



Community Emissions Reduction Planning: A Guide for Municipalities



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Guide for Readers

This Guide has been prepared to support provincial land-use planning direction related to the completion of energy and emissions plans. The plans will typically include community-wide and municipal/corporate greenhouse gas (GHG) inventories, emissions reduction targets, and strategies to reduce GHG emissions.

The Government of Ontario has established provincial GHG reduction targets of 15% below 1990 levels by 2020, 37% below 1990 levels by 2030, and 80% below 1990 levels by 2050. This Guide describes how the activities of municipalities are vital to achieving these targets and for planning low-carbon communities.

The Guide has two core objectives: to educate planners, other municipal staff, citizens, and stakeholders on the municipal opportunities to reduce energy and GHG emissions (in particular for land-use policy); and to provide guidance on methods and techniques to incorporate consideration of energy and GHG emissions into municipal activities of all types. To support the second objective, a detailed planning process is described.

The Guide is divided into three modules.

Part A:

Rationale and Context for Community
Energy and Emissions Planning

Part B:

The Energy and Emissions Planning
Process

Part C:

Tools and Resources

Throughout the Guide there are:

- » Example practices from municipalities;
- » Summary tables;
- » Illustrations from studies and academic literature; and
- » Tools or methods that can be used to support analysis.



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Acronyms

ACRONYM	DEFINITION
AEF	Average Emissions Factor
BAU	Business as usual
CCAP	Climate Change Action Plan (Ontario)
CDM	Conservation and Demand Management Plan
CEEP	Community energy and emissions plan
CEEM	Community energy and emissions model
CEIP	Community energy investment plan
CNCA	Carbon Neutral Cities Alliance
CO ₂ e	Carbon dioxide equivalents
CURB	Climate action for urban sustainability (GHG model)
DPA	Development permit area
EUI	Energy use intensity
FCM	Federation of Canadian Municipalities
GHG	Greenhouse gas emissions
GMF	Green Municipal Fund
GPC	Global Protocol for Community-Scale GHG Emissions Inventories
HDD	Heating degree days
ICLEI	ICLEI – Local Governments for Sustainability
IESO	Independent Electricity System Operator
IPCC	Intergovernmental Panel on Climate Change
LAP	Local Action Plan
IRR	Internal rate of return
LGOP	Local Government Operations Protocol
LIC	Local improvement charge
MEF	Marginal emissions factor
MOECC	Ministry of Environment and Climate Change
MAC	Marginal abatement cost
MCA	Multi-criteria analysis
MPAC	Municipal Property Assessment Corporation
NGO	Non governmental organization
NPV	Net present value
OCP	Official Community Plan
PACE	Property assessed clean energy
PCP	Partners for Climate Protection
PPMF	Programs, protocols, methods and frameworks
PPS	Provincial Policy Statement
ROI	Return on investment
SCC	Social cost of carbon

A Note on Terms

In this Guide, 'local government' refers to entities providing government services in a specific geographic area. A municipality is defined as a geographic area whose inhabitants are incorporated. References to municipalities within this document include everything within that geographic area such as dwellings, businesses, transportation systems, etc. Community energy and emissions planning is considered to be equivalent to activities frequently described as municipal energy planning, climate action planning (mitigation and adaptation) and low carbon planning.

Executive Summary

THE CONTEXT

This Guide is intended to help municipalities in Ontario develop quantitative, targeted strategies for supporting their communities in making the transition to a low carbon future. The increasing role of municipalities in responding to climate change is a long term, global trend that began in Ontario nearly 30 years ago.

The Guide is intended to support Ontario municipalities for two key purposes:

1. To support actions under Ontario's Five Year Climate Change Action Plan 2016-2020 (CCAP). CCAP envisions a significant role for municipalities in the fight against climate change. The Municipal GHG Challenge Fund is ongoing and supports community GHG reduction projects. The CCAP also identifies provincial support for community energy and emissions planning through guidance and funding. Ontario's Municipal Energy Plan (MEP) program supports these CCAP commitments by providing funding for municipalities to develop community-wide GHG inventories, reduction targets and plans/strategies to meet their targets. A community energy and emission plan through the MEP program helps municipalities efforts to better understand their local energy needs, identify energy conservation and GHG emissions reduction opportunities, support economic development strategies, and develop plans to meet their goals.
2. New policy direction in the Growth Plan, 2017 for the Greater Golden Horseshoe, 2017 (Policy 4.2.10.2) added through the Coordinated Provincial Plans Review encourages municipalities, as a part of developing GHG reduction policies, through Official Plan conformity, to develop strategies to reduce greenhouse gas emissions within their communities, to complete greenhouse gas inventories for a range of sources, and to establish interim and long-term greenhouse gas reduction targets that support provincial targets and reflect the goal of low-carbon communities and to monitor progress towards the achievement of these targets.

Beyond providing guidance on how to comply with these new mandates, the Guide also helps municipalities of all sizes and contexts understand their influence on greenhouse gas emissions, and how to plan their communities so that the goal of reducing greenhouse gas emissions is aligned with other community social and economic goals and can be used to provide direction on other provincial policies related to climate change.

The Provincial Policy Statement, 2014 (PPS) contains policies related to climate change. For example, Section 1.8.1 states "Planning authorities shall support energy conservation and efficiency, improved air quality, reduced greenhouse gas emissions, and climate change adaptation through land-use and development patterns." Municipalities and other planning authorities are required to ensure that their planning decisions and planning documents (e.g., Official Plans and zoning

by-laws) are consistent with PPS policies including policies on climate change.

The recent amendment of the *Planning Act* through Bill 68 (*Modernizing Ontario's Municipal Legislation Act, 2017*) includes as a matter of provincial interest "the mitigation of greenhouse gas emissions and adaptation to a changing climate".

The '*Building Better Communities and Conserving Watersheds Act, 2017*', amended the *Planning Act* to support climate change action by municipalities and to require climate change mitigation and adaptation policies in municipal Official Plans. The Guide could be used to carry out a background study to identify actions that reduce greenhouse gas emissions and to inform climate change mitigation policies in municipal Official Plans.

THE PIVOTAL ROLE OF MUNICIPALITIES

Municipalities have a pervasive if mostly indirect impact on the level of greenhouse gas emissions in the community, although the GHG impacts of municipal land-use and infrastructure policies and practices are often not recognized.

Many municipal planning decisions made today will still be having environmental impacts well into the future. In the case of infrastructure investments and land-use plans, particularly those related to intensification in urban areas, density in greenfield areas and the creation of complete, low-carbon communities, the environmental consequences continue for centuries. This leads to "lock-in": a situation where past decisions limit the options and increase the costs for future decisions. In the context of community energy and emissions planning, this makes the longest term decisions among the most urgent.

THE OPPORTUNITY

In many cases, actions that reduce GHG emissions in communities correspond or directly overlap with actions that stimulate the economy, create a vibrant community, improve public health outcomes, reduce municipal operating and capital costs, and support innovation; these are no-regrets policies. Actions that reduce GHG emissions are synergistic with a wide range of other public goods, and in fact, these actions can be justified from the perspective of any of a number of public goods.

There are clear equity benefits also, from increasing accessibility through compact urban form and increased transit to lower household energy costs. However, equity benefits are contingent on the way in which the actions and policies are implemented.

ALIGNING MUNICIPAL GOALS AND OBJECTIVES

There is very often alignment between the priority goals and aspirations of community planning and the objective of lowering greenhouse gas emissions. In fact, a great deal of the moderation of greenhouse gas emissions growth that has already taken place has been a side effect of trends and measures that have been driven by goals other than GHG emission reduction. For example, energy efficiency developments can be key elements of strategies for local economic development, job creation and self-reliance. Public health policy advocates promote a variety of measures that also reduce greenhouse gas emissions, including active transportation infrastructure, green roofs, urban forestry, and reduced emissions from fossil fuel combustion.

THE ENERGY AND EMISSIONS PLANNING PROCESS

Community energy and emissions planning begins by developing a quantitative understanding of the community's greenhouse gas emissions (the inventory) and systematically identifying the ways in which municipalities can, and often already do, influence the level of community emissions.

The Guide includes six stages in the development of a community energy and emissions plan (CEEP) and each stage builds on the preceding one. Tasks are described for each of the stages, with detailed methodological guidance and references to complementary existing tools and resources. Tasks give rise to outcomes and the combination of all the outcomes constitutes the community energy and emissions plan. Municipalities may also elect to apply methods other than those described in this guide in order to achieve the outcomes described in Table 2.

This Guide recognizes the varying complexities of municipal efforts in undertaking community energy and emissions planning. The Guide has been developed to allow for flexibility for municipalities across the province to participate in programs and undertake actions based on local circumstances. To this end, the Guide describes three streams for each stage: basic, intermediate and advanced. Municipalities can choose the stream, or combination of streams, that best suits their context. The outcomes for each stage are similar; however, the process to arrive at those outcomes varies. For simplicity, this Guide assumes a general correlation between the population of the municipality and the sophistication of the approach, but small municipalities may also elect to choose the intermediate or advanced stream depending on resources and ambition.

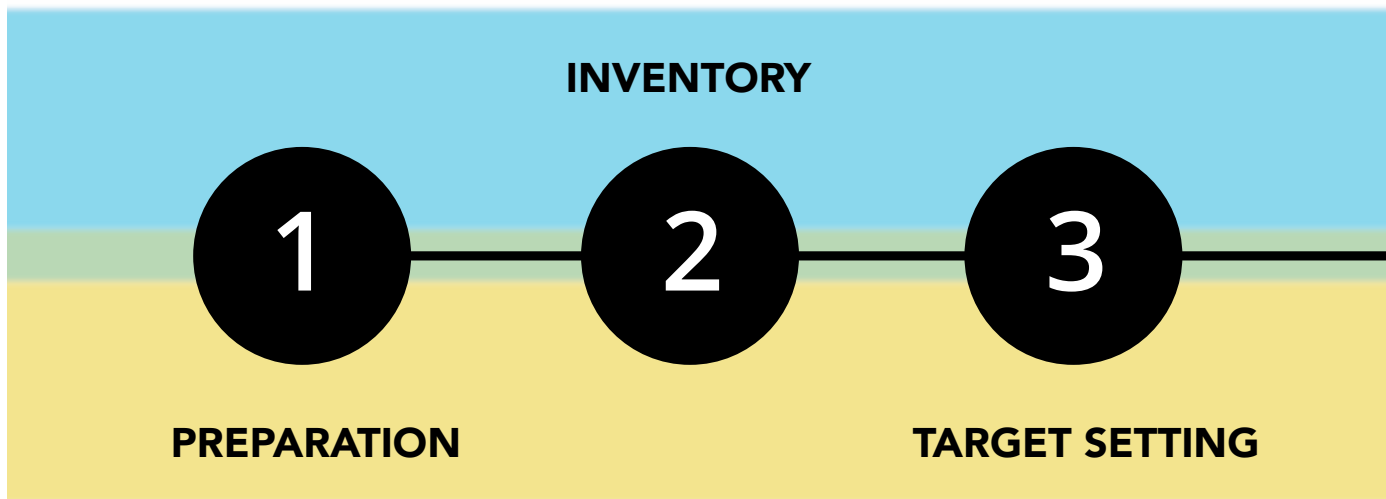
6 Stages to a Low-Carbon Municipality

Community Engagement Process

Set up a steering committee.

Identify & establish the partnerships needed to produce the emissions inventory.

Engage influencers & stakeholders in setting the target. Or, explain the rationale of the current target.



Develop a terms of reference, identify the governance structure and complete a situational analysis that describes the planning context.

Undertake a GHG inventory (corporate and community). Analyse municipal expenditures and spheres of influence.

Establish short, medium and long-term GHG targets.

Technical Process

LEVEL OF COMPLEXITY
FOR IMPLEMENTATION

BASIC

INTERMEDIATE

ADVANCED

Work with influencers & stakeholders to identify alignments/conflicts between planning goals & aspirations.

Implement identified policies, partnerships, bylaws & other opportunities identified in the plan. Deploy the support of influencers & stakeholders.

Work with partners to share data, assess progress, and continuously improve the plan.

SCENARIOS & ACTIONS

4

5

6

MONITORING & EVALUATION

IMPLEMENTATION

Complete a business as usual scenario and identify low carbon actions. Develop low carbon scenarios that include the actions. Undertake analysis of the co-benefits associated with the scenarios.

Identify policies and mechanisms to implement the preferred low carbon scenario, a short term action plan. Integrate the community energy and emissions plan with the Official Plan and other policies, plans and strategies. Develop an investment strategy.

Develop and implement a monitoring and evaluation plan.

BASIC

INTERMEDIATE

ADVANCED

Engagement

The engagement process should involve a steering committee with diverse stakeholders from within the local government and more broadly in the community. The structure of this committee will vary according to the context of the municipality. Various municipal staff, decision-makers, stakeholders and the public will also be involved throughout the planning process. There are numerous ways to structure engagement in planning process inputs, plan content development, document reviews, and other aspects of the planning process.

Table 1. Suggested roles in the development of a CEEP.

	Public	Steering committee	Municipal staff	Council
Terms of reference (Stage 1)		Participate	Lead	
Plan development (Stages 2–6)	Participate	Participate	Participate	Participate
Draft CEEP	Review	Review/Recommend	Review	Review
Final CEEP				Approve

Municipal Operations

The Guide describes the method for completing a GHG inventory and strategies to reduce GHG emissions from local government operations. GHG emissions from local government operations are typically a small portion of the total GHG emissions from a community. Understanding and managing these GHG emissions is important firstly in terms of reducing costs, secondly to demonstrate leadership and thirdly to learn about the implementation of strategies first hand. The Growth Plan, 2017 indicates the need for municipalities to complete an inventory and plan.

In developing the corporate GHG inventory, the municipality should follow the accounting protocols of the Federation of Canadian Municipalities and ICLEI-Local Government for Sustainability's Partners for Climate Protection program or the Local Government Operations Protocol. While the corporate and community GHG inventories are undertaken separately, the CEEP as a whole applies an integrated lens to corporate and community GHG emissions.

THE ENERGY AND EMISSIONS PLANNING OUTCOMES

Each of the six stages of the CEEP have specific outcomes. In combination, these outcomes form the municipality’s community energy and emissions plan, which incorporates the GHG inventory and GHG emissions reduction targets. The CEEP supports the actions under the CCAP, including requirements of the Municipal GHG Challenge Fund and the climate change policies of the Growth Plan, 2017 for the Greater Golden Horseshoe, as well as supporting municipalities in the implementation of other provincial direction related to climate change action and identifying a low carbon pathway that delivers multiple community benefits.


Table 2. The stages and outcomes of the CEEP.

Stage	Required outcomes	Relative level of effort	Page reference
Preparation.	Terms of reference Situational analysis that describes the current planning context.	10%	63
Inventories.	GHG inventory (corporate and community). Spheres of influence analysis. Financial inventory.	15%	70
Target setting.	GHG targets.	5%	95
Actions and alternative scenarios development.	Actions catalogues. Scenarios. Analysis of co-benefits.	30%	103
Implementation.	Policies and mechanisms analysis. Integration with the Official Plan and other policies, plans and strategies Investment strategy.	35%	135
Monitoring and evaluation.	Monitoring and evaluation plan.	5%	154

Community Energy and Emissions Plan

CONCLUSION

The Government of Ontario has established provincial GHG reduction targets of 15% below 1990 levels by 2020, 37% below 1990 levels by 2030, and 80% below 1990 levels by 2050. These targets require a transformation in the energy system and built environment, a transformation which can result in multiple other societal benefits, for example on health and economic development. At the municipal scale, the Official Plan and other existing municipal planning tools implicitly influence GHG emissions by determining land-use patterns, transportation and transit options, and other characteristics of the built environment and can be used to create complete, low-carbon communities. The community energy and emissions planning process quantifies these relationships and identifies strategies to reduce GHG emissions while considering additional benefits for employment, economic development, improved health outcomes and others. This Guide is a step-by-step approach to developing a GHG inventory, identifying GHG targets and developing a community energy and emissions plan.



**PART A:
RATIONALE &
CONTEXT FOR
COMMUNITY ENERGY &
EMISSIONS PLANNING**

Introduction

This Guide is intended to help municipalities in Ontario develop quantitative, targeted strategies for supporting their communities in making the transition to a low carbon future. The increasing role of municipalities in responding to climate change is a long-term, global trend that began in Ontario nearly 30 years ago. The impetus for producing this Guide for Ontario municipalities at this time is two-fold:

- » To support actions under Ontario's Five Year Climate Change Action Plan 2016-2020 (CCAP). CCAP envisions a significant role for municipalities in the fight against climate change. The Municipal GHG Challenge Fund is ongoing and supports community GHG reduction projects. The CCAP also identifies provincial support for community energy and emissions planning through guidance and funding. Ontario's Municipal Energy Plan (MEP) program supports these CCAP commitments by providing funding for municipalities to develop community-wide GHG inventories, reduction targets and plans/strategies to meet their targets. A community energy and emission plan through the MEP program helps municipalities efforts to better understand their local energy needs, identify energy conservation and GHG emissions reduction opportunities, support economic development strategies, and develop plans to meet their goals.
- » New policy direction in the Growth Plan, 2017 for the Greater Golden Horseshoe (Policy 4.2.10.2) added through the Coordinated Provincial Plans Review encourages municipalities, as part of developing GHG reduction policies, through Official Plan conformity, to develop strategies to reduce greenhouse gas emissions within their communities, to complete greenhouse gas inventories for a range of sources, and to establish interim and long-term greenhouse gas reduction targets that support provincial targets and reflect the goal of low-carbon communities and to monitor progress towards the achievement of these targets.

Beyond providing guidance on how to comply with these new mandates, this Guide is intended to help municipalities of all sizes and contexts understand their influence on greenhouse gas emissions, and how to plan their communities so that the goal of reducing greenhouse gas emissions is aligned with other community social and economic goals.

While the Guide focuses on the relationship between land-use planning and community energy use and emissions, it is intended for all municipal staff. The most successful local community energy and emissions planning draws on the full range of municipal government experience and expertise: engineers, financial managers, community engagement specialists, economic development strategists, public health workers, community housing managers, elected officials, and the list goes on. Indeed, anyone interested in how their community can make the transition to a low-carbon, sustainable future will find useful material in this Guide.

ENERGY AND EMISSIONS PLANNING IMPETUS

The infrastructure planning and financing decisions made today will determine the world's climate and development outcomes for the next century. Taken together, these decisions will lead to the building of either low-emission, climate-resilient infrastructure that increases economic opportunity or more of what we have already, effectively locking the world into a carbon-intensive pathway with sprawling human

2. Provincial policy

Purpose of this chapter: | To describe policy drivers for municipal action on climate change

Addressing Provincial Policy and Legislative Requirements

Ontario has developed a comprehensive and coordinated response to climate change, addressing both mitigation and adaptation across a range of legislation, policy, strategy, and guidance. This overarching framework informs a number of key areas for municipalities, who are leading actors in addressing climate change, whether through land use planning, economic development, asset management, agriculture, or building standards.

The *Community Emissions Reductions Planning: A Guide for Municipalities*, provides advice for municipalities on a specific aspect of climate change mitigation, but is situated within a broader framework of the provincial response to climate change. As Ontario's municipalities vary greatly in size, context, and capacity, their responses to climate change will vary accordingly. Municipalities have been provided with the flexibility to achieve conformity or consistency with provincial standards according to their unique circumstances, while developing strategic actions that recognize local priorities, resources, and unique climate change-related challenges.

This section provides a brief overview of the broader framework of the provincial response to climate change. While municipalities are responsible for their decisions, including meeting legal requirements, this context may be helpful in understanding the provincial requirements, what resources are available to meet those requirements, and how this Guide can support municipalities in meeting or exceeding those standards.

The Climate Change Mitigation and Low-carbon Economy Act (2016)

The *Climate Change Mitigation and Low-carbon Economy Act, 2016* establishes a long-term framework for climate action by setting out the framework for Ontario's cap and trade program, and sets requirements for accountability and transparency. Specifically, the Act:

- » Enshrines in legislation Ontario's GHG emissions reduction targets in a statute for 2020, 2030 and 2050.
- » Embeds government action and accountability in a statute to ensure participants and the public are fully informed through the development of a climate change action plan.

- » Prescribes content that must be included in each action plan including:
 - » Timetable for implementing each action;
 - » Estimated reduction in greenhouse gases resulting from each action;
 - » Assessment of the cost per tonne of the potential reduction in greenhouse gases; and
 - » The estimated amount of funding from cap and trade proceeds, if any.

Ontario's Climate Change Strategy

Ontario's Climate Change Strategy affirms Ontario's commitment to carbon-pricing while setting out a provincial vision for meeting long-term greenhouse gas emissions reduction target: a reduction of 80% of greenhouse gas emissions below 1990 levels by 2050. To help mark progress and keep on track, the Strategy aims to achieve two mid-term targets: 15% below 1990 levels by 2020 and 37% below 1990 levels by 2030.

The Strategy, supported by a series of five-year action plans, highlights various areas of transformation to help reach Ontario's long-term goals:

- » A Prosperous Low-Carbon Economy with World-Leading Innovation, Science and Technology;
- » Government Collaboration and Leadership;
- » A Resource-Efficient, High-Productivity Society;
- » Reducing Greenhouse Gas Emissions Across Key Sectors;
- » Adapting and Thriving in a Changing Climate; and
- » Raising Public Awareness.

Ontario's Five-Year Climate Change Action Plan (2016-2020)

The Climate Change Action Plan (CCAP) is a five-year plan that builds on Ontario's Climate Change Strategy, laying a foundation to build the policies and programs that must be put in place to achieve short- and long-term targets, and make the shift towards a low-carbon economy. The CCAP identifies over 90 actions, organized into themes in the following action areas:

- » Transportation;
- » Buildings and homes;
- » Land use planning;
- » Industry and business;
- » Collaboration with Indigenous communities;

- » Research and development;
- » Government; and
- » Agriculture, forests and land.

Table 3. Energy and emissions planning initiatives designed to support municipalities.

Strengthen climate change policies in the municipal land-use planning process	Support municipal and other stakeholder climate action	Reduce congestion and improve economic productivity
<ul style="list-style-type: none"> » Require electric vehicle charging in surface lots. » Set green development standards. » Make climate change planning a priority. » Put climate change in Official Plans. » Eliminate minimum parking requirements. 	<ul style="list-style-type: none"> » Establish a Challenge Fund. » Support community energy planning. » Support community energy mapping and platforms. 	<ul style="list-style-type: none"> » Help manage congestion. » Reduce single-passenger vehicle trips through Transportation Demand Management Plans.

Table 4. Additional initiatives that will support energy and emissions planning.

Transportation	Buildings and homes	Other
<ul style="list-style-type: none"> » Develop a renewable fuel standard for gasoline. » Pilot waste and agricultural methane as a fuel source. » Maintain incentives for electric vehicles. » Provincial and federal governments to explore eliminating HST on zero emission vehicles. » Free overnight electric vehicle charging. » More charging stations. » Electric-vehicle-ready homes and workplaces. » Electric and Hydrogen Advancement Program. » Improve commuter cycling network. » Improve competitiveness of short-line railways. » Accelerate Regional Express Rail Deployment. » Create a well-connected multi-modal transportation system. 	<ul style="list-style-type: none"> » Retrofit social housing apartments. » Protect tenants from the price of carbon. » Provide incentives for apartment building retrofits. » Boost low-carbon technology in homes. » Near Net Zero Carbon Home Incentive. » Update the Building Code. » Introduce a renewable content requirement for natural gas. » Build new schools and large institutional buildings and campuses that are energy efficient. 	<ul style="list-style-type: none"> » Develop a provincial land-use carbon inventory to assess emissions and removals of GHGs by forests, agriculture and other lands.

Municipal Energy Plan Program

The Ministry of Energy supports municipalities’ efforts to better understand their local energy needs, identify energy conservation and greenhouse gas (GHG) emissions reduction opportunities, support economic development strategies, and develop plans to meet their goals through the Municipal Energy Plan (MEP) program. The program is available to all municipalities across Ontario.

[Click here for more information on the MEP program.](#)

Community Energy Planning is supported in Ontario’s 2017 Long-Term Energy Plan:

“Ontario’s Municipal Energy Plan program and the IESO’s Aboriginal Community Energy Plan (ACEP) program both support the efforts of municipalities and Indigenous communities to assess their energy use and needs, consider the impact of future growth, and foster local economic development. Communities

are encouraged to develop their own energy plans that identify opportunities for conservation and priorities for infrastructure. The resulting community energy plans have helped communities recognize opportunities to conserve energy, improve energy efficiency and reduce greenhouse gas (GHG) emissions.”¹

Municipal Act, 2001 and City of Toronto Act, 2006

Under the *Municipal Act, 2001* and the *City of Toronto Act, 2006*, municipalities have broad powers to pass by-laws concerning the economic, social, and environmental well-being of the municipality and the health, safety, and well-being of individuals (subject to certain limits).

The *Modernizing Ontario’s Municipal Legislation Act, 2017* clarified that municipal broad powers include addressing climate change. In addition, municipalities may consider passing by-laws with respect to other environmental matters that may be related to climate change, including trees, site alteration, and long-term energy planning.

The City of Toronto has the authority to require and govern the construction of green roofs or alternative roof surfaces in certain circumstances. As part of the *Modernizing Ontario’s Municipal Legislation Act, 2017*, all municipalities were provided with authority to require certain environmental standards regarding the construction of buildings, subject to certain limits. These new powers cannot be exercised until a Building Code standard is in place and is specified in the Building Code as one that municipalities can require. For example, municipalities other than the City of Toronto will not be able to require green roofs until the Building Code establishes specific technical requirements for such, and until those standards have been identified in the Building Code as ones that municipalities can require.

As of March 1, 2019, municipalities will be required to adopt a policy regarding the protection and enhancement of tree canopy and natural vegetation. This mandatory policy is an opportunity for municipalities to consider, for example, how climate change impacts trees (e.g. increased number and extent of wildfires, new diseases). Municipalities may also wish to consider how protecting trees can also help support other initiatives, such as climate change adaptation (e.g. stormwater management, cooling). Municipalities have flexibility to develop a policy that addresses their unique local needs (e.g. geography, population, etc.).

Infrastructure for Jobs and Prosperity Act, 2015

Ontario Regulation 588/17 under the *Infrastructure for Jobs and Prosperity Act, 2015* requires every municipality to prepare an asset management plan, which should include actions to mitigate risks to assets from climate change and related adaptation measures in addition to “mitigation approaches to climate change, such as greenhouse gas emission reduction goals and targets.”

¹ Delivering Fairness and Choice, Ontario’s 2017 Long-Term Energy Plan, p. 141.

Ontario Regulation 397/11 under the Green Energy Act, 2009

Starting in 2013, Broader Public Sector (BPS) organizations are required under Ontario Regulation 397/11, to report their energy and GHG emission annually. Starting in 2014, BPS organizations were also required to develop 5-year energy conservation and demand management (CDM) plans and post their CDM plans their website and make them available in hard copy.

The regulation was developed to help BPS organizations better understand where and how they use energy so that they could develop plans to reduce consumption. Ontario's Climate Change Action Plan (CCAP) recognizes the role BPS organizations can play in helping the province meet its GHG emission reduction targets.

Stage 5: Implementation, outlines ways in which municipalities can integrate their community emissions reduction plans with other areas in municipal planning and operations.

Chapter 8 provides additional tools and resources for implementation planning.

LAND-USE PLANNING

Land-use planning policy in Ontario influences the shape and configuration of buildings and the way in which people move around the landscape.

The Planning Act

The *Planning Act* sets out the ground rules for land use planning in Ontario and describes how land uses may be controlled, and who may control them.

Section 2 of the *Planning Act* sets out provincial interests in land use planning, which include "the mitigation of greenhouse gas emissions and adaptation to a changing climate" as a matter of provincial interest.

The *Planning Act* also requires that an official plan shall contain policies that identify goals, objectives and actions to mitigate greenhouse gas emissions and to provide for adaptation to a changing climate, including through increasing resiliency

An Official Plan shall contain policies that "identify goals, objectives and actions to mitigate greenhouse gas emissions and to provide for adaptation to a changing climate, including through increasing resiliency".

Municipalities and other planning authorities that undertake the emissions reduction planning process in this guide may use their resulting community GHG reduction strategy to help inform the development of climate change mitigation

policies in Official Plans.

An amendment through Bill 68 (*Modernizing Ontario's Municipal Legislation Act, 2017*) includes "the mitigation of greenhouse gas emissions and adaptation to a changing climate" as a matter of provincial interest. This means that all decisions under the *Planning Act*, including decisions on matters that end up before appeal, shall have regard to this provision. Bill 139, the *Building Better Communities and Conserving Watersheds Act, 2017*, will amend the *Planning Act* to support climate change action by municipalities by requiring climate change mitigation and adaptation policies in municipal Official Plans.

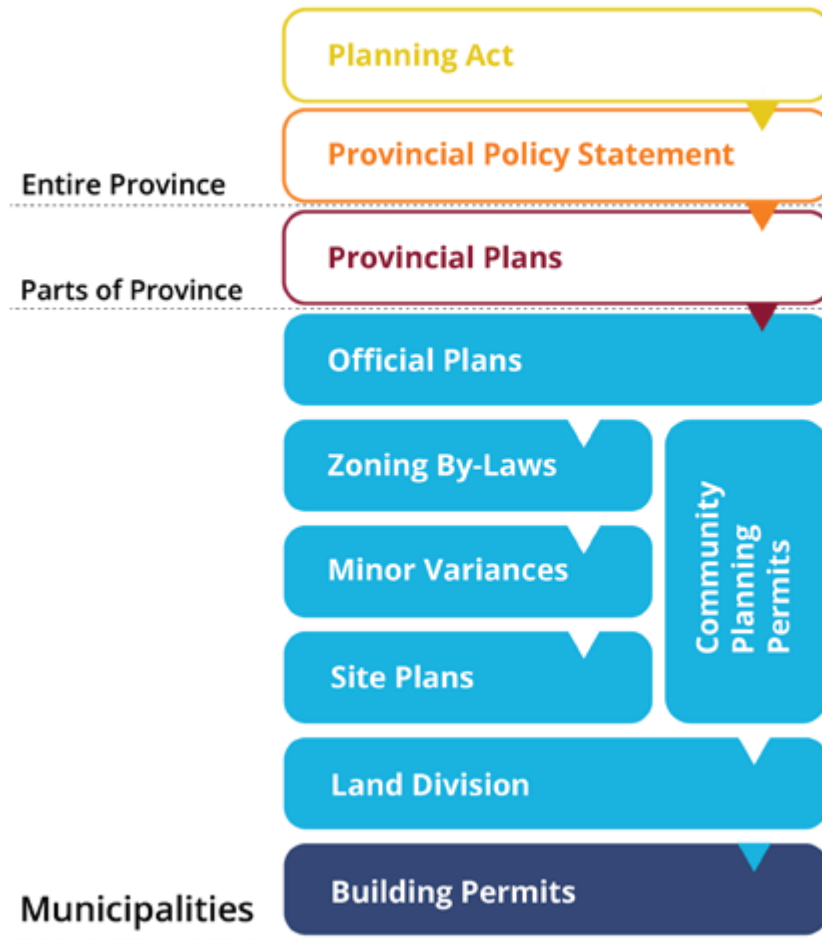


Figure 1. Land-use planning system in Ontario²

² Ministry of Municipal Affairs. (2016). *Review of the Ontario Municipal Board—Public consultation document*.

Provincial Policy Statement, 2014

The Provincial Policy Statement, 2014 (PPS) is issued under Section 3 of the *Planning Act*. It provides policy direction on matters of provincial interest related to land use planning and development and sets the provincial policy foundation for regulating the development and use of land. The PPS policies are intended to be read together and all relevant policies are to be applied to each situation. Addressing climate change is related to a broad range of matters, many of which are beyond the scope of land use planning, such as the regulation of emissions. Land use planning plays an important role in addressing climate change—the way communities are planned and designed influences their greenhouse gas emissions and resilience to climate change impacts.

The PPS provides policy direction in a number of areas to support addressing climate change, including policies:

- » promoting the efficient use of land, redevelopment, intensification, compact form and a structure of nodes and corridors;
- » promoting land use and development patterns that promote energy efficiency and conservation, reduce greenhouse gas emissions and support adaptation to climate change;
- » promoting density and mix of uses that reduce travel distances and support active transportation and transit, and integrating transportation and land use considerations at all stages of the planning process;
- » promoting design and orientation which maximizes energy efficiency and conservation, considers the mitigating effects of vegetation and maximizes opportunities for the use of renewable energy systems and alternative energy systems, and
- » encouraging green infrastructure and strengthening stormwater management requirements as important components of broader infrastructure planning.

The PPS also provides policy direction related to resources and natural hazards planning that help promote increased resilience to the impacts of climate change, including policies:

- » preserving and protecting agricultural lands and supporting local food which help with greenhouse gas sequestration and management;
- » requiring the identification of natural heritage systems in southern Ontario and recognizing the conservation of biodiversity as a planning consideration, and
- » requiring planning authorities to consider potential risks associated with natural hazards related to climate change.

Section 3 of the *Planning Act* requires that land use decisions, such as those related to municipal Official Plans, shall be consistent with the PPS policies.

Municipalities and other planning authorities that undertake the planning process in this Guide may use the end results to help inform the development of climate

change mitigation policies that support the implementation of PPS policies.

Key stages of the community emissions reduction planning process can be found in the following sections:

Tasks 1.1 – 1.3 under Stage 1: Preparation, can help municipalities prepare and scope their community emissions reduction planning process and strategy. Appendix 2 and Appendix 12 provide helpful references.

Tasks 2.1 – 2.5 under Stage 2: Inventories, outline a process for creating a community GHG inventory within a municipality.

Additional resources municipalities can use to create a community GHG inventory can be found in Chapter 8: Tools and Resources as well as Appendices 3, 4, 5 and 7.

Task 3.1 under Stage 3, outlines a process for adopting provincial GHG reduction targets within a municipality. Additional resources municipalities can use to set GHG reduction targets can also be found in Chapter 8: Tools and Resources.

Tasks 4.1 – 4.6 under Stage 4: Action and Scenario Development outline the process to identify potential actions that will help municipalities reach their GHG emissions reduction targets. Additional resources municipalities can use to prioritize and integrate actions can be found in Appendices 9,10 and 11.

Tasks 5.1 – 5.3 under Stage 5: Implementation outlines ways in which municipalities can plan for the implementation of their priority actions, and ways in which they can integrate these actions with other areas of municipal planning and operations. Chapter 8 provides additional tools and resources for implementation planning.

Growth Plan for the Greater Golden Horseshoe, 2017

The Growth Plan for the Greater Golden Horseshoe, 2017 (Growth Plan, 2017) forms an integral part of a unique land use planning framework for the GGH and supports the achievement of complete communities, a thriving economy, and a clean and healthy natural environment.

The Growth Plan, 2017 aligns with the objectives of the Ontario Climate Change Strategy and Action Plan and represents a key contribution toward the Province's goal of developing low-carbon communities. The way communities are planned and designed directly influences their GHG emissions and resilience to climate change impacts.

Key policies in the Growth Plan, 2017 contribute towards addressing climate change. These include increased intensification and density targets, particularly those for major transit station areas, increased protection of natural and agricultural areas that may sequester carbon to improve resiliency to climate change, and integrated infrastructure planning that considers risk and vulnerabilities from climate change.

Subsection 4.2.10 of the Growth Plan, 2017 seeks to recognize this broad range of progressive actions that municipalities are already implementing across the region, and seeks to encourage municipalities to continue to develop their own locally appropriate set of actions to deliver optimal results.

The subsection provides GGH municipalities with flexibility to develop climate change policies and actions that respond to their own local context. For

example some municipalities are incenting green buildings, some are focused implementing low impact development standards, others have created district energy systems, some have invested heavily in active transportation networks, and many municipalities have been working to green their corporate services, facilities and fleets.

The subsection provides two policies explicitly related to climate change:

- » Policy 4.2.10.1: requires upper and single-tier municipal Official Plans to identify actions that will reduce GHG emissions and advance adaptation goals aligned with Ontario's Climate Change Strategy and Climate Change Action Plan. This policy promotes attributing a climate change perspective to certain Growth Plan, 2017 policies allowing municipalities to develop linkages between specific elements of the plan and targets developed through related policy 4.2.10.2 including: planning for complete communities using intensification and density targets; minimizing automobile dependence and promoting active transportation; undertaking stormwater management in a manner that assesses the impacts of extreme weather events; watershed scale land use planning; and the protection of a natural heritage and agricultural system, among others.

- » Policy 4.2.10.2: encourages municipalities to implement strategies that reduce emissions and improve resilience; develop GHG inventories; and establish GHG reduction targets. The technical support provided in this Guide will assist municipalities in establishing a baseline inventory of community emissions that can inform realistic targets for reducing emissions through a range of approaches that either follow directly from requirements contained in the Growth Plan, 2017 and other provincial direction, or from locally designed climate change strategies. The development of local GHG inventories and targets can be instrumental in evaluating the success of policy implementation and provide critical information for performance measurement.

The Growth Plan, 2017 provides additional climate change related direction on:

- » Building complete communities that are well-designed and well-connected to transit through measures such as increased intensification and density targets, particularly around transit stations (to reduce GHG emissions). (Section 2)

- » Undertaking stormwater management and stormwater master planning with consideration of green infrastructure and low impact development to increase resilience to the impacts of climate change. (policy 3.2.7)

- » Assessing infrastructure risks and vulnerabilities, including those caused by the impacts of a changing climate on infrastructure, and to identify actions and investments to address those risks. (policy 3.2.1)

- » Completing watershed planning and water-related infrastructure master planning that considers the impacts of climate change. (policy 2.2.8, 3.2.1, and 3.2.6)

- » Expanding settlement area boundaries through stronger criteria with respect to the protection of natural heritage, water and the agricultural system thereby increasing resilience in the region. (policy 2.2.8)

- » Promoting a culture of conservation to support energy efficiency and improved air quality and reduced emissions. (policy 4.2.9)

Municipalities play a crucial role in addressing climate change. The province is working to support these important efforts and along with this Guide has recently released several other pieces of guidance. More specifically:

- » [A Natural Heritage System for the Growth Plan for the Greater Golden Horseshoe](#); and
- » An [Agricultural System for the Greater Golden Horseshoe](#).

