CRIAQ

Stimulate collaborative innovation in Aerospace

Presented by:

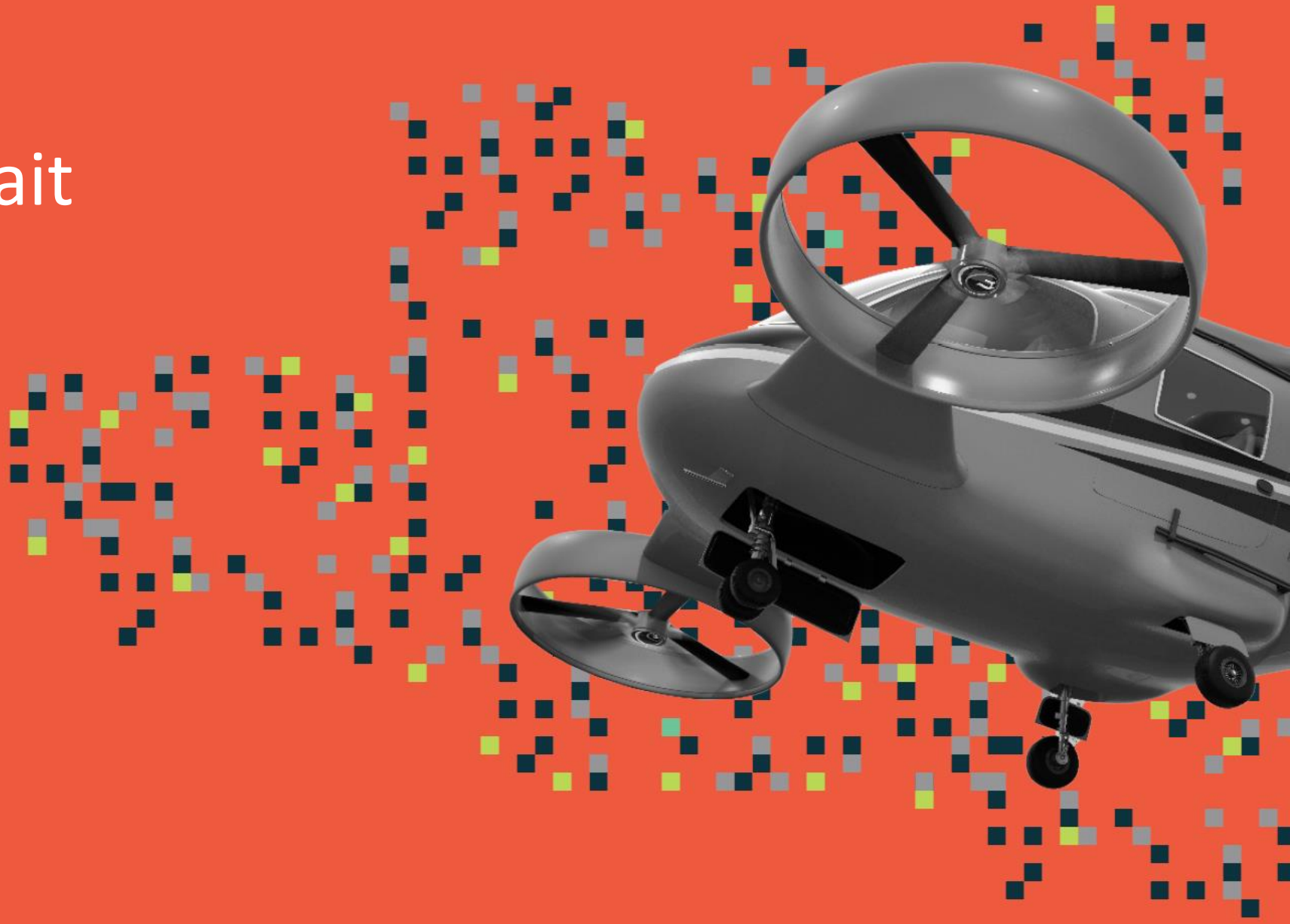
Alain Aubertin, CEO

Financial partner:

Québec

CRIAQ

Industry portrait



CRIAQ

Quebec's aerospace industry a global innovation hub

17,8 G$ — Sales by the Quebec industry

1.4 G$ — Investment in R&D; almost a quarter of total R&D in the manufacturing industry in Canada.

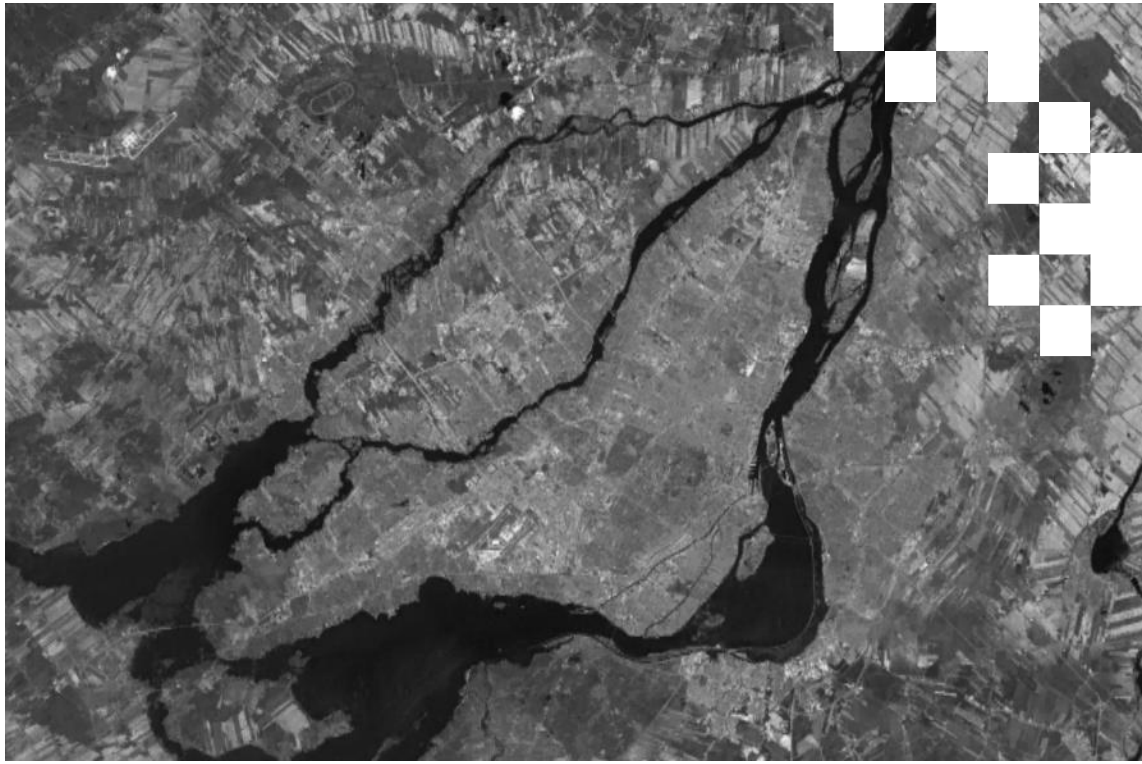
80 % — of Quebec's aerospace production is exported outside Canada

