HOUSING RESEARCH

Research Insight

JANUARY 2023

Impact Framework for Sustainable Communities and Buildings

The design of the built environment impacts the world around us. This includes economic, environmental, and social impacts that influence how sustainable our cities and communities will be in the future. Rapid urbanization has led to increases in energy and resource consumption, emissions, transportation, and stress on natural ecosystems. This also affects social factors like affordability, health, and social support services — especially for people who are vulnerable and at risk.

It's difficult to measure the full extent of costs, impacts and benefits resulting from our choices for community development patterns and building forms. This is especially true when building in different parts of cities that often contain multiple, varied communities. In Canada, there isn't an accessible mechanism in the form of a model or tool to fully measure and attribute life-cycle costs, impacts and benefits of urban and building development.

As a result, stakeholders in the public and private sectors may only consider short-term priorities when making decisions. These decisions may not consider a comprehensive view of short- and long-term impacts associated with the full life cycle of planning, design, construction, operation and renewal of both housing and the community in which it resides.

Community and neighbourhood development need to consider different built environments and their impacts on the future. It's important for stakeholders to be able to understand the costs, benefits, and impacts of these environments over time so they can make decisions based on evidence.

Canada

CMHC SCHL

About CMHC Data, Research and Analysis

CMHC exists to make housing affordable for everyone in Canada. To achieve our goal that everyone in Canada has a home that they can afford and then meets their needs, our data, research and analysis efforts will primarily focus on, but are not limited to:

- investments required for households in core housing need;
- market housing demand, supply gaps and affordability imbalances;
- racism and discrimination as a barrier to housing;
- the effects of climate change on housing;
- effectiveness of current housing policies and potential future policies; and
- working with Indigenous groups to understand their distinct housing needs.

As a trusted source of housing information, CMHC provides unbiased housing-related data, research and market information to help close knowledge gaps and deepen understanding of complex housing issues to inform future policy decisions.

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Project Overview

This research project was initiated by CMHC to develop a framework that can be used as a basis for understanding and to later create tools. These tools will help us understand the total life-cycle costs, impacts, and benefits associated with different community development and building forms found in urban centres.

The framework will help us see impacts grouped by environmental, economic, and social themes through the lenses of government, households, and private industry.

The goal of this research was to:

1. Explore whether public and industry stakeholders need a tool that can do this type of analysis.
2. Identify what must be defined and included in a framework, given the needs of end users and practicalities, such as the availability of data, information as well as feasibility of models and calculation methodologies.

Based on the outcome of this framework, the next step is to

3. Consider how to create and implement a tool.

Ultimately, if the framework leads to the development of a tool, then better decisions can be made by stakeholders to support sustainable, affordable, and livable housing and communities.

The framework was developed using a bottom-up approach. This means that we started with the basics and built up from there. We talked to organizations and people (stakeholders), looked at what data was available, outlined reliable and most useful calculation methodologies. This needs assessment was critical to define a minimum viable product for a tool that could be used by industry. We looked at existing studies, models, and tools to see what else was out there and how this framework could be different or better.

The project team worked with multiple stakeholders to help refine the framework methodologies. A key source of feedback on the project was the external user-advisory group. This group is made up of members from different parts of government, academia, and private industry.

The user-advisory group helped with the assessment of industry needs and identified use cases that have the potential to be analyzed by a future tool built from the framework. These use cases were critical as a feasibility check ensuring the contents described are relevant and transferable to a tool for decision making by potential users.

An internal CMHC working group consisting of members from multiple sectors was consulted, in addition to the external user-advisory group. They helped conduct a general feasibility assessment and identify supporting data, studies, tools, and other resources.

We looked at the feasibility of creating a tool that would help people understand the effects of different community and building development decisions. We concluded that it is possible to create such a tool and created a framework that could be used as a basis to build it.

Key Findings

The project created a framework to help identify, understand, and compare the environmental, economic, and social impacts of different patterns of urban development and building types within Canada. This framework is a vital step in understanding the need for and feasibility of developing a tool for analysis purposes. The content of the framework is meant to represent the minimum viable product of a future tool.

