



# BUILDING CANADA'S LOW-CARBON APPROACH TO INFRASTRUCTURE INVESTMENTS

through Prioritization,  
Policy and Procurement

---

*This report was originally prepared by Evergreen,  
Sara Wilson, and Actual Media in November 2017  
with support from the Ivey Foundation.*

# Table of Contents

3	Executive Summary
5	Recommendations
8	Introduction
11	Economic Boost from Investing in Low-Carbon, Climate-Resilient Infrastructure
13	Proactive Procurement Shifting to a Value for Money Across the Life Cycle Approach
15	Low-Carbon Procurement Integrating Life Cycle Assessment
16	The Ontario Government is Leading the Way Forward on Integrating LCA into Infrastructure Planning
18	Life Cycle Assessment Tools
20	Community and Economic Benefits
21	Building Resilience through Low-Carbon Investments
23	Municipal Asset Management
25	Conclusion
26	Acknowledgements
27	Endnotes

# EXECUTIVE SUMMARY

A lack of funding for public infrastructure across Canada has created a major infrastructure debt – including roads, bridges, public transit and recreation centres.

A lack of funding for public infrastructure across Canada has created a major infrastructure debt – including roads, bridges, public transit and recreation centres. The Government of Canada is making historic new investments in infrastructure to build the cities of the 21st century through its *Investing in Canada Plan* – spending more than \$180 billion over 12 years on infrastructure priorities, and the newly established Canada Infrastructure Bank, which will create a pool of \$35 billion for public-private partnership financing. Over the next decade, over \$750 billion is expected to be invested across all three levels of government in Canada’s cities and communities. These expenditures provide a timely opportunity to invest in clean growth, urban innovation, social infrastructure and smart cities.

At the same time, the federal government has committed to transitioning to a low-carbon, resilient economy. *The Pan-Canadian Framework on Clean Growth and Climate Change*, released in the fall of 2016, provides a plan to grow Canada’s clean economy while meeting Canada’s target to reduce greenhouse gas emissions 30% below 2005 by 2030, and building resilience to adapt to a changing climate.

The transportation, energy, and buildings sectors contribute about 75% of Canada’s total greenhouse gases (GHG) emissions.<sup>1</sup> These emissions will need to decrease significantly in order for Canada to meet its international commitments and to transition to a low-carbon economy. As such, investments in the renewal of existing assets as well as new infrastructure will have a significant impact on whether Canada can make this transition. These investments will impact GHG emissions directly in terms of how they are built (i.e. carbon emissions embedded in construction materials and the efficiency of operational systems); but, they will also determine opportunities for indirect GHG reductions in terms of where they are built, the modes of transportation options that are prioritized, and whether they are well integrated into complete community design and provincial growth planning.

A proactive approach is required to reduce GHG emissions across government decision-making. The purpose of this report is to provide recommendations for the federal and Ontario governments on the public policies that will drive clean innovation and growth, and provide guidance for investments in sustainable, low-carbon, resilient infrastructure that are aligned with compact, complete community design, provincial growth planning, and that provide economic and community benefits.

The Organisation for Economic Co-operation and Development (OECD) states that investment in modern, smart and clean infrastructure over the next 10 to 15 years is critical to avoid locking in emission-intensive infrastructure, and will determine whether the 2015 Paris Agreement's objective to stabilize the global climate can be achieved. Delaying action will be more costly – for example, taking action after 2025 would lead to an average Gross Domestic Product (GDP) loss of 2% for G20 economies, relative to taking action now.

Recent economic modelling by the OECD shows that integrating ambitious climate policies with economic reforms in a synergistic manner towards decarbonization of G20 economies can spur economic growth while also mobilizing investment for longer-term climate objectives and clean innovation. Their results demonstrate that collective decisive action to transition to a trajectory pathway set to hold warming below 2 degrees Celsius will boost economic output (GDP) by 1% by 2021 and 2.8% by 2050, on average, across the G20.<sup>2</sup> When policy measures to avoid damages from climate change are included, the net effect for 2050 increases to a boost in GDP of 4.7%.

# RECOMMENDATIONS

1

At the federal level, when an opportunity emerges to update the Climate Lens, include reference to LCA as a tool to quantify both direct and indirect emissions, and ensure that future sector-specific technical guidance also includes LCA as a tool. In addition, LCA should be applied as part of the screening and eligibility requirements for infrastructure funding transfers to provinces for:

- a. bilateral agreements with provinces and territories;
- b. funding from the Canada Infrastructure Bank; and
- c. funding from the Smart Communities Challenge Fund.

2

Ensure an enterprise-wide approach to reducing GHG emissions by including a requirement in mandate letters for government ministries and agencies to establish climate change objectives, targets and to integrate LCA and life cycle costing (LCCA) into decision-making. These objectives and targets should be aligned with the Pan-Canadian *Framework for Clean Growth and Climate Change* and provincially set targets. This will provide a framework for ministry level policy development and the integration of LCA into policy, decision-making and to implement targets for low-carbon infrastructure benchmarks.

