



Strength, resilience, sustainability

Canada's construction sector recommendations
on adapting to climate change

2021

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CONTEXT

In a country with the world's longest coastline, wide-ranging geography and climate zones, and rugged, northern winters, ensuring that infrastructure can withstand the conditions that prevail across the country has always been a key tenet of construction project planning, design, and execution.

But the conditions that have prevailed are changing. Our climate is in flux. Whether it is increased damage from flooding, extreme precipitation, high winds, ice storms, or wildfires; power outages and grid failures associated with heatwaves and high demand for air conditioning; or thawing permafrost, the evidence is everywhere, and the risks (and costs) are significant.

Physical infrastructure has been assessed as one of six major climate change risk areas that are nationally significant and could lead to significant losses, damages, or disruptions over the next 20 years in Canada.¹ It has been estimated that infrastructure failures linked to climate change could cost Canada \$300 billion over the next decade if no further changes are made to existing practices.²

So, what needs to be done to ensure the Canadian construction sector has the ability to be part of the solution, both in terms of reducing greenhouse gas (GHG) emissions and fortifying existing and new infrastructure against the impacts of climate change? The Canadian Construction Association (CCA) has developed this white paper to examine the issue of the construction sector's adaptation to climate change and to make recommendations.

TAKING ACTION TO ADAPT

This paper surveys national and international research and data to explore the linkages between climate risk and infrastructure decisions; the cost of addressing the issue and the cost of doing nothing; how other jurisdictions are responding to the same challenges; and efforts already underway in the Canadian construction industry. At its heart is a call to action to government and other key stakeholders on the critical need to act now to take into consideration our changing climate, building strength, resilience and sustainability into infrastructure projects.

The timing is propitious. The COVID-19 pandemic has created a pressing need to find pathways to economic recovery. Supranational, national, and subnational governments have recognized the important role infrastructure investments can play in the recovery. Canada has too and, at the same time, is focused on building back better.

Part of building back better means adapting our construction practices to climate change. The Canadian construction sector sees the urgency and is prepared to play its part but achieving greater resiliency in the construction sector necessitates a broad paradigm shift, towards a long-term investment model that values resilient design and materials up-front.

Long-term thinking and broad-based action will pay dividends. Research indicates that the benefits of investing in community adaptation and resilience outweigh the cost of such investments by a ratio of six to one. Moreover, the potential to effect environmental and economic change in the construction sector is immense.³ The Canadian construction industry accounts for 1.4 Million people, generating \$141 Billion to the economy annually which accounts for 7.5% of Canada's gross domestic product.— it also consumes 40 percent of Canada's energy.

The Government of Canada has highlighted the importance of long-term thinking and broad-based action with the recent announcement of Canada's first-ever *National Infrastructure Assessment*. The Assessment will use data and evidence to identify Canada's long-term infrastructure needs and priorities, linking government investments with desired policy outcomes, and ensuring a plan for pandemic recovery that creates jobs, competitive advantage, and long-term growth, while building a cleaner, more inclusive future for all Canadians.⁴ This is an important step.

But more is needed than simply identifying challenges or even making commitments. There is also a need for new approaches, informed by the latest data and technologies, and codified into standards, regulations, and corporate



practices over time. A rigorous approach to continuous improvement is what will ensure that investments in infrastructure resilience have the greatest impact, both financially and environmentally.

Moreover, whether a project is being tendered to address a specific climate-related concern or an unrelated infrastructure need, the project scoping must deliberately make room for resiliency considerations. In a competitive landscape, it is unrealistic to think that construction companies will add costs to their bids to take into account long-term resilience if the client, whether within the public or private sectors, does not explicitly consider it a requirement of the bid.

CCA stands ready to play its part and offers the following recommendations for the federal government and other key stakeholders, including its members, to help advance the work.

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RECOMMENDATIONS

- The Government of Canada's *National Infrastructure Assessment* should provide a **national vision for infrastructure resilience**. Notably it should:
 - o Bring together builders, policymakers, communities, Indigenous governments, provincial and territorial governments, municipalities, key stakeholders and the general public around the common purpose of improving infrastructure resilience.
 - o Provide a common understanding of the challenge of infrastructure resilience and a recognition of the investment needed to address it.
 - o Recognize that infrastructure is far from homogenous and therefore a framework from which regional solutions and sectoral approaches can be developed is preferable to prescriptive remedies.
 - o Seek to align infrastructure priorities from all levels of government – municipal, provincial, territorial, and federal, as well as Indigenous governments.
 - o Identify international best practices and learn from them.
 - o Widely share international and domestic best practices to inform the national conversation
 - o Update the national vision every five years to reflect the ever-evolving context; and, most importantly,
 - o Include a commitment to immediate action on the findings.
- Canada needs policies and approaches that support **better data, technologies, tools, and standards**. This is a joint responsibility of government and industry. Notably, we must:
 - o Improve data accessibility including climate modeling, modeling and tracking of migration patterns of populations which can now be prohibitively expensive – the Climate Data Canada portal, launched by the Government of Canada in June 2019, is an excellent example and deserves more visibility within the construction sector, which CCA is prepared to help facilitate.
 - o Incentivize the development and deployment of innovations that align with national infrastructure goals – this should be a top government priority going forward.
 - o Update standards and regulations as materials and approaches are tested and de-risked, so best practices are incorporated into updated standards that govern and guide how infrastructure is built in Canada. This is a joint responsibility of governments and industry.
 - o Continue to contribute to the development by the Canadian Standards Association of a national resilience taxonomy to help identify investments as 'sustainable.' This is ongoing and a joint responsibility of Governments and industry.
 - o Develop processes and structures for risk-based climate adaptation management plans by Canadian construction companies. CCA is currently developing a guide for member companies to design and implement climate adaptation management plans.
- As a society we must be willing to pay the roughly 10 percent in additional cost for resilience and governments at all levels must ensure that **procurement and project design are aligned with the national vision for infrastructure resilience**.
 - o While we can and should expect companies to compete to deliver the desired level of resilience at the least cost, required resilience must be clearly stated by governments at the tendering stage.



- o Through repayable and non-repayable contributions, governments should help to defray costs that are directly related to the improved climate resilience of an asset.

A FINAL WORD

There is no time to waste. Communities are living with growing climate risk every day and project design and capital allocation decisions are being made without appropriate resilience assessment. While the *National Infrastructure Assessment* is essential, we cannot wait years for a full accounting of the issue and a comprehensive strategy – we must begin the journey today.

As Canada builds back better with infrastructure investments, the role of infrastructure as not only a driver of economic growth but also innovation must be recognized. In addition to supporting Canada's post-pandemic economic recovery strategy and putting Canadians to work today, these investments can be used to accelerate the transition to stronger, more resilient and sustainable infrastructure, capable of withstanding the challenges and risks of climate change. Working together we can weather the storm ahead, but there is not a moment to lose.

CCA and its members are committed to the work ahead and stand ready to play a constructive and collaborative role.



INTRODUCTION

“If Canada is serious about meeting our climate commitments, we need to move faster in areas like renewable energy, green building construction, building retrofits, and transportation infrastructure. Meeting our climate goals is good for the planet and good for the economy and job creation.”⁵

Charley Beresford, Columbia Institute

In the quote above, the four priorities highlighted infer that energy, the built sector, and transportation are in dire need of new investments in order to lower GHG emissions and be more climate-resilient. The other commonality of the four priorities is they all represent physical infrastructure that are long-term investments. These are assets that can last between 30 and 100 years; therefore, the decisions made now – and the priorities that guide them – are essentially locked in for decades.⁶

The significant impact of a changing climate is not a revelation for the Canadian construction sector; ensuring that infrastructure can withstand extreme weather conditions that vary across the country has always been a key tenet to project planning, design, and execution. The Red River Floodway in Winnipeg is an excellent example of this. Completed in 1968 at a cost of \$65 million, the diversion channel around the city has since been used more than two dozen times, preventing over \$12 billion in damages (2014), and has since been expanded to provide 1-in-700 year flood protection.⁷

However, the frequency of extreme weather events as well as the chronic impacts of a changing climate have added another complex layer to the process, compounded by the uncertainty of future effects. As with any sector, uncertainty makes it all the more challenging when it is not clear if upfront costs of climate-resilient materials and design will be mitigated by savings in the medium to long-term. This uncertainty can lead to short-term thinking that does not serve the project or Canadians writ large.

The inclination to constrain scale and stringency of efforts to address climate change in the construction sector and instead opt for incremental change can limit the adoption of new or time-tested technologies, having a lasting detrimental effect both environmentally and economically.⁸

The question to be answered then is, “What needs to be done to ensure the Canadian construction sector has the ability to entrench itself as part of the solution, both in terms of reducing GHGs and fortifying existing and new infrastructure against the impacts of climate change?”

CCA has developed this report as a call to action to government and other key stakeholders and to demonstrate that the construction sector recognizes the critical need to build stronger, faster. This report covers the following topics:

- The need for adaptation measures in the infrastructure and construction sector.
- What other jurisdictions are doing to spur investment in infrastructure that specifically addresses climate change and environmental risk.
- What the Canadian construction industry is already doing to adapt and prepare for impacts to their sector, and what it needs to help it do this better.
- Recommendations for how the Canadian construction industry and the various levels of government can work hand-in-hand to accelerate progress.

The potential to affect change in this sector is immense, both environmentally and economically. The Canadian construction industry is now worth \$141 billion of the GDP per year, and employs approximately 1.4 million people



across the country, but it also consumes 40 percent of Canada's energy. It has been estimated that infrastructure failures linked to climate change could cost Canada \$300 billion over the next decade, if no further changes are made to existing practices.⁹ Investments in infrastructure are crucial at this time; structurally, Canada's infrastructure is aging poorly and needs updating while economically, infrastructure investments can spur post-pandemic growth and get Canadians back to work. There is no better time to act to ensure that investments in infrastructure today take into consideration our changing climate.

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DEFINITIONS & KEY TERMS

Adaptation: Refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change. In simple terms, countries and communities need to develop adaptation solution and implement action to respond to the impacts of climate change that are already happening, as well as prepare for future impacts.

Climate change: Refers to any change in climate over time regardless of the source (natural factors, human activities, or both).

Embodied carbon: Refers to the carbon that is released in the manufacturing, production, and transportation of building materials. For the decades that the building community has been working on improving energy efficiency, the strategy has been to use relatively high-embodied carbon materials, such as insulation, to offset long-term operational carbon loads, which over the life of the building are considerably greater (especially for conventional buildings).

Horizontal construction: Refers to heavy civil construction, often associated with structures that are longer than they are tall. Horizontal construction encompasses bridges, roads, highways, railroads, airfields, and other structural projects that focus on transit. One major difference between horizontal and vertical construction is that horizontal construction projects rarely have to engage an architect. Typically, in horizontal construction projects, the structural engineer acts as the project manager.

Mitigation: Limiting climate change through anthropogenic intervention to reduce GHG emissions or increase the sinks for them. The goal is to reduce or prevent changes in the climate system. It is regarded as complementary to adaptation.

Operational carbon: Refers to the carbon load created by the use of energy to heat and power a building.

Resilience: Refers to the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change. The ability to adapt when external conditions change, and to respond to new opportunities.

