# Infrastructure Trends and Innovations

## Implications for Employment and Skills in Canada

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The Diversity Institute conducts and coordinates multi-disciplinary, multi-stakeholder research to address the needs of diverse Canadians, the changing nature of skills and competencies, and the policies, processes and tools that advance economic inclusion and success. Our action-oriented, evidence-based approach is advancing knowledge of the complex barriers faced by under-represented groups, leading practices to effect change, and producing concrete results. The Diversity Institute is a research lead for the Future Skills Centre.

The Future Skills Centre (FSC) is a forward-thinking centre for research and collaboration dedicated to driving innovation in skills development so that everyone in Canada can be prepared for the future of work. We partner with policymakers, researchers, practitioners, employers and labour, and post-secondary institutions to solve pressing labour market challenges and ensure that everyone can benefit from relevant lifelong learning opportunities. We are founded by a consortium whose members are Toronto Metropolitan University, Blueprint, and The Conference Board of Canada, and are funded by the Government of Canada's Future Skills Program.

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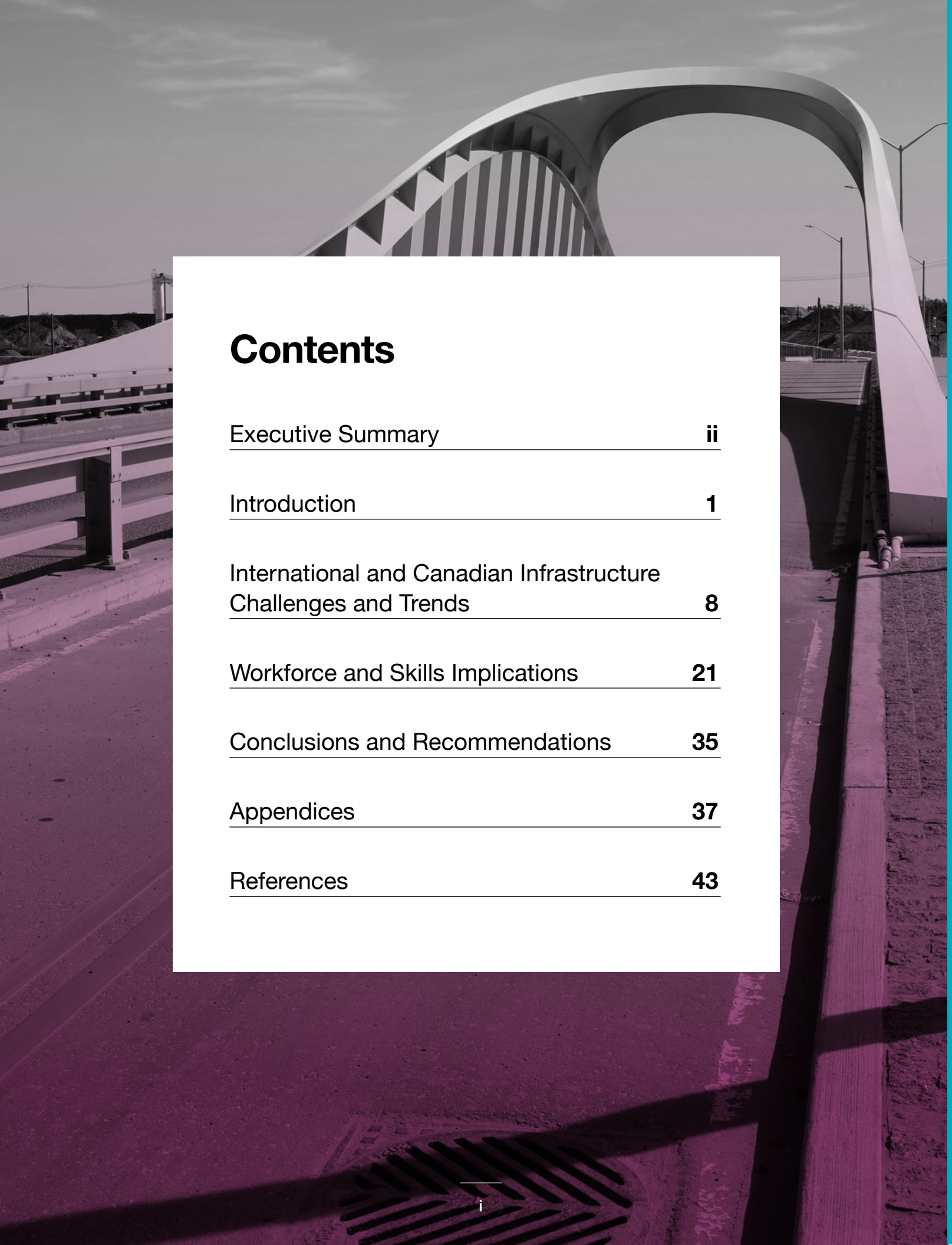


# Contents

# Executive Summary

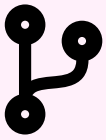
Canada and other nations face a pivotal moment in addressing aging infrastructure, rapid urban growth, housing affordability challenges and the urgent need for sustainable and resilient development. At the same time, the infrastructure sector—encompassing construction of buildings, transportation systems, utilities and more—is undergoing a technological transformation that promises to boost productivity and sustainability. The newly elected federal government recognizes this issue, and has made a renewed commitment to addressing Canada's housing shortage as part of a wider economic strategy to deal with the threat of American tariffs. This report examines global and Canadian infrastructure trends, highlights innovative practices (digitalization, green construction, modular methods, regulatory reforms) and analyzes the implications for the workforce and skills required in the coming years.

Globally, demand for infrastructure is surging, yet many projects struggle with cost overruns and delays. An overwhelming 91.5% of large projects worldwide go over budget or behind schedule, underscoring challenges in project delivery and management. In Canada, decades of underinvestment have led to an infrastructure deficit: a significant share of roads, bridges, transit and water systems are in fair or poor condition. Meanwhile, population growth in urban centers (5.2% nationally from 2016–2021) has intensified pressure on housing and transit, contributing to a housing affordability crisis; over 10% of Canadian households are in "core housing need," spending 30%+ of income on shelter. Climate change adds urgency, as infrastructure must be adapted to more extreme weather and decarbonized to reduce emissions.

Case studies, such as Minneapolis's zoning overhaul to allow higher-density housing that expanded supply by 12% and Canadian initiatives like Calgary's city-wide upzoning in 2024, illustrate the impact of forward-looking policies.

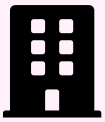
The implications for employment and skills are profound. The construction industry remains a significant employer (about 1.6 million Canadian workers, ~8% of GDP), but is confronted with a looming labour shortfall. An estimated 269,000 construction workers—roughly one-fifth of the workforce—are expected to retire by 2034, far outpacing the number of new entrants and contributing to a projected shortage of around 108,300 workers.

**The infrastructure sector is innovating across multiple fronts. This report identifies key innovation areas:**



**Digital transformation**

Building information modeling, automation, data analytics – **to improve efficiency**



**Advanced and modular construction techniques**

Prefabrication, 3D printing, mass timber – **to speed up building and address labour shortages**

**Sustainable infrastructure practices**

From low-carbon materials to green design – **to reduce environmental impact**

**Regulatory and policy innovations**

Zoning reform, updated building codes, streamlined approvals, new procurement models – **to enable and scale these solutions.**

The workforce also lacks diversity: women represent only around 14% of Canada's construction workforce and are heavily concentrated in office-based roles, while skilled trades remain overwhelmingly male. New competencies are in demand, from digital skills to operate BIM and robotics to expertise in energy-efficient building and retrofitting. This report discusses the current skills gaps, future workforce projections (including the need to attract more youth, immigrants and equity-deserving groups) and strategies for upskilling and reskilling existing workers to meet the sector's evolving needs.

Finally, this report provides policy and practice recommendations to capitalize on these insights. With the federal government's renewed commitment to invest in housing and infrastructure, it is essential to make smart investments and coordinated policy decisions. Governments and industry stakeholders are urged to invest in innovation and productivity (through incentives for technology adoption and pilot projects), modernize regulatory frameworks (to encourage sustainable and modular construction and reduce approval bottlenecks) and strengthen workforce development (via enhanced training programs, support for apprenticeships, immigration pathways for tradespeople and initiatives to improve diversity and inclusion on work sites). By taking coordinated action, Canada can leverage emerging infrastructure innovations to not only build the roads, transit, housing and utilities its growing population needs, but also create quality jobs and a future-ready workforce.

# Introduction

Infrastructure is the backbone of economic competitiveness and community well-being. Around the world, countries are grappling with aging infrastructure and rising demand for new investment. Developed economies face the dual challenge of rehabilitating old assets while building modern, sustainable systems. In developing regions, rapid urbanization and population growth are driving an urgent need for housing and basic infrastructure. According to the World Economic Forum, about 1.6 billion people worldwide lack access to adequate housing, a number that could reach 3 billion by 2030 without drastic action.[1] The global affordable housing crisis has been fueled by factors such as rapid urban migration, insufficient public housing supply, underinvestment by governments and the financialization of housing (treating housing as an investment asset).[2] In addition, the volume and complexity of infrastructure projects are increasing, with more megaprojects (projects over US$1 billion) being undertaken. This increased complexity has resulted in 91.5% of large projects worldwide running over budget or behind schedule.[3]

Federal governments in Canada have attempted to address the housing affordability crisis. The government of Prime Minister Justin Trudeau announced its National Housing Strategy in 2017, which grew from a $40-billion plan into a $82-billion plan to improve housing affordability. Despite these efforts, this plan coincided with an increase in house prices and homelessness.[4] The newly elected government of Prime Minister Mark Carney has promised to redouble these efforts, with a goal of building nearly half a million homes a year. Part of this strategy calls for investing $25-billion in building prefabricated and modular homes using innovative construction practices. This investment will be combined with cuts in the goods and services tax for first time homebuyers, other financial incentives and other measures.[5]

These developments make it essential to have a better understanding of the labour force and the skills needed to successfully build out infrastructure and housing. This report examines the state of the Canadian construction industry, current labour market challenges, best practices for upskilling and reskilling in Canada and globally, and the state of equity, diversity and inclusion in the infrastructure workforce.

