FORUM INNOVATION AÉROSPATIALE INTERNATIONAL

WHITE PAPER

AÉRO MONTRÉAL INTERNATIONAL AEROSPACE

INNOVATION FORUM 2024

AÉRO MONTRÉAL

Québec

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This document was prepared by Innovitech Inc. under the direction of Jarrod Morley, Senior Director of Strategy and Head of Innovation at Aéro Montréal and members of Aéro Montréal's Innovation Working Group. Its purpose is to summarize the discussions, conferences and panels that took place during the 2024 edition of Aéro Montréal's International Aerospace Innovation Forum held on May 21 and 22, 2024 at the Palais des congrès de Montréal.

We would like to acknowledge the contribution of Éric Laurendeau, professor in the mechanical engineering department at Polytechnique Montréal, who wrote an unpublished summary of the 2022 event.

Aéro Montréal Innovation Working Group

The mission of the Innovation Working Group is to develop an aerospace innovation strategy for Québec and to identify and coordinate projects in support of the innovation strategy in collaboration with the other organizations involved in innovation to ensure that the efforts of all players are optimized.

Members of the Innovation Working Group

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EXECUTIVE SUMMARY

Aéro Montréal's International Aerospace Innovation Forum is the largest event of its kind in Canada and enjoys an international reputation. The 2024 edition focused on the importance of innovation and collaboration. It was marked by the official designation of the Espace Aéro innovation zone by Québec Premier François Legault, including a major investment of $415 million in Québec's aerospace ecosystem.

With this announcement, the Montreal region is strengthening its position in relation to aerospace cities such as Toulouse and Seattle, as a global player that includes the industry's biggest players in its ecosystem. The Québec industry has total sales of $20.9 billion and employs more than 41,700 highly skilled workers. Over the past year, Québec's aerospace industry has seen its sales grow by 16%, despite a number of challenges. [1]

The main theme of the 2024 Aéro Montréal International Aerospace Innovation Forum was collaboration among ecosystem stakeholders around sustainable transformation, innovation and emerging technologies.

6 HIGHLIGHTS
for the Québec aerospace industry:

1

The launch of Espace Aéro, Québec's aerospace innovation zone

The launch of Québec's aerospace innovation zone, Espace Aéro, represents a major turning point for the industry. This innovation zone, whose goal is to accelerate the commercialisation of innovations geared towards decarbonisation and intelligent air mobility, demonstrates the positive impact that collaboration between government agencies, research institutes, academic institutions, startups and SMEs, Tier 1 & 2 suppliers and Original Equipment Manufacturers (OEM) can have.

2

Strong demand, but production struggling to keep pace

The post-pandemic recovery from COVID-19 is still underway. Disruption to supply chains, labour shortages, inflation and high demand for air travel are making the situation complex for the various stakeholders.

3

Urgent need to attract and retain talent

More than ever, attracting and retaining talent are major challenges for the industry. There are a number of reasons for this labour shortage, including the growing demand for air transport, a decline in the attractiveness of the sector to the next generation, and the large number of people approaching retirement.

[1] https://www.quebec.ca/nouvelles/actualites/details/lancement-de-la-4e-zone-dinnovation-quebec-creation-dune-zone-dinnovation-en-aerospatiale-a-longueuil-mirabel-et-montreal-55961

4

A turning point for Advanced Air Mobility (AAM)

Advanced air mobility projects are evolving rapidly. While the technical issues are beginning to be resolved, the social acceptance, the viability of the business model, and the large capital requirements needed to complete development and begin mass production of the aircraft are still unresolved.

5

The inevitable need to decarbonize industry

Companies in the industry are increasingly turning to innovative solutions that reduce greenhouse gas (GHG) emissions, such as sustainable aviation fuel (SAF), lightweight and recyclable composites, greener propulsion technologies, etc. Companies are paying more attention to the entire lifecycle of aircraft and approaches to recycling aircraft parts. Environmental requirements for suppliers have never been higher.

6

Increased defence investment by governments

The current tense global situation has led to calls for all NATO member governments to increase defence investment to the desired level of 2% of gross domestic product. Canada has also decided to make an effort to meet the defence investment target called for by all NATO members. On April 8, 2024, Canada released "Our North, Strong and Free: A Renewed Vision for Canada's Defence." Canada announced: "We will change our approach to working with industry, innovators, and researchers—moving away from transactional approaches for acquiring capabilities to sustained strategic partnerships founded on transparency and trust." Québec's aerospace industry is exploring ways to support this government approach, particularly in its collaboration with the United States. To this end, a seminar on U.S.-Canada defence cooperation was organized in conjunction with the Forum.

4 RECOMMANDATIONS

have been put forward by Aéro Montréal's Innovation Working Group:

☞ Optimize calls for projects

To strengthen collaborative innovation within the aerospace ecosystem, adjustments are proposed to improve the predictability, duration, coherence, and governance of calls for projects. These include sufficient time for proper planning, funding durations adapted to aerospace projects (4-5 years), regular frequency of calls to better anticipate opportunities, and harmonization of governance processes to simplify procedures, especially for SMEs.

☞ Support sustainable aviation fuels (SAF)

The transition to zero net emissions by 2050 for the aerospace industry depends in part on the development of sustainable aviation fuels. It is recommended that the Québec and Canadian governments provide incentives for the R&D, production, and use of SAFs, in harmony with U.S. efforts to optimize coordination across the value chain.

☞ Align the industry with public needs

Aerospace technologies are increasingly being used to meet public needs. It is recommended that governments actively promote local and collaborative solutions to meet these needs before turning to foreign solutions. A strategic alignment of investment in infrastructure and innovation would also attract foreign direct investment to Canada.

☞ Increase financial support

To strengthen technological innovation in the aerospace industry, it is recommended that the provincial government provide more support for innovations that reach a Technological Readiness Level (TRL) of 6 and above. Existing support models, such as the federal INTAD/INSAT program and Horizon Europe, could also be studied to enrich provincial programs and maximize the benefits of the aerospace industry to the Québec economy.

TABLE OF CONTENT

FOREWORD

Mélanie Lussier
President, Aéro Montréal

Aéro Montréal is proud to present this White Paper, the result of the rich exchanges and discussions that took place at the 9th edition of the International Aerospace Innovation Forum held in Montreal on May 21 and 22, 2024. This event, which brings together the largest number of international aerospace decision-makers in Canada, was attended by nearly 1,700 participants, all driven by a common vision: to transform the aerospace industry to meet tomorrow's challenges through innovation and collaboration.

At a time when the aerospace industry is at an inflection point, the ambitions and needs for sustainable, intelligent air mobility require, more than ever, unwavering commitment and wide-ranging creative resources to implement positive change. Throughout the Forum, discussions converged on one inescapable conclusion: the era of working in silos is coming to an end and the emerging era of a more collaborative and innovative Aerospace 2.0 is taking shape.

This White Paper paints a portrait of aerospace innovation in Québec and around the world, and presents the solutions and recommendations that emerged from the panels, conferences and discussions that took place over the two days of the International Aerospace Innovation Forum. These are at the heart of Aéro Montréal's mission. I would like to express my sincere gratitude to the speakers from Québec and around the world who contributed to the rich content of this event. Their expertise, perspectives and commitment were essential to the success of this major industry gathering.

With its mature aerospace ecosystem, Québec is poised to contribute even more to this new era of sustainable, innovative aerospace. By focusing on optimized collaboration, our goal is to foster synergies between industry, academia and public institutions to develop shared infrastructures and forge partnerships that will accelerate the commercialization of technologies, services and products that contribute positively to the environmental, economic and human aspects of our industry. I would like to thank all the partners, collaborators, speakers and participants for their commitment and contribution to the 2024 International Aerospace Innovation Forum and, by extension, to this White Paper.

Together, and thanks to all of you, we are shaping the future of aerospace.

INTRODUCTION

Aéro Montréal's International Aerospace Innovation Forum is the largest event of its kind in Canada and enjoys an international reputation. The 2024 edition focused on the importance of innovation and collaboration. It was marked by the official designation of the Espace Aéro innovation zone by Québec Premier François Legault, including a major investment of $415 million in Québec's aerospace ecosystem.

With this announcement, the Montreal region is strengthening its position in relation to aerospace cities such as Toulouse and Seattle, as a global player that includes the industry's biggest players in its ecosystem. The Québec industry has total sales of $20.9 billion and employs more than 41,700 highly skilled workers. Over the past year, Québec's aerospace industry has seen its sales grow by 16%, despite a number of challenges [2].

HERE ARE SOME FIGURES FROM THE 2024 EDITION
of Aéro Montréal's International Aerospace Innovation Forum :

1700
participants

19
Countries represented

80 +
exhibitors

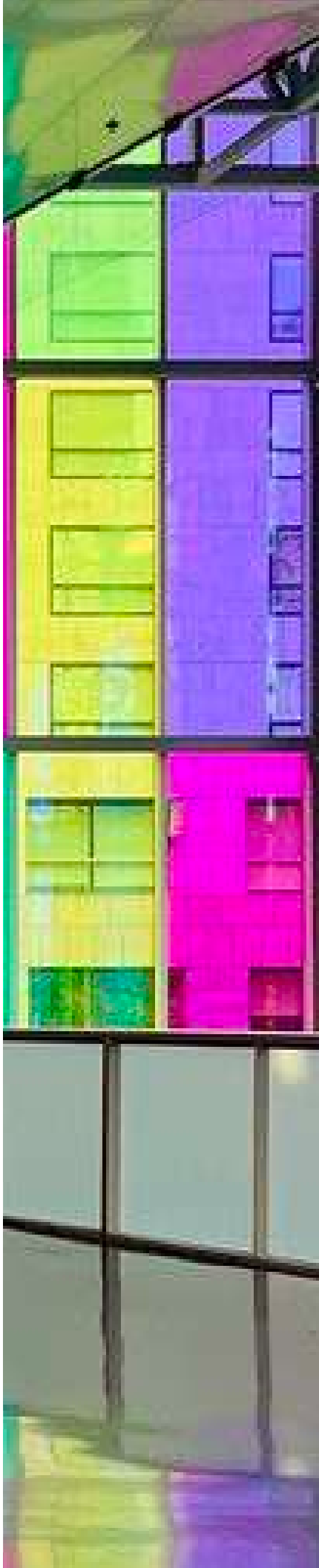
- **21** partners involved
- **560** B2B meetings
- More than **140** speakers
- **20** technologies/vehicles showcased in the Tech Zone

[2] https://www.quebec.ca/nouvelles/actualites/details/lancement-de-la-4e-zone-dinnovation-quebec-creation-dune-zone-dinnovation-en-aerospatiale-a-longueuil-mirabel-et-montreal-55961

This event increases business opportunities and strengthens links between world leaders and the Québec aerospace industry. It aims to attract the next generation of aerospace workers and encourage international companies to participate in Québec's collaborative innovation model. Recent investments by various government agencies are aimed at keeping the ecosystem at the forefront and attracting the most innovative companies and the best talent to Québec.

The main theme of the 2024 International Aerospace Innovation Forum was collaboration between ecosystem stakeholders around sustainable transformation, innovation, and new technologies.

By promoting innovation and technologies that reduce greenhouse gas emissions, the aerospace industry is positioning itself as an agent of change for tomorrow's communities. Through concrete actions, Québec's aerospace industry is proving that performance and sustainability can go hand in hand. The expected growth in demand for air travel represents an additional environmental challenge that is mobilizing the entire industry.



Objectives of the White Paper

The purpose of this White Paper is to provide an account of the conferences and discussions that took place at Aéro Montréal's International Aerospace Innovation Forum, which was held on May 21 and 22 at the Palais des congrès de Montréal. In addition, this paper provides an overview of the aerospace industry and the evolution of the ecosystem in recent years. It aims to highlight the opportunities, risks, challenges, innovative successes, and trends in the industry.

The program of the 2024 International Aerospace Innovation Forum was designed to include all industry players, from Québec and Canada as well as internationally. This document continues to create a meeting place for the various stakeholders to foster new partnerships, strengthen existing ones, develop joint projects, and solve common problems.

Document structure

This White Paper is organized around six (6) themes that represent the essence of the conferences and discussions, as shown in Figure 1 below :

Figure 1 – 2024 Forum themes

While there were a number of discussions on the profile and development of the industry (Theme 1), collaboration (Theme 2) was the main theme of the Forum, with the announcement of the Espace Aéro innovation zone. More than ever, all players in the ecosystem need to work together to meet the challenges and opportunities presented by sustainable aerospace (Theme 3), advanced air mobility (Theme 4) and attracting and retaining talent (Theme 5). Finally, the current geostrategic situation led to many discussions on defence and the resilience of the industry's supply chain (Theme 6).

THEME 1 : DEVELOPMENTS IN THE AEROSPACE INDUSTRY OVER THE LAST 10 YEARS

Changes in the industry between 2014 and 2024

The last white paper published following an Aéro Montréal Innovation Forum dates back to 2014 [3] A comparison between 2014 and 2024 shows the extent to which the industry has undergone major transformations and must remain constantly at the forefront of the factors driving change.

One of the key issues of the 2014 edition was the future impact of globalization at all organizational levels. These impacts were felt not only in supply chains, but also in R&D, organizational management, sustainable development, and talent management. In 2014, the major drivers of change in the industry were:

Profound and sustained changes in supply and demand that stimulate new product development. The impact of globalization on industry was a major trend in 2014. This had the effect of increasing the level of activity in emerging countries, both in terms of supply and demand. In 2014, the relocation or reconfiguration of various supply chains influenced asset deployment strategies and business models.

