



The Metaverse and its potential for Canada

Final Report

May 2023

Important notice

This final report (the “Final Report”) has been prepared by Deloitte LLP (“Deloitte”) for Meta Platforms, Inc. in accordance with the contract with them dated 16th May 2022 (“the Contract”) and on the basis of the scope and limitations set out below.

The Final Report has been prepared solely for the purposes of assessing the potential of the metaverse in Canada, as set out in the Contract. It should not be used for any other purpose or in any other context, and Deloitte accepts no responsibility for its use in either – including its use by Meta Platforms, Inc. for decision making or reporting to third parties.

The Final Report is provided exclusively for Meta Platforms, Inc.’s use under the terms of the Contract. No party other than Meta Platforms, Inc., is entitled to rely on the Final Report for any purpose whatsoever and Deloitte accepts no responsibility or liability or duty of care to any party other than Meta Platforms, Inc. in respect of the Final Report or any of its contents.

As set out in the Contract, the scope of our work has been limited by the time, information and explanations made available to us. The information contained in the Final Report has been obtained from third party sources that are clearly referenced in the appropriate sections of the Final Report. Deloitte has neither sought to corroborate this information nor to review its overall reasonableness. Further, any results from the analysis contained in the Final Report are reliant on the information available at the time of writing the Final Report and should not be relied upon in subsequent periods.

Any decision to invest, conduct business, enter or exit the markets considered in the Final Report should be made solely on independent advice and no information in the Final Report should be relied upon in any way by any third party. This Final Report and its contents do not constitute financial or other professional advice, and specific advice should be sought about your specific circumstances. In particular, the Final Report does not constitute a recommendation or endorsement by Deloitte to invest or participate in, exit, or otherwise use any of the markets or companies referred to in it. To the fullest extent possible, both Deloitte and Meta Platforms, Inc. disclaim any liability arising out of the use (or non-use) of the Final Report and its contents, including any action or decision taken as a result of such use (or non-use).

All copyright and other proprietary rights in the Final Report remain the property of Deloitte LLP and any rights not expressly granted in these terms or in the Contract are reserved.

Table of Contents

Executive Summary **4**

1. The Metaverse and its Emergence in Canada **6**

2. The Potential Economic Opportunity of the Metaverse in Canada **12**

3. Wider Implications of the Metaverse in Canada **26**

4. Enabling Successful Metaverse Growth in Canada **32**

5. Conclusion **40**

Endnotes **42**

Executive Summary

The metaverse is envisioned to be the next significant iteration of the internet. While still in its nascent stage, early metaverse experiences around 2D augmented reality (“AR”), artificial intelligence (“AI”), and immersive 3D virtual reality (“VR”) technologies are emerging through current connectivity infrastructure and user devices (e.g., smartphones, computers, headsets). Over time, as technologies and applications continue to evolve and connect, they have the potential to transform the way in which societies and economies interact, bringing together physical and virtual worlds through seamless and immersive experiences.

Interest in the metaverse is growing in Canada. Canadian developers such as Bit Space Development and VR Vision are investing in extended reality applications that aim to augment education and healthcare. National and local governments are also testing metaverse applications by piloting enhanced public services in partnership with developers. These trends are expected to continue, with research suggesting that Canadian AR and VR markets will grow at a compound annual rate (CAGR) of 15.5% between 2022-2027.



The metaverse could contribute between CAD\$45.3bn-CAD\$85.5bn to Canada’s annual GDP by 2035.

Metaverse technologies are still in their nascent stages of development, implying that their economic impact may be limited in the near-term. However, with a strong startup ecosystem and a diverse, highly-skilled labor force, Canada is well positioned to benefit from metaverse technologies in the long-term. Based on predicted levels of investment, the metaverse could contribute between CAD\$45.3bn and CAD\$85.5bn in additional annual GDP by 2035 (in 2021 Canadian dollars, CAD). This is equivalent to 1.3% to 2.4% of GDP in 2035.

Early use cases suggest that the near term economic benefits of metaverse technologies can be driven by their applications in a range of sectors. These include retail, public services (particularly in health and education), gaming, arts, and entertainment. For example, platforms like Xero and Shopify could improve the virtual shopping experience in the near future. Furthermore, Canada’s growing video game industry is stepping into the metaverse, with local developers such as Archiact and Stitch Media already releasing AR/VR games. In the longer term, it is also expected that Canadian manufacturing and resource sectors will benefit from metaverse technologies, with early adopters such as Veerum developing digital twins for firms in these sectors.



In the near term, the retail, education, health, gaming, arts, and entertainment sectors will most likely benefit from the metaverse.



The uptake and impact of the metaverse may vary across Canada. Some regions are at the forefront of its development, whilst others could take longer to adopt metaverse technologies. For example, British Columbia is a global hub for immersive tech, with more than 260 companies using AR and VR for entertainment, education, healthcare, and more. In addition, Ontario and Quebec are the nation's leading hubs for video game development and are anticipated to be among the early adopters of the metaverse.

Successful adoption of the metaverse and its enabling factors could support access to the labor market. For example, Wavemakers connects post-secondary students with leading employers across Canada, providing collaboration and network opportunities for a diverse set of students. There are also ongoing efforts to promote social reconciliation through metaverse technologies in Canada. For instance, Indigenous (First Nations, Métis, Inuit) developers such as in Origin and the IM4 Lab are working on incorporating XR technologies into educational, cultural, language, artistic, and commercial applications to help their communities access new opportunities.



There are ongoing efforts in the metaverse to promote reconciliation in Canada.

However, Canada's vast geography and diverse population mean that some rural, remote, and Indigenous communities continue to be less well-served by connectivity infrastructure and can lack digital skills. In the early stages of the metaverse, these segments would still be able to experience metaverse technologies that are supported by existing connectivity infrastructure and do not require advanced digital skills. However, as more immersive technologies develop, Canadian stakeholders will need to collaborate to address these challenges, particularly among historically disadvantaged groups, to ensure access to the metaverse. This would ensure that communities have the means to benefit first from the offerings of existing technologies (e.g., the internet), and then future technological innovations as they develop. If the relevant stakeholders take action to mitigate any future digital divides, Canada will have the opportunity to take a leading role in shaping an inclusive metaverse and benefit from its socio-economic implications.



In order for these benefits to be fully materialized, stakeholders should collaborate to overcome challenges in connectivity and digital divide.

1. The Metaverse and its Emergence in Canada

The metaverse is the next evolution of digital social connection

The metaverse is envisioned to be the next significant iteration of the internet. While still in its nascent stage, early metaverse experiences around 2D augmented reality ("AR"), artificial intelligence ("AI"), and immersive 3D virtual reality ("VR") technologies are emerging through current connectivity infrastructure and user devices (e.g., smartphones, computers, headsets). As the metaverse develops, it is expected to be the next significant advance in how we use digital technologies and networks. It has the potential to provide immersive 3D experiences, making online interactions more seamless, intuitive, and engaging. While there is no universally accepted definition of the metaverse and what it would entail, it will have several key features, as shown in Figure 1.

Reaching its full potential will take some time and will require many years of innovation. Nonetheless, it has great promise for economies such as Canada, which is home to a vibrant technology ecosystem with major tech hubs such as the Toronto-Waterloo corridor, the second largest tech cluster in North America.¹

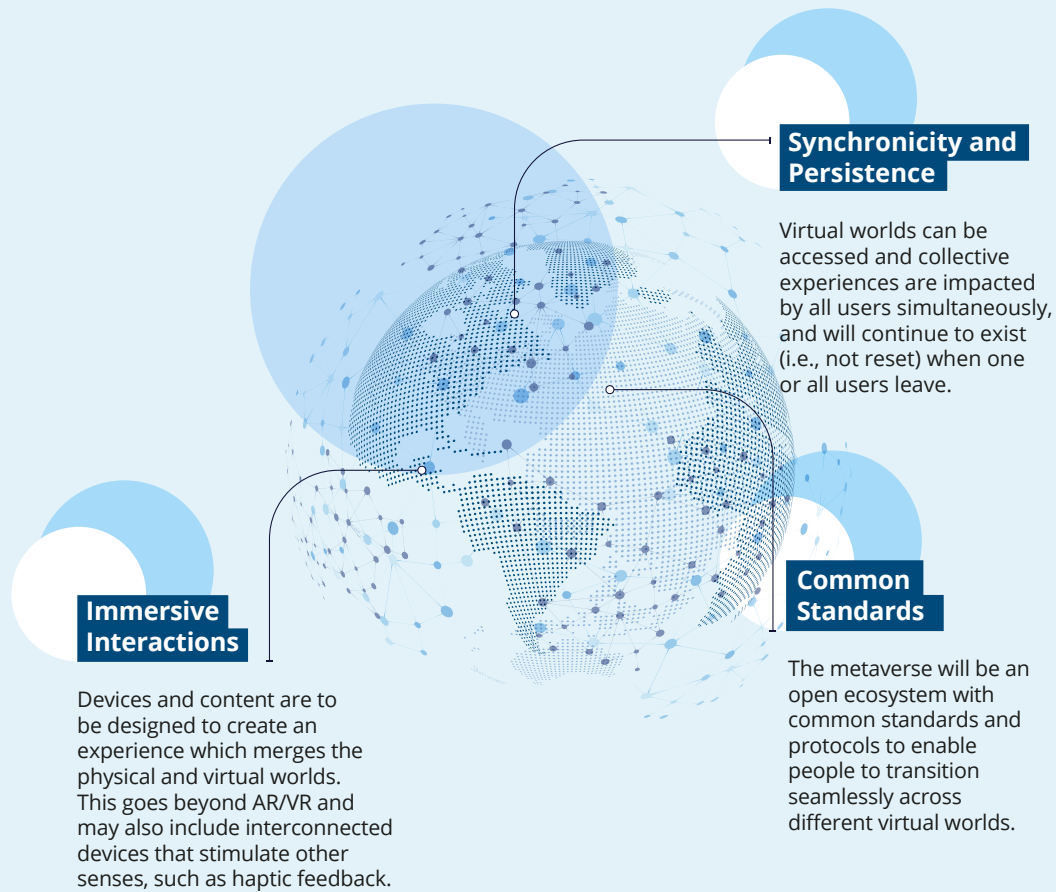


"The metaverse is a massively scaled and interoperable network of real-time rendered 3D virtual worlds which can be experienced synchronously and persistently by an effectively unlimited number of users with an individual sense of presence, and with continuity of data, such as identity, history, entitlements, objects, communications, and payments."

– Ball, M., (2021) "Framework for the Metaverse. The Metaverse Primer"



Figure 1. Potential characterizations of the metaverse



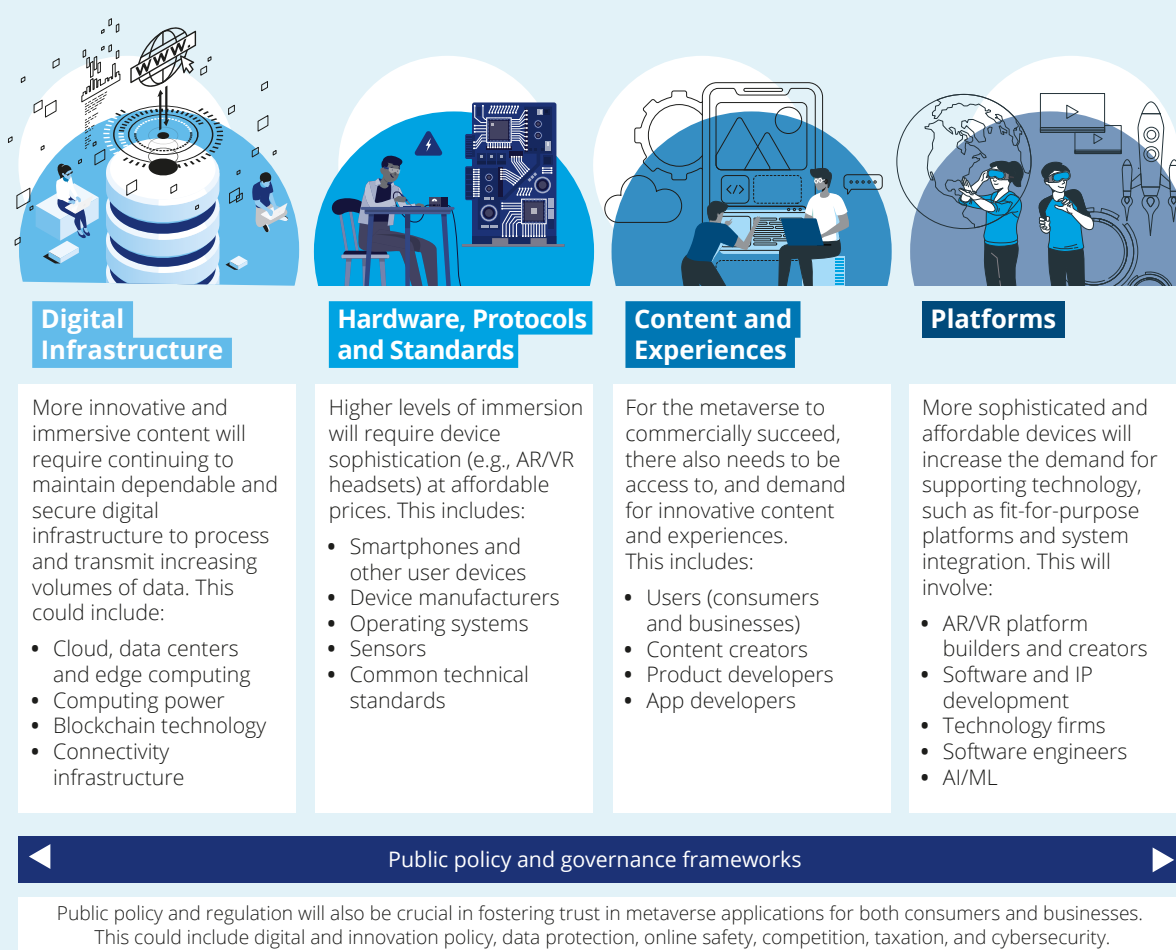
Source: Deloitte analysis

- **Immersive interactions:** Platforms, devices and content are designed to create an experience that bridges the divide between physical and virtual worlds. They include technologies such as Extended Reality (XR) which comprises Augmented Reality (AR), Mixed Reality (MR) and Virtual Reality (VR). While still in its initial stages of development, use cases for AR, VR and AI technologies are emerging through current generation devices and connectivity infrastructure. However, in time, new devices and technologies are expected to be integrated, enabling greater levels of immersion and to stimulate other senses such as touch, using haptic technology.
- **Synchronicity and persistence:** The metaverse will enable large numbers of users to interact simultaneously regardless of their physical location. Virtual spaces will evolve as users interact and will continue to exist after users leave.
- **Common Standards:** Collective agreement to harmonize digital standards and protocols for metaverse platforms and devices would enable users to transition seamlessly between digital spaces. The establishment of common standards could provide a reliable way to prove ownership of digital assets and serve as the driving force behind interoperability.

