



# Smart City Priority Areas and Labour Readiness of Canadian Cities

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# Preface

ICTC is a national centre of expertise for the digital economy. With over 25 years of experience in research and program development related to technology, ICTC has the vision of strengthening Canada's digital advantage in the global economy. Through forwardlooking research, evidence-based policy advice, and creative capacity building programs, ICTC fosters innovative and globally competitive Canadian industries, empowered by a talented and diverse workforce.

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# Background

Home to over 55% of the world's population[1] and accounting for 70% of global GDP,[2] the impact of urbanization on our economy cannot be understated. However, as these spaces continue to be changed by digital disruption, the need to focus on key elements of future sustainability is imminent. Top considerations for our future cities include labour market preparedness, green energy, and infrastructure needs, among others.

These concepts are increasingly gaining centre stage in Canada and the world around, and the global race for smart city development is accelerating, with no sign of slowdown. In fact, investment in “smart” technologies is estimated to have reached \$81 billion globally in 2018, and is expected to nearly double to \$158 billion by 2022.[3] Growing digital ubiquity and advanced organizational and planning models for cities will continue to drive much of this investment. Many cities around the world are growing and expanding at a rapid rate, and the concept of a “Smart City” is one that is quickly redefining expectations on what it means to be an innovative urban space.

However, despite the notion gaining popularity, there is no standardized definition of a “smart city”. This is something that can add a layer of complexity when it comes to assessing a city's relative evolution according to a “smart” pathway. Although many early initiatives under the smart city banner were largely driven by technology adoption, cities today generally use the term “smart city” when referring to the improvement of the overall quality of life, facilitated via the use of data and digital technology integrated throughout the environment.[4] In these cases, technology is used to provide opportunities for economic development as well as to enhance urban services, resource conservation, and cost effectiveness. Key focus areas of smart cities generally include: fostering innovation in industries and neighbourhood communities; advancing urban infrastructure; improving transportation and utility performance; improving community services; as well as creating and attracting top talent.

[1] 68% of the World Population Projected to Live in Urban Areas by 2050, says UN. UN News: May 16, 2018.

<https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html>

[2] Urban World: Mapping the Economic Power of Cities. McKinsey Global Institute: March 2011. <https://www.mckinsey.com/featured-insights/urbanization/urban-world-mapping-the-economic-power-of-cities>

[3] Shirer, Michael. IDC Forecasts Smart Cities Spending to Reach \$158 Billion by 2022, with Singapore, Tokyo, and New York City Among Top Spenders. IDC Media Centre: July 23, 2018. <https://www.idc.com/getdoc.jsp?containerId=prUS44159418>.

[4] Bloom, Rachel; Landry, Jean-Noe; Lauriault, Tracey. Open Smart Cities in Canada: Assessment Report. Open North: April 11, 2018. <https://osf.io/preprints/socarxiv/qbyzj/>

## CREATING A SMART WORKFORCE IS KEY TO UNLOCKING THE POTENTIAL OF SMART CITIES

A study by ICTC found that in recent years, the employment of ICT professionals was consistently outpacing total employment across the economy at a rate of six-to-one.[5] At the same time, developments like blockchain, artificial intelligence (AI), 5G mobile networks, 3D printing and augmented and virtual reality (AR/VR) are creating an accelerated need for digital skills across all sectors. This demand is so pronounced that even without smart city development, it is estimated to reach upwards of 216,000 by 2021.[6] As a result, the ability to etch pathways for the development and attraction of highly-skilled talent to meet the needs of our quickly-evolving cities are key to the sustainability of our Canadian urban landscape.

The disruption of traditional employment skillsets creates the need for the development of new skills – and when considering smart city growth, these skills need to be future-proof. Moreover, as industries increasingly recognize the importance of a digital adoption and digitally-based growth strategies, competition for tech workers has increased. In 2017 alone, Canada saw a 5% increase in the employment of digitally-skilled workers – the highest growth in 10 years.[7] However, while Canadian companies are struggling to find enough digitally and technically skilled workers to fill positions at present, this demand will only accelerate as smart city innovations continue to permeate our economic sectors, and reshape our communities and societies. Increasingly, all jobs will have a digital component, and traditional skillsets across a variety of occupations will see shifts with smart city growth.

Overall, smart city developments may still be nascent in Canada, with much planning and organization to take place in the coming years on this journey. However, work must be completed today to understand which skills will be needed across a number of occupations – including those that correspond to both high-skilled and lower-skilled jobs.

[5] Cutean, A; Ivus, M. The Digital Talent Dividend: Shifting Gears in a Changing Economy. ICTC: December 2018. [https://www.ictc-ctic.ca/wp-content/uploads/2018/01/ICTC-Report\\_The-Digital-Talent-Dividend-FINAL-ENGLISH-1.30.18.pdf](https://www.ictc-ctic.ca/wp-content/uploads/2018/01/ICTC-Report_The-Digital-Talent-Dividend-FINAL-ENGLISH-1.30.18.pdf)

[6] Ivus, M.; Ye, Z. The Next Talent Wave: Navigating the Digital Shift – Outlook 2021. ICTC: April 2017. [https://www.ictc-ctic.ca/wp-content/uploads/2017/04/ICTC\\_Outlook-2021.pdf](https://www.ictc-ctic.ca/wp-content/uploads/2017/04/ICTC_Outlook-2021.pdf)

[7] Cutean, A; Ivus, M. The Digital Talent Dividend: Shifting Gears in a Changing Economy. ICTC: December 2018. [https://www.ictc-ctic.ca/wp-content/uploads/2018/01/ICTC-Report\\_The-Digital-Talent-Dividend-FINAL-ENGLISH-1.30.18.pdf](https://www.ictc-ctic.ca/wp-content/uploads/2018/01/ICTC-Report_The-Digital-Talent-Dividend-FINAL-ENGLISH-1.30.18.pdf)

Many high-skilled roles such as data scientists or cybersecurity analysts will see strong demand in our future smart economy. These roles will be critical to the development, shaping and maintenance of smart infrastructure, smart supply chains, smart energy applications and many other enhancements. At the same time, smart city growth will have the capacity to open up avenues for employment across a number of verticals, including a need for lower-skilled or even low-tech occupations and applications that can have tremendous impacts on our future cities and the overall quality of life for Canadians.

Autonomous vehicles – a key contributor to future smart mobility solutions – will not necessarily replace the need for automotive technicians or mechanics. Instead, their prevalence will alter the skills needed for these roles, bringing in new considerations related to maintenance, diagnostic detection and others. Similarly, the development of vertical farms will not lead to the total displacement of those in farming occupations. Skilled growers with the ability to monitor crop nutrition, take preventative measures and respond to challenges will still be needed – however, when working with vertical farms controlled by a remote system, their skills will need to shift to accommodate these new circumstances.

Technology and smart cities in particular are often regarded as the knells for labour changes and disruptions that will cause displacement. However, while this growth in Canada will partly be steered by the potential for efficiency and productivity gains, it will also need to be thoroughly shaped by the guiding principle of enhancing the quality of life of all Canadians; by spearheading a future anchored in inclusivity. Sustainable smart city growth in Canada will not depend on any one sector, or on only a cluster of high-skilled jobs. It will rely on people with diverse skills, backgrounds and viewpoints, and must include a variety of talent streams such as Indigenous people, those living in remote communities, and persons with disabilities.