Systems-based technology innovation. The development of new technologies increasingly involved intelligent systems that were interconnected and developed in a systemic way. This increase in requirements meant that teams had to be more multidisciplinary. These factors influenced the development of new programs, new materials, and new manufacturing and assembly processes. Boeing's 787, Airbus A350 and Bombardier's C-Series come to mind.

International and geographically dispersed players, but more integrated than ever, who need to coordinate more upstream (innovation) and downstream (manufacturing). With the increase in innovation modes, a large part of OEM innovation programs have been decentralized to first-tier suppliers and thus cascaded down to other subcontractors. This has increased the role of innovative SMEs in implementing innovative projects.

[3] https://www.aeromontreal.ca/download/fca8add89c97/aero_mtl_livre_blanc_web_francais-FINAL-WEB.pdf

Over the past decade, Canada's aerospace industry has been influenced by a number of major trends and events. Here is an overview of the key drivers of change between 2014 and 2024:

1. **The growing importance of digital aerospace.** The evolution of additive manufacturing, the development of artificial intelligence, the automation of manufacturing and management processes, data analysis and more have all helped to improve productivity and the development of increasingly high-performance products.

2. **The need to reduce environmental impact.** A growing environmental imperative over the past few years has intensified the actions of various authorities. A number of public investments have led to an increase in research and development of alternative sustainable aviation fuels (SAF). Several other types of aircraft propulsion - electric, hybrid electric, hydrogen, distributed propulsion and others - are being developed to limit the environmental impact of aviation.

3. **Effects of the COVID-19 pandemic.** The collapse in demand caused by the pandemic had a major impact on airlines and commercial aircraft production. These disruptions created supply uncertainties, forcing companies to pivot supplies to limit risk. Some supply chains have yet to fully recover. In many cases, lead times remain significantly longer than before the pandemic.

4. **Market and demand trends.** In the face of growing demand, the number of orders for commercial aircraft has increased, putting pressure on supply chains and production. In recent years, demand has grown faster than production capacity. Technical problems with the Boeing 737 Max and durability issues with the Pratt & Whitney geared turbofan (GTF) are affecting deliveries of the Airbus A220 and A320neo.

5. **The emergence of advanced air mobility.** The last 10 years have seen significant technological developments in drones and electric Vertical Take-Off and Landing aircraft (eVTOL). Advanced air mobility is the civil sector that has seen the greatest number of investments and new companies trying to position themselves.

6. **Geopolitical uncertainties.** The wars in Ukraine and the Middle East, as well as geostrategic tensions between China and the United States, have made access to international markets more complex, requiring a number of strategic changes in procurement and the management of foreign direct investment. The increase in the number of conflicts in different regions of the world has had a particular impact on defence supplies, demand for different types of equipment, and demographic changes.

The aerospace industry has had to adapt to innovation and technological development as well as changes in demand and geopolitical tensions. The 2024 edition bridges the last 10 years by emphasizing the need for a sustainable transformation of the sector through innovation. A transformation that can only be achieved through greater cooperation between the various players in the sector.

	2014	2024
PROGRAMS	Massive investment in the development of “classic” commercial aircraft: 737 Max, A320NEO, C-Series, etc.	No major new commercial aircraft program in development. Insufficient production capacity
RESEARCH AND DEVELOPMENT	Accelerated but more integrated technological innovation	Sustainability-focused research and development (R&D) and increased collaboration between stakeholders Unparalleled openness of stakeholders to the adoption of disruptive new technologies
GLOBALIZATION	Trend towards offshoring of production	Recent geopolitical challenges, national security pressures and global challenges have prompted a shift towards relocation strategies.
SOURCING	Globalized and delocalized just-in-time supply chains	Disruptions to supply chains and access to labour are forcing companies to increase supply chain resilience
COLLABORATION	Traditional collaboration between industry players	The need for new mechanisms for intra- and inter-industry collaboration (digital, energy, land transport, etc.)
SUSTAINABLE AEROSPACE	Not a major issue discussed in 2014	The industry's main challenge
DIGITAL AEROSPACE	Not a major issue discussed in 2014	Omnipresent in all discussions and on all issues
ADVANCED AIR MOBILITY	Not a major issue discussed in 2014	A major opportunity for Québec and a direction for Espace Aéro
ATTRACTING AND RETAINING TALENT	Not a major issue discussed in 2014	Massive retirements and industry less attractive
GEOPOLITICS, DEFENCE AND SUPPLY CHAIN RESILIENCE	Not a major issue discussed in 2014	A major issue following the impact of the war in Ukraine

Overview of the aerospace industry in Québec

The sector is facing a real technological and environmental inflection point that requires the development of a basket of new technologies in order to achieve the industry's goal of carbon neutrality by 2050 [4] while ensuring the long-term competitiveness of the Canadian and Québec aerospace industry.

In 2023, Québec's aerospace industry surpassed $20.9 billion in sales. About 80% of production is exported, making the aerospace industry the leading exporter, accounting for 13.5% of Québec exports. Over the last 25 years, the average annual growth of the aerospace industry in Québec has been 5% [5] [6].

Demand for aircraft has been growing since the post-pandemic period. For example, the book-to-bill ratio indicates that there will be twice as many orders as deliveries in 2023. Aircraft delivery times may now exceed 10 years. AeroDynamic Advisory notes a slower recovery in commercial and business aircraft production than in previous economic recoveries. The COVID-19 pandemic has had a greater impact on aircraft production than other recoveries, largely due to disruptions in supply chains [7].

In Québec, industry coordination and collaboration continues to be hampered by the lack of a common physical location for collaboration to accelerate innovation, similar to the world-class collaboration centres that have emerged around the globe. Strategic investments, increased collaboration and continuous innovation are essential to maintain Québec's and Canada's position on the world stage. Coordination between researchers, companies and institutions must be strengthened to stimulate and accelerate innovation and meet these challenges.

More than ever, innovation is at the heart of sustainable development in the aerospace sector. Examples include the development of sustainable aviation fuels (SAF), alternative propulsion methods, aircraft lifecycle management and end-of-life recycling. Companies are increasingly developing green technologies to reduce their carbon footprint.

The industry is also recognizing that aviation's impact on global warming is more complex than simply reducing CO_2 emissions.

[4] https://www.icao.int/environmental-protection/Pages/LTAG.aspx
[5] https://www.economie.gouv.qc.ca/bibliotheques/le-secteur/aerospatiale/presentation-de-lindustrie-de-laerospatial#:~: text=Le%20secteur%20a%C3%A9rospa tial%20au%20Qu%C3%A9bec, est%20export%C3%A9e%20hors%20du%20Canada.
[6] https://www.tvanouvelles.ca/2024/06/30/industrie-aerospatiale-40-000-postes-a-combler-dans-la-prochaine-decennie
[7] Conference: Industry analysis (21 may, 9 h, 210 A/E)

A paper by Lee et al. published in the journal Atmospheric Environment in 2021 suggests that CO2 emissions may account for only a third of the global warming associated with aviation, and that the potential contribution of contrails may be greater than that of CO2. [8]. Since then, several research programs have been launched to gain a better understanding of these phenomena.

A current concern is the lack of qualified talent. Recruiting and retaining highly skilled professionals in fields such as engineering, materials science and artificial intelligence is a top priority for most industry players. According to Aéro Montréal, Québec's aerospace sector will need to fill more than 40,000 jobs over the next decade.

Many of the technologies entering the innovation cycle are completely new, making the task of certification more complex. Advanced air mobility is a good example of the impact of new technologies on certification, posing challenges both to certification bodies, which must develop new standards, and to companies (often startups and/or organizations with little experience) in the certification of aeronautical products. Examples include longer battery life for aircraft, flight safety for electric aircraft, alternative propulsion, sustainable fuels, etc. Regulatory agencies must adapt and develop the skills necessary to develop regulations that take into account technological advances while ensuring that they fulfill their primary mission of ensuring public safety when adopting operations at lower altitudes than traditional civil aviation.

[8] https://www.sciencedirect.com/science/article/pii/S1352231020305689

THEME 2 : COLLABORATION: AN ESSENTIAL LEVER FOR ACHIEVING ECOSYSTEM GOALS

This section presents several models of collaboration discussed at the 2024 International Aerospace Innovation Forum.

Espace Aéro, une collaboration accrue dans l'écosystème québécois et canadien

The opening of the International Aerospace Innovation Forum marked the official designation of Espace Aéro as Québec's aerospace innovation zone. The announcement, along with a $415 million public/private investment, was made by various government bodies, including Québec Premier François Legault, Canada's Minister of Innovation, Science and Industry, the Honourable François-Philippe Champagne, and Québec's Minister of Economy, Innovation and Energy, Pierre Fitzgibbon. An investment of $85 million was announced by the Ministry of Economy, Innovation and Energy (MEIE) in Espace Aéro, with the participation of the project's main strategic partners, including Boeing, Héroux-Devtek, Pratt & Whitney Canada, H55, Aéro Montréal, and the cities of Longueuil, Mirabel and Montréal.

Figure 2: Québec Premier François Legault announcing Espace Aéro at the International Aerospace Innovation Forum 2024 (Source : Aéro Montréal [9])

[9] https://www.linkedin.com/posts/aero-montreal_iaif2024-activity-7199519595374804992-Vnvb?utm_source=share&utm_medium=member_desktop

The zone will be developed in three distinct hubs around Greater Montreal: the Longueuil hub, the Montreal hub and the Mirabel hub. Espace Aéro will capitalize on the critical mass of industrial players in the province to further increase the level of collaboration in the ecosystem. The Longueuil hub will focus on aerospace technical training, bringing together the École nationale d'aérotechnique (ENA), the Centre technologique en aérospatiale (CTA) and the École de technologie supérieure (ÉTS). The Mirabel hub will provide a test and validation environment for technological developments in autonomy and UAVs, as well as an infrastructure for research into new composite materials. Large-scale and/or virtual simulations will be offered to companies in addition to aircraft manufacturing, maintenance and recycling activities. The Mirabel hub's main partners are Aéroports de Montréal, the Unmanned Aerial System Centre of Excellence (CED) and Cégep of Saint-Jérôme.

«With the creation of the Espace Aéro innovation zone, Québec companies are taking their place at the heart of the new aerospace era. Thanks to investments from world-renowned leaders, we are consolidating our position as world leaders in aerospace. Together, we are shaping a future where innovation, decarbonization and aviation safety converge to propel our industry to new heights of success and sustainability.»

The Honourable François-Philippe Champagne, Canada's Minister of Innovation, Science and Industry

The Montréal hub, located in the borough of Saint-Laurent, will develop the Collaborative Centre for Innovation in Aerospace and Mobility (CCIAM), which will focus its activities on research, collaboration and graduate training. Bringing together in the same building a world-class research centre, two aircraft manufacturers (Boeing and Bombardier) and three universities (Concordia, McGill and Polytechnique Montréal), the CCIAM will be a unique place in the world for aerospace collaboration, involving a large number of ecosystem players.

The announced investments amount to $415 million, including $240 million from Boeing for facilities and equipment, for research and development in collaboration with Héroux-Devtek on landing gear, and to increase the number of employees at its Wisk Canada subsidiary in the field of advanced air mobility. Boeing's integration into the Montreal ecosystem will make Montreal the first place in the world to host three of the world's largest aircraft manufacturers (Airbus, Boeing, and Bombardier).

«The new Espace Aéro zone will strengthen Québec's aerospace industry by attracting major investment, stimulating innovation and training new talent to meet the aviation challenges of tomorrow.

Pierre Fitzgibbon, former Minister of Economy, Innovation and Energy of Québec, Minister responsible for Regional Economic Development and Minister responsible for Greater Montreal and the Montreal Region

Impacts of Espace Aéro on the ecosystem

Each Espace Aéro hub will offer opportunities for the entire aerospace ecosystem by :

1. Positioning Québec in the development of technologies such as advanced air mobility and sustainable aviation;
2. Enabling an unprecedented level of global collaboration between OEMs, suppliers, startups, universities and research centres;
3. Helping to solve the sector's labour shortage and training needs.

Espace Aéro will strengthen Montréal's position as one of the world's leading aerospace cities, alongside Toulouse and Seattle. Montréal will become a major attraction for foreign workers and companies looking to innovate.

«The announcement sends a very clear message to the industry that Montreal is not only the third-largest aeronautics and aerospace development centre in the world, but that we are aiming to be the best in the world in terms of decarbonization and autonomous mobility. [...] Every time a company decides to set up and invest in a city, they look for talent, and talent looks for places to work, but also places to live. Montreal is certainly one of the best places in North America to live because of its affordability, safety, dynamism and viability.» [10]

Luc Rabouin, President of the Executive Committee - responsible for finance, economic development and higher education, Borough Mayor, Le Plateau-Mont-Royal

As part of the creation of Espace Aéro, the MEIE (Ministry of Economy, Innovation and Energy) has allocated $3.3 million to the Consortium for Research and Innovation in Aerospace in Québec (CRIAQ) to carry out 9 collaborative industrial projects to accelerate the transformation of Québec's aerospace industry towards advanced air mobility. The projects have a total value of $9.3 million. An additional $3.5 million will be allocated to the Fonds de recherche du Québec - Nature et technologies (FRQNT) to support the scientific program of the innovation zone.