The following important insights were identified when developing the framework:

1. **The character of the built environment is a determinant of well-being:** Academic literature provides extensive evidence of the relationship between environmental, social, and economic outcomes, and the built environment.
2. **The design and development of the built environment can be suboptimal:** There are structural barriers to the development of a built environment that is optimized for environmental, social, and economic outcomes, notably the split incentive between the developer and the building occupants.
3. **Community and neighbourhood planning can be fragmented and biased in favour of short-term impacts:** Consideration of the environmental, social, and economic impacts of decisions on the character of the built environment is generally limited to evaluations of discrete themes given the lack of availability of comprehensive analysis tools. This means that it is difficult to assess the big picture and/or trade-offs. One example of this is a theoretical decision to develop housing in greenfields, which can be less expensive up front, however, when compared to an infill redevelopment, may come with a greater expense of infrastructure provision and maintenance, and further longer-term economic, climate and social impacts associated with transportation.
4. **Planners want to embed social and environmental considerations in policy:** Planners and other professionals have a qualitative understanding of these relationships, and some policies are being implemented to advance relevant objectives (Green Development Standards in Ontario for example).[1] There is a growing interest to better incorporate further environmental and social considerations. However, the quantitative, analytical aspects of these can be overwhelming and require further tools and approaches to assess.
5. **There are few, if any, accessible tools that evaluate the comprehensive, broader impacts of the built form:** Neither the public nor professionals have access to a comprehensive tool or model in the Canadian context that allows them to undertake an evidence-based, full life-cycle assessment of the built environment's integrated impacts on social, environmental, and economic aspects.

Further to the example in item 3, the engagement process highlighted the importance of evaluating infill development and greenfield development.

Infill projects are often highly contested in Canadian cities — but are critical to reducing greenhouse gas emissions and providing affordable housing. The framework was set up to consider both greenfield and infill settings, and future tools built from the framework will be able to analyze and compare both situations.

[1] Some municipalities in Ontario are implementing Green Development Standards, which use planning policies to require varying combinations of social and environmental considerations.

Framework overview

The conceptual framework proposed to evaluate community and building forms is explained in figure 1. There are 5 steps: use cases, geography, scenarios, systems dynamics model and multi-criteria analysis. They are all connected by how information and outputs flow between them. Within the conceptual framework, systems are defined around themes that cover social, environmental, and economic impacts.

1. This conceptual layout starts with a **use case**, which would define the geography and scenarios under consideration. Should the framework be later used to build a tool, the use cases will be defined by the user of the tool. Therefore, understanding user needs was critical in defining the framework. An example use case defined by a municipal user could include a municipality looking to expand its development boundaries, however, with the need to balance fiscal needs with climate goals and well-being of homeowners and private businesses.
2. The **geography** defined by the use case would then be used to identify locally relevant data, such as from online data sources or data libraries. Examples of geographically defined data include climate and weather data, population densities, existing neighbourhood layouts, and proximity measures.
3. **Scenarios** are defined using archetypes (representative examples) of both neighbourhood layouts and buildings, which illustrate different possible configurations of the built and natural environment. A library of representative archetypes has been defined from pre-existing model databases and relevant studies. Neighbourhood archetypes include different road and block layouts with varying population densities, while building archetypes include residential, commercial, institutional, and other building types of varying size and shape. Pre-existing archetypes were chosen as these will allow for a reduced modelling burden and ease of incorporation into a tool as part of a later step.
4. A **systems dynamics model** would then be used to evaluate the various quantitative social, environmental, and economic themes described in the framework and connected by relationships. Quantitative outputs or evaluation indicators would be calculated in the systems dynamics model once built into a tool. However, at the conceptual framework stage, these have only been described and categorized by data source(s), formulas, or model to be used, and relationship.
5. The framework quantitative evaluation indicators (grouped by social, environmental, and economic themes) would then be combined with qualitative social inputs from the user-defined scenario in a **multi-criteria analysis (MCA)**. The framework describes an MCA process for these outputs, which can be a powerful tool to compare multiple outputs at once, particularly given the many evaluation indicators present in complex urban settings. The result would be defined by the MCA and is an optimized scenario based on the performance against the themes and needs of users. An MCA also allows for adjustment of the relative weighting of items depending on the desired priority, for example weighting of specific climate and social items higher in the MCA where a user wants to meet climate and social inclusion goals quicker.

