Connecting and growing B.C. regions, business, and industry:

The socio-economic contribution of British Columbia's aviation and aerospace sector

Prepared for the British Columbia Ministry of Transportation and Infrastructure

February, 2023

pwc

Contents

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We note that as at the time of report drafting, there remains a high level of uncertainty as to the overall trajectory of both the Canadian and global aviation sector more broadly as it recovers from COVID-19. All analysis in this report reflects information available at the time of drafting (Q4 2022). Accordingly, changes in circumstances after the date of this report could affect the findings outlined herein. We are providing no opinion, attestation or other form of assurance with respect to our work and we did not verify or audit any information provided to us.

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Executive summary

Background

B.C.'s Ministry of Transportation and Infrastructure ("MoTI" or the "Ministry") is responsible for the safe and efficient movement of people and goods throughout the province by planning and improving B.C.'s transportation networks, building new infrastructure, providing transportation services, and implementing transportation policies. In early 2020, the onset of a global pandemic associated with the proliferation of the novel coronavirus ("COVID-19") caused an unprecedented disruption to B.C.'s aviation sector which persisted throughout 2020, 2021, and the first half of 2022. Given the magnitude of COVID-19's impact on the overall B.C. aviation sector as well as its critical contribution to a range of wider socio-economic outcomes, as laid bare during the pandemic, the Ministry is now in the process of compiling information to guide future decisions on the sector - specifically information related to the sector's socio-economic contribution to the province of B.C. and the regions that comprise it.

Within this context, the Ministry commissioned PricewaterhouseCoopers ("PwC", "we" or "us") to conduct a socio-economic analysis of B.C.'s aviation sector (the "Assessment"). Our Assessment focused on the following elements:

- **Socio-economic contribution baselining:** Developed quantitative estimates of the economic footprint of B.C.'s aviation sector in 2019 (prior to the onset of COVID-19) across macroeconomic indicators including gross domestic product ("GDP"), employment in terms of full-time equivalent ("FTE") workers, labour income and tax revenues at the federal and provincial levels. This also includes qualitative analysis of the wider socio-economic contributions of the sector.
- **COVID-19 impacts:** Developed quantitative estimates of the economic footprint of B.C.'s aviation sector in 2021 during the global COVID-19 pandemic to assess its headline impacts on the sector. We also conducted qualitative analysis of the sector's role and experience during the pandemic.
- **Emerging trends and prospects:** Assessed and outlined key trends that will influence the future of the B.C. and Canadian aviation sectors as well as a number of strategic objectives for the sector. We also analyzed the potential growth trajectory of key economic indicators for the Canadian aviation sector based on a consensus view of forecasting agencies as the sector continues its recovery path following COVID-19.

Approach summary

The following elements summarize the overall approach of our Assessment:

1. **Aviation sector definition:** For the purposes of this Assessment, B.C.'s aviation sector was defined to include the following three industries per Statistics Canada's definition: (1) Aerospace Product and Parts Manufacturing; (2) Air Transportation; and (3) Support Activities for Air Transportation, hereafter referred to as "the B.C. Aviation sector" or "B.C.'s Aviation sector".
2. **Data collection:** Primary data was provided by MoTI and other relevant B.C. government ministries on information including B.C. Air Access Program ("BCAAP") funding initiatives, emergency management metrics, as well as other economic indicators related to the B.C. Aviation sector. These data were supplemented with secondary data collected through a range of sources including Statistics Canada and the International Air Transport Association ("IATA"), as well as through stakeholder interviews, as outlined below.
3. **Economic framework development and modeling:** Based on the primary and secondary data collected, an economic framework was developed to estimate the following:
    - A baseline economic footprint of the B.C. Aviation sector in 2019 for B.C.'s seven economic regions, which represented sector operations prior to the effects of COVID-19; and
    - A pandemic-impacted economic footprint of the B.C. Aviation sector in 2021 which applied industry-specific economic shocks to the 2019 baseline footprint to assess the impact that COVID-19 had on the sector's economic contributions to the B.C. economy.

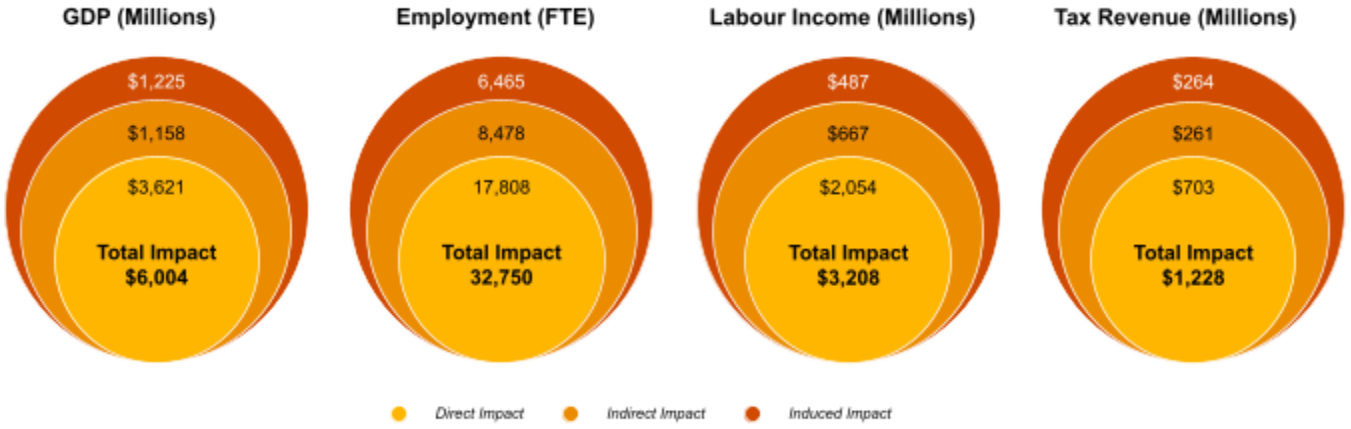
4. **Industry interviews:** PwC conducted interviews with B.C. Aviation sector stakeholders to gain insights on how various sector operations were impacted as a result of COVID-19, recovery of the sector following the pandemic as well as emerging trends and future prospects.
5. **Wider socio-economic impact assessment:** Other wider socio-economic contributions of the B.C. Aviation sector, including growth spin-offs, emergency management, regional connectivity, skills development and sustainability were informed by a combination of stakeholder interviews and secondary research. These impacts were presented on a qualitative basis.

Key findings

Socio-economic contribution baselining

The figure below presents the total estimated economic footprint of the B.C. Aviation sector. We estimated that in 2019, the B.C. Aviation sector generated and facilitated approximately $6 billion to provincial GDP, the employment of 32,750 individuals on an FTE basis, approximately $3.2 billion in labour income and approximately $1.2 billion in tax revenue to federal, provincial, and local governments.

Figure A: Total economic footprint of the B.C. Aviation sector, 2019[1]



COVID-19 impacts

Prior to COVID-19, the B.C. Aviation sector was experiencing steady growth in air passenger traffic, air cargo volumes, aircraft movements and aerospace products and parts manufacturing sales. However, the onset of the global pandemic led to the imposition of significant international and domestic travel restrictions and public health safety measures. With these policies came the closure of Canadian international borders to non-essential travelers, which significantly impacted the B.C. Aviation sector as the demand for international flights halted almost completely and demand for domestic flights also significantly declined.

As a result of the dramatically reduced demand for passenger flights, many aviation operators opted to temporarily halt operations and in some cases, closed permanently. Reduced air traffic also had large spillover impacts throughout the B.C. Aviation sector given the interdependent nature of the industries comprising it. With the volume of flights significantly curtailed, there was an associated reduction in demand for airport and other air transportation support services as well as for original equipment manufacturers (“OEM”) and maintenance, repair and overhaul (“MRO”) services.

During COVID-19, the B.C. Aviation sector continued to play a significant but greatly reduced role in 2021, having generated and facilitated approximately $2.5 billion to provincial GDP, the employment of 23,987 FTE workers, and $975 million in government tax revenue to federal, provincial, and local governments.

[1] All tax revenue figures presented in this figure include Personal income tax (“PIT”), Corporate income tax (“CIT”) as well as taxes on production and products.

Wider socio-economic contributions

B.C.'s Aviation sector plays a critical role by connecting B.C. to the world, Canada, and its own regions. In doing so, B.C.'s Aviation sector facilitates trade, investment, and tourism. The sector employs high-skilled workers across a range of occupations and aviation industries. The sector has played a crucial role in facilitating emergency response services and regional connectivity during the COVID-19 pandemic and in the face of recent natural disasters such as wildfires and floods. Additionally, the sector is supporting Canada's and B.C.'s transition to net zero by investigating and implementing a range of technologies aimed at lowering its carbon footprint.

Figure B: Summary of wider socio-economic contributions of B.C.'s Aviation sector

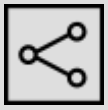
Wider socio-economic contribution	Description The *B.C. Aviation sector…*	Most relevant Aviation Industries	COVID-19 impacts The *B.C. Aviation sector…*
 **Economic growth spin-offs**	Enhances the economic prosperity of the province by connecting B.C. to the rest of the world, facilitating the flow of people, goods, and investment, and promoting trade and tourism	• Air Transportation • Support Activities for Air Transportation • Aerospace Product and Parts Manufacturing	Witnessed a marked decline in demand for passenger air transport services across all markets, which dampened B.C.'s trade, investment and tourism activity
 **Emergency management**	Plays a vital role in provincial emergency management operations, including the transportation of people, medical supplies, fire suppression, and emergency relief	• Air Transportation • Support Activities for Air Transportation	Was instrumental in emergency response activities, including the distribution of COVID-19 vaccines, tests, patients, and through wildfire suppression and flood relief operations
 **Regional connectivity**	Provides critical links to hard-to access areas throughout the province, including a large number of remote Indigenous communities and job sites in the resource sector	• Air Transportation • Support Activities for Air Transportation	Maintained connectivity to remote regions (including health care support), despite an almost complete stoppage in scheduled air passenger transportation
 **Skills development**	Provides a diverse range of high-skilled employment opportunities and technical training, enhancing the province's skilled labour pool	• Aerospace Product and Parts Manufacturing • Support Activities for Air Transportation	Faced uncertainty as a result of reduced demand for aviation services, layoffs, and impact of lockdowns
 **Sustainability**	Is exploring and implementing a range of technological and operational options to support a path to decarbonization	• Air Transportation • Aerospace Product and Parts Manufacturing	Has focused on progressing sustainable aviation fuels ("SAF"s) and hydrogen and electric propulsion research to support a sustainable economic recovery

Future prospects of the sector

The COVID-19 pandemic represented a once-in-a-generation disruption to every aspect of B.C.'s Aviation sector. The pandemic intensified aviation megatrends that were previously unfolding in the sector, including technological innovations, such as Advanced Air Mobility ("AAM") and Industry 4.0 manufacturing processes. In addition, the disruption and re-shaping of the sector induced by the pandemic has also spurred new influences that will be critical factors shaping the future of B.C.'s Aviation sector.

We note that as at the time of report drafting, there remains a high level of uncertainty as to the overall trajectory of both the Canadian and global aviation sector more broadly as it recovers from COVID-19. The following analysis reflects a view on the future prospects of the sector as at the time of drafting (Q4 2022).

Figure C: Summary of key aviation sector megatrends

Key aviation megatrend	Description	Implications for B.C. *For B.C., this megatrend could…*
 **Technological innovation**	Technological advancements, including the growth in AAM applications and industry 4.0 manufacturing processes will continue to advance and modernize the aviation sector to enhance productivity and support de-carbonization efforts	• Support the realization of provincial sustainability initiatives and targets • Drive operational efficiency and boost productivity • Expand the mobility of cargo and people being transported by AAM in urban and regional areas across the province • Reduce the social inequity of air travel in rural, remote and Indigenous communities • Provide opportunities for cross-sector collaboration within the province (e.g. in the production of SAFs)
 **Labour shortages and skills gaps**	As it emerges from COVID-19, the sector is faced with severe labour and skills shortages, including an acute difficulty attracting and retaining workers in key aviation occupations and industries	• Act as a headwind to the recovery of the sector and hamper future growth • Encourage faster adoption of automation process across a range of aviation industries • Have implications for provincial labour force training strategies and the need to attract new talent to the sector
 **E-commerce and air freight**	Air freight will continue to be a key transportation solution for e-commerce activity as a result of continued growth in consumer demand and expectations for short delivery turnaround times	• Lead to increased requirements for dedicated cargo fleet, which may induce increased aircraft conversions (to “freighters”) • Encourage the use of AAM technology, specifically for the use in first/last mile and rural delivery • Increase the demand for B.C.’s industrial land dedicated to warehouse and distribution facilities (particularly in the Lower Mainland)
 **Supply chain re-evaluation**	The risks and vulnerabilities associated with supply chain disruptions that played out during the pandemic, coupled with geopolitical tensions, will lead to increased focus on onshoring, nearshoring, and friendshoring elements of manufacturing supply chains	• Provide opportunities for aerospace manufacturers to expand their economic footprint by participating in new or expanded Pacific-Northwest manufacturing supply chains and more broadly, United States-Mexico-Canada supply chains • Increase the attractiveness of B.C. aerospace sector to nations perceived as “friendly” • Lead to a re-evaluation of sourcing approaches by B.C. aerospace companies

As noted throughout this report, the scale of disruption experienced in B.C.’s Aviation sector both during and in the wake of the COVID-19 pandemic has been unprecedented. The sector is currently emerging from the pandemic with its business models and supply chains permanently re-configured, and operating in a more volatile and uncertain environment than it ever has.

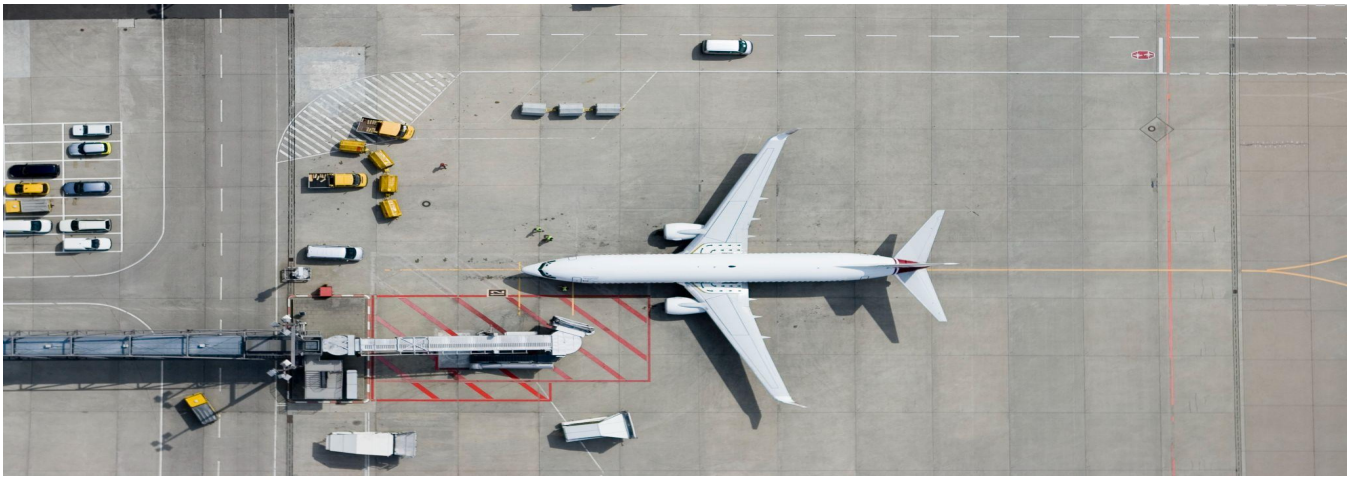
Within this context, the long-term trajectory of B.C.’s Aviation sector will be dictated by its ability to achieve a number of strategic objectives. Throughout B.C.’s Aviation sector ecosystem, as underscored through consultations conducted with industry participants as part of this study, the following elements are considered key to the future of the sector:

1. Embrace innovation and facilitate technology adoption to improve operational efficiency;
2. Strengthen the “brand” of the aviation sector to attract talent;
3. Develop/refresh provincial aviation sector strategy;
4. Review the National Airports Policy;
5. Embrace sustainability to capitalize on the transition to a low-carbon economy and B.C.’s Environmental, Social, and Governance (“ESG”) advantage; and
6. Reduce the regulatory and operational costs of doing business and increase investment attractiveness.

1. Introduction

1.1 Study background

B.C.'s Ministry of Transportation and Infrastructure ("MoTI" or the "Ministry") is responsible for the safe and efficient movement of people and goods throughout the province by planning and improving B.C.'s transportation networks, building new infrastructure, providing transportation services, and implementing transportation policies.



With respect to B.C.'s aviation sector, MoTI administers the B.C. Air Access Program ("BCAAP"), a cost-sharing initiative designed to assist airport operators improve their infrastructure, environmental initiatives and in select cases, develop airport master plans. BCAAP provides these cost-sharing opportunities to B.C. airport operators that operate public use air facilities and serve fewer than one (1) million passengers annually. MoTI also administers additional funding for local and regional airports through the Small Communities Fund to support capital programs that improve overall traffic or passenger volumes, enhance international trade flows or increase connectivity between remote locations within B.C. and larger metropolitan areas.

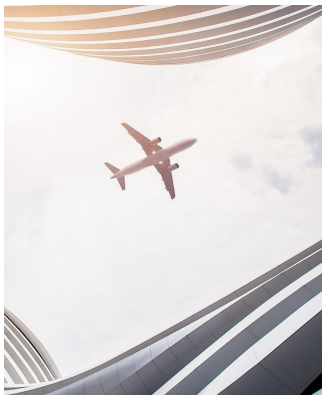
In early 2020, the onset of a global pandemic associated with the proliferation of the novel coronavirus ("COVID-19") caused an unprecedented disruption to B.C.'s aviation sector which persisted throughout 2020, 2021, and the first half of 2022. During this time, Canadian international borders were closed to non-essential travelers, various testing and vaccination verification measures were implemented at national borders, and demand for international and domestic flights was heavily curtailed. Monthly air passenger volumes at most B.C. airports declined by over 90% during the first half of 2020. B.C.'s largest airport, Vancouver International Airport ("YVR"), witnessed a 97% decline in passenger volumes (from January to April 2020). Throughout 2020, total B.C. air passenger traffic decreased by 68% relative to 5-year historical averages.

This reduced demand for air travel had spillover impacts throughout B.C.'s aviation sector, with aerospace product and part manufacturing sales falling by 47% in 2020 compared to 5-year historical averages and air transportation support services largely halting.

Given the magnitude of COVID-19's impact on the overall B.C. aviation sector as well as its critical contribution to a range of wider socio-economic outcomes, as laid bare during the pandemic, the Ministry is now in the process of compiling information to guide future decisions on the sector - specifically information related to the sector's socio-economic contribution to the province of B.C. and the regions that comprise it. From this, implications for various government policies and programs can be investigated by the Ministry.

1.2 Study objectives

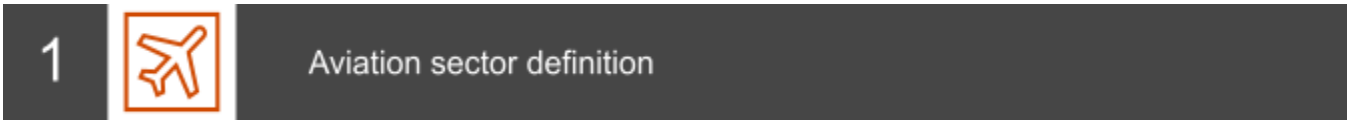
Within this context, the Ministry commissioned PricewaterhouseCoopers (“PwC”, “we” or “us”) to conduct a socio-economic analysis of B.C.’s aviation sector (the “Assessment”). Our Assessment focused on the following elements:



- **Socio-economic contribution baselining:** Developed quantitative estimates of the economic footprint of B.C.’s aviation sector in 2019 (prior to the onset of COVID-19) across macroeconomic indicators including gross domestic product (“GDP”), employment in terms of full-time equivalent (“FTE”) workers, labour income and tax revenues at the federal and provincial levels. This also includes qualitative analysis of the wider socio-economic contributions of the sector.
- **COVID-19 impacts:** Developed quantitative estimates of the economic footprint of B.C.’s aviation sector in 2021 during the global COVID-19 pandemic to assess its headline impacts on the sector. We also conducted qualitative analysis of the sector’s role and experience during the pandemic.
- **Emerging trends and prospects:** Assessed and outlined key trends that will influence the future of the B.C. and Canadian aviation sectors as well as a number of strategic objectives for the sector. We also analyzed the potential growth trajectory of key economic indicators for the Canadian aviation sector based on a consensus view of forecasting agencies as the sector continues its recovery path following COVID-19.

1.3 Approach overview

The following elements summarize the overall approach of our Assessment:



For the purposes of this Assessment, B.C.’s aviation sector was defined to include the following three industries per Statistics Canada’s definition: (1) Aerospace Product and Parts Manufacturing; (2) Air Transportation; and (3) Support Activities for Air Transportation, hereafter referred to as “the B.C. Aviation sector” or “B.C.’s Aviation sector”. Within these industries, there are seven sub-industries that make up the broader B.C. Aviation sector:

- **Aerospace product and part manufacturing:** consists of firms that manufacture aircraft, aviation device and control systems, space vehicles and propulsion units as well as those that provide maintenance, repair and overhaul services.
- **Scheduled air transportation:** consists of establishments that transport passengers and goods via aircraft on specific schedules and flight routes.
- **Non-scheduled chartered air transportation:** consists of establishments that transport passengers and goods via aircraft and charge for services on a per hour or mile basis.
- **Non-scheduled specialty flying services:** consists of establishments that provide air transport via small and general purpose aircraft, emergency services transport and flight training services.
- **Air traffic control:** consists of establishments that provide services to ensure safe air traffic flows.
- **Other airport operations:** consists of establishments that provide cargo handling and loading, hangar operations and general operations and maintenance services for airports.
- **Other support activities for air transportation:** consists of establishments that provide specialized aircraft repair and maintenance, inspection and testing services.

2 Data collection

Primary data was provided by MoTI and other relevant B.C. government ministries on information including BCAAP funding initiatives, emergency management metrics, as well as other economic indicators related to the B.C. Aviation sector. These data were supplemented with secondary data collected through a range of sources including Statistics Canada and the International Air Transport Association ("IATA"), as well as through stakeholder interviews, as outlined below.

3 Economic framework development and modelling

Based on the primary and secondary data collected, an economic framework was developed to estimate the following:

- A baseline economic footprint of the B.C. Aviation sector in 2019 for B.C.'s seven economic regions[2], which represented sector operations prior to the effects of COVID-19; and
- A pandemic-impacted economic footprint of the B.C. Aviation sector in 2021 which applied industry-specific economic shocks to the 2019 baseline footprint to assess the impact that COVID-19 had on the sector's economic contributions to the B.C. economy.

The framework was designed to capture key impacts of the industries that comprise the B.C. Aviation sector while avoiding double counting across interrelated supply chains within the sector. In doing so, Statistics Canada's Input-Output model was used, which provided estimates of the baseline and pandemic-impacted economic footprints of each industry within the sector at the direct, indirect and induced levels.

4 Industry interviews

PwC conducted interviews with B.C. Aviation sector stakeholders to gain insights on how various sector operations were impacted as a result of COVID-19, recovery of the sector following the pandemic as well as emerging trends and future prospects. Stakeholders consulted included a sample of B.C. regional and international airport facilities, fixed-wing and helicopter operators, flight schools and training facilities, original equipment manufacturers ("OEM"), and maintenance, repair and overhaul ("MRO") providers. For a full list of all B.C. Aviation sector stakeholders interviewed, refer to **Appendix H**.

5 Wider socio-economic impact assessment

Wider socio-economic impact assessment: Other wider socio-economic contributions of the B.C. Aviation sector, including growth spin-offs, emergency management, regional connectivity, skills development and sustainability were informed by a combination of stakeholder interviews and secondary research. These impacts were presented on a qualitative basis.

[2] We note that B.C. has eight economic regions as defined by Statistics Canada. However, for the purpose of this analysis, the North Coast and Nechako economic regions have been combined given their relatively small population counts compared to other regions within the province. For more information including detailed regional maps of B.C., refer to B.C. Government.

1.4 Report structure

The remainder of this report is structured as follows:

Section 2

Presents an overview of the B.C. Aviation sector and estimates baseline sector economic footprint as well as a pandemic-impacted economic footprint for the sector.

Section 3

Presents the wider socio-economic impacts of the B.C. Aviation sector including growth spin-offs, tourism, emergency management, sustainability, skill development and regional connectivity.

Section 4

Presents key trends that will influence the future of the B.C. and Canadian aviation sectors, as well as a number of strategic objectives for the sector as it emerges from COVID-19.