The metaverse will require both innovation and investment

The metaverse is not a single technology, platform, or company. It is a coalescence of multiple technologies and features in an interconnected ecosystem of digital infrastructure, devices, applications, and platforms to provide an immersive experience – as shown in Figure 2. Across this ecosystem, the Canadian governments, businesses, and consumers can all play a vital role in its development.

Figure 2. Four key components of the metaverse



Source: Deloitte analysis

To build the metaverse, four key inter-connected areas will be important:

1. **Continued digital infrastructure improvements** over time to ensure various technologies are supported with high-quality processing, low cost of data transmission and efficiency
2. **Hardware, protocols, and standards** to improve accessibility and interaction
3. **Content and experiences** that differentiate the metaverse for the end-user
4. **Platforms** to house and develop content and virtual worlds.

Public policy, regulations, and governance frameworks will be needed to facilitate the development of metaverse technologies and to provide an enabling ecosystem for the metaverse to become a safe, secure and inclusive environment for consumers and enterprises to use and invest in.

However, these components will not, on their own, guarantee benefits for everyone. Crucially, the extent to which the metaverse and its applications extend across society will depend on factors such as access to connectivity, social acceptance of metaverse technologies and digital skills of end users. These factors are crucial to an understanding of how the socioeconomic benefits from the metaverse could vary across Canada and what actions may be needed to address them.

Canada's interest in the metaverse is rising

Canadians have a high level of digital engagement. 97% of the population use the internet, with over 90% of internet users owning a smartphone, and around 80% owning a laptop or desktop computer.² Canadians also have a relatively high level of interest in smart technology, ranking third in the world for smart home device ownership, after the UK and Ireland.³ However, an Ipsos survey found that Canadian consumers are generally less aware of the metaverse than consumers in other countries.⁴ For instance, according to the Ipsos survey, 74% of Canadian adults were familiar with VR, 43% with AR, 30% with XR, and only 37% with the metaverse. The familiarity of Canadian consumers with each of these four technologies was below the average of the 28 countries in the survey.⁵ Another report showed that, in 2021, only 3.8% of internet users in Canada used a VR headset to play video games compared to 8.4% in the US.⁶ However, as consumer interest gains momentum, the market for AR/VR technologies (including B2C revenues from software, hardware, and advertising) is expected to grow at a compound annual growth rate (CAGR) of 15.5% over the period 2022 to 2027.⁷



The AR/VR market in Canada is expected to grow at a CAGR of 15.5% over the next five years.

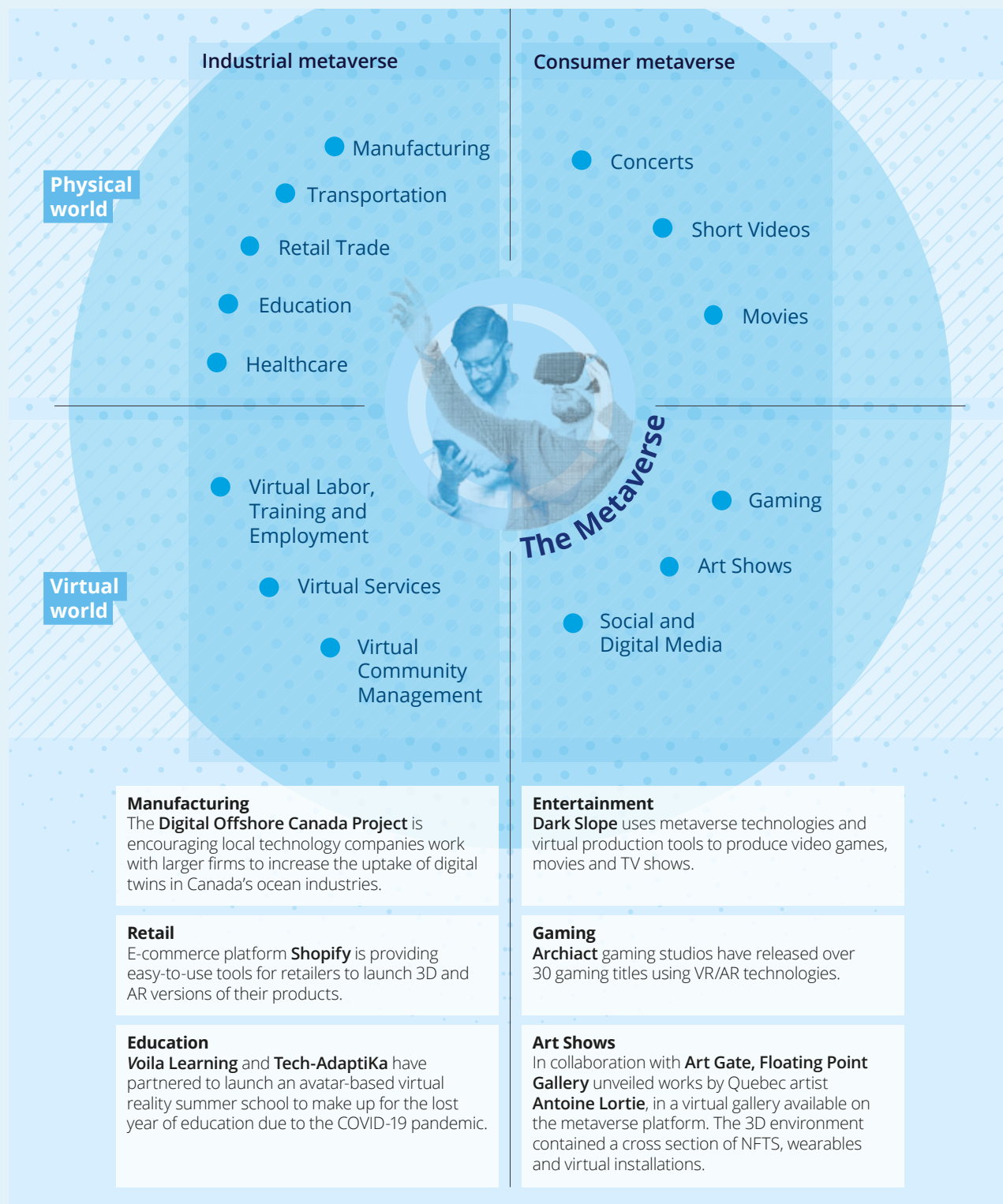
There is greater awareness of metaverse technologies among Canadian businesses than consumers. In the Ipsos study, 82% of small and medium sized enterprises (SMEs) had heard of VR devices and apps, and 56% had heard of AR devices and apps. This could be due to a growing interest amongst businesses in how new technologies might support their activities, particularly post-COVID.



In addition to a growing XR developer ecosystem in Canada, early adopters include universities, and businesses, especially in retail, healthcare, education, and gaming.

Canadian businesses have started to develop early metaverse use cases in retail, education, healthcare, and gaming. Figure 3 summarizes the sectors which could benefit from the industrial and consumer metaverse, along with some recent metaverse developments.

Figure 3. Metaverse applications in key industries and early examples in Canada



Source: Canada's Ocean Superluster (2020). [Digital Offshore Canada – Zones extracôticières numérique du Canada. Inc. \(2022\). How Shopify Is Bringing Online Retailers Into the Future. Lifewire \(2021\). Tech-Adaptika is Launching a VR Summer School With Avatars. Dark Slope | Virtual Production and Motion Capture. Archiact | Blazing the trail of virtual reality. Floating Point Gallery | Canadian Meta Lounge.](#)

Universities and schools in Canada are also among the early adopters of metaverse technologies, and use cases include virtual campus tours and immersive education techniques. For example, in partnership with **Odyssey3D**, a Canadian start-up, Toronto universities such as **York University** and **the University of Toronto** provide 3D virtual tours of their campuses.⁸ Many universities and colleges have been implementing VR technology in classrooms. For example, **Georgian College** has already started to develop 12 VR learning programs in various areas such as architecture, tourism, and nursing.⁹ Global metaverse developers are also investing in research on metaverse technologies in Canada by partnering with research institutions. For example, **Meta** has granted awards to 17 Canadian research labs working on innovations needed to build the metaverse.¹⁰



The local and national governments of Canada are among the early adopters of the metaverse technologies.

The Government of Canada (GC) has launched initiatives to support the digitalization of the country, with programs such as **Canada's Digital Ambition 2022** building towards a more digital government and the **Canada Digital Adoption Program** to help SMEs.^{11, 12} These initiatives are not metaverse specific, but the GC's Digital Ambition provides a clear, long-term strategic vision to advance digital service delivery, cyber security, talent recruitment, and data privacy. In line with these ambitions, national and local governments are also adopting metaverse technologies to increase the quality and accessibility of public services and to train government officials. For example, **The Institute on Governance**, which offers courses for government employees, created a **Digital Executive Leadership Program** for public service leaders to give them experience with VR, improve their remote working and digital collaboration, and help them start thinking about the future implications of metaverse technologies.¹³

Overall, Canada is well placed to shape the development of the metaverse and adopt various industrial use cases. However, this will require concerted efforts between the public and private sectors to develop technological fundamentals and enablers for the metaverse, and specific technological innovations to make this an inclusive proposition.

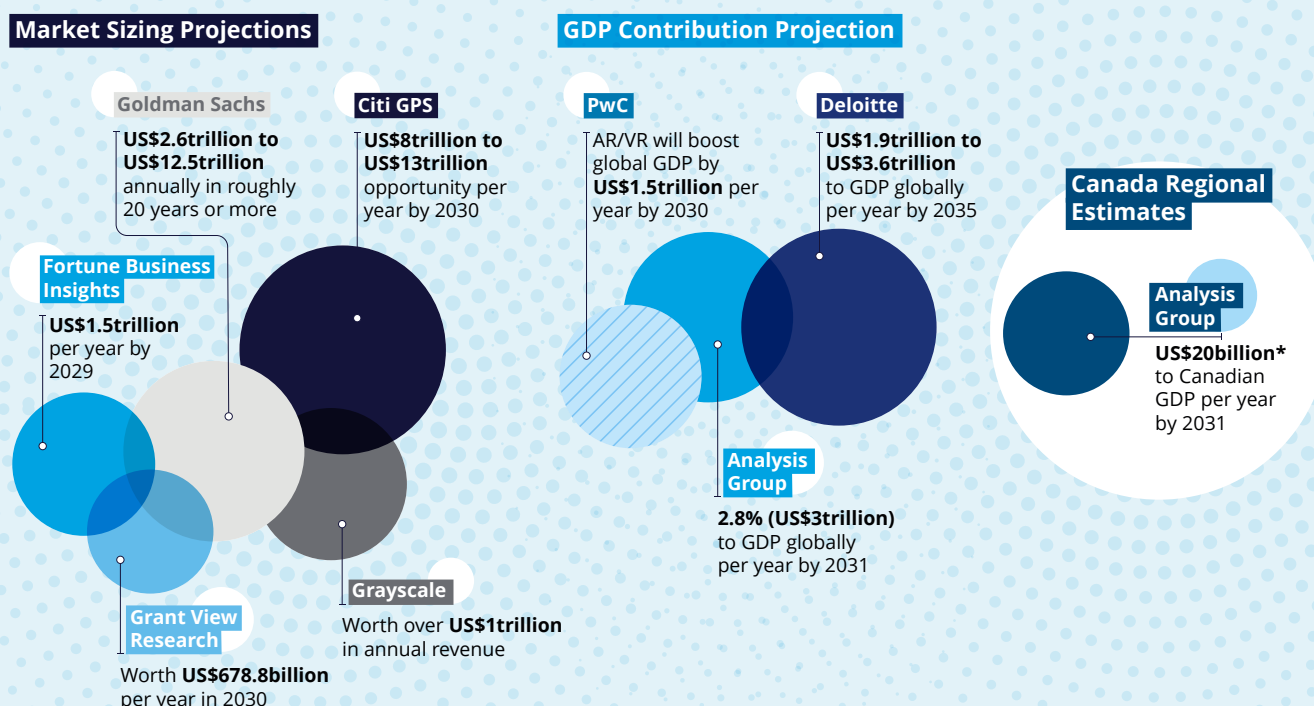


2. The Potential Economic Opportunity of the Metaverse in Canada

The potential annual economic impact of the metaverse could be CAD\$45.3bn-CAD\$85.5bn by 2035

Given the nascent nature of metaverse technologies, there is uncertainty in how the technology will continue to develop, and the rate at which it will be adopted. Therefore, it is difficult to accurately forecast what the scale of its impact will be. Published estimates of its contribution to GDP have varied widely, but most of them predict that the economic impact could be substantial, as illustrated in Figure 4. Research into the impact of the metaverse suggests that if innovation and adoption trends continue at their current pace the opportunity for Canada could be significant.