The Growth Plan, 2017 requires municipalities to incorporate both systems into their Official Plans and maintain, restore, or enhance their diversity and connectivity. The systems collectively provide essential ecosystem services, which may include carbon sequestration, creating “carbon sinks” and improving resiliency to climate change.

Additionally, in an effort to further assist municipalities in ensuring efficient use of land and existing infrastructure, the province is developing a Methodology for Land Needs Assessment for the Greater Golden Horseshoe and technical guidance on the application of the intensification and density targets.

Key parts of the community emissions reduction planning process can directly support the implementation of 4.2.10.2 in the Growth Plan, 2017:

Tasks 1.1 – 1.3 under Stage 1: Preparation, can help municipalities prepare and scope their community emissions reduction planning process and strategy. Appendix 2 and Appendix 12 provide helpful references.

Tasks 2.1 – 2.5 under Stage 2: Inventories, outline a process for creating a community GHG inventory within a municipality.

Additional resources municipalities can use to create a community GHG inventory can be found in Chapter 8: Tools and Resources.

Appendices 3, 4, 5 and 7 provide further information to help develop community GHG inventories.

Task 3.1 under Stage 3, outlines a process for adopting provincial GHG reduction targets within a municipality.

Additional resources municipalities can use to set GHG reduction targets can also be found in Chapter 8: Tools and Resources.

Tasks 4.1 – 4.6 under Stage 4: Action and Scenario Development outline the process to identify potential actions that will help municipalities reach their GHG emissions reduction targets.

Additional resources municipalities can use to prioritize and integrate actions can be found in Appendices 9, 10 and 11.

Tasks 5.1 – 5.3 under Stage 5: Implementation outlines ways in which municipalities can plan for the implementation of their priority actions, and ways in which they can integrate these actions with other areas of municipal planning and operations. Chapter 8 provides additional tools and resources for implementation planning.

Tasks 6.1 – 6.2 under Stage 6: Monitoring and Evaluation, outlines potential ways in which municipalities can measure the implementation of their GHG reduction strategies. Chapter 8, provides additional tools and resources to assist municipalities with Monitoring and Evaluation.

The Growth Plan for the Greater Golden Horseshoe requires that upper- and single-tier municipalities develop policies in their official plans to identify actions that will reduce greenhouse gas emissions.

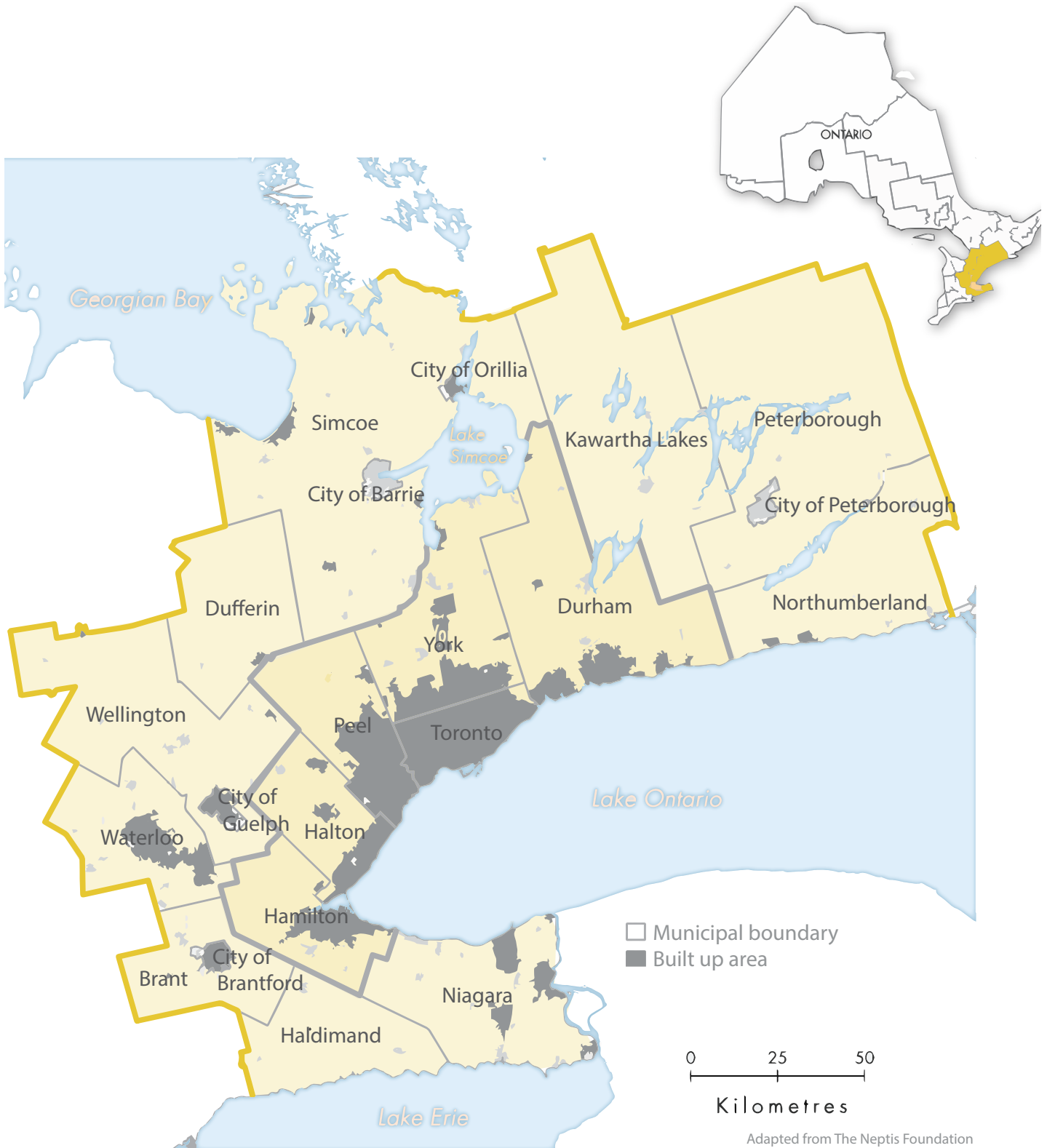


Figure 2. A map of Ontario's Golden Horseshoe region.

Greenbelt Plan, 2017; Oak Ridges Moraine Conservation Plan, 2017; Niagara Escarpment Plan, 2017

Through the Coordinated Land Use Planning Review, the Greenbelt Plan, the Oak Ridges Moraine Conservation Plan, and the Niagara Escarpment Plan were all updated, along with the Growth Plan for the Greater Golden Horseshoe, to incorporate a new emphasis on climate change adaptation and mitigation. Refer to these plans directly for more information.

Ontario Building Code

In 2017, the Building Code was amended to require electric vehicle charging in new non-residential buildings and new houses. These requirements will generally be mandatory for building permits applied for on or after January 1, 2018. Integrating electric vehicle charging infrastructure in new buildings will promote the selection of electric vehicles and support the reduction of GHG emissions. Additional changes anticipated as part of the next edition of the Building Code will further align the Building Code with the Climate Change Action Plan by significantly reducing GHG emissions from new buildings, in particular, through provisions to ensure greater energy efficiency.

ONTARIO'S GREENHOUSE GAS EMISSIONS AND THE PROVINCE'S EMISSION TARGETS

In 2015, Ontario greenhouse gas emissions totalled 166 Mt CO₂e—12.0 tonnes per capita CO₂e. The largest sources of greenhouse gas emissions are the tailpipes of personal and commercial vehicles (37%), the chimneys and vents of residential and commercial building furnaces (20%), and the smokestacks of industrial boilers and kilns (14%). Fossil fueled electricity contributes 4% to the total. All totalled, fossil fuel combustion accounts for 76% of Ontario's greenhouse gas emissions, with the remainder split between industrial process gases (13%) and agricultural practices (8%), and methane from landfills and other waste treatment operations (5%).

Table 5. Ontario's GHG emissions

Ontario Greenhouse Gas Emissions in 2015 (Mt CO ₂ e)			
	Energy (fossil fuels)	Other processes	Total
Residential Buildings	20.7		20.7
Commercial Buildings	12.5		12.5
Personal and Commercial Transportation	61.2		61.2
Manufacturing & Construction	22.2	21.8	44
Waste		9	9
Agriculture and Forestry	1.4	9.7	11.4
Electricity Generation	6.2		6.2
Total	126	40.1	166

Note: Adjustments are due to rounding.

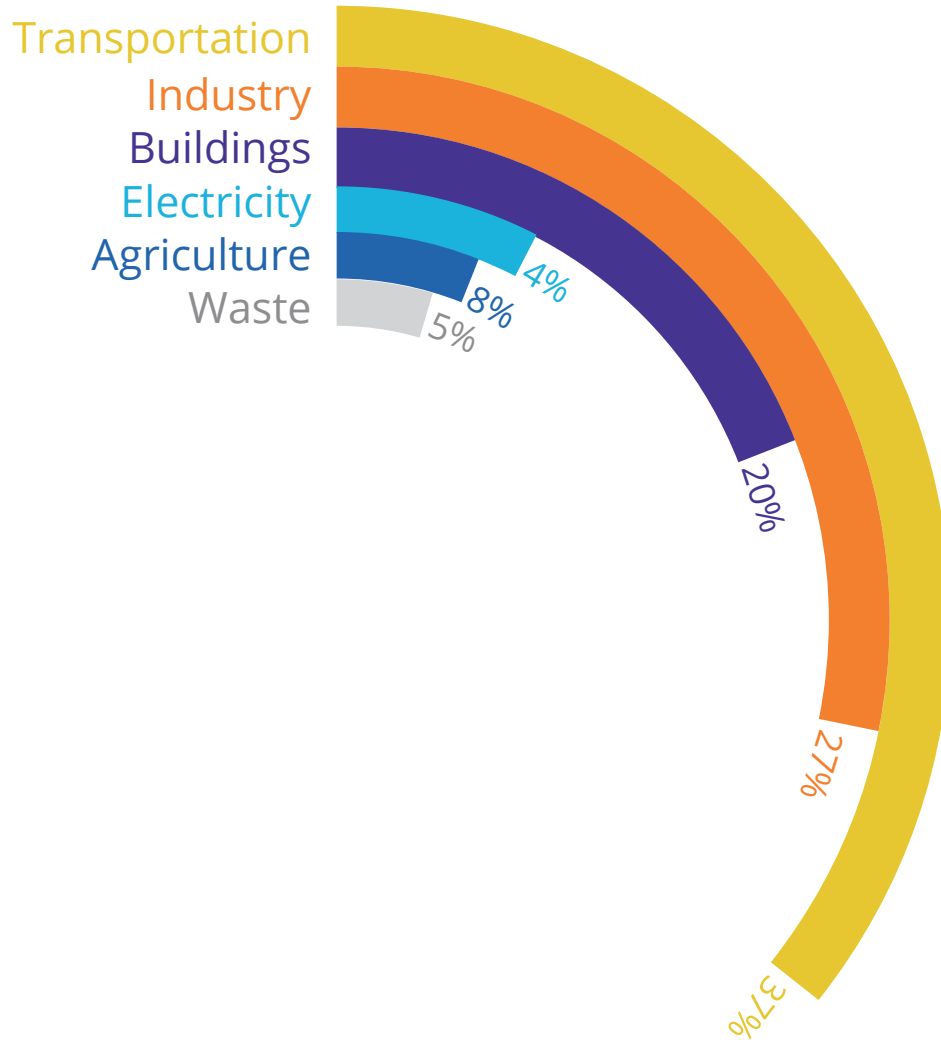


Figure 3. Illustration of relative importance of major sources of GHG emissions in Ontario³.

The Government of Ontario has established GHG reduction targets of 15% below 1990 levels by 2020, 37% below 1990 levels by 2030, and 80% below 1990 levels by 2050. In 2013, Ontario's GHG emissions were 171 Mt CO₂e, 6% below 1990 levels. Table 6 shows the targeted emission levels and how they translate into per capita emissions, given the currently expected population growth.

³ From Ontario Climate Action Plan, 2016.

Table 6. Ontario's GHG emissions targets

	Ontario population (millions)	Actual or Targeted GHG Emissions (Megatonnes CO₂e)	Average per capita emissions (tonnes CO₂e)
1990	10.30	182	17.7
2013	13.56	171	12.6
2021	14.98	146	9.7
2031	16.66	115	6.9
2050 est	19.75	36	1.8

Note: The emissions for 2021 and 2031 are actually the provincial target emissions for 2020 and 2030, respectively.

Note: The 2050 population has been estimated by extrapolating the growth rate in the Ministry of Finance population projection, which goes to 2041.

The targets are consistent with the commitments made by Canada in the Paris Accord, which in turn are based on an understanding of what it will take to limit average global warming to less than two degrees Celsius, considered to be the maximum temperature change that can be risked if humankind is to avoid dangerous and potentially catastrophic climate change impacts. Given the central role that fossil fuels play in the Province's energy system, the targets also imply transformational change in buildings, vehicles and transportation systems, industrial production systems, and communities. The efficiency of energy use must be much greater, the role of electricity in providing heat and transportation services must increase, the electricity supply must remain essentially carbon free, a sustainable biofuels industry must be established, and innovation will be required to reduce demand for energy services.

3. The Role of Municipalities

Purpose of this chapter: To describe the role of municipalities in reducing GHG emissions

DIRECT CONTROL AND INDIRECT INFLUENCE

Municipalities have a pervasive if mostly indirect impact on the level of greenhouse gas emissions in the community, although the GHG impacts of municipal policies and practices are often not recognized. Community energy and emissions planning begins by developing a quantitative understanding of the community's greenhouse gas emissions (the inventory) and systematically identifying the ways in which municipalities can, and often already do, influence the level of community emissions.

The Official Plan and other existing planning tools implicitly influence GHG emissions by determining land-use patterns and other characteristics of the built environment. The community energy and emissions planning process quantifies these relationships and identifies strategies to reduce GHG emissions while considering additional benefits for employment, economic development, improved health outcomes and others.

Sample Official Plan policies are included in Appendix 13 of the guideline to provide further direction on how climate change can be incorporated into Official Plans.

Table 7 illustrates some direct and indirect control that local governments exert over community greenhouse gas emissions.

Table 7. Roles of local governments on energy and GHG emissions.

Local government as...	Authority	Sample actions	Community energy and emissions planning techniques	Potential impact on GHG emissions reductions
Energy consumers.	Direct control.	Retrofits of municipal buildings, construction of high performance municipal buildings, purchase of zero emissions vehicles, development of renewable natural gas from organic materials.	Corporate GHG inventory and plan.	Low.
Investors.	Indirect control.	Renewable natural gas from a landfill, zero emissions transit system, cycling infrastructure, electric vehicle charging stations, recycling programs, public/private partnerships.	Situational analysis [review of capital budgets].	Medium-High.
Influencers.	Indirect control.	Official Plan policies, Property Assessed Clean Energy (PACE) programs.	Modelling and scenario-planning.	High.

Local governments are creatively developing policies in order to reduce GHG emissions, focussing on the investment and influence roles. Property Assessed Clean Energy (PACE) programs are an example in which municipalities enable retrofits of residential or commercial buildings on a neighbourhood or community-wide scale.

Municipalities, alongside and in cooperation with Conservation Authorities, social housing agencies, local school boards and municipally owned electricity distribution companies, and others play a key role in implementing and facilitating the implementation of policies of higher levels of government. Examples are illustrated in Table 8.

Table 8. Municipal energy and emissions policy roles and examples.⁴

Municipal government role	Municipal role examples	Corresponding national or provincial government role
<p>Policy architect & leader: Primary body responsible for policy design, formulation, application, implementation and enforcement.</p>	<ul style="list-style-type: none"> » Land-use planning. » Design/development of transit systems or transportation policies. » Development of infrastructure projects. » Waste management regulations. 	<ul style="list-style-type: none"> » Establish national policy frameworks. » Enable municipal government action through: <ul style="list-style-type: none"> » Capacity building and information sharing; » Access to funding; and, » Legal and policy alignment.
<p>Critical implementer: Responsible for key application, implementation, or enforcement actions related to a policy.</p>	<ul style="list-style-type: none"> » Building code implementation and compliance-checking. » Implementation of regionally coordinated, cross-jurisdictional infrastructure projects or transportation policies. 	<ul style="list-style-type: none"> » Policy design and/or standard setting. » Regional coordination. » Enabling city government implementation role.
<p>Complementary partner: Undertakes separate, complementary actions that contribute to the effectiveness, uptake, penetration, or success of a policy led by higher levels of government.</p>	<ul style="list-style-type: none"> » Complementary information and outreach, green standards development and implementation, certification and incentive programs for improved building energy efficiency and reduced GHG emissions through urban design measures. » Permitting or active installation of electric vehicle charging stations. » Permitting, tax incentives and/or subsidies for commercial and residential distributed energy resources. 	<ul style="list-style-type: none"> » Policy design and/or standard-setting. » Primary implementation and enforcement. » Coordination/integration of actions within and across different levels of government. » Enabling municipal government complementary actions through capacity building, funding or legal reform (such as enabling energy step codes, and financial mechanisms like congestion charges).

⁴ Adapted from: Broekhoff, D., Erickson, P., & Lee, C. M. (2015). *What cities do best: Piecing together an efficient global climate governance*. Stockholm Environment Institute Seattle, WA, US.

INFRASTRUCTURE, LAND-USE PLANNING AND LOCK-IN

Figure 4 illustrates the varying lengths of time that the environmental implications of different types of municipal planning decisions continue to be experienced. Many municipal planning decisions made today will still be having environmental impacts 100 years from now. In the case of infrastructure investments and land-use plans, the environmental consequences continue for centuries. This leads to “lock-in”: a situation where past decisions limit the options and increase the costs for future decisions. In the context of community energy and emissions planning, this makes the longest term decisions also among the most important.

TEMPORAL SCALES OF MUNICIPAL PLANNING DECISIONS VERSUS IMPLICATIONS

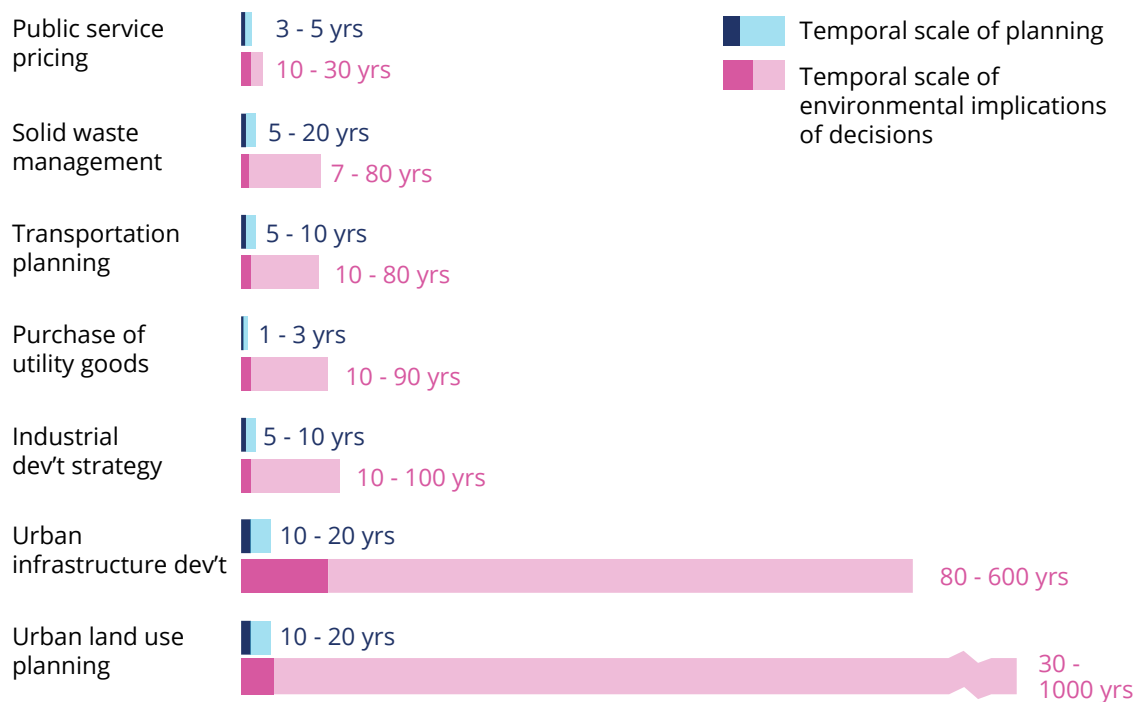


Figure 4. The temporal implications of municipal decisions.⁵

⁵ Adapted from: Bai, X., McAllister, R. R., Beaty, R. M., & Taylor, B. (2010). [Urban policy and governance in a global environment: complex systems, scale mismatches and public participation](#). *Current Opinion in Environmental Sustainability*, 2(3), 129-135.

LOCK-IN AND PATH DEPENDENCE: ATLANTA VS. BARCELONA

Atlanta's population is comparable to Barcelona's, but Atlanta is ~25 times larger than Barcelona and its GHG emissions from transportation are ~10 times higher. Barcelona's compact form locks in low carbon lifestyles, whereas Atlanta's investments in roads and buildings result in an energy and emissions trajectory that is costly and difficult to change. Whereas Barcelona can consider solutions such as district energy and enhanced transit to generate positive economic returns, these solutions may not be possible in Atlanta. Land-use planning determines population density and connectivity to goods and services and is therefore critical in enabling future low carbon opportunities. [For Ontario municipalities, the fundamental tools of land-use planning are Official Plans and Zoning By-laws.]

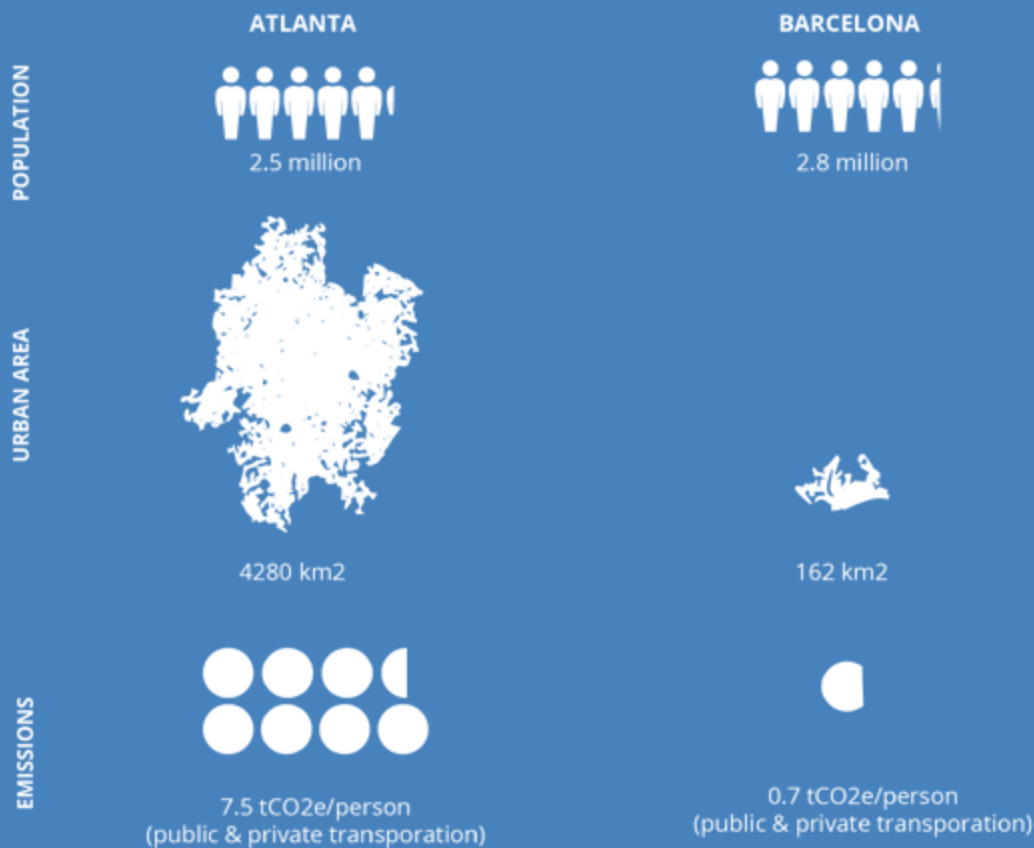


Figure 5. A tale of two cities: the influence of land-use planning on Transportation GHG emissions⁶

Municipalities mitigate against the negative effects of lock-in by planning for low-carbon communities through the use of land-use policy tools and approaches, consistent with provincial direction such as:

- » increasing intensification targets in existing settlement areas;
- » increasing density targets in designated greenfield areas;

⁶ Adapted from: Global Commission on the Economy and Climate. (2014). *Better growth, better climate: The new climate economy report*.

- » creating compact, complete communities (e.g. increasing mixed-use – commercial, residential, and employment – zones) and prioritizing transit-oriented development (to reduce dependence on private automobiles); and,
- » maximizing the use of existing and planned transit options.

Achieving these land-use and other planning objectives, when implemented together, will contribute greatly toward achieving the Province's GHG emissions reduction targets.

ENGAGEMENT, ALIGNMENT AND INTEGRATION – KEYS TO EFFECTIVE LOCAL GOVERNMENT GHG PLANNING

There is very often alignment between the priority goals and aspirations of community planning and the objective of lowering greenhouse gas emissions. In fact, a great deal of the moderation of greenhouse gas emissions growth that has already taken place has been a side effect of trends and measures that have been driven by goals other than GHG emission reduction. To take a few examples:

- » Energy efficiency developments can be key elements of strategies for local economic development, job creation and self-reliance. Ontario households, firms and institutions spend around \$40 billion per year on fossil fuels, most of which leaves their community and leaves the province. Even in a small rural community of 10,000, gasoline and natural gas expenditures drain several million dollars annually from the local economy. Efficiency investments redirect that flow to local employment and economic development. Energy NorthEast (now Acadia Centre) found that efficiency programs in Canada return \$3 to \$5 in savings for every \$1 of program spending, and generate 30 to 52 job-years per million dollars of program spending.
- » The trend toward redensification of urban communities and higher density, greenfield development in suburban and rural communities is favoured by local governments seeking to minimize the per capita cost of infrastructure while stretching capital budgets as far as possible.
- » Public health policy advocates promote a variety of measures that also reduce greenhouse gas emissions, including active transportation infrastructure, green roofs, urban forestry, and reduced emissions from fossil fuel combustion, the leading source of air pollution and smog precursors.
- » Community economic development strategies very often include the objective of attracting innovative firms that are driving the growth of Ontario's knowledge-based, service-oriented economy. This includes the clean energy technologies and services that are essential to the low carbon transition. One analysis suggests the global economic opportunity of investments in low-carbon urban actions is \$16.6 trillion⁷—the financial savings resulting from energy savings and lower cost generation in transportation, buildings and waste sectors. Technological and social innovations are occurring rapidly and the community energy and emissions plan is an opportunity to identify and plan for innovation, ensuring that benefits are maximized for those who need it the most.

These synergies between actions to reduce greenhouse gas emissions and other community objectives, along with many other co-benefits of community energy and emissions planning, underscore the importance of integration and engagement. Climate change targets and actions are more likely to succeed where they align with community goals, aspirations and policies for public health,

⁷ Gouldson, A. P., Colenbrander, S., Sudmant, A., Godfrey, N., Millward-Hopkins, J., Fang, W., & Zhao, X. (2015). [Accelerating low carbon development in the world's cities](#).

fiscal efficiency, self-reliance, economic prosperity, resilience, inclusiveness, full employment, and community planning and development.

More reading:

SSG. (2017). Technical paper #4: [Considerations of co-benefits and co-harms associated with low carbon actions for TransformTO](#).

Resource:

Floater, G., Heeckt, C., Ulterino, M., Mackie, L., Rode, P., Bhardwaj, A., ... Huxley, R. (2016). [Co-benefits of urban climate action: A framework for cities](#). LSE Cities.

Effective community energy and emissions planning unifies, and must be integrated with, many other municipal planning exercises. For example, in order to evaluate emissions trajectories, energy and emissions planning considers land-use patterns (Official Plan), transportation investments (Transportation Master Plan), and waste volume and treatment estimates (Solid Waste Management Plan). In turn, energy and emissions plan recommendations will likely alter policies on land-use planning, infrastructure deployment and upgrading, transportation, and waste management—as well as touch on social housing and equity considerations. Additionally, the plan will have implications for economic development and employment opportunities, which can be reflected in an Economic Development Strategy. Beyond the municipality, the plan will also influence the planning processes of energy utilities.

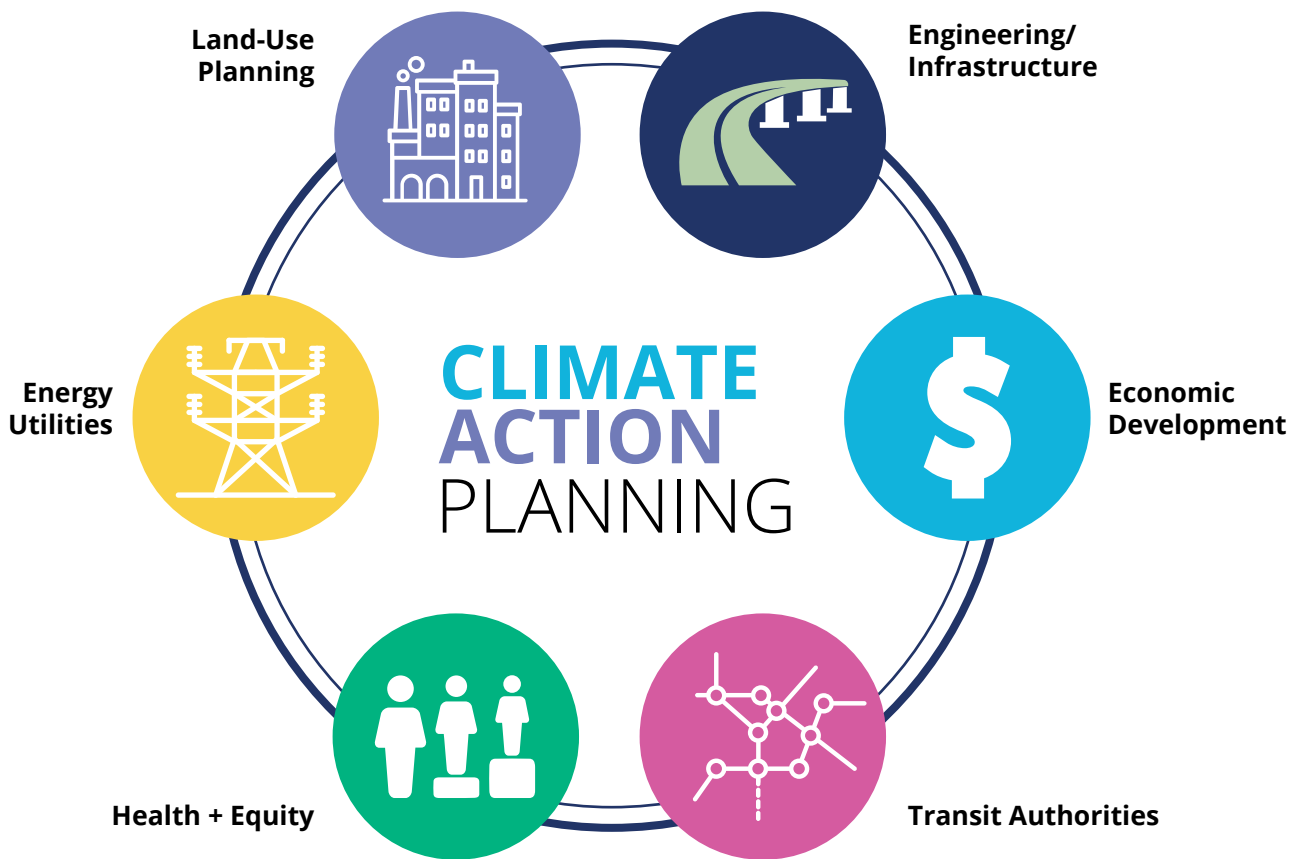


Figure 6. Energy and emissions planning incorporates many dimensions of municipal planning.

Energy and emissions planning incorporates many dimensions of municipal planning, and requires the involvement of multiple city government departments, stakeholders and communities, with particular attention to marginalized groups, in all phases of planning and implementation. Successful low carbon community transition requires grassroots citizen involvement and financial investment (municipality + private sector). Active citizen, household, business and investor engagement is the best route to successful energy and emissions action implementation. Many municipalities already have community engagement strategies and processes, specifically for purposes of outreach to First Nations, newcomer, youth, and other marginalized communities, and these can be adapted for climate change related program planning.

Calgary Development Options Financial Co-benefits

A development options comparison for the City of Calgary calculated 33% cost savings for dense versus dispersed development, with capital cost savings of \$11.2 billion (road construction, transit costs, water and wastewater infrastructure) and operating costs savings of \$130 million (provision of fire stations, recreation centres, and schools, as well as shorter distances to commute for services) per year over the next 60 years.

Link: [Community Lifecycle Infrastructure Costing Tool](#)

THE ENERGY AND EMISSIONS PLANNING ETHOS: REDUCE, IMPROVE, SWITCH

Reduce, Improve, Switch is a simple mantra to follow in performing energy and emissions planning. Adapted from similar approaches such as Reduce-Reuse-Recycle (from the waste sector), and Avoid-Shift-Improve⁸ (from the transportation sector), it provides guidance on an overall approach to community energy and emissions planning.

The logic of the approach is that by avoiding energy consumption, retrofit requirements (improve) and the need to generate renewable energy (switch) are both reduced. If switch occurred first, the capacity of the renewable energy installed would be greater, implying a higher cost; and once improve and reduce had been implemented, renewable energy capacity would be greater than demand. Table 9 describes this framework for sample actions in different sectors.

Table 9. Reduce, Improve, Shift framework for community energy and emissions planning.

	SAMPLE ACTIONS		
	Buildings	Transportation	Waste
<p>REDUCE Reduce energy consumption and optimize energy demand.</p>	Build efficient and low carbon new buildings.	Build compact, complete communities and transit-oriented development. In rural areas, develop nodes or village centres.	<p>Implement strategies to prevent the creation of waste.</p> <p>Educate residents on reducing food waste.</p>
<p>IMPROVE Increase energy use efficiency.</p>	Upgrade to energy efficient lighting systems. Perform energy retrofits for existing buildings. Introduce energy storage and district energy.	Improve fuel efficiency of the vehicle fleet.	<p>Improve the efficiency of waste collection practices.</p> <p>Expand recycling program to include more materials.</p>
<p>SWITCH Shift to low carbon energy sources.</p>	Source energy from renewable sources.	Switch to electric vehicles that use renewable energy sources.	Collect fugitive emissions from landfills for use as renewable natural gas.

8 GIZ. (2011). *Sustainable urban transport: Avoid-shift-improve*.

4. Guiding Principles of Energy and Emissions Planning

Purpose of this chapter:	To describe the primary principles of community energy and emissions planning.
Key guidance:	Use the principles described in this chapter to frame the community energy and emissions plan.

There are now hundreds of local governments around the world committed to climate change mitigation. Their accumulated experience provides valuable insights into the interrelated principles that contribute to successful municipal action on climate change. Carrying these principles through municipal energy and emissions planning processes will help to ensure enduring, meaningful outcomes that maximize benefits for community members.

Leadership

Innovation in community energy and emissions planning in Canadian municipalities has been defined by leadership as opposed to regulation. Mayors, councils, citizens and staff have sought to mobilize municipal powers to address climate change through fora such as the Federation of Canadian Municipalities Partners for Climate Protection (PCP), Quality Urban Systems of Tomorrow (QUEST) and the Clean Air Council. While other responsibilities of municipalities—such as land-use planning—are clearly defined in law and practice, the practice of community energy and emissions planning is evolving, primarily as a result of municipal leadership.

Climate action planning requires changes to established frameworks and practices, and these in turn are most likely to succeed when they are inspired by an understanding of how they will benefit the community, and are encouraged and supported by both the leadership of elected officials and senior managers in the municipality. Taking action on climate change requires a champion, ideally at the executive level (e.g. CAO/Council), as many decisions require Council approval. Developing and implementing vision requires leadership, which requires experience, opportunity and will.

Alignment

Climate change targets and actions are more likely to succeed where they align with community goals, aspirations and policies for public health, fiscal efficiency, self-reliance, economic prosperity, resilience, inclusiveness, full employment and community planning and development.

Leverage

Beyond its own direct use of energy, the key to local government success in lowering community emissions is in its ability to leverage its control and influence over decisions, investments and behaviours in the community that determine emissions levels. The most effective role of local government varies with the particular circumstances and opportunity, and exercising effective leverage requires understanding what needs to happen to achieve a low carbon outcome, who the key players are in realizing each outcome, and how local government can use its powers, financial resources and influence to accelerate the desired transition.

Engagement and Empowerment

Successful low carbon community transition requires grassroots citizen involvement and financial investment (municipality + private sector). Active citizen, household, business and investor engagement is the best route to successful energy and emissions action implementation.

The most effective energy and emissions plans reflect local circumstances and local knowledge. Climate literacy for municipal leadership and staff, and community stakeholder relations that are mutually empowering are key to achieving the multiple benefits of the transition to low carbon communities.

Integration

The transition to a low carbon future requires embedding the low carbon objective in all aspects of community planning, policy, and infrastructure investments. In combination with the principle of alignment, integration is a powerful approach to advancing low carbon urban forms. Coordination with other municipalities and relevant entities is also an important strategy, particularly for those with significant interconnectivity.

Opportunities

Taking advantage of opportunities can play a key role in developing momentum in the transition to a low carbon community. Such opportunities may be direct—such as financial support available from federal and provincial governments—or indirect—such as a proposal to redevelop a brownfield site or social housing, public health or youth employment initiatives. Seizing opportunity requires understanding the various ways government influences community emissions, so that opportunities to advance the low carbon objective will be recognized when they arise.

Inclusivity

Many of the most important emissions reduction actions require partnerships within municipal departments and between the municipality and other

organizations. Energy and emissions plans need to involve multiple city government departments, stakeholders and communities, with particular attention to marginalized groups, in all phases of planning and implementation.