Appendices

2. Economic footprint of B.C.'s Aviation sector

Key insights

- *In 2019, B.C.'s aviation sector generated and facilitated approximately $6 billion to provincial GDP, the employment of 32,750 FTE workers, and $1.2 billion in government tax revenue.*
- *During COVID-19, the B.C. Aviation sector continued to play a significant but greatly reduced role within the provincial economy in 2021, having generated and facilitated approximately $2.5 billion to provincial GDP, the employment of 23,987 FTE workers, and $975 million in government tax revenue.*

2.1 Defining the B.C. Aviation sector

The B.C. Aviation sector comprises three industries: aerospace product and part manufacturing, air transportation and support activities for air transportation. Within these industries are several sub-industries. The figure below presents an illustration of the B.C. Aviation sector by industry and sub-industry, and includes examples of activities included within each sub-industry.[3]

Figure 1: B.C. Aviation sector definition

**Excludes aircraft conversions or overhauls*

[3] For a comprehensive list of activities included within each aviation sub-industry, refer to https://www23.statcan.gc.ca/imdb/p3VD.pl?Function=getVD&TVD=1369825&CVD=1369826&CPV=48-49&CST=27012022&CLV=1&MLV=5

2.2 Summary of B.C.'s Aviation sector

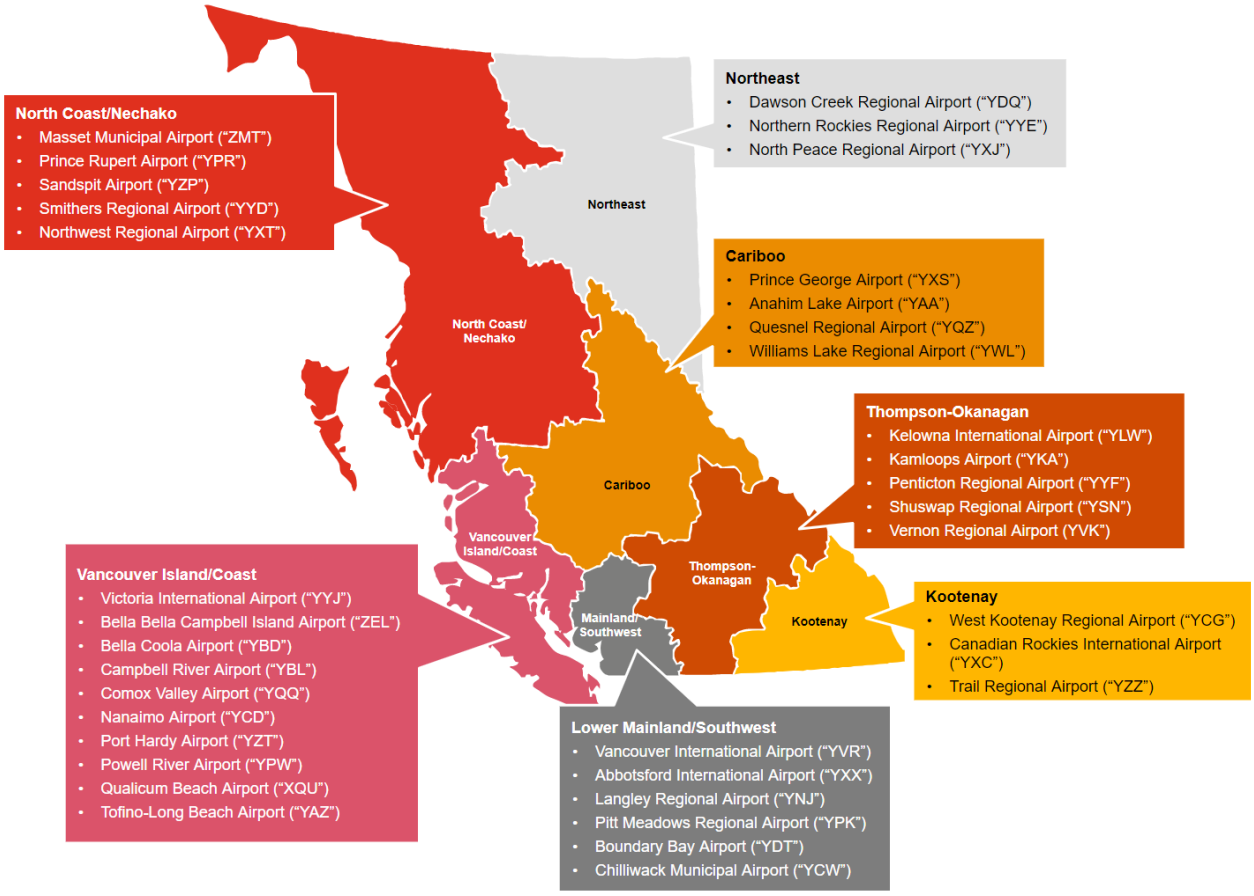
The B.C. Aviation sector plays an important role in contributing to overall growth within the provincial economy, with Air transportation and Aerospace Products and Parts Manufacturing industries having exhibited average annual real GDP growth rates of approximately 6% and 2% respectively between 2010 and 2019.

Combined, these industries have directly contributed on average approximately 1% of provincial GDP during this same period. While B.C.'s Aviation sector comprises a diverse array of aviation industries that made this contribution, it must be noted that the sector also plays a critical role in facilitating the movement of people and goods in B.C.'s largest economic sectors including natural resources, agriculture and seafood, tourism, education (including international students) and a range of professional service industries.

B.C. is a one million square kilometer landmass that comprises several mountain ranges, thousands of kilometers of coastline, vast forest regions, and over 200 Gulf Islands. Fixed-wing aircraft, float planes and helicopters have all played an important role in B.C.'s economic development through enhancing regional connectivity as well as facilitating access to key markets. B.C. has hence developed expertise in specific aviation applications including operations on and over water as well as forest firefighting and air ambulance services.

There are over 300 airports and other aviation facilities across the province, including 36 certified airports located in each of B.C.'s economic regions.[4][5]

Figure 2: Map of Certified B.C. Airports, by economic region[6]



[4] Certified airports and aerodromes are maintained and operated according to standards as defined by Transport Canada. Adhering to Transport Canada standards and receiving this certification allows an airport to host scheduled passenger traffic. For more information, refer to https://tc.canada.ca/en/aviation/publications/air-operator-certification-manual-tp-4711

[5] Source: B.C. Aviation strategy

[6] We note that for the purpose of this analysis, North Coast and Nechako economic regions have been aggregated. For more information including detailed regional maps of B.C., refer to https://www2.gov.bc.ca/gov/content/data/geographic-data-services/land-use/administrative-boundaries/census-boundaries

These airports play an important role in facilitating connectivity both within and outside of the province. B.C.'s five largest airports accounted for about 90% of the total passenger traffic at all B.C. airports.

Figure 3: Summary table of B.C. Airports (Top 5)

Airport	Passengers (as at 2019)[7]		Direct connections (as at 2022)		
	# (Millions)	Share of B.C.	International	Canada (including B.C.)	B.C.
Vancouver International Airport (YVR)	25.7	74.7%	69	40	26
Kelowna International Airport (YLW)	2.0	5.8%	6	8	3
Victoria International Airport (YYJ)	1.9	5.5%	3	9	3
Abbotsford International Airport (YXX)	1.0	2.9%	3	6	-
Prince George Airport (YXS)	0.5	1.5%	1	7	5
Total Top 5 B.C. Airports	**31.1**	**90.4%**			
Total B.C.	**34.4**	**100%**			

Source: Statistics Canada, 2022 YVR Non-Stop Destinations, Flight Connections

B.C.'s top five airports, by 2019 passenger traffic, are summarized below:

1. **Vancouver International Airport (YVR)**: B.C.'s largest airport and Canada's second busiest. With a large continental and global network of routes, YVR is a leading North American gateway for the Asia Pacific region.
2. **Kelowna International Airport (YLW):** Canada's tenth busiest airport supporting domestic connections to cities within B.C. and Canada, and direct international connections to various cities in the U.S. and Mexico. YLW offers non-stop commercial flights with 9 airlines.
3. **Victoria International Airport (YYJ):** The eleventh busiest airport in Canada, YYJ offers intra-B.C. and domestic flights, and direct international connections to various cities in the U.S. and Mexico.
4. **Abbotsford International Airport (YXX):** One of Canada's fastest growing airports in terms of passenger volume. YXX supports domestic connections along with direct international connections to 3 Mexican cities.
5. **Prince George Airport (YXS):** Serves Prince George (including remote resource-based operations in the region) and other B.C. communities, providing connectivity within B.C. and Canada. Internationally, YXS provides nonstop connections to Tucson, Arizona in the U.S.

In addition to offering provincial connectivity with a significant number of airports throughout the province, the B.C. Aviation sector in early 2020 had approximately 260 licensed rotary and fixed-wing operators offering both scheduled and non-scheduled air transportation services to facilitate the movement of both people and goods. Several of these providers also offer specialty flying services which include medical evacuation ("medevac") and wildfire suppression services.

[7] Based on 2019 data from Statistics Canada. We have used 2019 data to reflect the regular air passenger volumes of B.C.'s largest airports to reflect a pre-COVID-19 snapshot.

The figure below details a sample of notable air transportation operators in B.C. and includes a description of the main service offerings, additional services, main operating locations within B.C. as well as the location of their main headquarters.

Figure 4: Sample of notable B.C. Air Transportation service providers

Service Provider	Main Service Offering	Additional Services	B.C. Operating Location(s)	HQ Location
Central Mountain Air	• Scheduled air transportation (passengers and cargo)	• Non-scheduled air transportation (passenger and cargo)	Vancouver, Prince George, Smithers	Smithers
Harbour Air Seaplanes	• Scheduled air transportation (passengers and cargo)	• Non-scheduled air transportation (passenger and cargo) • Aerospace services (MRO and engineering) • Consulting services (operations, licensing and brand management)	Richmond, Vancouver Harbour, Victoria Harbour	Richmond
Helijet International	• Scheduled air transportation (passengers and cargo)	• Non-scheduled air transportation (passenger and cargo) • Non-scheduled specialty flying services (air ambulance) • Consulting services (heliport development)	Richmond, Vancouver Harbour, Victoria, Nanaimo, Haida Gwaii, Prince Rupert	Richmond
KF Aerospace	• Refer to Figure 5	• Non-scheduled air transportation (passenger and cargo)	Kelowna	Kelowna
Pacific Coastal Airlines	• Scheduled air transportation (passengers and cargo)	• Non-scheduled air transportation (passenger and cargo)	Richmond	Richmond

Source: Dun & Bradstreet, Inc.'s D&B Hoovers, PwC Analysis

The aerospace products and parts manufacturing industry also plays an important role for the broader B.C. Aviation sector with over 200 firms of which approximately 90% are small and medium-sized enterprises ("SME"s).[8] Over the years, the province has worked to ensure that it is well positioned to take advantage of its proximity to the U.S. Pacific Northwest aerospace cluster by establishing strong manufacturing capabilities, with a particular focus on MRO in the following areas:

- In-Service Support ("ISS");
- Heavy and line maintenance;
- Helicopter maintenance; and
- Propulsion maintenance.

While the majority of aerospace product and part manufacturing firms operating in the province are primarily focused on MRO, industry players also offer educational training and flight simulation services and have OEM capabilities that include:

- Avionics manufacturing;
- Machining;
- Systems and components manufacturing;
- Aerostructures manufacturing;
- Composites and plastics;

[8] Source: AIAC, British Columbia Aerospace Capabilities Guide

- Retrofitting and aircraft conversion; and
- Ground support equipment manufacturing.

The figure below details a sample of notable aerospace product and parts manufacturing firms operating in B.C. and includes a description of main and additional capabilities, operating locations within B.C. as well as the location of their main headquarters.

Figure 5: Sample of notable B.C. Aerospace Products and Parts Manufacturing firms

Firm Name	Main Service Offering	Additional Services	B.C. Operating Location(s)	HQ Location
Avcorp Industries	• Structures and integration	• Composites and plastics manufacturing • Processing • Supply chains • MRO parts	Delta	Delta
Cascade Aerospace	• Heavy maintenance	• Avionics • Retrofitting • Avionics • Structures • Systems and components • Line maintenance • MRO Spares • Defense security systems and electronics • Simulations • Educational services	Abbotsford	Abbotsford
Heli-One	• Helicopter MRO (heavy maintenance)	• Line maintenance • Propulsion maintenance • Modifications • MRO Spares	Richmond	Richmond
KF Aerospace	• MRO (heavy maintenance)	• Avionics • Composites and plastics • Retrofitting • Structures • Line maintenance • Modifications • MRO spares • Simulations • Educational services	Vancouver, Kelowna	Kelowna
Viking Air (De Havilland)	• OEM	• Retrofitting • Structures • Heavy and line maintenance • MRO Spares • Educational services • Factory new spares	Sidney	Sidney

Source: Dun & Bradstreet, Inc.'s D&B Hoovers, PwC Analysis

2.3 Overview of the economic footprint modelling framework

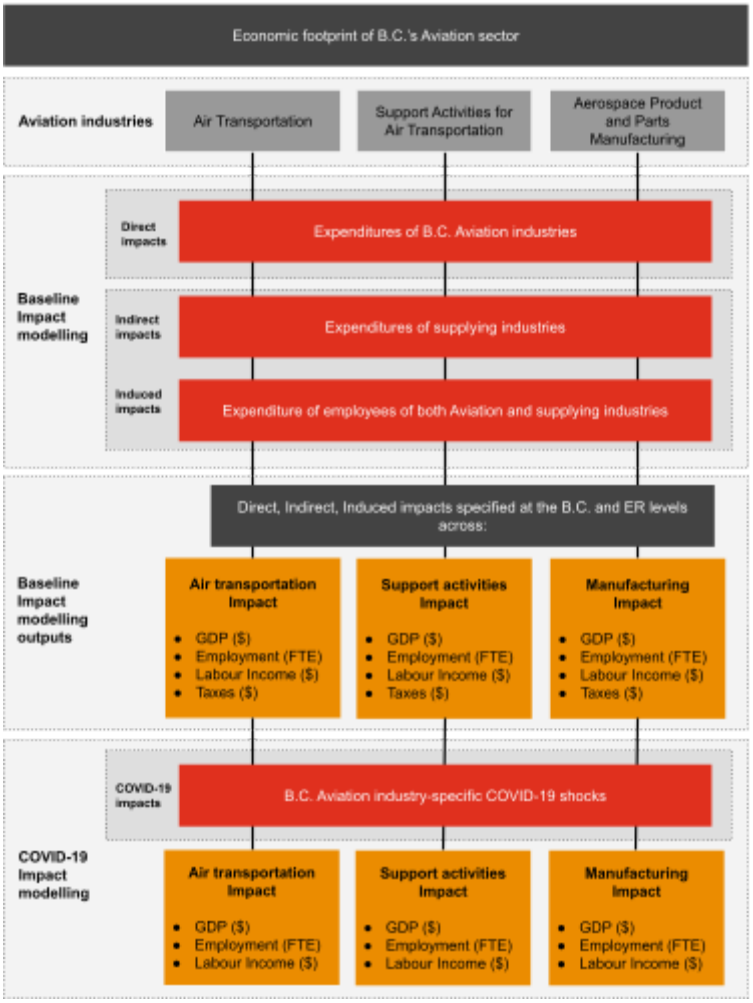
2.3.1 Input-Output Model

The economic footprint of the B.C. Aviation sector, which includes both a 2019 pre-pandemic sector baseline as well as a 2021 pandemic-impacted estimate has been calculated at the direct, indirect and induced levels using an Input-Output ("IO") modelling approach. As outlined in the figure on the right, these impacts, individually and collectively, represent how the activities associated with the operations of the industries and sub-industries that comprise the B.C. Aviation sector ripple throughout B.C.'s economy.

The fundamental philosophy behind IO analysis is that spending on goods and services has attendant impacts throughout the economy. For instance, scheduled air transportation would generate demand for the inputs to this process, such as labour and raw materials, which in turn generates additional demand that extends beyond the initial spending.

The IO model used for the purpose of this report estimates the relationship between a particular economic activity for a given good or service and the resulting impacts throughout the economy (i.e. including demand for other goods and services, and tax revenues). For the purpose of this report, economic footprints for each B.C. Aviation industry and sub-industry were estimated for the following measures of economic activity:

Figure 6: B.C. Aviation sector economic footprint modeling framework



- **Value added, also called GDP** – the value added to the economy, or the unduplicated total value of goods and services produced. GDP includes only final goods to avoid the double counting of inputs.
- **Employment** – the number of jobs created or supported, expressed as the number of FTE jobs indicated in person years.
- **Labour income** – the value of income generated by labour from wages, salaries, supplementary labour income and mixed income. Mixed income largely consists of non-wage income earned by self-employed persons.
- **Taxes on production and products** – the amount of tax revenues generated from taxes on products and production (e.g. gas tax, sales taxes, and excise taxes) at the federal and provincial levels.
- **Personal income tax ("PIT")** – the amount of federal and provincial tax revenues generated from taxes on the income of employees and self-employed individuals.
- **Corporate income tax ("CIT")** – the amount of federal and provincial tax revenues generated from taxes on the profits of corporations.

The above tax impacts were estimated at the federal and provincial levels of government. For a discussion on PIT and CIT estimation methodology, refer to **Appendix C**.

Economic footprints were estimated at the direct, indirect and induced levels based on overall Aviation sector operations within B.C.:

- **Direct impacts** - Direct impacts result from companies' spending on suppliers and employees. This includes direct employment and direct purchases of goods and services.
- **Indirect impacts** - Indirect impacts arise from the activities of the firms providing inputs to a company's suppliers (in other words, the suppliers of its suppliers).
- **Induced impacts** - Induced impacts are the result of consumer spending by employees of the businesses stimulated by direct and indirect expenditures.
- The **total economic footprint** equals the sum of the direct, indirect, and induced economic impacts.

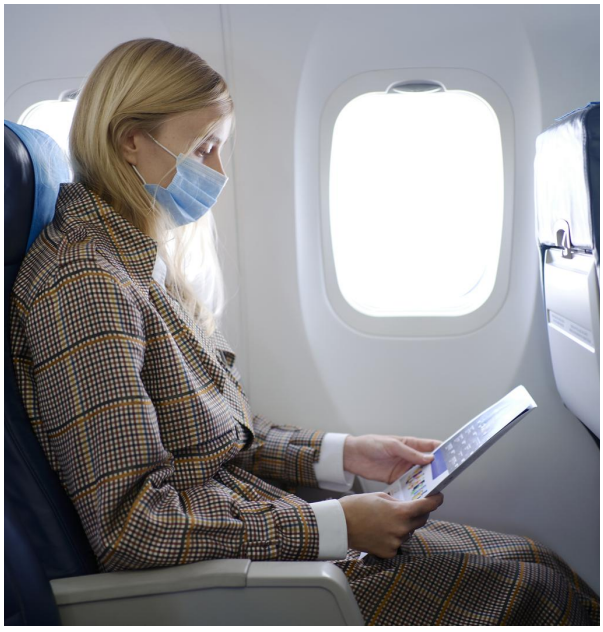
The above impacts were estimated separately for B.C. at both the regional and provincial levels. Note that these impacts were estimated at the B.C. level (and its regions) and not on a Canada-wide basis.

The results presented for the baseline economic footprint of the B.C. Aviation sector are for the calendar year 2019, which represents sector operations prior to the effects of the global COVID-19 pandemic. We note that 2019 has been selected as a baseline year for the sector based on discussions with the Ministry as well as insights gathered from stakeholder interviews, noting that COVID-19 had a dramatic impact on overall sector operations, commencing in March 2020.

Given the B.C. Aviation sector comprises distinct industries that engage in inter- and intra-industry trade, there is the potential for double counting across supply chains, as the sales of a product from one industry to another are recorded twice by Statistics Canada when the purchasing industry adds value to that product and then sells it. To avoid this, the intermediate consumption of aviation outputs (defined as outputs primarily generated by B.C. Aviation sector industries) as well as their indirect and induced impacts were removed from our estimates.[9]

We note that there are a number of external economic footprint analyses which have been conducted for airports across B.C. at various points in time, including for YVR. To this end, the results of this study and these external economic analyses are not directly comparable to these analyses given the use of different economic modelling methodologies and assumptions, including the scope of impact categories quantified.

2.3.2 Estimating COVID-19 impacts



Consistent with the baseline economic footprint, we estimated the economic footprint of the B.C. Aviation sector following the onset of the global COVID-19 pandemic using an IO modelling approach across each of the industries that comprise the sector. We note that for the purpose of this study, the impact of COVID-19 was calculated as the difference between the estimated economic footprints for the 2019 and 2021 calendar years.

For the purpose of this analysis, the pandemic-impacted economic footprint of the B.C. Aviation sector was estimated through applying industry-specific reductions (observed between 2019 and 2021 across key industry variables) to baseline sector estimates. To this extent, these industry-specific reductions characterize how direct historical declines in sector-specific GDP, employment and labour income rippled throughout the B.C. economy as well as the impact the declines had on the total sector economic footprint. Refer to **Section 2.5** for the results of our COVID-19 impact estimation analysis.

[9] We note that this was conducted using identified aviation-related input commodities according to Statistics Canada Supply and Use Tables. To this extent, the adjustments applied act to proxy/estimate the true input structure of the B.C. Aviation sector and in turn produce a more conservative estimate of the overall sector economic footprint.

2.3.3 Regionalizing economic impacts

Figure 7: Map of B.C. economic regions

In addition to assessing the B.C. Aviation sector's economic footprint in the province, we took a regional view to estimate the baseline and pandemic-impacted economic footprints of the sector across regional economies within the province. This assessment was conducted at the economic region level, as defined by Statistics Canada, with outputs generated for B.C.'s seven economic regions, which are depicted in the figure to the left.[10]

To assess the regional baseline and pandemic-impacted economic footprints of the B.C. Aviation sector, we relied on publicly available data regarding the industrial concentration of each of the economic regions. Regional impacts were assessed separately for each of the three industries that comprise the B.C. Aviation sector.

Refer to **Appendix B** for details regarding the regionalization methodology.

2.3.4 Tourism impacts

To model the economic footprint of aviation-related tourism, we developed a tourism expenditure profile for non-B.C. Canadian residents traveling to B.C. This profile was used to identify the proportion of overall tourism expenditures associated with aviation using an IO modelling approach. The resulting multipliers produce estimates of the total economic footprint associated with a given level of aviation-related tourism expenditures made within B.C. by non-B.C. Canadian residents, at the direct, indirect and induced levels.

We note that the estimated tourism impacts presented throughout this report are considered separately from the B.C. Aviation sector baseline and COVID-19 economic footprints, and are not additive. This is because there is the potential for some tourism-related activities and the resulting economic impacts to be double counted across several aviation sub-industries.

In addition, only aviation-related tourism expenditures made within B.C. by non-B.C. Canadian residents were considered as part of our analysis. This was in order to represent the incremental economic footprint generated by aviation-related tourism activity as a result of net new domestic tourism expenditure inflows into B.C. We note that aviation-related tourism expenditures made by B.C. residents were excluded from our analysis given these represent a re-allocation of personal expenditures that would have otherwise occurred within the province and would not generate an associated incremental economic footprint. In addition, international aviation-related tourism expenditures were not included as part of our analysis due to data limitations as international tourists have unique expenditure profiles that largely depend on where they are visiting from and are not comparable to Canadian resident expenditure profiles at the regional level.

[10] We note that B.C. has eight economic regions as defined by Statistics Canada. However, for the purpose of this analysis, the North Coast and Nechako economic regions have been combined given their relatively small population counts compared to other regions within the province. For more information including detailed regional maps of B.C., refer to B.C. Government.

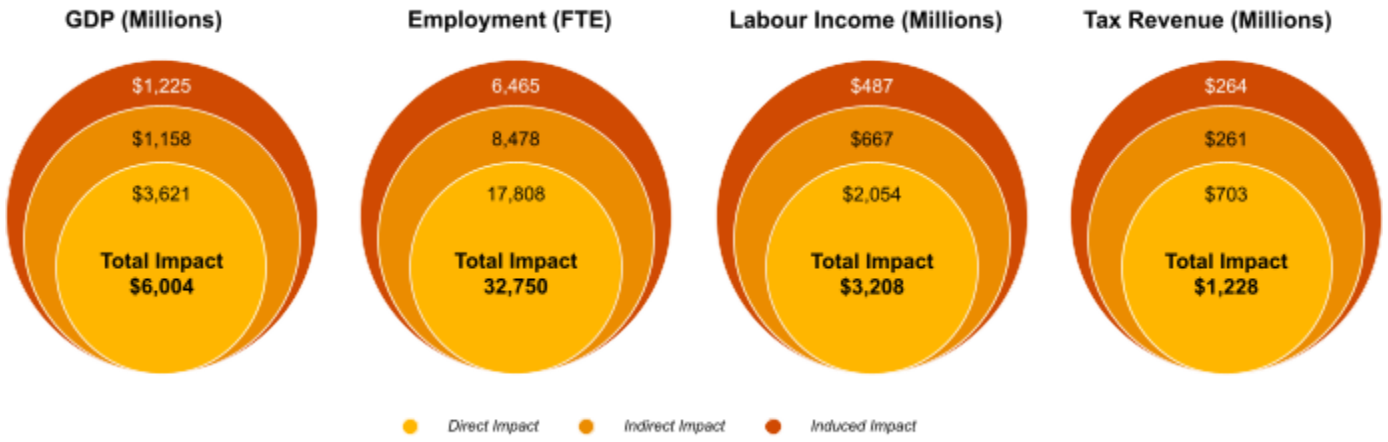
2.4 Sector baseline modelling results

This section includes an overview of the results of applying our baseline modelling framework (as described above) to estimate the B.C. Aviation sector economic footprint in 2019 as well as for the industries that comprise the sector.