4 500 — New graduates each year

+20 — Leading contractors and tier 1 companies in the territory

+70 % — of Canadian aerospace R&D is done in the Greater Montreal area

43 400 — Direct and indirect employment



Sources: 2019 data from AIAC, ISED, Aéro-Montréal

CRIAQ

Canada's aerospace legacy continues

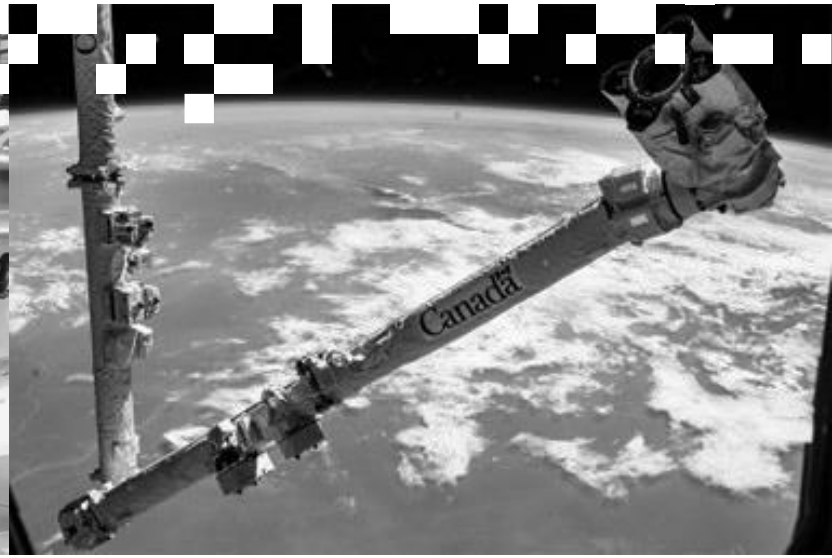
31 G$ Annual revenues

1.4 G$ Investment in R&D

+ 700 Companies contribute $31 billion

160 000 Direct and indirect employment

70 % Share of manufacturing in industry activities (GDP)



Sources: 2019 AIAC data, ISED

CRIAQ

Quebec: a connected hub with various assets for the mobility of tomorrow

AEROSPACE MANUFACTURERS

5 major contractors
Strong presence of Tier 1
High concentration of SMEs

- Aircraft integration technologies
- Rotorcraft technologies
- Engine technologies
- Modelling and simulation platforms
- Space technologies
- Landing Gear
- Avionics
- Advanced Manufacturing
- Complex Composites

UNIQUE ACADEMIC AND RESEARCH INSTITUTIONS

World-renowned universities

National Research Council of Canada

Canadian Space Agency

VERY ATTRACTIVE LIVING ENVIRONMENT

Pool of talent and genius

Quality of research in science and engineering

SKILLED LABOUR

50,000 engineers, including 9,000 in aerospace, the highest concentration of skilled technicians

INTERNATIONAL AVIATION ORGANISATIONS

ICAO , IATA, ACI…

FINANCING

MEI, IQI, FTQ, Caisse depot et placement, NSERC, Fond amorcage and many others

STRONG SUPPORT FROM GOVERNMENTS

in aerospace and several innovative sectors

FORCES IN KEY SECTORS

AI, medical technologies, electrification and many others

CRIAQ

Aerospace and aviation: at the crossroads

Crisis situation

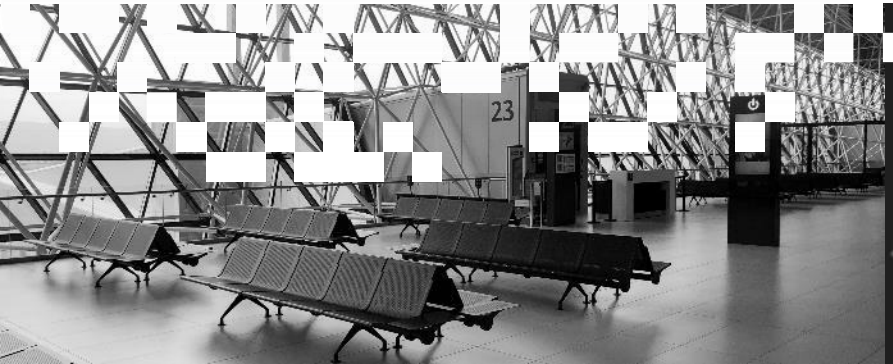
- Unprecedented health crisis
- Economic and public finance crisis
  - -80% decrease in air traffic compared to 2019

Transitions to be accelerated

- Energy transition
- Digital transformation
- Growing interdependencies between society and technology
- Cross-domain competences and skills
- Complexity of training, research and innovation management
- Talents

CRIAQ's strengths and ambitions

- Accelerating the decarbonization of air transport
- Customer-centric future air mobility
- Renewing the aerospace world in the digital age



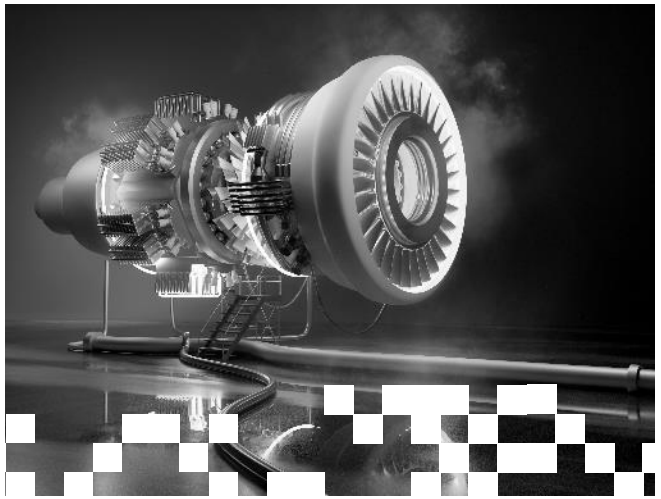
CRIAQ

Introduction

CRIAQ

Purpose

CRIAQ, a creator of wealth in Quebec through sustainable air mobility.