## The Canadian construction industry

The construction industry contributes $183 billion to Canada's GDP, representing 8% of Canada's GDP in 2021.[6] It has been one of the largest employers of skilled tradespeople and the sector employed 1.6 million workers in aggregate in 2023.[7] Historically, investment in the sector has been subject to significant cyclical fluctuations due to its sensitivity to the interest rate environment, the cost of financing, government investment and other macro economic factors. In recent years, this dynamic business environment has resulted in fierce competition, escalating costs and thin profit margins.[8, 9]

The Canadian construction industry is also characterized by a high level of fragmentation.[10] Of the sector's 405,139 establishments, over one-half have no employees (or an unknown number), and of the remaining 156,219 firms, 61.5% have 1–4 employees, 37.4% have 5–99 employees, 1% have 100–499 employees and 104 establishments or 0.1% have 500+ employees.[11] This structural factor, combined with the cyclical nature of the industry, affects the sector's conduct and performance. Research has shown that while SMEs across sectors account for the lion's share of private sector employment in Canada, they often lack the resources and know-how to innovate, grow and upskill their employees.

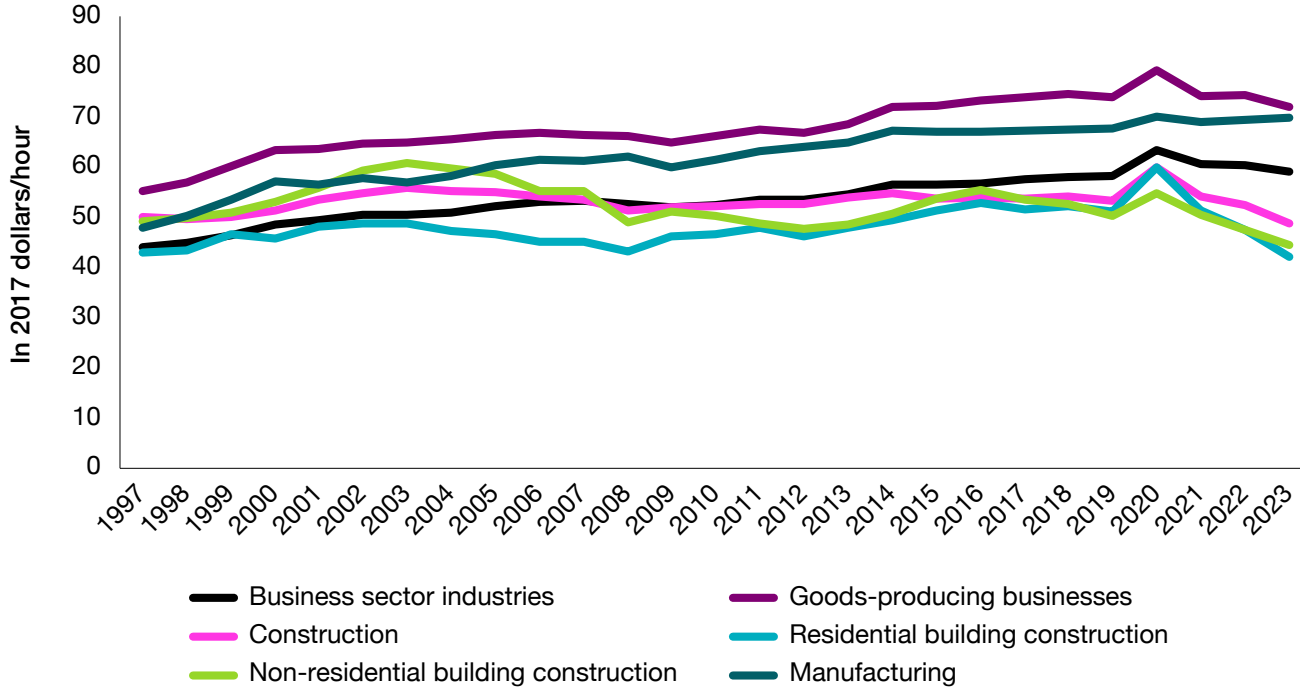
*The construction industry contributes **$183 billion to Canada's GDP**, representing 8% of Canada's GDP in 2021. It has been one of the largest employers of skilled tradespeople and **the sector employed 1.6 million workers in aggregate in 2023**.*

The Canada Mortgage and Housing Corporation (CMHC) has highlighted industry fragmentation as a key barrier to technology adoption and productivity improvement within the industry.[12] They note that "low market consolidation hinders investment in R&D and efficient recruitment, training, resource allocation and project management."[13] Canada cannot realize its national housing strategy goals without sector consolidation and regulatory reform.[14]

Labour productivity in the construction sector lags that of the Canadian economy overall and productivity has further declined relative to the average productivity across sectors.[15]
A key factor in this is its low rate of technology adoption. A 2020 CCA/KPMG study found only 23% of construction companies surveyed said their decisions are based on data to a considerable or great degree, and the majority expressed that they had either not

**Figure 1**

**Labour productivity trend (GDP/hour worked), by industry, 1997–2022.[23]**




adopted advanced technologies or their use was only experimental.[16] Only 25% of firms reported having the skills to undergo digital transformation to a considerable or great degree.[17] Further, the majority of firms in the sector have no plans to adopt new technology in the next 12 months.[18] While technology adoption has been a global issue as the sector overall has been slow to innovate,[19] productivity, innovation and digital adoption in Canada lag our global competitors. As a consequence, Canada is starting from an uncompetitive position and the requisite investments and rate of transformation are substantive.[20]

Beyond the opportunity costs of lost productivity, our uncompetitive position matters given the recent government procurement trend toward mega-projects. Mega-projects not only limit who can compete (pushing out SMEs), they place Canadian companies in competition with large suppliers from Asia, Europe and the United States.[21] Further, skills and labour shortages in the sector have been partly attributed to the lagging adoption of new construction technologies.[22]

## Figure 2

**Construction investment forecast 2024–2033, residential vs. non-residential.**[25]


Note: this graph reflects 2023 data as the updated data tables were not available at the time of publication.

Given Canada's housing affordability crisis and aging infrastructure, strong investment in residential and non-residential construction is anticipated through to 2034 (Figure 2).[24] This projection excludes government investments in new housing and their efforts to incentivize and stimulate construction, which will further accelerate growth.

A stable business environment, combined with zoning and regulatory changes, new policy and government incentives may create a more favourable environment to stimulate technology integration and productivity improvements. This forecast assumes a timely resolution to the Canada – U.S. trade dispute, the impact of which is unknown. The federal government's plan to accelerate housing construction is in part an effort to mitigate the impact of tariffs.

*Given Canada's housing affordability crisis and aging infrastructure,* ***strong investment in residential and non-residential construction*** *is anticipated through to 2034.*

## Trends in the sector

Environmental sustainability is an overarching concern. The built environment (infrastructure and buildings) produces a substantial share of greenhouse gas emissions worldwide. A recent McKinsey study found that the construction and operation of buildings and infrastructure account for about 26% of global GHG emissions, and 37% of energy-related (combustion) emissions.[25] Annual emissions from the global built environment are on the order of 14 gigatons of CO2 equivalent,[26] highlighting the sector's critical role in climate change. Efforts to date have focused largely on reducing emissions from building operations (e.g., through energy efficiency in heating, cooling and lighting), and the United Nations projects that operational building emissions could be cut in half by 2030 with current policies and technologies.[27] However, attention is now also turning to "embodied" carbon—the emissions from producing construction materials like steel and cement, and from the construction process itself.[28] Tackling these will require innovation in materials, design and construction methods. In short, sustainability imperatives are reshaping infrastructure priorities globally.

The Canadian context mirrors many of these international trends, while also presenting unique challenges. Canada's population is increasingly urban: census data show that large metropolitan areas accounted for most of the country's population growth from 2016 to 2021.[29] Overall, Canada's population grew 5.2% in that five-year period—the fastest growth in the G7—driven mainly by immigration.[30]

This rapid growth, concentrated in cities (nearly 74% of people in Canada now live in urban centres),[31] has created surging demand for affordable housing, public transit and utilities, yet housing supply has not kept pace. Over 1.8 million households (about 10% of the total) are in "core housing need," meaning they cannot access housing that meets basic standards of affordability, size and condition.[32] Canada would need roughly 5.8 million new homes by 2030 to restore affordability, according to the national housing agency.[33] Supply gaps are especially acute in social and affordable housing; only 3.5% of Canada's housing stock is social housing, roughly one-half the OECD average of 7%, and far below countries like the UK (16%) or the Netherlands (35%).[34] Not surprisingly, homelessness remains a serious problem; by one metric, Canada ranks 9th among OECD nations in per-capita homelessness.[35]

Like other advanced economies, Canada also faces aging physical infrastructure. Much of the nation's infrastructure was built in the postwar decades and is in need of renewal. The 2019 Canadian Infrastructure Report Card found that a significant portion of assets are in middling or poor condition. For example, 16% of public roads (over 146,000 km) and 12% of bridges are in poor or very poor condition, and only about 50% of roads and 60% of bridges were rated as good or very good.[36] One-third of urban transit track will require investment within the next 10 years, and an estimated one-third of recreation and cultural facilities are due for renewal.[37] In Ontario alone, the provincial government has earmarked $222 billion for infrastructure over the next decade, yet the City of Toronto still faces a funding shortfall of roughly $26 billion for its needed projects.[38] The strain is evident in daily life; for instance, traffic congestion in the Greater Toronto Area due to insufficient transit infrastructure is estimated to cost the economy $6–11 billion annually in lost productivity.[39] At the same time, Canada is grappling with a severe shortage of affordable housing, as noted above, as well as growing needs in health care infrastructure (e.g., hospitals and long-term care). An aging population means that demand for long-term care (LTC) facilities and senior-friendly housing is rising sharply. In Ontario, nearly 48,000 people are on waitlists for long-term care beds—a number that has doubled in the past decade—and the waitlist is projected to exceed 50,000 by 2025.[40] Governments have announced plans to build and upgrade thousands of LTC spaces (Ontario aims for 30,000 new and 28,000 refurbished beds by 2028),[41] but delivering these on schedule will be challenging.

*Canada would need roughly* ***5.8 million new homes by 2030 to restore affordability,*** *according to the national housing agency.*

Compounding these issues, economic and geopolitical factors have introduced new uncertainties. Inflation and supply chain disruptions in recent years have driven up construction costs for materials and labour. Trade disputes have also had an impact; for example, U.S. tariffs on steel, aluminum and other construction-related goods, as well as Canada's retaliatory tariffs, threaten to increase prices for key inputs.[42] Rising interest rates and a potential economic slowdown could constrain infrastructure investment from both the public and private sectors. These cross-currents make it even more imperative to find smarter, more efficient ways to plan and build infrastructure.