Figure 1: Illustration of the conceptual impact framework

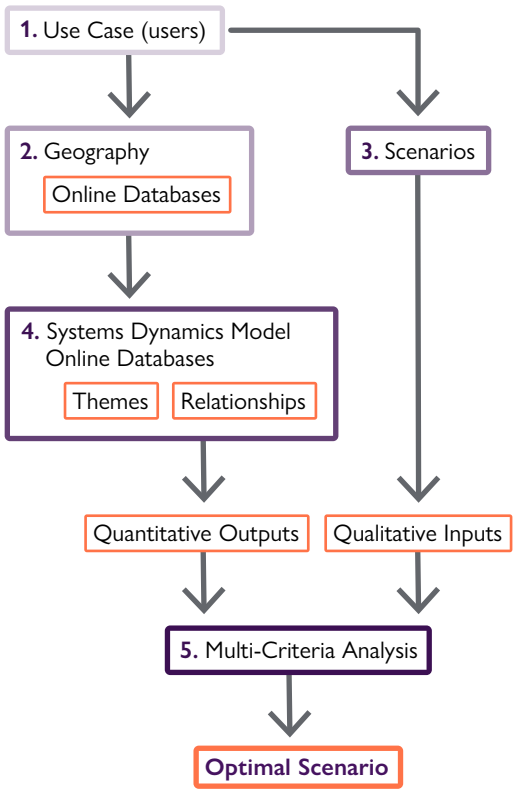


Illustration of selected framework component — systems dynamics model

The conceptual framework describes, by **relationships**, how information flows from inputs to outputs within the economic, social, and environmental themes, and between themes. Figure 2 summarizes how the framework has defined these relationships, including inputs, evaluation indicators, and how the outputs are grouped according to the Municipal (government), Business (private industry) and Household lenses from which results can be assessed. The white box labelled as "calculations" in the figure represents the various proposed calculations, equations, models, and data required that are outlined in the framework. A more comprehensive description of the system relationships and calculations required to go from inputs to outputs is described within the full research report linked in the "For Further Reading" section at the end of this insight.