[10] Conference: Espace Aéro: a collaborative approach by 3 centres (22 May, 8.25 am, 210 A/E)

The announcement of Espace Aéro also represents a strategic initiative to alleviate the labour shortage in the sector. Québec wants to create a dynamic ecosystem in which companies, academic institutions and research centres work closely together. This synergy will encourage the development of specialized training programs tailored to the specific needs of the aerospace industry in order to attract and retain talent. An ÉTS campus will be created in the Longueuil hub, a stone's throw from the École nationale d'aérotechnique (ÉNA) and the Centre technologique en aérospatiale (CTA). A bachelor's degree program in aeronautics and astronautics is expected to be launched at these facilities by 2025. The CCIAM, an academic collaboration between Concordia, McGill and Polytechnique Montréal, will make this centre a unique place in the world for graduate studies in aerospace.

NRC's Canadian collaborative innovation models

The National Research Council Canada (NRC) is an international reference in supporting aerospace research, both in national laboratories and in innovative SME projects. The Aerospace Research Centre has five (5) research areas:

1	2	3	4	5
Sustainable aviation	Advanced Air Mobility (AAM)	Supporting the defence fleet	Digitization	Aircraft safety and accessibility

In addition, the NRC Industrial Research Assistance Program **(NRC-IRAP)** plays a critical role in supporting innovation and technology development within the Canadian aerospace ecosystem. By providing technical and financial assistance to SMEs, NRC-IRAP helps turn innovative ideas into marketable products and services. The program offers a range of services, including R&D grants, access to technical experts and collaborative initiatives that facilitate the growth and global competitiveness of Canadian companies.

NRC-IRAP has invested more than $489 million in the projects of 3,486 companies and 6,204 business advisory services to companies. A survey of NRC-IRAP clients conducted in 2022-2023 estimated that 89% of them had been helped by the program to achieve their goals, and that its clients had increased their annual revenues by an average of 35%.

Eureka

Eureka is a unique intergovernmental network dedicated to promoting and supporting collaborative research and development (R&D) in aerospace and other technology sectors. Founded in 1985, Eureka brings together more than 40 countries and provides a collaborative platform for companies, universities, and research institutions. By facilitating access to funding, supporting market-oriented research projects, providing networking services and fostering international partnerships. Eureka enables aerospace stakeholders to share knowledge, develop innovative technologies and enter new markets.

Canada joined the network as an associate member in 2012 and became a full member in 2022. South Korea and Canada are the first two countries outside of Europe to officially join the network as members. Since 2012, Canada has supported more than 320 projects with more than 600 partners from 35 countries.

CyberFactory No.1 is a good example of a Eureka Network project. CyberFactory No.1 is a project to design, develop, integrate, and demonstrate optimization and resilience capabilities for factories of the future (FoF). The project has a budget of €24.6 million and involves 27 partners. In 2022, this project won the ITEA Award for Excellence for Business Impact.

Horizon Europe

The European Commission created the Horizon Europe program to develop projects from 2021 to 2027 with a budget of approximately $140 billion for 27 European countries and 18 non-European countries and international scientific partners. This funding is targeted at projects that demonstrate scientific excellence, address global challenges, and have an innovative aspect for Europe.

This is an opportunity for Canadian aerospace companies to develop their own technologies, receive funding and collaborate with European partners. Figure 3 below shows examples of projects that the NRC has undertaken with European partners in recent years.

Figure 3 : Examples of collaborative projects between NRC and the European Union (Source : CNRC [11])

Collaboration between OEMs and startups, from research to marketing

The aerospace industry is constantly evolving, characterized by rapid technological advances and increasingly complex challenges. In this context, collaboration between Original Equipment Manufacturers (OEMs) and startups plays an important role in the applied development of new technologies.

OEMs bring much-needed stability and strength to the industry with their established expertise, vast resources, and large-scale production capabilities. They provide the perfect testing ground for the innovative ideas of startups. Startups, in turn, bring new technologies, flexibility and innovative ideas that can transform the industry. Together, these strategic partnerships help overcome technical barriers, reduce time to market and respond more effectively to changing market needs.

Videns Analytics was mentioned at the 2024 International Aerospace Innovation Forum as an example of a company using AI and data mining to improve the efficiency of production lines. Airbus and Videns Analytics have been working together to deploy this solution on production lines. In the first year of testing on part of an assembly line, Airbus estimates it saved $4.5 million in operating costs [12].

[11] Conference : Canadian models of collaborative innovation - new opportunities on the horizon (May 21, 2 p.m., 210 A/E)

[12] Conference: OEM and start-up collaboration models (May 21, 2 p.m., 511 D)

However, increased collaboration between OEMs and startups presents a number of challenges, including the procedural complexities of large companies that make smooth collaboration difficult. More often than not, the difficulties arise at the procurement level, where the integration of new suppliers, especially startups, can be complex. To return to Videns Analytics, the procurement department qualified the startup as a supplier six months after the application was submitted. This type of lead time can be critical for smaller companies with limited financial resources, a limited number of employees, and in the prototyping phase.

> «From my experience at Airbus, we often say that working with startups comes with risks, but by imposing high demands and big operational procedures, we amplify those risks.»
>
> ***Jean-Francois Barrand, Head of Startup Engagement, Airbus Innovation***

AXYA, which develops subcontract management software, also cites an example where subcontract agreements can be over 300 pages long. The administrative burden of OEMs is difficult for startups to manage with very few employees.

Working with Original Equipment Manufacturers (OEMs) also brings many benefits to startups developing new technology solutions. In addition to being able to test their innovations in the field, startups develop a large customer base that gives them the credibility to expand their customer portfolio. OEMs have many requirements and standards to follow, so it can be easy for startups to adapt their solutions for new customers.

NASA and the Sustainable Flight National Partnership (SFNP)

NASA has developed the Sustainable Flight National Partnership (SFNP) to achieve carbon neutrality by 2050. Several projects are being developed to reduce CO2 emissions and the climatic impact of nitrogen oxides (NOx).

Figure 4 How NASA uses SAF to reduce the effects of non-CO_2 (Source : NASA [13])

[13] Conference : Overview of NASA's sustainable aviation programme (May 21, 4:40 p.m., 210 A/E)

In 2023, NASA signed an agreement with Boeing to design, build, test and fly an aircraft demonstrator that would significantly reduce fuel consumption. This joint development represents a total of $550 million for NASA and $725 million for Boeing and its industry partners. The aircraft will use a T**ransonic Truss-Braced Wing (TTBW)** configuration.

Another NASA project is the development of **Hi-Rate Composite Aircraft Manufacturing (HiCAM),** which would increase the production rate of composite parts by 4 to 6 times, while maintaining the same cost and weight as current production. This breakthrough will be made possible through the exploration of advanced manufacturing technologies, materials and simulation. This is a collaborative project involving 8 organizations.

NASA is also working with a number of partners on the ***E*lectrified Powertrain Flight Demonstration (EPFP)** project, which will transfer electric propulsion to existing aircraft platforms. This will accelerate the transition of existing infrastructure and pave the way for the development of certification standards to accommodate the conversion of existing aircraft to electric propulsion. This initiative is part of NASA's broader **Electrified Aircraft Propulsion (EAP)** program, which aims to develop cleaner, quieter, and more energy-efficient aircraft. In addition to developing all-electric propulsion systems, EAP is exploring the integration of hybrid electric technologies to enable a gradual transition to more sustainable aviation.

NASA is also developing a collaborative project to shorten flight times and routes to reduce fuel consumption. The **Collaborative Digital Departure Rerouting (CDDR)** project optimizes commercial flights to reduce the carbon footprint of aircraft operated by companies such as American Airlines, Envoy Air, Southwest, and the Federal Aviation Administration (FAA). NASA tested its system on flights between two Dallas airports (Dallas Fort Worth and Dallas Love Field International) from January 1, 2022 to September 16, 2022 and estimates that it saved more than 10,000 kg of kerosene, 34,000 kg of CO2 and more than US$31,000 in savings for passengers [14].

IFAR

The International Forum for Aviation Research (IFAR) is a global organization that brings together leading aviation research institutions. Founded in 2010, IFAR's main objective is to promote international collaboration and knowledge exchange in the field of aviation research. It is represented by 27 research institutes (one per country), bringing together more than 40,000 researchers. Canada is represented by the National Research Council Canada (NRC).

Figure 5: List of IFAR member institutions (Source: International Forum for Aviation Research [IFAR] [15])

[14] Conference: Overview of NASA's sustainable aviation programme (May 21, 4:40 p.m., 210 A/E)

[15] Conference: IFAR presentation (May 22, 9.15 a.m., 210 A/E)

The organization facilitates collaboration among its members through joint projects, conferences, workshops and meetings. By focusing on common challenges such as energy efficiency, emissions reduction, aviation safety and technological innovation. IFAR plays an important role in advancing sustainable aviation and achieving the global goals of the aviation industry.

IFAR's main activities are information exchange and networking, bilateral/multilateral international cooperation, career development and the development of external partnerships. The aim is to increase cooperation between different nations. The projects are in partnership with universities and have a Technological Readiness Level (TRL) of 3 to 6.

THEME 3 : THE IMPERATIVE OF SUSTAINABLE AEROSPACE

Aerospace carbon neutrality targets

The aerospace industry is developing a number of initiatives to achieve carbon neutrality by 2050. The industry is at a pivotal point in meeting the challenges of the next generation. How can we meet the strong growth in demand for air travel while reducing our environmental footprint?

Increasing demand over the coming decades will make greenhouse gas reduction targets even more important. New aircraft types, especially through the development of new propulsion technologies and even more efficient aerodynamic concepts, will play an important role in achieving the industry's carbon neutrality goals. In 2017, Rolls-Royce LibertyWorks conducted a study with NASA for its R-R LibertyWorks EVE concept, which could reduce aircraft fuel consumption by 28% [16].

Figure 6 below shows how the basket of measures to reduce the sector's environmental impact can offset such an increase in demand in order to meet the targets set.

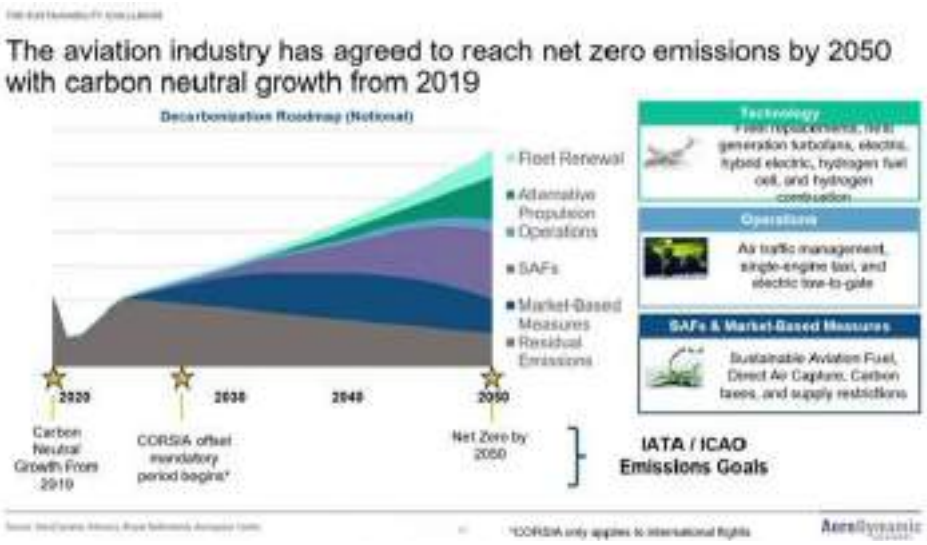


Figure 6 – Aerospace decarbonization roadmap to 2050
(Source : AeroDynamic Advisory, Royal Netherlands Aerospace Center [17])

Carbon neutrality can only be achieved through a series of measures at the technological level (replacement of the aircraft fleet, greater efficiency of the next generation of engines and development of alternative propulsion systems), at the operational level (air traffic management, single-engine taxis, electric towing of aircraft, etc.) and at the level of sustainable fuels and market solutions (sustainable fuels, carbon capture, carbon taxes and environmentally responsible restrictions on suppliers).

[16] https://www1.grc.nasa.gov/aeronautics/eap/airplane-concepts/hybrid-electric/

[17] Conference : Industry analysis (May 21, 9 a.m., 210 A/E)

Comparison of different alternative propulsion systems compared with current solutions

With very few new aircraft being developed, the industry is not in a position to wait for the development of new alternative propulsion solutions. AeroDynamic Advisory believes that there will be a next generation of aircraft engines using conventional fuel or SAF even before alternative propulsion systems are used 100%. The alternative propulsion systems being developed will not be available in the near future, nor will they be able to replace all of the trips made by the current fleet of aircraft. Programs such as CFM International's RISE (Revolutionary Innovation for Sustainable Engines) program (a joint venture between GE and Safran), which is developing a new generation open fan engine, or even Pratt & Whitney's second generation geared turbofan engine, will be good avenues for developing new engines that reduce environmental impact.

Figure 7 below shows the feasibility of alternative propulsion technologies for different types of commercial aircraft by 2040, based on the passenger capacity and range of today's aircraft. It shows that hybrid, fuel cell and electric propulsion systems are mainly applicable to small aircraft flying short distances. However, it is technically challenging to modify current aircraft with alternative propulsion technologies while maintaining the same passenger capacity and range.