In summary, Canada faces a confluence of infrastructure challenges: growing demand for new and upgraded assets (especially housing and transit), the need to rehabilitate aging systems, pressure to reduce the carbon footprint and improve resilience, and a tight labour market for construction skills. The following sections of this report delve into how the sector can respond through innovation. We explore international and domestic trends, identify promising technological and process innovations in the construction and infrastructure domain, examine their implications for the workforce, and finally recommend policy and practice changes to support a sustainable, skilled and future-ready infrastructure sector.

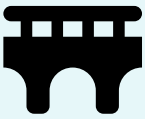
# International and Canadian Infrastructure Challenges and Trends

Globally, as in Canada, rapid urbanization, dwindling public housing stock, the failure of governments to invest and the financialization of housing have all been key contributors to the housing crisis.[43] In addition to housing market challenges, developed countries are dealing with aging infrastructure, increasing the number of megaprojects, whose complexity creates challenges for timelines, budgets and environmental impact.[44] Sustainability remains an issue for the construction industry: the built environment accounts for 14.4 metric gigatons of $CO_2$ equivalent ($GtCO_2e$) of emissions around the world annually.[45] About 26% of all GHG emissions and 37% of combustion-related emissions (i.e., related to fuel consumption) come from the construction and operation of the built environment.[46] The UN notes that, to date, GHG emissions from building operations (heating, cooling, lighting, etc.) have been the focus of emissions reduction efforts and, as of 2023, the UN projects that emissions will decrease by 50–75% over the next decade in this area.[47] The other area of concern is embodied emissions—emissions related to producing and transporting building materials, and the construction of buildings and structures. This remains an issue and has not been a focus of the sector until more recently.[48] There is a need for the sector to reduce waste, use raw materials more efficiently, reduce GHG emissions and mitigate the risks of climate change and severe weather events.[49, 50]

## The Canadian context

As is the case across the globe, Canada's urban population continues to grow, placing increased demands on affordable housing, social, transportation and utility infrastructure [51] Census metropolitan areas (CMAs) accounted for most of Canada's population growth (+5.2%) from 2016 to 2021, and at the same time urban sprawl has continued.[52] This trend will continue, with the population in the Greater Toronto Area expected to grow by 46% by 2046.[53] This is within a market where insufficient transit and the resulting traffic gridlock already cost $6–$11 billion per year in lost productivity.[54] The 2019 Canadian Infrastructure Report Card found that most of Canada's infrastructure is more than 20 years old and requires continued reinvestment.[55] This is in addition to the new infrastructure investment that is needed.

## 2019 Canadian Infrastructure Report Card Highlights



**16%** of roads

**12%** of bridge and tunnel structures

were in poor or very poor condition

Only 50% of roads and 60% of bridges and tunnels were in good or very good condition

**Over 30%**

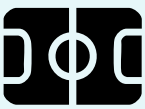
of linear water infrastructure assets (watermains, sewers)

are in fair, poor or very poor condition

**More than 30%**

of transit tracks

require investment within the next 10 years



**1/3** of cultural, recreation and sports facilities

require reinvestment

**The report card noted that:**

> 146,255 km (16.4%) of roads and 9,661 bridge and tunnel structures (12.4%) were in poor or very poor condition

> Only 50% of roads and 60% of bridges and tunnels were in good or very good condition[56]

> Over 30% of linear water infrastructure assets (watermains, sewers) are in fair, poor or very poor condition[57]

> More than 30% of transit tracks require investment within the next 10 years

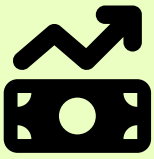
> One-third of cultural, recreation and sports facilities require reinvestment[58]

In Ontario alone, there is a planned $222 billion infrastructure investment over the next 10 years; a further $26 billion is needed in Toronto, but funding is lacking.[59] Canada faces a deep housing affordability crisis; based on the 2021 census over 10% of Canadian households are in “core housing need,” having to spend over 30% of their pre-tax income on shelter.[60] It is estimated that Canada needs 5.8 million new homes by 2030.[61] Supply gaps exist across the housing continuum and are especially acute in the area of social housing. In Canada, social housing represents 3.5% of the housing stock, whereas the OECD average is 7%. In the UK, for example, social housing represents 16% of housing stock, and in the Netherlands close to 35%.[62] Canada does not do well comparatively, ranking 9th among OECD countries in the number of people per capita experiencing homelessness.[63]

Further, in developed nations like Canada, the aging population creates the need to construct or adapt buildings to accommodate aging, assisted living and long-term care needs.[64] Long-term care demands can't keep pace. Ontario, for example, has promised to create 30,000 new LTC spaces while redeveloping 28,000 existing spaces; however, nearly one-third of Ontario's long-term care homes need to be redeveloped.[65] Nearly 48,000 people in Ontario are currently waiting for long-term care, a waitlist that has doubled over the past 10 years and is expected to surpass 50,000 in 2025.[66] There is also a need for aging-in-place options, which require renovations or building retrofits. This demographic trend (aging population) also affects the availability of skilled workers to meet present and future labour force requirements. Over 269,000 construction workers are expected to retire by 2034.[67]

Sustainability is also an issue for the sector; in Canada, considering building materials and construction and building operations (heating, cooling, etc.), emissions from the sector are close to 30% of Canada's total, making the building sector Canada's third-highest carbon emitter.[68] Emissions from construction and construction materials represent 11% of Canada's total emissions[69] and building operations comprise 18% of Canada's emissions.[70] There is a need for innovation and new technologies to accelerate the rate of housing and infrastructure development and to produce more sustainable outcomes; however, these technologies will also place new skill demands on the sector.[71]

The political and regulatory environment is also a factor in infrastructure development. Regulation (e.g., health and safety, financial, labour standards, environmental) can positively or negatively affect the sector—adding complexity but also creating avenues for faster approvals and accelerated timelines.[72] More recently, the impact of U.S. tariffs, Canada's retaliatory tariffs and the anticipated slowdown in the Canadian economy pose threats to the sector.[73] An economic slowdown would result in reduced residential housing investment, affecting housing construction and supply.[74] Further, retaliatory tariffs on US imports such as glass, appliances, tile and specific steel and aluminum products would drive further cost escalation.[75]



***The impact of U.S. tariffs,*** *Canada's retaliatory tariffs and the anticipated slowdown in the Canadian economy pose threats to the sector. An economic slowdown would result in* ***reduced residential housing investment, affecting housing construction and supply.***

To meet these challenges, transformation is required at the company, sector and government levels. Innovation is requisite across several areas, such as zoning and regulatory reform, building information modeling (BIM) and other digital adoption, advanced construction techniques and sustainable infrastructure and workforce development.

## Sector innovations in infrastructure

Innovation in the infrastructure sector is occurring on multiple fronts, driven by the need to improve productivity, reduce environmental impact and deliver projects faster and more affordably. Globally and in Canada, industry leaders and governments are experimenting with new technologies and methods to address these objectives. According to the World Economic Forum, leading firms are pursuing innovations that simultaneously target better safety, higher efficiency and lower carbon footprints in construction.[76] These efforts can be categorized into several broad (and inter-related) areas.

**This report focuses on four key domains of innovation:**

> Digital transformation of construction and infrastructure management

> Sustainable infrastructure solutions

> Advanced construction techniques such as modular and off-site construction

> Regulatory and policy innovations that enable and accelerate the above.

***To meet these challenges, transformation is required at the company, sector and government levels.*** *Innovation is requisite across several areas, such as:*

> zoning and regulatory reform

> building information modeling (BIM) and other digital adoption

> advanced construction techniques

> sustainable infrastructure and workforce development

Workforce development is another critical area of innovation, which is addressed later in the report. It is important to note that progress in any one category often depends on progress in the others; for instance, adopting digital building information modeling (BIM) can require changes in processes and regulations, and modular construction benefits greatly from supportive building codes and procurement policies.[77] An integrated approach is essential to truly transform the sector.

## Digital transformation and automation

Construction has historically been one of the least digitized industries, but this is rapidly changing as new digital tools are adopted throughout the project lifecycle. Building information modeling (BIM) —the creation of detailed 3D digital models of projects— is increasingly used to improve design coordination, catch conflicts, and simulate construction before ground is broken. BIM, combined with project management software and common data environments, allows for greater collaboration among architects, engineers, and contractors, and can reduce costly errors and changes in the field.[78]

Other digital technologies gaining traction include drone-based site surveys, reality capture (e.g., 3D scanning), Internet of Things (IoT) sensors for real-time monitoring of construction sites and infrastructure performance, and data analytics platforms that optimize scheduling and maintenance. These technologies promise significant efficiency gains: for example, better coordination through BIM can reduce rework and delays – one Canadian case study found substantial cost savings through clash detection in a major transit project using BIM.[79]

However, the construction sector's digital transformation is uneven, and Canada risks lagging behind international peers. The World Economic Forum has noted that construction worldwide has been slow to innovate compared to other sectors.[80] In Canada, surveys indicate that a majority of construction firms have no immediate plans to adopt new technology.[81] According to the Canadian Construction Association (CCA), Canadian contractors are "falling behind on the development and acquisition of cost-saving technologies" relative to firms in other countries.[82] Tools like BIM, advanced software, IoT devices, 3D printing, and autonomous equipment are becoming commonplace in leading markets in Asia and Europe, fundamentally changing how construction is done.[83] In Canada, uptake is increasing—large contractors and infrastructure owners have begun implementing digital twins (virtual models of infrastructure assets updated in real time), AI-driven project management assistants and robotics for repetitive tasks—but the industry's overall productivity metrics still trail countries like the United States and United Kingdom. The productivity gap is often attributed to the slower adoption of such technologies in Canada.[84]

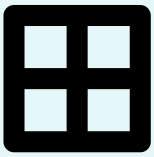
To accelerate digital adoption, a mix of industry initiative and policy support is needed. Public infrastructure clients can play a role by mandating or incentivizing BIM and digital project delivery on projects (as the UK government did by requiring BIM Level 2 on all public projects by 2016, which led to a step-change in BIM uptake there).[85] Investment in construction tech R&D and pilot projects can also demonstrate value. One barrier for smaller firms is the cost and skills required for new technologies; this barrier calls for training programs and possibly shared digital resources or consortiums that allow small contractors to access tools they couldn't deploy alone. Over time, greater use of digital technology is expected not only to raise productivity and reduce project risks, but also to make construction more attractive to younger workers with IT skills, helping with recruitment. The next generation of infrastructure workers will likely need to be as comfortable with tablets and data dashboards as they are with traditional tools.

