

Onwards and Upwards

Digital Talent Outlook 2025



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Preface

The Information and Communications Technology Council (ICTC) is a not-for-profit, national centre of expertise for strengthening Canada's digital advantage in a global economy. Through trusted research, practical policy advice, and creative capacity-building programs, ICTC fosters globally competitive Canadian industries enabled by innovative and diverse digital talent. In partnership with an expansive network of industry leaders, academic partners, and policy makers from across Canada, ICTC has empowered a robust and inclusive digital economy for over 25 years.

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Researched and written by Maryna Ivus, Manager of Labour Market Research and Akshay Kotak, Senior Economist & Research Analyst, with generous support from Alexandra Cutean (Chief Research Officer), Rob Davidson (Director, Data Science), Ryan McLaughlin (former Senior Economist & Research Analyst), and the Digital Think Tank team.

The opinions and interpretations in this publication are those of the authors and do not necessarily reflect those of the Government of Canada.

Abstract

This report builds on ICTC's previous Digital Talent Outlook reports, the most recent released in fall 2019 and summer 2020. It includes an analysis of the impacts of the COVID-19 pandemic on Canada's economy and an assessment of the economic outlook going forward. This macroeconomic outlook is supplemented by an analysis of key trends in consumer behaviour and primary research on digitization that have been expedited by the pandemic. A survey of 400 businesses in Canada's digital economy and in-depth key informant interviews with industry leaders form the basis for discussions on the pandemic's implications for Canada's digital economy and six key innovation areas: cleantech, clean resources, health and biotech, advanced manufacturing, agri-foods and food tech, and interactive digital media. Building on these insights, this report also provides updated employment forecasts for the Canadian digital economy and the six innovation areas to 2025.

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Alain Guez

Vice President, Western Canada at Novari Health

Audrey Mascarenhas

President and CEO of Questor Technology Inc. and CEO of ClearPower Systems Inc.

Chad Leaman

Director of Innovation at Neil Squire Society

Christin Wiedemann

Director Quality Engineering at Slalom Build

Donny Ouyang

Founder and CEO of Blackcart

Grace Quan

President and CEO of Hydrogen in Motion Inc (H2M)

Graham Cavanagh

Senior Planner at TransLink

Heather McKay

Director of Talent at Semios

Jayson Hilchie

President & CEO of Entertainment Software Association of Canada

Jeanne-Marie Owens

Vice President, Operations at Phoenix Labs

Jeremy Shaki

CEO of Lighthouse Labs

Jessica Lu

Planning & Evaluation Manager at Genome British Columbia

John Weigelt

National Technology Officer at Microsoft Canada

Joseph Shin

Director of People Operations at Terramera

Kevin Han

Co-founder & CEO of AON3D

Mark Uhrbach

Chief, Digital Economy Metrics at Statistics Canada

Matthew Meadows

Privacy Advisor at Export Development Canada

Michelle Grady

Senior Vice-President of Production at Sony Pictures Imageworks

Mischa Steine

CEO of Awesense, Inc.

Natalie Macarthur

Director of Talent Strategy at Invest Ottawa

Patrick Brannon

Director of Major Projects at APEC (Atlantic Provinces Economic Council)

Rob Fraser

CEO of Molecular You

Sheldon Nimchuk

Project Manager at Qikiqtaaluk Corporation

Stephany Lapierre

Founder and CEO of Tealbook

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Executive Summary

The last 18 months have been turbulent, to say the least. The COVID-19 pandemic has been a human tragedy that left no nation or region unaffected. As of end June 2021, there have been over 181 million confirmed cases of COVID-19 and almost 4 million lives lost.¹ Studies of excess mortality worldwide suggest that official counts significantly underestimate the true death toll of the pandemic.^{2,3} Vital public health restrictions and lockdowns worldwide precipitated the worst economic downturn since the Great Depression.⁴ As employment and output cratered in the second quarter of 2020, the Canadian economy suffered shocks not witnessed in generations.^{5,6} While there has since been a partial recovery, it has been strikingly inequitable.^{7,8} The economic crisis in Canada continues to affect younger workers, women, and visible minorities disproportionately.⁹

However, the pandemic has also borne some unexpected and even positive changes. The policy response worldwide has, with some notable exceptions, been swift, decisive and, in several cases, unprecedented in scale.^{10,11} The rapid mobilization and broad funding of medical research worldwide has led to the development, testing, approval, and commercialization of eight different vaccines against COVID-19,¹² the first of which was approved a mere 11 months after the virus was first fully sequenced.¹³ Lessons from these vaccine development efforts are expected to facilitate the fight against other diseases.¹⁴

- 1 World Health Organization, "WHO Coronavirus (COVID-19) Dashboard," accessed 30 June 2021, <https://covid19.who.int>
- 2 World Health Organization, "The True Death Toll of COVID-19: Estimating Global Excess Mortality," accessed 30 June 2021, <https://www.who.int/data/stories/the-true-death-toll-of-covid-19-estimating-global-excess-mortality>
- 3 "Tracking Covid-19 Excess Deaths across Countries," *The Economist*, 11 May 2021, <https://www.economist.com/graphic-detail/coronavirus-excess-deaths-tracker>
- 4 Gita Gopinath, "The Great Lockdown: Worst Economic Downturn Since the Great Depression," IMF Blog (blog), accessed 30 June 2021, <https://blogs.imf.org/2020/04/14/the-great-lockdown-worst-economic-downturn-since-the-great-depression/>
- 5 Maryna Ivus, Akshay Kotak, and Ryan McLaughlin, "The Digital-Led New Normal: Revised Labour Market Outlook for 2022" (Ottawa, ON: Information and Communications Technology Council, 2020), <https://www.ictc-ctic.ca/wp-content/uploads/2020/08/Outlook-ENG-FINAL-8.24.20.pdf>
- 6 Statistics Canada, "COVID-19 in Canada: A Six-Month Update on Social and Economic Impacts," 20 October 2020, <https://www150.statcan.gc.ca/n1/pub/11-631-x/11-631-x2020003-eng.htm>
- 7 Heather Long et al., "The Covid-19 Recession Is the Most Unequal in Modern U.S. History," *Washington Post*, accessed 30 June 2021, <https://www.washingtonpost.com/graphics/2020/business/coronavirus-recession-equality/>
- 8 Bank of Canada, "Economic Progress Report: A Very Uneven Recovery," 10 September 2020, <https://www.bankofcanada.ca/2020/09/economic-progress-report-a-very-uneven-recovery/>
- 9 Statistics Canada, "COVID-19 in Canada: A One-Year Update on Social and Economic Impacts," 11 March 2021, <https://www150.statcan.gc.ca/n1/pub/11-631-x/11-631-x2021001-eng.htm#a5>
- 10 Max Roser et al., "Policy Responses to the Coronavirus Pandemic - Statistics and Research," *Our World in Data*, 2020, <https://ourworldindata.org/policy-responses-covid>
- 11 International Monetary Fund, "Policy Responses to COVID19," accessed 25 June 2021, <https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19>
- 12 Carl Zimmer, Jonathan Corum, and Sui-Lee Wee, "Coronavirus Vaccine Tracker," *The New York Times*, sec. Science, accessed 30 June 2021, <https://www.nytimes.com/interactive/2020/science/coronavirus-vaccine-tracker.html>
- 13 Ed Yong, "How Science Beat the Virus," *The Atlantic*, 14 December 2020, <https://www.theatlantic.com/magazine/archive/2021/01/science-covid-19-manhattan-project/617262/>
- 14 Philip Ball, "The Lightning-Fast Quest for COVID Vaccines — and What It Means for Other Diseases," *Nature* 589, no. 7840 (18 December 2020): 16–18, <https://doi.org/10.1038/d41586-020-03626-1>

The COVID-19 crisis has also been an opportunity for the digital economy. The digital economy was a lifeline for locked down Canadians in 2020. Over the course of several waves of lockdowns, digital tools and services helped Canadians work and study from home, shop for food and other physical and digital goods, access news and entertainment, stay connected with one another, and perform other day-to-day tasks.¹⁵ Digital tools were also vital for Canadian businesses, helping them serve and maintain connections with their customers, as storefronts were shuttered.¹⁶ Digital firms were able to transition to the “new normal” with relative ease and no appreciable loss in productivity. This positive pressure, on both the demand and supply side, meant that the digital economy has not just survived the economic turmoil of the pandemic but has seen its output and employment levels reach new highs.

Going forward, there are several positive signs for Canada’s digital economy. The pandemic introduced many Canadians to various digital tools and services for the first time¹⁷ and with a level of immersion that is likely to make this behaviour “sticky” (to persist even after restrictions are lifted). Several large data sets—medical, geospatial, socioeconomic, and demographic—have been extensively used to study the incidence and progression of the disease and understand its effects on public health and the economy.¹⁸ This led to a greater awareness of the use of data science and analytics and raised important discussions on privacy, ethics, and data sovereignty. Globally, the crisis has also served as an impetus to the advanced manufacturing¹⁹ and biotech sectors.²⁰ Fiscal stimulus plans in much of the developed world include provisions for spending on increased broadband connectivity and on the transition to green energy.^{21,22,23}

- 15 Statistics Canada, “The Daily — Canadian Internet Use Survey, 2020,” 22 June 2021, <https://www150.statcan.gc.ca/n1/daily-quotidien/210622/dq210622b-eng.htm>
- 16 Statistics Canada, “Retail E-Commerce and COVID-19: How Online Shopping Opened Doors While Many Were Closing,” 24 July 2020, <https://www150.statcan.gc.ca/n1/pub/45-28-0001/2020001/article/00064-eng.htm>
- 17 Statistics Canada, “Internet Use and COVID-19: How the Pandemic Increased the Amount of Time Canadians Spend Online,” 24 June 2021, <https://www150.statcan.gc.ca/n1/pub/45-28-0001/2021001/article/00027-eng.htm>
- 18 Katherine Unger Baillie, Michele W. Berger, and Erica K. Brockmeier, “The Role of Data in a World Reshaped by COVID-19,” Penn Today | University of Pennsylvania, accessed 30 June 2021, <https://penntoday.upenn.edu/news/role-data-world-reshaped-covid-19>
- 19 “The Impact of COVID-19 on the Future of Advanced Manufacturing and Production: Insights from the World Economic Forum’s Global Network of Advanced Manufacturing Hubs,” World Economic Forum, accessed 30 June 2021, <https://www.weforum.org/reports/the-impact-of-covid-19-on-the-future-of-advanced-manufacturing-and-production-insights-from-the-world-economic-forum-s-global-network-of-advanced-manufacturing-hubs/>
- 20 Brian Abrahams et al., “Biotech Outlook 2021: Innovation, IPOs and COVID-19,” RBC Capital Markets, accessed 30 June 2021, <http://www.rbc.com/en/gib/biopharma/story.page?dcr=templatedata/rbccm/episode/data/biopharma/biotech-outlook-2021-innovation-ipos-and-covid-19>
- 21 European Commission, “A European Green Deal,” Text, accessed 30 June 2021, https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
- 22 The White House, “Build Back Better,” accessed 29 June 2021, <https://www.whitehouse.gov/build-back-better/>
- 23 Department of Finance Canada, “Budget 2021: A Healthy Environment for a Healthy Economy,” backgrounders, 19 April 2021, <https://www.canada.ca/en/department-finance/news/2021/04/budget-2021-a-healthy-environment-for-a-healthy-economy.html>

The effects of the COVID-19 crisis will likely persist long after the pandemic passes. Changes in consumer behaviour, accelerated digitization, and the adoption of new technologies are likely to have significant effects on productivity,²⁴ innovation,²⁵ and the workforce.²⁶ The digital economy is well placed to capitalize on these trends and to continue increasing its share of total employment in Canada. By 2025, ICTC forecasts employment in the Canadian digital economy to reach 2.26 million—triggering a demand for an additional 250,000 jobs.

After what seems like an interminable year and a half, there is light at the end of the tunnel. As Canada’s mass vaccination campaign continues to make impressive strides, provinces and territories are on track to reopen in summer 2021 and there is a sense of cautious optimism.²⁷ In the near term, this might lead to an “attention recession”²⁸ as Canadians, tired from over a year of lockdowns, shun their screens and head out to enjoy their regained freedoms. In the second half of 2021, as more Canadians resume activities that they have had to forego over the last eighteen months—dining out, congregating with family and friends, travel and tourism, in-person entertainment and recreation—these sectors will experience an economic recovery that has thus far excluded them. In the medium to long term, the digital economy will continue outpace growth in the general economy, bring forward new and high-quality employment prospects for Canadians, and build on the shocks and lasting impacts of the COVID-19 pandemic.

- 24 “Why a Dawn of Technological Optimism Is Breaking,” *The Economist*, 16 January 2021, <https://www.economist.com/leaders/2021/01/16/why-a-dawn-of-technological-optimism-is-breaking>
- 25 Derek Thompson, “World War II’s Lesson for After the Pandemic,” *The Atlantic*, 28 June 2021, <https://www.theatlantic.com/ideas/archive/2021/06/covid-19-pandemic-golden-age-innovation/619300/>
- 26 Susan Lund et al., “The Future of Work after COVID-19,” McKinsey & Company, accessed 30 June 2021, <https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-work-after-covid-19>
- 27 CBC News, “Coronavirus: What’s Happening in Canada and around the World on Wednesday | CBC News,” CBC, accessed 30 June 2021, <https://www.cbc.ca/news/world/coronavirus-covid19-canada-world-june30-2021-1.6085619>
- 28 “As Lockdowns Lift, Media Firms Brace for an ‘Attention Recession,’” *The Economist*, 27 June 2021, <https://www.economist.com/international/2021/06/27/as-lockdowns-lift-media-firms-brace-for-an-attention-recession>



Introduction

ICTC's previous Outlook report, *Canada's Growth Currency: Digital Talent Outlook 2023*,²⁹ analyzed the labour composition of the Canadian digital economy. It defined the components of the digital economy, along with six key innovation areas: cleantech, agri-foods and food tech, interactive digital media, advanced manufacturing, clean resources, and health and biotech. Based on an analysis of supply and demand trends, supplemented with primary research in the form of surveys and interviews with industry leaders across Canada, the report presented employment forecasts to 2023.

The onset of the COVID-19 global pandemic in early 2020 and subsequent financial and economic turmoil necessitated a revision of these forecasts. In the summer of 2020, ICTC published a revised report, *The Digital New Normal: Revised Labour Market Outlook for 2022*.³⁰ It included an analysis of the initial impacts of COVID-19 and other shocks to the Canadian economy and labour market. Acknowledging the greater uncertainty in public health and economic outcomes of the pandemic at the time, the report presented updated forecasts to 2022. While uncertainty was the order of the day, the report ended on an optimistic note, as there were signs that the pandemic could accelerate Canada's digital journey.

This appears to have been the case. The COVID crisis has been an opportunity for Canada's digital economy. While lockdowns have boosted the demand for digital goods and services as more Canadians spent more time indoors, digital firms have been able to transition to the "new normal" more comfortably than other firms and have even seen employment and output recover and surge past pre-pandemic levels. Businesses in the digital economy appear to have fared better in this crisis than those in the rest of the economy. Going forward, the outlook is positive. Trends accelerated by the pandemic—changes in consumer behaviour, accelerated digitization, and the adoption of new technologies—are likely to persist in some measure. Growth in the digital economy is poised to continue outpacing the general economy in the coming years, building upon the pandemic's positive effects on certain sectors.

²⁹ Alexandra Cutean et al., "Canada's Growth Currency: Digital Talent Outlook 2023" (Ottawa, ON: Information and Communications Technology Council, October 2019), <https://www.ictc-ctic.ca/wp-content/uploads/2019/11/canada-growth-currency-2019-FINAL-ENG-10.28.19.pdf>

³⁰ Ivus, Kotak, and McLaughlin, "The Digital-Led New Normal: Revised Labour Market Outlook for 2022."

This report studies these trends and the general economic outlook, and presents employment forecasts to 2025. It is structured as follows:

- ▶ **Section I** discusses the impacts of COVID-19 on the broader Canadian economy, with a focus on employment and output across various sectors. It also outlines the general economic outlook going forward and key factors and risks that inform this outlook. It concludes with updated forecasts for output and employment in the aggregate economy.
- ▶ **Section II** focuses on the digital economy in Canada. The pandemic has brought about significant shifts in consumer behaviour and accelerated trends in digitization and the consumption of digital goods and services. This section outlines these key trends, in-demand occupations, and discusses their implications for the prospects of Canada's digital economy, supplemented by findings from ICTC's national survey of Canada's digital economy. It also presents updated statistics and employment forecasts for the digital economy to the end of 2025.
- ▶ **Section III** updates at the six innovation areas highlighted in ICTC's previous outlook reports and presents employment forecasts that account for the progression of the pandemic and the future economic outlook. This section also includes snapshots of emerging occupations for specific sectors, and their corresponding critical hard skills.

A description of research and forecasting methods used in this report is provided in the appendix, along with supplementary forecasts for the four major provinces.

●○○ Section I

General Economic Outlook



The turmoil wrought by the COVID-19 pandemic has been one of the most severe public health and economic crises to hit Canada and the rest of the world.

Apart from the large loss of life, in Canada and worldwide, the rolling out of necessary public health measures and lockdowns in the second quarter of 2020 meant that employment and economic output suffered the single biggest shock since the Second World War. A raft of fiscal,³¹ monetary, and macroprudential³² policy responses helped bring about a sharp rebound in economic activity in the third quarter of 2020, when reduced COVID caseloads allowed for the relaxation of public health measures. However, the recovery was hampered by subsequent waves of infections and lockdowns: a second wave from October 2020 to January 2021, and a third wave in April/May 2021.

COVID-19: Daily New Cases and Deaths in Canada 7-day moving average

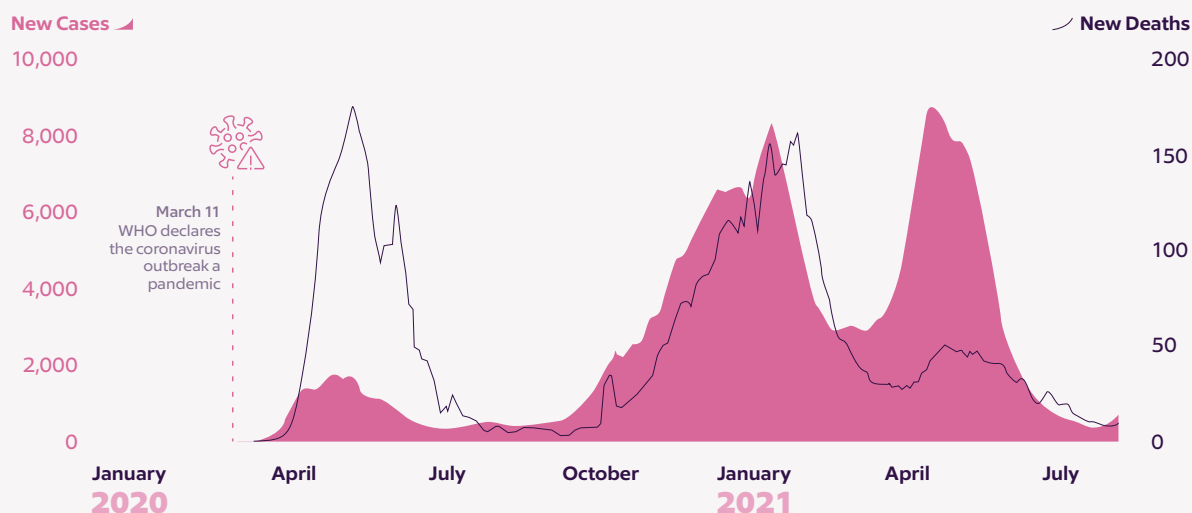


Figure 1: Seven-day moving average of daily new COVID-19 cases and deaths in Canada, March 2020 – August 2021. Source: Government of Canada

While the second and third waves necessitated the re-implementation of restrictions across most of Canada, the reduction in the mortality rate of COVID-19, especially in the third wave, speaks to the improvements in diagnosis and treatment of the disease, and the effect of vaccinations.

31 Government of Canada, "Overview of Canada's COVID-19 Economic Response Plan," 6 January 2021, 19, <https://www.canada.ca/en/department-finance/services/publications/economic-fiscal-snapshot/overview-economic-response-plan.html>

32 Bank of Canada, "COVID-19: Actions to Support the Economy and Financial System," Bank of Canada, accessed 25 June 2021, <https://www.bankofcanada.ca/markets/market-operations-liquidity-provision/covid-19-actions-support-economy-financial-system/>

After a slow start and initial delays,³³ Canada’s vaccination campaign progressed with impressive pace in the subsequent months. The initial pace of vaccine imports meant that most provinces followed a strategy of prioritizing first doses and delaying second doses.³⁴ Supply lines of mRNA vaccine shipments are now stable,³⁵ and most Canadians are facing reduced timelines between their shots. As of July 31, over 71% of the Canada’s population has received at least one dose of vaccine, and almost 60% is fully vaccinated.³⁶

A sense of cautious economic optimism in the medium term has emerged on the heels of a successful rollout of COVID-19 vaccination campaigns across Canada and large parts of the developed world—alongside examples of recovery in countries further ahead of Canada in vaccination rates and reopening. ICTC’s economic forecasts for the general and digital economy in Canada are based around three scenarios that factor in this general optimism but also considers some of the risks.

COVID-19: Vaccination Rate in Canada Proportion of Population Vaccinated

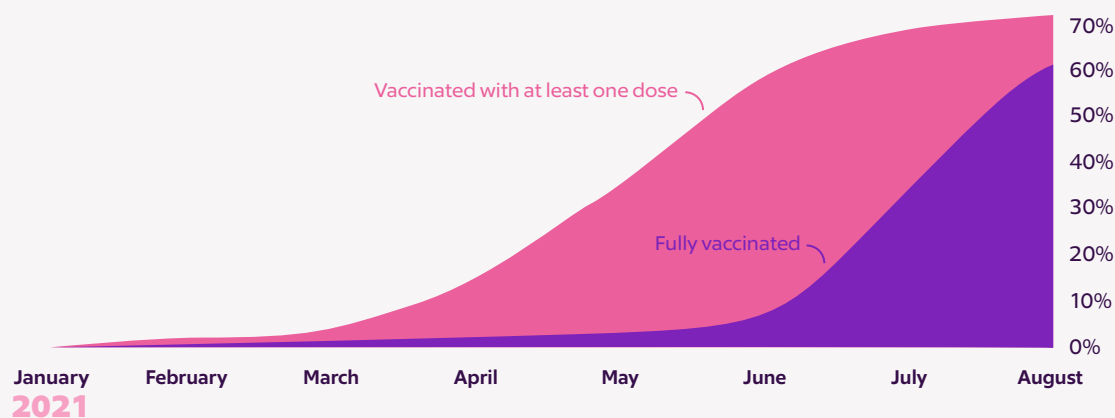


Figure 2: Vaccination Rate in Canada, January 2021 – August 2021. Source: Government of Canada

- 33 John Paul Tasker, "Canada's Pfizer Vaccine Shipment Delayed by Winter Weather in the U.S. | CBC News," CBC, 16 February 2021, <https://www.cbc.ca/news/politics/pfizer-delays-winter-weather-1.5915661>
- 34 Mia Rabson, "Canada Investigating Whether Delaying Second COVID-19 Vaccine Doses Could Help More People," The Globe and Mail, accessed 25 June 2021, <https://www.theglobeandmail.com/canada/article-canada-investigating-whether-delaying-second-covid-19-vaccine-doses/>
- 35 Public Services and Procurement Canada, "Procuring Vaccines for COVID-19," 11 December 2020, <https://www.canada.ca/en/public-services-procurement/services/procuring-vaccines-covid19.html>
- 36 Public Health Agency of Canada, "Demographics: COVID-19 Vaccination Coverage in Canada - Canada.Ca," accessed 5 July 2021, <https://health-infobase.canada.ca/covid-19/vaccination-coverage/>



Economic Impacts of COVID-19



Employment

Figure 3 below shows seasonally adjusted employment in Canada from 2000 onwards. The COVID period (Feb 2020 onwards) is marked in grey. The employment shocks brought about by the first, and to a lesser extent the second and third waves, are clearly visible. For comparison, note the relatively small size of the employment shock that occurred in 2008-10. The snapback in employment after the first wave and relatively fewer losses in the second and third wave point to fewer restrictions in the latter and to an increased ability for those who can work remotely to do so. However, there still remains a sizable employment gap compared to pre-pandemic levels. As of May 2021, employment was still 2.9% below the pre-pandemic level, on a seasonally adjusted basis.

Canada: Payroll Employment Seasonally adjusted employment (x 1,000)

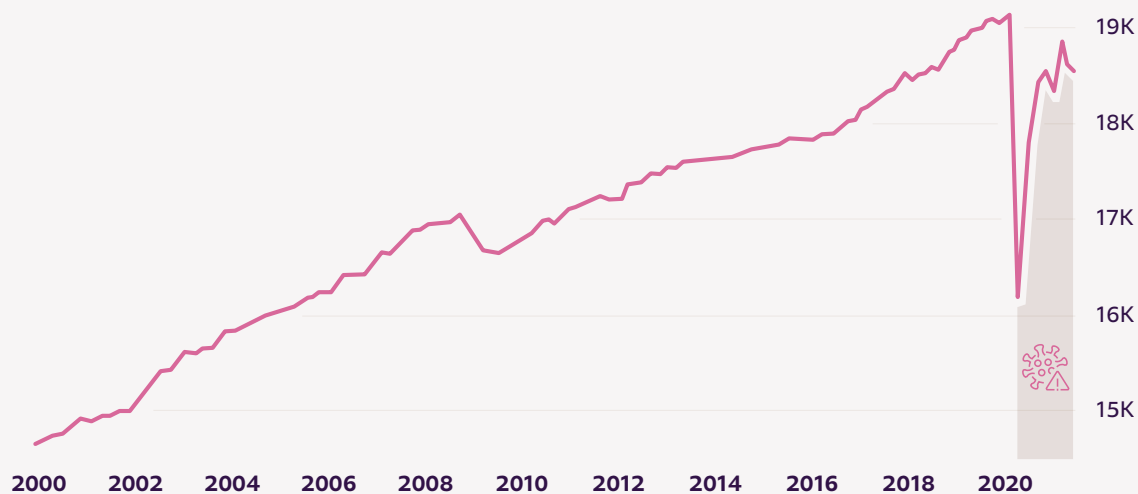


Figure 3: Payroll Employment in Canada, January 2000 – May 2021. Source: Statistics Canada

Drilling down by sector, we see that most sectors that are either essential or are fairly well suited to remote work have seen employment recover and even surpass pre-pandemic levels. **Figure 4** shows snapshots of sector employment levels (compared to pre-pandemic) after the first, second, and third wave of lockdowns. With each successive wave, many of these sectors were able to enhance their remote work readiness and adapt to the “new normal,” allowing for an improvement in employment numbers.

