Interested in taking part in a GARDN project? Contact us!
project@gardn.org
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MESSAGE FROM THE CHAIRMAN OF THE BOARD

It is estimated that over the next twenty years, the global aircraft fleet will grow by 58% and require nearly 37,000 new aircraft in order to keep up with demand. As air travel continues to grow around the world, the aerospace industry is committed to developing technologies that reduce the environmental footprint of air transport. This is GARDN’s raison d’être, and over the last year we have made good progress towards the creation of green aerospace technologies.

GARDN I brought new firsts to green aviation, and the launch of GARDN II has elevated our work to new levels. The new projects selected for GARDN II in 2015, in addition to seven other projects already started, promise continued technological advances in the years ahead.

The launch of GARDN II demonstrates the importance of our work to the future of the aerospace industry. It also demonstrates the positive impact that close collaboration between industry, the research community, and government can have on environmental progress and achievement in aerospace.

On behalf of GARDN’s Board of Directors, I wish to thank the companies, research centres, universities, and colleges who make up our membership for their joint commitment to ensuring that aerospace continues to make advances in sustainable technologies. I would also like to thank the federal government and the Business-Led Networks of Centres of Excellence program for their support and contributions to this important work.

This report highlights our successes and achievements over the past year. I look forward to working with all of you to building on that success in the months and years to come.

Sincerely,

JIM QUICK
CHAIRMAN OF GARDN’S BOARD OF DIRECTORS

PRESIDENT AND CEO OF THE AEROSPACE INDUSTRIES ASSOCIATION OF CANADA (AIAC)
Once again, you helped us make aviation cleaner, quieter and more sustainable.

This was a start-up year for the seven projects from the first round of GARDN II, amongst the most promising projects in Canada. This year also saw a number of workshops designed to hatch new project ideas for the second round of GARDN II. Over 350 Canadians across the nation participated in one of these four workshops organized jointly with the Consortium for Aerospace Research and Innovation in Canada (CARIC). The new projects presented in the following pages were developed with the significant assistance of members from our community, including SMEs.

Finally, the 3rd GARDN Conference, organized with the Canadian Aeronautics and Space Institute (CASI), AERO 2015, was held from May 19 to 21, 2015. At the conference, we presented the results of many GARDN I projects. In total, 350 participants gathered together for aerospace R&D.

Your support and expertise promote the aerospace environmental industry and provide outstanding collaboration on GARDN projects. I cannot thank and congratulate you nearly enough for your involvement in the community!

Looking forward to having you on the team!
GARDN’s COLLABORATIVE APPROACH

Example of the first round of GARDN II

The world’s growing need for aerospace R&D

$4.6T IN SIZE ORDER OVER THE NEXT 20 YEARS

This growth in global needs involves Canada: it provides almost 80% of its aerospace production for export to highly diversified markets and product segments.

Project ideas presented at events gathering the industry

16 project ideas at the four workshops conducted in partnership with the Consortium for Aerospace Research and Innovation in Canada (CARIC) in Toronto, Montreal, Winnipeg and Vancouver.

OVER 350 MEMBERS AND PARTICIPANTS

Projects reviewed by GARDN’s Scientific Committee

12 LETTERS OF INTENT FOR PROJECTS

GARDN projects with a TRL (Technology Readiness Level) of 3 to 6 uniting aerospace players

15 UNIVERSITIES, COLLEGES AND RESEARCH CENTRES

12 SMEs

2 AIRLINES

4 OEMs

A shared financing

50% GARDN

50% INDUSTRY

$20M in direct investment in R&D

Ecological impact: some benefits from GARDN I (2009-2014)

- First commercial flight powered by biofuel in Canada
- First civilian jet in the world powered by 100% pure biofuel
- A technological advancement that could lead to a 25% to 40% decline in fuel consumption and CO₂ emissions for regional and business aircraft

Keep an eye out for even greater benefits from GARDN II, projected for 2019!

THE ORGANIZATION BEHIND GREEN AVIATION

The Green Aviation Research & Development Network (GARDN) aims to promote the development of green technologies for the Canadian aerospace industry. GARDN is funded by the Business-Led Networks of Centres of Excellence program (BL-NCE) and the Canadian aerospace industry.

Any organization in GARDN is involved in the following:
- Increasing in the capacity of research and development and public-private partnerships
- The competitiveness and differentiation of this major Canadian sector
- The promotion of Canadian expertise in reducing aviation’s environmental impact

GARDN makes a major contribution to complementary, R&D projects for an aviation more...

3RD GARDN CONFERENCE

The 3rd GARDN Conference, AERO 2015, organized jointly with CASI, was held from May 19 to 21, 2015. With more than 350 players from the industry, the event was an opportunity to present the results of many GARDN I projects. Finally, the 4th GARDN Recognition Award was presented to Benny Pang, from Bombardier Aerospace, who contributed greatly to the creation, development and growth of the organization.

The discussion panel on GARDN’s research themes. From left to right: Sylvain Cofsky from GARDN, Alain Aubertin from CARIC, James Corrigan from Bell Helicopter Textron Canada, Richard Ullyot from Pratt & Whitney Canada, and Benny Pang from Bombardier Aerospace.
OVERVIEW OF GARDN II PROJECTS
The second GARDN program took flight in 2014 to bring green aerospace innovation even further. In addition to the launch of seven projects, a few months after the kick-off of GARDN II, six new collaborative R&D projects will be added to the organization’s portfolio.

NEXT GENERATION COMBUSTOR FOR SMALL GAS TURBINE ENGINES

**Objectives**
Evolve current low emissions technology developed for large turbofan engines to the next generation turboprops by a new combustor system.

This new combustion system is an enabler for greenhouse gas reduction on the engine and has the potential to deliver significant reductions of NOx and particulate matter while improving component life.

