



Economic footprint of the A220 program in Québec and Canada

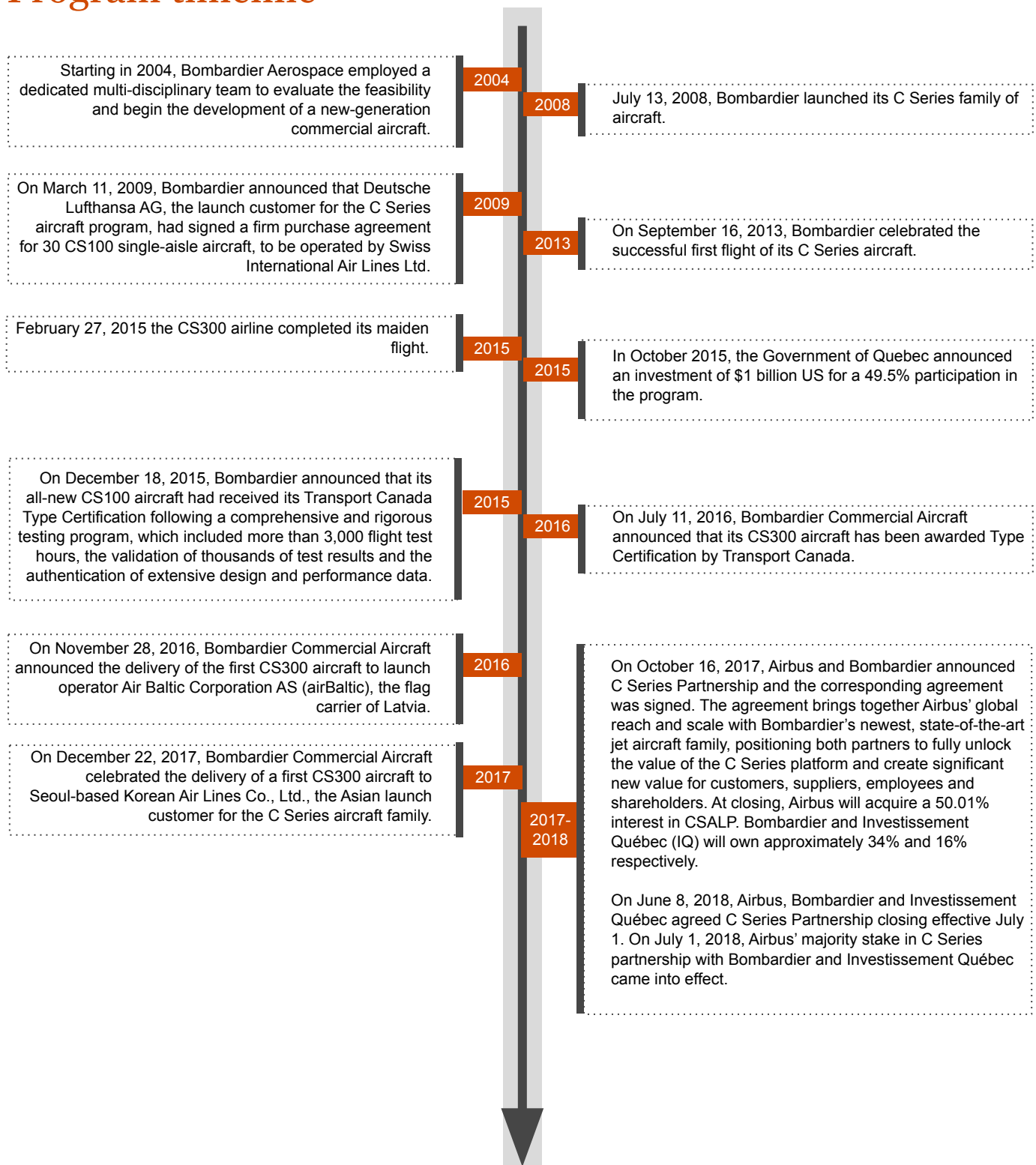
About the program

The Airbus A220 program (originally called the C Series) started in July 2004 when Bombardier launched a feasibility study for a 5-seat abreast aircraft. Bombardier's goal was to fill the gap left between OEMs moving to larger aircraft and regional jets. There was no aircraft specifically designed for the 100-150 seat segment with lower operating costs and environmental footprint. The C Series program included 2 aircraft: a smaller version (C100) with 110-115 seats and a larger (C130) with 130-135 seats.