## Sustainable and low-carbon infrastructure

Infrastructure planning and construction are increasingly guided by sustainability and climate change considerations.[86] This involves both mitigating emissions (building infrastructure that is low-carbon in construction and operation) and adapting to the impacts of climate change (making infrastructure resilient to extreme weather, sea-level rise, etc.). A major focus is on reducing the carbon footprint of construction. As noted, nearly 30% of Canada's greenhouse emissions are attributable to buildings and construction.[87] To address this, governments and industry are pursuing strategies to cut both operational emissions (through energy-efficient buildings, electrification of transit and vehicles, use of renewable energy, etc.) and embodied emissions (through low-carbon

materials and processes).[88] Green building standards and rating systems (like LEED and Canada's Zero Carbon Building standard) are promoting designs that use less energy and incorporate recycled or bio-based materials.

One key area of innovation is materials. High-emission materials like cement and steel are being re-examined; for example, through new concrete mixes with lower clinker content, carbon capture during cement production and greater use of recycled steel. Mass timber construction has emerged as a viable low-carbon alternative for many building types; engineered wood products (like cross-laminated timber) can replace concrete and steel in mid-rise and even high-rise structures, storing carbon in the wood and reducing construction emissions. Cities such as Vancouver have updated building codes to allow mass timber towers and are targeting reductions in embodied carbon in new developments.[89] Meanwhile, the concept of a "circular economy" in construction is gaining traction: this means designing for disassembly, reusing building components and recycling materials at end-of-life. Achieving these shifts often requires regulatory support; building codes and standards must permit the use of novel low-carbon materials and recycled aggregates safely.[90]



***The concept of a "circular economy" in construction is gaining traction:*** *this means designing for disassembly, reusing building components and recycling materials at end-of-life.*

Infrastructure resilience is another aspect of sustainability innovation. With more frequent floods, wildfires and heatwaves in Canada, infrastructure owners are adopting new design standards for climate resilience (e.g., higher flood defences, heat-resistant materials for roads or grid hardening for utilities).[91] Nature-based infrastructure solutions are also being implemented, such as green roofs and walls, urban tree planting to reduce heat island effects and wetlands or bioswales for stormwater management. These approaches can complement traditional infrastructure while providing environmental co-benefits like improved urban biodiversity.

Policy frameworks are critical to driving sustainable infrastructure. Governments are setting targets for net-zero emissions by mid-century, which translate into tighter building energy codes, mandates for zero-emission vehicles and transit, and requirements for climate risk assessments on projects. The federal government's Greening Government

Strategy, for instance, requires new federal buildings to be net zero and promotes the use of lifecycle assessments.[92] Some jurisdictions provide incentives such as tax credits or grants for green infrastructure projects and retrofits. Still, there are challenges: sustainable options can have higher upfront costs, and benefits often accrue over a long horizon. Innovation—making green solutions more cost-effective through scale and new technology—is therefore essential. Encouragingly, many sustainable practices are becoming more economical; for example, costs of solar PV cells and battery storage have plummeted, and mass timber can sometimes be cheaper than steel or concrete for certain builds.[93] By embedding sustainability into infrastructure development now, Canada can avoid costly retrofits later and create infrastructure that aligns with climate goals.

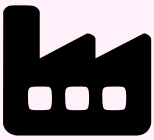
## Advanced construction techniques

To boost productivity and meet pressing needs like housing quickly, the construction industry is turning toward advanced construction techniques that industrialize the building process. Foremost among these is modular construction—the practice of manufacturing modules or entire building sections in a factory and then assembling them on-site. This approach offers numerous advantages: controlled factory conditions can improve quality and safety, while parallel fabrication and on-site preparation shorten overall project timelines.[94] Studies have found that modular construction can reduce building times by 20% to 50%[95] and significantly cut material waste.

For example, a factory-built housing project might complete in half the time of a traditional build, with far fewer off-cuts of lumber and drywall ending up in landfills. When modular techniques are combined with mass timber (factory-produced wooden modules), the environmental benefits are even greater, as the wood sequesters carbon and replaces more carbon-intensive materials.[96]

Canada has seen a growing number of modular projects, from pre-fabricated affordable housing units to modular student residences and health care facilities. During the COVID-19 pandemic, some hospitals and long-term care homes were rapidly expanded using modular additions.[97, 98, 99, 100]
Despite its benefits, modular construction currently represents only a small fraction of the market.[101]

A barrier has been the traditional procurement and contracting methods. Public projects often use design–bid–build contracts with very specific design requirements, which can inadvertently rule out modular solutions if they are not accounted for at the design stage.[102]
Financing is another challenge: modular projects incur more costs upfront in the manufacturing phase, whereas conventional projects pay gradually as work progresses on-site. This requires developers or contractors to carry different cash flow, and lenders to adapt to new payment models.[103]



*The impact on the workforce will be significant –* ***more construction work may shift from the job site to factories, changing the types of skills needed*** *(more manufacturing and assembly skills, potentially more unionized factory settings, etc.).*

Beyond modular techniques, other advanced techniques include 3D printing of construction elements (already used for some building components and even entire low-rise structures globally), robotic bricklaying or welding, and the use of artificial intelligence in project scheduling and logistics. Some firms are deploying exoskeletons or automated machinery to assist workers with heavy or repetitive tasks.[104] Off-site fabrication is not limited to volumetric modules; it also includes panelized construction (factory-built wall or floor panels) which can then be quickly assembled on-site. Panelization can achieve around time savings of up to 30% while reducing labour needs and cost.[105]

The impact on the workforce will be significant; more construction work may shift from the job site to factories, changing the types of skills needed (more manufacturing and assembly skills, potentially more unionized factory settings, etc.). This could help alleviate on-site labour shortages to some degree, since one factory can supply

modules to multiple projects. A McKinsey analysis suggests that by industrializing construction (standardizing designs and manufacturing components at scale), many cost-effective opportunities open up for the sector.[106] Ultimately, no single technique is a silver bullet; rather, the future likely involves a combination of modular, panelized and traditional methods, optimized for each project. Building codes and standards are beginning to adapt; for instance, the Canadian Standards Association (CSA) has issued standards for modular construction to ensure quality and facilitate approvals.[107] As familiarity grows and more success stories emerge, modular and advanced construction methods are expected to become mainstream, particularly for housing and institutional buildings where repetition and standardization can be maximized.

## Regulatory and policy innovation

Regulatory frameworks play a pivotal role in either enabling or hindering innovation in infrastructure. Recognizing this, governments at all levels are pursuing regulatory reforms to accelerate construction and encourage new solutions. One critical area is land-use regulation and zoning. Many cities in North America, including Canadian cities, have restrictive zoning that limits density; for example, large swathes of residential land allow only single-family homes. This has contributed to a "missing middle" in housing supply (a lack of townhouses, duplexes, and small apartment buildings).[108]

In Toronto, about 60% of residential land is zoned exclusively for single-detached houses.[109] Such rules, combined with lengthy site-by-site rezoning processes, constrain the ability to add housing in existing neighborhoods. To address this, some jurisdictions are moving to liberalize zoning. Minneapolis in the United States eliminated single-family-only zoning in 2018 and implemented other pro-density measures (like reducing parking minimums and allowing multi-unit dwellings on traditionally single-family lots). As a result, Minneapolis increased its housing stock by 12% between 2017 and 2022, and rent increases slowed dramatically to around 1% annually.[110]

In 2023, the city of Calgary became the first major Canadian city to approve "blanket rezoning" of all single-detached zones to allow up to four units per lot, removing the need for case-by-case approvals.[111] These zoning innovations aim to spur more efficient land use, increase affordable housing supply and create more livable, transit-supportive communities.

Building codes and permitting processes are another focus. Modernizing building codes to accommodate new materials and methods is crucial; outdated codes can be a barrier to mass timber buildings or the use of recycled materials, for instance. The World Economic Forum has advocated for harmonized, flexible building codes that promote low-carbon construction and material reuse.[112] Canada is in the process of updating its National Building Code (NBC) to better address


energy efficiency and even, in future editions, embodied carbon. Some provinces have already adopted innovative code changes (e.g., British Columbia's early allowance of mass timber high-rises up to 12 stories, which influenced the 2020 NBC changes).[113]

Permitting and approval timelines are also being targeted for improvement, as slow permitting significantly delays projects. Municipalities are increasingly turning to digital permitting systems to speed up approvals and improve transparency. The federal Housing Accelerator Fund (launched in 2023) provides incentives to municipalities to cut red tape and update zoning to boost housing construction.[114] Standardized designs have also been made available, reducing development times via architectural design packages aligned with building codes and planning standards in regions across Canada. For example, the Government of Canada released its Housing Design Catalogue, which includes 50 standardized designs for multi-unit and accessory dwellings.[115] In addition, EllisDon recently launched its Base Design housing design and delivery platform. The tool was created to help non-profit housing providers address Canada's missing middle housing shortage, with code-compliant designs for buildings of up to 10 stories.[116]

Infrastructure delivery models and procurement policies are likewise evolving. Governments are considering the balance of public and private roles in financing infrastructure, with some projects structured as public–private partnerships (P3s) to

leverage private capital and expertise.[117] When done well, P3s can allocate risk appropriately and encourage innovation, though they require strong governance. There is also a push for procurement that emphasizes outcomes and allows for creative solutions. Traditional public procurement often prescribes detailed design specifications, which can inadvertently exclude approaches like modular construction unless specifically allowed.[118] Moving toward performance-based specifications (where the required outcome is defined, but bidders can propose different methods to achieve it) could open the door to more innovation.[119] Additionally, including criteria for sustainability and community benefits in RFPs (requests for proposals) can drive firms to incorporate greener designs and local hiring or training initiatives. Some cities have experimented with expedited permitting or density bonuses for projects that meet certain innovation or affordability criteria. Overall, the regulatory environment is beginning to shift from one of precaution—which often favored the status quo—to one that is more permissive of experimentation in construction, as long as safety and public interest are safeguarded.

