamenity – meaning visual obstruction, among other visual annoyances – and social equity, which can be more effectively managed at the regional level. An example is the need for multi-modal integration, routes and vertiports planning, which does not fit into the current regulatory framework in BC.

2.3.2 State of Local AAM Cluster Development

Officially there are currently no local PAM, OEM or vertiports operators in Metro Vancouver, although existing local operators could soon fill

the space. HeliJet is a helicopter operator that also owns heliports. In 2021, HeliJet signed an agreement with air mobility platform provider Blade Urban Air Mobility, which paves the way for eVTOL flights in the future.[124] In contrast, there is a thriving drone cluster in the Metro Vancouver area. A list of organizations in the local cluster can be found in Appendix B. The drone cluster includes companies supplying drones, counter-drone and DAA technologies; and providing delivery services and surveillance for the real estate, construction, agriculture, silviculture, industrial and film sectors. Drones have also been deployed for wildfire management with hotspot mapping and land management using LiDAR mapping for landslide risk assessment and geological survey.[125,126] However, the RPAS research capacity in BC still lags behind Ontario.[127]

Individuals interviewed for this study noted that the drone cluster in Vancouver is working on expanding BVLOS operations to attain commercial viability. In addition, industry collaboration and investment into the learning and development process for the commercialization of AAM – working through the kinks of trials and new processes – was mentioned as crucial for the adoption of advanced air mobility in the region. Some interviewees also pointed out that weather in the Metro Vancouver area is less conducive to AAM than in the southern US, with fog and clouds affecting visibility and the risk of icing in winter. Nonetheless, they acknowledged that Vancouver has among the mildest weather and winters in Canada and is therefore more likely to be able to accommodate year-round operations.

Public agencies and most interviewees mentioned that AAM applications must be socially equitable and inclusive within Vancouver. Use cases with clear public benefits, such as medical and emergency services, are believed to have the broadest public support. Moreover, representatives of local authorities have expressed openness to partnering and advocating for these initiatives. Some industry interviewees reported that government contracts can play a significant role in AAM adoption. Based on a 2015 study, drone use support generally is highest for public and research purposes, followed by industrial use, and then by commercial services.[128] Of note is that package delivery faced strong opposition (48.6 percent opposed); along with law enforcement and routine or public monitoring tasks (such as vehicle speeding) likewise receiving weak support.

The key informant interview survey responses suggest that tourism applications, though concentrated among higher-income individuals, could be a publicly acceptable use case of AAM due to the importance of tourism to the local economy and its accompanying benefits; examples provided include sight-seeing flights using battery powered engines. Another potential public benefit cited by interviewees is the improvement of access to medical or food supplies to remote communities; these present a different set of challenges given the limitations of rural infrastructure. When the technology matures, AAM has a large potential for serving remote and rural communities, notably Indigenous communities. However, the technology must be accepted by these communities as beneficial for the long haul. Trust and sustainable relationships with culturally respectful engagement are necessary prerequisites for AAM's adoption by remote and Indigenous communities, and could be facilitated by the administrative capacity of the communities.

2.3.3 Strengths

Interviewees from industry noted Metro Vancouver's advantageous location beside the ocean and land masses traversed by large bodies of water. This not only makes air travel more efficient with more direct routes, but could also potentially reduce the negative effects of AAM (i.e. noise, privacy, and risks to people and property on the ground). This risk-mitigating potential of water bodies also makes it suitable as a realistic test environment for commercial deployment given the busy Vancouver–Victoria airspace. Some interviewees from industry think this more than compensates for Metro Vancouver's lack of a drone test range. In addition, the scarcity of unused land militates in favour of eVTOL or eSTOL aircraft, which require less area for takeoff and landing than conventional small aircraft.

Metro Vancouver also has long operational experience with seaplanes and helicopters. It has a thriving ecosystem of operators and heliports, and is the home of Harbour Air, one of the largest seaplane operators in the world and the largest

in North America.[3,71] It also has a sizeable aviation cluster with close access to Washington State's globally renowned aerospace manufacturing cluster in the wider Cascadia region.[70,82,129] Vancouver International Airport (YVR) was mentioned as a potential key player in enabling AAM adoption, and has expressed support for future deployment of AAM technologies in its operations. Metro Vancouver's openness to innovation and sustainability focus, as evident by green initiatives such as BioPortYVR and the world's first commercial electric flight within its region by Harbour Air[xi], are compatible with the deployment of AAM.[130] Vancouver also hosts the office of Aerospace Industries Association of Canada (AIAC) Pacific, BC Aviation Council, and Canadian Advanced Air Mobility consortium (CAAM), and can leverage the Canada-wide AAM ecosystem collaboration facilitated by CAAM.[xii]

British Columbia was designated a Digital Technology Supercluster under the Innovation Superclusters Initiative by Innovation, Science and Economic Development Canada, which provided up to CA$173 million in funding to be disbursed over five years. Its focus on virtual, mixed and augmented reality, and data collection and analytics with project applications to agritech, serve as good complements and a strong foundation for local advanced air mobility developments. Furthermore, British Columbia has a strong hydrogen cluster supplemented by a dedicated, provincially administered BC Hydrogen Office and the Canadian Hydrogen and Fuel Cell Association (CHFCA).[131] It has companies that provide development, simulation, and testing technology for powertrains, H2FC (hydrogen fuel cells) and other energy storage systems, which are relevant to the development of H2FC in AAM.