A sustainable, green, agile and bold aerospace industry

Air mobility for the benefit of humanity

An egalitarian and diverse society

CRIAQ: a sectoral grouping for industrial aerospace research

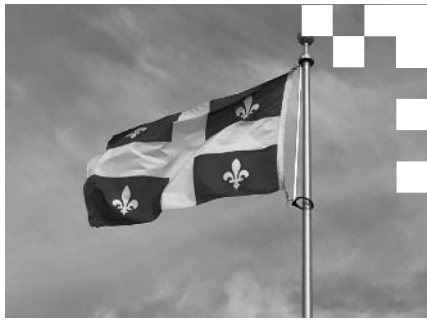
In the service of:

- Transportation of passengers and goods
- Satellite telecommunications and Earth observation networks

Our areas of expertise:

- Aviation, Aeronautics and Space
- Vehicles and platforms
- Key technologies
- Navigation and operational framework

A strategic vision to meet the challenges of the sector



1 Strengthen Quebec's technological leadership in cutting-edge aerospace applications - sustainable aerospace, future air mobility and digital aviation;

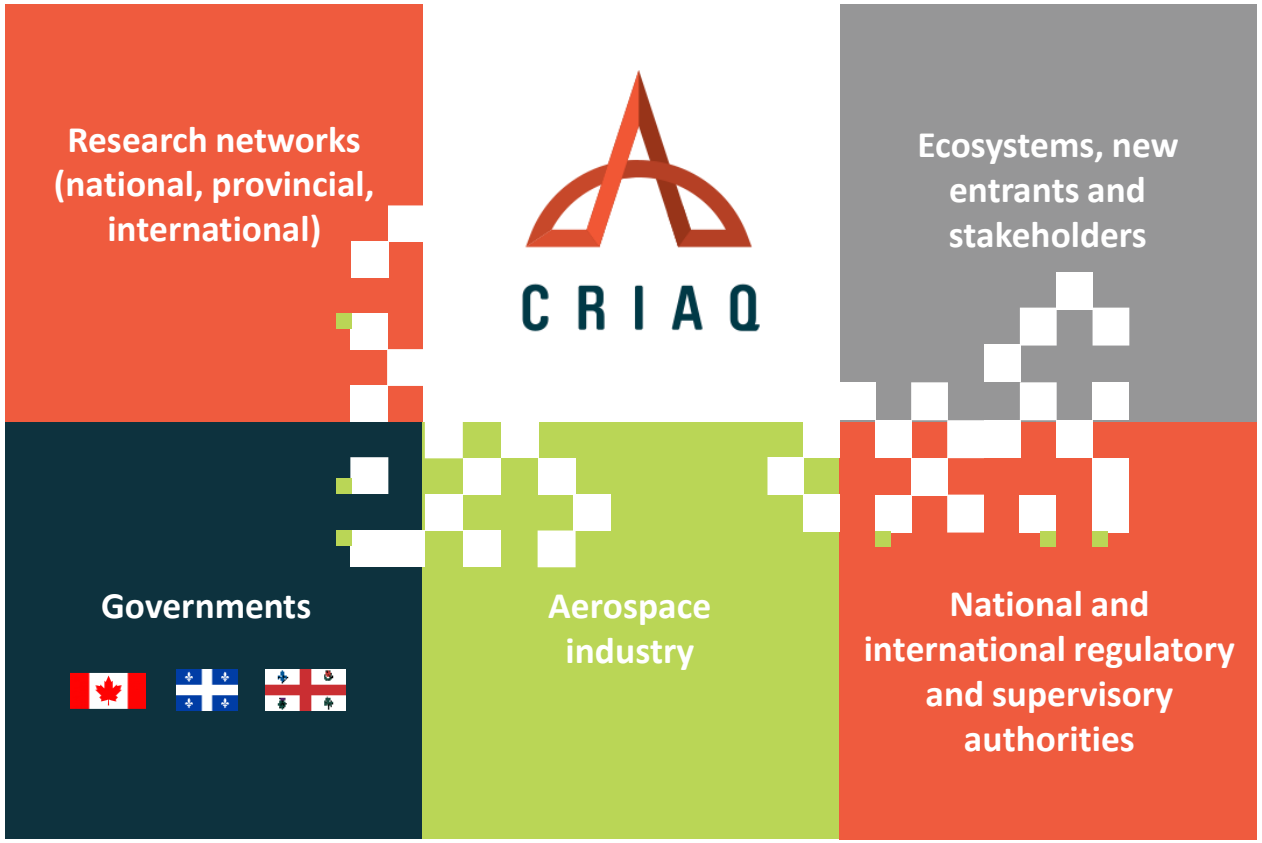
2 Support the co-evolution of the aerospace research and innovation ecosystem with other innovative ecosystems;

3 Stimulate diversity, creativity, talent development and the emergence of entrepreneurs and innovators

Leading the evolution of the research and innovation ecosystem

CRIAQ **finances the development** and **facilitates the valorisation of innovations** created by local and international universities, CCTTs and public research centres

CRIAQ's action **stimulates public and private investment** in research and innovation



Digital, energy, electric, automotive, financial, cities and territories

CRIAQ participates in **identifying technological advances** and steps towards certification for safe and secure air mobility

CRIAQ **fosters the creation of impacts** on talent, intellectual property and the economic performance of businesses and Quebec

CRIAQ

20 years of impact* through innovation and R&D for the Quebec ecosystem

Projects

+180
Completed and ongoing projects

+270 M$
Total value of projects completed and in progress

15 M$
In estimated value for projects under development

A network of companies and academics mobilised

+115
Member companies

+85%
Of the member companies are SMEs or start-ups

+30
Member universities and research centres

+1,900
academics, researchers and industrial specialists involved in projects

Tangible impacts

+200
patents/licences filed

+40**
Solutions, processes implemented, and technologies commercialised

+1,700
Students involved in projects

* The data presented is since the creation of CRIAQ

**Data from 1 April 2015 to 31 March 2020

CRIAQ

Technologies and talent development

Success stories from high impact projects

Additive Manufacturing Technologies for aerospace components
Projects from CRIAQ 2.8 MANU-601 and MANU-604

Industrial leader: Bell Flight

Opportunities :
Develop a better understanding and strengthen expertise in metal additive manufacturing, through academic and industrial research.