Fairness

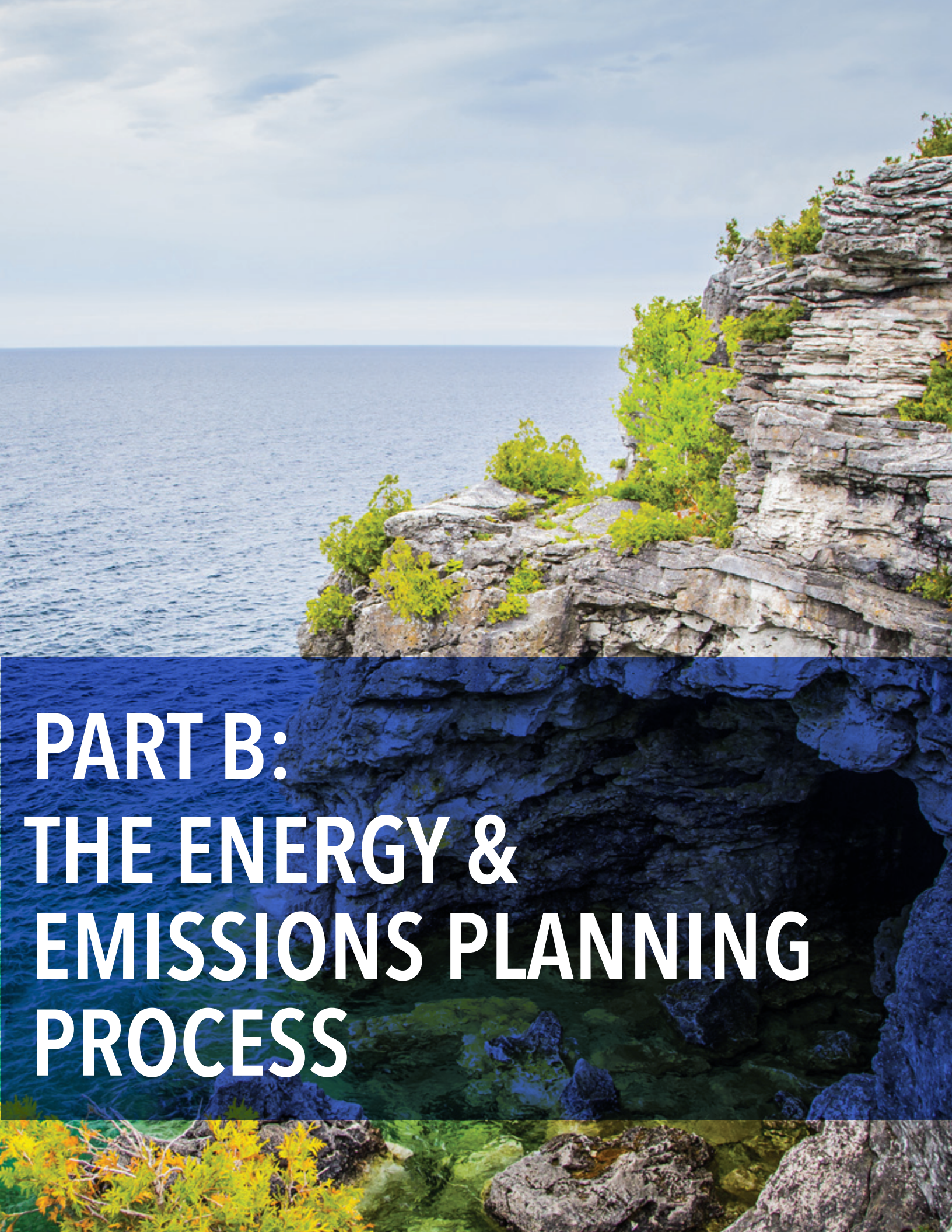
The design of energy and emissions plans needs to ensure that their activities equitably address the risks of climate change and share the costs and benefits of action across the municipality. Considerations include impact on access to services, household incomes, economic opportunities, investment in infrastructure, and others.

Innovation

Energy and emissions planning is an evolving field and the need for innovation is urgent in order to develop and secure pathways to deep GHG emissions reductions. Innovation requires a willingness to take risks, to fail, and to learn.

Accountability

Transparency is key to ensuring that energy and emissions plans are accountable. Transparency includes following an open decision-making process, and setting goals that can be measured, reported, independently verified, and evaluated. Using transparent modelling and assumptions instills trust in the justification for actions and policy changes. Ensuring that energy and emissions planning processes and documentation are accessible for all enhances participation in the processes and encourages community support for actions.



**PART B:
THE ENERGY &
EMISSIONS PLANNING
PROCESS**

5. Energy & Emissions Plan Development

Purpose of this chapter:	To provide an overview of the community energy and emissions planning process.
Key guidance:	Apply the process described here to identify where the local government is currently on the energy and emissions planning pathway, and to learn more about the tasks involved in developing energy and emission plans.

Ontario municipalities vary in size, mandate, and the services they provide. Responsibility for services is divided in different ways in the tiered system of local governance throughout the province, thus there is no single approach to developing community energy and emissions plans. Varied local circumstances create localized opportunities that are best engaged at the municipal level, underscoring the importance of creating energy and emissions plans by local governments.

To account for regional issues such as cross-border transportation or economic activity, regional coordination is recommended. This can be as simple as involving representatives of neighbouring municipalities or other ties on a steering committee. In some cases, municipalities have joined together across the tiers to undertake regional community energy and emissions planning processes, achieving an economy of scale and more effectively considering cross boundary activities such as transportation. Examples of this type of collaboration include the Peel Climate Change Partnership, Durham Region Community Energy Plan, Sustainable Peterborough and Sustainable Severn Sound.

5.1 A MAP OF THE PLANNING PROCESS

Like any example of sustainability-related planning, community energy and emissions planning follows a circular process, ever refining and progressing toward new goals. The process described here involves six stages, closely paralleling the milestones of the PCP program. The three steps of the Municipal Energy Plan process are also incorporated within these six stages. Note that while the stages are ordered 1 to 6, municipalities may not take this sequential approach or may apply the stages in a different order as a result of local circumstances.

The Energy and Emissions Planning Process

1. Preparation
 - ◇ The plan objectives, partners, data sources, process approach, etc. are identified.
2. Inventory

- ◇ An energy use and emissions production inventory (sources, amounts) is completed for a base year, providing the basis of future scenarios development, and creating a reference against which future inventories and policy and action effects can be measured.
3. Target setting
 - ◇ Energy and emissions reduction targets are established.
 4. Action and scenario development
 - ◇ Potential actions and policies that reduce energy and emissions are identified and bundled into scenarios. A preferred scenario that achieves the target is selected and the actions within that scenario are prioritized.
 5. Implementation
 - ◇ The policies and actions developed are implemented by the municipality and its partners.
 6. Monitoring and evaluation
 - ◇ Implementation of the policies and actions are monitored for their effectiveness. Feedback is applied to the next iteration of the planning process.

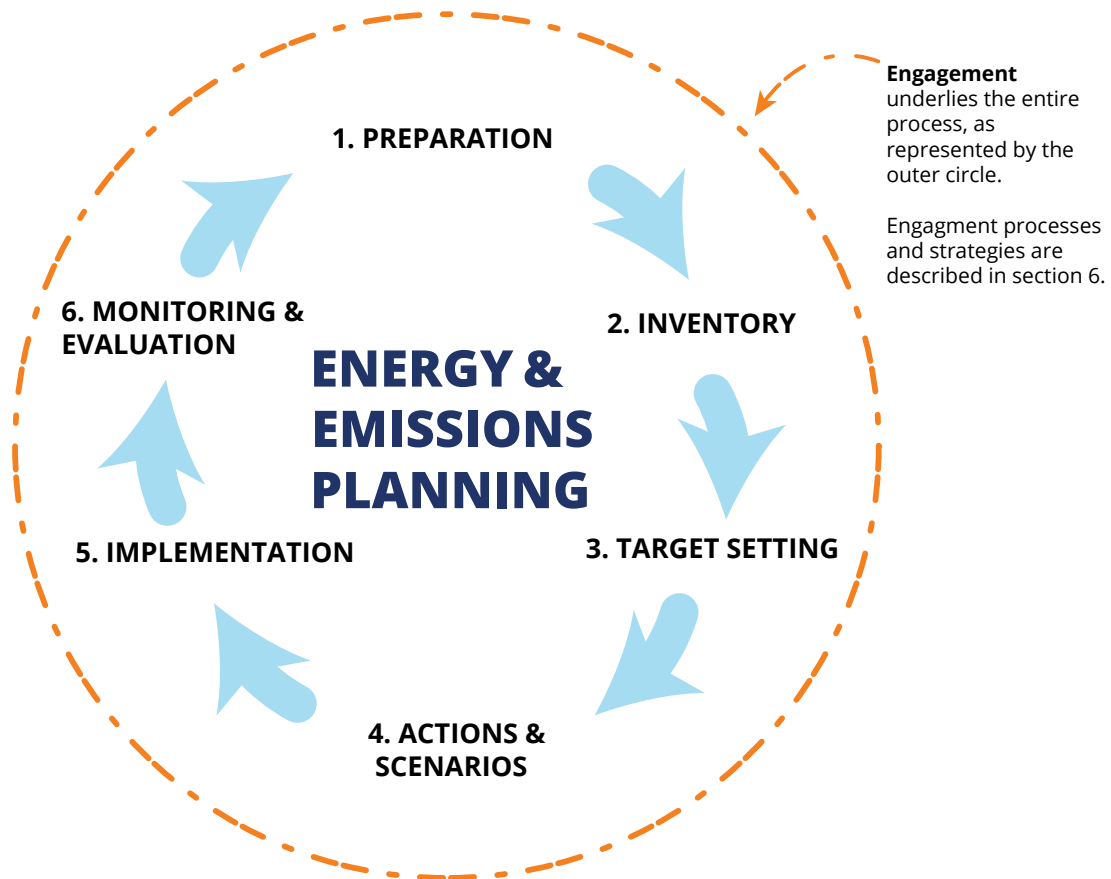


Figure 7. The energy and emissions planning process.

Factors of Success

While there are many elements that contribute to the success of a CEEP, the following four threads unite all of the stages of the process.

Continuity of leadership: Ensuring consistent staffing and ongoing support from the Mayor and Council facilitates the development of organisational knowledge and capacity and the development of networks over time. A champion, ideally a staff member, is critical to the development and implementation of the CEEP.

Focus on economic development: Energy is a major expenditure for municipalities, businesses and households. There are many opportunities to reduce this cost and create opportunities for new businesses and employment, some of which can only be unlocked by the municipality.

Deep technical analysis: Detailed modeling facilitates the development of a plan that can be implemented and the identification of financial and other resources needed. Scenarios can be used to explore the long-term implications of different policies and actions by the municipality.

Community engagement: A CEEP necessitates the involvement of a wide range of organisations and broad support and participation from the community.

Three Stream Options for Plan Development

This Guide describes three streams for each energy and emissions plan development stage: basic, intermediate and advanced. Municipalities can choose the stream, or combination of streams, that best suits their context. The outcomes for each stage are similar; however, the process to arrive at those outcomes varies. For simplicity, this Guide assumes a general correlation between the population of the municipality and the sophistication of the approach.

Some municipalities may undertake this process with internal resources, particularly at the basic level. Consultants will likely be engaged to support modelling of actions and scenarios for the intermediate and advanced levels. If desired, a municipality can build its capacity to perform this type of analysis using open source models and tools that are available.

Table 10. Considerations for the three streams.

	Basic	Intermediate	Advanced
Duration of the planning process.	<1 year	1-2 years	1-2 years
Approximate budget for a consultant to be contracted for the planning process.	\$75,000-\$125,000	\$100,000-\$200,000	\$150,000-\$500,000

Each subsection of this part of the Guide includes descriptions of the three streams. Table 11 describes the variation amongst the stages at a high level. Streams are designed to be followed throughout all the stages, as each stage builds on an earlier one.

Table 11. Planning streams.

Stage	Streams		
	Basic	Intermediate	Advanced
1. Preparation.	Similar approach for all streams.		
2. Inventory.	GPC inventory using the Partners for Climate Protection tool, GPC Basic.	GPC Basic, spatial analysis.	GPC Basic+, spatial analysis.
3. Target setting.	Similar approach for all streams.		
4. Actions & scenarios.	Qualitative approach to identifying and evaluating actions based on principles, opportunities, pressing issues and/ or best practices. Qualitative scenarios may be developed.	Simple (energy and emissions) quantitative modelling to evaluate possible actions, land-use policies and develop future scenarios.	Comprehensive (energy, emissions, co-benefits, financing, etc.) quantitative modelling to evaluate actions and land-use policies and to develop future scenarios.
5. Implementation.	Emphasis on policies and short-term actions.	Detailed implementation plan with action and policy prioritization to support a low-carbon pathway.	Detailed implementation plan with action and policy prioritization, with financial analysis to support investments. Policies are aligned with a low-carbon pathway.
6. Monitoring & evaluation.	Similar approach for all streams.		

Table 12. Energy and emissions planning process overview

1

PREPARATION

BASIC

INTERMEDIATE

ADVANCED

Tasks	Description	Approach: Level of Complexity		
		Basic	Intermediate	Advanced
1.1 Terms of reference/ project charter.	Describes the objectives of the process, who will be involved and how, the schedule and the outcomes.	Variable.		
1.2 Governance and leadership	Provides guidance on the approach to encourage leadership and different governance/organizational structures to support plan development.	Variable.		
1.3 Situational analysis.	Describes the current planning context, including: <ul style="list-style-type: none"> » Climate and ecosystem; » Demographics; » Policies by other levels of government; » Policies and strategies of the local government; » Built environment characteristics; » Transportation systems; » Other relevant factors. 	Variable.		
Tools.				
Engagement activities.		Steering committee.	Community advisory group.	Citizens jury.

2

INVENTORY

BASIC

INTERMEDIATE

ADVANCED

Tasks	Description	Approach: Level of Complexity		
		Basic	Intermediate	Advanced
2.1 Data request. 2.2 Data collection. 2.3 GHG inventory.	The GHG inventory is a snapshot of energy use and emissions production, and their driving factors. The year for which the most complete and reliable data is available can be set as the 'baseline year'.	PCP.	GPC Basic [LGOP for corporate emissions].	GPC Basic+ [LGOP for corporate emissions].
2.4 Spheres of influence.	An analysis of the GHG emissions or activities that the local government can influence.	Variable.		
2.5 Financial inventory.	An analysis of the GHG impact of existing expenditures by the local government and other entities in the community.	Variable.		
Tools.		PCP Milestone Tool.	City Inventory Reporting and Information System.	CityInSight.
Engagement activities.		Steering committee.	Steering committee + community mapping.	Steering committee + community mapping + advisory committee.

3

TARGET SETTING

BASIC

INTERMEDIATE

ADVANCED

Tasks	Description	Approach: Level of Complexity		
		Basic	Intermediate	Advanced
3.1 Set an emissions reduction target for the community.	Establishment of a GHG target consistent with or exceeding the provincial targets.	Adopt Provincial targets for each time period.	Use recommended approach in the Guide.	

4

ACTIONS & SCENARIOS

BASIC

INTERMEDIATE

ADVANCED

Tasks	Description	Approach: Level of Complexity		
		Basic	Intermediate	Advanced
4.1 Actions identification.	Develop a catalogue of potential municipal actions.	Best practices from other municipalities.	Identification by steering committee and best practices.	Identification through public engagement, best practices and steering committee.
4.2 Alternative scenarios development.	Bundle the actions into alternative energy and emissions future scenarios. Land-use patterns need to be one dimension of the scenarios.	Staff development of scenarios; scenarios may be qualitative.	Scenario- planning workshop; scenarios are modelled.	
4.3 Modelling.	Quantitatively evaluate the emissions impact of the scenarios versus the reference scenario.	Qualitative assessment.	Excel-based tool with GIS analysis.	CityInSight/ Urban Footprint.
4.4 Analysis of co-benefits.	Evaluate the impact of the scenarios and actions on a range of co-benefits.	Qualitative assessment.	Non-spatial quantitative analysis.	Spatial quantitative analysis.
4.5 Preferred scenario.	Select a preferred scenario.	Qualitative and quantitative assessment.		
4.6 Prioritization.	Prioritize the actions within the scenario.	Discussion/ voting.	Multi-criteria analysis.	Multi-criteria analysis + engagement.
Tools.		PCP Milestone Tool.	Climate action for URBan sustainability (CURB).	CityInSight/ Urban Footprint.
Engagement activities.		SWOT analysis.	Crowdsourcing, workshops.	Crowdsourcing, workshops, focus groups, participatory decision-making.

5

IMPLEMENTATION

BASIC

INTERMEDIATE

ADVANCED

Tasks	Description	Approach: Level of Complexity		
		Basic	Intermediate	Advanced
5.1 Policies and mechanisms identification.	Identification of policies and other mechanisms to achieve the actions.	Policies and mechanisms are identified to implement the actions.		
5.2. Investment strategy.	Evaluation of the financial requirements for the actions and how to secure the required funding.	Project-level analysis.	Integrated, inter-departmental analysis, financial modelling.	
5.3 Integration.	Ensure that the actions are reflected in all local government policies and actions.	<p>Implementation roles and responsibilities are assigned to a department. The Official Plan is revised to reflect the CEEP.</p> <p>Implementation roles and responsibilities are assigned across departments. The Official Plan and other plans or policies are revised to reflect the CEEP.</p>		
Tools.		Municipal organizational chart.	Workplans.	Workplans, departmental policy documents and processes, business planning.
Engagement activities.		None.	Senior staff engagement.	Senior and junior staff engagement, financial industry.

6

MONITORING & EVALUATION

BASIC

INTERMEDIATE

ADVANCED

Tasks	Description	Approach: Level of Complexity		
		Basic	Intermediate	Advanced
6.1. Monitoring and evaluation plan.	A monitoring and evaluation plan, including indicators and surveys, is developed.	Simple pass/fail evaluation.	Annual indicators assessment, updating of plan.	Frequent tracking of indicators and departmental roles and responsibilities updates.
Tools.		Workplans, indicators checklist.	Workplans, indicators assessment matrix, plan update mechanisms.	Workplans, indicators assessment matrix, plan update mechanisms, integrated reporting tools.
Engagement activities.		Council reports.	Council and staff reports, senior staff engagement.	Council and staff reports, senior and junior staff engagement, public reporting and engagement.

5.2 BUILDING ON PREVIOUS WORK

Many Ontario municipalities have been or are currently engaged in energy and emissions planning or municipal energy planning. The Guide provides a roadmap for municipalities to identify where they are at and what the next steps are in new or ongoing energy and emissions planning work. Using this pathway, a municipality can identify what work is already complete and enter into the process at the appropriate stage.

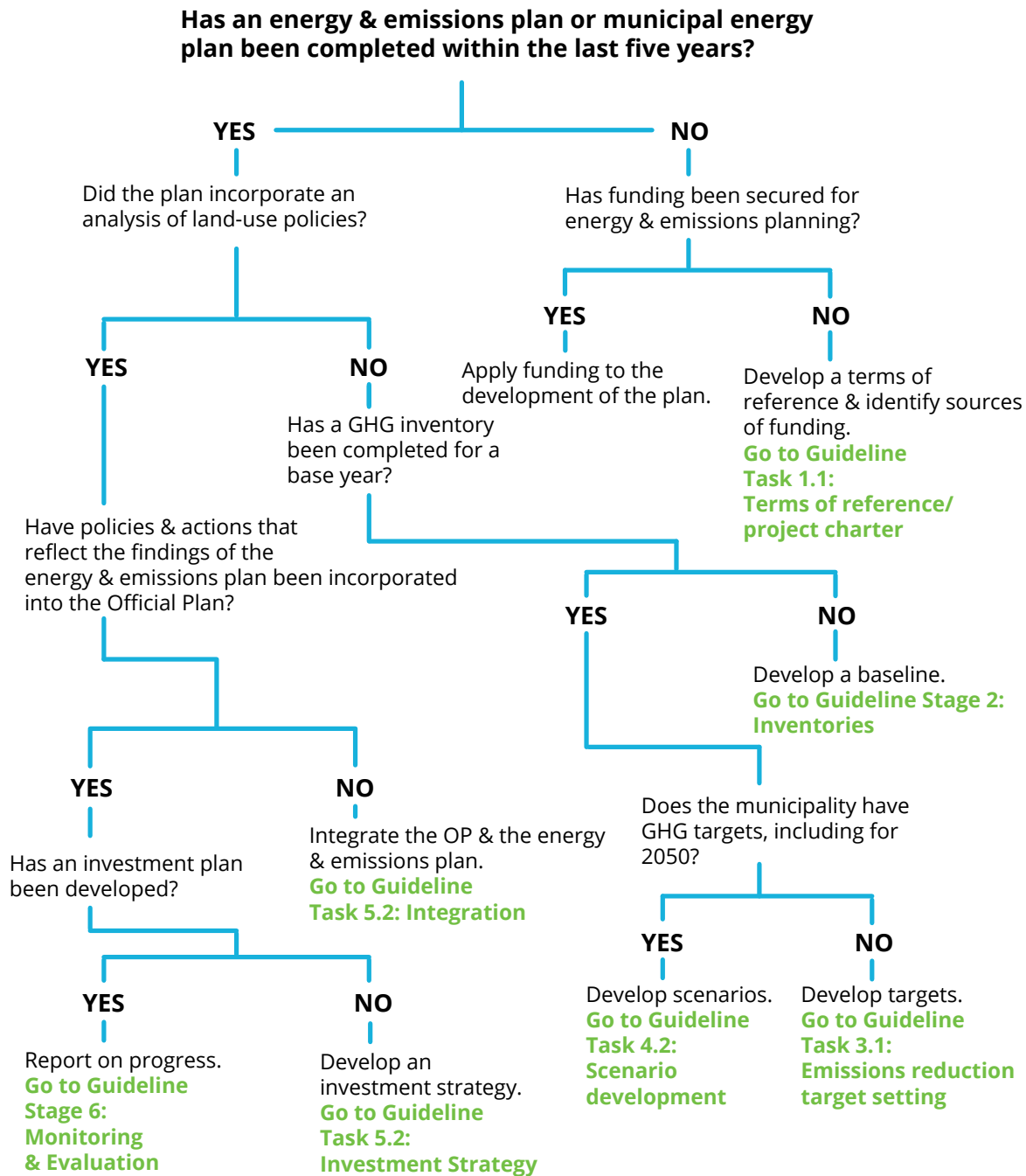


Figure 8. A roadmap for energy and emissions planning.

5.3 DETAILS OF KEY PLANNING PROCESS ELEMENTS

Stage 1: Preparation

» OUTPUTS:

- » **TERMS OF REFERENCE/PROJECT CHARTER;**
- » **SITUATIONAL ANALYSIS**

Before embarking on the energy and emissions plan development process, there are several preparatory steps to be undertaken. Understanding the reasons for undertaking the planning, setting the direction for the process, determining roles and responsibilities, and understanding the context in which the planning process is taking place are all important elements to confirm before commencing the planning process. Table 13 (following page) summarizes some planning preparation tasks, which are further described in this section.

Table 13. Planning preparation tasks.

Tasks	Description	Approach: Level of Complexity		
		Basic	Intermediate	Advanced
Stage 1: Preparation				
1.1 Terms of reference/ project charter.	Describes the objectives of the process, who will be involved and how, the schedule and the outcomes.	The terms of reference or project charter can be adjusted to reflect the local context. A sample terms of reference that supports the advanced approach is included in Appendix 2.		
1.2 Governance and leadership.	Provides guidance on the approach to encourage leadership and different governance/organizational structures to support plan development.	The governance and leadership approach will vary according to the practices of each municipality and the recommended approach is applicable to all municipalities.		
1.3 Situational analysis.	Describes the current planning context, including: <ul style="list-style-type: none"> » Climate and ecosystem; » Demographics; » Policies by other levels of government; » Policies and strategies of the local government; » Built environment characteristics; » Transportation systems; and » Other relevant factors. 	The themes reviewed in the situational analysis will be similar for most municipalities; however, the extent of the analysis will vary according to the size and complexity of the municipality.		

Engagement

Various municipal staff, decision-makers, stakeholders and the public will be involved throughout the planning process. There are numerous ways to structure engagement for the community energy and planning process, and the specific approach will reflect the local context. Table 14 suggests a few central structures for engagement in order of complexity. Some municipalities will undertake variations of all three approaches in combination.

Table 14. Engagement techniques in order of complexity

Basic	Intermediate	Advanced
<p>Internal steering committee: A committee composed of staff from different departments guides the project, reviewing documents and outcomes, prior to going to Council.</p> <p>Individuals and entities with a significant impact on GHG emissions can be engaged through an advisory committee.</p>	<p>Internal steering committee; External steering committee: A steering committee composed of representatives of the municipality and other stakeholders.</p> <p>The committee guides the process of developing the CEEP. The committee helps to develop the terms of reference/ project charter and reviews key documents.</p>	<p>Internal steering committee; External steering committee; Citizens panel: A multi-stage process in which randomly selected citizens go through an educational process in order to make recommendations on the development of the CEEP.</p>

Example: Citizens' Panel on Edmonton's Energy and Climate Challenges.

TASK 1.1: TERMS OF REFERENCE/PROJECT CHARTER

RELEVANT STREAMS

Developing Terms of Reference or a Project Charter for the planning process is useful in defining the project objectives and scope. Municipal decision-makers, municipal staff, and stakeholders can all be involved in the development of these documents. Sample questions to address in the Terms of Reference development are presented in Table 15.

Table 15. Considerations in developing the terms of reference/project charter.

Aspect	Consideration
Vision	<ul style="list-style-type: none">» What is the local government's vision of a low carbon future?
Objectives	<ul style="list-style-type: none">» How does the plan address land-use planning?» How does the plan integrate with other plans, including the Official Plan?» How does the plan address co-benefits?» What aspects of the municipality will the plan address? For example, agriculture, forestry or land-use.
Governance/management	<ul style="list-style-type: none">» Who is responsible for the plan in the local government?» Who will manage the plan's development?» Who will undertake the analysis and prepare the plan?» What is the approval process?
Engagement	<ul style="list-style-type: none">» Will there be a steering/advisory committee? Who will participate in it?» What are the target audiences for engagement?» What engagement mechanisms will be used?
Deliverables (scope)	<ul style="list-style-type: none">» What stages of work are required to deliver the plan?» What are the outcomes of the plan?

Aspect	Consideration
Implementation	<ul style="list-style-type: none"> » What policy mechanisms should be considered? » Who will be responsible for implementation?
Financial resources	<ul style="list-style-type: none"> » How will the planning process be financed? » How will implementation be financed?
Other considerations	<ul style="list-style-type: none"> » What are the risks to project? » Are there any constraints that should be noted?

The Terms of Reference can be shared with municipal staff, stakeholders, funding agencies, and others so that they understand the details of the plan. A sample terms of reference is included in Appendix 2.

TASK 1.2: GOVERNANCE AND LEADERSHIP

RELEVANT STREAMS

The Terms of Reference and Project Charter will help determine the governance structure for the planning process, which will vary according to the scale and context of the municipality. Some considerations include:

- » **Authority:** The governance structure should involve senior staff and elected officials. It is important that decision-makers are involved in the process, for understanding of energy and emissions issues and to send a signal that the municipality is taking plan development seriously.
- » **Leadership:** The governance structure should support and empower leaders to shape the process. A leader in this process is anyone with unusual commitment to advance climate change policies or actions. They may be involved in an advisory or steering committee and could be in local government and/or the broader community.
- » **Multi-disciplinary:** The governance structure should incorporate a variety of disciplines and representatives from various departments, reflecting the different spheres affected by climate change.
- » **Engaged:** Participants who can provide their full attention and critical feedback should be engaged.

One department—ideally the sustainability or planning department, if the municipality has these resources available—should be lead and appoint a

project manager. An internal interdisciplinary project management committee should involve a range of municipal departments such as planning, engineering, transportation, economic development, public health, and parks & recreation, as the energy and emissions plan will consider inputs from, and likely affect responsibilities and workloads in, all of these departments.

External stakeholders like community leaders and individuals with relevant expertise can comprise a high-level steering/advisory/management committee. This committee can be supported by the project manager to steward the plan. The configuration of project manager, internal and external stakeholders will vary by municipality, and should reflect local practices. In particular, consideration should be given on how to meaningfully involve vulnerable populations in the process, both in governance and more broadly.

Governance responsibilities also include the plan approval process. While this process will vary according to the governance practices of different municipalities, Table 16 provides a suggested approach.

Table 16. Suggested roles in plan development.

	Public	Steering committee	Municipal staff	Council
Terms of reference		Participate	Lead	Review/ Approve
Plan development	Participate	Participate	Lead	Participate
Draft report	Review	Co-Lead; Review/ Recommend	Co-Lead; Review	Review
Final report				Approve

Leadership by the Mayor in Halton Hills

The Town’s current planning around climate action is framed by its Mayor’s Community Energy Plan. The primary driver for the Town’s participation in mitigation and adaptation planning came from the Mayor and Council, whose view was that it was important to address the issue of sustainability. As a first step, the Town’s Green Plan was completed and then adopted by council in 2007. Following the recommendations of the Green Plan, the Office of Sustainability was established, the 2013 Integrated Community Sustainability Strategy was developed, and then the 2015 Municipal Energy Plan was completed.

TASK 1.3: SITUATIONAL ANALYSIS

RELEVANT STREAMS

There is basic information required to situate the plan, providing building blocks for its development. A situational analysis provides a comprehensive synopsis of the considerations that will influence plan development, and helps establish which energy and emissions actions will be appropriate for the local context.

Table 17. Sample scope of a situational analysis.

Category	Description
Climate and ecosystem.	Describe the current and future climatic conditions. Describe the local ecosystem.
Population and demographics.	Describe the current demographic context including age structure, immigration and emigration, and population change.
Geography.	Describe settlement patterns, land-use, terrain, etc.
Economy and finances.	Describe the economy of the community, households and local government (e.g. local GDP, major employers, average incomes, unemployment and poverty, cost of housing, the municipal budget).
Buildings.	Describe the built environment (e.g. buildings by type/age, infrastructure, tenure).
Transportation.	Describe the transportation system (e.g. roads, transit, walking and cycling).
Energy.	Describe the energy system (e.g. sources, fuels used, energy systems in buildings, utilities, EV infrastructure). Identify and describe current and future conservation and demand management programs offered by the energy utilities and IESO.
Policies.	Complete a policy review of relevant municipal, regional, provincial and national policies. Municipal and regional policies, plans and strategies should be reviewed to identify synergies and conflicts with the direction of the plan.

The process of completing the situational analysis will begin to identify energy and emissions policy and action opportunities.

Stage 2: Inventories

»OUTPUTS:

- » **GHG INVENTORY;**
- » **SPHERES OF INFLUENCE ASSESSMENT;**
- » **FINANCIAL ASSESSMENT**

Performing a GHG inventory involves identifying GHG emissions sources, gathering data from governments, utilities, and third parties, processing and organizing the data, and reporting it in a standardized manner. Depending on the GHG sources, data availability, and characteristics of the municipality (e.g. large, small, urban, rural, etc.), inventorying tasks may range from simple to complex. A municipality may seek advice from the province or FCM to help determine if creating a GHG inventory is something best done in-house or through engagement of a third party (e.g. consultant). Often, municipalities can independently monitor, evaluate and evolve inventories that are initially produced with the support of a consulting team.

Municipalities will complete two inventories, a corporate inventory and a community inventory. The corporate inventory provides insights on GHG emissions directly within the control of the municipality, while the community inventory evaluates the GHG emissions resulting from the activities of the population within the municipal boundary. The Guide provides a greater focus on community inventories due to their complexity. The Growth Plan, 2017 provides direction that both a community and corporate inventory be completed.

The GHG inventories provide insight into potential emissions reduction opportunities, highlighting the most significant sources of emissions and key opportunities for reductions. For example, are there opportunities for the generation of renewable natural gas from organic materials or increased active transportation mode shares?

Table 18 provides some typical tasks required in creating a GHG inventory. It also suggests a varying complexity of approaches that can be taken by a municipality, depending on its capacity. Municipalities can increase the complexity of their approach as they gain more experience and/or capacity. Beyond the municipality, the plan can also influence and be integrated with regional transportation plans, regional electricity plans and utility conservation demand management and demand side management plans.

Table 18. Typical GHG inventory tasks.

Tasks	Description	Approach: Level of Complexity		
		Basic	Intermediate	Advanced
Stage 2: Inventories				
2.1 Data request.	The GHG inventory is a snapshot of energy use and emissions production, and their driving factors. The year for which the most complete and reliable data is available can be set as the 'baseline year'.	Apply the PCP inventory tool, which is pre-populated with relevant assumptions.	A GPC Basic inventory involves detailed calculations [LGOP for corporate emissions].	A GPC Basic+ inventory involves reporting on additional areas beyond the GPC basic [LGOP for corporate emissions].
2.2 Data collection.				
2.3 GHG inventory.				
2.4 Spheres of influence.	An analysis of the GHG emissions or activities that the local government can influence.	The spheres of influence analysis can be relatively simple or complex depending on the scale of the municipality.		
2.5 Financial inventory.	An analysis of the GHG impact of existing expenditures by the local government and other entities in the community.	The financial inventory can be simple or complex depending on the scale of the municipality.		

TASK 2.1: DATA REQUEST

RELEVANT STREAMS

Data is a major consideration for completing the inventory and modelling.

Questions include:

- » What type of inventory will be completed?
- » What sectors will be included in the inventory?
- » Who has the required data?

- » Is a data confidentiality agreement required?
- » What are the privacy issues if any?
- » What format is the data in?
- » How can the data be accessed?
- » What is the level of confidence in the data?
- » Which key partners need to be engaged to assist with collecting data?
- » What are the costs associated with acquiring the data and are funds available?
- » Are there opportunities for streamlining data collection efforts for efficiency?

A systematic approach to data should identify the data required for the community and/or corporate inventories and for modelling future projections. A comprehensive checklist of the data required for the planning process and its potential sources is the “data request” and an example is outlined in Appendix 3.

Table 19. Data collection efforts.

	Basic	Intermediate	Advanced
Description.	Total GHG emissions are inventoried without seeking to evaluate the drivers of those emissions.	Energy and GHG emissions are represented spatially.	GHG emissions are calculated based on the factors that drive emissions.
Sample data requested.	<ul style="list-style-type: none"> » Total electricity consumption; » Total natural gas consumption; » Estimates of other energy sources; » Estimates of gasoline and diesel consumption; and » Solid waste totals. 	<ul style="list-style-type: none"> » Natural gas consumption by sector and postal code; » Electricity consumption by sector and postal code; and » Vehicle types by location. 	<ul style="list-style-type: none"> » Building type and shape; » Energy equipment (furnaces, air conditioning, etc); » Vehicle types and efficiencies; and » Trip length.
Estimated duration of data collection.	6 weeks to 2.5 months.	2–4 months.	4+ months.

TASK 2.2: DATA COLLECTION

RELEVANT STREAMS



The data collection process is an opportunity to liaise with different departments and stakeholders such as electric and natural gas utilities. The expected outputs of the plan should be made clear so that data providers supply the correct data and understand how the plan will support or modify their work and how they can contribute to emissions reductions.

Data collected can be cross referenced with the data request to ensure completeness. A naming protocol for document and data should be established and data should be stored in a secure location. Careful documentation ensures that future efforts can replicate the same data collection processes, ensuring comparability.

TASK 2.3: GHG INVENTORY

RELEVANT STREAMS



Inventories are fundamental to energy and emissions planning work, setting the foundation for projections and modelling. There can be many details to consider in performing an inventory (hence the length of this Guide section), but the remaining work of the planning process, as well as that for future inventories and energy and emissions planning, will be made much easier for the effort invested up front. Table 20 summarizes the characteristics of typical inventories, for different scales of effort.

Table 20. Characteristics of community-scale GHG inventories.

	Basic	Intermediate	Advanced
Description	A basic inventory is completed using the PCP tool. PCP's platform provides standard assumptions that can be used.	A GHG inventory is completed according to the GPC accounting system. The inventory is completed to the level of GPC basic. The inventory includes spatial information.	A GHG inventory is completed according to the GPC accounting system. The inventory is completed to the level of GPC+. The inventory is developed in a model that enables analysis of future scenarios.
Characteristics	The relationship between the drivers of GHG emissions such as land-use and other variables is hidden in this approach.	Comprehensive data collection is required and GHG emissions must be calculated using standard formula. Because the inventory includes spatial information, insight into land-use policies is possible.	The inventory can be used as the basis for generating future scenarios. The integration of the inventory and land-use patterns and policies is fully supported.
Approach	The PCP tool can be used to support this approach.	The Guide describes the relevant steps.	
Outputs	Corporate: PCP or LGOP municipal inventory. Community: GPC compliant GHG inventory.		

GHG Inventory Principles

The GHG inventory informs and encourages action in lowering the community's carbon footprint. It guides where and how to target initiatives to reduce emissions. The GPC defines the following principles for use in compiling GHG inventories.

- » **Relevance:** The reported GHG emissions shall appropriately reflect emissions occurring as a result of activities and consumption patterns of the city.
- » **Completeness:** Municipalities shall account for all required emissions sources within the inventory boundary. Any exclusion of emission sources shall be justified and clearly explained.
- » **Consistency:** Emissions calculations shall be consistent in approach, boundary, and methodology.
- » **Transparency:** Activity data, emission sources, emission factors, and accounting methodologies require adequate documentation and disclosure to enable verification.
- » **Accuracy:** The calculation of GHG emissions shall not systematically overstate or understate actual GHG emissions.

GHG Inventory and Reporting Standards

At the outset of preparing an inventory, it is useful and recommended to choose an inventory and reporting standard as a guide. There are several global reporting standards, methodologies and models to choose from. Their application will depend on the energy and emissions planning extent and approach of the municipality.

Table 21. GHG inventory and reporting standards.