The University of British Columbia (UBC) produces among the most patents in hydrogen technologies nationwide.[132] An example of such research is the Hydrogen Hub project by MéridaLabs at UBC, which serves as a test bed for clean energy solutions.[133]

MéridaLabs is also working on developing long-range beyond visual line-of-sight (BVLOS) and zero-emission RPAS operations over the 5G network. In parallel, British Columbia Institute of Technology (BCIT) provides a wide variety of remotely piloted aircraft systems (RPAS) training courses, from preparation for RPAS certification with Transport Canada to applications for geomatics.[134] Furthermore, BCIT has set up the RPAS Hub, a collaborative centre for education, training and research in drone technology.[135] The RPAS Hub has drone applications research programs that range from search-and-rescue to climate change.

Interviewees from provincial and municipal public agencies primarily mentioned sustainability as a priority aligned with AAM, with Vancouver's green economy and clean transportation identified as key industrial clusters to reinforce. The vision of a sustainable economy can be realized by setting environmental standards in government procurement. Some participants also view TransLink's role favourably in facilitating AAM's development as a bridge between local public agencies in the region for cooperation and policy coordination. The knowledge and experience gained from the Drone Transport Initiative (DTI) at UBC paves the way for easier and more effective deployment of drones by remote communities when the technology matures and they are ready for adoption.[xiii]

[xi] **https://harbourair.com/harbour-air-and-magnix-announce-successful-flight-of-worlds-first-commercial-electric-airplane/**

[xii] Canadian Advanced Air Mobility (CAAM) is a socially responsible, federal not-for-profit consortium that acts as the national catalyst for the Advanced Air Mobility (AAM) industry in Canada. Its members come from the industry, government, academia, and associations.

[xiii] DTI was established by UBC's Faculty of Medicine to study how drone technology can be used to improve healthcare for rural and remote First Nations communities. More information can be found on its website: **https://mednet.med.ubc.ca/AboutUs/StrategicPlanning/InitiativesAndProjects/DroneTransportInitiative/Pages/Home%20Page%20-%20Drone%20Transport%20Initiative.aspx**

2.3.4 Opportunities to advance the AAM cluster in Vancouver

1. Public engagement

1.1 Current public engagement is mostly ad-hoc through operators and on a project-by-project basis; there is no broader public study on AAM perceptions (especially on some of the more controversial applications, such as those carrying passengers or people in general, as in rescue).

1.2 Aviation infrastructure and operational deployments would benefit from a more holistic and established process for gaining community acceptance, with minimum standards beyond safety requirements. This is to ensure positive perceptions and acceptance of AAM among the general public.

2. Industry development

2.1 Some industry study participants argued that an anchor company or government agency with large procurement capacity (and appetite) for AAM applications would be helpful to the local cluster development. Projects run by public–private partnerships could boost local cluster development.

2.2 Interviewees from public agencies hold the common view that AAM projects or applications should typically be initiated by end-users or the industry. These public agencies have yet to form a clear and consistent vision of how AAM can be deployed for the benefit of society; some do not perceive AAM to be beneficial enough to enact policies facilitating its development.

2.3 Policies and support schemes applicable to AAM, including complementary clusters that can spur its development, were cited as fragmented by interviewees and hard to navigate, thus impeding potential AAM investments in the region.

2.4 Industry collaboration within the Cascadia region, between BC and Washington State or Alberta, could be more active in some AAM relevant sectors to access a larger market or wider range of projects.[xiv]

2.5 Sufficient scale-up capital has yet to be raised for investment in vertiports and aircraft.

2.6 Knowledge and experience gained from research and trials are not always systematically accessible or shared with AAM stakeholders to avoid duplicate efforts. Such information, if made widely available, can also provide more certainty on AAM progress and induce industry collaboration in Canada.

2.7 Some of the drones used by local operators for longer range or higher payload missions are gas-powered, which is incompatible with zero-emissions targets.

3. Policy and planning

3.1 Existing multi-layer regulations are not designed to address AAM challenges. With the exception of safety, there is no clarity on the allocation of regulatory responsibilities. Moreover, regulations exist primarily on a federal level, so there is a lack of a regional consensus on the roles, vision, goals and challenges of AAM. These feed into the high regulatory burden perception identified by the 2020 Deloitte study.[134,135]

3.2 Municipalities and regional governments are ill-equipped to handle the adoption of AAM. There are currently no policies on AAM noise, privacy or visual disamenity; there is also a lack of regional consensus on how these issues could intersect with social equity concerns during AAM deployment.

[xiv] Edmonton International Airport in the province of Alberta, leads the implementation of RPAS operations from an airport. It is the first airport in Canada to fully operate commercial drone delivery services. More details can be found on the following Canadian Aviation News website: https://canadianaviationnews.wordpress.com/2022/06/02/drone-delivery-canada-project-with-edmonton-international-airport-commercially-operational/

3.3 There is lack of clarity on the recourse and regulations around AAM-related accidents. This includes insurance requirements, accident response, standard operating procedures and the jurisdictions involved.