Figure 2: Summary of proposed inputs and outputs of the conceptual framework

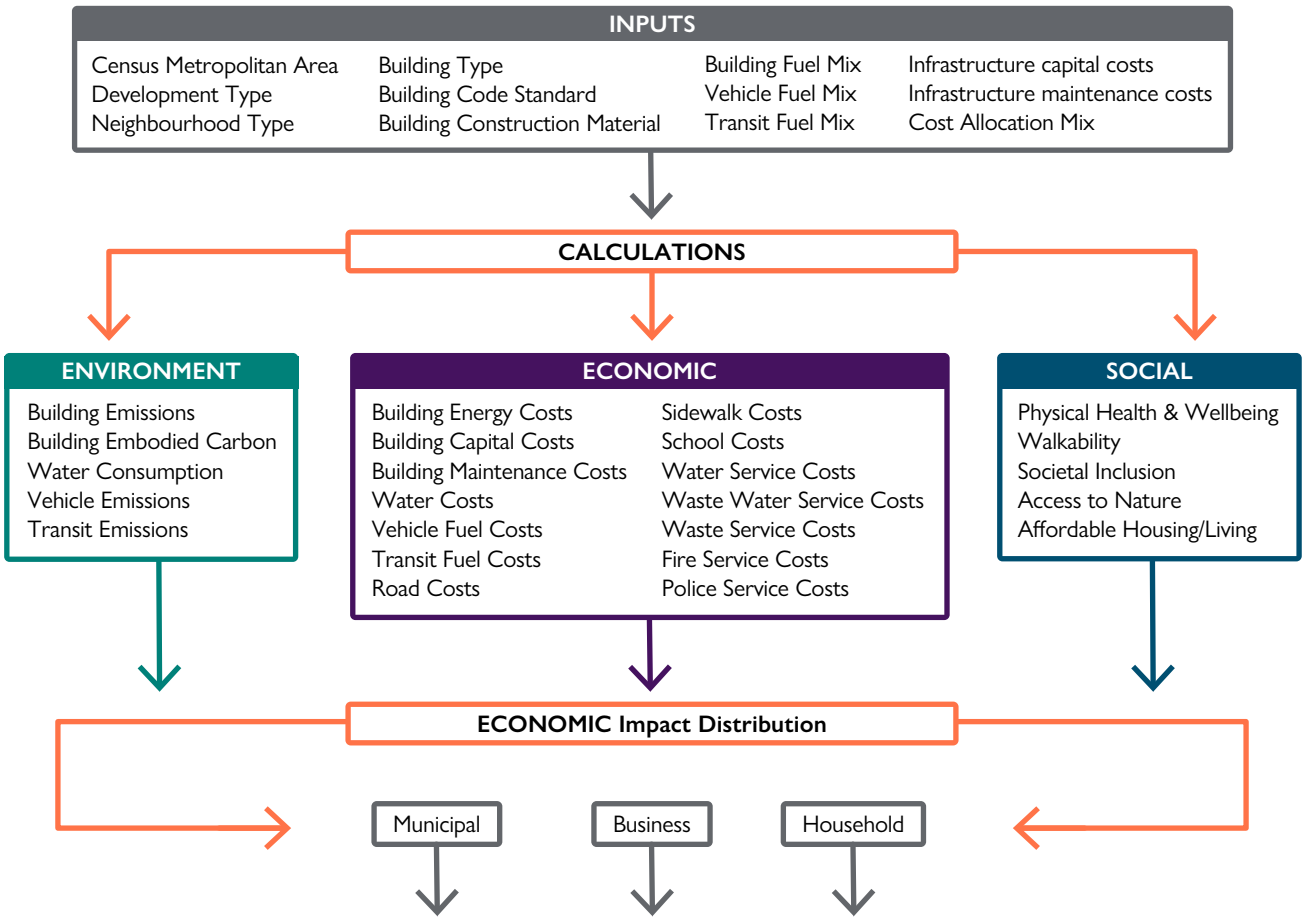
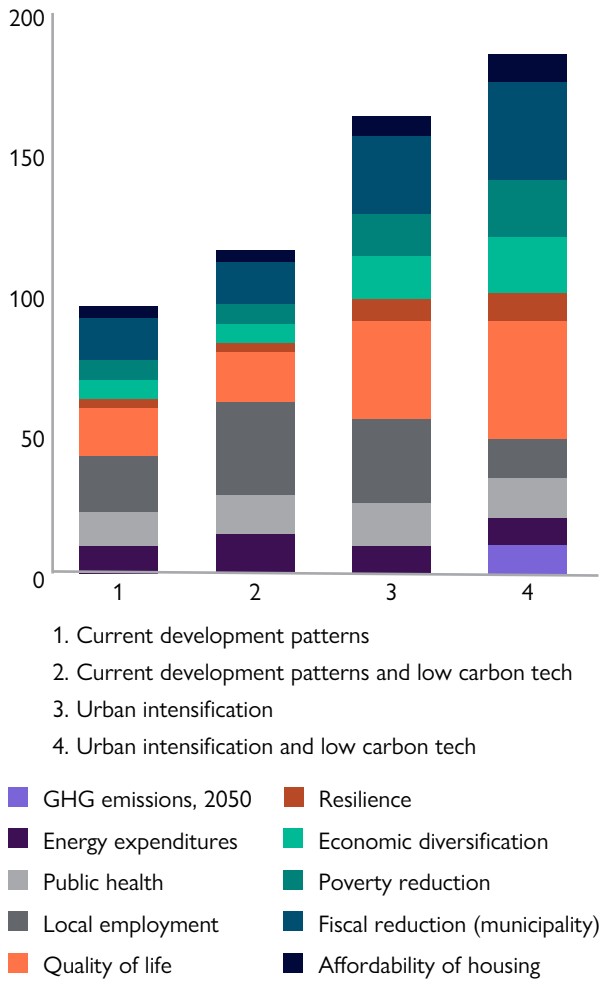