Once this demand for both high and lower-skilled employment opportunities under our future smart cities are identified, we can begin to shape the appropriate pathways that will help today's workers obtain those skills. With a proactive approach like this, we can embark on this journey while ensuring that our future smart economy is one where everyone has the opportunity to participate.

# Smart City Priority Areas for Canada

## CANADA'S COMMITMENT TO THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT

In September 2015, Canada and 192 other UN member states adopted the 2030 Agenda for Sustainable Development. The 2030 Agenda is a 15-year global framework centred on an ambitious set of 17 Sustainable Development Goals (SDGs), 169 targets and over 230 indicators that are universal in nature.

In many ways, these goals are tied to smart city developments as they integrate social, economic, and environmental dimensions of sustainable development, as well as peace, governance and justice elements.[8] It can be argued that the concept of smart cities has emerged to address the challenges that are faced by the world's urban centres in these very areas. Here, efficiency gains through better urban planning enabled by tech-based innovation is often viewed as a necessity to provide solutions. The SDGs, along with ISO smart city standards were taken into consideration for ICTC's Smart City Priority Areas for Canada.

## ICTC'S SMART CITY PRIORITY AREAS FOR CANADA

### i. SMART GOVERNMENT

With the growing use of online platforms, in addition to the increasing reliance on data to facilitate decision-making, government institutions can sometimes face challenges keeping up with these changes. Oftentimes, the impact of these developments for the public sector are focused on the delivery of government services via online methods.

[8] The following SDGs were considered in the development of ICTC's Smart City Priority Areas: 3 – Good Health and Well-being, 4 – Quality Education, 5 – Gender Equality, 6 – Clean Water and Sanitation, 7 – Affordable and Clean Energy, 8 – Decent Work and Economic Growth, 9 – Industry, Innovation, and Infrastructure, 10 – Reduced Inequalities, 11 – Sustainable Cities and Communities, 12 – Responsible Consumption and Production, 13 – Climate Action, 14 – Life below Water, 15 – Life on Land, 17 – Partnerships for the Goals



In 2018, the United Nations launched an E-Government Survey with the purpose of measuring the level, quality and effectiveness of digital government services. Consulting with representatives from 40 different countries, the survey found that Denmark, Australia, and South Korea topped the list of countries leading e-government development.[9] On the same ranking, Canada placed 23rd, in between Ireland (22nd) and Italy (24th).[10] A renewed focus on digitization and online service provision in the public sector would help Canada better develop this central pillar for smart city growth, and compete with international counterparts.

Top 10 Global e-Governments	
Country	Rank
Denmark	1
Australia	2
Republic of Korea	3
United Kingdom	4
Sweden	5
Finland	6
Singapore	7
New Zealand	8
France	9
Japan	10

Source: United Nations E-Government Development Index, 2018.

Similarly, the availability of open data frameworks, and in particular open government data, is an important consideration for Smart Government development, as it encourages transparency and accountability in the public sector. When it comes to open data, Canada fared slightly better than it did on e-government development, coming in at 7th globally, tied with Norway[11] in 2018. However, compare this to Open Data leaders like the UK and the US, ranking 1st and 2nd globally, where the impact of that data was found to be 100% in each jurisdiction (compared to 58% in Canada).

[9] United Nations e-Government Survey 2018. United Nation – Economic & Social Affairs: 2018. [https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2018-Survey/E-Government%20Survey%202018\\_FINAL\\_PRINT.pdf](https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2018-Survey/E-Government%20Survey%202018_FINAL_PRINT.pdf)

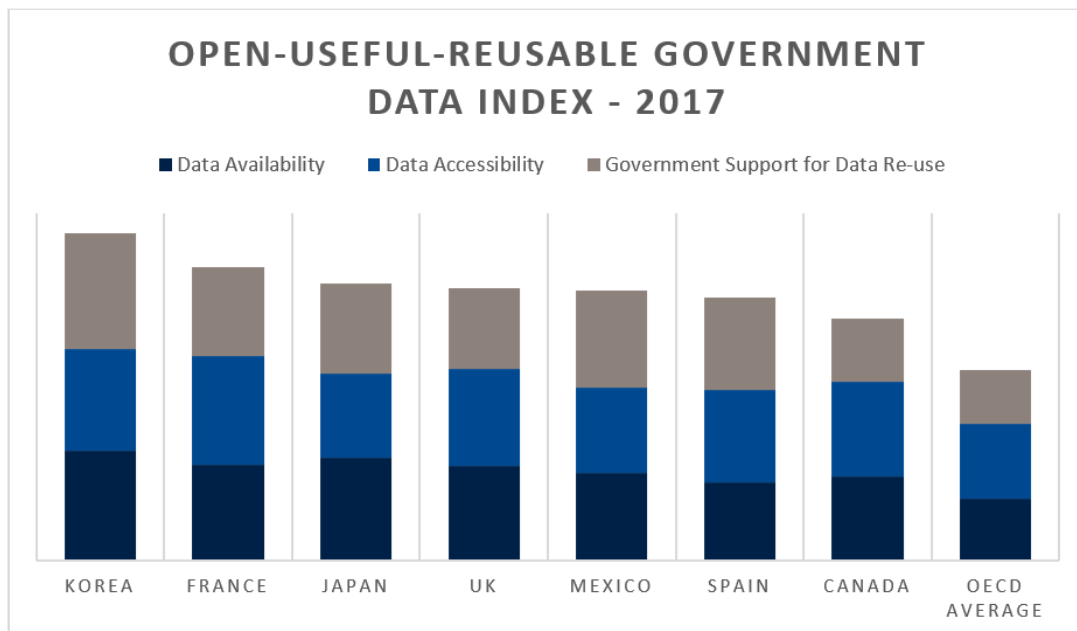
[10] Idem.

[11] Global Rankings. Open Data Barometer. <https://opendatabarometer.org/2ndEdition/analysis/rankings.html>

Top 10 Open Data Countries		
Country	Ranking	Impact of open data
United Kingdom	1	100%
United States	2	100%
Sweden	3	88%
France	4	84%
New Zealand	4	55%
Netherlands	6	57%
Norway	7	64%
Canada	7	58%
Denmark	9	95%
Australia	10	43%
Germany	10	53%

Source: Open Data Barometer, 2019.

Open government data is also a concept that is gaining ground, putting Canada among the ranks of international leaders in this space like France and the UK. In 2017, Canada placed 7th globally on the OECD's Open-Useful-Reusable Government Data Index, with data availability and accessibility outstripping the OECD average.[12] While some improvements may still be required for Canada to be a top global leader in this space, the high rates of availability, accessibility and re-use of open government data is a significant contributor for Canada's future Smart Government framework.