3.4 Public policy and planning agencies have yet to create any framework, even a provisional version, that satisfies the (yet to exist) policy direction for AAM, or for deciding the location of vertiports and flight paths, multi-modal integration or innovation corridors used to conduct trials that minimize the negative effects on society.

3.5 There are no known regulations or regulatory review processes on vertiports, or on retrofitting or upgrading heliports. Consultation could be broadened to include local stakeholders, such as communities and public service providers.

3.6 Having a clear policy direction is important for investment, yet there is a lack of policy commitment by relevant authorities (for instance, by municipalities or Transport Canada) for AAM commercialization based on the satisfaction of performance targets.

3.7 Compared to the jurisdictions in other countries analyzed above, R&D calls for proposal and proof-of-concept projects in Vancouver are typically more specific. This could be attributed to the earlier stage of applied research. There are opportunities to leverage industry expertise and creativity to develop holistic solutions or resolve more complex challenges. This could include taking a more unified approach to AAM to inform regulations for integrated airspace.

Table 3: Summary of selected attributes of regions analyzed

Region	PAM Target Year	Aerospace Manufacturing Country Rankings[70,136,137]	Government Development Funding (million)	2020 Population (million)	Land Area ('000km^2)	Climate; Geography
Canada: **Vancouver region**	-	3, 3, 2	CA$0	0.7; 2.7	0.1; 2.9	Temperate oceanic, coastal
Australia: **Greater Melbourne** **City of Brisbane**	2026	5, 6, 5	AU$35.7	5.2; 1.3	10.0; 1.3	Temperate oceanic, coastal; Subtropical, coastal
UK: **London**	2024	7, 7, 4	£125	9.0	1.6	Temperate oceanic, inland
US: **Seattle, Puget Sound Region** **City of LA**	- 2028	2, 1, 1	Unknown*	0.7, 4.3; 4.0	0.2, 16.2; 1.2	Temperate oceanic,coastal; Mediterranean, coastal
France: **Paris Region**	2024	Out of top 10	Unknown^	12.2	12.0	Temperate oceanic, inland
Germany: **Munich** **Met. Region**	-	8, 8, 7	€41 (€24 from state)	6.2	25.5	Continental, inland
South Korea: **Seoul**	2025	4, 4, 10	Unknown^	9.6	0.6	Continental, inland
Singapore	2024	1, 2, 3	Unknown	5.7	0.7	Tropical, island

* NASA provides a significant, probably relatively large amount of R&D funding.

^ Likely to be minimal as the official AAM program websites do not mention the provision of any funding. Choose Paris Region requires participants to be capable of self-financing.

3. Recommendations for the Vancouver Region

3.1 Setting a Direction

As the first step, government authorities and public agencies in Vancouver that wish to see the deployment of advanced air mobility (AAM) must first establish a shared vision and values for advanced air mobility.[xv] They should build upon existing strategies, initiatives and literature by holding more extensive consultations with the public and industry. Any public engagement must emphasize the purpose of AAM deployment, drawing specific attention to intended positive outcomes, alignments with existing public strategies, and identify any other implications or public impacts from deployment. To maintain credibility, surveys should be conducted by a neutral organization based in the region and supported by public funding.

Industry consultation should focus on the economic prospects of the AAM supply-side industrial development, while maintaining a sufficient grasp of the wider end-user benefits, including cost savings. The CanaDAC could serve as a good starting platform. However, the study should be expanded to include passenger air mobility (PAM), as well as other industry and economic development experts who can advise on the wider impacts and economic benefits of AAM on society and other industry sectors. Ideally, the analysis could be expanded to the regional level, such as via collaboration with Pacific Economic Development Canada (PacifiCan).

As noted earlier, the Australian and UK governments were informed on the economic impacts of drones before formulating their AAM vision and policies. The research and resulting vision should, at minimum, cover:

- Desirable and best-use cases, including benefits and phasing;
- Wider economic impacts and potential challenges, i.e. compatibility with other economic development objectives; and
- Desired extent of domestic industrial development given resources available.

In formulating Metro Vancouver's, British Columbia's, or Canada's vision for AAM, local public agencies must decide on the role of advanced air mobility development in their overall economy strategies or economic development plans. As evident from the importance of industrial development in the policy objectives of other global clusters, this decision will affect the pace and strategy of AAM development, particularly for PAM. For instance, if it is decided that AAM is to serve as a significant medium for economic development, regional and federal governments must step up their efforts to participate in industrial development to maintain a competitive edge for their export economy. On the other hand, it can be advantageous to delay AAM development to learn more from other clusters before selecting which technologies to adopt (such as in the case of Vancouver's late adoption of ride-hailing services). PAM, in particular, is not expected to begin before 2030. If the decision is to defer AAM development, then the corresponding immediate policy objectives should focus on facilitating AAM adoption and alleviating its downsides.

After the collective AAM vision has been created, the policies and future directions should be communicated regardless of its industrial development stance. Australia's policy statement provides a good model of conveying its near-term future policies and setting timeline certainty for the market.[25] The following sections on policy and planning, and industrial development, present specific policy recommendations, with those more relevant to an active industrial policy ordered towards the end.