Sustainable finance: Sustainable finance generally refers to the process of taking due account of environmental, social and governance (ESG) considerations when making investment decisions in the financial sector, leading to increased longer-term investments into sustainable economic activities and projects.

Sustainability: Meeting the needs of the present without compromising the ability of future generations to meet their own needs.

Vertical construction: Vertical construction includes construction projects that stretch vertically. Examples include apartment buildings, office buildings, skyscrapers, and other types of commercial buildings. Many vertical construction projects are funded privately, whereas horizontal construction projects are generally funded by the government.

Vulnerability: The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity. Therefore, adaptation would also include any efforts to address these components.



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CHAPTER 1. CLIMATE-RELATED RISK – THE NEED FOR ADAPTATION MEASURES IN THE INFRASTRUCTURE AND CONSTRUCTION SECTOR: IMPACTS FELT TODAY CAN EXPONENTIALLY RISE TOMORROW

The impacts associated with changing climate and extreme weather are being felt in Canada and globally. Canada is a large, geographically diverse country that will experience varied climate impacts. Climate change may exacerbate existing risks and present new risks as well as opportunities. The implications for the construction sector may be significant. The construction sector is a capital-intensive sector with many long-life fixed assets, reliant on supply chain and access to transportation infrastructure to enable operations. The infrastructure and assets built by the construction sector in Canada and globally has always been vulnerable to extreme weather and flooding.

According to a 2019 report on Canada's Top Climate Change Risks commissioned by the Council of Canadian Academies, physical infrastructure is one of six major climate change risk areas that are nationally significant and could lead to significant losses, damages, or disruptions over the next 20 years in Canada.¹⁰

Physical infrastructure includes homes, buildings, transportation systems including roads and bridges, and other critical infrastructure such as power systems, water and sewer systems, healthcare facilities, information and telecommunications systems.¹¹ Climate-related risks to physical infrastructure in Canada include damage from flooding, extreme precipitation, high winds or ice storms, wildfires, power outages and grid failures associated with heatwaves and high demand for air conditioning, thawing permafrost, and cascading failures affecting multiple infrastructure systems, and the services that these provide.¹² Damage to physical infrastructure can have knock-on effects for human health and wellness, as access to health services could be compromised by infrastructure failures and extreme weather events.¹³

Extreme weather events in Canada today: Impact to physical infrastructure and the construction industry

Extreme weather events have not only led to delays in construction, property damage, operational and rebuilding costs, but are also the major cause of insurers starting to refuse to insure extremely vulnerable regions and increasing their insurance premiums over the last few years in places across the world like Australia.¹⁴ Climate change is forecasted to increase the intensity and/or frequency of extreme weather events and thus further increase the property and construction sector's exposure to a wide range of risks. It is important for construction firms to understand the likely scale and speed of such forecast changes.

The increasing frequency and severity of extreme weather events have already caused significant damage or disruptions to infrastructure such as ports, airports, and waterways in North America.¹⁵ The consequences of risks to infrastructure systems include short-term economic implications and long-term impacts on growth and productivity. The Insurance Bureau of Canada identifies climate change and associated losses among major issues facing business insurance today, noting that business and supply chain disruptions are increasing along with severe weather. An analysis of 79 U.S. industries found that climate change could have material financial impacts on 72 of these, representing 93 per cent of U.S. equities.¹⁶

From 2009 to 2019, Canada-wide severe weather losses averaged about \$1.9 billion annually, according to the Insurance Board of Canada.¹⁷ These costs are expected to rise overtime. Examples of existing vulnerabilities include:



Hailstorms	A hailstorm in Calgary in June of 2020 resulted in flooding and stranded motorists on major roadways, coming in at \$1.2 billion in insured claims, the costliest hailstorm in Canadian history. ¹⁸
Flooding	The Alberta floods of 2014 had a cost of \$3.2 billion in insured damage. The 2013 Alberta floods destroyed 1,000 km of roads and washed away hundreds of culverts and bridges; over 5 million hours of work were lost, leading to \$485 million in lost economic output by the private sector. ¹⁹ The full economic impact of the flooding is projected to exceed \$6 billion. ²⁰ Climate change is expected to greatly increase risk of flooding, which could cost Canada between \$1 and \$8 billion per year by the 2050s. ²¹
Rainfall events	On July 8, 2013, a record amount of rain (126 mm) fell over the City of Toronto over a period of three hours, leading to widespread urban flooding. It is recognized as Ontario's costliest natural disaster, causing more than \$850 million in property damage and knocking power out to 300,000 customers. ²²
Wildfires	The Slave Lake wildfire destroyed 374 properties and damaged another 52; almost half of the town was ravaged. From May 14 to 16, 2011, destructive wildfires consumed Slave Lake, Alberta. Insured damage caused by the fires amounted to more than \$700 million, making this the second-costliest insured disaster in Canadian history at the time. ²³

Climate-related disasters in Canada just over the last seven years – such as the hailstorm in Calgary in 2020, the Fort McMurray wildfire in 2016, flooding in Alberta and Ontario in 2013 and in Quebec in 2017, have resulted in billions of dollars in damages and insurance claims.²⁴ As highlighted by the Report from the Council of Canadian Academies, in 2016 alone the Canadian insurance industry paid out 200,000 claims worth a record \$4.9 billion for property damage associated with weather related events, including wildfire, flooding, and severe wind.²⁵

Further, migration within and beyond Canada's borders will be another key consequence of extreme climate variability. Estimates of the numbers of people worldwide who will be compelled to move by 2050 because of climate change range from 25 million to 1 billion.²⁶ The most widely cited figure appears to be 200 million climate migrants by 2050 globally. It has also been estimated that between 500 million and 600 million people (approximately 10 per cent of the world's population) are at extreme risk due to climate change.²⁷

In the years ahead, domestic relocation or displacement could take place within our borders due to climate stresses such as coastal flooding/erosion, flood-plain inundation, and thawing permafrost. In turn, communities at risk may, as weather variability accentuates, see a gradual movement of people away from these lands and into other areas of Canada. Consequently, infrastructure investment need be informed, now and into the future, by climate variability modeling to identify risk areas, as well as internal migration modeling and tracking to ensure investment is matching needs.

Costs to governments arising from extreme weather are also increasing. Liabilities accruing to the federal Disaster Financial Assistance Arrangements program have regularly exceeded \$1 billion per year since 2010.²⁸ Estimates of future impacts are similarly troubling. For example, an analysis of the potential costs of climate change-induced lower water levels along the St. Lawrence River between the Quebec-Ontario border and Trois-Rivières estimated that for the 4,300 properties with water access in that area, the cost in reduced property values would be roughly \$72 million, representing 2 per cent of the value of those properties by 2064.²⁹



Although research has been conducted on the effects of extreme weather events, such as flooding, rainfall and high temperatures on physical infrastructure, limited research has been conducted on the effects of rainfall and hot weather conditions on the ability for construction crews to complete projects. Rainfall presents a somewhat different risk profile to construction, unlike extreme weather events such as flooding and hot weather that present physical obstacles to work on site. Rainfall and hot weather can have a devastating impact in the construction industry in the future. With rainfall and hot weather being expected to occur more commonly in the coming years, the construction industry may suffer unlike any other industry during this period. This creates the need to investigate methods that would allow construction activities to progress during rainfall and hot weather condition periods with minimum effect on construction projects.³⁰

Costs incurred by not acting on climate risks to physical infrastructure and the construction industry:

The cost of inaction on climate adaptation is high, threatening the economy and Canadians' well-being.³¹ Inaction on climate change carries significant costs for Canadians. Even at a modest level of warming of 1.5°C or 2°C, the Intergovernmental Panel on Climate Change (IPCC) estimates the global cost of the associated damages at \$54 and \$69 trillion, respectively—that includes impacts to our health, our homes, and our economy.³² Climate change costs for Canada could escalate from roughly \$5 billion per year in 2020 to between \$21 billion and \$43 billion per year by the 2050s.³³

There are significant costs associated with not investing in resilient infrastructure. In addition to the projected environmental costs and damages, there are costs associated with the resulting global capital flowing away from Canada, non-competitive products, shifts in consumer tastes, carbon tariffs and emissions.³⁴

The state of Canada's aging infrastructure leaves all levels of government, especially municipalities, particularly vulnerable to the impacts of extreme weather events.³⁵ The increased risks of failure caused by climate change heightens the urgency for new or updated infrastructure.³⁶ The Canada Infrastructure Report Card for 2016³⁷ estimates the replacement value for existing assets deemed to be in poor or very poor condition at \$141 billion. Funding will be required first, and most importantly, to close this public infrastructure deficit, then to catch up to public expectations for new investment, and for further expansion and enhancement.³⁸

A report by the Canadian Federation of Municipalities and the Insurance Bureau of Canada found that Canada's eastern and northern regions are generally most in need of adaptation investments — with flooding, erosion and melting permafrost posing the greatest risk. Among infrastructure priorities, local buildings, dikes, and roads require the most urgent upgrades.³⁹



Climate risks, forecast change, potential impacts, and adaptation strategies:

Climate risk	Forecast change	Impacts to construction	Adaptation strategy
More intense cyclones – flooding	N/A	<ul style="list-style-type: none"> • Delays to construction and even risk to meeting completion targets 	<ul style="list-style-type: none"> • Increase design and construction standards
More frequent hailstorms – Flooding	N/A	<ul style="list-style-type: none"> • Damage to cranes • Increased construction costs associated with additional site flood mitigation measures 	<ul style="list-style-type: none"> • Ensure cranes are secured or temporarily taken down • Flood defense measures
More Intense extreme rain – fall events	N/A	<ul style="list-style-type: none"> • Increased insurance costs 	<ul style="list-style-type: none"> • Effective stormwater management • Pumping equipment and backup generators
Reduced water availability	N/A	<ul style="list-style-type: none"> • Inadequate water to service developments damages feasibility of any proposed projects • Increase in water prices and costs • Water restrictions for landscape watering in droughts, higher electricity costs due to lower quantity of water for power stations 	<ul style="list-style-type: none"> • Design and build water efficient buildings • Landscape with drought tolerant plants
Average higher temperatures	<ul style="list-style-type: none"> • 0.1 – 1.5°C by 2020 • 0.3 – 4.0°C by 2030 • 0.4 – 8.0°C by 2080 	<ul style="list-style-type: none"> • Higher summer electricity demand, “peak-time” costs, consumption 	<ul style="list-style-type: none"> • Invest in energy efficiency opportunities
More days over 35°C	<ul style="list-style-type: none"> • 7 – 11 days per annum by 2000 • 69 days per annum by 2030 • 308 days per annum by 2070 	<ul style="list-style-type: none"> • Greater risk of blackouts, construction interruptions and business interruption to customers • Productivity loss from heat related fatigue and higher risk of accidents 	
Higher risk of fires	Days with very high and extreme Forest Fire Danger Index (FFDI) ratings: 15 – 70% by 2050	<ul style="list-style-type: none"> • Potential building restrictions in prone regions • Difficulties in gaining insurance • Damage to construction equipment 	<ul style="list-style-type: none"> • Future construction in low bushfire risk regions • Best practice bushfire building codes • Build appropriate fire breaks • Reduce bushfire fuel loads around construction site • Work with rural fire service



Climate risk	Forecast change	Impacts to construction	Adaptation strategy
Sea level rises	10 to 40cm by 2050 18 to 89cm by 2100	<ul style="list-style-type: none"> • Restrictions on building approval for building projects on land one metre or less above sea level • Increased costs and delays to construction 	<ul style="list-style-type: none"> • No new buildings on land at least one metre or less above sea level • Design and build so building materials can be recovered and reused upon dismantling • Temporary builds that can be dismantled

Need to prioritize investment in resilient infrastructure to manage climate related risk:

Increasing frequency and intensity of extreme weather and natural disasters have raised awareness of climate risks and have given rise to a new notion of “building resilience,” so that buildings and sites can survive and thrive despite such threats.⁴⁰ Building for resilience can help developers and property owners adjust to these changing times with some assurance that they are building well and wisely for the future. Development and redevelopment are being viewed as opportunities to reduce disaster-related risks, increase community resilience, enhance livability, and protect natural resources.