3

Require LCA and LCCA as criteria and a tool in prioritization of infrastructure investments. For example, prioritizing infrastructure projects that would support government objectives to reduce GHG emissions and contribute to other government policies regarding transportation options and complete communities; and, when prioritizing decisions on renewing and repurposing existing assets versus new asset builds.

4

Require LCA and LCCA in policies, Treasury Board project approvals and procurement processes for infrastructure planning, design and construction.

- a. Pilots: Begin a phased-in requirement of LCA with pilot projects in government agencies such as Infrastructure Ontario's AFP (Alternative Financing Procurement) RFQ/RFPs that would require LCA at the design stage as a competitive incentive for successful bids (i.e. short-listed bids that meet the greatest lowest life cycle GHGs would be given priority in the bidding process). Pilots could be rolled out based on the infrastructure asset types that have established LCA baselines for life cycle GHGs as well as market ready LCA software-based tools.
- b. Supporting Research: Undertake research to establish current baseline information for LCA for different infrastructure asset types (e.g. GHGs/km road, GHGs/km track, GHGs/sq. foot), to develop benchmarks and targets to incentivize progressive life cycle GHG emission reductions through pilot projects through to full roll out of requirements enterprise-wide. Pilot projects could also inform this research and its outcomes.
- c. Identification of Tools: Commission a study to assess and identify the criteria that should be met for comparable LCA for different infrastructure types and assess which currently available LCA tools meet this screening.

5

Develop LCA and LCCA technical guidance for ministry level staff and for municipalities. Provide training for ministry staff to utilize guidance in making project approvals, integrating into prioritization processes within ministries, and for assessing funding transfers to municipalities.

6

Improve government-wide climate change governance by establishing a standing committee on integrating life cycle assessment and climate change objectives into infrastructure prioritization, planning and procurement.

- 7** Over the long-term, establish standardized outcomes and/or benchmarks for the measurement of life cycle GHGs (cradle-to-grave) including embodied carbon of materials, construction assemblies and construction processes (e.g. Environmental Product Declarations [EPDs]). This could include creating a national or provincial database that provides accessible information of the embodied carbon emissions of materials, best practices in long-term value-based procurement, and successful case studies for the creation of sustainable, resilient, and low-carbon infrastructure assets. For example, the Netherlands has developed a government database for LCA and EPDs for building assessments.
- 8** Integrate LCA into provincial and municipal asset management. Financial support for municipalities where an increase in upfront costs is necessary for integrating LCA and climate resilience into infrastructure prioritization, planning, procurement and asset management. Federal government loan or grant programs that would help municipalities and provinces pay the additional upfront costs where they occur could be set to support this transition.

Together, these recommendations provide a framework for integrating a low-carbon life cycle approach to decision-making for infrastructure in Canada. Given the \$500 billion+ the federal and provincial governments are making in infrastructure over the next decade, there is a significant opportunity to align Canada's procurement policies with current priorities and to ensure these investments are supporting the transition to a prosperous, low-carbon, resilient future.

# INTRODUCTION

The Government of Canada is making historic new investments in infrastructure to build the cities of the 21st century through its *Investing in Canada Plan*—spending more than \$180 billion over 12 years on five main infrastructure priorities—and the newly established Canada Infrastructure Bank, which will create a pool of \$35 billion for public-private partnership financing. Over the next decade, over \$750 billion is expected to be invested across all three levels of government in Canada’s cities and communities. These expenditures provide a timely opportunity to invest in clean growth, urban innovation, social infrastructure and smart cities.

At the same time, the federal government has committed to transitioning to a low-carbon, resilient economy. *The Pan-Canadian Framework on Clean Growth and Climate Change*, released in the fall of 2016, provides a plan to grow Canada’s clean economy while meeting Canada’s GHG reduction targets, international commitments, and building resilience to adapt to a changing climate.

**Given Canada’s commitment to transition to a low-carbon, resilient economy, the federal government and other jurisdictions will need to update their procurement policies to promote value for money across the life cycle of assets to ensure investments are prioritized towards low-carbon infrastructure, materials, products and services.**

The importance of taking a life cycle view towards reducing total construction sector GHG emissions is increasingly being recognized as a key action for mitigating climate change. It is estimated that about 20% of GHG emissions are embodied in the construction sector. Climate change policies generally have not accounted for embodied carbon for buildings and infrastructure. For example, policies for net-zero buildings generally do not include embodied and full life cycle GHG emissions.