On the other hand, sectors that rely on the reopening of the economy and the resumption of normal activity—tourism, food and drink, entertainment and recreation, and brick-and-mortar retail—still lie well below their employment levels in January 2020. These sectors also often happen to be those with lower average wages, highlighting the inequity in the economic recovery thus far.³⁷

37 Don Pittis, “Beware the Letter K as Canadian Economy Threatens to Split in 2 | CBC News,” CBC, 7 October 2020, <https://www.cbc.ca/news/business/jobs-data-k-shaped-recovery-canadian-economy-splits-pittis-1.5752687>

Canada: Employment by Sector Seasonally adjusted employment

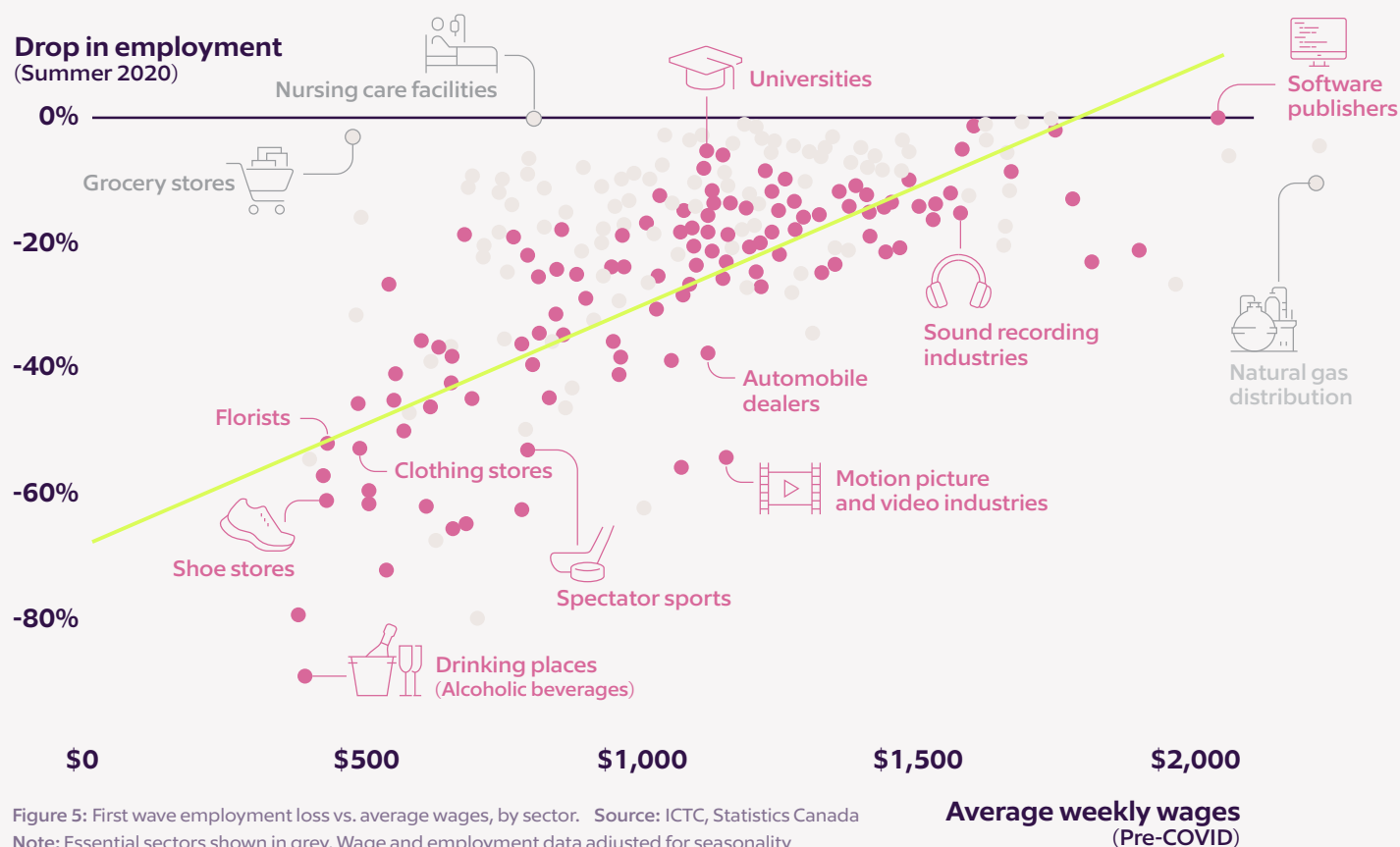


Figure 4: Employment in Canada, by sector, January 2020 – May 2021. Source: ICTC, Statistics Canada

Figure 5 highlights how lockdowns impacted lower wage workers more severely by plotting the drop in employment of various sectors³⁸ during the first wave against the average wage in the sector. Workers in non-essential industries that suffered job losses tended to be from low wage sectors. While some of this damage was mitigated by government programs such as the Canada Emergency Response Benefit (CERB),³⁹ these industries and workers are still a long way from full recovery.

Lockdowns Impacted Lower Wage Workers More Severely

Drop in employment through the first wave of lockdowns (H1 2020) vs. pre-pandemic average



As we can see in **Figure 6**, higher wage industries suffered significantly fewer job losses during the peak of the crisis and have since also either nearly recovered to pre-pandemic levels or surpassed them. Lower wage industries, especially high-touch sectors such as accommodation and food services, brick-and-mortar retail, and arts, entertainment, and recreation, have suffered the most and still suffer from very high unemployment.

38 Using 4-digit NAICS.

39 Service Canada, "Canada Emergency Response Benefit (CERB)," 24 April 2020, <https://www.canada.ca/en/services/benefits/ei/cerb-application.html>

COVID-19 Has Impacted Lower Wage Workers More Severely

Drop in employment through the first wave of lockdowns (H1 2020), and current employment as a proportion of pre-pandemic levels, by wage decile

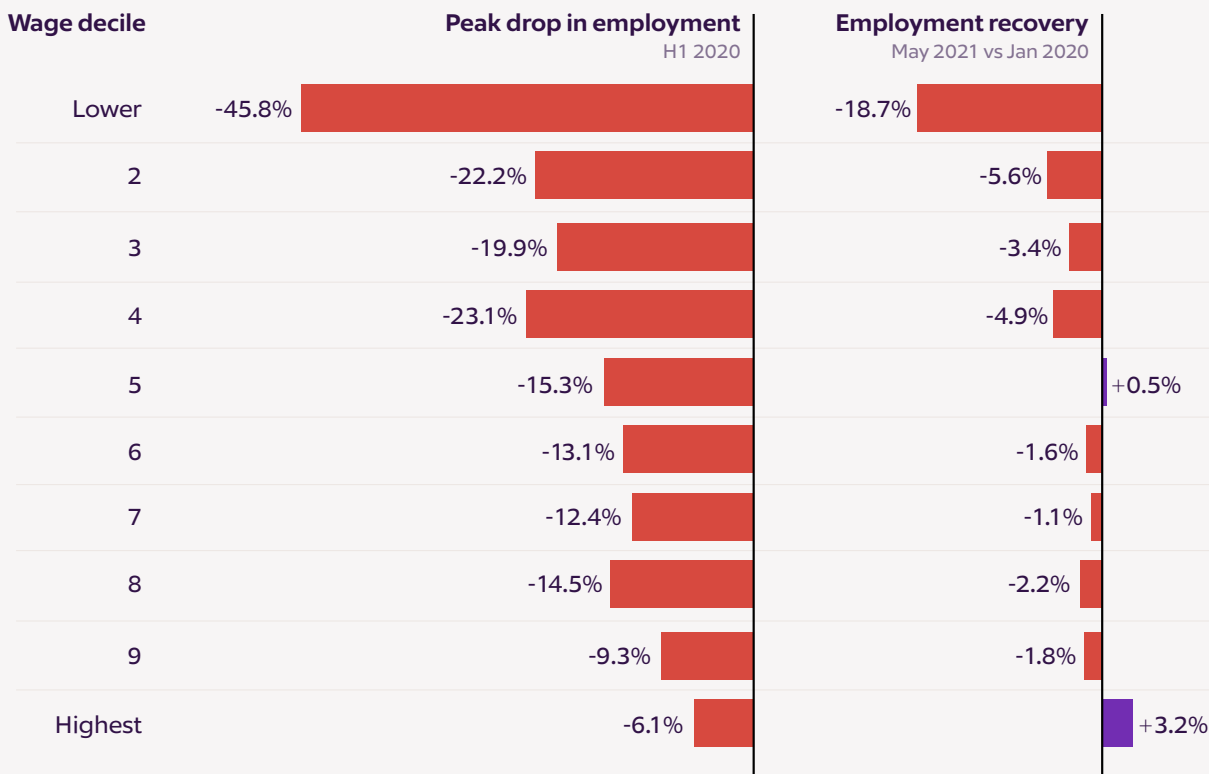


Figure 6: Employment impact and recovery of Canadian industries, by wage decile. Source: ICTC, Statistics Canada

On a related note, this crisis has also disproportionately impacted women, young people (15-24 years old), and those with less formal education. As seen in **Figure 7**, women in the Canadian workforce suffered a higher proportional drop in employment during the peak of the COVID-19 crisis and are currently at a proportionally lower level of employment compared to pre-pandemic levels. Apart from a proportionally higher representation in the sectors most affected by lockdowns, women workers have also been disproportionately impacted by the closures of schools and daycares.⁴⁰ The latest federal budget includes provisions to address some of these issues⁴¹ and hopefully marks an important step toward regaining ground on gender equality in the workforce.

40 Dawn Desjardins, Carrie Freestone, and Naomi Powell, "Pandemic Threatens Decades of Women's Labour Force Gains - RBC Economics," RBC Thought Leadership, 16 July 2020, <https://thoughtleadership.rbc.com/pandemic-threatens-decades-of-womens-labour-force-gains/>

41 Government of Canada, "Minister Carr Highlights She-Cession Investments in Budget 2021," news releases, 27 April 2021, <https://www.canada.ca/en/intergovernmental-affairs/news/2021/04/minister-carr-highlights-she-cession-investments-in-budget-2021.html>

COVID-19 Has Impacted Female Workers More Severely

Drop in employment through the first wave of lockdowns (H1 2020), and current employment as a proportion of pre-pandemic levels, by sex

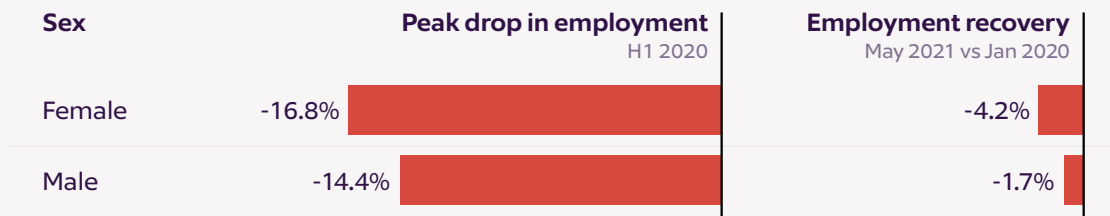


Figure 7: Employment impact and recovery of Canadian workers, by sex. Source: ICTC, Statistics Canada

Figure 8 below repeats the same analysis across age groups instead of gender. Again, we see that younger workers suffered the steepest job losses during the pandemic and still are the farthest from a complete labour market recovery. The key driver here is the disproportionate number of younger Canadians working in the sectors most affected by lockdowns and other public health restrictions. For example, Canadians aged 15 to 24 make up almost 40% of employment in the accommodation and food services sectors – more than three times their share of the aggregate labour force.⁴²

COVID-19 Has Impacted Younger Workers More Severely

Drop in employment through the first wave of lockdowns (H1 2020), and current employment as a proportion of pre-pandemic levels, by age group

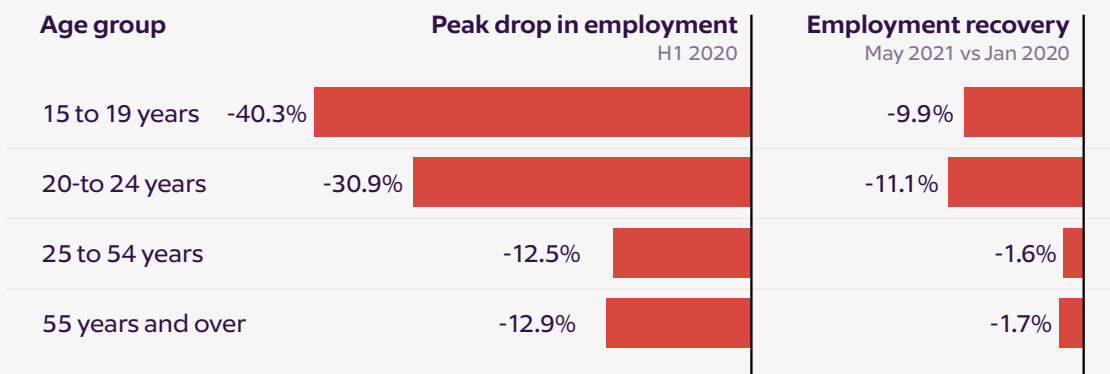


Figure 8: Employment impact and recovery of Canadian workers, by age. Source: ICTC, Statistics Canada

42 Bank of Canada, "Canada's Labour Market: Rebound, Recuperation and Restructuring," 23 February 2021, <https://www.bankofcanada.ca/2021/02/canadas-labour-market-rebound-recuperation-and-restructuring>

Similar analysis of Canadian workers, categorized by education, highlights the relative “COVID-safe” nature of employment for Canadians with university education. In general, more knowledge-intensive sectors in Canada have been better able to switch to remote work and suffered fewer losses during the peak of first wave lockdowns in Q2 2020. Employment levels of Canadians with a bachelor’s degree or higher have completely recovered and now sit well above pre-pandemic levels, while Canadians with fewer than eight years of formal schooling are currently still almost 27% below their pre-pandemic levels of employment.

COVID-19 Has Severely Impacted Workers With Less Formal Education

Drop in employment through the first wave of lockdowns (H1 2020), and current employment as a proportion of pre-pandemic levels, by age group

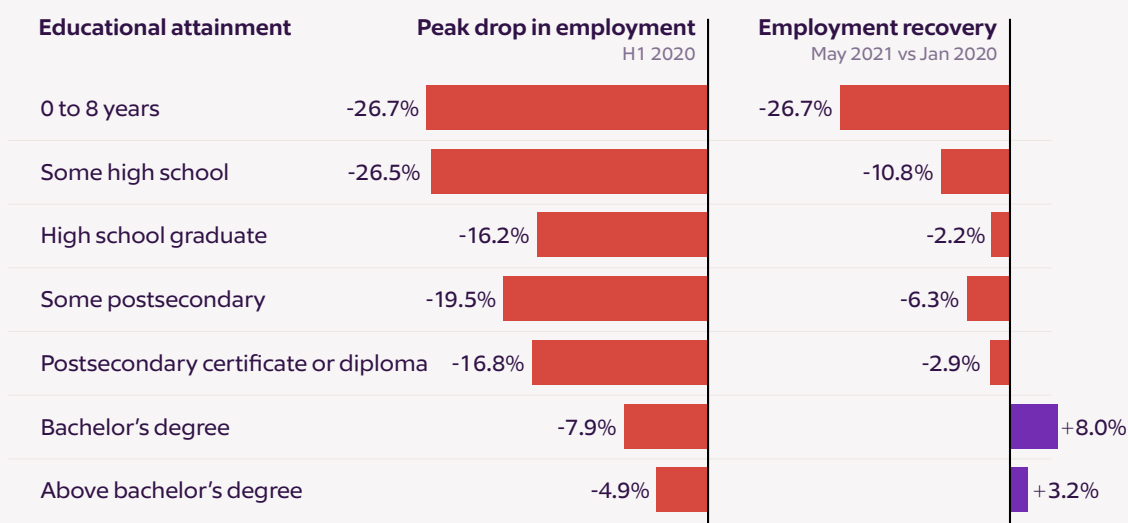


Figure 9: Employment impact and recovery of Canadian workers, by educational attainment. Source: ICTC, Statistics Canada

Another worrying outcome of the pandemic has been chronic long-term unemployment. As of February 2020, the number of Canadians in long-term unemployment—for longer than 26 weeks—stood at over half a million, the highest level in 30 years.⁴³ This is likely to cause an erosion of human capital and have some lasting impacts on the opportunities available to those trapped in long-term unemployment. While a broad and sustained reopening of the economy should help reduce some of these adverse effects, ensuring that Canada’s economic recovery is sustainable and inclusive will require investment in skills development, digitization, and programs aimed at driving inclusive and equitable innovation.⁴⁴

43 Ibid.

44 ICTC, “ICTC Insights on the 2021 Federal Budget,” Information and Communications Technology Council, 20 April 2021, <https://www.ictc-ctic.ca/ictc-insights-2021-federal-budget/>

Economic Output

Aggregate output in Canada suffered a similar drop through the first wave of lockdowns with a contraction of over 38% (annualized) in the second quarter of 2020 followed by a snapback in the second half of the year as restrictions were lifted. As shown in **Figure 10** below, the drop in GDP in a single month from February to March 2020 was equivalent to the entire peak-to-trough drop from July 2008 to May 2009 during the prior decade’s “great recession.” In short, the COVID-19 economic crisis was both large and extremely rapid. Likewise, the recovery has been very rapid, and indeed fairly “V-shaped.” While the second and third waves of restrictions have probably had a bit of a dampening effect, as of April 2021, Canada’s GDP is just 1.1% below the pre-pandemic peak of February 2020.

Canada: Gross Domestic Product CAD, adjusted for seasonality and inflation

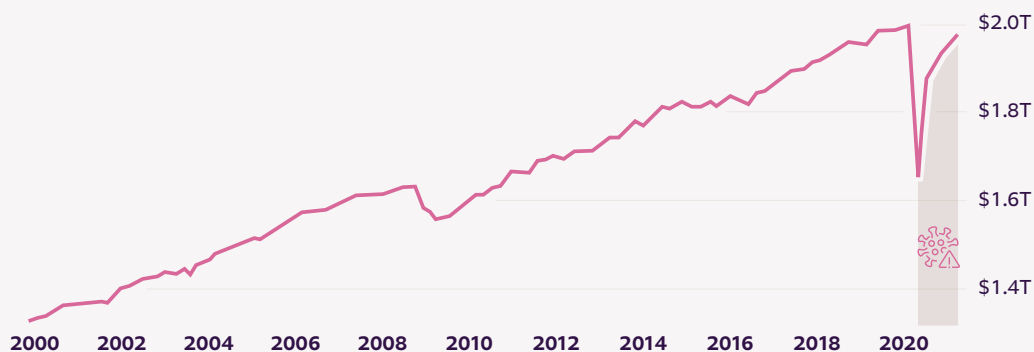


Figure 10: Aggregate Canadian GDP (chained 2012 dollars), January 2000 – March 2021. Source: Statistics Canada

As with employment, individual sectors follow their own idiosyncratic patterns. Knowledge sectors such as technology, finance, and professional, scientific, and technical services have been able to transition relatively easily to the digital new normal and have recovered and surpassed pre-pandemic levels. Essential sectors such as education, healthcare, and public administration have also recovered to near pre-pandemic levels.

GDP in the oil and gas and mining sector was still below pre-pandemic levels as of Q1 2021, but the outlook is brighter with the recent increase in energy and metal prices. This came on the back of expectations of an increase in demand as more economies are poised to reopen in the second half of 2021 following successful mass vaccination campaigns. The agriculture, forestry, and fishing sector has also seen steady growth since the first wave, driven in large part by the surge in prices of forestry commodities since mid-2020 (see **Figure 14**).

Canada: GDP by Sector GDP data adjusted for seasonality and inflation

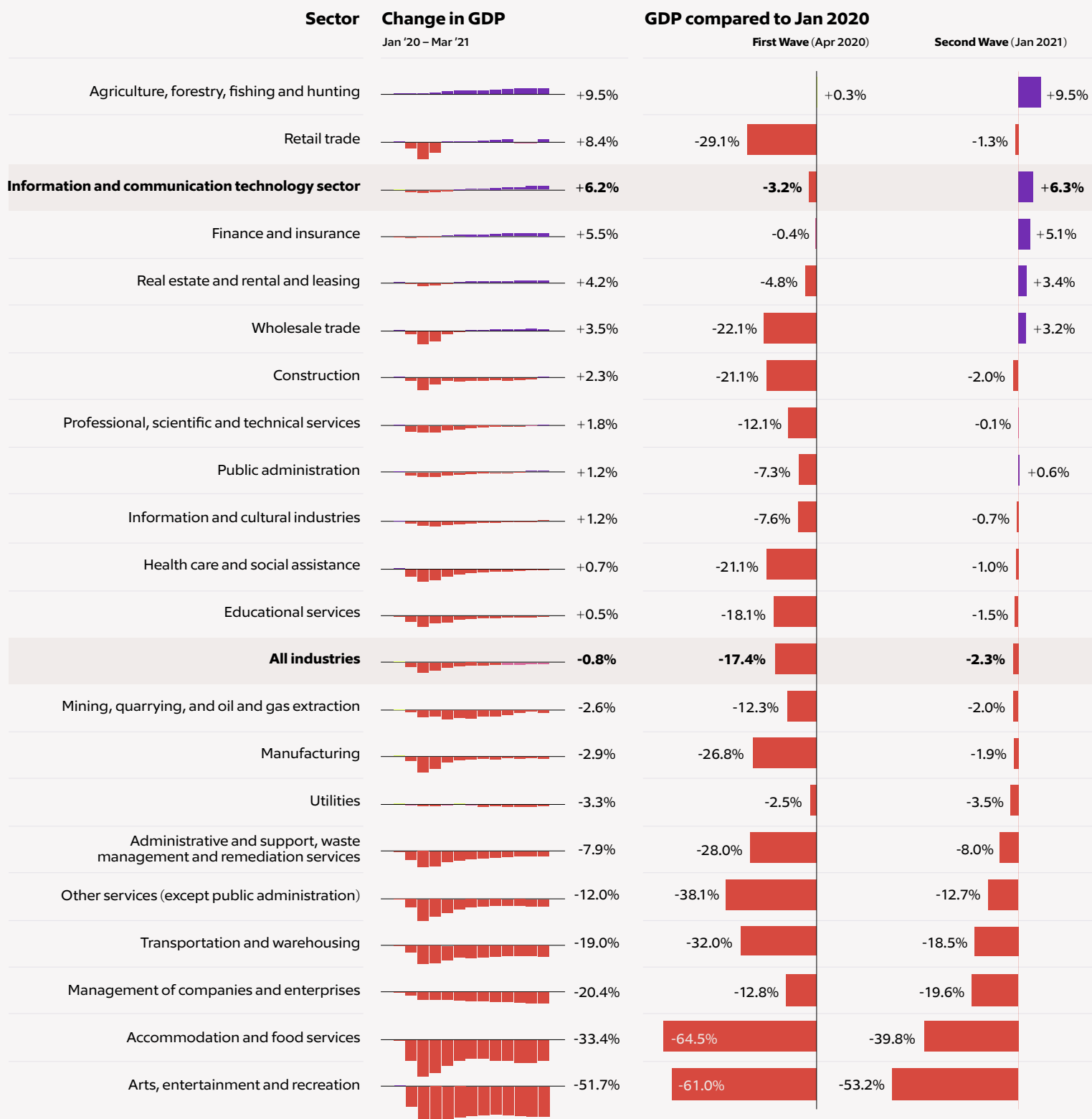


Figure 11: Canadian GDP (chained 2012 dollars), by sector, January 2020 – March 2021. Source: Statistics Canada

Interestingly, the retail sector has seen output grow to greater than pre-pandemic levels since the end of the second wave in January 2021, even as employment levels remain below pre-pandemic levels. While GDP data for the second quarter of 2021 might show the impact of third wave restrictions on output in this sector, this recent decoupling of output and employment, especially when compared to the first wave, points to the increasing importance of e-commerce and intelligent retail to drive sales even when storefronts remain shuttered. As can be seen in **Figure 12**, retail e-commerce sales in Canada had been steadily increasing since 2016, albeit at a modest pace, before almost doubling in the two months following the imposition of COVID-19 restrictions in March 2020. While there was a subsequent drop after most of Canada reopened during the summer of 2020, the level remained well above the pre-pandemic average and bounced up again during the second and third waves of lockdowns.

Canada: Retail e-Commerce Sales CAD, adjusted for seasonality

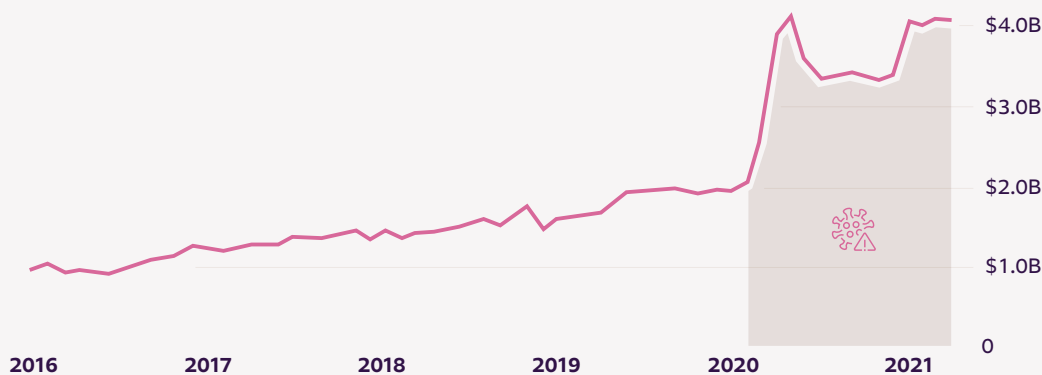


Figure 12: Retail e-commerce sales in Canada, January 2016 – April 2021. Source: Statistics Canada

Finally, high-touch sectors like accommodation and food services, and arts, entertainment, and recreation remain significantly depressed, but their outlook is positive as well. Warmer weather and provincial reopening in the coming months are anticipated to bring significant domestic demand for these goods and services.

Future Outlook and Key Factors

The general economic outlook in Canada for the short to medium term is fairly positive. This is informed by the five factors discussed below.