**PWC-23**
Term: 5 years

**A PROJECT FROM**
Pratt & Whitney

**PARTNERS**
PAVAC Industries Inc.
Queens University

**HYDROFORMED CROSS TUBES FOR HELICOPTER SKID TYPE LANDING GEAR**

**Objectives**
Reduce weight and assembly costs through an enhanced methodology for hydroforming aerospace tubular products.

The developed technology will enable the manufacturing of high strength, corrosion resistant and environmental-friendly landing gear components and provide superior quality products at lower life-cycle costs values.

**BHTC-21**
Term: 2 years

**A PROJECT FROM**
Bell Helicopter

**PARTNERS**
Canada NRC-CCAC
Université Laval

**EXPERIMENTAL VALIDATION OF INNOVATIVE ENVIRONMENTALLY FOCUSED AIRCRAFT CONFIGURATIONS**

**Objectives**
A continuation of prior work, the GARDN II project involves the development of a novel aircraft concept which is designed to satisfy various performance and stability and control (S&C) requirements.

This aircraft concept will then be tested in a wind tunnel test campaign to validate the S&C characteristics. Various alternative designs will be tested in addition to the baseline configuration.

**BA-21**
Term: 4 years

**A PROJECT FROM**
Bombardier

**PARTNERS**
Canada NRC-CCAC
University of Toronto
FLIGHT MANAGEMENT PERFORMANCE OPTIMIZATION II

Objectives
Optimize the vertical and horizontal path of the aircraft within the flight management system by taking into account the required time of arrival, the wind grids and meteorological conditions.

The main motivation of the project is to reduce overall carbon emissions and flight costs.

GREENING THE AEROSPACE SUPPLY CHAIN

Objectives
Define a supply chain management framework to provide industrials with the capacity to prioritize eco-responsible purchasing actions, define technologies’ green specifications and efficiently treat environmental information.

The acquired knowledge will offer a collaboration model fully adapted to the Canadian aerospace sector, facilitating ecodesign across the supply chain.

NOISE REDUCTION FOR NEXT GENERATION REGIONAL TURBOPROP

Objectives
Leverage new technologies, develop new design methodology, and mature concepts in support of a low-noise large regional turboprop aircraft meeting stringent noise requirements.

The technology advancement to TRL6 of noise reduction concepts is a must for the development of a new large environmentally-friendly turboprop aircraft.
<table>
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<th>Project Code</th>
<th>Project Title</th>
<th>Term</th>
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<td>BA-22</td>
<td>AIRFRAME NOISE REDUCTION FOR BUSINESS AND COMMERCIAL AIRCRAFT</td>
<td>4 years</td>
<td>Reduce noise impact of aircraft operations in the vicinity of airports by leveraging new technologies, developing new design methodology and maturing concepts in support of a low-noise business and commercial aircraft. The project will lay groundwork to help reducing the adverse effects of the expected large increase in aircraft traffic volumes in Canada and elsewhere in the next decades.</td>
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<td>NU-21</td>
<td>ENERGY EFFICIENT AIRCRAFT CONFIGURATIONS AND CONCEPTS OF OPERATION</td>
<td>2 years</td>
<td>Investigate novel air vehicle configurations, advanced propulsion systems, and noise reduction techniques to enable cleaner and quieter UAV operations and air transportation. The research will include an analysis of hybrid propulsion systems, lightweight and flexible wings and unique energy harvesting methods on the flexible wing structures.</td>
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<td>SRS-21</td>
<td>TURBOPROP FLIGHT ADVISORY SYSTEM (FAS) FOR CRUISE FUEL BURN REDUCTION</td>
<td>2 years</td>
<td>Reducing the fuel burn and corresponding CO₂ emissions of small commercial turboprop aircraft (19 or less seats) during the cruise flight phase using a software application installed on stand-alone Electronic Flight Bag (EFB) device. The main motivation for developing an EFB-based solution stems from the need to achieve an average improvement in fuel efficiency of 1.5% per year per industry target.</td>
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<td>LTA-21</td>
<td>INTEGRATED ELECTRIC PROPULSION SYSTEMS FOR AIRCRAFT</td>
<td>3 years</td>
<td>Ensure that constituent technology components for an aerospace-grade Integrated Electric Propulsion System (IEPS) are commercially available, operationally viable, meet Certification Authority requirements, and are through-life supportable in a cost effective way. This project will give involved business entities a jump on a key emerging branch of aerospace technical capability.</td>
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# ADDITIVE MANUFACTURING FOR LANDING GEAR

**Objectives**

Validate the performance of additive manufacturing (AM) process for aerospace non-structural parts and the use of standard post-manufacturing processes required, and evaluate the certification of aerospace parts produced by AM.

At the end of the project, the performance of parts made by AM will be compared to certifiable machined parts used as reference.

**Objectives**

Advance the development and production of biojet fuels in Canada from sustainable biomass feedstocks.

The project will assess the potential of producing biojet from Canada’s considerable forest residue resources, using the experience of Canada’s established forest products sector and the growing pellet sector.

**Objectives**

Demonstrate the operational feasibility of biojet fuels in the domestic jet fuel supply system, catalyze the development of the domestic biojet sector by using HEFA biojet, validate CND biojet supply chain elements, and generate hands-on experience with biojet handling and integration to develop best practices in a Canadian context.
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- Bombardier
- Pratt & Whitney Canada
- Air Canada
- WestJet
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- Héroux Devtek
- amrikart Ultraprecision
- Burloak Technologies
- Group AGEKO
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- LTA Aerostructures
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- Nebula Unmanned Aerial Systems
- Noram
- PAVAC Industries Inc.
- SRS
- SkyNRG
- Waterfall Group