Figure 4. Estimates of the metaverse market size and GDP contribution



* Note Analysis Group figures are given in 2015 dollars. Source: Grand View Research (2022), [Market Analysis Report](#); Fortune Business Insights (2022), [Metaverse Market Size, Share & COVID-19 Impact Analysis](#); Goldman Sachs (2021), [Framing the Future of Web 3.0](#); Grayscale (2021), [The metaverse](#); Citi GPS (2022), [Metaverse and Money](#); PwC (2019), [Seeing is believing](#); Analysis Group (2022), [The Potential Global Economic Impact of the Metaverse](#); Deloitte (2022), [The Metaverse and its Potential for Türkiye](#).



Research produced by Deloitte, based on estimated metaverse related ICT investment scenarios, suggests that the annual economic contribution to global GDP could range from US\$1.9-US\$3.6trillion by 2035. Adopting this methodology, it is estimated that the impact of ICT investment in the metaverse in Canada could reach up to US\$36.1-US\$68.2bn by 2035 (in 2021 US dollars). This is equivalent to CAD\$45.3-CAD\$85.5bn by 2035 (in 2021 Canadian dollars) and 1.3% to 2.4% of GDP in 2035.¹⁴



The metaverse could contribute between CAD\$45.3bn and CAD\$85.5bn to Canada's annual GDP by 2035.

This estimate depends on several modeling assumptions, including global GDP forecasts, investment scenarios, and whether investments in the metaverse will be additional or whether they will replace other investments (see Methodology Overview). The extent to which the potential economic benefits are realized, and how they are shared, will depend on overcoming a variety of challenges such as continuing to expand connectivity to those who are currently not connected or under-connected.



METHODOLOGY OVERVIEW

To estimate the impact of the metaverse for Canada, the methodology begins by estimating the potential global economic impact of the metaverse based on global metaverse investment scenarios. It then apportions this global total to obtain country level estimates. For the analysis, two scenarios for global investment in the metaverse based on the literature are considered:

- **Baseline scenario** where global investment in the metaverse is US\$140bn per year between 2022 to 2029
- **Upside scenario** where global investment is US\$270bn per year over the same time period.

Using estimates in the economic literature for the relationship between investment in ICT capital and economic growth, our analysis suggests that investments in the metaverse could add between **US\$1.9trillion and US\$3.6trillion** to global GDP by the end of 2035 (in 2021 US dollars), which is about **1.3%-2.4%** of estimated global GDP in 2035. To apportion this global total, a proportion is attributed to Canada based on its forecast contribution to global GDP. From this, we estimate that the impact of investments in the metaverse could add **US\$36.1-US\$68.2billion** annually to Canada's GDP by 2035. These estimates are based on assumptions that include continued and sustained investment in the metaverse, globally and in Canada (see below). For more details of the methodology framework, please see Deloitte's report "The Metaverse and its Potential for Türkiye". Please note that following publication of the Türkiye report, the IMF (in April 2023) published updated GDP forecasts which have been used in this report.

These impact estimates are dependent on several assumptions and external forecasts, including:¹

- Country level and global real GDP forecasts from the IMF for 2022-2028, and a CAGR for 2029-2035 based on World Bank figures for GDP over the period 2009-2019
- The investment scenarios considered look at spending that is likely to arise from large technology firms in the development of the metaverse platforms and technologies. Therefore, they do not necessarily consider wider, longer term investment that may take place across a number of wider domains such as in communications, connectivity, and underlying infrastructure
- Global ICT investments in the metaverse being incremental to other ICT investments, rather than substitutes for ICT investments that will no longer take place
- The development of an enabling environment to support adoption of the metaverse, e.g., sustaining current rates of investment into network infrastructure
- Exclusion of metaverse-related investments by firms outside the ICT sector or by public authorities, which may indicate that the estimates are conservative

Therefore, caution should be maintained over the exactness of the estimates as a result of assumptions and forecasts differing over time. Consequently, the impact of the metaverse both globally and in Canada may be larger or smaller.

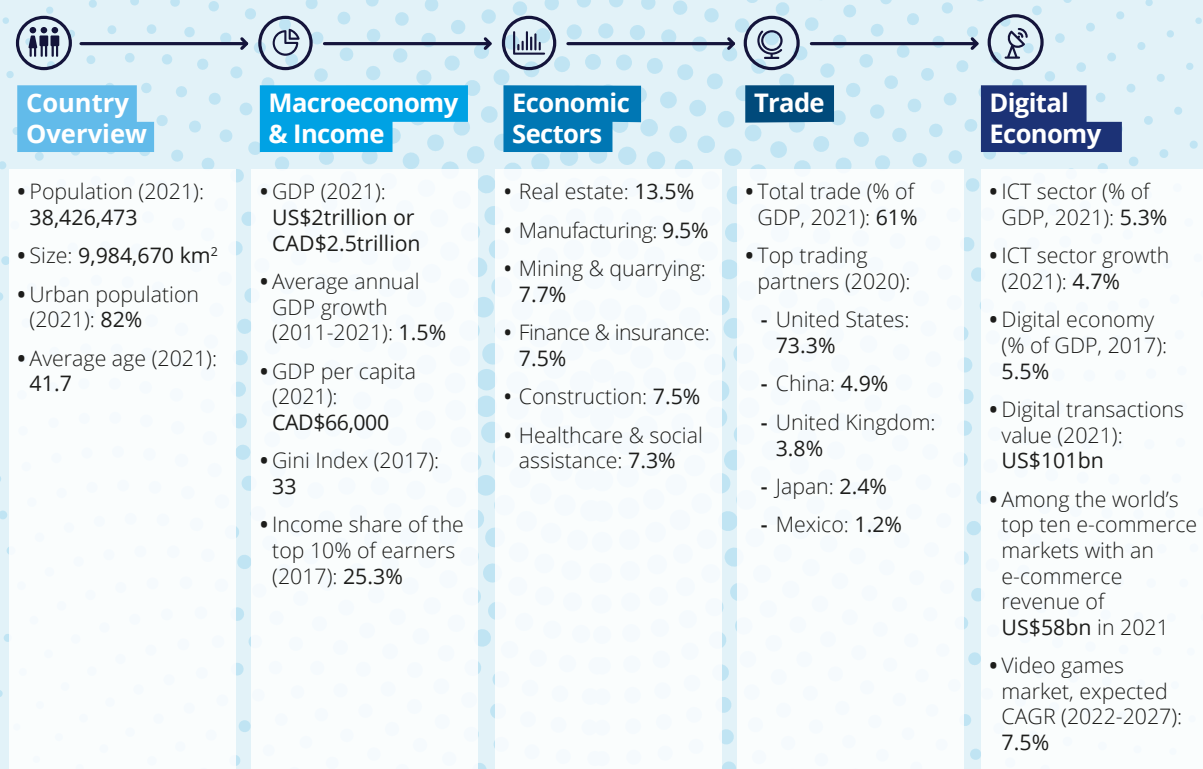
Source: Deloitte analysis

1. Note, the estimates consider investments by large technology firms in the development of the metaverse and which could include spending on various forms of ICT capital such as metaverse-specific hardware, computing networks and supporting infrastructure such as data centres, and in less tangible assets such as software, databases, human capital, and content creation.

Canada's macroeconomic environment could contribute to opportunities in the metaverse

Canada is the world's ninth largest economy with a GDP of nearly US\$2trillion.¹⁵ As shown in Figure 5, the two sectors contributing most to GDP were real estate (13.5% of GDP), followed by manufacturing (9.5%).¹⁶ Nevertheless, the Canadian economy has become increasingly diversified over time, with prominent service-led industries such as the professional services and ICT sectors increasing their share of national output.¹⁷ This is exemplified by a fast-growing ICT sector and digital economy. In 2021, the ICT sector generated 5.3% of GDP (as well as 1.5% of goods exports and 22.5% of service exports), up from 4.7% in the previous year.¹⁸ It is estimated that over the period 2010-2017, digital economic activities (defined as activities that enable digitization or are highly affected by it) grew at a faster rate than the rest of the economy (40.2% compared to 28.0%) and created almost four times as many jobs as the rest of the economy on average.¹⁹ There has also been strong ICT growth amongst technology firms and also the gaming industry. Revenues in the video games market doubled between 2017 and 2021 and are expected to show an annual growth rate (CAGR 2022-2027) of 7.5%.²⁰

Figure 5. Snapshot of the Canadian Economy



Source: World Bank, Statistics of Canada, Statista. All citations are provided in the endnotes.

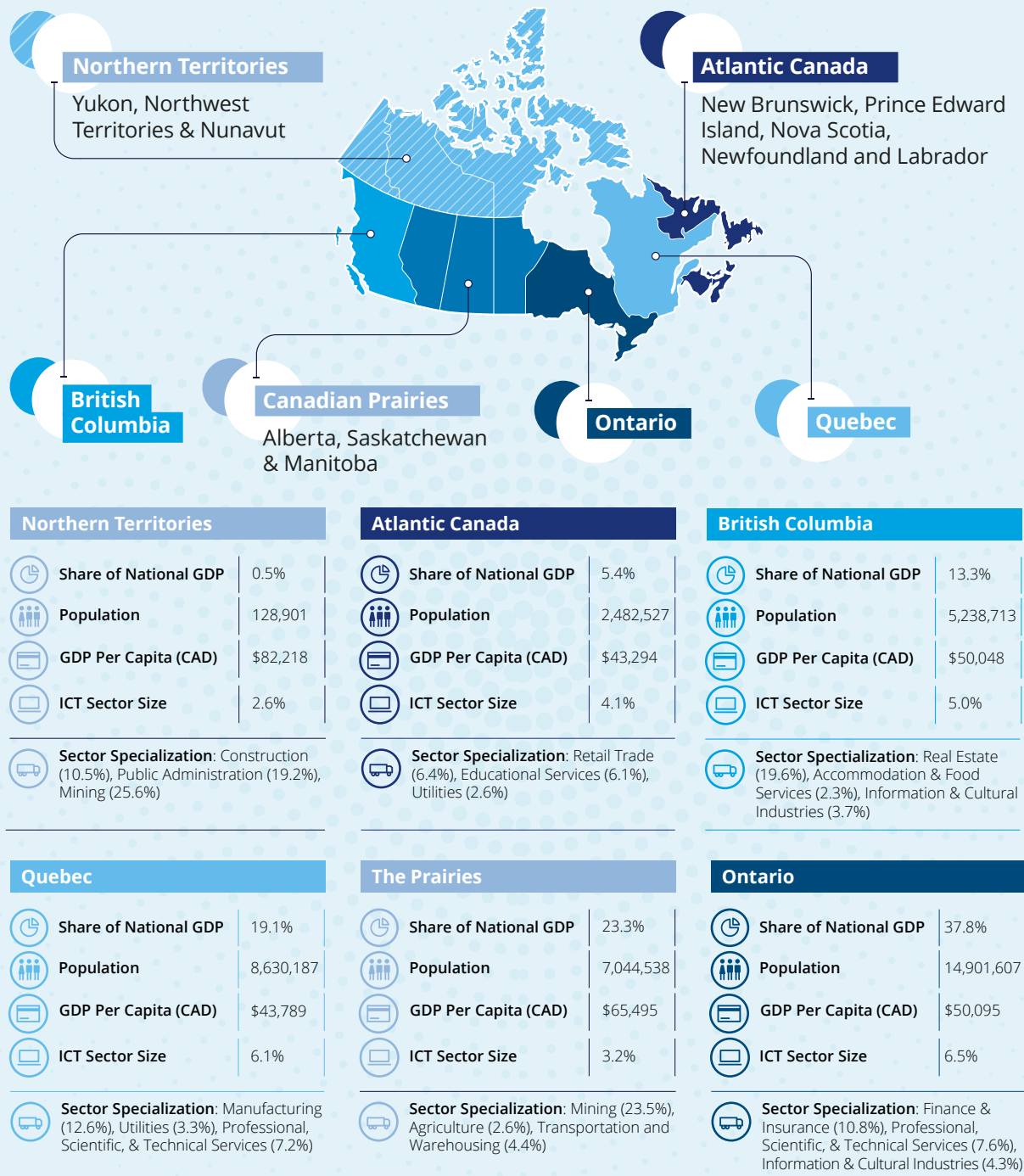
Canada's sectoral make-up puts it in a promising position to benefit from economic opportunities from metaverse technologies. For instance, the ICT, retail, entertainment, arts and culture, healthcare and education sectors could all be expected to benefit from metaverse technologies, even in the near term.



The economic impact will vary across Canada's provinces

Whilst the potential economic impact of the metaverse across Canada as a whole is large, the benefits may differ significantly between provinces, at least in the near term. This may be due to factors such as differences in economic activity, population, geography, and ICT development across the nation, as seen in Figure 6.²¹ Canada's vast geography and diverse population mean that access to key connectivity infrastructure and characteristics like digital skills and income levels may result in differing rates of technological adoption across provinces, especially among individuals. These are the same challenges that have impacted rates of internet adoption and use of basic digital services in general over time. Nevertheless, gaps in connectivity are expected to narrow over time as the internet infrastructure continues to expand. Other important considerations are explored further in Section 4.

Figure 6. Overview of Canadian Provinces



Sector Specialization refers to the percentage of regional GDP for sectors that make up a large share of regional GDP relative to national GDP.

Source: Statistics of Canada, Innovation, Science and Economic Development Canada. All citations are provided in the endnotes.