Title	Description	Applicability	Considerations	Complexity
Global Protocol for Community Scale GHG Emission Inventories (GPC)	Accounting and reporting standard for community- scale GHG inventories.	Guidance on how to complete a community GHG inventory.	Applicable to all local governments.	Intermediate, Advanced
Local Government Operations Protocol (LGOP)	Accounting standard for local government operations.	Guidance on how to complete a corporate GHG inventory.	Applicable to all local governments. Designed for US municipalities. Municipalities in Ontario report on energy and emissions for buildings as a requirement of O. Reg. 397/11. LGOP provides a comprehensive corporate inventory, of which stationary energy from buildings are one sector.	Basic, Intermediate, Advanced
City Inventory Reporting and Information System	Excel-based tool for managing and reporting city greenhouse gas inventory data	Tool for completing community-scale GHG inventories.	Applicable to all local governments.	Intermediate
Partners for Climate Protection Milestone Tool (PCP)	A web-based tool for GHG inventories and projections for community and corporate inventories. Pre-populated with assumptions for each province.	Tool for completing community and corporate GHG inventories.	PCP members only. Currently being updated.	Basic

Title	Description	Applicability	Considerations	Complexity
CityInSight	A systems-dynamics model used for generating land-use, energy and emissions scenarios.	Tool for generating scenarios.	Open source but complex to apply.	Intermediate, Advanced

The PCP Milestone Tool, GPC, and the LGOP provide guidance on the assembly of GHG inventories. Each of these lays out the sectors that should be covered in the inventory, their data requirements, calculation methodologies, inclusion/exclusion protocols, and options for different levels of municipal resources and data availability.

The simplest of these to follow is the PCP Protocol using its Milestone Tool, which generates corporate and community inventories and projections. While the PCP Protocol will be updated to be compatible with GPC, its primary weakness is that it does not involve spatial inputs or outputs, and as such does not provide insight on the impacts of land-use planning decisions.

A more comprehensive approach uses the LGOP for the corporate inventory and GPC for the community inventory. Both protocols provide detailed guidance on methods to calculate emissions, with options for different levels of data availability. The GPC has been officially adopted as the standard emissions inventory accounting framework of C40 and the Global Covenant of Mayors, which collectively represent close to 650 cities worldwide.

The GPC requires cities to measure and disclose a comprehensive inventory of GHG emissions and to total these emissions using two distinct but complementary approaches. One captures emissions from both production and consumption activities or sectors taking place within the city boundary, including some emissions released outside the city boundary. The other categorizes all emissions into “scopes,” depending on where they physically occur. Table 22 defines the 3 scopes and Figure 9 illustrates how the scopes incorporate GHG emissions from different sectors.

Table 22. GHG inventory scopes.

Scope	Definitions
1	GHG emissions from sources located within the municipal boundary.
2	GHG emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling within the municipal boundary.
3	All other GHG emissions that occur outside the municipal boundary as a result of activities taking place within the municipal boundary.

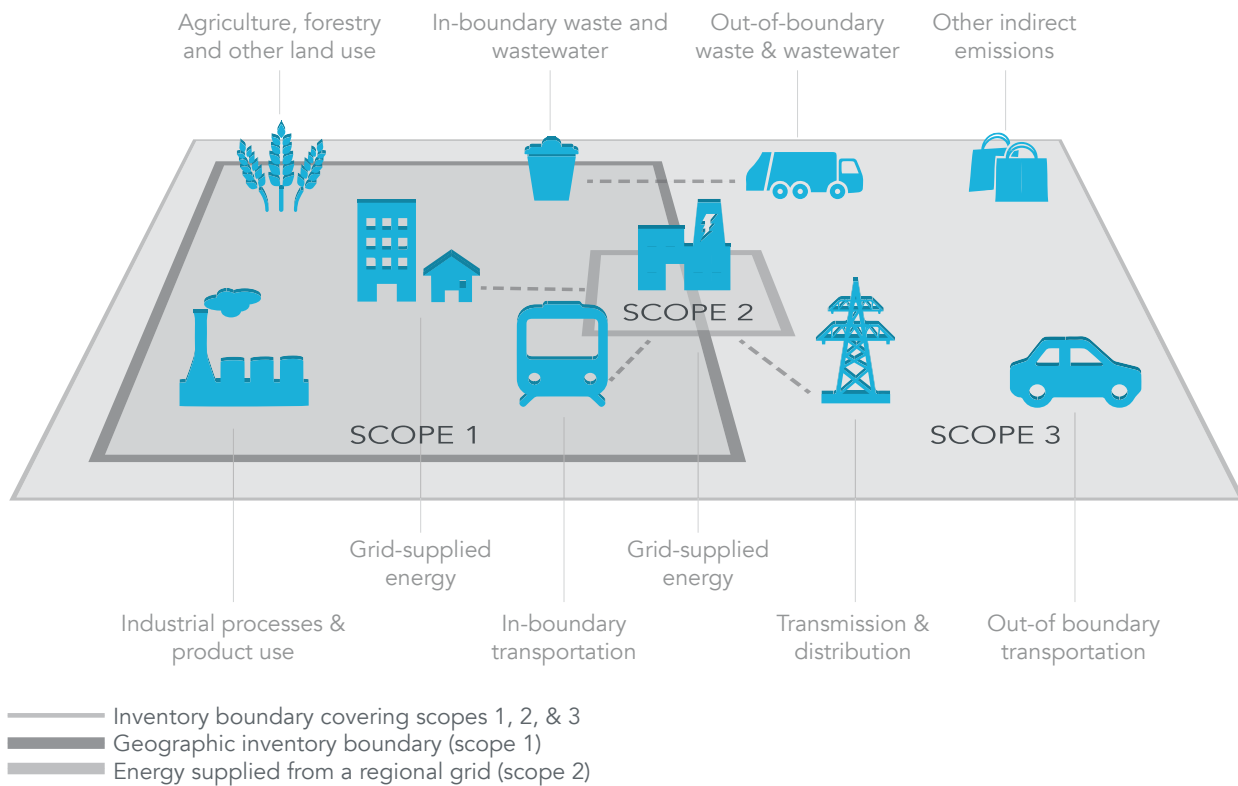


Figure 9. The relationship between emissions scopes and sectors.⁹

GPC has two levels of reporting.

1. BASIC level includes emissions from scope 1 and 2 stationary energy and transportation and scope 1 and 3 waste. GPC also includes fugitive emissions in scope 1 stationary energy.
2. BASIC+ requires additional reporting on Scope 3 emissions resulting from stationary energy and transportation, as well as emissions from industrial processes and product use, and agriculture, forestry and other land-use.
3. BASIC level of reporting is the minimum standard for municipalities in Ontario, with BASIC+ as an advanced option. Appendix 4 provides a detailed review of BASIC and BASIC+ requirements.

⁹ Adopted from: World Resources institute, C40 Cities, & ICLEI. (2014). [Global protocol for community-scale greenhouse gas emissions inventories](#).

Geographic vs Consumption Inventories

RELEVANT STREAM

There are two distinct approaches for completing a GHG inventory. The geographic inventory focuses on emissions resulting from the consumption of energy and production of waste within the geographic boundary of the municipality. A consumption-based GHG inventory accounts for emissions resulting from the consumption of goods and services consumed, irrespective of where the GHG emissions occur (Figure 10).

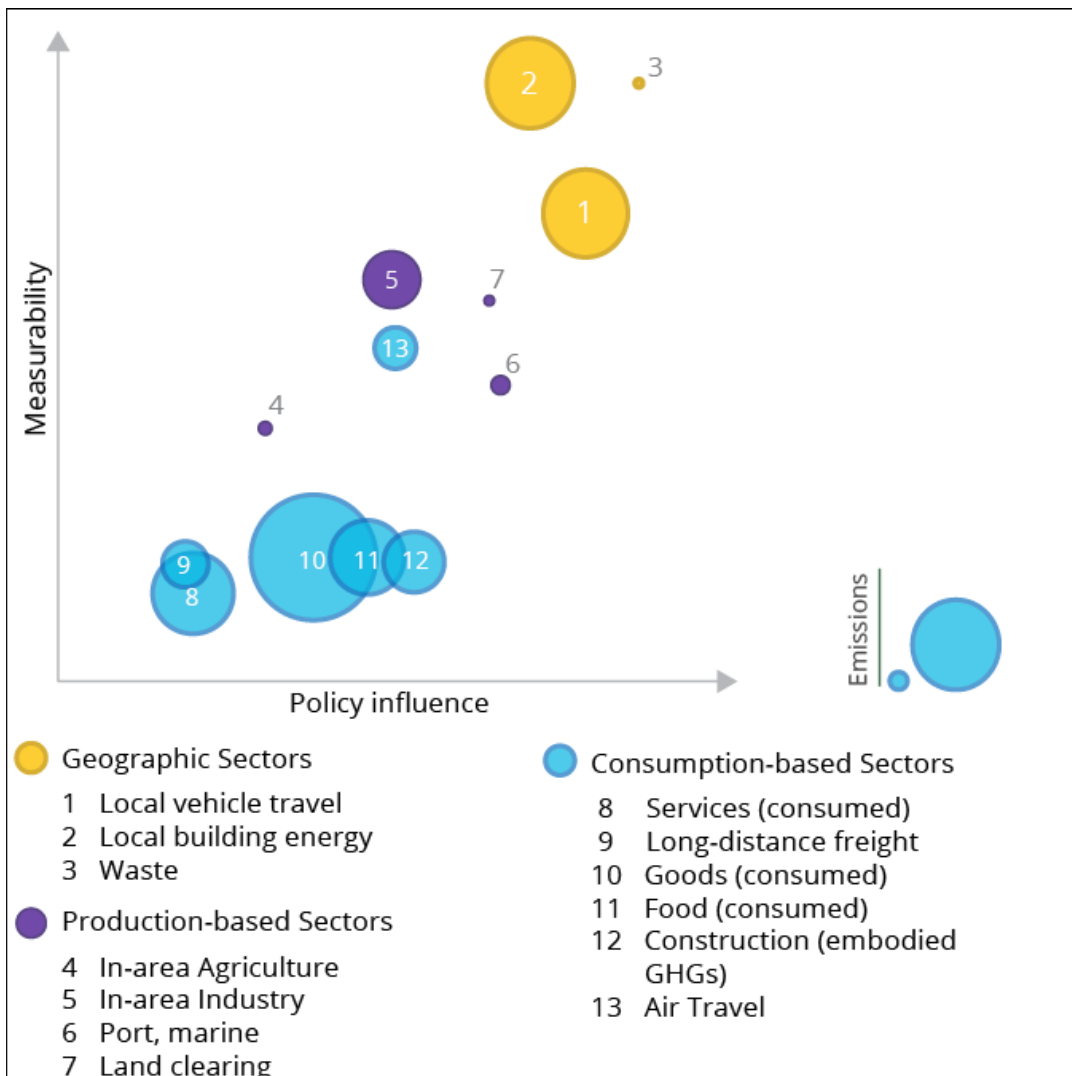


Figure 10. Geographic vs consumption-based inventories.¹⁰

¹⁰ Adapted from: Erickson, P., & Lazarus, M. (2012). [Revisiting community-scale greenhouse gas inventories](#). *Environmental Science & Technology*, 46(9), 4693–4694.

Consumption-based inventories provide insight into GHG emissions that are not addressed within a geographic inventory, as illustrated in Figure 10. The geographic and production-based sectors in this graphic are included in geographic inventories in contrast with consumption-based sectors which inform a consumption-based inventory. Consumption-based emissions are more difficult to measure and to influence with policies. For example, recycling would receive greater emphasis in a consumption-based inventory because it reduces upstream GHG emissions resulting from the production of goods, which a geographic-based inventory does not capture. In general, the GHG emissions tracked in a consumption-based inventory are more challenging to influence due to the limited consumption-influencing powers available to municipalities. Consumption-based inventories provide a stronger case for action on food production and consumption, and waste diversion, than geographic inventories.

Example: Stockholm Environment Institute. (2011). Consumption-based emissions inventory for San Francisco.

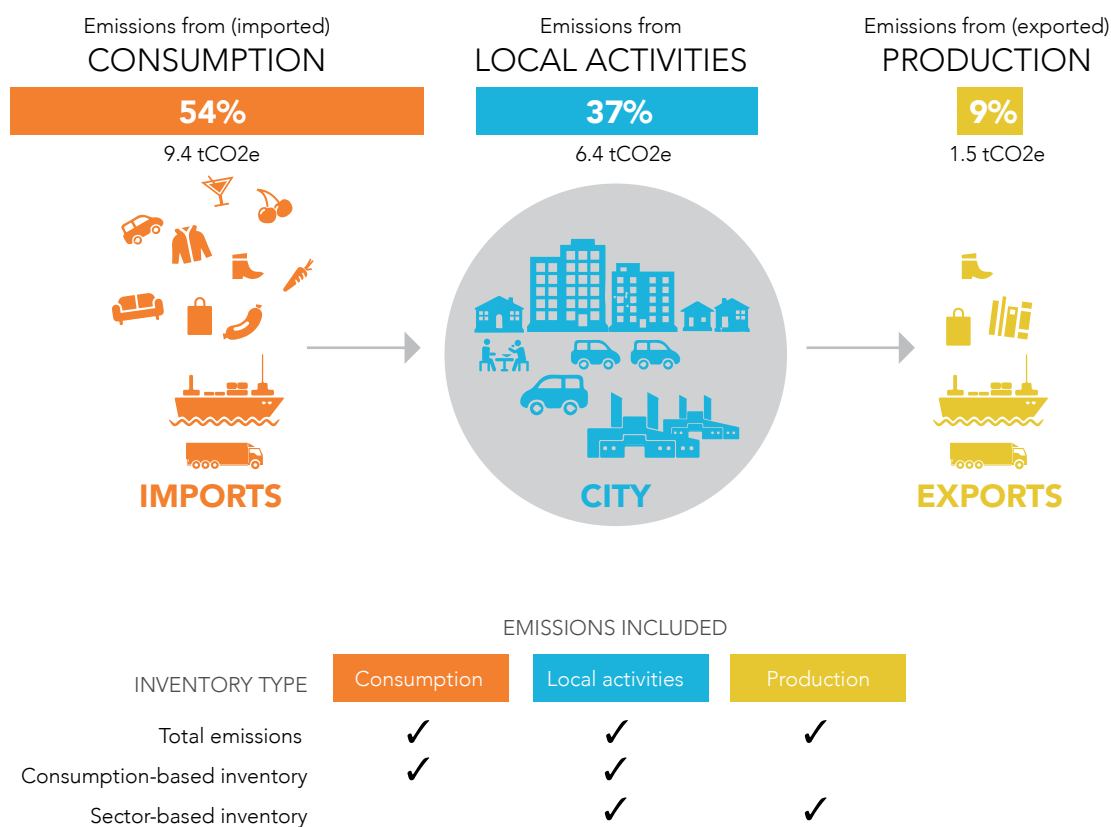


Figure 11. Insights from a consumption-based inventory for Portland, Oregon.¹¹

Consumption-based inventories are recommended as an advanced option for Ontario municipalities, completed in addition to a geographic inventory. Methods

11 Adapted from: City of Portland, & Multnomah County. (2015). [Climate action plan](#).

for consumption-based inventories are not addressed in this Guide.

Geographic Boundary Inventory Considerations

RELEVANT STREAMS


GHG inventories based on geographic boundaries consider geographic area, GHG gas types, emissions sectors/sources, and time span covered. GPC and LGOP establish recommended boundaries for corporate and community inventories as summarized in Table 23.

Table 23. Boundary inventory considerations.

Category	Corporate	Community
Geographic.	Operational control.	The municipal boundary.
Time period.	12 months.	12 months.
Greenhouse gases.	Carbon dioxide (CO ₂), methane (CH ₄), nitrous oxide (N ₂ O). Optional: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF ₆), and nitrogen trifluoride (NF ₃).	
Sectors.	<ul style="list-style-type: none"> » Buildings and other facilities; » Streetlights and traffic signals; » Water delivery facilities; » Vehicle fleet; » Energy generation facilities; » Solid waste facilities; » Wastewater facilities; and » Other processes and fugitive emissions. 	<ul style="list-style-type: none"> » Stationary energy; » Transportation; » Waste and wastewater; » Industrial processes and product use (IPPU); and » Agriculture, forestry, and other land-use (AFOLU).
Resource	Local Government Operations Protocol.	Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories.

Establishing a Baseline Year


RELEVANT STREAMS



The baseline year is the reference point against which GHG targets are referenced. In modelling, it is the year for which the model is calibrated to ensure consistency with observed data. Ontario's provincial target uses a baseline year of 1990; however, it is not practical for municipalities to track down data from 1990. 2011 or 2016 are appropriate baseline years because they were census years—most building and population data is available. It is important to develop a comprehensive and consistent inventory for the baseline year. Where there are data gaps, the baseline year can be reverse calculated from a more recent GHG inventory.

Municipal Corporate vs Community Inventories

RELEVANT STREAMS



There are two categories of GHG inventories that municipalities commonly undertake. The municipal inventory tracks emissions associated with the operations of the municipality (the corporation). The community inventory tracks emissions associated with the people who live within the geographic boundary of the community. Emissions associated with the corporate inventory are a small portion of the total GHG emissions of the community. The corporate inventory enables the local government to manage emissions directly under its control and is typically more precise, relying on observed data. Data collection and analysis for the community inventory is more complex and resource intensive, requiring the use of assumptions as well as data collection from other organizations. The Guide recommends that municipalities complete both corporate and community inventories, consistent with provincial direction. The Guide includes greater emphasis on community inventories as they are a more complicated process.

Table 24. Comparison of municipal corporate and community inventories.

Sector	Corporate inventory	Community inventory
Buildings.	Buildings and other facilities (including streetlights and traffic signals) operated by the municipality. Municipalities in Ontario report on energy and emissions for buildings as a requirement of O. Reg. 397/11.	All buildings in the municipal boundary.
Transportation.	Energy consumed by vehicles owned or operated by the municipality.	Energy consumed to move people and goods in the municipal boundary.
Energy systems.	Energy consumed as a result of the activities of the municipality; energy consumed by energy generation facilities operated by the municipality.	Energy consumed as a result of activities in the municipal boundary; energy consumed by energy generation facilities within the municipal boundary.
Waste.	Energy used by waste and wastewater facilities operated by the municipality.	Emissions from waste and wastewater produced by people living or working within the municipal boundary.
Fugitive emissions.	Fugitive emissions from the municipal facilities.	Fugitive emissions resulting from activities within the municipal boundary.

Inventory Spatial Analysis Considerations

RELEVANT STREAMS

In order to relate GHG emissions to land-use and infrastructure planning, a spatial (land-based) analysis should be completed. This requires inventories to include spatial data (e.g. GIS). Several Ontario municipalities have completed energy maps, an aspect of spatial analysis.

Table 25. Sample energy and emissions spatial considerations.

Type	Calculation	Use case	Future projections
People and employment density.	People and jobs per area (people and jobs/hectare).	Can be used as a measure of the 'people' density of a local government. Note that even if people and jobs are added, the number of buildings does not necessarily change. This can be used as an indicator of locations to target transit in particular.	Illustrates development patterns of the local government as population and jobs are added.

Type	Calculation	Use case	Future projections
Buildings density.	Number of units or square metres per area (units/hectare or square metres/hectare).	An indicator of the density of heated and cooled space (energy use). New buildings do not necessarily increase total energy use if they are high efficiency and/or existing buildings are retrofit.	Indicates the nature of change in building stock as different types of buildings or dwellings are added.
Energy Use Intensity (EUI).	Energy consumed per area of floorspace (GJ/m ² or kWh/m ²).	Can show the average EUI for all buildings in a zone or parcel. If the information is granular enough, it will show over time how retrofitting or other measures can improve EUIs.	EUI's can only change by decreasing energy demand (e.g. by increasing efficiencies/envelope etc.) or by changing building types (e.g. single family home to mid-rise apartment).
Energy Density.	Stationary energy consumed per area of developable land (GJ/ha or GJ/m ²).	Can be used to compare the energy impacts of land-use for growth nodes, corridors, or other areas in the city. Areas of high energy densities are potential sites for district energy systems.	As building density increases overall energy density increases.
Energy Per Capita.	Energy consumed per person (GJ/cap).	Can be used to compare how much energy is consumed by each resident or worker. This metric can be used to understand how energy efficiently a neighbourhood is able to accommodate residents.	As building density increases, more people live within a zone, resulting in higher overall energy demand. On a per capita basis, energy/capita should decrease over time with increased density and efficiencies, as people are more likely to be living in apartments.
VKT Per Capita.	Kilometres by mode per person from the origin.	Can be used to compare the extent of travel by different modes in different areas. Areas with high levels of vehicular travel can be identified for interventions such as travel planning or transit.	Indicates how travel behaviour changes over time.

Spatial analysis provides insight on the geography of energy use and other drivers that influence emissions, directly linking energy and emissions plans to land-use planning and Official Plan policies.

Figures 12 to Figure 14 illustrate three different perspectives on stationary energy use in the residential sector.¹²

¹² Graphics prepared for the City of Markham's Municipal Energy Plan by SSG and whatIf? Technologies.

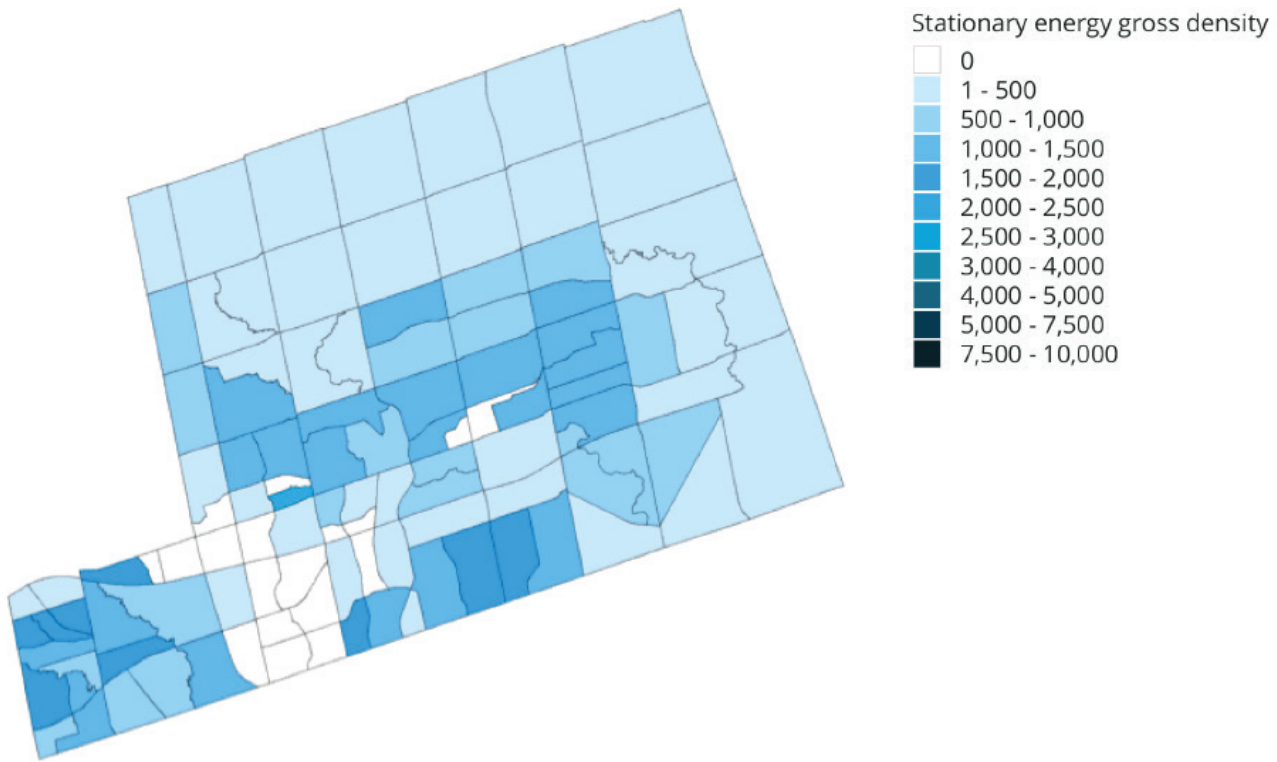


Figure 12. An example of stationary energy **density** mapping (in gigajoules per hectare).

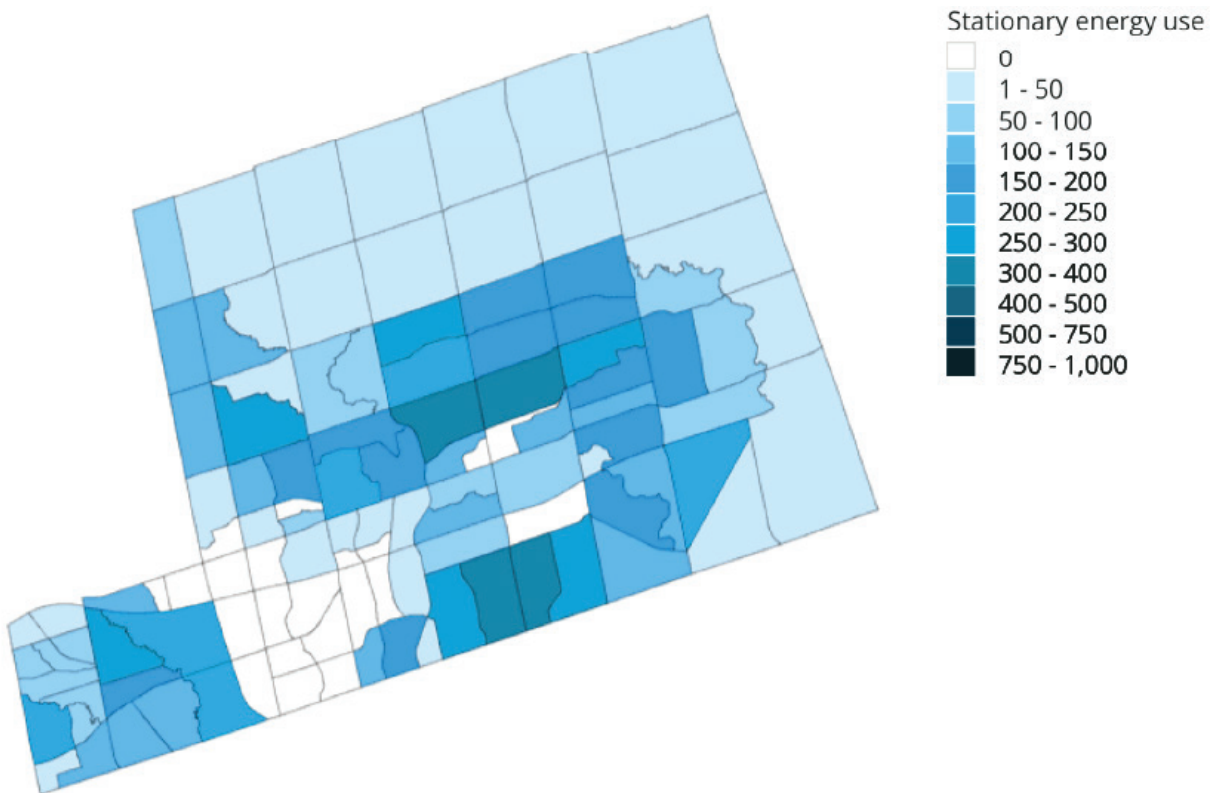


Figure 13. An example of stationary energy **use** mapping (in terajoules).

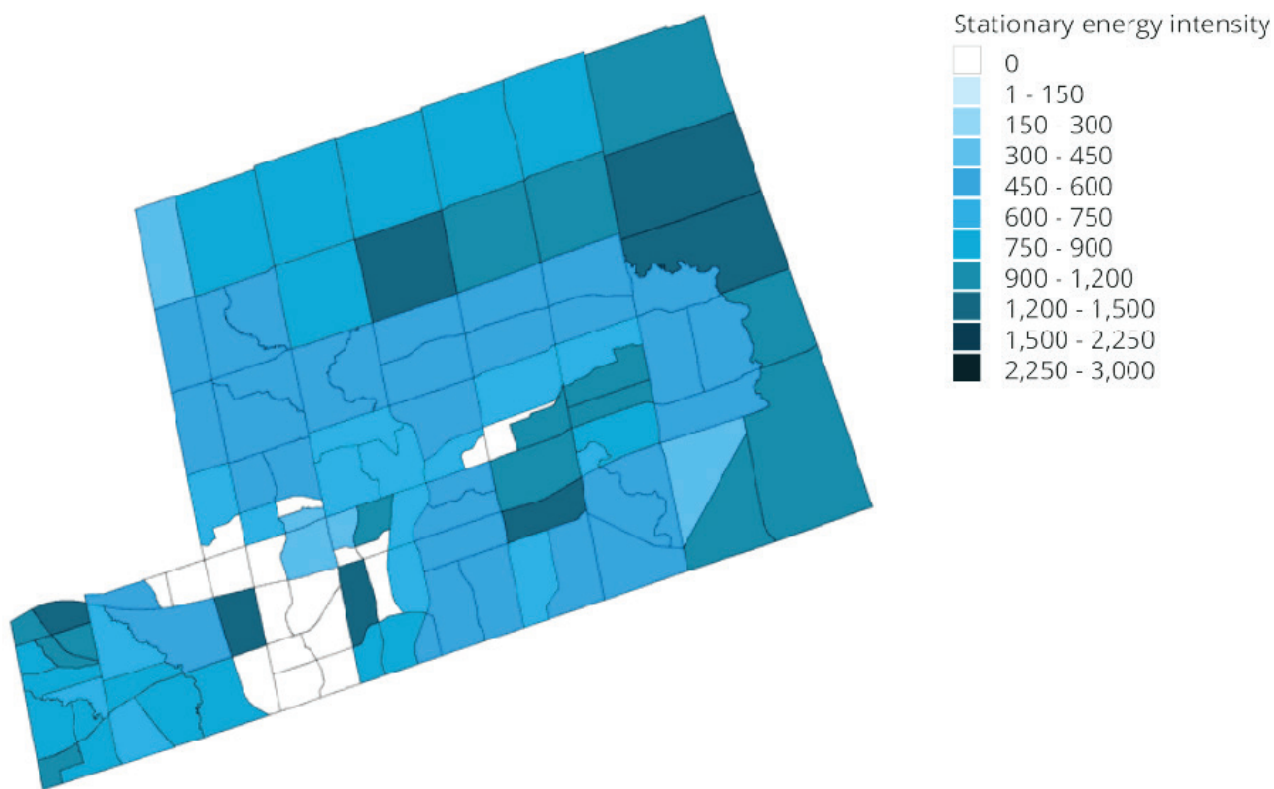


Figure 14. An example of stationary energy **density** mapping (in megajoules per square metre).


Sector-specific Considerations for Inventories

RELEVANT STREAMS

There are a variety of emissions sources (e.g. scopes) and data treatments to consider for each emissions sector of a GHG inventory. Additional guidance on this topic is provided in Appendix 5.

Collecting Emissions Data Versus Estimating

RELEVANT STREAMS



A community emissions inventory requires estimating some data based on underlying causal factors (e.g. automobile emissions can be estimated using the number of registered vehicles, estimated length and number of trips, vehicle fuel efficiencies, and fuel use). The inventory also requires understanding the causes of energy use and emissions production; even if certain data is known, it may not be enough to inform action. For example, knowing the total amount of natural gas sold in a community is sufficient for computing the emissions, but it is also necessary to know how the gas was used and for what purposes (e.g. how much for heating homes, and how much for office buildings, etc.). As a result, a community GHG inventory calculates GHG emissions from the *drivers* of the GHG emissions. Figure 15 is an example of such a calculation for transportation emissions.

$$\mathbf{CO_2 \text{ Emissions} = (A/B) * C * D * E}$$

- where*
- A** is the number of person trips made using the mode
 - B** is the number of people per vehicle (capacity factor)
 - C** is the trip length
 - D** is the fuel consumption per vehicle mile
 - E** is the CO₂ emissions per unit of fuel


Figure 15. Example of emissions calculation for transportation that considers emissions transportation drivers.

An inventory in 40 hours

The City of London updates its GHG inventory annually. The first inventory was completed in 1994, and was updated in 1999. The method used at that time was evaluated by ICLEI to ensure it was valid and this approach is used today. Electricity and natural gas are straightforward, based on data provided by the utilities. Transportation GHG emissions are calculated using retail sales data purchased from Kent Group, an approach that is straightforward in comparison with analyzed origin-destination information and is appropriate for London as a geographically defined city. The cost of the Kent data is \$200/year and the approach is consistent year over year, facilitating the identification of trends over time. The City also purchases vehicle registration data from Polk (now IHS) in order to track vehicle ownership rates, which have been growing four times faster than population growth. The Kent data indicates, however, that vehicles are using less fuel per vehicle. Since signing on to the Compact of Mayors, the City has begun to report on GHG emissions from aviation and rail on a per capita basis using provincial numbers. Total GHG emissions in London have declined. In 2015, London's greenhouse gas emissions were about 3.2 million tonnes of equivalent carbon dioxide, a reduction of 8% below 1990 levels and 18% below 2007 levels.

Mapping the Inventory to Key Stakeholders

RELEVANT STREAMS



Following the completion of the GHG inventory, it is useful to the rest of the planning process to identify stakeholders and key decision-makers who influence community emissions, a process that is a key part of the engagement strategy. These are potential partners in developing low carbon objectives and implementing low carbon actions, and the success of the plan requires understanding stakeholder priorities and addressing their critical issues. For example, the thermal efficiency of new housing is influenced by the building code and its enforcement, the skills and practices of the housebuilder, the preferences of the buyers, the marketing strategy of the developer, etc. Achieving low carbon housing requires a plan that aligns with these stakeholders' motivations. Table 26 maps the emissions sectors, high-level emissions drivers, factors in emissions levels, and key decision-makers. A tailored version of this table should be developed for each plan to identify stakeholders.

Table 26. Examples of stakeholders by emissions sector.

Emissions Sector	Key Stakeholders
Residential.	<ul style="list-style-type: none"> » Building and home owners; » Builders and construction industry; » Architects; » Banks and mortgagors; » Occupants and tenants; » Condo boards; » Real estate industry; » Gas and electric utilities; and » Building technology suppliers.
Personal Transportation.	<ul style="list-style-type: none"> » Vehicle operators; » Vehicle manufacturers and suppliers; » Transit organizations; » Infrastructure providers; » Highway operators and concessionaires; » Parking authorities; and » Developers.
Commercial Buildings.	<ul style="list-style-type: none"> » Owners, occupants, and tenants; » Energy and asset managers; » Commercial real estate developers; » Gas and electric utilities; » Financiers, investors; » Architects; and » Construction industry.

Emissions Sector	Key Stakeholders
Institutional Buildings.	<ul style="list-style-type: none"> » Owners; » Occupants; » Energy and asset managers; » Government finance managers; » Elected officials; and » Community agencies, boards, commissions.
Goods Movement.	<ul style="list-style-type: none"> » Supply chain managers; » Logistics companies; » Vehicle operators; » Infrastructure providers (local, provincial, federal governments); » Regulators (local, provincial, national and international); » Fleet managers; » Vehicle manufacturers; and » Consumers.
Manufacturing.	<ul style="list-style-type: none"> » Plant managers; » Investors; » Shareholders; » Equipment suppliers; » Energy utilities; » Policy makers; and » Regulators.

Inventory Continual Improvement

RELEVANT STREAMS


GHG inventories evolve from one year to the next for various reasons: data sources can become available or unavailable; local governments may merge with their neighbours; calculation errors may be discovered. The GPC provides guidance on when a local government should revise its previous inventories, indicating that changes should only be made if the implications are significant (Table 27). While GPC does not define significant, it is recommended that historical inventories should be revised if there is an impact of greater than 5%.

Table 27. Inventory recalculation triggers (adopted from GPC).

Change	Example	Recalculation needed? (significance)
Change in inventory boundary.	A community is included in or set aside from a city's administrative boundary.	Yes.
	Change in goal boundary from BASIC to BASIC+, or from 6 GHGs to 7 GHGs.	Yes.
	Shutdown of a power plant.	No.
	Build of a new cement factory.	No.
Change in calculation methods.	Change in calculation method for landfilled solid waste.	Yes.
	Adoption of a more accurate activity data instead of a scaled-down national figure.	Yes.
	Change in global warming potential factors used.	No.
	Change in electricity emissions factors.	No.
Discovery of significant errors.	Discovery of significant mistakes in calculations.	Yes.

TASK 2.4: SPHERES OF INFLUENCE

RELEVANT STREAMS



The final step in completing the inventory is to evaluate the local government's spheres of influence in emissions reduction, determining which emissions sources and volumes the government can effectively influence and which it cannot. To be effective in leading a community-wide transition to low-carbon, the local government must lead by example by addressing its own emissions (which typically account for 5–10% of total community emissions), as well as strategically leveraging its planning, infrastructure investment, permitting and regulatory activities, procurement, and other powers and influences.

As previously discussed, municipalities have different types of influence on emissions, which vary by region, size and type: upper tier (regions and counties) and lower tier (cities, towns, municipalities, and townships). At times, upper and lower are combined into a single tier, which assumes the responsibilities of both.¹³

Upper tier municipalities often co-ordinate service delivery between lower tier municipalities in their area or provide area-wide services. Emissions-relevant municipal services typically include:

- » Waste management;
- » Water & sewage;
- » Regional roads (as designated in Official Plans);
- » Natural heritage (possibly through MOU with Conservation Authorities);
- » Emergency services (police, ambulance);
- » Health unit;
- » Long term care; and
- » Mass transit.

Lower tier municipalities are primary service providers, which includes emissions-relevant services like:

- » Tax collection;
- » Building permit issuance;
- » Land development (Planning Act applications);

¹³ Municipal Affairs and Housing, Ministry of. "[Municipal Councillors Guide: Section 2](#)". Queen's Printer for Ontario.

- » Fire & emergency management;
- » Public works (roads maintenance); and
- » Parks & recreation facilities.

In order to determine where to focus its emissions reduction efforts, local governments can perform a simple spheres of influence assessment, outlined below.

Table 28. Approach to spheres of influence assessment.

	Basic	Intermediate	Advanced
Description.	Municipal levers can be identified for each of the major sources of GHG emissions through a process of inquiry. For example, if the major source of GHG emissions is from transportation, the discussion can focus on what levers the municipality has over the variables that influence transportation GHG emissions.	A method has been developed by C40 to systematically evaluate spheres of influence.	
Approach.	A workshop can be used to qualitatively identify the influence of the municipality on major sources of GHG emissions.	The spheres of influence method is described in the Guide appendices.	
Output.	Short document that describes the levers that the municipality can apply against the major sources of GHG emissions.	Report with charts that illustrate the spheres of influence.	