Illustration of selected framework component — list of outputs

The conceptual framework has also been developed to allow for the possibility of incorporating impacts that are not directly quantified in the systems dynamics model. The framework lays out the possibility of qualitative assessments being inputted alongside quantitative indicators in a multi-criteria analysis (MCA). The purpose of the MCA is to indicate which scenario performs best against all indicators when weighted for relative importance. For further analysis flexibility, the relative weights of the MCA indicators can be adjusted by the user to allow for sensitivity and to best fit the scenario under review. A sample of a potential MCA scoring output that can be applied to multiple scenario runs of the framework is presented in figure 3 below.

Figure 3: Prioritization Outputs



Implications for the Housing System

The framework described in this research can help us understand what is needed to assess community and building forms. This includes information about users, data, models, and calculations. The framework can be used by different groups who are trying to make decisions about housing, especially when we need more housing units. These groups include government agencies, planners, designers, developers, and citizens.

The impact framework is most useful when considering what can be built from it. For example, a tool that accomplishes the analytical plans laid out by the framework.

Decisions around the built environment and particularly housing, are difficult because they involve long-term investments. A reliable method to assess social, environmental, and economic impacts would make these debates more transparent and help decision making to provide better societal outcomes.

The framework describes a life-cycle approach to assess these impacts and has been determined through user and stakeholder consultations to be useable by the industry once implemented in the form of a tool. The next step of this research is to build out and refine tools to support decision making, of which the framework provides a solid foundation. This next step requires continued validation of the framework concept through real-life scenarios or use-cases, sourcing data, and buy in from various stakeholders who will develop and use such a tool.

For Further Reading

Project Managers

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Canada Mortgage and Housing Corporation

Research Consultant

Sustainability Solutions Group

Full Report

Impact Framework for Sustainable Communities and Buildings, 2022

https://assets.cmhc-schl.gc.ca/sf/project/archive/research_6/20221121-003_rr_assembly_impact_framework_for_sustainable_communities_and_buildings.pdf

CMHC helps Canadians meet their housing needs

Canada Mortgage and Housing Corporation (CMHC) has been helping Canadians meet their housing needs for more than 70 years. As Canada's authority on housing, we contribute to the stability of the housing market and financial system, provide support for Canadians in housing need, and offer unbiased housing research and advice to Canadian governments, consumers and the housing industry. Prudent risk management, strong corporate governance and transparency are cornerstones of our operations.

For more information, visit our website **cmhc.ca** or follow us on Twitter, LinkedIn, Facebook, Instagram and YouTube.

You can also reach us by phone at 1-800-668-2642 or by fax at **1-800-245-9274**.

Outside Canada call **613-748-2003** or fax to **613-748-2016**.

Canada Mortgage and Housing Corporation supports the Government of Canada policy on access to information for people with disabilities. If you wish to obtain this publication in alternative formats, call **1-800-668-2642**.

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Alternative text and data for figures

Figure 3: Sample of MCA scoring output

	1. Current development patterns	2. Current developpment patterns and low carbon tech	3. Urban intensification	4. Urban intensification and low carbon tech
GHG emissions, 2050	0	0	0	10
Energy expenditures	10	14	10	10
Public health	12	14	15	14
Local employment	20	33	30	14
Quality of life	17	18	35	42
Resilience	3	3	8	10
Economic diversification	7	7	15	20
Poverty reduction	7	7	15	20
Fiscal reduction (municipality)	15	15	28	35
Affordability of housing	4	4	7	10
Total	95	115	163	185