1

Vaccine Developments and Reopening

Most advanced economies are making steady progress with their vaccination campaigns and reopening of economic activity is moving to the forefront, setting the stage for strong growth in the second half of this year and into next year. Emerging markets still lag in terms of access and rollout of vaccines, although more is being done via the World Health Organization's COVAX (COVID-19 Vaccines Global Access) initiative and separate efforts by G7 nations.⁴⁵ In Canada, the vaccination schedule is currently on track to allow most provinces to reopen in the summer.⁴⁶ While there are some risks in the potential disruption of vaccine supply chains, new variants of concern, and potential vaccine hesitancy, these risks are currently regarded to be fairly low.^{47,48}

As restrictions ease and more movement is allowed within and across the country, Canada is likely to see strong domestic demand for goods and services as households look to unleash some of the pent-up demand over the last year. The easing of restrictions in the US earlier in spring 2021 led to a strong start to the year, with US GDP growing at an annualized rate of 6.4% in the first quarter of 2021.⁴⁹ This has no doubt been helped by its substantial fiscal stimulus programs since the start of the pandemic, which have totalled to more than 27% of GDP.⁵⁰ The easing of restrictions in Canada can also be expected to similarly boost output in the second half of 2021.

45 "G7 Announces Pledges of 870 Million COVID-19 Vaccine Doses, of Which at Least Half to Be Delivered by the End of 2021," World Health Organization, accessed 28 June 2021, <https://www.who.int/news/item/13-06-2021-g7-announces-pledges-of-870-million-covid-19-vaccine-doses-of-which-at-least-half-to-be-delivered-by-the-end-of-2021>

46 Trevor Lawson et al., "COVID-19: Recovery and Re-Opening Tracker | McCarthy Tétrault," McCarthy Tétrault, accessed 29 June 2021, <https://www.mccarthy.ca/en/insights/articles/covid-19-recovery-and-re-opening-tracker>

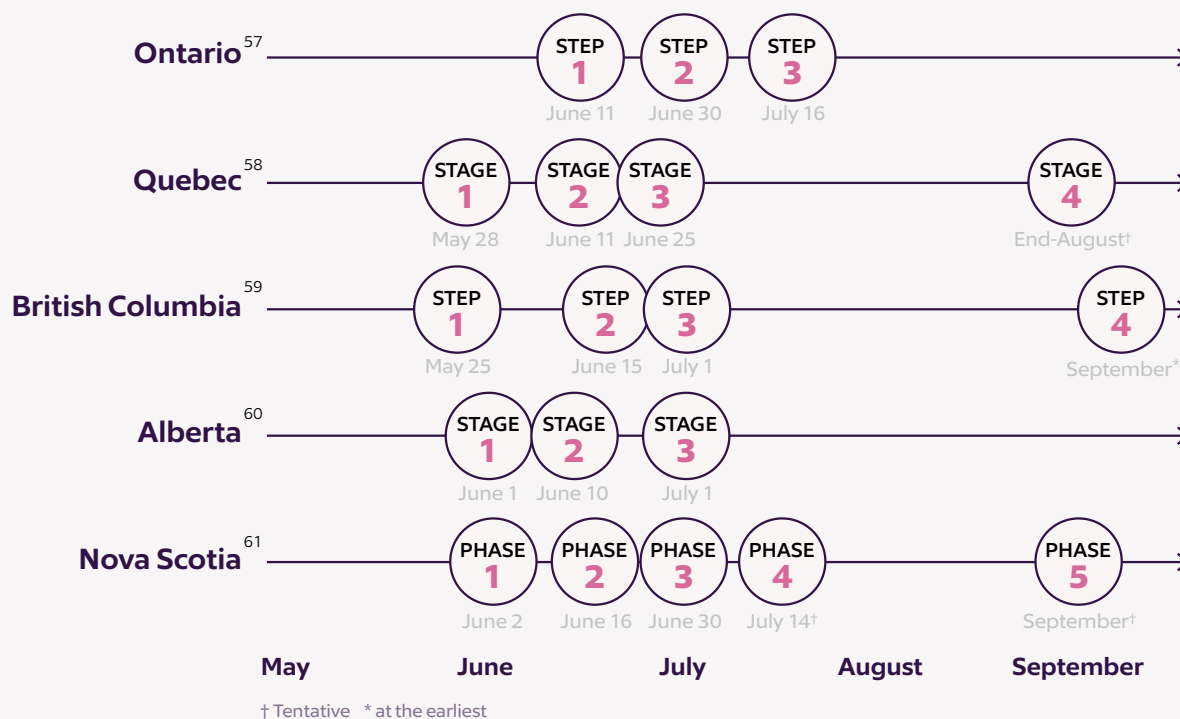
47 John Paul Tasker, "New COVID-19 Cases Have Dropped 80 per Cent — and 5.3 Million More Shots Are Set to Arrive next Week | CBC News," CBC, 11 June 2021, <https://www.cbc.ca/news/politics/covid-cases-drop-vaccine-supply-surges-1.6062444>

48 Ludwig Burger and Aishwarya Nair, "AstraZeneca, Pfizer Vaccines Effective against Delta COVID-19 Variants: Study," CTV News, 23 June 2021, <https://www.ctvnews.ca/health/coronavirus/astrazeneca-pfizer-vaccines-effective-against-delta-covid-19-variants-study-1.5482427>

49 U.S. Bureau of Economic Analysis (BEA), "Gross Domestic Product (Third Estimate), GDP by Industry, and Corporate Profits (Revised), 1st Quarter 2021," accessed 28 June 2021, <https://www.bea.gov/news/2021/gross-domestic-product-third-estimate-gdp-industry-and-corporate-profits-revised-1st>

50 Adam Taylor, "How the \$1.9 Trillion U.S. Stimulus Package Compares with Other Countries' Coronavirus Spending," Washington Post, 5 April 2021, <https://www.washingtonpost.com/world/2021/03/10/coronavirus-stimulus-international-comparison/>

To temper this optimism, the case of the UK and the rise of Delta variant there serves as a cautionary tale.⁵¹ The easing of restrictions in mid-April,⁵² when the fraction of fully vaccinated Britons was just under 12%,⁵³ has allowed the more transmissible Delta variant of the COVID-19 virus to spread among its still large unvaccinated and partially vaccinated populations, which temporarily derailed reopening plans.⁵⁴ Authorities in Canada appear to have taken a more conservative approach to reopening,^{55,56} which should hopefully allow for a sustained reopening through the second half of 2021 with fewer hiccups.



51 Michelle Roberts, "UK Covid Infections Rise as Delta Variant Dominates," BBC News, 18 June 2021, sec. Health, <https://www.bbc.com/news/health-57525891>

52 "England's Lockdown to Ease as Planned on 12 April," BBC News, 5 April 2021, sec. UK, <https://www.bbc.com/news/uk-56641596>

53 "COVID-19 Data Explorer," Our World in Data, accessed 29 June 2021, <https://ourworldindata.org/coronavirus-data-explorer>

54 Becky Morton and Joseph Lee, "Covid: Lockdown Easing in England to Be Delayed by Four Weeks," BBC News, 14 June 2021, sec. UK, <https://www.bbc.com/news/uk-57464097>

55 Rhianna Schmunk, "B.C. Aiming to Lift Virtually All Restrictions by September under New Restart Plan | CBC News," CBC, 25 May 2021, <https://www.cbc.ca/news/canada/british-columbia/bc-covid-restrictions-update-may-25-1.6039243>

56 "Ontario to Move into next Phase of COVID-19 Reopening 2 Days Early, Sources Say | CBC News," CBC, 23 June 2021, <https://www.cbc.ca/news/canada/toronto/covid-19-ontario-june-23-2021-second-dose-delta-hot-spots-1.6076469>

57 Government of Ontario, "Reopening Ontario | Ontario.Ca," accessed 14 July 2021, <https://www.ontario.ca/page/reopening-ontario>

58 Benjamin Shingler, "Quebec's Reopening Plan Brings Much-Needed Hope — and Yes, Some Risks | CBC News," CBC, 20 May 2021, <https://www.cbc.ca/news/canada/montreal/quebec-reopening-legault-1.6033064>

59 Government of British Columbia, "BC's Restart" (Province of British Columbia), accessed 5 July 2021, <https://www2.gov.bc.ca/gov/content/covid-19/info/restart>

60 Government of Alberta, "COVID-19 Public Health Actions," accessed 5 July 2021, <https://www.alberta.ca/covid-19-public-health-actions.aspx>

61 Government of Nova Scotia, "Reopening Plan," Reopening plan, 29 May 2021, <https://novascotia.ca/reopening-plan/>

2 Household Savings and Pent-Up Demand

The first wave of lockdowns saw unprecedented levels of job losses in the Canadian economy, but the policy response also included extraordinary fiscal transfers. While Canadians lost an average of \$1,600 in labour income over 2020,⁶² this was more than offset by government programs like the Canada Emergency Response Benefit (CERB),⁶³ the Canada Emergency Wage Subsidy (CEWS),⁶⁴ and other programs. With the support of these measures, the disposable income of the average Canadian actually increased in 2020 to about \$1,800.⁶⁵ This additional income was coupled with a sharp reduction in household spending, brought about by lockdown restrictions and a loss of consumer confidence in the face of the pandemic. Combined, this has meant that Canadian households saved an unprecedented \$180 billion in aggregate.⁶⁶ The household saving rate in Q1 2021 stood at 13.1%, compared to the pre-pandemic average of about 3.3% (see **Figure 13**).

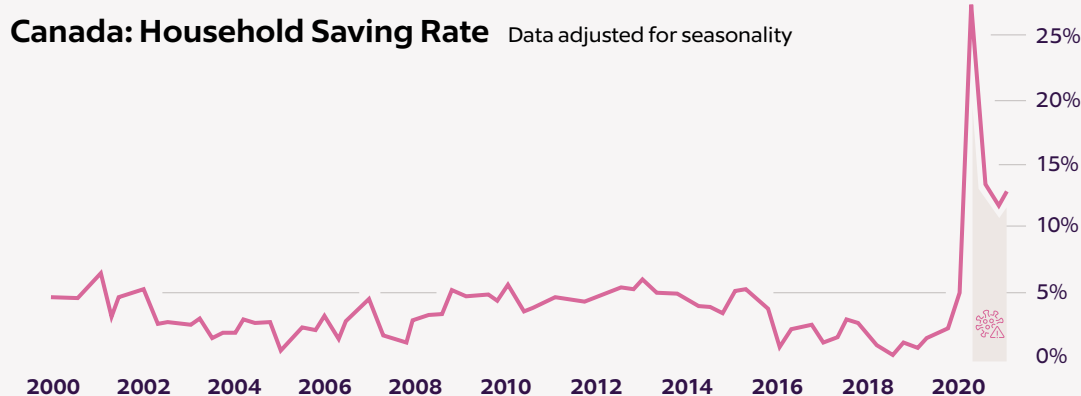


Figure 13: Saving Rate in Canadian Households, Q1 2000 – Q1 2021. Source: Statistics Canada

While it is possible, even likely, that some of these funds will form part of an increased level of precautionary savings amongst households, part of this saving will fuel pent-up demand as the economy reopens. As vaccination rates progress and restrictions are lifted in the second half of 2020 and beyond, Canada is likely to see an increase in demand, especially for the kinds of high-touch services that were severely restricted by lockdowns: transportation and tourism, accommodation and food services, arts, entertainment, and recreation. At the same time, as most foregone consumption last year was in the form of services, it is unlikely that this release of pent-up demand will propel the economy back to its pre-pandemic growth trajectory.

62 Bank of Canada, "COVID-19, Savings and Household Spending," 11 March 2021, <https://www.bankofcanada.ca/2021/03/covid-19-savings-and-household-spending/>

63 Service Canada, "Canada Emergency Response Benefit (CERB)."

64 Canada Revenue Agency, "Canada Emergency Wage Subsidy (CEWS)," 18 September 2020, <https://www.canada.ca/en/revenue-agency/services/subsidy/emergency-wage-subsidy.html>

65 Bank of Canada, "COVID-19, Savings and Household Spending."

66 Ibid.

3 Supply Chain Disruptions

Recent supply shortages, notably in the global semiconductor market, have caused disruptions in several industries including smartphones and automobiles.⁶⁷ Furthermore, high demand for shipping containers is also disrupting shipping schedules and adding to costs.⁶⁸ These high shipping costs and disruptions to global supply chains are causing production delays for manufacturers, weighing on output, and causing inventory drawdowns. This puts upward pressure on consumer prices as demand for these goods has started to surge with the reopening of large economies.

Mismatches between demand forecasts made during the pandemic and surges in actual demand since the reopening have caused some of these delays, especially for products with long lead times and fragmented supply chains.⁶⁹ Fixing these supply constraints is likely to take several months. In the meantime, further reopening of the economy will continue to stoke price pressures in these markets in the near term. However, previous occurrences suggest that such bottlenecks and disruptions caused by wide disparities in supply and demand are mostly transitory, and markets return to equilibrium reasonably quickly.⁷⁰

4 Commodity Prices and Inflation

Another effect of the turbulence in global supply and demand patterns caused by the pandemic can be seen in commodity prices. In the first half of 2020 as global demand shrank, commodity prices, especially for energy,⁷¹ saw a steep decline. Lumber prices then surged over the last year as public health restrictions forced lumber mills to shut down while simultaneously demand surged as people worked on renovations and home improvement during lockdowns.⁷² A recent surge in broad commodity prices is prompting discussion of a new commodities "supercycle."⁷³

67 Peter Armstrong and John Mazerolle, "Playstations Scarce, Automakers Stalled amid Pandemic Supply-Line Disruptions | CBC News," CBC, 25 February 2021, <https://www.cbc.ca/news/business/semiconductor-shortage-1.5925709>

68 CBC Radio, "Lack of Shipping Containers Causing Bike Shortages, Headaches for Canadian Farm Exporters | CBC Radio," CBC, 13 April 2021, <https://www.cbc.ca/radio/costofliving/from-boat-blockages-to-bike-shortages-and-whether-real-estate-love-letters-work-1.5980146/lack-of-shipping-containers-causing-bike-shortages-headaches-for-canadian-farm-exporters-1.5980385>

69 Susan Helper and Evan Soltas, "Why the Pandemic Has Disrupted Supply Chains," The White House, accessed 29 June 2021, <https://www.whitehouse.gov/cea/blog/2021/06/17/why-the-pandemic-has-disrupted-supply-chains/>

70 Ibid.

71 Jillian Ambrose, "Oil Prices Dip below Zero as Producers Forced to Pay to Dispose of Excess," the Guardian, 20 April 2020, <http://www.theguardian.com/world/2020/apr/20/oil-prices-sink-to-20-year-low-as-un-sounds-alarm-on-to-covid-19-relief-fund>

72 Peter Armstrong, "Lumber Prices Sky-High as COVID-19 Causes Supply Issues That Aren't Going Away | CBC News," CBC, 2 April 2021, <https://www.cbc.ca/news/business/lumber-prices-covid-19-cost-of-housing-1.5973416>

73 "Is a Commodities Supercycle under Way?," The Economist, 2 June 2021, <https://www.economist.com/the-economist-explains/2021/06/02/is-a-commodities-supercycle-under-way>

There is broad demand for commodities on the back of an improved economic outlook and sweeping proposals for infrastructure spending in several large economies. However, commodity supercycles tend to be driven by sustained demand pressure of structural transformation (China’s mass industrialization, for example) whereas the current signs point to prices being pushed up temporarily by a mismatch between supply and demand.⁷⁴ In the longer term, the prices of certain metals and minerals will likely depend on whether the pace of the transition to green energy matches market expectations.

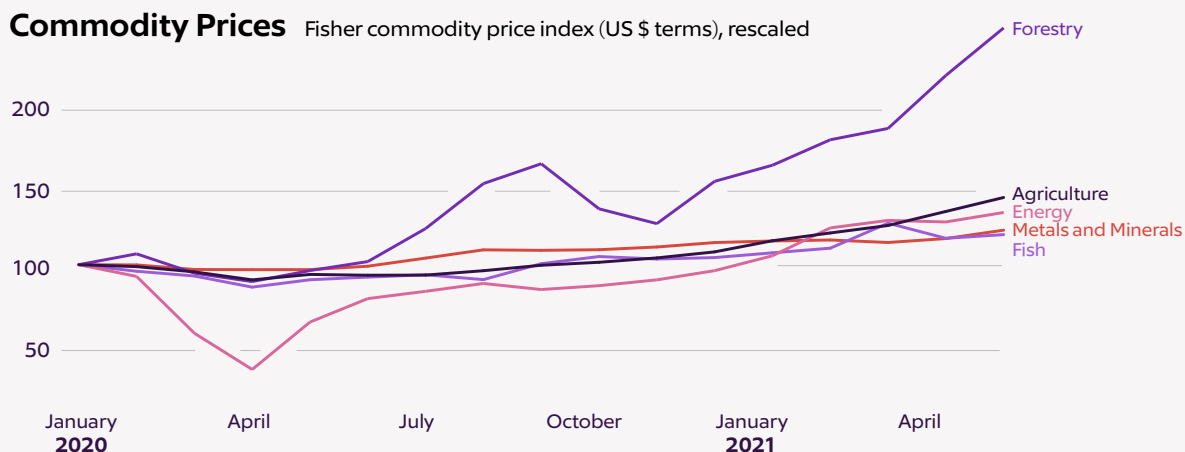


Figure 14: Commodity price indices, January 2020 – May 2021. Source: Bank of Canada, Statistics Canada Note: January 2020 = 100

5 Monetary and Fiscal Policy

Sustained inflation in the wider economy is also of concern given the extraordinary amount of fiscal and monetary stimulus governments around the world have applied in response to the pandemic.

Measures of Core Inflation Year-over-year percent change

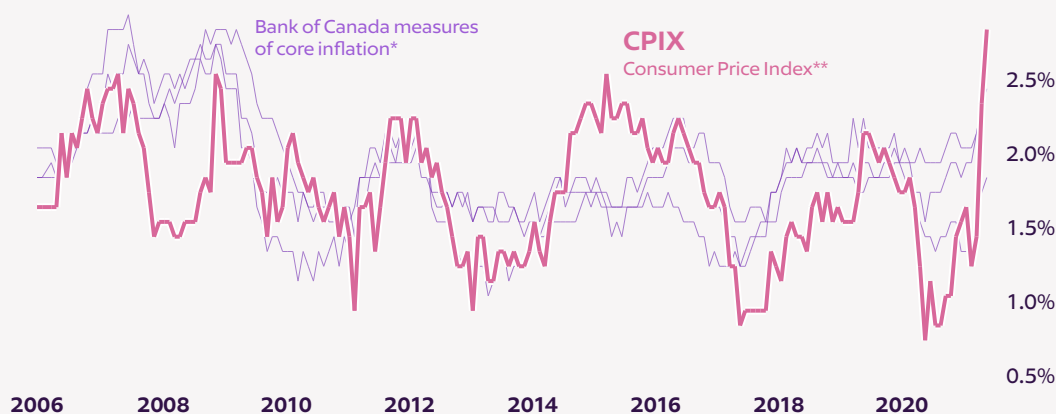


Figure 15: Inflation in Canada, January 2006 – May 2021. Source: Bank of Canada, Statistics Canada
 *CPI-common, CPI-median, CPI-trim **All items excluding eight of the most volatile components

74 Martin Stuermer and Nico Valckx, "Four Factors Behind the Metals Price Rally," IMF Blog (blog), accessed 29 June 2021, <https://blogs.imf.org/2021/06/08/four-factors-behind-the-metals-price-rally/>

Data from the US⁷⁵ and Canada⁷⁶ show that inflation (year-over-year change) in May reached a new high not seen in a decade. Some of this can be explained by the price drop of some goods during the lockdown in comparison to their price recovery. Other factors affecting inflation include the recent rally in commodity prices and price increases for goods affected by the recent supply chain disruptions. While some of this turbulence is likely to persist in the near term, as aggregate demand and supply patterns normalize with the reopening of economies and the resumption of some form of normality, inflation is not likely to be a major concern in the medium and long term. Temporary inflation related to constrained supply followed by the unleashed demand of an economic reopening fuelled by pent up savings are likely to cause inflation in the near term that will hover above the Bank of Canada's target range. However, forward guidance from the Bank⁷⁷ and recent moves in bond markets⁷⁸ suggest that longer-term inflation expectations remain anchored.

This sentiment was echoed by leaders of the G7 group of nations in their recent meeting in the UK.⁷⁹ The leaders also agreed that continuing to support their respective economies through expansionary fiscal policy was critical for a sustained and broad economic recovery. Apart from the fiscal support for households and businesses announced in the latest federal budget,⁸⁰ the Canadian economy will likely also benefit from the substantial stimulus packages tabled in the US, Canada's largest trading partner.⁸¹ The US \$1.9 trillion American Rescue Plan was enacted by Congress in March 2021.⁸² As of June, the plan has already delivered stimulus cheques worth US \$390 billion delivered to US households.⁸³ It is expected to raise US GDP by 2.4 % and global GDP by about 0.5 %.⁸⁴ Additional infrastructure spending plans,^{85,86} if passed, could further boost output growth. While there may be "Buy American" clauses tied to some of these measures, there will still be spillovers for Canadian exporters of good and services from indirect and induced effects.

75 Gwynn Guilford, "U.S. Inflation Is Highest in 13 Years as Prices Surge 5%," Wall Street Journal, 10 June 2021, sec. Economy, <https://www.wsj.com/articles/us-inflation-consumer-price-index-may-2021-11623288303>

76 Statistics Canada, "The Daily – Consumer Price Index, May 2021," 16 June 2021, <https://www150.statcan.gc.ca/n1/daily-quotidien/210616/dq210616a-eng.htm>

77 Bank of Canada, "Bank of Canada Will Hold Current Level of Policy Rate until Inflation Objective Is Sustainably Achieved, Adjusts Quantitative Easing Program," accessed 30 June 2021, <https://www.bankofcanada.ca/2021/04/fad-press-release-2021-04-21/>

78 Paul J. Davies, "Government Bond Yields Expected to Stay Low as Inflation Fears Ease," Wall Street Journal, 3 June 2021, sec. Markets, <https://www.wsj.com/articles/government-bond-yields-expected-to-stay-low-as-inflation-fears-ease-11622729563>

79 Guy Faulconbridge, "G7 Leaders Agreed to Keep the Money Taps Open," Reuters, 11 June 2021, <https://www.reuters.com/business/g7-leaders-agreed-keep-stimulus-flowing-their-economies-2021-06-11/>

80 Department of Finance Canada, "Budget 2021: A Recovery Plan for Jobs, Growth, and Resilience," news releases, 19 April 2021, <https://www.canada.ca/en/department-finance/news/2021/04/budget-2021-a-recovery-plan-for-jobs-growth-and-resilience.html>

81 The White House, "Build Back Better."

82 The White House, "American Rescue Plan," accessed 7 July 2021, <https://www.whitehouse.gov/american-rescue-plan/>

83 U.S. Department of the Treasury, "Treasury & IRS Release State-by-State Data on Third Round of Economic Impact Payments Totaling Nearly \$390 Billion," accessed 7 July 2021, <https://home.treasury.gov/news/press-releases/jy0248>

84 Bank of Canada, "Monetary Policy Report – April 2021," accessed 7 July 2021, <https://www.bankofcanada.ca/wp-content/uploads/2021/04/mpr-2021-04-21.pdf>

85 The White House, "American Jobs Plan," accessed 7 July 2021, <https://www.whitehouse.gov/american-jobs-plan/>

86 The White House, "American Families Plan," accessed 7 July 2021, <https://www.whitehouse.gov/american-families-plan/>

General Employment Forecast

ICTC’s forecasts are built around three possible scenarios based on assumptions about the speed and nature of the Canada’s post-COVID reopening and economic recovery and the potential risks identified above.

The baseline forecast assumes that the vaccine rollout across the country progresses on schedule, and broad reopening of provincial economies during the summer and into the second half of the year fuels growth on the back of strong domestic demand and the spending of pent-up household savings from the past year. The momentum is expected to continue into 2022 with the resumption of some forms of international travel and tourism, though presumably only between regions that meet a certain threshold for vaccination rates and other public health metrics.

This scenario also assumes that variants of concern do not spiral out of hand and force more restrictions, that supply chain disruptions are not protracted leading to persistent shortages and inflation, and that fiscal and monetary policy stay their current course. GDP is anticipated to reach pre-pandemic levels in the second half of 2021 and settle into a steady growth path by end 2022 but at a trajectory slightly below the pre-pandemic trend.

Unemployment Projected quarterly unemployment rate, seasonally adjusted (2021-2025)

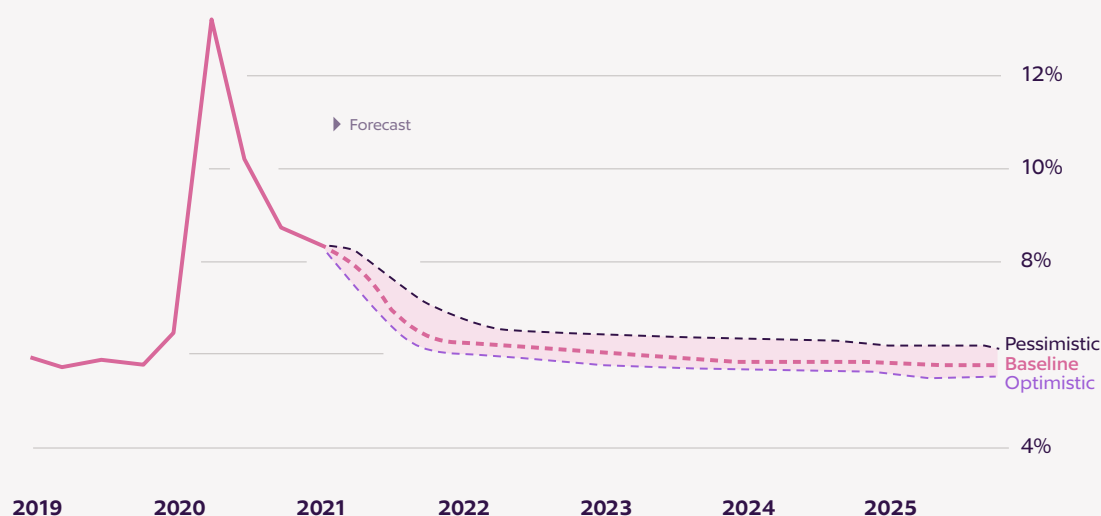


Figure 16: Projected trajectories of unemployment rate, 2021 – 2025. Source: ICTC, Statistics Canada

Real GDP Projected trajectories of normalized GDP growth, seasonally adjusted (2021-2025)

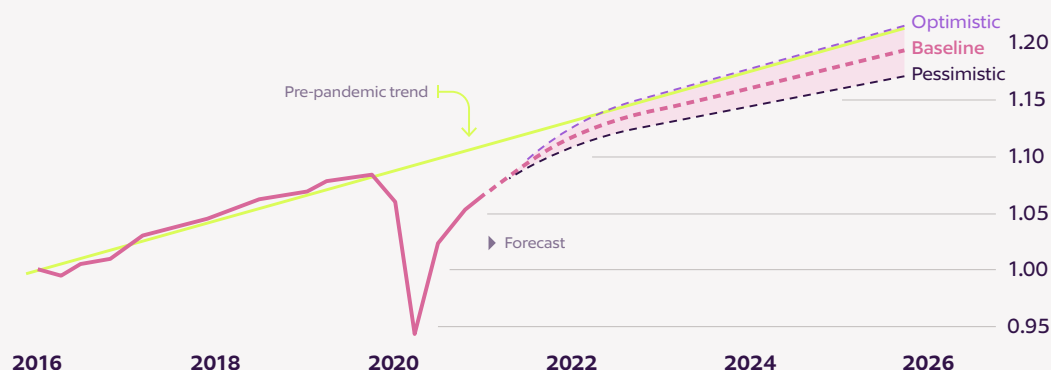


Figure 17: Projected trajectories of GDP growth, normalized from Q1 2016, 2021 – 2025. Source: ICTC, Statistics Canada

The optimistic scenario envisions a sharper uptick in the reopening schedule and in consumer spending, coupled with the smooth functioning of global supply chains. Output in this scenario reaches pre-pandemic levels in Q3 2021 and settles into the pre-pandemic growth trajectory by late 2022.