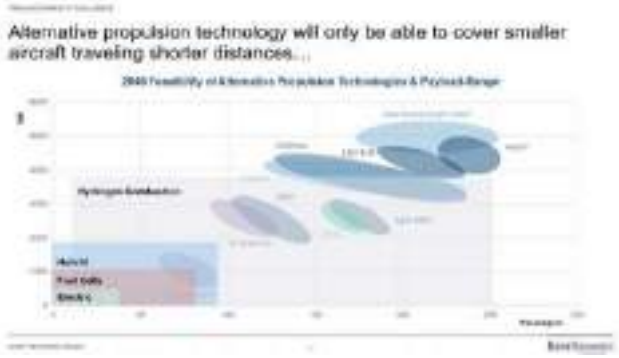


Figure 7 – Link between alternative propulsion and aircraft distance travelled by 2040 (Source: AeroDynamic Advisory: AeroDynamic Advisory [18])

The major challenge for alternative propulsion technologies is the mass energy density to be transported. Aircraft must transport their energy source while limiting their weight to maintain efficiency. Batteries and other alternative energy sources (e.g. hydrogen) often have a lower mass energy density than traditional fossil fuels such as kerosene, which limits their use over long distances and for large aircraft.

The energy density of current batteries limits electric aircraft to carrying small numbers of passengers over short distances. Electric propulsion is an interesting solution for advanced air mobility (eVTOL) as these aircraft carry fewer passengers over short distances than conventional aircraft. The use of fuel cells and hybrid electric engines increases the distance and the number of passengers. Nevertheless, as shown in Figure 7, hydrogen propulsion could eventually make it possible to carry up to 250 passengers over nearly 7,000 km (3,900 nautical miles). For larger numbers of passengers and/or longer distances, the use of advanced turbofan engines and sustainable aviation fuels (SAF) remains currently the only technically feasible option.

Aircraft powered by hydrogen combustion remain a good alternative for carrying payloads on commercial flights. However, the capacities of hydrogen-powered aircraft are lower than those of conventional aircraft. Despite its high mass energy density, hydrogen has a very low volumetric energy density, requiring larger storage volumes and increasing the weight and drag of the aircraft.

[18] Conference: Industry analysis (May 21, 9 a.m., 210 A/E)

Initiative for Sustainable Aviation Technology™ (INSAT)

Over the past few decades, a number of programs have been established in Canada to stimulate and enhance collaboration in the development of environmentally responsible aerospace projects. Examples include the Groupement aéronautique de recherche et développement en environnement (GARDN) (2008 to 2021) and the Coalition for Greener Aircraft (SA2GE) since 2010.

On June 19, 2023, at the Paris-Le-Bourget International Air Show, the Government of Canada announced an investment of $350 million in the Strategic Innovation Fund to create a national sustainable aeronautics innovation network, the Initiative for Sustainable Aviation Technology™ (INSAT).

This organization is responsible for managing and allocating this investment to collaborative sustainable aerospace projects. INSAT's goal is to support the growth of the aerospace sector and contribute to Canada's economic prosperity by advancing sustainable aviation.

There are four (4) types of project categories :

1. Hybrid and Alternative Propulsion;
2. Alternative Fuel Transition;
3. Aircraft Architecture and Systems Integration;
4. Infrastructure and Aircraft Support Operations.

Projects must have a maximum eligible expenditure of $20 million, a maximum duration of three years, and a Technology Readiness Level (TRL) of 3 to 7. Financial assistance may cover up to 40% of project expenditures [19].

[19] https://insat.aero/fr/

STEP-Tech from Pratt & Whitney and Collins Aerospace

Raytheon Technologies (RTX) has announced significant advances in hybrid electric propulsion with the Scalable Turboelectric Powertrain Technology (STEP-Tech) demonstrator, developed by Pratt & Whitney and Collins Aerospace. This modular, scalable demonstrator recently completed its first engine and electrical system integration test. STEP-Tech is designed to rapidly test distributed propulsion concepts for a wide range of next-generation applications, including AAM vehicles, high-speed eVTOLs and blended wing-body aircraft [20].

RTX is also advancing the development of hybrid electric propulsion through several demonstration programs supported by public-private and government partnerships, most notably the Hybrid Electric Flight Demonstration Program funded by Canada, Québec and the European Union-supported SWITCH consortium. These initiatives are part of RTX's overall strategy to develop a broad portfolio of sustainable aviation technologies.

IMOTHEP, an international collaborative project in hybrid electric propulsion

The Investigation and Maturation of Technologies for Hybrid Electric Propulsion (IMOTHEP) project is a major collaboration between industrial and academic partners to develop an integrated urban and regional mobility network powered by innovative hybrid electric technology. This ambitious project aims to transform the way we move around by exploring the possibilities of electric vertical take-off vehicles (eVTOLs) and other hybrid air transport concepts. By integrating advanced propulsion solutions, IMOTHEP aims to improve energy efficiency while reducing the carbon footprint of transportation systems, contributing to more sustainable and accessible mobility.

The European Union funded the program in 2020 with €10.4 million for 54 months. It includes the participation of 33 international members. Canada participates through the National Research Council Canada (NRC). The outcomes of the project will be the definition of preliminary designs for an aircraft and the specification of the aircraft architecture and hybrid propulsion components.

[20] https://www.prattwhitney.com/en/newsroom/news/2023/06/20/rtx-step-tech-demonstrator-completes-first-engine-run-and-electrical-system-integ

ZeroAvia, from hydrogen propulsion to the market

ZeroAvia is distinguished by its significant advances in hydrogen propulsion for aviation. The company is focused on developing zero-emission electric propulsion solutions for aircraft using hydrogen as the primary fuel. The company is currently developing the 600 kW ZA600 hydrogen electric engine for use in aircraft with 9 to 19 seats.

At the same time, ZeroAvia is actively exploring collaborations with industry partners and research institutions to accelerate the deployment of its technologies. ZeroAvia is developing hydrogen aircraft support infrastructure for airports to make this type of technology more accessible, both for the development of storage structures and for the management of safety processes.

At the International Aerospace Innovation Forum, ZeroAvia signed an agreement with Airbus and Canada's three busiest airports: Montreal-Trudeau International Airport (YUL), Toronto Pearson International Airport (YYZ) and Vancouver International Airport (YVR). The goal of this collaboration is to study the feasibility of integrating hydrogen propulsion infrastructure into airports. This is an important opportunity to work together to determine the supply, infrastructure, refuelling and regulatory requirements for the deployment of hydrogen technologies at Canadian airports [21].

[21] https://www.airbus.com/sites/g/files/jlcbta136/files/2024-05/FR-Airport-Sign-with-Airbus-and-ZeroAvia-for-Hydrogen-Hubs-at-Canadian%20Airports_0.pdf

Sustainable Aviation Fuel (SAF)

Several research and development programs are currently underway to develop different variants of sustainable aviation fuel (SAF). Indeed, this is an essential means of reducing greenhouse gas emissions from the aviation sector. IATA estimates that 65% of the reduction needed to meet the 2050 zero emissions target will come from the use of SAF [22].

Figure 8 below shows that the use of sustainable aviation fuel can potentially reduce CO_2 emissions by 50-90% compared to kerosene, depending on the type of sustainable fuel used.

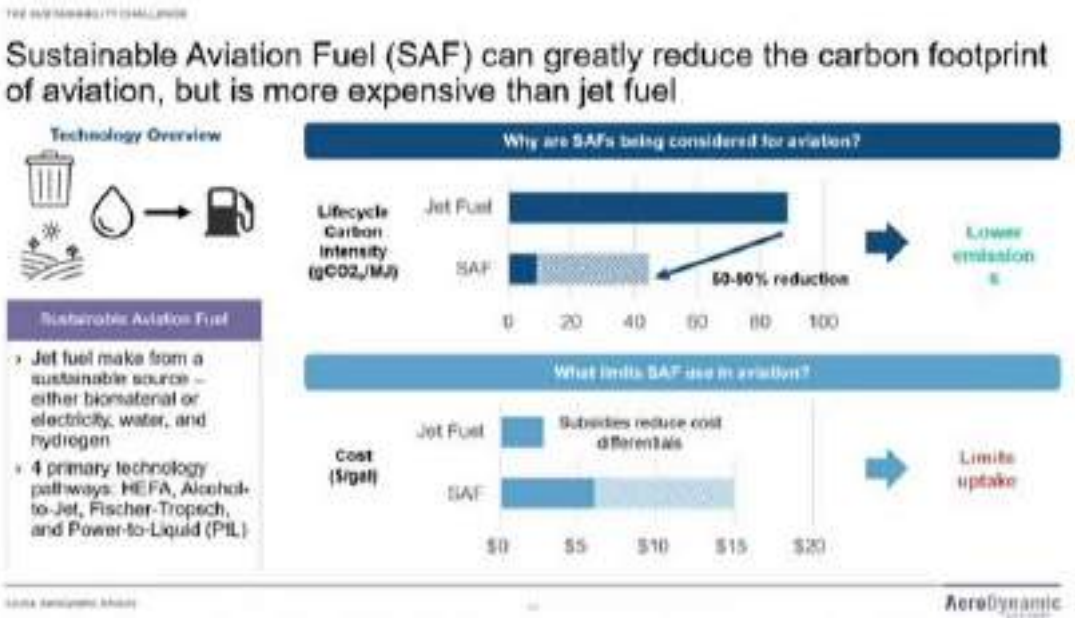


Figure 8 – Link between emissions reduction and SAF cost (Source : AeroDynamic Advisory [23])

[22] https://www.iata.org/en/programs/sustainability/flynetzero

[23] Conference: Industry analysis (May 21, 9 a.m., 210 A/E)

High fuel costs and supply difficulties remain the main barriers to the use of sustainable aviation fuels. Innovations in recent years have made it possible for most aircraft to use a certain percentage of sustainable aviation fuel (blend).

Catherine Guillemart, Head of Public Affairs Canada, Airbus Representative to ICAO, told the Forum that Airbus aircraft can already use 50% Sustainable Aviation Fuel (SAF) blended with kerosene. By 2030, the OEM hopes its commercial aircraft, helicopters and military aircraft will be able to use up to 100% sustainable aviation fuel.

There are still a number of technological challenges to overcome before we can use 100% sustainable fuels :

1. Cold starts;
2. Difficulty in relighting in flight;
3. Risks of switching between different types of fuel for the same aircraft;
4. Deposits of hydrocarbon residues (coke) in engines;
5. Changes (improvements) in performance (fuel consumption, temperature, acoustics, etc.) [24];
6. Agricultural land requirements and potential competition for sustainable biomass fuels;
7. Energy consumption required for production.

Bombardier EcoJet

Bombardier is focusing on 4 main areas to guide their innovation activities [25] :

1. Operations and infrastructure;
2. Sustainable Aviation Fuel (SAF);
3. Aircraft technologies;
4. Measures based on the global market (purchase of carbon credits from other industries).

The EcoJet project was born on the basis of new aircraft technologies. EcoJet began with a GARDN project from 2008 to 2015 (concept and design), the launch of the Horizon collaborative program from 2016 to 2022 (data collection), and now the EcoJet (flying laboratory).

[24] Conférence : Round Table : SAF (Robert Peluso, Executive Director – Systems Engineering, Pratt & Whitney Canada) (May 21, 1:45 p.m., 511 A/B)

[25] Conférence : Lunch & Learn - Bombardier: The history and future of the ECOJET (May 21, 1:25 p.m., 210 A/E) A/E)

Using advanced technologies, the EcoJet incorporates lightweight materials and more efficient propulsion systems to minimize fuel burn and reduce emissions. Bombardier estimates a 20% aerodynamic gain and a 50% improvement in fuel efficiency compared to conventional aircraft. Its optimized aerodynamic design and more efficient engines not only deliver significant fuel savings, but also significantly reduce noise, contributing to a greener and more pleasant flying experience for passengers and local communities.

In 2017, Bombardier produced a 7% scale demonstrator that was used for reduced-scale flight testing to study dynamic and transient behavior and control schemes, followed by aerodynamic data collection. This demonstrator allowed for rapid development and optimization of control technologies, as well as flight and operations crew training. In 2022, Bombardier reached an important milestone with a 20% full-scale demonstrator with improved finish, more accurate equipment and sensors, and the ability to perform more precise flights and maneuvers.

The eco-responsibility of materials and aircraft lifecycle

The materials used in aircraft manufacturing are critical to aircraft performance and environmental responsibility. Composite materials are increasingly being used to reduce weight and optimize aircraft performance.

Additive manufacturing, which has been developed over several years by various industry players, offers greater design flexibility and can be used to produce geometrically more complex parts than with traditional processes. Advances in additive manufacturing now mean that it is often possible to achieve properties close to those of forged parts. It is also a way to reduce the environmental footprint of aircraft by reducing part weight and optimizing material volumes *(buy to fly)*.

The costs of aircraft dismantling companies have increased by approximately 30 to 40% in recent years. These cost increases affect most of the aircraft dismantling and recycling value chain. Dismantling and recycling aircraft requires a large amount of labour, which is becoming increasingly expensive. The heavy equipment used to cut up parts is difficult to access and increasingly expensive. Decontamination of the parts is also very expensive.