It stands to reason that if you are going to build a mixed-use town centre in, for example, Regina, Saskatchewan, a part of the country prone to drought and extreme heat in a not-so-distant future⁴¹, it means you would do well to conserve and recycle water typically wasted in buildings to nurture attractive amenities such as landscaped parks. Such strategies not only make sense, they also make money for developers and owners. Resilience plays out not just in managing risk, but also in maintaining value. Research indicates that the benefits of investing in community adaptation and resilience outweigh the cost of such investments by a ratio of six to one.⁴²

An assessment by the Council of Canadian Academies holds that targeted adaptation in responding to physical infrastructure-related risks can reduce the damages or costs that could arise as a result of climate change. At the higher end of the spectrum, the assessment determined that over 75 percent of the associated costs, damages, or disruptions from climate risks to physical infrastructure could potentially be avoided over a 20-year timeframe.⁴³

Building resilience makes sense for developers. The payback for resilience efforts can be measured in many ways, including cost savings from preventing damages and reducing operating costs, as well as revenue enhancements from improved marketing, company brand, and project image. These efforts also demonstrate the private sector commitment and leadership that is necessary for strong public/private collaborations in tackling climate change, including in reducing buildings' contributions to climate change.⁴⁴

Asset developers also have a key role to play in driving the push to building resilience. Real Estate Investment Trusts (REITs), and asset developers – including governments – continue to value short-term return on investment and low-cost ahead of prioritizing resiliency. According to the Institute of Sustainable Finance's Capital Mobilization Plan for a Canadian Low-Carbon Economy report, there is a temptation to invest in the lowest abatement cost projects.⁴⁵ An investment now in a low-cost alternative may be counter-productive if it restricts investment in higher cost but higher long-term potential projects. For instance, there is a long-standing imperative in Request For Proposals (RFPs) for construction projects, whether vertical or horizontal, to award bidders on the basis of lowest-cost and overlook the value of long-term resilience. As such, the construction industry faces a



critical barrier to the deployment of more sustainable materials. De-risking of new processes, adoption of better practices, and deployment of more sustainable materials is costly. Achieving greater resiliency in the construction sector necessitates a paradigm shift towards a long-term investment model that values resilient design and materials up-front.

The federal government committed through its new climate plan, introduced on December 11, 2020, to reduce embodied carbon in construction projects by 30 per cent starting in 2025, and to ensure that 75 per cent of domestic office floor space (new leases and lease renewals) will be in net-zero carbon, climate resilient buildings starting in 2030. The government also committed in its climate plan to work with the building materials sector and other stakeholders to develop a robust, low-emissions building materials supply chain to ensure Canadian, locally-sourced products are available. If done adequately, the implementation of these commitments could generate incentives to foster industry transformation towards long-term resilience.

Alignment amongst federal, provincial, and municipal governments:

To expedite the transition to a cleaner economy pillared on resilient infrastructure requires alignment across all orders of government. Building a future clean economy with good jobs requires that the federal government work in partnership with provinces, territories, and municipalities as well as industry stakeholders, to change the way public infrastructure projects are determined and funded.

In addressing Canada's infrastructure gap, important steps have been taken, such as the launch of the Investing in Canada Plan. Nevertheless, a differing sense of urgency and lack of coordination have slowed down the prioritization of much-needed infrastructure projects. As orders of government look to rebuild the post-COVID-19 economy, alignment of short-term, medium-term, and long-term infrastructure priorities and risks is needed to leverage construction as a tool for economic reactivation.

In November 2020, the Minister of Infrastructure and Communities Canada, the Honourable Catherine McKenna, announced the intent to develop Canada's first-ever National Infrastructure Assessment, using data and evidence to identify Canada's long-term infrastructure needs and priorities.⁴⁶ Further, the climate plan introduced by the federal government in December 2020 noted the National Infrastructure Assessment will also chart Canada's path towards achieving emissions reduction objectives. The development of a National Infrastructure Assessment initiative presents a unique opportunity to tie together all of Canada's infrastructure priorities and deficits into a strategy that lays out how Canada will address them and can help accomplish much needed coordination across all orders of government. Further, a National Infrastructure Assessment can set the stage for much-needed harmonization of priorities from all orders of government, including municipal, provincial, territorial, and federal, as well as Indigenous governments, in turn expediting infrastructure work and sending the private sector clear signals on public sector priorities.

Similar assessments are already underway around the globe, including in Australia and New Zealand. A key component is the use of data and evidence to identify long-term infrastructure needs and priorities, providing long-term clarity for industry and the supply chain.⁴⁷ The United Kingdom finalized its assessment in 2018. It was set up to address the lack of a long-term infrastructure strategy, siloed decision-making in infrastructure sectors, fragile political consensus, and short termism. The assessment addressed these issues by taking a long-term, cross-sectoral approach, with in-depth analysis and broad consultation. It further made key recommendations to address climate risks, including the development of a national standard of flood resilience for all communities by 2050, and ensuring resilience to extreme drought.



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CHAPTER 2. HOW OTHER JURISDICTIONS ARE SPURRING INVESTMENT IN INFRASTRUCTURE THAT ADDRESSES CLIMATE CHANGE AND ENVIRONMENTAL RISK

There is no shortage of capital to be invested in infrastructure across supranational, national, and subnational jurisdictions. It is estimated that global investments in infrastructure will reach US\$90 trillion in the lead up to 2030.⁴⁸ This translates to approximately US\$6.3 trillion a year to meet infrastructure development needs globally and, according to the Organization for Economic Co-operation and Development (OECD), making these investments climate compatible will only cost an addition 10 per cent or US\$0.6 trillion a year in the same time frame.⁴⁹ Infrastructure investments are typically associated with a host of socioeconomic benefits including job creation, and projects directed towards climate change and environmental risk are no different.⁵⁰

Governments across the world have recognized the importance of committing to sizable climate action and have put forward strategies to communicate their intended approach. A consistent theme across various jurisdictional climate plans is an emphasis on the role of critical infrastructure, both existing and new builds. Policies and funding mechanisms that seek to better utilize existing infrastructure to mitigate the impacts of climate change, update or upgrade systems to better adapt to current realities, and ensure new projects are climate resilient feature heavily in the broader climate change strategies.

Furthermore, the COVID-19 pandemic has created unprecedented global social and economic hardship. Countries have been forced to deal with the immediate impacts of the crisis to help mitigate the spread of the virus, keep citizens safe, and in some cases, provide financial support to help compensate for the loss of jobs and/or to encourage people to stay home. While the utmost priority remains the sustained urgent response to the pandemic, many governments are now developing a parallel pathway to plan for the post-COVID-19 economy. For some countries, this creates an opportunity to further entrench their climate action priorities as these efforts become a part of their overarching economic recovery strategies.

The following are examples of how sample supranational, national, and subnational jurisdictions are spurring investment in infrastructure to address climate change.

European Union (Supranational)

Infrastructure and investment

The EU's physical infrastructure includes more than 217,000 km of railways, 77,000 km of motorways, 42,000 km of inland waterways, 329 key seaports and 325 airports. To increase global competitiveness and ensure growth, the European Union (EU) aims to build a modern integrated transport system that can move people and goods efficiently and sustainably. The [Trans-European Transport Network policy](#) and EU funding programs support this objective.⁵¹ Funding initiatives include:

- [Connecting Europe Facility](#): Supports investments in cross-border connections and missing links while promoting sustainability and digitalization.⁵²
- [European Fund for Strategic Investment \(EFSI\)](#): In collaboration with the European Investment Bank (EIB) the EFSI makes strategic investments in infrastructure, energy efficiency and renewable energy, environment, technology, and more. Investments are supported through financial guarantees.⁵³
- [Horizon 2020](#): The EU's biggest research and innovation program.⁵⁴
- [European Structural and Investment Funds \(ESIFs\)](#):
 - o [Cohesion Fund](#): Funding for transport and environment projects in countries where the gross national income per inhabitant is less than 90 percent of the EU average.⁵⁵



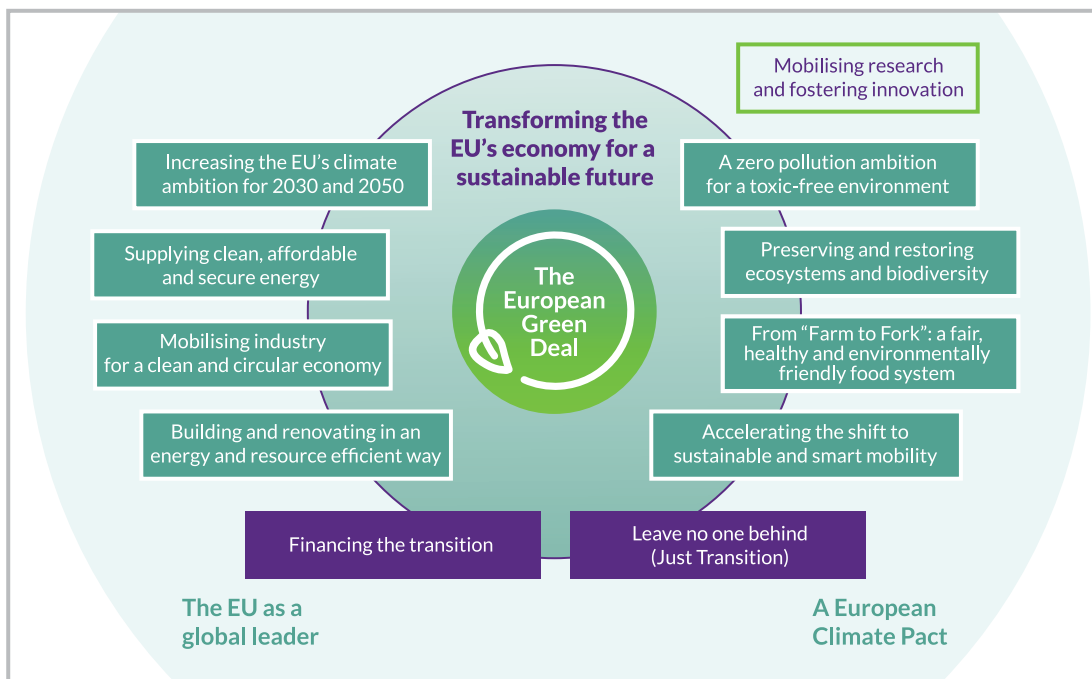
- o [European Regional Development Fund](#): Promotes balanced development in different regions of the EU.