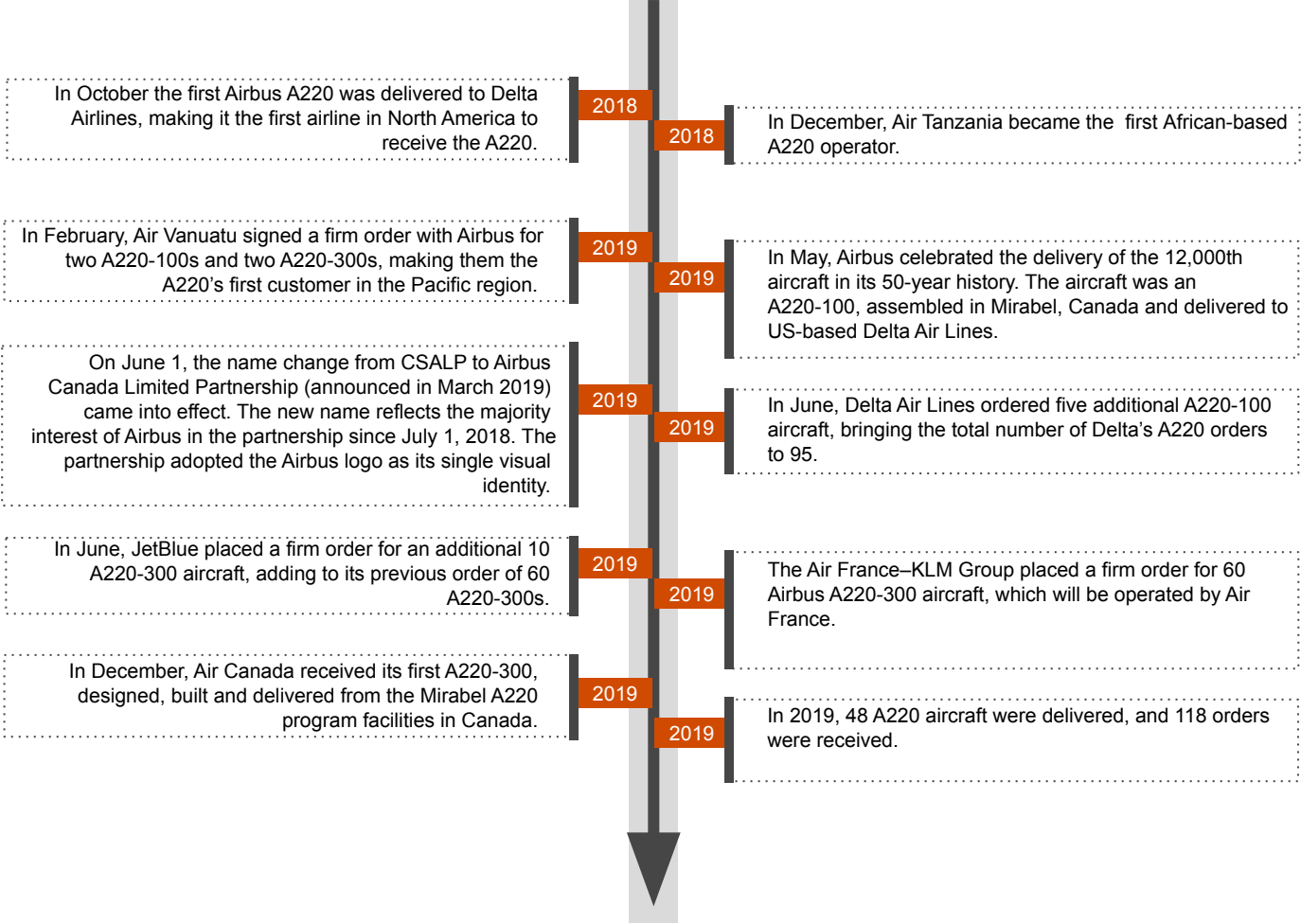
Total investment in the program up to July 2018 was \$7.5 billion US, of which \$1 billion US was invested by the Quebec government. Further economic impact will be created through manufacturing in Mirabel Quebec, currently committed until 2041.