Canadian technology hubs are well-placed to benefit from the metaverse

Around 39% of Canada's population lives in **Ontario** which is one of the country's leading manufacturing and technology powers. The **Toronto-Waterloo** Corridor is the second largest technology cluster in North America, only behind Silicon Valley. The region is home to 15,000 technology companies employing 300,000 people. It hosts some of Canada's fastest growing technology start-ups working across AI, cybersecurity, fintech, health-tech, and sustainability, as well as technology giants such as Google.²² This has attracted significant investment into these sectors and has created a hub for international tech talent.²³ In this context, Ontario is therefore well-placed to be at the forefront of metaverse developments. Indeed, nearly 60% of metaverse use cases described in this report are from Ontario with various applications such as healthcare (e.g., VR Vision), retail (e.g., Xesto), and education (e.g., InStage).



Ontario, Quebec, and British Columbia have a higher ICT share in their regional economy compared to the country's average, may therefore adopt metaverse applications sooner.

Quebec is the country's second largest video game hub after Ontario in terms of number of video game companies but is the largest video gaming center with regards to the sectoral employment size.²⁴ There were 291 video gaming companies in Quebec which employed 13,500 employees as of 2021. **Montreal**, recognized globally as one of the top cities for developers, offers a cost advantage for developers with its existing incentive programs (tax credits, grants, tax-free loans, etc.).²⁵ The region is also known for its growing technology ecosystem in sectors including life sciences, digital arts, and the optics and photonics industries, through a highly educated workforce and with the assistance of the financial and legal sectors.²⁶ As a result, the metaverse could offer a range of opportunities and generate new businesses in the region. For instance, design studios in Montreal such as Dpt, have developed immersive projects for museums, galleries, and brands, and generated a new way of narrative telling using VR technology.²⁷

British Columbia is one of the world's leading regions for the development of AR and VR technologies and has around 260 immersive technology companies.²⁸ The region could be among the first to benefit from the metaverse as it currently accounts for 35% of all AR/VR revenue activity in Canada.²⁹ British Columbia also specializes in other sectors such as life sciences, aerospace, and health-tech that could also benefit from the metaverse in the near term. For instance, in **Vancouver**, gaming studios such as Architact, and health-tech companies such as PrecisionOS are currently using VR in their products.^{30, 31}

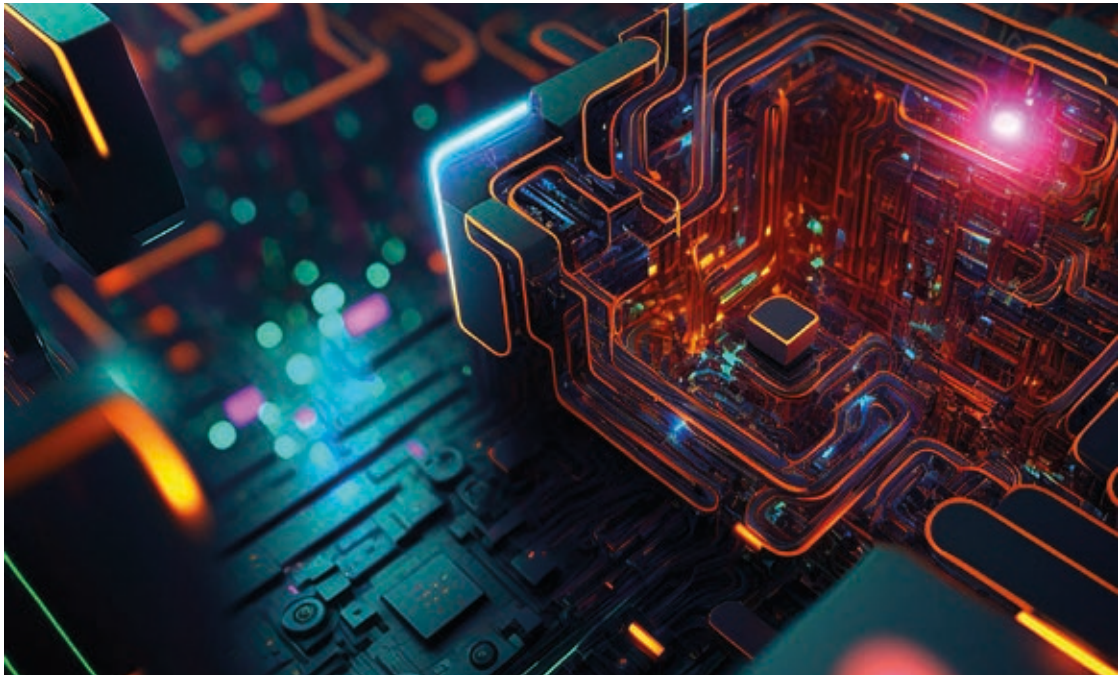
The enabling environment in the industrial hubs stemming from the availability of advanced digital skills, high concentration of tech firms and early metaverse applications could result in the metaverse developing here earlier than in other parts of Canada.

Other regions are expected to benefit as industrial use-cases mature

A large proportion of economic output in Canada's **Prairie provinces** – Alberta, Saskatchewan, and Manitoba – comes from the energy and the real estate sectors. However, the ICT sector, particularly in Alberta, has been growing with expertise in diverse areas, such as bioinformatics, telecommunications, and software development.³² As the industrial use-cases become widespread, companies in the region are likely to be impacted by metaverse technologies in time. As an example, Veerum, a Calgary based SaaS provider (Software as a Service), is building digital twins for companies in the oil & gas, mining, and the power & utilities sectors, as well as for industrial capital projects. These digital twins are then used to ensure operational safety, optimize energy efficiency, build eco-friendly data centers, and increase efficiency.³³

Although the region's top economic contributors are the real estate and mining sectors, **Atlantic Canada** (the provinces of New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island) has a diversified economy with other prominent sectors such as retail trade, education, health and social care, manufacturing, finance, and ICT. Furthermore, **Halifax**, Nova Scotia has been named among the emerging technology hubs, and multinational technology companies such as Avanade have plans to expand in the region.³⁴ Atlantic Canada could benefit from the metaverse potential through its growing technology ecosystem as innovative use cases are being developed for various applications. For example, **Prince Edward Island** has demonstrated the potential use of VR in recruiting doctors to the province, hoping the technology will enable prospective employees to gain exposure to their new potential surroundings in the workplace and within the community, showing landmarks and surrounding areas.³⁵

Lastly, **Northern Territories** (Yukon, Northwest Territories, Nunavut) may see a slower adoption of the metaverse in the near term, because of the industries in which they specialize, their geographic, economic and infrastructure characteristics. However, as use cases in mining and tourism mature, the businesses in the region could adopt metaverse technologies.



The metaverse could promote economic value in Canada through several key channels

Creating new marketplaces and types of business

The metaverse and its technologies will provide a new virtual space for users and enterprises to exchange digital goods and services of value, and even physical products. This will enable businesses to create new revenue streams by trading virtual goods and services as well as complementing existing revenue streams by marketing physical goods and services in the metaverse.

For example, retail businesses can make online shopping more engaging by providing greater personalization, interactivity, and immersion. **MetaVRse**, a Toronto based universal 3D/XR creation and deployment platform, is building a 3D shopping center, called **TheMall**.³⁶ Private investors and retailers are invited to purchase digital assets such as non-fungible tokens (NFTs) representing ownership of spaces in TheMall and will have the autonomy to develop this space in whatever way they want, for example by building stores that sell virtual and physical goods, or by creating entertainment experiences. **Xesto** is also integrating metaverse-technologies into its business, to enable shoppers to scan their shoe sizes from home. New types of businesses can be developed in other sectors too. For example, in healthcare access can be improved, and in tourism users can visit distant locations in virtual settings.



Using augmented reality to enhance shopping experience



Founded in 2015, and based in Toronto, Ontario, Xesto has developed a smart-phone application which allows consumers to scan their feet at home and receive personalized shoe size recommendations across a variety of brands.

Xesto uses AR and metaverse concepts, such as scanning and using user generated 3D assets. More than 30,000 data points are collected from each foot and processed via the iPhone's FaceID technology. The infrared camera on the phone reads the dot patterns to capture an infrared image which is then read by Xesto to determine the exact specifications of the foot.

With accuracy to 1.5mm, Xesto has the potential to enhance the shoe shopping experience for customers; customers may no longer need to spend time traveling to buy, try on, or return shoes. While the application is only compatible with an iPhone, Xesto allows individuals to save and share of their profiles to friends and family. Sharing of foot profiles can also simplify gift-giving experiences.

Source: Xesto (2022), <https://xesto.io>

Enhancing employment and training opportunities

The metaverse should help to enhance employment and training opportunities. The growth in digital economies will likely lead to the creation of new employment opportunities and demand for digitally skilled individuals, irrespective of their geographical location. Further, existing enterprises can augment their operations using the metaverse to improve efficiencies by training their workforce.

Sectors such as education, healthcare and professional services could benefit from metaverse technologies and will have incentives to create value by improving educational processes and providing the workforce with the necessary skills through immersive training and an interactive learning environment.

In Canada, the potential for these use cases is already evident in the healthcare sector. For example, **Marion Surgical** uses virtual reality technology in surgery for medical students.³⁷ Further, Canadian businesses in a variety of industries have started to explore metaverse technologies for training and recruitment. **InStage**, for instance, has developed an application for a government agency to teach communication skills through simulations and virtual avatars and practice speaking in front of an audience.³⁸



Leveraging VR technology for real – surgical training



Founded in 2016, and based in Toronto, Marion Surgical uses virtual reality (VR) technology to provide virtual surgery simulation training for medical students. Students can enter a virtual operating theater in real-time, alongside the digital avatar of their professor, to observe a realistic proxy of a patient and operate using a haptic (touch technology) robotic arm. The technology allows practicing surgeons and medical teams to rehearse complicated surgeries in advance, and under a realistic operating setting, increasing odds of procedural safety and improvement in patient outcomes. Prior to a scheduled procedure, the CT scan of the patient is uploaded to Marion. Marion creates the virtual reality environment of the particular surgery, enabling surgeons to practice the procedure and improve accuracy on the actual patient.

For Canada's health care sector generally, which represents a majority of provincial budgets – operating room resources are generally expensive, and by providing alternate real-life virtual settings, Marion technology can be useful in cutting operating costs as its use can shorten the teaching time required in a physical operating room.

Sources: Marion Surgical (2022) <https://www.marionsurgical.com>

Improving ways of working

The metaverse may be used to augment many current ways of working. It could facilitate remote working, training, and collaboration across different locations, and improve flexibility, resulting in higher productivity.³⁹ The immersive nature of the metaverse may make communication and interaction with colleagues more life-like in time, aiding collaboration and the exchange of ideas in ways that current video conferencing technology cannot.

Some Canadian firms are already taking advantage of metaverse-enabled technologies to improve their business operations. For instance, **vGIS** has developed AR solutions to improve the safety and efficiency of construction projects. Wider applications are also being trialed, with **CAVR** developing VR solutions across a wide range of industries.⁴⁰ The company goes beyond traditional call-in technology, and creates a virtual clone of a client's product, animates it, and presents it to prospective customers using remote virtual showrooms in a VR or AR app, a mobile app, or a website.



Making construction projects safer, faster, and more accurate with metaverse technologies



Founded in 2016, and based in Toronto, vGIS uses spatially referenced data to produce augmented reality (AR) visualizations. vGIS is suitable for customers of all sizes – from small teams to major multinationals and federal agencies. Some of its notable clients are the City of Toronto, the City of Ottawa, and PCL Construction.

Construction field personnel can use the vGIS system to visualize holograms of infrastructure objects ranging from underground pipes, valves, cables, and other utility objects, in real-time. Such in-field visualizations can help save time and improve environmental assessments by construction personnel thereby, reducing excavation-related accidents resulting from human error. For example, utility workers, such as the City of Toronto's plumbers, can wear Microsoft's HoloLens headsets and to obtain a three-dimensional vision of the ground to identify the location of underground facilities – from water and sewer pipes to electrical conduits, gas lines and fiber optic cables. This can reduce significantly the time required to locate and repair critical infrastructure.

Source: vGIS, <https://www.vgis.io/>

Expanding access to information, content, and digital services

Enabling people to connect in new ways is central to the metaverse. The metaverse will enable the transmission of ideas and the provision of services without geographical restrictions. It will benefit both users and the providers of these new services and goods such as content creators, artists, and event organizers. Sectors that are likely to grow through this driver are entertainment and gaming, sports and arts, creative industries, and tourism by offering a more immersive experience that links the virtual and real worlds. Two such examples in Canada are **Dark Slope** which uses virtual production methods to produce entertainment, and **Stitch Media** which has developed immersive games (see case studies below).

There are also metaverse applications in Canadian art circles. For instance, with the aim of making it more affordable and inclusive, Quebec City's premier alternative music festival, **Le Phoque OFF**, last year reinvented itself in a ground-breaking fashion to present its eighth edition entirely in the **NOWHERE** metaverse.⁴¹ **Art Collision**, founded by Candice Houtekier and supported by the Canada Digital Adoption Funding Program (CDAP), is helping artists instal their exhibitions in virtual reality. It has partnered with Art Galleries (e.g., Caviar20, Floating Point), independent artists, universities (e.g., Université De L'Ontario Français, OCAD University), VR platforms (e.g., Meta, Immersive Wire), and creative agencies.⁴²



Using the metaverse to create new forms of entertainment

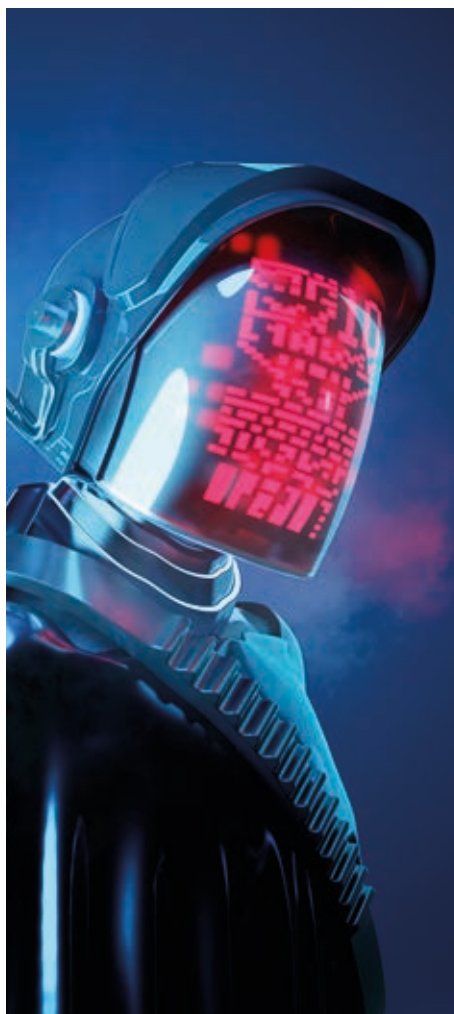
**DARK
SLOPE**

Founded in Toronto in 2018, Dark Slope utilizes metaverse technologies and virtual tools to produce entertainment, including video games, movies, and television shows, for clients such as Warner Media and Nickelodeon.