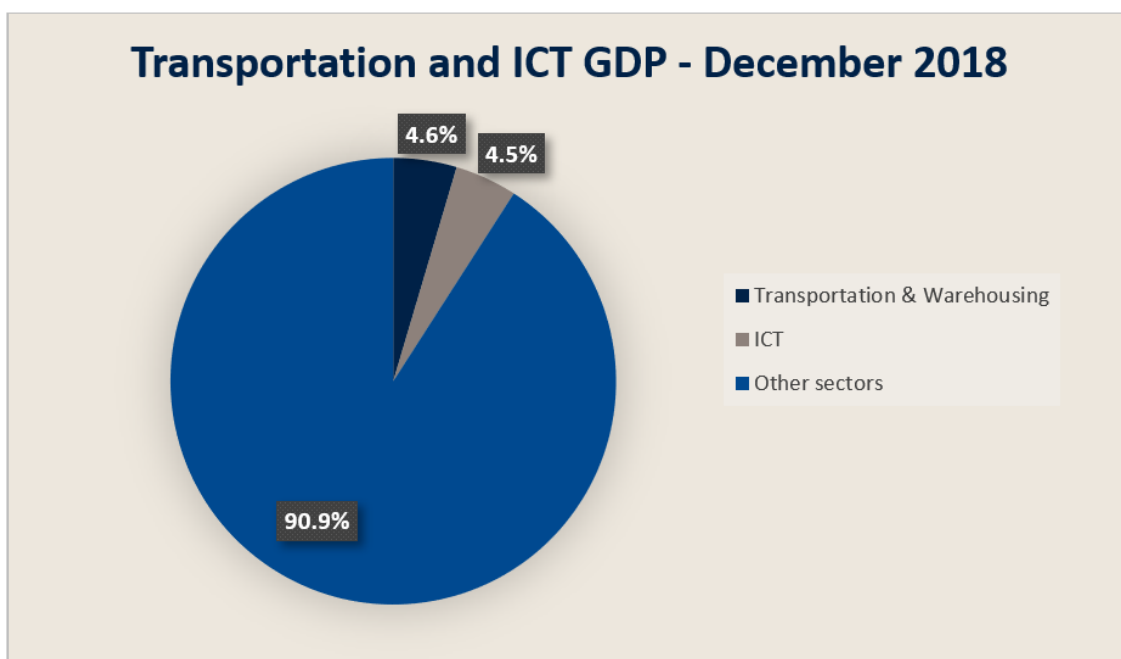
Source: OECD Survey on Government Data, 2017.

[12] Open Government Data. OECD: 2019. <http://www.oecd.org/gov/digital-government/open-government-data.htm>

Canadian citizens increasingly expect open and transparent governance, and responsible data usage as new models emerge for civic engagement; with key themes being inclusion, literacy, and choice. The digital interconnectedness of our future smart cities will likely function to accelerate these trends, placing a greater need on smart government frameworks, digitally-skilled workers, and smart government services for Canada.

## ii. SMART MOBILITY

Mobility encompasses not only the development of major transportation sectors and routes, but also the infrastructure that forms the foundation of communities across Canada. This includes public transit, roads, and bike paths, among others; with all of the movement taking place across these verticals being increasingly tracked and analyzed. At the end of 2018, the transportation and warehousing industry contributed nearly \$88.5 billion in GDP to the Canadian economy. This accounted for slightly more than 4.5% of total Canadian GDP. [13] By contrast, the ICT sector – where many new developments in smart mobility may stem from – accounted for \$87.6 billion at the end of 2018.[14] These sectors will likely see growing interconnection and collaboration as smart mobility technologies are refined and launched.



Source: Statistics Canada, GDP by Industry: Table 36-10-04340-1.

[13] GDP by Industry: Table 36-10-04340-1. Statistics Canada: 2019.

[14] Idem.

Intelligent traffic planning, the promotion of public transport, and the improved connectivity of road users in a city-wide communication infrastructure are all characteristics of a smart city. Fewer traffic jams in the inner city, along with the development of a largely zero-emission public transport system will ultimately have a positive impact on not just our transportation networks, but the environment and the quality of life in smart cities as well.

Smart mobility should be accessible, affordable, and effective; and the development and implementation of digital technologies into the transportation infrastructure of communities across Canada will highlight the critical importance of upskilling existing workers in this sector. Continuous learning and professional development will be required to help workers with their evolving responsibilities. Specific smart mobility initiatives are quickly gaining ground across Canada, with some significant developments including:

- Montreal, QC: launch of Propulsion Quebec, a cluster aiming to position Quebec as a global leader in the development and implementation of smart and electric ground transportation.
- Vancouver and Surrey, BC: implementing Canada's first two collision-free multi-modal transportation corridors in an effort to increase transportation safety, reduce greenhouse gas emissions, and increase transportation efficiency.
- The City of Victoria, BC: implementing a multi-modal transportation network that is convenient, green and affordable.
- Ottawa, ON's Autonomous Vehicle (AV) clusters: Ottawa, ON has more than 70 companies and organizations contributing technology and expertise in networking, software, cybersecurity and IoT to AVs and connected cars. A recent announcement by the federal government and BlackBerry, committed to a combined investment of \$350 million on AV technology, with the aim of creating hundreds of new jobs and co-op placements.[15]

[15] Kilpatrick, Sean. BlackBerry, federal government pour \$350M into autonomous cars. CBC News: February 25, 2019. <https://www.cbc.ca/news/canada/ottawa/blackberry-funding-government-autonomous-vehicles-1.5020137>

### iii. SMART INFRASTRUCTURE

Smart cities and communities are relying more and more on emerging digital technologies to manage everything from infrastructure and utilities, to social services. Smart infrastructure impacts everyone within a community, and as a result, requires the collaborative involvement of various stakeholders including academia, industry, civil society, and government.

One notable benefit of smart city development is the increased connectivity and data availability that will bolster economic growth and participation (as well as civic engagement and problem solving).[16] Increased visibility of city usage patterns may enable new business opportunities and innovations that can strengthen economic participation and job-creation across sectors.

Beyond economic benefits, there are also hopes that increased transparency and higher quality of data collection will inform better urban planning policies that can help cities address social challenges and inequalities. It is an essential aspect of the smart city to look at issues of sustainability through ethical and social lenses, in order to ensure that resources are used effectively and fairly.

Increasingly, smart city infrastructure challenges are being examined with an emphasis on topics like equitable communities, inclusive innovation (ensuring that innovations and benefits are shared broadly) and accessibility.[17] For example, Fredericton has begun to look at projects tying digital infrastructure and data to physical infrastructure, in an effort to alleviate mobility accessibility issues.[18]

When considering key infrastructure to enable improved connectivity, increased competition in the telecommunications sector must be a central focus. By allowing competition, not only will developments like 5G come to full fruition; but other critical telecommunications options such as mobile virtual network operators (MVNOs) and white space spectrum, as well as satellite technology, can be deployed to ensure that access to connectivity is inclusive, widespread, and cost-effective. This in turn, can help to support the longer-range development and deployment of smart infrastructure solutions backed by IoT.