Means implemented by CRIAQ:
Funded by CRIAQ-MEI's Exploring Innovation program

Benefits for Bell Flight, and Quebec :

- **Increased knowledge of metal additive manufacturing, which was relatively new to the industry in 2013,**
- **Development of a network of experts and collaborators between principal aerospace actors, universities and research centres such as CRIQ;**
- **Development of a supplier relationship, for example with Fusia Inc. which printed a titanium part that was approved, installed and delivered on the Canadian Coast Guard's Bell 429 helicopters,**
- **Development of technologies at Mirabel, in Bell Flight's factories and with Quebec partners, which could be major developments in the design, construction and use of future vertical take-off vehicles, whether helicopters, air taxis or drones, and thus reduce the environmental footprint**

Technologies and the emergence of new businesses

Success stories from high impact projects

Development of magnetorheological fluid actuators
CRIAQ Project ENV-404

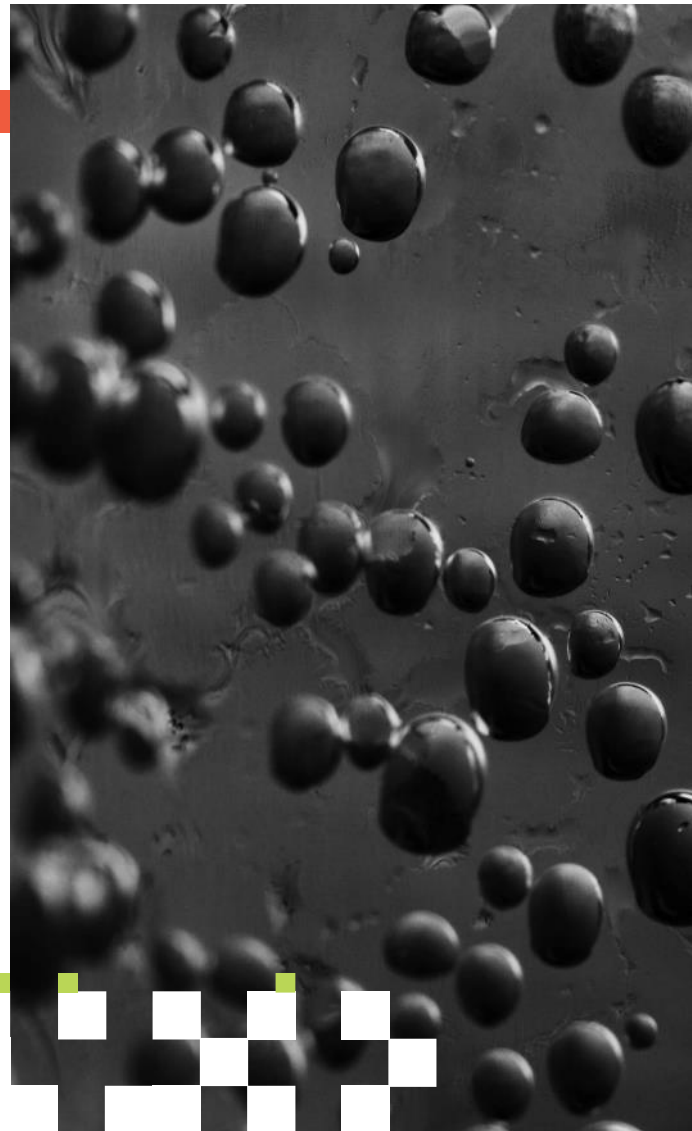
Industrial leader: Bell Flight

Opportunities:
This technology, based on magnetorheological fluids, offers lighter and faster actuation than conventional technologies, while meeting the reliability required for the aerospace sector.

Means implemented by CRIAQ:
Funding from the CRIAQ-MEI Exploring Innovation program

Benefits for Bell Flight and Quebec :

- Emergence of a new generation of magnetorheological fluid actuators
- **Creation of Exonetik** in 2013, a spin-off from the University of Sherbrooke
- **30 employees** (more than 50% with MSc, MBA or PhD)
- **More than 25 patents/inventions**
- **2.5M investment** in the Sherbrooke area for a plant/development centre
- **Long-term Bell-Exonetik partnership**
- Exonetik is now pursuing the development of collaborative robots with the objective of going into production in 2022.
- **9 developments underway** with international leaders in the aeronautics, automotive, medical and robotics sectors



Technologies and the emergence of new businesses

Success stories from high impact projects

Development of a helicopter drone
CRIAQ Project AUT-703

Industrial leader: Laflamme Aéro (PME)

Opportunities :
Laflamme Aéro's LX300 is one of the largest unmanned helicopter-type drones weighing 300 kg, and offering a flight autonomy of up to eight hours.

Means implemented by the CRIAQ:
"Small demonstrators" measure of the Quebec aerospace strategy

Benefits for Laflamme Aero and Quebec:

- Established a partnership with 3 other SMEs and 2 universities
- Creation of 8 jobs
- Development of several technologies and patents
- Positioning of a service offer in the autonomous systems sector
- Obtained $1 million in funding from General Dynamics to develop a variant for maritime and military applications. Investment made under the RIT Policy.
- New investment for aerospace R&D: this funding resulted in a 2nd CRIAQ project approved in winter 2020 (UASMaSu)

Technologies and the emergence of new businesses

Success stories from high impact projects

Pilot training: customising training to optimise it

Opportunities :
Define the state of stress of pilots and adapt the training process for the new generation of pilots.

Means used:
Funding by the CRIAQ-MEI Exploring Innovation program

- **Deepening of knowledge** on human cognitive/affective states through the use of biometric data,
- Ultimately, adapting a student's training to their specific needs in order to maximise the benefits of the training,
- An innovative framework will be developed to bring advanced biometric measurement technologies and algorithms,
- This framework can be easily extended to other complex and critical field applications such as medical and military mission training.

