

Making the Case
for Clean Construction

TORONTO



BURO HAPPOLD

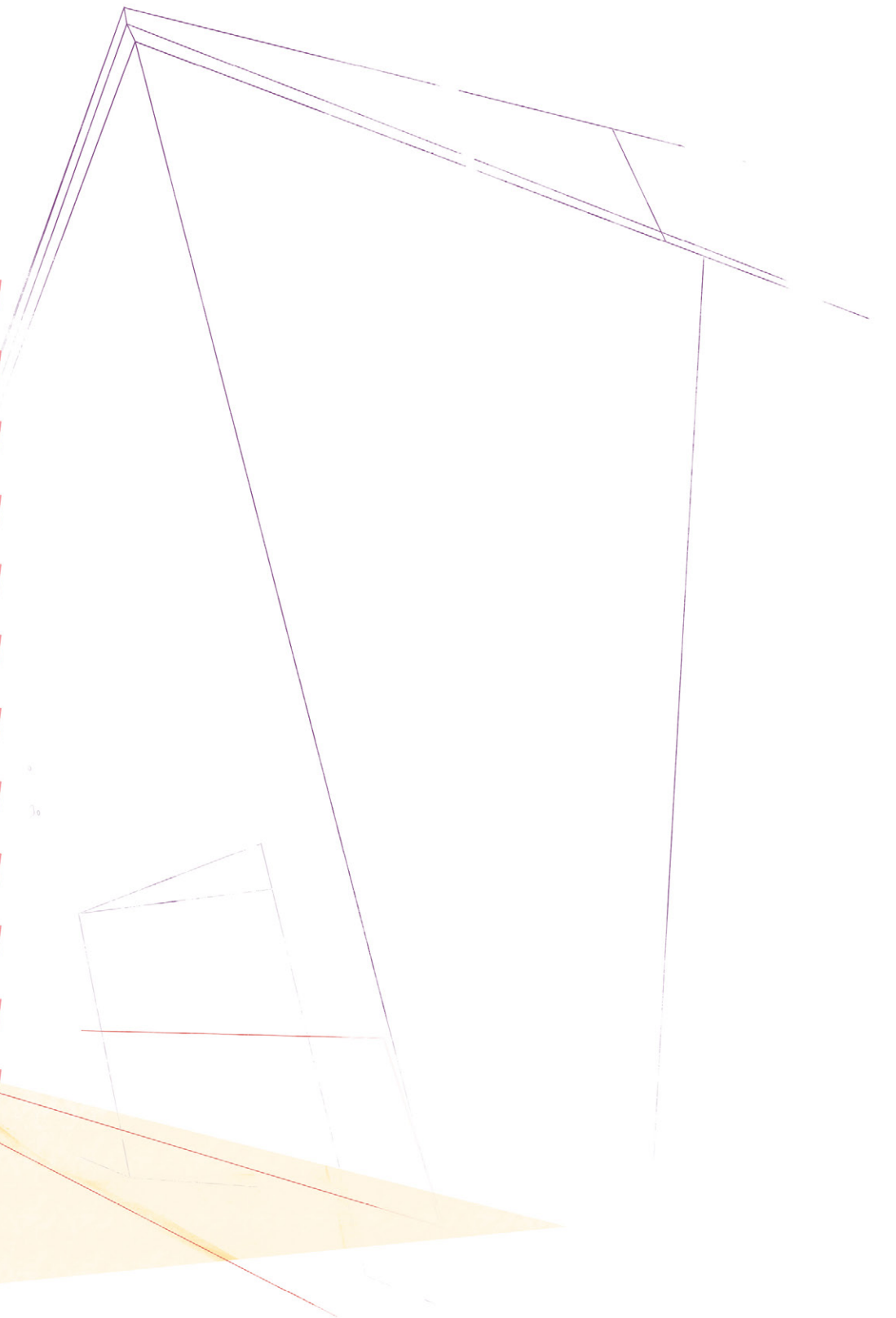
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FOREWORD



The Toronto Clean Construction Deep Dive was a very helpful exercise in connecting the dots between the work of the different City divisions with overlapping interest and responsibility for Clean Construction (including City Planning, Toronto Building, Environment and Energy and Solid Waste). The responses from the development industry and the final recommendations will assist City Planning in developing the 2022 version of the Toronto Green Standard.

Jane Welsh

**Project Manager, Environmental Planning, Policy Strategic Initiatives, Policy and Analysis City Planning
City of Toronto**



The circular economy tries to solve complex problems that require interdisciplinary insights and collaborative approaches. I have appreciated the opportunity to convene with like-minded colleagues at the City of Toronto to explore how our various disciplines and subject areas can complement each other in achieving clean, circular, and sustainable outcomes for Toronto's construction sector.

Meaghan Davis

**Solid Waste Management Services
City of Toronto**



Toronto's overall Net-Zero emissions goal can only be achieved through cross-divisional collaboration and innovation. TransformTO sets a series of ambitious targets, with buildings accounting for the largest source of emissions, so this Clean Construction work will be vital to achieve our targets.

Linda Swanston

**Manager, Policy & Research Environment and Energy Division
City of Toronto**

FOREWORD



The C40 Clean Construction Declaration marks an exciting step towards tackling not only carbon emissions and material and energy consumption, but also in addressing social and economic injustices. Initiatives such as creating the infrastructure for a circular economy, switching to bio-based materials, and shifting procurement processes to prioritise measuring and reducing whole-life-carbon brings with it employment opportunities, healthier environments for humans and non-humans, and higher quality homes. We at Buro Happold are thrilled to be part of the project and are excited to be working with cities across the world to together devise pathways to a Clean Construction industry.

Maria Smith
Director, Sustainability
Buro Happold



The built environment is everywhere around us; we depend on it daily. It's our home, school, office, health centre, cycle lane – and much more when a pandemic does not restrict our moves. Its construction massively contributes to the climate crisis, yet in a largely invisible way. This report, and the series it kicks off, is pivotal to understand the local impacts of construction, the range of actions cities can take to tackle them and the wealth of benefits a clean and just transition can bring. Let it inspire urgent and transformative change.

Cecile Faraud
Clean Construction Programme Manager, C40
Cities

EXECUTIVE SUMMARY

All around the world, cities face a complex system of challenges including a lack of affordable housing, economic and health inequalities, and an urgent need to reduce greenhouse gas emissions. There is mounting pressure from citizens to bring forward policies and initiatives to improve the quality of life for all inhabitants. The urgency and scale of these challenges have been exacerbated and further exposed by the COVID-19 pandemic.

The construction sector has long been a vehicle for addressing the social, economic and environmental factors affecting urban life. Looking to the coming decade, a transition to a Clean Construction industry – an industry with dramatically reduced greenhouse gas emissions – can bring with it a broad set of benefits, including health and wellbeing, employment and biodiversity.

Cities have a critical role to play in showing the vision and leadership needed to facilitate this transition to Clean Construction. This report takes a deep dive into Toronto, Canada, setting out an overview of the construction industry landscape and presenting evidence gathered from literature reviews and interviews with stakeholders in Toronto and beyond. It proposes a pathway to Clean Construction that address greenhouse gas emissions together with wider social, economic, and environmental issues.

The proposed pathway for Toronto includes adopting circular economy principles and whole life carbon considerations so that building materials are reclaimed, remanufactured and reused saving substantial carbon emissions. This incentivises reduced demolition, improved recovery of built fabric, and prioritising adaptation and renovation of existing structures over new build. This should be supported by improved waste management practices and high-quality design and construction methodologies such as modular design, design for disassembly, and off-site prefabrication. Where new construction is carried out, this should make use of low-carbon materials, especially timber, and, where concrete is unavoidable, low-carbon cement. Finally, the municipality should drive knowledge and skills development within the industry through publishing guidance while supporting data collection and dissemination.

This transition will bring many and varied benefits to Toronto. Social benefits include high-quality housing, good governance, and health and wellbeing improvements to Toronto residents and people working in the sector. Economic benefits include green jobs and skills, innovation and a shift to a more sustainable – and therefore resilient – economy. Environmental benefits include reduced greenhouse gas emissions, reduced pollution, improved biodiversity and better soil quality. This system of benefits together addresses social and environmental justice.

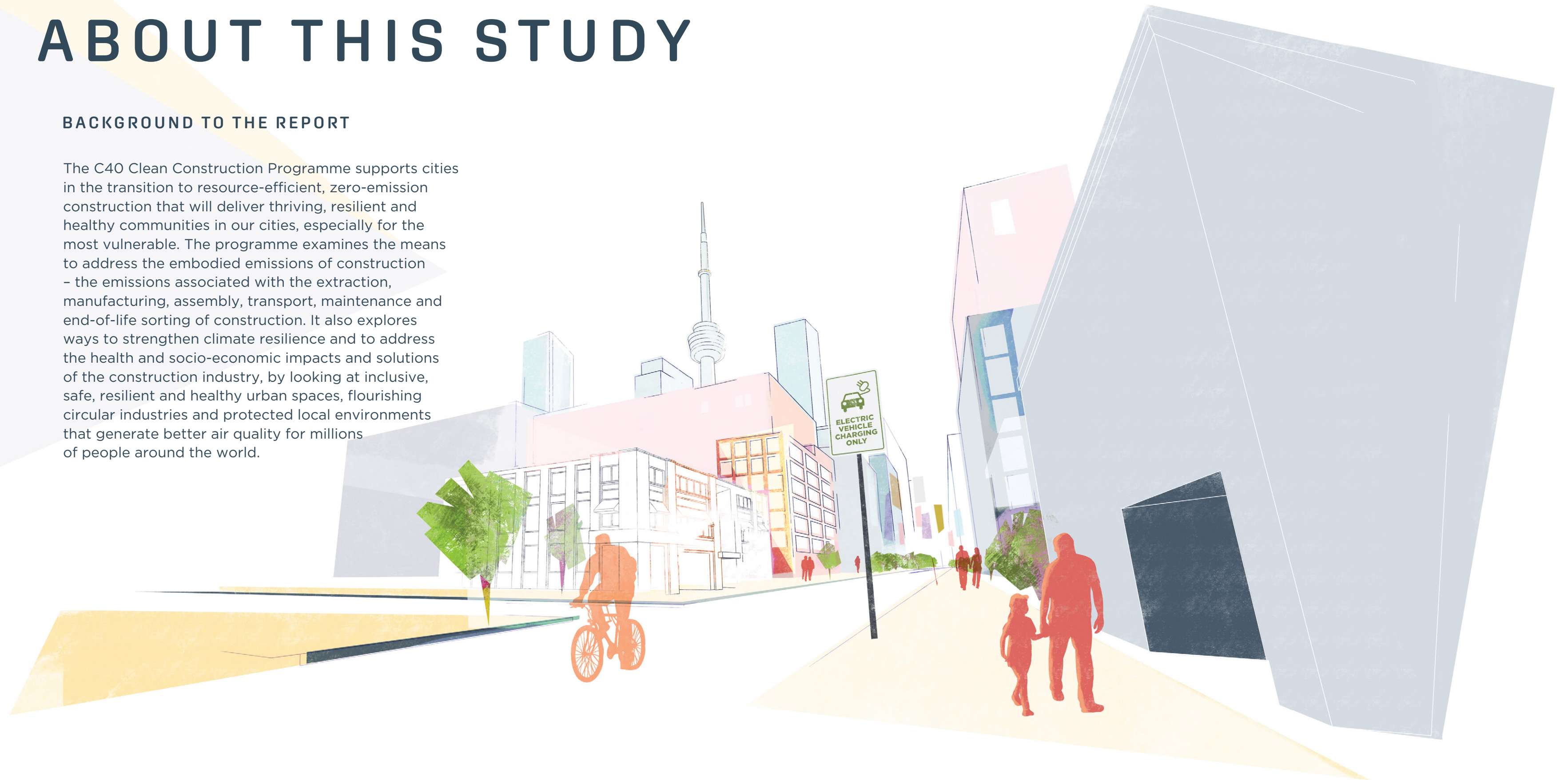
The proposed pathway and benefits for Toronto will be applicable, to varying degrees, to cities elsewhere in the world. This report represents one of several deep dives that, combined, will provide a broader insight into how a transition to Clean Construction might be achieved in a variety of contexts; the specific benefits this will yield in terms of tackling the climate and biodiversity emergencies, as well as the wider challenges that cities face, will also be addressed.

The proposed recommendations for Toronto includes the adoption of circular economy principles enabled by whole lifecycle considerations

ABOUT THIS STUDY

BACKGROUND TO THE REPORT

The C40 Clean Construction Programme supports cities in the transition to resource-efficient, zero-emission construction that will deliver thriving, resilient and healthy communities in our cities, especially for the most vulnerable. The programme examines the means to address the embodied emissions of construction – the emissions associated with the extraction, manufacturing, assembly, transport, maintenance and end-of-life sorting of construction. It also explores ways to strengthen climate resilience and to address the health and socio-economic impacts and solutions of the construction industry, by looking at inclusive, safe, resilient and healthy urban spaces, flourishing circular industries and protected local environments that generate better air quality for millions of people around the world.



METHOD

This study uses a mixed-methods approach in collaboration with the City of Toronto municipality and wider stakeholders in the Toronto construction and building sector.

As outlined in Figure 1, there are several strands of work. Initially, a broader database of Clean Construction policy interventions is prepared using a wide-ranging literature review of Clean Construction global case studies, research and innovation. This is then synthesised with research into the Toronto construction context; through desktop study, interviews and surveys, the main policy database is analysed to understand which policy interventions might be applicable in Toronto. High-priority areas are determined by selecting the policy interventions that will not only be highly influential in shifting the Toronto construction industry to cleaner processes but also align closely to the city’s target benefits. Identification of key implementation mechanisms and benefits are based on analyses which establish the industry structure, municipality powers and key priorities for the city, as defined by city officials and private interviewees. Refer to Appendix B for a full list of interviewees and Appendix A for a detailed methodology.