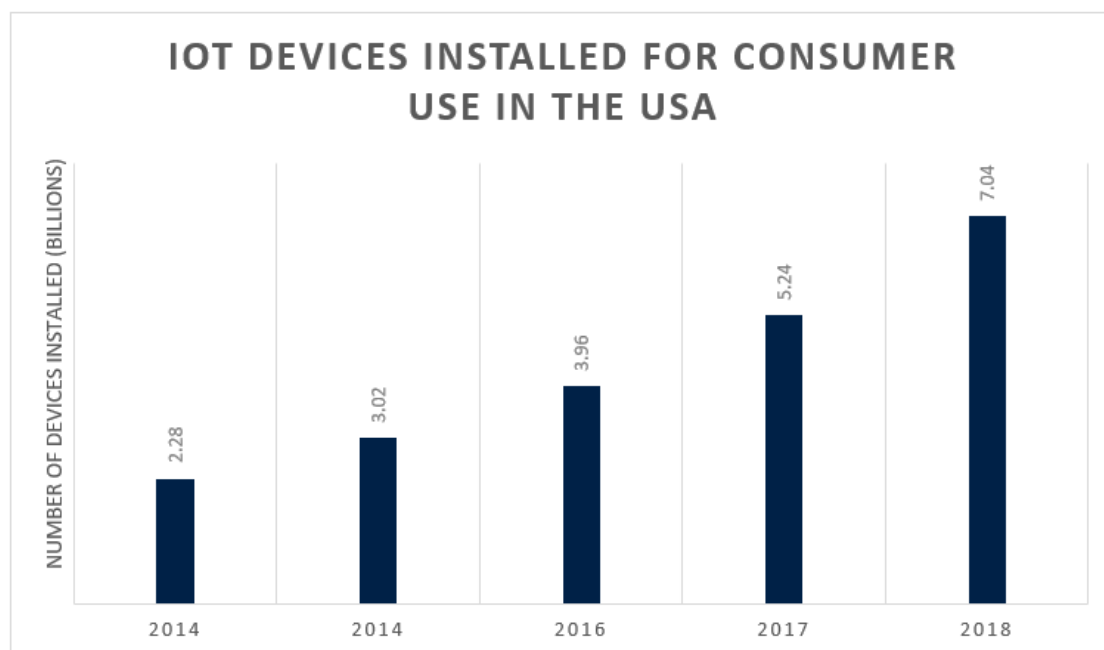
[16] Future Cities Canada. Future Cities Canada: 2019. <https://futurecitiescanada.ca/about/>

[17] Smart Cities Council Readiness Challenge Criteria. Smart Cities Council: 2019. <https://smartcitiescouncil.com/>

[18] Maccoubrey, David. St. Mary's First Nation and City Federation Gather for Joint Briefing on Smart Cities Challenge. Fred Scene: January 31, 2019. <https://fred-e-scene.com/st-marys-first-nation-and-city-of-fredericton-gather-for-joint-briefing-on-smart-cities-challenge/>



Some jurisdictions are looking to smart infrastructure to solve connectivity challenges, with examples including IoT-equipped streetlights hosting a citywide communication network.[19] Street lighting networks provide one of the most equitable and cost-effective means of deploying technology. Richmond Hill, Ontario, has already replaced conventional street lights with smart, IoT-based LED luminaires that have slashed energy and maintenance costs.[20] In the US, it is estimated that IoT installations at the consumer level have grown from slightly under 2.3 billion in 2014, to over 7 billion by 2018.



Source: Statista, IoT units installed by category, 2019.

Benefits via the implementation smart infrastructure are seen on many levels. A notable example includes the optimization of traffic and parking options that will lead to reduced road time for cars, while correspondingly reducing greenhouse gas (GHG) emissions. Sensors of real-time traffic can be used to control smart traffic signals and reduce intersection delays.[21] Edmonton, Alberta is looking at ways to move traffic more efficiently through trouble spots on its roads using artificial intelligence.[22] These are but a few examples of future smart infrastructure applications for Canada, with the impending rollout of 5G undoubtedly acting as a central factor influencing further smart infrastructure developments across a number of cities.

[19] The new street-lighting ecosystem. *Cities Today*: February 25, 2019. <https://cities-today.com/industry/the-new-street-lighting-ecosystem/>

[20] Halper, Mark. Toronto town settles on smart lights for now. *LEDs Magazine*: April 11, 2018. <https://www.ledsmagazine.com/articles/2018/04/toronto-town-settles-on-smart-lights-for-now.html>

[21] Johnston, Scott. City of Edmonton commits to start using smart traffic signals next year. *Global News*: June 19, 2018. <https://globalnews.ca/news/4284417/city-of-edmonton-smart-traffic-signals/>

[22] Stolte, Elise. The way of the future: Edmonton to embrace artificial intelligence for new traffic signals. *Edmonton Journal*: June 19, 2018. <https://edmontonjournal.com/news/local-news/the-way-of-the-future-edmonton-to-embrace-artificial-intelligence-for-new-traffic-signals>

#### iv. SMART ENVIRONMENT AND ENERGY

A sustainable environment is essential to the long-term viability of communities, and is integral to the well-being of the entire Canadian economy. Creatively and carefully managing essential resources such as land and water, and building climate-change resiliency are skills that today's workforce as well as future generations, will increasingly need.

Smart cities incorporate sustainable and resilient growth agendas that promote the use and support of green technologies and energy, as well sustainable consumption and production of traditional energies through innovative policies. Developments in this area should incorporate traditional environmental studies, as well as newer digital tools (and technical training) that can help connect, analyze, and predict trends related to the environment.

Across Canada, various smart technologies are addressing the challenges of climate change, food security, and sustainable and resilient growth,[23] with notable examples including:

- Guelph, ON: Canada's first technology-enabled Circular Food Economy is re-imagining an inclusive food-secure ecosystem that will increase access to affordable, nutritious food. Here, 'waste' becomes a resource, and new circular businesses and collaborations are created.
- The Pas, Opaskwayak Cree Nation, and Kelsey, MB: Utilizing LED smart farm technology, this community is supporting local nutritious food growth and promoting food security. Via a smartphone distribution system and integrated wearable technology, the project aims to achieve reductions in the number of imported vegetables and community diabetes rates.

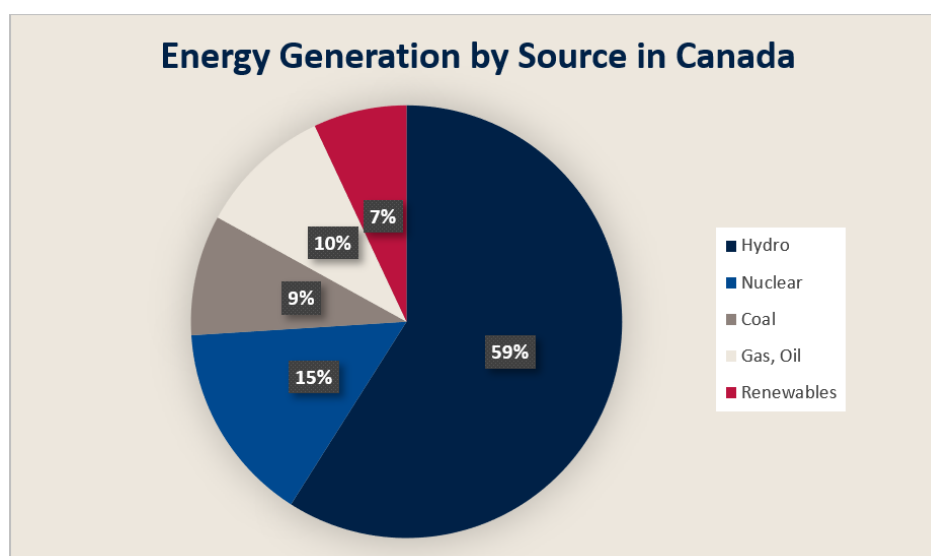
A major component of a Smart Environment pillar is energy usage. Cities and urban environments represent large contributors of economic activity (only 600 urban centers generate about 60 percent of global GDP)[24] and represent the majority of the global population. Given these realities, energy implications in urban areas have significant impacts on the environment and livability.