Today, the program employs over 2,700 people at its main site in Mirabel. In addition to its economic impacts, the C Series program provided significant wider benefits by reinforcing technological know-how for the aerospace ecosystem in Quebec, helping to establish it as an aerospace global powerhouse.

Program timeline



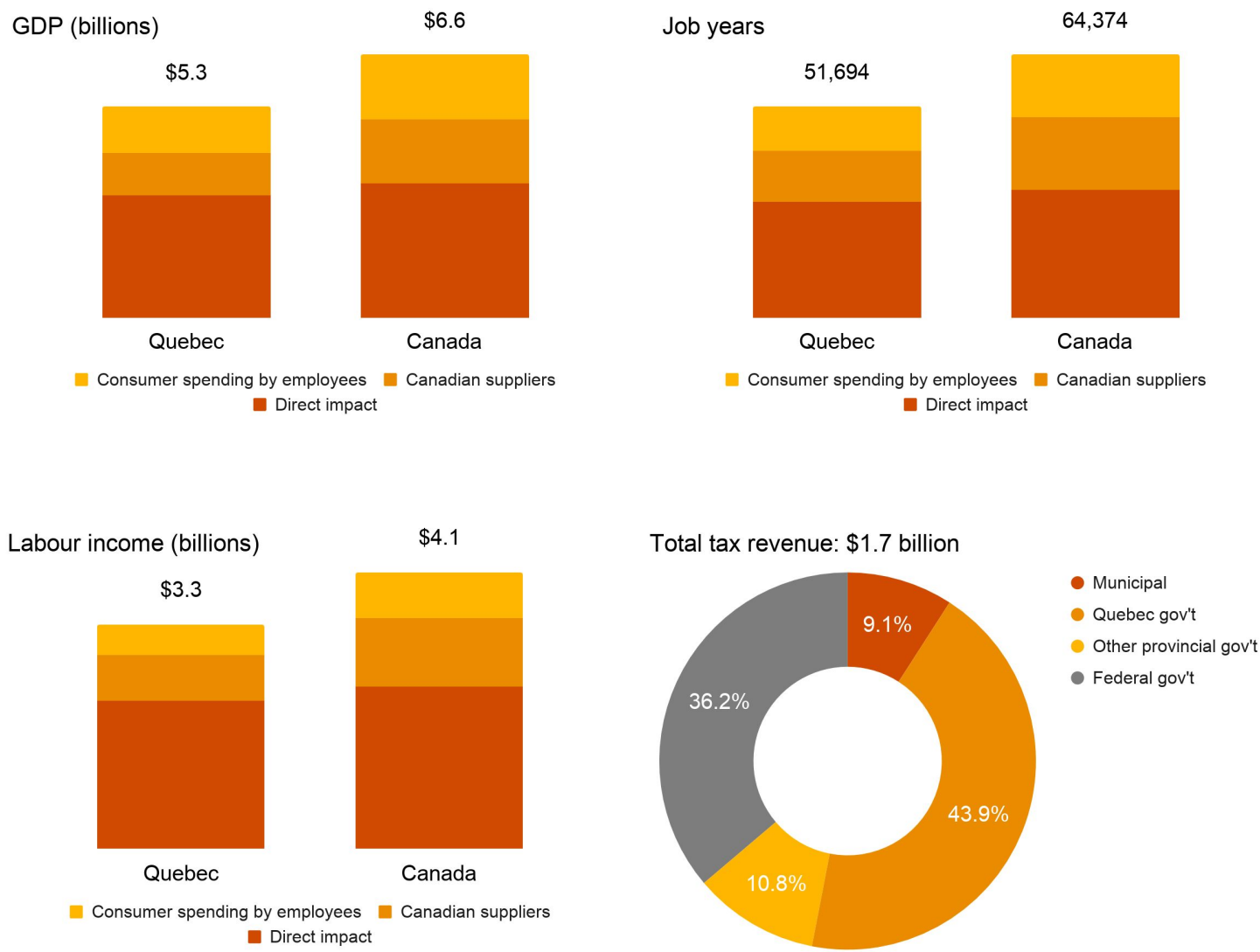
Program timeline (continued)