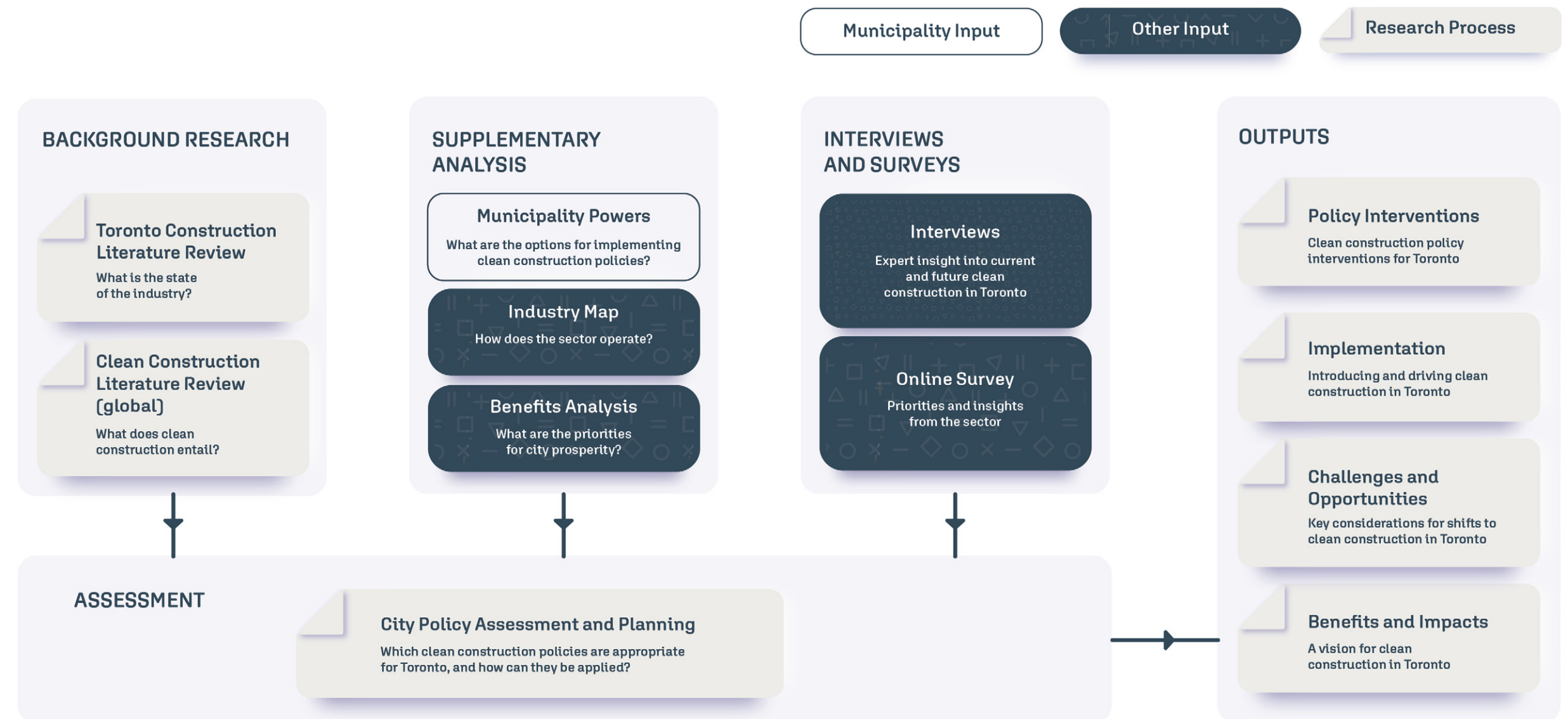
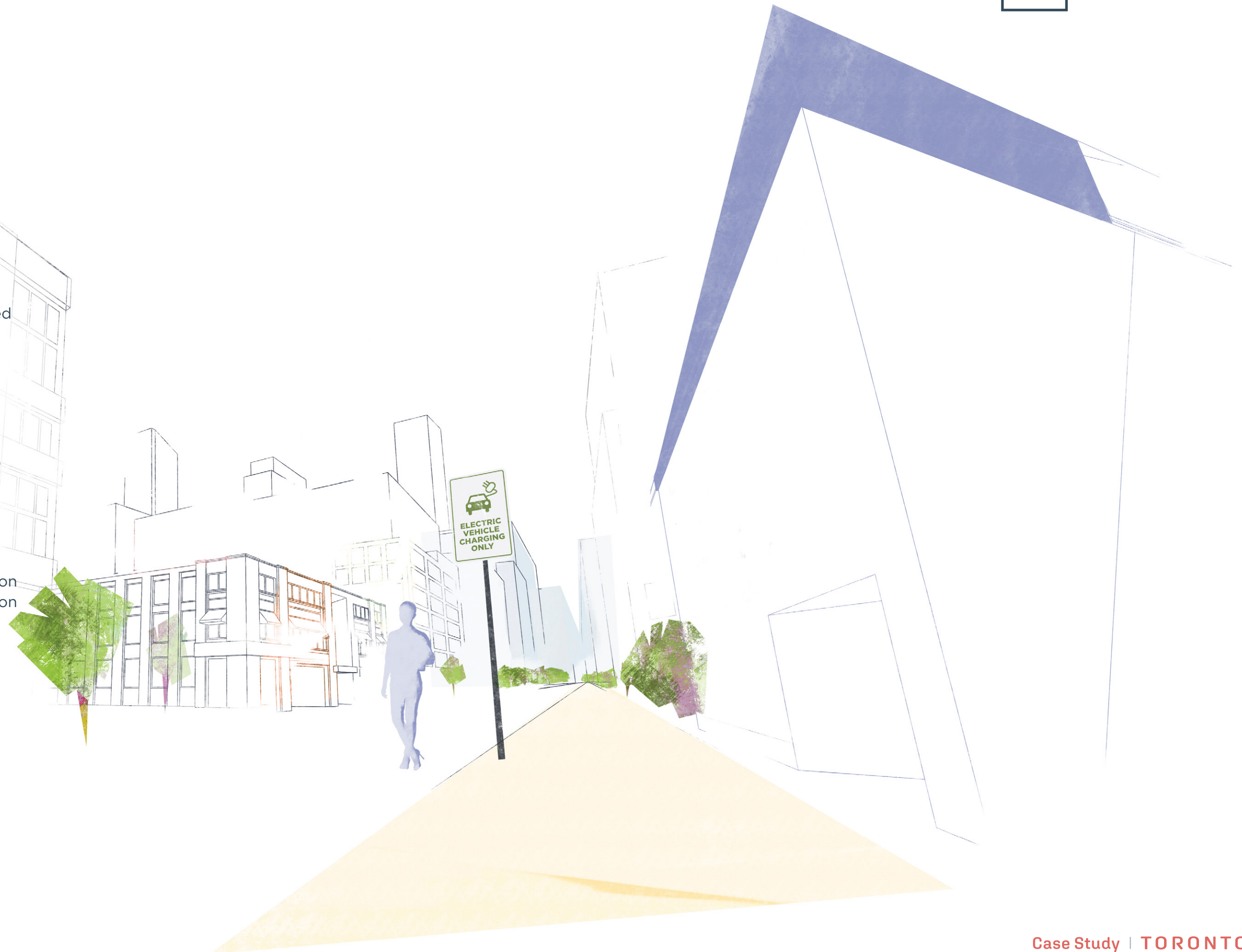


FIGURE 01
Methodology for
the C40 Clean
Construction deep
dive project

DOCUMENT STRUCTURE

This report examines current construction trends and policy levers in Toronto and identifies the most relevant mechanisms for, and benefits of, shifting towards Clean Construction. It is structured as follows:

- Setting the Scene introduces Clean Construction and its associated benefits.
- The Toronto Deep Dive outlines the current status of building and construction in Toronto, including an assessment of city powers, priorities and existing actions linked to Clean Construction. Recommendations for viable areas of Clean Construction in the city are introduced, with 'highly recommended' policy interventions identified. Suitable implementation mechanisms for the different Clean Construction processes are established, and a SWOT assessment of key barriers and opportunities for Toronto's transition to Clean Construction is provided. The anticipated benefits of Clean Construction for Toronto are highlighted.
- To conclude, main takeaways for Toronto are summarised, and discussion provided as to the relevance of findings to other cities.



1 SETTING THE SCENE



1.1 NEED FOR ACTION

1.5°C TARGET	<p>In 2016, C40 adopted 1.5°C as the only viable science-based target to secure humanity's long-term future, and the required goal for the climate action plans and strategies of its members. Despite a suite of major world powers declaring new commitments to limit carbon emissions in 2020, this trajectory remains out of reach.¹ A massive recalibration of the global economy is needed for countries to meet this 1.5°C target; or even the goal of the Paris Agreement to limit average temperature changes to 'well below' 2°C by 2100.</p>	CITIES AND CONSTRUCTION SECTOR	<p>Construction sites can also physically impact urban spaces, having negative impacts on diverse facets of city living – from air quality to local traffic flows to noise levels.⁴⁶ In terms of economics, reducing consumption emissions from construction to levels where cities meet their 1.5°C warming emission targets will initiate changes in the current supply chain and economic structure of the construction industry, with knock-on impacts on jobs, skills and innovations globally.</p>	<p>This will exacerbate the climate crisis, and cities' resilience to future pandemics and climate shocks will be undermined. Cities should therefore integrate these considerations when planning their recovery plans, ensuring a just transition is secured for those working in high-carbon industries and correcting long-running environmental injustices for those disproportionately impacted by the climate crisis.</p>
CITIES AND CLIMATE CRISIS	<p>Consuming over two-thirds of the world's energy, and responsible for more than 70% of global CO₂ emissions, cities have a leading role to play in combatting the climate crisis by taking strong science-based climate action.² Cities are also highly exposed to climate risks. C40 research indicates that, without action, 970 cities face extreme heat, 570 risk sea-level rise and 500 cities face freshwater insecurity.³ Scientists have found that human-caused climate change has increased the severity of an extreme weather event in 78% of cases studied from the last two decades.⁴</p>	COVID-19 RECOVERY	<p>The COVID-19 pandemic and the subsequent economic crisis highlights that national governments are seeing infrastructure and construction as one of the main engines of the economic recovery, supported by increased public funding and stimulus packages.⁷ While the intention is to create jobs, pushing construction for the sake of it may prove damaging. By overlooking and disregarding Clean Construction principles and materials impacts, urban air pollution will intensify due to increased numbers of construction sites, significant embodied emissions will be released and locked in the atmosphere.</p>	<p>This Clean Construction Deep Dive series was launched to understand the construction landscape and impacts at city-level and to assess the potential impact of Clean Construction policies and practices at scale in diverse urban environments across the world, as well as to explore how these actions might be implemented. It forms part of the C40 Clean Construction programme.</p>
CONSTRUCTION SECTOR EMISSIONS	<p>Construction currently contributes over 23% of the world's greenhouse gas emissions⁵ and more than 30% of global resource consumption.⁶ Many of these emissions are driven by cities' consumption of construction products and services, though they rarely appear in carbon accounting since they are typically produced outside of the city boundaries (Scope 3 emissions). By 2050, an additional 2.5 billion people are projected to live in the world's cities. As urban populations grow, the need for new buildings and infrastructure will intensify on a global scale. Refusing to make our urban infrastructure more sustainable will have devastating consequences for the environment.</p>			

1.2 WHAT IS CLEAN CONSTRUCTION?

Clean Construction means a just and net-zero emissions built environment system that tackles the global negative impacts of the construction sector, especially in terms of high greenhouse gas emissions, climate risks, resource depletion and socio-economic inequalities. In terms of emissions, Clean Construction looks at the whole lifecycle of buildings and infrastructure assets and focuses on reducing embodied emissions, which refer to the emissions related to the extraction, manufacturing, assembly, maintenance, retrofit and end-of-life of materials, as well as emissions from construction machinery. In this report we refer to several construction areas:



Building and infrastructure design and innovation

Efforts to remove whole-life carbon emissions, pollutants and waste, and deliver resilient, equitable, high-quality, affordable, low-waste buildings and infrastructure through design and assessment.



Construction site machinery and equipment

Eliminating construction machinery emissions, with reduced pollution and disruption from sites, improved productivity and better conditions for site workers.



Net zero carbon construction materials

Eliminating embodied carbon emissions from new builds and renovations, which are dominated by the footprint of materials.



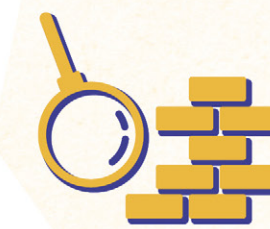
Waste and recycling

Reuse of structurally sound materials and infrastructure, and high quality sorting and separation of waste with maximum high value reuse and recycling of materials.



Management and municipal processes





















































Complementary actions by the municipality to drive and support industry-wide shifts to cleaner processes.



Demolition and decommissioning

Adaptive and sustainable approaches to end of life, prioritising renovation first then deconstruction, with reduced emissions and reduced waste generation.

GLOSSARY TABLE FOR POLICY INTERVENTION

 Building and infrastructure design and innovation	 Net zero carbon construction materials	 Management and municipal processes	 Construction site machinery and equipment	 Waste and recycling	 Demolition and decommissioning
 Whole-life embodied carbon assessments used to drive design and planning decisions, including considering the relative carbon footprint of rebuilding and demolition 	 Use of bio-based materials and certified timber products 	 Utilise or sell city land for flagship projects and pilots 	 Switch to low carbon machinery and equipment 	 Material takeback programmes 	 Design for disassembly, adaptation and reuse 
 Pre-fabricated, off-site and modular construction methods 	 Use of low-carbon cement, concrete and aggregates 	 Clean Construction municipality procurement rules 	 Construction machinery retrofit support 	 Mass soil coordination, storage and reuse programmes 	 End of life demolition assessments to encourage renovation, reuse and adaptive use of buildings 
 Material-efficient structural designs 	 Use of low-carbon asphalt 	 Clean Construction training courses, guidelines and tools 	 Use of alternative fuels in construction machinery 	 Physical waste processing infrastructure: materials reuse facilities, recycling centres, local materials disposal routes 	
 Widespread adoption of circular construction practices 	 Manufacturer or supply-side reductions in embodied carbon of products 	 Inclusion of Clean Construction in Climate Action Plans and other sustainability declarations 			
 Technologies and methods to reduce carbon footprint of sites preparation, soil stabilisation and foundations 	 Expansion of local sustainable materials industry 	 Clean Construction data collection 			
 Embed circular economy principles into the sector 	 Direct reuse of (deconstructed) building materials in new buildings 	 Identify and remove bureaucratic and legal barriers 			
 Use existing spaces to their maximum ability and repurpose assets for different uses 		 Reduce numbers of unoccupied and vacant spaces in the city 		 Improved waste sorting and separation to increase rates and quality of recycling and reuse 	
 Refurbishment programmes to improve efficiency of buildings in operation, using low carbon materials, solutions and innovation 					

Crucially, these aim to deliver the C40 Clean Construction hierarchy: optimise existing building stock, refurbish and retrofit existing structures and, finally, to build new using low-carbon and circular processes. This hierarchy follows circular economy and zero waste principles, and leads to a substantial reduction of virgin material input and generation of emissions. Such policy areas should be implemented using the diverse powers and leverage mechanisms available to different cities.

FIGURE 02

The C40 Clean Construction Hierarchy with example Clean Construction policy interventions and implementation options. For full lists of Clean Construction policy interventions and implementation mechanisms please see Section 2.



C40 Clean Construction Declaration commitments

Under the Clean Construction Declaration, signatories pledge to bring together and inspire stakeholders to take action, and enact policies and regulations where they have the powers to:

- Reduce embodied emissions by at least 50% for all new buildings and major retrofits by 2030, striving for at least 30% by 2025.
- Reduce embodied emissions by at least 50% of all infrastructure projects by 2030, striving for at least 30% by 2025.
- Procure and, when possible, use only zero-emission construction machinery from 2025 and require zero emission construction sites citywide by 2030.