The pessimistic scenario assumes that a full reopening does not take effect until the end of 2021, and the delay makes for a weaker economic recovery. Coupled with prolonged supply chain disruptions, this relatively weaker demand implies that the economy settles into a lower growth path compared to the other two scenarios.

Using labour market and wage data, and estimates for GDP and expected inflation, **Figure 18** forecasts employment in the general Canadian economy to yearend 2025. Under the baseline scenario, employment gradually recovers to its pre-pandemic level by early 2022 and reaches a level of 20.39 million by Q4 2025. The forecast level of employment by Q4 2025 is 20.71 million for the optimistic scenario, and 19.96 million in the pessimistic case.

General Economy Employment forecast for Canada (2021-2025)

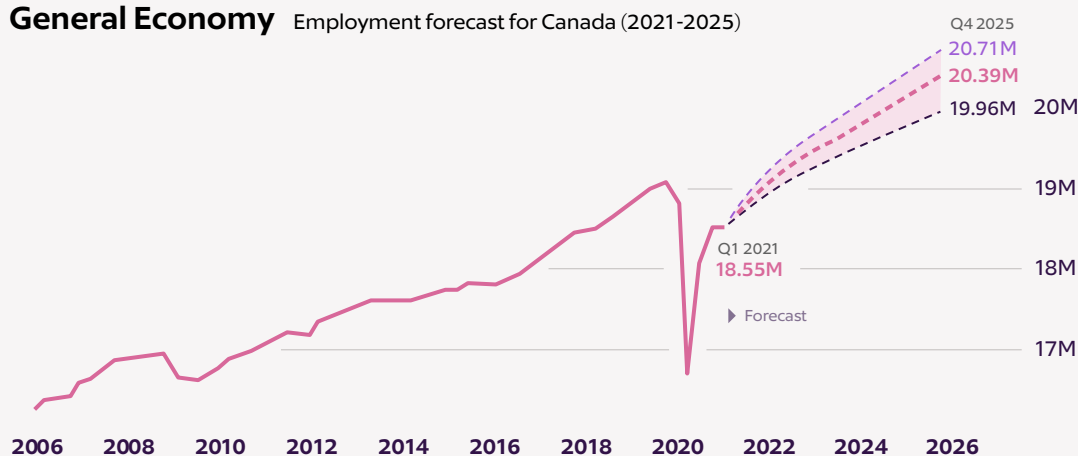


Figure 18: Payroll Employment in Canada (forecast), 2021 – 2025. Source: ICTC, Statistics Canada
Note: Seasonally adjusted employment

●●○ Section II

The Canadian Digital Economy



COVID-19 has already caused an unprecedented restructuring of the Canadian economy. Technology firms, which now drive major stock indices, have surged as a proportion of the economy. This is part of the reason why stock indices have performed well despite the losses within the “Main Street” economy. Consumer spending habits have shifted as a result of the pandemic,⁸⁷ and there are signs that a fair amount of this shift will be permanent.

BDO—a consultancy firm—identifies several trends that have been accelerated due to COVID-19 lockdowns. These include remote working, omnichannel commerce and intelligent retail, digital content consumption, digital health and telemedicine, and “platformification” i.e., the use of digital platforms to access and serve customers.⁸⁸

“We definitely were hiring software developers through the pandemic. We were able to hire them not close to the office, not even in the same city.” – Healthtech company

Personal Internet Use in Canada

Percent of the population, 15 years and over, that accessed the internet for personal use

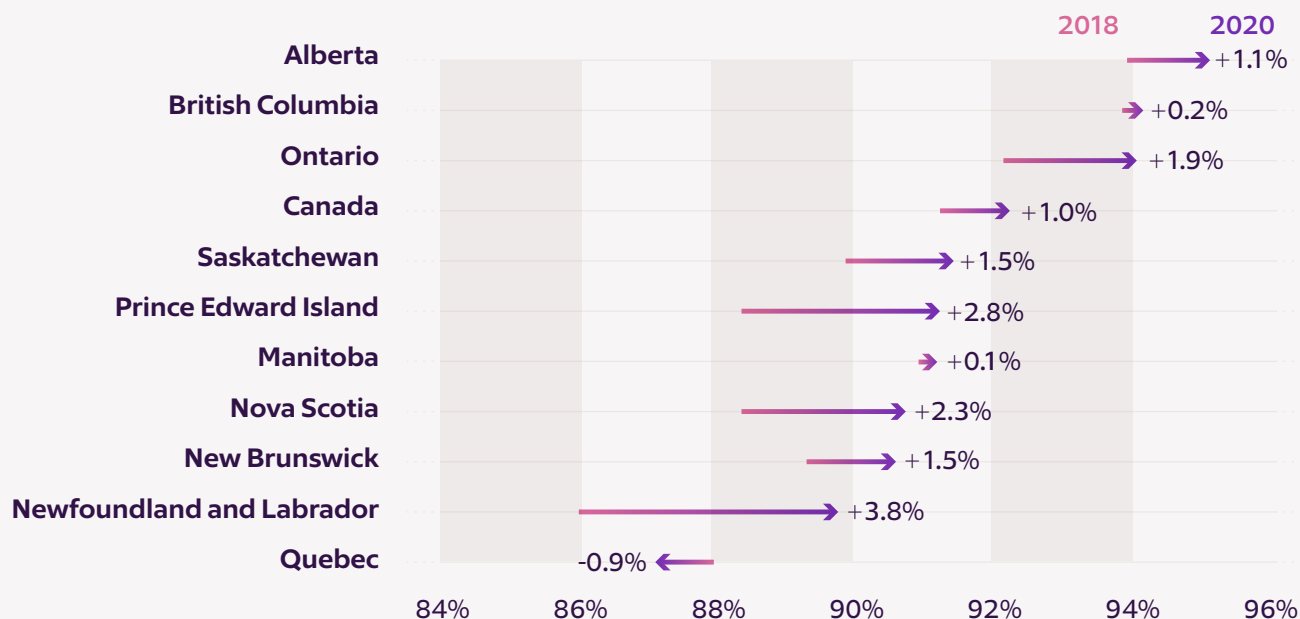


Figure 19: Personal internet use in Canada, by province, 2018 – 2020. Source: Statistics Canada

⁸⁷ Lauren Leatherby and David Gelles, “How the Virus Transformed the Way Americans Spend Their Money,” The New York Times, 11 April 2020, sec. Business, <https://www.nytimes.com/interactive/2020/04/11/business/economy/coronavirus-us-economy-spending.html>

⁸⁸ BDO, “COVID-19 Is Accelerating the Rise of the Digital Economy,” BDO, accessed 25 June 2021, <https://www.www.bdo.com/insights/business-financial-advisory/strategy-technology-transformation/covid-19-is-accelerating-the-rise-of-the-digital-e>

The Canadian Internet Use Survey⁸⁹ found that the pandemic and lockdowns dramatically impacted how Canadians use the internet and for how long each day. There has been increased participation in a wide variety of online activities in Canada, with notable increases in the number of Canadians who shopped online for digital and physical goods and services, watched video streaming services and live television online, made online voice and video calls, used smart home devices, and took part in formal online training and e-learning. The pandemic also resulted in many Canadians trying various online activities for the first time, most notably making video calls, ordering groceries online for delivery or curbside pick-up, working from home, e-learning, watching streamed video content, and using online government services.⁹⁰

Online Activities in Canada

Percent of the population, 15 years and over, that engaged in the following activities online

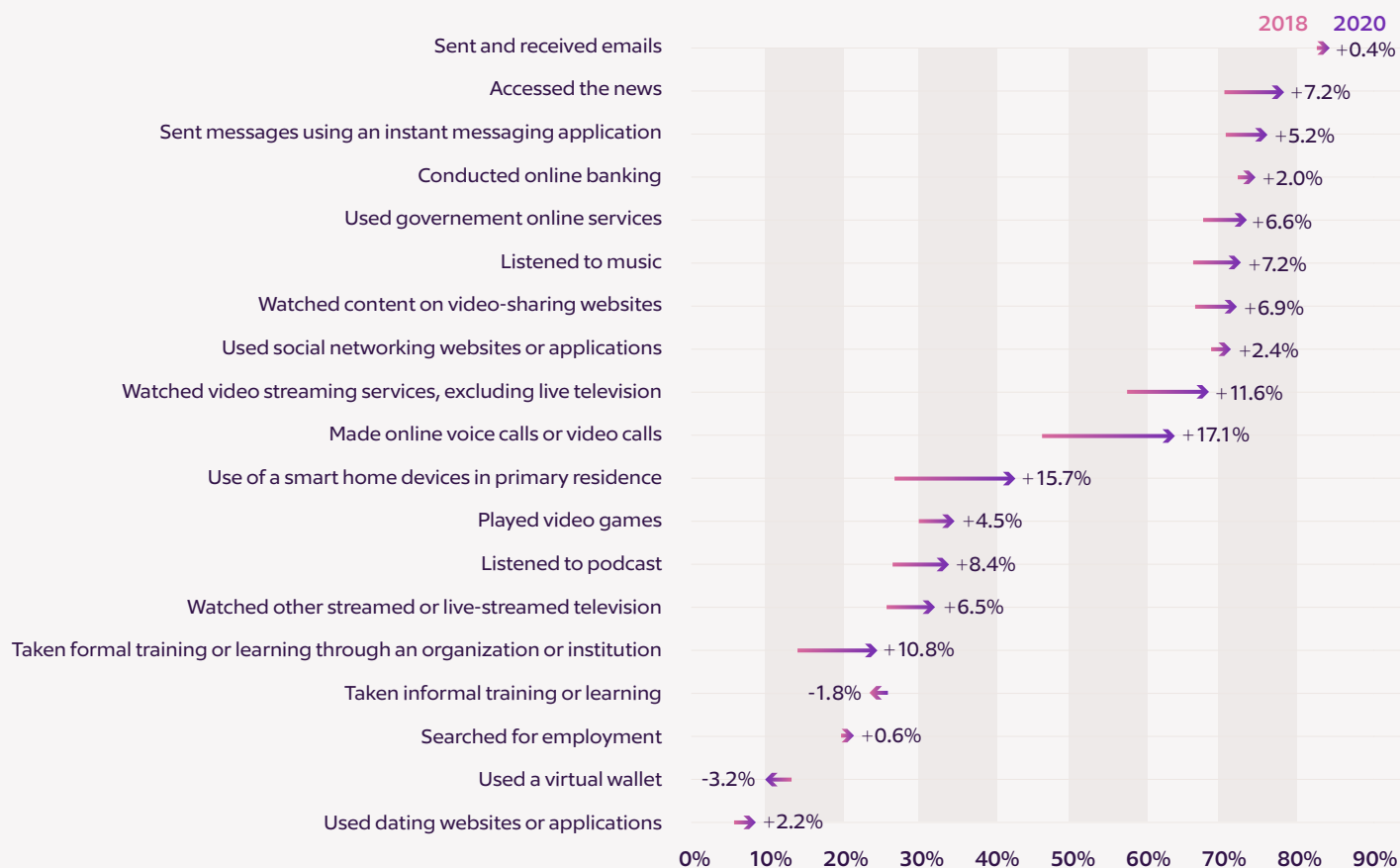


Figure 20: Online activities in Canada, 2018 – 2020. Source: Statistics Canada

89 Statistics Canada, "The Daily – Canadian Internet Use Survey, 2020."

90 Statistics Canada, "Internet Use and COVID-19."

Online shopping for physical and digital goods and services rose sharply in 2020. About 82% of Canadians shopped online in 2020, up from 73% in 2018. Online spending rose by approximately 50% over this period, from \$57.4 billion to \$84.4 billion.⁹¹ Across all age cohorts, more Canadians shopped online in 2020 than in 2018, and they also spent significantly more.

Online Shopping in Canada

Percent of the population, 15 years and over, that bought goods and services online

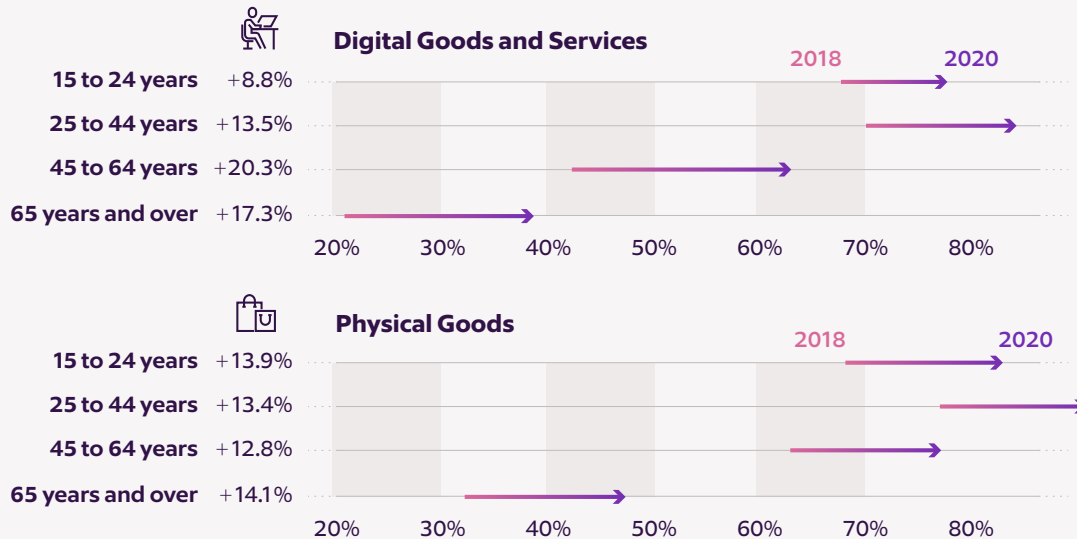


Figure 21: Online shoppers in Canada, by age and type of purchase, 2018 – 2020. Source: Statistics Canada
 Note: Includes purchases made for personal or household use, and excludes business-related use.

Online Shopping in Canada

Average expenditure per person on goods and services ordered over the internet

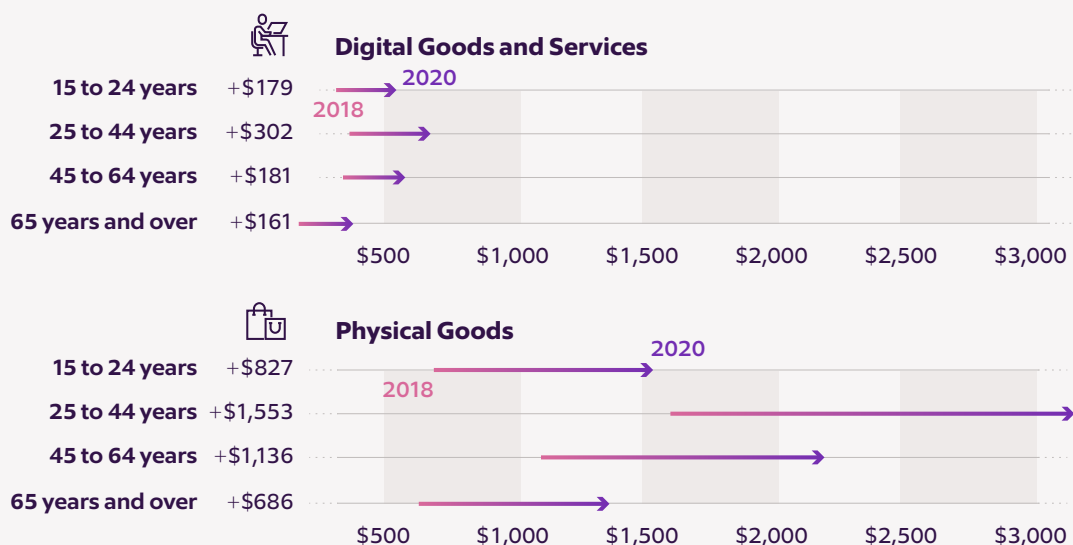


Figure 22: Average expenditure on online shopping in Canada, by age and type of purchase, 2018 – 2020. Source: Statistics Canada
 Note: Includes purchases made for personal or household use, and excludes business-related use.

COVID-19 lockdowns have affected Canadian consumers' purchasing habits with many switching to online shopping.⁹² While there is likely to be a rebound in in-store retail sales with the lifting of public health restrictions, recent survey data suggests that online shopping and e-commerce will continue to grow post-COVID,⁹³ highlighting the need for retailers of all sizes to embrace advances in digital technology and omnichannel strategies.^{94,95}

Digital healthcare is another area that has seen a significant increase in adoption and implementation in the last 18 months. While the history of telemedicine in Canada dates back to the 1970s,⁹⁶ its applications came to the forefront during the successive waves of lockdowns since the start of the pandemic. Lockdown measures during the first wave of COVID-19 forced a shift from in-person to virtual care where feasible. Between March and July 2020, office visits in Ontario declined by almost 80% and virtual care increased 56-fold, making up over 71% of all primary care physician visits in this period.⁹⁷ While not a substitute for all forms of in-person care, the use case for virtual healthcare has been firmly established over the course of the pandemic. Recent national surveys conducted by the Canadian Medical Association⁹⁸ and the Montreal Economic Institute⁹⁹ show that a large majority of Canadians have been satisfied with the service they received via telehealth/virtual health and expect to continue accessing primary care virtually even after pandemic restrictions are lifted.

These trends in consumer behaviour and digitization, which the pandemic has accelerated, have meant that the Canadian digital economy has not only weathered the economic turbulence of the last 18 months but has grown in importance since the onset of the pandemic. Examining GDP data, we see a much stronger performance from the digital economy and the ICT sector than the general economy. **Figure 23** shows GDP in the ICT sector through March 2021. The sector has substantially outperformed the general economy and is already well above pre-crisis levels.

92 Statistics Canada, "Retail E-Commerce and COVID-19."

93 PayPal, "Canadians Increased Online Shopping Spend by More than \$2B per Month Compared to Pre-Pandemic," PayPal Newsroom, accessed 28 June 2021, <https://newsroom.ca.paypal-corp.com/Trends-Spends>

94 Rob Davidson, "From Innovation to Imperative," ICTC, 2 October 2020, <https://medium.com/digitalthinktankictc/from-innovation-to-imperative-canadian-intelligent-retail-and-covid-19-6baffd50e209>

95 Business Development Bank of Canada, "E-Commerce Increases Profitability, Accelerates Growth and Brings Resilience in Times of Crisis: BDC Study," BDC.ca, accessed 27 June 2021, <https://www.bdc.ca/en/about/mediaroom/news-releases/e-commerce-increases-profitability-accelerates-growth-brings-resilience-times-crisis-bdc-study>

96 Canadian Medical Association, "Virtual Care in Canada: Discussion Paper," CMA Health Summit, 2019.

97 Richard H. Glazier et al., "Shifts in Office and Virtual Primary Care during the Early COVID-19 Pandemic in Ontario, Canada," CMAJ 193, no. 6 (8 February 2021): E200–210, <https://doi.org/10.1503/cmaj.202303>

98 "Virtual Care Is Real Care: National Poll Shows Canadians Are Overwhelmingly Satisfied with Virtual Health Care," Canadian Medical Association, accessed 27 June 2021, <https://www.cma.ca/news/virtual-care-real-care-national-poll-shows-canadians-are-overwhelmingly-satisfied-virtual>, <https://www.cma.ca/news/virtual-care-real-care-national-poll-shows-canadians-are-overwhelmingly-satisfied-virtual>

99 "Healthcare in Canada 2020," Montreal Economic Institute, accessed 23 June 2021, https://www.iedm.org/wp-content/uploads/2020/11/healthcare_ipsos_poll_2020.pdf

Canada: ICT Sector Gross Domestic Product

CAD, adjusted for seasonality and inflation

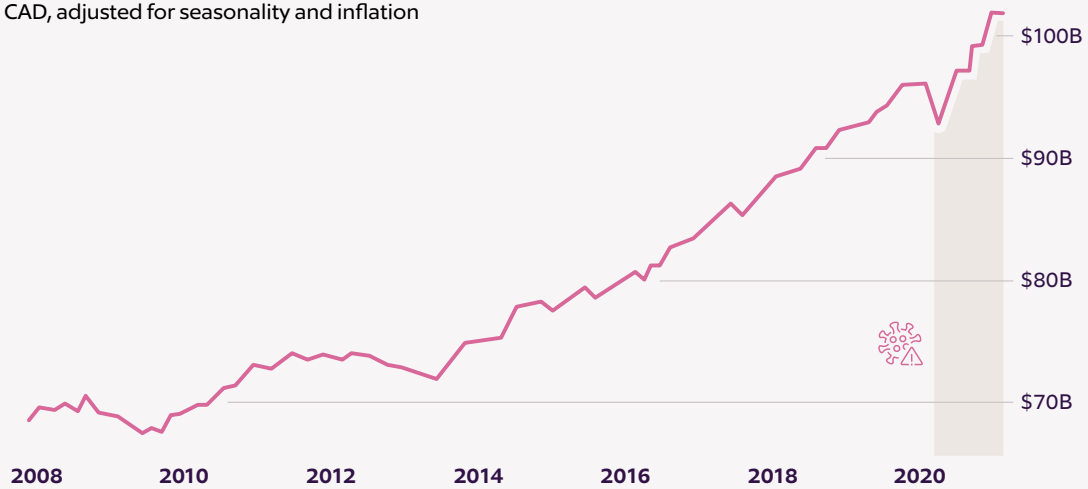


Figure 23: GDP of the Canadian ICT Sector (chained 2012 dollars), January 2007 – March 2021. Source: Statistics Canada

Furthermore, as previously shown in **Figure 4**, the digital economy has surpassed all other sectors in Canada in employment recovery, with employment nearly 12% higher than pre-pandemic levels as of May 2021. The picture painted by these statistics was, in broad terms, corroborated by the findings of ICTC’s survey of firms in the Canadian digital economy.



National Survey of Canada's Digital Economy

To better understand the impacts of COVID-19 on Canada's digital economy and to better inform some of the assumptions underpinning the employment forecasts, ICTC commissioned a national survey of firms in Canada's digital economy. The survey was launched in January 2021 and was completed in February 2021. The goal of the survey was to explore how organizations in the digital economy were recovering from COVID-19 by examining changes in their business priorities, hiring patterns, skill requirements and a general shift to a remote working environment. The survey was structured to closely match the Statistics Canada Survey on Business Conditions (CSBC) in Canada for Q1 2021.¹⁰⁰ The questions chosen were framed identically to those in the CSBC and the survey was administered within the same time interval as the CSBC to ensure that overall macroeconomic and public health conditions and other external factors were similar. In doing so, ICTC was able to use the Statistics Canada survey data on the broader economy as a "control group" against ICTC's data set focused on the digital economy. This allowed for a meaningful comparison of the impact of COVID-19 on the digital economy against the impact on the broader economy.

The survey was completed by representatives from 400 companies. All respondents were senior executives with significant influence on key decisions related to hiring and business strategy and included founders, executives, managers with oversight of operations, finance, or human resources. The survey was targeted at digital businesses across Canada that were screened for eligibility and then categorized into the following areas: cleantech, clean resources, health and biotech, agri-foods and food tech, advanced manufacturing, and digital industries.

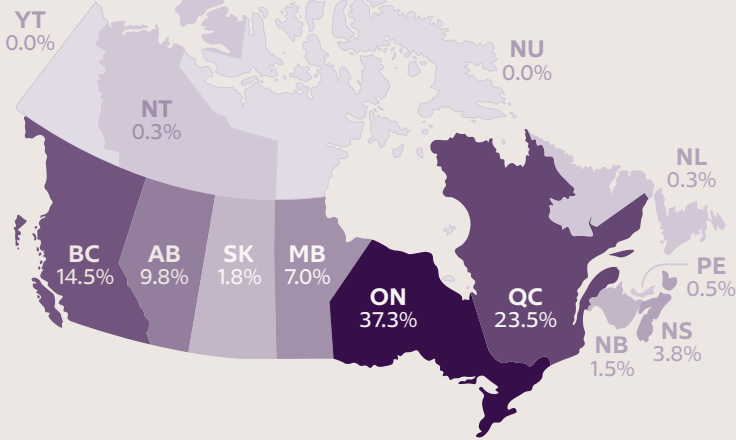
The respondents were spread across the provinces, roughly in line with their respective shares of national population and GDP. There was adequate representation from all six innovation areas.