Economic footprint of program development

We estimate that the development of the A220 program created a cumulative economic footprint¹ in Canada of \$6.6 billion² in GDP, 64,374 job years (e.g. 6,437 jobs lasting ten years), and \$4.1 billion in labour income, as shown below. The large majority of this footprint occurred in Quebec. Total taxes collected in relation to the program were \$1.7 billion, of which \$0.7 billion went to the Quebec government and \$0.6 billion went to the federal government.

Economic footprint over program development ³

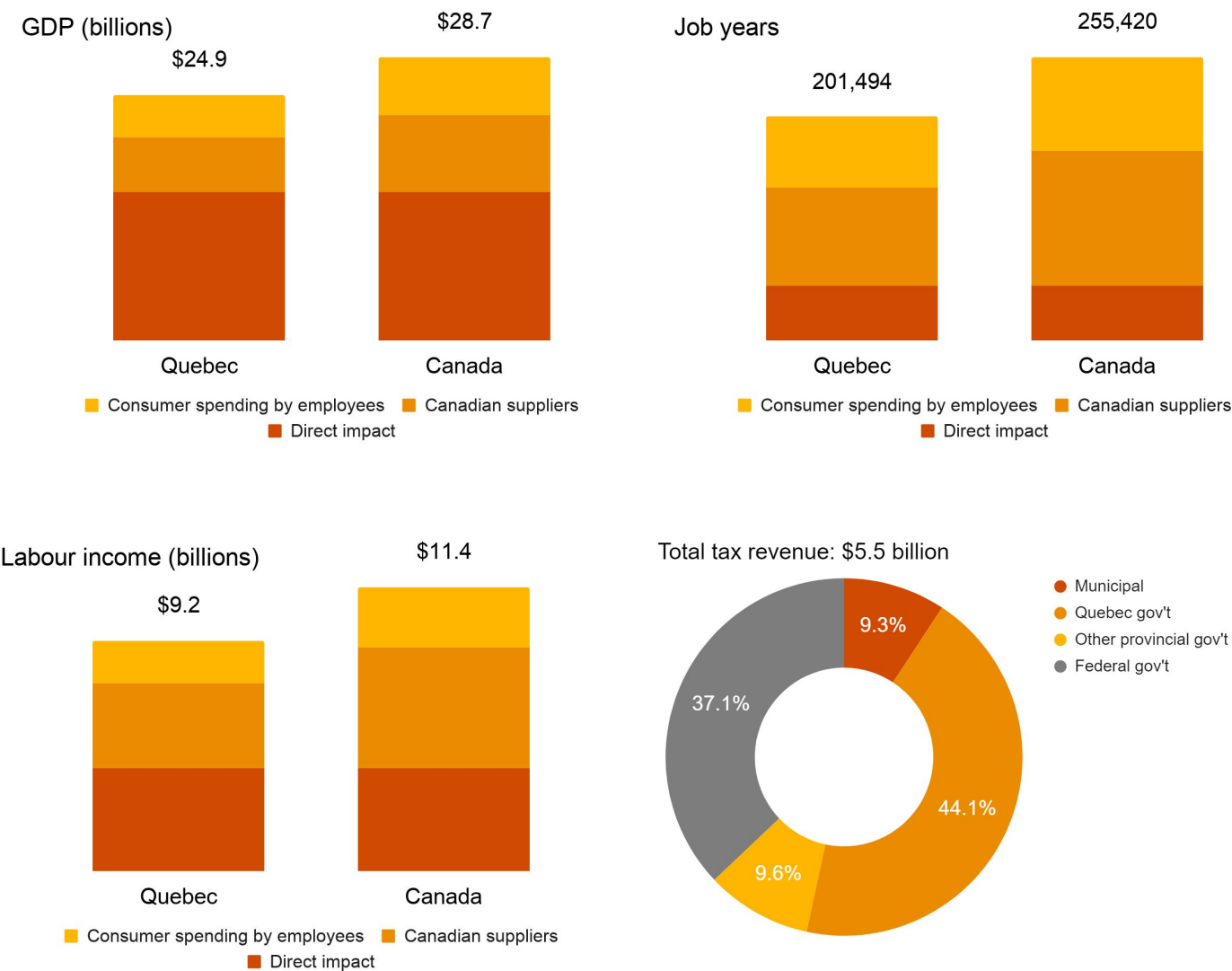


The A220 program has been a significant contributor to Bombardier's R&D investment in aerospace, which has positioned Bombardier as the #1 corporate R&D investor in Canada. R&D provides economic value by driving productivity enhancement and creating and sustaining high value-added jobs.

Economic footprint of ongoing operations

The majority of A220 aircraft are manufactured at a plant in Mirabel, Quebec, whose economic footprint will continue to grow with production levels expected to more than double in the coming years. The total economic contribution of projected aircraft manufacturing in Canada is estimated at \$28.7 billion in GDP, 255,420 job years (i.e. an average of 15,964 jobs over 17 years), and \$11.4 billion in labour income, as shown below. The large majority of this footprint would occur in Quebec. Total taxes to be collected in relation to the ongoing operations would be \$5.5 billion, of which \$2.4 billion will be collected by the Quebec government, \$2.0 billion by the federal government.

Total economic footprint ⁴



The large majority of A220 aircraft are exports, contributing to aircraft being the largest export from Quebec, and the fourth-largest in Canada in 2018. A strong export base sustains diversified economic activity in Canada.

The A220 program contributes to Quebec's status as a global aerospace powerhouse