Finally, policy innovation extends to how infrastructure is planned at a high level. Integrated planning approaches consider land use, transportation and housing together, aiming to align infrastructure provision with growth in a sustainable way. There is recognition that building more highways, for example, can induce sprawl and more traffic, whereas investing in transit and transit-oriented development can create more sustainable urban forms. Progressive policies, such as Ontario's recent moves to allow greater density near transit stations and the federal encouragement of transit-oriented housing projects, reflect this integrated thinking. In sum, regulatory and policy levers—from zoning bylaws to building codes to procurement rules—are powerful tools to catalyze innovation in infrastructure. Jurisdictions that modernize these frameworks are seeing tangible results in faster project delivery and the uptake of new technologies.

***Integrated planning approaches consider land use, transportation and housing*** *together, aiming to align infrastructure provision with growth in a sustainable way.*

# Innovative policies and technology to improve productivity

## Innovative zoning and incentives to build more housing

Calgary introduced incentives and revised its regulatory frameworks to expedite the approval of office conversions. Simple incentives were developed in consultation with the construction sector. Office buildings converted into residential buildings received a $75 per square foot incentive; conversions into hotels, $60; and conversions into educational/arts facilities, $50. This program transformed two million square feet of unused office space and created over 1,500 residential units. In total $165 million in incentives were paid.[120]

## Regulatory change to accommodate new modes of construction

In Sweden, 84% of residential dwellings were built either partially or entirely in factories.[121] Production at scale is enabled by a country-wide performance-based building code that allows manufacturers and builders to apply the same specifications across their developments.[122]

The performance-based system also offers flexibility as manufacturers must only meet outcomes.[123] In contrast, in Canada, modular buildings must comply with a regulatory environment designed for traditional construction.[124]

## Circular built environment

Japan's Construction Material Recycling Law was enacted in 2000 to make sure that construction waste such as concrete and asphalt would be recycled more regularly. As a result of the law, the rate of recycling for significant construction materials rose from about 60% in the 1990s to over 90% more recently.[125]

## Modular construction

A study conducted by the University of Alberta on a four-storey 42 suite building in Alberta found that the timeline of the construction was shortened by four months on a project that would normally take 11 months using modular construction. Additionally, CO2 emissions saw a 43% reduction.[126, 127]

## Building information modeling and digital twins

In a recent project in Vancouver, the use of 3D modeling and digital twins allowed builders to improve efficiency. Using 3D simulations, builders were able to digitally construct the building seven times before physical construction began. As a result, the builders were able to efficiently schedule construction of the building, down to 15-minute blocks.[128]

## Robotics

Robots can be used on-site for various uses, including to lay bricks or tie steel reinforcement bars. In 2021, during PCL and Pomerleau Construction's build of a 47-storey tower in Toronto, the companies utilized Spot the Robo-dog. The robot had tools including 360-degree cameras, a laser scanner and air quality and GPS sensors. This data was collected by the robot and fed into a smart construction tech platform for offsite project managers and designers to leverage. Robots can also be used to perform tasks in areas that are too dangerous for workers.[129, 130]

# Workforce and Skills Implications

The trends and innovations discussed above have far-reaching implications for the construction and infrastructure workforce. As the industry evolves, it faces the dual challenge of addressing an existing labour shortage and skills gap while also preparing workers for new technologies and methods.[131] This section examines the current workforce challenges, projects future labour market needs and considers how diversity and skills development will shape the sector's capacity to deliver on infrastructure goals.

## Current labour market gaps and challenges

Canada's construction industry is already experiencing significant labour shortages. Unemployment in construction trades is near historic lows. Sector employment growth is forecast to remain strong (Figure 3) and employers report difficulty filling both skilled and entry-level positions.[132] In a 2023 survey, 86% of Canadian construction companies said that shortages of skilled tradespeople

**Figure 3**

**Construction employment growth forecast—residential and non-residential, 2021–2033[133]**

were affecting their ability to bid on projects and meet schedules.[134] The industry has been unable to keep up with surging demand, driven by major infrastructure and housing projects. As of late 2023, there were an estimated 64,000 unfilled jobs in the sector nationally.[135] Particularly acute are shortages in certain trades like carpenters, electricians, plumbers and heavy equipment operators, but contractors are also struggling to hire for general labourer positions such as framers, installers and concrete finishers. These shortages are already leading to project delays and cost escalation.[136]

Shortages in trades and general labourers have a profound impact on the sector. Fully 76% of those employed in the sector work in trades, equipment operation or as labourers, 9% work in business and administration, 6% in engineering and related occupations, 3% in sales and service and 2% in senior management (Appendix 1). If we consider infrastructure development only, skilled trades comprise just over one-half of the workforce, with labourers, middle management and technicians comprising 25% of employment.[137] The skilled trades shortage has been attributed in part to the lagging adoption of new construction technologies by Canadian companies.[138] However, the issue is circular as skills shortages in emerging methods and technologies are also impeding the industry's technology transformation. Presently only 0.5% of the construction industry's workforce works in computer and information systems, software development or other information and communications technology occupations (Appendix 1). In comparison, these occupations represent 4% of the finance and insurance workforce.[139]

Several other factors contribute to the current gaps. Construction work can be physically demanding, seasonal, and subject to economic cycles, making it less attractive to some job seekers. For years, the sector has struggled with an image problem, sometimes perceived as offering limited career progression or being a "last resort" option. High turnover is common, partly due to the transient nature of project-based work. Additionally, the industry has not recruited sufficient numbers of young people to replace an aging workforce. In the past, a steady supply of new workers came through the apprenticeship system and immigration, but those pipelines have not kept up. During the pandemic, apprenticeship registrations and completions dropped sharply,[140] and they have yet to fully recover. Meanwhile, demand for construction workers has increased due to government stimulus and ambitious infrastructure plans. Some provinces are experiencing particular strains; for example, in Ontario, it's projected that more than 100,000 new construction workers will be needed over the next decade to support growth and replace retirees.[141]

The current shortages underscore a need for immediate measures to attract and retain workers. Stakeholders are responding in various ways: industry associations are running campaigns to promote skilled trades

3D Printing a building with concrete.

careers, wages have been rising in many trades and governments have begun to adjust policies (for instance, Canada has eased immigration pathways for construction workers, including a federal pilot in 2023 to grant permanent residency to up to 6,000 undocumented construction workers in the Greater Toronto Area). These stopgap measures can help, but a longer-term strategy is needed to ensure the sector has a sustainable workforce supply.

## Future outlook: Demographics and demand

Looking ahead, the gap between labour demand and supply in construction could widen further if proactive steps are not taken. Employment and Social Development Canada (ESDC) recently identified the shortage of skilled trades workers as the greatest challenge to the industry's long-term performance.[142] The sector's growing use of 3D printing and prefabrication is expected to help address the gap; however, it will not fully alleviate the threat posed by impending retirements. Demographics are a major concern: the construction workforce is aging, and retirement rates are accelerating. More than 269,000 construction workers (about 21% of the workforce) are expected to retire by 2034.[143, 144] Notably, among tradespeople in roles that require apprenticeship (such as electricians, pipefitters, and carpenters), over 22% are already age 55 or older.[145] This wave of retirements will hit the industry hard, as experienced journeypersons are lost. BuildForce Canada projections indicate that retirements will far exceed the number of new entrants to the industry, potentially leaving a shortfall of around 108,300 workers by 2034 if current trends continue.[146] Compounding the issue, the pool of younger workers is not growing fast enough. The share of young Canadians pursuing construction trades has been flat or declining; Statistics Canada reported that the number of working-age adults with apprenticeship certifications in construction has stagnated in recent years.[147]

## Future labour shortages and surpluses

The Government of Canada's Canadian Occupational Projection System (COPS) estimates challenges with:

**Recent labour market conditions** (2021-2023)

**Labour demand** from job creation, retirements and emigration

**Labour supply** through immigration, the school system and re-entrants

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Even in a scenario with sector growth of 1.4% and construction employment growth at only 1.3%, over one-half of the key construction occupations are anticipated to show modest or strong signs of shortage by 2033 (Appendix 2). Carpenters, heavy-duty equipment mechanics and heating, refrigeration and air conditioning mechanics all show strong signs of shortage by 2033. However, a 1.3% employment growth scenario does not address the scale of the infrastructure and housing supply investments required over the next decade. The push to build 5.8 million homes by 2030 to address housing affordability as estimated by CMHC,[149] alone implies requiring a substantially larger construction workforce, or dramatic productivity improvements, or both. BuildForce Canada estimates incremental construction to address the housing supply gap (over the current run-rate) will necessitate an 83% increase in the residential construction labour force compared with 2023 levels.[150, 151] The non-residential construction sector, supplying the infrastructure needed to support the new housing (e.g., roads, sewers) would require a 19% expansion of its labour force.[152] RBC has estimated that an additional 500,000 construction workers will be required, on average, to build the homes Canada needs over the next six years.[153]

Public infrastructure spending in Canada is projected to stay robust, supported by federal programs and provincial commitments (for example, multi-billion-dollar transit expansions, highway improvements and green infrastructure projects in the pipeline). Even

if overall economic growth slows, specific demands—such as retrofitting buildings to be more energy-efficient, constructing renewable energy projects or rebuilding climate-resilient infrastructure—will create new types of work. In short, unless productivity gains from innovation significantly reduce labour intensity, the sector will need tens of thousands of additional qualified workers in the coming decade.

This looming shortfall has serious implications. If not addressed, it could act as a brake on Canada's infrastructure plans, causing delays or inflated costs. The situation also represents an opportunity: attracting more workers to construction and equipping them with needed skills can create good-paying jobs and spur economic growth. Recognizing this, policy makers are increasingly treating construction labour supply as a strategic issue. Enhanced labour market forecasting and skills mapping are being refined to better align training with future needs (e.g., COPS and industry-led analyses like those by BuildForce). These projections consistently point to the need for ramped-up recruitment into trades to offset retirements.