¹⁰⁰ Statistics Canada, "The Daily — Canadian Survey on Business Conditions, First Quarter 2021," 5 March 2021, <https://www150.statcan.gc.ca/n1/daily-quotidien/210305/dq210305b-eng.htm>



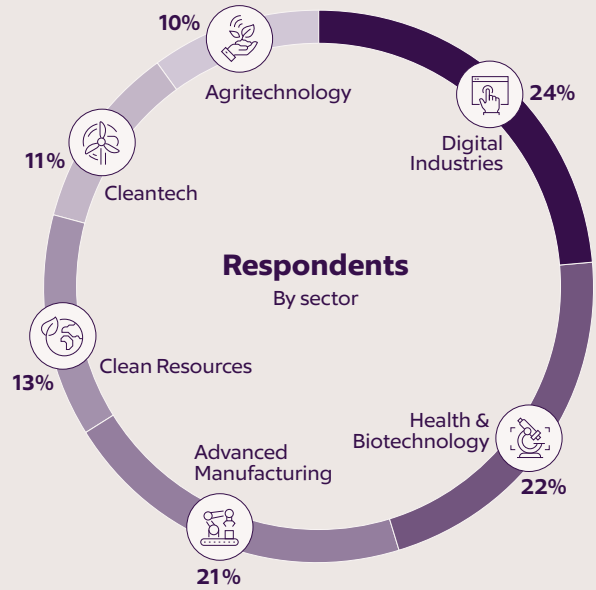
Respondents

By location



Respondents

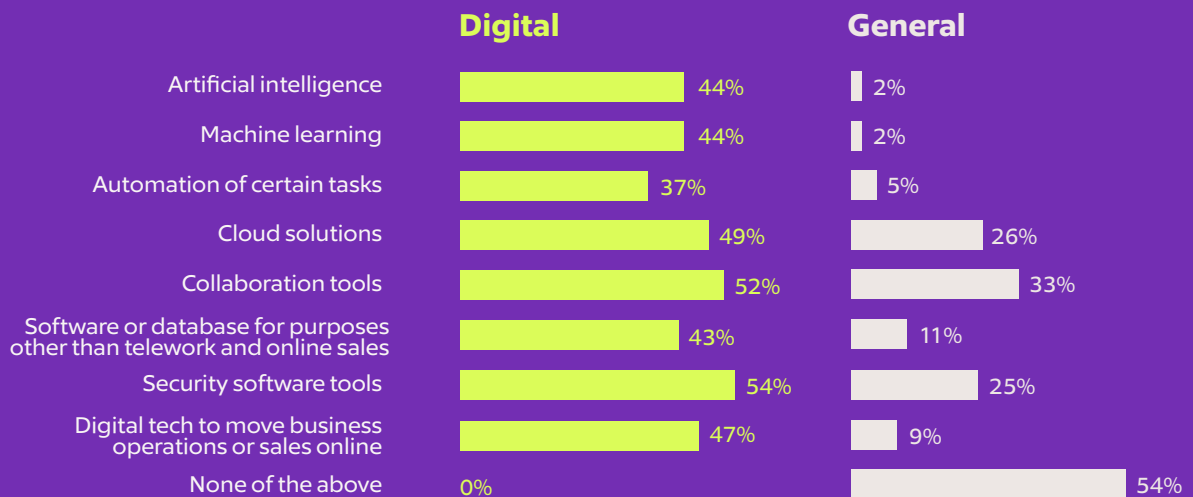
By sector



Unsurprisingly, firms in the digital economy reported significantly higher usage of advanced technologies such as artificial intelligence and machine learning, and of digital tools such as cloud solutions, security software, and online collaboration tools.



Has this business or organization adopted or incorporated any of the following technologies?

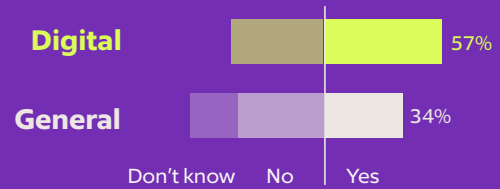
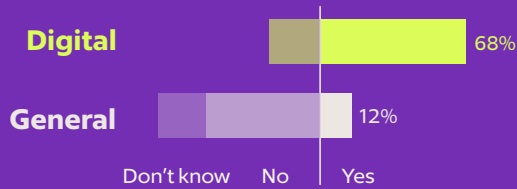




Compared to firms in the general economy, a significantly larger proportion digital economy firms had a more positive outlook for the medium term in terms of expansion plans and balance sheet health.

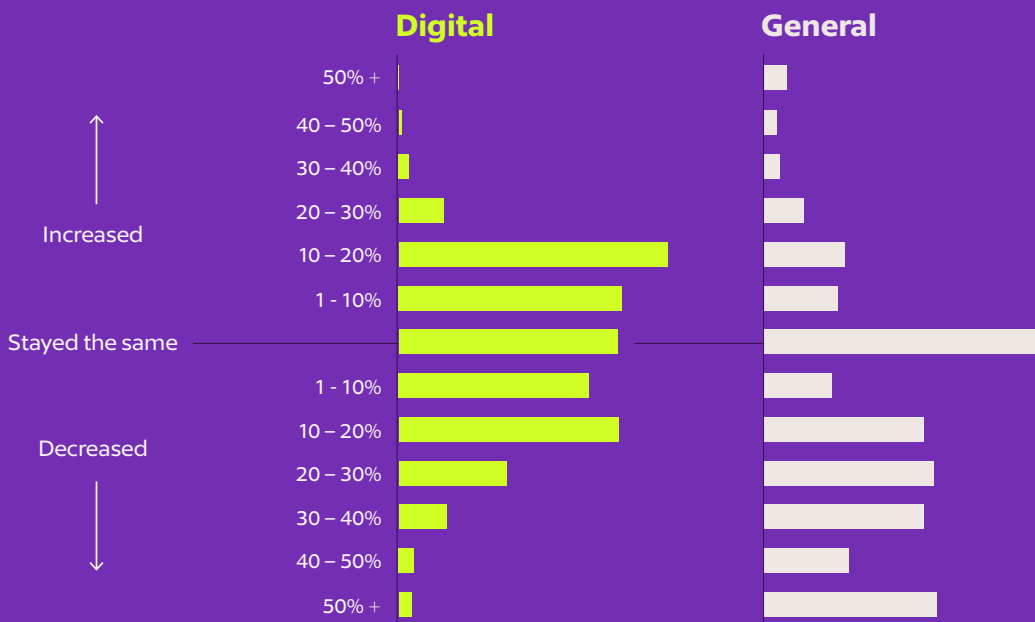
Q In the next year, are there any plans to expand or restructure this business, or acquire or invest in other businesses?

Q Does this business or organization have the ability to take on more debt?



In 2020, many businesses across Canada saw revenues dry up as aggregate demand slumped during lockdowns and a general loss in consumer confidence. Costs, on the other hand, increased for many companies, as they incurred expenses toward setting up a more COVID-safe work environment (erecting barriers, disinfection on work sites, IT infrastructure and hardware to enable remote work and online sales, etc.). On average, revenues for digital firms in 2020 appear to have been better preserved than in the general economy, though there is significant variation across the sample. This is likely because lockdowns precipitated a surge in demand for digital goods and services among Canadian households and businesses.

Q Compared to 2019, how did the revenues of this business or organization change in 2020?

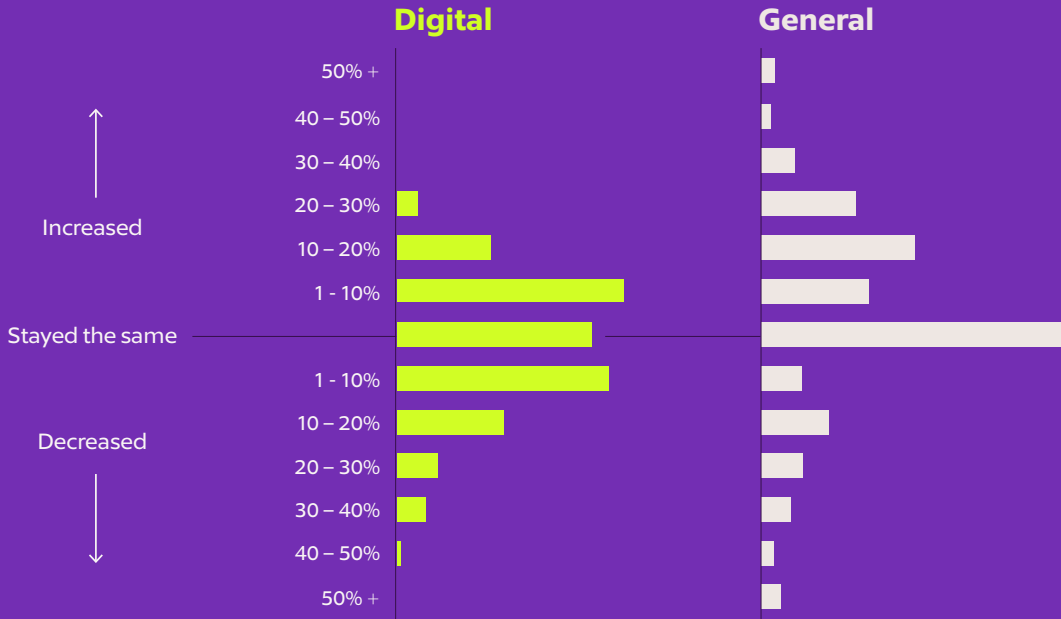




On the other hand, the change in business expenses caused by the pandemic appears to be very similar across firms in the digital and broader economy.



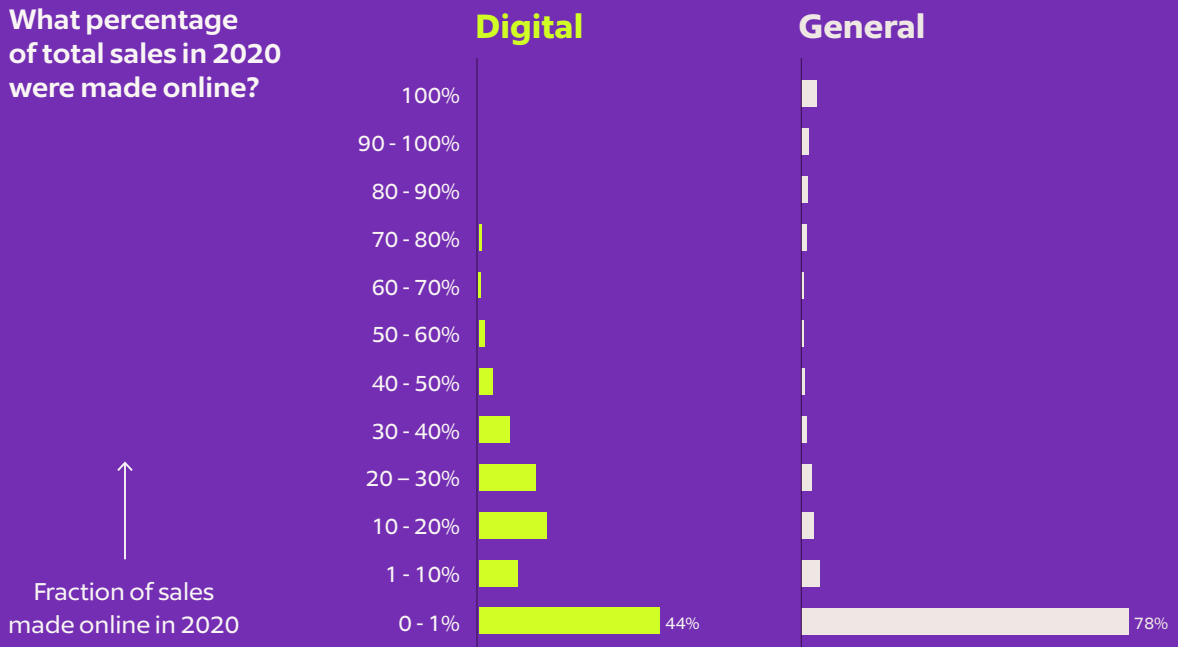
Compared to 2019, how did the expenses of this business or organization change in 2020?



Underscoring the relative resiliency of the digital economy, the survey data also showed that a larger proportion of firms in the digital economy had an established online sales channel in 2020 as compared to the general economy.



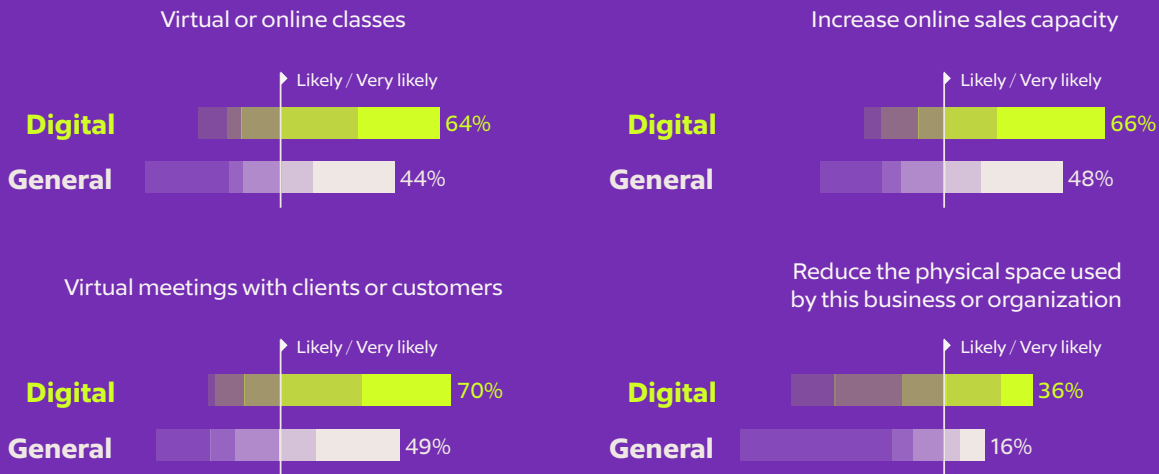
What percentage of total sales in 2020 were made online?





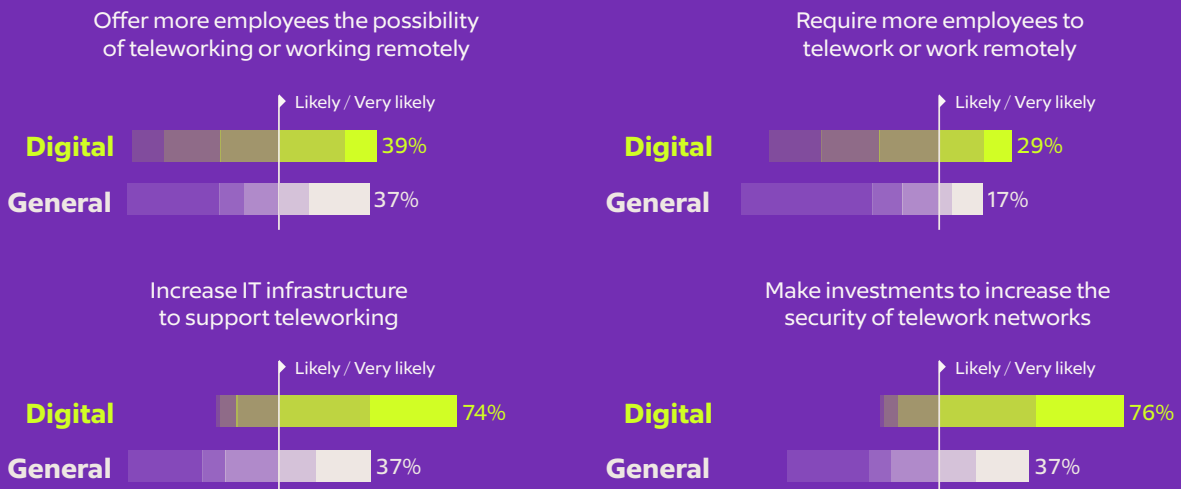
The survey also shed light on some potential longer-term changes catalyzed by the pandemic. The potential for increased adoption of online training and virtual classes, online sales channels, and virtual meetings all saw strong support among digital economy firms and reasonably strong support among firms in the broader economy as well.

Q How likely is this business or organization to permanently adopt each of the following measures once the COVID-19 pandemic is over?



Teleworking and remote work also has strong support for continuing in some form post-COVID, especially among firms in the digital economy.

Q How likely is this business or organization to permanently adopt each of the following measures once the COVID-19 pandemic is over?





Finally, the survey was also an opportunity to better understand the key technical roles needed by firms in the digital economy. The survey results were analyzed and categorized as shown below. Roles in data analysis, software and web design, and web development, maintenance, and DevOps saw strong growth along with specialist engineers with specific domain expertise.



Over the last 12 months, please list any new technical **job titles** that have emerged at your company.

Data Analysts

- Data Scientist
- Business Intelligence Analyst
- Big Data Developer

62

Designers

- User Experience Designer
- User Interface Design Specialist
- Instructional Designer

53

DevOps

- DevOps Engineer
- Site Reliability Engineer

44

Engineers & Specialists

- Robotics Engineer
- Service Desk Engineer
- ICT Specialist

43

Programmers & Developers

- Full Stack Developer
- Application Architect & Developer
- IT Programmer

31

AI / ML Experts

- Artificial Intelligence Specialist
- Deep Learning Expert

27

Cloud Systems Experts

- Cloud Systems Engineer
- Cloud Architect

27

Embedded Systems Experts

- IoT Specialist
- Embedded Software Engineer

26

Managers

- Product Owner
- IT Project Manager

20

Cybersecurity

- Cybersecurity Analyst
- Security Professional

11

Other Analysts & Specialists

- Customer Success Specialist
- Demand Generation Specialist
- Business Analyst

21

Updated Forecasts and Statistics

As described in previous ICTC reports,^{101,102} the digital economy is the union of digital occupations and digital industries. In other words, the digital economy comprises tech workers¹⁰³ (in all sectors) and (all) workers in the tech sector¹⁰⁴ (without double counting tech workers in the tech sector).

The digital economy represents a growing share of Canadian employment over the last 15 years. Particularly employment in digital occupations across all sectors of the economy (tech workers) has been outpacing the employment growth of digital occupations in digital industries. In other words, key tech workers are increasingly found outside of the tech sector. For instance, software developers and data scientists are now often found in sectors like finance, natural resources, healthcare, and retail. The latest data, in **Figure 24** below, shows a continuation in this trend.

Canadian Digital Economy Components of employment (2006-2021)

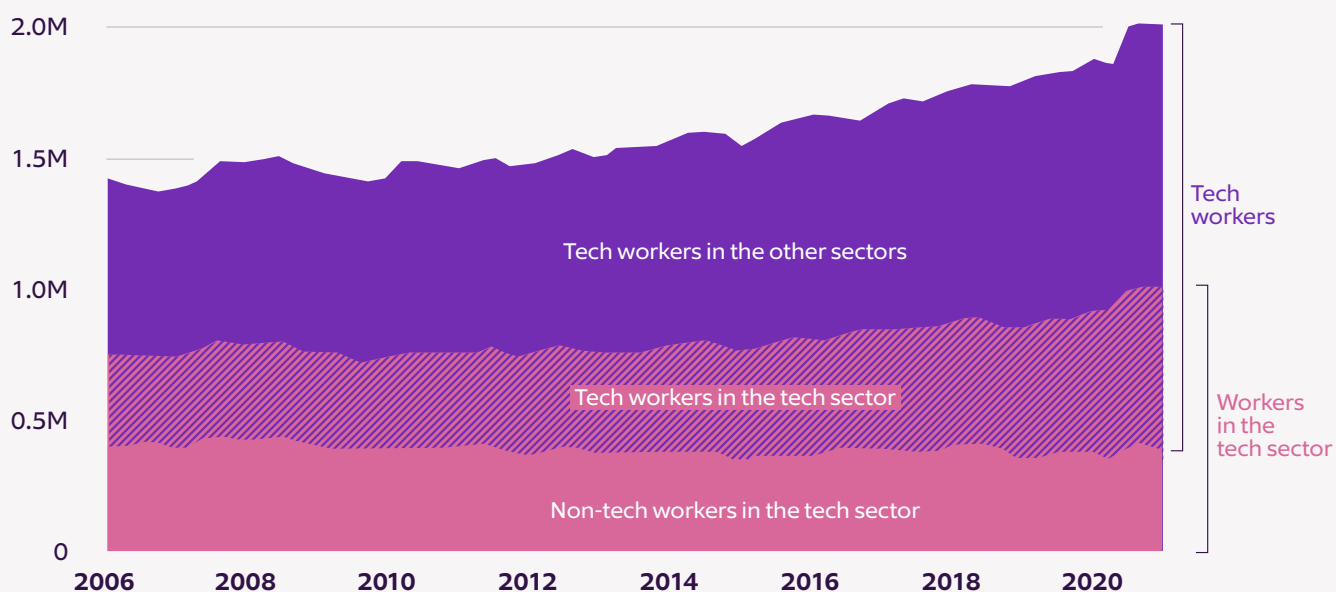


Figure 24: Employment in the Canadian Digital Economy, by component, Q1 2006 – Q1 2021. Source: ICTC, Statistics Canada
Note: Unadjusted for seasonality

101 Alexandra Cutean et al., "Canada's Growth Currency: Digital Talent Outlook 2023."
 102 Ivus, Kotak, and McLaughlin, "The Digital-Led New Normal: Revised Labour Market Outlook for 2022."
 103 Tech workers are defined by 30 National Occupational Classification (NOC) codes.
 104 The Tech sector is defined by 18 North American Industry Classification System (NAICS) codes.

As a proportion of the total economy (in terms of employment), the digital economy leaped from under 10% in 2019 yearend to over 11% during the onset of the COVID-19 crisis (Q2 2020) when activity stalled and layoffs surged in large parts of the non-digital economy. Some of this base effect was eased as general employment recovered in the second half of 2020, but the digital economy's contribution to total employment has settled at a higher proportion because of the pandemic and the shifts it has brought about. With wider economic reopening, ICTC forecasts a near term easing of this proportion as jobs in sectors outside the digital economy are recovered. However, in the medium to long term, the above average employment growth of the digital economy will continue to drive the digital economy's share of total employment higher, as shown in **Figure 25**.

Digital Economy Employment As a percentage of total employment in Canada (2006-2025)

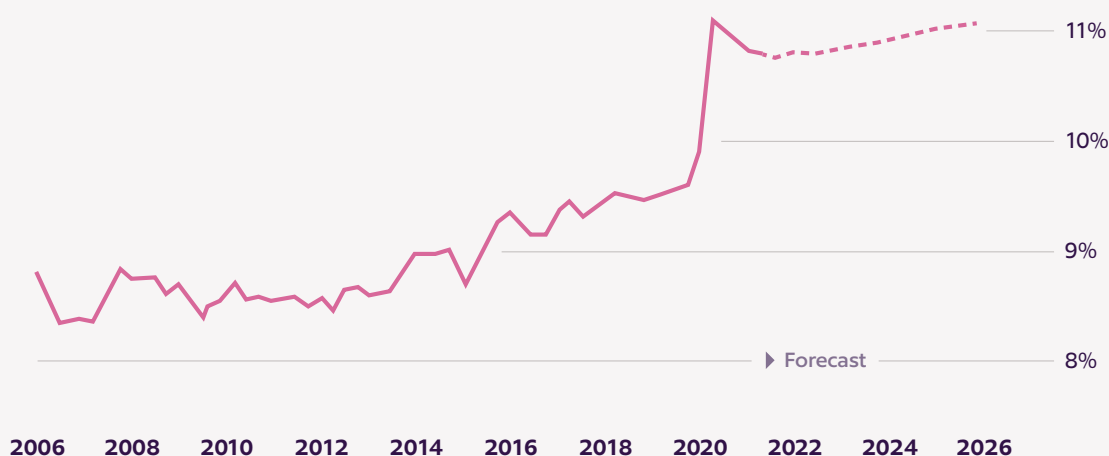


Figure 25: Employment in Canada's Digital Economy as a percent of aggregate employment, 2006 – 2025. Source: ICTC, Statistics Canada

Figure 26 breaks down the components of the above figure by showing employment growth in the general and digital economy, normalized to their respective levels in 2010. It reveals that employment in the digital and general economy moved in opposite directions through 2020. While the general economy slumped and then partially recovered in the second half of 2020, the digital economy surged past its pre-pandemic levels.

In the near term, with the successful rollout of vaccinations and the gradual reopening of the economy, employment growth in some sectors outside the digital economy will likely outpace that of the digital economy, given the slack in those labour markets. Sectors such as hospitality, tourism, travel, and some segments of brick-and-mortar retail face a more optimistic outlook with the resumption of in-person services and access to ready labour due to the mass layoffs during lockdowns.¹⁰⁵

In the medium to long term, however, the digital economy is likely to continue its impressive growth since 2010. While it remains to be seen how the pandemic will permanently alter the Canadian economy and citizen behaviour, ICTC forecasts that employment and GDP growth in the digital economy will continue to outpace growth in the general economy for the coming years. From early 2010 to early 2020, employment in the digital economy grew at an annual rate of 2.65% compared to 1.14% in the general economy. Following the boost in digital economy in the latter half of 2020, over the next five years (2021-2025), employment is forecast to grow at an annual rate of 2.22% compared to 1.97% in the general economy.

Normalized Employment Growth Canadian general economy and digital economy (2010-2025)

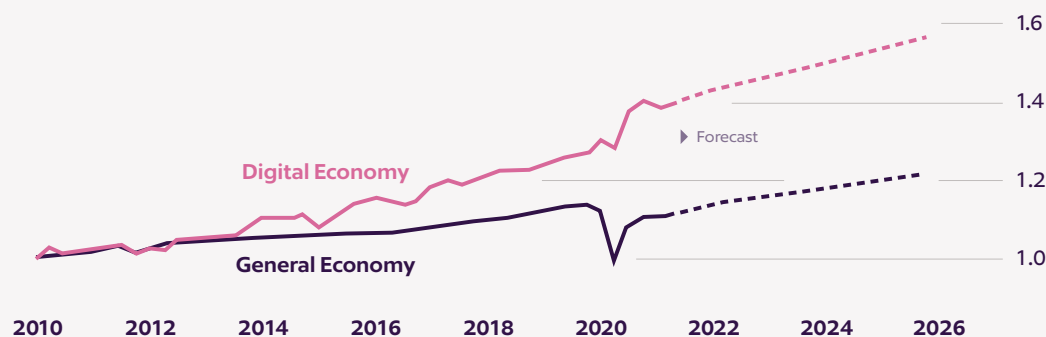


Figure 26: Employment growth in Canada's Digital and General Economy, normalized, 2010 – 2025. Source: ICTC, Statistics Canada

Figure 27 shows ICTC's forecast for employment in the digital economy under optimistic, baseline, and pessimistic scenarios through the end of 2025. Having made a strong recovery from the economic shocks of Q2 2020 and surge to new highs at the end of 2020, employment in the digital economy is expected to continue to progress on this new trajectory at a pace comparable to its pre-pandemic average, and higher than the long-term growth rate of employment in the general economy. While the loosening of public health restrictions and the slack in some sectors of the general economy will mean higher job growth in some sectors than the digital economy in the near term, the five-year forecast for job growth in digital economy is likely to outpace most other sectors.