3.2 Policy and Planning

Efforts around local public engagement must continue after the initial consultation and direction-setting exercise, and community engagement processes should be institutionalized for AAM projects. For example, notices to consult and inform the public about upcoming projects could be issued in a similar way to what is done in the construction industry. The initial introduction of AAM operations into an area with no previous exposure to AAM could

[xv] Local public agencies in general refer to public agencies in Metro Vancouver whose jurisdiction lies within the provincial level. Some examples of local public agencies are the BC government, Metro Vancouver, TransLink, Invest Vancouver, Vancouver Economic Commission, City of Vancouver, and the remaining municipalities and Treaty First Nation in Metro Vancouver. It may refer to specific local public agencies with the relevant scope of responsibilities based on the usage context.

require an open house for demonstrations to allay the community's concerns. Prior to that, approval of projects should be based on clear procedural guidelines on where, when and how AAM is permitted to operate. The guidelines should be accessible to industry and the public, and developed by the municipalities with support from higher levels of government. Lastly, there is merit in utilizing major events – such as the FIFA World Cup 2026 in Vancouver – to showcase AAM deployments for gaining public confidence (for example, a demonstration of fire-fighting drones) or how medical supplies could be delivered to remote areas.

At the local level, a regional office should be created for AAM coordination and development support to implement the regional vision. It would play a similar role to that of LA's Urban Movement Labs (UML) and Australia's Skyportz to undertake a policy and planning review with local public agencies and the industry. The capacity of the office should be aligned with the vision's goals and timeline. Possible options for structuring the office to leverage the existing ecosystem are to house it under TransLink or a local office of CAAM. The office will take on the following tasks to resolve the policy gaps identified earlier in "Areas for Improvement" (corresponding gaps are noted in square brackets):

- Clarify regulatory scope and responsibilities of public agencies [3.1].
- Advise and collate feedback on municipality procedural guidelines on the selection of operating locations and times, AAM zoning ordinances, additional local vertiports standards, enforcement and community engagement process [3.2, 3.5].
- Perform analysis for infrastructure planning, including geomapping, energy requirements, vertiports and flight path network phasing and neutrality, and multimodal integration [3.4].
- Manage regional R&D efforts for the office's vision implementation, i.e. environmental impacts, social equity impacts, real estate implications, business models, and monitoring of various trials that build up local knowledge base [2.6, 3.2, 3.6].
- Communicate the regional AAM vision, roadmap and regulatory commitments conditional on technical performance outcomes, and incorporate federal policies to create a single resource for local stakeholder reference [3.6].
- Advise industry on intermunicipal projects and set up innovation corridors for trials and scaling up to ease regulatory burden. For instance, a remotely piloted aircraft system (RPAS) study by Chin suggested creating test routes between Waterfront Station and Lonsdale Quay, and between the base and peak of Grouse Mountain to minimize liability risks [3.1].[138]

At the federal level, the following measures are suggested:

- Develop a roadmap with clear sequential performance outcome milestones and regulatory commitment so industry and investors can monitor their progress and plan accordingly. Create a suitable public channel – such as an online database, website or dashboard – to track industry progress in tackling AAM challenges along the roadmap [2.6, 3.6].
- Fill the policy gap on insurance requirements, accident response, standard operating procedures and the jurisdiction involved when an AAM-related accident occurs [3.3].
- Depending on the AAM vision and economic development policy, a unified and general AAM Advisory Committee could be formed separately or developed out of CanaDAC at an appropriate time in anticipation of airspace and uncrewed traffic management (UTM) integration. Existing near-term priority for drone development should remain. The new committee should also include representatives from the PAM ecosystem, including the cybersecurity, energy supply, venture capital, insurance and real estate fields [3.7].
- At the appropriate time, encourage the private sector to address more complex, systems-level challenges facing the AAM sector. Such an approach can help in harmonizing AAM and aviation regulations but should maintain interoperability and network neutrality across Canada [3.7].

3.3 Use Cases and Market Opportunities

The recommended sequence of AAM use cases and timeline is summarized in Table 4. The non-delivery drone market should be explored further as a priority for development, given Porsche Consulting's assessment that it is the largest AAM market.[4] The use case for the film industry is omitted as Vancouver already has a number of companies in operation. The use cases for remote and First Nations communities are also excluded as Indigenous sovereignty must be respected: its adoption here is determined by community acceptance, not imposed. However, there could be outreach efforts once commercial viability for use in remote settings is established.

Table 4: Phasing of AAM use cases

Timespan	Use Cases

Near (3 years)	• Medical supplies delivery (high-value, time sensitive), such as:
	  • Organs
	  • Radioisotopes
	• Geological and marine
	• Agritech (such as crop and soil health monitoring, data management and pest control)
	• Wildfire services
	• Marine port and ship-to-shore operations
	• Defense, and border or remote area enforcement
	• Infrastructure and mining
	• Municipal services (exploratory): concepts such as those from Portugal's Omniflow

Medium (6 years)	• Municipal services
	• Business-to-Business (B2B) deliveries with drone corridors over public urban areas
	• Substitution and expansion of existing air passenger services (e.g. eVTOL aircraft replacing helicopters):
	  • Medevac and air ambulance
	  • Tourism (low carbon remote sight-seeing, and not necessarily PAM)

Long (>6 years)	• Remote access PAM
	• Regional air travel
	• Review services with selected conditions:
	  • Business-to-Consumer (B2C), retail drone deliveries
	  • Air taxi (within Metro Vancouver, between municipalities)

The following are market opportunities for consideration:

1. **Build on existing cluster synergies:**

   1.1 Decarbonize aviation and hydrogen power development for long-range or high-payload applications.

   1.2 Introduce hydrogen fuel cell (H2FC) power generation for vertiports with grid constraints (e.g. AFC Energy supply for Air-One).