Spheres of Influence Method

RELEVANT STREAMS



A three-step method for assessing the emissions influences of a municipality—developed by C40 and adapted for the Ontario context—is described below. The method can also be used later in the planning process to evaluate the municipality's approach to specific actions.

- » Step 1: Identify major emissions sectors (e.g. transportation or buildings).
- » Step 2: Review the inventory to identify those causal factors over which municipality has direct or indirect influence. Add any other factors that are relevant to the particular context to ensure a complete list.
- » Step 3: Apply the assessment of local government's influence to each of these areas (from C40, information in Appendix 8 of this Guide).

The assessment of spheres of influence is a representation of the current powers of local government or municipally-owned entities. It will likely identify gaps between the required emissions reductions and the influence local government can wield. There are two approaches to bridging these gaps: partnering with entities that have influence, and developing new services to meet the requirement.

There are four main categories of influence for municipalities:

- » Own or operate;
- » Control budget;
- » Set or enforce regulations or policies; and
- » Set vision.

All energy and emissions actions a municipality is able to take will fall into one or more of these categories

More information on spheres of influence is available in Appendix 8.

Resource: ARUP. (2015). [Powering climate action: cities as global changemakers.](#)

TASK 2.5: FINANCIAL ASSESSMENT

RELEVANT STREAMS

An assessment of municipal expenditures can guide local governments as part of the situational analysis, using the idea of “follow the money” to bolster GHG mitigation. The financial assessment may also highlight some early opportunities to implement actions to reduce GHG emissions. Here is a suggested seven-step

financial assessment framework:

- » *Step 1:* Review pending and planned spending across municipal departments. Identify the top 10 capital investments planned in the next five years and the top 10 ongoing expenditures in the annual budget.
- » *Step 2:* “Ask the climate question” as to the impact of these expenditures on GHGs. Evaluate the impact of investments or expenditures on GHG emissions.
- » *Step 3:* Identify opportunities. Consider whether there are opportunities to adjust, modify, redirect, reorient, or relocate spending to maximize GHG reduction (e.g. how can a new development reduce emissions by incorporating transit, energy efficiency, active transportation, renewable energy production, etc.?). Discuss whether the incremental cost of possible changes would be major, significant, negligible, or generate net savings.
- » *Step 4:* Assess practicality. Once an opportunity is identified, review the current status of the project/policy/program/expenditure, what it took to get it there, key decision makers, key stakeholders, and their priority concerns, in order to assess the practicality of making a shift. Explore how the activity could incorporate GHG mitigation with the staff in charge of the activity.
- » *Step 5:* Conduct more detailed analyses. Once there is an initial engagement from the department in charge of the project, more detailed analysis will be required to assess implementation steps, costs and benefits.
- » *Step 6:* Integrate the financial opportunities in the community energy and emissions plan. The same process can be used to identify the impacts of municipal spending on climate resilience. Both mitigation and adaptation could be considered in this same exercise, which would shed light on synergistic, low-carbon resilience opportunities. For example, a recreation centre could potentially be designed as a community cooling centre during heat waves, or a shelter-in-place location with energy backup and storage to ride out severe storms.
- » *Step 7:* Consider investments by other levels of government. Beyond the analysis of municipal government investments and expenditures, community energy and emissions planning requires an understanding of the planned investments in the community by other levels of government and the private sector, how those investments will influence greenhouse gas emissions, and how municipal government influence could be brought to bear to achieve a low carbon outcome. Although municipal government is a significant player when it comes to investment—particularly in infrastructure—many investments are made by the private sector, and identifying and leveraging opportunities to lower the emission impacts of all investment in the community is key to a successful CEEP for achieving GHG emissions reductions.

Stage 2 Conclusion

The GHG emissions inventory may seem a daunting task, but if data partners such as utilities are engaged early and a systematic approach is applied, it can be completed within one to three months. The process of the inventory is a valuable exercise for the municipality which brings together diverse data sets and results in a more detailed understanding of the drivers of GHG emissions and energy use. There are many considerations, but all are sensible and most are straightforward. In addition to the information in this Guide, the GPC, LGOP, PCP and C40 provide useful documentation on performing emissions inventories guidance.

Stage 3: Target Setting

»OUTPUTS:

» TARGETS THAT ALIGN WITH THE PROVINCIAL TARGETS

After completing the GHG emissions inventory, a municipality has insight into the emissions reduction challenge at hand. Taking into consideration provincial and international emissions reduction targets, municipalities can begin to estimate and establish their own targets. Table 29 outlines this task.

Table 29. Stage 3 tasks.

Tasks	Description	Complexity of approach		
		Basic	Intermediate	Advanced
Stage 3: Target Setting				
3.1 Set an emissions reduction target for the community	Establish a GHG target consistent with or exceeding the provincial targets.	Adopt provincial targets for each time period.	Use recommended target setting approach in the Guide. For municipalities in the Growth Plan area, Schedule 3 forecasts are to be used. For municipalities outside of the Growth Plan area, Ministry of Finance projections are acceptable.	

TASK 3.1: EMISSIONS REDUCTION TARGET SETTING

RELEVANT STREAMS

Municipalities should consider aligning emissions reduction targets with provincial targets, while also setting targets that allow for flexibility to account for the local and regional context. Targets that exceed those of the province, in the level of ambition, are also valid. There is nothing preventing a municipality from adopting more ambitious reduction targets through adjustments to timelines or actions towards achieving deeper emissions reductions. Municipalities with existing targets should evaluate whether or not to revise their target after applying the recommended approach described below.

Provincial Targets

The province has established GHG emission targets for 2030 and 2050: 115 Mt CO₂e and 36 Mt CO₂e, respectively (Figure 16). These targets are based on achieving a 37% reduction in emissions by 2030 and an 80% reduction by 2050, in both cases as compared with the international reference year of 1990.

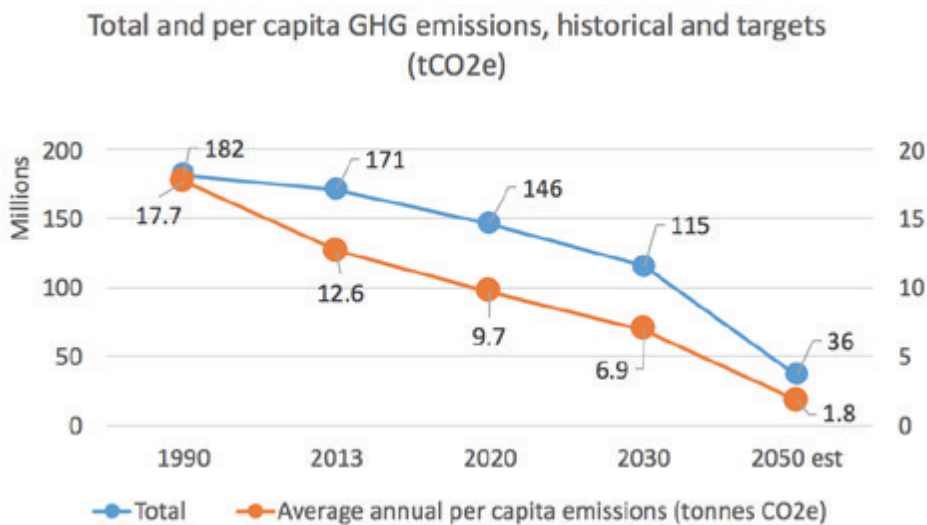


Figure 16. Ontario total and per capita GHG emissions, historical and targeted.

Notable Issues

There are several issues of note in setting municipal targets to be supportive and consistent with the provincial objectives:

- » The Ontario population is projected to increase significantly in the decades ahead, exceeding 16 million by 2030 and 19 million by 2050.¹⁴
- » Given the province's targets, deep reductions will be required in every sector; no one or two sectors are responsible for producing enough emissions to carry the burden of an 85% reduction.
- » Ontario populations are expected to increasingly urbanize. The economy is expected to continue to be dominated by the service sector. These expected demographic and economic trends will increase the portion of the province's GHG emissions that fall under the direct or indirect control and influence of municipal governments.
- » Population growth is projected to be overwhelmingly concentrated in southern Ontario, especially in the Greater Toronto and Hamilton Area. Other areas projected to grow rapidly include the City of Ottawa and communities in northern Ontario. Opportunities for decarbonizing are different in populous, growing, urban areas than in smaller, rural communities.

14 Ontario Ministry of Finance. (2017). [Ontario population projections update, 2016–2041](#).

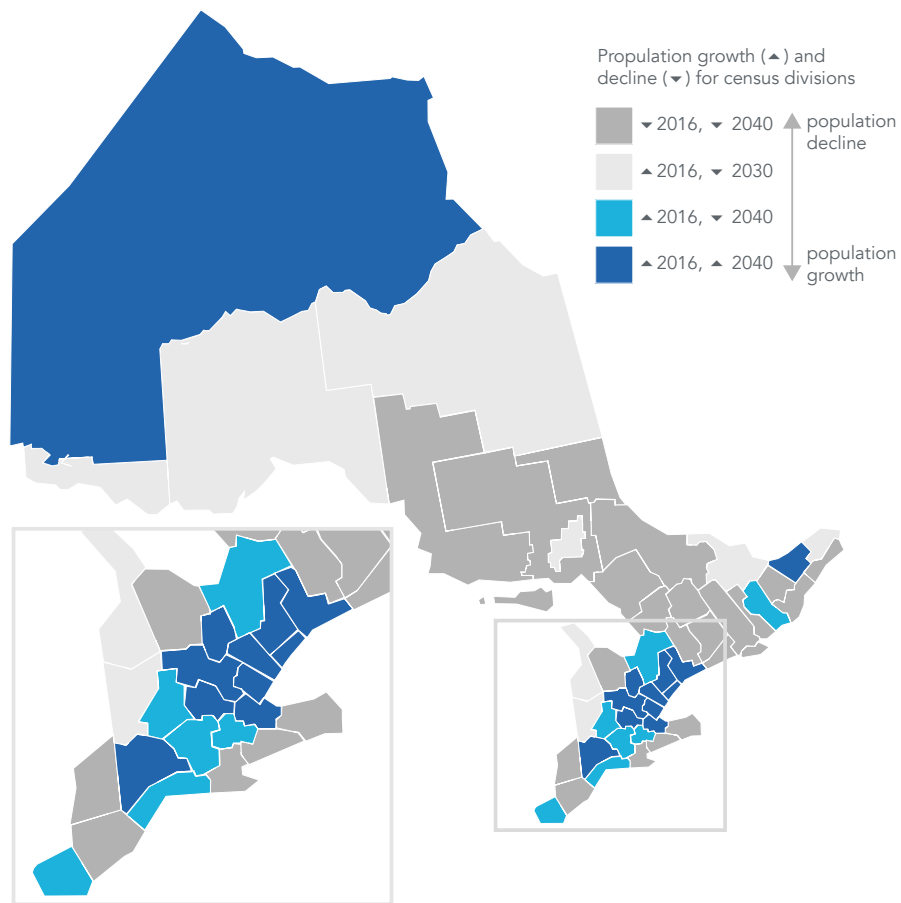


Figure 17. Projected population growth/decline by census division between 2016 to 2041.¹⁵

Setting Interim Targets

The importance of setting interim targets and the timing of action implementation is illustrated by Figure 18. Delaying action implementation and neglecting to set interim targets results in the requirement of a steep decline in GHG emissions close to the target year in order to achieve the emissions reduction target (rightmost illustration). At this point, the required reductions will probably be unachievable, and/or the transition will be so rapid that the emissions reduction actions will have major social impacts. Delaying action and neglecting to set interim targets also results in more emissions produced over the period to the target year. Conversely, imminent action implementation and setting interim targets results in the fewest emissions over the period (leftmost illustration).

¹⁵ Ontario Ministry of Finance. (2017). [Ontario population projections update, 2016–2041](#).

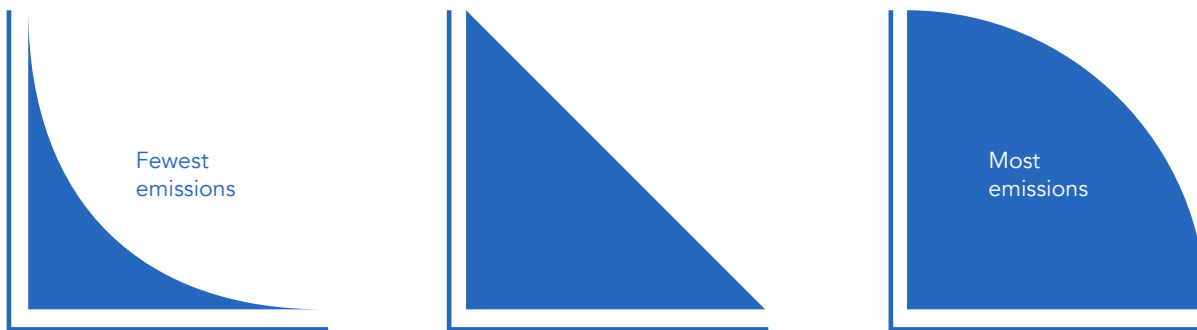


Figure 18. Emissions reductions associated with timing of actions and setting interim targets.

Recommended Method for Aligning Targets

While municipalities may choose to set alternative targets based on what is realistic and suitable for their municipality, it is recommended that municipalities consider adopting targets for 2020, 2030 and 2050 in parallel to the province's targets. The following table portions out the province's GHG budget on a per capita basis, as defined by the provincial targets.

Table 30. Per-Capita GHG emissions in Ontario, historical and targeted.

Year	Ontario population	Actual or Targeted GHG Emissions (tCO ₂ e)	Average annual per capita emissions (tCO ₂ e)
1990	10,295,832	182,000,000	17.7
2013	13,556,200	171,000,000	12.6
2020	14,980,400	146,000,000	9.7
2030	16,658,300	115,000,000	6.9
2050 est.	19,754,035	36,400,000	1.8

Notes: 1. The population projections are for 2021 and 2031, due to availability of data. 2. The 2050 population has been estimated by extrapolating the growth rate in the Ministry of Finance population projection, which extends to 2041.

The process to align municipal emissions reduction targets with the province's has three main steps.

- » **Step 1:** Identify or develop a population projection until 2050 for the municipality. Many municipalities will have existing population projections in their official plans. In the Greater Golden Horseshoe upper and single tier municipalities are required to use the forecasts in the Growth Plan; while lower-tier municipalities should use forecast that are specified for them in the applicable in effect upper-tier Official Plan. For others, population projections are available from the Ontario Ministry of Finance out until 2041. Municipalities will likely have to make a projection from their land use planning horizon to 2050 and this should be done on a straight

line basis. Any such projection should only be used for the purposes of GHG target setting and, even then, should be revisited whenever population forecasts in the Official Plan or Growth Plan are updated.

- » **Step 2:** Calculate the municipal GHG emissions allocation. Multiply the average per capita GHG emissions by the projected population in 2020, 2030 and 2050.
- » **Step 3:** Calibrate the target against the municipal GHG inventory. This process of calibrating the provincial target with the municipality's inventory ensures the target reflects the local context.

Table 31. Calculating the municipal emissions allocation.

Year	Municipality population	Per capita GHG emissions (tCO ₂ e)	Municipal Allocation (tCO ₂ e)	Notes
Base year: 2013	10,000	12.6	126,000	Compare this number with the municipal GHG inventory.
2020	15,000	9.7	145,500	
2030	20,000	6.9	138,000	
2050 est.	30,000	1.8	54,000	

The per capita GHG emissions include emissions from industry and other sources which the municipality cannot easily influence. If the GHG inventory for the base year is less than the municipal allocation for the base year, adjust the allocation using a calibration factor. The calibration factor is calculated by dividing the 2013 GHG inventory by the municipal allocation. If the GHG inventory is greater than the provincial allocation, this is likely the result of regional differences in driving patterns, the size of dwellings, the presence of industry and other factors. Do not adjust the target upwards as this could result in municipal targets that in aggregate exceed the provincial target. With one exception: if industry accounts for more than 50% of the community's GHG emissions. In this case, the municipality can generate targets that align with the percentage reductions identified by the Province (a 37% reduction in emissions by 2030 and an 80% reduction by 2050, in both cases as compared with the international reference year of 1990).

If a 2013 GHG inventory is not available, an inventory from the period 2011-2014 can also be used. If no inventory is available, the municipal allocation can be adopted as the target.

Table 32. Calibrating against the GHG target.

Year	Municipality A population	Per capita GHG emissions (tCO ₂ e)	Provincial allocation (tCO ₂ e)	GHG inventory	Calibration factor	Target (tCO ₂ e)
Base year: 2013	10,000	12.6	126,000	100,000	0.79	
2020	15,000	9.7	145,500		0.79	115,500
2030	20,000	6.9	138,000		0.79	109,500
2050 est.	30,000	1.8	54,000		0.79	43,000

A Carbon Budget

The target resulting from this process constitutes a carbon budget for the municipality for each time period—the total amount of carbon all emissions-producing activity in the municipality cannot exceed if the targets are to be achieved.

More reading: ARUP, & C40. (n.d.). *Deadline 2020*.

More Ambitious Targets

Some municipalities may elect to adopt more ambitious targets, with either a more aggressive timeline or deeper emissions reductions. Examples include 100% renewable energy or net zero GHG emissions by 2050 or earlier. These approaches also address the intention of the Guide, although municipalities should accompany this target with additional interim targets.

Example: Oxford County. (n.d.). *Draft 100% renewable energy plan*.

Lower and Upper Tier Governments

The method also ensures that targets are consistent for both upper and lower tier governments. To identify its target, an upper tier government needs to sum the targets of lower tier governments.

Table 33. Calculating a GHG target for a Region.

Year	Municipality 1 target (tCO ₂ e)	Municipality 2 target (tCO ₂ e)	Region target (tCO ₂ e)
Base year: 2013	10,000	15,000	25,000
2020	15,000	15,000	30,000
2030	20,000	25,000	45,000
2050 est.	30,000	35,000	65,000

In the case when lower tier municipalities have not completed inventories, an upper tier municipality can use the municipal allocation in Table 31 to calculate targets, without calibrating against local inventories. Upper tier governments should seek to align their targets with their constituent lower tier governments.

Stage 4: Actions and Scenarios Development

»OUTPUTS:

- » **LOW CARBON PATHWAY;**
- » **CO-BENEFITS ANALYSIS**

Following the identification of a target, the municipality needs to determine and implement actions to achieve it. In the context of this Guide, an action is defined as a physical intervention or a series of interventions which results directly or indirectly in GHG emissions reductions. An action can be implemented through various mechanisms including a policy, a by-law, a financing program, an investment, an educational program or another approach that has a physical impact on energy and GHG emissions.

Tasks	Description	Complexity of approach		
		Basic	Intermediate	Advanced
Stage 4: Actions and Alternative Scenarios Development				
4.1 Actions identification.	Develop a catalogue of potential municipal actions.	Best practices from other municipalities.	Identification by steering committee and best practices.	Identification through public engagement, best practices and steering committee.
4.2 Alternative scenarios development.	Bundle the actions into alternative energy and emissions future scenarios. Land-use patterns need to be one dimension of the scenarios.	Staff development of scenarios; scenarios may be qualitative.	Scenario planning workshops, scenarios are modelled.	
4.3 Modelling .	Quantitatively evaluate the emissions impact of the scenarios versus the reference scenario.	Qualitative assessment.	Quantitative modelling.	Integrated energy, emissions and spatial modelling.
4.4 Analysis of co-benefits.	Evaluate the impact of the scenarios and actions on a range of co-benefits.	Qualitative assessment.	Non-spatial quantitative analysis.	Spatial quantitative analysis.
4.5 Preferred scenario.	Select a preferred scenario.	Qualitative assessment.		
4.6 Prioritization.	Prioritize the actions within the scenario.	Discussion/voting.	Multi-criteria analysis.	Multi-criteria analysis + engagement.
Tools.		PCP Milestone Tool.	Climate action for URban sustainability (CURB).	CityInSight/ Urban Footprint.

Table 34. Sample engagement activities.

	Basic	Intermediate	Advanced
Engagement activities.	SWOT analysis, committees.	Committees, crowdsourcing on web-based platforms, workshops.	Committees, crowdsourcing on web-based platforms, workshops, focus groups, participatory decision making.

TransformTO, the City of Toronto's low carbon planning process included scenario planning and analysis of co-benefits.

- » Baseline and Build-as-planned: this component involved the development of an baseline emissions inventory for 2011, the development of a build-as-planned (BAP) scenario to 2050, and development of a series of energy maps.
- » 2020 Analysis: the quantification of reduction potentials of key measures or strategies to achieve Toronto's 2020 target.
- » 80x50 Low Carbon Scenario: explores the potential pathways of achieving Toronto's 2050 target; it involved the modelling and quantification of reduction potentials of key low carbon actions to support this effort have been modelled in the form of a Low Carbon scenario.
- » Analysis of Health, Economic Prosperity and Social Equity: a research paper detailing a synopsis of the literature describing co-benefits and co-harms of actions and policies designed to reduce greenhouse gas (GHG) emissions, focusing on health, social equity and economic prosperity.
- » Multi-criteria analysis (MCA): MCA was used to identify (through quantitative and qualitative analysis) the co-benefits of bundles of actions against criteria which were identified in the co-benefits literature review and weighted the Modelling Advisory Group (MAG). Amongst others, criteria included public health, clean air and quality affordable housing.
- » Financial analysis: a detailed financial analysis of the BAP and low carbon scenario, including capital, operating and maintenance costs of all components within the actions, and all sectors, including employment.

SSG (2017). Modelling Toronto's low carbon future: Results of modelling greenhouse gas emissions to 2050.

Case study: North Cowichan Climate Action and Energy Plan.

North Cowichan is a small rural municipality on Vancouver Island. The District considered mitigation and adaptation actions in the same plan.

Mitigation Actions	Adaptation Actions
<p>1. Create a transportation planning program with dedicated staff</p> <ul style="list-style-type: none"> » 1a. Implement a Smarter Travel Choices Program » 1b. Establish a taxi-bus rural public transit system » 1c. Increase community biodiesel purchases and require municipal fleet biodiesel use » 1d. Join Project Get Ready and transition the municipal fleet to electric vehicles 	<p>1. Establish a climate change adaptation working group.</p>
<p>2. Ensure strict Implementation of OCP Development Guidelines</p>	<p>2. Mainstream adaptation into existing planning, operations and decision-making processes.</p>
<p>3. Employ municipal energy policy mechanisms</p>	<p>3. Identify high priority risks and opportunities to define and prioritize actions.</p>
<p>4. Implement a community solar energy program</p>	<p>4. Engage stakeholders and citizens.</p>
<p>5. Establish a municipal energy utility</p>	<p>5. Establish and maintain partnerships and networks.</p>
<p>6. Reduce municipal building energy use</p>	<p>6. Identify funding opportunities and strategies.</p>

TASK 4.1: ACTIONS IDENTIFICATION

The identification of actions is a two-stage process: identifying a long-list of actions, then narrowing the options to a short-list. In some cases, an initial demonstration project (or, 'proof-of-concept' project) may be appropriate in order to show the effects of a particular action and can be implemented to kick-start the action implementation process.

Actions Long-List

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The process of developing the long-list is a brainstorming exercise in which no actions should be immediately ruled out. Key sources of ideas are summarized in Table 35.

Table 35. Sample ideas sources for long-list actions.

Sources	Description
Review the situational analysis	The situational analysis includes a review of expenditures by the municipality, potential partnerships, land-use policy, review of policy from other levels of government and best practices from other jurisdictions.
Review the GHG emissions Inventory	The inventory provides insight into the major sources of GHG emissions in the community and therefore provides an indication of opportunities for investments in low carbon actions.
Community engagement	The community engagement process will identify actions that may not have been considered by the local government, are important to the community or address local priorities and co-benefits.
Best practices	A municipality can learn from the efforts of other municipalities, identifying what has worked and what has not and translating those experiences into the local context.
Review academic papers and reports	Academics and researchers publish papers and reports on municipal actions to reduce GHG emissions.

Actions Short List

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The short-list consists of actions that make strides towards the emissions reduction target and are appropriate for the local context. They can be bundled into scenarios and modelled.

As guidance for selecting actions, the municipality should consider these questions:¹⁶

- » Is the action appropriate to the scale of the municipality, now and/or in the future?
- » Is the action likely to have a significant impact on current or future GHG emissions?
- » Does the action avoid making irreversible decisions and getting locked into patterns or technologies that would be difficult and costly to reverse if new information or changing preferences arise?
- » Does the action perform well under a broad range of possible futures, rather than just being optimal for the most likely future?
- » Does the action achieve multiple policy goals and therefore garner support?
- » Does the action increase or decrease the burden (of risk, of cost, etc.) on vulnerable communities?

The process of selecting the short-list of actions can involve the project team, a steering committee or the community in a workshop, whichever is most appropriate for the context.

Actions should address the major emissions sectors, including buildings, the energy system, transportation, waste, and agriculture, forestry and land-use. If one of these systems is not a major source of GHG emissions as identified in the GHG inventory, the municipality may elect to set it aside. For example, if the municipality has limited area available for agriculture or forestry, this sector may not be considered.

Table 36 provides an example of a set of actions that can be used as a template.

¹⁶ Fay, M., Hallegatte, S., Vogt-Schilb, A., Rozenberg, J., Narloch, U., & Kerr, T. M. (2015). Decarbonizing development: three steps to a zero-carbon future. Washington, DC: World Bank Group.

Table 36. The cheat list: 20 key municipal energy and emissions actions.¹⁷

	Action	Justification	Impact	Estimated magnitude of GHG reductions
	LAND-USE			
1	Concentrate future development in areas appropriate for district energy and accessible to transit.	Land-use planning enables broader deployment of transit and district energy, and increased proximity for walking and cycling.	Reduce energy consumption.	Medium-high.
2	Green/sustainable community design and development.	Green/sustainable planning and design components/standards can reduce community energy footprints and enhance energy efficiency.	Reduce energy consumption.	Medium.
	TRANSPORTATION			
3	Enhanced transit.	Enhanced transit can displace vehicle use and achieves economies of scale.	Reduce energy consumption, fuel switch.	Medium.
4	Transportation demand management.	Transportation demand management can help people shift to lower carbon modes of travel.	Reduce energy consumption.	Medium.
5	Enhanced walking and cycling infrastructure.	New infrastructure can provide conditions that enable people to walk and cycle as opposed to drive.	Reduce energy consumption	Low.
6	Increased adoption of electric vehicles.	Electric vehicles are more efficient than gasoline powered vehicles and result in fewer GHG emissions.	Reduce energy consumption, fuel switch.	High.
	BUILDINGS			
	Future buildings			
7	Incentivize advanced energy performance.	It is more cost effective to build high efficiency buildings than to retrofit them afterwards.	Reduce energy consumption.	High.
	Existing buildings			
8	Incentivize retrofit of dwellings.	The existing building stock needs to be retrofit to minimize energy consumption, particularly electricity in order to offset additional electricity demand in the transportation sector. Retrofits also tend to be cost effective.	Reduce energy consumption.	High.
9	Incentivize retrofit of commercial buildings.		Reduce energy consumption.	High.
10	Incentivize re-commissioning of commercial buildings.	Re-commissioning represents a tune-up of the building systems to ensure they are operating at maximum efficiency.	Reduce energy consumption.	Low.

17 The estimated impact is based on modelled results from a number of municipalities in Ontario.

	Action	Justification	Impact	Estimated magnitude of GHG reductions
	ENERGY SYSTEMS			
11	Incentivize incorporation of solar photovoltaic systems into new construction.	Solar PV can be integrated into the built environment, displacing electricity from the grid from non-renewable sources.	Generate renewable energy.	Low.
12	Incentivize incorporation of solar photovoltaic systems on roofs of existing buildings.		Generate renewable energy.	Low.
13	Introduce zero carbon district energy systems.	District energy is used to provide renewable heat sources, displacing natural gas. District heat also results in economies of scale.	Generate renewable energy, fuel switch.	Variable.
14	Incentivize installation of electric heat pumps for space heating.	Electric heat pumps are an efficient way to use electricity to displace natural gas for heating.	Fuel switch.	High.
15	Incentivize installation of distributed energy storage.	Energy storage increases the efficiency with which distributed renewable such as solar PV can be used.	Store renewable energy.	Low.
16	Increase the use of renewable natural gas in district energy systems.	Renewable natural gas can be used in industry to displace natural gas consumption.	Fuel switch.	Variable.
	INDUSTRY			
17	Incentivize energy efficiency improvements for industrial processes.	There are significant opportunities for industrial energy efficiency gains.	Reduce energy consumption.	Variable.
	FREIGHT			
18	Incentivize the transition to zero emissions vehicles.	Electric vehicles are more efficient than gasoline powered vehicles and result in lower GHG emissions.	Reduce energy consumption, fuel switch.	Medium.
	WASTE			
19	Increase waste diversion rates.	Waste which goes to a landfill results in GHG emissions.	Reduce waste.	Medium.
20	Generate biogas from landfills and wastewater.	Methane resulting from wastewater treatment and landfills can be transformed into a renewable energy source.	Generate renewable energy.	Low.
	AGRICULTURE, FORESTRY & LAND-USE			
21	Increase forest area or restore wetlands.	Forests and wetlands absorb and store carbon from the atmosphere.	Increase storage of carbon.	Low.

TASK 4.2: SCENARIO DEVELOPMENT

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Once a short-list of actions has been developed, the next step is to bundle those actions into scenarios. A scenario may contain a selection of actions or all of the actions, at different levels of ambition. Scenarios are used to explore possible low-carbon futures for the community in order to understand the implications of different actions and how actions interact with each other.

Table 37. Scenario development approaches.

	Basic	Intermediate	Advanced
Approach	Develop narrative scenarios that describe a possible future for the municipality.	Develop future land-use scenarios for the municipality and quantitatively evaluate them in a model.	
Tools	n/a	UrbanFootprint	CityInSight
Outcomes	Document with a conceptual description of possible futures.	Representation of future land-use patterns in a model.	Coherent quantitative representation of the future energy system in a model.

What is a Scenario?

A scenario is a comprehensive representation of a possible future. Scenarios help decision-makers explore cause and effect; for example, envisioning high, low or no population growth or an economic upturn or downturn. A scenario emphasizes the process of change rather than a particular point in the future. Scenarios need to address all the aspects that influence the urban energy system including assumptions on population, land-use, buildings, energy systems, transportation systems, etc. in a coherent package.

How are Scenarios Used?

In community energy and emissions planning, scenarios are used to explore different types of actions and to identify a low carbon trajectory. The application of scenarios provides a framework for bundling the actions into a coherent picture of the future. Their use of scenarios provides various insights, as summarized in Table 38. Following the development, analysis and prioritisation of scenarios, the resulting preferred scenario can be translated into policies such as the Official Plan

and secondary plans. This approach ensures congruence between a desired future and municipal policies.

Table 38. Uses of scenarios in energy and emissions planning.

Use	Description	Sample Questions
Decision-making	“Future proof” a portfolio of activities and proposed actions.	What is the impact of changing climate on heating and cooling loads and potential district energy locations?
Prioritization	Determine where and how to allocate infrastructure investments.	Where should future development be located to support frequent transit?
Testing	GHG reductions impacts of taking actions to differing extents.	How much money can be saved by retrofitting the building stock in the community?
Oversight	Add perspective and insight to transportation, land-use planning or other planning processes.	How do different land-use patterns impact total vehicle kilometres travelled?
Integrative	Explore the impact of different interventions on the community as a whole.	What is the impact of introducing heat pumps and electric vehicles on total electricity demand?
Generative	Generate innovative ideas, programs, products, and services.	What mechanisms can be used to support retrofits in low income households?
Timing	Understand the timing of interventions.	What is the optimal order of actions to maximize benefits to the local community?
Scanning	Monitor for major technological or technical shifts.	How do autonomous vehicles impact land-use planning and GHG emissions?
Anticipatory	Prepare for major changes in the future.	Where should district energy systems be located?
Engaging	Support engagement around complicated and difficult issues in a safe (hypothetical) way.	What are the implications of scenarios on employment and energy costs?

How are Scenarios Developed?

Scenarios should be designed to explore key issues or discussions in the community. For example, a discussion around the form of future development could be used to frame scenarios around suburban development versus a compact downtown. While the form of future development is the focus, the scenarios can also incorporate all or some of the short-list actions. Population projections are generally held constant across all the scenarios in order to clearly assess the impact of policies and strategies on a per capita basis. However, different population projections and economic development trajectories may also be reflected in the scenarios.

The following guidelines inform scenario development:

- » *Use two or four scenarios.* Each scenario should be characterised by a theme that represents the key emphasis of the scenario. An odd number of scenarios should be avoided as the tendency is always to choose the middle one as the preferred scenario.
- » *Challenge conventional wisdom.* The scenarios should explore both

potential and unusual futures, and the results of these two different approaches can provide insight on the future of the community. Examples could include 'net-zero' or 'net positive' scenarios for the community.

- » *Use highly differentiated futures.* The scenarios should represent very different futures so that it is possible to evaluate the impacts of the differences between the scenarios.
- » *Present alternatives.* Efforts should be made to avoid a 'preferred' future scenario. Alternative courses of action should be identified in different scenarios in order to avoid scenarios that replicate an established vision for the future.
- » *Scenarios should focus on specific issues.* Scenarios should reflect near-term decision-making concerns, but should not directly answer the focal question.
- » *Scenarios should be plausible,* given the current world situation. A scenario that assumes that technology will solve all the world's problems is not realistic because it relies on a highly improbable outcome.
- » *Scenario names should be memorable,* so they can easily be evoked and referred to.
- » *Implement provincial land use policy direction.* Scenarios that would not implement provincial land use policy direction (e.g. those that would not conform with the Growth Plan for the Greater Golden Horseshoe) should be avoided.

Table 39 describes four sample scenarios, illustrating a possible approach to scenario development.

Table 39. Sample scenarios.

Scenario	1. Reference.	2. Compact growth.	3. Deep reductions.	4. Local economic development.
Theme	Existing policies and plans are implemented.	Future growth is concentrated in the downtown core.	Maximize efforts to reduce GHG emissions.	Emphasis on job creation and businesses opportunities.

Case Study: City of Toronto and Region of Durham

The Region of Durham Community Energy Plan.

The Region of Durham Community Energy Plan. The Region of Durham worked together with its eight constituent municipalities to develop a collaborate community energy plan. At the heart of the plan was the development and quantification of four scenarios. Each scenario was a combination of technology and land-use projections. A Business as Planned technology scenario extrapolated existing provincial and federal policies as they related to building performance, energy systems and transportation, as well as an interpretation of current regional and municipal planning policy. A low carbon technology scenario applied ambitious actions to the same themes. A conventional expansion scenario illustrated the impacts of ongoing land-use development according to current policy and an urban intensification scenario refocused growth on centres. These scenarios were overlaid on each other to better understand the impact of land-use on the low carbon technologies and quantified in an urban energy systems model.

City of Toronto low carbon scenario

The Low Carbon Scenario explores a potential pathway for achieving Toronto's 2050 target; reducing emissions by 80% by 2050 over 1990 levels, known as 80x50. Actions are developed for each theme including retrofits for both residential and commercial sectors, energy performance targets for new construction, renewable energy installations on buildings, district energy for selected neighbourhoods, electric vehicle uptake and so on.

The Reference Scenario

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Typically, one scenario will reflect the energy and emissions future that will arrive if the municipality does not undertake any additional actions; this scenario is defined as the reference scenario, business as usual (BAU) or business as planned (BAP). Various projections may be available to help inform the development of the reference scenario (Table 40). If these are not accessible, the municipality can develop assumptions according to its best judgement, emphasising that there is no perfect answer.

Table 40. Framing the reference scenario¹⁸.

Projection Types	Considerations	Implications	Potential data sources
Population.	<ul style="list-style-type: none"> » Will the the population grow, remain flat or decline? » Will the number of people per dwelling grow, remain flat or decline? 	<ul style="list-style-type: none"> » The change in population determines the number of new dwellings required and the number of new jobs generated. 	<ul style="list-style-type: none"> » The Growth Plan projections (2017); Official Plan projections; Ministry of Finance population projections.
Employment.	<ul style="list-style-type: none"> » What will the employment rate be? » How will the size of workplace change for different sectors? 	<ul style="list-style-type: none"> » The number of jobs and area of space r equired for those jobs determines the additional commercial or industrial floor space required. 	<ul style="list-style-type: none"> » Economic development strategies; Growth Plan (2017).
Land-use planning.	<ul style="list-style-type: none"> » Where will the new dwellings be located? » Where will new non-residential dwellings be located? » How can natural areas be protected or enhanced? 	<ul style="list-style-type: none"> » The location of the buildings influences how people move around and the potential for decentralized energy. Natural areas store carbon. 	<ul style="list-style-type: none"> » Official Plan projections, transportation modelling projections, the Growth Plan (2017), Provincial Policy Statement, 2014 and other provincial direction.
Buildings.	<ul style="list-style-type: none"> » How will the size of dwellings change? » How will the mix of dwellings change? » How will the design of buildings change with respect to energy efficiency? 	<ul style="list-style-type: none"> » The size, type and design of buildings influences their energy consumption. 	<ul style="list-style-type: none"> » Building code projections

18 For the Buidlings row. [Code projection examples see page 92: Environmental Commissioner of Ontario \(2016\). Conservation: Let's get serious.](#)

Projection Types	Considerations	Implications	Potential data sources
Vehicles.	<ul style="list-style-type: none"> » How will vehicle technologies change? » How will vehicle efficiency change? » How will commercial transportation technologies change? » How will commercial transportation trip length change? 	<ul style="list-style-type: none"> » The types of vehicles influences the energy consumption and the type of fuel that is used. 	<ul style="list-style-type: none"> » Federal fuel efficiency regulations.
Mode share.	<ul style="list-style-type: none"> » How will people's perspective on transit, walking and cycling change? » How will the transit system evolve? 	<ul style="list-style-type: none"> » The mode of transportation impacts energy use and GHG emissions. 	<ul style="list-style-type: none"> » Transportation master plan.
Solid waste.	<ul style="list-style-type: none"> » How will waste generation patterns change? » How will waste diversions rates change? » How will the landfill management processes change? 	<ul style="list-style-type: none"> » Solid waste management impacts GHG emissions from landfills. 	<ul style="list-style-type: none"> » Solid waste management plan.