## Future skills and the evolution of construction occupations

Construction 4.0 will necessitate new jobs and skills resulting from investments in carbon reduction, climate change mitigation and digital technologies.[154] The adoption of digital technologies will increase labour productivity and help mitigate the present shortage of skilled tradespeople. It will also place construction jobs that require medium to low education (about 38-45% of jobs) at high risk of redundancy within the next 10 years.[155] An estimated 51% of construction tasks are executed by workers today, whereas only 36% of these tasks will be completed by workers by 2030.[156] Increased automation will account for about 71% of this shift in the proportion of human-performed tasks.[157] In WEF's Future of Jobs Report, its survey of construction sector employers highlighted that 27% of employees will require upskilling within their current jobs and 17% will require reskilling to transition to alternate roles.[158] At the local level, uncertainty around the rate of technological adoption makes skills, occupational requirements and workforce shortages challenging to predict.[159]

**Kaarwan, a learning management platform for architects, civil engineers and designers, has identified the following skills that the industry will need to prioritize:**

> **Technical expertise:**
Developing proficiency in BIM software, data management and digital modelling is essential.

> **Communication and collaboration:**
To realize productivity gains through technological integration across construction processes and dimensions, collaboration and communication are critical. In the new world, working in silos will not lead to success; everyone must be aligned and working toward common goals.

> **Problem-solving and critical-thinking:**
To solve complex problems, analytical thinking and adaptability are key.

> **Project management:**
This continues to be critical, especially within more complex environments.

> **Interdisciplinary knowledge:**
Understanding how various disciplines engage with one another within the BIM ecosystem.

> **Adaptability:**
Continuous learning is needed to integrate and adapt to emerging technologies.

> **Attention to detail:**
Precision and accuracy are critical within the context of BIM.[160]

A scoping review analyzing 108 research articles on the topic of Construction 4.0 and emerging technologies found that research on the new skills and competencies needed was less developed versus research on the construction technology itself.[161] Overall, the authors identified 34 important skills which they categorized as social-emotional skills (e.g., communication, problem solving, learning agility and team building/collaboration) and technical skills such as digital literacy and programming/coding which would be a requirement across the construction workforce. Other needed skills are management, human–machine communication, data analysis, quality control, automatic manufacturing, BIM skills, cybersecurity and expertise in digital twins, virtual reality and augmented reality.[162]

## Table 1

**Select prefabrication, digitization and construction automation role descriptions[164]**

| Role | Description |
|---|---|
| **Dfab Manager** | Specialist in automated construction systems who acts as an advisor, overseeing the planning phase. Defines the scope of the digital fabrication identifying the appropriate level of automation, sets dfab goals, tasks and competencies, and develops the standards for the BIM models and for the dfab application at the construction site, including software and hardware requirements and communications. |
| **Dfab Coordinator** | Establishes methods required for coordination. Checks and validates models; e.g., clash detection and automated construction planning on-site. Works with project manager and planners to resolve issues. |
| **Dfab Programmer** | Specialist in dfab software design. Prepares/programs the software and its integration with other systems (e.g., BIM), resolves compatibility issues, structures data storage and backup, and addresses issues/enhancements during the execution phase. Uses BIM model to develop codes for robots. |

Construction 4.0 will continue to lead to the creation of new roles such as BIM project managers, BIM directors, BIM coordinators, specialists, consultants and designers, digital fabrication specialists and BIM technologists and analysts.[164, 165] Specialized AI jobs such as construction AI researchers, trainers and data analysis professionals are needed.[166] Further, the trend toward digital fabrication, or dfab (i.e., prefabrication, digitization and construction automation), will create demand for new positions such as digital fabrication manager, digital fabrication management coordinator, digital fabrication programmer, digital fabrication technician and digital fabrication programmer (Table 1).[167]

However, digital fabrication will mean less demand for project managers, engineers, designers, drafters, construction managers and site supervisors.[168, 169] Similarly, while some workers will be displaced by automation, trainers and testers will be needed to implement robots and autonomous agents.[170] Within this shifting landscape, workers have legitimate fears of being displaced by new technologies without having the skills for comparable jobs in this new world.[171] Efforts to support workers with suitable upskilling and reskilling programs will be critical. Employers need to upskill their existing workforce, and university and apprenticeship programs will need to further prioritize BIM and other construction technologies within their curriculum.[172]

*The shift toward **net zero and green building** is expected to create **three million jobs** in the building trades by 2050.*

New technologies will place significant demands on sector employees with respect to evolving knowledge, skills and abilities; however, they also stand to make the sector more attractive to workers.[173] Dangerous, dirty and difficult tasks can be automated to improve employee job satisfaction and state-of-the-art technology will attract younger tech-savvy workers to the sector.[174] The shift toward net zero and green building is expected to create three million jobs in the building trades by 2050.[175] This transition may also attract more women to the sector as women have a greater propensity toward occupations where the social impact is clear. For example, in undergraduate engineering programs, women comprise only 25% of enrolments; however, they represent 39% of environmental engineering enrolments and 55% in biosystems engineering.[176]

## Upskilling, training and education

The changing landscape of infrastructure work means that many of tomorrow's jobs will require different skills than in the past. While traditional trades skills (carpentry, masonry, electrical, plumbing, etc.) remain fundamental, new competencies are rising in importance. For instance, widespread use of BIM and other digital tools means that site supervisors and project managers need strong computer skills and the ability to interpret digital models. Machine operators may need to interface with semi-automated equipment or use augmented reality goggles to receive instructions. Sustainability goals are spawning new specializations—energy modellers, building commissioning experts, and retrofit coordinators—to upgrade existing buildings and infrastructure.

To prepare the workforce for these skill and competency shifts, investment in upskilling and continuous learning is critical. Currently, the construction training ecosystem in Canada includes formal apprenticeship programs (typically three to five years, combining in-class and on-the-job training for trades), college diplomas in construction technology and engineering, union training centers and safety certification courses. These will need to adapt to embed new content like digital literacy and green construction techniques. Some encouraging initiatives are underway. For example, Canadian colleges such as George Brown[177] and Mohawk College[178] have introduced certificate programs in BIM, and

BuildingSMART Canada offers a professional certification program with BIM courses at the entry, foundational, management and professional levels.[179] There are pilot programs for training in advanced manufacturing methods applied to construction, such as courses in modular assembly techniques and lean construction principles. New micro-credential programs allow mid-career workers to learn specific skills like operating drones or performing energy audits without going through a full lengthy program.

Canada can also learn from other countries; for example, Germany, Japan, Switzerland and the Nordic countries all have taken a systematic approach to workforce development in critical areas such as prefabrication and modular construction.[180] Germany, for example, has introduced apprenticeships specialized in prefabrication; "Apprentices learn specific skills such as precision assembly, CNC machining, and advanced materials handling. This structured approach ensures that trainees not only understand the technical requirements of their roles but also develop a broader understanding of factory workflows and quality control standards."[181]

Upskilling the existing workforce is only part of the solution; educating the next generation is equally important. Outreach to youth about careers in infrastructure is being ramped up, including integrating exposure to trades and STEM (science, technology, engineering, and math) in high school curricula and expanding co-op and internship opportunities on infrastructure projects. The federal government's Future Skills Centre has identified construction as a priority area and is funding projects that develop new training approaches and curricula to meet emerging skill needs.[182] Employers also have a role to play in upskilling, by investing in their workers' training and fostering mentorship on the job. One challenge is that the construction sector's predominance of small firms can make it difficult to devote resources to training—an argument for collective industry action or government-supported training initiatives.

Overall, a multi-pronged workforce development strategy is needed: one that not only brings in the numbers of people required but also equips them with the evolving skills the industry will need. This includes reinforcing the apprenticeship system (potentially expanding apprenticeship seats and incentives to employers to take on apprentices), enhancing training in new technologies, and promoting a culture of lifelong learning in construction. The payoff will be a workforce that is more adaptable, productive and capable of delivering the innovative infrastructure that Canada's future requires.

# Innovative upskilling programs

## Workforce 2030: Rapid Upskilling for Green Building Occupations

This FSC-funded program is designed to fill the growing need for workers in the green building industry. Workers who have been displaced from industries like retail and hospitality are trained to gain low-carbon construction skills and support their entry into the green building industry. The program has trained 587 workers so far, with 90% of the workers belonging to an equity-deserving group.[183]

## Digital Tools and Apprentice Learning On-the-Job

Led by the Canadian Apprenticeship Forum—Forum canadien sur l'apprentissage (CAFFCA), this FSC-funded program piloted digital tools to facilitate better on-the-job learning for construction apprentices and early career journeypersons. The tools utilized existing Red Seal standards from Ontario and Quebec and were tested by apprentices and journey-persons, who were then surveyed about the strengths and weaknesses of each tool. The final report provides insights into the requirements of the construction industry and its stakeholders to move forward with digital learning tools.[184]

## Virtual Recruitment and Assessment Centre for the Unionized Construction Industry

This project is designed to meet the increasing need for construction workers by providing a free online platform that offers skills development, resources and career advice to job seekers and active workers. The program was led by SkillPlan: BC Construction Industry Skills Improvement Council and funded by FSC. The project partnered with building trades unions to develop a recruitment plan and improve the platform and assessment tools. The program has attracted 4,500 participants, including groups that are traditionally under-represented in the industry, including women, racialized people, newcomers, Indigenous Peoples and others.[185]

## Skills, Explore, Achieve, Revive (SOAR)

In spite of labour market needs in Newfoundland, early career tradespeople were having difficulty completing apprenticeships and other requirements a result of disruptions to the construction industry during the COVID-19 pandemic. The SOAR program was created by the Murphy Centre and is funded by FSC. It provides free and accessible tutoring and counselling services to help early career tradespeople stay in the industry and advance their career.[186]

## Ontario Home Builders' Job-Ready Program

This program provides entry-level, unemployed or underemployed job seekers with skills training and experience to prepare workers for a career in the construction industry. Participants receive hands-on industry training focused on residential construction skills, a paid job placement and continuing supports designed to support a long-term career in construction.[187]

## Women in Skilled Trades (WIST)

Funded by ESDC and delivered by local partners across Canada, WIST offers skills training and employment opportunities to women that want to pursue Red Seal Trades. In addition to training, WIST also provides participants with experience through work placements, a support network of mentorship and pre-employment coaching and participant financial supports.[188]

## Skills Blueprint

Funded by the EU, Skills Blueprint is designed to take a strategic approach to better matching the skills demanded by employers and those provided by skills training organization. EU countries worked together to research and map regional best practices and programs that successfully attract workers to construction trades as well as innovative skills training programs, which are compiled in an interactive map.[189]