The A220 program has contributed to Quebec's increase in competitiveness within the global aerospace sector. From 2015 to 2019, Canada's aerospace sector, which is concentrated in Quebec, went from the 6th place to the 2nd place in the PwC global Aerospace Manufacturing Attractiveness Rankings.⁵ In 2017, Quebec was ranked as the top foreign direct investment destination for Aerospace in North America.⁶ One factor underlying this increase in aerospace competitiveness was the development of the A220 program, which in recent years represented a significant share of aerospace investment in Quebec. The following represent key areas in which the A220 contributed to Quebec's current position in aerospace.



Technological leadership

New technologies developed as part of the A220 advanced the state of technology in aerospace:

- Pratt & Whitney geared turbofan engines especially designed for the A220 to reduce emissions, noise and fuel burn;
- Advanced structural materials contributing to +2,000 pound weight savings: advanced aluminium-lithium for fuselage and advanced composite for wing, center wing box, empennage, rear fuselage and nacelle;
- Advanced flight deck, fly-by-wire flight control system and integrated avionics;
- Electro-mechanically controlled brakes;
- Ground testing facility - Complete Integrated Aircraft System Test Area;
- Advanced interior configuration delivering a widebody feel in a single-aisle aircraft, with unmatched passenger comfort and widest seats in class.

These advances are already benefiting the aerospace industry in Quebec.



Environmental leadership

The A220 program set new standards in environmental performance:

- 20% less GHG emissions per seat (up to 120,000 tons of CO₂ emissions per aircraft)
- 50% less NOx emissions
- A220-100 and A220-300 estimated to be ~75% recyclable
- Suppliers encouraged to be ISO 14.001 certified⁷
- Manufacturing plants following LEED standards⁸
- The quietest commercial jet in its class⁹

Both A220-100 and A220-300 have received Environmental Product Declarations as a result of environmental life-cycle assessments, the first and only aircraft in the world to earn this certification.