The most straightforward approach to projections is to integrate existing projections or targets from municipal, provincial or federal policies. In the absence of projections, the municipality can identify its best estimate or set new targets. For example, if there is no existing target for solid waste diversion, this process can be used to establish such a target within one or more of the scenarios. Comparison of the reference scenario target year emissions to the emissions reduction target for that year yields the emissions reduction gap between where a community's emissions level is headed, versus where it is recommended or required to be (Figure 19).

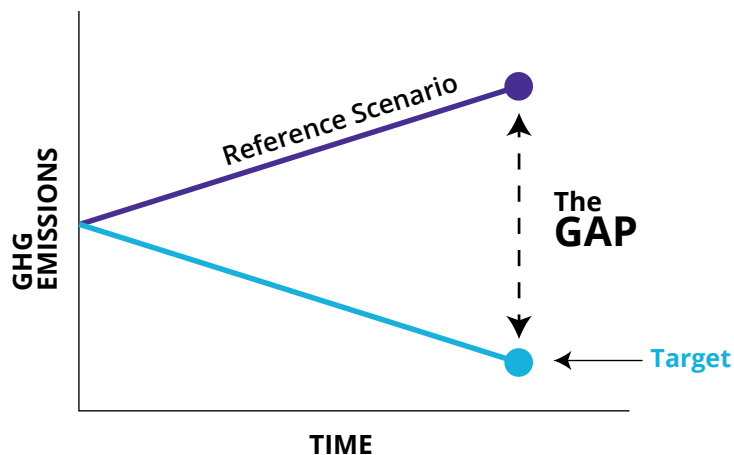


Figure 19. The gap between the target and the reference scenario.

Low Carbon Scenarios

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The assumptions for each low carbon scenario should be described in detail and quantified wherever possible. In some modelling approaches, such as an optimization model, the action will be implemented according to its relative costs. In other approaches, the actions are defined by the project team.

Table 41. Sample questions to answer for scenario development.

	Action	Sample Questions
	LAND-USE	
1	Concentrate future development in areas appropriate for district energy and transit accessibility ; ensure a mixed of uses to create 'complete communities'.	How many future dwellings will be redirected? Where will the dwellings be located? Will different uses be mixed or segregated? What form will the dwellings take?
	TRANSPORTATION	
2	Enhanced transit.	Where will transit be added? What type of transit will be added? What will the capacity of the added transit be? Are major transit stations located in close proximity to high density development?
3	Transportation demand management.	What type of programs will be introduced? Where will the programs be introduced? What impact will the programs have?

	Action	Sample Questions
4	Enhanced walking and cycling infrastructure.	What kind of infrastructure will be added? Where will the infrastructure be added?
5	Increased adoption of electric vehicles.	How many vehicles will be added? How efficient will the vehicles be?
BUILDINGS		
Future buildings		
6	Require advanced energy performance.	When will the requirements be applied? To how many dwellings/buildings will the requirements be applied? What level of energy savings will be achieved?
Existing buildings		
7	Incentivize advanced energy performance.	Which types of dwellings will be retrofit? How many dwellings will be retrofit each year? Which individual and/or combination retrofits are planned for each dwelling type? What are the anticipated energy, emissions and cost savings for individual and/or combination retrofits per dwelling type?
8	Incentivize retrofit of commercial buildings.	What type of buildings will be retrofit? How much floor area per building type will be retrofit each year? What energy savings and GHG emission reductions will be achieved? (total and percentage)?
9	Incentivize re-commissioning of commercial buildings.	What type of buildings will be recommissioned? How much floor area will be recommissioned each year? What energy savings will result (total and percentage)?
ENERGY SYSTEM		
10	Incentivize incorporation of solar photovoltaic systems into new construction.	How many buildings will include solar PV? How large will the solar PV systems be? When will the systems be installed?
11	Incentivize incorporation of solar photovoltaic systems on roofs of existing buildings.	Will the systems be different for different types of buildings?
12	Introduce zero carbon district energy systems.	Where will the district energy systems be installed? What will be the energy sources? How many buildings will be connected to the systems?
13	Install electric heat pumps for space heating.	What will the efficiency of the heat pumps be? How many heat pumps will be installed?
14	Incentivize installation of electric heat pumps for space heating.	What type and size of storage will be installed? Where will the storage be installed?
15	Increase the use of renewable natural gas	Where will the renewable natural gas come from? How will the renewable natural gas be used?
INDUSTRY		
16	Incentivize energy efficiency improvements for industrial processes.	What type of improvements will be introduced? In what sectors will the improvements be applied? What energy savings will result?

	Action	Sample Questions
	FREIGHT	
17	Incentivize the transition to zero emissions vehicles.	How many vehicles will be added? What type of vehicles will be replaced?
	WASTE	
18	Increase waste diversion rates.	What will the diversion rate be? Will the diversion apply to all solid waste types?
19	Generate biogas from wastewater.	What volume of biogas will be generated? Where will the biogas be used?
	AGRICULTURE, FORESTRY & LAND-USE	
20	Increase forest area (leaf area index).	How much forest will be added? How much carbon can the forest store?

For many of the actions, a time-related question can be explored, such as, when will the action commence? Over what time period will it occur?

City of Surrey's actions and targets

From the City's modelling work, public input and policy review, action recommendations were made in 5 categories: land-use, transportation, buildings, district energy, and waste. The primary directions of these actions are:

- » Developing complete, compact, connected corridors to support transit and district energy;
- » Developing rapid transit, improved bus service, and active transportation infrastructure;
- » Performing building energy retrofits;
- » Creating green car strategies;
- » Creating a framework to meet steadily rising building energy standards to deliver energy savings; and
- » Providing guidance to build on the city's zero waste agenda.

The key targets of the plan are:

- » Increase proportion of Surrey residents within a 5 minute walk to Frequent Transit Stations 10% by 2020 and 21% by 2040;
- » Reduce personal vehicle driving distances 4% by 2020 and 9% by 2040 • Increase bicycle route kilometers 57% by 2020 and 148% by 2040;
- » Improve building energy performance 10% beyond typical new construction by 2040 • Increase the annual retrofit rate of existing buildings to 2% from 1% by 2040;
- » Meet City-owned DE energy requirements with 40% renewables by 2020 and 75% renewables by 2040 (illustrative and modeling purposes only; see section for notes); and
- » Divert 75% of solid waste to recycling and composting by 2020 and 85% by 2040.

Pursuing the directions in its CEEP, Surrey could reduce emissions by 47% on a per capita basis and by 41% on a total community wide basis by 2040. Community-wide, Surrey aims to reduce emissions 33% by 2020, and 80% by 2050, relative to 2009 levels.

TASK 4.3: MODELLING

RELEVANT STREAMS

The relationship between land-use planning, the form of the built environment, transportation systems, energy consumption and GHG emissions is complex and varies from one municipality to the next. While there are common themes and specific actions that likely make sense in every context, in order to relate potential outcomes of actions to targets and policies—and to understand the financial implications—a model is generally required.

A model is a concept of an existing or proposed real system. Models are used to explore the results of scenarios and to evaluate the impacts of actions. They typically consist of a computer program that requires inputs and assumptions, and generates results.

Many planners work with models, most commonly for spatial population projections and for transportation planning. Energy and emissions models incorporate consideration of land-use planning, transportation engineering, waste management, building design, GHG emissions accounting, and other aspects. For this reason, a community energy and emissions model can be used to support a number of planning exercises simultaneously. There is no clear consensus on what this type of model is called in the literature, but the Government of BC has defined them as community energy and emissions models (CEEMs).

Scenarios should be represented in a model in as much detail as possible. A spatial model facilitates the analysis of different land-use policies on transportation patterns, the provision of district energy, and the form of buildings. The model should also illustrate the introduction of different technologies and their impacts on GHG emissions and energy consumption.

The framework of Reduce, Improve, Switch provides guidance on the order in which the actions can be implemented. If an action reduces energy consumption, it should occur prior to an action that requires the introduction of new technologies. This approach results in saved energy costs, and reduced capital costs for new technologies.

Selecting a Model

RELEVANT STREAMS

The following specifications are recommended in considering which model to select to perform scenario analysis.

Table 42. Model characteristics.

Basic specifications	Desirable attributes
<ul style="list-style-type: none">» Analyze land-use patterns» Incorporate future scenarios» Evaluate policy levers and other actions» Construct scenarios» Represent building and transportation systems» Analyze GHG emissions and energy	<ul style="list-style-type: none">» Assess financial implications» Assess co-benefits, health impacts, and financial impacts» Transparent assumptions and data treatment (e.g. open source)

It is important to understand the underlying assumptions that a model makes about how the world works. For example, some models assume that humans make decisions based on economic signals, while other models are driven by historical patterns of behaviour, and still others are constrained by physical characteristics of the world. Each approach has strengths and limitations that are important to consider. In order to better understand these assumptions, local government should ask the model creators how their model addresses:

- » Economic trends;
- » Population trends (residents + employment);
- » Land-use development (number of units and/or floor area of new construction, demolitions, renovation);
- » Transportation behaviour;
- » Technological development;
- » Government legislation, policies and initiatives; and
- » GHG emissions (e.g. are the GHG emissions analyzed bounded by a geographical boundary or are they the result of the behaviour of a population, irrespective of where they are emitted? Is a specific GHG accounting protocol used?)

The Importance of 'Integrated' Models

It is important to note that some models are 'integrated' and some are not. In an integrated model, the way in which the actions are modelled has implications for the GHG reductions associated with each action. In non-integrated models, action effects have no implications on other actions, which is typically inaccurate. For example, the GHG reduction associated with enhanced transit is much greater if the vehicle fleet is assumed to be primarily fuelled by gasoline, than if electric vehicles have been introduced. Similarly, the GHG reductions associated with building retrofits are greater if they are undertaken prior to replacing natural gas furnaces with electric heat pumps. Integrated models better reflect real world actions and their impacts: they are also consistent with the emphasis on integrated planning in the Growth Plan, 2017.

Refer to Appendix 9 for more information on selecting a model, establishing modelling assumptions, and calibrating models.

Read more: Condon, P. M., Cavens, D., & Miller, N. (2009). *Urban planning tools for climate change mitigation*. Cambridge: Lincoln Institute of Land Policy.

Managing Modelling Uncertainty

RELEVANT STREAMS

The modelling process incorporates considerable uncertainty, a characteristic of any exploration of the future. The first strategy for managing this uncertainty is transparency: documenting the modelling approach, inputs and assumptions in an accessible manner. A second strategy is to explicitly acknowledge the uncertainty, avoiding any claims of prediction. A third strategy is sensitivity testing: adjusting variables by 10% or more to evaluate the impact of the variable on the overall result. This approach seeks to address the questions: What if our assumption for this variable is wrong? To what degree does that influence the result? A fourth strategy is tied to monitoring and evaluation, so that the modelling and policies evolve as new information is collected and analyzed.

Considering Disruption

RELEVANT STREAMS

Technological developments are always on the cusp of instigating considerable disruption into municipal operations and the delivery of energy in a municipality. The modelling of energy and emissions scenarios is an opportunity to explore the potential impacts of these technologies on social, ecological and economic outcomes—to capture opportunities and manage impacts.

Table 43. Examples of disruptive technologies.

Technology	Possible Impacts
Electric vehicles.	Stress on the electric grid, job losses in production, maintenance and repair, reduced energy and GHG emissions.
Autonomous vehicles.	Reduced transit use, smaller vehicle fleet, reduced parking, increased VKT, increased accessibility, fewer driving-related jobs.
Energy storage.	More resilient grid, new employment opportunities, reduced GHG emissions, orientation of buildings, new investment opportunities.
Decentralized energy production.	More resilient grid, new employment opportunities, reduced GHG emissions, orientation of buildings, new investment opportunities.

Modelling Results: Telling a Story

Once the scenarios have been modelled, visualizations can be used to better understand and communicate their implications. The following figures provide several examples.

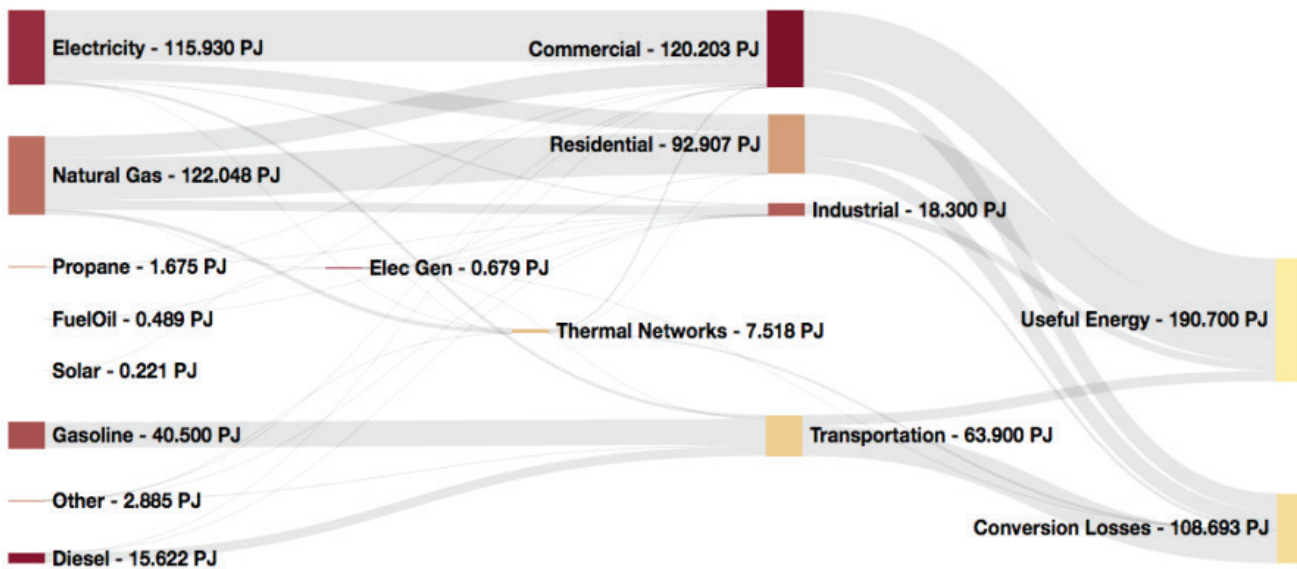


Figure 20. Example of a Sankey diagram.

A Sankey diagram illustrates how energy sources are used. In Figure 20, natural gas and electricity are the dominant fuel sources—most of the electricity flows into the commercial sector and most of the natural gas flows into the residential sector. Just over one third of the total energy is lost. A comparison of Sankey diagrams for different scenarios illustrates the transformation of the energy system.

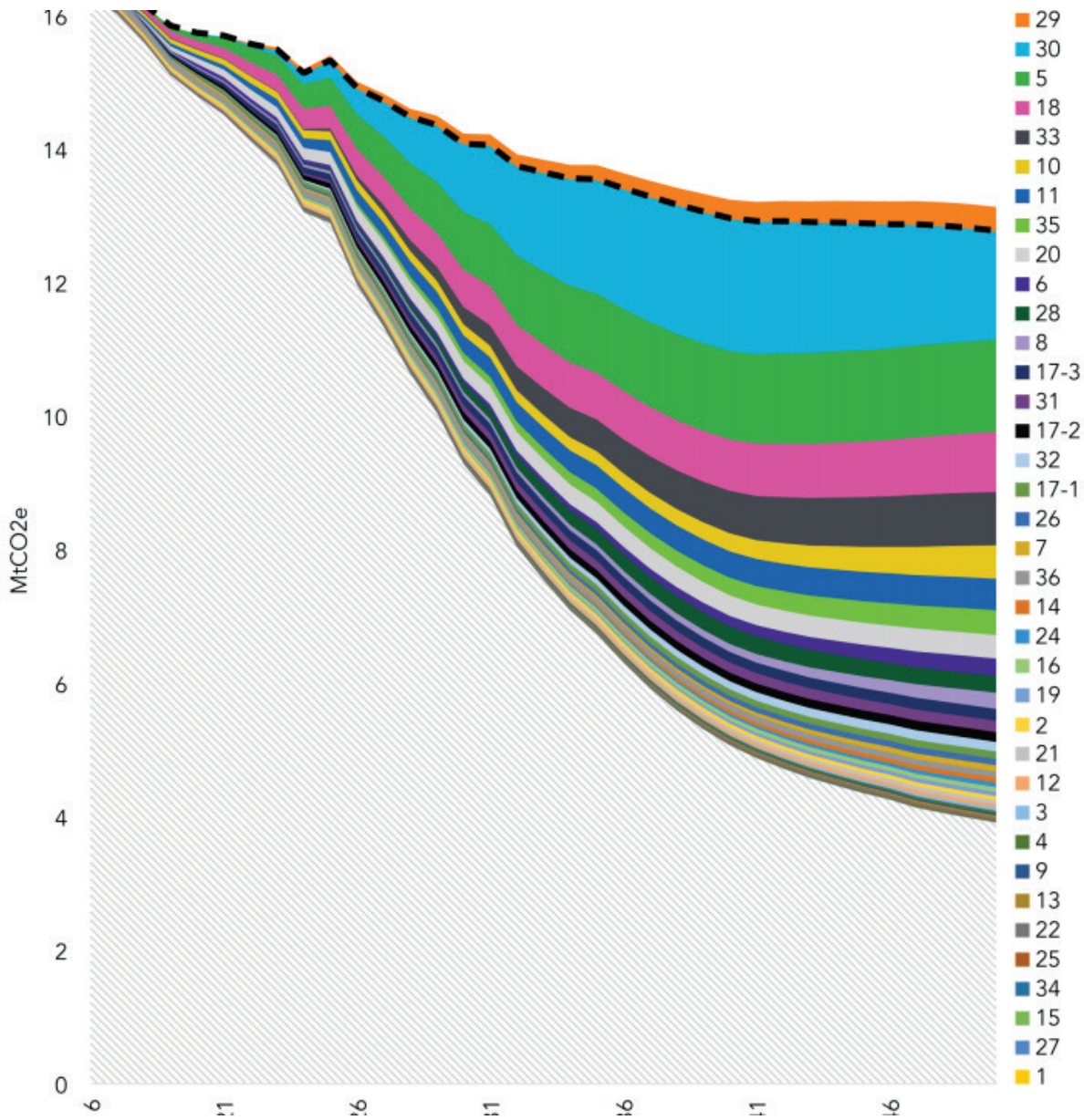


Figure 21. Example of a wedge diagram.¹⁹

A wedges diagram illustrates the relative contribution of different actions to a low carbon scenario. While it is quickly apparent which actions make the most significant contribution, wedge diagrams do not convey dependencies between different actions, feedback cycles, or the importance of the order in which actions are implemented.

¹⁹ SSG and whatIf? Technologies (2017). [TransformTO: Climate action for a healthy, equitable, prosperous Toronto.](#)



TASK 4.4: ANALYSIS OF CO-BENEFITS

RELEVANT STREAMS



In this Guide, co-benefits or co-harms are assumed to be any benefits or harms additional to the impact on GHG emissions. Analysis of co-benefits and co-harms is critical to understanding the opportunities to advance equity, support economic development and enhance community vitality. In many cases, actions that reduce GHG emissions in communities correspond or directly overlap with actions that create a vibrant community, improve public health outcomes, reduce municipal operating and capital costs, and support innovation; these are no-regrets policies. Actions that reduce GHGs are synergistic with a wide range of other public goods, and in fact, these actions can be justified from the perspective of any of a number of public goods.

There are clear equity benefits also, from increasing accessibility through compact urban form and increased transit to lower household energy costs. However, equity benefits are contingent on the way in which the actions and policies are implemented.

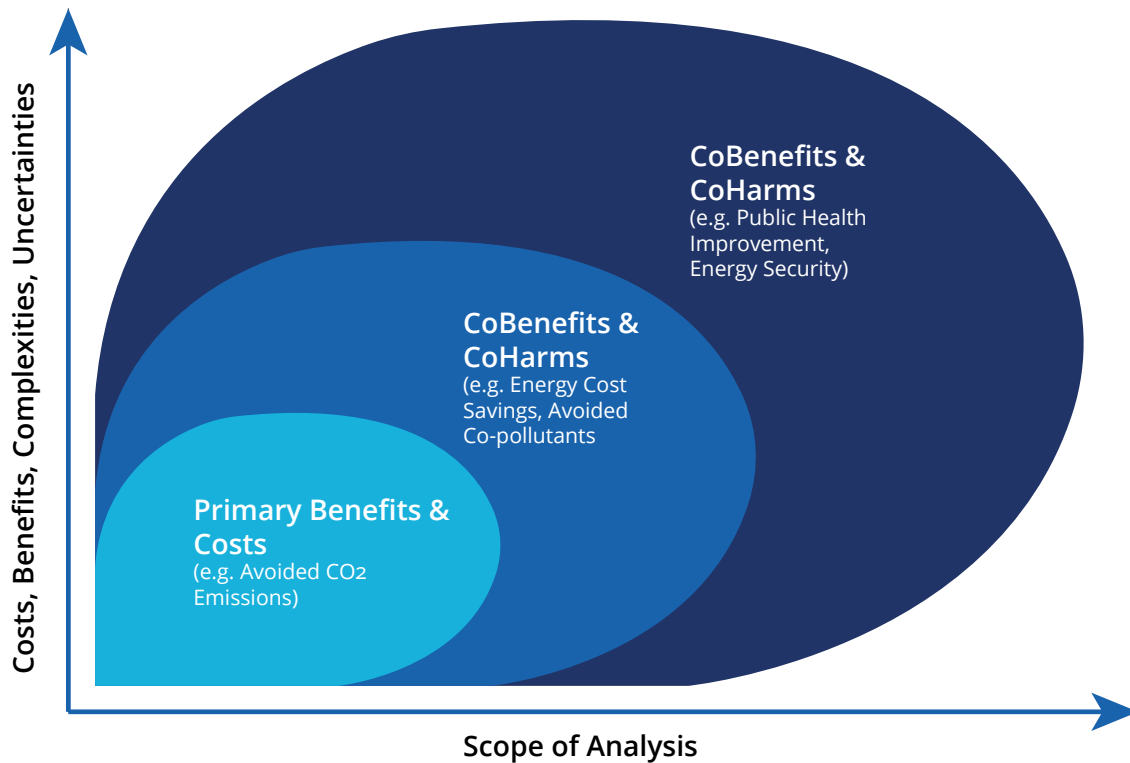


Figure 22. representation of co-benefits.²⁰

Not all co-benefits are equal. They can be evaluated against five factors:²¹

- » **Synergies:** Many low carbon actions have multiple socio-economic benefits, including transit, energy efficiency, and compact urban design.
- » **Urgency:** Some actions are associated with a higher degree of urgency in order to avoid loss of inertia, lock-in effects, irreversible outcomes, or deferred, elevated costs. Examples include road infrastructure decisions, major ecosystems displacement, and urban form. Some low carbon actions require time to realize their effects, making immediate implementation paramount.
- » **Costs:** Costs of early action is generally lower than later action, in particular because delayed action involves ongoing investments in infrastructure, activities and utilities that are higher emitting than low carbon solutions would be. Examples include district energy, transit, and energy efficiency.
- » **Longevity:** Related to urgency, the longevity of planning and development decisions locks cities into their effects for decades, if not centuries.
- » **Distribution effects:** Low carbon actions have different impacts on different subsets of the population, including income levels, generations (including future generations), and ethnicities.

²⁰ Dhakal, S., & Ruth, M. (Eds.). (2017). *Creating Low Carbon Cities*. Cham: Springer International Publishing.

²¹ Adapted from (Fay et al., 2015).

The evaluation of co-benefits or co-harms is challenging because the techniques for measuring each impact vary. In some cases, the technique of measuring itself may be inappropriate. As well, cause and effect relationships are often imprecise. Identifying co-benefits as precisely as possible facilitates the engagement of a wider range of stakeholders, who are able to align a diverse set of interests with the community energy and emissions plan. Achieving co-benefits with energy and emissions actions also provides added impetus to implement an action or policy. Table 44 summarizes some approaches to assessing sample co-benefits and co-harms.

Table 44. Assessing sample co-benefits and co-harms.

Co-benefits/ co-harms	Impact	Possible Indicator	Complexity
HEALTH			
Air quality.	Reduced combustion of fossil fuels reduces air pollution.	Change in city-wide air pollution levels.	Medium.
Physical activity.	Decreased driving can result in increased active transportation.	Additional kms walked and cycled per capita.	Medium.
Increasing accessibility.	Land-use planning patterns that support reduced driving also supports increased accessibility.	Portion of dwellings within 400m of frequent transit.	Low.
ECONOMIC PROSPERITY			
Employment.	Investments in low carbon actions result in the creation of jobs.	Number of new jobs created.	High.
Household incomes.	Investment in the energy system can increase energy costs, while increased efficiencies can result in cost savings.	Impact on household energy costs by neighbourhood.	Medium.
Economic development.	Advancing the low carbon economy results in new business opportunities.	Total investment required to support the low carbon scenario.	High.
Municipal finances.	Many actions require investments by municipalities, and can also create new revenue streams.	Municipal investment required to support the low carbon scenario.	Moderate.
SOCIAL EQUITY			
Poverty.	Increased energy efficiency may reduce household energy costs; although investments are required to do so.	Impact on household energy costs by neighbourhood.	High.
Elderly.	Increased proximity may increase accessibility for the elderly.	Feeling of isolation (identified through survey).	Medium.
Children.	Increased proximity may increase accessibility for children.	Number of households within walking distance of a school.	Medium.

Co-benefits/ co-harms	Impact	Possible Indicator	Complexity
ENVIRONMENTAL			
Biodiversity.	Increased forest area for carbon storage can create habitat and contribute to protecting endangered species or species at risk.	Change in leaf area index.	Medium.

There are many different strategies to translate co-benefits and co-harms into a dollar value, including market valuation, willingness to pay, willingness to accept, and others. Many co-benefits and co-harms are difficult to translate into a dollar value and therefore require a method that incorporates both qualitative and quantitative inputs. Appendix 10 describes Multi-Criteria Analysis, an alternative approach to cost-benefit analysis that can incorporate a qualitative assessment of intangible benefits, such as the indicators described in Table 44. The social cost of carbon is a estimate of the avoided damage resulting from GHG reductions that has been used by regulators in Canada and the US. In Canada, the application of the social cost of carbon has been displaced by a price on carbon, which is not directly related to potential economic damages. The carbon price can therefore be represented as an economic impact, whereas the social cost of carbon can be represented as avoided social impact.²²

Energy and Emissions Planning as Community Economic Development in Wawa

Wawa has experienced economic hardship with the 1998 closure of an ore mine, and again with a mill closure in 2007. A lack of opportunity prompted an outmigration of youth and skilled workers. Wawa is struggling to maintain existing services and generate new revenue. The town has the third highest electricity prices in the province, and spends an annual \$800,000 on energy and municipal services. The community energy plan represents an opportunity to increase self-reliance, encourage economic growth, and manage risk.

²² For estimates of the social cost of carbon see: Government of Canada (2017). Canada's approach on the social cost of greenhouse gases (archived). Presentation at the National Academy of Science Symposium on the Social Cost of Carbon. Washington, DC.

Resource: QUEST. (2016). *Methods for measuring the economics of community energy plans: An introduction for community energy managers.*

Increasing the Energy Performance of Buildings in Toronto

The Better Buildings Partnership (established in 1996) and the Home Energy Loan Program provide support to assist homeowners, commercial building owners, and social housing providers to reduce emissions in this sector. With Energy and Water Reporting and Benchmarking for Large Buildings (Ontario Regulation 20/17), Toronto will be able to monitor how effective these programs have been. Increasing the Energy Performance of Buildings in Toronto The City of Toronto has the authority to set standards for energy efficiency and other environmental attributes through an interpretation of the Planning Act which it applies through the Toronto Green Standard. For any new building being built, the City can set standards based on total energy use intensity, thermal energy demand intensity and GHG intensity for new buildings. Furthermore, the Better Buildings Partnership (established in 1996) and the Home Energy Loan Program provide support to assist homeowners, commercial building owners, and social housing providers to reduce emissions in this sector. With Energy and Water Reporting and Benchmarking for Large Buildings (Ontario Regulation 20/17), Toronto will be able to monitor how effective these programs have been.

Resource:

California Air Pollution Control Officers Association (2009). *Model policies for greenhouse gases in General Plans.*

Example:

City of Toronto. (2016). *Energy Strategy Terms of Reference.*

TASK 4.5 SELECTION OF A PREFERRED SCENARIO

RELEVANT STREAMS



Based on the outcomes of the co-benefits analysis and the scenario modelling analysis, a preferred scenario should be identified. The preferred scenario becomes the pathway for the municipality to achieve its GHG emissions target. In selecting the preferred scenario, the following considerations should be addressed:

- » Does the scenario meet or exceed the GHG target?
- » Does the scenario optimize co-benefits?
- » Does the scenario make sense for the context of the municipality?
- » What is the compelling case for the selection of the preferred scenario?
- » Does the scenario implement provincial land use policy direction?

The next planning steps, including prioritization and implementation, will focus on the actions contained within the preferred scenario.

TASK 4.6 PRIORITIZATION

RELEVANT STREAMS



Following the selection of the preferred scenario, scenario actions are prioritized. The prioritization process is important to identify the order of implementation, so that the municipality does not have too much on its plate at once, pursues actions in the appropriate order, and can achieve some quick wins.

Prioritization is typically an ad-hoc process, which cannot be easily understood by an outside party. Figure 23 illustrates how a decision framework can be used to

ensure transparency in the decision-making or prioritization.

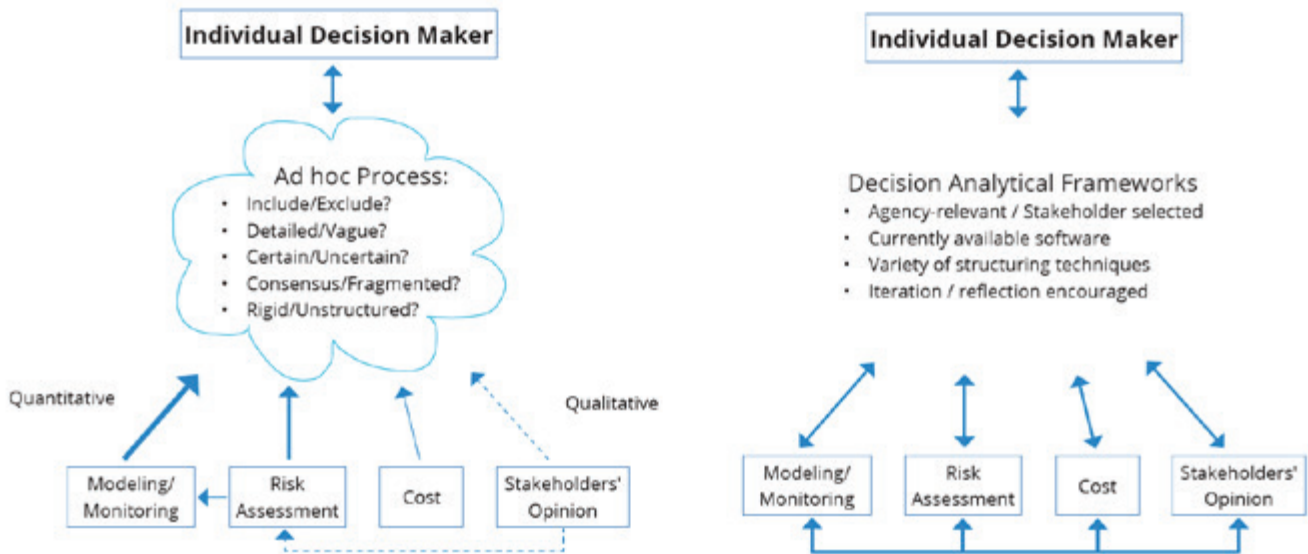


Figure 23. Ad-hoc versus structured decision-making²³

Prioritization and decision-making frameworks are useful in navigating this process and arriving at outcomes that are transparent, justifiable and defensible. One recommended tool is multi-criteria analysis (MCA, also known as multi-criteria decision analysis). MCA can be set up in a basic spreadsheet and can be as simple or complex as desired. It can manage quantitative, monetary, and qualitative data in a single framework, as well as varying degrees of certainty. An overview of MCA can be found in Appendix 10. Considerations incorporated in the MCA can include GHG emissions, co-benefits (Table 44) and implementation considerations (Stage 5).

23 Adapted from: Kiker, G. A., Bridges, T. S., Varghese, A., Seager, T. P., & Linkov, I. (2005). Application of multicriteria decision analysis in environmental decision making. *Integrated Environmental Assessment and Management*, 1(2), 95–108.

Stage 5: Implementation

» OUTPUT:

» IMPLEMENTATION PLAN

Table 45. Implementation engagement.

Tasks	Description	Complexity of approach		
		Basic	Intermediate	Advanced
Stage 5: Implementation				
5.1 Policies and mechanisms identification.	Identification of policies and other mechanisms to achieve the actions.	Policies and mechanisms are identified to implement the actions.		
5.2. Investment strategy.	Evaluation of the financial requirements for the actions and how to secure the required funding.	Project level analysis.		Integrated, inter-departmental analysis, financial modelling.
5.3 Integration.	Ensure that the actions and the preferred scenario are reflected in all local government policies and actions.	Implementation roles and responsibilities are assigned to a department or partner. The Official Plan is revised to reflect the CEEP.	Implementation roles and responsibilities are assigned across departments or partners. The Official Plan and other plans or policies are revised to reflect the CEEP.	
Tools.		Municipal organizational chart.	Workplans.	Workplans, departmental policy documents and processes, business planning.

	Basic	Intermediate	Advanced
Engagement activities.	Staff, Council.	Staff, Council, committees, utilities, neighbouring municipalities, other levels of government, businesses, and non-profit organisations.	Staff, Council, committees, community partners, public, utilities, neighbouring municipalities, other levels of government, businesses, and non-profit organisations.

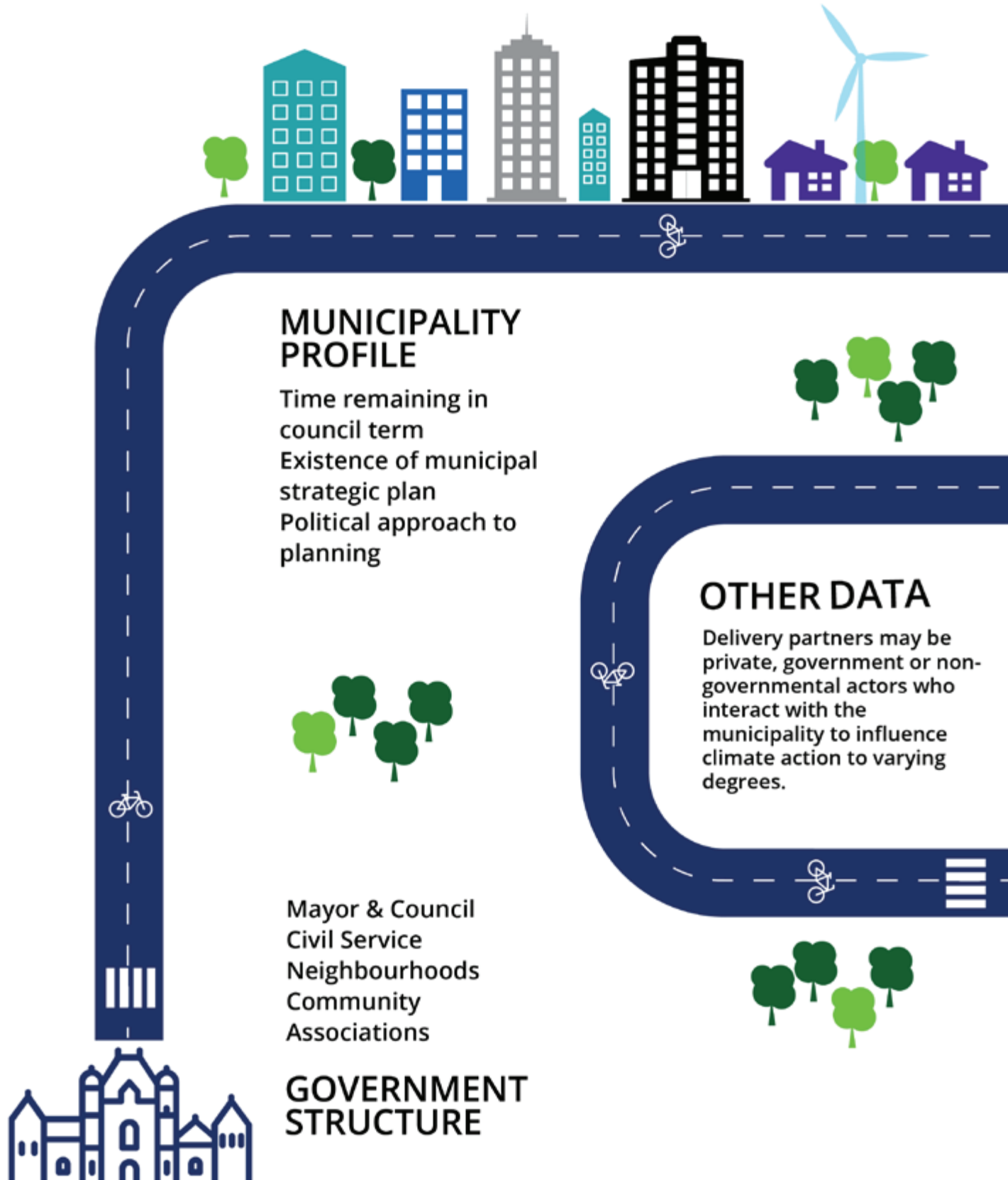
The municipality now has a clearly defined low carbon pathway:

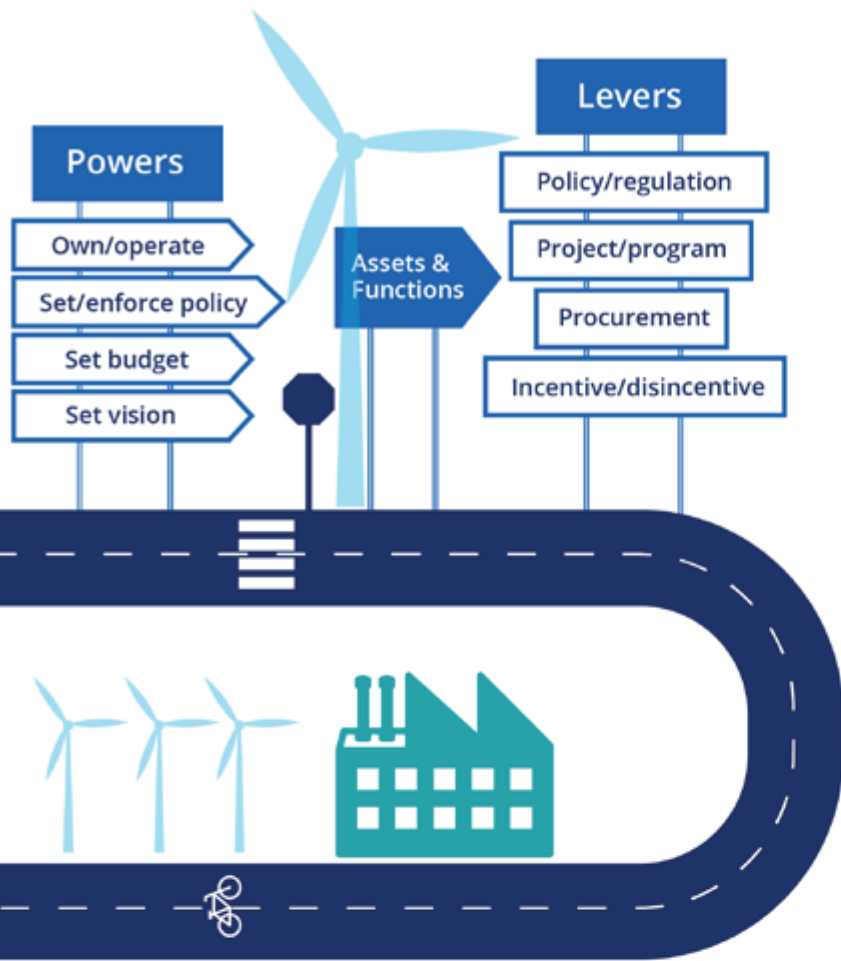
- » The local energy and emissions context and baseline inventory has been established;
- » The municipal spheres of influence have been established;
- » An emissions reduction target has been set;
- » Scenarios have been modelled to establish the anticipated outcomes of actions and policies;
- » A GHG emissions trajectory has been defined with the selection of the preferred scenario;
- » Co-benefits have been evaluated; and
- » Actions have been prioritized.