The figure below presents the total estimated economic footprint of the B.C. Aviation sector. We estimated that in 2019, the B.C. Aviation sector generated and facilitated approximately $6 billion to provincial GDP, the employment of 32,750 individuals on an FTE basis and approximately $3.2 billion in labour income. In addition, we estimated that the B.C. Aviation sector generated and facilitated $1.2 billion in tax revenue in 2019, of which $728 million was paid to the federal government and the remaining $500 million to B.C. provincial and local governments.

For a breakdown of tax revenues by type, refer to **Appendix G.**

Figure 8: Economic footprint of the B.C. Aviation sector, 2019[11]



The figure below details the total estimated economic footprint of the B.C. Aviation sector by economic region.[12]

We estimate that in 2019, the economic footprint of the B.C. Aviation sector was largely concentrated in the Lower Mainland/Southwest Region, which generated and facilitated approximately $4.1 billion in provincial GDP (68% of the sector's total GDP footprint in B.C.), 22,344 FTE jobs, approximately $2.2 billion in labour income and $840 million in federal and B.C. provincial taxes.

Vancouver Island/Coast and Thompson-Okanagan Regions also accounted for a large portion of the sector's economic footprint in 2019. Within these regions, the B.C. Aviation sector generated and facilitated approximately $1.4 billion in provincial GDP (23% of the sector's total GDP footprint in B.C.), 7,719 FTE jobs, approximately $737 million in labour income and $286 million in federal and B.C. provincial taxes.

Figure 9: Total economic footprint of the B.C. Aviation sector, by economic region, 2019

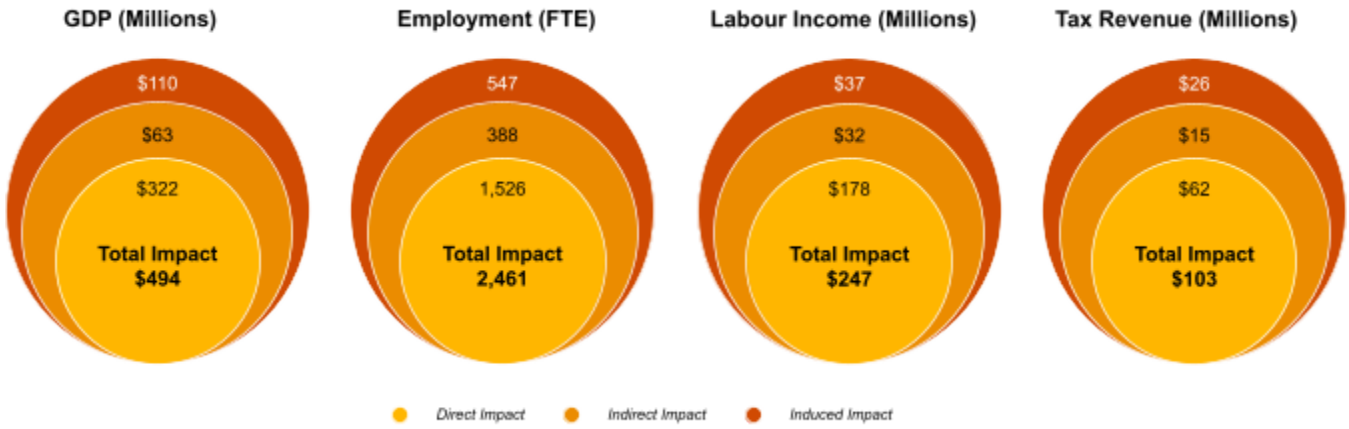
Economic region	GDP ($M)	Employment (FTE)	Labour Income ($M)	Tax Revenue ($M)
Cariboo	$160	876	$83	$33
Kootenay	$115	653	$58	$24
Lower Mainland/Southwest	$4,095	22,344	$2,216	$840
Nechako/North Coast	$139	785	$78	$29
Northeast	$81	373	$36	$16
Thompson/Okanagan	$606	3,262	$312	$122
Vancouver Island and Coast	$808	4,457	$425	$164
Total	**$6,004**	**32,750**	**$3,208**	**$1,228**

[11] All tax revenue figures presented in this figure include PIT, CIT as well as taxes on production and products.
[12] All regional impact figures are reported as the sum of direct, indirect and induced impact channels.

2.4.1 Aerospace Products and Parts Manufacturing industry baseline

We estimate that in 2019, the Aerospace Products and Parts Manufacturing industry generated and facilitated approximately $494 million to B.C.'s GDP, the employment of 2,461 individuals on an FTE basis and approximately $247 million in labour income. In addition, we estimated that in 2019, Aerospace Products and Parts Manufacturing generated and facilitated $103 million in tax revenue, of which $63 million was paid to the federal government and the remaining $40 million to B.C. provincial and local governments.

Figure 10: Economic footprint of the B.C. Aviation sector - Aerospace Products and Parts Manufacturing, 2019[13]



The figure below details the total estimated economic footprint of the B.C. Aerospace Products and Parts Manufacturing industry by economic region.[14]

Figure 11: Total economic footprint of B.C. Aerospace Products and Parts Manufacturing, by economic region, 2019

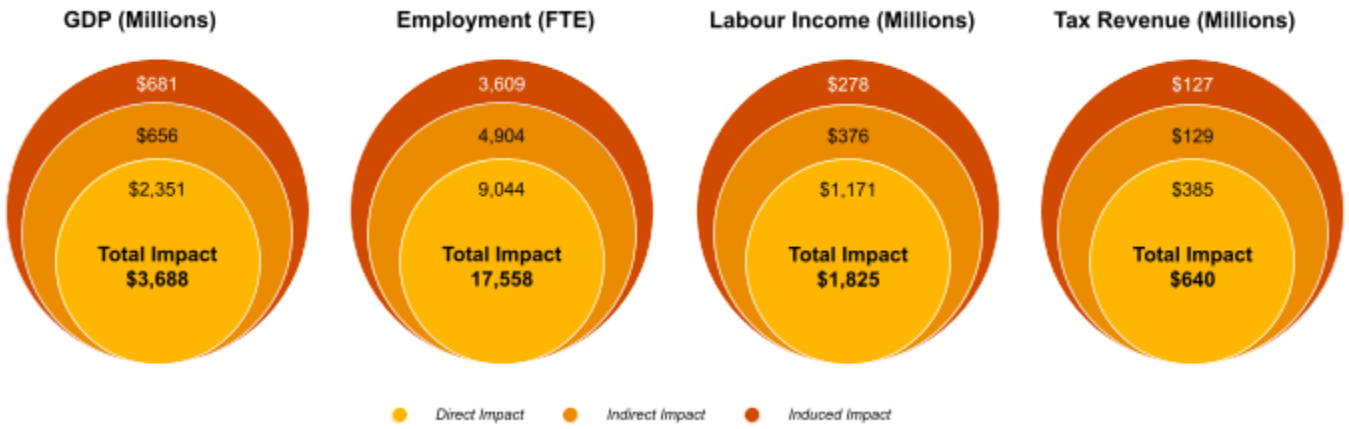
Economic region	GDP ($M)	Employment (FTE)	Labour Income ($M)	Tax Revenue ($M)
Cariboo	$5	28	$2	$1
Kootenay	$6	32	$3	$1
Lower Mainland/Southwest	$345	1,714	$174	$72
Nechako/North Coast	$3	16	$1	$1
Northeast	$3	13	$1	$0
Thompson/Okanagan	$48	239	$23	$10
Vancouver Island and Coast	$84	419	$43	$17
Total	**$494**	**2,461**	**$247**	**$103**

2.4.2 Air Transportation industry baseline

We estimate that in 2019, the Air Transportation industry generated and facilitated approximately $3.7 billion to B.C.'s GDP, the employment of 17,558 individuals on an FTE basis and approximately $1.8 billion in labour income. In addition we estimated that in 2019, Air Transportation generated and facilitated $640 million in tax revenue, of which $382 million was paid to the federal government and the remaining $258 million to B.C. provincial and local governments.

[13] Due to rounding, the totals presented may not always add up to the sum of the items. All tax revenue figures presented in this figure include PIT, CIT as well as taxes on production and products.
[14] All regional impact figures are reported as the sum of direct, indirect and induced impact channels.

Figure 12: Economic footprint of the B.C. Aviation sector - Air Transportation, 2019[15]



The figure below details the total estimated economic footprint of the B.C. Air Transportation industry by economic region.[16]

Figure 13: Total economic footprint of B.C. Air Transportation, by economic region, 2019

Economic region	GDP ($M)	Employment (FTE)	Labour Income ($M)	Tax Revenue ($M)
Cariboo	$97	456	$46	$17
Kootenay	$70	364	$33	$12
Lower Mainland/Southwest	$2,504	11,858	$1,253	$437
Nechako/North Coast	$78	352	$38	$13
Northeast	$53	201	$20	$8
Thompson/Okanagan	$382	1,824	$184	$66
Vancouver Island and Coast	$503	2,502	$250	$88
Total	**$3,688**	**17,558**	**$1,825**	**$640**

The table below details the total estimated provincial economic footprint of the sub-industries that comprise the B.C. air transportation industry.

We estimate that in 2019, the Scheduled Air Transportation sub-industry accounted for the largest portion of the economic footprint generated by the B.C. Air Transportation industry, having generated and facilitated approximately $3.1 billion to air transportation GDP, contributed to the employment of 14,573 individuals on an FTE basis, generated and facilitated approximately $1.5 billion in labour income and approximately $531 million in federal and B.C. provincial tax revenues. For a breakdown of tax revenues by type, refer to **Appendix G**.

Figure 14: Total economic footprint of B.C. Air Transportation, by sub-industry, 2019[17]

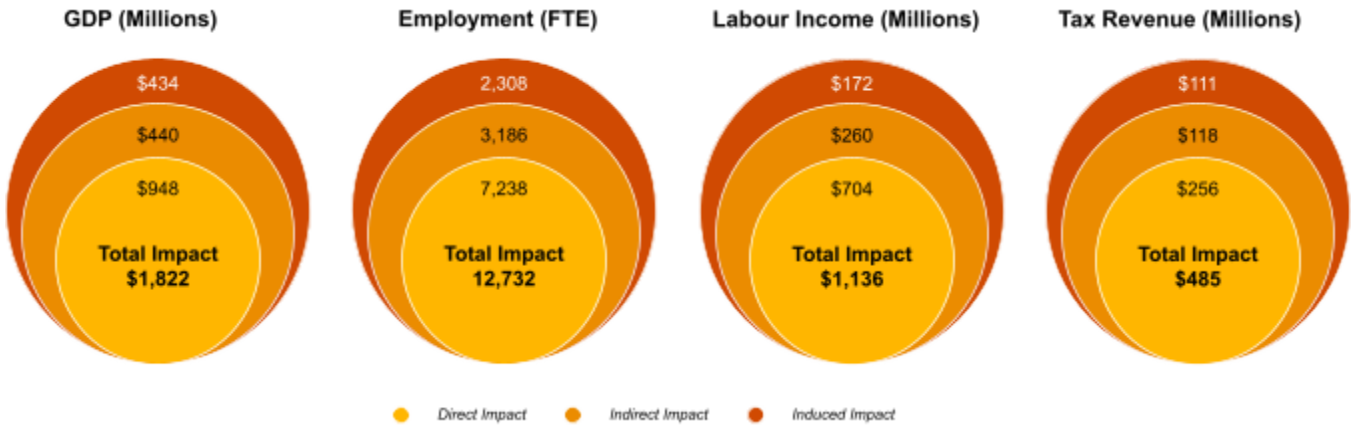
Sub-industry	GDP ($M)	Employment (FTE)	Labour Income ($M)	Tax Revenue ($M)
Scheduled Air Transportation	$3,061	14,573	$1,515	$531
Non-scheduled Chartered Air Transportation	$443	2,107	$219	$77
Non-scheduled Specialty Flying Services	$184	878	$91	$32
Total	**$3,688**	**17,558**	**$1,825**	**$640**

[15] Due to rounding, the totals presented may not always add up to the sum of the items. All tax revenue figures presented in this figure include PIT, CIT as well as taxes on production and products.
[16] All regional impact figures are reported as the sum of direct, indirect and induced impact channels.
[17] Due to rounding, totals for respective sub-industries may not sum to the totals for the air transportation industry. All sub-industry impact figures are reported as the sum of direct, indirect and induced impact channels.

2.4.3 Support Activities for Air transportation industry baseline

We estimate that in 2019, the Support Activities for Air Transportation industry generated and facilitated approximately $1.8 billion to B.C.'s GDP, the employment of 12,732 individuals on an FTE basis and approximately $1.1 billion in labour income. In addition, we estimate that in 2019, Support Activities for Air Transportation generated and facilitated $485 million in tax revenue, of which $283 million was paid to the federal government and the remaining $202 million to B.C. provincial and local governments.

Figure 15: Economic footprint of the B.C. Aviation sector - Support Activities for Air Transportation, 2019 [18]



The figure below details the total estimated economic footprint of the B.C. Support Activities for Air Transportation industry by economic region.[19]

Figure 16: Total footprint of B.C. Support Activities for Air Transportation, by economic region, 2019

Economic region	GDP ($M)	Employment (FTE)	Labour Income ($M)	Tax Revenue ($M)
Cariboo	$58	392	$35	$15
Kootenay	$39	257	$22	$10
Lower Mainland/Southwest	$1,246	8,772	$789	$332
Nechako/North Coast	$58	417	$39	$15
Northeast	$25	160	$14	$7
Thompson/Okanagan	$176	1,199	$105	$46
Vancouver Island and Coast	$220	1,536	$133	$58
Total	**$1,822**	**12,732**	**$1,136**	**$485**

The table below details the total estimated provincial economic footprint of the sub-industries that comprise the B.C. Support Activities for Air Transportation industry.

We estimate that in 2019, the Other Support for Air Transportation sub-industry accounted for the largest portion of the economic footprint generated by the Support Activities for Air Transportation industry, having generated and facilitated approximately $893 million to Support Activities for Air Transportation GDP, contributed to the employment of 6,239 individuals on an FTE basis, generated and facilitated approximately $557 million in labour income and approximately $238 million in federal and B.C. provincial tax revenues. For a breakdown of tax revenues by type, refer to **Appendix G**.

[18] Due to rounding, the totals presented may not always add up to the sum of the items. All tax revenue figures presented in this figure include PIT, CIT as well as taxes on production and products.
[19] All regional impact figures are reported as the sum of direct, indirect and induced impact channels.

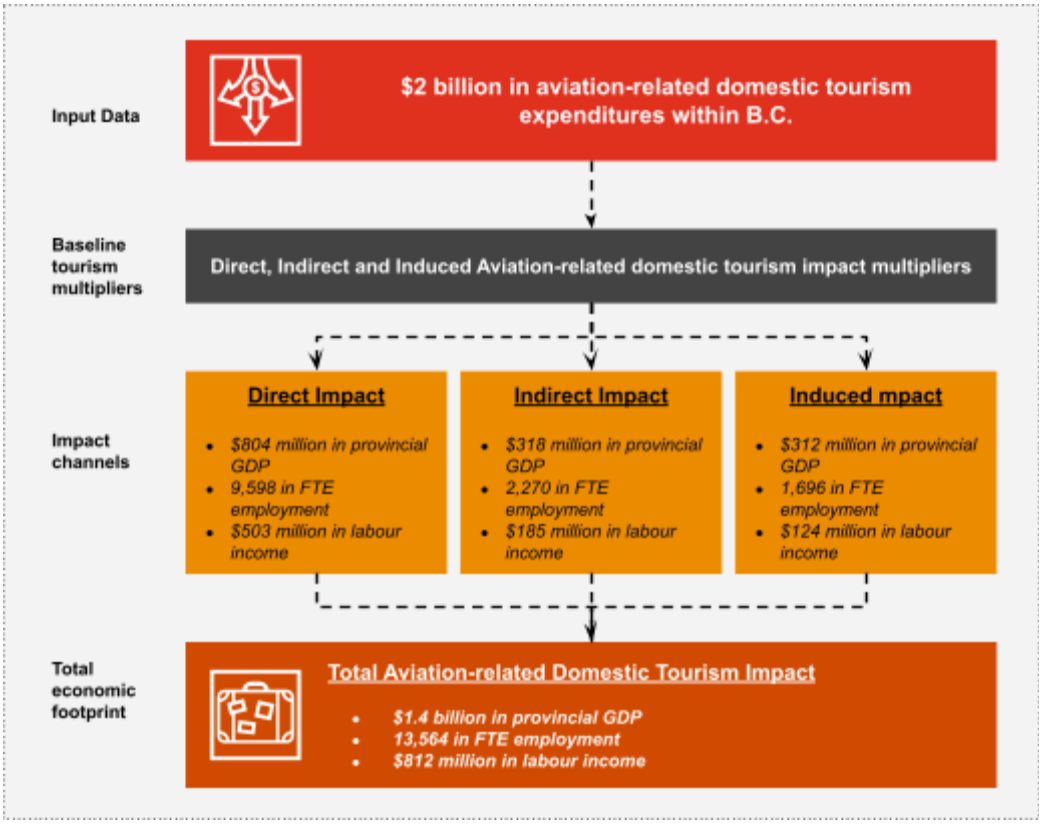
Figure 17: Total economic footprint of B.C. Support Activities for Air Transportation, by sub-industry, 2019[20]

Sub-industry	GDP ($M)	Employment (FTE)	Labour Income ($M)	Tax Revenue ($M)
Air Traffic Control	$201	1,408	$126	$54
Other Airport Operations	$728	5,085	$454	$194
Other Support for Air Transportation	$893	6,239	$557	$238
Total	**$1,822**	**12,732**	**$1,136**	**$485**

2.4.4 Aviation-related tourism baseline[21]

We have also estimated the economic footprint associated with domestic out-of-province tourism activity generated by the B.C. Aviation sector in 2019. The figure below presents an example of the total estimated economic footprint associated with $2 billion in aviation-related domestic tourism expenditures within B.C. in 2019.[22] We estimated that in 2019, this level of expenditure generated and facilitated approximately $1.4 billion in provincial GDP, contributed to the employment of 13,564 individuals on an FTE basis and approximately $812 million in labour income.

Figure 18: Total economic footprint of $2 billion in aviation-related tourism expenditures in B.C., 2019[23]



For a breakdown of the total estimated economic footprint presented above by tourism region, refer to **Appendix D**.

[20] Due to rounding, totals for respective sub-industries may not sum to the totals for the support activities for air transportation industry. All sub-industry impact figures are reported as the sum of direct, indirect and induced impact channels.
[21] We note that the estimated tourism multipliers and the associated examples presented within this section are considered separately from the total estimated baseline economic footprint of the B.C. Aviation sector in 2019. Estimates presented in this section consider aviation-related tourism expenditures within B.C. made by non-B.C. Canadian residents in order to isolate the economic impact that net new tourism expenditure inflows have on the provincial economy.
[22] We note that this figure is based on domestic out-of-province tourism expenditure estimates provided by DestinationBC.
[23] Due to rounding, the totals presented may not always add up to the sum of the items.

2.5 Accounting for COVID-19 impacts

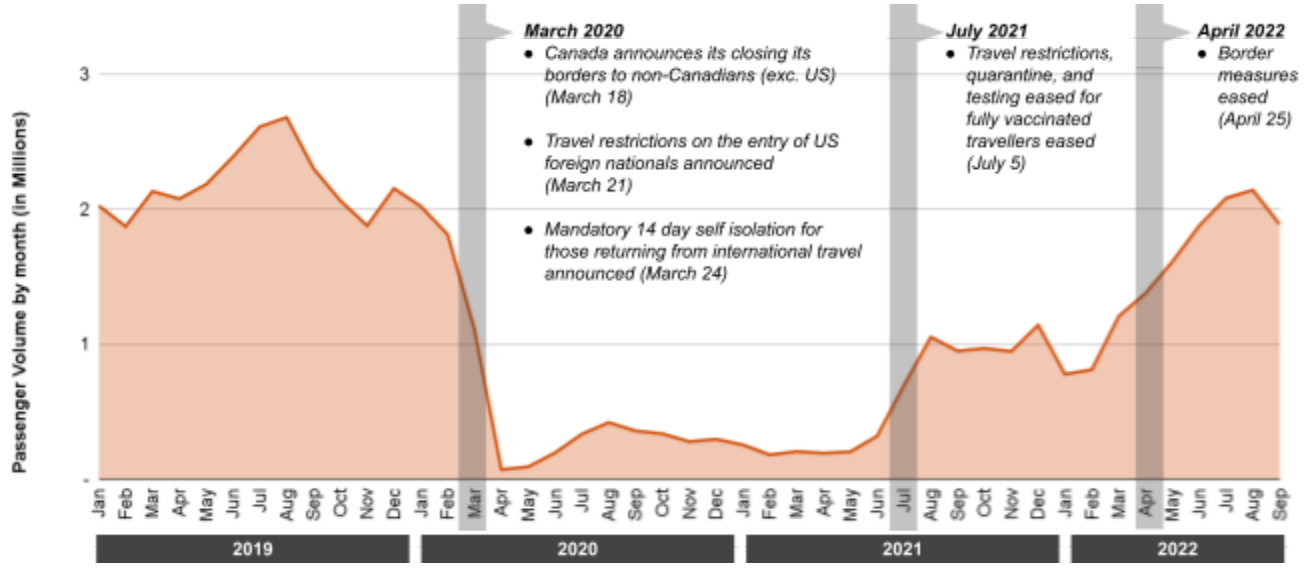
This section includes an overview of the impact that the COVID-19 global pandemic had on the B.C. Aviation sector as well as the industries that comprise the sector including the impacts on air traffic passenger volumes, air cargo volumes, aircraft movements and aerospace products and parts manufacturing industry sales. Estimates of the impact that COVID-19 has had on the B.C. Aviation sector's economic footprint are also included.

2.5.1 Overview

Prior to COVID-19, the B.C. Aviation sector was experiencing steady growth in air passenger traffic, air cargo volumes, aircraft movements and aerospace products and parts manufacturing sales. However, the onset of the global pandemic led to the imposition of significant international and domestic travel restrictions and public health safety measures. With these policies came the closure of Canadian international borders to non-essential travelers, which significantly impacted the B.C. Aviation sector as the demand for international flights halted almost completely and demand for domestic flights also significantly declined. The figures below show monthly passenger volumes from 2019 to 2022, for B.C.'s 5 largest airports.

Following the early onset of the COVID-19 pandemic, monthly passenger volumes at YVR experienced a steep decline of 97% from January to April 2020. By the end of 2020, the decline in monthly passenger volume was 86% (as compared to January 2020). The first half of 2021 saw a similar trajectory with some signs of recovery. Recovery became more pronounced with the ease of travel restrictions for fully vaccinated travelers in July 2021. By August 2021, the drop in monthly passenger volume was 48% in comparison to January 2020. By the summer of 2022, following the easing of border measures in April, travel volumes started to approach pre-COVID levels.