Human capital

The A220 investment has helped a whole generation in Quebec and Canada to develop new skills in science, engineering and technical jobs. Indeed, over 300 interns have been trained through the A220 program since 2015. Namely, Bombardier has led significant cooperation with academia since 2008, including (but not limited to):

- Consortium for Research and Innovation in Aerospace in Quebec (CRIAQ)
 - Bombardier sponsored +60 CRIAQ projects between 2008-2015, 15 of which studied composite materials
 - +700 students trained on Bombardier-sponsored projects between 2008-2015.
- SA2GE Phase 1 – 2009-2015
 - Projects on composite aircraft fuselage and integrated modular avionics
 - 130 students implicated in different projects of Phase 1 from Bombardier and others
- GARDN Phase 1 2009-2015
 - Projects on environmental impact evaluation methodology and database of aeronautical products and on landing gear noise diagnostics and production
 - +100 students involved in projects from Bombardier and others
 - +270 industrial and academic researchers from Bombardier and others

Appendix A: Data sources and approach

Data sources

Data on program development spending was provided by Bombardier and Airbus Canada LP (“Airbus”). PwC allocated the spending to industry categories based on descriptions provided by Airbus Canada.

Data on operational spending at the Mirabel plant in 2018 and 2019 was provided by Bombardier and Airbus.

For years 2020 to 2024, we used forecasts based on the five year plan (2020-2024) approved by the Board of Directors of Airbus Canada LP, as well as direct employment forecasts provided by Airbus for the same period. For the period 2025 to 2034, we used forecasts based on growth assumptions provided by Airbus. No information was provided for the period 2035 to 2041 and consequently this period is excluded from our economic footprint analysis.

Input output analysis

To estimate the economic footprint of the A220 program, we have applied Statistics Canada’s input-output multipliers to data provided by Bombardier and Airbus.

The fundamental philosophy behind economic impact analysis is that spending on goods and services has attendant impacts throughout the economy. For instance, production of A220-100 and A220-300 will generate demand for the inputs to this process (such as tools and labour) that in turn generates additional demand that extends beyond the initial spending. Our analysis permits the estimation of this cascading effect by using the input-output model of the Canadian economy.

The input-output model used for the purpose of this report estimates the relationship between economic activity for a given good or service and the resulting impacts throughout the economy (including demand for other goods and services and tax revenues). For the purpose of this report, economic impacts were estimated for the following measures of economic activity:

- **GDP (also known as value added)** – the value added to the economy, or the output valued at basic prices less intermediate consumption¹⁰ valued at purchasers’ prices. GDP includes only final goods to avoid double counting of products sold during a certain accounting period.
- **Employment** – the number of jobs created or supported.
- **Labour income** – the amount earned by the employment expected to be generated.
- **Government revenue** – the amount of revenue collected by provincial, municipal and federal governments. It includes personal and corporate income taxes, as well as taxes on products and production.

Economic impacts are typically estimated at the direct, indirect, and induced levels:

- Direct impacts are those that result directly from the company’s expenditures on labour and capital as well as gross operating profits.
- Indirect impacts arise from the activities of the firms providing inputs to the company’s suppliers (in other words, the suppliers of its suppliers).
- Induced impacts are the result of consumer spending by employees of the businesses stimulated by direct and indirect expenditures.

In applying the input-output analysis we made the following key assumptions:

- Spending breakdown associated with the A220 program is similar to that in the industry as a whole (aerospace product and parts manufacturing).
- Employment levels from 2025 to 2034 will follow changes in revenue similarly to the way it did between 2019 and 2024.
- Labour income for direct employees will remain constant in real (2019) terms over the forecast period.
- No aftermarket activity will take place in Canada.

Appendix B: Limitations

Limitations

Data limitations: PwC has relied on the information provided by Bombardier and Airbus regarding the allocations of operating and capital expenses of A-220 operations in Canada. PwC has relied upon the completeness, accuracy, and fair presentation of all information and data obtained from Bombardier and Airbus and the various sources set out in our report, which were not audited or otherwise verified. The findings in this report are conditional upon such completeness, accuracy, and fair presentation, which have not been verified independently by PwC. Accordingly, we provide no opinion, attestation or other form of assurance with respect to the results of this study.