Our services

Development of ecosystems and technological sectors

DEEL – DEpendable & Explainable Learning

AéronumérIQ – Écosystème d'Innovation

AI and Digital Systems

SAGE – Phase 3

AERO21

Sustainable Aerospace

Transport Canada

RPAS TASK FORCE

Mobility of the Future

Intermediation, mobilisation, network animation and visibility of members

RDV/forum

RDV/network online

RDV/AGM

RDV/digital

Management of research partnerships and funding

EXP

MAT

PARTENAR·IA

FINANCEMENT DE PROJETS DE R-D COLLABORATIVE EN IA

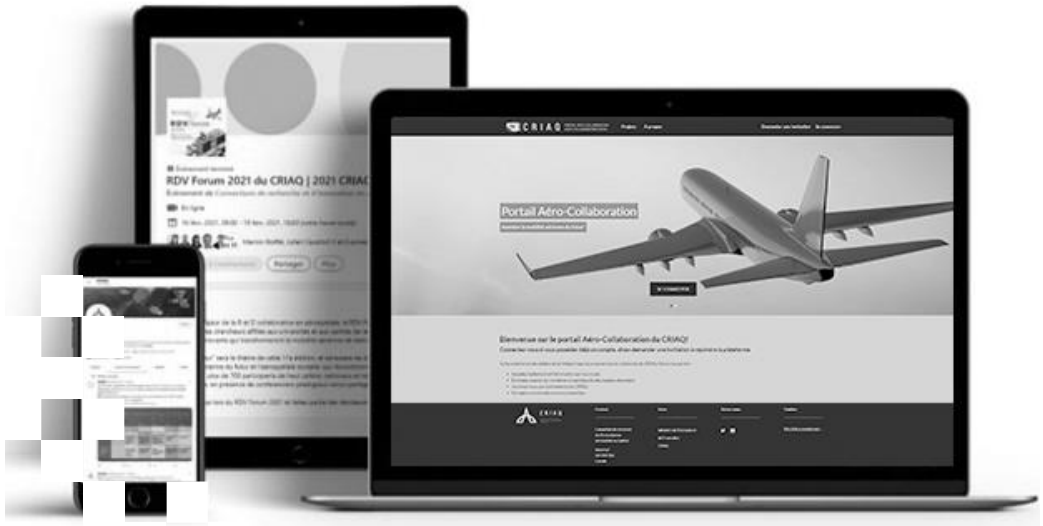
Monitoring and intelligence, tools, practice guides