**The Government of Canada is making historic new investments in infrastructure to build the cities of the 21st century.**

Leading international jurisdictions that are taking significant action to reduce embodied carbon in construction have been reviewed in a recent Canadian report.<sup>3</sup> All of these jurisdictions are European countries. For example:

- > Germany requires whole-building LCA for new federal construction as part of the mandatory Assessment System for Sustainable Building. This system provides points for performance against a standard benchmark, which is supported by a national LCA/EPC (environmental product declaration) database and a free LCA software tool.
- > The Netherlands requires an embodied carbon reporting at the building permit application stage for all new residential and office buildings over 100 m<sup>2</sup>; and it has set up a national EPD database, a standardized method for whole-building LCA and several LCA software tools. Their embodied carbon policy is the first public policy that requires whole-building LCA for non-government buildings.
- > Similarly, Switzerland requires whole-building LCA for all new government buildings in several municipalities, including Zurich.
- > In the U.K., voluntary green building rating programs (e.g. BREEAM) include an LCA component, and embodied carbon performance targets for residential and commercial/institutional buildings are expected to be in place by 2018.
- > Finally, Sweden requires that all large transportation infrastructure projects report embodied carbon and GHG emissions with incentives provided to reduce embodied GHGs below a set target. Sweden has also established a national LCA-based software tool to support these programs.

In Canada, some provinces are already requiring low-carbon procurement and the consideration of life cycle in procurement processes. In May 2017, the City of Vancouver's Green Buildings Policy for Rezoning became mandatory. This policy



"Federal, provincial, and territorial governments will work together to modernize procurement practices, adopt clean energy and technologies, and prioritize opportunities to help Canadian businesses grow, demonstrate new technologies, and create jobs."

*-Pan-Canadian Framework on Clean Growth and Climate Change, 2016.*

requires that “all projects report life cycle equivalent carbon dioxide emissions or embodied carbon for each building in CO<sub>2</sub>e/m<sup>2</sup> as calculated by a whole-building life cycle assessment (LCA); or be designed to an emissions standard like Passive house.”<sup>4</sup> In Quebec, the Quebec Wood Charter requires a comparative analysis of GHG emissions for structural materials used to build provincially funded new building projects. At the federal level, Public Services and Procurement Canada is now requesting a whole-building LCA for its new building projects; and Infrastructure Canada’s 2017 Integrated Bilateral Agreement Letters for the next phase of infrastructure investments, announced in Budget 2017, will require that new funding meet national objectives and outcomes including improving environmental quality, reducing greenhouse gas emissions and increasing the resiliency of communities.<sup>5</sup>

Although Ontario has not established a requirement for LCA for infrastructure investments yet, in September 2016, the Ontario Premier’s Instructions to the Minister of Infrastructure set out a commitment in the Ministry’s Mandate Letter to integrate the province’s commitments in the *Climate Change Action Plan 2016-2020* across the province’s *Infrastructure Plan*. This commitment includes incorporating LCA and LCCA into the capital planning process as part of the development of the province’s *Long-Term Infrastructure Plan*.<sup>6</sup> The Ministry of Infrastructure’s plan and annual report for 2017-2018 includes a commitment to integrate the province’s commitments in the *Climate Change Action Plan* across the Province’s *Infrastructure Plan*. In addition, Ontario’s *Climate Change Action Plan* includes an action requiring that the Ontario Public Service (OPS) Procurement Directive be reviewed to enable low-carbon procurement, including the consideration of the full life cycle of products.<sup>7</sup>

Governments have been stretched by the financial burden of managing and maintaining existing infrastructure assets and a large infrastructure deficit, which has created a culture where the lowest bid is generally seen as the most viable and best value for public infrastructure projects and other government services. The result is a public procurement system that fails to encourage the integration of new innovative low-carbon materials, best practices and building methods, and therefore create the environment that will facilitate a transition to a low-carbon, climate resilient infrastructure system and economy.

Canada can become a global leader in building 21st century infrastructure networks that are future-proof, innovative, resilient and with a low-carbon footprint. However, new values and tools for enabling low-carbon decisions across infrastructure prioritization, planning and procurement need to be implemented quickly with a phased-in approach that includes new requirements into government procurement systems.

# ECONOMIC BOOST FROM INVESTING IN LOW-CARBON, CLIMATE-RESILIENT INFRASTRUCTURE

---

Further economic impacts such as the impact of improved public infrastructure that reduces costs for private businesses through enhanced transportation networks and reliable water management can boost real GDP in the long-term by up to \$6 per dollar spent.

According to the Centre for Spatial Economics, the benefits of Ontario's 10-year, \$140 billion public infrastructure spending plan, as set out in 2016, would include a short-term rise in GDP of \$0.91 per dollar spent, 4.7 jobs generated per million dollars spent, and \$0.27 for each dollar spent recovered by government in revenues.<sup>8</sup> **These benefits would result from the direct program spending, mostly on construction.** Further economic impacts such as the impact of improved public infrastructure that reduces costs for private businesses through enhanced transportation networks and reliable water management can boost real GDP in the long-term by up to \$6 per dollar spent.