Figure 9 : Prototypes (7% and 20% scale) of the Bombardier EcoJet [26])

Figure 10 : EcoJet prototype at the 2024 International Aerospace Innovation Forum (Source: Aéro Montréal)

[26] https://bombardier.com/en/media/news/bombardier-ramps-second-test-phase-ecojet-research-project-sees-18-foot-wide-prototype

THEME 4 : QUÉBEC'S STRATEGIC POSITIONING IN ADVANCED AIR MOBILITY

Portrait of a developing industry

Advanced Air Mobility (AAM) is a major evolution in aviation, marking a transition to more flexible solutions for short-haul air travel. Through the Espace Aéro innovation zone, Québec aims to position the province as a world leader in the development of AAM technologies. During the announcement at the Forum, Boeing also noted that it is investing $95 million in its Canadian subsidiary, Wisk Aero, to continue development of its electric vertical take-off and landing vehicle (eVTOL) in Québec.
Advanced air mobility could address a number of current and future challenges. In rural and remote areas, for example, a number of projects are focused on supporting emergency services or even delivering medicines. AAM has strong economic potential for Québec, with the potential to stimulate the economy by creating jobs in technological development and infrastructure and offering different business models for cargo deliveries to remote regions.

Technological advances in Advanced Air Mobility (AAM) and Advanced Regional Mobility (ARM) could disrupt the current hub-and-spoke airport network model. The hub-and-spoke model is based on central hubs that connect different airports and facilitate connections. However, advances in AAM and ARM are making it possible to design aircraft that are more fuel efficient and require fewer crews, paving the way for direct point-to-point air service over short distances. This transition offers numerous opportunities, particularly in short-haul passenger transport, emergency medical response, cargo transport, infrastructure monitoring and inspection, and others.

When Espace Aéro was announced, the Ministry of Economy, Innovation and Energy (MEIE) awarded $3.3 million to the Consortium for Research and Innovation in Aerospace in Québec (CRIAQ) to carry out nine collaborative industrial projects to accelerate the transformation of Québec's aerospace industry towards advanced air mobility. CRIAQ's new CEO, Guillaume Côté, spoke at the forum about the need to take AAM projects beyond traditional project management by working more closely with research and academic institutions in a secure environment open to collaboration. The Espace Aéro innovation zone will play an important role in the development of the advanced air mobility sector in Québec.

Examples of AAM projects

Recent years have seen significant investment and major initiatives in the AAM space. In 2020, Roland Berger estimated that a total of 230 urban AAM projects were under development, led by companies such as Joby Aviation, Archer, Volocopter, Lilium and others. A few years later, more than 600 projects were in development, reflecting the growing interest in these new technologies. Advanced air mobility is at a turning point due to the growing financial needs for aircraft certification and mass production. It can therefore be expected to see significant consolidation in the sector over the next few years.

Laflamme Aero

Laflamme Aéro's LX300 SATP (remotely piloted aircraft system) stands out as an innovative project in the field of aerial vehicles. The LX300 combines cutting-edge technology with environmental performance. The company is headquartered in Saint-Joseph-de-Coleraine, Québec, and develops a variety of applications, including agriculture, mapping and specialized cargo transport.

By integrating sophisticated flight management systems, the SATP LX300 ensures optimal safety while offering greater autonomy and reliability for a variety of airborne missions. This versatility is further enhanced by its ability to operate in both urban and rural environments.

Figure 11 : Laflamme Aéro Prototype LX300 (Source : Laflamme Aéro)

BETA Technologies

Beta Technologies' ALIA project represents a bold step forward in the field of electric vertical take-off and landing vehicles (eVTOLs). Designed to meet the growing challenges of sustainable urban mobility, the ALIA combines technological innovation with futuristic design.

BETA Technologies is targeting the regional mobility market with a piloted electric aircraft capable of carrying passengers. The ALIA eVTOL is capable of vertical take-off and landing and has a maximum payload of 3,175 kg. BETA estimates that the ALIA eVTOL will reduce hourly operating costs by approximately 50% and CO2 emissions by 83% compared to a non-electric aircraft of similar size [27]. The company is currently carrying out flight tests with a view to certifying the ALIA in the near future.

Figure 12 : BETA Technologies' ALIA VTOL (BETA Technologies)

[27] https://www.beta.team/aircraft/ (données de comparaisons https://www.cirium.com/ et https://www.globalair.com/airport/region.aspx)

Figure 13 : Wisk Aero's Generation 6 eVTOL at the 2024 International Aerospace Innovation Forum (Source: Aéro Montréal)

Wisk Aero

Boeing subsidiary Wisk Aero is currently developing an eVTOL aircraft for autonomous transportation. The target market is passenger air taxis. Because absolute safety is a priority for daily flights, Wisk has opted for supervised autonomy, where a supervisor can manage up to three aircraft simultaneously, modify flight plans, and intervene in emergency situations if necessary.

Wisk began by testing the subsystems and autonomous flight capabilities, with trials carried out in New Zealand. Feedback has been positive, not only for the aircraft itself, but also for the integrated autonomous systems, marking a promising step forward for this Boeing subsidiary.

Figure 14: Espace Aéro announcement at the 2024 International Aerospace Innovation Forum (Source: Aéro Montréal)

Horizon Aircraft

Horizon Aircraft is developing a regional hybrid electric eVTOL capable of travelling between 480 and 800 km and carrying up to 680 kg of equipment. In total, the Horizon Cavorite X7 would be able to carry 7 passengers. This hybridization is intended to increase the flexibility and safety of operations. The main objective is to offer regional flights over longer distances than would be possible with all-electric aircraft.

Through market research, Horizon Aircraft has identified a significant need for medical services and crisis intervention in remote communities. The vertical takeoff allows access to hard-to-reach areas faster than a traditional aircraft and more efficiently than a land vehicle. These characteristics make the aircraft a promising solution for meeting the urgent and essential needs of remote communities.

Figure 15 : Prototype Cavorite X7 d'Horizon Aircraft (Source : Horizon Aircraft)

Figure 16 : Horizon Aircraft's Cavorite X5 prototype at the 2024 International Aerospace Innovation Forum (Source: Aéro Montréal)

Drones

In recent years, drones have undergone significant technological growth, particularly in terms of autonomy, navigation, obstacle detection and the integration of artificial intelligence. Initially developed for military use, drones are now being used in a variety of sectors to meet diverse needs, including agriculture, logistics, emergency services, and others.

Drones play a key role in the design and certification of new passenger aircraft, such as Bombardier's EcoJet, thanks in part to their ability to simulate complex flight conditions and test advanced technologies safely and cost-effectively. As experimental platforms, they allow engineers to validate critical systems before integrating them into larger aircraft, including eVTOLs and commercial airliners.

The Unmanned Aerial System Centre of Excellence (CED) in Alma, Québec, plays a key role in this development dynamic. As a centre for research and innovation with capabilities for controlled beyond visual line of sight (BVLOS) airspace operations, the CED provides a unique environment for testing and certifying drone technologies, particularly those intended for integration into larger aircraft. The centre fosters collaboration between industry players, researchers and regulators, facilitating the emergence of innovative solutions for advanced air mobility.

Challenges and Opportunities

Regulations and airspace integration

Regulatory bodies such as the Federal Aviation Administration (FAA) in the United States, the European Union Aviation Safety Agency (EASA) and Transport Canada (TC) are actively developing regulatory frameworks to safely integrate AAM into existing airspace. The FAA is currently drafting legislation to authorize the certification and commercialization of AAM aircraft in the United States.

In China, the government is strongly supporting this new industry and is very aggressive in its regulatory approach. China is investing heavily in AAM technologies, with companies like EHang leading the way. Several flights and full-scale prototypes have recently been completed. Two eVTOL models have already been approved by Chinese authorities [28] [29].

Financing AAM projects

In 2021, several major investments took place in just a few months. Among the various publicly traded advanced air mobility companies (Archer, Eve Air Mobility, Joby Aviation, Lilium, and Vertical Aerospace), a total of US$5.54 billion in capital has been raised and more than $3.2 billion has been spent by these companies (as of the end of the first quarter of 2024). Figure 17 below shows the total funding awarded to the various companies developing advanced air mobility prototypes.

[28] https://www.ehang.com/news/990.html

[29] https://www.autoflight.com/en/news/autoflights-tc-application/

Funding will be a major challenge for advanced air mobility in the coming years. The high cost of certification and manufacturing support will be a challenge for companies without sufficient financial backing. It is currently difficult to raise capital without a proven, concrete business model. The newness of the market makes funding very risky for the various financial institutions or investment funds. Graham Warwick, technology editor of Aviation Week, believes that once two or three companies are in production, financing for companies in the sector will be much more accessible.

Part of the funding problem can be attributed to very high initial expectations, often fuelled by ambitious forecasts and significant media interest, which have not always been followed by performance to match. The reality is that companies have encountered technical, regulatory and economic challenges that have slowed the commissioning of projects and disappointed investors.

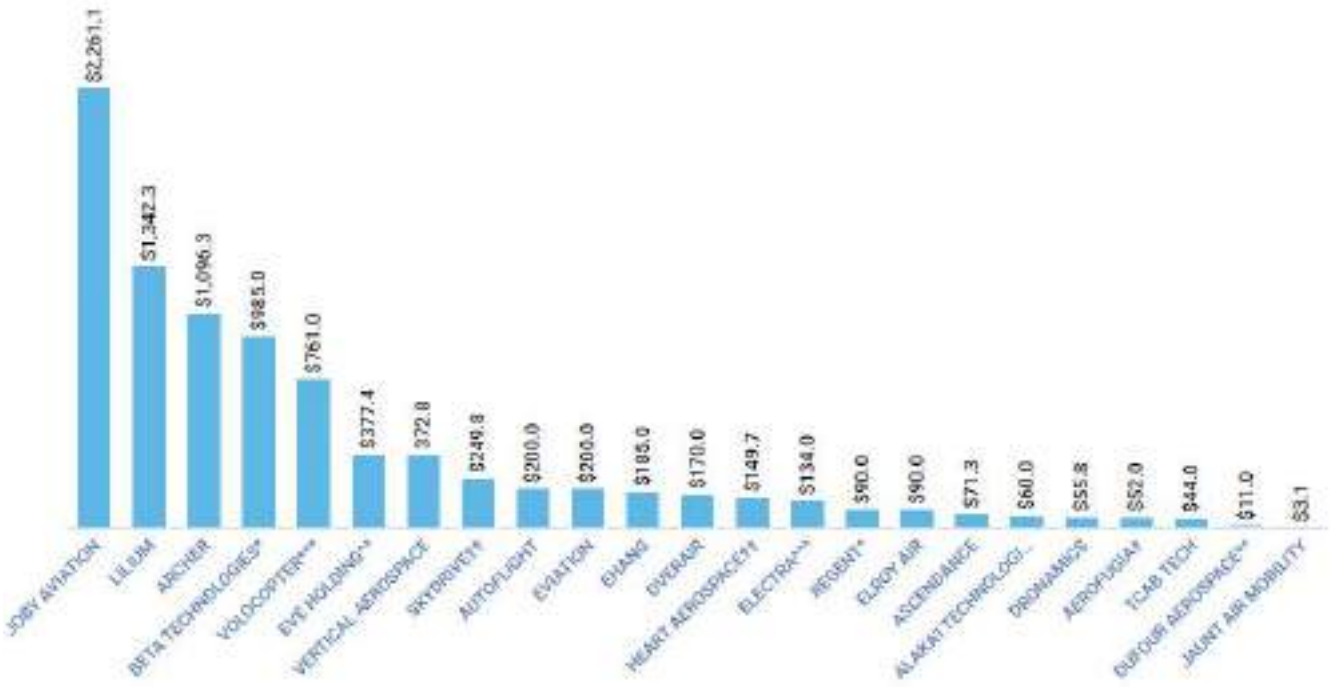


Figure 17 : Financing of advanced air mobility companies (in millions of dollars) (Source: SMG Consulting, 2024 [30])

Social acceptability of AAM

Social acceptance of advanced air mobility (AAM) is a critical challenge for the success and integration of these new technologies into people's daily lives. Several factors influence this acceptance, ranging from the public's perception of the benefits and risks associated with AAM to the active participation of communities in the sector's development and implementation process. As the prototype testing and approval phase draws to a close, a number of questions are being asked about the relevance of this type of aircraft.

[30] https://aamrealityindex.com/aam-reality-index

The business model still needs to be clearly articulated in order to attract more funding for companies in the sector and to achieve greater social acceptance/desirability. One current perception is that the development of this type of transportation, such as eVTOLs, is taking precedence over the business model. It will be easier to define the business model once the capabilities of the aircraft have been demonstrated.

A survey by the European Union Aviation Safety Agency (EASA) in 2021 revealed that 71% of Europeans were in favour of the idea of air taxis, with concerns mainly centred on safety and noise [ ]. However, a great need has been identified to raise awareness and educate the general public about both the positive aspects and the challenges associated with advanced air mobility.

All the infrastructure required to support the operation of advanced air mobility aircraft needs to be built and installed. Integration into existing airspace poses a number of technical and regulatory challenges. It is essential to develop clear protocols for the interaction between the new air vehicles and other aircraft. Integration into an ever-changing urban environment remains complex, with multiple vertiports and infrastructure to be developed to make the service operational and efficient. Advanced air traffic management systems will need to be implemented to ensure safe and efficient operations. These systems are likely to use advanced technologies such as real-time communications, automated detection and avoidance, and dedicated air routes for AAM vehicles.

Cooperation with civil aviation authorities is essential to create an appropriate regulatory framework. This includes the establishment of strict safety standards, rigorous certification procedures, and operational guidelines for AAM operators.
Figure 18 below shows estimates from a 2018 study (Sun, Wandelt, and Stumpf, 2018) of the frequency of transportation mode use relative to travel distance for car, airplane, air taxi, and train.