PAC

CRIAQ

PORTAIL AÉRO-COLLABORATION

AERO-COLLABORATION PORTAL



Talent development, accelerator and support

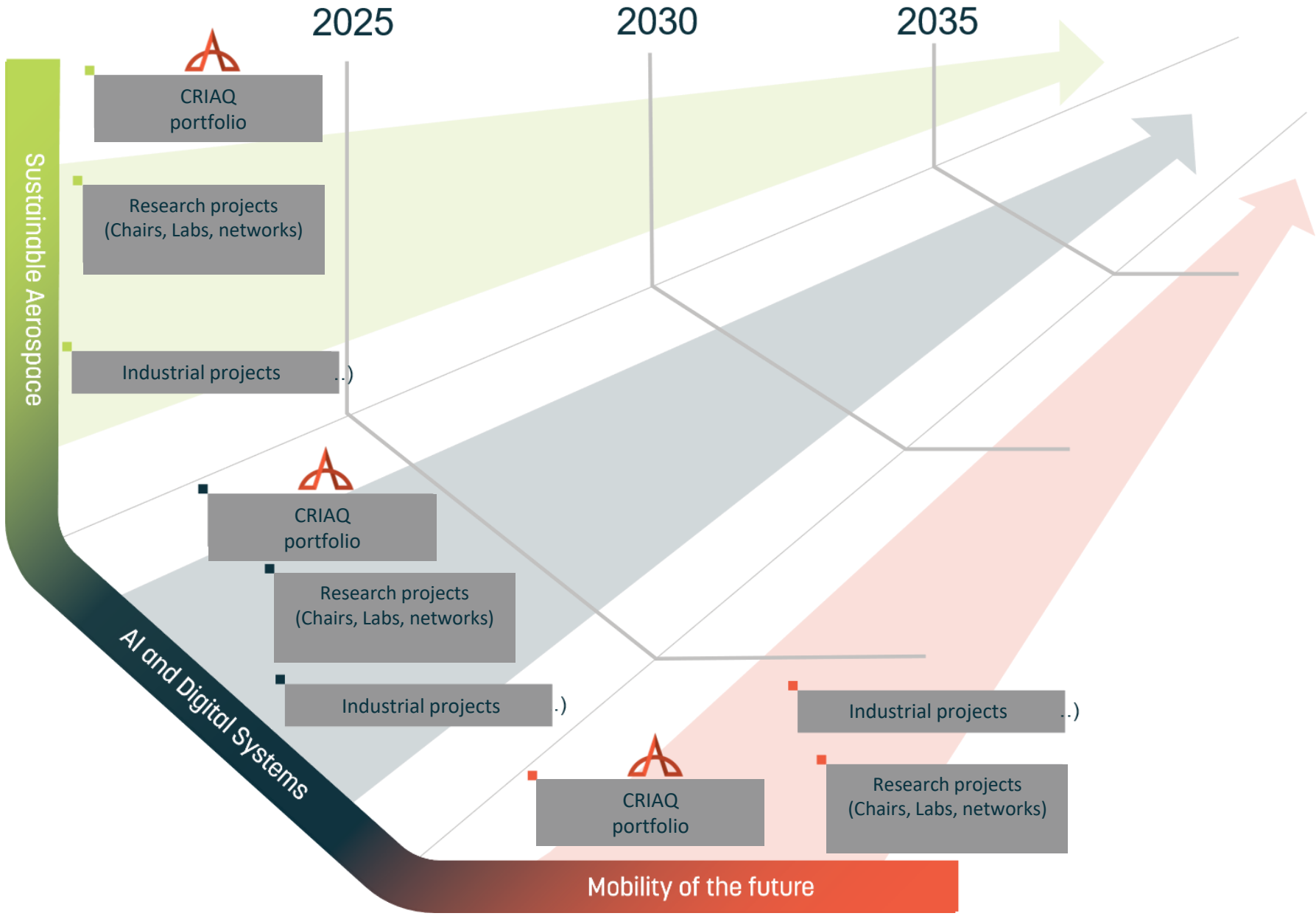
STR

ACC

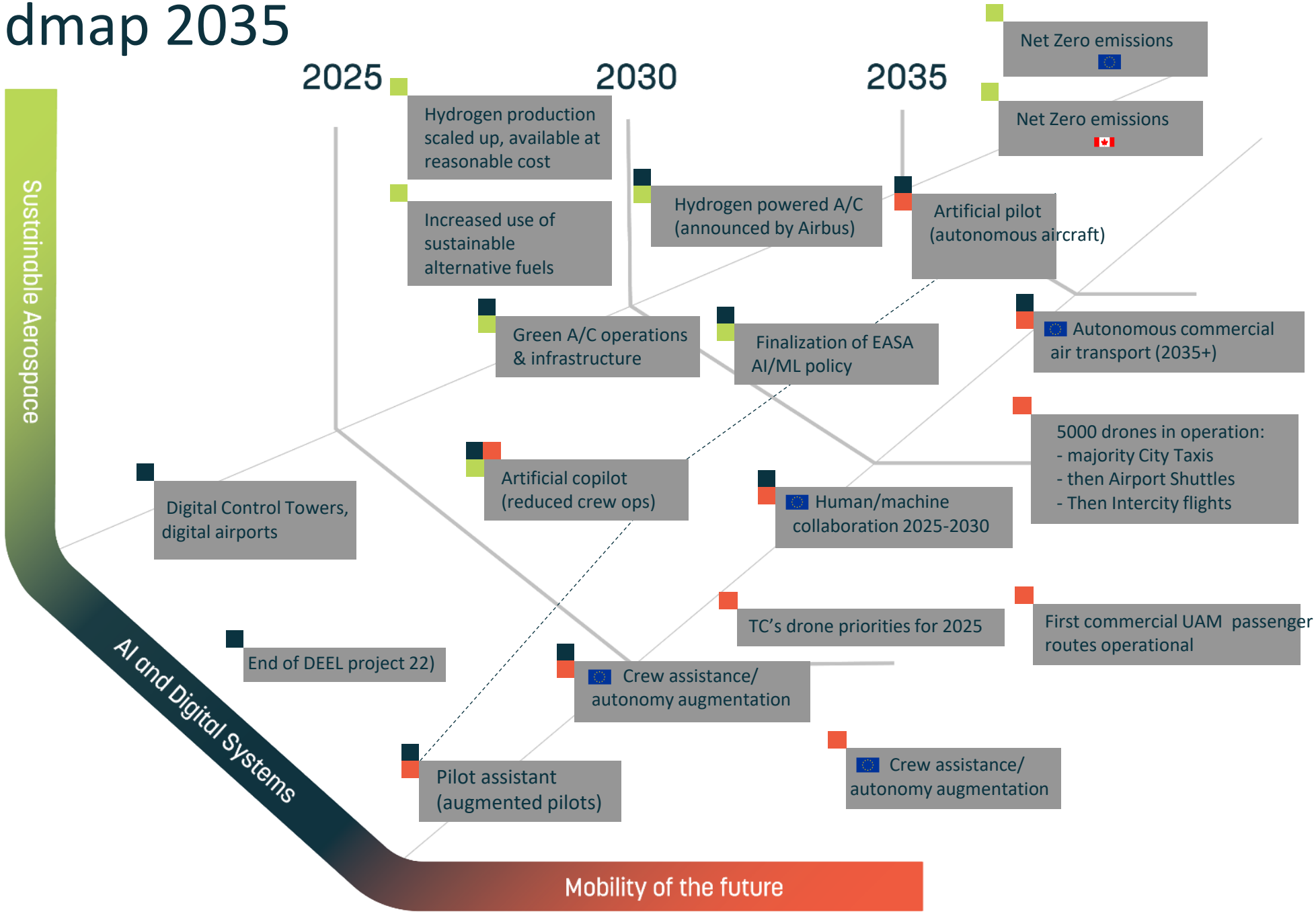
FEM

CRIAQ

Roadmap


2025
2030
2035
CRIAQ portfolio
Research projects (Chairs, Labs, networks)
Industrial projects ..)
CRIAQ portfolio
Research projects (Chairs, Labs, networks)
Industrial projects ..)
Industrial projects ..)
CRIAQ portfolio
Research projects (Chairs, Labs, networks)
Sustainable Aerospace
AI and Digital Systems
Mobility of the future

Roadmap 2035



Research and innovation is a collective and social act

CRIAQ has practices, processes, work tools, and a portfolio of projects that are

evolving on all types of innovation

For 20 years, CRIAQ has been a network of social and professional interactions advancing science, technology, products and services – that

support the mobility of people and goods

CRIAQ is your research and innovation network, a network of exchange and creativity for specialists, students, professors, entrepreneurs,