105 Bank of Canada, "Business Outlook Survey—Summer 2021," accessed 5 July 2021, <https://www.bankofcanada.ca/2021/07/business-outlook-survey-summer-2021/>

According to the baseline scenario, ICTC forecasts that by the end of 2025, employment in the digital economy will reach 2.26 million or roughly 11% of all employment in Canada. This means that the Canadian digital economy will see a demand for 250,000 additional jobs.

Digital Economy Employment forecast for Canada (2021-2025)

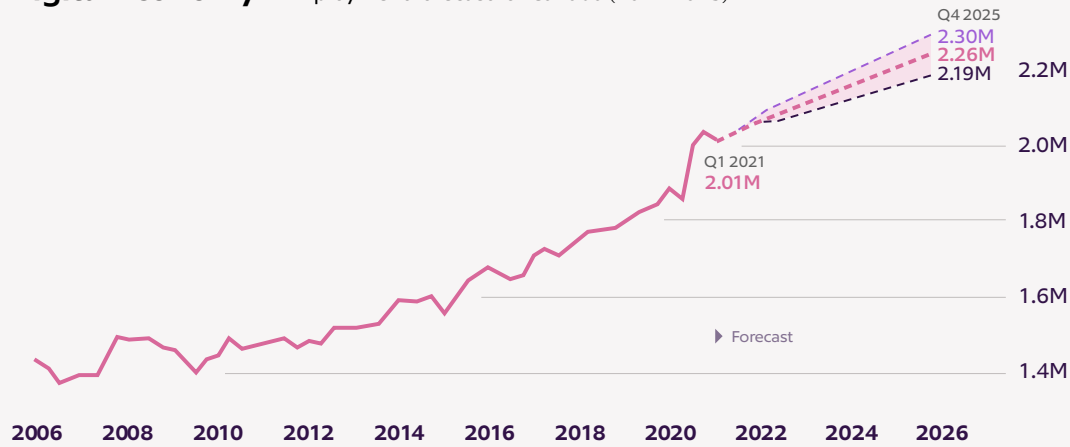


Figure 27: Employment in Canada's Digital Economy (forecast), 2021 – 2025. Source: ICTC, Statistics Canada

Most In-Demand: Occupations Across the Digital Economy and Their Critical Competencies and Skills

Under all potential growth scenarios, the demand for skilled digital talent remains high. The following section provides a snapshot of most in-demand digital occupations seeing high demand across Canada, along with their top critical “hard” skills. Although only “hard” (technical) skills for the in-demand digital roles are listed below, employers are increasingly looking for workers equipped with a blend of business or even “soft” skills. Most commonly cited as “must-haves” for the digital roles were communication and interpersonal skills, project management, critical thinking and problem-solving skills, ability to work in teams and other collaborative environments, strong task and time management skills, business acumen and client relationship management, sales, and awareness of financial metrics tied to deliverables.

Tech Snapshot:

Profiles of the 10 Most In-Demand Digital Roles in the Digital Economy

Software Engineer

Knowledge of software development practices and processes

Proficiency with Application Programming Interface (API)

Familiarity with scalability

Proficiency with Java

Familiarity with Agile Methodology

Proficiency with Python

Proficiency with JavaScript

Proficiency with React.js

Proficiency with C++

Proficiency with SQL

Web Developer

Proficiency with JavaScript

Proficiency with PHP

Proficiency with QL

Proficiency with HTML

Proficiency with jQuery

Proficiency with Python

Proficiency with Linux

Proficiency with C#

Proficiency with Git

Proficiency with Java

Data Engineer

Proficiency with Python

Proficiency with SQL

Knowledge of Extract Transform Load (ETL)

Proficiency with Apache Spark

Knowledge of Big Data

Familiarity with Agile Methodology

Familiarity with Data Warehousing

Knowledge of Machine Learning

Knowledge of Data Science

Proficiency with Microsoft Azure

Data Analyst

Knowledge of Data Analysis

Proficiency with SQL

Proficiency with Python

Proficiency with Microsoft Excel

Knowledge of Data Modelling

Knowledge of Extract Transform Load (ETL)

Familiarity with Data Warehousing

Proficiency with Power BI

Proficiency with R

Proficiency with Tableau

Manager, Software Engineering

- Proficiency with Java
- Proficiency with JavaScript
- Proficiency with AWS
- Proficiency with Kubernetes
- Proficiency with Microsoft Azure
- Proficiency with SQL
- Proficiency with Python
- Proficiency with Application Programming Interface (API)
- Proficiency with C++
- Proficiency with Docker

DevOps Engineer

- Proficiency with automation products for software infrastructure
- Proficiency with Python
- Proficiency with Jenkins
- Proficiency with Docker
- Proficiency with Kubernetes
- Proficiency with Ansible
- Proficiency with Linux
- Proficiency with Terraform
- Familiarity with Agile Methodology
- Familiarity with scalability

System Administrator

- Proficiency with Linux
- Proficiency with SQL
- Proficiency with Microsoft Azure
- Proficiency with VMware
- Proficiency with PowerShell
- Proficiency with AWS
- Proficiency with Python
- Familiarity with DNS
- Proficiency with Jenkins
- Familiarity with DHCP

Engineering Manager

- Proficiency with Python
- Proficiency with Kubernetes
- Proficiency with Java
- Proficiency with SQL
- Proficiency with JavaScript
- Familiarity with Android
- Proficiency with Linux
- Proficiency with Docker
- Proficiency with C++
- Proficiency with AutoCAD

Data Scientist

- Proficiency with Python
- Knowledge of Machine Learning
- Proficiency with SQL
- Knowledge of Computer Science principles and practices
- Familiarity with algorithms
- Familiarity with Data Analysis
- Proficiency with R
- Knowledge of Artificial Intelligence (AI)
- Knowledge of Statistics
- Knowledge of Big Data

Security Analyst

- Proficiency with Linux
- Proficiency with Python
- Proficiency with SQL
- Proficiency with Kubernetes
- Proficiency with Microsoft Azure
- Proficiency with AWS
- Proficiency with Java
- Knowledge of Security Information and Event Management (SIEM)
- Familiarity with NIST
- Proficiency with PowerShell

Business Snapshot:

Profiles of the Three Most In-Demand Business Roles in the Digital Economy

Project Managers

- Proficiency with SQL
- Familiarity with tracking tools like Jira
- Familiarity with project management tools like Microsoft Project
- Proficiency with Google Analytics
- Proficiency with Azure

Business Development Managers

- Proficiency with CRM software like Salesforce
- Proficiency with Excel
- Proficiency with Google Analytics
- Proficiency with marketing tools like HubSpot
- Familiarity with Software as a service (SaaS)

Business Analyst

- Familiarity with Agile Methodology
- Knowledge of Business Analysis
- Proficiency with SQL
- Proficiency with Excel
- Knowledge of economics or statistics

● ● ● Section III

Six Key Innovation Areas: Recent Developments and Employment Forecasts



In May of 2020, the Honourable Navdeep Bains, Minister of Innovation, Science and Industry, announced the creation of the Industry Strategy Council. Built on the Economic Strategy Tables, the Industry Strategy Council serves as an advisory board to assess the scope and depth of COVID-19's impact on key sectors of the economy and inform government's understanding of specific sectoral pressures.¹⁰⁶ In December of 2020, the Council launched its first report titled: "An ambitious growth plan for building a digital, sustainable and, innovative economy," which included detailed findings on COVID-19's impact on Canadian industries and recommendations for a strong recovery across sectors.¹⁰⁷ The report proposes the three-phase action plan (restart, recover, and reimagine) and five recommendations. These recommendations are:

- 1 Boosting the confidence of Canadian businesses and consumers to navigate the new normal, and adjusting the economic response plan to better support a safe reopening of the economy
- 2 Stabilizing and securing the hardest-hit sectors through targeted measures
- 3 Reigniting growth by doubling down on a future-oriented investment plan
- 4 An industrial strategy with four key pillars for a digital, sustainable, and innovative economy for all Canadians
- 5 Establishing renewed public-private sector partnerships and investments anchored in a sound and rigorous fiscal framework¹⁰⁸

The following section provides an update on the six key innovation areas discussed in the previous ICTC Outlook reports, including updated employment forecasts through 2025. The *Digital-Led New Normal: Revised Labour Market Outlook*¹⁰⁹ report showed that these six areas were already growing faster—from an economic and employment perspective—than non-digital sectors pre-COVID. It is expected that these innovation areas will continue to perform better than the rest of the economy as COVID-19 will likely to continue to accelerate digitization trends in more "traditional" areas of the economy (e.g., agriculture, natural resources).

¹⁰⁶ Industry Strategy Council, Innovation, Science and Economic Development Canada, https://www.ic.gc.ca/eic/site/062.nsf/eng/h_001117.html

¹⁰⁷ Ibid.

¹⁰⁸ Industry Strategy Council, Innovation, Science and Economic Development Canada, https://www.ic.gc.ca/eic/site/062.nsf/eng/h_001117.html

¹⁰⁹ Ivus, M., Kotak, A., McLaughlin, R., "The Digital-Led New Normal: Revised Labour Market Outlook for 2022," Information and Communications Technology Council, August 2020. <https://www.ictc-ctic.ca/wp-content/uploads/2020/08/Outlook-ENG-FINAL-8.24.20.pdf>

Cleantech

Cleantech sector businesses are predominantly engaged in the development and sale of environmentally friendly goods and services with cross-sectoral uses related to energy, water, agriculture, forestry, waste management, biodiversity, minerals, and adapted goods such as energy efficient equipment and sustainable mobility.¹¹⁰ Cleantech companies focus on generating efficiencies through technology, while simultaneously minimizing environmental impacts.

Developments in Canada

Canada has the potential to become a global cleantech leader as its position in the global cleantech market continues to advance. Eleven Canadian companies were featured in the 2021 Global Cleantech 100 list by Cleantech Group.¹¹¹ This representation placed Canada second in the world on the 2021 Global Cleantech innovation Index, ranking it just behind the US and ahead of Germany, France, the UK, the Netherlands, and China.¹¹²

Canada made calls for a renewed focus on climate-neutral energy generation and practices, on the heels of the pandemic. In November of 2020, Canada announced its ambitious goal to achieve net-zero emissions by 2050.¹¹³ This goal requires support and engagement from all parts of society, including government, businesses, and Canadians at large.

The federal government demonstrated its commitment to investments in clean energy technology to make Canada one of the best places in the world for clean tech manufacturing and services. In the 2021 budget, the federal government allocated \$17.6 billion toward a green recovery that creates middle-class jobs, builds a stronger, greener, and more sustainable economy, helps Canada reach its goal of conserving 25% of Canadian lands and oceans by 2025, and helps to fight climate change.¹¹⁴ The budget included \$5 billion over seven years for the Net Zero Accelerator, funding that allows the government to provide support for projects used by industry that will help reduce domestic greenhouse gas (GHG) emissions across the Canadian economy. This funding is an addition to the \$3 billion over five years announced previously in 2020.

¹¹⁰ Ibid.

¹¹¹ Cleantech Group is a San Francisco-based consultancy that measured industry leaders that had a significant impact in reducing CO2 emissions through transformative products and changes.

¹¹² "Canada Ranks 2nd on the 2021 Global Cleantech Innovation Index," Canada Action, December 12, 2020. <https://www.canadaaction.ca/cleantech-innovation-index-ranking#:~:text=Canada%20ranked%202nd%20on,Germany%2C%20France%2C%20and%20the%20U.K.&text=Canada%20is%20a%20global%20leader,leadership%20on%20the%20world%20stage!>

¹¹³ "Net-Zero Emissions by 2050," Environment and natural resources, <https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/net-zero-emissions-2050.html>

¹¹⁴ "Minister Champagne highlights clean technology investments in Budget 2021," Newswire.ca, April 30 2021, <https://www.newswire.ca/news-releases/minister-champagne-highlights-clean-technology-investments-in-budget-2021-804000338.html>

Budget 2021 also proposed new tax instruments including a 50% tax reduction on the general corporate and small business income tax rates for manufacturers of zero-emission technologies. It also proposed expanding the list of equipment eligible for tax incentives to encourage businesses to invest in clean energy generation and energy efficient equipment.¹¹⁵

Many Canadian businesses have already made net-zero commitments to help Canada meet its climate goals. In March of 2021, Air Canada announced it would be setting climate targets to realize a goal of net-zero GHG throughout its global operations by 2050. To reach it, Air Canada has committed to invest \$50 Million in Sustainable Aviation Fuel (SAF), and carbon reductions and removals.¹¹⁶ In June of 2021, Canadian oilsands producers announced forming an alliance to achieve net-zero GHG emissions from their operations by 2050. The alliance includes Canadian Natural Resources, Cenovus Energy, Imperial Oil, MEG Energy, and Suncor Energy, all of whom made a commitment to working with the federal and Alberta governments to achieve these goals.¹¹⁷

Cleantech Employment forecast for Canada (2021-2025)

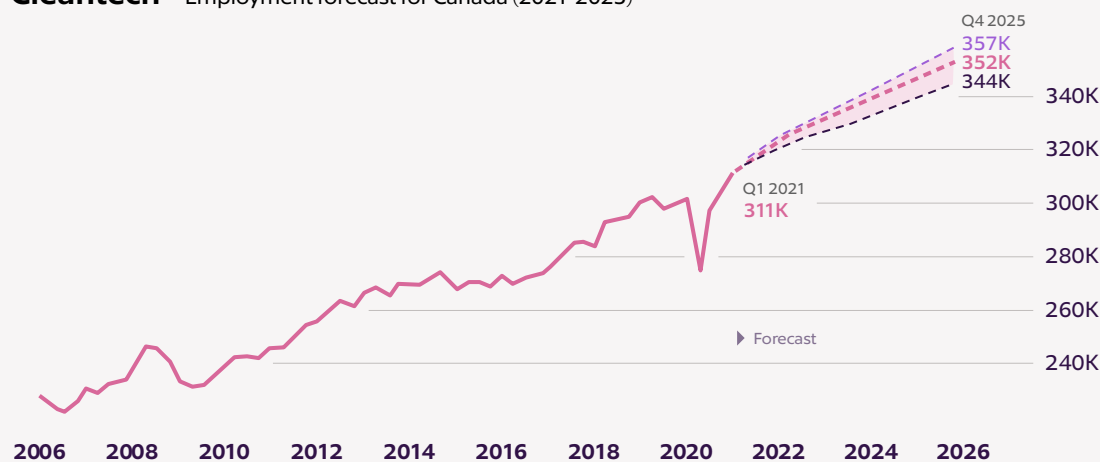


Figure 28: Employment in Canada's Cleantech sector (forecast), 2021 – 2025. Note: Seasonally adjusted employment Source: ICTC, Statistics Canada

115 Ibid.

116 "Air Canada Commits to Ambitious Net Zero Emissions Goal by 2050," Newswire.ca, March 15, 2021, <https://www.newswire.ca/news-releases/air-canada-commits-to-ambitious-net-zero-emissions-goal-by-2050-853464854.html>

117 "Canada's oilsands producers form alliance to achieve net-zero emissions by 2050," CBC news, June 9, 2021, <https://www.cbc.ca/news/canada/calgary/oilsands-canada-net-zero-alliance-1.6058809>

Cleantech is a key area for innovation, but its role in employment generation will be gradual, following the introduction of carbon emission policies, as private investments in this space scale, and as businesses commercialize new products.

Figure 28 represents ICTC’s forecast for employment in the cleantech sector. The forecast shows a steep decline in employment at the beginning of 2020, followed by a gradual recovery to pre-crisis employment levels by the end of the year. In Q1 of 2021, the cleantech’s sector employment reached 311,000, higher than the level seen before the COVID-19 downturn. Under a baseline scenario, the demand for workers in this sector is expected to reach approximately 41,000 by 2025. If fulfilled, Canada’s cleantech sector will employ approximately 352,000 workers.

Snapshot: Key Occupations and Skills

The following offers a snapshot of key in-demand occupations in the cleantech sector, along with their top 15 critical “hard” skills. These skills were sourced through a job posting analysis.

Electric Vehicle (EV) Engineer

An EV engineer can be any type of engineer who works on electric cars. This would include electrical, electronics, mechanical as well as a materials engineers who design, develop, test and supervise the manufacturing process of EV car components.

EV Engineer Profile

Proficiency with Matlab	Knowledge of Electrical Engineering
Proficiency with C++	Familiarity with Finite Element Analysis
Proficiency with AutoCAD	Proficiency with C
Proficiency with Simulink	Knowledge of Failure Mode and Effects Analysis (FMEA)
Knowledge of Mechanical Engineering	Six Sigma certification
Proficiency with SolidWorks	Familiarity with Product Design
Knowledge of Automotive Engineering	Knowledge of Design failure Mode and Effect Analysis (DFMEA)
Familiarity with Product Development	

Clean Resources

The clean resources sector refers to the blend of the natural resources and clean technology sectors. Clean resources businesses focus on the extraction or use of natural resources in ways that are environmentally friendly, carbon neutral, or climate positive.¹¹⁸ Companies in the clean resources sector work in forestry, mining, fisheries, and oil and gas activities.

Developments in Canada

Canada has the 3rd largest endowment of natural resources in the world, behind China and Saudi Arabia.¹¹⁹ The resource sector represents around 11.5% of Canadian GDP.¹²⁰ Canada is an energy intensive country and natural resources is the leading contributor to Canada's exports, mainly driven by crude oil, accounting for around 42% of exports.¹²¹

Fossil fuels (crude oil, natural gas, and coal) account for the greatest share of primary energy production in Canada, while renewable energy sources (solar, wind, biomass, geothermal, hydropower, solid biomass, biogas and liquid biofuels) currently provide 16%¹²² of Canada's total primary energy supply. As a comparison, OECD countries, on average, supply 10.5% of their energy from renewable sources, while the world average is 13.4%.¹²³

Hydrogen technologies have witnessed strong demand over the last few years.¹²⁴ Hydrogen is an energy carrier that does not produce any carbon emissions when consumed in a fuel cell to generate electricity, power, and heat. Hydrogen has a broad range of applications across many sectors like transportation, commercial, industrial, residential, and portable.¹²⁵ Canada is already among the top 10 producers of hydrogen power in the world; it is known for its leading hydrogen and fuel cell technology companies and expertise. Canada can boast over 100 established hydrogen and fuel cell technology companies, employing more than 2,100 people and generating revenues over \$200 million.¹²⁶ Canada has an incredible opportunity to become a global leader in the clean resources market.

118 Cutean, A., Hamoni, R., McLaughlin, R., Ye, Z., "Canada's Growth Currency: Digital Talent Outlook 2023," Information and Communications Technology Council (ICTC), October 2019, <https://www.ictc-ctic.ca/wp-content/uploads/2020/03/canada-growth-currency-2019-FINAL-ENG-10.28.19.pdf>

119 "Countries With The Most Natural Resources," WorldAtlas, <https://www.worldatlas.com/articles/countries-with-the-most-natural-resources.html>

120 "Restart, recover, and reimagine prosperity for all Canadians," A Report from Canada's Industry Strategy Council, November 2020, [https://www.ic.gc.ca/eic/site/062.nsf/vwapj/00118a_en.pdf/\\$file/00118a_en.pdf](https://www.ic.gc.ca/eic/site/062.nsf/vwapj/00118a_en.pdf/$file/00118a_en.pdf)

121 "Table 12-10-0012-01 International merchandise trade by province, commodity, and Principal Trading Partners, inactive (x 1,000)," Statistics Canada, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1210001201>

122 "Renewable energy facts," Natural Resources Canada, accessed June 2021, <https://www.nrcan.gc.ca/science-data/data-analysis/energy-data-analysis/energy-facts/renewable-energy-facts/20069>

123 Ibid.

124 "Hydrogen," IEA.org, <https://www.iea.org/fuels-and-technologies/hydrogen>

125 Olexiuk, P., Duncanson, S., Kennedy, J., Baker, J., Brinker, C., Mckop, S., "Federal government announces Canada's hydrogen strategy," Osler, December 22, 2020, <https://www.osler.com/en/resources/regulations/2020/federal-government-announces-canada-s-hydrogen-strategy>

126 "Hydrogen Strategy for Canada: Seizing the Opportunity for Hydrogen," Natural Resources Canada, December 2020, https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/environment/hydrogen/NRCan_Hydrogen-Strategy-Canada-na-en-v3.pdf

At the end of 2020, the Government of Canada launched the Hydrogen Strategy for Canada, an ambitious strategy that seeks to position Canada as a global hydrogen supplier on its way to net-zero carbon emissions by 2050. The Hydrogen Strategy suggests that hydrogen could satisfy 30% of Canada's energy needs by 2050.¹²⁷ To achieve the goals of this strategy, the government announced a \$1.5 billion investment in a Low-carbon and Zero-emissions Fuels Fund to increase the production and use of low-carbon fuels, including hydrogen.¹²⁸ The Strategy is expected to bring new investments and strategic partnerships across the country as well as globally, alongside economic and environmental opportunities to Canada, creating as many as 350,000 green jobs over the next 30 years.¹²⁹

The federal government continues to support the transition of Canada's energy industry to a low-carbon future by investing in renewable energy and technology solutions. In the federal budget 2021, the government announced investments in Critical Minerals and Low-Carbon Fuels. The federal government allocated \$9.6 million over three years to create a Critical Battery Minerals Centre of Excellence located at Natural Resources Canada to coordinate federal policy and programs on critical minerals, such as lithium, helium, cobalt, potash and others.¹³⁰ Also in the 2021 budget, \$67.2 million was allocated over seven years for the implementation and administration of the Clean Fuel Standard.¹³¹ The funding is aimed at developing new economic opportunities for Canada's biofuel producers, including farmers and foresters. Moreover, \$1.5 billion was allocated over five years to Natural Resources Canada to establish a Clean Fuels Fund to support the production and distribution of low-carbon and zero-emission fuels, including hydrogen and biomass.¹³² This fund will help to position Canada as a global hydrogen leader and deliver on the Hydrogen Strategy.¹³³

127 Minister O'Regan Launches Hydrogen Strategy for Canada", Newswire.ca, December 16, 2020, <https://www.newswire.ca/news-releases/minister-o-regan-launches-hydrogen-strategy-for-canada-818474032.html>

128 Ibid.

129 "Hydrogen Strategy for Canada: Seizing the Opportunity for Hydrogen," Natural Resources Canada, December 2020, https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/environment/hydrogen/NRCan_Hydrogen-Strategy-Canada-na-en-v3.pdf

130 "Budget 2021: A Recovery Plan for Jobs, Growth, and Resilience," Government of Canada, <https://www.budget.gc.ca/2021/home-accueil-en.html>

131 Ibid.

132 Ibid.

133 Ibid.

Clean Resources Employment forecast for Canada (2021-2025)

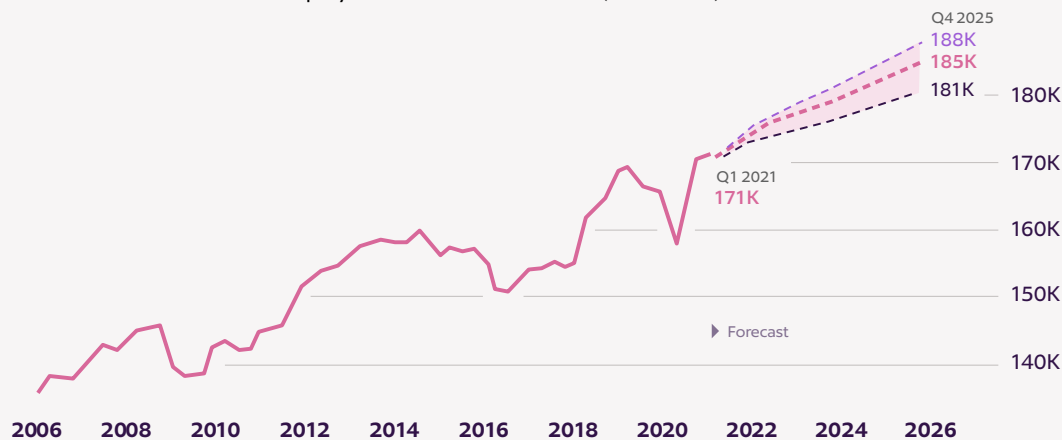


Figure 29: Employment in Canada's Clean Resources sector (forecast), 2021 – 2025. Source: ICTC, Statistics Canada
Note: Seasonally adjusted employment

ICTC's Clean Resources forecast is shown in **Figure 29**. External factors such as global and national environmental commitments, energy sector trends, and others play a role in clean resources employment prospects. Similar to cleantech, the forecast shows a steep decline in 2020 followed by a gradual recovery to pre-crisis employment levels by early 2021. The clean resources sector contains a large number of natural resources companies (the majority are in the oil and gas industry), which were significantly impacted by suppressed energy demand during the COVID-19 pandemic. Consequently, as the economy returns to "normal," businesses are likely to hire extensively as they launch new "green economy" projects. Under a baseline growth scenario, ICTC forecasts demand for approximately 14,000 workers in the clean resources sector by 2025, bringing total employment to 185,000. The increased demand for talent with the right mix of skills is likely to be fuelled by an increasing number of projects focused on renewable energy sources. Filling this demand will be necessary for Canada to achieve its 2030 and 2050 climate change goals.

Snapshot: Key Occupations and Skills

The following offers a snapshot of key in-demand occupations in the cleantech sector, along with their top 15 critical "hard" skills. These skills were sourced through a job posting analysis.

Smart Grid Engineer

A smart grid engineer is focused on smart grid technology, specifically on smart grid power generation and supply. Smart grid engineers are involved in the system design that regulates smart grids, improves power distribution, and ensures efficient operations; they ensure proper implementation of essential capabilities and components of smart grids.