Investing in infrastructure has always been a priority for the EU to help sustain the Union’s interconnectedness. This priority has been further solidified through the region’s commitment to fighting climate change and transitioning to carbon neutrality.

European Green Deal

In December 2019, the European Commission launched the [European Green Deal](#) (EGD), a comprehensive plan to make the EU’s economy sustainable. In response to the existential threat of climate change, the European Commission (the Commission) put forth the EGD as “...a new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use.”⁵⁶ The measures included in the package seek to ambitiously cut greenhouse gas emissions, invest in research and innovation, and preserve Europe’s natural environment. There is also emphasis placed on ensuring the transition to a lower-carbon economy is just and does not leave any person or place behind.⁵⁷

The EGD has four structural elements: a set of transformative policies, a financing strategy, a commitment to act as a global leader, and a European Climate Pact to engage with citizens throughout the transition.



Source: The European Green Deal⁵⁸

The ways in which the EGD is spurring investment in green infrastructure are demonstrated in the first two components: the set of transformative policies and the financing strategy.

Transformative policies

The policy areas covered in the EGD include biodiversity; from farm to work; sustainable agriculture; clean energy; sustainable industry; building and renovating; sustainable mobility; eliminating pollution; and climate action. These areas reflect key and interconnected socioeconomic sectors and considerations of the European economy including clean energy; industry; production and consumption; large-scale infrastructure; transport; food and agriculture; construction; taxation; and social benefits.⁵⁹ Within those policy buckets, there are several proposals focused

on upgrading existing infrastructure and buildings to adapt to climate impacts as well as ensuring new builds are efficient and climate resilient.

Most notable for investment in climate mitigating infrastructure are the policy proposals for 'building and renovating in an energy and resource efficient way.' Buildings account for 40 per cent of energy consumed in Europe and the annual renovation rate needs "to double to reach the EU's energy efficiency and climate objectives."⁶⁰ As such, the Commission has proposed EU Member States engage in a 'Renovation Wave' of public and private buildings. The EGD notes that increasing renovation rates can boost the construction sector and is an opportunity to create jobs.⁶¹ It is estimated the 'Renovation Wave' would create upwards of 160,000 jobs in the EU construction sector where 90 per cent of operators are small and mid-size enterprises.⁶² Furthermore, given the labour-intensive nature of the building sector, the Commission has also identified the 'Renovation Wave' as a key part of its post-COVID-19 recovery plan to boost economic activity.⁶³

To support this initiative, the Commission published a strategy called '[A Renovation Wave for Europe – Greening our buildings, creating jobs, improving lives.](#)' The strategy places emphasis on energy efficiency, affordability, decarbonization and the integration of renewables, life-cycle thinking and circularity, digitization and smart energy distribution systems, as well as respect for aesthetic and architectural quality.⁶⁴ Based on its analysis and public consultation, the Commission identified a list of barriers and necessary actions to enable the uptake of large scale renovations across Europe. Ensuring adequate and well-targeted funding through more grants, technical assistance, project development support, and loans is needed. "Making the construction ecosystem fit to deliver sustainable renovation, based on circular solutions, use and reuse of sustainable materials, and the integration of nature-based solutions" also ranked on the list of necessary next steps.⁶⁵

Other aspects of the building and renovating policy proposals include an assessment of Member States' national long-term renovation strategies, consideration of including building emissions in Europe's emissions trading system in order to provide the right price signals for energy efficiency, and review of the Construction Products Regulation to ensure new and renovated buildings are in line with the needs of a circular economy.⁶⁶ The Commission is also proposing to create a new platform "bringing together the building and construction sector, architects and engineers and local authorities to address the barriers to renovation."⁶⁷

Beyond the building and renovating specific proposals, other transformative policies that address clean energy and sustainable mobility place emphasis on the need for new or updated infrastructure thus contributing to investment in projects that will help to address climate change.

To reach their climate objectives it is critical for Europe to decarbonize its energy system as the production and use of energy accounts for 75 per cent of its GHG emissions.⁶⁸ The Commission is proposing to phase out coal, decarbonize gas, and prioritize the development of renewable sources such as offshore wind energy.⁶⁹ Furthermore, to transition to climate neutrality the regulatory framework for energy infrastructure will be reviewed and revised to foster the deployment of innovative technologies and infrastructure, such as smart grids, hydrogen networks or carbon capture, and energy storage.⁷⁰

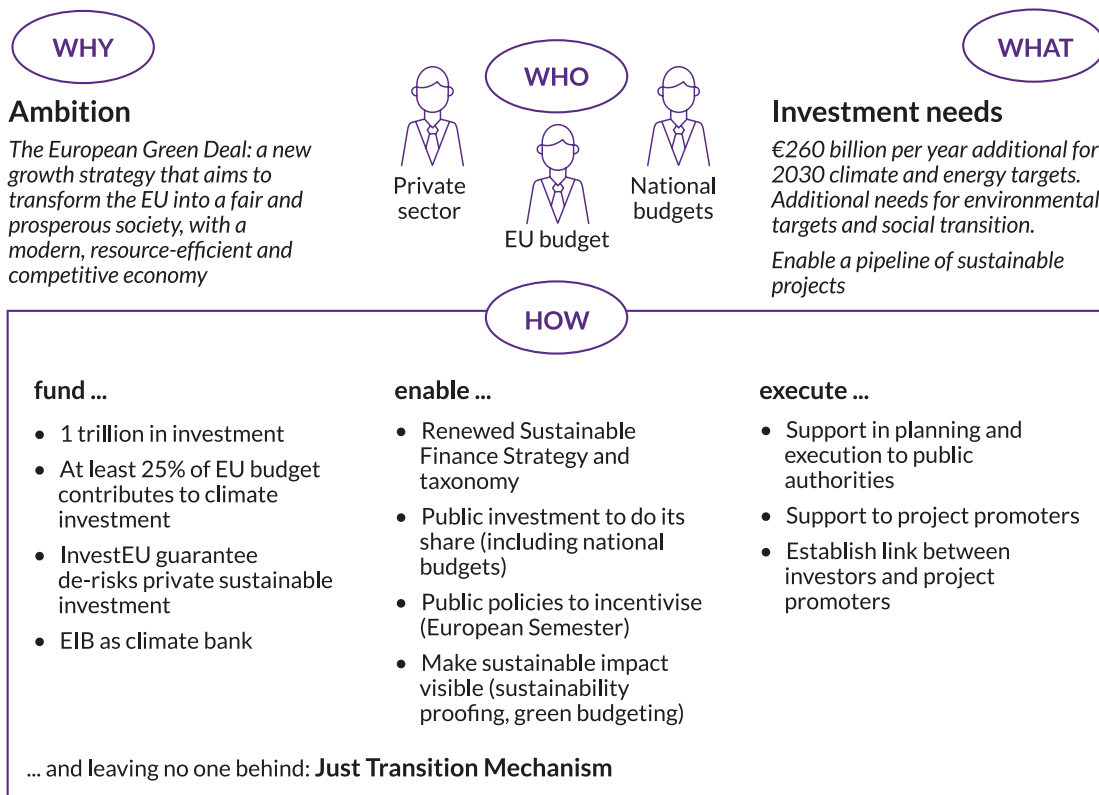
Shifting to sustainable mobility is also a necessity to achieve climate neutrality by 2050. Transportation accounts for approximately 25 per cent of Europe's GHG emissions and to achieve its climate objectives there needs to be a 90 per cent reduction in emissions from transport.⁷¹ One proposal is to shift inland freight carried by road onto rail and inland waterways, which will require the construction of increased capacity of this infrastructure.⁷² Other proposals include retrofitting the EU transport system and infrastructure to support movement that reduces congestion and pollution, eliminating fossil fuel subsidies, and ramping up the deployment of public recharging stations to service low and zero emission vehicles.⁷³



Financing strategy

Proposing transformative policies is meaningless without a robust financing strategy to give the stated objectives the resources necessary to come to fruition. It is estimated that achieving the current 2030 climate and energy targets will require €260 billion of additional annual investment, about 1.5 per cent of 2018 GDP, and that investment from both the public and private sector is required.⁷⁴ The financing strategy for elements of the EGD are outlined in the Sustainable Europe Investment Plan (Investment Plan) which includes a Just Transition Mechanism and Just Transition Fund to ensure no one is left behind. The Investment Plan addresses three aspects: funding, an enabling framework for sustainable development, and support for the identification, structuring and execution of sustainable projects.⁷⁵

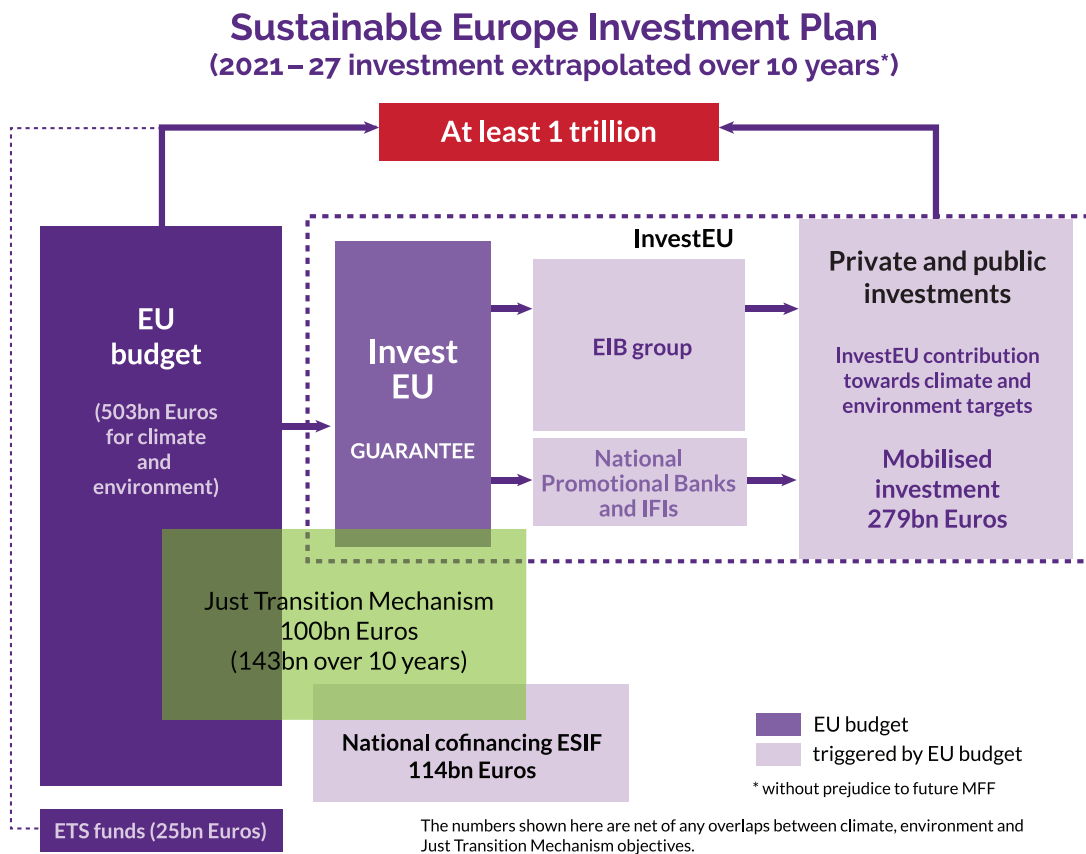
Sustainable Europe Investment Plan



Source: Sustainable Europe Investment Plan⁷⁶

The Commission intends to mobilize €1 trillion of public and private financing through the EU budget and other associated instruments, like [InvestEU](#), over the next decade to achieve its carbon neutral mandate. A combined €503 billion from the EU's long-term budget will go towards climate-related purposes and environmental expenditure. Approximately €100 billion will be dedicated to the Just Transition Fund which will provide funding and targeted support to the most affected regions to alleviate the socioeconomic impacts of the transition to carbon neutrality. Furthermore, the [European Investment Bank](#) (EIB) will become the EU's climate bank with 50 percent of its financing dedicated to climate action and environmental sustainability by 2025. Making such sizeable contributions to the implementation of the EGD by the EU, it is anticipated this will help to unlock further investments from national budgets and the private sector.⁷⁷