Where the information or data provided is not sufficient to conduct the analysis that has been requested, we have made assumptions, as noted throughout the report.

Receipt of new data or facts: PwC reserves the right at its discretion to withdraw or revise this report should we receive additional data or be made aware of facts existing at the date of the report that were not known to us when we prepared this report. The findings are as of February 2020 and PwC is under no obligation to advise any person of any change or matter brought to its attention after such date, which would affect our findings.

Input-output analysis: Input-output analysis does not address whether the inputs have been used in the most productive manner or whether the use of these inputs in this industry promotes economic growth by more than their use in another industry or economic activity. Nor does input-output analysis evaluate whether these inputs might be employed elsewhere in the economy if they were not employed in this industry at the time of the analysis. Input-output analysis calculates the direct, indirect and induced economic impacts that can reasonably be expected to affect the economy based on historical relationships within the economy. This analysis does not take into account fundamental shifts in the relationships within the economy that may have taken place since the last estimation of multipliers by Statistics Canada, nor shifts that may take place in the future.

Use limitations: This report has been prepared solely for the use and benefit of, and pursuant to a client relationship exclusively with Bombardier. We understand that Bombardier may share our report with third parties. Bombardier can release this report to third parties only in its entirety and any commentary or interpretation in relation to this report that Bombardier and Airbus intend to release to the public either requires PwC's written consent or has to be clearly identified as Bombardier's own interpretation of the report or Bombardier is required to add a link to the full deliverable. PwC accepts no duty of care, obligation or liability, if any, suffered by Bombardier or any third party as a result of an interpretation made by Bombardier of this report.

Further, no other person or entity shall place any reliance upon the accuracy or completeness of the statements made herein. In no event shall PwC have any liability for damages, costs or losses suffered by reason of any reliance upon the contents of this report by any person other than Bombardier.

This report and related analysis must be considered as a whole: Selecting only portions of the analysis or the factors considered by us, without considering all factors and analysis together, could create a misleading view of our findings. The preparation of our analysis is a complex process and is not necessarily susceptible to partial analysis or summary description. Any attempt to do so could lead to undue emphasis on any particular factor or analysis.

We note that significant deviations from the above listed major assumptions may result in a significant change to our analysis.

Endnotes

¹ We estimated the economic footprint of program development for the period from 2007 to 2018.

² Dollar values in this report are in 2019 CAD unless otherwise noted.

³ Direct impacts result from business expenditure on suppliers and employees. Indirect (Canadian suppliers) impacts arise from the activities of businesses providing inputs to the A220's suppliers (in other words, its suppliers' suppliers). Induced (consumer spending by employees) impacts result from consumer spending by employees of the businesses stimulated by the direct and indirect expenditures. Total economic impacts are equal to the sum of direct, indirect and induced economic impacts.

⁴ Airbus and the Government of Quebec have announced a partnership that is planned to last until 2041. However, production forecasts are only available until 2034, so our economic footprint represents 2018 to 2034. Forecasts from 2020 to 2034 were discounted at a 6.0% discount rate, and added to actual results in 2018 and 2019.

⁵ The rankings were determined through the combination of seven category ranks: labor, infrastructure, industry, geopolitical risk, economy, cost and tax policy. For more information, please refer to: <https://www.pwc.com/us/en/industrial-products/publications/assets/pwc-aerospace-manufacturing-attractiveness-rankings-2019.pdf>

⁶ Research on Investments, *FDI aerospace industry trends for the U.S. and Canada (2018)*

⁷ ISO 14001 is the international standard that specifies requirements for an effective environmental management system (EMS).

⁸ LEED certification provides independent, third-party verification that a building, home or community was designed and built using strategies aimed at achieving high performance in key areas of human and environmental health: location and transportation, sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality.

⁹ Air Canada
<https://www.aircanada.com/ca/en/aco/home/fly/onboard/fleet/a220.html#/sustainability>

¹⁰ Defined as the value of goods and services used or transformed as inputs by a process of production.