Smart Grid Engineer Profile

Knowledge of Electrical Engineering	Proficiency with Matlab
Knowledge of Renewable Energy production	Proficiency PLC
Proficiency with SCADA	Knowledge of Power Generation
Knowledge of Electric Power Systems	Proficiency with C++
Knowledge of process automation	Knowledge of Control Systems Design
Familiarity with Power Distribution	Proficiency with AutoCAD
Knowledge of Energy Management	Proficiency with Simulink
	Proficiency with LaTeX

Health and Biotech

The health and biotech sector encompasses a wide range of firms, from the developers and manufacturers of pharmaceuticals, medical devices, and biomedical innovations to the producers of digital health solutions using disruptive technologies such as artificial intelligence, big data analytics, 3D printing, robotics, and nanotechnologies.¹³⁴

Developments in Canada

The health and biotech sector in Canada encompasses over 900 firms; this includes pharmaceutical multinational enterprises, generics firms, biopharmaceutical SMEs (small and medium sized enterprises), contract research and manufacturing organizations, and medical technology manufacturers. The sector contributes 1.8% to Canada’s annual GDP as part of the broader healthcare ecosystem.¹³⁵

134 "Health/Bio-sciences Table," Innovation, Science and Economic Development Canada, <https://www.ic.gc.ca/eic/site/098.nsf/eng/00016.html>

135 "Restart, recover, and reimagine prosperity for all Canadians," A Report from Canada's Industry Strategy Council, November 2020, [https://www.ic.gc.ca/eic/site/062.nsf/vwapj/00118a_en.pdf/\\$file/00118a_en.pdf](https://www.ic.gc.ca/eic/site/062.nsf/vwapj/00118a_en.pdf/$file/00118a_en.pdf)

The health and biosciences sector has been recognized as a prominent sector in Canada and is poised for global growth due to its successful utilization of innovation, and its spinoff to other domestic companies in the supply chain.¹³⁶ Canada boasts health and biotech companies that commercialize products that include zero-carbon fertilizers, phenotyping, drought-resistant crops, and plant-based products and proteins,¹³⁷ as well as innovative firms that are developing the next generation of manufacturing equipment and technologies that incorporate automation, artificial intelligence, machine learning and robotics to achieve new levels of productivity, safety, and precision.¹³⁸ Over the last few years, the health and biotech sector has been experiencing an investment boom. Technological innovations in the sector allowed it to become “far and away the most innovative age in biotechnology”.¹³⁹ Over the first six months of 2020, biotech and life sciences companies were able to raise more than \$1 billion in venture capital funding, surpassing the total raised 2019, which was a record of \$1.085 billion.¹⁴⁰ Moreover, in 2019-2020 the sector witnessed multiple initial public offerings (IPO) by Vancouver’s AbCellera Biologics Ltd. (human antibodies), Toronto-based MindBeacon (e-health), Montreal’s Repare Therapeutics (oncology), Toronto-based Think Research (healthcare software), Hamilton-based Fusion Pharmaceuticals (cancer therapies) and Victoria-based Aurinia Pharmaceuticals (lupus).¹⁴¹

“” *In Canada, the major problem is access to healthcare and wait time... The COVID-19 pandemic had a negative impact on surgery backlogs, but it had a positive impact on the kinds of services we provide. The pipeline is definitely growing for us.* – Healthtech company

COVID-19 changed the way healthcare is being delivered in Canada, triggering pain points such as the slow adoption of digital health platforms.¹⁴² Digital health platform implementation was lagging before the COVID-19 pandemic but became widely adopted in 2020 and may even become a long-term trend.

136 Ibid.

137 Ibid.

138 “Canadian Biotechnology: Solving for Today, Building for Tomorrow,” BIOTECanada, 2020, <http://www.biotech.ca/wp-content/uploads/2020/10/solving-for-today-building-for-tomorrow.pdf>

139 Silcoff, S., “Biotech blind spot: How Canada’s big investors missed the boom happening right now,” The Globe and Mail, July 3, 2020, <https://www.theglobeandmail.com/business/article-biotech-blind-spot-how-canadas-big-investors-missed-the-boom/>

140 Gnocato, K., “Canada’s biotech and life sciences sector needs an infusion of talent to scale,” MaRS, March 30, 2021, <https://marsdd.com/news/canadas-biotech-and-life-sciences-sector-needs-an-infusion-of-talent-to-scale/>

141 Ibid.

142 “Restart, recover, and reimagine prosperity for all Canadians,” A Report from Canada’s Industry Strategy Council, November 2020, [https://www.ic.gc.ca/eic/site/062.nsf/vwapj/00118a_en.pdf/\\$file/00118a_en.pdf](https://www.ic.gc.ca/eic/site/062.nsf/vwapj/00118a_en.pdf/$file/00118a_en.pdf)

According to the survey conducted by the Canadian Medical Association (CMA), 47% of Canadians have used some form of telehealth in 2020.¹⁴³ Telehealth or virtual care is just one of the key trends taking place in this space. Healthcare more broadly is moving to a new digital age where it aligns with the concept of “4P medicine”: predictive, preventive, personalized and participatory.¹⁴⁴ A strong health and biotech sector is vital for Canadian health security and economic growth. Its “health” is critical to Canadian recovery from COVID-19. In the 2021 federal budget, the government announced an investment of \$2.2 billion over seven years toward strengthening and growing a vibrant domestic Canadian life sciences sector and restoring biomanufacturing capabilities.¹⁴⁵ The funding can be broken down as follows:

\$500 million over four years for the Canada Foundation for Innovation. This money is to support the bioscience capital and infrastructure needs of post-secondary institutions and research hospitals

\$250 million over four years for the federal research granting councils. These funds are to create a new tri-council biomedical research fund

\$92 million over four years for adMare. This money is to support company creation, scale up, and training activities in the life sciences sector

\$59.2 million over three years for the Vaccine and Infectious Disease Organization

\$45 million over three years to the Stem Cell Network. These funds are to support stem cell and regenerative medicine research¹⁴⁶

143 Zafar, A., “Many Canadians used virtual medical care during COVID-19, poll suggests,” CBC News, June 8, 2020, <https://www.cbc.ca/news/health/virtual-care-cma-survey-1.5603713>

144 “The digital disruptors changing healthcare in Canada,” PWC, <https://www.pwc.com/ca/en/industries/technology/digital-disruptors-changing-health-care-in-canada.html>

145 “Government of Canada highlights Budget 2021 investments to keep Canadians healthy,” Department of Finance Canada, April 23, 2021, <https://www.canada.ca/en/department-finance/news/2021/04/government-of-canada-highlights-budget-2021-investments-to-keep-canadians-healthy.html>

146 Ibid.



We've hired during the pandemic and, despite COVID-19, we've been able to grow. We've been very lucky particularly in hiring scientists, but harder to hire are software developers. We've brought in designers and some product managers as well, but getting developers right now is pretty challenging. – Biotech company

Health and Biotech Employment forecast for Canada (2021-2025)

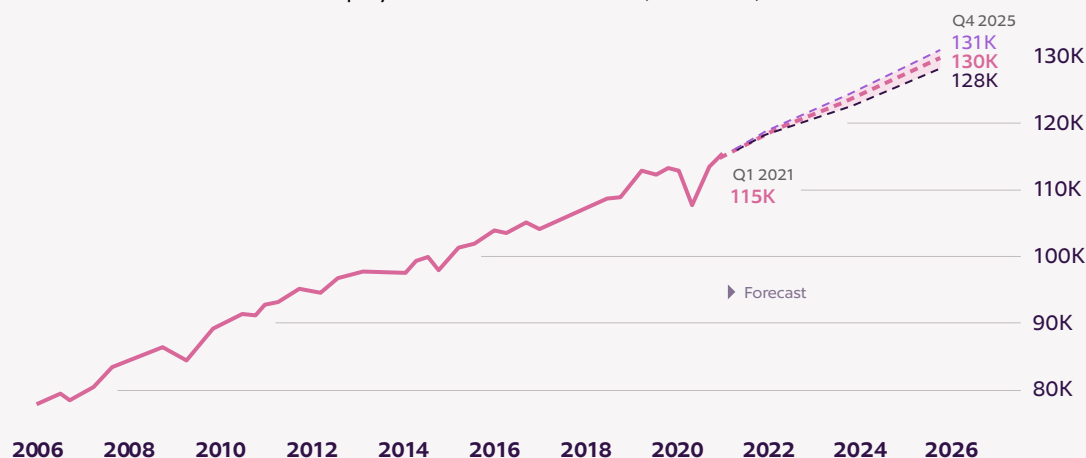


Figure 30: Employment in Canada's Health and Biotech sector (forecast), 2021 – 2025. Source: ICTC, Statistics Canada
 Note: Seasonally adjusted employment

Figure 30 showcases ICTC’s employment forecast for the health and biotech sector in Canada. COVID-19 caused an interruption in elective procedures, scheduled non-urgent surgeries, medical care appointments, and dental appointments, all of which all led to a drop in the sector’s overall employment in early 2020. In this context, health and biotech employment saw a dip during 2020, although to a much smaller extent than sectors like advanced manufacturing. Health and biotech returned to its pre-crisis baseline by the end of 2020 and reached 115,000 workers in Q1 of 2021. ICTC forecasts that employment prospects for this sector will remain steady over the next five years. Should we see sustained investments in Canadian biotech and digital health firms, alongside improved digital infrastructure and increased adoption of data-driven digital health technologies, the demand for employment in this innovation area will scale. By 2025, the health and biotech sector is expected to see demand for 14,000 workers, bringing total employment to 129,000.

Snapshot: Key Occupations and Skills

The following is a snapshot of a key in-demand occupation in the health and biotech sector, along with its top 15 critical “hard” skills. These skills were sourced through a job posting analysis.

Biostatistician

A biostatistician collects and analyzes data by applying statistical theory and methods. Biostatisticians gain knowledge from the data and provide information and recommendations to scientific fields such as medicine, biology, and agriculture.

Biostatistician Profile

Knowledge of Data Analysis	Knowledge of epidemiology
Knowledge of Biostatistics	Familiarity with clinical research
Proficiency with SAS	Proficiency with IBM SPSS
Proficiency with R	Knowledge of Data Management
Knowledge of Statistics	Knowledge of Data Mining
Knowledge of with clinical trials	Familiarity with Survival Analysis
Knowledge of Statistical Modelling	Familiarity with Statistical Programming
Proficiency with Excel	

Advanced Manufacturing

Advanced manufacturing is defined as the development and adoption of technologies like robotics, 3D printing, etc. to create new products, enhance processes, and establish more efficient and cost-effective ways of making things.¹⁴⁷ Manufacturing has traditionally been and remains a significant contributor to the Canadian economy. At the beginning of 2021, the manufacturing sector employed more than 1.74 million people,¹⁴⁸ accounting for around \$186 billion or 10.6% of Canadian GDP.¹⁴⁹ Advanced manufacturing made up 64% of all of Canada’s merchandise exports.¹⁵⁰

147 “Advanced Manufacturing,” Canada’s Economic Strategy Tables, September 2018, [https://www.ic.gc.ca/eic/site/098.nsf/vwapj/ISEDCTable_AM.pdf/\\$file/ISEDCTable_AM.pdf](https://www.ic.gc.ca/eic/site/098.nsf/vwapj/ISEDCTable_AM.pdf/$file/ISEDCTable_AM.pdf)

148 “Table 14-10-0022-01 Labour force characteristics by industry, monthly, unadjusted for seasonality (x 1,000),” Statistics Canada, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410002201>

149 “Table 36-10-0434-02 Gross domestic product (GDP) at basic prices, by industry, monthly, growth rates (x 1,000,000),” Statistics Canada, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610043402>

150 “Table 12-10-0136-01 Canadian international merchandise trade by industry for all countries,” Statistics Canada, <https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1210013601>

Developments in Canada

The adoption of new advanced technologies is essential to the global competitiveness of Canadian manufacturers. According to the most recent data, in 2019, around 45%¹⁵¹ of Canadian companies in the manufacturing sector used advanced or emerging manufacturing technologies. Although less than half of manufacturers currently use advanced or emerging manufacturing technologies, according to the 2020 Management Issues Survey by CME, 55% of respondents plan to invest in or increase their use of advanced technologies over the next three years.¹⁵²

The manufacturing sector has been hit hard by the COVID-19 pandemic. In the beginning of 2020, many manufacturers suffered a decline in demand and an increase in supply chain disruptions. Many businesses were forced to rethink their manufacturing operations, to shift gears, and to explore new ways of doing business, which required to quickly adapt and transform their operations. According to the 2020 Management Issues Survey, 15% of manufacturers surveyed have scaled up or retooled their operations to build products and supply the components for things like eye protection and face shields, hand sanitizer, disinfectant and disinfectant wipes, and surgical masks.¹⁵³

By the end of 2020, the sector recovered at a somewhat faster pace than that of the overall economy, but it still faces numerous challenges.¹⁵⁴ According to the 2020 Management Issues Survey, around 42% of manufacturers reported that their level of production in 2020 was lower compared to the prior year.¹⁵⁵ The top three important factors identified by manufacturers as limiting their ability to expand sales and increase production are: 1) insufficient demand, 2) ability to find a qualified workforce, and 3) foreign competition.¹⁵⁶ Finding qualified workers has been an ongoing challenge for manufacturers. About 60% of the survey respondents noted an immediate labour shortage.¹⁵⁷ About 36% of respondents mentioned a shortage of skilled workers (machinist, operators), and 26% mentioned a shortage of unskilled workers (i.e., general labourers and assembly positions).¹⁵⁸

151 "Table 27-10-0367-01 Use of advanced or emerging technologies, by industry and enterprise size," Statistics Canada, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2710036701>

152 Arcand, A., "2020 Management Issues Survey," Canadian Manufacturers & Exporters, https://cme-mec.ca/wp-content/uploads/2020/12/CME-MEC_MIS-Survey-Report-2020.pdf

153 "Manufacturing Business Condition Survey," Canadian Manufacturers & Exporters, May 25, 2020, <https://cme-mec.ca/wp-content/uploads/2020/05/Manufacturing-Business-Conditions-and-Outlook-Survey-May-2020.pdf>

154 Arcand, A., "2020 Management Issues Survey," Canadian Manufacturers & Exporters, https://cme-mec.ca/wp-content/uploads/2020/12/CME-MEC_MIS-Survey-Report-2020.pdf

155 Ibid.

156 Ibid.

157 Ibid.

158 Arcand, A., "2020 Management Issues Survey," Canadian Manufacturers & Exporters, https://cme-mec.ca/wp-content/uploads/2020/12/CME-MEC_MIS-Survey-Report-2020.pdf

Canadian manufacturers are expecting to continue to face labour shortages, as manufacturing technologies become even more sophisticated, and the skillsets that businesses need to operate the advanced machinery is expected to evolve and change.¹⁵⁹

Advanced technology and digital enablement are essential to building resilience in the manufacturing sector. COVID-19 proved that digital solutions and advanced technologies allow manufacturers to respond faster to a disruption while mitigating the pandemic’s adverse impact on production. The federal government recognized the importance of digital technologies for the manufacturing sector by addressing many challenges faced by Canadian manufacturers in the Budget 2021.¹⁶⁰ In particular, the federal government introduced the Canada Digital Adoption Program. The Canada Digital Adoption Program aims to help small and medium sized businesses adopt new digital technologies. The adoption of these technologies translates into funding for technology advisory expertise as well as financing options for the deployment of these technologies. The government has earmarked \$1.4 billion in funding over four years through the department of Innovation, Science & Economic Development (ISED). The aim of this funding is to provide access to skills, training, and advisory services, and to create work opportunities for young people to help businesses adopt new technology. Beyond the ISED funding, the government also allocated \$2.6 billion over four years to the Business Development Bank of Canada (BDC). The primary objective of this funding is to help finance technology adoption.¹⁶¹

Advanced Manufacturing Employment forecast for Canada (2021-2025)

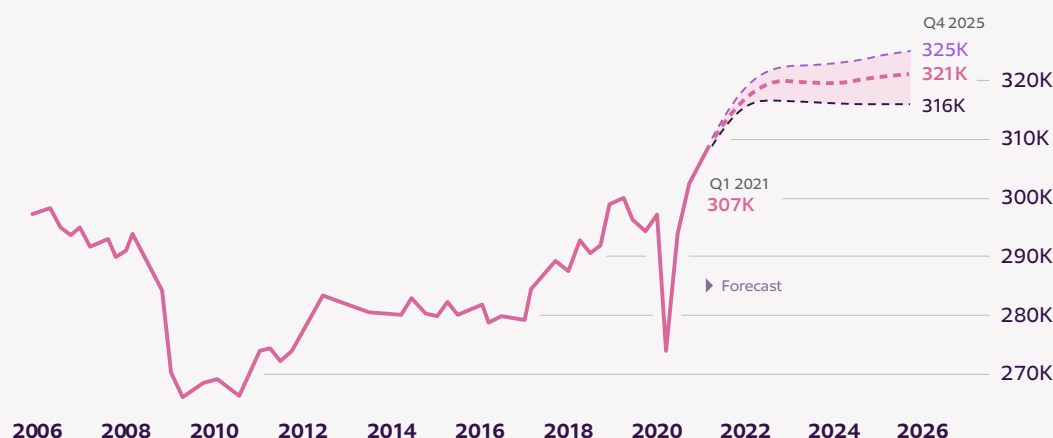


Figure 31: Employment in Canada's Advanced Manufacturing sector (forecast), 2021 – 2025. Source: ICTC, Statistics Canada
 Note: Seasonally adjusted employment

159 Ibid.

160 "Budget 2021: A Recovery Plan for Jobs, Growth, and Resilience," Government of Canada, <https://www.budget.gc.ca/2021/home-accueil-en.html>

161 "Budget 2021: Impacts on Manufacturing & Distribution," BDO Canada, April 22, 2021, <https://www.bdo.ca/en-ca/insights/tax/federal-and-provincial-budgets/2021/budget-2021-impacts-on-manufacturing-distribution/>

Figure 31 represents ICTC’s employment forecast for the advanced manufacturing sector in Canada. As mentioned earlier, the sector was dramatically impacted by COVID-19 in early 2020, with many factories forced to shut down their operations. Yet, by the end of 2020, the sector was able to rebound reaching pre-pandemic employment levels. ICTC forecasts a demand for approximately 14,000 workers in the advanced manufacturing sector by 2025, with total employment reaching around 321,000.

Snapshot: Key Occupations and Skills

The following is a snapshot of a key in-demand occupation in the advanced manufacturing sector, along with its top 15 critical “hard” skills. These skills were sourced through a job posting analysis.

Additive Manufacturing Designer

An additive manufacturing (AM) Designer is responsible for design and development of all steps of the AM process for equipment or parts. An AM Designer works with materials, machines, processes, and software for AM with the objective of creating parts with complex shapes while reducing weight and material consumption.

AM Designer Profile

Knowledge of Product Design	Proficiency with Adobe Photoshop
Knowledge of Additive Manufacturing	Knowledge of Design for Manufacturing (DfM)
Proficiency with Computer-Aided Design (CAD)	Familiarity with Industrial Design
Familiarity with Rapid Prototyping	Proficiency with Photoshop
Proficiency with SolidWorks	Knowledge of 3D Modelling
Knowledge of 3D Printing	Proficiency with Autodesk Fusion 360
Knowledge of Product Development	Knowledge of Mechanical Engineering
Proficiency with Adobe Creative Suite	

Agri-Food and Food Tech

Agri-food and food tech industries encompass several subsectors, including animal genetics, industrial bioproducts, regular agriculture, and livestock rearing.¹⁶² Agtech companies develop and implement technologies that seek to help producers make food more effectively and efficiently while ensuring that processes are sustainable and cost-effective. They also bring value to producers by improving and simplifying the supply chain.

Developments in Canada

The agri-food sector in Canada presents a strong global growth opportunity. With the world's population projected to reach 10 billion by 2050, the demand for food is growing. Canada is attempting to seize this opportunity and boost its supply of safe, trusted, sustainable, traceable, and high-quality food products through increased adoption of cutting-edge digital technologies. One strategy, as suggested by the Industry Strategy Council, is to turn Canada into a leader in "precision agriculture." The Industry Strategy Council suggests four actionable recommendations: 1) build the necessary infrastructure and market access for future waves of growth, 2) deploy investments in competitive areas, 3) increase digitization to improve productivity, 4) modernize regulatory systems and build a 21st century talent pipeline.¹⁶³

“” *Farmers continue to grow food and people continue to need to eat. So, we haven't had a fall in demand like you see in other industries, and from that standpoint, we've been very fortunate.* – Agtech company

¹⁶² Canadian agri-food sector intelligence," Agriculture and Agri-Food Canada, July 24, 2019, <https://www.agr.gc.ca/eng/canadian-agri-food-sector/?id=1361290241756>

¹⁶³ "Restart, recover, and reimagine prosperity for all Canadians," A Report from Canada's Industry Strategy Council, November 2020, [https://www.ic.gc.ca/eic/site/062.nsf/vwapj/00118a_en.pdf/\\$file/00118a_en.pdf](https://www.ic.gc.ca/eic/site/062.nsf/vwapj/00118a_en.pdf/$file/00118a_en.pdf)

The agri-food and food tech sector faces various issues and pain points, including infrastructure and logistical issues, regulatory barriers, trade challenges, labour shortages as well as a general lack of broadband access in many rural locations across the country.¹⁶⁴ COVID-19 re-emphasized the need to continue the shift toward greater digitization across the country, across all sectors. During 2020, the sector had to deal with new challenges like supply disruptions, inventory management disruptions, shifts in demand for agri-food products from food services to retail grocery, and new delivery models.¹⁶⁵ Some of these challenges could be partially solved with supply chain digitization, however, the lack of broadband access in many rural and remote areas remains a large barrier to widespread digitization of the agriculture sector.¹⁶⁶ On October 1, 2020, the Government of Canada announced the three-year Canadian Infrastructure Bank Growth Plan, which included \$10 billion in infrastructure initiatives to create jobs and economic growth and a \$2 billion allocation to connect approximately 750,000 homes and small businesses to broadband in underserved communities.¹⁶⁷ Moreover in April of 2021, the federal Budget 2021 announced an additional \$1 billion over six years to the Universal Broadband Fund. This fund was put in place to support a more rapid expansion of broadband projects across rural Canada.¹⁶⁸

Agricultural digital innovation remains the key driver of economic growth in the sector, and Canada is home to a number of promising agtech companies.¹⁶⁹ Technologies like robotics, AI, and big data analytics have contributed enormously to the transformation of Canada's agricultural sector,¹⁷⁰ and advancing digitization is recognized as an enabler of greater competitiveness as well as opportunities to meet food security and sustainability goals. In the federal government's Budget 2021, the government announced the extension of the Agricultural Clean Technology Program, which was allocated \$165 million (\$10 million of the \$165.5 million was allocated toward powering farms with clean energy over the next two years).¹⁷¹ As well, the government announced the allocation of an additional \$200 million over two years to the Agricultural Climate Solutions program, which will help to accelerate emission reductions.

164 Ibid.

165 Ibid.

166 "High-Speed Access for All: Canada's Connectivity Strategy," Innovation, Science and Economic Development Canada, https://www.ic.gc.ca/eic/site/139.nsf/eng/h_00002.html

167 "Prime Minister announces infrastructure plan to create jobs and grow the economy," Canada Infrastructure Bank, October 1, 2020, <https://cib-bic.ca/en/the-canada-infrastructure-bank-announces-a-plan-to-create-jobs-and-grow-the-economy/>

168 "Universal Broadband Fund," Innovation, Science and Economic Development Canada, https://www.ic.gc.ca/eic/site/139.nsf/eng/h_00006.html

169 Remi Schmaltz, "Canada AgriFood Tech Market Map: 166 Startups Growing Canada's Agricultural Sector," AgFunderNews, May 2, 2019, <https://agfundernews.com/canada-agrifood-tech-market-map-166-startups-grow-canadas-agricultural-sector.html>

170 "Digital Opportunities for Better Agricultural Policies," OECD, 2019, <https://doi.org/10.1787/571a0812-en> <https://www.oecd-ilibrary.org/sites/367ac383-en/index.html?itemId=/content/component/367ac383-en>

171 "Budget 2021: A Recovery Plan for Jobs, Growth, and Resilience," Government of Canada, <https://www.budget.gc.ca/2021/home-accueil-en.html>



In Canada and the US, people are interested in traceability and sustainability of their foods and how much pesticides were used to produce that food. – Agtech company

Agri-Food and Food Tech Employment forecast for Canada (2021-2025)

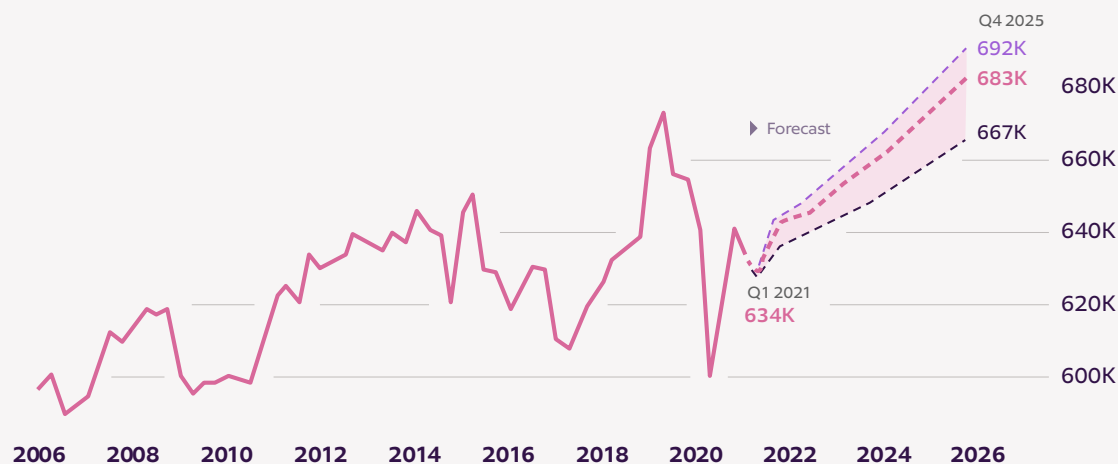


Figure 32: Employment in Canada's agri-food and food tech sector (forecast), 2021 – 2025. Source: ICTC, Statistics Canada
 Note: Seasonally adjusted employment

Figure 32 shows ICTC’s employment forecast for the agri-food and food tech sector. The sector saw a dip in employment during 2020 and has yet to fully recover to 2019 levels. Food production and distribution was restructured during the pandemic, leading to an immediate contraction in employment. It is expected that the sector will be on track to recover starting in the middle of 2021. At the same time, employment opportunities are expected to shift, bringing new skill needs in areas linked to AI, predictive analytics, food safety, traceability, and supply chain management. A baseline growth scenario points to a demand for approximately 49,000 workers by 2025 in the agri-food and food tech sector. If filled, this will bring total employment in the sector to 683,000 workers.