During the COVID-19 pandemic, the company used its technologies to help provide Canadians with entertainment in their homes. Dark Slopes' video games give players an enhanced 3D visual experience in their homes. The company also uses VR and the metaverse to offer unscripted television series. Leveraging the unscripted formats and in-studio filming with AR and VR-enhanced animation enables customers to switch between real and virtual worlds.

Creators can also use the Unreal Game Engine (a 3D graphics engine) alongside motion tracking capabilities, for environmental design, motion capture and animation. This enables production teams to avoid restrictions on physical location, budget and timeline.

Source: Dark Slope (2022), <https://darkslope.com>



Exploring ways to combine storytelling with metaverse technologies



Founded in 2007 and located in Toronto, Stitch Media is a production company that uses metaverse-related technologies to develop games. The company creates immersive games experiences for users through web, mobile and VR/AR.

Stitch Media designs games for VR headsets. It has already launched a game in the Meta Quest store called 'Flow Weaver'. The game takes place in a 'multi-dimensional' VR escape room, where players experiment with their immediate environment to solve intuitive puzzles in order to escape from the room. The company brings video game enthusiasts together in a VR universe for playing and socializing around shared games.

In the long run, Stitch Media aims to establish itself within the gaming metaverse sector but also intends to broaden the scope of its operations to include other industries, such as building VR training simulators for the medical field.

Source: *Stitch Media (2022)*, <https://www.stitch.media>



3. Wider Implications of the Metaverse in Canada

The metaverse may have wider social as well as economic benefits. It is expected to support wider objectives in Canadian society such as promoting inclusion and providing wider access to economic opportunities and crucial access to information and services. Using the metaverse is also expected to contribute to Canada's decarbonization initiatives and climate change agenda.

However, there might be challenges. First, the extent to which the metaverse supports inclusion goals will depend on the uptake of technology by various social groups. Second, as with many other technologies, as the demand for metaverse related technology grows over time, the net impact on greenhouse gas emissions overtime is unclear at this stage.⁴³



Beyond its economic benefits, the metaverse could contribute to a more inclusive and sustainable Canadian society.

The metaverse may be a tool to support inclusion efforts in Canada

Canada celebrates its diversity in many aspects including language, religion, ethnicity, and culture. More than 450 ethnic or cultural origins were reported in its 2021 Census.⁴⁴ Social and economic inclusion of diverse Canadian communities can be sustained by ensuring equal opportunities in education, health, work, and social participation.⁴⁵ Inclusion, in return, can help support more resilient economies through small business formation, creativity, and innovation.⁴⁶ Therefore, for a diverse country such as Canada, an increased focus on inclusion through accessible public services could be a driver of growth that can lead to a more resilient economy.

Early metaverse use cases suggest that they could expand access to public services via remote technologies, especially in education and health. In addition, immersive training opportunities could increase economic opportunities for diverse groups of Canadians, such as Indigenous communities.

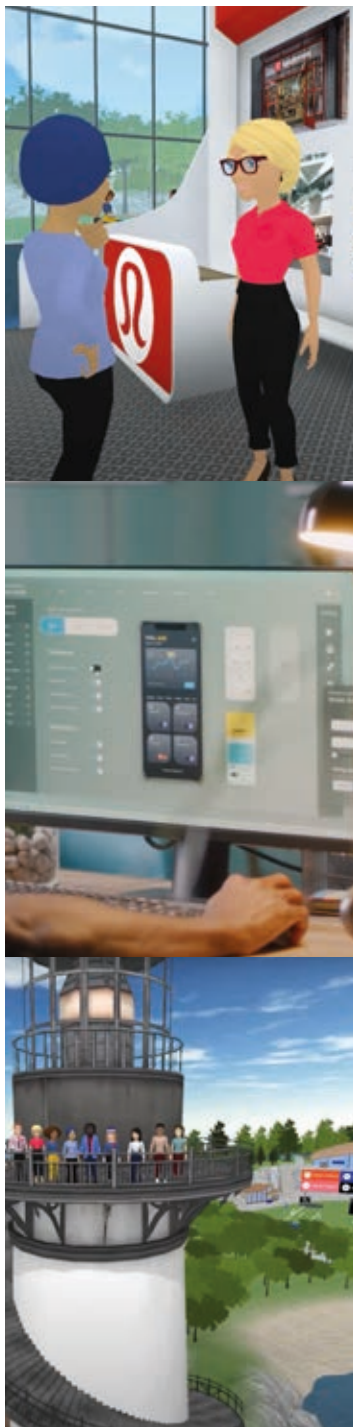
Expanding access to public services

Around 20% of Canadians live in rural areas, including many remote and Indigenous communities (First Nation, Métis, and Inuit) in the northern reaches of the country. Rural areas are important for the Canadian economy, contributing up to 30% of the country's GDP with leading sectors such as mining, forestry, energy, and agriculture.^{47, 48} However, isolated populations in rural areas often face limitations in connectivity, mobility, and access to public services.^{49, 50}

Due to the challenging economics of rural networks, internet deployment and adoption in rural areas has historically been a challenge faced around the world.⁵¹ Ensuring widespread connectivity could extend the benefits of digital technologies to rural communities who could then have equal opportunities to access services such as digital healthcare and digital education.

As with existing digital services, having connectivity and access to the internet is an important enabler for metaverse adoption, which in turn can maximize the benefits of emerging technologies. For example, **Wavemakers**, an integrated virtual reality learning program supported by the Government of Canada, connects diverse post-secondary students with leading employers across Canada.⁵²

The program aims to provide a work-integrated learning program accessible to all Canadian post-secondary students, wherever they are located. Similar metaverse applications may also create employment opportunities for individuals across Canada's territories and help diversify primarily goods-based regional economies.



Using the metaverse to enhance learning and promote work opportunities for students



With remote learning and working opportunities, a candidate's physical location may no longer be a factor for companies seeking to hire talent. To take advantage of these opportunities, workers should want the opportunity to develop skills suited to a modern workforce.

Founded in 2021 and based in Toronto, Wavemakers is a learning program, supported by the Government of Canada, to connect post-secondary students, experts, and industry partners in a VR environment to develop skills required for the future workforce. Students can interact with the VR educational campus with help from customizable avatars. They can control these virtual characters, personified as themselves, and attend sessions, participate in live activities, work in groups, and join recreational activities such as soccer, beach dances and paddle boat tours. They can respond to virtual events in real-time. Wavemakers also offers students an opportunity to collaborate, network, and gain access to industry partner mentors.

Since its inception in June 2021, the Wavemakers program has made steady progress. It has delivered 54 sessions to more than 100 students. Of the participating students, 50% students were from remote and rural areas. 71% students were Black, Indigenous, or people of color. 40% were first-generation students, 69% were women, 19% had some form of disability, and 23% were LGBTQ2S (Lesbian, Gay, Bisexual, Transgender, Queer and Questioning, and Two Spirit). 21 employer partnerships, 24 mentor partnerships, and 39 post-secondary institution partnerships were created in the past year to help drive further adoption of the program. Overall, students delivered 26 learning projects, and Wavemakers helped facilitate five career fairs.

Sources: Wavemakers (2022). <https://www.wavemakers.network/>

With the COVID-19 pandemic, telehealth went mainstream. According to Canada Health Infoway data published in June 2021, rates of virtual care use in Canada rose from 10%–20% in 2019 to 60% of all health care visits across provider categories in April 2020 and accounted for 40% of all visits in 2021.⁵³ Although virtual healthcare resources might vary between provinces, the majority of Canadians can access telehealth services. MyHealth Alberta, BC's E-Health, Health Links, Tele-Care, Nova Scotia Health, OTN, CliniqueGO, eHealth Saskatchewan, and Tia Health are some examples of regional telehealth service platforms.⁵⁴

Telemedicine, disability aids and virtual social care efforts in Canada could be scaled up through the metaverse, without the need for large investments in physical healthcare infrastructure. For example, **SenseTech Solutions**, a Toronto-based start-up, designs accessible virtual reality and augmented reality simulations for individuals with disabilities.⁵⁵ Currently its products are being utilized by the blind community for interpreting sensory cues, and developing and testing skills in high-risk environments (e.g., traffic density, pedestrians, weather, lighting conditions, and other interruptions). **OVA**, a Quebec based start-up, has developed a software called **StellarX** to develop XR experiences for clients in healthcare.⁵⁶ It is partnering with the **University of Manitoba** to develop a rehabilitation program in the form of an interactive VR simulation, allowing patients to recover physical and cognitive abilities at their own pace and in the comfort of their own homes. Similarly, **VR Vision**, another Toronto-based start-up, has developed a VR platform for the seniors, called **RealityWell**. The platform has been used by many organizations including senior care houses for bucket list experience and promoting exercise.⁵⁷



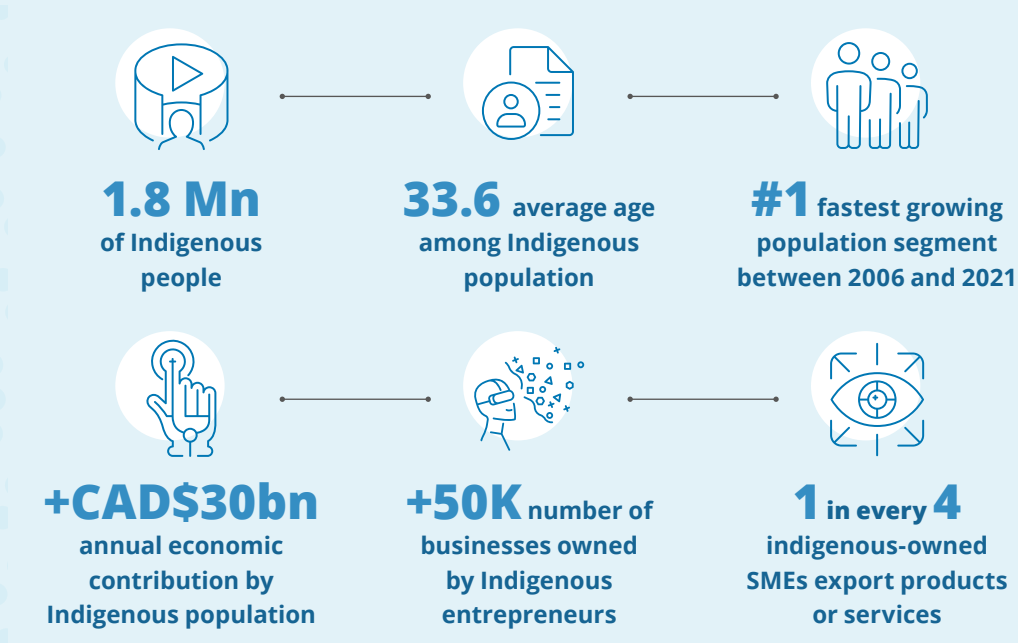
The metaverse could be used to scale up telemedicine and virtual social care in Canada, without the need for large investments in physical healthcare infrastructure.

Empowering the Indigenous economy and culture through the metaverse

There are 1.8 million Indigenous people (First Nation, Métis, and Inuit) in Canada, and nearly two-thirds of these fast-growing population segments are of working age. However, as a result of many historical factors such as public policy, Indigenous people face lower educational attainment levels, poorer socioeconomic conditions, and lower levels of employment.^{58, 59, 60, 61} These are significant issues that neither existing technologies nor metaverse technologies can resolve entirely, but early case studies show that some metaverse applications could offer new approaches to supporting inclusivity.

In the future, the metaverse could provide an additional channel for Indigenous communities to participate in the workforce through immersive and remote training, and working technologies. For example, **Origin**, an Indigenous-owned business based in Ontario, develops customized VR solutions through its system **ImmersiveLink** on Meta Quest, and specializes in Indigenous inclusion and workforce development.⁶² The company partnered with **Skills Ontario**, a program funded by the Government of Canada and the Government of Ontario, and contributed 45 VR headsets utilizing the ImmersiveLink system as a part of a school outreach. Through the program, which was specifically designed to increase participation in trades, especially amongst Indigenous populations, and to address skills gaps across Ontario, students had an opportunity to use VR headsets to experience job opportunities in trades. As similar programs become available to wider groups, digital development platforms could help Indigenous youth to develop workplace skills that employers need, from a remote location, improving their prospects for employment and workplace opportunity.