Source: Sustainable Europe Investment Plan⁷⁸

To create an enabling framework, the Investment Plan identifies a series of targeted actions that will directly impact investment decisions of private investors and public entities hoping to incentivize investment in the green economy, including green infrastructure. An example of a targeted action is the development of the EU Taxonomy, a classification system for sustainable activities. The EU Taxonomy “...aims to provide guidance for policy makers, industry and investors on how best to support and invest in economic activities that contribute to achieving a climate neutral economy” by evaluating a project or economic activity against a set of harmonized criteria that determines whether it qualifies as ‘green’ and therefore a sustainable investment.⁷⁹

Other actions to create an enabling framework centre on ensuring Member States have guidance and the appropriate means to making sustainable investments, such as an understanding of green budgeting practices; and revising the State Aid framework to take into consider the EGD objectives and assist Member States transition to carbon neutrality, including enhanced aid for things like energy efficiency in buildings, the closure of coal fired plants, and district heating.⁸⁰

The final component of the Investment Plan focuses on identifying and supporting the execution of sustainable projects by helping to bridge the gap between economically sound projects and suitable investors.⁸¹ This can be achieved through support of project promoters, structural reform support programs for the Member States, an InvestEU Advisory Hub, and other platforms to increase the visibility of EU businesses and investors seeking opportunities.⁸²

Other funding

While the Sustainable Europe Investment Plan is the primary strategy for financing the transition to carbon neutrality, which includes investments in infrastructure that address climate change and environmental risk, another sizeable funding commitment has been made in relation to the COVID-19 pandemic. To address the extraordinary challenges created by COVID-19 and to prepare for an economic recovery, the Commission has proposed a funding instrument called Next Generation EU. They have committed to spending 37 per cent of the €750 billion recovery fund on EGD objectives.⁸³

EU funded projects to green the economy

The Commission's green economy strategy is already being put into practice by funding projects across the Member States. A few examples of this activity are below.

- **Creating new economic opportunities in former mining towns** – The Commission provided funding to Poland to support the transformation of an old coal mine in Katowice into a cultural area which now consists of a museum, a congress centre, and a new concert hall. This created economic opportunities in construction, tourism, culture, and food services.⁸⁴
- **Helping citizens and businesses cut emissions and lower energy bills** – The European Investment Bank guaranteed by the European Fund for Strategic Investment provided funding to Lithuania for the installation of solar panels on private homes, the renovation of multi-residential buildings, and energy efficiency investments in industrial companies.⁸⁵
- **Supporting social housing** – The European Investment Bank guaranteed by the European Fund for Strategic Investment provided funding to Spain to support building 524 affordable and energy efficient social housing units in Navarra. This created 700 jobs in the construction phase.⁸⁶

The mammoth size of the EU's climate change objectives and funding commitments means there is ample resources available with supportive policies and buy-in from a supranational entity to spur investment in infrastructure that addresses climate change and environmental risk.

Australia (National)

Australia and the Pacific Islands are particularly vulnerable to the impacts of climate change. The increase in extreme weather events such as drought, floods, and cyclones are impacting livelihoods, critical infrastructure, and industry.⁸⁷ Most notably, this can be seen through the already existing and ongoing degradation of the Great Barrier Reef, an important ecological structure and economic driver for the region. As such, Australia has made a commitment to take climate action at home and in the surrounding Pacific region, including the Pacific Islands, Southeast Asia, and South Asia. Both domestic and international efforts place emphasis on planning for climate impacts, risk management, and necessary investments in critical infrastructure.

Domestic response

The Department of Infrastructure, Transport, Regional Development and Communities (DITRDC) is investing AUD\$110 billion in transport infrastructure over 10 years starting in 2020 – 21 and as part of its [Infrastructure Investment Program](#). The program aims to create an integrated land transport network that improves national and regional connectivity, improves logistics and trade, addresses the national freight challenge, enhances health and safety, and is consistent with environmental sustainability.⁸⁸ Furthermore, the government has committed AUD\$1.5 billion to the [Local Roads and Community Infrastructure Program](#) and AUD\$2 billion to a [Road Safety Program](#). Across states and territories, these funds are being used to upgrade bridges, highways, rail hubs, and more.⁸⁹



In recent years, the Australian government has become more of an informed investor of infrastructure projects rather than strictly a funder. In 2019 – 20, the government invested AUD\$13 billion through innovative financing options including concessional loans, guarantees, phased grants and availability payments, equity injection, value capture, and wider application of user charging. The government also established the [Infrastructure and Project Financing Agency](#) to expand its capacity to undertake detailed financial assessments.⁹⁰

Two departments in Australia's government are responsible for delivering on domestic climate action. The Department of Industry, Science, Energy and Resources (DISER) is responsible for developing and administering domestic actions to reduce GHGs and meet obligations under the Paris Agreement, and the Department of Agriculture, Water and the Environment (DAWE) is responsible for delivering climate change adaptation and climate science policy and programs.⁹¹

To mitigate climate change impacts and avoid associated risks, DISER is currently developing Australia's Long-term Emissions Reduction Strategy which will include a Technology Investment Roadmap, a National Hydrogen Strategy, emissions abatement strategies, and a regulatory framework to enable the construction and operation of offshore renewable energy projects.⁹² The country is investing in climate solutions through the AUD\$3.5 billion Climate Solutions Package. The package includes a [Climate Solutions Fund](#), supports for energy efficiency initiatives in homes, businesses, and community organizations, funding to develop a national electric vehicles strategy including charging infrastructure, and additional investments in energy storage, specifically pumped hydro.⁹³ The Climate Solutions Fund builds on the success of the Emissions Reduction Fund that provides funding to GHG reducing projects associated with energy consumption, waste, transport, coal and gas production, and more.⁹⁴

Clean energy projects and renewable energy projects are financed through the [Clean Energy Finance Corporation](#) (CEFC) and the [Australian Renewable Energy Agency](#) (ARENA). The CEFC is investing AUD\$10 billion on energy generation and storage, infrastructure, transport, and more.⁹⁵

DAWE has already developed a [National Climate Resilience and Adaptation Strategy](#) that details how Australia is managing the risks of climate change and outlines a set of guiding principles for effective adaptation practice and resilience-building.

The country has also created a [Critical Infrastructure Resilience Strategy](#), originally published in 2015 and currently being reviewed and updated for release in 2020 – 2021. The strategy includes a plan and a policy statement that prioritizes the continued operation of critical infrastructure in the face of all hazards, including climate change. There are two core policy objectives underpinning the strategy. The first is for "critical infrastructure owners and operators to be effective in managing reasonably foreseeable risks to the continuity of their operations, through a mature, risk-based approach" and the second is for "critical infrastructure owners and operators to be effective in managing unforeseen risks to the continuity of their operations through an organizational resilience approach."⁹⁶ The strategy is implemented through the [Trusted Information Sharing Network](#) (TISN), a non-regulatory business-government partnership.⁹⁷

Another useful planning tool created by DAWE is a framework called the [Climate Compass](#). This framework intends to help "public servants manage risk to policies, programs and asset management from climate change."⁹⁸ It utilizes climate change adaptation research and science and uses best practices in guidance for climate risk, management, and long-term planning.⁹⁹ Gauging risk and knowing when the time is right to invest in new climate resilient builds or in retrofitting existing systems is crucial. Planning tools like the Climate Compass help to make more informed and smarter investments.

International response

Australia has taken a leadership role in the region to address climate change and build disaster resilience. As part of its foreign policy and to fulfil its Paris Agreement commitments, the Australian government has spent AUD\$1 billion



in climate development assistance from 2015 – 2020 and has pledged an additional \$500 million from 2020 – 2025 to address Pacific climate change and build disaster resilience.¹⁰⁰ Understanding there is a need for further integration of climate adaptation, disaster resilience, and strong engagement with the private sector for financing solutions, the Department of Foreign Affairs and Trade put together a [Climate Change Action Strategy](#) with three overarching objectives.

The first objective is to “promote the shift to lower emissions development in the Indo-Pacific region.”¹⁰¹ This includes investing in renewable energy, improving energy efficiency in buildings, adopting clean technologies like carbon capture and storage, and making investment in infrastructure a priority to “tackle bottlenecks in the region, help create the right conditions for the private sector, and expand trade...”¹⁰² One example of this objective in action is the Tina River hydropower project which brings renewable energy to the Solomon Islands and is backed by the Australian government, the World Bank, and the Green Climate Fund.¹⁰³

Investing in sustainable cities and transportation is also providing support in shifting to lower emission development. With so much of the world's population living in urban areas, it is critical to ensure these communities are sustainable. Australia has access to an abundance of skills and established technologies to mitigate climate impacts in densely populated areas including by utilizing low emissions building materials, enhancing energy efficiency in buildings, smart traffic systems, and sustainable water and waste management.¹⁰⁴

The second objective is to “support partner countries to adapt to climate change, and to plan, prepare for and respond to climate related impacts.”¹⁰⁵ Part of this approach is to provide investments that will strengthen adaptation efforts in areas of mutual priority, like infrastructure. There is a risk of eroding development gains if climate change and disaster risk are not addressed. Helping Pacific region partner countries plan and create solid National Adaptation Plans is a focus.¹⁰⁶

The third objective is to “support innovative solutions to climate change, including those that encourage private sector investment.”¹⁰⁷ This part of the strategy emphasizes the need for innovative financing models to spur sustainable finance and encourage private sector investment.