[23] Greenwood, Max. Canada's \$300 Million Smart City Challenge Finalists Unveiled. Techvibes: June 1, 2018. <https://techvibes.com/2018/06/01/canadas-300-million-smart-city-challenge-finalists-unveiled>

[24] Urban World: Mapping the Economic Power of Cities. McKinsey Global Institute: March 2011. <https://www.mckinsey.com/featured-insights/urbanization/urban-world-mapping-the-economic-power-of-cities>

Energy considerations for cities and urban planning can be sorted into several different broad categories. First, smart cities can increasingly incorporate direct energy generation projects into their urban planning and infrastructure development. There are a large variety of projects that can make use of Canadian advantages such as natural resources or environmental conditions.

A second consideration is regarding energy efficiency. Cities across Canada are increasingly aware of the need to reduce energy usage, and the significant benefits to the environment and cost-savings that can result. Lastly, power grid management is an area frequently referenced as an opportunity for smart cities technologies. Due to increasing energy demands and population growth, power grids are challenged at a daily rate, with significant issues of demand and system capacity. One example is the poor matching of the amount of energy that can be supplied by clean sources, compared to peak demand (high usage during the workday compared to quiet times when most people are sleeping). This is also exacerbated by seasonal challenges (whether for air conditioning in the summer or heating in the winter), which can place a varying demand on energy. In 2016, Natural Resources Canada found that only 7% of all energy generation in Canada came from renewables.



Source: Natural Resources Canada - Energy Sources, 2016.

There is increasing awareness that in the future, better connected cities can use their data to optimize energy usage – at an individual level, smart building level, as well as at a city-wide level.

In the future, a smart system for energy management can help with load leveling, by using energy stored through local batteries at homes or offices to offset high demand periods. Better knowledge of energy usage is valuable for incentivizing and shaping behaviours to improve overall performance at a city level.

## v. SMART HEALTH AND WELL-BEING

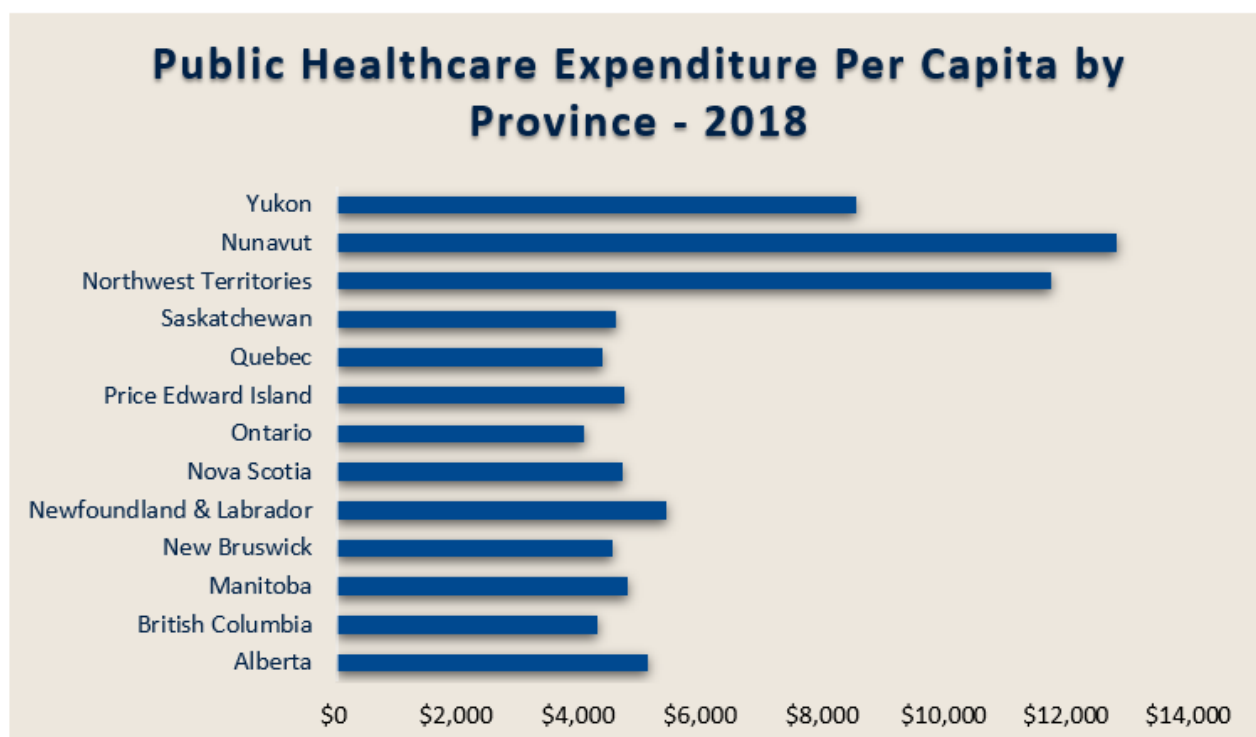
For cities and communities across Canada, the health and well-being of their citizens is a vital component of what makes them attractive places to live. Factors such as ageing populations and increasing urbanization highlight the critical need to provide important health services in a quick and efficient manner.

Innovative solutions to enhance the overall well-being of Canadian residents through key services such as smart health technology will be critical. Using technological advances, combined with the latest in mobile devices and apps devoted to healthcare can also help promote more equitable access to health care. Big Data, AI, and Blockchain technologies can be used to securely manage sensitive personal data, while enabling health care providers to offer more effective and efficient treatments. AR/VR is also an increasingly-used tool in the healthcare sector, with applications including remote surgeries.

Aging populations, chronic disease and ‘lifestyle’ diseases have placed great burdens on healthcare systems and spending around the world. Non-communicable diseases (NCDs or ‘lifestyle’ conditions) are leading causes of death that are strongly correlated with increased economic development and urbanisation.[25] In 2018, Canadian healthcare expenditure was estimated to have reached more than \$253 billion, or nearly \$7,000 per person on average, totalling more than 11% of GDP that year.[26] The lowest rates of healthcare expenditure were found in Ontario, at slightly more than \$4,000 per person; and the highest was seen in Nunavut, totaling more than \$11,500 per person.

[25] Majid, Aisha. Mapped: the global epidemic of ‘lifestyle’ disease in charts. The Telegraph: March 29, 2018.  
<https://www.telegraph.co.uk/news/0/mapped-global-epidemic-lifestyle-disease-charts/>

[26] How has health spending growth changed over the last 40+ years? Canadian Institute for Health Information: 2019.  
<https://www.cihi.ca/en/health-spending/2018/national-health-expenditure-trends/how-has-health-spending-growth-changed-over-the-last-40-years>



Source: Statsita, Government Healthcare expenditure per Capita, 2018.

Cities and communities will have an important role to play when it comes to bolstering preventative healthcare efforts and addressing local challenges. In Canada, several community leaders have been embracing smart health and well-being initiatives, with notable examples including:

- Edmonton, AB: The Healthy City Ecosystem intends to provide integrated, community-based health support.
- Côte Saint-Luc, QC: With more than 25% of all seniors in Canada living alone, this community is examining technological ways to connect with isolated seniors.