   1.3 Initiate agritech applications with digital tools (Digital Technology Supercluster).

   1.4 Leverage the Digital Technology Supercluster:

   - Predict real-time weather and winds in urban landscape.
   - Implement precise, real-time navigation and geo-fencing.
   - Identify urban noise footprint.
   - Engage in more complex remote operations and UTM development.
   - Engage in airspace integration and counter-drone technology.
   - Promote cybersecurity.

   1.5 Work with gateway transportation operators:

   - Vancouver International Airport (YVR) could play a role as the anchor institution to lead regional development and adoption.
   - Adapt AAM for maritime use cases such as shipping inspection, cleaning, and ship-to-shore deliveries.
   - Abbotsford Airport could further develop its aerospace cluster development by extending it to include AAM, which has a more level playing field in the Cascadia region and Canada without any entrenched cluster yet.[xvi]

2. **Information exchange and trust building** for wildfire management could develop local cluster access to the US procurement market, and vice versa: NASA and the west coast of the US have extensive experience and programs to apply uncrewed aerial vehicle (UAV) technologies for wildfire management.

3. **Establish an AAM maintenance, repair and overhaul** (MRO) hub for Western Canada.

4. **Establish a remote operations command centre in BC.**

5. **Consider securing an investment from Dymond's yet-to-be-decided second vertiport in Western Canada,** with potential use cases of high-value agriculture transportation or providing employment and access to Indigenous communities if/when they are ready to adopt AAM.[57]

6. **BC academic institutions could review and enhance existing programs** to cater to hydrogen technologies applied to aviation (drones and other eVTOL aircraft), AAM remote operations and UTM development.

7. **Develop infrastructural solutions on flight corridors to dampen or filter high-frequency noise.**

8. **Boeing Vancouver Labs' analytics, software development and professional consulting services could be expanded** to support and benefit from AAM development.

[xvi] Abbotsford, though not part of Metro Vancouver, is adjacent to it. Metro Vancouver can work with it to develop the regions' AAM cluster.

3.4 Industrial Development of AAM

Due to the sector's high regulatory and safety requirements, including the necessity of filling in policy gaps, industrial development of AAM in Metro Vancouver should primarily be led by or conducted in lockstep with the regional or provincial government with support from PacifiCan and the federal government, possibly in the form of an AAM regional office. The extent of development depends on the collective AAM vision. Some potential measures (to be taken by the regional office, unless specified otherwise) are:

- Provide a one-stop interface for AAM information and services to support investment and development of AAM operations as much as possible through the regional office.

- Connect Transport Canada with the regional office to offer technical regulatory support adapted to Metro Vancouver, similar to UK's Innovation Hub and Connected Places Catapult.

- Streamline existing opportunities from complementary industries into a user-friendly package for AAM development. Some of these initiatives include:
    - TransLink's Open Call for Innovation;
    - Project Greenlight by the Vancouver Economic Commission; and
    - Business Scale-up and Productivity (BSP), Strategic Innovation Fund (SIF) administered in BC by PacifiCan. For example, Canadian UAVs successfully secured funding from BSP in Alberta for its detect-and-avoid technology development.[139]

- Prepare and maintain (with feedback) best-practice procurement guide for AAM services, advising on navigating the market as well as stipulation of environmental standards to aid the development of the local AAM cluster. The guide should also cover the involvement of local AAM companies in government projects and be aligned with the AAM vision and regional plans where relevant.

- Leverage prominent, high-attention international events, such as FIFA World Cup 2026, to showcase AAM deployments. Such ventures offer an attractive value proposition for investors, a policy commitment, and an opportunity for public engagement and industry development. For example, the 2010 Winter Olympics offered learning opportunities, particularly for Ballard's current success in vehicle H2FC systems, and the potential for risk management of future demonstration project procurements.[140]

- Perform the function of cluster manager with CAAM's assistance to advocate for Metro Vancouver's AAM development, including securing external funding:
    - Work with existing networks, such as Pacific Northwest Aerospace Cluster (PNAC), Canadian Hydrogen and Fuel Cell Association (CHFCA) and Invest Vancouver for external financing outreach and global cluster networking.
    - Coordinate with local clusters to secure federal funding through the BC government, similar to Washington State and Québec. CAE received federal and provincial funding from Québec to develop eVTOL simulation, virtual/mixed reality (VR/MR) and data analytics, areas that are covered in BC's Digital Technology Supercluster.[136]
    - Leverage green financing to gain access to the Environmental, Social, and Governance (ESG) market; for example, through the sale of green bonds.[xvii]
    - Facilitate public–private partnerships. A successful example by a benchmarked region is the Air-One project offered by Coventry in the UK with 20 percent seed funding from Future Flight Challenge[xviii].