These activities are supported by numerous regional partnership organizations, dedicated funds, and an effort to remove technical, regulatory, or economic barriers to adoption. In terms of infrastructure-specific investment to address climate needs in the Pacific, in 2019 the government created the AUD\$2 billion [Australian Infrastructure Financing Facility for the Pacific](#) (AIFFP). The AIFFP enables quality infrastructure across the region through AUD\$1.5 billion in financing and AUD\$500 million in grants. The financing is open to Pacific governments and private sector projects that are finance ready.¹⁰⁸

California (Subnational)

A subnational economy as large as California's allows the state to be an influential national and international leader on climate action. Being highly populated, coastal, and prone to wildfires leaves state officials no option but to be progressive and even aggressive with their strategies to mitigate, adapt to, and ensure resilience to climate impacts. In September 2019, the Governor of California signed an [Executive Order](#) outlining the actions the state will take to fight climate change. This included direction to the state agencies with responsibility over major state-owned or operated assets to align investments with the state's climate goals. The Executive Order also directed the Department of Finance to work with the state's pension funds on a framework to advance California's climate leadership.¹⁰⁹

The state's 2020 – 21 Budget was enacted on June 26, 2020 and includes the Five-Year Infrastructure Plan. “The Plan recognizes that infrastructure investments are foundational to addressing climate change, expanding opportunity, and supporting economic growth.”¹¹⁰ The plan consists of four elements: climate resilience, education,



broadband, and other critical state infrastructure. The majority (76 per cent) of the proposed USD\$53 billion in state infrastructure investment over the five-year period is dedicated to the state's transportation system. The rest will be used to invest in other key areas like housing, water, and energy.¹¹¹

Climate resilience

Climate resilience means state officials must integrate climate risk assessment and adaptation into decisions affecting infrastructure, natural systems, and communities. In 2017 the state published [Planning and Investing for a Resilient California: A Guidebook for State Agencies](#). In support of climate resiliency goals, the Budget commits USD\$12 billion over five years for a Climate Budget which combines Greenhouse Gas Reduction Fund investments with a proposed climate resilience bond and a new revolving loan fund.¹¹² Funding for climate resilience is targeted towards housing, transportation, water, and energy.

Housing: The state is prioritizing the production of affordable housing located closer to job centres, to the tune of USD\$17 billion over five years, so people have shorter commutes, produce fewer GHGs, have healthier lifestyles, and a higher quality of life.¹¹³ Some of this money will be spent on planning grants to local governments for technical assistance in developing plans, grants for infrastructure that support higher-density affordable housing, expansion of the Mixed-Income Loan Program, and state tax credits for the development of new affordable housing and deeper subsidies for preservation projects.¹¹⁴

Transportation: Most of the infrastructure budget is allotted to transportation since it represents 40 per cent of the state's total emissions. California is notorious for long commutes and pollution-inducing traffic jams. Over the next five years, the Plan invests USD\$5 billion in public transit and rail infrastructure, USD\$1.1 billion in projects to increase multi-modal transportation options, and high-speed rail which is partly funded by the state's Cap and Trade revenues.¹¹⁵

Another USD\$22 billion is earmarked for state highway repair and rehabilitation projects. Facilitated through the State Highway Operations and Protection Program (SHOPP), road maintenance and safety projects will ensure this basic state infrastructure is made resilient to physical climate impacts.¹¹⁶ This investment in fundamental infrastructure will not only make state highways more resilient it will lower GHGs by making travel more efficient and reducing commute times. Furthermore, portions of a USD\$3.3 billion State Transportation Improvement Program will go towards implementing a Sustainable Communities Strategy and enhancing interregional travel.¹¹⁷

Water: The state released a [Water Resilience Portfolio](#) in July 2020 as the blueprint for managing extreme droughts, floods, rising temperatures, declining fish populations, and over-reliance on groundwater. Portfolio initiatives will be funded through a proposed Climate Resilience Bond.¹¹⁸

Energy: Investment in energy will prioritize making the transmission and distribution infrastructure more resilient to wildfires, grid hardening and vegetation management, and preparing for an electrified transportation future. In addition to increasing clean energy generation, the state will invest in energy efficiency and energy storage, further adopt smart grid technology, facilitate dynamic pricing, create demand response programs, and look towards distributed generation.¹¹⁹

Other critical infrastructure

Beyond housing, transportation, water systems, and energy, California's other capital assets that support core state functions include office buildings, fire protection facilities, correctional facilities, and courts. Protecting and making more resilient these vertical assets is also part of the state's strategic investment in infrastructure to address climate change.

Lease revenue bond financing is being used to fund building renovation projects for government buildings, and facility relocations, remodels, and new construction for fire protection facilities. The investment plan also seeks



to remedy past neglect of maintenance of existing infrastructure by reroofing, repainting, rewiring, and restoring access roads.¹²⁰

Debt financing

The primary financing instrument for public infrastructure investment in California is debt financing. When borrowing to pay for infrastructure, approximately one out of every two dollars spent pays interests costs rather than construction costs. Over the years, this has been supplemented by general obligation bonds and lease revenue bonds.

Conclusion

The abovementioned examples represent only a fraction of the activity taking place to spur investment in climate-resilient and climate-mitigating infrastructure across the world. Some of the examples are applicable to Canada while others are not, but inventorying the options is a crucial first step in helping Canada create its own vision for infrastructure resilience. All levels of Canadian government and the Canadian construction sector should look to other jurisdictions for inspiration and cherry-pick the ideas that make the most sense for our economy and our climate risks.

One strategy that is seen in all three jurisdictional examples and that would transpose well to Canada is a road safety and maintenance program. The size of Canada's landmass necessitates protected and resilient roadways to facilitate the movement of people and goods. Canadians rely on roads, highways, and bridges to get to work, buy groceries, visit friends and family, and go about their day-to-day lives. Except for those living in the urban cores of densely populated cities, Canadians generally cannot walk to the places they need to be. This paired with the reality that Canada is a tri-coastal country experiencing increasing climate impacts further emphasizes the need for resilient roadways. The EU, Australia, and California have all proposed programs to enhance road safety and regional interconnectedness while preparing for the physical impacts of climate change. These are strategies that Canada can look to for ideas and opportunities.

Another strategy that would translate well to Canada is Europe's proposed 'Renovation Wave.' Canada is no exception when it comes to the devastating impacts the COVID-19 pandemic has had on the economy. It is an unfortunate reality that many Canadians have lost their jobs during this difficult time. As the country plans for its recovery, the government must consider how it will get people back to work as soon as possible. Europe's proposed 'Renovation Wave' and the volume of construction sector jobs it will create presents a great option for Canada and the Canadian construction industry. Renovating and retrofitting Canada's building stock will not only create jobs, but also align with the country's climate objectives as these retrofits will make homes and buildings more energy efficient and less polluting.

Canada could also benefit from a Construction Products Regulation, as seen in Europe, to ensure building materials are sustainable and suited for a circular economy.

The development of our own taxonomy to evaluate the sustainability of potential infrastructure projects could also help to ensure policymakers and investors are making the right decisions to help Canada achieve its carbon neutrality objectives.

Governments around the world are focusing their attention on how infrastructure investments can help withstand increasingly severe weather patterns while mitigating climate change itself. The COVID-19 pandemic has provided a pressing need to invest in infrastructure as a pathway to economic recovery. Supranational, national, and subnational governments are seizing the moment to capitalize on infrastructure investments of all sorts, and Canada should look to do the same.



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CHAPTER 3: THE CANADIAN CONSTRUCTION INDUSTRY: INNOVATION IS HAPPENING, MORE NEEDS TO BE DONE

Looking to other jurisdictions for insight into innovative approaches to resiliency will undoubtedly spur new ideas in Canada, but it would be remiss to not acknowledge that there is progress being made in this country's construction sector as well. As noted earlier in the paper, infrastructure in Canada has to be able to withstand both chronic changes to the climate – such as rising sea levels, permafrost degradation, increased temperatures, as well as more frequent extreme weather events such as fires, floods and earthquakes.¹²¹

As is the case elsewhere, incorporating new practices to address the impacts of climate change can be challenging when decisions to innovate can be hamstrung by the need to adhere to fixed costs in public procurement processes or terms set by REITs.

However, there have been examples across Canada that demonstrate the ability for the construction sector to adapt when the circumstances allow for new approaches. This is evident by the fact that construction and trades account for 46 per cent of Canada's green building employment; that is close to one fifth of Canada's total construction workforce. This activity by construction and trades in the green building business contributes approximately CA\$19.13 billion of total green-building GDP.¹²²

This has been achieved through the following ways: building new infrastructure projects that are more resilient to climate change; applying building retrofits for greater energy efficiency; integrating new (or time-tested) materials into projects; finding opportunity in the growing need for transparency of climate risk of infrastructure; and maximizing partnerships where possible.

Building infrastructure projects that are more resilient to climate change

When presented with the right conditions within an RFP or project outline, the construction sector has the opportunity to build new projects that are more resilient to climate change or reduce potential GHG emissions. This opportunity is potentially immense, given that new construction makes up almost 80 per cent of all green building activity.¹²³

Not surprisingly, the initial planning period of any infrastructure project is when the potential of incorporating climate resilient measures is at its highest. Retrofits and redesigns are effective alternatives but can be more difficult and expensive.¹²⁴

It is at this time in the process that decisions can be made to choose recycled or natural building materials that emit fewer GHGs during the manufacturing process.¹²⁵

Given the unique and often difficult climate challenges across Canada, the idea of incorporating resilience to climate change is not foreign to the construction sector. The Confederation Bridge, which crosses the Northumberland Strait in the Gulf of Saint Lawrence and connects Prince Edward Island to the Canadian mainland, is a strong example of infrastructure in which the design and planning recognized the need to adapt to changing climate. It spans 12.9 kilometers and is approximately 50 metres high.

Planning for the bridge commenced in 1985 in order to replace the ferry service that went between Prince Edward Island and the mainland. While the bridge was designed to accommodate the needs of travelers and ocean vessels over the next 100 years, climate change and rising sea levels were considered from the very beginning as well. The structure, completed in 1997, can accommodate a one metre rise in sea levels that could have otherwise undermined the integrity and structure of the bridge.¹²⁶



There are increasingly more examples of buildings being planned and designed in Canada that respond to the need to reduce emissions. The Evolv1 building in Waterloo, built by Cora Group with design by Stantec in 2018, is a strong example; it is the first building in Canada to achieve a new national zero carbon designation – Zero Carbon Building (ZCB) Design certification – from the Canadian Green Building Council. One of 16 participants in CaGBC's Zero Carbon Building Pilot Program, Evolv1 is a 110,000 square foot office building that is very energy efficient, with triple-glazed windows, a three-story atrium, an open-loop geothermal system using a 160-metre-deep aquifer for heating and cooling, and produces enough solar power generation to offset the annual emissions associated with its operations.¹²⁷

Evolv1 also received the ZCB Performance certification in 2020, in that the building achieved a zero-carbon balance over a 12-month period of operations.¹²⁸ Cora Group indicated that what it hopes will lead to an increase in buildings like Evolv1 is that they were able to deliver it at market rates similar to any other new building in the market.

Despite the success of Evolv1, more broadly there continues to be some reluctance to plan and design zero-emissions buildings because of the concern of higher costs. The Canadian Green Building Council acknowledges that such a building can cost on average 8 per cent more up front than a traditional structure, but that over a 25-year lifespan, those costs can pay for themselves and more, with savings on heating, cooling and maintenance.¹²⁹

Driving energy efficiency into building planning and retrofits

While 80 per cent of all green building activity is related to new construction, existing infrastructure can present an incredible opportunity for the sector.