The next step is to identify the policies and mechanisms that can be used to support implementation, and a short term action plan.

Resource: QUEST. (2016). *Community energy implementation framework*.

COMMUNITY ENERGY & EMISSIONS IMPLEMENTATION PATHWAY





DELIVERY PATHWAYS

STAGES ON THE URBAN GOVERNANCE PATHWAY

The political context & governance structure describe the municipality from an institutional perspective. The assets, such as road infrastructure and functions, such as promoting economic development, are what the municipality exercises power over. The levers deliver change. The delivery partners may help the municipality take further action than it could alone. All result in the delivery of the low carbon pathway.

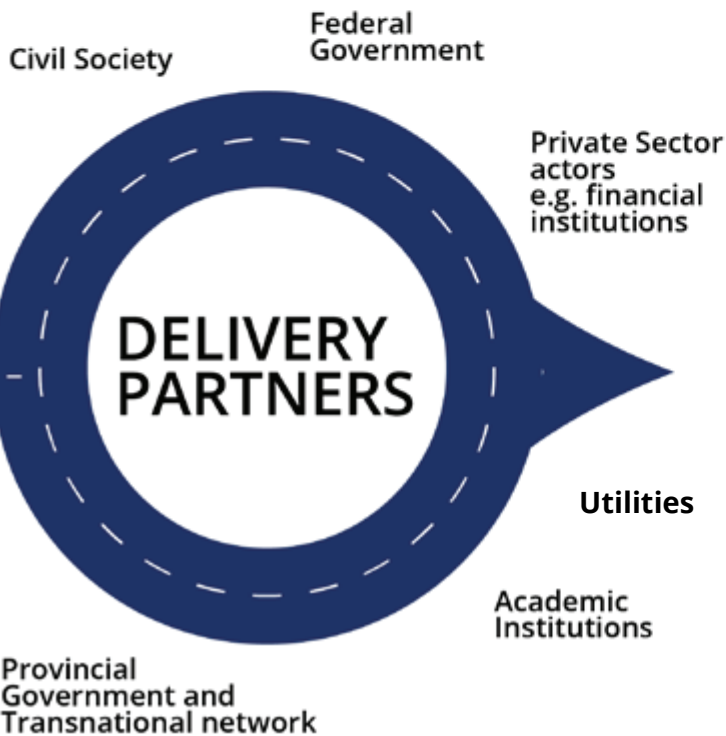


Figure 24. The implementation pathway (prior page).²⁴

TASK 5.1: POLICIES AND MECHANISMS IDENTIFICATION

RELEVANT STREAMS

There is a standard set of policies available to municipalities that influence land-use patterns and therefore GHG emissions, described in Table 46. For more detail on these tools see Appendix 7.

Table 46. Summary of typical land-use policies that can influence GHG emissions.

Tool	Purpose	Low carbon strategy examples
Official Plans.	Describe policies on how land should be used.	Identify goals, objectives and actions to mitigate greenhouse gas emissions. Policies can focus on compact, complete communities, supporting intensification, density targets and transit intensity, mixed-uses and walkability.
Community improvement plans.	Facilitate improvement of a particular area.	Support building retrofit programs with local improvement charges.
Zoning by-laws.	Regulate land-uses and physical characteristics of land-use. Can set standards for building design and form, and neighbourhood design using minimum or maximum standards.	Ensure mixed-use and compact development. Urban design standard can support safe, compact, well-designed, walkable and vibrant streetscapes and communities.
Site plan control.	Regulates building and site characteristics.	Require enhanced energy performance in buildings.
Height and density bonusing.	Enables municipalities to obtain community benefits in exchange for additional height or density beyond that otherwise permitted.	Can use height and density bonuses, connected to density targets, to support local improvements to transit facilities and provision of pedestrian and cycling facilities.

²⁴ Adapted from: C40 and Arup (2015). Powering Climate Action: Cities as Global Changemakers.

Tool	Purpose	Low carbon strategy examples
Plan of subdivision.	Allows for the division of land into multiple lots.	Require lot pattern that optimizes energy efficiency.
Community planning permit system.	Regulates land uses and physical characteristics of land-use in enhanced way.	Can specify characteristics related to height and density to support compact, complete communities.
Zoning with conditions.	Conditions can be required with zoning.	Require enhanced energy performance in buildings.

Within, and in addition to, these policy mechanisms, there are some policies and actions that municipalities typically implement (to varying extents). A list of sample policies and actions can be found in Appendix 13.

Incorporating Climate Action into Guelph's Official Plan

Guelph is the fifth fastest-growing city in Canada with a population growth rate of approximately 2% per year. According to the Growth Plan for the Greater Golden Horseshoe, Guelph's population is forecasted to be 191,000 by the year 2041. Population varies throughout the year because of the influx and departure of the university student population. The City's Official Plan was amended prior to 2014, to include climate change considerations in land development applications. The Claire Maltby Secondary Plan incorporates energy use, climate change and other sustainability requirements front and centre in the planning policy.

Actions Prioritization Revisitation

Following the identification of mechanisms and policies, the municipality likely needs to revisit the actions prioritization, to identify an order for introduction. Community and stakeholder engagement is critical at this phase to ensure a high level of awareness on the direction of the municipality and the benefits of implementing the actions.

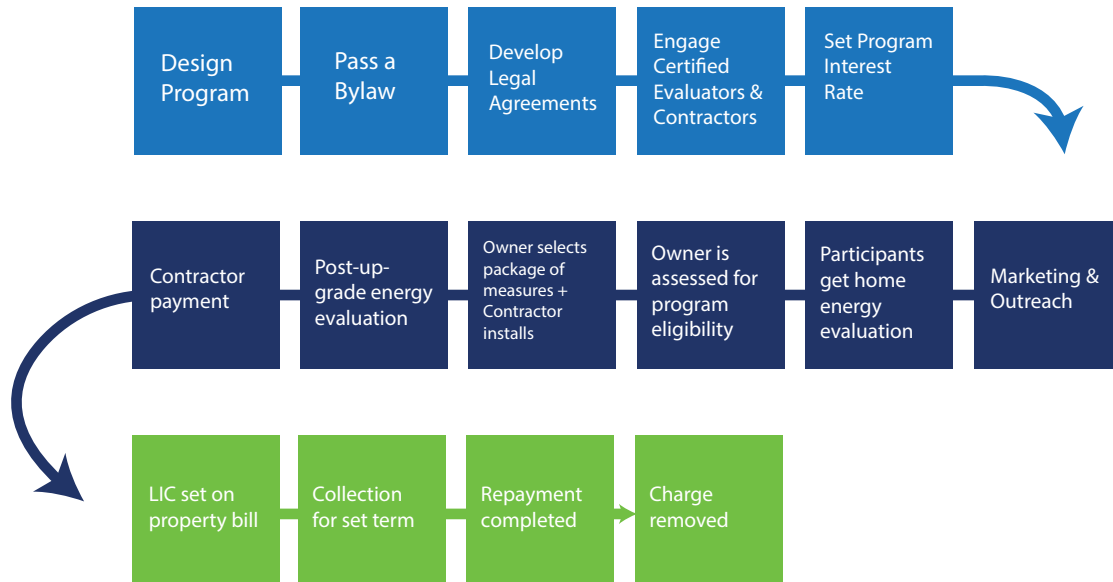


Figure 25. Example of the steps involved in the development of a local improvement charge program.²⁵

It is recommended that a five-year implementation plan be developed, which identifies what will be achieved each year, who will be responsible, required funding and the required governance process.


Example:

District of North Cowichan (2014). [Climate action and energy plan implementation and monitoring framework](#).

²⁵ Adapted from: Persram, S. (2013). [Using local improvements charges to finance residential energy upgrades](#). CHEERIO

TASK 5.2: INVESTMENT STRATEGY

RELEVANT STREAMS



While some actions, such as land-use, require the development of policies, others require financial investment. In order to achieve an 80% reduction in GHG emissions by 2050, most buildings will need to be retrofitted, non-fossil fuel-based heating systems will need to be installed, and the transportation system will need to transition to zero emissions fuels, amongst other changes. This transition will require unprecedented public and private sector investments, totalling billions of dollars each year. In some cases, such as the building industry, major investments are made regularly. They can be fine-tuned to achieve low carbon objectives, as well as co-benefit objectives.

Energy and emissions planning processes have not typically contemplated this scale of investment. In order to achieve reduction targets of 80% or more by 2050, planners and other municipal staff will need to develop and apply existing and new financing strategies, as municipalities, in cooperation with other partners, seek to mobilize the financial investments required.

Resource:

Low Carbon City Lab: [Climate finance opportunities for cities and investors](#).

More reading:


Cities Climate Finance Leadership Alliance. (2015). [The state of city climate finance](#).

Investment in Buildings

Ontarians invested \$1.5 trillion in their homes between 1990 and 2015. In 2015 alone, \$45 billion was invested in residential buildings—investments that determine housing emissions for decades to come. Home renovations have been the largest and fastest growing component of residential investment for over 25 years. Effective strategies to reduce community emissions must include renovations.

Investment Planning

RELEVANT STREAMS



Whether public or private sector investments, the municipality needs to develop detailed investment plans for each action, a process that can be incorporated into the modelling stage. In most cases, investments in low carbon actions generate a return, as a result of efficiency gains or avoided costs associated with infrastructure or equipment. There may be physical or legal gaps between the investing party and the party receiving savings—a phenomenon known as split incentive—which can be overcome by careful structuring of financial instruments.

In developing an investment case, the municipality should consider standard metrics such as the simple payback, internal rate of return, net present value and the marginal abatement cost. Considering these financial assessments will provide additional insight into action implementation. Figure 26 outlines four steps in the investment planning process.

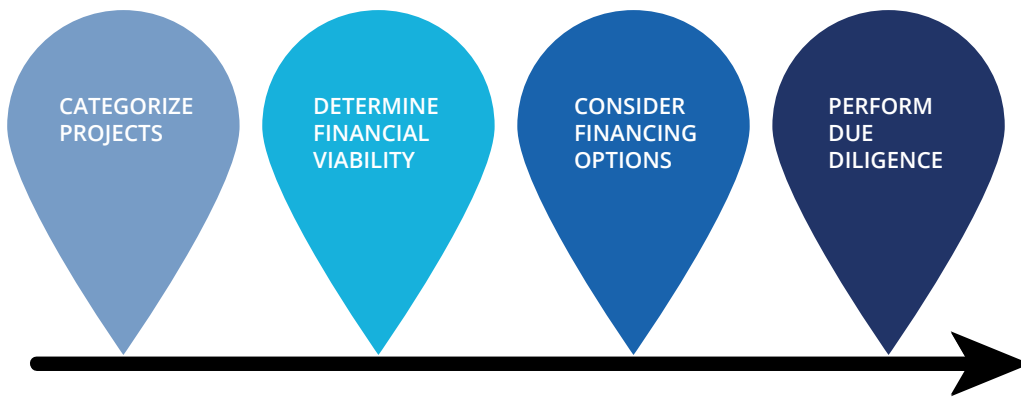


Figure 26. Categorization of projects for financing climate projects.²⁶

» **Step 1: Categorize Projects**

In order to identify the appropriate financing package, actions should be categorized by size (small or large) and nature (centralized or decentralized). However, if a municipality’s prioritized projects tend to fall into the same category, more detailed levels of categorization may be required. For example, breaking down projects by infrastructure capital investment versus operational measures.

	Large Scale	Small Scale
Decentralized	Green building codes Improved public transportation	Efficient lighting Household solar hot water
Centralized	Renewables development Water treatment system location	Biomass energy Landfill gas capture

Figure 27. Categorization matrix for energy and emissions financial investment.²⁷

²⁶ Chapter 2, “Cities”, Better Growth, Better Climate, [The New Climate Economy: The Global Commission on the Economy and Climate, 2014](#).

²⁷ The World Bank. [Sustainable Energy and Emissions Planning](#).

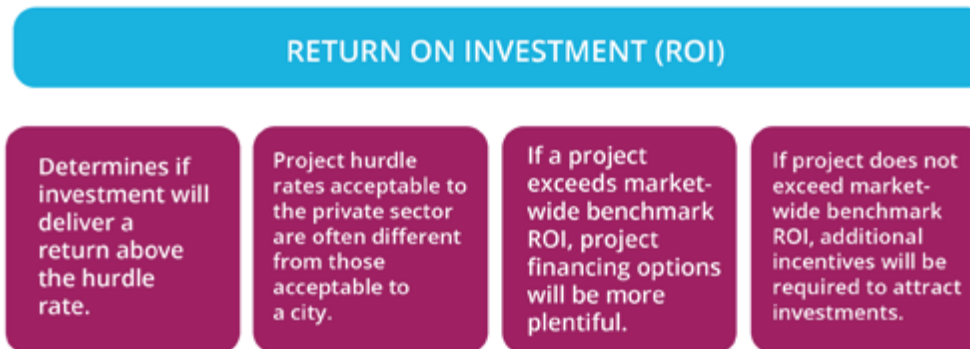
Different extents of financial analysis can then be assigned to each category, recognizing the significance of the investment and the potential funding sources.

Step 2: Determine Financial Viability

Actions are considered financially viable if the return on investment reaches an agreed-upon threshold, and the identified risks are tolerable and can likely be mitigated during implementation. A risk assessment and financial analysis are needed before deciding on financing options for viable climate actions.



EXAMPLE: Learn about financial barriers that prohibit financial viability of project and view some of the general and unique risks associated with energy projects.



EXAMPLE: Review a return on investment example.

Figure 28. A sample set of considerations when assessing financial viability.²⁸

Step 3: Consider Financing Options

There are both internal and external financial options for financing, depending on the categorization, risk, financial viability, and scale. The first decision is whether the municipality will finance the action with existing or new revenue sources or seek external financing, either from investors or grants, or with cross-sector partnerships. Careful consideration of the legal and regulatory context is required.

²⁸ The World Bank. [Sustainable Energy and Emissions Planning](#).

Table 47 includes possible financing strategies.

Table 47. Potential financing options for energy and emissions actions.

Source	Financing category	Financial mechanisms
Municipal budget.	Taxes.	<ul style="list-style-type: none"> » Value capture tools. » Tax increment financing.
	User fees.	<ul style="list-style-type: none"> » Density bonuses. » Developer impact fee. » Traffic congestion charge. » Electric vehicle charging.
Funders.	Investor financing.	<ul style="list-style-type: none"> » General obligation. » Green or climate bond. » Neighbourhood bonds. » Energy efficiency loan. » Property-assessed clean energy. » Revolving loan fund. » Infrastructure bank financing.
	Donor grants.	<ul style="list-style-type: none"> » Provincial grants (Challenge Fund). » Federal infrastructure funding. » Green Municipal Fund.
Partners.	Cross-sector partnerships.	<ul style="list-style-type: none"> » Public private partnership. » Community choice aggregation.. » Group purchasing

» Step 4: Perform Due Diligence

The municipality needs to ensure that the business case meets the policy and regulatory requirements, including return requirements, risk tolerance and debt ceiling. Examples of the questions to answer prior to finalizing a financing package include:

- » What are the important or unusual features of the action?
- » What is the total cost of the financing package?
- » What is the source of payment and the source of security?
 - ◇ The municipal general fund
 - ◇ Municipal tax revenues

- ◇ Revenues of a municipal subsidiary
- ◇ Contractual payments to be received from other levels of government

- » What is the plan for payment of the principal and interest?
- » What could happen that could fundamentally alter the arrangement?
- » What could go wrong in the short, intermediate and long term?
- » If the unexpected happens, what is the contingency plan?

Resource:

HIP Investor (2016). [Financing sustainable cities scan & toolkit](#).

Investing in Compact, Connected Cities

Compact and connected cities illustrate how a coordinated investment in low-emission infrastructure can be translated into investment decisions on the ground. According to the New Climate Economy 2014 report: Better Growth, Better Climate, a shift to more coordinated, compact urban development could reduce infrastructure capital requirements by more than \$3 trillion over the next 15 years (or \$200 billion a year) and significantly reduce emissions largely by limiting urban sprawl and the additional infrastructure it requires. For example, denser transit-oriented city planning can reduce the amount of road infrastructure required. Building more compact, connected cities can also result in social, health, and environmental benefits not fully captured in the estimate.

Green Bonds and Climate Bonds

A “green bond” is a bond whose funds are exclusively committed to finance or re-finance “green” projects, assets or business activities.⁶⁶ A green bond is a fixed-income financial instrument for raising capital from investors through the debt capital market. A climate bond is a type of green bond. Typically, the bond issuer raises a fixed amount of capital from investors over a set period of time (the “maturity”), repaying the capital (the “principal”) when the bond matures and paying an agreed amount of interest (“coupons”) along the way.

In 2007, green bonds were launched by a few development banks such as the European Investment Bank and the World Bank, and have grown considerably since then. According to the Climate Bonds Initiative, “[t]he green bond market has taken off in recent years, with the market really starting to take off in 2015 when USD 42 billion was issued; almost four times the 2013 issuance (USD 11 billion). This momentum has continued strong, with USD 200 billion in green bonds currently outstanding. There are projects for possibly USD 130 billion to be issued in 2017.”

Resource:

Green City Bonds Coalition (2016). [How to issue a green muni bond: The green muni bonds playbook](#).

Green bond and climate bond references ^{29 30}.

29 ICMA (2015), Green Bond Principles: Voluntary Process Guidelines for Issuing Green Bond, March.

30 The Climate Bonds Initiative. [Explaining Green Bonds](#).

TASK 5.3: INTEGRATION

RELEVANT STREAMS



The role of the energy and emissions plan within the overall planning context of a municipality varies from one context to another. A key consideration is the integration of the community energy and emissions plan with other major plans such as the Official Plan, transportation plan, waste management plan, economic development plan, and others.

Integration with Municipal Plans

Integration and alignment of plans can decrease GHG emissions, increase resilience and bolster economic development. On the other hand, it can happen that an Official Plan prioritizes development in efficient locations, but external funding from other government agencies—whether local, provincial or federal—promotes development in more remote areas via incentives, infrastructure investments or construction of government facilities, such as hospitals. Thus, integration and alignment is important: within municipal departments, with other municipalities in the region sharing infrastructure systems and markets, and with provincial and federal ministries and programs. Regional coordination is especially important for reducing transportation emissions.

Table 48. Energy and emissions plan integration with other plans.

Plan	CEEP consideration	Impact on others plans
Official Plan.	Official Plan land-use policies should be evaluated for their emissions impacts (e.g. through scenarios).	Municipalities are encouraged to use the CEEP to inform the relevant policies in an Official Plan (including the required climate change mitigation policies).
Transportation Master Plan.	The impact of proposed changes to and investments in transportation should be evaluated in a scenario.	The Transportation Master Plan should be updated to reflect the CEEP's actions and targets.
Solid Waste Plan.	Actions to reduce waste generation or to treat waste should be evaluated in a scenario.	The Solid Waste Plan should reflect the actions contained in the CEEP.

Plan	CEEP consideration	Impact on others plans
Economic Development Plan.	The extent to which actions have effects on investments, household incomes, and job creation should be assessed.	The CEEP will involve opportunities for businesses, new employment and investments. The Economic Development Plan can support these efforts, or an economic development strategy may be developed focussed on the actions in the CEEP.
Climate change adaptation and/or resilience plans.	Investments in low carbon infrastructure can simultaneously increase the resilience of the community by reducing risks to extreme weather events.	The CEEP will provide insights on how major infrastructure investments that reduce risk can also reduce GHG emissions.
Other municipal plans and strategies.	Other plans and strategies should be reviewed and reflected in a scenario, where relevant.	Actions or policies in the CEEP should be reflected in the relevant plans or strategies including: long-term energy plans, Asset Management plans, and sustainability plans.
Utility plans.	Consideration should be given to utility activities and the future plans by the utilities.	Energy, conservation or demand side management plans should seek to align objectives and programming with the CEEP.

The principal city plans through which the CEEP is implemented are identified in the figure below.

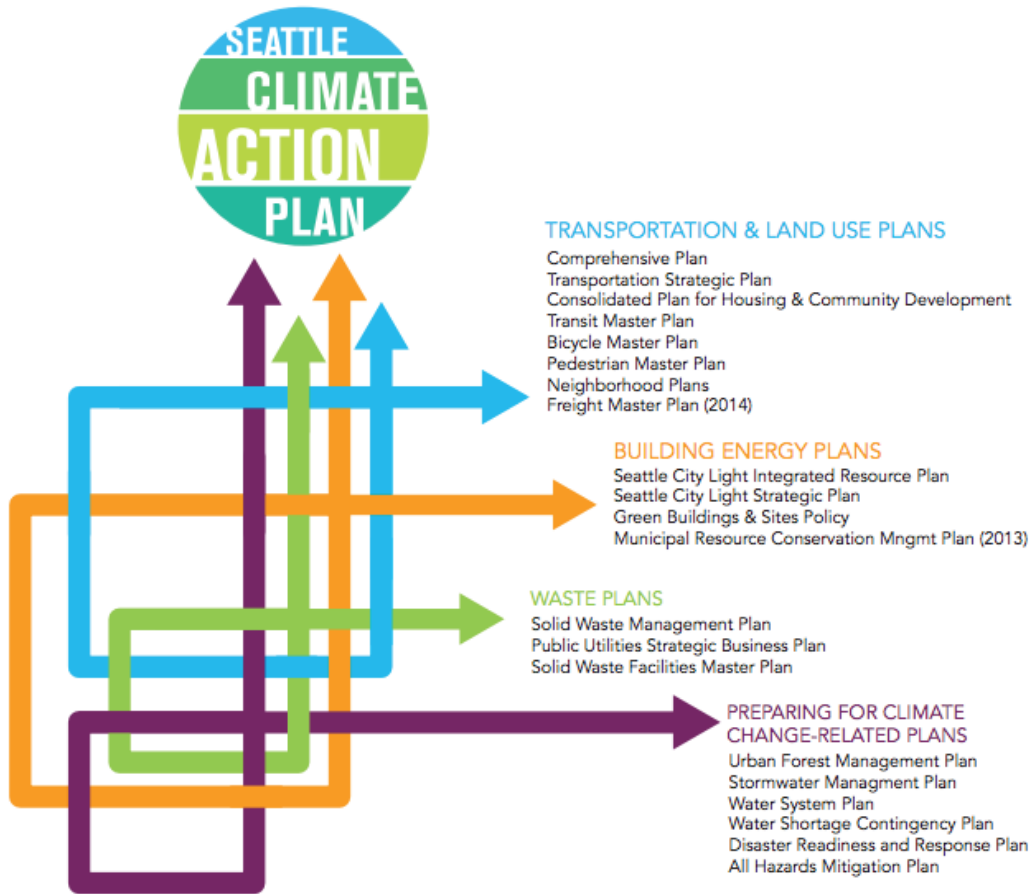


Figure 29. Diagram showing how Seattle’s Climate Action Plan (2013) considers, and is integrated into, the City’s other planning efforts.

Integrated Planning in Markham

The City of Markham is taking part in Ontario's Municipal Energy Plan Program, and is currently in the process of developing a Municipal Energy Plan (MEP). The plan is expected to be complete in the spring of 2018.

Preceding the development of the MEP, Markham developed Greenprint in 2011, Markham's integrated community sustainability plan (ICSP). Greenprint, under the Energy & Climate priority, includes an objective of achieving net zero energy and emissions by 2050, which has been one of the drivers for developing the MEP. In addition to the MEP, the City is also undertaking Community Energy Planning (CEP) at the neighbourhood scale. City staff have incorporated policies from York Region's New Communities Guidelines from York Region's Official Plan and Markham's new Official Plan, and have developed a Terms of Reference for future Community Energy Plans (CEPs) to accompany Secondary Plans. The intent is to have CEPs developed and submitted as part of the subdivision secondary planning process.

Increasing the Energy Performance of Buildings in Toronto

The Better Buildings Partnership (established in 1996) and the Home Energy Loan Program provide support to assist homeowners, commercial building owners, and social housing providers to reduce emissions in this sector. With Energy and Water Reporting and Benchmarking for Large Buildings (Ontario Regulation 20/17), Toronto will be able to monitor how effective these programs have been.

Integrated Planning in Seattle

Seattle's process produced a CAP that is implemented through related plans that are developed with and executed across multiple City departments. The CAP works with and through these plans by:

- » Providing a planning and monitoring framework for achieving climate change goals.
- » Highlighting critical actions for reducing emissions and fostering resilience to climate impacts.
- » Guiding consideration of emissions reduction potential across the range of City plans.

Municipal Structural Integration

Integral to the success of the final strategy and implementation of actions is the ability to integrate learnings into organizational processes, such as policy development and implementation of plans and strategies, and structures, such as departmental mandates and job descriptions. The ability to learn and adapt in the course of work (as opposed to perfecting through repetition) requires fostering a particular culture. The degree to which the local government can embed the knowledge gained through the monitoring and evaluation processes described above will be key to success in implementation. Characteristics of a learning organization are as follows:³¹

1. Recognizes, supports and is able to benefit from formal and informal structures.
2. Open to innovation both in terms of the way it is managed, and in operational activities.
3. Supports creative thinking, innovation and exploration of change from the personal to organizational level, allowing this to contribute to more formal governance and accountability structures.
4. Encourages and supports learning from experience at various levels (e.g. through attention to what is being learnt e.g. facts and skills, incorporation of learning from evaluations, support for action learning sets and other enquiry processes, etc.) towards improving practices, policies and programmes.
5. Recognizes that attention needs to be paid to all stages of the learning cycle (experience, reflection, conceptualization, and planning implementation) for learning to occur and change to happen. Indicative attributes include:
 - » Actively seeking new ideas and other ways of working, including examples from outside the organization;

³¹ UK Climate Change Adaptation Program.

- » Dissonant information that does not fit with current practice and thinking and experience is not seen as taboo but welcomed and actively explored;
- » The creation of and support for 'informal space' to experiment and innovate, and that processes of dialogue are supported that enhance collaboration rather than debate and argument that may exacerbate conflict;
- » Support is provided for processes of learning and enquiry e.g. action learning sets, learning histories, appreciative enquiry at all levels of the organization; and
- » 'Mistakes' are seen as an opportunity to learn.

Stage 6: Monitoring and Evaluation

Tasks	Description	Complexity of approach		
		Basic	Intermediate	Advanced
6.1. Monitoring and evaluation plan	A monitoring and evaluation plan is developed, including indicators and surveys.	Simple pass/fail evaluation.	Annual indicators assessment, updating of plan.	Frequent tracking of indicators and departmental roles and responsibilities updates.
Tools		Workplans, indicators checklist.	Workplans, indicators assessment matrix, plan update mechanisms.	Workplans, indicators assessment matrix, plan update mechanisms, integrated reporting tools.

Table 49. Sample engagement activities for monitoring and evaluation.

	Basic	Intermediate	Advanced
Engagement activities	Council reports	Council and staff reports, senior staff engagement.	Council and staff reports, senior and junior staff engagement, public reporting and engagement.

A process of monitoring and evaluation will track the community energy and emissions plan’s progress and effectiveness, while facilitating its evolution. This process will enable the local government to track how well actions achieve objectives, the impact of changing policies and technologies on the effectiveness of those actions, the impact of those actions on GHG emissions, and the impact of the actions on co-benefits.

TASK 6.1: MONITORING AND EVALUATION PLAN

Table 50 details a sample monitoring and evaluation cycle, illustrating the type of data collected and collection frequency.

Table 50. Monitoring and evaluation activities.

Activity	Purpose	Description	Frequency
Annual work plan and review.	Review work to-date and set annual priority actions.	Annual report with prioritized actions and key performance indicators.	Annual, or more frequent as required.
Annual indicator report.	Track effectiveness of actions.	Annual report on set of indicators with an analysis of the results.	Every 2 years.
Inventory.	Update GHG emissions profile.	Re-calculate the GHG emissions inventory.	Every year for larger municipalities, 2 years for smaller municipalities.
Update the community energy and emissions plan.	Update the CEEP to reflect changing conditions.	Work through each stage of the community energy and emissions planning process.	Every 5–8 years.

Annual work plan and review

Each year a work plan for the community energy and emissions plan should be developed. The work plan should identify all relevant activities to achieve the actions and policies in the plan, the responsible parties, the budget and the schedule. Each year the results of the previous year’s work plan should be reviewed to inform the development of subsequent work plans.

Annual indicator report

There are two aspects involved in the application of indicators: collecting data on indicators (monitoring), and interpreting the results of those indicators (evaluation). Over time, the municipality can also evaluate its effectiveness in embedding the knowledge and wisdom gained through this process into the organization. From the perspective of climate change mitigation, there are multiple purposes for which data is collected: to evaluate the effectiveness of the actions, to evaluate the impact of the actions on the community, and to evaluate the uptake of the lessons from the evaluation. Many of the indicators address two or more of these purposes which results in the challenge of discerning cause and effect.

Table 51. Types of indicators.

Indicator Category	Question
1. Effectiveness indicators.	Are the actions achieving their objectives?
2. Impact indicators.	What is the impact of the actions on the community?
3. Learning indicators.	Is the local government incorporating the knowledge gained?

The indicators identified for tracking the implementation of the community energy and emissions plan have the following characteristics:

- » Process-based approach: Seeks to illustrate trends rather than specific outcomes. By using process indicators it is possible to consider whether the direction of travel is correct given the current information.
- » Ability to tell a story: A good indicator represents a number of different inputs and outcomes so that it provides a quick snapshot of a complex situation.
- » Availability of data: Local governments are already able to access the data.

Effectiveness Indicators

These indicators will be designed to evaluate whether or not policies or actions are having an effect; they will vary from municipality to municipality according to the specifics of the community energy and emissions plan. For example, if a plan includes a PACE program, an indicator would be the number of inquiries about the PACE program, the number of households or businesses that participated in the PACE program and the average energy savings. The results of the indicators are then compared against the assumption in the modelling to monitor whether or not the municipality is on track with projections. Indicators should be developed for each action or policy.

Impact Indicators

The following indicators track macro trends and drivers of GHG emissions in the municipality; these are designed to be reported on each year.

Table 52. Recommended community-scale indicators.

Indicator	Trend	Data sources
Total new dwellings by type.	An indication of the growth of the building stock.	Building permits.
Average total floor area of new dwellings.	An indication as to whether there is more or less additional floor space to heat or cool.	Building permits.

Indicator	Trend	Data sources
Diversity of dwelling types.	An indication of the types of dwellings and whether or not they have shared walls.	Building permits.
Total new non-residential floorspace by type.	An indication of the growth of the building stock.	Buildings permits.
Total demolitions.	An indication of the change in the building stock.	Demolition permits.
Percent of dwellings units that are downtown versus on the periphery .	An indication as to whether residential development is occurring in areas more appropriate for walking, cycling and transit or not.	Downtown and periphery can be defined as appropriate for the municipality. Use building permits and GIS analysis.
Percent of non-residential floorspace that is occurring in the built-up area or in major transit station areas versus on the periphery.	An indication as to whether residential development is occurring in areas more appropriate for walking, cycling and transit or not.	Downtown and periphery can be defined as appropriate for the municipality. Use building permits and GIS analysis.
Number of dwellings that are within 400m of a transit stop	Indication of transit accessibility.	GIS layers of transit and building footprint.
Annual or monthly energy price by fuel (electricity, natural gas, gasoline, diesel) (\$/GJ).	Energy costs are an important indicator of opportunities for energy savings and renewable energy, household, municipal and business energy costs.	Electricity and natural gas rates are available from Ontario Energy Board; Fuels are available from for major urban centres from Statistics Canada CANSIM Table 326-0009 and for specific locations from sites such as GasBuddy.com .
Total energy consumption by sector for natural gas and electricity (GJ).	An indication of trends in energy use in buildings.	Available on request from utilities.
Total solar PV installs (# of installation).	An indication of extent of decentralized renewable energy.	Building permits if required.
Total gasoline sales (\$).	An indication of GHG emissions from vehicles.	Available for purchase from Kent Group Ltd.
Total vehicle fleet by vehicle class (#).	An indication of the number of low or zero emissions vehicles and whether the fleet is becoming more or less efficient.	Available on request from MTO, or for purchase from Polk.
Total VKT per capita.	An indication of transportation GHG emissions.	Transportation model, not available for many municipalities.
Total and per capita transit trips.	An indication of whether non-vehicular trips are increasing or not.	Available from the transit agency.
Length of physically separated cycling lanes.	An indicator of opportunity for people of all ages to cycle.	Municipality.
Total solid waste by composition.	Indication of major sources of waste.	Municipality or regional government. Data for ICI may not be available.

Indicator	Trend	Data sources
Total solid waste diverted.	Indication of diversion efforts.	Municipality or regional government. Data for ICI may not be available.
Total solid waste to landfill.	Indication of waste that will contribute to GHG emissions.	Municipality or regional government. Data for ICI may not be available.

Table 53. Recommended corporate indicators.

Indicator	Trend	Data sources
Total VKT.	Indication of transportation patterns associated with municipal services.	Municipal data: odometer readings.
% of municipally-owned vehicles that are electric or zero carbon.	Indication of leadership by the municipality.	Municipal data: vehicle purchase orders.
Total energy consumption by fuel (electricity, natural gas, gasoline, diesel, other) (GJ).	Indication of increase or decrease in efficiency.	Municipal data: accounting data.
Total renewable energy generated by the municipality (GJ).	Indication of the effort to install renewable energy.	Municipal data: utility reports.
Average energy use intensity of municipal buildings (GJ/m ²).	Measure of the energy performance of the building stock.	Municipal data: utility reports.
Total emissions by sector (tCO ₂ e).	Indication of the emissions trends for the local government.	Municipal data: GHG inventory.

Learning Indicators

Learning indicators track the organizational response to the community energy and emissions plan and the lessons resulting from the implementation of the plan.

Table 54. Recommended learning indicators.

Indicator	Trend	Data source
# of job descriptions that include climate change or GHG emissions.	Indication of the extent to which climate change planning is embedded in the organization.	Municipal data
% of major planning activities that included consideration of climate change and GHG emissions.	Indication of the extent to which climate change planning is embedded in the organization.	Assessment of plans completed (neighbourhood, community, transportation, etc.)
Description of major infrastructure projects that includes a GHG mitigation aspect.	Indication of how municipal expenditures are contributing to GHG emissions reductions.	Assessment of infrastructure projects
Percent of Council reports where consideration of climate change, GHG emissions and mitigation and/or adaptation is discussed.	Increased % of reports indicates increased literacy on climate change.	Council reports

Annual Progress Reporting in London, Ontario

A progress report on the implementation of the City of London's Community Energy Action Plan program activities is released every summer. It includes reporting on these indicators:

Category	Indicator
Energy Performance	<ul style="list-style-type: none"> » Total annual energy use (terajoules) » Percentage change in total energy use from peak energy use year (2007) » Per-person annual energy efficiency (gigajoules per person) » Percentage change in energy efficiency from peak energy year (2007)
Economic Impact	<ul style="list-style-type: none"> » Total annual energy cost (dollars) » Avoided annual energy costs (compared to 2010 business-as-usual) » Per-person annual energy expenditures (dollars per person) » Percentage change in per-person energy expenditures from baseline year (2010)
Environmental Impact	<ul style="list-style-type: none"> » Total annual GHG emissions (tonnes CO₂e) » Percentage change in total GHG emissions from GHG baseline year (1990) » Percentage change in total GHG emissions from peak GHG emissions year (2007) » Average annual GHG contribution (tonnes CO₂e per person) » Percentage change in per-person GHG emissions from GHG baseline year (1990) » Percentage change in per-person GHG emissions from peak GHG year (2007)

External Reporting

Several Canadian municipalities are reporting to external programs. As described earlier in the Guide, there are several energy and emissions reporting standards, some of which offer external reporting services at no cost. For example, CDP collects data for the Global Covenant of Mayors and CDP's own city reporting process. Reporting provides external validation and feeds into international reporting and analysis of city action on climate change. CDP also has a benchmarking tool municipalities can use to compare their performance against other municipalities. Reporting to provincial counterparts supports accurate provincial inventorying as well.

Table 55. Organizations that track GHG mitigation performance of cities.