[xvii] The federal government of Canada has issued its inaugural green bond through its Green Bond Program in 2022. More details can be found on its website: **https://www.canada.ca/en/department-finance/news/2022/03/canada-issues-inaugural-green-bond.html**

[xviii] **https://www.urbanairport.com/airone**

Conclusions

The authors of this report conducted a series of interviews with members of the AAM ecosystem and an analysis of AAM global clusters to understand how Vancouver can advance AAM in a beneficial manner. Lack of regional direction for AAM is a notable deficiency that must be rectified as a first step towards optimizing AAM adoption. To formulate an AAM vision that serves society for the long haul, it is recommended that residents are widely consulted with support from Transport Canada, and given the opportunity to register their concerns while learning about the many benefits of AAM. The industry should also be consulted to highlight the economic prospects of AAM development. Given that public acceptance is a prerequisite to the success of AAM adoption, community engagement should be ongoing, and holding AAM demonstrations at major events, such as FIFA World Cup 2026, poses an opportunity for public engagement and policy commitment.

It is noteworthy that global regions leading AAM adoption have incorporated local AAM industrial development into their policies. Furthermore, most of the countries where these regions are situated have a strong aerospace manufacturing cluster, like Canada, which is ranked third in the world.[70] In this respect, Vancouver is supported by its strengths in complementary clusters, including conventional aircraft and port operators; hydrogen power systems; agritech; and aerospace manufacturing. Vancouver also benefits from its proximity to the third most competitive US state cluster, Washington State.[70] Given this advantageous position, it would be beneficial for Vancouver to review, as part of its AAM vision, how AAM development may fit or enhance its economic development policy, and to proceed with conducting a cost-benefit or more quantitative economic impact analysis on pursuing the expansion of its advanced air mobility.

Another lesson drawn from the benchmarking exercise is a consistent and well-communicated roadmap using a government-wide approach. The Vancouver region would gain from having a regional AAM office to coordinate with public agencies to clarify their responsibilities and policy requirements, and provide planning, regulatory and industrial development support. The goal would be to convey its regional AAM vision, roadmap and challenges with clear sequential performance outcome milestones and regulatory commitments, so the AAM industry and investors can monitor their progress and plan accordingly. The office should also aim to provide a consolidated one-stop service for the industry by streamlining existing general support schemes and AAM ecosystem resources across the various jurisdictions into a user-friendly package.

In the near term, the focus should be on the use of drones for high-value public-use cases, such as medical supplies transportation, in addition to the inspection and delivery, monitoring and maintenance applications generally referred to by the industry as (non-citizen) surveillance. These have potential high-value and synergistic applications with the Vancouver region's strengths in agritech and maritime services. Medium- and long-term goal applications should be directed towards the commercial development of hydrogen-powered AAM aircraft, regional passenger air mobility services, and B2B drone deliveries.

Finally, given Metro Vancouver's advantageous geography for AAM applications, and increased deployment of the technology in jurisdictions around the world, the literature and interview insights of this study both suggest that the wider adoption of AAM technologies locally and within Canada is inevitable. Therefore, it would be prudent to create an environment that can most maximise its benefits for the public good, aligned to the values and vision of the Vancouver region's development, while at the same time understanding and mitigating any potential negative impacts or pitfalls.

Abbreviations and Definitions

Abbreviation	Definition
AAM	Advanced Air Mobility
AAMPNC	AAM Project National Campaign (US)
AIAC	Aerospace Industries Association of Canada
ATM	Air Traffic Management
AWS	Amazon Web Services
B2B	Business-to-Business
B2C	Business-to-Consumer
BC	British Columbia (Canada)
BCIT	British Columbia Institute of Technology (Canada)
BSP	Business Scale-up and Productivity (Canada)
BVLOS	Beyond Visual Line-of-Sight
CAA	Civil Aviation Authority (UK)
CAAM	Canadian Advanced Air Mobility consortium
CAAS	Civil Aviation Authority of Singapore
CAMI	Community Air Mobility Initiative
CanaDAC	Canadian Drone Advisory Council
CARIC	Consortium for Aerospace Research and Innovation in Canada
CASA	Civil Aviation Safety Authority (Australia)
CEO	Chief Executive Officer
CfP	Call-for-Proposal
CHARGE	Consortium for Hydrogen and Renewable Generated E-Fuels (US)
CHFCA	Canadian Hydrogen and Fuel Cell Association
ConOps	Concept of Operations
CPC	Connected Places Catapult (UK)
CRIAQ	Consortium for Aerospace Research and Innovation in Québec
DAA	Detect-and-Avoid
DfT	Department for Transport (UK)
DoT	Department of Transportation (US)
DTI	Drone Transport Initiative (Canada)
DTS	Digital Technology Supercluster (Canada)
EASA	European Union Aviation Safety Agency
ESG	Environmental, Social, and Governance
eSTOL	Electric Short Takeoff and Landing
EU	European Union
eVTOL	Electric Vertical Takeoff and Landing
FAA	Federal Aviation Administration (US)
FFC	Future Flight Challenge (UK)
GDP	Gross Domestic Product