“Construction currently contributes over 23% of the world’s greenhouse gas emissions and more than 30% of global resource consumption”

1.3 BENEFITS OF CLEAN CONSTRUCTION

As well as their role in emissions generation, implementing policies that look to reduce carbon emissions from building and infrastructure construction can contribute to many other city priorities, be they social or environmental, local or global (Figure 3).

Previous C40 and Arup⁴⁶ research highlighted that construction is a major contributor to congestion, air pollution and noise pollution, which can all negatively impact the physical and mental health of city dwellers. The affordability and quality of homes is dependent on both the design of spaces and selection of construction methods. Where properly managed, changes to urban zoning and planning can ensure a positive and healthy experience of the city for urban citizens/residents/dwellers, with proper access to all basic services and leisure opportunities.

SOCIAL LOCAL In particular, there can be a positive impact on city identity, social justice and cultural heritage through extending the lifetime of buildings and prioritising locally sourced materials and construction techniques.⁹ Importantly, Clean Construction aims to add value to existing structures through encouraging reuse and retrofit over demolition. This will have important impacts on local maintenance and repair industries, stable sources of income to an otherwise investment-dependent industry.⁹

SOCIAL GLOBAL Construction also influences social trends at a global scale: the importance of cities as homes, centres of innovation and governance nodes make actions taken by cities to revise their processes of construction and design intimately connected with systems across the world. In particular, adopting lower consumption emissions initiatives to meet science-based targets will initiate changes in the current supply chain and economic structure of the construction industry. The adoption of new processes and technologies will influence the creation of new jobs, stimulate innovation and investments and skills in both local and global supply chains, while initiatives to reduce carbon emissions, whether by design or through new assessment tools and changes to supply chains, can provide a catalyst to tackle other industry concerns – such as efforts to streamline processes, tackle overspend, add value to projects and improve worker conditions.⁵²

ENVIRONMENTAL LOCAL

The environmental influence of Clean Construction is far greater than carbon emissions: initiatives to tackle carbon consumption can identify and help reduce the environmental impact of construction processes and materials, such as damage to ecosystems, restoration and expansion of urban green spaces, pollution, exacerbation of climate risks, waste generation, etc.

ENVIRONMENTAL GLOBAL

These impacts are both local and global, for example, construction and design decisions are linked to both materials depletion rates and the air pollution footprint along the journey of delivery vehicles bringing these materials to sites.⁴⁶

Social

What would it mean for the people of this city to thrive?

-  Green jobs and skills
-  Climate Resilience
-  Social participation
-  Affordable, high-quality and accessible housing
-  Physical & Mental Health, Security

Ecological

What would it mean for this city to thrive within its natural habitat?

-  Water quality
-  Air quality
-  Biodiversity
-  Noise
-  Soil Quality

LOCAL

What would it mean for the people of this city to thrive?

-  Economic innovation, dynamism and competitiveness
-  Green jobs and skills
-  Good governance
-  Climate Resilience

What would it mean for this city to respect the health of the whole planet?

-  Sustainable production and consumption
-  Environmental and health awareness and behaviour
-  Greenhouse Gases and Emissions
-  Soil quality
-  Water Quality

GLOBAL

FIGURE 03
Key benefits of Clean Construction mapped to the four lenses of the City Portrait methodology⁸

2 TORONTO CLEAN CONSTRUCTION



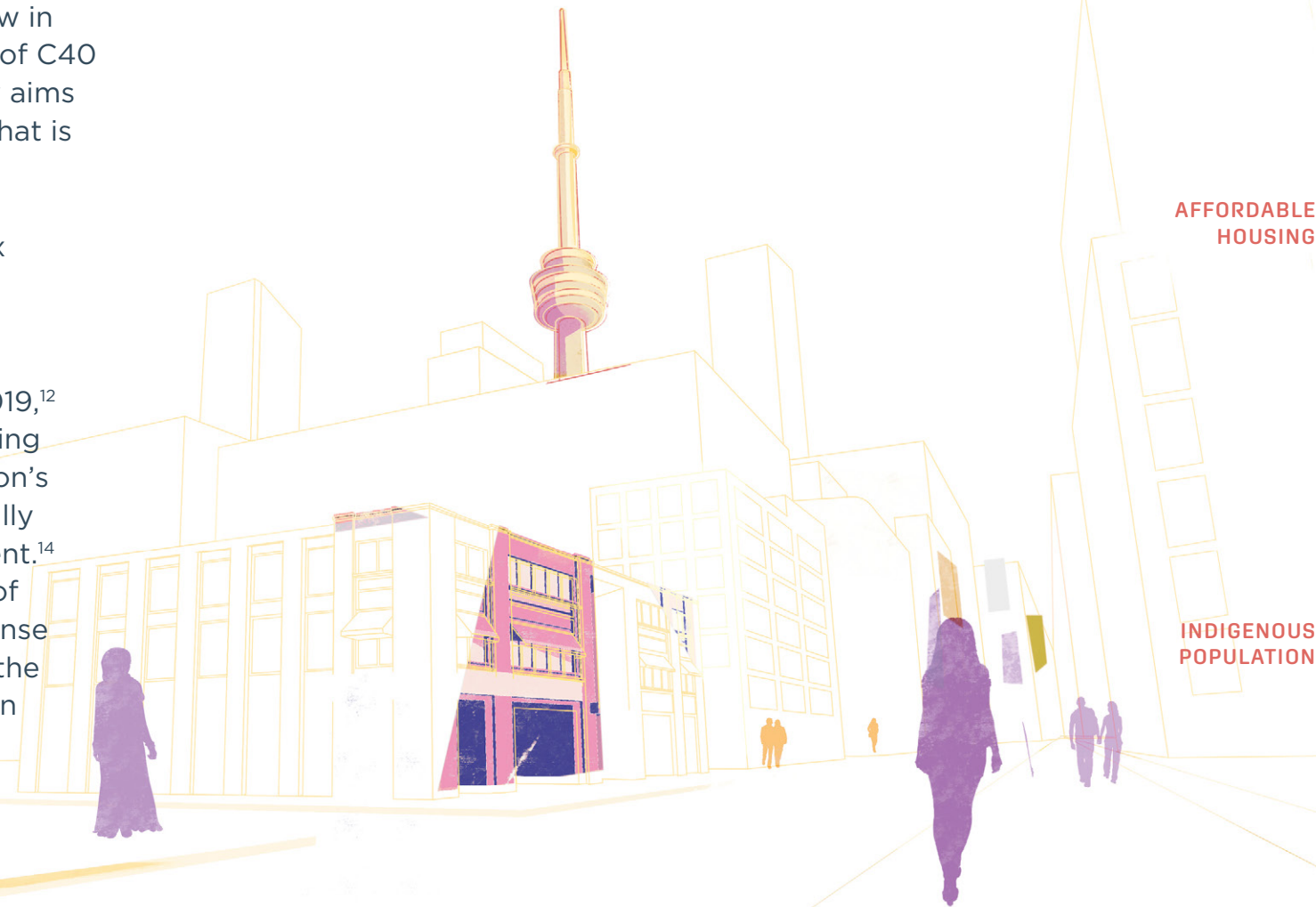
2.1 TORONTO CITY PROFILE

The capital of Ontario province, Toronto covers an area of 630km² and is the most populous city in Canada. With a multicultural population that has continued to grow in recent years, it is 'a vibrant global city'.¹⁰ A member of C40 Cities since the group was founded in 2005, the city aims for 'a path that can facilitate achievement of a city that is more healthy, equitable and prosperous'.¹¹

The literature and interviews identified a diverse mix of priorities and challenges in the city.

**TORONTO
ECONOMIC
TRENDS**

Toronto is experiencing a high level of development and is changing rapidly. Employment rose 3.1% in 2019,¹² 81,000 new dwellings were added to the city's housing stock between 2011 and 2016¹³ and the Toronto region's GDP has grown by an average of 2.4 per cent annually since 2009 compared to a national rate of 1.8 per cent.¹⁴ The city is performing well on numerous indicators of quality of life, including citizens reporting a rising sense of belonging in the city, better physical health than the Canadian national average and the highest education performance in Canada in 2019.¹⁵



**SOCIO-
ECONOMIC
CHALLENGES**

The city does, however, face social and economic challenges. Toronto Vital Signs 2019¹⁵ reports that the city has the highest income inequality in the country, linked to high wealth disparities: net worth increased by \$2,100 for the least wealthy 20% between 1999 and 2016 versus more than \$600,000 for the wealthiest 20%.

**AFFORDABLE
HOUSING**

In the buildings sector, 'housing prices are skyrocketing, with the purchase price of homes growing more than four times faster than income and rent growing more than two times faster than income.'¹⁵ This affordability crisis is compounded by concerns with living standards – a third of renting families, which make up a third of Toronto households,¹⁶ lived in overcrowded conditions in 2019; the social housing waiting list grew 68% between 2007-2019; and official homelessness counts have shown an increase in sheltered houseless people in Toronto of 69% in 2019.

**INDIGENOUS
POPULATION**

Toronto has the 4th largest Indigenous population in Canada, the largest in Ontario, with an increase in recent years.¹⁷ This group tends to experience lower employment, income and education than Canadian national averages. Pertinent to construction, in 2016 18.3% of Indigenous people lived in overcrowded housing and one in five lived in a dwelling that required major repairs (e.g. to protect from mould, improve heating and access to uncontaminated water).

Climate Action in Toronto and Canada

Since joining the C40 group at inception, the City of Toronto has actively worked to build climate policies and adaptation strategies into its planning and management. This strongly aligns with public opinion: in 2018, 78% of Torontonians reported being at least 'very concerned' about the impact of climate change in Toronto.¹⁹ On October 2, 2019 City Council voted unanimously to declare a climate emergency and accelerate efforts to mitigate and adapt to climate change, adopting a net zero emissions reduction target by 2050 or sooner.

Nationwide, Canada has a 2050 net zero target since 2019, with legislation drafted to enshrine this in law.²⁰ Canadian Climate Action is currently defined by the Pan-Canadian Framework on Clean Growth and Climate Change (2016), though the Climate Action Tracker notes that it is likely to miss its 2030 target by 15-20%. There are rising concerns about the use of gas as an alternative to oil and coal, the continued expansion of fossil fuel infrastructure across Indigenous Lands and uncertainty around new climate policies in COVID-19 pandemic recovery packages.



CLIMATE CHANGE

Toronto faces notable challenges from climate change. The Toronto Resilience Strategy¹⁸ reports that in the near future (2051-2080) the city can expect to see 4.5 times more very hot days per year than in the recent years, and an increased risk of flash or surface flooding. This is already having significant impacts on quality of life of Toronto's citizens: Toronto Vital Signs 2019¹⁵ reports that 'climate change impacts are already here...the average value of catastrophic [flood] loss payments has jumped to \$1.8 billion per year since 2009.' Historically, 120 people have died on average per year in Toronto during heatwaves, with one study finding 7.7% of Torontonian women exposed to temperatures above 24°C experiencing gestational diabetes.¹⁵

The city is performing well on numerous indicators of quality of life but face social and economic challenges

CONSTRUCTION LANDSCAPE IN TORONTO

GROWTH AND VALUE OF THE INDUSTRY

CONSTRUCTION ECONOMICS

In 2019, Canada had a GDP of around \$1.9 trillion, a 2.0% increase compared to the previous year.²¹ The construction industry (about \$142.6 billion) represents approximately 7.2% of the total GDP, an increase of 3.1% from 2018.²¹ At regional level, Ontario represents 37% of national GDP (about \$744.4b), with the construction sector generating around \$50.8 billion in 2019 (6.8% of total GDP).²¹ Toronto has amongst the highest construction activity of any city in Canada,²² and the construction sector represents 6.5% of regional GDP.²³

MAJOR CONSTRUCTION PROJECTS

Across Canada, large-scale construction projects, infrastructure upgrades and development projects have been prominent since the 2008 economic downturn²⁴ – including construction of high-value skyscrapers – such as the St Regis, Aura and One Bloor in Toronto.²⁵ Infrastructure upgrades and development are pursued at municipal, provincial and national level: by Infrastructure Canada, a federal department headed by the Minister of Infrastructure and Communities or the Ontario 2019 budget, which allocated \$144 billion for investments into infrastructure initiatives and projects, with a major focus on transit, transportation and highways, in the region over the next ten years.²⁶

COVID-19 RECOVERY

As the city is recovering from the Covid-19 pandemic, a short-term peak in demand for labour and material is expected, followed by a more 'subdued pace' into 2021.²⁷ Long term market uncertainty, coupled with supply chain disruptions and the ongoing adjustment to a rise in remote working, may continue to impact building construction prices in subsequent quarters.²⁷ This means that while the industry appears to be recovering well there may be short term challenges to the sector.



EMPLOYMENT, SKILLS AND WORKING CONDITIONS

EMPLOYMENT

Employment in the sector is high: 2.2% of jobs in Toronto are in construction, its fifth largest sector in 2019, according to North American Industry Classification System category. Key supply chain industries like manufacturing are well represented and scientific and technical roles are also prominent.²⁸ However, interviewees raised concerns over a labour shortfall, with Build Force Canada estimating that the national construction industry will be short 80,000 workers in 10 years.²⁹ This is despite local unemployment of 5-15% in Ontario (2016-2020), suggesting that upskilling and training is not effective in enabling those unemployed to fill the widening gap in the sector.³⁰

SKILLS AND EDUCATION

In parallel, the skills and education level of the sector employees has risen in recent years: In 2018, 63% of construction employees had a post-secondary certificate (compared to 42% of employees in 2003), with 19% of the sector holding a university degree (compared to 11% national industry average). This corresponds to the increasing adoption of new technologies and systems in the region: the Construction Forecast 2019 estimates that the largest near-term increases in employment demand will be engineering construction with specialized skills and qualifications,³¹ while new technologies such as Building Information Modelling, use of drones and lifecycle analysis methodologies were all highlighted as emerging innovations and spaces for upskilling and new jobs in our interviews.

WORKING CONDITIONS

The employment quality is also mixed. While the average wages in the construction sector (\$29.27/h) are slightly higher than in the Greater Toronto area (\$27.84/h), the average hours per week (37.1) are also higher than for other industries in the region.¹² Construction continues to be the most dangerous industry sector in Ontario for the number of traumatic and occupational disease fatalities.³² Between 2004 and 2013, 190 fatalities occurred in construction in Ontario; 26.6% of all workplace fatalities in the province during this decade, in spite of the construction sector accounting for only 6.6% of provincial jobs. The sector contributes to Toronto concerning levels of industrial and road traffic air pollution. Industrial air pollution, including construction, is responsible for 120 premature deaths and 200 hospitalisations annually, while road traffic pollution, of which the vast majority is emitted by heavy duty vehicles, causes 280 premature deaths and 1090 hospitalisations.³³



INDUSTRY STRUCTURE

SMALL FIRMS AND SELF-EMPLOYMENT

Matching nationwide trends, the construction sector in Ontario is characterised by the predominance of small firms and higher-than-national-average levels of self-employment. In 2018, 47% of all construction companies had less than 20 employees.¹² The significant role played by small firms and the self-employed reflects the heavy reliance of the construction industry on extensive subcontracting chains and the growing influence of independent operators.