a network of collaboration to face the future

CRIAQ

THANK YOU

Follow us on
Twitter @CRIAQ_aero and LinkedIn

criaq.aero

CRIAQ

Innovation continuum

TRL 1
Observing the basic principle

TRL 2
Technological concepts

TRL 3
Analytical and experimental proof of concept

TRL 4
Verification of the technology in the laboratory

TRL 5
Verification of the technology in a representative environment

TRL 6
Demonstration of technology in representative environment

TRL 7
Demonstration of the technology in an operational environment

TRL 8
Real system developed

TRL 9
Real system demonstrated

MARCHÉ

APPLIED RESEARCH

DEMONSTRATIONS

CRIAQ

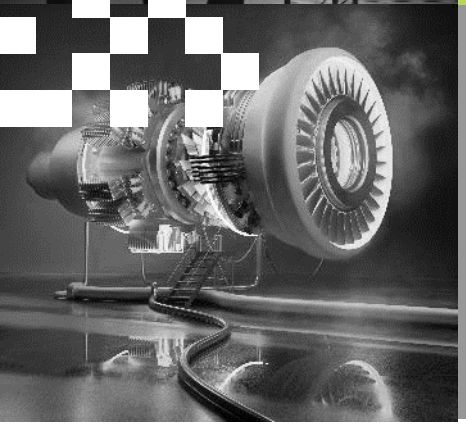
Project research topics

ENERGY EFFICIENCY AND HYBRID PROPULSION

DRONES AND AUTONOMOUS VEHICLES

ARTIFICIAL INTELLIGENCE AND DATA EXPLOITATION

MANUFACTURING, TESTING AND MAINTENANCE

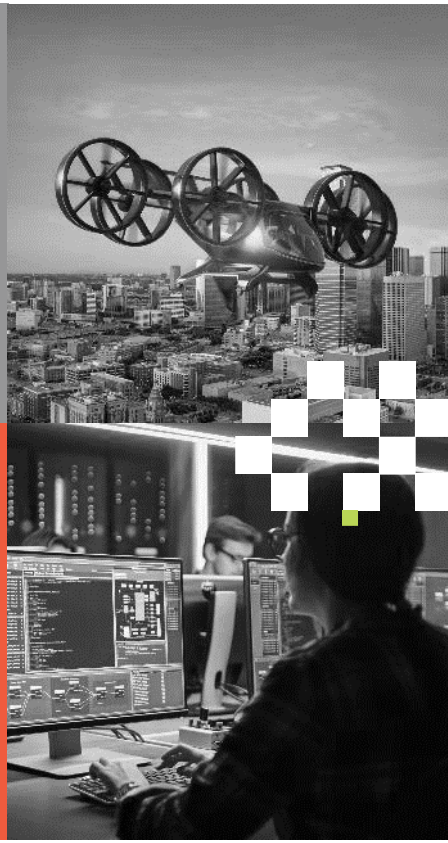


ADVANCED MATERIALS AND STRUCTURES

INTELLIGENT EMBEDDED TECHNOLOGIES

CIVIL AVIATION SERVICES AND FLIGHT OPERATIONS

DESIGN, SIMULATION AND VIRTUAL ENVIRONMENT



Services - Research partnership management and funding

Our project funding programs

Exploring Innovation

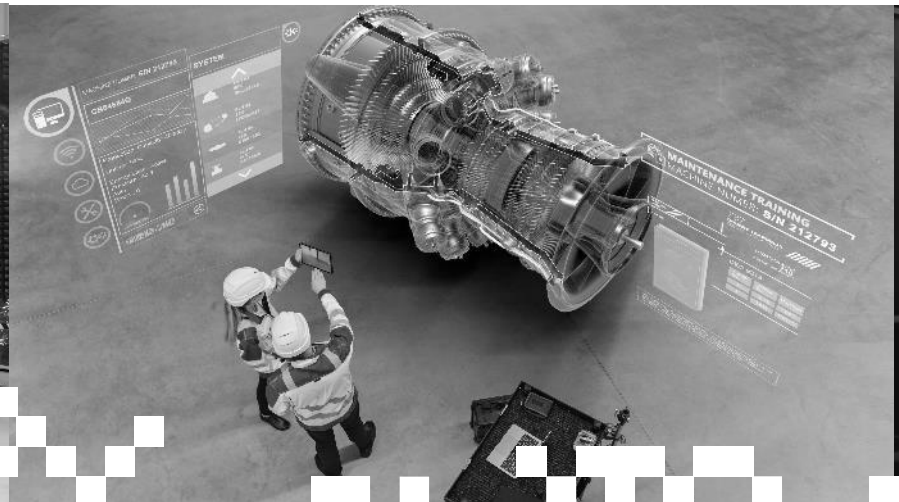
Starting in TRL 2 or 3

- **Exploring Innovation Quebec**
- **Exploring Innovation International**
  - Projects led and delivered by : Academics/Research Organizations
  - On need identified by : OEMS, SMES,...
  - Recipients of funding: Universities

Maturating Innovation

End of project TRL 6 or 7

- **Maturing Innovation Quebec**
- **Maturing Innovation International**
  - Projects led and delivered by : SMES
  - On need identified by: OEM, SME,...
  - Recipients of funding: SMEs and universities



Services - Research partnership management and funding

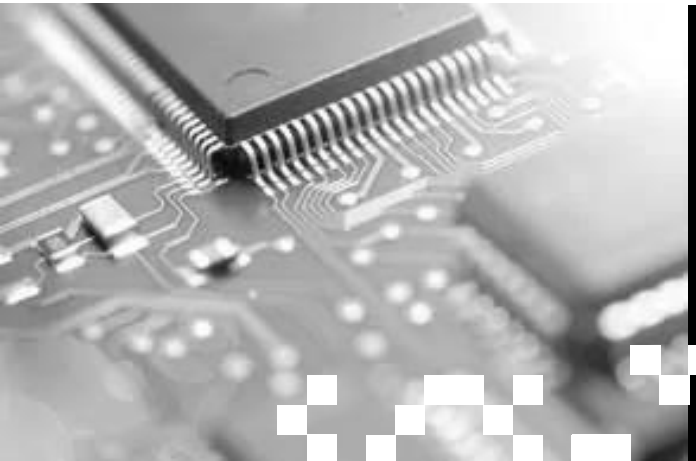
Our project funding programs

PARTENAR·IA ACADEMIC

- Applied research projects proposed and supervised by industry and conducted by researchers.
- Grant recipients: Academic lead from Quebec

PARTENAR·IA ENTERPRISE

- Consortia of companies that have collaborative research projects in artificial intelligence involving SMEs or startups, in collaboration with a public research centre.
- Recipients of the grant: SME project leader



Services - Talent Development, Accelerators and Support

Our support programs for SMEs and start-ups

Accelerating Innovation

In partnership with NRC-IRAP

Providing SMEs with an R&D strategy

- Helping aerospace SMEs address the operational, commercial, financial and competitive technology challenges they face nationally and globally.
- Flexible and tailored coaching services

CRIAQ Start-up Grant

Supporting the technological development of start-ups

- Targeted at Quebec-based start-ups active in the aerospace sector
- 2 grants of $10,000 awarded each year

Services - Talent Development, Accelerators and Support

Our programs to support the next generation

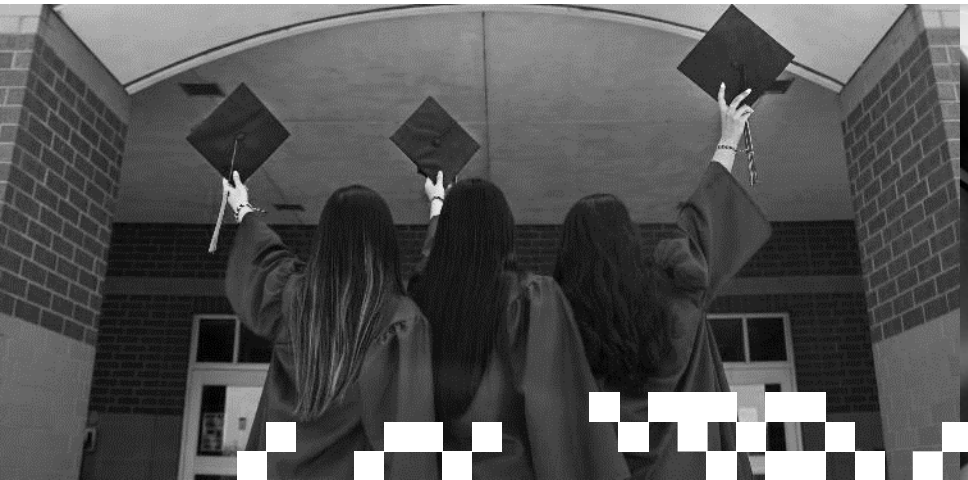
Women in Aerospace Scholarship Program

- **3 scholarships totalling $10,000**
  - Two $1,500 scholarships to attract female undergraduate students
  - One $7,000 scholarship to encourage a female master's student
- For female students in engineering programs and any other field related to aerospace and sustainable air mobility of the future, offered by universities located in Québec.