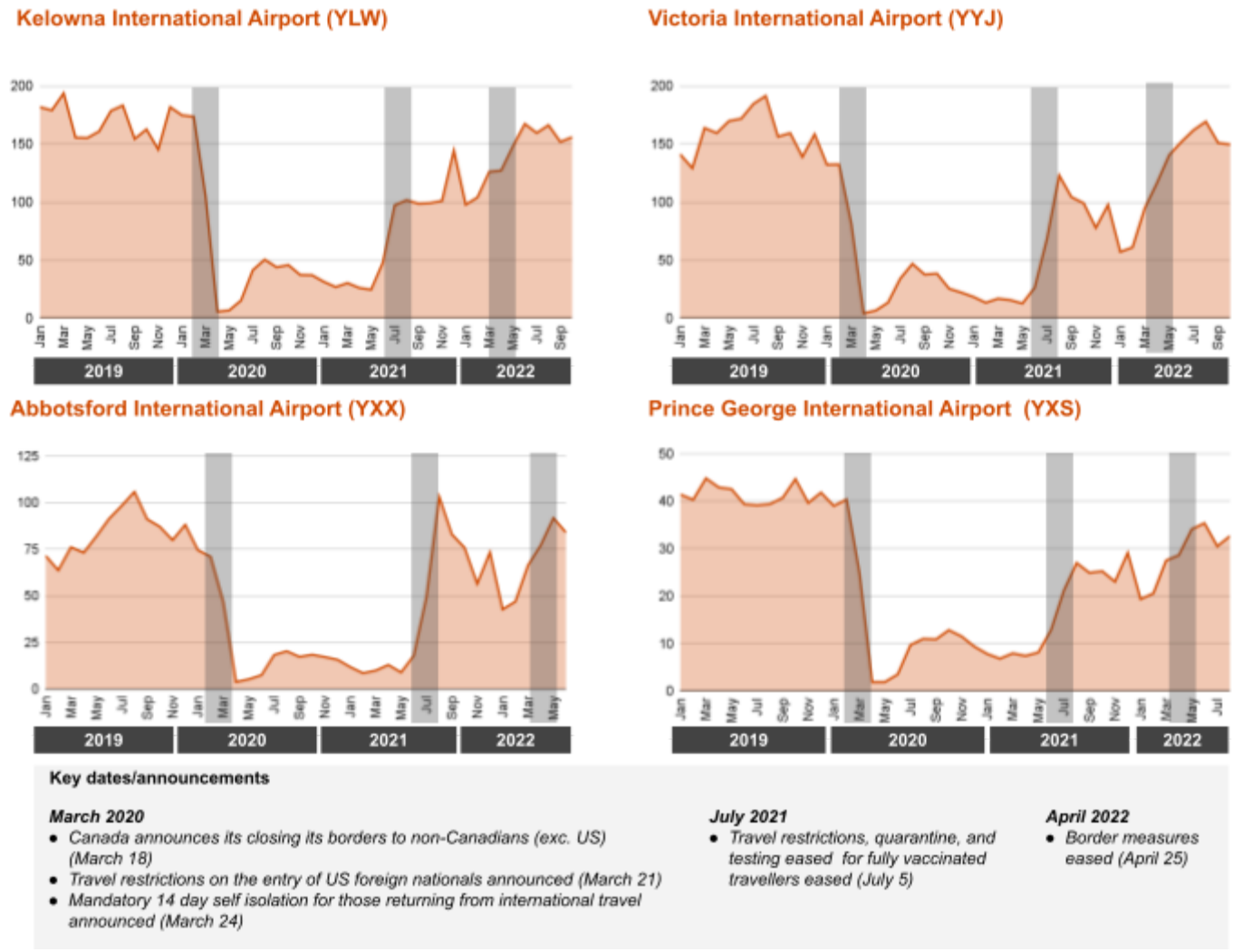
Figure 19: Monthly passenger volumes, Vancouver International Airport (YVR), 2019 - 2022



Source: YVR, Destination BC

The monthly passenger volumes at B.C.'s largest regional airports (excludes YVR) followed a similar trajectory as YVR. Kelowna International Airport ("YLW") and Victoria International Airport ("YYJ") saw a 97% decline in monthly passenger volumes in April 2020 (as compared to January 2020). Abbotsford International Airport ("YXX") and Prince George Airport ("YXS") experienced a 95% drop over the same period. From July 2021, there have been signs of recovery at most B.C airports with scheduled passenger service, consistent with the easing of border measures (as also reflected for YVR).

Figure 20: Monthly Passenger Volumes (in Thousands), Largest regional airports in B.C., 2019 - 2022

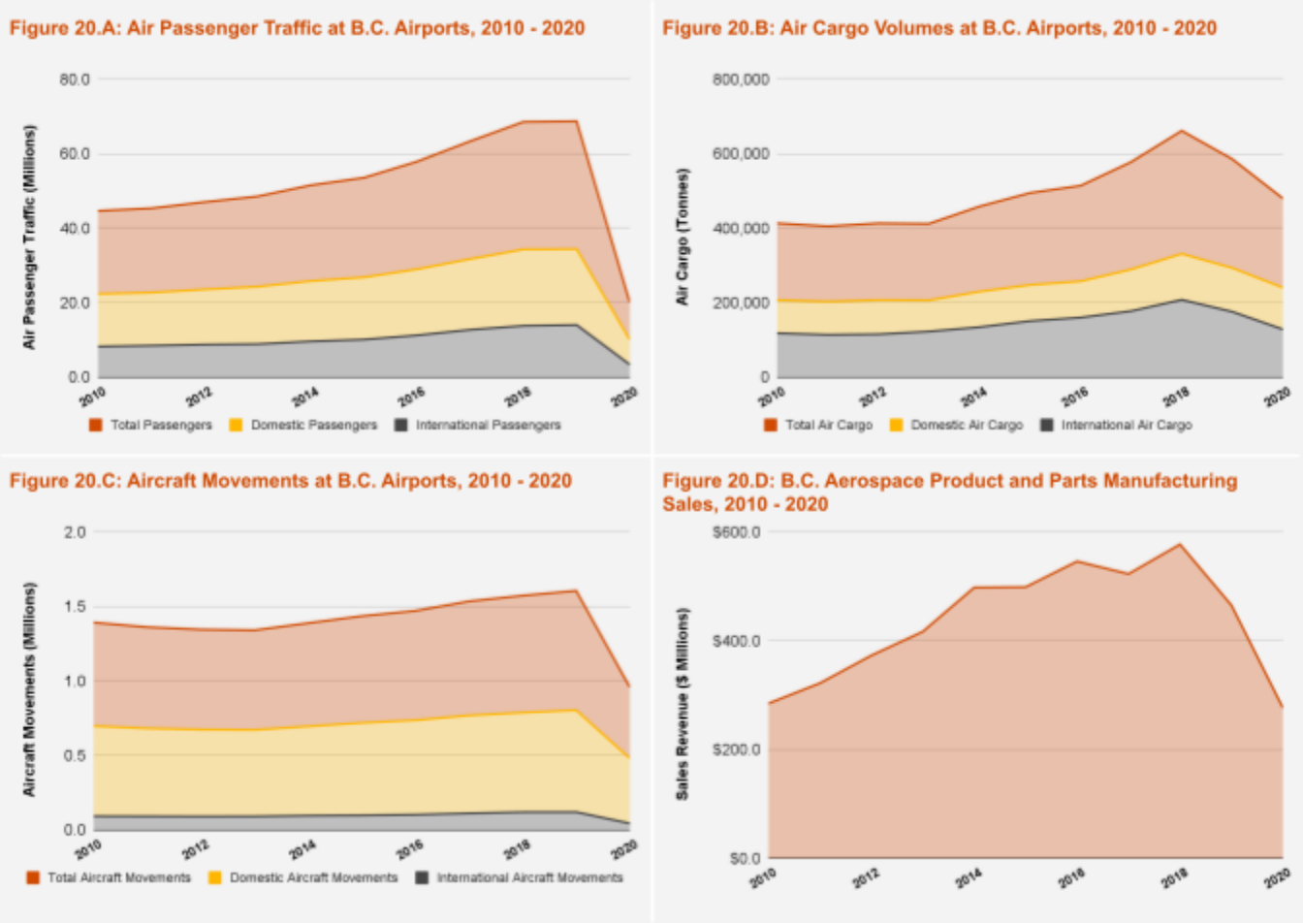


Source: Various B.C. Airports, Destination BC

As a result of the dramatically reduced demand for passenger flights, many aviation operators opted to temporarily halt operations and in some cases, closed permanently. Reduced air traffic also had large spillover impacts throughout the B.C. Aviation sector given the interdependent nature of the industries comprising it. With the volume of flights significantly curtailed, there was an associated reduction in demand for airport and other air transportation support services as well as for both MRO and OEM services.

The panel and table below provide an overview of pre- and pandemic-impacted trends observable across B.C. Aviation sector activity indicators including air passenger traffic, air cargo volumes, aircraft movements and aerospace products and parts manufacturing sales.

Figure 21: B.C. Aviation sector indicators



Source: Statistics Canada, PwC Analysis

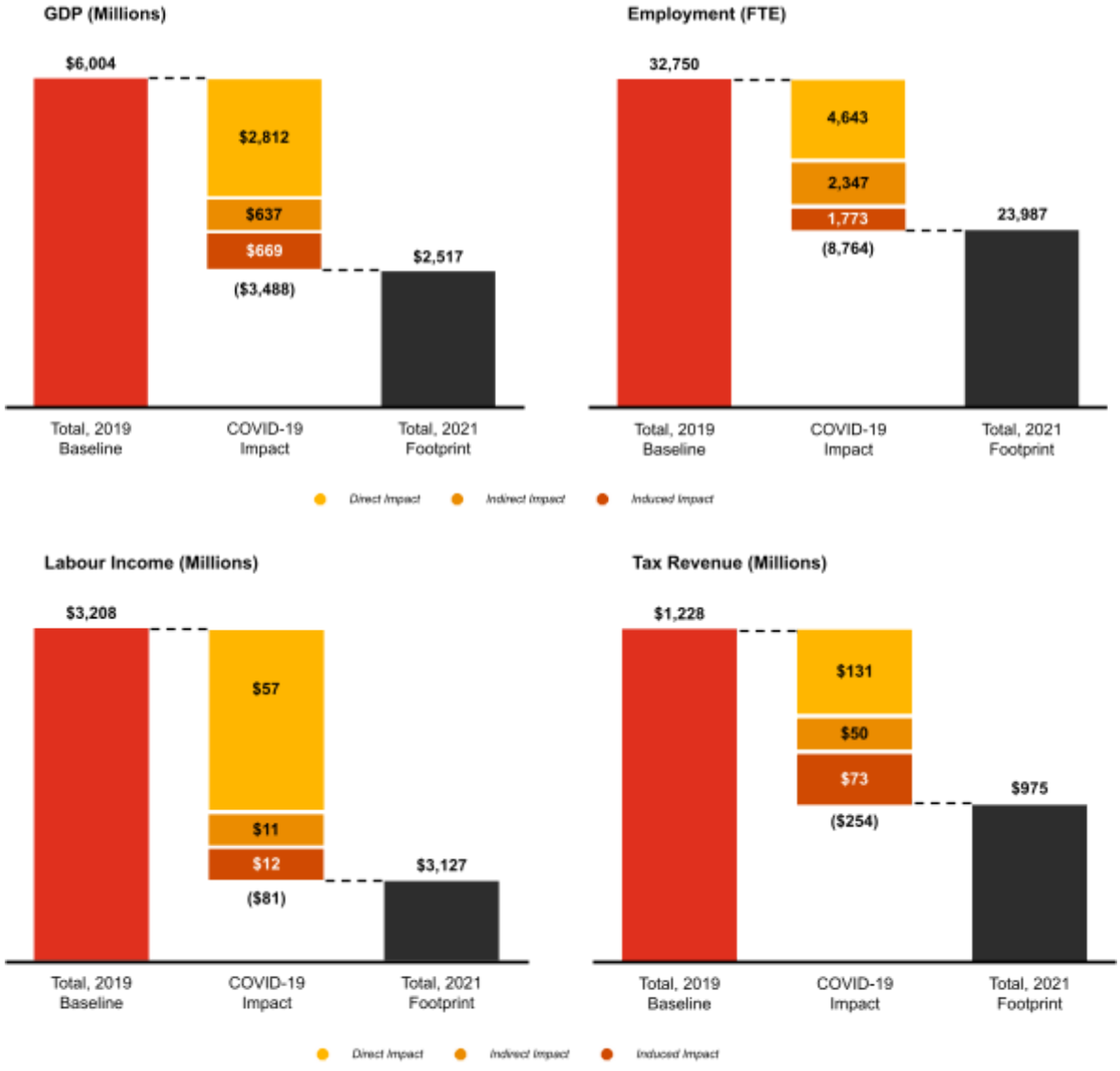
2.5.2 Modelling COVID-19's impacts on the sector footprint

The figure below presents a comparison of the pre-pandemic and pandemic-impacted B.C. Aviation sector total economic footprints in both the 2019 and 2021 calendar years, respectively. For the purpose of this study, the difference between these two economic footprints was defined as the COVID-19 impact.

While COVID-19 caused the B.C. Aviation sector's economic footprint to contract, the sector continues to play a significant role within the provincial economy. We estimated that in 2021, the B.C. Aviation sector generated and facilitated approximately $2.5 billion to B.C.'s GDP (42% of pre-pandemic levels), the employment of 23,987 individuals on an FTE basis (73% of pre-pandemic levels), approximately $3.1 billion in labour income (97% of pre-pandemic levels) and $975 million in federal and B.C. provincial tax revenues (79% of pre-pandemic levels).

For a breakdown of the individual pandemic-impacted economic footprints of the industries that comprise the B.C. Aviation sector, refer to **Appendix H**.

Figure 22: Economic footprint of the B.C. Aviation sector - COVID-19 Impacts[24]



For a full breakdown by economic region of the total pandemic-impacted economic footprint of the B.C. Aviation sector including direct, indirect and induced impacts, refer to **Appendix F**.

[24] All tax revenue figures presented in this figure include PIT, CIT as well as taxes on production and products.

3. Wider socio-economic contributions

Key insights

- *B.C.'s Aviation sector facilitates trade, investment, and tourism and employs high-skilled workers across a range of occupations and aviation industries.*
- *In recent years, the sector has played a crucial role in facilitating emergency response services and regional connectivity during the COVID-19 pandemic and in the face of natural disasters.*

3.1 Summary

This section details the wider socio-economic contributions made by B.C.'s Aviation sector, as informed by a combination of stakeholder interviews and secondary research.B.C.'s Aviation sector plays a critical role by connecting B.C. to the world, Canada, and its own regions. In doing so, B.C.'s Aviation sector facilitates trade, investment, and tourism. The sector employs high-skilled workers across a range of occupations and aviation industries. The sector has played a crucial role in facilitating emergency response services and regional connectivity during the COVID-19 pandemic and in the face of recent natural disasters such as wildfires and floods. Additionally, the sector is supporting Canada's and B.C.'s transition to net zero by investigating and implementing a range of technologies aimed at lowering its carbon footprint.

Figure 23: Summary of wider socio-economic contributions of B.C.'s Aviation sector

Wider socio-economic contribution	Description The *B.C. Aviation sector…*	Most relevant Aviation Industries	COVID-19 impacts The *B.C. Aviation sector…*
Economic growth spin-offs	Enhances the economic prosperity of the province by connecting B.C. to the rest of the world, facilitating the flow of people, goods, and investment, and promoting trade and tourism	• Air Transportation • Support Activities for Air Transportation • Aerospace Product and Parts Manufacturing	Witnessed a marked decline in demand for passenger air transport services across all markets, which dampened B.C.'s trade, investment and tourism activity
Emergency management	Plays a vital role in provincial emergency management operations, including the transportation of people, medical supplies, fire suppression, and emergency relief	• Air Transportation • Support Activities for Air Transportation	Was instrumental in emergency response activities, including the distribution of COVID-19 vaccines, tests, patients, and through wildfire suppression and flood relief operations
Regional connectivity	Provides critical links to hard-to access areas throughout the province, including a large number of remote Indigenous communities and job sites in the resource sector	• Air Transportation • Support Activities for Air Transportation	Maintained connectivity to remote regions (including health care support), despite an almost complete stoppage in scheduled air passenger transportation
Skills development	Provides a diverse range of high-skilled employment opportunities and technical training, enhancing the province's skilled labour pool	• Aerospace Product and Parts Manufacturing • Support Activities for Air Transportation	Faced uncertainty as a result of reduced demand for aviation services, layoffs, and impact of lockdowns
Sustainability	Is exploring and implementing a range of technological and operational options to support a path to decarbonization	• Air Transportation • Aerospace Product and Parts Manufacturing	Has focused on progressing sustainable aviation fuels ("SAF"s) and hydrogen and electric propulsion research to support a sustainable economic recovery

3.2 Economic growth spin-offs

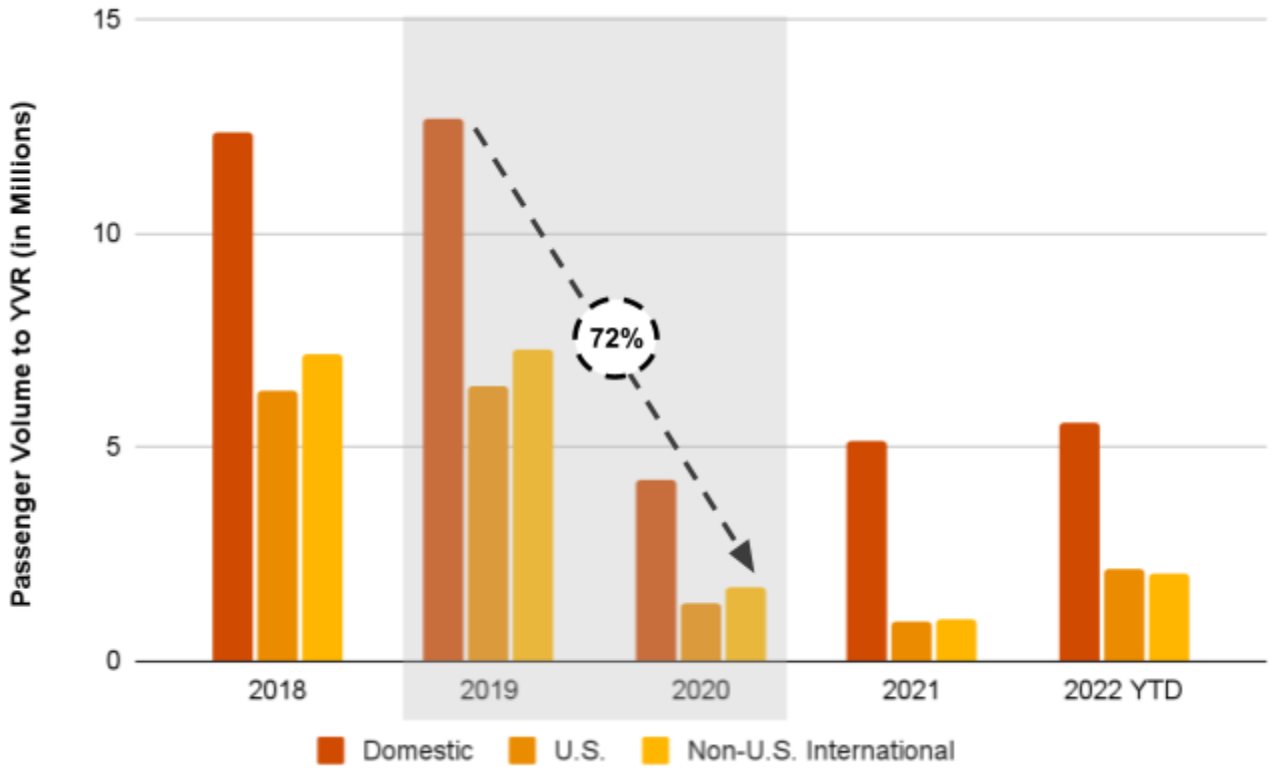
B.C.'s Aviation sector acts as a catalyst in the growth of B.C.'s economy by providing infrastructure that facilitates the movement of people and goods. In doing so, the sector is an integral element of B.C.'s tourism sector and trade activity. Additionally, the manufacturing elements of the sector are highly Research and Development ("R&D") intensive, with Canada's aerospace being top ranked in terms of R&D intensity among all manufacturing industries consistently for several years.[25]

3.2.1 Tourism

B.C.'s Aviation sector is a critical enabler of tourism by connecting B.C. cities to the rest of the world, Canada, and to each other. In addition to providing the key gateways for tourists to enter B.C., the sector provides unique experiences to visitors such as heli-skiing and aerial sightseeing tours (offered by both fixed-wing and helicopter operators throughout the province), which enhance the appeal of B.C. as a tourist destination.

In 2019, the passenger volume at YVR consisted of approximately 12.7 million domestic passengers, 6.4 million passengers from the U.S., and about 7.3 million passengers from other international regions.[26] As shown in the figure below, the COVID-19 pandemic heavily impacted B.C.'s tourism industry, which experienced a steep decline in international travelers entering the province by air.

Figure 24: Passenger volume to YVR, by Origin



Source: Destination BC
Note: 2022 YTD reflects year to date until July 2022

[25] Source: State of Canada's Aerospace Industry Report 2021.
[26] Based on data from Destination BC - Tourism Dashboard, PwC Analysis
Provided by the Vancouver International Airport, the data reports the total enplaned and deplaned passengers at YVR each month by country/region of origin; the update is available monthly.

As detailed in **Section 2**, on a monthly basis YVR (and most B.C. airports) experienced a drastic decline in passenger volumes (a 90%+ decline in April 2020, compared to January 2020). Between 2019 and 2020, the total passenger volume to YVR (from domestic, U.S. and non-U.S. international regions) decreased by 72%. 2021 saw recovery for domestic passenger volume to YVR, whereas U.S. and other international passenger volume to YVR continued to decline. In 2022 YTD, total passenger volume to YVR from all from all origins exhibited recovery, exhibiting an increase of 38% compared to 2021.

B.C.'s aviation sector enhances the province's tourism by making a range of aviation-tourism offerings possible. The province hosts more than 20 heli-skiing operations, with approximately 44,000 heli-skiers visiting B.C.'s mountains each year. During COVID-19, the heli-ski industry was heavily impacted by the lack of recreational travel and pandemic-related travel restrictions. According to HeliCat Canada's 2020 Annual Report, 2019-20 was the worst helicopter and snowcat skiing season ever, which has traditionally relied on international visitors.[27] Seaplane and helicopter tours offered throughout the province are also key tourism offerings made possible by B.C.'s aviation sector.

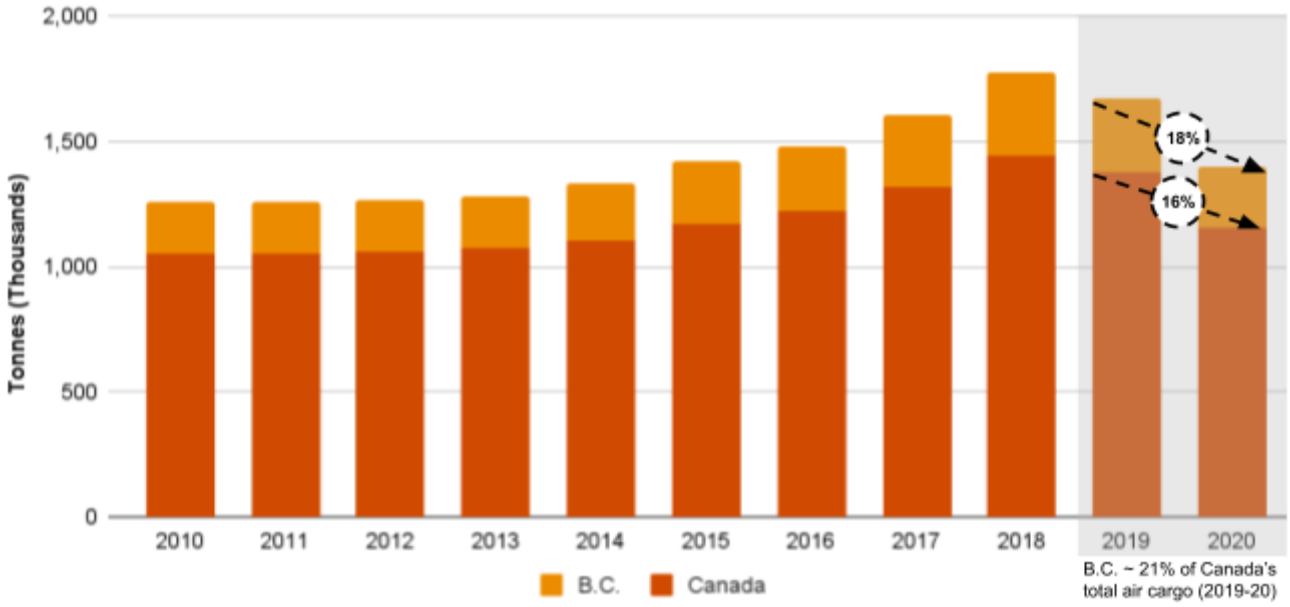
3.2.2 International trade

The aviation sector provides strong trade infrastructure to capitalize on B.C.'s unique geographic features and economic strengths. B.C. and Vancouver are strategically located near the U.S. Pacific Northwest aerospace cluster and act as Canada's gateway to the Asia-Pacific region. The largest airport in the province, YVR connects the province to a total of 109 non-stop domestic and international destinations, aiding the flow of goods from B.C. to global markets.

Air freight services play a critical role in expanding B.C.'s ability to market and export its locally sourced goods and services, particularly in Asia where high value and/or time sensitive B.C. goods such as seafood products, are in high demand. Air freight services are essential in enabling the delivery of perishable products and time-sensitive orders including seafood and agricultural produce such as cherries, berries, and vegetables, from B.C.'s regions to international markets.

Total air cargo traffic at Canadian airports was approximately 1.4 million tonnes in 2019, of which B.C. accounts for 21%. In 2020, following the onset of the COVID-19 pandemic, Canada and B.C. experienced a 16% and 18% year-over-year decrease in air cargo traffic respectively. Air cargo traffic volume at Canadian airports from 2010 to 2020 is depicted in the figure below.