BUILDING DESIGN

On the building design side, a few firms tend to dominate high-value projects. In 2018, the top 10 most active design firms in Toronto were involved in over 50% of the total projects tracked.²² However, while design firms will focus on large and high value projects, around 27% of the employees in the Canadian construction industry work in residential renovation and maintenance, reflecting the diverse mix of small and large firms in the sector.³¹

TRADE UNIONS

Trade unions are also key players, with hundreds of thousands of workers unionised in the Ontario region alone.³⁴ They are essential actors to support the sector, and provide important safety, productivity and skills protections to construction employees.

TRADE AND MATERIALS

BUILDING PRODUCTS

Canada was the world's seventh largest importer of building products, with the import market growing on average at 7.1% CAGR⁴³ in the 2009-2014 period. Imports were predominantly sourced from the US - including HVACR, lighting, wood, plumbing, insulation and glass.³⁵ In 2014 it was estimated that 60% of US building exports went to Canada, Mexico, China and Japan.³⁵ Whilst most building products are imported, there is a strong domestic supply of timber and forestry products.³⁶

CONSTRUCTION MACHINERY

Canada relies heavily on importing construction machinery (\$7.9 billion in 2019),³⁷ mainly from USA and Japan.³⁸ While the price for imported logging, mining and construction machinery and equipment grew by 51% between 2010 and 2020, the domestic price only increased by 26%.³⁹ Although foreign competition remains high, positive trends in the non-residential construction market will help support growth for Canadian construction machinery manufacturers, thus unlocking an opportunity for a strengthened local production of machinery.

CARBON FOOTPRINT

BUILDING EMISSIONS

The City of Toronto buildings emissions make up the largest source of emissions in its greenhouse gas database, with carbon emissions from electricity and gas used in constructing and operating buildings at around 45% of the city's overall inventory (Scopes 1 and 2).⁴⁰ Considering consumption-based emissions, which includes the embodied emissions of products and services across the construction supply chain, excluding operational emissions. Buildings and infrastructure are estimated to contribute 10% of the city's total consumption based emissions.⁴¹ Per capita this is relatively high: 49% greater than equivalent figures across Canada and USA; reflecting the high density and construction rate in the city.⁴¹

⁴³ Compound annual growth rate (CAGR) is the rate of return that would be required for an investment to grow from its beginning balance to its ending balance, assuming the profits were reinvested at the end of each year of the investment's lifespan

MUNICIPALITY POWERS AND PRIORITIES

As Figure 4 and the construction map shows, the city has a high influence over many 'soft power' areas – such as running awards, developing education materials and convening industry – along with its own portfolio and projects. Conversely, it has split or limited control over many more direct mechanisms.

“Toronto has the power to advance clean construction transition through its ability to issue demolition permits”

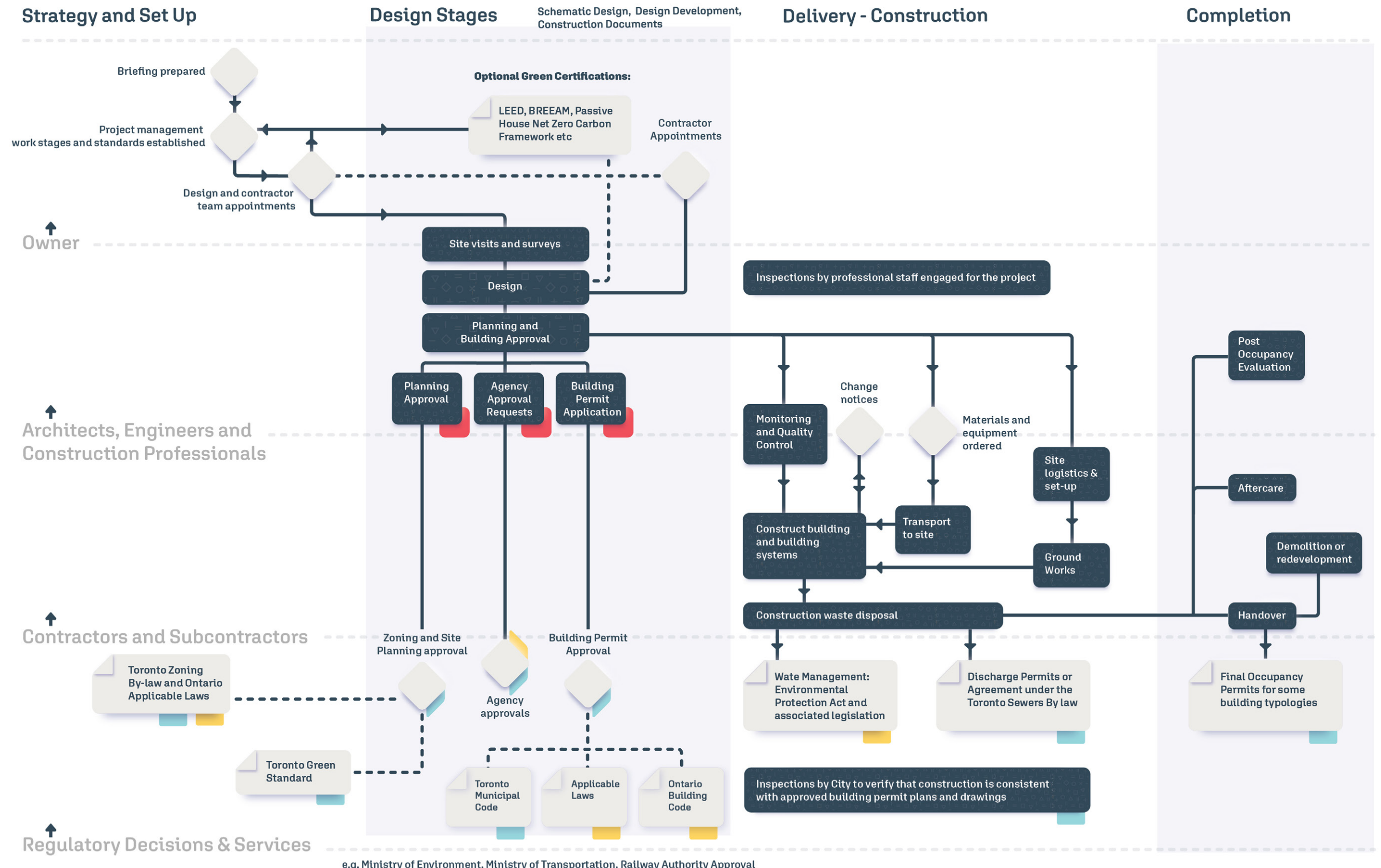
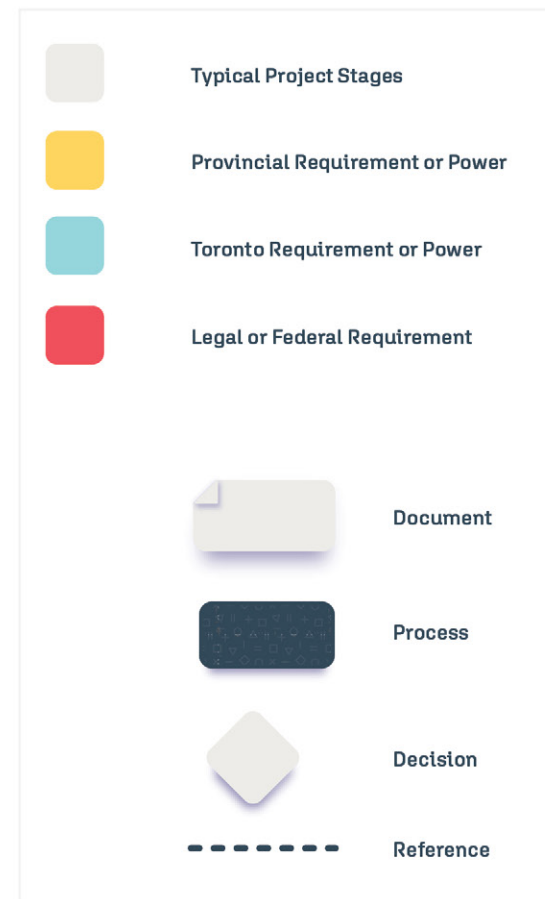


FIGURE 04
Implementation methods and mechanisms available to the City of Toronto as per power mapping analysis carried out with municipal officials

What would it mean for the people of this city to thrive?



TORONTO CONSTRUCTION MAP



BUILDING REGULATION

Regulation is split between federal laws, provincial building standards (the Ontario Building Code) and municipal permits, planning requirements and by-laws. Whilst building standards are set at provincial level, building permits are granted by the municipal planning office subject to the applicable regulation and an engineering review. This is then followed by municipal building site inspections. Some funds and capital investment for infrastructure is available, allocated in council budgets, and the city can offer financial incentives through reduced development fees.

DECARBONISATION TARGETS

Toronto's climate action plan, TransformTO, aims to decrease operational emissions by 65% from 1990 levels by 2030 and achieve net-zero emissions by 2050 or sooner, and it is currently developing a 2050 Net Zero Strategy.⁴² Toronto has so far achieved a reduction of 37% in emissions in 2018 compared to 1990 emissions. The wider TransformTO Climate Action Strategy outlines targets in several areas linked to building and construction:

- By 2030, all new buildings will be designed and built to produce near-zero operational greenhouse gas (GHG) emissions.
- By 2050, all existing buildings will have been retrofitted to achieve the highest operational emissions reduction technically feasible. City-owned buildings will be retrofit to this standard by 2040.



FIGURE 05
Summary of Clean Construction actions in Toronto

C40 Clean Construction Hierarchy

OPTIMIZE THE USE OF THE EXISTING BUILT ENVIRONMENT STOCK

Existing and connected work in Toronto

■ The Toronto Green Standard includes a voluntary '**BUILDING REUSE**' approach to encourage preservation of facades, roofs and floors: 'Reuse or salvage building materials from off-site or on-site equal to 50% of the surface area of the existing building.'



RETROFIT AND/OR REFURBISH THE EXISTING BUILDING STOCK

■ Retrofit and refurbishment is a growing industry area, with TransformTO looking to **RETROFIT ALL EXISTING BUILDINGS BY 2050**.⁴¹ This may support the industry to avoid demolition through increased maintenance and upgrades of its building stock and increased industry skills repurposing and refurbishing spaces.



■ Interviewees reported a small number of private and public modular and prefabricated construction programmes and projects undertaken in recent years. Under the **MODULAR HOUSING INITIATIVE**, the City of Toronto has announced it will be spending \$47.5 million to build 250 supportive modular housing units as part of a pilot project to help those who are homeless.⁴³ While associated carbon savings are not yet clear, expertise in the area is growing.



■ **STRONG TIMBER MARKET** in Ontario, with local expertise for building in timber.⁴⁴



■ The Toronto Green Standard includes voluntary targets for **PROCUREMENT OF LOCAL** materials - 20% of low-rise building materials to be sourced within 800km of the final project site.



■ **LOW-CARBON ASPHALT AND AGGREGATE RECYCLING RATES ARE HIGH.**⁴⁵



■ **THE MUNICIPALITY HAS DEVELOPED A CIRCULAR PROCUREMENT FRAMEWORK** and is utilising these principles on pilot procurements, including initiation of new public building projects. The City does not currently have a Circular Procurement Policy but intends to develop one through the findings of pilots and other framework implementation activities. They currently have a Sustainable Procurement Strategy, but interviewees reported that this is not always implemented.



BUILD NEW ONLY IF NECESSARY

EMERGING ACTIONS

A range of Clean Construction actions are emerging, both in terms of private business initiatives and by municipal activities, as outlined in Figure 5. The Toronto Green Standard, set and enforced by the municipality, largely oversees this trend. The Green Standard has a multi-tier system where some actions are mandatory, such as baseline energy efficiency standards and tree planting requirements, and others incentivised by reduced development fees for projects, such as on-site renewables provision and reuse of building elements in design. The municipality also has its own frameworks and procurement rules with requirements linked to Clean Construction. Notably, existing actions in Toronto are concentrated on the bottom of the list of the C40 Clean Construction Hierarchy, focussing on new building design and construction rather than optimising and repurposing the existing building stock.



FIGURE 05
CONT.

Summary of Clean Construction actions in Toronto

C40 Clean Construction Hierarchy

Existing and connected work in Toronto

- **SOME USE OF REMOTE AND ELECTRIFIED MACHINERY** in the private sector, according to interviewees, but this is not widespread. 
- **STRONG WASTE MANAGEMENT PROCESSES IN SECTOR**, which aim to increase recycling rates. This is mainly driven by LEED certification requirements and voluntary construction waste recycling targets in the Toronto Green Standard. Ontario 3R's waste audits are required for large construction and demolition projects but do not appear to be enforced. 
- **THE TORONTO GREEN STANDARD SETS REQUIREMENTS AND INCENTIVES FOR GREEN BUILDING AND CONSTRUCTION ACTIONS**. It focuses on energy efficiency, damage to ecosystems, air quality control and waste and is likely to move towards including embodied carbon reductions mechanisms according to interviewees, who highlighted an increasing use of Environmental Product Declarations and whole-life carbon analysis in the sector. 
- **LEED AND GREEN BUILDING CERTIFICATIONS ARE USED WIDELY ON PUBLIC AND PRIVATE BUILDINGS IN TORONTO**, despite no regulatory requirements to use such certification. As with the Ontario Building Code, these tend to focus on building operation and not construction, though can include embodied carbon assessments. 
- **GUIDANCE ON THE USES OF TIMBER AS A BUILDING MATERIAL IS INCLUDED IN THE ONTARIO BUILDING CODE**, which manages building design, but this is not a mandatory requirement. 
- **THE TORONTO ATMOSPHERIC FUND PROVIDES DIRECT FUNDING AND SUPPORT TO INITIATIVES THAT IMPROVE ENERGY EFFICIENCY AND REDUCE EMISSIONS**, though at present this focuses on operational building performance rather than Clean Construction. Other indirect financial mechanisms are available, notably savings on developer fees available where requirements in the Toronto Green Standard are met. Loans and financing are also available for energy-related projects through the Sustainable Energy Plan Financing program and Energy Retrofit Loan Program. 

OTHER TOOLS,
GUIDANCE AND
FUNDING

Beyond GHG emissions, a number of other challenges connected to the Toronto construction industry have been identified. Figure 6 shows the key areas that Toronto built environment professionals and city officials felt ‘greatly needs improvement’ in Toronto. Those priorities should be translated in targeted actions, policies and municipal activities. These assessments were derived from our survey: respondents scored a list of 19 benefits on a scale of 1 to 5 (where ‘5’ meant a ‘greatly needs improvement in Toronto’), with results presented by average score (see more Appendix A).