For example, Natural Resources Canada (NRCan) and Environment and Climate Change Canada (ECCC) stated in 2019 that Canada has approximately 2.9 billion square meters of largely inefficient buildings and homes that contribute 17 per cent to the country's overall GHG emissions, but with the inclusion of embodied carbon, it is closer to 30 per cent.¹³⁰

In Ontario, the Ministry of Transportation (MTO) has looked to energy efficiency retrofits to make the province's infrastructure in the north more resilient to climate change; an area that is especially vulnerable to the changing climate with average temperatures expected to rise by 2 – 3 degrees Celsius by 2050. Warming temperatures will thaw permafrost, deteriorating the roads and other infrastructure.¹³¹

Some of the measures MTO has taken include recycling road materials onsite, at-source erosion control, trenchless technologies, and using pervious pavement to enhance drainage.

It is worth noting that these initiatives went forward because of procurement direction by the MTO, which will help the province achieve its overall climate change target of reducing emissions by 30 per cent below 2005 levels by 2030.

Energy efficiency measures are also effective in the example of Allied Properties REIT in Toronto. With a significant budget of \$2.3 million, Allied installed a number of energy and water conservation measures in 24 of its buildings that are in some cases more than a hundred years old. One example of the new measures that Allied implemented was to install smart controls in seven of its buildings to adjust for outside temperatures and indoor occupancy. Using these new controls saw the heat actually being turned off 77 per cent of the time. Within two years, Allied has generated \$1 million in energy savings, proving that deep retrofits in mid-size and smaller buildings can generate substantial savings over time. Again however, according to Efficiency Canada, despite the evidence of these savings less than one per cent of the existing building stock in Canada is being retrofitted.¹³²



Opportunities posed by integrating new or time-tested building materials

The ability for the construction sector to demonstrate its role in addressing climate change is affected by the supply chain upon which it relies. For example, the steel that is needed for a project may come from manufacturers in China or India if a local source is not possible. This can have an impact on the embodied carbon attributed to a given project.¹³³ While products such as recycled steel and concrete fillers are driving some reduction in embodied carbon in new construction in Canada, they have yet to make a significant impact.

Cement has historically been one of the primary sources of embodied emissions, generating approximately seven per cent of global carbon emissions. However, new technology now exists that sequesters carbon in the cement. According to Nancy Novak, Chief Innovation Officer of Compass Datacenters, the technology works as follows:

“The technology focuses on converting carbon dioxide into a mineral... and injects it into concrete. The CO₂ is sourced from industrial emitters. They collect, purify, and distribute the CO₂ to concrete plants, which store it in pressurized tanks until it is ready to use. Once injected into the wet concrete mix, the CO₂ reacts with calcium ions from cement to form a nano-sized mineral, calcium carbonate, which then becomes embedded in the concrete. This makes the concrete stronger. Aside from increased strength, CO₂ does not impact the concrete properties. Set-time, slump, workability, pumpability, air content, temperature, and finishing are unaffected; neither are hardened properties, including pH, freeze-thaw, density, colour, texture, and durability.”¹³⁴

Novak continued to say that Compass Datacenters, a data centre construction company, has committed to using the carbon sequestration technology in its new campuses in Canada after studies by engineering firm Thornton Tomasetti indicated that Compass will reduce its carbon footprint by 1800 tons per campus.¹³⁵

While technology such as carbon sequestration into cement can help reduce the carbon footprint of infrastructure, cement can also be treated to bolster the climate resilience of a project. This can be done by waterproofing concrete (of which cement is the key component). It is widely known that concrete is one of the commonly used materials due to its versatility and durability. However, as a porous and permeable material, it can crack and damage material such as reinforcing steel under the structure; all of which can damage infrastructure foundations and shorten a structure's lifespan.¹³⁶

As climate change effects worsen with more frequent extreme weather and rising levels, waterproofing concrete could help mitigate much of these serious problems. Waterproofing can be done in an external or internal approach; the external approach uses membranes applied to the surface of the concrete, whereas the internal approach is the “...method of adding the waterproofing component to the concrete at batching stage.”¹³⁷ Additional time and costs are associated with waterproofing but long-term avoided costs would need to be considered, if permissible by the owner of the infrastructure project.

Services exist that can provide information as to which construction materials are most beneficial to a green building project by offering third party verified ‘eco-declarations’. Vertima is a company located in Quebec that offers this service, requiring that “...a manufacturer must undergo a rigorous and transparent analysis process.”¹³⁸ Vertima also houses a directory of certified products that includes specific brands of steel, wood, glass, insulation, and others.

There could also exist future financial benefits to using ‘green’ materials in the development and building of infrastructure projects, as an increasing number of asset owners and governments are required to be more transparent about their respective impact to the environment and their ability to withstand the impacts of climate change, as will be discussed in the next section regarding the need to measure progress.



Measuring progress – the need for better data to yield better outcomes

The adage – if you cannot measure it, you cannot manage it – appropriately applies to the growing need for data and analysis to demonstrate the value of investing in climate resilience in the construction sector. Data can help better inform the decisions made about the type of building materials that could be used to help reduce emissions and lead to long-term financial savings. It can also help a business in the construction sector depict its sustainability efforts; a practice that is becoming increasingly prevalent across all sectors in the economy. Recognizing this imperative, the CCA has initiated preliminary efforts on this front to build measurement tools, similar to its development of other standard documents that can be used as a reference.

There is growing evidence that using life-cycle assessments (LCA) is the best approach to measure embodied carbon emissions in buildings – specifically in the different structural elements (e.g., concrete, steel, or wood). LCAs can “...measure the environmental impacts from all stages; from raw material extraction and processing, transportation, and installation to use in service, and, if necessary, disposal.”¹³⁹ There are a number of existing software programs that can be used to estimate and compare materials' LCAs or whole buildings, such as [OneClick LCA](#), or [Tally](#).

As noted in the 2019 study by the International Institute for Sustainable Development (IISD), *Emission Omissions: Carbon Accounting Gaps in the Built Environment*, LCAs are seen as the best available tool to help consider all sources of carbon, but that there remain some points of vulnerability with LCAs around the need for more data, transparency and standard development.¹⁴⁰ The IISD report suggests that investments need to be made by government to invest in up-to-date regionalized national life-cycle inventories, in order to ensure results of LCAs can be better relied upon.¹⁴¹

As previously mentioned, certifications such as those offered by companies like Vertima provide transparent analysis and data that validate a product Eco-Declaration. The certification may include an LCA and certifications pertaining to health, recycled content, and chemical ingredients.¹⁴²

Notably it includes an environmental product declaration (EPD). An EPD is defined under ISO 14025 as a “...Type III declaration that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.”¹⁴³

The level of transparency that accompanies a validated Eco-Declaration or a stand-alone EPD can provide a contractor or larger entity with evidence of effort to improve their sustainability goals not only to customers but to shareholders. However, the same challenges exist here as with LCAs – variability of available data on which to base the analysis, and inconsistent approaches to declaration procedure and interpretation of results. As with LCAs, government-funded research and protocol development would enable more reliable results that can be used by the sector.

This type of government-led research and development is already taking place in other jurisdictions, as noted in Clean Energy Canada's 2019 report – *Building the Future: How Smart Public Infrastructure Decisions Can Cut Pollution, Save Money, and Support a Clean Economy*. In countries such as The Netherlands, Belgium, and Germany, free national LCA and EPD databases have been developed, as well as LCA software. These tools are used to fulfil requirements such as whole-building LCAs, and other government-led standards.¹⁴⁴

By formalizing these requirements, governments are making it clear that these assessments represent intrinsic value and should be treated as seriously as other criteria traditionally considered when building infrastructure.

Using this type of data can be useful to companies developing materials to showcase their sustainability attributes. More broadly, this type of data is being used by companies or governments that have made ambitious net-zero commitments, or are aiming to improve their ESG (environment, social, governance) score in a sustainability report. ESG metrics – traditionally non-financial factors – are increasingly being disclosed as investors analyze material



risks and growth opportunities; thereby making them an important part of a company's bottom line. There are a number of bodies that have developed standards that can be used to define materiality: the Global Reporting Initiative (GRI), the Sustainability Accounting Standards Board (SASB), and the Task Force on Climate-related Financial Disclosures (TCFD).¹⁴⁵

As the climate crisis continues to escalate, companies and governments want to be seen as moving towards a solution as opposed to being part of the problem. This has led to greater need for accountability and transparency of a company's activities that pertain to the environment, social issues such as gender equality and inclusion, and better governance structures.¹⁴⁶

In August 2020, Aecon released its first sustainability report. It disclosed its GHG emissions from its corporate operations (Scope 1, 2 and 3), and the commitment to broaden this to enterprise-wide emissions in the future. The report includes its ESG rating, per both the TCFD framework and SASB index.¹⁴⁷

Additionally, the report also featured some of its projects' environmental benefits, such as its foray into the commercial geoexchange industry, "...an energy efficient and environmentally friendly alternative to traditional oil-gas or coal-fired heating, ventilation and air conditioning (HVAC) system that is based on basic heat transfer principles."¹⁴⁸

REITs are also being held to greater account for their sustainability performance, beyond the existing green building certifications.¹⁴⁹ This higher level of expectation by owners and tenants can also have a positive impact on net asset values not only through decreased operating costs from energy efficiency initiatives but also due to the fact that this type of building can attract higher-paying tenants who will pay more for space that is 'green'.¹⁵⁰

The collection of both qualitative and quantitative data of population migration patterns due to climate change impacts will only continue to grow in importance. This has been recognized by the federal government in the recent updated climate plan, *A Healthy Environment and A Healthy Economy*, which referenced the establishment of the website climatedata.ca.¹⁵¹ The site "...provides engineers, public health professionals, urban planners, mayors, and anyone else doing long-term planning with user-friendly climate change information, data, resources and tools."¹⁵² The portal was developed by the Canadian Centre for Climate Services (CCCS), in partnership with the Computer Research Institute of Montréal, Ouranos, the Pacific Climate Impacts Consortium, the Prairie Climate Centre, and Habitat Seven. In addition, the CCCS also recently released a report *Climate-Resilient Buildings and Core Public Infrastructure: an assessment of the impact of climate change on climatic design data in Canada*. The report "... provides an assessment of how climatic design data relevant to users of the National Building Code of Canada (NBCC 2015, Table C-2) and the Canadian Highway Bridge Design Code (CHBDC/CSA S6 2014, Annex A3.1) might change as the climate continues to warm."¹⁵³

In theory, municipal planners and engineers could access this information to determine where climate impacts will be made on existing infrastructure that could make a certain area uninhabitable, such as flooding or melting permafrost. Planners could also extrapolate from this data where displaced communities may need to be relocated and build up the necessary infrastructure accordingly.

Greater visibility of these tools and their incorporation into planning and procurement will provide greater assurance to the construction sector that the necessary lens of climate impact has been applied and given priority.



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CHAPTER 4. RECOMMENDATIONS FOR ACCELERATING PROGRESS TOWARDS RESILIENT INFRASTRUCTURE

As the impacts of a changing climate become increasingly clear in terms of their economic and social impacts, adaptation must be prioritized alongside climate mitigation as an integral aspect of the response.

This report lays out the clear linkage between climate risk and infrastructure decisions. How we, as a nation, manage that linkage will determine the extent to which climate change impacts our daily lives and our economy in the years and decades ahead.