Figure 4. Competition of transport modes as a function of travel distance

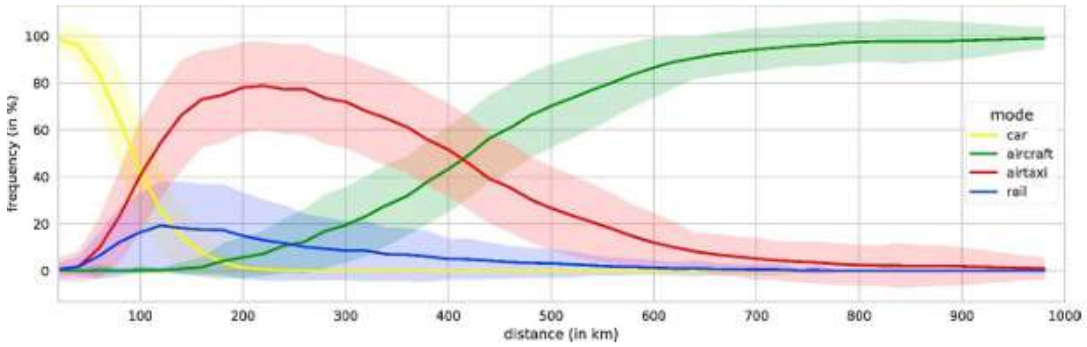


Figure 18 : Competition between modes of transport in relation to journey distance (Source: Sun, Wandelt and Stumpf, 2018 [32])

[31] https://www.easa.europa.eu/sites/default/files/dfu/uam-full-report.pdf
[32] Sun, X., S. Wandelt and E. Stumpf (2018), "Competitiveness of on-demand air taxis regarding door-todoor travel time: A race through Europe", Transportation Research Part E: Logistics and Transportation Review, Vol. 119, November 2018, pp. 1-18, https://doi.org/10.1016/j.tre.2018.09.006.

Estimates show that air taxis would remain competitive with cars for distances between 80 and 130 km, with trains for distances between 130 and 220 km, and with airplanes for distances between 220 and 340 km. It is difficult to justify short passenger trips by air taxi due to high costs, maximum passenger numbers and logistical constraints. Longer trips using air taxis are less efficient than using commercial aircraft due to lower cost per passenger, energy storage capacity, and optimal speeds and altitudes for long distances.

Several aircraft development companies are turning to emergency medical transport to remote areas to justify this type of aircraft. The vertical nature of takeoff and landing makes it easier to provide this type of service in remote areas, unlike traditional aircraft that require more expensive runways.

At the same time, equity of access to AAM must be a priority. It is essential that these technologies do not benefit only the wealthy, but that they are accessible to a large proportion of the population. This can be achieved by developing support infrastructure, such as vertiports, in underserved regions.

Social acceptance will also come from demonstrating aircraft that offer a level of safety comparable to that of general aviation. To gain public confidence and ensure successful adoption, it is critical that every aspect of aircraft design, manufacture and operation meet the highest safety standards. By ensuring the safety of passengers, operators and people on the ground, AAM can position itself as a safe and reliable alternative to traditional modes of transportation, paving the way for a new era of urban and regional mobility.

Environmental aspects play a crucial role in the social acceptance of AAM. Citizens are increasingly concerned about the environmental impact of new technologies, and AAM must demonstrate that it contributes to a more sustainable future. Citizens are questioning the need to develop advanced air mobility beyond other transportation technologies or even the development of medical technologies. AAM must respond to an urgent and relevant need if it is to be socially acceptable.

The public is also questioning the challenges posed by the electrification of transportation, which will increase demand for electricity in the coming years. In Québec in particular, Hydro-Québec predicts that electricity surpluses will be exhausted by 2026 and that the province will need 100 TWh by 2050. There are also questions about the full life cycle of aircraft that use rare metals for batteries.

Adapting the workforce to a new market

The development of a complete AAM industry also raises the issue of workforce support. The Longueuil hub of Québec's aerospace innovation zone plans to focus a large part of its activities on workforce training, both at the college and university levels.

Blain Newton, COO of BETA Technologies, spoke at the forum about the strong interest of the next generation in developing new technologies for advanced air mobility. The combination of an innovative sector with a high level of research and development, combined with the deployment of sustainable mobility solutions, will make it possible to attract a large number of talented school graduates. He believes that young workers have the necessary skills, but knowledge of specific aeronautical aircraft is rarer.

THEME 5 : THE CHALLENGES OF ATTRACTING AND RETAINING TALENT IN A FAST-GROWING INDUSTRY

Portrait of Québec's aerospace workforce

Québec's aerospace workforce is highly skilled, diverse and dynamic. It plays a crucial role in maintaining the province's position as a world leader in this strategic sector. However, the industry faces a number of workforce challenges as the population ages. According to Aéro Montréal, a total of 40,000 jobs in the sector will need to be filled in Québec over the next decade. By comparison, the sector currently employs 41,700 people. The combination of a fast-growing industry, an aging population and a labour shortage explains the challenges facing the aerospace industry in the coming years.

Montreal is recognized worldwide as one of the world's leading aerospace capitals, alongside cities such as Toulouse and Seattle. Bombardier, Airbus, Bell Flight, CAE, Pratt & Whitney and more than 230 other companies form a strong industrial cluster that attracts top international talent. With the announcement of Boeing's investments in Montreal and in the Espace Aéro innovation zone, Montreal is the first city to host three giants of the civil aviation industry (Airbus, Boeing and Bombardier). All of these factors combine to position the Greater Montreal region as one of the world's leading aerospace innovation centres, for both workers and companies.

The challenges of attracting talent

The retirement of a number of key employees in the industry is a major challenge for companies. The result is a high risk of losing institutional knowledge. Many companies are finding that they need to retain retiring employees longer, or even hire them back as consultants, in order to keep this expertise within their organization.

A major difficulty in attracting talent to the aerospace industry is that interest in the sector is lower than in previous generations. Despite a fast-growing industry, high salaries and a high level of innovation, many young people prefer to move to other sectors that they consider more attractive.

"In the aerospace industry, the biggest challenge in the coming years will be human resources. For every person in Québec who retires in the next 20 years, there will be 0.8 people to replace them. There are a lot of older people working in the aerospace industry, so it will be a challenge for Québec to be able to support the industry with productivity, automation and so on. We need to bring more research and development into our system to develop and integrate new certifications related to environmental responsibility in a way that is convenient for companies."

Stéphane Drouin,
Vice-President - Purchasing and Economic Development Québec, Investissement Québec

Representatives of Québec's academic institutions also expressed the need to make programs more attractive to new generations of students. However, bachelor's programs are limited in their flexibility, making it difficult to offer aerospace-related programs that are too specific or to make curricula more practical. A survey by the Université de Sherbrooke shows that only 10% of students are passionate about aerospace, although many are interested in the sector.

Diversity is another challenge for engineering programs. In Québec, only 15% of engineers are women and 17% are immigrants. At a university like Polytechnique Montréal, 29% of students are international and 30% are women. Organizations are seeing positive developments in diversity, but efforts must continue.

Stratégies d'atténuation des risques d'un manque de main-d'œuvre

Technological innovation plays a key role in attracting and retaining talent in the aerospace industry. By integrating cutting-edge technologies such as artificial intelligence, the Internet of Things and advanced automation, companies can offer a modern and dynamic work environment. Virtual and augmented reality technologies enhance training programs by providing immersive and interactive experiences, while collaborative tools enable the creation of global and flexible work teams. These types of innovations can be used to increase productivity as well as attract and retain employees.

Despite the desire for high salaries, young talent wants to be involved in innovative projects that have a positive impact on their community. The goal of carbon neutrality affects the vast majority of innovation projects in the sector, which is an attraction for new generations. It is important to communicate these innovative projects effectively and to involve as many employees as possible in this type of development.

The Québec government has announced investments of $3.1 million to accelerate training for workers in the aerospace sector [ ]. This acceleration is achieved through work-study formulas (ATE), which allow students to gain work experience and remuneration during their studies. One example is the COUD (short-term) project

[33] https://www.tvanouvelles.ca/2024/06/30/industrie-aerospatiale-40-000-postes-a-combler-dans-la-prochaine-decennie

in mechanical assembly at the École des métiers de l'aérospatiale de Montréal (EMAM), which allows students to spend 20% of their training with an industrial employer. This investment will cover $25 per hour for students' salaries during their on-the-job training, up to a maximum of $25,000.

Bombardier has developed an internal project called Heritage to retain critical know-how within the company. The project allows the company to better manage the knowledge of employees who are retiring or have already retired. Not only is there the issue of training the next generation, but also the need for this type of company to retain expertise that meets the high standards of the industry. **Heritage is a five-step process:**

Figure 22 – Methodology of the Bombardier Heritage Project (Source: Bombardier and Mosaic d'HEC Montréal [34])

The 3 strategically located Espace Aéro hubs of the zone will significantly increase the added value of aerospace jobs in Québec. In particular, Longueuil will focus on improving the training of current and future workers in the industry. Located at the Montreal Metropolitan Airport, the hub will bring together the École Nationale d'Aérotechnique (ENA), the Centre Technologique en Aaérospatiale (CTA) and the École de Technologie Supérieure (ÉTS). The establishment of the ÉTS campus at the airport on the south shore of Montreal will make it possible to develop a bachelor's degree program in aerospace, with the first class starting in the fall of 2025 with masters' and doctorate programs to follow.

The Montreal hub, in the borough of Saint Laurent, plans to build a collaborative research centre that will provide training for the region's workforce, as well as graduate education and research. Located in the Technoparc Montréal, near a station of the Réseau express métropolitain (REM), the centre will be less than 20 minutes by public electrified and autonomous transportation from Polytechnique Montréal, Concordia, McGill and ÉTS.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THÉMATIQUE 6 : GEOPOLITICS, DEFENCE AND CHANGES IN SUPPLY CHAINS

Geopolitics and defence, which are closely linked to aerospace supply chains, have undergone significant changes in recent years. After decades of globalization characterized by increased outsourcing to low-cost markets to reduce manufacturing costs, geostrategic and quality imperatives are now driving the repatriation of certain activities in-country or to allied countries.

This transition reflects a strategic shift toward diversifying sources of supply and reducing overdependence on specific foreign countries.

Aerospace procurement difficulties

The aerospace industry continues to face significant supply challenges that impact production, costs and delivery times. These difficulties are primarily due to the complexity and rigor of quality and safety requirements, the reliance on a global network of specialized & approved suppliers, and disruptions caused by external factors such as economic crises, pandemics, and geopolitical conflicts.

Aircraft innovations bring a new level of complexity to the materials used, the manufacturing processes and the assembly skills required. The constant need to reduce aircraft weight and increase performance is driving the industry to use more composite materials and complex alloys.

This increase in the complexity of manufacturing processes brings with it an increased risk of supply disruptions and difficulties in finding suppliers able to provide the required materials or assemblies. In recent years, there has been a shift towards a local supply chain, but some specific needs are still difficult to meet.

A company like Avior, which specializes in lightweight structures and critical mechanical assemblies for the aerospace industry, develops parts that sometimes have to cross the US-Canadian border up to 25 times. Some parts of the manufacturing process require a high degree of specialization, making it difficult to source from multiple locations. This challenge increases the risk of supply disruptions and limits the agility of companies in the industry.

The impact of the COVID-19 pandemic highlighted the complexity of aerospace supply chains. Climate change is also likely to have an impact on companies' supplies. Expectations for suppliers to comply with diversity, equity and inclusion policies are increasing, in addition to evolving environmental policies. In order to meet high industry standards, buyers are analyzing suppliers in terms of their corporate values, ecosystem, decarbonization and governance policies. A company like CAE requires a decarbonization plan from its suppliers and mobilizes financial institutions to help small companies that want to work with them develop a decarbonization plan. Aéro Montréal's Eco-Responsibility initiative, supported by Canada Economic Development (CED), assists companies wishing to develop such a plan.

Collaboration internationale

International aerospace diplomacy plays an essential role in bringing nations together to explore, develop and use airspace in a peaceful and cooperative manner. Over the past two years, a number of significant events have marked this dynamic, illustrating both the challenges and the progress in this strategic field.

The Global Aerospace Cluster Partnership (GACP) is a new international initiative to strengthen collaboration among aerospace clusters around the world. The partnership aims to foster innovation, economic development and sustainable growth in the global aerospace industry by facilitating knowledge exchange, strategic partnerships and joint development initiatives. The initiative was announced in 2023 at the Paris Air Show at Bourget, where Aéro Montréal was a founding signatory of the partnership. The GACP includes 12 international aerospace cluster members and 45 European aerospace cluster members. Its activities include: building an international network, supporting collaboration, organizing forums and conferences, and benchmarking global activities and policies.

Figure 23 – Carte des membres du GACP en avril 2024 (Source : Global Aerospace Cluster Partnership [35])

The fight against climate change is prompting governments to set ambitious targets for reducing aviation emissions. Agreements such as ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) aim to limit the environmental impact of international aviation. ICAO's Fly Net Zero also marks the airlines' intention to achieve carbon neutrality by 2050.

The use of Sustainable Aviation Fuel (SAF) is growing, but the industry is still far from annual global production sufficient to meet environmental targets. This is an important innovation in achieving the 2050 net zero emissions target, which represents a potential 65% reduction in the industry's carbon footprint [36].