H2FC	Hydrogen Fuel-Cell
ICAP	Innovation Cluster Accelerator Program (US)
LA	Los Angeles
LADOT	Los Angeles Department of Transportation
LiDAR	Light Detection and Ranging
LOS	Line-of-Sight
MOLIT	Ministry of Land, Infrastructure and Transport (South Korea)
MOT	Ministry of Transport (Singapore)
MoU	Memorandum of Understanding
MR	Mixed Reality
MRO	Maintenance, Repair and Overhaul
NARI	NASA Aeronautics Research Institute (US)
NASA	National Aeronautics and Space Administration (US)
NMA	New Mid-Market Airplane
NRC	National Research Council Canada
OEM	Original Equipment Manufacturer
PacifiCan	Pacific Economic Development Canada
PAM	Passenger Air Mobility
PNAC	Pacific Northwest Aerospace Cluster
PoC	Proof-of-Concept
PSRC	Puget Sound Regional Council (US)
R&D	Research and Development
RAM	Regional Air Mobility
RPAS	Remotely Piloted Aircraft System
SAF	Sustainable Aviation Fuels
SATE	Sustainable Aerospace Technologies and Energies (US)
SFOC	Special Flight Operations Certificate (Canada)
SIF	Strategic Innovation Fund (Canada)
TC	Transport Canada
UAM	Urban Air Mobility
UAMP	UAM Partnership
UAS	Uncrewed/Unmanned Aircraft Systems
UAV	Uncrewed/Unmanned Aerial Vehicle
UBC	University of British Columbia
UK	United Kingdom
UKRI	UK Research and Innovations
UML	Urban Movement Labs
US	United States
UTM	Uncrewed Traffic Management
VR	Virtual Reality
YVR	Vancouver International Airport

Appendix A

Interview design and methods

The interviews were conducted via online video calls. The researchers created a shortlist of interviewees to cover a broad range of potential stakeholders and perspectives within the AAM ecosystem. The interviewees were enlisted through email and the interviews only proceeded after receiving the required participation consent. All but one of the interviewees are based in Canada, with a large majority operating in British Columbia (BC). The project team conducted a total of 12 interviews, with the interviewees hailing from the following groups:

- Three from academic institutes or consultancies;
- Five from industry or trade organizations; and
- Four from public agencies.

The interview questions and discussion for the key informant survey were semi-structured, with most questions customised to the expertise and role of the interviewee. Follow-up improvised questions were asked in some of the interviews. Nonetheless, the interviews usually centred on the following basic questions:

- What are the most important components that are needed to support an AAM ecosystem?
- What are the biggest barriers to implementation of AAM in Vancouver and the Lower Mainland?
- What AAM applications do you anticipate will be used in Vancouver and the Lower Mainland?
- What attributes of Vancouver are, or could be, attractive to AAM cluster investors?
- Which global cluster or city do you think has advanced the furthest in enabling AAM?

The ground-truth survey involved an interviewee from a public agency, and from either industry or a trade organization. The questions were also customized, but sought to verify the researchers' findings and tease out the interviewees' view of the best possible options among the recommendations of the report.

Photo: Courtesy of **Joby Aviation** (c) Joby Aero, Inc.

Appendix B

The following table lists the organizations that are already, or potentially could become, part of Vancouver's AAM cluster ecosystem. The Aerospace Industries Association of Canada (AIAC) Pacific and BC Aviation Council website also hosts a document with a directory of BC's aerospace cluster: AIAC Pacific (2018). *British Columbia Aerospace Capabilities 2018 Guide*. **https://www.bcaviationcouncil.org/wp-content/uploads/2020/03/BC-Aerospace-Capabilities-Guide.pdf**

Cluster Level	Sub-group	Organization	Remarks
Research and development	University	MéridaLabs, UBC	From Vancouver; H2FC for RPAS, H2 and cleantech
		UVic Center for Aerospace Research	From Victoria
		Consortium for Aerospace Research and Innovation in Canada	Based in Montréal
Finance	Government	BC Hydrogen Office	Based in Victoria
Finance	Government	Invest Vancouver	Based in Burnaby
Finance	Government	National Research Council Canada	
Finance	Government	Pacific Economic Development Canada	
Infrastructure	Communications	AiRXOS	
Infrastructure	Communications	Altitude Angel	
Infrastructure	Communications	Amazon Web Services	Complementary digital cluster for remote operations centre
Infrastructure	Communications	ANRA	
Infrastructure	Communications	Bravo Zulu	From Vancouver, part of Indrotek; counter-drone
Infrastructure	Communications	Canadian UAVs	From Calgary; RPAS operator and training
Infrastructure	Communications	Collins Aerospace Systems	
Infrastructure	Communications	Iris Automation	In Vancouver; detect-and-avoid
Infrastructure	Communications	OneSky	Modelling and simulation
Infrastructure and Manufacturing	Energy or fuel cell	Canadian Hydrogen and Fuel Cell Association	
Infrastructure	Energy	AFC Energy	H2FC power generation for vertiports in UK
Infrastructure	Energy	BC Hydro	Existing energy supplier
Infrastructure	Energy	FortisBC	Existing energy supplier
Infrastructure	Energy	HTEC	From Vancouver; hydrogen distribution, refueling stations
Infrastructure	Ports	Aviation Projects	Australian airport planning specialist
Infrastructure	Ports	Skyports	
Infrastructure	Ports	Vertiko Mobility	From Montréal
Infrastructure		Skyportz	Australian ground infrastructure group
Manufacturing	Aircraft	AerialX	From Vancouver; counter-drone
Manufacturing	Aircraft	Airbus	
Manufacturing	Aircraft	Airspace X	