## vi. SMART REGULATION

Regulation is required to ensure the functionality of marketplaces, while safeguarding the rights and best interest of consumers. It is also a central cornerstone of discussions on “smart” policies that must work to continue to bolster these protections while spurring economic growth, innovation, and productivity in an increasingly digital and interconnected world.



Sustainable regulation must balance the creation of policies and practices that protect customers and industries, while allowing space for competition, innovation, and the disruption of our existing economic and business structures. Additionally, regulators must also factor in potential unintended consequences [27] of this disruption, such as shifting industry needs, changing job needs, and even labour displacement.

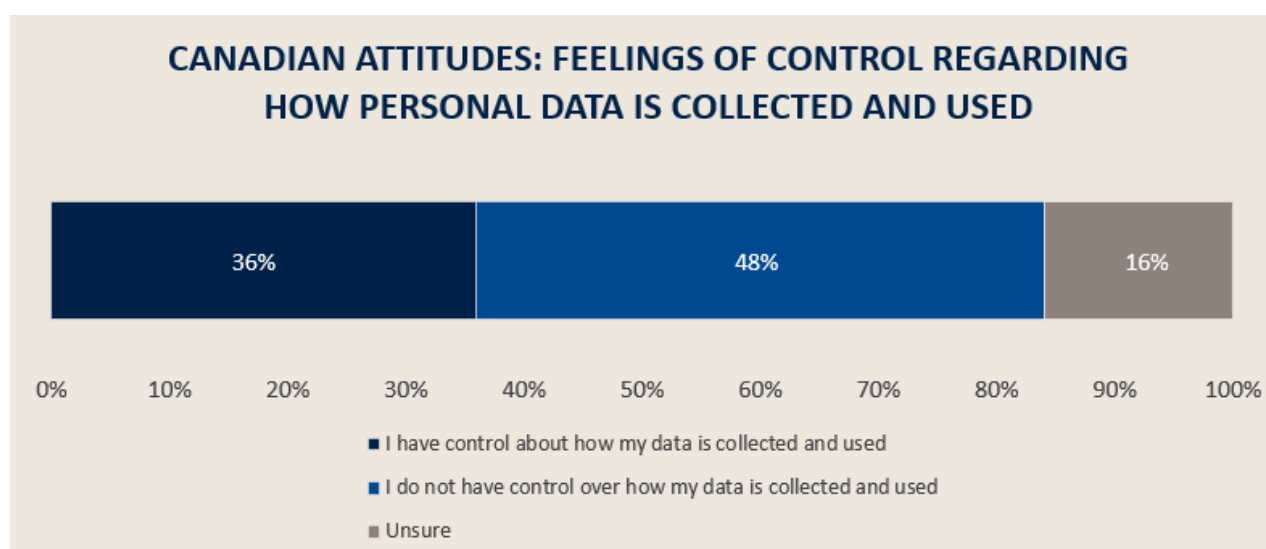
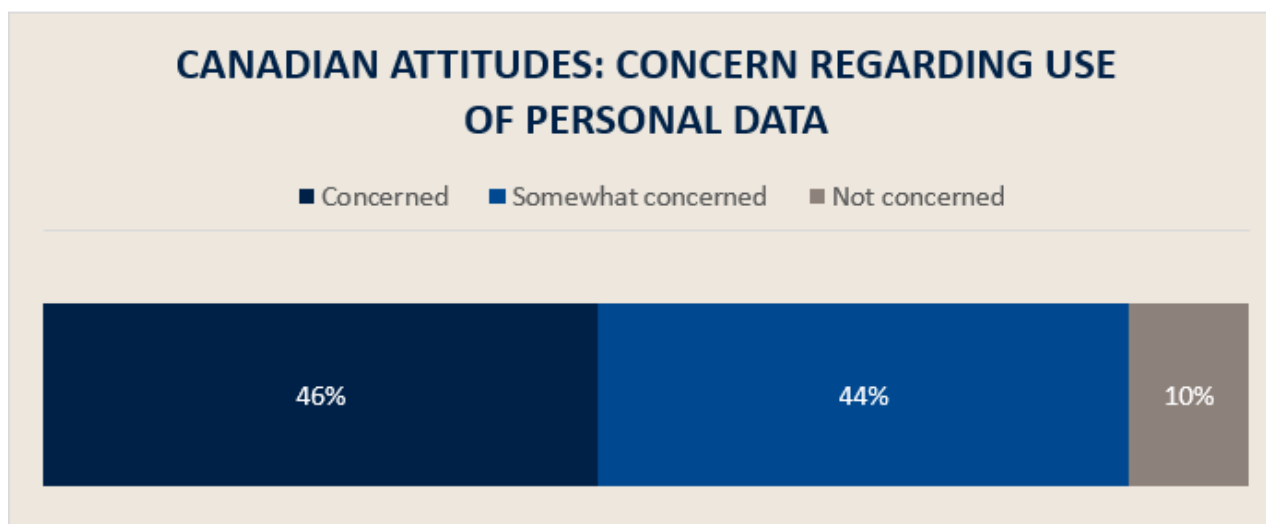
One central topic related to smart cities is the effective regulation of data privacy, to ensure that data is used effectively, securely and ethically. In the European Union, GDPR rules must be taken into account with any smart city development, meaning that the agents driving these changes are required to provide awareness to city residents on how and why data is collected, how and when it will be used, and what it will be retained for. GDPR sets a standard framework for future smart cities that will rely on the heavy utilization of various data, including that of individual citizens. A recent survey of city officials across Europe found that GDPR was largely seen as a positive measure. City officials from Dublin to Athens, to Barcelona and several others affirmed that GDPR provides clarity around purpose to data collections, producing better safeguards and assurance for citizens.[28]

The notion of regulation on data use is also quickly gaining ground in Canada, particularly as we move towards a “smart” future. With developments like Sidewalk Labs in Toronto and the Smart Cities Challenge, the Canadian privacy commissioner recently called for privacy and security information to be key selection criteria in the challenge.[29] Moreover, concerns about data use and control of personal data appears to be echoed by Canadian citizens. A recent survey by the Canadian Office of the Privacy Commissioner found that the vast majority of Canadians had at least some level of concern about how their personal information was being used, with many noting a feeling of lack of control of their own data. Being that our future cities will constantly collect, transmit and utilize data, the development of clear regulation on this topic is an increasing priority.

[27] Eggers, William; Kishnani, Pankaj; Turley, Mike. The future of regulation: principles for emerging technologies. Deloitte: June 19, 2018. <https://www2.deloitte.com/insights/us/en/industry/public-sector/future-of-regulation/regulating-emerging-technology.html>

[28] Andrews, Jonathan. How the EU’s new data laws will affect Smart City development. ITU News: August 7, 2018. <https://news.itu.int/eu-gdpr-smart-cities/>

[29] Privacy guardians: Smart city initiatives must include privacy protections. Office of the Privacy Commissioner: April 26, 2018. [https://www.priv.gc.ca/en/opc-news/news-and-announcements/2018/an\\_180426/](https://www.priv.gc.ca/en/opc-news/news-and-announcements/2018/an_180426/)



Source: Office of the Privacy Commissioner, 2016 Survey of Canadians on Privacy.