Snapshot: Key Occupations and Skills

The following is a snapshot of a key in-demand occupation in the agri-food and food tech sector, along with its top 15 critical “hard” skills. These skills were sourced through a job posting analysis.

Precision Agronomist

A precision agronomist utilizes data and technology (geographic information systems [GIS], Global Positioning System [GPS], and geo-referenced satellite, drone imagery, etc.) to observe, measure, and respond to variability in crop production with the goal to sustainably maximizing returns on inputs.

Precision Agronomist Profile

Knowledge of Sustainable Agriculture processes	Knowledge of agrochemicals
Knowledge of Agronomy	Knowledge of plant nutrition
Knowledge of Precision Agriculture	Knowledge of seed production
Knowledge of Crop Protection	Knowledge of nutrient management
Knowledge of Soil Fertility, Soil Sampling, Soil Science	Familiarity with Remote Sensing
Familiarity with Data Analysis	Familiarity with Global Positioning System
Knowledge of Geographic Information Systems	Proficiency with R
	Proficiency with Python

Interactive Digital Media

The Interactive Digital Media (IDM) sector is found at the intersection of ICT and creative industries and businesses that display data or information in creative or innovative ways.¹⁷² IDM includes animation, visual effects, video game development, music, and has interactions with other media-related industries like advertising and marketing.

172 Cutean, A., et al. “Canada’s Growth Currency: Digital Talent Outlook 2023,” Information and Communications Technology Council, October 2019, <https://www.ictc-ctic.ca/wp-content/uploads/2019/11/canada-growth-currency-2019-FINAL-ENG.pdf>

Developments in Canada

The IDM sector became increasingly globalized prior to the COVID-19 pandemic, but the pandemic emphasized the need for this sector to continue to compete internationally. It is believed that COVID-19 has accelerated the adoption of digital technologies by three to seven years,¹⁷³ in part due to the increasing use of digital tools for work,¹⁷⁴ education,¹⁷⁵ healthcare,¹⁷⁶ retail,¹⁷⁷ and other employment areas.

The IDM sector is an increasingly important component of the Canadian economy. Canada is particularly recognized as a global leader in creative technology (video game production, visual effects [VFX], and animation) thanks to a digital talent pool and favourable government policies that help the industry to succeed and compete globally.¹⁷⁸ Video games remain the biggest subsector of IDM. Along with the animation subsector, it saw a substantial growth in demand during 2020. According to the Entertainment Software Association of Canada, Canada has around 700 video game companies, which generated an estimated \$3.6 billion in revenue and directly employ 28,000 people full-time at an average salary of just over \$75,000.¹⁷⁹ The video game industry saw significant growth before COVID-19 and has continued to demonstrate its resilience during the pandemic.¹⁸⁰ In 2020, sales for video game consoles hardware increased by 58%, compared to 2019.¹⁸¹ ESAC estimates that 23 million Canadians were playing video games during the pandemic, and many reported that video games helped them stay connected with friends, interact with other users, and help them to get through difficult times both emotionally and mentally.¹⁸²

173 "How COVID-19 has pushed companies over the technology tipping point—and transformed business forever," McKinsey & Company, October 5, 2020, <https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/how-covid-19-has-pushed-companies-over-the-technology-tipping-point-and-transformed-business-forever>

174 Li, A., "COMMENTARY: Remote work isn't a trend. It's a fundamental shift in Canada's work culture," Global News, June 9, 2021, <https://globalnews.ca/news/7932593/remote-work-fundamental-shift-canada-work-culture/>

175 "Ontario considering making online school a permanent option," CBC News, March 25, 2021, <https://www.cbc.ca/news/canada/toronto/permanent-online-school-1.5964008>

176 Delitala, A., "Canadian healthcare services shift online amid COVID-19 pandemic," Global News, April 5, 2020, <https://globalnews.ca/news/6781772/canadian-healthcare-services-online-covid-19/>

177 Papagiannis, H., "How AR Is Redefining Retail in the Pandemic," Harvard Business Review, October 2020, <https://hbr.org/2020/10/how-ar-is-redefining-retail-in-the-pandemic>

178 "Canada's video game industry is a major player on the world stage," April 2021, The Globe and Mail, <https://www.theglobeandmail.com/business/adv/article-canadas-video-game-industry-is-a-major-player-on-the-world-stage/>

179 Ibid.

180 "Real Canadian Gamer: Essential Facts 2020," Entertainment Software Association of Canada, November 2020, https://essentialfacts2020.ca/wp-content/uploads/2020/11/RCGEF_en.pdf

181 Ibid.

182 Ibid.

The development of technologies like Augmented and Virtual Reality (AR/VR) help extend IDM sector applications far beyond video gaming. COVID-19 changed how we interact with and experience the world, and AR/VR is becoming a popular method of interacting. As an example, Vancouver-based ImagineAR uses AR to create an immersive experience for students using videos and animations.¹⁸³ Other AR applications include “try-before-you-buy” experiences. For example, AR allows consumers to preview furniture in their own home from retailers like Wayfair, Ikea, and Home Depot.

Interactive Digital Media Employment forecast for Canada (2021-2025)

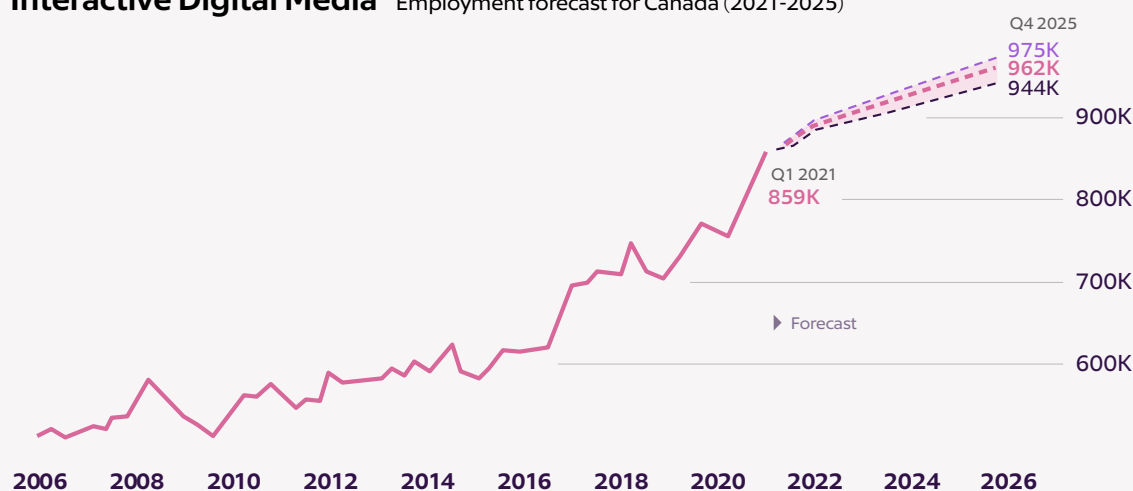


Figure 33: Employment in Canada's Interactive Digital Media sector (forecast), 2021 – 2025. Source: ICTC, Statistics Canada
 Note: Seasonally adjusted employment

Figure 33 shows ICTC’s employment forecast for the IDM sector. The forecast builds on already robust growth, especially when compared with the other five innovation areas. Being largely “COVID-safe”, the IDM sector was the least effected of all innovation areas and is expected to see the strongest employment demand. The digitization of the economy will continue to support demand for digital products that the IDM sector produces and will continue to support strong employment growth. By 2025, the IDM sector is expected to experience a demand for approximately 103,000 workers. If filled this sector alone will be responsible for approximately 962,000 jobs.

183 “How Augmented Reality is Transforming Online Learning During the COVID-19 Pandemic,” TechOnline.ca, June 17, 2020, <https://teachonline.ca/tools-trends/how-augmented-reality-transforming-online-learning-during-covid-19-pandemic>

Snapshot: Key Occupations and Skills

The following is a snapshot of a key in-demand occupation in the IDM sector, along with its top 15 critical “hard” skills. These skills were sourced through a job posting analysis.

Conversation Designer

A Conversation Designer is responsible for designing and creating consumer-facing intelligent virtual agents or virtual assistants.

Conversation Designer Profile

- | | |
|---|--|
| Proficiency with Adobe Creative Suite | Proficiency with social media platforms |
| Proficiency with Adobe Photoshop | Knowledge of User Interface Design |
| Knowledge of User Experience Design (UED) | Knowledge of Voice User Interface (VUI) Design |
| Proficiency with Adobe Illustrator | Proficiency with WordPress |
| Knowledge of Data Analysis | Proficiency with Adobe InDesign |
| Knowledge of Interactive voice response (IVR) | Proficiency with Adobe XD |
| Familiarity with Requirements Analysis | Proficiency with Cascading Style Sheets (CSS) |
| | Knowledge of Copywriting |

Conclusion

This report provides updated analysis of the state of the general and digital economy in Canada to 2025 along with updates to the government's six innovation areas. It provides an assessment of the impact of the pandemic on the Canadian economy and a discussion of the general economic outlook, highlighting key factors and risks in the short and medium term. This report also offers policy and investment updates on the six innovation areas and snapshots of a key emerging occupation in each, along with their top critical "hard" skills.

In the year since the publication of ICTC's Digital-Led New Normal (August 2020), we have seen a partial reopening of the Canadian economy in the third quarter of 2020, a slowing economic recovery following the second and third waves of lockdowns, and more recently, the successful rollout and steady progress of a mass vaccination campaign across the country. After months of uncertainty, there is now a growing sense of cautious optimism about in the air.

The COVID-19 pandemic has been a global human tragedy, bringing with it untold damage to physical, mental, and economic health worldwide. While the recent success of vaccination campaigns and the beginning of some form of normality in the developed world is indeed worth celebrating, the pandemic is not over. The virus knows no borders and the threat of the resurgence of virulent strains remains very real until most of the world is vaccinated. On the economic front, policy measures have helped bring about a partial but unbalanced economic recovery. At the time of writing, several sectors remain severely depressed and face uncertain prospects despite the broader reopening of the economy.

The digital economy, on the other hand, has shown great resilience. The pandemic proved to be an opportunity for the digital economy as lockdowns and other restrictions precipitated huge demand for digital goods and services. On the supply side, digital firms appear to have been able to pivot to the “new normal” of remote work relatively easily. The sector has thrived in the past year and employment in the digital economy currently (in June 2021) stands at over 2 million.

The outlook for the digital economy going forward remains strong. The pandemic facilitated changes in consumer behaviour and accelerated digitization and the adoption of new technologies. These changes are likely to persist to a fair degree, even after the pandemic passes. The digital economy is well placed to capitalize on these trends and to continue increasing its share of total employment in Canada. By the end of 2025, ICTC forecasts employment in the Canadian digital economy to reach 2.26 million—an addition of 250,000 new jobs. The Canadian digital economy is set to build and capitalize on the unprecedented shocks of the COVID crisis and to figure prominently in Canada’s recovery and future resilience.

Appendices

Research Methodology

The analysis underpinning this report is based on a combination of primary and secondary research.

Primary Research

The primary research portion of this study was comprised of four main elements: an employer survey, key informant interviews (KIIs), data scraping, and input from an advisory committee.

Employer Survey

As discussed in Section II, ICTC commissioned a national survey of Canada's digital economy in early 2021. The survey was designed to run concurrently with Statistics Canada's Survey of Business Conditions in Q1 2021 to allow for a meaningful comparison with the general economy by using the Statistics Canada data set as a control group. Insights from the survey informed assumptions about the outlook of the digital economy relative to the general economy, which in turn helped generate employment forecasts.

The survey was completed by representatives from 400 companies. All respondents were senior executives with significant influence on key decisions related to hiring and business strategy. They include founders, executives, managers with oversight of operations, finance, or human resources. The survey was targeted at digital businesses across Canada that were screened for eligibility based on whether they produced and sold digital goods and services or utilized advanced technology such as artificial intelligence, augmented reality/virtual reality, 5G wireless, the Internet of Things (IoT), robotics, 3D printing, and blockchain to improve efficiency and productivity. Respondents were then categorized into the following areas: cleantech, clean resources, health and biotech, agri-foods and food tech, advanced manufacturing, and digital industries.

Table 1: National COVID-19 Impact Survey of Canada's Digital Economy – respondents, by subsector

Advanced Manufacturing	21.0%
Agri-Food and Food Tech	10.0%
Health & Biotech	22.3%
Clean Resources	12.8%
Cleantech	10.5%
Digital Industries	23.5%

The respondents came from various provinces and in numbers roughly proportional to the national population and GDP.

Table 2: National COVID-19 Impact Survey of Canada's Digital Economy – respondents, by province

Alberta	9.8%
British Columbia	14.5%
Manitoba	7.0%
New Brunswick	1.5%
Newfoundland & Labrador	0.3%
Nova Scotia	3.8%
Northwest Territories	0.3%
Nunavut	0.0%
Ontario	37.3%
Prince Edward Island	0.5%
Quebec	23.5%
Saskatchewan	1.8%
Yukon	0.0%

The respondents were spread evenly across small, medium, and large companies (based on employee count).

Table 3: National COVID-19 Impact Survey of Canada's Digital Economy – respondents, by company size (number of employees)

Sole proprietor	0.0%
1-9	0.3%
10-99	33.5%
100-499	33.8%
500-999	17.5%
1,000-4,999	9.8%
5,000+	5.3%

Key Informant Interviews

Between January and February of 2021, ICTC completed eight semi-structured key informant interviews (KIIs) with subject-matter experts from industries across Canada. A diversity of participants and companies were chosen to ensure a broad range of perspectives and input for the report. Organizations that were interviewed ranged in size, location, maturity levels, revenue, and employment needs. ICTC's objective was to identify trends in the digital economy, its needs, challenges, opportunities and weaknesses, availability of talent, in-demand roles and skillsets, and the impact of COVID-19.

Data Scraping

ICTC used advanced analytics to identify in-demand occupations across the Canadian digital economy and key digital roles across six innovative sectors and to extract their critical skills. The roles were identified using primary research. Critical hard skills were identified via 1) web scraping of key jobs from popular job boards, and 2) text mining for critical skills.

Advisory Committee

A project advisory committee (AC) was developed to guide this study and to assess and validate the results. The advisory committee was comprised of 21 members from industry, industry associations, government, and academia, all related to the digital economy and/or innovation areas covered in this study. The committee met three times over the course of this study. The AC was engaged during the production of this report to discuss the digital economy labour market and its talent needs, the level of adoption of emerging technologies in the Canadian digital economy and across the six innovation areas, and the impact of COVID-19 on the digital economy.

Secondary Research

The secondary research component of this study focused on an analysis of existing data and literature. This included qualitative reviews of sectors under consideration, as well as key events taking place in the global and Canadian economy from the fall of 2020 to the spring of 2021. This research also relies heavily on secondary data obtained from Statistics Canada, the Bank of Canada, OECD, and other data sources. Publicly available growth forecasts for the Canadian and other major economies produced by the OECD, IMF, Canadian banks, and others informed assumptions in our economic models and forecasts. An analysis of the mentioned datasets was useful in tracking macroeconomic and labour market trends, supply trends, and business growth in the six innovation areas.

Forecast Methodology

ICTC uses monthly Statistics Canada Labour Force Survey data, split by NAICs and NOCs, to forecast employment levels for the various sectors under consideration in its Outlook reports.^{184,185} These monthly data series are adjusted for seasonality using the X-13ARIMA-SEATS Seasonal Adjustment Program.¹⁸⁶ In addition, several macroeconomic and financial data series from Statistics Canada and the Bank of Canada are used for analysis. These include data on output,^{187,188} prices,^{189,190,191} labour market conditions,^{192,193,194,195} financial variables,^{196,197,198} and other macroeconomic variables such as investment,¹⁹⁹ household savings,²⁰⁰ and retail sales.²⁰¹

Vector Autoregressive (VAR) models are used to perform the forecasting. VAR is a stochastic process model used to capture the linear interdependencies among multiple time series. In a VAR model, each variable has an equation explaining its evolution as a function of its own lagged values, the lagged values of other endogenous and exogenous variables, and the error term. VAR models do not require an understanding of the causal relationship between the variables within the model, merely the knowledge that the variables are interrelated. Model specification (variables, lags) are chosen based on minimization of the Schwarz-Bayesian and Hannan-Quinn Information Criteria (SBC & HQC).

- 184 Alexandra Cutean et al., "Canada's Growth Currency: Digital Talent Outlook 2023."
- 185 Ivus, Kotak, and McLaughlin, "The Digital-Led New Normal: Revised Labour Market Outlook for 2022."
- 186 CSRM US Census Bureau - Brian C. Monsell, "US Census Bureau - X-13ARIMA-SEATS Seasonal Adjustment Program - Version 1.1 Download Page, PC Version," accessed 29 June 2021, https://www.census.gov/srd/www/x13as/x13down_pc.html
- 187 Statistics Canada, "Gross Domestic Product, Income-Based, Quarterly," 1 October 2012, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610010301>
- 188 Statistics Canada, "Gross Domestic Product (GDP) at Basic Prices, by Industry, Monthly," 31 January 2013, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610043401>
- 189 Statistics Canada, "Consumer Price Index (CPI) Statistics, Measures of Core Inflation and Other Related Statistics - Bank of Canada Definitions," 22 December 2016, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810025601>
- 190 Statistics Canada, "Gross Domestic Product Price Indexes, Quarterly," 1 October 2012, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610010601>
- 191 Statistics Canada, "Fisher Commodity Price Index, United States Dollar Terms, Bank of Canada, Monthly," 18 June 2021, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1010013201>
- 192 Statistics Canada, "Labour Force Characteristics by Province, Monthly, Seasonally Adjusted," 4 June 2021, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410028703>
- 193 Statistics Canada, "Employment and Average Weekly Earnings (Including Overtime) for All Employees by Province and Territory, Monthly, Seasonally Adjusted," 27 September 2013, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410022301>
- 194 Statistics Canada, "Employment by Industry, Monthly, Seasonally Adjusted," 4 June 2021, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410035502>
- 195 Statistics Canada, "Labour Force Characteristics by Educational Attainment, Monthly, Unadjusted for Seasonality," 4 June 2021, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410001901>
- 196 Statistics Canada, "Bank of Canada, Money Market and Other Interest Rates," 29 June 2021, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1010013901>
- 197 Statistics Canada, "Toronto Stock Exchange Statistics," 1 June 2021, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1010012501>
- 198 Bank of Canada, "Canadian Effective Exchange Rates," accessed 29 June 2021, <https://www.bankofcanada.ca/rates/exchange/canadian-effective-exchange-rates/>
- 199 Statistics Canada, "Gross Fixed Capital Formation, Quarterly, Canada," 1 October 2012, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610010801>
- 200 Statistics Canada, "Current and Capital Accounts - Households, Canada, Quarterly," 1 October 2012, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610011201>
- 201 Statistics Canada, "Retail E-Commerce Sales," 22 November 2016, <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2010007201>

The employment forecast for each sector is a function of assumptions regarding the trend in the aggregate unemployment rate and other macroeconomic variables. In the previous ICTC outlook report,²⁰² produced during the first wave of the pandemic, the analysis was underpinned by the concept of a COVID-Safe Score for each sector based on the proportion of workers who are either essential or can work remotely. Given the current economic outlook and schedule for a broader reopening of the Canadian economy, the current unemployment rate projections are based on forward looking expectations at the level of the aggregate economy, supplemented by findings from ICTC's national survey of Canada's digital economy. Unemployment rate projections enter exogenously into the VAR models to predict output (GDP) and employment trends. Other variables like inflation, interest rates, stock indices, commodity prices, and wages sometimes enter the model depending on whether they optimize the information criteria.

Limitations of Research

While every effort was made to ensure that the research underlying this report was as exhaustive as possible, a few limitations exist.

Low Survey Response Rate for Certain Regions

Overall, the quality of survey responses was very high, with most respondents completing all questions. However, low survey response rates for certain regions and sectors remain a limitation. While the survey garnered 400 responses, there were no participants from the two territories Nunavut and Yukon.

Measuring "Size" of Innovation Areas

Because the innovation areas (e.g. advanced manufacturing, health and biotech, agri-foods and food tech, etc.) in this report are not documented by historical data, ICTC utilized a combination of secondary and primary research to estimate the size of these areas in Canada. While ICTC will continue to track this data over time, it is possible that the overall size of these areas may be smaller or larger than the initial estimates.

Key Informant Interviews

As discussed, ICTC conducted eight KIIs with individuals from companies across Canada. While the insights gathered in these interviews were used to provide qualitative insight and to elaborate on trends studied from broader data, it should be noted that the sample pool of interviews is very small and should not be considered representative of the entire digital economy.

202 Ivus, Kotak, and McLaughlin, "The Digital-Led New Normal: Revised Labour Market Outlook for 2022."



The Limits of Forecasts

Forecasting is a statistical process mixed with a fair amount of subjective judgment and assumptions. VAR methods tease out statistical relationships between data series to forecast future trends under the assumption that the relationships between the variables remain steady. These forecasts come with confidence intervals that illustrate the range of statistically likely outcomes. The constantly evolving nature of the pandemic adds further uncertainty to the analysis. Assumptions underpinning the forecasts in this report are laid out in the sections above. ICTC considers the point estimate for baseline forecasts to be the most likely outcome for Canada’s economy, but there are wide confidence intervals.



Provincial Digital Economy Employment Forecasts

Figure 34 below shows the relative employment shares of Canada’s digital economy by province and jobs growth in the provincial digital economies from 2010-2020.

Digital Economy Employment by province

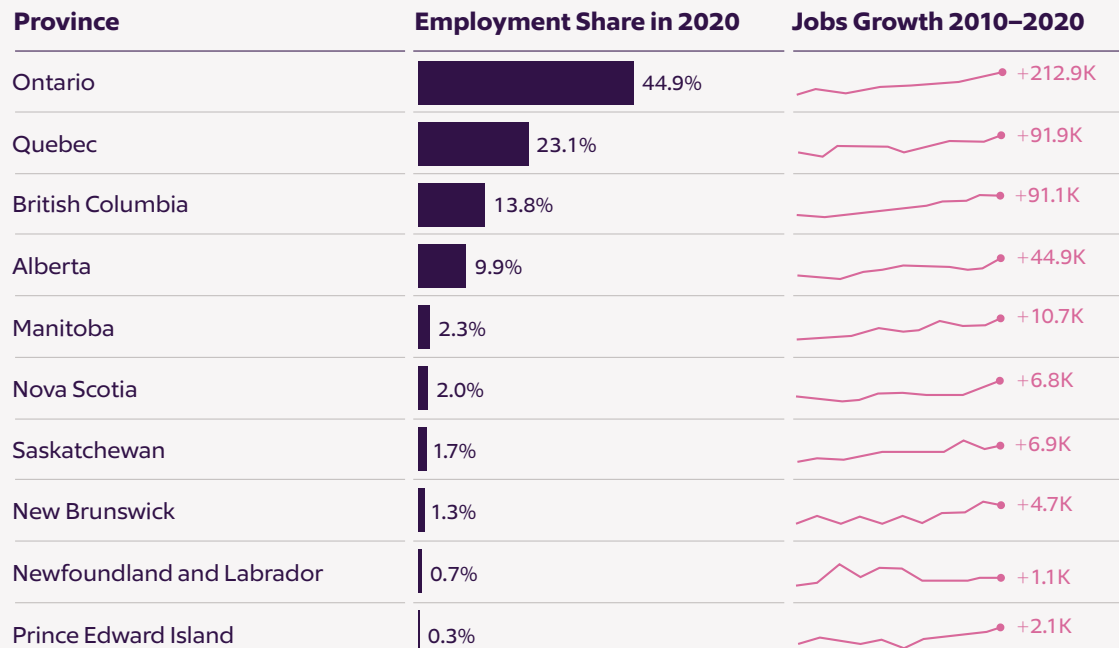


Figure 34: Employment in the Canada’s digital economy by province, 2010 – 2020. Source: Statistics Canada

Figure 35 provides a breakdown of employment demand in the Canadian digital economy across the four biggest provinces (Alberta, British Columbia, Ontario, and Quebec) from 2021 to 2025.

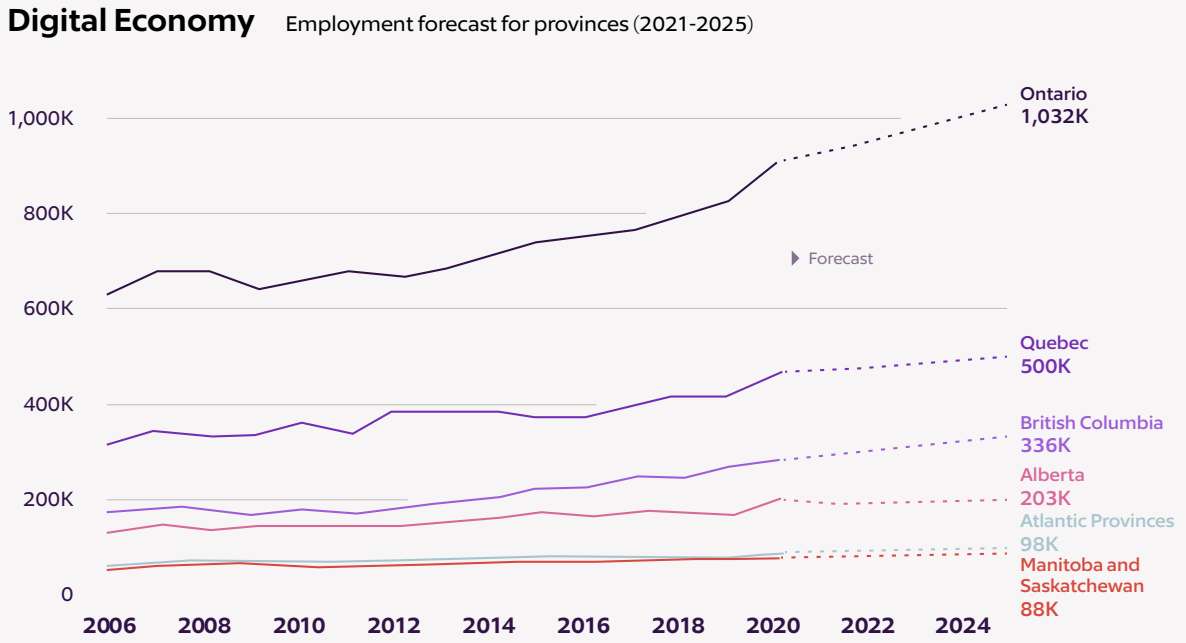


Figure 35: Employment in Canada's digital economy (provincial forecasts), 2021 – 2025. Source: ICTC, Statistics Canada