Economic modelling now demonstrates that integrating ambitious climate policies to mitigate GHG emissions as well as to build resiliency to the changing climate result in larger boosts to the economy. New OECD modelling shows how combining ambitious climate policies with economic reforms in an integrated, synergistic manner towards decarbonisation of G20 economies can spur economic growth while also mobilizing investment for longer-term climate objectives. Their results demonstrate that collective decisive action to transition to a trajectory pathway set to hold warming below 2 degrees Celsius will boost economic output (GDP) by 1% by 2021 and 2.8 % by 2050, on average, across the G20.<sup>9</sup>

When policy measures to avoid damages from climate change are included, the net effect for 2050 increases to a boost in GDP of 4.7%. This scenario is driven by a combination of investment in low-emission, climate-resilient infrastructure, additional fiscal initiatives to fund climate-consistent non-energy infrastructure, pro-growth reform policies to improve resource allocation, technological deployment and green innovation. The combined economic benefits more than offset the impact of higher energy prices, tighter regulations, and high carbon assets that may become economically stranded assets.

The OECD states that investment in modern, smart and clean infrastructure over the next 10 to 15 years is critical to avoid locking in emission-intensive infrastructure, and will determine whether the 2015 Paris Agreement's objective to stabilize the global climate can be achieved. Delaying action will be more costly – for example, taking action after 2025 would lead to an average GDP loss of 2% for G20 economies, relative to taking action now. Not only would delayed action increase transition costs, it would require more abrupt adjustments when action is taken and would affect a larger stock of high carbon infrastructure built in the intervening years leading to higher levels of stranded assets across the economy.

According to the OECD, public procurement at central and local government levels are particularly important to ensure low-emission and resilient infrastructure. This can be achieved by pricing life cycle carbon emissions in procurement criteria to encourage a competition to lower emissions. Public procurement can create lead markets for innovative low-GHG materials and infrastructure choices, and can ensure that the direction of infrastructure investment is aligned with the goal of increasing resilience to economic and climate-related shocks.

## Recommendation

1

At the federal level, when an opportunity emerges to update the Climate Lens, include reference to LCA as a tool to quantify both direct and indirect emissions, and ensure that future sector-specific technical guidance also includes LCA as a tool. In addition, LCA should be applied as part of the screening and eligibility requirements for infrastructure funding transfers to provinces for:

- a. bilateral agreements with provinces and territories;
- b. funding from the Canada Infrastructure Bank; and
- c. funding from the Smart Communities Challenge Fund.

# PROACTIVE PROCUREMENT

## Shifting to a Value for Money Across the Life Cycle Approach

---

Transitioning to a proactive approach to procurement will support the transition to a low-carbon, resilient infrastructure system that is based on value for money across the life cycle of assets, rather than solely upfront costs.

Transitioning to a proactive approach to procurement will support the transition to a low-carbon, resilient infrastructure system that is based on value for money across the life cycle of assets, rather than solely upfront costs. The current approach, focused on the lowest bid, would be replaced by a value for money across the life cycle narrative. This would enable cost-effective low-carbon solutions for infrastructure design, build, maintenance and renewal that reduce life cycle greenhouse gas emissions. For example, construction materials with lower embodied carbon and higher durability and renewable energy and waste heat recovery systems have a net benefit in life cycle costs and overall value to society.

The challenge for governments is to position infrastructure prioritization, planning and procurement as a catalyst for clean innovation and clean growth. The problem is that risks are inadequately identified and priced across the life cycle planning of infrastructure, which leads to inaccurate financial and value assessment of assets. Integrating the full costs and benefits, including climate risk, into infrastructure procurement is critical because infrastructure locks in capital, land use, design and technology for long periods of time.

The OECD report, *Going Green: Best Practices for Sustainable Procurement*, provides a snapshot of countries that have implemented green public procurement into national policy frameworks.<sup>10</sup> For example, the Netherlands now requires that Dutch public authorities implement 100% sustainable procurement. In response, the Department of the Ministry of Infrastructure and the Environment developed a methodology for the procurement of infrastructure projects based on functional, performance-based specifications and specific quality criteria including a public oriented approach, sustainability, project management, design and risk management. Quality aspects are monetized, so that the more effort the bidder makes to improve the quality of the bid, the higher the monetized value that will be deducted from its actual offer price. As a result, tenderers with the highest quality offers have the best chance of winning the tender.

The specific criteria for sustainability focuses on two attributes: carbon or GHG emissions and environmental impact. Two tools have been developed to support sustainable procurement including a CO<sub>2</sub> performance ladder as a certification system and the Sustainable Building Calculator or “Dubocalc” as the LCA tool. Dubocalc calculates embedded life cycle environmental impacts of material use from raw material extraction and production up to and including demolition and recycling. In addition, it calculates the energy consumed by infrastructure assets during the use phase. The software is based on an independent national database containing certified LCA information for each material. Dubocalc calculates the value using a shadow price method based on the costs of preventing emissions from arising, as the monetized indicator

of the environmental impact of the tender’s design. Bidders are encouraged to offer innovative and sustainable design options because tenders are evaluated on performance rather than compliance specifications. Compliance during the execution of the contract is enforced by economic sanctions if the actual quality does not comply with the offer (e.g. 1.5 times the calculated price for quality value in tender).