## Digital Built Britain

The UK, as part of their Digital Built Britain initiative, developed skills and competency frameworks that were based on existing standards or broad stakeholder engagement to better align skills requirements across the industry. Another part of this initiative was to create a user-friendly way for organizations and individuals to approach skills training. These initiatives were integrated with BIM framework partners to build a critical mass of digital skills training programmes and initiatives.[190]

## Crossrail-Bentley Information Academy

As part of the Crossrail project, which delivered the Elizabeth Line in London, U.K., an academy was set up to enable project team members, contractors and members of the supply chain to build a common understanding the organization's approach to technical information. The academy facilitated knowledge transfer and the sharing of best practices to drive improvements. Another goal was to provide the benefit of experience gained on the Crossrail project to other infrastructure projects.[191]

**Table 2**

Representation of women in selected Canadian construction occupations (2021)[193]

| Occupation Category | Total Workers | Women Workers | Women (%) |
|---|---|---|---|
| All construction occupations | 1,469,085 | 200,025 | 14% |
| Trades, transport and equipment operators | 1,123,840 | 52,810 | 5% |
| Trades helpers and labourers | 183,430 | 11,690 | 6% |
| Managers in construction and facility operations | 132,365 | 12,310 | 9% |
| Carpenters and cabinetmakers | 146,220 | 3,195 | 2% |
| Plumbers, pipefitters and gas fitters | 64,755 | 1,065 | 2% |
| Roofers, painters, decorators, etc. | 64,935 | 7,060 | 11% |

## Equity, diversity and inclusion in the infrastructure workforce

One reason the construction sector has struggled to recruit enough workers is its limited diversity. The workforce has historically been dominated by men and has not reflected the broader population. Women, for instance, comprise just 14% of the construction labour force in Canada,[193] a figure that has barely changed in decades. Moreover, women are disproportionately employed in office and administrative roles rather than on construction sites; they represent roughly 76% of the industry's workforce in business and administrative occupations but only about 5% of workers in on-site trades and production roles (see Table 2). The low participation of women in trades represents a vast untapped labour pool. There are encouraging signs as more women are entering apprenticeship programs today than in the past, but significant barriers remain, including a lack of awareness and mentorship and sometimes discriminatory workplace cultures.

Other equity-deserving groups include newcomers to Canada, racialized people and Indigenous Peoples. Immigrants account for roughly 23% of Canada's overall labour force but comprise 19% of the construction labour force and 18% of workers in construction trades.[194] Immigrants represent a larger portion of sector business owners, comprising 23% of all general contractors and builders in the residential sector,[195] and 40% of civil engineers are immigrants.[196] However, many more do not practise in their profession; only 18% of internationally educated engineers work as engineers in Canada.[197]

Many newcomers possess construction experience or qualifications from abroad; streamlining the recognition of foreign credentials and providing bridging training could help integrate them more quickly into the workforce. Immigration, Refugees and Citizenship Canada (IRCC) has also recognized that the country needs a stronger immigration pathway to permanent residency for skilled trades and construction workers.

In Feb 2025, the IRCC made significant revisions to the Express Entry category-based immigration stream focused on trades, adding 19 occupations, nearly all of which are focused on construction trades.[198] In 2025, the IRCC created a construction industry advisory board to guide its efforts to create new pathways, set goals and attract skilled tradespeople and foreign national construction workers to Canada.[199] At the provincial level, provinces like Nova Scotia have launched targeted immigration streams for construction trades. [200]

Indigenous workers are also under-represented in most regions (though in parts of Western Canada and the North, they form a significant portion of the construction workforce due to proximity to resource projects). Initiatives like community-based construction training programs in Indigenous communities and partnerships with Indigenous-owned construction firms can create pathways for greater participation.

Expanding diversity is not only a social imperative but an economic one: it enlarges the pool of potential workers and can improve business performance. Diverse teams have been found to be more innovative and productive,[201] bringing a variety of perspectives to problem-solving. However, to attract and retain equity-deserving groups, the industry must address longstanding cultural issues. Construction work sites have historically been male-dominated and sometimes prone to harassment or exclusionary attitudes. Efforts are underway

to change this. For example, many large contractors now have diversity and inclusion (D&I) policies,[202, 203] and programs exist to support women and racialized apprentices (such as those offered under the federal Women in Skilled Trades initiative). [204] The Union Training and Innovation Program (UTIP) also provides funding to improve the participation of equity-deserving groups in trades training.[205] Changing the job-site culture through training (e.g., anti-harassment training for all employees), enforcing zero-tolerance policies for discrimination and providing facilities and equipment that accommodate a diverse workforce (like personal protective gear sized for women) are all part of making construction a more welcoming career for everyone. The hope is that as the nature of construction work evolves to incorporate more technology and precision manufacturing, it may shed some of its "old boys' club" image and draw interest from a broader talent base.

Tapping into women and other underutilized labour sources will be essential to meet future labour needs. Governments are supporting these efforts through funding for pre-apprenticeship programs targeting women, Indigenous workers and other groups. Progress will likely be incremental, but even modest increases in retention and recruitment of these groups can make a difference over time. Immigration will continue to be a vital source of skills and helping internationally trained workers integrate must be an area of focus. Programs to assess and recognize foreign qualifications more swiftly, provide occupation-specific language training and connect new immigrants with employers can reduce the time it takes for an immigrant engineer or tradesperson to contribute fully.

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# Conclusions and Recommendations

Canada's infrastructure sector stands at a crossroads. The pressures of aging assets, climate change, and housing shortages demand urgent action, yet they also present an opportunity to reinvent how we build. New federal commitments to invest in innovative practices to meet ambitious targets for housing and infrastructure make it essential to intelligently invest in the construction and infrastructure workforce. The international trends and innovations reviewed in this report show that change is not only possible but already happening, from digitized construction sites to cities rewriting zoning rules. For Canada, the challenge is to scale up these innovations across a fragmented industry and to ensure the workforce is prepared to implement them. If successful, the reward will be infrastructure that is delivered faster, more cost-effectively, and sustainably, while providing inclusive employment opportunities.

In conclusion, addressing infrastructure needs and skills requirements must go hand-in-hand. Policies and industry practices should create a virtuous cycle where innovation improves productivity and sustainability, which in turn makes construction careers more attractive and rewarding, drawing in the talent needed to build the next generation of infrastructure.

**Key recommendations for policy and practice that emerge from this research:**

> **Modernize and streamline regulatory frameworks to accelerate construction and promote innovation**

This includes updating building codes to support the use of new low-carbon materials and modular construction, simplifying and digitizing permitting processes for faster approvals and reforming zoning bylaws to enable greater density and mixed-use development (as demonstrated by Calgary and other cities). Governments should reward municipalities that proactively remove barriers to affordable housing and infrastructure development.

> **Embed incentives for innovation and productivity in public procurement and funding programs**

For example, require or encourage the use of building information modeling (BIM) and other digital collaboration tools on publicly funded projects, and consider performance-based procurement that allows contractors to propose innovative solutions. The government can expand grants or tax credits for construction firms (especially SMEs) that invest in R&D, pilot projects or the adoption of proven technologies

(drones, 3D printing, etc.). The sharing of best practices through industry networks and innovation hubs should be supported to diffuse new techniques.

> **Invest in workforce development through enhanced training, education and apprenticeship support**

Policy makers should increase funding for apprenticeship seats in high-demand trades and provide incentives for employers to hire and train apprentices. Curriculum in trade schools and technical colleges should be updated to include digital skills (e.g., BIM software, CNC machining for prefab components) and green construction practices. Short courses and micro-credentials in emerging areas (like energy-efficient retrofit techniques or construction robotics operation) should be developed with industry input. Additionally, initiatives like the Union Training and Innovation Program and Future Skills Centre projects focused on construction should be scaled up.

> **Attract a broader pool of workers to infrastructure careers by improving diversity and job quality**

Governments and industry must intensify recruitment efforts targeting equity-deserving groups; for instance, funding pre-apprenticeship and mentorship programs for women, Indigenous workers and newcomers in construction. Setting diversity targets or requirements on large projects (such as mandating apprentices or local hires from equity-deserving groups) can help. Just as importantly, industry leaders should continue working to foster inclusive workplaces through anti-harassment policies and safety cultures that value all workers. Making construction sites safer, more respectful and technologically advanced will help shake off negative stereotypes and appeal to young entrants.

> **Leverage immigration as a strategic tool to fill skill gaps in the short and medium term**

This entails smoothing the path for qualified immigrants in construction trades and professions to work in Canada; for example, faster recognition of credentials and experience from abroad. Dedicated immigration streams (like the pilot programs for construction workers in Ontario and Nova Scotia)[206] should be maintained or expanded, and outreach should ensure potential immigrants are aware of opportunities in Canada's infrastructure projects. Integration supports (language training, bridging programs) will maximize the retention of newcomers in the sector.

> **Promote industry collaboration and capacity-building to improve efficiency**

Given the fragmentation of Canada's construction sector (dominated by many small firms),[207] collective approaches are needed. This could include supporting the formation of consortia or joint ventures so smaller firms can bid on larger projects and invest in shared resources like training facilities or fabrication plants. Governments can facilitate knowledge transfer by publishing data on project performance and case studies of innovative approaches so that lessons learned on one project can benefit the whole industry. Encouraging a consistent pipeline of infrastructure projects (reducing boom–bust cycles) will also help firms commit to long-term investments in their workforce and technology.