Figure 7. Snapshot of Indigenous people and the Indigenous economy



Source: Statistics Canada (2022), *First Nations people, Métis and Inuit in Canada*. Bélanger Baur, A. (2019). *Indigenous-Owned Exporting Small and Medium Enterprises in Canada*, *Global Affairs Canada & Canadian Council for Aboriginal Business*. TD Economics (2011), *Estimating the size of the Aboriginal market in Canada*

Indigenous developers are also helping their communities to incorporate XR technologies into educational, cultural, language, artistic, and commercial applications. **The IM4 Lab**, created by Indigenous filmmaker Loretta Todd, alongside media matriarchs Doreen Manuel, Cease Wyss, and Tracey Kim Bonneau, is collaborating with **Emily Carr University** to offer workshop training in XR for Indigenous peoples.⁶³ And in partnership with **Skills Council of Canada**, **Gitpo Spirit Lodge**, a First Nation group on the east coast, has been using virtual reality to provide courses on skills development in various industries and job roles, as well as creating cultural healing experiences in VR.⁶⁴

As the technologies develop and become more widely adopted, the metaverse might be used by Indigenous people as an example of a tool to preserve their culture and advance reconciliation in Canada. The metaverse can help to create a new space in which Indigenous individuals can interact socially on a global scale, in their own culture and language. These types of forums can help to preserve Indigenous culture, language, and music for future generations. For example, one of the biggest challenges when learning an Indigenous language is to practice and interact with other speakers in day-to-day life in order to become more proficient. This challenge can be solved in the digital world.

Biskaabiyaang: The Indigenous Metaverse program at **York University** in Toronto, aims to generate an experiential education to deliver the Anishinaabe (Ojibwe) language where learners explore the Indigenous culture and connect with community elders in real-time social events.⁶⁵ The project runs in tandem with the UN Decade of Indigenous Languages, and it is expected to expand to form a blueprint that is adaptable for any Indigenous language in danger of extinction. In a similar fashion, **Bit Space Development Ltd.** partnered with **Georgian College** to overcome remote learning challenges during the pandemic. The company has created a digital town as part of the **Language in the Home** experience, that students can explore while triggering words recorded by Indigenous elders so they can practice the language and also see a 3D representation of the word.⁶⁶

Meta partnered with **Essilor Luxottica** to develop **Ray-ban Stories**, the first-ever smart glasses that allow users to capture hands-free photos and videos. These are used by Indigenous people to record experiences such as preparing traditional meals and share them on social media to help connect people to Indigenous culture.⁶⁷

Metaverse technologies could provide an additional platform for Indigenous people to make their voices heard about the challenges they face. A project by Colin Van Loon, a Niisitapi writer and director of **This Is Not a Ceremony**, has developed a cinematic VR experience in which the audience enters an immersive virtual world where two Indigenous trickster poets guide them through the darker sides of living in Canada as an Indigenous person.^{68,69} As these examples illustrate, the metaverse might be operated by Indigenous people and businesses as a tool to preserve their culture and open up to the world. It can also provide opportunities for the Indigenous youth to participate in the technology sector by working remotely rather than leaving for employment in urban areas.

The metaverse could also contribute to Canada's environmental sustainability objectives

Canada is committed to reaching net zero emissions by 2050. Building on prior commitments, the 2030 Emissions Reduction Plan, introduced in 2022, provides a roadmap for how the Canadian economy can achieve ambitious targets to reduce greenhouse gas emissions by 40-45% (from 2005 levels) by 2030 and achieve net zero by 2050.⁷⁰

As the metaverse could facilitate remote collaboration, remote operations, remote/hybrid meetings and events, remote training, and immersive experiences in shopping, communication, and leisure activities, it could reduce the greenhouse gas emissions in Canada by providing alternatives to travel.



The metaverse will offer alternatives to travel for work and leisure, which in return could reduce carbon emission.

This was the case during the first year of the COVID-19 pandemic in Canada when 30% of employees worked from home and annual greenhouse gas emissions from passenger cars declined by 23% whereas the previous four-year decrease was only 6.4%.^{71,72} This suggests that as the metaverse develops and alternatives to travel for work and leisure become more feasible, the carbon footprint of Canada's main polluter sectors could decline. However, the overall net impact of the technology on emissions remains uncertain at this stage.

A study by Capgemini Research Institute found that for 60% of organizations, improving sustainability is a key reason for their digital twin implementations.⁷³ Digital twins may be used for example to optimize the supply chain in retail, ensure an uninterrupted water supply in utilities, aid design and test processes in manufacturing to reduce waste, or model energy demand in a region. Canadian mining start-up **The Metals Company (TMC)**, is developing a deep-sea nodule-collection system on a digital twin, for the responsible recovery of polymetallic nodules from the sea floor and transferring them to an onshore processing plant.⁷⁴ The project aims to use machine learning to make environmental impact predictions, and includes an environmental dashboard for monitoring and reporting impacts.⁷⁵ As the energy and mining sectors in Canada are very large, digital twin applications and the resulting efficiency gains could contribute substantially to achieving the country's sustainability goals.





Digital twins could help the energy sector and the manufacturing industry to run optimization tests more efficiently by using less energy and producing less waste.

It should be noted, however, that the metaverse could also have adverse environmental impacts if certain issues are not addressed. In the short-run, the immersive metaverse is expected to evolve primarily as AR, VR and AI over current connectivity infrastructure and computing power. Therefore, it is currently unclear whether this will need additional network infrastructure investment beyond what would already be invested organically over time. In the near term, early metaverse applications may not have a material environmental impact, however growth in both the supply and demand side of the metaverse could add to greenhouse gas emissions from the higher levels of computing power needed. Builders and users of the metaverse will therefore need to commit to reducing greenhouse gasses and incorporate strong ESG values from its inception.⁷⁶ **Meta** for example has made a commitment to becoming net zero emissions across its value chain by 2030.⁷⁷

The environmental concerns may build up as the metaverse develops over time and adoption increases.⁷⁸ Negative environmental impacts could be addressed largely by the transition to greener, low-carbon energy generation. Emissions and e-waste could also be reduced by device recycling and developing the industrial capabilities for re-using obsolete devices in the manufacture of new ones, in a circular economy. For example, **Poptronic**, an Ontario-based start-up, is building a process to allow consumers to rent refurbished or used tech, including VR equipment such as the Meta Quest in order to keep track of e-waste.⁷⁹

It is important that at an early stage in the development of the metaverse, key stakeholders and policymakers take steps to promote its sustainable development through circularity and better design to minimize the impact on the environment. For instance, stakeholders could explore design and production strategies that reduce the use of rare earth minerals like lithium and industrial diamonds, which are mined using methods that can be environmentally and socially damaging. This is especially important for Canada, a country rich in natural resources, ranking sixth in the world for lithium reserves and third for the production of rough diamonds.^{80, 81, 1}



1. Note that the list of environmental impacts discussed is not exhaustive and the development of the metaverse is expected to have multiple positive and negative effects that are not captured in the report.

4. Enabling Successful Metaverse Growth in Canada

The extent to which socioeconomic benefits can be realized will depend on key enablers

The metaverse is expected to follow a gradual evolution to become the next iteration of the internet. While still in its nascent stage, early metaverse experiences around 2D AR, AI, and immersive 3D VR technologies are emerging through current connectivity infrastructure and user devices. Existing infrastructure, devices and basic digital skills will be sufficient to experience the early phase of the metaverse. However, as the metaverse develops, several economic, social, and technological factors will need to be in place to achieve widespread adoption of metaverse technologies and promote innovation. These factors can be grouped into two broad enabling pillars: technology fundamentals and ecosystem enablers.

- **Technology fundamentals:** These are the wide range of technologies required for the metaverse to exist and operate in a country or region (e.g., connectivity device capability).
- **Ecosystem enablers:** These are non-technological factors that will likely support the success of the metaverse and achieve its widespread acceptance and adoption (e.g., social acceptance, digital skills for users and professionals).

These key factors and enablers provide a useful framework for assessing the extent to which Canada is positioned for the adoption of the metaverse by both consumers and businesses. The framework can provide a useful tool for indicating where the government, businesses and other stakeholders in the ecosystem should prioritize activities and investments to develop the metaverse.

Figure 8. Technology fundamentals and enablers overview



Technology Fundamentals

The viability of the metaverse requires:

- User devices
- Connectivity
- Transactions
- Computing power

The Metaverse



Ecosystem Enablers

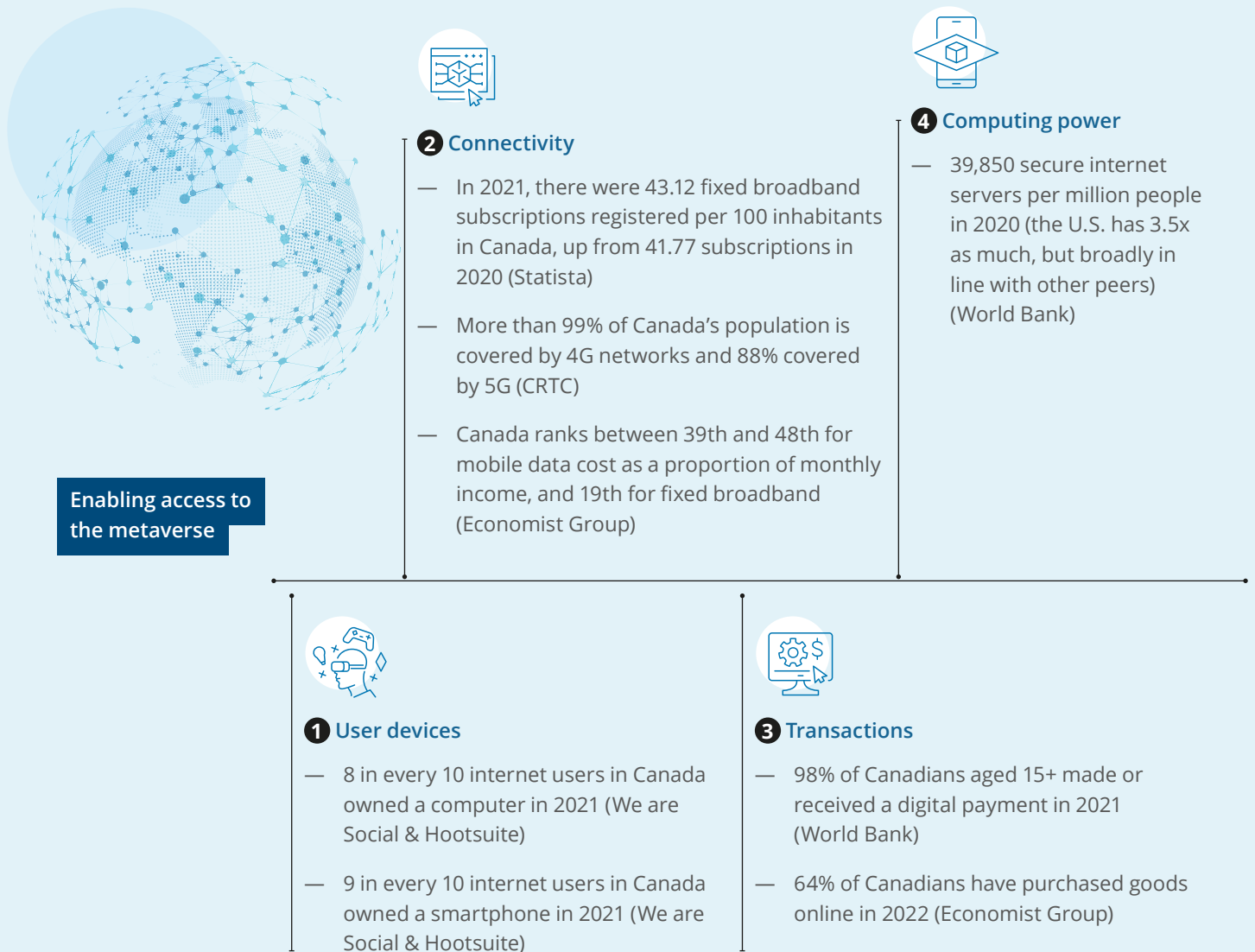
To allow the massive adoption of the metaverse businesses and individuals:

- Digital skills
- Technological readiness of businesses
- Social acceptance, security and privacy
- Competition and common standards

Source: Deloitte analysis

Metaverse technology fundamentals

Figure 9. Technology Fundamentals



1 User devices⁸²

The availability and affordability of high-quality immersive hardware will be essential for the metaverse. Availability and ownership of personal computers and smartphones are widespread in Canada. Canada's GDP per capita is almost three times higher than the global average, which may support demand for more sophisticated devices.⁸³ Canada's VR and AR market is also expected to be the fastest growing of all countries over the next few years.⁸⁴

However, Canadian governments and businesses will need to consider how access to new technology can be improved in a way that does not increase the digital divide. This is especially important in Canada's less densely populated provinces, where rates of smartphone adoption are lower.^{85, 86} For example, Atlantic Canada has the lowest regional ownership of both smartphones and video game consoles.

A lack of affordable devices may also risk exacerbating the digital divide in lower income groups such as Indigenous people, who have a median income of 20-25% lower than the non-Indigenous population.⁸⁷ For instance, Deloitte Canada's recent Digital Equity report found that those in the lowest household income bracket were twice as likely to cite the cost of devices as a barrier to fully participating in the digital world compared to those in the highest income bracket.⁸⁸



2 Connectivity⁸⁹

Connectivity has become a defining feature of the modern economy and has revolutionized every economic sector. It widens access to education, employment, healthcare, and public services and enables real-time information exchange that reinforces security and fosters resilience at both a national and international level. The connectivity divide between the urban and rural areas has continued to impact people's ability to access the internet over time. While 90% of all Canadian households had access to minimum broadband speeds in 2021, only 54% of rural households and 39% of First Nation reserves met this threshold.^{90, 91}

For the foreseeable future, immersive metaverse adoption will continue to be driven predominantly through VR. Almost all VR content is currently consumed over fixed networks through Wi-Fi. With respect to AR, existing services today are largely 2D and already supported by today's networks. As a result, existing fixed network capacity and mobile coverage, in combination with future network investments for 5G, particularly fixed wireless access, fiber-optic cables, along with continued development of edge computing, is likely sufficient to support the ongoing use of the Internet and foreseeable metaverse use cases. Further use cases are expected to develop gradually over the coming years.