CITY PRIORITIES

The results correspond with the wider trends outlined in the Toronto City Profile: A wide range of social, economic and environmental factors need consideration with affordable housing, climate resilience and sustainable consumption being major priorities. Interviewees also raised concerns around biodiversity, good governance and environmental awareness. Job creation and need for skills ranks highly, corresponding with interviewee views that jobs for marginalised groups are needed, and that there is a Clean Construction skills gap in the industry.. The high score of climate resilience reflects concerns about the low focus on adaptation in the sector, despite the serious findings of the Toronto Resilience Strategy.¹⁸



FIGURE 06
Key areas for improvement in Toronto

2.2 CLEAN CONSTRUCTION RECOMMENDATIONS FOR TORONTO

OVERVIEW OF CLEAN CONSTRUCTION POLICY INTERVENTIONS VIABLE IN TORONTO

CLEAN CONSTRUCTION IN TORONTO

The high local interest and commitment to climate action combined with the skill of the Toronto construction sector means that the city is well placed to take ambitious action in all areas of Clean Construction. This was agreed across all interviews: the City of Toronto should provide a clear, extensive vision for the industry across all their functions: in management of the municipal building stock, and through its role as city-wide convener and regulator and in providing education and guidance.

DIRECT EMBODIED EMISSION REDUCTION INTERVENTIONS

As shown in Figure 7, policy interventions in Toronto that would generate direct embodied emission reductions should primarily foster change in buildings materials selection and reduction in the use of materials in new builds. Implementation could take the form of reviewing safety factors to limit overdesign and foster resource efficiency. Pursuing designs which utilise principles of disassembly, modularity, and prefabrication will reduce emissions, as well as having key additional benefits to housing affordability and quality, among other areas (see more in Section 2.5).

“Policy interventions in Toronto that would generate direct embodied emission reductions should primarily foster change in buildings materials selection and reduction in the use of materials in new builds.”

SYSTEM CHANGE INTERVENTIONS

However, there are many policy interventions – as shown in the C40 Clean Construction hierarchy (Figure 8) and Buro Happold analysis (see Box: Method) – that would lay the groundwork for a city-wide shift to repurposing built fabric and positively impacting the environment. These include adopting early-stage whole-life carbon analysis, circular economy principles, and demolition assessments to consider building longevity and alternative uses for structurally sound spaces as opposed to building new (Tier 1 and 2). The City of Toronto should lead and encourage this shift with training and guidance programmes in collaboration with the Canadian Green Building Council and other industry bodies, data collection, and requirements for key sustainability and waste management assessments in planning (see: Implementation).

ENABLING INTERVENTIONS

Other enabling policy interventions entail expanding and improving local material availability, the use of electric construction machinery and improved waste sorting and management - though the City of Toronto is not responsible for disposal of construction and demolition waste, it has a key role as regulator. There are also options for new facilities and contractual arrangements should become the norm, including storage and exchange programmes for soil and materials, and agreements to require manufacturers take back a product for recycling at the end of its useful life.



METHOD

Viable Clean Construction policy interventions were selected from an initial literature review longlist and interviews with city officials to identify ongoing policy work and areas which would not be possible in Toronto given resource constraints, political barriers or lack of city powers. Few were excluded in Toronto given its highly skilled workforce, reasonably broad set of powers and access to global trade and resources. Selected policies were split into different categories:

- **DIRECT EMISSIONS REDUCTIONS** – policy interventions which are defined by their major impact on reducing the sector embodied and operational carbon emissions. These are defined by previous research by C40,⁴⁶ and primarily relate to shifts in less material intensive construction and major changes in materials supply
- **SYSTEMS CHANGE** – policy interventions leading to emissions reductions and wider benefits, as highlighted by CNCA and C40 research⁵² and other studies. Key social, economic and environmental benefits are explored in Section 2.5. These policy interventions principally relate to relevant Clean Construction design principles – such as principles of disassembly, modularity, materials efficiency and pre-fabrication.
- **ENABLING** – supporting policy interventions which do not have direct impacts on emissions or other benefits, but which facilitate or unlock other policy interventions. These might include developing physical facilities, contractual arrangements, training and guidance programmes, and research.

The longlist was cross-referenced against two key categories: relevant co-benefits, as found in the literature review, and suitable implementation options (Section 2.3), as identified through the interview and survey process. Of this longlist, 'highly recommended' policy interventions were identified as those that have a major role in reducing emissions or facilitating clear construction or those that influence more than 50% of the benefits identified as key priorities for the city (Figure 6).

POLICY HIERACHY FOR TORONTO

Direct Emissions Reductions

- Use of bio-based materials and certified timber products
- Use of low-carbon cement, concrete and aggregates
- Material-efficient structural designs
- Direct reuse of (deconstructed) building materials in new buildings

Systems Change

- Pre-fabricated, off-site and modular construction methods
- Use of alternative fuels in construction machinery
- Clean Construction municipality procurement rules
- Use of low-carbon asphalt
- Design for disassembly, adaptation and reuse
- Improved waste sorting and separation to increase rates and quality of recycling and reuse
- Technologies and methods to reduce carbon footprint of sites preparation, soil stabilisation and foundations
- Manufacturer or supply-side reductions in embodied carbon of products
- Expansion of local sustainable materials industry
- Refurbishment programmes to improve efficiency of buildings in operation

Enabling Areas

- Embed circular economy principles into the sector
- Whole-life embodied carbon assessments used to drive design and planning decisions, including considering the relative carbon footprint of rebuilding and demolition
- Utilise or sell city land for flagship projects and pilots
- Widespread adoption of circular construction practices
- Material takeback programmes
- Mass soil coordination, storage and reuse programmes
- Clean Construction training courses, guidelines and tools
- Physical waste processing infrastructure
- End of life demolition assessments to encourage renovation, reuse and adaptive use of buildings
- Inclusion of Clean Construction in Climate Action Plans and other sustainability declarations
- Construction machinery retrofit support
- Clean Construction data collection
- Identify and remove bureaucratic and legal barriers
- Reduce numbers of unoccupied and vacant spaces in the city
- Use existing spaces to their maximum ability and repurpose assets for different uses

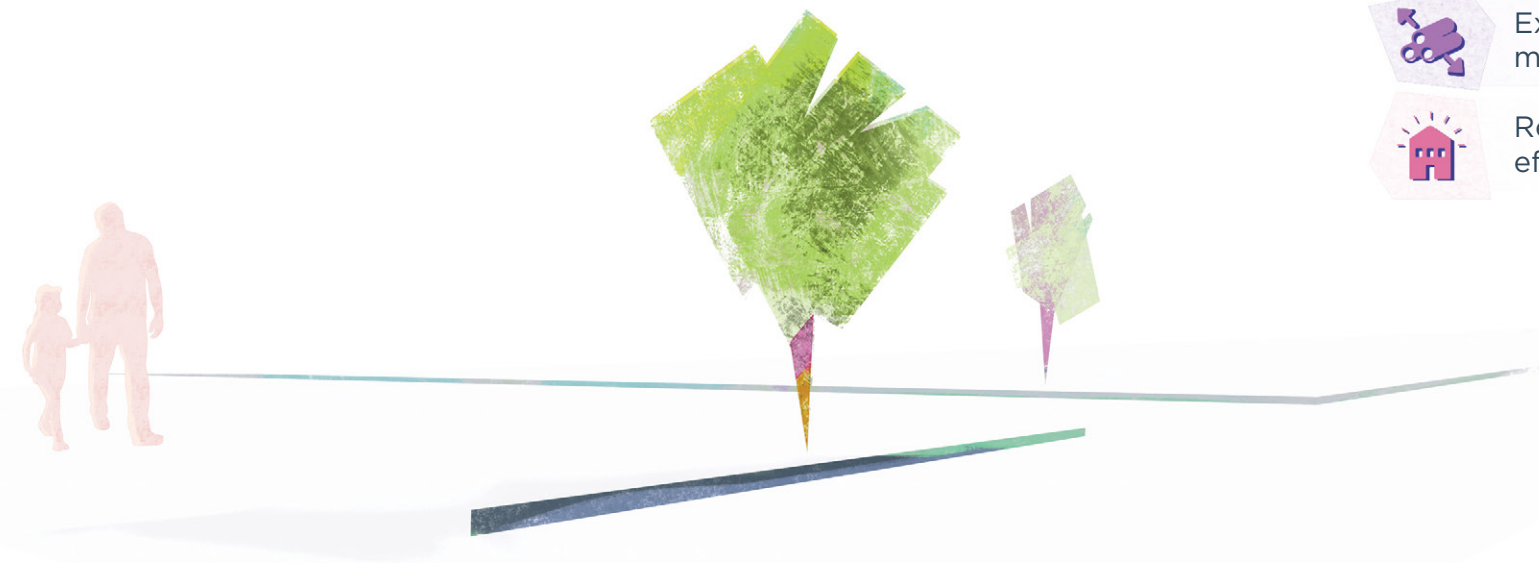
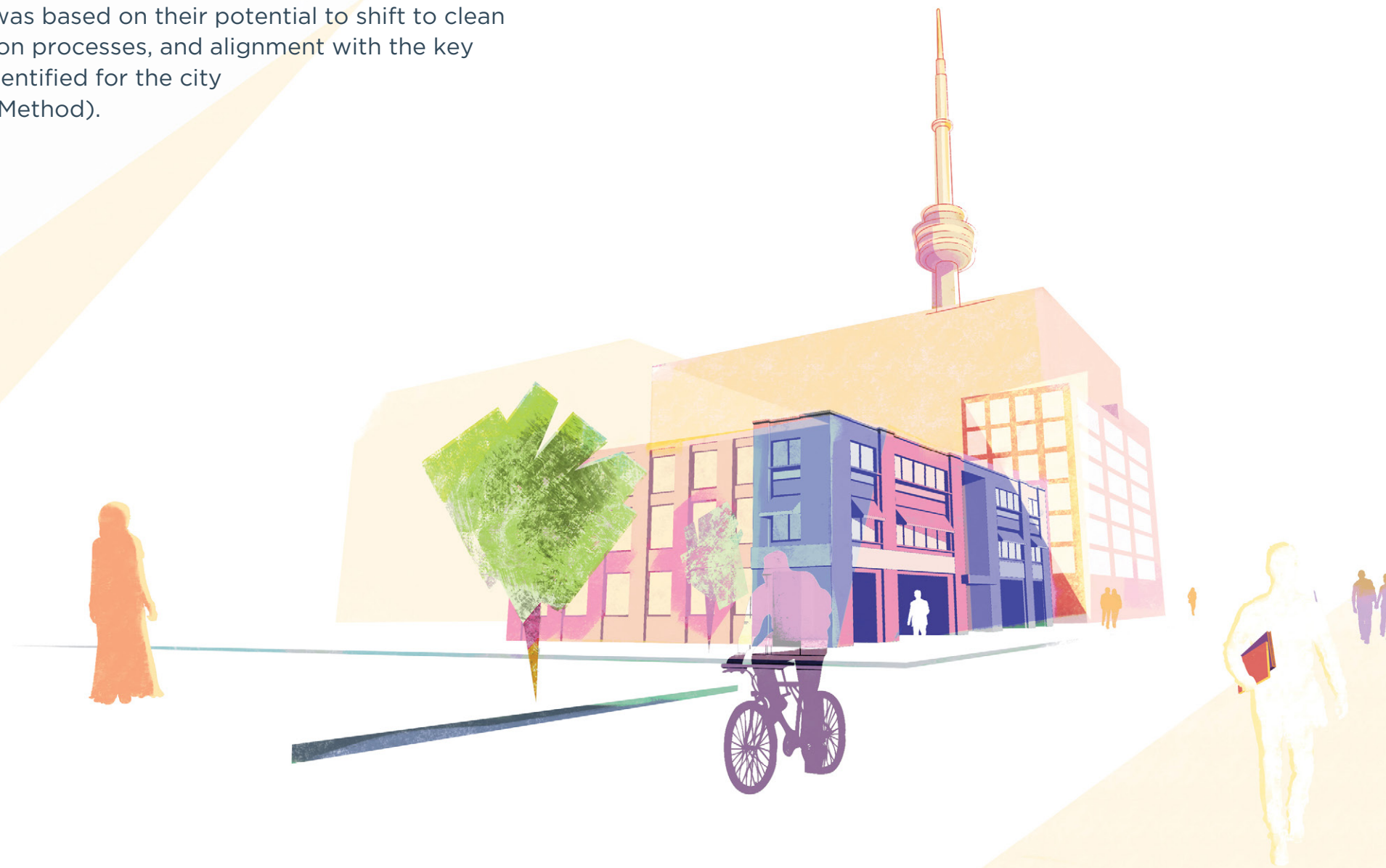


FIGURE 07 * Indicates a 'highly recommended' policy
Viable clean construction policy areas to pursue in Toronto

HIGHLY RECOMMENDED POLICY AREAS

Eight 'highly recommended' policy interventions were selected for Toronto (Figure 8, see Box: Method). The selection was based on their potential to shift to clean construction processes, and alignment with the key benefits identified for the city (See Box: Method).



OPTIMISE, RETROFIT OR REFURBISH

Primarily, these policies drive the industry to consider building longevity, optimised whole-life cycle emissions and alternative usage at 'end of life' of structurally sound buildings. Mandatory and widespread adoption of whole-life carbon and demolition assessments are highly recommended, accompanied by circular procurement strategies and circular design principles. The implementation of a circular approach can include adoption of material takeback contracts, supporting development of physical material reuse and storage facilities, flow analysis of materials in the city, increased quality of reuse and recycling, and incentivisation of low-carbon modular and prefabrication construction methods.

NEW BUILDINGS

Where new builds are required, Toronto would benefit hugely from a major shift to timber construction methods in order to dramatically reduce carbon emissions.⁴⁶ This material is widely available in Ontario and would enable the reduction of high-emitting concrete, which currently dominates the sector.

All of these policy interventions should be accompanied by extensive data collection, strategies and tools to ensure affordability and accessibility of clean construction projects for all people, and education, guidance and upskilling initiatives for workers.