Governments and the private sector must enter into a collaborative and sustained partnership to ensure that large-scale infrastructure built today, both vertical and horizontal, will withstand the weather patterns of tomorrow. For this to occur, governments must be prepared to lead the way in changing attitudes regarding procurement and long-term infrastructure investments. The lowest-bid ought not to be the model upon which projects are allocated. Rather, projects that include innovative materials and concepts, despite costing more, should be given consideration. Furthermore, long-term, consistent investments in infrastructure are necessary if governments want to address climate considerations on an ongoing basis.

Resistance comes from the fact that building resilience into infrastructure often costs more – approximately 10 per cent more, as was noted earlier in this paper. As a society, however, we must recognize and embrace the fact that this modest increase today pales in comparison to the devastation that will be wrought if we are underprepared for what is to come.

That is not to say that Canada ought to blindly throw money at the issue. Good data, research, and analysis, as well as protocols for incorporating adaptation considerations into the built environment, will help calibrate the approach in order to maximize the resilience gained per dollar spent.

We must also tip the scales to our favour by co-investing public and private dollars into innovation, de-risking new sustainable materials and processes and continuously improved toolsets designed to drive good decision-making in prioritization, procurement, and design.

Industry and governments recognize these critical imperatives and are mobilizing. In this section we identify a series of actions to accelerate the process and deepen the progress. In short, we believe Canada must:

- 1. Establish a national vision for infrastructure resilience that brings together builders, policy-makers, communities, Indigenous governments, provincial and territorial governments, municipalities, key stakeholders and the general public around the common purpose of improving infrastructure resilience and building stronger faster.**
- 2. Enable the continuous development of better data, technologies, tools, and standards.**
- 3. Align procurement and project design with the national vision, making use of the information, technologies, tools, and standards.**
- 4. Invest in the future today by focusing Canada's post-pandemic economic recovery strategy on the infrastructure that will see Canada through the next 50 years of national prosperity while putting Canadians to work today.**

While the Government of Canada has taken steps in this direction over the past five years, we have an opportunity in the post-pandemic environment, as Canada "Builds Back Better", to accelerate, formalize and institutionalize approaches that will see the country through to carbon neutrality in 2050 and beyond. Working together we can weather the storm ahead but there is not a moment to lose.



Establishing a national vision for infrastructure resilience

To chart a course, we must first know where we stand today and where we need to get to in the future. In this case, we need an assessment of the current state of infrastructure in Canada and the goals we wish to achieve in the coming months, years, and decades.

Minister McKenna seems to share this vision, and recently committed to developing Canada's first-ever National Infrastructure Assessment. The Assessment will use data and evidence to identify Canada's long-term infrastructure needs and priorities, linking government investments with desired policy outcomes, and ensuring a plan for pandemic recovery that creates jobs, competitive advantage, and long-term growth, while building a cleaner, more inclusive future for all Canadians.¹⁵⁴

CCA is aligned with this purpose and offers the following initial recommendations to the federal government as their important work proceeds.

Develop a National Infrastructure Assessment

- The Assessment must recognize that infrastructure is far from homogenous. Improving storm drainage to protect against urban flooding as the severity of storms worsens is different than ensuring that rural bridges will withstand increased wind speeds and ice loading.
- The Assessment must look at both horizontal and vertical infrastructure.
- The Assessment should avoid a prescriptive set of remedies and instead provide a framework from which regional solutions and sectoral approaches can be developed.
- The Assessment should look at the materials being used in terms of both sustainability and resilience.
- Canvass information and input from a wide array of experts, builders, infrastructure users, and policy-makers.
- The Assessment should seek to align infrastructure priorities from all levels of government – municipal, provincial, territorial, and federal, as well as Indigenous governments.
- Ultimately, the Assessment should serve to align government, stakeholders, communities, and Canadians around a common understanding of the challenge we face and a recognition of the investment that will be required to address it.
- As this common understanding will evolve over time, the National Infrastructure Assessment should be updated every five years, with specific workstreams identified for the periods between assessments.

Monitor international developments and approaches

As Canada works to develop its own National Infrastructure Assessment, we must not lose sight of climate change as a global challenge eliciting response from every country in its own way. The UK, Australia and New Zealand are developing their own national assessments. As we have demonstrated in this paper, an array of supranational, national and subnational governments are focused on improving infrastructure resilience. We must identify the leaders and learn from them.

This report notes two specific recommendations in terms of integrating international leadership into the Canadian approach. The first is to develop a road safety and maintenance agreement. The second is to make renovating and retrofitting Canada's building stock and transportation networks as a core element of Canada's post-COVID-19 economic recovery strategy.



Make a national commitment to act on the findings

While assessing the current status is critically important, the end goal must be rapid action towards improving resilience. This is not an academic exercise – it is about developing and deploying knowledge as quickly as possible to impact real-world infrastructure design and investment decisions.

Ensure that the findings are shared widely and inform the conversations on Canada's most pressing issues

The National Assessment and the continuous review of international approaches must inform a broader conversation than simply one between builders and governments. It must inform and be a core part of the national conversations on our most pressing matters, including post-pandemic recovery stimulus, Canada's 2030 and 2050 greenhouse gas emission commitments, Indigenous reconciliation, social and economic equality, and Canada's way of life.

Ensuring the continuous development of better data, technologies, standards, and corporate governance tools

Building stronger faster will take more than simply identifying the challenges and making a commitment to address them. It will require new approaches, informed by the latest data and technologies, that are codified into standards, regulations, and corporate practices over time. A rigorous approach to continuous improvement will also ensure that investments in infrastructure resilience have the greatest impact at the least cost.

Critical to success here is an ongoing commitment to developing more accurate and more user-friendly data sets, testing and deploying new technologies, codifying best practices in industry standard, and developing corporate approaches that ensure climate adaptation is considered at the appropriate stage of project development.

Improve data accessibility

Climate modeling is required to identify the site-specific weather parameters that can be expected in the decades ahead and that therefore should impact project design today. As well, modeling and tracking of migration patterns of populations in response to extreme climate variability will be required to inform infrastructure investment. Construction companies and governments in Canada typically rely on external sources for this type of modeling, and it can be quite costly to obtain. Democratizing climate data must be a critical near-term objective.

The Climate Data Canada portal, launched by the Government of Canada in June 2019, is an excellent resource in this regard. In June 2020, a new analysis feature was added, which allows users to set their own thresholds for defining wet days, freeze-thaw cycles, cooling and heating degree days, calculating the number of days above or below specific temperatures, as well as defining heatwave thresholds specific to a project's location. The tools deserve more visibility within the construction sector, which CCA is prepared to help facilitate.

Pilot new technologies

Canada's construction sector continues to improve on the materials and building methods to improve the sustainability within the construction phase and over the life of the asset. However, it is often difficult to pilot new approaches during major undertakings on a tight timeline. Also, if an innovative technology underperforms, it could be costly to the project or even dangerous to the users. Historically, then, the construction sector has been cautious towards innovation.

However, progress is being made. For example, CCA is currently working with a consultancy to improve the construction sector's access to the Scientific Research and Experimental Development (SR&ED) program. Administered by the Canada Revenue Agency, the SR&ED program offers Canadian companies of all sizes income tax deductions, tax credits, or refunds for experimenting with new technologies.



More can and must be done. Governments have a role in incenting the development and deployment of innovations that align with our national infrastructure goals. This should be a top priority going forward.

Update standards and regulations

As materials or approaches are tested and de-risked to the point that they become recognized as leading practices, they should be incorporated into updated standards that govern and guide how infrastructure is built in Canada. This ensures that the bar is continually raised on how infrastructure is built in Canada, and that best practices are shared widely across the sector so that all companies are held to the same standard.

Develop a national resilience taxonomy

Canadian banks, pension funds, NGOs, asset managements, auditing firms and industry groups have been working as a 'task group' with the Canadian Standards Authority (CSA) to develop a Canadian taxonomy that will help identify investments as 'sustainable.' The construction sector should support this effort to ensure that the value of infrastructure resilience is appropriately represented within the work.

Develop better corporate tools

Beyond the technical standards and regulations, Canada's construction companies should be working to develop the internal processes and structures that amount to a risk-based climate adaptation management plan. Climate adaptation and infrastructure resilience is an important element of any enterprise risk management process and the issue is only going to become more and more acute as the climate changes. CCA is currently developing a guide for member companies to design and implement an adaptation management plan. The guide will be available early in 2021.

Aligning project procurement with the national vision and make full use of available data, technologies, standards, and tools

The elements of a cohesive national infrastructure resilience strategy must come together to inform the procurement process. Whether a project is being tendered to address a specific climate-related concern or an unrelated infrastructure need, the project scoping must deliberately make room for resiliency considerations. It is unfair to think that construction companies will add costs to their bid to take into account long-term resilience if the client, whether within the public or private sectors, does not explicitly state it as a requirement of the bid.

Ensure that markets properly value infrastructure resiliency

Canadians value function, comfort, aesthetic, and modernity in our built environment, amongst other attributes. Resilience must be added to that list as a core deliverable of every infrastructure project. The bottom line is that as a society we must be willing to pay the roughly 10 per cent in additional cost for resilience. We should expect that companies will compete to deliver the desired level of resilience at the least cost, but the required resilience must be clearly stated at the tendering stage.

Help to defray resilience costs through government supports

Through both repayable and non-repayable contributions, the federal government can help to defray costs that are directly related to the improved climate resilience of an asset. For example, the Canada Infrastructure Bank could develop a program of low-cost loans with a long payback horizon to encourage private sector investments in improved resilience. The SR&ED program is helping with innovation; a similarly broad-based approach focused on motivating capital allocation decisions may also be required.

The time to start is now

The National Infrastructure Assessment may take years to carry out. Meanwhile, communities are living with growing climate risk every day and project design and capital allocation decisions are being made without a full and



proper resilience assessment. We cannot wait for a full accounting of the issue and a comprehensive strategy for moving forward – we must begin the journey today.

The Government of Canada made a good start when it launched, on September 28, 2020, the Disaster Mitigation and Adaptation Fund, a national merit-based program that will invest \$2 billion to support large-scale infrastructure projects to help communities better manage the risks of disasters triggered by natural hazards.

CCA is working with members to increase the awareness of the resilience imperative and is providing a platform for coordination across the sector and for deeper integration with infrastructure planning at all levels of government, including Indigenous governments.

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CONCLUSION

This report is meant to be a constructive addition to the critical national conversation focused on ensuring infrastructure resilience in the face of a changing climate. It has attempted to fulfill four objectives: communicating the importance of climate change adaptation to the construction sector; providing an understanding of the current perspectives and practices in the sector; recognizing the positive cost-benefit analysis of building resilient infrastructure today; and advancing key recommendations for the consideration of governments, construction sector companies and the broad set of stakeholders with an interest in infrastructure resilience.

There is no magic switch to go from the baseline approach to infrastructure that has served Canada well for generations to the resilience-centred approach required for the years and decades ahead. It will be a journey that requires contributions from governments, builders, procurement officers, innovators, and many others. CCA and its members are committed to the work ahead and stand ready to play a constructive and collaborative role. CCA is optimistic that working together we will achieve the outcomes Canadians deserve: infrastructure that supports the economy and the Canadian way of life today and into the future.