Figure 25: Annual air cargo traffic at Canadian airports, 2010 - 2020[28]



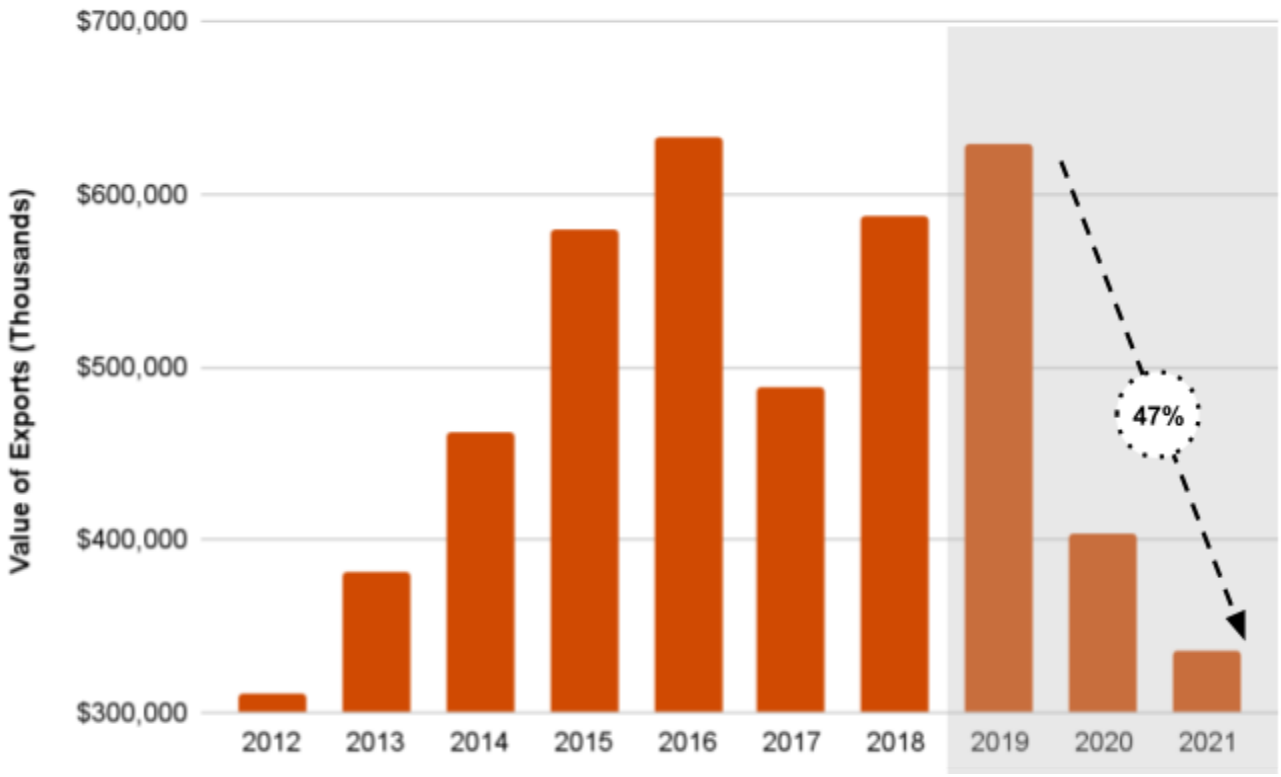
Source: Statistics Canada, Table: 23-10-0254-01: Air cargo traffic at Canadian airports, annual
Note: Data not available post-2020

[27] Based on data from CBC, HeliCat Canada
[28] Based on data from Statistics Canada

The sector not only facilitates trade through air cargo, the manufacturing elements of the sector are also significant contributors to B.C.'s export base. Total B.C. aerospace products and parts manufacturing exports valued on average at approximately $481 million between 2012 and 2021. During this period, the U.S. has consistently ranked first as B.C.'s top aerospace product and parts manufacturing trading partner in terms of exports value, representing on average approximately 40% of B.C.'s exports. Germany, Japan, and Australia are B.C.'s next largest international destinations for aerospace exports.

Leading up to the pandemic, B.C.'s aerospace manufacturing exports were on a strong trajectory, growing by 102% from 2012-2019 and expanding its exports outside of North America.[29] The figure below demonstrates this strong growth prior to a sharp decline in 2020 (47% from 2019-2021).

Figure 26: B.C. Aerospace products and parts exports, 2012 - 2021



Source: Trade Data Online, Statistics Canada

3.2.3 Innovation

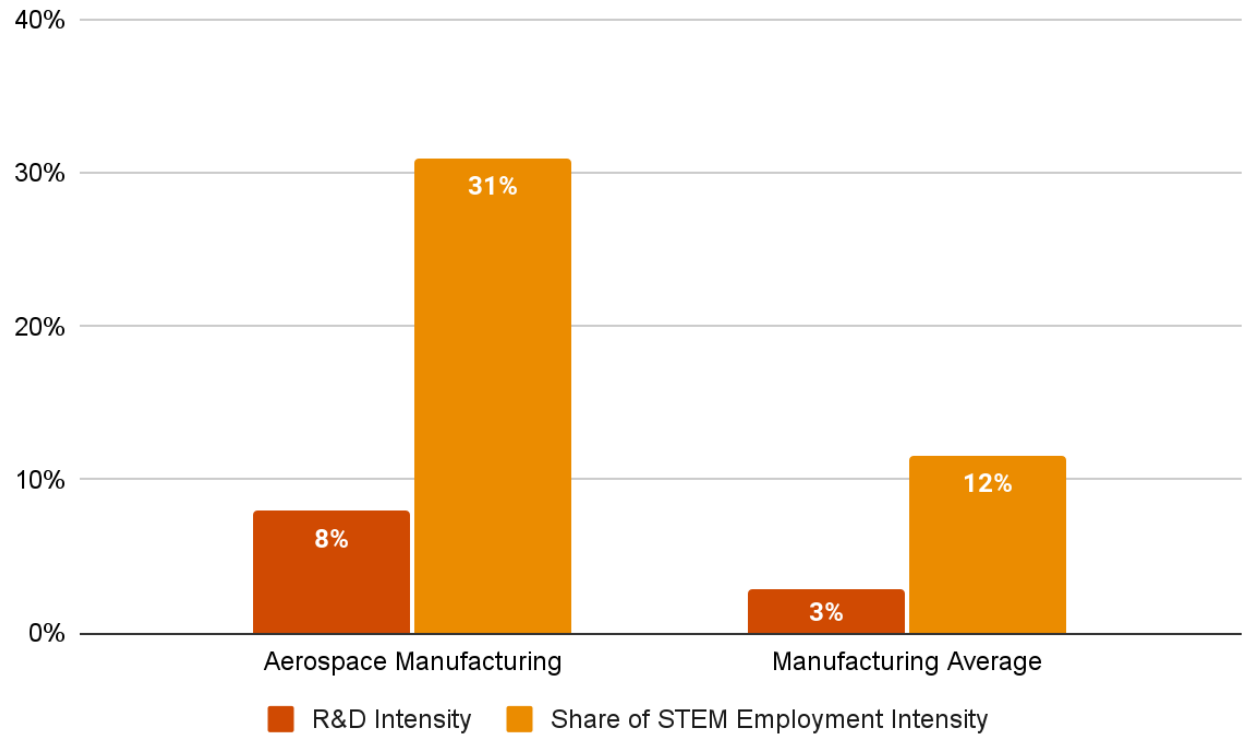
Aerospace is an R&D-intensive industry that accounts for a large share of Canada's R&D spend. Canada's aerospace industry invested $710 million in R&D in 2021. Although there was a 30% decline from aerospace R&D spend in 2019, aerospace maintained its top R&D ranking (in terms of R&D intensity) among all manufacturing industries in 2021, after being the top ranked consistently in both 2019 and 2020.[30]

With continued commitment to R&D, Canada's aerospace industry is surpassing the manufacturing average by approximately 50% in the use of advanced technologies, especially among small and medium enterprises.[31] In addition to driving innovation in the aviation sector, the R&D spend is facilitating the transition to net-zero emissions through the development of hydrogen and electric propulsion technologies throughout Canada and B.C.

[29] Based on data from Trade Data Online, Statistics Canada. Value of exports in thousands of Canadian dollars
[30] Source: State of Canadian Aerospace Industry, 2021
[31] For more information on the definition of advanced technologies, refer to State of Canadian Aerospace Industry, 2019

R&D intensity is calculated using the ratio of R&D to GDP in a given sector. STEM ("Science, Technology, Engineering, and Mathematics") employment intensity is the share of aerospace industry's STEM employment.[32] The aerospace industry performs well across both of these metrics, relative to the manufacturing average, as shown below.

Figure 27: Share of STEM employment intensity and R&D intensity, 2021



Source: State of Canada's Aerospace Industry Report 2021

Canada's aerospace manufacturing R&D and STEM intensity is over 2.5 times higher than the national manufacturing average in 2021. B.C.'s aerospace industry is also globally reputed as a leading hub for innovation with local aerospace companies considered to be globally competitive and having gained recognition for delivering highly specialized products and services.[33]

Whereas Canada's aerospace industry as a whole is primarily driven by the manufacturing sector, B.C.'s aerospace focus is in MRO, avionics, and communications systems, as well as possessing niche market capability in turboprop manufacturing, a market segment well suited for innovation in alternative propulsion technologies (e.g. electric and hydrogen as mentioned above). One of the objectives of the Aerospace Industries Association of Canada ("AIAC") in B.C. is to continue to enhance the R&D capabilities of B.C.'s aerospace sector by capturing a higher share of national research spend.[34] There were global implications of the COVID-19 pandemic on innovation and technological adoption within the aviation sector. The pandemic highlighted that technological competitiveness is no longer an option but a pathway to build resilience. Several new technologies and automation solutions were adopted during the pandemic across multiple industries comprising the sector, such as touchless processes at airports, ultraviolet technologies for disinfection of airport cabins, and biometric check in systems.[35]

[32] Source: State of Canadian Aerospace Industry, 2021
[33] Source: Trade and Invest B.C.
[34] Source: AIAC Pacific
[35] Source: Science Direct (COVID-19 pandemic and innovation activities in the global airline industry: A review)

3.3 Emergency management

Air transport services are critical for emergency response operations such as patient transfers, transportation of medical supplies, test samples and aid, medevac services, wildfire management and flood relief assistance.

3.3.1 Transportation of medical supplies

B.C.'s Aviation sector plays a vital role in the transport of medical supplies throughout the province, which has taken on an outsized role in the distribution of COVID vaccines, tests, Personal Protective Equipment ("PPE") and various medical equipment and supplies during the pandemic. B.C.'s Provincial Air Services Branch was stood up under the Provincial Emergency Coordination Centre ("PECC") in Emergency Management BC ("EMBC") on two occasions since 2020. One of these two occasions was during the early onset of COVID-19, supporting the transport of supplies to B.C.'s regions. During the COVID-19 pandemic, the B.C. government deployed aircraft to support transportation of vaccines, tests, PPE (as well as clinical personnel) to remote locations and communities. Helijet aircraft were used to transport vaccines and offered no charge flights for healthcare responders between Vancouver and Vancouver Island terminals in Victoria and Nanaimo. Air Canada modified their aircraft to support transportation of critical medical supplies, vaccines and cargo within Canada.[36]

3.3.2 Air ambulance services

The B.C. Emergency Health Services ("BCEHS") air ambulance program has a dedicated fleet of 16 helicopters and fixed-wing aircraft. Air ambulances facilitate crucial hospital patient transfers and respond to 911 emergency calls, transporting more than 7,300 patients each year. In addition to dedicated aerial assets, BCEHS can access 35 air carriers based on need. Dedicated aircraft bases include Vancouver, Kelowna, Kamloops, Prince George, Nanaimo, Fort St John and Prince Rupert/Seal Cove.

In response to the pandemic, BCEHS aviation deployed five dedicated aircraft (three fixed wing and two helicopters) and additional 2 temporary fixed wing aircraft. The figure below illustrates the sum of statute miles and number of patients transported through calendar years 2019 to 2021, demonstrating a marked increase in statute miles from 2019 to 2021.[37]

Figure 28: BCEHS Statute Miles and number of patients transported, 2019 - 2021

Metric	2019	2020	2021	2019-2021	
				Growth	% Growth
Statute miles flown	2,470,187	2,581,001	3,075,870	605,683 miles	24.5%
Total hours	3,511.8	3,201.8	4,301.9	790 hours	22.5%
Number of patients	7,571	7,251	8,737	1,166 patients	15.4%

Source: BC Emergency Health Services

[36] Source: Helijet, Elite Logix & Simple Flying
[37] Based on data from BCEHS

3.3.3 Wildfire management

B.C.'s Aviation sector is instrumental in detecting, managing and responding to wildfire threats in the province. Under B.C.'s Emergency Program Act legislation, the B.C. Wildfire Service is charged with responsibility for coordinating the province's aviation response to catastrophic events. This includes procuring flights and fuel services to support B.C. government ministries, agencies as well as regional communities. Assets such as helicopters and air tankers are an essential part of the wildfire detection and response in B.C. They facilitate the ground crews and provide logistical, evacuation and transportation support for crew and supplies along with mitigating loss to the natural environment. The Wildfire Service in B.C. has a fleet of approximately 40 aircraft with the option of deploying more if needed.[38]

Approximately 4,300 square kilometers (10-year average) of the province's landmass is damaged by wildfires each year.[39] In 2021, B.C. experienced the third worst wildfire season in terms of the area of land burned, with areas such as Lytton, Kelowna, Kamloops and Vernon being heavily hit. More than 1,600 fires burned nearly 8,700 square kilometers of land.

A state of emergency was declared in the province and Canadian Armed Forces aircraft and helicopters provided airlift support to transport personnel and equipment and evacuate people from areas affected by the fire.Abbotsford-based Conair Group has a fleet of 70 aircraft,[40] and their Single Engine Air Tankers "SEAT" played an important role in the containment of the B.C. 2021 fires.[41]Additionally, an aviation company based in Port Alberni, B.C.,Coulson Aviation signed a five-day contract to bring in their water bombing helicopters to fight fires in B.C.'s Interior in the 2021 fire season.

3.3.4 Flood relief

Aviation assets also play a key role in responding to floods in B.C., as demonstrated when the province experienced heavy flooding in late 2021.The second occasion on which the B.C.'s Provincial Air Services Branch was stood up was during the 2021 floods season, to facilitate flood relief operations and maintain connectivity between regions within B.C. The floods displaced thousands of people and damaged major transportation infrastructure. The associated efforts to evacuate and supply affected areas were performed by various private, commercial and military aircraft. More than 500 Canadian Armed Forces personnel, and some aircraft, both fixed wing and helicopters were deployed for the relief mission.[42]

Before the Canadian Armed Forces could reach isolated parts of B.C., groups of volunteer pilots, mainly from the Fraser Valley, flew back and forth to evacuate people and provide essential supplies. Volunteers were members of local flying clubs based in the Lower Mainland and Vancouver Island. Airlines such as Air Canada and WestJet also assisted in the flood relief efforts, increasing cargo capacity and using larger aircraft to accommodate more people and supplies.

[38] Source: B.C. Wildfire Service

[39] Source: B.C. Wildfire Service: Wildfire Averages & Wildfire Season Summary

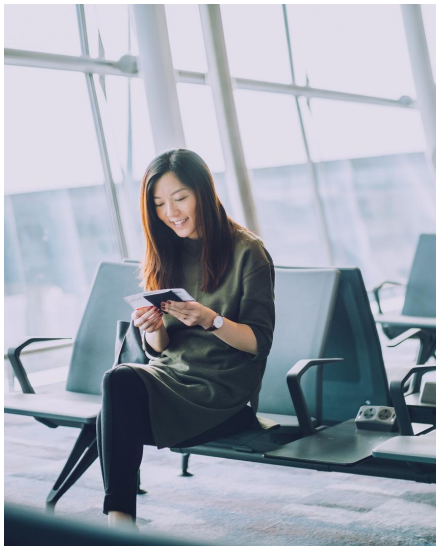
[40] Source: Conair Air

[41] Source: Canadian Aviator 2021

[42] Source: Vertical Mag

3.4 Regional connectivity

B.C.'s mountainous terrain and rugged geography result in limited accessibility to remote regions of the province. Aviation connects B.C.'s regions by providing reliable inter-connectivity to these regions that are otherwise inaccessible by surface transport. Remote and isolated communities (which in many cases across the province are Indigenous) rely on the B.C. Aviation sector to receive basic necessities, medical supplies as well as emergency services including medevac, wildfire fighting and policing. In doing so, the sector is an active contributor to the reduction of spatial justice inequalities across B.C.'s regions.



3.4.1 Emergency services and healthcare support

Regional airports provide significant value to remote communities. Small facilities such as Dease Lake Airport ("YDL") in the northwest provide a pathway of access to residents and visitors alike. YDL acts as a staging area for mining operations and also enables medevac services for the Highway 37 corridor.[43]

During the height of COVID-19, the reliance that rural and remote communities had on the B.C. Aviation sector was brought into light, as many regional airline operators largely reduced or completely halted service resulting from imposed travel restrictions and public health measures. Despite an almost complete stoppage in scheduled air transportation, regional airports and operators in Northern and interior B.C. stayed open to receive medevac and other emergency flights and provided additional critical healthcare support by providing charter services to fly healthcare professionals, blood samples and COVID-19 vaccines into remote Indigenous communities from the Lower Mainland. During the pandemic, Northwest Regional Airport in Terrace was the only airport in Northwest B.C. to offer medevac services and was responsible for dispatching these services to other communities in the region, such as Prince Rupert and Smithers.

In addition, during COVID-19, some regional airports continued to act as hubs for wildfire fighting services for the B.C. Ministry of Forests as well as Royal Canadian Mounted Police ("RCMP") emergency operations. Prior to the pandemic, Cascadia Air had planned to commence air-taxi commute services in February 2020 to provide better connections for remote communities to B.C. However, following the onset of COVID-19, Cascadia leveraged its new flight operations to fly essential services personnel and medical supplies to small and rural regions.[44]

3.4.2 Partnerships with rural communities

Several business ventures have been established by airlines operating B.C., aimed at increasing connectivity within the province. For example, in 2018, WestJet partnered with Pacific Coastal Airlines, a B.C. based regional airline, to introduce WestJet Link. Operated by Pacific Coastal Airlines, WestJet Link connects regional cities in B.C. and Alberta through the provision of feeder flights to WestJet's domestic hubs in Calgary and Vancouver. Within B.C., WestJet Link provides non-stop flights from Vancouver to Cranbrook, Comox, Kamloops, and Nanaimo. Expanding on this existing relationship, WestJet and Pacific Coastal Airlines launched an interline in October 2022, optimizing connecting times as visitors can buy tickets through either airline for any travel that involves connecting flights on their network. WestJet has also added the regional route between Penticton and Vancouver on WestJet Link, beginning in February 2023. This route will enhance the intra-BC connectivity for remote communities and local businesses.[45]

Another example is Iskwew Air, which entered into a partnership with YVR to foster connectivity across B.C. communities as well as to work together towards a sustainable ecosystem. The agreement also highlights the vision to support the development of Indigenous businesses. Iskwew Air started its first commercial flight in 2021 and connects Vancouver and Qualicum Beach on Vancouver Island.[46]

[43] Source: B.C. Aviation Strategy
[44] Source: Trade and Invest B.C.
[45] Source: Pacific Coastal WestJet Link, Pacific Coastal Interline & WestJet
[46] Source: YVR

3.5 Skills development

B.C.'s Aviation sector supports high-skilled employment and training opportunities in a diverse range of technical and support occupations. B.C. hosts several aviation-specific education and training programs, enhancing the province's skilled labour pool.

3.5.1 B.C. Aviation training programs

B.C. hosts 37 licensed flight schools and aviation-specific training programs for a variety of career paths across a range of aviation focused occupations and industries.[47] The British Columbia Institute of Technology ("BCIT"), one of the largest aviation training schools in Canada, provides courses for pilot training, and aviation management and operations. The Aerospace Technology Campus of BCIT has a 40,000 square feet hangar with its own fleet, aiding hands-on training during the course of the aviation programs.[48]

Okanagan College offers a combination of programs aimed at pilot training and other technical occupations within the aviation sector. Several other institutes offering programs for occupations across the aviation sector include the University of Fraser Valley, Northern Lights College, Selkirk College and Coastal Pacific Aviation. There are several pilot training facilities within B.C. such as the Pacific Flying Club, one of the leading flying schools, which has collaborated with BCIT to deliver a comprehensive pilot training curriculum that focuses on aviation specific knowledge as well as flight training.[49] A sample of other notable training simulators across the province include KF Aerospace, which supports Royal Canadian Air Force ("RCAF") pilot training and works closely with BCIT and Okanagan College, and Chinook Helicopters which offers airplane and helicopter pilot training programs. In addition, the University of British Columbia's Sauder School of Business offers an Air Transportation course covering topics such as: air transport management including: demand analysis, sales and marketing, globalization trends, aircraft selection and fleet planning; airport economics and management.[50]

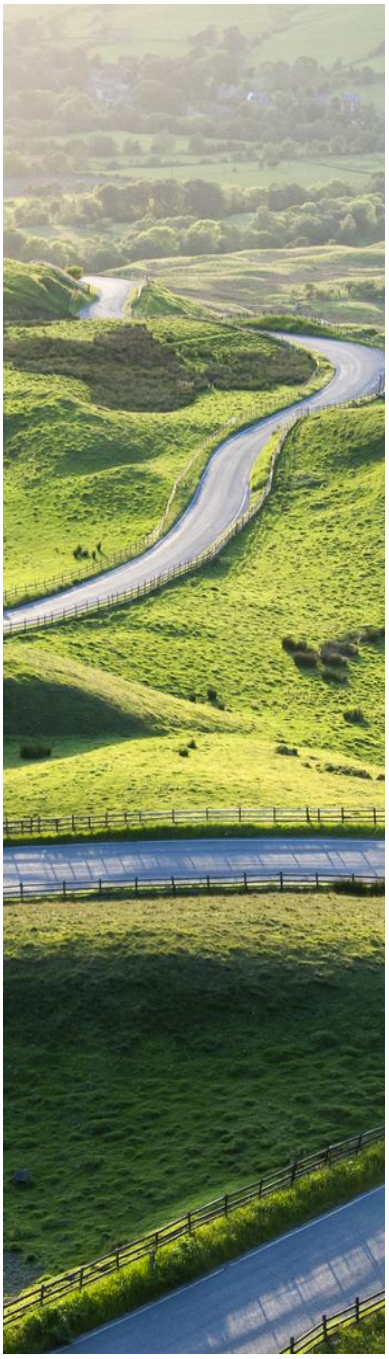
Relative to Canada, B.C.'s aviation labour market exhibits high productivity levels; both air transportation and aerospace product and parts manufacturing industries have exhibited the second highest labour productivity growth rates among all provinces at approximately 3% and 5% respectively between 2010 and 2019 (in Compound Annual Growth Rate terms). In addition, air transportation average weekly earnings remain approximately 15% above aggregate provincial average weekly earnings and approximately 10% above Canadian industrial average weekly earnings between 2010 and 2018.[51]

[47] Source: British Columbia Aviation Council, BC General Aviation Association
[48] Source: BCIT
[49] Source: Okanagan College, BCIT
[50] Source: UBC
[51] Based on data from Statistics Canada Table 36-10-0480-01

3.6 Sustainability

The global aviation sector is pivoting towards a decarbonization pathway, with efforts aimed at reducing carbon emissions from aviation. B.C.'s Aviation sector is exploring alternative fuel and engine options, namely sustainable aviation fuels as well as electric and hydrogen propulsion.

3.6.1 Net-zero prioritization



In 2021, International Air Transport Association ("IATA") approved a resolution for the global air transport industry to reach net-zero carbon emissions by 2050, centered on a combination of the use of Sustainable Aviation Fuel ("SAF"), electric or hydrogen propulsion solutions, consistent improvement in operational efficiency and the use of approved offsets including carbon capture and storage technology.[52]

B.C. airports are supporting this transition to achieve net-zero emissions. Vancouver International Airport ("YVR") expects to invest $135 million over the next decade to achieve its net-zero commitment by 2030. Kelowna International Airport ("YLW") has also committed to achieve carbon neutrality by 2030. Victoria Airport Authority ("VAA") has already reduced its emissions by 22% and committed to becoming carbon neutral by 2030. Nanaimo Airport Commission is also striving to become carbon neutral in its operations and over the last decade has launched several programs aimed at addressing climate change.[53]

Airlines including Air Canada and Westjet have committed to achieving net-zero emissions by 2050. Canada's first company to fly an electric seaplane, Harbour Air plans to produce zero emissions from aviation by 2040. Helijet is also a proponent of the transition to sustainable solutions, and has completed the Climate Smart certification program which is aimed at helping businesses reduce their greenhouse gas emissions. Global aerospace company Airbus, with operations in Canada and B.C., is aligning their activities to support the aviation sector goal of achieving net zero emissions by 2050.[54]

3.6.2 Sustainable Aviation Fuels ("SAF"s) and "green" propulsion technologies

SAF is the main term used to define an aviation fuel that is not derived from fossil fuel sources. This sustainably produced fuel can reduce emissions during its full lifecycle, and can be instrumental in the decarbonization pathway as biofuels can be directly substituted for fossil fuels.[55]

In 2019, BioPortYVR was launched by YVR in partnership with The Green Aviation Research and Development Network ("GARDN"), SkyNRG and Waterfall Group, to drive the SAF initiative development. BioPort YVR produced a feasibility study that found YVR to be a suitable location to facilitate production and use of SAF. Factors that contribute to this include the availability of sustainable feedstock (sustainable canola, waste oils and fats), and logistical infrastructure in B.C. Additionally, YVR does not require new investments in fuel distribution-related infrastructure to receive SAF. Major airlines such as Air Canada and WestJet support the regional approach for producing SAFs in Canada.[56]

We note that due to data limitations, 2019 average weekly earnings data for B.C. air transportation is not available.