# Appendices

## Appendix A

### Table A

Construction Workforce by Occupation and Gender (2021)[208]

| Occupation | Total Labour Force | Women | Women % |
|---|---|---|---|
| All construction occupations | 1,469,085 | 200,025 | 14% |
| Trades, transport and equipment operators and related occupations | 1,123,840 | 52,810 | 5% |
| 7511 Trades helpers and labourers | 183,430 | 11,690 | 6% |
| 7231 Carpenters and cabinetmakers | 146,220 | 3,195 | 2% |
| 7001 Managers in construction and facility operation and maintenance | 132,365 | 12,310 | 9% |
| 7220 Technical electrical trades and electrical power line and telecommunications workers | 104,405 | 2,500 | 2% |
| 7201 Contractors/supervisors, technical industrial, electrical and construction trades | 76,970 | 3,740 | 5% |
| 7311 Roofers, glaziers, painters, decorators and floor covering installers | 64,935 | 7,060 | 11% |
| 7230 Plumbers, pipefitters and gas fitters | 64,755 | 1,065 | 2% |
| 7340 Operators, drillers and blasters | 54,010 | 1,475 | 3% |
| 7310 Concrete finishers, tilesetters and plasterers | 45,135 | 1,645 | 4% |
| 7240 Machinery and transportation equipment mechanics (except motor vehicles) | 44,380 | 605 | 1% |
| 7320 Building maintenance installers, servicers and repairers | 42,215 | 1,450 | 3% |
| 7202 Contractors/supervisors, technical maintenance trades, heavy equipment/transport operators | 40,225 | 1,595 | 4% |

| Occupation | Total Labour Force | Women | Women % |
|---|---|---|---|
| 7210 Machining, metal forming, shaping and erecting trades | 37,540 | 870 | 2% |
| 7330 Transport truck and transit drivers | 32,640 | 1,185 | 4% |
| 7232 Bricklayers and insulators | 23,085 | 715 | 3% |
| 7510 Longshore workers and material handlers | 7,105 | 635 | 9% |
| 7250 Crane operators and water well drillers | 7,020 | 140 | 2% |
| 7241 Automotive service technicians | 4,250 | 90 | 2% |
| 7420 Transport equipment operators, utility maintenance and related maintenance workers | 3,080 | 185 | 6% |
| 7521 Water and rail transport operators and labourers and related occupations | 3,005 | 190 | 6% |
| 7242 Small engine/equipment mechanics and related repairers | 2,590 | 45 | 2% |
| 7520 Taxi, personal service and delivery service drivers | 2,260 | 155 | 7% |
| 7002 Managers in transportation and postal and courier services | 1,020 | 125 | 12% |
| Other trades, transport and equipment operators and related occupations | 1,190 | 140 | 12% |
| Business, finance and administration occupations | 137,825 | 105,190 | 76% |
| 1310 Administrative, property and payroll officers | 26,990 | 23,245 | 86% |
| 1311 Office administrative assistants - general, legal and medical | 19,615 | 18,855 | 96% |
| 1410 Office support and court services occupations | 15,355 | 13,310 | 87% |
| 1420 Financial, insurance and related administrative support workers | 14,575 | 13,035 | 89% |
| 1220 Accounting, insurance and related business administrative occupations | 13,815 | 12,405 | 90% |
| 1001 Administrative services managers | 8,625 | 4,460 | 52% |
| 1110 Auditors, accountants and investment professionals | 8,285 | 5,090 | 61% |
| 1440 Supply chain logistics, tracking and scheduling coordination occupations | 7,650 | 2,195 | 29% |
| 1210 Administrative and regulatory occupations | 6,385 | 3,615 | 57% |
| 1120 Human resources and business service professionals | 5,975 | 3,655 | 61% |
| 1002 Managers in financial and business services | 3,835 | 1,790 | 47% |
| 1201 Administrative and financial supervisors | 2,330 | 1,035 | 44% |
| 1320 Transportation/production logistics coordinators, customs brokers and related | 1,780 | 775 | 44% |
| 1411 Survey, statistical and data entry occupations | 1,490 | 1,160 | 78% |

| Occupation | Total Labour Force | Women | Women % |
|---|---|---|---|
| Other business, finance and administrative occupations | 1,135 | 565 | 50% |
| Natural and applied sciences and related occupations | 87,275 | 13,325 | 15% |
| 2230 Technical occupations in civil, mechanical and industrial engineering | 26,525 | 3,685 | 14% |
| 2231 Technical occupations in electronics and electrical engineering | 14,100 | 570 | 4% |
| 2130 Civil and mechanical engineers | 14,040 | 1,645 | 12% |
| 2223 Technical inspectors and regulatory officers | 7,425 | 1,850 | 25% |
| 2221 Technical occupations in architecture, drafting, surveying, geomatics and meteorology | 5,965 | 2,010 | 34% |
| 2120 Architects, urban planners and land surveyors | 3,385 | 715 | 21% |
| 2131 Electrical, electronics and computer engineers | 3,005 | 290 | 10% |
| 2001 Managers in engineering, architecture, science and information systems | 2,845 | 465 | 16% |
| 2222 Technical occupations in computer and information systems | 2,330 | 310 | 13% |
| 2123 Computer, software and Web designers and developers | 2,300 | 360 | 16% |
| 2122 Computer and information systems professionals | 1,650 | 455 | 28% |
| 2112 Public and environmental health and safety professionals | 1,150 | 425 | 37% |
| 2132 Manufacturing and processing engineers | 775 | 185 | 24% |
| 2211 Technical occupations in life sciences | 545 | 125 | 23% |
| 2210 Technical occupations in physical sciences | 480 | 70 | 15% |
| 2133 Natural resources engineers | 240 | 20 | 8% |
| 2111 Life science professionals | 195 | 75 | 38% |
| 2110 Physical science professionals | 185 | 15 | 8% |
| 2121 Mathematicians, statisticians, actuaries and data scientists | 100 | 30 | 30% |
| 2139 Other engineers | 40 | 0 | 0% |
| Sales and service occupations | 44,090 | 14,955 | 34% |
| Legislative and senior management occupations | 26,350 | 3,190 | 12% |
| Other construction occupations | 49,710 | 10,560 | 21% |

# Appendix B

## Table B

Construction sector key occupations forecast 2024–2033—Canadian occupational projection system[209]

| Occupation (NOC) | 2023 Employment | Percentage of workers aged 50+ in 2023 | 2024–2033 Projected Job Openings | 2024–2033 Projected Job Seekers | Labour Market Condition by 2033 |
|---|---|---|---|---|---|
| Carpenters (72310) | 132,000 | 24% | 44,700 | 38,800 | Strong signs of shortage |
| Heavy-duty equipment mechanics (72401) | 70,600 | 26% | 26,500 | 26,100 | Strong signs of shortage |
| Heating, refrigeration and air conditioning mechanics (72402) | 46,100 | 25% | 21,800 | 21,800 | Strong signs of shortage |
| Transport truck drivers (73300) | 319,400 | 48% | 148,900 | 139,400 | Moderate risk of shortage |
| Home building and renovation managers (70011) | 146,000 | 44% | 72,400 | 35,700 | Moderate risk of shortage |
| Construction trade helpers and labourers (75110) | 143,200 | 20% | 38,200 | 34,400 | Moderate risk of shortage |
| Electricians (72200) | 119,300 | 18% | 56,300 | 55,800 | Moderate risk of shortage |
| Construction managers (70010) | 108,900 | 35% | 44,600 | 27,900 | Moderate risk of shortage |
| Welders and related machine operators (72106) | 90,900 | 26% | 25,600 | 25,000 | Moderate risk of shortage |
| Construction millwrights and industrial mechanics (72400) | 88,500 | 36% | 36,000 | 36,000 | Moderate risk of shortage |
| Civil engineers (21300) | 65,600 | 30% | 21,800 | 26,200 | Moderate risk of shortage |
| Plumbers (72300) | 59,900 | 19% | 22,800 | 24,000 | Moderate risk of shortage |
| Painters and decorators (73112) | 39,200 | 39% | 14,300 | 13,800 | Moderate risk of shortage |
| Roofers and shinglers (73110) | 23,000 | 20% | 7,500 | 8,200 | Moderate risk of shortage |
| Construction estimators (22303) | 22,900 | 32% | 12,600 | 13,200 | Moderate risk of shortage |

| Occupation (NOC) | 2023 Employment | Percentage of workers aged 50+ in 2023 | 2024–2033 Projected Job Openings | 2024–2033 Projected Job Seekers | Labour Market Condition by 2033 |
|---|---|---|---|---|---|
| Floor covering installers (73113) | 16,600 | 33% | 6,100 | 6,200 | Moderate risk of shortage |
| Sheet metal workers (72102) | 13,900 | 25% | 4,700 | 4,800 | Moderate risk of shortage |
| Concrete finishers (73100) | 13,400 | 22% | 4,300 | 4,300 | Moderate risk of shortage |
| Bricklayers (72320) | 10,700 | 31% | 3,300 | 3,100 | Moderate risk of shortage |
| Gas fitters (72302) | 5,500 | 29% | 1,400 | 1,400 | Moderate risk of shortage |
| Heavy equipment operators (73400) | 75,900 | 33% | 30,300 | 28,600 | Balanced |
| Contractors and supervisors, mechanic trades (72020) | 73,800 | 42% | 33,700 | 34,200 | Balanced |
| Contractors and supervisors, heavy equipment operator crews (72021) | 64,000 | 35% | 26,100 | 23,900 | Balanced |
| Contractors and supervisors, other construction trades, installers, repairers, and services (72014) | 63,600 | 37% | 20,500 | 17,500 | Balanced |
| Residential and commercial installers and servicers (73200) | 57,400 | 30% | 18,700 | 16,100 | Balanced |
| Contractors and supervisors, carpentry trades (72013) | 31,500 | 28% | 12,800 | 10,700 | Balanced |
| Plasterers, drywall installers and finishers and lathers (73102) | 27,500 | 28% | 7,400 | 6,900 | Balanced |
| Steamfitters, pipefitters and sprinkler system installers (72301) | 25,800 | 22% | 6,300 | 7,100 | Balanced |
| Construction inspectors (22233) | 25,700 | 33% | 13,000 | 12,800 | Balanced |
| Contractors/supervisors, machining, metal forming, shaping and erecting trades, and related (72010) | 20,200 | 36% | 7,500 | 7,900 | Balanced |
| Crane operators (72500) | 16,600 | 33% | 5,900 | 5,900 | Balanced |

| Occupation (NOC) | 2023 Employment | Percentage of workers aged 50+ in 2023 | 2024–2033 Projected Job Openings | 2024–2033 Projected Job Seekers | Labour Market Condition by 2033 |
|---|---|---|---|---|---|
| Iron workers (72105) | 14,700 | 18% | 4,800 | 6,400 | Balanced |
| Contractors and supervisors, pipefitting trades (72012) | 14,100 | 38% | 5,900 | 6,100 | Balanced |
| Tilesetters (73101) | 10,100 | 30% | 3,200 | 3,700 | Balanced |
| Insulators (72321) | 9,700 | 31% | 3,300 | 3,500 | Balanced |
| Elevator constructors and mechanics (72406) | 6,000 | 16% | 2,100 | 1,300 | Balanced |
| Glaziers (73111) | 5,400 | 27% | 2,200 | 1,700 | Balanced |

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