International life cycle inventory databases such as Ecoinvent, one of the world’s largest life cycle databases, provide data and support for LCAs and the development of LCA software-based tools.<sup>11</sup> In Canada, the Interuniversity Research Centre for the Life Cycle of Products, Processes and Services (CIRAIG) is a joint initiative of the Polytechnique Montreal and the École des sciences de la gestion de l’Université du Québec à Montréal (ESG UQAM) in Quebec. The CIRAIG’s International Life Cycle Chair’s principle objective is to develop tools and approaches to operationalize life cycle thinking for partner applications. Their current research includes developing ways that administrators can use tools to support public procurement, assessment of infrastructure projects or determination of public policies, and how this can be used to better manage risks, leverage performance and foster strategic and innovative development.<sup>12</sup>

The Athena Sustainable Materials Institute is a non-profit think tank working on developing life cycle assessment for the construction sector. Most recently, Athena has released a white paper on how to set Whole-building LCA Benchmarks.<sup>13</sup> As LCA is integrated into decision-making and procurement for infrastructure, benchmarking is needed to compare results and set performance targets. The Athena Institute’s new report proposes a new standardized system to provide LCA performance benchmarking for whole-building LCAs across North America.

LCA needs to be integrated in the visioning and prioritization stages of infrastructure planning and into the early procurement and approvals stages for design and materials acquisition.

# LOW-CARBON PROCUREMENT

## Integrating Life Cycle Assessment

---

LCA needs to be integrated in the visioning and prioritization stages of infrastructure planning and into the early procurement and approvals stages for design and materials acquisition. These early stages are where the greatest influence can be made in regards to sustainability, resilience and reducing life cycle GHG emissions.

Integrating LCA at the beginning of the infrastructure procurement process is critical, and should include the production of materials, assemblies and systems (i.e. embedded carbon of construction materials), construction, as well as, where possible, the in-use stages and operational energy performance, maintenance and renewal, and end-of-life GHG emissions. An LCA tool that accounts for carbon or GHGs is required to ensure that both the asset owner and the contractor have an accurate record of the life cycle GHGs emitted across the life cycle of the asset.

According to the OECD, public procurement expenditures amount to about 13% for a typical OECD country's GDP. As such, public procurement is recognized as a key process to engage in low-carbon transition policies and to demonstrate a commitment to international commitments under the Paris Agreement by leading in Canada's investments. Public procurement is also recognized as a catalyst – an important tool for leading innovative technology and policy. Public procurement can lead on bringing existing low-carbon solutions to market, but can also create leading markets for new innovative and smart technologies and materials, especially where government demand is significant (e.g. transportation, buildings). The pure advantage is that public procurement can spur innovation without engaging new spending.

# THE ONTARIO GOVERNMENT IS LEADING THE WAY FORWARD ON INTEGRATING LCA INTO INFRASTRUCTURE PLANNING

---

The Ontario Ministry of Infrastructure's plan and annual report for 2017-2018 includes a commitment to integrate the province's commitments in the *Climate Change Action Plan* across the Province's *Infrastructure Plan*. This includes ensuring that priorities for the Province align with *Ontario's Climate Change Action Plan* and will include the Ministry of Infrastructure working across government to incorporate LCA into the infrastructure planning process, demonstrating low-carbon technologies in government assets, incorporating climate change into existing and future municipal funding programs, and developing strategies to reduce GHG emissions in government owned buildings.<sup>14</sup>

The Association of Municipalities of Ontario (AMO) supports the provincial government's *Climate Change Action Plan*, with high priorities for municipalities set on integrating climate change initiatives that support economic development, transit, active transportation, green building standards, and climate adaptation for infrastructure including roads and bridges. As part of AMO's commitment to a low-carbon economy, it has established a Low Carbon Economy Opportunities Task Force to provide advice to their Board on integrating energy, climate and economic policy.