[52] Source: IATA Fact Sheet

[53] Source: YVR Strategic Plan, YLW GHG Emission Reduction Policy, YYJ New Sustainability Plan & YCD Nanaimo Airport

[54] Source: BIV, Helijet, Airbus Decarbonisation

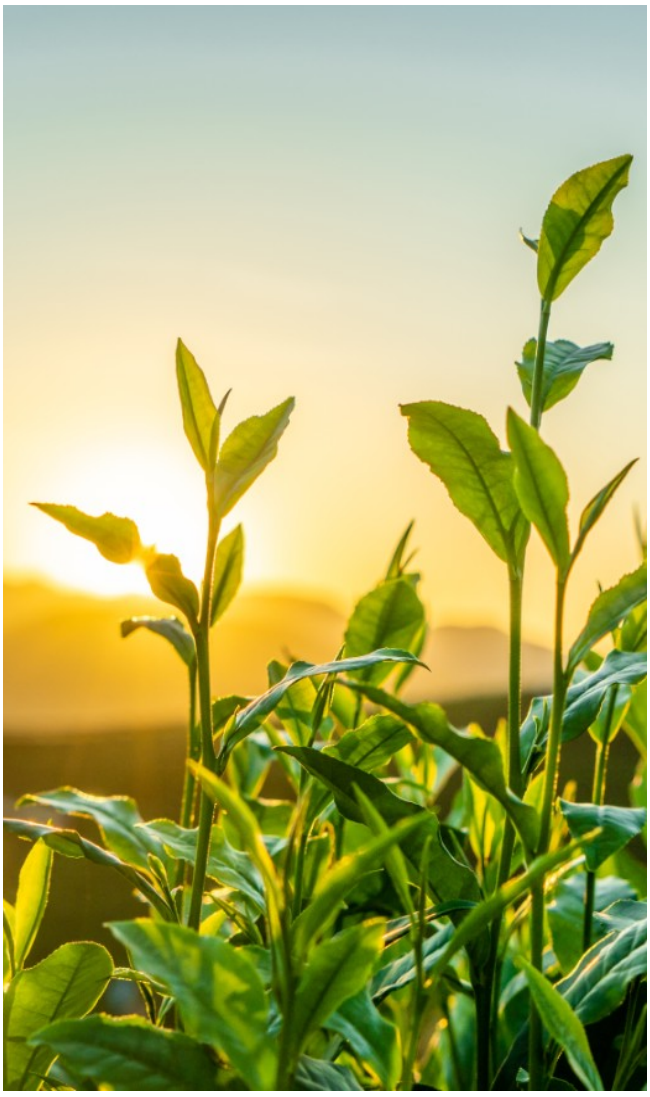
[55] Source: IATA: What is SAF?, BioPort YVR Feasibility Study 2020

[56] Source: BioPort YVR, BioPort YVR Feasibility Study 2020

Fuel technologies such as hydrogen and electricity have gained traction as technologies that can contribute to the reduction of emissions from aviation, with research indicating that electric propulsion can offer the prospect of limiting global aviation's CO2 emissions to their current levels of 2% to 3% of total global carbon emissions. It should be noted that, as per IATA, electrical fuel cells can be more suited for short-range aircraft while hydrogen combustion would be suitable for long-range and higher payloads. Hydrogen, as a fuel source in the context of aviation, can be used either as a replacement of liquid fuel or as a fuel cell for electrical power.[57]

In early 2019, Harbour Air partnered with Washington based magniX, the company powering the electric aviation revolution with a commitment to build the world's first all-electric commercial airline. The first fully electrical aircraft took flight in Richmond, B.C. in December 2019. Recently, magniX has announced plans to develop hydrogen fuel cells. MagniX believes this would complement their battery electric and hybrid electric systems, which will remain more suitable for small aircraft.[58] Canadian Flight Centre's newly constructed Kamloops hangar includes a 6,000 square foot rooftop solar panel installation to operate the facility and as is set up accept electric aircraft[59]

As a step towards achieving their net-zero commitments, Air Canada has placed an order to buy 30 hybrid-electric aircraft from Swedish manufacturer Heart Aerospace and also secured an equity stake valued at US $5 million in the company. DHL Express, a global giant in logistics and delivery, has placed a purchase order for 12 electric cargo aircraft from the U.S.-based Singapore owned aviation company, Eviation Aircraft, in efforts to improve their carbon footprint.[60]



B.C.'s Hydrogen Strategy highlights the plan to support the growth of hydrogen in various modes of transportation within the 2020-2030 time period and beyond, including experimenting with hydrogen fuel cells in aviation and expanding its use in the sector. The province is making efforts to use hydrogen in low carbon and synthetic fuel production to tackle carbon emissions from aviation. As per the study, access to B.C.-produced low-carbon hydrogen is inevitable to deliver large quantities of clean fuel (produced when carbon dioxide is merged with renewably generated hydrogen). Additionally, in efforts to lower emissions from the sector, the province is supporting R&D in the use of hydrogen technologies in aviation.[61]

[57] Source: Roland Berger Insights, IATA Hydrogen Fact Sheet
[58] Source: Aerospace Services, Harbour Air, magniX
[59] Source: InfoTel
[60] Source: Electric Autonomy Air Canada, Electric Autonomy DHL
[61] Source: B.C. Hydrogen Strategy

4. Future prospects of the sector

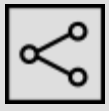
Key insights

- *COVID-19 represented a once-in-a-generation disruption and intensified aviation megatrends that were previously unfolding in the sector.*
- *The disruption and re-shaping of the sector induced by the pandemic has also spurred new influences that will be critical factors shaping the future of B.C.'s Aviation sector.*

4.1 Sector megatrends

This section provides an overview of key aviation megatrends that will shape the future of B.C.'s Aviation sector, as informed by a combination of stakeholder interviews and secondary research. The COVID-19 pandemic represented a once-in-a-generation disruption to every aspect of B.C.'s Aviation sector. The pandemic intensified aviation megatrends that were previously unfolding in the sector, including technological innovations, such as Advanced Air Mobility ("AAM") and Industry 4.0 manufacturing processes. In addition, the disruption and re-shaping of the sector induced by the pandemic has also spurred new influences that will be critical factors shaping the future of B.C.'s Aviation sector.

Figure 29: Summary of key aviation sector megatrends

Key aviation megatrend	Description	Implications for B.C. *For B.C., this megatrend could…*
 **Technological innovation**	Technological advancements, including the growth in AAM applications and industry 4.0 manufacturing processes will continue to advance and modernize the aviation sector to enhance productivity and support de-carbonization efforts	• Support the realization of provincial sustainability initiatives and targets • Drive operational efficiency and boost productivity • Expand the mobility of cargo and people being transported by AAM in urban and regional areas across the province • Reduce the social inequity of air travel in rural, remote and Indigenous communities • Provide opportunities for cross-sector collaboration within the province (e.g. in the production of SAFs)
 **Labour shortages and skills gaps**	As it emerges from COVID-19, the sector is faced with severe labour and skills shortages, including an acute difficulty attracting and retaining workers in key aviation occupations and industries	• Act as a headwind to the recovery of the sector and hamper future growth • Encourage faster adoption of automation process across a range of aviation industries • Have implications for provincial labour force training strategies and the need to attract new talent to the sector
 **E-commerce and air freight**	Air freight will continue to be a key transportation solution for e-commerce activity as a result of continued growth in consumer demand and expectations for short delivery turnaround times	• Lead to increased requirements for dedicated cargo fleet, which may induce increased aircraft conversions (to "freighters") • Encourage the use of AAM technology, specifically for the use in first/last mile and rural delivery • Increase the demand for B.C.'s industrial land dedicated to warehouse and distribution facilities (particularly in the Lower Mainland)
 **Supply chain re-evaluation**	The risks and vulnerabilities associated with supply chain disruptions that played out during the pandemic, coupled with geopolitical tensions, will lead to increased focus on onshoring, nearshoring, and friendshoring elements of manufacturing supply chains	• Provide opportunities for aerospace manufacturers to expand their economic footprint by participating in new or expanded Pacific-Northwest manufacturing supply chains and more broadly,, United States-Mexico-Canada supply chains • Increase the attractiveness of B.C. aerospace sector to nations perceived as "friendly" • Lead to a re-evaluation of sourcing approaches by B.C. aerospace companies

We note that as at the time of report drafting, there remains a high level of uncertainty as to the overall trajectory of both the Canadian and global aviation sector more broadly as it recovers from COVID-19. The following analysis reflects a view on the future prospects of the sector as at the time of drafting (Q4 2022).

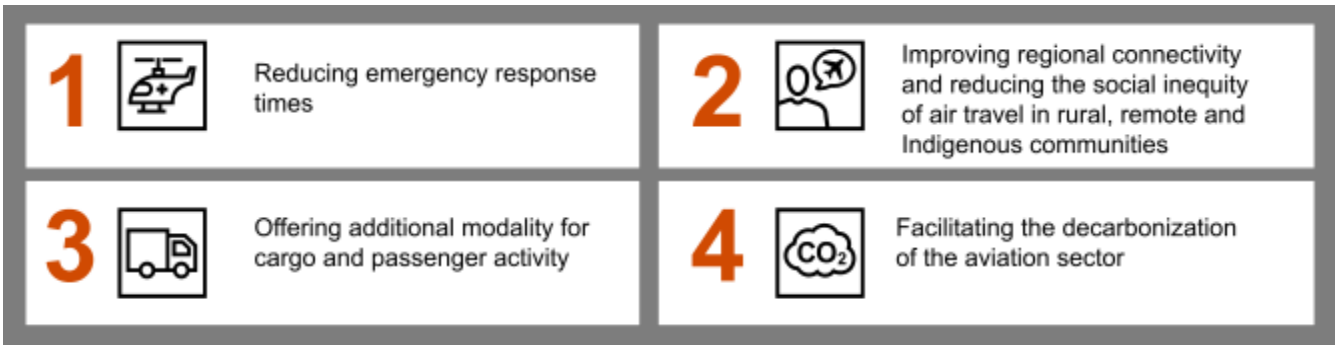
4.1.1 Technological innovation

The future of the aviation sector is being shaped by the evolution of modern technologies including the development of AAM and the adoption of industry 4.0 manufacturing processes that continue to modernize the aviation sector, enhancing productivity and supporting efforts aimed at reducing its carbon footprint.

Advanced Air Mobility

AAM is the use of electric and often autonomous aircraft, including drones and small passenger planes, capable of maneuvering in tighter airspaces (such as vertical takeoff and landing) including low urban altitudes. It has the potential to enhance the mobility of people and goods that are not conveniently served through other means of transportation, including maritime, surface and conventional air transportation. In doing so, AAM enhances various systems in the aviation sector through its impacts on safety, communications, and energy usage.

As a result, the introduction and implementation of AAM technologies has the potential to transform key elements of B.C.'s Aviation sector landscape by:



Vancouver is considered to be well-suited for the deployment of AAM technologies that can alleviate mobility challenges presented by the city's location and surrounding terrain. The Greater Vancouver region currently has 54 heliports amenable to servicing AAM aircraft and this figure is steadily growing.[62] Key B.C. air operators exploring and investing in AAM technologies include Cascadia Air, Iskwew Air, Harbour Air and Helijet. Regional airports within B.C. that have expressed interest in implementing AAM include Kamloops (YKA) in partnership with Tk'emlups First Nation, and Powell River (YPW) in collaboration with industry stakeholders.

The Canadian Advanced Air Mobility Consortium ("CAAM") envisions the following timeline for the development of key AAM mobility applications.

Micro mobility

Remote Piloted Aircraft Systems ("RPAS") or drones, can facilitate the delivery of emergency medical supplies, expand access to remote communities, including Indigenous communities. There are already several Indigenous-owned companies engaging in this space in B.C., such as Iskwew Air, an Indigenous and woman-owned airline based out of YVR that is focusing on bringing Indigenous communities together with the RPAS and AAM technologies. Other initiatives include the Stellat'en First Nation's collaboration with UBC to provide medical equipment to rural areas during the COVID-19 pandemic through the use of drones, and the critical delivery of medical items in Penelakut Island during COVID-19 with InDro Robotics and Rogers Communications. Central Chilcotin Rehabilitation Limited, a joint venture between two Tsilhqot'in communities, is trialing the use of drones to direct seed to nearly 52 hectares of fire-impacted forest. Additionally, the First Nations Technology Council is supporting drone training and certification in Indigenous communities.

[62] Source: NEXA Study Vancouver 2020

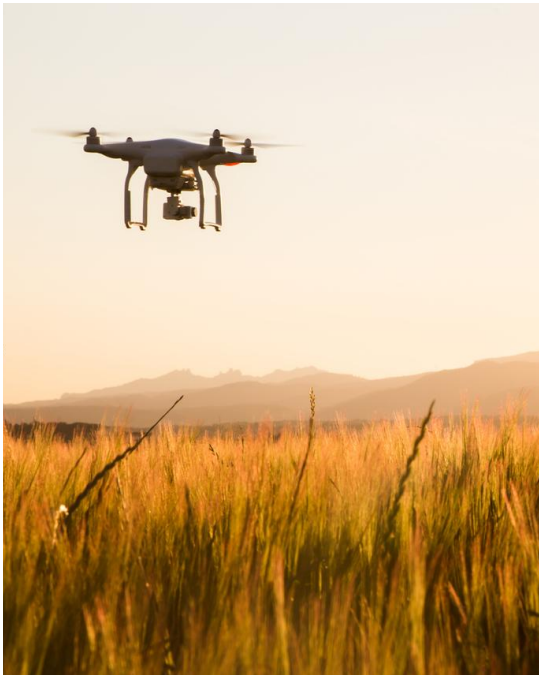
Regional mobility

Emerging technological advancements have made AAM applications for regional air mobility a possibility that uses innovative aircraft to allow convenient and affordable travel and improve regional connectivity.[63] Harbour Air partnered with magniX, the company powering electric aviation, and Harbour Air's seaplane was retrofitted with an electric motor, taking its first flight in 2019, in Richmond, B.C. Harbour Air recently completed their first direct all-electric point to point test flight in August 2022. The historic De Havilland Beaver was retrofitted in 2019 to operate using 100% electricity, and flew 45 miles in 24 minutes. After leaving the Harbour Air terminal on the Fraser River next to YVR, the aircraft landed in Patricia Bay next to YYJ on Vancouver Island.[64]

With the successful first flight complete, the aircraft is currently undergoing the certification and approval process with Transport Canada. The progression of the certification will be an important step for Harbour Air on their pathway to electrifying their fleet. Additionally, existing aircraft designs can be modified and retrofitted to be powered by new sources of energy. B.C. has national leadership in turboprop manufacturing, which is led by Viking Air, the sole OEM in B.C. As discussed in Section 3.1, turboprop manufacturing is a niche market segment that is very relevant for emerging hydrogen and electric propulsion technologies, giving B.C.'s aerospace industry a competitive edge in its efforts aimed at decarbonizing the aviation sector.

Urban mobility

Applications of AAM can be used to increase urban mobility with the use of drones and electric vertical takeoff and landing ("eVTOL") aircraft. In addition, a prosperous eVTOL ecosystem in the province could lead to stronger technological industry networks, for instance, by boosting investment in related academic programs and accelerating the growth of B.C. hydrogen projects. As per a study from Roland Berger, there are some technological and logistical obstacles in fully leveraging the potential of Urban Air Mobility ("UAM").[65] Building a commercially viable AAM ecosystem will also require significant investment into a range of industry subsectors. CAAM envisions UAM to develop further between the years 2025 and 2035.[66]



Current helicopter operators in the region such as Helijet are the most likely to lead the piloted eVTOL charge. Helijet is a commercial and charter helicopter operator, and one of the largest air medical services providers in Western Canada. Helijet was contracted by BCEHS to provide air ambulance services. As per NASA, using an Uncrewed Aerial Vehicle ("UAV") as an ambulance is useful because it can escape traffic and improve accessibility to locations that regular ambulances and helicopters cannot access.[67]

In order to create a green, cost-effective and commuter-friendly eVTOL aviation network, the UAM geomatics Urban Mobility Study projects that Greater Vancouver would need to build 12 new vertiports and possibly one multiport by 2040. CAAM estimates the cost to build this infrastructure to be in the range of $70 million. These funds would go toward a mix of remodeling existing heliports, of which Vancouver has 54, and creating new vertiports. Transport Canada has yet to finalize the standards for building these.[68]

Several global companies, including major industry players such as Airbus, Boeing and Bell Textron, are currently in the late stages of developing their eVTOL prototypes. These aircraft vary greatly in their size, capacity and applications. While nearly all of them are designed to be piloted, in the next two decades developers will increasingly aim to create autonomous eVTOLs, making them the industry standard.[69]

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[63] Source: Regional Air Mobility 2021

[64] Source: Harbour Air 2019, Harbour Air 2022

[65] Source: Roland Berger: Urban Air Mobility

[66] Source: CAAM

[67] Source: AAM use cases: Ambulance

[68] Source: NEXA Study Vancouver 2020

[69] Source: NEXA Study Vancouver 2020

Intercontinental mobility

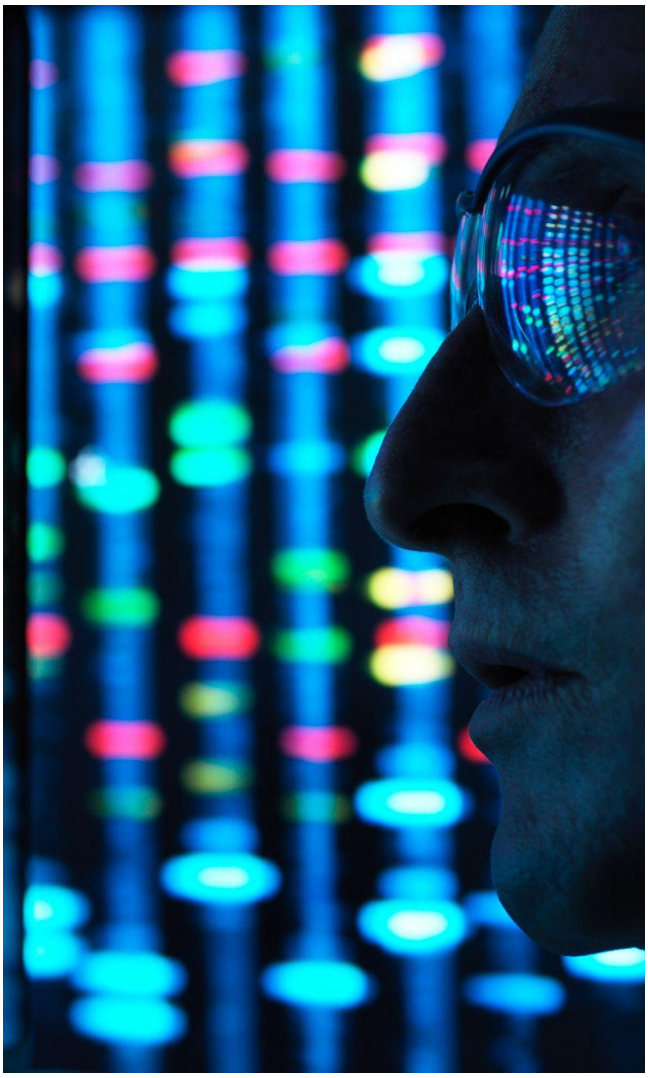
CAAM envisions that beyond the year 2035, AAM technologies would be used in long-haul routes that would facilitate mobility of people and goods around the world, with zero carbon emissions. Global aerospace companies such as Airbus, Boeing and Embraer and making capital investments to compete in the AAM space.

Airbus' ZEROe hydrogen aircraft project demonstrates a commitment to zero emission operations being made by key commercial aviation players. Airbus' ZEROe concept aircraft allow for the exploration of a range of hydrogen technologies supporting future zero-emission aircraft, such as: conventional Turbofan aircraft; Turboprop and; Blended-Wing Body. All three of these ZEROe concepts are hybrid-hydrogen aircraft, powered by hydrogen combustion through modified gas turbine engines. In addition, hydrogen fuel cells generate electrical power that complements the gas turbine, resulting in a highly efficient hybrid-electric propulsion system.

In 2022, Airbus launched the ZEROe demonstrator with the aim to test hydrogen combustion technology on an A380 multimodal platform. Through future ground and flight testing, Airbus is targeting a mature technology readiness level for a hydrogen-combustion propulsion system by 2025.[70]

Refer to **Section 3.6** for the existing contributions being made with respect to additional propulsion technology and fuel sources aimed to support sustainability outcomes, including SAFs. These future fuel technologies are all at various stages of research and development both within the province and globally.

Industry 4.0



Industry 4.0 technology facilitates the end-to-end digitization of physical assets and integration into digital ecosystems. Examples include: location detection technologies, smart sensors, cloud computing, Internet of Things ("IoT") platforms, mobile devices, and 3D printing. These Industry 4.0 technologies and processes are transforming manufacturing processes to induce greater levels of value-added manufacturing, reduce dependency on an in-person workforce and improve overall operational efficiencies. For globally competitive aerospace manufacturers, Industry 4.0 technologies are now core capabilities.

Commercial aviation has traditionally lagged other sectors in terms of applying digital tools to create value in manufacturing processes, but that is changing. Applications such as 3D printing are now in wide use in the sector, and leading original OEMs and major suppliers are investing in Industry 4.0 technologies such as IoT platforms and smart sensors to capture real-time manufacturing data to accelerate prototyping and quality assurance processes.

Visual overlay technology is a key technology that can reduce the time required in building aircraft with the use of augmented reality ("AR") and virtual reality ("VR") software, as well as reduce the aircraft maintenance requirement by allowing for an immersive visualization of aircraft part conditions. These advancements can play a pivotal role in increasing productivity, improving quality and cost effectiveness, and training technical staff within aerospace manufacturing as well as applied in the context of flight training.

[70] Source: Airbus

Industry 4.0 manufacturing technologies present a huge opportunity for B.C. to re-evaluate conventional aerospace manufacturing processes. With strong capabilities in MRO, avionics and communications systems, B.C.'s Aviation sector has the opportunity to further integrate Industry 4.0 manufacturing technologies and data analytics into its MRO operations to enhance the accuracy of maintenance schedules and requirements.

Researchers from UBC Faculty of Applied Science, Fraunhofer Institute for Experimental Software Engineering ("IESE"), and Fraunhofer Institute for Machine Tools and Forming Technology ("IWU") are currently working with industry 4.0 applications in an effort to digitally transform manufacturing processes in the aerospace and automotive industries. The initial two-year pilot is seeking to create "digital twins". In this context, digital twins will use IoT sensors to track data generated by various manufacturing processes and machinery in the real world and replicate this in a virtual environment.[71]

Further applications of industry 4.0 applications are being pursued by UBC, TrustFlight, Boeing and RaceRocks, who have partnered to create a new digital aircraft maintenance platform, which aims to improve efficiency and potentially lead to sector savings of about $3.5 billion annually. This project, called Digital Aviation Record System ("DARS") aims to allow for easy transfer of accurate aircraft data and eliminate the need for manual data entry, resulting in a more streamlined and efficient process that will enhance the functionality of aerospace industry maintenance and MRO providers.[72]

Technological innovations leveraging many of the same building blocks of Industry 4.0 manufacturing applications are increasingly being adopted elsewhere in the aviation ecosystem to enhance airport operations and passenger experience at airports. Robotics, sensors and other smart technologies are critical elements of customer facing features of airport operations, for example, by performing tasks at check-in, security processes, facial recognition and baggage monitoring. Artificial intelligence ("AI") tools can enhance visibility of ground operations and provide key information such as average turn times and gate utilization that can aid in avoiding disruptions at the ground. Autonomous vehicles can provide support in handling cargo and towing the aircraft, replacing manual labour for ground operations. AI and data analytics tools can also expand airport operational capabilities by enabling prediction of departure capacities and delays in departure/arrival times.[73]

4.1.2 Labour shortages and skills gaps

The Canadian and B.C. economies are currently experiencing acute labour force shortages across a range of occupations, particularly for skilled tradespeople and engineering professions in industrial sectors of the economy. The B.C. government's 2021 Labour Market Outlook ("BCLMO") forecasts 1,004,000 job openings between 2021 and 2031. After accounting for reduced unemployment, young people, new immigrants and in-migrants from other provinces and territories joining the workforce, the BCLCMO is forecasting an additional labour supply requirement of 83,000 workers (up from 49,000 forecasted in 2019).[74]

As the global aviation ecosystem transitioned from a state of severely weakened demand due to COVID-19-related travel restrictions followed by a resurgence in demand spurred by the lifting of restrictions, matching available capacity and human capital to meet this demand has been a challenge across the entire aviation ecosystem.[75] In line with the shortages being witnessed across many industrial sectors in B.C.'s economy, the aviation sector is experiencing broad-based labour shortages for skilled trades, technical/engineering talent, management professionals and entry-level workers in aerospace manufacturing industries; as well as pockets of labour and skills gaps for specialized aviation occupations.