Highly recommended policy areas for Toronto

Description

Key implementation mechanisms

C40 Clean Construction Hierarchy Tiers 1-2: Optimise , retrofit or refurbish the existing built environment stock

<p>EMBED CIRCULAR ECONOMY PRINCIPLES INTO THE SECTOR</p>	<p>REDUCES DEMAND FOR RAW MATERIALS BY REFURBISHING, RECOVERING AND REPURPOSING EXISTING BUILDING FABRIC. Toronto is well suited to this: it has strong existing infrastructure and business capacity, and a highly skilled industry. As a minimum, a 22% reduction in virgin metal and petrochemical-based materials by 2050 should be targeted as per C40 and Arup analysis.⁴⁶</p>	<ul style="list-style-type: none"> ■ Integrate Clean Construction and circular economy principles into the Toronto Green Standard; ■ Provide training and guidance; ■ Consider tax incentives to reduce vacancy rates in the building stock.⁴⁷
<p>END-OF-LIFE DEMOLITION ASSESSMENTS TO ENCOURAGE RENOVATION, REUSE AND ADAPTIVE USE OF BUILDINGS</p>	<p>Assessments of alternative options for the end-of-life of buildings encourage building longevity and retrofit, AVOIDING UNNECESSARY DEMOLITION AND REBUILD, and therefore greatly reducing the materials requirement of the sector. This can be carried out at design stage regarding potential alternative use and retrofits and/or take the form of a pre-demolition assessment.</p>	<ul style="list-style-type: none"> ■ Request in planning process and permitting; ■ Develop guidance and training as a priority and embed in city plans.
<p>WHOLE-LIFE EMBODIED CARBON ASSESSMENTS USED TO DRIVE DESIGN AND PLANNING DECISIONS, INCLUDING CONSIDERING THE RELATIVE CARBON FOOTPRINT OF REBUILDING AND DEMOLITION</p>	<p>USE OF LCA'S and other life cycle assessments is rising in Toronto and the region.</p> <p>LCA's are fundamental mechanisms for identifying, validating and analysing appropriate Clean Construction methodologies and defining appropriate target reductions, particularly with regard to USE OF LOW-CARBON MATERIALS, avoiding demolition and promoting circular principles.</p> <p>LCA's should be used to IDENTIFY OPPORTUNITIES FOR RETROFIT AND REPURPOSING OF STRUCTURES, and to analyse options for optimising and reusing building stock.</p>	<ul style="list-style-type: none"> ■ Incentivise assessments in planning through the Toronto Green Standard; ■ Provide and reward assessments in planning; ■ Provide training and guidance, sector convening to share expertise and collaborate to set baselines and enforcement principles.











FIGURE 08
 Summary of highly recommended Clean Construction policy area interventions for consideration in Toronto

Highly recommended policy areas for Toronto

Description

Key implementation mechanisms

C40 Clean Construction Hierarchy Tier 3: Build new only if necessary

 <p>PREFABRICATED, OFF-SITE AND MODULAR CONSTRUCTION METHODS</p> 	<p>THESE DESIGN METHODOLOGIES ARE CAPABLE OF SIGNIFICANT CARBON REDUCTIONS,</p> <p>and work well with TIMBER CONSTRUCTION. This is a growing sector in Toronto, and such technologies report significant improvements in building costs and quality, a high priority for the city.</p>  	<ul style="list-style-type: none"> Continued municipal adoption on projects and pilot studies; Incentivise with expedited permitting.
 <p>USE OF BIO-BASED MATERIALS AND CERTIFIED TIMBER PRODUCTS</p> 	<p>USE OF TIMBER REDUCES NEW BUILD EMISSIONS AND IS APPROPRIATE FOR MODULAR AND PREFABRICATED CONSTRUCTION. It is widely available in Toronto, with growing local design expertise. Toronto is therefore well suited to becoming a world-leading location for sustainable timber construction. A major shift to timber would be approximately 90% of residential and 70% of commercial new builds from sustainable timber.⁴⁶</p> 	<ul style="list-style-type: none"> Establish a vision and target for a major shift to timber construction; Support with guidance and inclusion in the TGS.
 <p>USE OF LOW-CARBON CEMENT, CONCRETE AND AGGREGATES</p> 	<p>Cement is a major source of emissions and is widely used in Toronto. While the recycled aggregate industry is well-established, low-carbon cement and cement alternatives should be prioritised as a key Clean Construction shift, with an ambitious aim of 61% OF CEMENT REPLACED WITH LOW CARBON ALTERNATIVES.⁴⁶</p> 	<ul style="list-style-type: none"> Industry convening and collaboration with supply chain to investigate availability and financial impact, guidance and education materials.

Supporting: data and tools

 <p>CLEAN CONSTRUCTION TRAINING, GUIDELINES AND TOOLS</p> 	<p>Interviewees felt that firms were often unaware of how to use or practice Clean Construction design principles. The municipality should support EDUCATION AND DISSEMINATION OF CLEAN CONSTRUCTION GUIDANCE materials, through training, webinars and explanatory materials.</p> 	<ul style="list-style-type: none"> Develop publicly available industry guidance and training as part of policy rollouts.
 <p>CLEAN CONSTRUCTION DATA COLLECTION</p> 	<p>IMPROVING DATA COLLECTION ON CONSTRUCTION METHODOLOGIES in the planning process is essential to track progress, understand where municipality support is needed, to track material and waste flows and to build a knowledge base.</p> 	<ul style="list-style-type: none"> Monitor planning and building permit applications through site inspections; Establish LCA data collection, analysis and monitoring .

FIGURE 8 CONT.
Summary of highly recommended Clean Construction policy area interventions for consideration in Toronto

2.3 IMPLEMENTATION

The implementation of the Clean Construction interventions suitable for Toronto can be varied, given the City of Toronto has a relatively wide range of powers. Figure 9 summarises potential implementation mechanisms for Clean Construction policy interventions in Toronto.

EDUCATION SUPPORT

Notably, most Clean Construction policy interventions can be integrated into the City of Toronto's procurement activities and procurement - these should be aligned with the Circular Procurement Framework currently being implemented. Similarly, a popular suggestion among interviewees was the introduction of strategies, awards, industry convening and collaboration and education materials. These are all useful in creating wide ownership whilst defining and implementing Clean Construction policy.

REGULATION SUPPORT

In terms of regulation, it is essential to leverage the Toronto Green Standard, and to influence the Ontario Building Code and the permit and planning process. In particular, interviewees reported that waste management regulations and processes for construction and demolition waste needed to be more stringent and better regulated in Toronto and Ontario, both as waste leaves site and at the point of processing.

“ Innovative areas could be supported by the City of Toronto through pilot projects, direct funding and physical infrastructure ”

NASCENT INDUSTRY SUPPORT

Several implementation mechanisms would foster, testing and stimulate nascent areas of Clean Construction. Material separation, exchange and storage programs, electric construction machinery, design for disassembly, material-efficient design and similarly innovative areas could be supported by the City of Toronto through pilot projects, direct funding and physical infrastructure.

SHORT-TERM

The timing of clean construction policy interventions recommended for Toronto will largely depend on the implementation mechanism. Interviewees felt strongly that the City of Toronto should act quickly in order for new policies to achieve meaningful changes before net zero deadlines approach. As seen in Figure 9, more immediate policy implementations relate to shifts in material usage patterns, sustainability commitments relating to municipal procurement and frameworks and establishing data collection processes.

MEDIUM-TERM

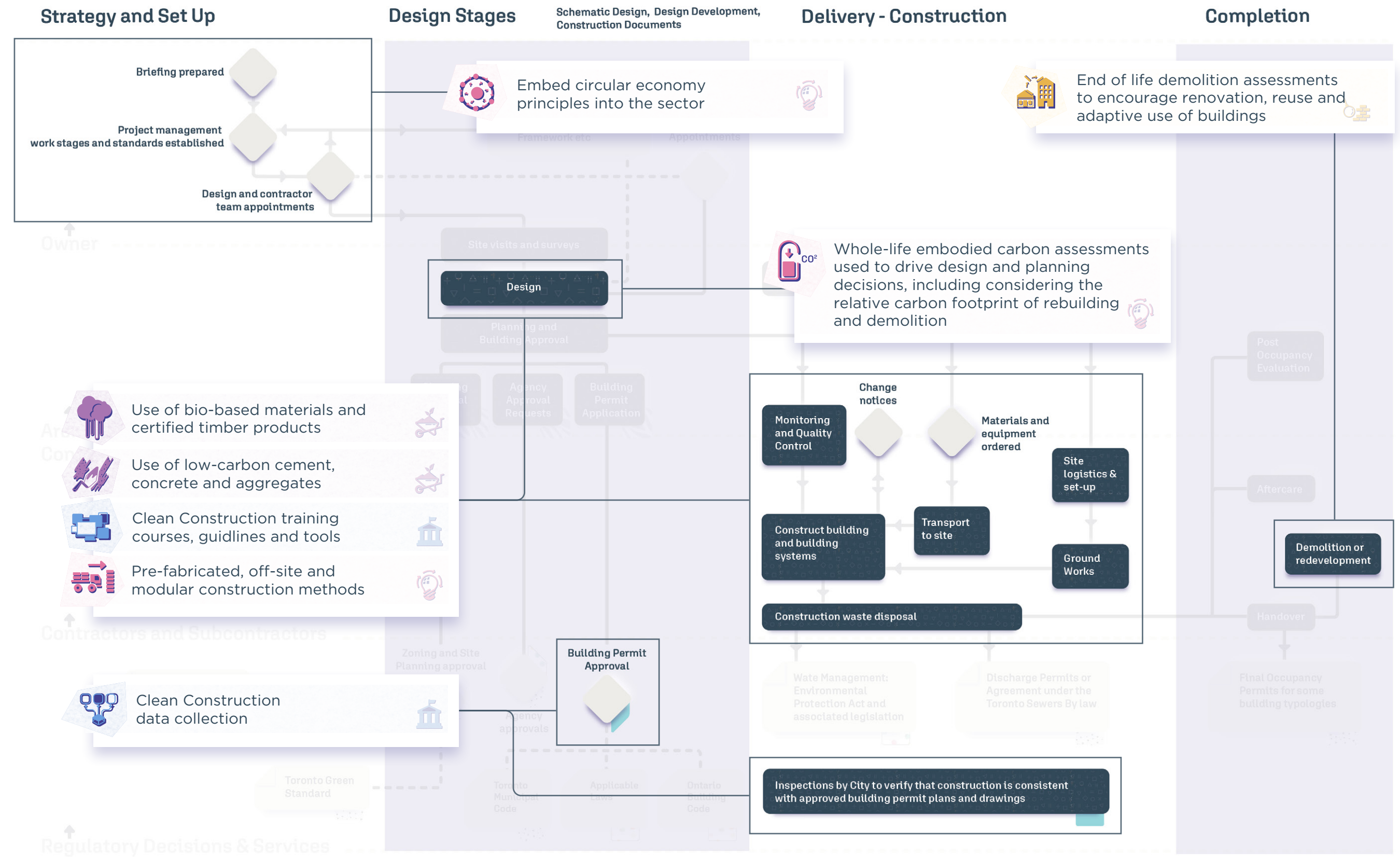
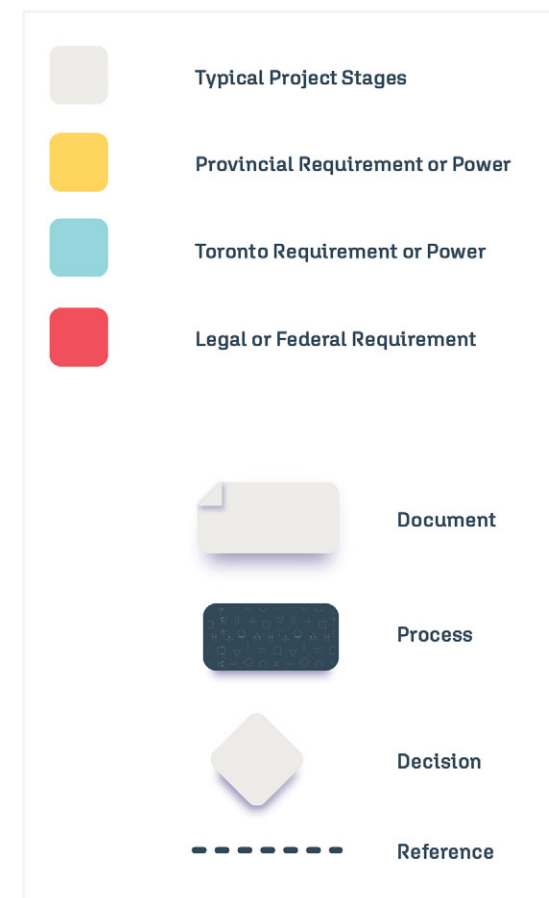
Medium-term changes include design shifts, tighter regulation of waste processing infrastructure and materials transfer, which could include the municipality incentivising or developing new construction and demolition waste infrastructure as appropriate.

LONG-TERM

Longer timescales are expected for shifts in electric construction machinery, and local sustainable materials industries being fully established.

TORONTO CONSTRUCTION MAP

Clean Construction policy area intervention: annotated construction map



e.g. Ministry of Environment, Ministry of Transportation, Railway Authority Approval

FIGURE 09

Policy interventions and possible implementation mechanisms

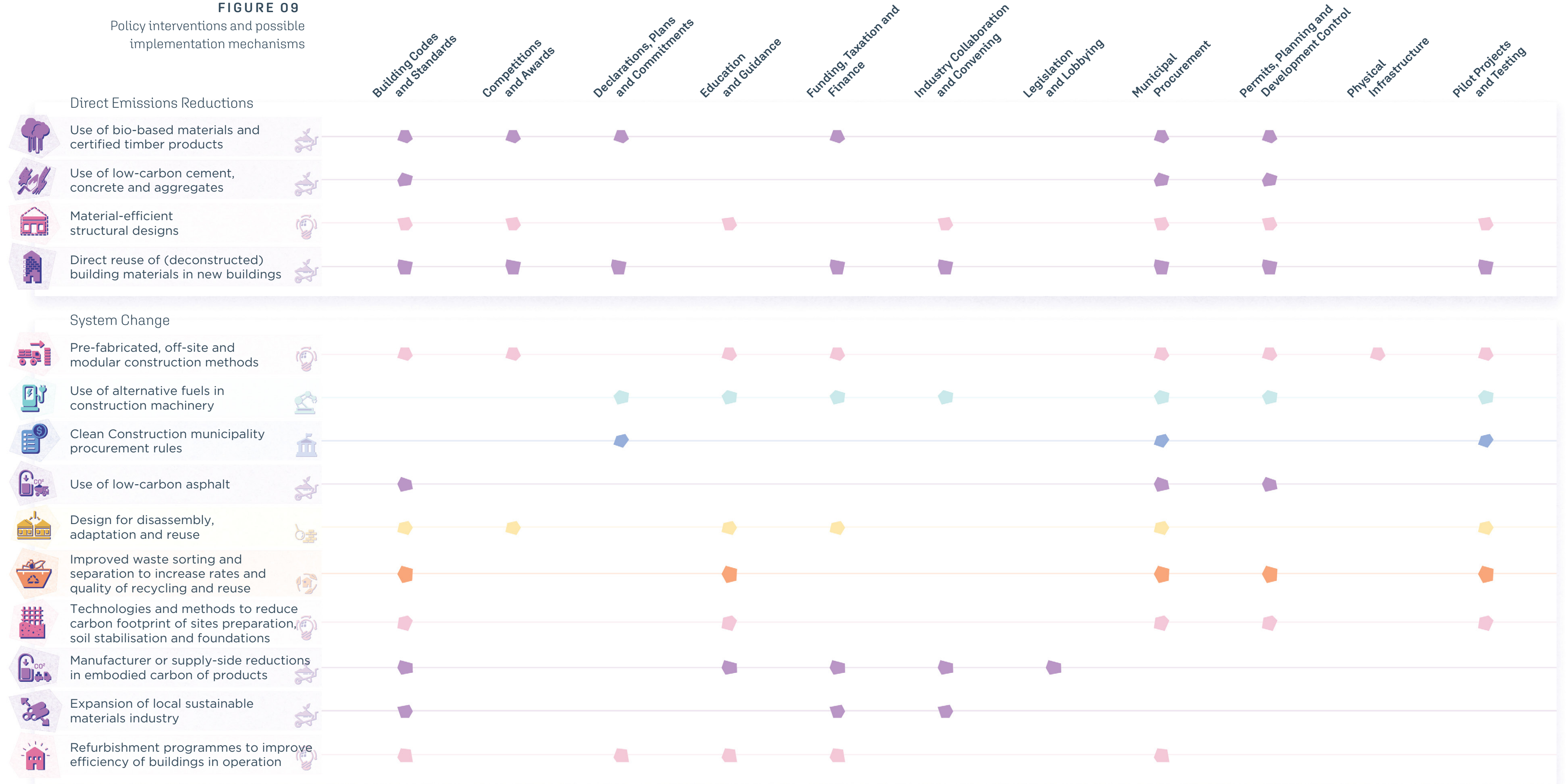


FIGURE 09 CONT.
Policy interventions and possible implementation mechanisms



**CLEAN
CONSTRUCTION
PROCESS**

The annotated construction map on page 33 highlights how this implementation of Clean Construction processes might affect the current construction process in Toronto. This is concentrated at design stages, where efforts must be made to assess how to integrate circular and clean principles across the whole project life cycle, including demolition. However, substantial input from the municipality in terms of regulations and training will help develop the cycle, and supply chain actions are needed through changes to physical construction and materials sourcing.