Related to data use, two other important regulatory considerations are data portability, and the responsible development and use of artificial intelligence (AI). Data portability refers to the ability of an individual to receive his or her data which has been collected or used by one party, and provide it to another party, without hindrance from the original data controller.[30] Another key component of GDPR, data portability can allow for the development of innovative services such as open banking. Additionally, the need to craft regulations on the responsible development and use of AI is also essential, since AI will be a driving force of future smart cities. It is of tantamount importance that AI applications be developed under regulatory parameters incorporating ethical considerations such as the removal of inherent biases, as well as legal considerations like causation principles in dispute settlement.

[30] General Data Protection Regulation: Article 20 – Right to data portability. <https://gdpr-info.eu/art-20-gdpr/>

Naturally, the need for regulation in the smart city context does not stop at data collection and usage or AI regulation. Other important considerations for regulation include the changing infrastructure, insurance, zoning and safety needs related to the increased permeation of smart mobility technologies from ridesharing to autonomous vehicles. A second example is the increasing commercial use of IoT devices – with the built-in security features of many IoT devices being basic to subpar,[31] the need for regulation of data security and protocols for security breaches related to IoT is looming. Other areas of regulation needs include new policies for a healthcare sector that will increasingly be digital, environmental protection and climate change standards and protocols, and many others. In a future that will be highly connected, interwoven, and “smart,” effective, timely and adaptable regulation and policies will cut across all sectors; and they will be a central determinant of the success of our cities and communities.

## TRACKING AND SUPPORTING OUR SMART FUTURE

Examining “smart” developments in Canada across these pillars will help track Canada’s cities on their pathways to a smart future. These pillars will be the basis by which to analyze the growth of smart city technologies, and their actual and potential impact across the economy.

Highlighting innovations and breakthroughs in these priority areas is the starting point for shining a spotlight on the considerations that will drive new and shifting skill needs across a number of occupations. Once we understand the demands and skill needs that these changes will usher in across our cities, we can better respond and begin to prepare workers a job-ready future.

[31] Sears, Alec. Why Smart Cities Need Smart Policies. IoT For All: December, 11. 2019. <https://www.iotforall.com/why-smart-cities-need-smart-policies/>

# Smart City Labour Readiness Index

In an effort to measure the effective “readiness” of cities to respond to emerging smart city job and skill needs, ICTC is designing a Smart City Labour Readiness Index. This index will examine and quantify various dimensions that will be consolidated into an overall evaluation of a given city’s readiness to tackle emerging labour market demands. These metrics will be useful in measuring current skills and labour availability, and will also provide insights on how well-positioned a city may be to adapt to further disruption or future trends. Since large metropolitan areas would likely have different needs and capacities than smaller cities, it is important to craft an Index that can provide an appropriately scaled and weighted framework to ensure a valid comparison of both.

ICTC’s Smart City Labour Readiness Index is based on four main pillars, and comprised of various indicators. The following is a representation of the Index and its components.

## PILLAR ONE: EDUCATION AND SKILL LEVELS OF EXISTING WORKERS

### AVAILABILITY AND QUALITY OF EDUCATIONAL RESOURCES

- **University saturation:** A breakdown of universities by province is available through the organization Universities Canada. This can be used as a baseline by which to further identify the presence of universities (public and private) in a city – a key factor in assessing availability of important educational resources.
- **College and technical institute saturation:** The number of these institutions in a city can be measured via a search by jurisdiction or through listings on national college associations such as Colleges and Institutes Canada and the National Association of Career Colleges. The availability of colleges and technical institutes is also a central contributor to overall availability of educational resources in a city.

- Saturation of alternative training institutes (e.g. bootcamps): Without the existence of a national, regulated database on such resources, their availability can be measured through city-specific searches. As most tend to be located in major tech hubs, some existing databases like Course Report or Switchup may prove useful as guiding tools. These alternative educational pathways are increasingly relevant upskilling or retraining solutions, particularly for technology-related occupations.
- Training programs geared at underrepresented groups: The availability of such sources can act as an element to measure support for boosting the participation of underrepresented groups in digital and other in-demand occupations. Partnerships or collaborations with specific stakeholder organizations such as the First Nations Tech Council or Blackboys Code can be useful in providing visibility in this area.
- City rankings for 'Best Student Cities': Encompassing various measures like affordability, desirability, employer activity, and student ratings, these rankings can prove to be useful indicators in measuring the availability of youth and post-secondary graduates to fill industry demand in a given city.

## EDUCATION LEVELS OF TALENT

- Portion of the population holding traditional post-secondary education credentials: Knowledge of current education levels is useful to assessing baseline "job-readiness", as well as existing qualifications related to upskilling needs. Statistics Canada and the OECD measure various indicators for educational attainment such as the highest level of attainment, field of study, location, Registered Apprenticeship certificates, and demographics. The following data can be collected:
  - STEM degrees (as a % of total)
  - CIP (Classifications of Instructional programs) Codes and measures of regional completions



- Portion of the population holding non-traditional post-secondary education credentials: This includes the portion of the population holding certificates, bootcamp certifications, MOOC qualifications, and other such credentials. [32] Understanding these trends can be extremely useful to measuring the acceptance of short-duration programs by both job-seekers and employers – something that can prove very meaningful when crafting upskilling pathways for various supply streams. Some of this data (on types of certificates, for example) is available via open data portals of provincial ministries of advanced education. Baseline data bootcamp certifications can be obtained from Canadian-based organizations offering these services; and data on MOOC completion can be estimated using LinkedIn.

## TECHNICAL AND DIGITAL SKILL LEVELS OF TALENT

- Basic digital skill levels: Since all future jobs will require some degree of digital literacy, another angle of measuring workforce readiness is to focus on digital skill levels. A variety of skill dimensions and international measures track the Canadian population in relation to the attainment of foundational (basic) digital skills. Such sources include:
  - Survey of Adult Skills (PIAAC)
  - EUCIP (European Certification of Informatics Professionals)
  - SFIA (Skills Framework for the Information Age - UK)
  - The Government of Canada’s Future Skills Centre

These surveys track basic digital competencies like digital literacy, numeracy, and problem-solving skills in technology-rich environments.

- Advanced digital skill levels: An understanding of the population with advanced digital skills is relevant to track potential supply streams for high-demand roles that require more comprehensive digital skillsets. Once the parameters of these skills are identified, they can be captured via LinkedIn and Riipen estimates.

[32] Possible sources: CICan, Universities Canada, Riipen, Lighthouse Labs, EvolveU, LinkedIn.

## PILLAR TWO: EMPLOYMENT AND TALENT DEVELOPMENT

### CURRENT EMPLOYMENT LEVELS

- Macroeconomic labour force results and trends: An understanding of overall labour force trends is an appropriate foundation by which to gain insights on the unique local labour environments for each city. These can be measured using Statistics Canada data for:
  - Labour force participation (overall, by age, gender, etc.)
  - GDP per capita (possible reflection of productivity per worker)
  - Labour force participation in “high-demand jobs”[33] across various demographic indicators
  - Unemployment (reflection of economic realities and the potential untapped pool of labour)
  - Unemployment in “high-demand jobs”
  - Other relevant factors such as job location data and wage trends

### WORKER MOBILITY AND FLEXIBILITY

- Prevalence of non-traditional or fractional work: The presence of non-traditional work (i.e. non-fulltime employees) is an important metric by which to capture changing labour and economic trends of a city. This will be captured by assessing the rate of temporary, contract and part-time employment, along with participation levels in the sharing or gig economy, where data is available. Some of this data can be obtained via secondary datasets from Statistics Canada, the OECD or other sources, while others may need to be obtained via supply steam surveys.
- Availability of co-working spaces: The availability of co-working spaces is a key consideration when assessing the level of entrepreneurialism in a city. The availability of such spaces can be measured by tracking available space at tech hubs and other co-working service providers.