For specific aviation sector occupations, the BCLMO identified the following as High Opportunity Occupations for the province: aerospace engineers, aircraft mechanics and aircraft inspectors, pilots, flight engineers and flight instructors, air traffic controllers and related occupations, aircraft instrument personnel, electrical and avionics mechanics, technicians and inspectors.[76]

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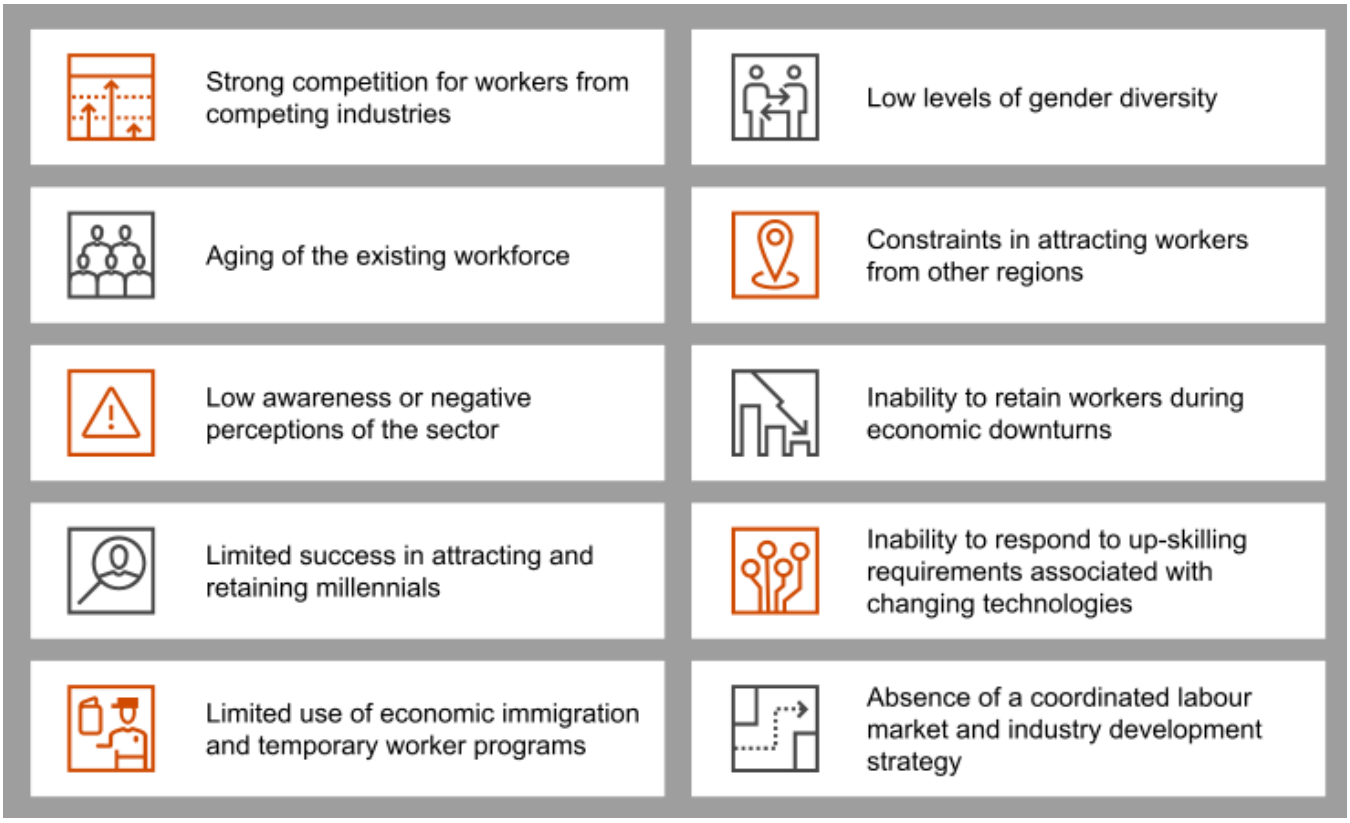
[71] Source: UBC News
[72] Source: UBC Innovation
[73] Source: Journal of Business: Smart Airport, Airport Industry News, Adoption of Industry 4.0 Technologies in Airports
[74] Source: B.C. Labour Market Outlook: 2021 Edition
[75] Source: Airports Council International
[76] The BCLMO identifies High Opportunity Occupations as those that offer greater employment opportunities to both workers and the overall economy based on a number of labour market indicators. For more information on the definition and estimation of HOO applied in the BCLMO, refer to B.C. Labour Market Outlook: 2021 Edition

Skills shortages in B.C.'s Aviation sector, while exacerbated by the pandemic, have been present and widely acknowledged for a number of years. As outlined by the Aerospace Industries Association of Canada in 2018, B.C. has historically faced the following impediments when attracting and retaining in-demand occupations including:[77]



As the aviation sector recovers from the pandemic, strong demand for labour is anticipated to continue, with the BCLMO forecasting Air Transportation employment growth to be one the province's fastest growing industries (3.2% a year from 2021-2031, in Compound Annual Growth Rate terms). This equates to 11,800 job openings.[78]

To date, B.C. Aviation sector's labour force has not been keeping pace with the growing demand for aviation services, as refilling positions furloughed during the pandemic has been hampered by labour shortages across the sector, resulting from accelerated retirements and career pivots to other sectors. Additionally, with the integration of AAM infrastructure, about 10,000 additional engineers over the current global vertical take-off and landing ("VTOL") talent pool will be needed over the next decade to meet the requirements of advanced rotorcraft and AAM applications in the future.[79]

As underscored in stakeholder engagements, existing labour market shortages are exacerbated by long training lead times for a number of aviation occupations in shortage (e.g. pilots, aviation mechanics and engineers , and other air transportation support staff). There are several opportunities for B.C.'s aviation ecosystem to collaborate to develop educational programs that are more responsive to market needs for in-demand occupations and evolving skills and credentials being demanded across the sector. In its Vision 2025 report, AIAC highlights the need for such programs to be responsive to the changing technological landscape.[80] Digital training solutions offer such an opportunity, as do the creation of industry co-op placements and bachelors and masters programs at the intersection of aerospace and advanced technologies.

[77] Source: AIAC 2018, Labour Market Study
[78] Source: B.C. Labour Market Outlook: 2021 Edition
[79] Source: The Vertical Flight Society
[80] Source: AIAC Vision 2025

4.1.3 E-commerce and air freight

There has been a major shift in global consumer behavior following pandemic-induced lockdown measures that forced consumers to shift to online retail, resulting in a surge in e-commerce activity. Many retailers adopted new e-commerce platforms in response while existing e-commerce retailers experienced strong demand for their products. This change in the e-commerce landscape posed new logistical challenges as fulfillment of consumer and business needs required faster, efficient and cost-effective delivery systems. Air cargo has become a critical transportation channel for e-commerce as a result of continued growth in consumer demand and expectations for: short delivery turnaround times; product tracking and traceability; and ease and efficiency of returns. Air cargo is well suited to serve these needs with speed, efficiency and reliability.

The boom in e-commerce activity has stimulated high demand for air cargo. Boeing's 2022 World Air Cargo Forecast suggests that, over the past five years, growth in the Canadian domestic air cargo market has averaged 8.5% annually. This is largely due to the expansion of e-commerce operators, who are responsible for nearly 70% of this change. As e-commerce demand slows upon reaching a stabilizing point where operators have built the majority of their infrastructure, domestic air cargo traffic growth will also gradually ease. Over the next 20 years, Canadian air cargo traffic is expected to average 4.4% over the first decade and 3.1% over the entire 20-year period.[81]

As per IATA, e-commerce represented 15% of air cargo volumes in 2019 and this number is experiencing continuous growth and accelerated further during the COVID-19 pandemic.[82] IATA has developed the following four e-commerce logistic models through their research on prominent online retailers:

- **Owned and fully dedicated air transport capabilities:** Leads to a reduction of firms' dependence on third-party carriers, mitigating risk and increasing margins.
- **Air freight shippers:** Goods are moved by these companies to fulfillment centers in freight format and then local ground distribution is carried out in the destination country (owned or outsourced).
- **Hybrid model:** Through this model of internal and external capabilities, freight is moved to fulfillment centres and single parcels are shipped to consumers through air cargo.
- **Air parcel shippers:** Firms rely on standard courier express-parcel and airmail shipping solutions as they are frequently used for individual orders.[83]

With the transition towards higher e-commerce activity, air cargo providers have come to realize the significant impact of online retail on their businesses and are increasingly focused on the use of new technologies to increase operational efficiencies. Technological developments will benefit air cargo stakeholders by expediting their services for e-commerce. These technologies include applications of AAM infrastructure including electric vehicles and drones that facilitate rapid distribution and delivery services. In addition to this, increased digitization, implementation of sensors, new screening technologies and AI tools will enable air cargo industry players to adapt to evolving e-commerce needs.[84]

Over the last decade, e-commerce retailers, notably Amazon, have advanced their air transportation networks by leasing and acquiring dedicated air freighters as part of the company's strategy to meet one- and two-day delivery targets. In 2015, Amazon conducted trial runs for "Amazon Prime Air" (rebranded as "Amazon Air" in 2016) with the vision of operating aircraft dedicated to freight transport. In 2016, Amazon Air leased 20 Boeing 767 from Air Transport Services Group ("ATSG"). Since then, Amazon Air has grown rapidly and increased its leasing activity with ATSG as well as Atlas Air Worldwide Holdings and expanded its relationship with Cargojet in Canada. In 2022, for the first time in its history, Amazon Air purchased 11 used Boeing 767-300 (7 from Westjet and 4 from Delta Airlines) as part of its continued expansion during the pandemic and its desire to increase its ability to internally manage its delivery fleet. When these aircraft are in service (planned for the end of 2022), Amazon Air will operate a fleet of more than 85 aircraft.[85]

[81] Source: Boeing World Air Cargo Forecast (2022 - 2041)
[82] Source: IATA: E-Commerce and Logistics
[83] Source: IATA: A new era for air cargo
[84] Source: Future Flight Vision Roadmap August 2021, IATA: Air cargo and e-commerce enabling global trade
[85] Source: FreightWaves, Simple Flying, Forbes, E-Commerce Monitor, City News, CNBC News

Airlines are partnering with logistics providers to adapt to increased e-commerce activity. Qatar Airways and the Chinese logistics company, Cainiao, belonging to Alibaba, have entered into a collaboration where Cainiao charters the freighter and provides the shipments, and Qatar Airways Cargo flies the goods. Other major airlines such as Lufthansa Cargo, China Southern Airlines and Saudia Cargo have also entered in partnership with logistics providers to increase their cargo capabilities.[86]

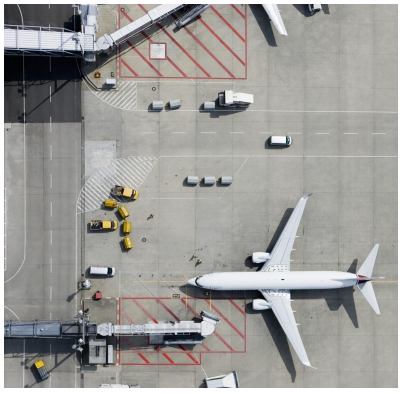
In addition to this, cargo became a more prominent revenue source for some airlines when passenger travel was at an almost stoppage during COVID-19. The three main air cargo corridors (North America-Europe, North America-Asia, Asia-Europe), together account for nearly 50% of global cargo traffic in 2019, exhibited a V-shaped recovery in global air freight post-2020. In 2021 overall, air cargo volumes rose by 18.7% year-over-year, the second best performance since 1990 (albeit from a historically low base in 2020 as a result of COVID-19.[87]

With global ocean shipping in a crisis since the onset of the pandemic and further supply chain complications triggered by the Ukraine war, airlines are converting passenger aircraft to cargo at a record pace in efforts to increase their cargo services. Over the past 30 years, an average of 50-70 conversions of passenger to cargo aircraft take place each year. This number is forecast to rise to 180 by 2025, as projected by AeroDynamic Advisory. Lufthansa Cargo forecasts growth in e-commerce shipments to be 20% annually over the next 5 years and announced plans to permanently convert two Airbus A321 into freighters. Boeing expects that over the next 20 years, there will be a 60% increase in the world freighter fleet.[88]

Typically, the age for freighter conversion stock is 15 to 20 years but younger aircraft are also being converted such as DHL's acquisition of two 767s that are less than a decade old. Conversion volumes may ease through the second half of the decade, but even after that, conversions are expected to remain at historic levels. [89]

Boeing stated plans for the addition of 3 conversion lines for its 737-800BCF across North America and Europe, and 2 of these will be located at KF Aerospace in Kelowna, B.C. Air Canada has also added freighter aircraft to its fleet to fulfill the additional cargo capacity required on key air cargo routes, with the goal of facilitating movement of goods, and tackling the increasing e-commerce demand.[90] Cascade Aerospace, headquartered in B.C. also offers aircraft freighter conversions, including conversions of Bombardier Q400 and CRJ aircraft into package freighters.[91]

4.1.4 Supply chain re-evaluation



Over the last two years, industrial sector supply chains have experienced critical disruptions. The COVID-19 pandemic triggered and exposed supply chain bottlenecks (and worker shortages), which were followed by further supply chain impacts, worker shortages, and inflationary pressures interacting to deepen these impacts in the wake of the Russian invasion of Ukraine. A 2022 member survey by Canadian Manufacturers & Exporters ("CME") shows that 9 out of 10 Canadian manufacturers are encountering supply chain issues, with over 60% rating the impact of these disruptions as either major or severe.[92]

Aviation sector supply chains have not been immune to these disruptions. Faced with sharply reduced consumer demand for travel, the aircraft manufacturing and maintenance subsectors scaled down activity and experienced considerable layoffs they have yet to fully recover from as a result of workers leaving the sector through either accelerated retirements or career pivots to competing sectors. These labour shortages continue to cause bottlenecks in aerospace OEM and aircraft part production. In addition, the industry has struggled in recent years with commodity price volatility, particularly with respect to fuel, aluminum, and a number of key inputs, which have seen increased instability and unpredictability as a result of Russia's invasion of Ukraine.

[86] Source: E-Commerce Monitor
[87] Source: IATA Economic Reports (September 2021), IATA Economic Reports (December 2021)
[88] Source: Business Insider, LinkedIn: Can the cargo conversion boom last?, Aviation Week Network
[89] Source: LinkedIn: Can the cargo conversion boom last?
[90] Source: Global News, Canadian Aviation News
[91] Source: Cascade Aerospace
[92] Source: CME, 2022 Business outlooks and supply chains survey

These supply chain disruptions have led to an increased interest in exploring nearshoring or onshoring of manufacturing supply chains. “Nearshoring” brings business processes geographically closer, generally to a country just across a shared national border. “Onshoring” relocates operations inside the domestic borders of the country itself.

While interest in these practices has increased in the past few years, there are a number of barriers faced by Canadian industry participants. As noted by Canadian manufactures in CME’s 2022 member survey, the key barriers to sourcing more inputs within Canada and relocating/scaling up Canadian manufacturing activities was a lack of Canadian suppliers (of their specific inputs) as well as the availability and cost of labour.[93]

In the midst of geopolitical instability, there is however significant momentum towards the notion of “friendshoring”, in which democracies (and their key companies) are now attempting to shift supply chain dependence from dictatorships to democracies. This was explicitly outlined in the forward to the Government of Canada’s Fall Economic Statement in November 2022 and previously underscored in the Biden Administration’s Executive Order on America’s Supply Chains in 2021. [94]

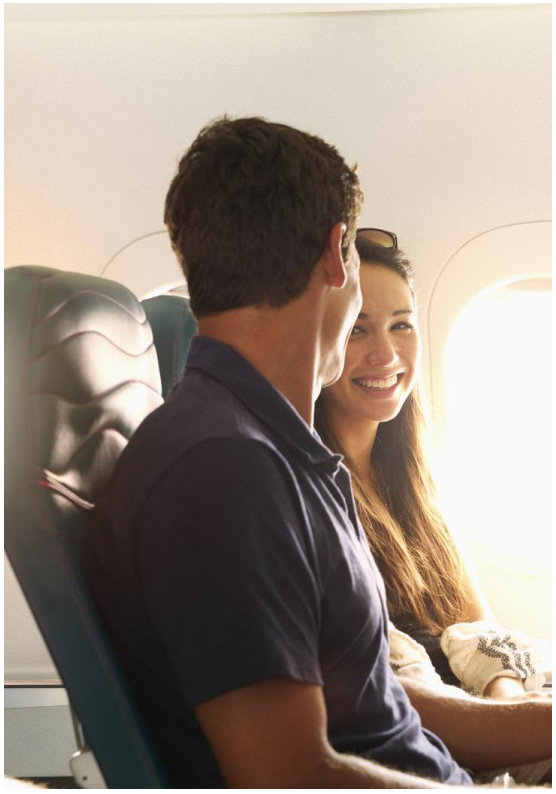
With respect to aviation supply chains, this will likely seek to incentivize Canadian companies to further integrate themselves in the U.S. Pacific Northwest aerospace cluster (largely driven by Boeing) as they seek to capitalize on the U.S.’s friendshoring motivations, consistent with current trends unfolding in Canada’s automotive sector.

B.C.’s aviation supply chains will likely see additional transformations as the industry recovers. The financial struggles of smaller suppliers may lead to increased consolidation at the lower tier supply base as larger players take greater shares of the market. Moreover, aviation manufacturers in B.C. may consider localizing their supply chain, where possible and practical, in order to create stronger domestic industry networks whilst also looking to further integrate into Pacific-Northwest (and North American) aerospace supply chains.

4.2 Sector outlook

This section includes projections of future aviation sector activity in Canada, focusing on air transportation and aerospace manufacturing, developed based on a synthesis of third party forecasts generated in 2022. GDP, Revenue and Employment forecasts generated by third party agencies including the Conference Board of Canada, IBISWorld, and IHS Market have been synthesized to present a “Consensus” medium-term outlook for Canada’s aviation sector up to 2025.

This Consensus outlook has been presented with respect to historical GDP, Revenue, and Employment levels for both the Air Transportation and Aerospace Products and Parts Manufacturing industries in Canada and indexed to pre-pandemic levels (2019=100)[95].

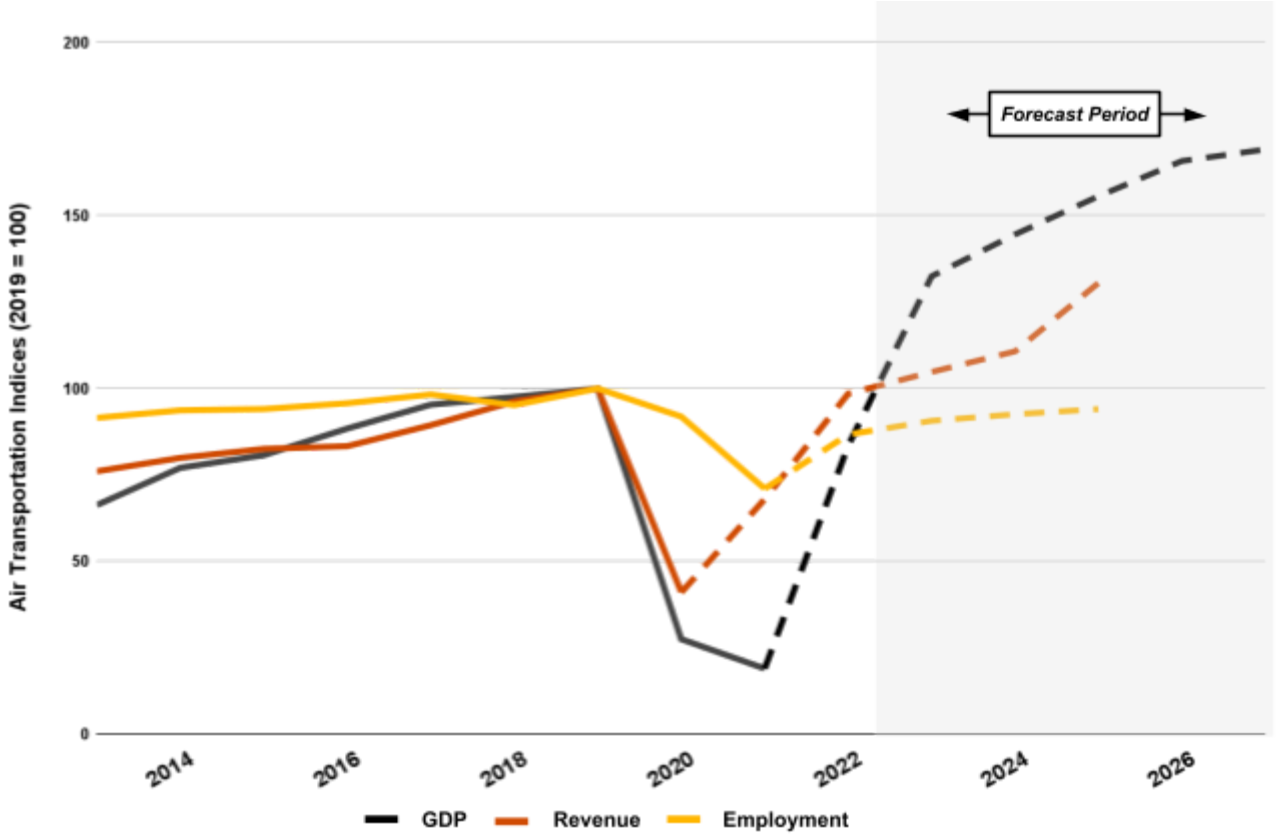


4.2.1 Air Transportation

As outlined above in Section 2, the onset of COVID-19 caused an abrupt decline in global air travel as international travel restrictions and public health safety measures were imposed. Renewed travel demand is expected to be a primary driver of the significant forecasted economic recovery and growth of Canada’s air transportation industry across key economic indicators, as outlined in the figure below.

[93] Source: CME, 2022 Business outlooks and supply chains survey
[94] Source: Government of Canada, 2022, Fall Economic Statement and United States Government, 100-day supply chain review
[95] Due to data limitations, the Consensus outlook for sector Air Transportation revenue commences in 2021, a year prior to the outlook for GDP and Employment.

Figure 30: Canadian Air Transportation, Historical performance and Consensus outlook



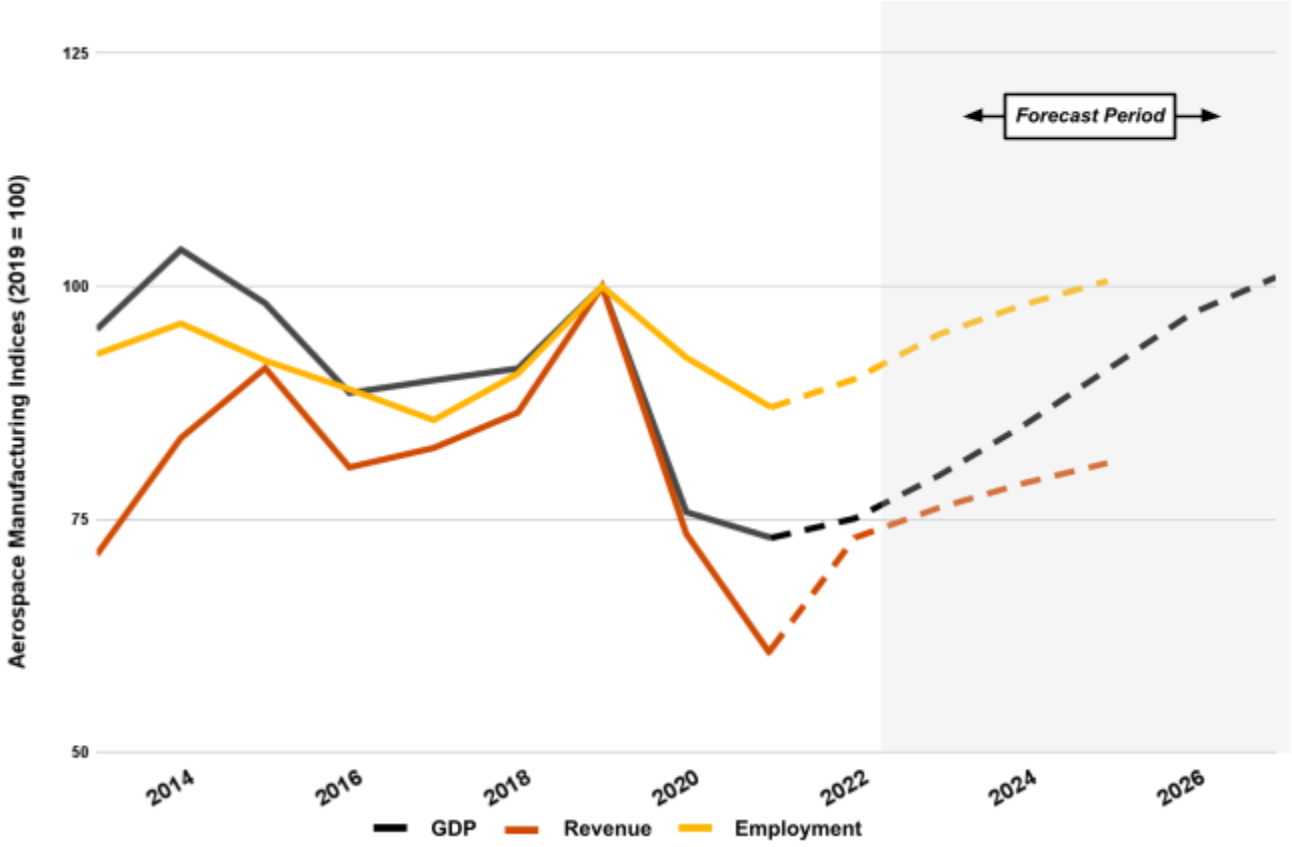
Source: PwC Analysis based on third party forecasting agencies and Statistics Canada
Note: Consensus outlook figures for Revenue and Employment were not available beyond 2025.