5G coverage has been increasing in Canada, reaching 88% nationally by 2021. Further progress will be required in the future to reduce regional differences in coverage and enable access to adequate connectivity for all Canadian communities. For instance, coverage in Atlantic Provinces ranged from 38% to 57% whilst 5G deployment has not started in Northern Provinces.⁹² 5G download and upload speeds are also limited by reliance upon low-band networks, with Canada ranking 14th among 25 leading countries.⁹³

The cost of connectivity may also pose challenges, particularly among lower income groups, and mobile broadband costs have been found to be relatively high by some studies.⁹⁴ However, the Canadian government is actively supporting the availability and affordability of connectivity for those who need it with the Connecting Families initiative.⁹⁵



3 Transactions⁹⁶

Transactions in the metaverse could take the form of digital payments and transferring of assets across various virtual platforms. Extending secure and interoperable digital payments platforms and systems into the virtual world will be essential for transacting in the metaverse. Canada is advanced in the adoption of digital payments and is the ninth largest market in the world for e-commerce, with a revenue of US\$58 billion in 2021.^{97, 98} This suggests Canada is well positioned for metaverse transactions.

However, 15% of Canadians still do not have a bank account. This is driven by limitations in access to physical bank branches, particularly in rural areas.^{99, 100} However, digital financial infrastructure is well-developed in Canada and is available through mobile networks. This includes formal online banking services, mobile money accounts, cryptocurrency exchanges and payment processors.^{101, 102, 103} All of these are legally recognised. Common standards of digital transactions systems can encourage flexibility in the use of these services so should be further encouraged.



4 Computing power¹⁰⁴

The metaverse will likely require significant computing power to offer high-quality immersive experiences to large numbers of participants.¹⁰⁵ Canada ranks seventh in the world in terms of computing power, estimated by the number of secure internet servers per one million people.¹⁰⁶ Canada has well-developed computing fundamentals and benefits from strong links to the US' neighboring computing infrastructure. This could lend Canada a significant advantage in achieving the required synchronicity and immersion that is envisaged for the metaverse.



Metaverse ecosystem enablers

Figure 10. Ecosystem Enablers



Technological Readiness of Businesses

- 89% of Canadian businesses had at least one type of web presence (Statistics Canada)
- One in ten Canadian businesses employed at least one ICT specialist (Statistics Canada)



Competition and Common standards

- Canada is 14th of 141 nations in the 2019 Global Competitiveness Index (WEF)
- According to the Inclusive Internet Index, Canada has some of the best open data policies

Support the development of the metaverse



Digital Skills

- Salesforce gave Canada a digital skills index score of 23; the average was 33, and the US scored 36
- 74% of Canadians have at least intermediate digital skills (Statistics Canada)



Social Acceptance, Security, and Privacy

- Canada achieved a ranking of 8th in the ITU's Global Cybersecurity Index
- 48% of Canadians are confident their online activity is private, ranking 68th in the Inclusive Internet Index; this is significantly worse than Canada's peers
- Canada ranks 88th for trust in non-government websites and apps



Digital skills¹⁰⁷

For a widespread take up of the metaverse, the population needs to be technologically proficient. Although 74% of Canadians have at least intermediate digital skills, almost 9% of Canadians are non-users of the internet and just under 16% are 'basic users'.¹⁰⁸ Among the non-users and basic users there is a very high proportion of individuals who are elderly, less educated, or from rural populations.¹⁰⁹ Digital skills and wider literacy programs to improve the skills of vulnerable groups will be key for widespread adoption of the metaverse.

The development of the metaverse also requires people with advanced digital skills, for example in AI, coding and app development, and cyber security. A recent study found that 28% of businesses in Canada needed people with advanced computer science skills (software engineering and artificial intelligence) while more than half these firms reported a skills shortage.¹¹⁰ Canada would therefore benefit from higher levels of business-oriented digital skills.



Technological readiness of businesses^{111, 112}

The ability of businesses to adopt new technologies will be crucial for generating economic value for Canada. For many enterprises, technology was shown to be a key lifeline following the COVID-19 pandemic, and since 2019 usage of technology by Canadian enterprises has improved in almost every metric including cloud computing, customer relation management (CRM) or electronic data interchange (EDI).

Despite the progress, small-sized enterprises suffer from lower levels of digital maturity. In 2021, 17% of small enterprises had no web presence at all compared to less than 6% of medium-sized enterprises and less than 4% of large enterprises. Although most enterprises that were not using the internet said that they did not need it, other reasons given for non-use were 'cost of service equipment,' 'employees lacking the skills, training or experience,' and 'limited access to the internet'. In addition, some of the more advanced types of ICT were not in common use in all sizes of Canadian enterprises, such as AI (4%), 3D printing (2%), advanced robotics (1%), and blockchain technologies (less than 1%). For Canadian businesses to access the opportunities associated with metaverse technologies, both the public and private sectors should consider identifying and prioritizing technological needs (e.g., infrastructure, cost, and skills).



Social acceptance, security and privacy^{113, 114}

Trust is a key factor to the social acceptance of technologies. While awareness of metaverse technologies is growing in Canada, adoption may be hindered if users do not feel their privacy or safety is adequately protected online. This could also undermine the commercial incentive to invest and scale-up the technology.¹¹⁵

While Canada is one of the leading countries in cybersecurity, the nation does not fare well in its trust of social media and non-government websites and apps, as well as online privacy as measured by the Inclusive Internet Index.¹¹⁶ Furthermore, evidence suggests that these concerns may be heightened amongst rural, elderly, and Indigenous communities.¹¹⁷

Canada's government has already proposed legislation that includes laws on consumer privacy. Nonetheless, collaboration will be needed across the private and public sectors to increase transparency for end users in the choice between how their data is handled and processed for example, as well as clearly communicating the economic and social benefits of the use of wider digital technologies including the metaverse.



Competition and Common Standards¹¹⁸

Development of the metaverse will rely on competition and adoption of common standards to deliver widespread opportunities to a diverse range of users. Competition encourages efficiency and innovation in the developing metaverse and can provide various forms of protection to users, and businesses. Common standards and protocols are important in allowing for seamless transition of assets and activity between virtual spaces and platforms. In absence of collectively agreed norms and standards, competition in the metaverse space may suffer, with multiple siloed or fragmented worlds co-existing. This would give rise to siloes and walled gardens that would limit user choice.

Canada shows encouraging signs for a competitive metaverse. Its start-up ecosystem is ranked 4th in the world, resulting from high volumes of entrepreneurial activity and strong levels of traction generated by these enterprises.¹¹⁹ The competitive environment can encourage and facilitate market entry, which can promote innovation and challenge market leaders in industries key to the metaverse.

Canada is an active proponent of digital common standards and could take a leading role in developing common standards that will contribute to the governance of the metaverse. It is one of eight countries in the Digital Government Exchange's 'Digital Identity Working Group'¹²⁰, which has established a set of governing principles supporting the promotion and maintenance of common standards. These include openness, technology neutrality and data portability, and transparency. Unanimous support for these principles will be key in ensuring the metaverse works seamlessly across different applications and devices. Canada is already beginning to implement measures that enforce common standards, for instance through the upcoming Digital Charter Implementation Act.



Addressing the digital divide is important for promoting an inclusive metaverse

In general Canada is relatively well positioned to benefit from the metaverse, but the government has identified key challenges for digitalization across the country, which it is aiming to address. One issue which is common across many parts of the world, is how disparities in connectivity create a digital divide between Canada's regions and provinces.

Connectivity plays a fundamental role in ensuring access to technological innovations and providing the opportunity to connect and interact in a remote setting. Similarly, connectivity is key to the metaverse as it will enable users to access increasingly immersive experiences. Canada's vast geographical area presents challenges for the provision of high-quality broadband internet access services to all Canadians. Where data travels long distances on old infrastructure, latency could be a barrier to the metaverse.^{121, 122, 123} High latency results in discomfort using VR devices.¹²⁴ Therefore, continuation of current investment into modernizing infrastructure could help latency issues in addition to supporting Canada's connectivity strategy on high-speed connection.

In 2019, Canada published a connectivity strategy, High-Speed Access for All.¹²⁵ This allocated CAD\$6billion towards universal connectivity and aimed to deliver high-speed connectivity to 90% of Canadians by 2021, 95% of Canadians by 2026, and the hardest-to-reach Canadians by 2030. Failure to do so could mean that rural, remote, and Indigenous groups would be under-represented in the metaverse.

LEO satellites are an emerging technology that could also be of great assistance. They can be used to provide high-speed internet to isolated areas, filling in remaining broadband gaps. LEO satellites can provide a minimum expected speed of 50 Mbps download and 10 Mbps upload, meeting Canada's target for high-speed connectivity.¹²⁶ The service can also provide latency of under 20ms.¹²⁷ An LEO satellite launched in 2016 has even reached download speeds of 800Mbps, indicating the potential of these satellites to meet the requirements for an immersive metaverse.¹²⁸

5. Conclusion

The metaverse is expected to enrich digital interactions and transform the way we socialize, work and play. With several diverse consumer applications and industrial use cases already developed or in development, the metaverse promises a significant boost to the economy through the creation of new markets and improving collaboration and ways of working. Canada's start-up ecosystem specializes in ICT, education, healthcare, retail, and gaming, which are sectors that are anticipated to benefit first from early stage metaverse use cases.

If made accessible to large parts of the population, the metaverse could enable the democratization of access to information, goods, and services. Our estimates suggest that the metaverse could boost Canada's annual GDP by up to CAD\$45.3-CAD\$85.5 billion by 2035, whilst also supporting policy goals of achieving greater inclusion and cohesive economic growth for all Canadians.

Although metaverse technologies are still at an early stage of development, the promise is significant, and Canada is well placed to benefit from them. The digital economy in Canada is large and most of the population can benefit from fixed broadband connectivity and 4G or 5G coverage.¹²⁹ Canada also has a burgeoning technology start-up scene, a rich supply of talent and several enterprises already demonstrating the potential of innovative and metaverse-enabling technologies.

However, there are a number of essential enabling factors that will also require attention, in particular addressing regional and rural inequalities regarding uptake and provision of access, connectivity, digital infrastructure, digital skills and affordability. More broadly, work will be required to address digital skills shortages, to encourage wider social acceptance, and for wider adoption of advanced technologies by industry.

Coordinated action will be needed across the metaverse ecosystem to realize the prospective benefits of the metaverse. In the future, the government will have a key role in ensuring that the existing digital gap is effectively bridged in remote and rural communities. This would help realize the benefits of connectivity to a larger extent. This continued improvements will require cooperation beyond federal and regional governments, including cooperation within industry. Developers of metaverse technologies, hardware and content must also be actively engaged in considering how they can help enable a metaverse that everyone in Canada will be able to adopt and enjoy.

More widely, collaboration will be required not just within Canada, but across the world, between the public sector, private sector and international organizations. There is a need for robust conversations on legal and regulatory frameworks between these different sectors to address issues such as common standards, data privacy, safety, intellectual property rights, content licensing, competition, and taxation. While these issues are not new, the suitability and interpretation of regulations will be affected by the creation of new marketplaces, and different types of virtual content and ways of interacting. Achieving an open, safe, and inclusive metaverse must align with Canada's own digital ambitions as laid out in its Digital Charter, to create an environment which emphasizes the need for universal access, safety, and security and, transparency and common standards.





Endnotes

1. Invest Canada, <https://www.investcanada.ca/industries/technology>
2. DataReportal, We are Social, Hootsuite (2022). "Digital 2022: Canada", retrieved from <https://datareportal.com/reports/digital-2022-canada>
3. DataReportal, We are Social, Hootsuite (2022). [Digital 2022: Global Overview Report – Global Digital Insights](#)
4. Ipsos (2022). [Enthusiasm for the metaverse and extended reality is highest in emerging countries](#)
5. Ipsos (2022). [Enthusiasm for the metaverse and extended reality is highest in emerging countries](#)
6. DataReportal, We are Social, Hootsuite (2022). "Digital 2022: Canada", retrieved from <https://datareportal.com/reports/digital-2022-canada>. Devices used to play video games
7. Statista Advertising & Media Market Outlook (2022). [AR & VR – Canada](#)
8. The Metaverse Insider (2022). [Canadian Startup Brings Toronto Universities into the Metaverse by Creating 3D Virtual Tours of its Campuses](#)
9. Experience Georgian (2021). [VR technology is changing the learning landscape at Georgian](#)
10. Meta (2022). [Fostering Metaverse Innovation at Canadian Labs, 2022](#)
11. Government of Canada (2022). [Canada's Digital Ambition 2022](#)
12. Government of Canada (2022). [Canada Digital Adoption Program](#)
13. Institute on Governance (2021). [Taking Digital Leadership into the Metaverse – Institute on Governance \(iog.ca\)](#)
14. The exchange rate between US dollars and Canada dollars was taken as 1.25 USD/CAD. See Bank of Canada's [Annual Exchange Rates](#)
15. World Bank (2022). [Gross Domestic Product 2021](#)
16. Statistics Canada (2022). [Gross domestic product \(GDP\) at basic prices, by industry, provinces and territories](#)
17. Hirshhorn, Industry Canada (2011). [Impacts of Structural Changes in the Canadian Economy \(canada.ca\)](#)
18. Innovation, Science and Economic Development Canada, Government of Canada (2022). [2021 Canadian ICT Sector Profile](#)
19. Statistics Canada (2019). [The Daily – Measuring digital economic activities in Canada, 2010 to 2017](#)
20. Statista Digital Media Outlook (2022). [Video Games – Canada](#)
21. Regional macroeconomic data was derived from Statistics Canada, while the regions' ICT ratios were obtained from Innovation, Science and Development of Canada's ICT sector profile report (please see footnote 17).
22. Waterloo EDC (2022). [What is the Toronto-Waterloo Corridor? \(waterlootedc.ca\)](#)
23. CBC (2022). [Big Tech hiring cements Canada's status as Silicon Valley North – but there's a catch](#)
24. Entertainment Software Association of Canada (ESAC) (2021). [The Canadian Video Gaming Industry 2021](#), created by Nordicity
25. Montreal International (2022). [Welcome to Greater Montréal's World-Leading Video Game Hub](#)
26. Québec City Business Destination (2018). [Québec City: A booming hub for technology entrepreneurship](#)
27. See Dpt.'s website for further details: [Marco & Polo Go Round](#)