Despite prices that are still high compared to traditional fuels, several countries have set targets for the use of SAF. Examples include the European Union, which has mandated the use of 70% sustainable aviation fuel by 2050; the United Kingdom, which has mandated 22% by 2040; Japan, which has mandated 10% by 2030; Norway, which has mandated 30% by 2030; and Malaysia, which has mandated 47% by 2050. There is a need for cooperation and coordination between countries to

[35] Conference: Wings of Unity - Strengthening international collaboration in aerospace (22 May, 15:00, 511 D
[36] https://www.iata.org/contentassets/4b18fa1ac4a246879c058cf75954dbda/netzero-roadmaps-presentation-agm2023.pdf

encourage the entire aviation value chain to use SAF. Coordinated policies and appropriate incentive mechanisms at the international level will be crucial to ensure widespread adoption of SAF and thus accelerate the transition to more sustainable aviation.

In recent years, there has been a significant increase in international cooperation in space exploration. Initiatives such as NASA's Artemis program, which aims to return astronauts to the Moon with international partners including the European Space Agency (ESA), the Canadian Space Agency (CSA), and other nations, illustrate this collaboration. Public-private partnerships continue to play a critical role in the technological development and commercialization of space. Private companies such as SpaceX, Blue Origin, and Rocket Lab have worked with national space agencies to launch satellites, develop reusable launch technologies, and open new opportunities for commercial space exploration.

Défense et sécurité

The defence aerospace industry is a strategic sector where innovation and technological development play a critical role in meeting today's security and national defence challenges. Over the past few decades, the industry has undergone a rapid transformation, characterized by significant advances in a number of technologies that can help alleviate labour force shortages in the armed forces. The Royal Canadian Air Force (RCAF) estimates that it is short 2,000 regular force and 500 reserve force members.

Advances in satellite communications systems and navigation technologies have revolutionized the command-and-control capabilities of the armed forces. The development of new technologies is driving the growth of threat detection tools over large geographic areas. Developments in quantum physics-based communication systems are likely in the next few years. A company like Qubic Technologies, based in Sherbrooke in the heart of one of Quebec's three other innovation zones, Distriq, the quantum innovation zone, is developing radar technologies using quantum microwaves that can cover twice the area, with targets four times smaller, and with zero risk of signal interception [37].

Advanced Air Mobility (AAM) is of particular interest to the defence sector. Events in Ukraine have shown how UAVs have become essential tools for surveillance, reconnaissance and high-risk operations. The autonomy of this type of aircraft is very attractive to an industry with high security risks.

[37] Lecture: Digital series: quantum detection (Jérome Bourassa, Chief Executive Officer, Qubic Technologies) (May 22, 3.45 p.m., 511 A/B)

The development of digital technologies in AI, data management and cybersecurity will also be important in improving the effectiveness of the armed forces.

Canada's Industrial and Technological Benefits (ITB) policy has a significant impact on aerospace procurement. This policy aims to maximize the economic benefits to Canada from defence spending and procurement. The policy requires foreign companies that win contracts with the Canadian government to invest in the local economy.

A good example of the impact of this type of policy is the purchase of 88 F-35 fighter jets from Lockheed Martin in January 2023 by the Canadian government. [ ] This agreement has enabled the integration of Canadian suppliers into the supply chain, including Magellan Aerospace, Avcorp Industries and Pratt & Whitney. Lockheed Martin has also invested in research and development (R&D) projects in Canada, contributing to technological innovation in the Canadian aerospace sector. These investments have supported advances in composite materials, advanced propulsion systems and manufacturing technologies.

The war in Ukraine has caused significant disruption to the global aerospace industry. Sanctions imposed on Russia have led to disruptions in supply chains, particularly for critical raw materials essential to aircraft manufacturing. These factors, combined with rising energy prices, have increased costs for aircraft manufacturers and operators. This situation has created numerous challenges for the industry as a whole, requiring rapid adjustments to maintain production and meet global demand.

[38] https://www.canada.ca/fr/ministere-defense-nationale/nouvelles/2023/01/annonce-concernant-lacquisition-des-f-35.html


FORUM INNOVATION AÉROSPATIALE INTERNATIONAL

CONCLUSIONS AND RECOMMANDATIONS

In conclusion, the aerospace industry has never been more vibrant, with innovation and collaboration at its core. Our ecosystem is working together to provide solutions to meet the challenges of tomorrow. The Forum provided an opportunity to discuss the challenges of the future and set the direction for all stakeholders. Six (6) key highlights and four (4) recommendations for ecosystem stimulation and action emerged.

More than ever, all players in the Québec aerospace ecosystem must work closely together to meet the challenges facing the Québec industry and ensure its international competitiveness.

QUÉBEC AEROSPACE industry highlights

1

Launch of Québec's aerospace innovation zone, Espace Aéro

The launch of Québec's aerospace innovation zone, Espace Aéro, represents a major turning point for the province's aerospace industry. This zone demonstrates the positive impact that collaboration between government agencies, research institutes, academic institutions, startups, SMEs, integrators, OEMs and others can have. By catalyzing synergies, offering mutualised state-of-the-art equipment, expertise and regulatory support while attracting investment, this initiative promises to consolidate Québec's position as a world leader in aerospace. It will make it easier to carry out field tests and provide the tools to commercialize innovations. In the coming years, the ecosystem will be mobilized to develop innovative projects to reduce the environmental impact of aviation and to train the next generation of aerospace professionals.

2

Strong demand but limited production

The post-pandemic recovery from COVID-19 has highlighted the difficulties faced by the various aerospace stakeholders in resuming production. Disrupted supply chains, labour shortages, inflation, and strong demand for air travel make the situation complex for the various stakeholders. This dichotomy has resulted in longer lead times, higher production costs and increased pressure on suppliers. Aerospace companies have had to adapt quickly, implementing resilience strategies and investing in research and development to overcome these challenges and meet market expectations.

3

Setting up innovative, sustainable and eco-responsible technologies

Companies in the sector are increasingly turning to innovative solutions such as sustainable aviation fuels, lightweight composites that are easier to recycle, alternative propulsion technologies, etc. Companies are paying more attention to the full lifecycle of aircraft and the potential for recycling the various parts of an aircraft. Environmental standards among suppliers have never been higher.

4

Urgent need to attract and retain talent

There are a number of reasons for the shortage of aerospace workers in Québec: growing demand for air transportation; major investments by various levels of government; a decline in the sector's attractiveness to the next generation of workers; an increase in the need for specialized workers; and a large number of workers nearing retirement. Québec's aerospace sector will need to fill more than 40,000 jobs over the next decade.

5

The arrival of a nerve centre for advanced air mobility

The advanced air mobility industry is developing rapidly, with several tests of prototype vertical takeoff and landing aircraft underway. This sector is at a turning point because of the challenges it faces. Access to finance will become increasingly critical. Regulatory developments will test the resilience of companies with demanding deadlines, requirements and costs. There are also questions about the social acceptability of airspace integration and environmental impact assessment. By overcoming these challenges, advanced air mobility will be able to realize its potential to transform transportation.

6

Increased defence investment by governments

The current tense global situation has led to calls for all NATO member governments to increase defence investment to the desired level of 2% of gross domestic product. Canada has also decided to make an effort to meet the defence investment target called for by all NATO members. On April 8, 2024, Canada released “Our North, Strong and Free: A Renewed Vision for Canada's Defence.” Canada announced: “We will change our approach to working with industry, innovators, and researchers—moving away from transactional approaches for acquiring capabilities to sustained strategic partnerships founded on transparency and trust.” Québec's aerospace industry is exploring ways to support this government approach, particularly in its collaboration with the United States. To this end, a seminar on U.S.-Canada defence cooperation was organized in conjunction with the Forum.

RECOMMANDATIONS

Calls for projects

While a strength for Québec and a benefit for the ecosystem, an important and cost-neutral solution to support progressive and collaborative innovation among members of the ecosystem (OEMs, Tier 1 & 2, SMEs and startups) is to rapidly implement the following changes in the way calls for projects are prepared, launched and followed up :

1. **Predictability :** Ensuring that the timeframes required to complete a call for projects application are sufficient and realistic to encourage a broad cross-section of the aerospace ecosystem to plan collaboration and work together to submit a proposal.
2. **Duration :** The duration of government financial support should allow this project to meet the needs of the aerospace industry (3-4 years). This would increase the likelihood of project success and permit a more fluid integration of student involvement in industrial innovation projects.
3. **Consistency :** Industry recommends that calls for projects be predictable and recurring, so that if a particular solicitation is missed, industry members will know when to prepare and be ready for the next one.
4. **Governance :** The governance process for industrial calls for projects and the associated administrative burden poses a challenge for the industry and the innovation process, especially for SMEs. It needs to be harmonized as much as possible between the various levels of government. This will ensure greater consistency for the industry and enable members to acquire effective knowhow and processes to manage their innovation projects without having to integrate multiple governance processes, thus spending more time & energy on the innovation that on administration.

Sustainable aviation fuel

The aerospace industry and related stakeholders recognize the critical importance and relevance of Sustainable Aviation Fuel (SAF) to the industry's roadmap to net zero emissions by 2050. Without SAF, this goal cannot be achieved.

It is recommended that the Governments of Québec and Canada work to implement incentives to support affordable research, development, certification, production, transportation and distribution, storage and use of sustainable aviation fuel. All of these activities must be coordinated and consistent with approved and ongoing activities in the U.S. that address the entire multidisciplinary value chain.

☞ Alignment between industrial strategy and public needs

Increasingly, all three levels of government are using aerospace technologies to improve services to the public, whether it's a city using drones to map tree plantings or swimming pool facilities, the provincial government or its state agencies using advanced air mobility technology to inspect infrastructure, agriculture or forests, or the federal government looking to improve its air and space defence capabilities. Québec can offer its expertise in supplying or developing the technology needed to meet this demand.

The industry recommends that different levels of government proactively share and promote collaborative and local solutions to meet diverse needs. A proactive response to needs must take place before alternative solutions are sought abroad. To support proactive and collaborative planning, financial investment in innovation infrastructure and projects should be targeted to support locally developed solutions. Such actions would have the spin-off benefit of attracting foreign direct investment.

☞ Maximize financial support

Financial support for innovation is a need common to all aerospace regions of the world.

In order to optimize the use of funds and the benefits they bring, the industry recommends that the provincial government provide more financial support for technological innovation at a Technology Readiness Level (TRL) of 6 and above to assist innovators who wish to conduct practical research, prototype testing and/or commercialization.

It is also recommended that consideration be given to reviewing other existing models of financial support. For example, the federal INSAT program or international programs such as Horizon Europe could be considered to provide and enable additional public support to provincial programs.

APPENDICES

Appendix 1 — Complete Program

DAY 1 - MAY 21 2024

OPENING INTRODUCTION

Jarrod Morley, Senior Director of Strategy and Head of Innovation, Aéro Montréal
Samantha Golinski, Vice President, Public Affairs and Global Communications, CAE

THE PROVINCIAL GOVERNMENT'S PERSPECTIVE ON THE AEROSPACE INDUSTRY

Animateur :
Donald Martel, Parliamentary Assistant to the Minister of MEIE, MNA for Nicolet
Speakers :
François Legault, Premier of Québec
Pierre Fitzgibbon, Minister of Economy, Innovation and Energy, Government of Québec
François Philippe Champagne, Minister of Innovation, Science and Industry, Government of Canada
Pierre Ruel, Acting Chief Executive Officer and Director of Strategy and Policy, Boeing Canada
Martin Brassard, President and Chief Executive Officer, Héroux-Devtek
Maria Della Posta, President, Pratt & Whitney Canada
Martin Larose, Chief Executive Officer, H55
Mélanie Lussier, President, Aéro Montréal

WELCOME

Bicha Ngo, President and CEO, Investissement Québec
Mitch Davies, President, National Research Council Canada

INTRODUCTORY REMARKS

Her Excellency Susannah Goshko, British High Commissioner to Canada

INTRODUCTION - COLLABORATION: INNOVATION'S ACCELERATOR

Fassi Kafyeke, Fellow Research, Innovation and Collaboration, Bombardier
Richard Aboulafia, Managing Director, AeroDynamic Advisory
Kevin Michaels, Managing Director, AeroDynamic Advisory

TOWARDS NET ZERO: NEW AIRCRAFT PROGRAMS AND CONFIGURATIONS

Moderator:
Sofiane Benyouci, Vice-President, Consulting, Innovitech
Speakers:
Rui Pedro Silva, Vice President Engineering, Bombardier
Nathalie Duquesne, Managing Director, Liebherr-Aerospace Toulouse

TOWARDS NET ZERO: ADVANCES IN PROPULSION

Moderator:

Eymeric Boyer, Principal, Roland Berger

Speakers:

Uwe Minkus, Chief Engineer Research, Technology and Future Programmes, Rolls-Royce

Alexandre Gagnon, Vice-President Corporate Affairs & Transformation, Pratt & Whitney Canada

TOWARDS NET ZERO: A KEYNOTE OVERVIEW OF HYDROGEN IN AEROSPACE

Val Miftakhov, Founder and CEO, ZeroAvia

ROUND TABLE: THE STEPS, BENEFITS AND CHALLENGES OF INTEGRATING HYDROGEN IN AEROSPACE

Moderator:

Susan Liscouet-Hanke, Associate Professor, Concordia University

Speakers:

Val Miftakhov, Founder and CEO, ZeroAvia

Hans Bernd Aringhoff, Head of Corporate Innovation, Lufthansa Technik

Karine Guenan, Vice-President Ecosystem (ZeroE), Airbus

Mikael Cardinal, Vice-President E-Aviation - organ delivery systems, Unither Bioelectronics

FULLY-ELECTRIC FLIGHT - THE FUTURE STATE OF BATTERIES IN AEROSPACE:

Moderator:

JR Hammond, Executive Director, CAAM

Speakers:

Martin Larose, Chief Executive Officer, H55

Karim Zaghib, Professor at Concordia University and CEO of Volt-Age Electrifying Society

Riona Armesmith, Chief Technology Officer, MagniX

Erika Holtz, Head of Engineering and Quality, Harbour Air

LUNCH AND LEARN - INNOVATION AND SUSTAINABILITY AT THE HEART OF BOMBARDIER'S NEW BRAND IDENTITY

Ève Laurier, Vice President, Communications, Marketing and Public Affairs, Bombardier

BOMBARDIER: THE HISTORY AND FUTURE OF THE ECOJET

Fassi Kafyeke, Fellow Research, Innovation and Collaboration, Bombardier

Enguerran Michel, Director, Research and Technology, Bombardier

Sid Banerjee, Technical Expert, Engineering, Bombardier

ROUND TABLE: SAF

Moderator:

Jean-Sebastien Pard, Senior Manager Facilitation, Passenger Services and Operations, Airports Council International (ACI) World

Speakers:

Michel Chornet, Executive Vice President, Technology and Global Commercialisation, Enerkem

Catherine Guillemart, Head of Public Affairs Canada, Representative for ICAO, Airbus

Robert Peluso, Executive Director - Systems Engineering, Pratt & Whitney Canada

Dale Smith, Regional Director, SAF Producers, Policy, Business Development & Climate Policy, Boeing

OEM AND STARTUP COLLABORATION MODELS

Moderator:

Julian Lucchesi, Director - Development & Strategic Partnerships, Centech

Speakers:

Félix Bélisle Dockrill, CEO & Co-founder, AXYA

Jean-Francois Barrand, Head of Startup Engagement, Airbus Innovation X

Sarah Legendre Bilodeau, Chief Executive Officer, Videns Analytics

Grégoire Michel, Open Innovation Manager, Safran Corporate Ventures

EVTOLS: THE LAST 2 YEARS

Graham Warwick, Managing Editor, Technology, Aviation Week

ADVANCED AIR MOBILITY: VEHICLES, A MANUFACTURER'S PERSPECTIVE

Moderator:

Stella Marissa-Hughes, Air Traffic Services Training Leader, CAE

Speakers:

Brandon Robinson, Co-founder and CEO, Horizon Aircraft

Guillaume Beauchamp, Head of Aircraft Development, Wisk

Didier Papadopoulos, President of Aircraft OEM, Joby Aviation

Blain Newton, Chief Operating Officer, BETA Technologies

AIR CORRIDORS AND THE SOCIAL ACCEPTABILITY CHALLENGES OF AAM

Moderator:

Thomas Bombaert, RPAS Technical Officer, ICAO

Speakers:

Gary Cutts, Challenge Director - Future Flight, UK Research & Innovation (UKRI)

Catherine Roy, Design Centre Québec Leader, Design Centre Network Community Leader, Thales

Ryan Coates, Director RPAS, Transport Canada

Bob Tanner, Executive Director of Aerospace Partnerships, Parallax Advanced Research

CANADIAN MODELS OF COLLABORATIVE INNOVATION: NEW OPPORTUNITIES AHEAD

Ibrahim Yimer, Vice President Transportation & Manufacturing, National Research Council Canada

UNLOCKING THE POTENTIAL: A SUBNATIONAL MODEL OF COLLABORATIVE INNOVATION BETWEEN KANSAS AND QUÉBEC

Moderator:

Jean-François Hould, Québec's Delegate in Chicago, Government of Québec

Speaker:

Laura Kelly, Governor of Kansas

A NASA AERONAUTICS SUSTAINABLE AVIATION OVERVIEW

Jennifer Cole, Deputy Manager for Sustainable Flight National Partnership (SFNP), NASA

EMERGING TECHNOLOGY AND COLLABORATION OPPORTUNITIES IN THE UNITED KINGDOM

Sophie Lane, Chief Relationship Officer, Aerospace Technology Institute

DAY 2 - MAY 22, 2024

OPENING INTRODUCTION

Jarrod Morley, Senior Director of Strategy and Head of Innovation, Aéro Montréal
Janie Mercky, Senior Manager - Public Affairs and Global Communications, CAE

ESPACE AÉRO - THE ROLE OF MUNICIPALITIES IN STIMULATING INCLUSIVE AND COLLABORATIVE INNOVATION

Mélanie Lussier, President, Aéro Montréal
Luc Rabouin, Chairman of the Executive Committee - responsible for finance, economic development and higher education, Borough Mayor, Le Plateau-Mont-Royal
Patrick Charbonneau, Mayor of Mirabel
Julie Ethier, Chief Leader, Economic Development, Longueuil Agglomeration

UNITING FORCES TO DELIVER LONG-TERM VALUE FOR A SUSTAINABLE INDUSTRY

Moderator:
Janie Mercky, Senior Manager - Public Affairs and Global Communications, CAE
Speakers:
Hélène V. Gagnon, Chief Sustainability Officer and Senior Vice President, Stakeholder Engagement, CAE
Valerie Myers, Senior Director - Global Supply Chains & Sustainability, CAE

IFAR PRESENTATION

Moderator:
Jarrod Morley, Senior Director of Strategy and Head of Innovation, Aéro Montréal
Speakers:
Ibrahim Yimer, Vice President Transportation & Manufacturing, National Research Council Canada
Dr. Bjorn Nagel, Founding Director-Institute of System Architectures in Aeronautics, German Aerospace Centre (DLR)
Marc Lesturgie, Director of international affairs, ONERA

ROYAL CANADIAN AIR FORCE 100TH ANNIVERSARY KEYNOTE PRESENTATION

Major General Jamie Speiser-Blanchet, Canadian Armed Forces

ARTIFICIAL INTELLIGENCE: AN ACCELERATOR TO SUSTAINABILITY IN AEROSPACE

Moderator:
Allison Meyssonnier, Senior Advisor, Partnerships, MILA-Québec's Artificial Intelligence Institute
Speakers:
Amine Smires, Chief Executive Officer, CS Group North America
Youssoupha Diop, Managing Director, Sopra Steria Canada
Remi Duquette, Vice-President & Industrial AI, MAYA HTT
Geraldina Iraheta, Chief Commercial Officer, UK Digital Catapult

INNOVATION AND COLLABORATION IN DEFENCE

Moderator:

Louis Brunet, Managing Director - Canada, Collins Aerospace

Speakers:

Inbal Marcovitch, Acting Section Head at the Research and Development Security Science Centre (DRDC), Defence Canada

Ray Townsend, Chief of Operations, Lockheed Martin Canada

Mouhab Meshreki, Director General, National Research Council Canada

Anne-Marie Thibaudeau, Director, Program Capture, Bombardier Defence

TECHNOLOGIES BEHIND A MORE CONNECTED AND SUSTAINABLE AVIATION

Frank Preli, Vice President of Propulsion and Materials Technologies, Pratt & Whitney

Nivine Kallab, Vice President, Customer Programs, Pratt & Whitney Canada

NEXT GENERATION WORKFORCE SERIES: INDUSTRY NEEDS

Moderator:

Dominique Sauvé, Director, Canadian Mobility and Aerospace Institute (CMAI)

Speakers:

Patricia Gilbert, Program Portfolio Manager, Collaboration and Government Programs, and Academic Partnerships, CAE

Marco Beaulieu, Director School Partnerships and Internship Experience, Bombardier

Chantal Boucher, Integrated Product Team Manager, Commercial Programs, Bell

Kathy Malkoske, Chief Financial Officer, Boeing Winnipeg

William Denaire, Senior Director Human Resources, Airbus Canada

NEXT GENERATION MRO

Welcoming remarks:

Damien Pereira, Director, Growth and International Affairs, Aéro Montréal

Gilles Néron, Vice-President, Strategic Procurement, Air Canada

Speakers:

Michaël Kamel, Partner-Value Creation, Industrial Manufacturing Deals Leader Price Waterhouse

Louis-Philippe Mallette, President AJW Technique

Etienne Thibault, Software Engineer, Beslogic

Kevin GS Jo, President & CEO, Augmented Knowledge

David Pollack, Engineering Manager, Rolls-Royce

Michael Ernst, Co-Founder & Sales Director, 3D.Aero

NEXT GENERATION WORKFORCE SERIES: AN ACADEMIC APPROACH

Moderator:

Carole El Ayoubi, Director of Education, CIADI Concordia University

Speakers:

David Rancourt, Professor, Université de Sherbrooke

Annie Ross, Deputy Director for Research, Research and Innovation Directorate, Full Professor, Department of Mechanical Engineering, Polytechnique Montréal

Susan Liscouet-Hanke, Associate Professor, Concordia University

Siva Nadarajah, Professor, AIAA Associate Fellow, Department of Mechanical Engineering and Director, McGill Institute for Aerospace Engineering, McGill University

Julien Lavergne Roberge, Electrical Engineering Master's student, Polytechnique Montréal

Patrick Germain, Director, Aerospace Engineering Department, Ecole de technologie supérieure

CHALLENGES IN MATERIALS: AMBITIONS OF LIGHTER, STRONGER AND MORE SUSTAINABLE

Moderator:

Christian Moreau, Professor, Canada Research Chair Tier 1 Thermal Spray and Surface Engineering, Concordia University

Speakers:

Stéphane Drouin, Vice-President, Investissement Québec
Kahina Oudjehani, Senior Lead-R&T and Sustainable Innovation, Airbus
Ron Harber, President, Aerocycle
Pooja Bajaj, Director Materials Engineering, Collins Aerospace

WINGS OF UNITY - STRENGTHENING INTERNATIONAL COLLABORATIONS IN AEROSPACE

Welcoming remarks:

Damien Pereira, Director, Growth and International Affairs, Aéro Montréal
Thilo Schoenfeld, Deputy Director International Affairs, Aerospace Valley

Introductory remarks - Aerospace Diplomacy

Moderator:

Elisa Valentin, Assistant Deputy Minister, Ministry of International Relations and de la Francophonie

Speakers:

Chloe Adams, British Consul General Montreal, British High Commission
Hyelim Juliana Kim, President Québec-Korea Business Association
John Fleming, Deputy Senior Commercial Officer, U.S. Embassy, Ottawa

Panel on the Americas

Moderator:

Marie-Eve Jean, Vice-President, Export, Investissement Québec International
Mélanie Lussier, President, Aéro Montréal
Nikki Malcolm, CEO & Executive Director, Pacific Northwest Aerospace Alliance (PNAA)-USA
Antonio Velasquez, General Manager, Querétaro Aerospace Cluster-Mexico

Panel on Europe-Middle East-Africa (EMEA)

Moderator:

Erandi Motte Cortes, Senior Director, International Markets, Entrepreneurship and Business Information, Investissement Québec

Speakers:

Andrew Mair, Chief Executive officer, Midlands Aerospace Association-UK
Francine Schulz, Manager Sustainability and International Affairs, Hamburg Aviation-Germany
Petr Tomasek, Chief Executive Officer, Aerospace Cluster of Czech Republic

Panel on Asia Pacific

Moderator:

Thi Be Nguyen, Executive Director, Canada-ASEAN Business Council

Speakers:

Sia Kheng Yok, Chief Executive, Association of Aerospace Industries Singapore
Shamsul Kamar Abu Samah, Chief Executive Officer, National Aerospace Industry Corporation (NAICO)-Malaysia

Arrey Perrez, President and CEO, Clark Int'l Airport Corporation, Philippines

DIGITAL SERIES: QUANTUM SENSING

Moderator:
David Rancourt, Professor, University of Sherbrooke
Speakers:
Vincent Aimez, Vice-President of Partnerships & Knowledge Transfer, DISTRIQ-Quantum Innovation Zone of Québec
Lilian Childress, Lead Scientist, SBQuantum
Jérome Bourassa, Chief Executive Officer, Qubic Technologies
Geraldina Iraheta, Chief Technology Officer, UK Digital Catapult

CAE'S ROAD TO SUSTAINABILITY THROUGH COLLABORATION

Moderator:
Janie Mercky, Senior Manager - Public Affairs and Global Communications, CAE
Speakers :
Hélène V. Gagnon, Chief Sustainability Officer and Senior Vice President, Stakeholder Engagement, CAE
Stella Filippatos, Director, Program Management - Electric Aircraft, CAE

COLLABORATION OPPORTUNITIES IN QUÉBEC AND CANADA

Moderator:
Catherine Beaudry, Professor and Canada Research Chair in the Management and Economics of Innovation
Speakers:
Fassi Kafyeke, Project Manager, Espace Aéro, Québec Aerospace Innovation Zone
Michel Dion, Executive Director, Initiative for Sustainable Aviation Technology™ (INSAT)
Guillaume Coté, President and CEO, Consortium for Research and Innovation in Aerospace in Québec (CRIAQ)

CLOSING SPEECH FOR THE 9th EDITION OF THE IAIF 2024

Mélanie Lussier, President, Aéro Montréal

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