The Consensus outlook for Air Transportation indicates that both GDP and revenue are expected to return to 2019 levels by 2023, with the former experiencing the sharpest rebound. By comparison, employment will be slower to return to 2019 levels, projected to reach 94% of its former levels by 2025, which may be the result of labour shortages or difficulties filling positions (see **Section 4.1** for further information). With a projected rebound in GDP and revenue, despite tight labour market conditions, this could suggest that the Canadian Air Transportation industry has increased overall labour productivity and/or deployed additional capital assets in favour of additional labour.

4.2.2 Aerospace Products and Part Manufacturing

Canadian aerospace products and part manufacturing have also experienced considerable declines in key economic indicators during the pandemic. Compared to air transportation, the industry experienced fewer sharp declines across key economic indicators (particularly for GDP). It is also expected to recover to pre-pandemic levels, albeit at a much slower pace. Refer to the figure below.

Figure 31: Canadian Aerospace products and parts manufacturing, Historical performance and Consensus outlook



Source: PwC Analysis based on third party forecasting agencies and Statistics Canada.
Note: Consensus outlook figures for Revenue and Employment not available beyond 2025.

The Consensus outlook indicates that recovery in the aerospace manufacturing industry is expected to be gradual, relative to air transportation. Industry GDP is projected to reach 2019 levels by 2027 while revenues are expected to reach 83% of 2019 levels by the end of the forecast horizon in 2026. By comparison, recovery in employment will be more rapid, reaching 98% of 2019 levels by 2024 with steady growth until the end of the forecast horizon in 2026.

Another factor that may contribute to the slower recovery of the aerospace manufacturing industry relative to air transportation is the price volatility of key inputs such as aluminum and fuel. Given that they comprise a large portion of production costs in the sector, it is likely that events like the ongoing Russia-Ukraine war will continue to affect profitability, which in turn would result in a slower recovery (see **Section 4.1.** for further information). Some operators may choose to leave the industry in light of this, especially smaller ones that struggled to maintain their business during the pandemic.

4.3 Strategic objectives for the sector

As noted throughout this report, the scale of disruption experienced in B.C.'s Aviation sector both during and in the wake of the COVID-19 pandemic has been unprecedented. The sector is currently emerging from the pandemic with its business models and supply chains permanently re-configured, and operating in a more volatile and uncertain environment than it ever has.

Within this context, the long-term trajectory of B.C.'s Aviation sector will be dictated by its ability to achieve a number of strategic objectives. Throughout B.C.'s Aviation sector ecosystem, as underscored through consultations conducted with industry participants as part of this study, the following elements are considered key to the future of the sector:

1. Embrace innovation and facilitate technology adoption to improve operational efficiency

The uptake of Industry 4.0 technologies and processes centered on automation, artificial intelligence, machine learning and robotics are now core capabilities for competitive aerospace manufacturing and MRO players as they enhance productivity and reduce overhead costs. In addition, technology will become a critical element across the aviation ecosystem as airports look to implement digital platforms to track and predict performance on many aspects of their operations such as passenger activity, the condition of airport assets, and emissions.

An increased level of investment in R&D can catalyze the ability of the B.C.'s Aviation sector to integrate and leverage Industry 4.0 capabilities, as well as other emerging aviation technologies, such as AAM technologies, to improve the operational efficiencies and foster growth across the sector.

2. Strengthen the "brand" of the aviation sector to attract talent

With the B.C. Aviation sector projected to have one of the fastest growing labour markets within the province, strengthening the brand of the sector will be required to attract top talent and meet future labour market demands.

Increasing awareness of the range of career paths available in the aviation sector as well as demonstrating the criticality of airports, manufacturing and MRO facilities (and other elements of the aviation ecosystem) as engines for economic growth will help strengthen the sector's brand and grow the knowledge of, and potentially interest in, a career in aviation. Bolstering talent pipelines through academic and industry partnerships, developing improved training programs to encourage hands-on and updated skills development and targeting international student markets will help reinforce this.

3. Develop/refresh provincial aviation sector strategy

Building upon the previous sector strategy released in 2012, an updated strategy for the B.C. Aviation sector in a post-pandemic context can crystalize the province's vision and priorities with respect to sector strengths and opportunities. For B.C. Aviation stakeholders, a provincial strategy can also demonstrate support of the sector and provide a roadmap in light of the post-pandemic realities and changed business models. This could also aid in the development of industry players' own respective strategies and give them the opportunity to align their own business models and focus with the priorities of the province.

4. Review the National Airports Policy

There exists the opportunity for the National Airports Policy and associated funding mechanisms to be re-evaluated to consider the different operating models of the province's large international airports and regional airports. Considering a mixture of funding options and revisiting existing cost-recovery policies may allow B.C. airports of different sizes to evaluate their debt levels, funding mechanisms and revenue profiles, as impacted during the global pandemic. This in turn may assist airports in planning for key infrastructure investments in order to maintain and grow their facilities to meet increasing air transportation demand and position them better against increased competition from the U.S.

5. Embrace sustainability to capitalize on the transition to a low-carbon economy and B.C.'s Environmental, Social, and Governance ("ESG") advantage

As ESG performance and reporting requirements gain momentum across all sectors (with increased focus on transportation sectors), there is an opportunity for the B.C.'s Aviation sector players to leverage B.C.'s strong sustainability credentials, global leadership, and government commitments.

The B.C.'s Aviation sector players can leverage B.C.'s economy-wide sustainability credentials and government commitments to support their own strategies related to decarbonization and accelerate the process of exploring key fuel and engine alternatives. In addition, with the emergence of new digital platforms to track emissions, B.C. aviation players will be required to develop a deep understanding of current emission levels to measure the impact their operations have on the environment and make data-driven decisions on how best to achieve low-carbon objectives.

6. Reduce the regulatory and operational costs of doing business and increase investment attractiveness

As companies decide where to locate and expand their operations, a competitive tax, regulatory and overall ESG supported business environment is a prerequisite for B.C. to attract and retain aviation businesses and investors in the province.

For B.C. to most effectively leverage its geographic advantages with the Pacific-Northwest's Aerospace cluster, the competitiveness of B.C.'s tax and investment environment, relative to competing jurisdictions through the U.S., are key factors driving sector investment attractiveness and growth and B.C.'s position as a gateway between Asia and North America.

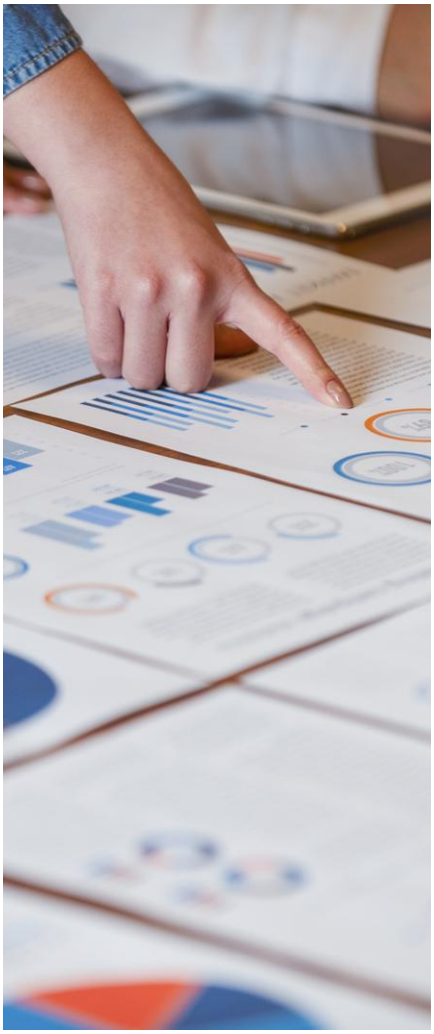
Appendices

Appendix A: Report assumptions and limitations

The conclusions expressed and information presented in this report rely on the following major assumptions:

- Completeness, reliability, and accuracy of data provided by MoTI and other relevant B.C. government ministries, as well as participating B.C. Aviation stakeholders on the impacts of COVID-19, sector recovery, emerging trends and future prospects.
- Reliability and accuracy of external sources used in this report.
- The Statistics Canada Supply-Use Tables for British Columbia and Canada and the Statistics Canada Interprovincial Input-Output ("IO") Model based on 2018 constitute a reasonable representation of the underlying relationships in the economy during the relevant periods modeled in the report.

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



Data limitations: PwC has relied on the information provided by MoTI and other relevant B.C. government ministries, including BCAAP funding initiatives, emergency management metrics, as well as other economic indicators related to the B.C. Aviation sector. In addition, PwC has relied on the information provided by participating B.C. aviation sector stakeholders on the impacts of COVID-19, sector recovery, emerging trends and future prospects. PwC has relied upon the completeness, accuracy, and fair presentation of all information and data obtained from MoTI, other relevant B.C. government ministries, participating B.C. aviation sector stakeholders and various data sources, 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 Assessment.

We further note that as at the time of report drafting, there remains a high level of uncertainty as to the medium and long-term trajectory of both the Canadian and global aviation sector more broadly. All analysis in this report reflects information available at the time of drafting (Q4 2022).

Use limitations: This report has been prepared solely for the use and benefit of, and pursuant to a client relationship exclusively with MoTI. You may share our report with third parties, provided it is issued in its entirety. You will not use our report to provide any excerpt to any third party. PwC accepts no duty of care, obligation or liability, if any, suffered by any third party that reads our deliverable, any excerpts from our deliverable or statements describing our deliverable. Further, no person or entity, other than MoTI, shall place any reliance upon the accuracy or completeness of the statements made in our deliverable. In no event, shall PwC have any liability for damages, costs or losses suffered by reason of any reliance upon the contents of this deliverable by any person or entity other than the MoTI.

Receipt of new data or facts: PwC reserves the right at its discretion to withdraw or make revisions to 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 November 2022, 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.

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.

Input-output analysis

An input-output analysis (used to estimate GDP, employment, tax and other impacts) does not address whether inputs have been used in the most productive manner or whether the use of these inputs in a particular industry promote economic growth more than their use in another industry. Nor does input-output analysis evaluate whether these inputs might be employed elsewhere in the economy if they were not employed directly in this industry at the time of the analysis.

Input-output analysis calculates the direct, indirect and induced economic footprint that can reasonably be expected to affect the economy based on historical relationships within the economy. Note that the input-output analysis conducted in this report includes economic footprint estimations at the B.C. level (and its regions), and not on a Canada-wide basis. This analysis does not take into account fundamental shifts in the relationships within the economy that may have taken place since the estimation of multipliers by Statistics Canada, nor shifts that may take place in the future

Appendix B: Regionalization methodology

In order to appropriately map the economic impact of the Aviation sector on other industries in B.C., we required industry-level labour force characteristics data at the 4-digit NAICS code. Provincial labour force data at this level of granularity is available from the Census of Population and thus, data from the 2016 Census[96] performed by Statistics Canada informed the basis of our regionalization analysis.

[96] We note that at the time of this report, the most recent labour force data available was from the 2016 Census performed by Statistics Canada.

Appendix C: Tax impact methodology

C.1 Personal Income Tax

1. PIT was estimated using labour income impact estimates from the IO model as well as Statistics Canada data on compensation of employees and personal income tax.
2. The ratio of PIT paid to total employee compensation at either the provincial level was calculated and applied to estimated labour income impacts to estimate the total PIT impact.
3. The respective federal and provincial shares of PIT generated were calculated using data from Statistics Canada on household income tax collected by federal, provincial and territorial governments in British Columbia.
4. These ratios were applied to the total PIT impact to obtain the respective federal and provincial shares of PIT revenue.

C.2 Corporate Income Tax

1. CIT was estimated using gross operating surplus ("GOS") impact estimates from the IO model as well as Statistics Canada data on GOS, taxable income and CIT paid at federal and provincial levels in Canada.
2. The ratio of taxable income to industry-specific GOS was calculated and applied to the GOS impact estimates from the IO model.[97]
3. The respective federal and provincial effective CIT rates for specific industries were calculated as the ratio of total federal taxes and provincial income taxes to total taxable income.
4. These ratios were applied to taxable income calculated from GOS to obtain the respective federal and provincial shares of CIT revenue.[98]

C.3 Tax on Production and Products

In addition to PIT and CIT, IO model results provide additional information on taxes in two broad categories as outlined below.[99] Throughout this report, these taxes are referred to as "taxes on production and products."

a. **Taxes on production:** These are taxes that are paid by business and non-business entities, including persons, that are not linked to any productive activity. Taxes on production are levied by all three levels of government. Examples of federal taxes include capital taxes levied against corporate entities, Canada Deposit Insurance Corporation premiums, and Canadian Dairy Commission levies. Provincial taxes include (personal and commercial) motor vehicle license fees, and capital taxes. Local taxes include real property taxes and developer lot levies. Taxes are compulsory payments made by institutional units to governments. The government provides nothing in return to the unit making the payment, although funds raised in taxes may be used by governments to provide goods and services to other units, individually, or collectively, or to the community as a whole.

[97] We note that the industry-specific ratio was applied to Air Transportation GOS impact estimates, however, due to data availability, the total industry ratio is applied to Aerospace Products and Parts Manufacturing and Support Activities for Air Transportation GOS impact estimates.
[98] We note that the industry-specific ratio was applied to Air Transportation taxable income estimates, however, due to data availability, the total industry ratio is applied to Aerospace Products and Parts Manufacturing and Support Activities for Air Transportation taxable income estimates.
[99] For more information, refer to https://unstats.un.org/unsd/nationalaccount/docs/sna2008.pdf.

b. **Taxes on products:** This is the sum of taxes levied on goods and services beyond the basic price valuation level. They are paid by business and non-business industries on their current purchases and by final users such as households on all their expenditures. Examples include the Goods and Services Tax (“GST”), the Harmonized Sales Tax (“HST”), provincial sales taxes, federal excise taxes, import duties, and fuel taxes. Unlike taxes on production, these taxes are levied on quantities or values of goods and services produced or purchased in the economy. Together with trade and transport margins, these taxes account for the difference between basic prices and purchasers' price valuations of goods and services. Taxes are compulsory payments made by institutional units to governments. The government provides nothing in return to the unit making the payment, although funds raised in taxes may be used by governments to provide goods and services to other units, individually, or collectively, or to the community as a whole.

Appendix D: Aviation-related tourism baseline

This appendix presents the total estimated economic footprint associated with $2 billion in aviation-related domestic tourism expenditures in 2019 (made by non-B.C. Canadian residents only) broken down by tourism region. All tourism region figures are presented as the sum of direct, indirect and induced impact channels. See **Section 2.3** for further information on the modeling framework utilized as part of this analysis[100]. We note that due to rounding, totals for tourism region economic impacts may not sum to the provincial economic impacts.

Figure D.1: Total economic footprint of $2 billion in aviation-related tourism expenditures, by tourism region, 2019 [101]

Tourism region	GDP ($M)	Employment (FTE)	Labour Income ($M)
Cariboo Chilcotin Coast	$2	23	$1
Kootenay Rockies	$44	412	$25
Northern B.C.	$26	246	$15
Thompson Okanagan	$210	1,984	$119
Vancouver Coast and Mountains	$816	7,723	$462
Vancouver Island	$336	3,176	$190
Total	**$1,434**	**13,564**	**$812**

The table below presents multipliers used to produce estimates of the total economic footprint associated with a given level of aviation-related tourism expenditures within B.C. made by non-B.C. Canadian residents at the direct, indirect and induced levels. We note that all multipliers are expressed per million dollars of expenditures.

Figure D.2: B.C. Aviation-related Tourism Expenditures - Economic footprint multipliers, 2019[102]

Impact Channel	GDP (per $1M)	Employment (FTE, per $1M)	Labour Income (per $1M)
Direct	$400,000	5	250,000
Indirect	$160,000	1	90,000
Induced	$160,000	1	60,000
Total	**$720,000**	**7**	**$410,000**

[100] Note, aviation-related tourism expenditures made by B.C. residents were excluded from this analysis. In addition, international aviation-related tourism expenditures were not included as part of this analysis due to data limitations as international tourists have unique expenditure profiles that largely depend on where they are visiting from and are not comparable to Canadian resident expenditure profiles at the regional level

[101] The aviation-related tourism economic footprint for B.C. has been allocated to tourism regions, as defined by DestinationBC. For more information on DestinationBC's tourism regions, including their geographic boundaries, refer to https://www.destinationbc.ca/research-insights/type/regional-research/

[102] Due to rounding, the totals presented may not always add up to the sum of the items.

Appendix E: Pandemic-impacted B.C. Aviation Industry economic footprints

This appendix presents the individual pandemic-impacted estimated economic footprints of each industry that comprises the B.C. Aviation sector. All tax revenue figures presented include PIT, CIT as well as taxes on production and products. We note that due to rounding, the totals presented may not always add up to the sum of the items.

Figure E.1: Economic footprint of the B.C. Aviation sector - Aerospace Products and Parts Manufacturing, 2021

Impact Channel	GDP ($M)	Employment (FTE)	Labour Income ($M)	Tax Revenue ($M)
Direct	$232	1,235	$164	$53
Indirect	$45	314	$29	$12
Induced	$79	443	$34	$21
Total	**$356**	**1,993**	**$227**	**$86**

Figure E.2: Economic footprint of the B.C. Aviation sector - Air Transportation, 2021

Impact Channel	GDP ($M)	Employment (FTE)	Labour Income ($M)	Tax Revenue ($M)
Direct	$454	5,542	$1,014	$256
Indirect	$127	3,005	$325	$83
Induced	$131	2,212	$240	$68
Total	**$712**	**10,759**	**$1,579**	**$406**

Figure E.3: Economic footprint of the B.C. Aviation sector - Support Activities for Air Transportation, 2021

Impact Channel	GDP ($M)	Employment (FTE)	Labour Income ($M)	Tax Revenue ($M)
Direct	$754	6,387	$818	$263
Indirect	$350	2,811	$302	$116
Induced	$345	2,037	$200	$103
Total	**$1,449**	**11,236**	**$1,320**	**$482**

Appendix F: Pandemic-impacted regional economic footprints

This appendix presents the pandemic-impacted regional estimated economic footprints of the B.C. Aviation sector, as well as individually for each industry that comprises the sector. All regional figures are presented as the sum of direct, indirect and induced impact channels. We note that due to rounding, totals for the regional economic impacts may not sum to the provincial economic impacts.

Figure F.1: Total footprint of the B.C. Aviation sector, by economic region, 2021

Economic region	GDP ($M)	Employment (FTE)	Labour Income ($M)	Tax Revenue ($M)
Cariboo	$69	648	$82	$27
Kootenay	$49	476	$57	$19
Lower Mainland/Southwest	$1,722	16,395	$2,162	$670
Nechako/North Coast	$64	596	$79	$25
Northeast	$32	274	$35	$12
Thompson/Okanagan	$248	2,369	$303	$96
Vancouver Island and Coast	$333	3,228	$410	$128
Total	**$2,517**	**23,987**	**$3,127**	**$975**

Figure F.2: Total footprint of B.C. Aerospace Products and Parts Manufacturing, by economic region, 2021

Economic region	GDP ($M)	Employment (FTE)	Labour Income ($M)	Tax Revenue ($M)
Cariboo	$4	23	$2	$1
Kootenay	$4	26	$2	$1
Lower Mainland/Southwest	$248	1,388	$161	$60
Nechako/North Coast	$2	13	$1	$1
Northeast	$2	11	$1	$1
Thompson/Okanagan	$34	194	$22	$8
Vancouver Island and Coast	$61	339	$39	$15
Total	**$356**	**1,993**	**$227**	**$86**

Figure F.3: Total footprint of B.C. Air Transportation, by economic region, 2021

Economic region	GDP ($M)	Employment (FTE)	Labour Income ($M)	Tax Revenue ($M)
Cariboo	$19	280	$40	$10
Kootenay	$14	223	$29	$8
Lower Mainland/Southwest	$483	7,266	$1,084	$278
Nechako/North Coast	$15	216	$33	$8
Northeast	$10	123	$18	$5
Thompson/Okanagan	$74	1,118	$159	$41
Vancouver Island and Coast	$97	1,533	$216	$56
Total	**$712**	**10,759**	**$1,579**	**$406**

Figure F.4: Total footprint of B.C. Support Activities for Air Transportation, by economic region, 2021

Economic region	GDP ($M)	Employment (FTE)	Labour Income ($M)	Tax Revenue ($M)
Cariboo	$46	346	$41	$15
Kootenay	$31	227	$26	$10
Lower Mainland/Southwest	$991	7,741	$917	$331
Nechako/North Coast	$46	368	$45	$16
Northeast	$20	141	$16	$7
Thompson/Okanagan	$140	1,058	$122	$46
Vancouver Island and Coast	$175	1,356	$154	$58
Total	**$1,449**	**11,236**	**$1,320**	**$482**

Appendix G: Tax impacts

This appendix presents a breakdown of the total estimated federal and B.C. provincial tax impacts generated by the B.C. Aviation sector as well as those generated by each B.C. Aviation industry in 2019. These impacts include estimated CIT, PIT as well as Taxes on Production and Products. We note that due to rounding, the totals presented may not always add up to the sum of the items.

Figure G.1: Total tax impacts of the B.C. Aviation sector, 2019

Impact Channel	CIT ($M)	PIT ($M)	Taxes on Production & Products ($M)	Total Tax Revenue ($M)
Direct	$72.5	$472.8	$157.7	$703.0
Indirect	$33.9	$153.6	$74.0	$261.5
Induced	$53.2	$112.1	$98.7	$264.0
Total	**$159.5**	**$738.5**	**$330.4**	**$1,228.4**

Figure G.2: Total tax impacts of B.C. Aerospace Products and Parts Manufacturing, 2019

Impact Channel	CIT ($M)	PIT ($M)	Taxes on Production & Products ($M)	Total Tax Revenue ($M)
Direct	$15.8	$41.1	$5.4	$62.3
Indirect	$3.4	$7.3	$4.0	$14.7
Induced	$9.0	$8.5	$8.9	$26.3
Total	**$28.2**	**$56.9**	**$18.3**	**$103.4**

Figure G.3: Total tax impacts of B.C. Air Transportation, 2019

Impact Channel	CIT ($M)	PIT ($M)	Taxes on Production & Products ($M)	Total Tax Revenue ($M)
Direct	$27.8	$269.7	$87.3	$384.8
Indirect	$6.2	$86.5	$36.0	$128.6
Induced	$8.5	$64.0	$54.4	$126.9
Total	**$42.5**	**$420.1**	**$177.7**	**$640.3**

Figure G.4: Total tax impacts of the B.C. Air Transportation Industry, 2019

Impact Channel	CIT ($M)	PIT ($M)	Taxes on Production & Products ($M)	Total Tax Revenue ($M)
Direct	$28.9	$162.0	$64.9	$255.8
Indirect	$24.3	$59.8	$34.0	$118.2
Induced	$35.7	$39.7	$35.5	$110.8
Total	**$88.9**	**$261.5**	**$134.4**	**$484.8**

Appendix H: B.C. Aviation sector stakeholder consultations

This appendix presents the list of B.C. Aviation stakeholders that were engaged as part of this study. Insights from these interviews were gathered to inform our analysis of the wider socio-economic contributions and future prospects of the sector.

Figure H.1: B.C. Aviation Stakeholder List, by group

Airports & aviation operators	Manufacturing & MRO	Other B.C. Aviation stakeholders
• Abbotsford International Airport (YXX) • Kelowna International Airport (YLW) • Nanaimo Airport (YCD) • South Cariboo Regional Airport (ZMH) & Anahim Lake Airport (YAA) • Terrace Northwest Regional Airport (YXT) • Vancouver International Airport (YVR) • Helijet International • Pacific Coastal Airlines	• AVCORP Industries • Cascade Aerospace • KF Aerospace	• BC Aviation Council • BC Emergency Health Services • BC Institute of Technology • Canadian Advanced Air Mobility • Chinook Helicopters • Tourism Industry Association BC

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