**The Ontario Ministry of Infrastructure's plan and annual report for 2017-2018 includes a commitment to integrate the province's commitments in the *Climate Change Action Plan* across the Province's *Infrastructure Plan*.**

## Recommendations

- 2** Ensure an enterprise-wide approach to reducing GHG emissions by including a requirement in mandate letters for government ministries and agencies to establish climate change objectives, targets and to integrate life cycle assessment (LCA) and life cycle costing (LCCA) into decision-making. These objectives and targets should be aligned with the *Pan-Canadian Framework for Clean Growth and Climate Change* and provincially set targets. This will provide a framework for ministry level policy development and the integration of LCA into policy, decision-making and to implement targets for low-carbon infrastructure benchmarks.
- 3** Require LCA and LCCA as criteria and a tool in prioritization of infrastructure investments. For example, prioritizing infrastructure projects that would support government objectives to reduce GHG emissions and contribute to other government policies regarding transportation options and complete communities; and, when prioritizing decisions on renewing and repurposing existing assets versus new asset builds.
- 4** Require LCA and LCCA in policies, Treasury Board project approvals and procurement processes for infrastructure planning, design and construction.
  - a.** Pilots: Begin a phased-in requirement of LCA with pilot projects in government agencies such as Infrastructure Ontario's AFP (Alternative Financing Procurement) RFQ/RFPs that would require LCA at the design stage as a competitive incentive for successful bids (i.e. short-listed bids that meet the greatest lowest life cycle GHGs would be given priority in the bidding process). Pilots could be rolled out based on the infrastructure asset types that have established LCA baselines for life cycle GHGs as well as market ready LCA software-based tools.
  - b.** Supporting Research: Undertake research to establish current baseline information for LCA for different infrastructure asset types (e.g. GHGs/km road, GHGs/km track, GHGs/sq. foot) to develop benchmarks and targets to incentivize progressive life cycle GHG emission reductions through pilot projects through to full roll out of requirements enterprise-wide. Pilot projects could also inform this research and its outcomes.
  - c.** Identification of Tools: Commission a study to assess and identify the criteria that should be met for comparable LCA for different infrastructure types and assess which currently available LCA tools meet this screening.
- 5** Develop LCA and LCCA technical guidance for ministry level staff and for municipalities. Provide training for ministry staff to utilize guidance in making project approvals, integrating into prioritization processes within ministries, and for assessing funding transfers to municipalities.
- 6** Improve government-wide climate change governance by establishing a standing committee on integrating life cycle and climate change objectives into infrastructure planning and procurement.

# LIFE CYCLE ASSESSMENT TOOLS

---

Establishing clearly defined language is important to successfully introduce a new procurement framework for a low-carbon approach that includes LCA.

Establishing clearly defined language is important to successfully introduce a new procurement framework for a low-carbon approach that includes LCA. Setting common standards for the measurement of GHG/carbon emissions throughout the life cycle of infrastructure assets will provide clarity for government, agencies and proponents. These tools could also be used as a climate lens or screening for government funding eligibility and prioritization for federal transfers of infrastructure funding to the provinces, territories and municipalities.

Criteria for the types of LCA tools need to be assessed to ensure comparable LCAs for different infrastructure types and assess which currently available LCA tools meet this screening. In order to track GHG emission reductions, government would need to be confident that the LCA results are accurate and comparable among projects, design teams and contractors.

Over the long-term, the federal or provincial governments may want to commission the development of a life cycle GHG/carbon accounting tool, that could be used by all government organizations as well as proponents bidding on government projects across the country.

Net-zero carbon and net-positive energy pilot projects are underway at Evergreen Brick Works in Toronto, Mohawk College in Hamilton, and Evolv1 commercial build in Waterloo. The Carbon Impact Initiative (CII), the EllisDon-led initiative is exploring carbon reduction strategies across all stages of project development, from design to operations. CII is planning 15 pilot projects including public and private infrastructure sectors to build capacity and information on effective solutions for carbon reduction. The Evolv1 project office space will include approximately 1.5 acres in rooftop and carport solar panels for clean energy generation to create a net positive energy building.

## Recommendation

7

Over the long-term, establish standardized outcomes and/or benchmarks for the measurement of life cycle GHGs (cradle-to-grave) including embodied carbon of materials, construction assemblies and construction processes (e.g. EPDs). This could include creating a national or provincial database that provides accessible information of the embodied carbon emissions of materials, best practices in long-term value-based procurement, and successful case studies for the creation of sustainable, resilient, and low-carbon infrastructure assets. For example the Netherlands has developed a government database for LCA and EPDs for building assessments.

# COMMUNITY AND ECONOMIC BENEFITS

---

Governments are seeking pathways to maximize infrastructure spending to achieve multiple policy objectives by generating better social and economic value on investments.

Governments are seeking pathways to maximize infrastructure spending to achieve multiple policy objectives by generating better social and economic value on investments. For example, Ontario's *Infrastructure for Jobs and Prosperity Act* (IJPA) encourages long-term infrastructure planning that supports jobs, economic growth and the protection of the environment. To achieve these objectives, the IJPA requires public infrastructure investments consider community benefits.<sup>15</sup> Using a value for money across the life cycle approach in infrastructure procurement is intended to have a positive impact on community benefits by creating new economic opportunities for low-carbon materials and renewable energy systems, GHG reductions, air quality improvements, material recycling, and the enhancement of social infrastructure and natural assets that support resiliency including green space, urban trees, watersheds and public parks.