Cluster Level	Sub-group	Organization	Remarks
Manufacturing	Aircraft	AMSL Aero	Australian eVTOL
Manufacturing	Aircraft	Archer	
Manufacturing	Aircraft	Avcorp	BC MRO
Manufacturing	Aircraft	Bell	
Manufacturing	Aircraft	Brinc	From Seattle; RPAS
Manufacturing	Aircraft	Drone Delivery Canada	In Vancouver, from Ontario; RPAS operators
Manufacturing	Aircraft	EHang	
Manufacturing	Aircraft	Electra Aero	STOL, existing helipilot
Manufacturing	Aircraft	Embraer	
Manufacturing	Aircraft	Hyundai	
Manufacturing	Aircraft	InDro Robotics	In Vancouver, from Victoria, part of Indrotek; RPAS operators
Manufacturing	Aircraft	Insitu	In WS Klickitat County; RPAS for drug interdiction, surveillance, reconnaissance missions in the defense sector, environmental monitoring, search-and-rescue, and disaster relief applications
Manufacturing	Aircraft	Jaunt Air Mobility	In Montréal, Toronto
Manufacturing	Aircraft	Joby Aviation	
Manufacturing	Aircraft	Kittyhawk	
Manufacturing	Aircraft	Lilium	
Manufacturing	Aircraft	Opener	Canadian designer-founder
Manufacturing	Aircraft	Pegasus Imagery	From Alberta; RPAS manufacturer for fire and general surveillance
Manufacturing	Aircraft	Samad Aerospace	
Manufacturing	Aircraft	Skylift UAV	RPAS operators
Manufacturing	Aircraft	Skymount	In Vancouver, from Calgary; counter-drone
Manufacturing	Aircraft	Swoop Aero	Australian RPAS
Manufacturing	Aircraft	Vertical Aerospace	
Manufacturing	Aircraft	Viking Air	BC MRO
Manufacturing	Aircraft	Volocopter	
Manufacturing	Aircraft	VRCO	
Manufacturing	Aircraft	Wing	From US; RPAS manufacturer, operations in Australia
Manufacturing	Aircraft	Wingcopter	In Vancouver
Manufacturing	Aircraft	Wisk	
Manufacturing	Fuel cell	AVL	From Vancouver; development, simulation and testing technology of powertrains (for automotive, at present)
Manufacturing	Fuel cell	Greenlight Innovation	From Vancouver; testing and manufacturing equipment for H2FC, electrolyzers, batteries and energy storage systems
Manufacturing	Ports	Ferrovial Airports	
Manufacturing	Ports	Lilium	
Manufacturing	Ports	Urban-Air Port	
Manufacturing		Abbotsford Airport	Aerospace cluster facilities developer

Cluster Level	Sub-group	Organization	Remarks
Manufacturing		Aerospace Industries Association of Canada (AIAC) Pacific	Trade group
Manufacturing		BC Aviation Council	Trade group
Manufacturing		Hydra Energy	From Vancouver; hydrogen-diesel combustion engine
Manufacturing		Pacific Northwest Aerospace Cluster	Trade group
Manufacturing		Westport Fuel Systems	From Vancouver; hydrogen combustion engine
Operations	Operator training	BCIT	
Operations	Operator training	CAE	In Vancouver; modelling and simulation
Operations	Service provider	Avestec Technologies	From Vancouver; aerial inspection - industrial
Operations	Service provider	BLADE	In Vancouver; flight booking-matching platform
Operations	Service provider	CAN·UAS	From Squamish; drone mapping, construction, inspection, real estate
Operations	Service provider	Carson Air	BC MRO
Operations	Service provider	Coulson	BC aerial firefighting
Operations	Service provider	Flash Forest	In Vancouver; tree planting drones
Operations	Service provider	Harbour Air	
Operations	Service provider	HeliJet	
Operations	Service provider	NAV Canada	Civil air traffic control and navigation
Operations	Service provider	Revered Cinema	From Vancouver; camera and drone filming
Operations	Service provider	Spexi Geospatial	From Vancouver; aerial inspection: real estate, construction, agriculture
Operations	Service provider	UAViation Aerial Solutions	From Coquitlam/Vancouver; aerial surveillance
Operations	Service provider	Unither Bioelectronics	From Québec; uses autonomous aircraft to deliver transplantable organs
Operations	Service provider	Vancouver International Airport	
Regulations	Aviation standards	Transport Canada	Federal agency
Regulations	Market and legal	TransLink	Coordinator to municipalities in Metro Vancouver, regulatory powers lie with municipalities
Regulations		Airspace Link	US planner of flightpath routes and aerial highway
End-user	Business	Vancouver Coastal Health	
End-user	Research or public	BC Emergency Health Services	
End-user	Research or public	BC Wildfire Services	
End-user	Research or public	River Dynamics Laboratory, Hakai Institute	From Vancouver; geological surveillance

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VEC respectfully acknowledges that it is located on the traditional, ancestral and unceded territory of the Sḵwx̱wú7mesh (Squamish), Səl̓ílwətaʔ/Selilwitulh (Tsleil-Waututh) and xʷməθkʷəy̓əm (Musqueam) Nations.