[33] To be determined by ICTC.

- Remote work opportunities: Remote work opportunities is a useful metric by which to measure changing employment practices, which may aid in fostering greater economic participation and productivity. Remote work opportunities can be tracked via employer surveys as well as job postings advertising remote work options.
- Broadband availability and quality: Broadband availability and quality are important benchmarks when it comes to measuring the actual potential of non-traditional work structures such as remote work or gig work. Some of this data can be found via the CRTC or CIRA, including statistics on the following:
  - Mobile internet coverage/WiFi connectivity on buses and trains
  - Rural/Northern internet connectivity coverage
  - Upload/download speeds.

Other data, such as the relative quality level of connectivity, will be measured via targeted supply surveys for each city.

### **IMMIGRATION AND ATTRACTION OF INTERNATIONALLY-TRAINED PROFESSIONALS**

- Net Migration: Immigration is a significant component of a region's ability to attract and retain the workers required for economic growth. This is particularly vital for smart city projects that will likely demand highly-qualified personnel (highly educated or trained workers that are valued around the world). The ability of a region to attract internationally-skilled workers can be measured according to various methods including:
  - Provincial Nominee Programs: Data from these programs can be used to create a baseline understanding of the volume of immigrants coming in to a given province, and their skill background. Where available, data will be requested for city of landing.
  - ICTC GO Talent database: The ICTC GO Talent database can be used as a baseline metric by which to assess volume of immigrants with key educational and skill backgrounds immigrating to various cities. This data can be used to compare inbound immigration per city over the last number of years to determine potential future trends.

- Availability of immigration settlement and assistance programs: The availability of such programs (e.g. SUCCESS, Manitoba Start, World Skills, YMCA) is a useful measure by which to estimate a city's level of attractiveness for international talent. More, the amounts of funding, participants helped, and outcomes from these programs can be useful ways of evaluating a city's capacity to help settle immigrants. This data can be captured via partnership on information sharing with the appropriate service-providers.

## PILLAR THREE: CAPACITY TO TACKLE FUTURE EMPLOYMENT AND SKILL NEEDS

### INVESTMENT IN EDUCATION AND TRAINING

- Investment in youth training programs: Investment in youth training programs is an important measure by which to gauge the ability of future graduates to become "job ready" and meet future industry demand. Data on investment can be gathered via federal and provincial funding commitments, as well as industry funding commitments on the topic.
- Investment in adult training or reskilling programs: Investment in adult training or reskilling programs are key to understanding the potential future availability of existing workers to fill in-demand jobs (including career transitioners, Indigenous groups, women, people with disabilities). Data on investment can be gathered via federal and provincial funding commitments, as well as industry funding commitments on the topic.

### OUTPUTS OF INVESTMENT IN EDUCATION & TRAINING

- Youth: analyzing the outputs of investment in youth programs will be valuable to understand how investments have contributed towards a greater (or better-skilled) supply of talent to meet industry needs. The skill and employment outcomes for graduates with co-op/internship experience can be tracked via results from:
  - Riipen projects
  - ICTC's WIL digital graduate outcomes
  - ICTC's FIT certificate graduate outcomes

- Adults: understanding the outcomes of adult upskilling/retraining can be useful in determining a potential sample of job-ready workers for in-demand jobs. Specifically, skill and employment outcomes can be measured from partnerships formed with organizations providing upskilling such as Lighthouse Labs or EvolveU. Indigenous organizations such as the Canadian Council of Aboriginal Business, Indspire and the First Nations Tech council may be able to provide data on upskilling programs under their mandate. The First Nations Tech Council in particular may be able to provide data from their Pathways to Technology tech training program. Similarly, groups like Women in Communications Technology and SCWIST may be able to offer data on training programs under their mandate; and organizations like March of Dimes and Neil Squire Society may be similarly appropriate for people with disabilities.

## PILLAR FOUR: CAPACITY TO FOSTER AN INNOVATIVE BUSINESS CULTURE

### ENTREPRENEURIALISM AND LOCAL BUSINESS INFORMATION

- Portion of students graduating from “entrepreneurship” programs: Understanding the relative volume of students graduating from business programs with an entrepreneurial focus is useful to gauge possible future business growth and development in a city. This data can be gathered from post-secondary institutions.
- Availability of accelerators, incubators, hubs, mentorship programs: Knowledge on the availability of small business and entrepreneurial support frameworks in a region can act as strong indicators of the strength of the local start-up or entrepreneurial environment. This data can be accessed through sampling from organizations like Fundica that maps the location of these services across Canada.

- Quantity and quality of start-ups: The growth of startups in a given region or city can be an indicator of local small business growth and a supportive climate for innovation. This can be further measured by:
  - % of start-ups that focus on digital priority areas, including projects under the government of Canada’s Innovation Superclusters
  - % of startups that have become “unicorns”
  - % of startups that succeed beyond 3 years

This data can be gathered from the economic development agencies in a given city, AngelList, or regional databases such as Vancouver Startups.

## ATTRACTION OF INTERNATIONAL CAPITAL AND INVESTMENT

- Venture Capital: Venture Capital can be seen as a proxy for a measure of the economic dynamism of a region. This form of investment capital is strongly tied to high growth and innovation sectors such as ICT, biotech, AI, or cleantech. This capital is also reflective of larger business networks, entrepreneurship, mentorship, and international ties. This data can be captured through a variety of secondary sources such as the Canadian Venture Capital and Private Equity Association and AngelList.
- Foreign Direct Investments (FDI) under smart city priority areas: FDI is a valuable measure of international networks. It can boost the economic performance of companies, as it reflects information and best-practice sharing from foreign investors or multinationals. A higher measure of FDI may also tie to the economic strength and innovativeness of a region, and the knowledge gained can be useful for measuring the readiness or capacity for smart projects. It may be measured at a city level by organizations such as Invest in Canada, FDI Intelligence, the World Bank, or the OECD. Particularly important data points in this space include:
  - Type of FDI (greenfield, horizontal FDI)
  - Dollar-value of the investment
  - Industry sector, subsector, or cluster
  - Number and type of jobs created from the investment

Tracking these trends over time will be a valuable method of capturing a given city’s potential to attract high-quality foreign investment.

## **MEASURING OUR SMART LABOUR READINESS**

Measuring the relative readiness of a city to become a “smart city” involves an analysis of many moving parts, such as quality of infrastructure, regulation, technology adoption and many others. However, one key element for consideration is the quality and skill level of talent in that city. ICTC’s Smart City Labour Readiness Index can serve as a baseline method by which to measure the availability and “readiness” of that city to grow and develop the talent needed to tackle smart city challenges and contribute to continued development and growth.