28. Trade and Invest British Columbia (2021). [AR, VR, and Gaming in British Columbia Canada](#)
29. Ibid.
30. See the company's website for further details: [Virtual reality games](#)
31. See Precision OS for further details: [Virtual Reality \(VR\) Surgery Training & Simulators](#)
32. Government of Alberta | [Alberta ICT Industry Profile](#)
33. See the company's website on their ESG approach: [Veerum | Our Approach to ESG](#)
34. Avanade (2022). [Avanade Expands into Atlantic Canada, Launches First Engineering Hub in Halifax](#)
35. CTV News (2021). [P.E.I. uses virtual reality to recruit doctors to the province](#)
36. See [The MetaMall: Retail in Cyberspace](#) for further details.
37. Marion surgical (2022). [About Us | Marion Surgical](#)
38. InStage (2022). [How A Government Agency Used InStage Simulations to Engage Employees in Communication Skills Training](#)
39. HR Reporter (2022). [Is the metaverse the next stage of hybrid work?](#)
40. See the company's website for further details: [CAVR](#)
41. Mountain Lake, PBS (2022). [Join in a unique music festival... in the Metaverse!](#)
42. See the company's website for further information: [Art Collision](#)
43. Rosenberg L., (2022). [Here's how the metaverse impacts the environment | World Economic Forum \(weforum.org\)](#)
44. Statistics Canada (2022). [The Canadian census: A rich portrait of the country's religious and ethnocultural diversity](#)
45. Deloitte Access Economics (2019). [The economic benefits of improving social inclusion](#)
46. Deloitte Access Economics (2019). [The economic benefits of improving social inclusion](#)
47. Infrastructure Canada (2019). [Infrastructure Canada – Minister of Rural Economic Development Transition Book Overview of Rural Economic Development](#)
48. Government of Canada (2022). [Rural economic development](#)
49. Canadian Geographic (2022). [Contrary connections: Mapping Canada's rural-urban internet divide](#)
50. Infrastructure Canada (2019). [Infrastructure Canada – Minister of Rural Economic Development Transition Book Overview of Rural Economic Development](#)
51. Deloitte (2021). [Vodafone-rural-connectivity-deloitte-paper.pdf](#)
52. See the company website for further information: [Wavemakers](#)
53. Canada Health Infoway (2022). [Canadians' Health Care Experiences During COVID-19](#)
54. Benefits by Design (2019). [Provincial Telehealth Resources: An Interactive Map of Canada](#)
55. IT Business (2019). [Toronto startup helps disabled and their communities with VR](#)
56. See Stellarx's website for further details: [Stellarx | Case Studies](#)
57. See the company's website for further details: [RealityWell | Case Studies](#)
58. Statistics Canada (2022). [Labor force characteristics by Indigenous group and educational attainment](#)
59. Statistics Canada (2019). [Employment of First Nations men and women living off reserve](#)
60. Indigenous Corporate Training Inc. (2019). [8 Basic Barriers to Indigenous Employment](#)
61. Archibald J., and Xiiem Q. (2020). Indigenous Education in Canada
62. Daily Commercial News (2020). [Indigenous firm contributes VR headsets to Skills Ontario](#)

63. See [The IM4 VR/AR Lab is Dedicated to Indigenizing VR/AR/360](#) for further details.
64. See [Gitpo Spirit Lodge | Transforming the Realities of Skills Development](#)
65. See [Biskaabiiyaang | The Indigenous Metaverse](#)
66. See [Bit Space Development | VR Training & Development Services](#)
67. Meta (2022). [By Meta Diversity | Facebook](#)
68. NFB (2022). [Matriarchs and Buffalo pull no punches, yet lead us with care](#)
69. Tricksters are characters in a story (god, goddess, spirit, human or anthropomorphization) who exhibits a great degree of intellect or secret knowledge and uses it to play tricks or otherwise disobey normal rules and defy conventional behavior.
70. See Canada's [Climate Plan](#) supervised by the Government of Canada for further details.
71. Statistics Canada (2021). [Working from home during the COVID-19 pandemic, April 2020 to June 2021](#)
72. Environment and Climate Change Canada (2022). [National Inventory Report 1990-2020: Greenhouse Gas Sources and Sinks in Canada](#).
73. Capgemini (2022). [Digital Twins: Adding Intelligence To The Real World](#)
74. The Metals Company (2021). [TMC Enters Agreement with Kongsberg Digital to Develop Digital Twin of Deep-Sea Operating Environment Ahead of Polymetallic Nodule Collection System Test](#)
75. Ibid.
76. PwC (2023). [ESG and Climate Reporting Requirements | PwC Canada](#)
77. Meta (2022). [Climate](#).
78. Rosenberg L., (2022). Here's how the metaverse impacts the environment | World Economic Forum (weforum.org)
79. Seaway News (2022). [Poptronic Powers the Circular Economy with Tech Rentals across Canada](#)
80. Penticton Herald (2022). [Future of lithium mining in Canada](#)
81. National Resources Canada, Government of Canada (2021). [Diamond facts \(nrcan.gc.ca\)](#)
82. DataReportal, We are Social, Hootsuite (2022). "Digital 2022: Canada", retrieved from <https://datareportal.com/reports/digital-2022-canada> Device Ownership
83. World Bank (2021). [GDP per capita, PPP \(constant 2017 international \\$\) – Canada, World](#)
84. Kommando Tech (2022). [30 Virtual Reality Statistics for 2022](#)
85. Statistics Canada (2022). [Population and dwelling counts: Canada, provinces, and territories](#)
86. Statistics Canada (2019). [Table 22-10-0113-01 Use of Internet services and technologies by age group and household income quartile](#) DOI: <https://doi.org/10.25318/2210011301-eng>
87. Indigenous Services Canada, Government of Canada, Annual Report to Parliament (2020). [Median income, Indigenous and non-Indigenous populations](#)
88. Deloitte (2022). [Digital equity: focusing on every Canadian's digital future](#). Devices are unfordable for many.
89. ITU (2022). [ICT Price Baskets \(IPB\) \(itu.int\)](#)
90. Minimum broadband speeds are defined by the CRTC as at least 50 megabits per second (Mbps) for downloads and 10 Mbps for uploads. See Canada's [Telecom Regulatory Policy CRTC 2016-496](#) for more details.
91. Deloitte (2022). [Digital equity: focusing on every Canadian's digital future](#). Diving into the numbers: digital equity visualized
92. Canadian Radio-television and Telecommunications Commission (2021). [Reported Mobile Coverage across Canada](#)
93. PwC (2021). [The importance of 5G and the digital economy in Canada](#)

94. ITU (2022). [ICT Price Baskets \(IPB\) \(itu.int\)](https://itu.int)
95. See the announcement by the Government of Canada on [affordable high-speed Internet to help connect low-income families and seniors](#) (2022)
96. The ratio of adults engaged in e-commerce is obtained from the following question in the Value of the Internet Survey conducted by the Economist Group: "How often do you purchase goods via the Internet? The indicator is ranked by responses indicating "About once a month", "About once a week", and "More than once a week", [The Inclusive Internet Index 2022 – Methodology Report](#)
97. Total transaction value in the Digital Payments segment is projected to reach US\$119.80bn in 2022. Total transaction value is expected to show an annual growth rate (CAGR 2022-2027) of 15.20% resulting in a projected total amount of US\$243.10bn by 2027. The market's largest segment is Digital Commerce with a projected total transaction value of US\$88.22bn in 2022. See [Statista Digital Market Outlook \(2022\). Digital Payments – Canada](#)
98. Statista Digital Market Outlook (2022). [Canada E-commerce Market](#)
99. Burgess, R. and Pande, R., 2005. Do rural banks matter? Evidence from the Indian social banking experiment. American Economic Review, 95(3), pp.780-795. [dobanksmatterjune20.dvi \(lse.ac.uk\)](#)
100. [The role banks can play in financial inclusion and financial health for Canada \(canada.ca\)](#)
101. Government of Canada (2022). [Online banking – Canada.ca](#)
102. Government of Canada (2022). [Mobile wallets – Canada.ca](#)
103. Triple A | [Cryptocurrency ownership data for Canada 2021](#)
104. World Bank (2020). [Secure Internet servers \(per 1 million people\) – Canada](#)
105. The precise computing requirements are not yet known, but existing virtual worlds such as Fortnite and Roblox do not allow more than 200 participants due to computational constraints. See Ball, M. (2022). [Compute and the Metaverse – MatthewBall.vc](#)
106. [Chipmall \(2022\). Ranking of Countries by Computing Power](#)
107. Salesforce (2022). [Global Digital Skills Index 2022](#)
108. Statistics Canada (2022). [Internet-use Typology of Canadians: Online Activities and Digital Skills.](#)
109. See [Table 3: Distribution of individuals across Internet-user groups, by socioeconomic characteristics, Canada, 2018](#) for further details. Accordingly, more than 62% of Canadians above 65 years old, 70% of Canadians with less than high school attainment, 29% of Canadians living in rural areas are either non-user of internet or pose only basic skills.
110. Mahboubi, P (2022). [The Knowledge Gap: Canada Faces a Shortage in Digital and STEM Skills. Commentary 626. Toronto: C.D. Howe Institute.](#)
111. Statistics Canada (2022). [Table 22-10-0117-01 Information and communication technologies used by industry and size of enterprises](#) DOI: <https://doi.org/10.25318/2210011701-eng>
112. Statistics Canada (2022). [Table 22-10-0119-01 Reasons for not using the Internet by industry and size of enterprise](#) DOI: <https://doi.org/10.25318/2210011901-eng>
113. Government of Canada (2022). [Bill C-11: An Act to enact the Consumer Privacy Protection Act and the Personal Information and Data Protection Tribunal Act and to make related and consequential amendments to other Acts \(justice.gc.ca\)](#)
114. ITU (2021). [Global Cybersecurity Index 2020](#)
115. O'Neill S. (2022). [What Privacy Issues Will Haunt the Metaverse? \(lxahub.com\)](#)
116. The Inclusive Internet Index (3i), produced by Economist Impact and commissioned by Meta, assesses countries on the ability of their citizens to use the Internet for personally and societally enriching purposes. [Economist Impact: The Inclusive Internet Index, supported by Meta](#)

117. Wu, K., Zhao, Y., Zhu, Q., Tan, X. and Zheng, H. (2011). A meta-analysis of the impact of trust on technology acceptance model: Investigation of moderating influence of subject and context type. *International Journal of Information Management*, 31(6), pp.572-581. [A-meta-analysis-of-the-impact-of-trust-on-technology-acceptance-model-Investigation-of-moderating-influence-of-subject-and-context-type.pdf \(researchgate.net\)](#)
118. WEF (2019). [Global Competitiveness Report 2019](#)
119. StartupBlink (2022). [Global Map of Start-up Ecosystems \(startupblink.com\)](#)
120. DGX Digital Identity Working Group (2022). [DGX 2021 Digital Identity in Response to Covid-19](#)
121. Latency is critical for ensuring smooth and accurate movements in the user's vision.
122. Mangiante, S., Klas, G., Navon, A., GuanHua, Z., Ran, J. and Silva, M.D., 2017, August. Vr is on the edge: How to deliver 360 videos in mobile networks. In *Proceedings of the Workshop on Virtual Reality and Augmented Reality Network* (pp. 30-35). [\(PDF\) VR is on the Edge: How to Deliver 360° Videos in Mobile Networks \(researchgate.net\)](#)
123. Ball, M and Navok, J (2021). Networking and the Metaverse. The Metaverse Primer. [Networking and the Metaverse – MatthewBall.vc](#)
124. Brunnström, K., E. Dima, T. Qureshi, M. Johanson, M. Andersson, and M. Sjöström, (2020). Latency impact on Quality of Experience in a virtual reality simulator for remote control of machines. *Signal Processing: Image Communication*. Vol. 89, Article no. 116005, DOI: <https://doi.org/10.1016/j.image.2020.116005>.
125. Government of Canada (2022). [High-Speed Access for All: Canada's Connectivity Strategy](#)
126. Government of Canada (2022). [High-Speed Access for All: Canada's Connectivity Strategy](#)
127. PCMag (2022). [SpaceX's Satellite Internet Service Latency Comes in Under 20 Milliseconds \(pcmag.com\)](#)
128. See [Satellite Imaging Corporation | WorldView-4 Satellite Sensor](#)
129. Statistics Canada. [The Daily – Access to the Internet in Canada, 2020 \(statcan.gc.ca\)](#)



This publication has been written in general terms and we recommend that you obtain professional advice before acting or refraining from action on any of the contents of this publication. Deloitte LLP accepts no liability for any loss occasioned to any person acting or refraining from action as a result of any material in this publication.

Deloitte LLP is a limited liability partnership registered in England and Wales with registered number OC303675 and its registered office at 1 New Street Square, London EC4A 3HQ, United Kingdom.

Deloitte LLP is the United Kingdom affiliate of Deloitte NSE LLP, a member firm of Deloitte Touche Tohmatsu Limited, a UK private company limited by guarantee ("DTTL"). DTTL and each of its member firms are legally separate and independent entities. DTTL and Deloitte NSE LLP do not provide services to clients. Please see www.deloitte.com/about to learn more about our global network of member firms.

© 2023 Deloitte LLP. All rights reserved.

Designed and produced by 368 at Deloitte. J30346