Next Gen Innovation

Sponsorship Program

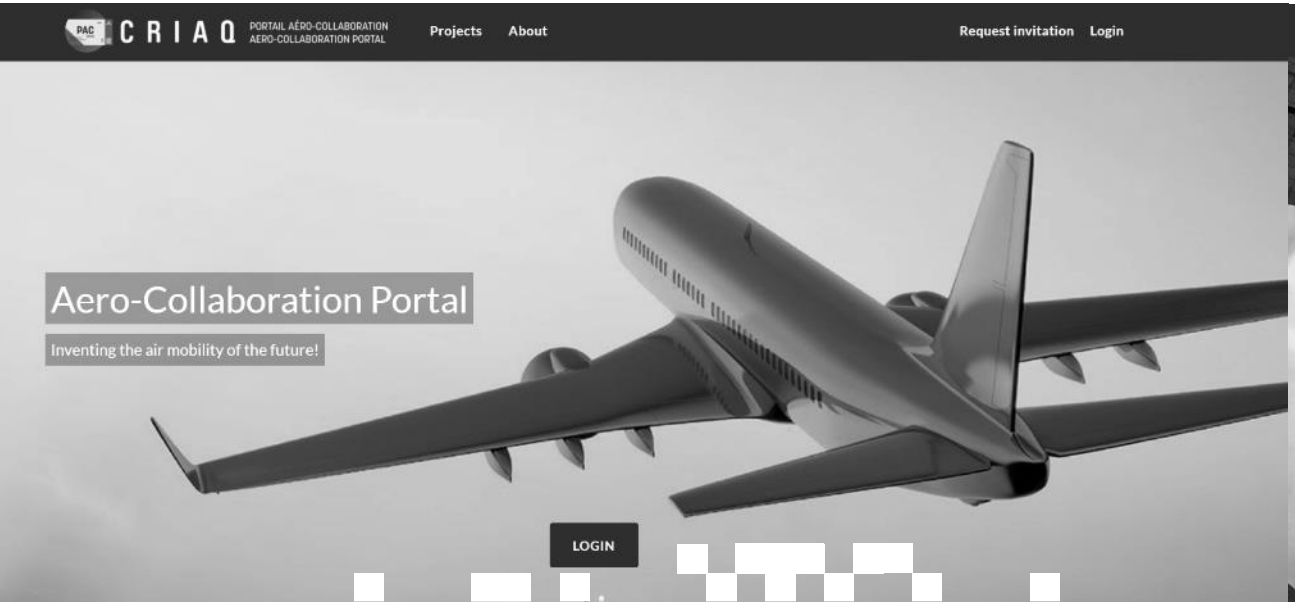
- To financially support students who develop prototypes to participate in student competitions directly related to aerospace

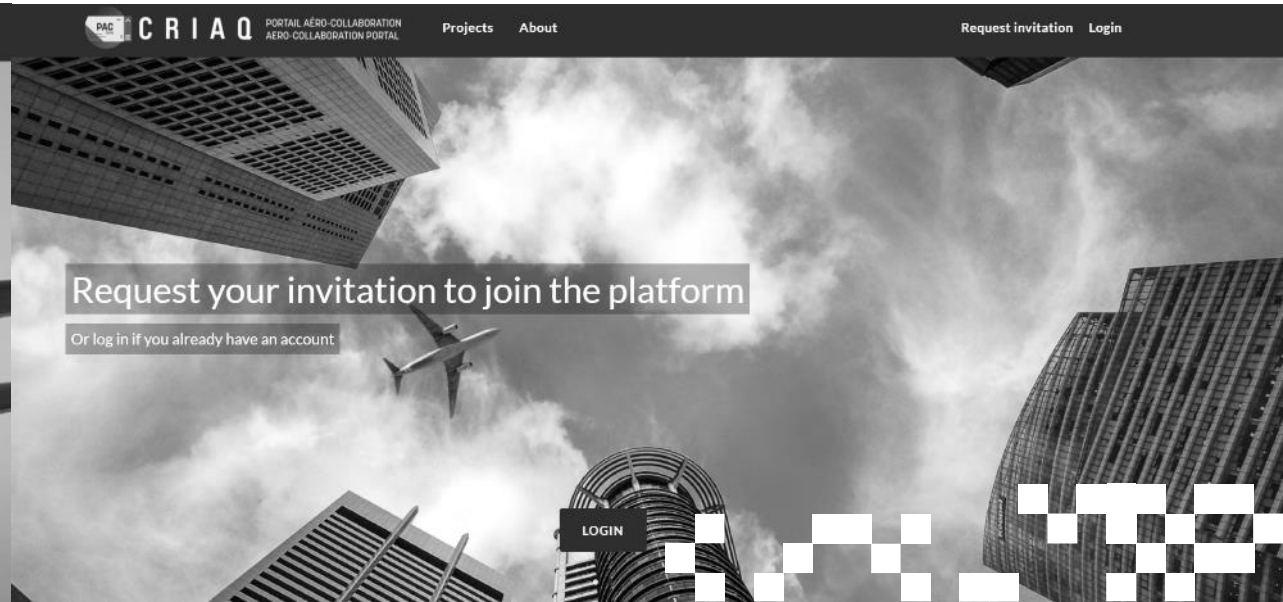


Services - Intelligence, tools, practical guides

Aerocollaboration, CRIAQ's platform for collaborative innovation in future air mobility

- Free
- Reserved for CRIAQ members
- Access to all research programs
- Access to information on CRIAQ projects
- Exchange with project team members and participants
- Register to CRIAQ events





Mobilising the aerospace industry

RDV/forum

- The **leading event** for collaborative aerospace innovation
- Held every 2 years (odd years)
- Between 300 and 1,200 participants at each event
- Between 20 and 70 **project ideas** submitted at each event
- Participants from all over the world

RDV/réseau

RDV/réseau en ligne

- **4 events per year**, face-to-face or virtual
- Between 20 and 60 participants at each event
- Presentations of new members and expertise
- **Opportunities to network** with all CRIAQ member representatives

RDV/numérique

- Video clips on **industry trends and challenges**
- High calibre speakers
- Opportunities to discover and become known **within the CRIAQ network**

CRIAQ

Mobilising the aerospace industry

CRIAQ

AI and Digital Systems

Sustainable Aerospace

Mobility of the Future

DEEL — DEpendable & Explainable Learning

AéronumérIQ — Écosystème d'Innovation

SAGE — Phase 3

AERO21

Transport Canada

RPAS TASK FORCE

Partnership agreements:

IATA

IRT SAINT EXUPÉRY

IVADO

Hydrogène Québec

OPTONIQUE

ACI AIRPORTS COUNCIL INTERNATIONAL

SAAB TECHNOLOGIES

SAAB

And many more.