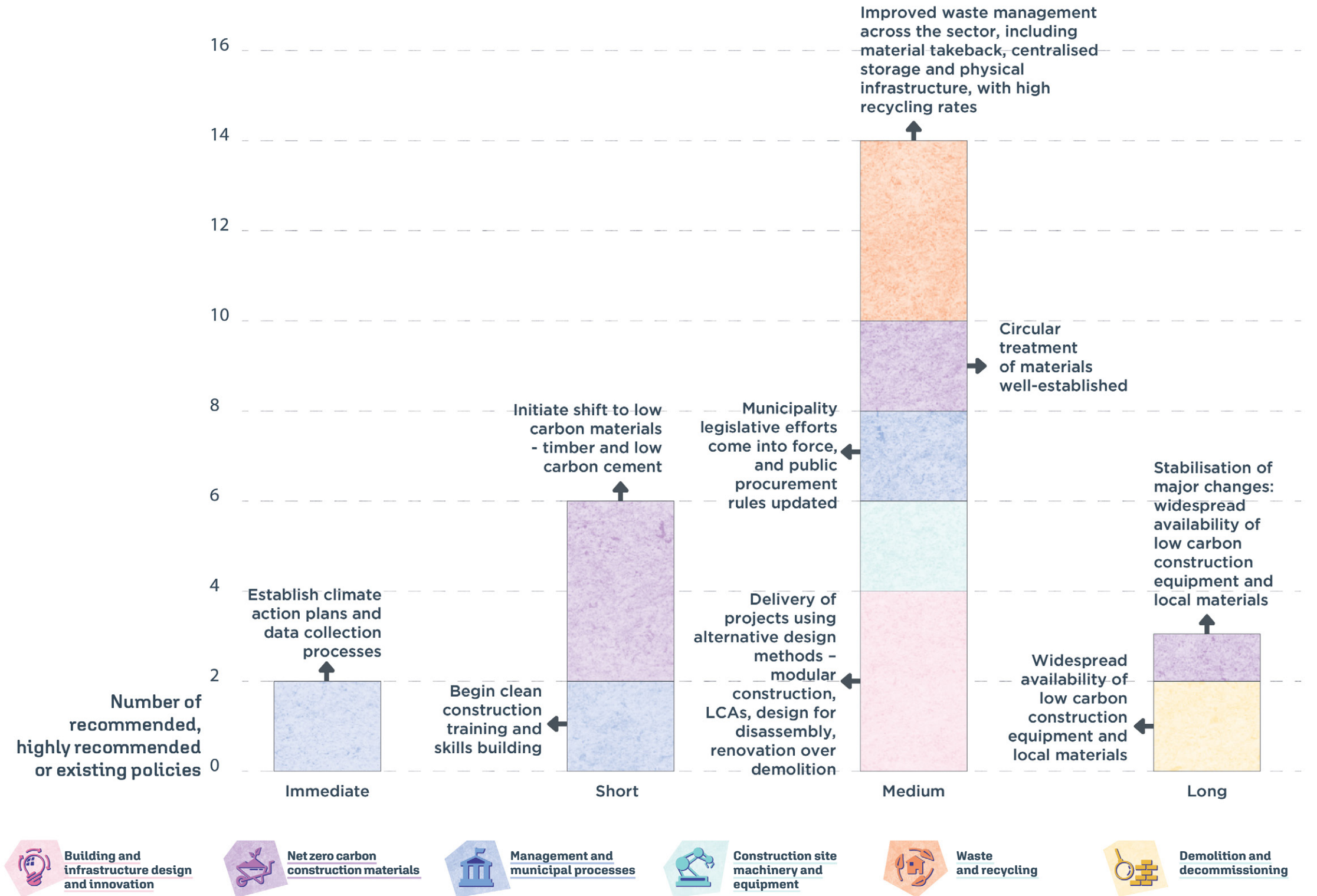


FIGURE 10
Lead time for implementation of key policy interventions. Immediate actions are within a year; Short < 5 years; Medium 5-10 years and Long are 10+ years

2.4 CHALLENGES AND OPPORTUNITIES

Figure 11 shows a SWOT analysis of key challenges and opportunities related to the policy interventions and implementation mechanisms highlighted as relevant to Toronto, with the challenges identified by interviewees or in the literature review. This analysis demonstrates that the construction sector in Toronto is well placed to adopt new technologies and undergo a transition to Clean Construction thanks to the high skill set of those in the sector, availability of materials and basic legislation. However, this will require a concerted effort on the part of the City of Toronto together with industry uptake, citizen engagement and client appetite. Recurring considerations in interviews related to levels of ambition, regulation and training:












- At present, the strongest drive seems to come from designers. Interviewees wanted more vision and direction from the City of Toronto: 'In Toronto we are very scared to make commitments for new things and new strategies... we need the vision and the leadership from the city.'
- The Ontario Building Code and the Toronto Green Standard need to be ambitious and fast-paced - 'more reflective of international trends.' Interviewees felt that the industry has 'proactive players', but that regulations are needed to make green construction cost-competitive.
- Interviewees felt that there was a lack of understanding of Clean Construction and green building design requirements in the sector, with labour shortages or lack of skills a key barrier for attempts to set up new ways of working. Guidance, skills development and training for staff are key requirements to drive a shift to Clean Construction, not only at federal level.

Strengths

- **CONSIDERABLE PROGRESS IN CLEAN CONSTRUCTION** and reducing emissions in buildings to date, with the renovation programme for operational energy highly ambitious. 
- Much of the **BASIC LEGISLATION AND REGULATION IS IN PLACE** – the Toronto Green Standard, Building Permit and inspections process and applicable laws. 
- Interviewees felt that ‘the city is good at working with the developers to achieve their expectations’, which is promising for recommendations around new technologies. Similarly, **THE CITY’S DESIGN REVIEW IN PLANNING AND SITE INSPECTIONS ARE A ROBUST METHOD OF INTRODUCING MEASURES.** 

Weaknesses

- There is **LIMITED BASELINE DATA FOR EMBODIED CARBON IN TORONTO** at present, supporting the adoption of better tracking and management as a priority for the city to adopt. 
- Many **GREEN BUILDING TECHNIQUES ARE NOT YET COST-COMPETITIVE IN TORONTO**, and it may take time for the market to shift. New policies will need to consider and manage affordability for the sector and the wider public. 
- Some Clean Construction processes require **CAREFUL DESIGN AND MANAGEMENT** to ensure carbon benefits are captured – such as in the case of modular design, which an interviewee working in the field reported was not currently saving carbon in Toronto. It is essential that Clean Construction process selection is well-informed, and data driven. 
- There are **CONCERNS ABOUT THE SUSTAINABILITY OF THE USE OF TIMBER.** Strong controls over timber provenance are in place, but it is essential that timber production does not impact protected land or Indigenous territory. 
- **THE TORONTO GREEN STANDARD DOES NOT PROVIDE REGULATORY INCENTIVE OR CLEAR GUIDANCE FOR DEVELOPERS ON MANY KEY TOPICS** – notably use of timber or use of embodied carbon assessments with ambitious benchmarks. 
- Strong municipality oversight and expertise but **LACK OF COORDINATION BETWEEN DEPARTMENTS COULD BECOME A MAJOR ISSUE** – interviewees reported challenges from fire marshals over mass timber construction planning application. 
- One interviewee noted that **LACK OF GREEN FINANCE OR CARBON PRICE WAS A REAL BARRIER TO RENOVATION** and other capital-intensive green efforts. 
- The City of Toronto cannot drive a full shift to Clean Construction alone – **INDUSTRY COLLABORATION AND ENGAGEMENT WILL BE ESSENTIAL.** 
- Interviewees noted that **BUILDING NEW REMAINS THE PREVAILING ATTITUDE, STILL PREFERRED TO ‘RETROFIT’.** 

Opportunities

- There are already **EXISTING AND EMERGING EXPERTISE IN SEVERAL KEY AREAS** in Toronto – timber construction, reuse of foundations and facades, retrofit programmes and whole life carbon assessments. 
- **GROWING MARKET INTEREST:** some felt more drive was needed, others reported ‘Higher appreciations from investors, more of our clients are asking how to get to higher level of performance and at what cost.’ 
- High usage of concrete and growing market for timber means Toronto is well placed to **SHIFT TO TIMBER CONSTRUCTION,** saving a large amount of carbon. 

Threats

- Direct emissions reductions from shifts to **LOW-CARBON MATERIALS IS NOT ENOUGH TO REACH NET ZERO.** The municipality risks continuing to focus on policy interventions that reduce the impact of new build rather than moving to circular and clean principles, or trying to prioritise, better use and repurpose the much bigger existing stock of structurally sound buildings in Toronto. 
- Interviewees reported that often **VIRGIN MATERIALS, LIKE CONCRETE BLOCKS, ARE CHEAPER THAN ALTERNATIVES.** Some interviewees attributed this to lower risk and cheaper labour in established industries. 
- A key benefit of many Clean Construction policies and new areas of innovation is the creation of new jobs. However, **SKILLS AND TRAINING ARE LACKING,** despite being vitally needed to develop this workforce. Interviewees noted training is typically only managed at federal level. 
- A shift to Clean Construction will need **POLITICAL STIMULUS AND PUBLIC FUNDING.** There may be little popular appetite for public spending on Clean Construction policy without education and public understanding on the topic. City officials gave the example of alternative fuels in construction machinery being likely to be of low public interest. 
- Cost-effectiveness and utility rate structure: in Ontario, **GAS IS CHEAP, THREATENING SHIFTS TO ELECTRIC CONSTRUCTION MACHINERY.** 

FIGURE 11
SWOT analysis
of a transition to
Clean Construction
processes in Toronto

2.5 BENEFITS AND IMPACTS FOR TORONTO

Implementation of Clean Construction policies in Toronto will not only reduce emissions associated with building and construction but also yield wider benefits. These are summarised for Toronto in Figure 12. Crucially, the policy interventions and implementation mechanisms suggested will help deliver many of the key concerns noted by interviewees for Toronto (Figure 6).

EMISSIONS

CONSUMPTION BASED EMISSIONS REDUCTIONS

Targets and policy action for material efficiency, reuse and switching to low-carbon alternatives like timber, would help Toronto achieve a 57% reduction in consumption-based emissions (the emissions associated with goods and services consumed within Toronto) by 2030, against a 2020 baseline.⁴¹ Long-term, greater emissions reductions and a substantially reduced use of materials can be driven across the supply chain through a move to whole life carbon and demolition assessments. These drive a circular, adaptive construction industry with widespread reuse of materials and clean design processes.

SOCIAL

AFFORDABLE, HIGH- QUALITY AND ACCESSIBLE HOUSING

In terms of social benefits, interviewees believed that affordable, high-quality and accessible housing was the most important concern for Toronto.

Affordable and better quality homes can be created through modular and prefabricated buildings, designed to be adaptable so as to prevent premature demolition.

These methodologies can also substantially reduce the length and delivery requirements associated with construction, reducing congestion and local air pollution build-up.⁴⁶

Increased use of data collection and training will also support local governance procedures as well as environmental and health awareness and behaviours in the sector. It would also help build a local, skilled workforce with higher standards of working conditions leading to better health and well-being.

Affordable homes and training schemes should include active efforts to reach First Nation and Indigenous communities, which suffer disproportionate rates of unemployment, low quality of housing and lack of access to consultation.^{48, 49}

“Implementation of Clean Construction policies in Toronto will not only reduce emissions associated with building and construction but also yield wider benefits.”

ECONOMIC

**GREEN JOBS
AND SKILLS
AND ECONOMIC
INNOVATION**

In terms of economic benefits, Clean Construction interventions relate to many new, emerging areas of business and technology. Likely benefits include positive impacts on green jobs and skills and economic innovation, particularly around an expansion of local circular markets as well as new roles and expertise in the supply chain through a market for repair, materials sharing and retrofit, and the introduction of new building design and construction methodologies.

COST-SAVINGS

Cost-savings can also be expected through use of modular housing principles, efficient use of materials, resource sharing and Cost-savings can also be expected through choosing refurbishment rather than rebuild, more efficient use of materials, resource sharing, and modular construction. in public projects. Use of LCA and consideration of building lifecycle at design and construction stage are also necessary to harness lifecycle and operational emissions reductions and cost savings - for example, studies by the Canadian Green Building Council model zero carbon in operation buildings as 'economically strong' in Toronto, with a lifecycle return of \$58/m² - the incremental capital cost increases of 8% being offset by reduced annual energy demand savings of 27%.⁵⁰ This has a further social benefit in helping tackle the 7% fuel poverty rate in the province.

ENVIRONMENTAL

**CLIMATE
RESILIENCE,
BIODIVERSITY
AND SOIL QUALITY**

Climate resilience, biodiversity and soil quality were considered key environmental concerns for Toronto. All three should be fundamental to future municipal actions, with Clean Construction actions incorporated into other climate actions and policies undertaken by the City of Toronto.