# BUILDING RESILIENCE THROUGH LOW-CARBON INVESTMENTS

---

“Infrastructure resilience is the ability to reduce the magnitude and/or duration of disruptive events. The effectiveness of a resilient infrastructure or enterprise depends upon its ability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially disruptive event.”

*-National Infrastructure Advisory Council  
A Framework for Establishing Critical  
Infrastructure Resilience Goals, 2010*

Investments in rebuilding and repurposing Infrastructure to move us towards a low-carbon economy provides an opportunity to build better infrastructure systems that also boost resiliency and adaptation across infrastructure networks.

Investments in rebuilding and repurposing Infrastructure to move us towards a low-carbon economy provides an opportunity to build better infrastructure systems that also boost resiliency and adaptation across infrastructure networks. This will provide a way to reduce the damages and financial risk that individuals, businesses and governments face in terms of increased risks associated with the impacts of the changing climate, including an increase in the frequency of extreme and catastrophic weather events that are predicted to occur as the climate changes.

Enhancing the resiliency of critical infrastructure means identifying the risks of climate-related impacts to critical infrastructure and the cascading effects of potential failures due to the interdependencies of infrastructure networks; assessing and prioritizing the highest risks for damages and disruption of services; and, integrating mitigative or protective measures to reduce these risks and the potential for disruptions. In addition, critical infrastructure emergency and recovery planning is a part of resiliency in order to ensure swift and effective response and recovery efforts when disruptions do occur.

Incorporating infrastructure resilience into procurement ensures that early project design integrates risk assessment. Additional upfront costs that may occur with this proactive approach would be much lower than the overall cost of not investing in resiliency and only reacting after a severe weather event by rehabilitating or rebuilding assets.

**Engineers Canada's Infrastructure Resilience Professional (IRP) Certification program provides engineers with the additional knowledge and competencies they need to plan, design, and manage resilient infrastructure in the face of a changing climate (i.e. climate vulnerability assessment, risk management and climate adaptation).**

# MUNICIPAL ASSET MANAGEMENT

---

Infrastructure  
management  
plans facilitate  
long-term  
infrastructure  
planning.

Infrastructure management plans facilitate long-term infrastructure planning. Requiring LCA in infrastructure asset management planning could result in less of a focus on politically motivated decisions and short term gains. The Federation of Canadian Municipalities (FCM) is currently developing programs to assist municipalities with integrating climate change and sustainability goals into municipal asset management planning.

Municipalities are already financially strained due to an increasing infrastructure deficit, and the addition of new policies surrounding infrastructure that would increase their costs without the necessary support are not likely to succeed.

Providing a financial incentive that offsets the cost of the infrastructure upgrades would support governments to begin investing in infrastructure that provides higher value for money over the asset's life cycle, but which might cost more up-front. Some investments will incur higher upfront costs but lower overall life cycle costs, and some investments may reduce upfront costs as well as overall life cycle costs (e.g. more efficient design of space reduces amount of construction materials which results in lower embedded carbon). In addition, as new materials, technologies and innovations become more mainstream, the need for financial assistance will decline. For example, in the renewable energy sector, the cost of solar and wind energy have dropped making them affordable solutions for power generation.

## Recommendation

8

Integrate LCA into provincial and municipal asset management. Financial support for municipalities where an increase in upfront costs is necessary for integrating LCA and climate resilience into infrastructure prioritization, planning, procurement and asset management. Federal government loan or grant programs that would help municipalities and provinces pay the additional upfront costs where they occur could be set to support this transition.

# CONCLUSION

The federal government and the Ontario government have committed to take action to transition Canada to a low-carbon economy. Investing in infrastructure to build climate-resilience and to transition to a low-carbon economy have been identified as priorities: doing so, will require a shift in the current systems for decision making including infrastructure prioritization, planning, approvals and procurement.

**The federal government and the Ontario government have committed to take action to transition Canada to a low-carbon economy.**

An incredible opportunity exists to transform Canada's infrastructure systems to sustainable, resilient and low-carbon networks. Given the government's current commitment to vast investments in infrastructure and to addressing climate change mitigation and adaptation, modernizing government procurement systems by requiring value for money across the life cycle and using LCA to measure cradle-to-grave life cycle GHG emissions will be a key tool to make the transition to a low-carbon, resilient and sustainable future.