**CLIMATE
RESILIENCE**

In particular, climate resilience can be bolstered by Clean Construction policy through a renewed attention to renovation - intersecting, for example, with the City of Toronto's goals to retrofit all buildings by 2050 - through innovation in materials that can include properties to reduce overheating.

BIODIVERSITY

Designing mixed-used neighbourhoods with the right use of bio-based materials and nature-based solutions would both reduce embodied emissions and tackle resilience, biodiversity, soil quality and provide local health and wellbeing benefits to communities.

SOIL QUALITY

Soil quality can also be improved by Clean Construction processes in Toronto through reduced waste to landfill,⁵¹ centralised materials storage and reuse programmes - which minimise virgin soil extraction and disturbance from other material extractions⁵² - and high-quality timber certification requirements that drive good regional soil management.⁵³ Revising approaches to materials selection and construction management through the municipality requiring whole life carbon assessments and other tools can provide a lens through which developers can reconsider and control the impact of construction processes, catalysing improved extraction practices, reducing resource usage and wastage, and shortening project lead times through local sourcing.⁵⁴



Highly recommended policy areas for Toronto

C40 Clean Construction Hierarchy Tiers 1-2: Optimise, retrofit or refurbish the existing built environment stock



FIGURE 12

Summary of emissions reductions and benefits of 'highly recommended' policy interventions

Highly recommended policy areas for Toronto

C40 Clean Construction Hierarchy Tier 3: Build new only if necessary



FIGURE 12 CONT.

Summary of emissions reductions and benefits of 'highly recommended' policy interventions

Highly recommended policy areas for Toronto

C40 Clean Construction Hierarchy Tiers 1-2: Optimise, retrofit or refurbish the existing built environment stock



FIGURE 12 CONT.
Summary of emissions reductions and benefits of 'highly recommended' policy interventions

3 CONCLUSION



3.1 MAIN TAKEAWAYS FOR TORONTO

CONTEXT

Construction in Toronto is a significant part of the economy, employing many thousands of people and delivering important large-scale construction projects. However, house prices are rising rapidly, the industry is fragmented and Toronto faces climate resilience challenges from increasingly high temperatures and frequency of flooding.

According to our survey of city officials and members of the built environment sector, key priorities for the city relate to affordable and high-quality housing, sustainable production and consumption and climate resilience. Other priority areas relate to biodiversity, public budget, green jobs and skills, environmental awareness, economic innovation, soil quality and good governance.

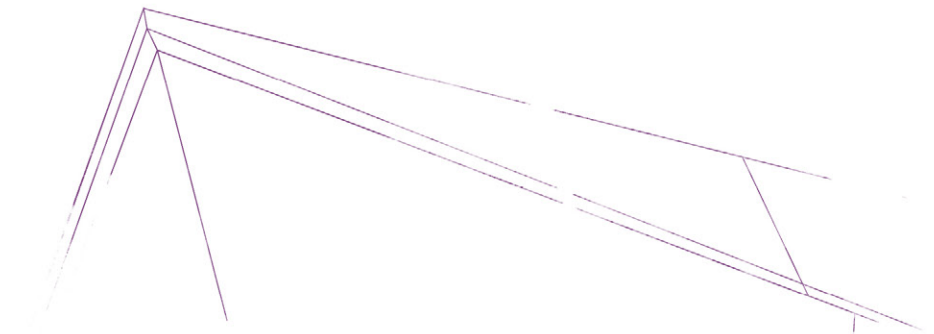


RECOMMENDATIONS

The City of Toronto has declared a climate emergency and committed to an emissions reduction target of net zero by 2050 or sooner. Considering embodied emissions, the city's **BUILDING AND CONSUMPTION EMISSIONS CONTRIBUTE TO 10% OF THE CITY'S TOTAL CONSUMPTION-BASED EMISSIONS, WITH PER CAPITA EMISSIONS** 49% greater than the North America average.



Clean Construction processes are emerging: the Toronto Green Standard and other accreditations (such as LEED) are popular among developers, though not mandatory and currently only focused on operational carbon and new builds. **WHOLE-LIFE CARBON ASSESSMENTS** and **TIMBER CONSTRUCTION** are increasingly popular among designers, and there are reports of a growing modular and prefabricated design industry. **EMISSIONS REDUCTIONS OF AROUND 57%** (by 2030 against a 2020 baseline) can be achieved through reduced use of materials and a shift to timber. The city has **INTERNAL CIRCULAR PROCUREMENT AND RELATED FRAMEWORKS, AND FUNDING IS AVAILABLE** for green construction through the Toronto Atmospheric Fund and other systems.



CLEAN CONSTRUCTION PROCESSES ARE VIABLE ACROSS ALL AREAS OF CONSTRUCTION IN TORONTO thanks to its highly skilled and developed industry. This means that a transition to Clean Construction can be pursued by the municipality in its **OWN BUILDING STOCK, AND THROUGH ITS ROLE AS CONVENER, REGULATOR AND PROVIDER OF EDUCATION AND GUIDANCE** covering the full building lifecycle: building design, materials, construction machinery and processes, waste and demolition.

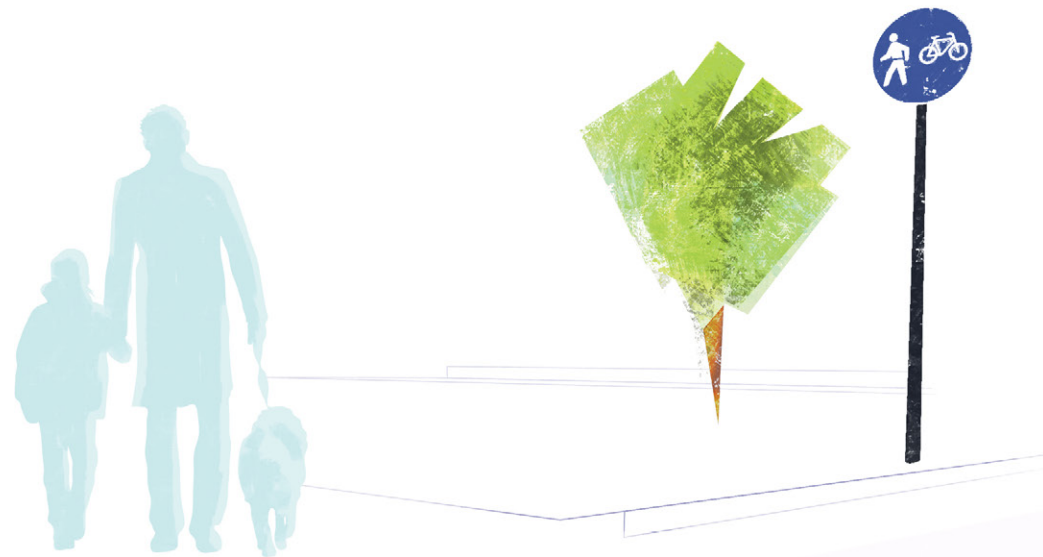


Highly recommended policy interventions, selected on account of their impact and links to key priorities for the city, are to **EMBED CIRCULAR ECONOMY PRINCIPLES IN THE SECTOR**, in particular looking to consider **ALTERNATIVE OPTIONS TO DEMOLITION** in order to extend building life, and to expand the use of **WHOLE LIFE CYCLE ASSESSMENT**. Where new buildings are required, **PREFABRICATED AND MODULAR DESIGN WITH TIMBER** should be pursued. The city should further look to support the industry in moving to Clean Construction processes through **DATA COLLECTION, TRAINING AND GUIDELINES**.



CHALLENGES

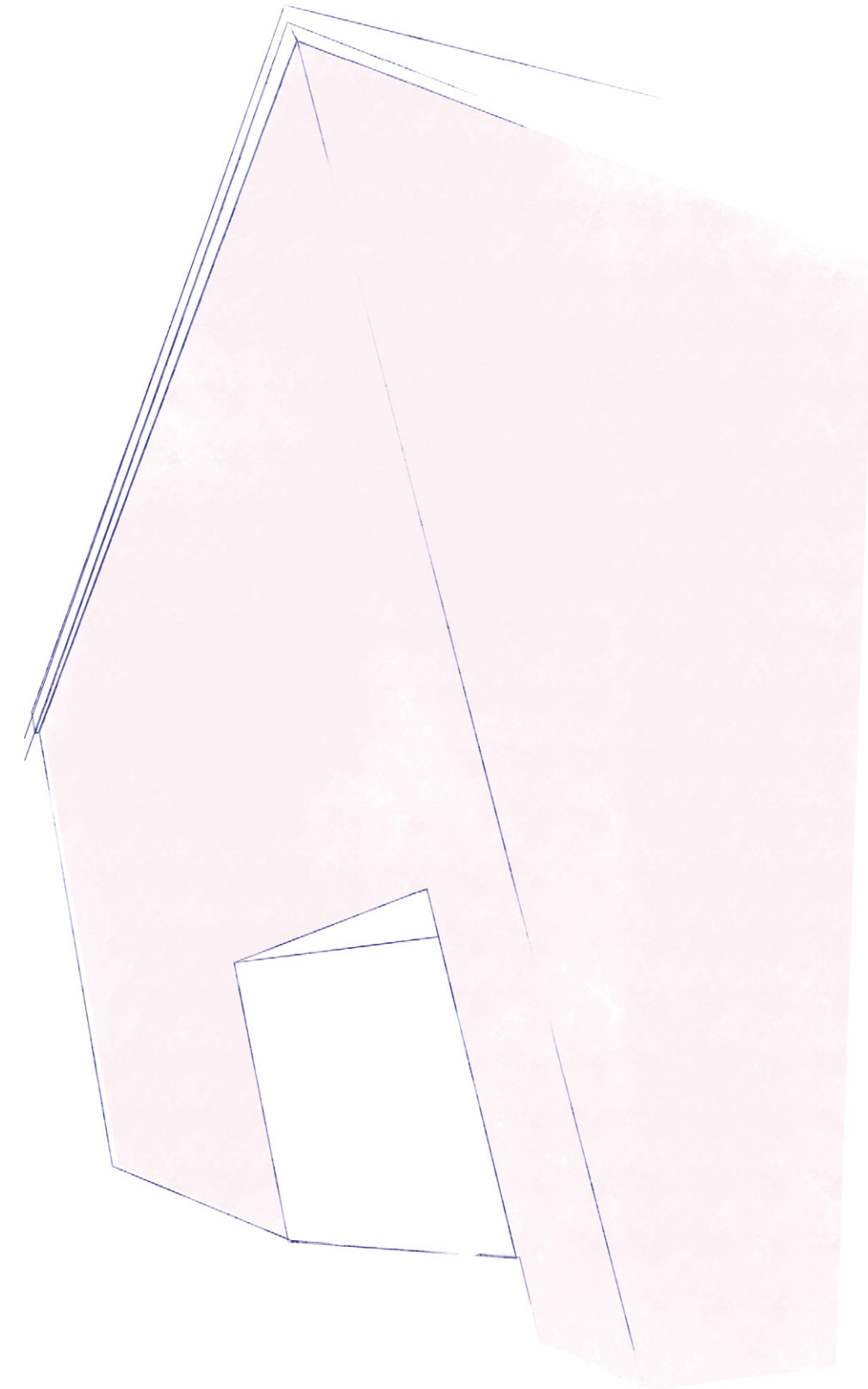
Key challenges to a transition to a cleaner sector include a lack of understanding of Clean Construction and green building design requirements in the industry, with labour shortages or lack of skills a key barrier for attempts to set up new ways of working. However, there is a strong local and industry interest in the area, with our interviewees' opinion that the city was well-placed to provide 'vision and leadership'.



BENEFITS

Toronto can expect to see social, economic and environmental benefits from a shift to Clean Construction.

- Increased levels of modular and prefabricated design with adaptive strategies to avoid demolition would support better quality and more affordable homes, generate cost savings as well as reduce air and noise pollution for workers and residents around construction sites
- Clean Construction interventions are associated with numerous local emerging areas of business and technology, which would have positive impacts on green jobs and skills and economic innovation. As such, they would play an important role if integrated in any green and just recovery plans.
- Renewed attention to renovation, innovation in material usage, reduced waste to landfill and high-quality low-carbon material certification requirements will help to reduce the impact of construction both locally and throughout its supply chain.



3.2 MAIN TAKEAWAYS FOR OTHER REGIONS AND CITIES

The policy areas and associated implementation mechanisms recommended for Toronto are based on a specific analysis of the structure of the industry, regional concerns voiced by interviewees and local implementation powers. However, many of these findings and recommendations are broadly transferable to other cities.

“Cities can follow Toronto in driving changes through the use of planning incentives, expedited applications, tax reductions, reduced planning control fees and embedding ambitious clean construction requirement in public projects to stimulate the market

MANY EXISTING CLEAN CONSTRUCTION ACTIONS

In particular, Toronto’s relative wealth, the availability of low-carbon materials, its skilled industry, and the high level of ambition on climate action, all make it well placed to adopt clean construction policies in all areas of the sector. This means pursuing ambitious targets, requiring designers to undertake basic tools and assessments such as LCA, site waste management and demolition audits; and testing and driving emerging industry technologies, innovations and processes, such as uptake of electric construction machinery and schemes to share and sort construction materials.

AVAILABILITY OF TIMBER

Other cities with a strong national timber industry will also benefit from a swift move to timber construction. These characteristics are likely to be common among cities in North America and Europe.

POWER SPLITS

Other cities internationally may also share Toronto’s split level of powers: Toronto has close control over its own activities, and of planning and permitting, but remains subject to national legislation for building codes and regulation, to which it has less input.

DEVELOPMENT CONTROL

These cities can follow Toronto in driving changes through the use of planning incentives, most effectively, according to City of Toronto officials, through development charge refunds tied to green standards.

DEVELOPMENT CONTROL

This is also driven, to an extent, through expedited applications, tax reductions and reduced planning control fees, and embedding ambitious Clean Construction requirements in public projects to stimulate the market. This should be supplemented with clear vision, training and guidance on the topic.

TORONTO LIST OF INTERVIEWEES

CITY OFFICIALS

Interviewee Name	Department
Fernando Carou Linda Swanston	■ Environment and Energy Division
Jane Welsh Shayna Stott	■ City Planning
Dylan Aster Natasha Zappulla	■ Toronto Building
Meaghan Davis	■ Solid Waste Management Services
Howlan Mullally	■ Corporate Real Estate Management

AGENCY

Interviewee Name	Agency
Emma Loewen Aaron Barter	■ WaterfrontTO
Hon Lu	■ CreateTO

STAKEHOLDERS

Interviewee Name	Company
Jennifer Burstein Maurice Wager	■ CollecDev
John Peterson	■ MJMA
Carol Philips	■ Moriyama&Teshima
Mark Garber	■ KingSett
Don Delaney	■ Flynn
Luka Matunovic	■ Purpose Building
Lisa Prime	■ PrimePlanning and Strategy
Anthony Pak	■ PRIOPTA
Ryan Zizzo	■ Mantle314

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Making the Case
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