## ACKNOWLEDGEMENTS

### Procurement workshop participants:

ALUS Canada	Lara Ellis	Munk School of Global Affairs	Dina Graser
Ameresco Canada	Tim Cresswell	Ontario Ministry of Economic Development and Growth	Sara Ehrhardt
Analytica Advisors	Celine Bek	Ontario Ministry of Environment and Climate Change	Adam Shedletsky
Canadian Centre for Economic Analysis	Matt DesRosiers	Ontario Ministry of Environment and Climate Change	Alex Wood
Canadian Council for Public-Private Partnerships	Mark Romoff	Ontario Ministry of Environment and Climate Change	Ernest Opoku-Boateng
Canadian Urban Institute	Amanda Smith	Ontario Ministry of Environment and Climate Change	Kathleen O'Neil
Cement Association of Canada	Adam Auer	Ontario Ministry of Environment and Climate Change	Sara Wilson
Delphi Group	Mike Gerbis	Ontario Ministry of Infrastructure	Cam Whitehead
EllisDon	Cameron Blair	Ontario Ministry of Infrastructure	Martin Canning
Engineers Canada	David Lapp	Ontario Ministry of Infrastructure	Sarah McQuarrie
Environmental Commissioner of Ontario	Nancy Palardy	Ontario Sewer Main & Watermain Construction Association	Giovanni Cautillo
Evergreen	Geoff Cape	Office of the Premier of Ontario	Dan Skilleter
Evergreen	Isabel Cascante	Pivot Strategic Group	Aaron Freeman
Evergreen	Michelle German	Purchasing Consultants Int'l Inc.	Stephen Bauld
Evergreen	Robert Plitt	Residential and Civil Construction Alliance of Ontario	Andy Manahan
Federation of Canadian Municipalities	Donna Chiarelli	R.J. Burnside & Associates Ltd.	Arunas Kalinauskas
Federation of Canadian Municipalities	Matt Gemmel	Sustainable Prosperity	Anthony Young
Fenn Advisory Services	Michael Fenn	Treasury Board of Ontario	Alexi White
groundSHIFT	Neluka Leanage	University of Ontario Institute of Technology	Dan Hoornweg
Hatch / OCSI	Carl Bodimeade	Waterfront Toronto	Kevin Newson
Infrastructure Canada	Mathieu Belanger	WaterTAP	Lesley Herstein
International Institute for Sustainable Development	Fida Rana	Zizzo Strategy	Ryan Zizzo
International Institute for Sustainable Development	Oshani Perera		
Ivey Foundation	Andrea Moffat		
Ivey Foundation	Michael McCulloch		
Lowry Consulting Services	Rob Lowry		

### Special thanks to the following for their feedback on the report:

Actual Media Inc.	Todd Latham	Ivey Foundation	Andrea Moffat
Cement Association of Canada	Adam Auer	Pivot Strategic Group	Aaron Freeman
Environmental Commissioner of Ontario	Dianne Saxe	R.J. Burnside & Associates Ltd.	Arunas Kalinauskas
Federation of Canadian Municipalities	Matt Gemmel	University of Ontario Institute of Technology	Dan Hoornweg
Hatch / OCSI	Carl Bodimeade	WaterTAP Ontario	Lesley Herstein
International Institute for Sustainable Development	Fida Rana	Zizzo Strategy	Ryan Zizzo
International Institute for Sustainable Development	Oshani Perera		

## ENDNOTES

- 1 Government of Canada (2016) "National Inventory Report 1990-2014: Greenhouse Gas Sources and Sinks in Canada." <https://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=662F9C56-1>
- 2 OECD. Investing in Climate, Investing in Growth: A Synthesis. <http://oe.cd/g20climate>
- 3 Zizzo, R. 2017. Embodied Carbon of Buildings and Infrastructure: International Policy Review. Forestry Innovation Investment.
- 4 "Green Buildings Policy for Rezoning." City of Vancouver Planning By-Law Administration Bulletins. Planning, Urban Design and Sustainability Department. Vancouver, B.C. [vancouver.ca/files/cov/G002.pdf](http://vancouver.ca/files/cov/G002.pdf)
- 5 <http://www.infrastructure.gc.ca/plan/letters-lettres/pt-on-eng.html>
- 6 <https://www.ontario.ca/page/september-2016-mandate-letter-infrastructure>
- 7 <https://www.ontario.ca/page/climate-change-action-plan>
- 8 The Centre for Spatial Economics. 2015. The Economic Benefits of Infrastructure Spending in Canada. Broadbent Institute. <http://www.broadbentinstitute.ca/infrastructure>
- 9 OECD. Investing in Climate, Investing in Growth: A Synthesis. <http://oe.cd/g20climate>
- 10 <https://www1.oecd.org/gov/public-procurement/green/>
- 11 <http://www.ecoinvent.org/home.html>
- 12 [http://www.ciraig.org/en/research\\_program\\_ilc.php](http://www.ciraig.org/en/research_program_ilc.php)
- 13 <http://www.athenasmi.org/news-item/whole-building-lca-benchmarking-white-paper/>
- 14 <https://www.ontario.ca/page/published-plan-and-annual-report-2017-2018-ministry-infrastructure>
- 15 Also see Evergreen's report: Graser, D. and Leanage N. 2017. Realizing Social and Economic Benefits through Infrastructure Planning and Investment. <https://www.evergreen.ca/downloads/pdfs/2017/CommunityBenefitsReport.pdf>