Organization	Requirements	Level of effort
PCR.	Reporting requirements for each of the milestones.	Low.
Global Covenant of Mayors.	Questionnaire that includes information on GHG emissions, strategies and commitments.	Moderate.
CDP.	Questionnaire that includes information on risks, climate adaptation, mitigation, local government operations, strategy and water.	High.
BPS.	Mandatory: includes reporting on energy and GHG emissions for buildings.	Moderate.

The City of Calgary's Annual CDP Reports

The City has found that using the CDP's reporting platform has been particularly useful in both advancing and maintaining its climate action planning efforts for several reasons. Firstly, it has brought together multiple reporting protocols and platforms (GPC, Compact of Mayors). Secondly, it is seen as a potential tool to attract businesses that report under the same platform and may be interested in investing in City efforts. Thirdly, participation was part of a resolution at a big city mayor's caucus that they attended, and the CDP's platform is currently seen as 'the place' for leading cities to voluntarily report. Fourthly, its ongoing reporting requirements have allowed the City to develop a process around yearly reporting that has included regular contact and communications with its other departments.

5.4 ENERGY AND EMISSIONS PLANNING PROCESS CONCLUSIONS

Stages 1 through 6 represent a systematic approach to community energy and emissions planning. Municipalities may elect to vary the order of the stages or emphasize a stage or an aspect of a stage according to their particular context. Each of the six stages of the community energy and emissions planning (CEEP) have specific outcomes. In combination, these outcomes form the municipality's community energy and emissions plan, which incorporates the GHG inventory and GHG emissions reduction targets. The CEEP fulfills the requirements of the Municipal GHG Challenge Fund and can be used by municipalities to implement policy 4.2.10.2 of the Growth Plan, 2017. It also supports municipalities in identifying a low carbon pathway that delivers multiple community benefits.

The outcomes of the process are many. First, the municipality will have developed a pathway towards deep GHG emissions reductions and will have a clear picture of the actions, policies and measures required to implement that pathway. Second, the Official Plan and planning policies will incorporate low carbon pathway considerations, guiding land-use policy that enhances GHG emissions reductions.

Third, the co-benefits of the low carbon pathway will be broadly understood in terms of their impact on well-being, accessibility, health, the elderly and children, among others. The community energy and emissions plan will be understood as an economic development strategy that will improve the building stock, generate new employment opportunities and reduce energy costs.

There are also some technical side benefits or insights that will result from the process. The municipality will have articulated land-use scenarios based on its current planning policies, an exercise which may or may not have been completed previously, providing new insight into the near and long-term future of the community. Other policies related to transportation and buildings will be scrutinized and quantified to help inform the development of the scenarios. This work will contribute to an improved planning context in general.

Above all, the planning process will transform the threat of climate change into an opportunity to improve people's lives, a symbol of hope against what can seem like an overwhelming challenge.



PART C: RESOURCES

6. Engagement: A Cross-cutting Theme

Purpose of this chapter:	To present the importance of community engagement in the production of energy and emissions plans, and to suggest engagement technique options.
Key guidance:	Community engagement techniques should be applied throughout the development of the community energy and emissions plan.
Learn about:	<ul style="list-style-type: none">» Principles of community engagement» Community engagement strategies

6.1 OBJECTIVES

There are a variety of potential objectives in performing public engagement in the development of community energy and emissions plans, including:

- » Informing and educating the public, and building public capacity;
- » Collecting public knowledge and opinion inputs;
- » Engaging and empowering citizens in civic democratic processes;
- » Identifying community champions and influencers; and
- » Developing public support for plans and their implementation.

To ensure a well-informed, effective plan that has community traction in its implementation, all of these objectives should be pursued.

As part of planning preparation, the planning process team should identify the stakeholders, organizations, and public to engage at different points in the process, and how best to engage them to achieve the desired results. Consideration must be made for what inputs are needed to develop the plan (e.g. local context, data), who has useful knowledge and experience to contribute (e.g. expert climate change knowledge), who will be responsible for parts of plan implementation (e.g. community partners), and who will be affected by plan implementation (e.g. members of the public). Typical stakeholders in energy and emissions planning processes include:

- » The general public;
- » Subject matter experts;
- » Consultants (if employed during the process);
- » Electricity, natural gas, and other utilities/energy suppliers (e.g. propane, wood, oil);
- » Representatives of the building development and real estate sectors;

- » Representatives from non-profit and community organizations;
- » Representatives from institutional organizations;
- » Representatives of vulnerable populations;
- » Representatives of First Nations;
- » Representatives of business and industry communities; and
- » Representatives from local governments.

6.2 PRINCIPLES OF ENGAGEMENT

The International Association for Public Participation (IAP2) has developed a spectrum of public participation that details five levels of engagement. Using its guidance, the engagement spectrum for community energy and emissions planning includes the items in Table 56. At various points throughout the planning process, these approaches will be used in different combinations.

Table 56. Adaptation of the IAP2 planning participation spectrum.

	Inform	Consult	Involve	Collaborate	Empower
Purpose	To deliver information to the public that articulates the need for a plan, describes the planning process, and expresses the desired outcomes.	To collect public feedback and suggestions for the plan or its components.	To engage the public in a manner that ensures public concerns are properly considered and addressed in the plan.	To partner with the public in policy development and decision-making in the plan.	To place the final policy development and decision-making in the hands of citizens.
Example techniques	Newsletter, website, lectures, media coverage, videos.	Focus groups, surveys/polls, public meetings.	Workshops, interactive websites, interactive meetings.	Participatory decision-making, advisory committees, citizen committees.	Participatory budgeting, citizen juries, citizen decision committees.
Example usage	To inform re: project launch, to provide project updates, to deliver project background information.	To collect local context information, to collect opinion on issues of concern, to gather feedback on a plan proposal.	To develop planning element options and alternatives, to explore ideas and proposals, to debate merits of plan elements.	To host democratic processes (e.g. consensus-building, voting) that help decide policy inclusion.	To host democratic processes through which citizens decide on the plan policies and their implementation parameters.

The City of Toronto has developed 9 Principles for Effective Engagement, through conversations with its citizens. They detail what typically makes public engagement enjoyable and useful. Engagement processes should be:



Transparent

Engagement processes should be transparent by providing clarity on the level of engagement residents can expect, making records of consultation processes available to the public in a timely manner, and clearly indicating how feedback has affected project outcomes.



Timely

Engagement processes should be designed to ensure that feedback is sought at appropriate and meaningful times in a planning process.



Iterative

Engagement processes should be iterative, providing multiple opportunities for participants both to offer feedback and to see how their feedback has been used



Inclusive

Engagement processes should be designed to engage the widest possible audience, and should include strategies to reach under-represented groups, including youth, newcomers and renters.



Innovative

Engagement processes should be designed using innovative methodologies in order to achieve the highest level of engagement possible.



Respectful

Engagement processes should be respectful of the expert knowledge that residents have of their communities, and should promote a respectful and positive environment where people feel comfortable voicing constructive opinions.



Educational

Planning processes should seek to improve the public's understanding of planning issues, with clear objectives to improve planning literacy.



Fun

Where appropriate, engagement processes should be designed to be as fun as possible for participants.



Community-Building

Engagement processes should be designed to encourage community-building by strengthening relationships between members of the community and between members of the community and the City Planning Division.

It is useful practice in preparing a public engagement plan for energy and emissions planning processes to include these engagement principles and the spectrum of public participation as a type of checklist against which to assess the engagement activities. As engagement activities apply more principles and place further along the participation spectrum, the more meaningful and enduring the engagement process.

6.3 PROCESSES

Community energy and emissions plans comprise many types of plan elements: climate change mitigation and adaptation, environmental conservation, social and health equity, economic development, land-use, transportation, waste management, etc. As such, the processes of developing the plans has the potential to engage the vast majority of citizens in some manner. There are many engagement activities to employ to reach a variety of citizens, stakeholders, community groups, businesses, and institutions. Some typical examples are included in Table 57.

Table 57. Example public engagement activities.

IAP2 Spectrum	Engagement Activity	Sample Use	Expected Sample Outputs
Inform	Planning project website.	A project website can house project background information, local climate issue information, ways to engage in the planning process, reports and project updates, a schedule of events, social media feeds, etc. It can be updated throughout the planning process.	The public is made aware and is informed about the project, the issues addressed, the process progress, and how to contribute to plan development.
	Web newsletter and social media posts.	Distribution of project information, updates, and invitations in web newsletter format to municipal and partner contacts. The web newsletter can be emailed, posted to social media, and hosted on the project website.	
	Media coverage.	Project promotion through municipal staff interviews with TV/radio, press releases.	
Consult	Focus groups.	Engage representatives of a public sector to provide feedback on how to address an issue or respond to a plan proposal.	Public input is gathered on relevant issues and issues of concern are identified. Plan vision and objectives elements are gathered.
	Surveys and polls.	Post a multiple-choice survey on social media and the project website to gather feedback on a project issue.	
	Public meetings.	Host a public meeting with small group discussions to identify the issues the plan should address.	
Involve	Workshops.	Host a public workshop to develop policy ideas or discuss proposed policy.	Public involvement generates constructive dialogue on proposed policy, evolves ideas to be addressed by the plan, and narrows potential policy options.
	Interactive websites.	Use interactive websites to visualize and generate feedback on policy options.	
	Interactive meetings.	Host meetings in which participants play key presentation and leadership roles.	
Collaborate	Participatory decision-making process.	Host a decision-making process – such as voting – to determine the direction of a plan, the content of a policy, or the manner of a policy's implementation.	Project staff and decision-makers collaborate with the public to arrive at policy decisions and plan content together.
	Advisory committee.	Establish an advisory committee with public and stakeholder membership that directs the planning process and has democratic inputs to the plan.	

IAP2 Spectrum	Engagement Activity	Sample Use	Expected Sample Outputs
Empower	Participatory budgeting process.	Host a process that enables the public to determine how budget is allocated amongst plan actions.	Members of the public and stakeholders decide the plan policies and actions, and the manner of their implementation.
	Citizen decision committees.	Establish citizen decision committees that have – through democratic processes – the power to decide on plan content, policy direction, actions to be taken, and plan implementation mechanics.	

Example: [Edmonton's Citizen's Panel](#).

6.4 PLAN ELEMENTS FOR PUBLIC INPUT CONSIDERATION

Several key energy and emissions plan elements can benefit from public engagement inputs and discussion. Typical elements are summarized in Table 58.

Table 58. Typical plan elements for public input consideration

Plan Element	Public Engagement Contribution
Plan vision statement.	Vision statement elements, essence, and manner of expression.
Plan objectives.	Objectives identification and expression.
Energy and emissions reduction targets.	Establishment of, and rationale for, energy and emissions reduction targets.
Energy and emission actions.	Identification of potential actions in pursuing the energy and emissions reduction targets.
Extent of energy and emissions actions.	Commentary on the extent to which each action should be taken and what resources to allocate to them.
Action implementation roles and responsibilities.	Identification of primary and supporting roles in action implementation, including public partners.
Draft and final plans.	Confirmation or refinement suggestions for plan elements.

7. Planning Support

Purpose of this chapter: | To illustrate the relationship between the method in this guide and that of other relevant programs

There are several programs that support municipalities in energy and emissions planning processes by providing funding, technical support, and/or guidance. The Guide incorporates these programs or their aspects where possible to avoid duplicating activities for municipalities. Table 60 describes key programs. Municipalities can subscribe to any of the support or reporting services offered by these programs and organizations in furthering their energy and emissions planning efforts.

Table 59. Energy and emissions planning support programs.

Program	Description	Municipalities enrolled	Resources	Applicability	Complexity of program	Relationship with the Guide
Federation of Canadian Municipalities Partners for Climate Protection.	A network of Canadian municipal governments that have committed to reducing greenhouse gases (GHG) and to acting on climate change.	74	Financial support (Green Municipal Fund, Municipalities for Climate Innovation Program), peer network, capacity building tools and resources throughout the milestone process.	All municipalities.	Low.	Planning approach parallels the PCP's five milestones.
Ontario Ministry of Energy Municipal Energy Plan (MEP).	Provides funding to Ontario municipalities for the development of Municipal Energy Plans (MEP).	36	Financial support.	All municipalities	Low.	MEP requirements are incorporated.
California's Local Government Operations Protocol (LGOP).	Guidance to support local governments in quantifying and reporting GHG emissions from their operations.	No known applications.	Protocol for corporate inventories.	All municipalities.	High.	Recommended as the inventory protocol for corporate inventories.
Global Greenhouse Gas Protocol	Emissions accounting framework for calculating community-scale GHG inventories.	11	Protocol for community inventories.	All municipalities.	Medium- high.	Recommended as the community inventory tool.
Global Covenant of Mayors.	Participation includes requirement to register a commitment, complete an inventory, create reduction targets and a system of measurement, and to establish an action plan.	11	Guidance on planning processes.	All municipalities.	Medium- high.	The Guide is compatible with the Covenant of Mayors requirements.

Program	Description	Municipalities enrolled	Resources	Applicability	Complexity of program	Relationship with the Guide
Carbon Neutral Cities Alliance.	Peer networks to support cities that commit to GHG reductions of 80% or more by 2050.	1	Guidance on carbon neutral cities.	Municipalities with deep GHG emissions reductions.	High.	Support for plans with a focus on deep emissions reductions.
C40 Cities.	A network of megacities (population of 3 million or more), innovator cities which can have a smaller population. Provides dedicated support staff that aid selected cities in program and policy development and implementation.	1	Development of guidance and tools.	Toronto and any other large cities that meet the innovation criteria.	High.	Target setting method (2 degrees) has been incorporated into the Guide.
Broader Public Sector GHG Reporting.	Requires that every municipality, post-secondary institution, hospital and school board in Ontario to report its use of energy (natural gas, electricity, etc) on an annual basis and prepare energy conservation and demand management (CDM) plans every five years for subject corporate owned facilities.	All.	Program-specific website, email, webinars, brochures.	All municipalities	Low.	Corporate GHG inventory is integrated with this reporting.

The Federation of Canadian Municipalities and ICLEI – Local Governments for Sustainability’s Partners for Climate Protection (PCP) has a long track record and high level of participation in Ontario. The five milestones of PCP have been maintained as the structure for this Guide to ensure consistency, while the focus and activities of the milestones have evolved to reflect new approaches in community energy and emissions planning. Table 61 shows the evolution of the PCP to the Guide. Note that the Guide introduces a preparatory stage prior to the inventory.

Table 60. An evolution of the PCP five milestone approach.

PCP milestones	Historical PCP approach		Guide approach
	Corporate emissions reductions	Community emissions reductions	Low carbon community transformation
1. Create a GHG emissions inventory and forecast.	Includes buildings, street lighting, waste and wastewater treatment, municipal fleet and corporate solid waste. Forecast is generated based on projections of population.	Includes institutional, commercial, industrial, transportation and residential waste sectors. Forecast is generated based on projections of population, economic growth and fuels.	Inventory GHG emissions according to GPC and/or LGOP. Also assesses spheres of influence of the local government, and the financial levers or opportunities.
2. Set an emissions reduction target.	Typically expressed as a percentage reduction below the quantity of emissions released in the baseline year.		Focus shifts from reducing emissions from a status quo baseline to a redefined, low carbon community. From remedial to anticipatory. Target may be expressed in various forms – carbon budget, % reduction over baseline or 100% renewable.
3. Develop a local action plan.	Integrate with asset management, fleet management, building management, capital budget.	Enhanced energy efficiency and increased use of carbon-free energy in an otherwise “business-as-usual” future.	Design a low carbon community in all of its dimensions (land-use planning, infrastructure, buildings, transportation).
4. Implement the local action plan or a group of activities.	The local government has full authority to implement.	Incremental improvements occur, often smaller than the noise of growth as the municipality implements small scale programs in a silo. Overall GHG reductions, if any, result from the actions of other levels of government, such as the phaseout of coal in electricity generation.	A comprehensive approach, integrating all the activities of the city towards the the low carbon objective. New initiatives reach beyond the traditional service area, including city-scale building retrofits, renewable energy utilities, justified by multiple benefits in addition to GHG reductions.
5. Monitor progress and report results.	Standard, internal reporting.	Repeat the inventory on a regular basis, possibly quantifying co-benefits.	Focus shifts to the economic, social and other benefits of the transition. Track drivers of emissions in addition to emissions themselves.
6. Engagement strategy.	Limited or none required outside of the municipal organization.	Stakeholder engagement to support the local government plan to reduce community emissions.	Focus shifts from engagement to empowerment. Key player-focussed to identify how the local government can help accelerate low carbon actions and investments.

8. Tools and Resources

Purpose of this chapter: To describe tools that can be used to support community energy and emissions planning

STAGE 1: PREPARATION

Resource	Description	Classification
Human settlements, infrastructure and spatial planning	IPCC chapter on municipalities, detailing a wide range of literature.	Document
Renewable energy in cities	A guidebook on enhancing renewable energy in cities by International Renewable Energy Association.	Document
Framework for long-term deep carbon reduction planning	A detailed synthesis of the processes, strategies, practices, tools, and institutional structures used by leading-edge cities worldwide to plan long-term, deep reductions in carbon emissions.	Document
Municipal Energy Plan Program	The Program provides funding for the development of Municipal Energy Plans.	Program

STAGE 2: INVENTORIES

Resource	Description	Classification
GHG Protocol for Cities	Guidance on completing community-scale GHG emissions inventories.	Protocol
Local Government Operations Tool	Guidance on quantifying and reporting on corporate GHG emissions.	Protocol
City inventory and reporting system	An excel-based tool for completing GHG emissions inventories.	Tool
PCP Milestone Tool	A web-based tool that helps municipalities complete corporate and community GHG inventories, set targets, and develop action plans.	Tool

STAGE 3: TARGET SETTING

Resource	Description	Classification
Science-based targets methods	Detailed guidance on setting targets, geared toward companies but applicable to municipalities.	Method
Deadline 2020	A method for identifying a target that is within 1.5 degrees of warming, developed by C40 and ARUP.	Method
NAZCA	Global platform for reporting on GHG reduction commitments by cities.	Reporting platform

STAGE 4: ACTIONS AND ALTERNATIVE SCENARIO DEVELOPMENT

Resource	Description	Classification
CAPCOA- Quantifying greenhouse gas mitigation measures	A resource for local government to calculate the impact of actions without a detailed model	Method
TRCA- Getting to carbon neutral	Guidance on calculating the GHG impacts of specific actions and strategies to reduce GHG emissions	Document
TAF Building Energy Efficiency Policy Calculator	Excel-based tool allows users to calculate the estimated local impacts of various municipal energy efficiency options that range from tighter building standards to financial incentives and energy reporting.	Tool
Envision Tomorrow	Scenario planning tool used to evaluate current and future growth patterns against a wide range of indicators.	Model
Climate action for urban sustainability (CURB)	An excel-based tool for identifying future low carbon scenarios for municipalities.	Model
CityInSight*	Model designed to evaluate land-use, energy and emissions scenarios for municipalities. CityInSight has been used by Toronto, Markham and the Region of Durham.	Model
UrbanFootprint	Model designed for evaluating land-use scenarios against a wide range of indicators.	Model
OPS Guidance Document for Quantifying GHG Reductions	The purpose of this guidance document is to provide assistance to OPS ministries for their process of preparing and submitting estimates of projected and actual GHG emission reductions for CCAP projects.	Protocol

Resource	Description	Classification
Land-use, land-use change and forestry guidance for GHG project accounting.	A document that provides guidance on accounting for the GHG emissions impacts of reforestation and forest management approaches.	Guidance document

*Developed by the authors of the Guide.

TOOLS FOR SPECIFIC ACTIONS

Resource	Description	Classification
HOT2000	A whole home energy simulation program that supports home energy evaluations and underlies the EnerGuide Rating System.	Tool
PLUM	Model for developing detailed population, employment and land-use scenarios.	Model
Retscreen	A model for evaluating energy efficiency, renewable energy and cogeneration project feasibility analysis.	Model
Plan4DE (Plan for district energy)*	Model for evaluating the impact of land-use plans on district energy feasibility.	Model
Community Lifecycle Infrastructure Costing Tool	Model to evaluate life cycle costs of different development patterns over 100 years.	Model
PVWatts	Model estimates the energy production and cost of energy of grid-connected photovoltaic (PV) energy systems.	Model
CREST Cost of energy models	Economic cash flow model designed to allow policymakers, regulators, and the renewable energy community to assess project economics, design cost-based incentives.	Model
Jobs and Economic Development Impact (JEDI)	Tool that estimates the economic impacts of constructing and operating power generation and biofuel plants.	Model
Walkscore	Tool for evaluating the walkability of a particular location.	Tool
TAF Building Energy Efficiency Policy Calculator	The Excel-based tool allows users to calculate the estimated local impacts of various municipal energy efficiency options that range from tighter building standards to financial incentives and energy reporting.	Tool
EnergyPlus	A whole building energy simulation program that engineers, architects, and researchers use to model both energy consumption—for heating, cooling, ventilation, lighting and plug and process loads—and water use in buildings.	Tool
Transit supportive guidelines	A distillation of transit-friendly land use planning, urban design and operational practices for application in Ontario.	Document

Resource	Description	Classification
Freight-Supportive Guidelines	A guideline to help municipalities better understand and plan for the vehicles that transport goods through their communities.	Document

*Developed by the authors of the Guide.

STAGE 5: IMPLEMENTATION

Resources	Description	Classification
Climate Innovation Program	Funding and training provided by the Federation of Canadian Municipalities.	Program
Municipal GHG Challenge Fund	The Challenge Fund provides funding for projects that reduce GHG emissions in municipalities.	Program

Resources	Description	Classification
Getting to implementation	<p>A series of reports and studies by QUEST on implementing community energy plans. These resources include:</p> <ul style="list-style-type: none"> » A readiness survey that allows the community to assess the extent to which the community has the factors in place to implement a Community Energy Plan. » Community Energy Implementation Framework: Ten strategies to help communities move their plans from a vision to implementation. » Smart Energy Atlas: A spatially-based resource of policies, plans, programs, resources, and projects across Ontario » Ontario energy community of practice: A series of 4 training modules and webinars relating to CEEP development and implementation in Ontario. » Community energy planning in Ontario: A competitive advantage for municipalities: A primer developed on community energy planning with an emphasis on economic development » Community energy planning and data: An assessment for small and rural municipalities: A resource developed to support rural and small communities, particularly with developing baseline inventories and data. » Community energy planning: The value proposition: A resource highlighting the environmental, health, and economic benefits of CEEPs. » Integrated community energy solutions (ICES) municipal policy toolkit: A toolkit of policies for municipalities to consider in their CEEPs, for land use, transportation, buildings, infrastructure, waste, and water & sanitation » Advancing integrated community energy planning in Ontario: A primer. » Towards planning alignment (in development): A report on best practices for alignment between CEEPs, IESO Regional Planning, and utility distribution and conservation planning. 	Documents
Low carbon city lab	<p>Project exploring how to support low carbon financing for municipalities.</p>	Resource
Neighborly	<p>Community bond tool, not yet available in Canada.</p>	Tool

STAGE 6: MONITORING AND EVALUATION

Resources	Description	Classification
CDP	A platform for disclosing risks and opportunities of climate change on an annual basis.	Reporting platform
ISO 37120: Sustainable development of communities	A standard that defines and establishes methodologies for a set of indicators to steer and measure the performance of city services and quality of life.	Document

9. Glossary

Average emissions factors are derived by dividing the total emissions from electricity production by the total quantity of electricity produced.

Active transportation is non-motorized travel, including walking, cycling, in-line skating and movements with mobility devices. The active transportation network includes sidewalks, crosswalks, designated road lanes and off-road trails to accommodate active transportation.

Adaptive capacity is the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.

Community energy and emissions planning refers to the process of incorporating consideration of GHG emissions and energy into the policies and operations of a municipality.

A **consumption-based inventory** is an inventory of GHG emissions resulting from consumption of goods and services associated with a defined population.

Community mapping is a participatory process of identifying existing and planned low carbon assets in a community including physical infrastructure such as renewable energy, high performance buildings, EV charging stations and social infrastructure such as relevant community organisations or non-profits.

Co-benefits have been traditionally used to describe the impacts of energy efficiency beyond reductions in energy demand – e.g. the benefits that occur in addition to a single prioritized policy goal. While these terms have been used interchangeably with multiple benefits in other literature, this publication opts to use multiple benefits in order to avoid a preemptive prioritization of various benefits; different benefits will be of interest to different stakeholders.

Discount factor is the ratio applied to current values in order to derive a value for future annual revenues and costs; it reflects factors such as perceived future risk and the premium that is placed on immediate revenues and deferred costs. Economic prosperity is defined as the capability to flourish.

Effect describes an additional factor (or factors) that can influence how benefits and impacts manifest.

Energy efficiency improvement is an improvement in the ratio of energy consumed to the output produced or service performed. This improvement results in the delivery of more services for the same energy inputs or the same level of services from less energy input.

Equity is the absence of avoidable or remediable differences among groups of people, whether those groups are defined socially, economically, demographically, or geographically.

A **geographic inventory** is an inventory of the GHG emissions released as a result of

human activity in a defined area.

Health is defined as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

Indicator is an observable or measurable result that shows evidence of whether an impact has occurred and the nature of that impact. It provides a metric by which one can quantify and define the scale of a resulting change.

Induced impacts refer to impacts that arise further down the causal chain, as a result of indirect impacts (see definition above); examples might include additional spending by the people employed as a result of direct or indirect benefits.

Leaf area index characterizes plant canopies and is defined as the one-sided green leaf area per unit ground surface area.

Local government refers to entities providing government services in a specific geographic area.

Marginal abatement cost (MAC) curves are a visual (graphic) illustration of the results of model-based scenarios that convey both the economic co-benefits (costs or savings) of an action or policy and the potential GHG reduction that can be achieved with the action or policy.

Marginal emissions factor is the emissions reduction that results from reducing electricity consumption generated from specific fuels.

Mitigation is a human intervention to reduce the sources or enhance the sinks of greenhouse gases. Mitigation can be accomplished through technological change and substitutions that reduce resource inputs and emissions per unit of output.

Monetization is the attribution of financial value to phenomena, usually by relating a change in status of a good or service to the relevant market value of the good or service.

Multi-criteria analysis describes any structured approach used to determine overall preferences among alternative options. The actual measurement of indicators need not be in monetary terms, but are often based on the quantitative analysis (through scoring, ranking and weighting) of a wide range of qualitative impact categories and criteria. Explicit recognition is given to the fact that a variety of both monetary and nonmonetary objectives may influence policy decisions.

A **municipality** is defined as a geographic area whose inhabitants are incorporated. References to municipalities within this document include everything within that geographic area such as dwellings, businesses, transportation systems, etc.

Net benefit is the measure of the value of an outcome after the cost of delivering the outcome has been accounted for and deducted.

Power is the degree of control or influence mayors exert over assets (such as buses) and functions (such as economic development) across all city sectors.

Resilience is the capacity of a social-ecological system to cope with a hazardous event or disturbance, responding or reorganizing in ways that maintain its

essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.

Risk is the potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as the probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard. In the IPCC report, the term risk is used primarily to refer to the risks of climate-change impacts.

Social capital is the links, shared values and understandings in society that enable individuals and groups to trust each other and so work together.

Social equity implies fair access to livelihood, education, and resources; full participation in the political and cultural life of the community; and self-determination in meeting fundamental needs.

Transformation is altering the fundamental attributes of a system, including value systems, regulatory, legislative, or bureaucratic regimes, financial institutions, and technological or biological systems.

Well-being refers to the integrated physiological, psychological and mental state of an individual, a household or group of people. It is broader than health, which typically refers to the physical state of an individual, family or group of people (public health).

10. References

- Ahlers, D., Krogstie, J., Driscoll, P., Lundli, H.-E., Loveland, S.-J., Rothballer, C., & Wyckmans, A. (2016). Supporting Municipal Greenhouse Gas (GHG) Emission Inventories Using Business Process Modeling: A Case Study of Trondheim Municipality. In Workshop on Sustainability-Aware Business Process Management@ BPM2016. Retrieved from <http://www.informatik.uni-oldenburg.de/~there/sabpm-GHGInventoriesTrondheim.pdf>
- Alliance, C. C. F. (2015). The State of City Climate Finance. Retrieved from <https://sustainabledevelopment.un.org/content/documents/2201CCFLA-State-of-City-Climate-Finance-2015.pdf>
- Anguelovski, I., & Carmin, J. (2011). Something borrowed, everything new: innovation and institutionalization in urban climate governance. *Current Opinion in Environmental Sustainability*, 3(3), 169–175. <https://doi.org/10.1016/j.cosust.2010.12.017>
- ARUP. (2014). Cities alive: Rethinking green infrastructure.
- ARUP. (2015). Powering climate action: cities as global changemakers.
- ARUP. (2016). Perspective input into the World Energy Council Scenarios: Innovating urban energy.
- ATKINS. (2013). Integrated city development. Retrieved from http://www.atkinsglobal.com/~media/Files/A/Atkins-Global/Attachments/sectors/urban-development/LCC_Report_March%202013%20LowRes.pdf
- Aylett, A. (2014). Progress and challenges in the urban governance of climate change: results of a global survey. MIT. Retrieved from <http://espace.inrs.ca/2835/>
- Bai, X., McAllister, R. R., Beaty, R. M., & Taylor, B. (2010). Urban policy and governance in a global environment: complex systems, scale mismatches and public participation. *Current Opinion in Environmental Sustainability*, 2(3), 129–135. <https://doi.org/10.1016/j.cosust.2010.05.008>
- Bassett, E., & Shandas, V. (2010). Innovation and Climate Action Planning: Perspectives From Municipal Plans. *Journal of the American Planning Association*, 76(4), 435–450. <https://doi.org/10.1080/01944363.2010.509703>
- Broekhoff, D., Erickson, P., & Lee, C. M. (2015). What cities do best: Piecing together an efficient global climate governance. Stockholm Environment Institute Seattle, WA, US. Retrieved from <http://ledsgp.org/wp-content/uploads/2015/12/SEI-WP-2015-15-Cities-vertical-climate-governance.pdf>
- Broto, V. C., & Bulkeley, H. (2013). Maintaining Climate Change Experiments: Urban Political Ecology and the Everyday Reconfiguration of Urban Infrastructure. *International Journal of Urban and Regional Research*, 37(6), 1934–1948. <https://doi.org/10.1111/1468-2427.12050>
- Bryson, J. M. (2011). Strategic planning for public and nonprofit organizations: A guide to strengthening and sustaining organizational achievement (Vol. 1). John Wiley & Sons.
- Bulkeley, H. (2010). Cities and the Governing of Climate Change. *Annual Review of Environment and Resources*, 35(1), 229–253. <https://doi.org/10.1146/annurev-environ-072809-101747>
- Bulkeley, H., Broto, V. C., Hodson, M., & Marvin, S. (2010). Cities and Low Carbon Transitions. Routledge.
- Bulkeley, H., Castan Broto, V., Hodson, M., Marvin, S., & others. (2011). Cities and the low carbon transition. *The European Financial Review*, 14. Retrieved from <http://www.europeanfinancialreview.com/?p=2667>

- Burch, S. (2010). Transforming barriers into enablers of action on climate change: Insights from three municipal case studies in British Columbia, Canada. *Global Environmental Change*, 20(2), 287–297. <https://doi.org/10.1016/j.gloenvcha.2009.11.009>
- Carmin, J., Chu, E., & Dodman, D. (2013). *Urban Climate Adaptation and Leadership* (OECD Regional Development Working Papers No. 2013/26). <https://doi.org/10.1787/5k3ttg88w8hh-en>
- Cashmore, M., & Wejs, A. (2014). Constructing legitimacy for climate change planning: A study of local government in Denmark. *Global Environmental Change*, 24, 203–212. <https://doi.org/10.1016/j.gloenvcha.2013.09.019>
- Condon, P. M., Cavens, D., & Miller, N. (2009). *Urban planning tools for climate change mitigation*. Cambridge: Lincoln Institute of Land Policy.
- Corfee-Morlot, J., Kamal-Chaoui, L., Donovan, M. G., Cochran, I., Robert, A., & Teasdale, P.-J. (2009). *Cities, climate change and multilevel governance*. OECD Environment Working Papers, (14), 0_1.
- Dhakai, S., & Ruth, M. (Eds.). (2017). *Creating Low Carbon Cities*. Cham: Springer International Publishing. <https://doi.org/10.1007/978-3-319-49730-3>
- Dodman, D., McGranahan, G., Dalal-Clayton, D. B., United Nations Environment Programme, & International Institute for Environment and Development. (2014). *Integrating the environment in urban planning and management: key principles and approaches for cities in the 21st century*.
- Dulal, H. B., & Akbar, S. (2013a). Greenhouse gas emission reduction options for cities: Finding the “Coincidence of Agendas” between local priorities and climate change mitigation objectives. *Habitat International*, 38, 100–105. <https://doi.org/10.1016/j.habitatint.2012.05.001>
- Dulal, H. B., & Akbar, S. (2013b). Greenhouse gas emission reduction options for cities: Finding the “Coincidence of Agendas” between local priorities and climate change mitigation objectives. *Habitat International*, 38, 100–105. <https://doi.org/10.1016/j.habitatint.2012.05.001>
- Fay, M., Hallegatte, S., Vogt-Schilb, A., Rozenberg, J., Narloch, U., & Kerr, T. M. (2015). *Decarbonizing development: three steps to a zero-carbon future*. Washington, DC: World Bank Group.
- Floater, G., Heeckt, C., Ulterino, M., Mackie, L., Rode, P., Bhardwaj, A., ... Huxley, R. (2016). *Co-benefits of urban climate action: A framework for cities*. LSE Cities. Retrieved from <http://www.c40.org/researches/c40-lse-cobenefits>
- Forsyning, G., & DHI. (2016). *Urban climate change guidelines*.
- Gusdorf, F., & Hallegatte, S. (2007). Compact or spread-out cities: Urban planning, taxation, and the vulnerability to transportation shocks. *Energy Policy*, 35(10), 4826–4838.
- Hill, K. (2016). Climate Change: Implications for the Assumptions, Goals and Methods of Urban Environmental Planning. *Urban Planning*, 1(4), 103. <https://doi.org/10.17645/up.v1i4.771>
- Hoppe, T., van der Vegt, A., & Stegmaier, P. (2016). Presenting a Framework to Analyze Local Climate Policy and Action in Small and Medium-Sized Cities. *Sustainability*, 8(9), 847. <https://doi.org/10.3390/su8090847>
- Ingram, J., & Hamilton, C. (2014). *Planning for climate change: A strategic, values-based approach for urban planners*.
- International Renewable Energy Agency (IRENA). (2016). *Renewable energy in cities*. Retrieved from http://www.irena.org/DocumentDownloads/Publications/IRENA_Renewable_Energy_in_Cities_2016.pdf
- Jabareen, Y. (2013). Planning the resilient city: Concepts and strategies for coping with climate change and environmental risk. *Cities*, 31, 220–229. <https://doi.org/10.1016/j.cities.2012.05.004>
- Jabareen, Y. (2015). *Planning Practices of the Risk City Around the World*. In

- Y. Jabareen, *The Risk City* (Vol. 29, pp. 105–136). Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-94-017-9768-9_6
- Jabareen, Y. (2017). A New Evaluation Method Applying Sustainability and Climate Change Concepts: The Case of Planning New York City 2030. In T. S. Uyar (Ed.), *Towards 100% Renewable Energy* (pp. 289–296). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-45659-1_31
- Kassens-Noor, E. (2016). Flip, move, tweet: a blended course design for different learning environments in urban planning, sustainability, and climate change university courses. *International Journal for Scholarship of Technology Enhanced Learning*, 1(1). Retrieved from <http://ejournals.library.gatech.edu/ijstotel/index.php/ijstotel/article/view/7>
- Kern, K., & Alber, G. (2009). Governing climate change in cities: modes of urban climate governance in multi-level systems. In *The international conference on Competitive Cities and Climate Change*, Milan, Italy, 9-10 October, 2009 (pp. 171–196). Retrieved from <http://library.wur.nl/WebQuery/wurpubs/fulltext/51364>
- Kii, M., Doi, K., & Nakamura, K. (2017). Urban Planning Research in the Climate Change Era: Transdisciplinary Approach Toward Sustainable Cities. In R. Á. Fernández, S. Zubelzu, & R. Martínez (Eds.), *Carbon Footprint and the Industrial Life Cycle* (pp. 37–51). Springer International Publishing. https://doi.org/10.1007/978-3-319-54984-2_3
- Knopman, D. S., & Lempert, R. J. (2016). *Urban responses to climate change: framework for decisionmaking and supporting indicators*. Santa Monica, Calif: RAND Corporation.
- LSE Cities, & EIFER. (2014). *Cities and energy: Urban morphology and heat energy demand*. Retrieved from <https://files.lsecities.net/files/2014/03/LSE-Cities-EIFER-2011-Morphology-and-Energy-Report1.pdf>
- Maddocks. (2010). *Planning policy and practice: The right mechanism to tackle climate change?* Retrieved from <https://www.maddocks.com.au/app/uploads/articles/planning-policy-and-practice-the-right-mechanism-to-tackle-climate-change-update-september-2010.pdf>
- McGrail, S. (2014). A review of roadmaps for transitioning to a zero carbon built environment in Australia. VP2040 Foreground Paper. Retrieved from http://www.visionsandpathways.com/wp-content/uploads/2014/05/McGrail_Roadmaps-Paper_290514.pdf
- Mcguirk, P., Dowling, R., Brennan, C., & Bulkeley, H. (2015). Urban Carbon Governance Experiments: The Role of Australian Local Governments: Urban Carbon Governance Experiments. *Geographical Research*, 53(1), 39–52. <https://doi.org/10.1111/1745-5871.12098>
- Moloney, S., & Horne, R. (2015). Low Carbon Urban Transitioning: From Local Experimentation to Urban Transformation? *Sustainability*, 7(3), 2437–2453. <https://doi.org/10.3390/su7032437>
- OECD. (2010). *Cities and climate change*. OECD Publishing. <https://doi.org/10.1787/9789264091375-en>
- Olazabal, M., & Pascual, U. (2015). Urban low-carbon transitions: cognitive barriers and opportunities. *Journal of Cleaner Production*, 109, 336–346. <https://doi.org/10.1016/j.jclepro.2015.08.047>
- Pouffary, S., & Rogers, H. (2014). *Climate finance for cities and buildings: A handbook for local governments*. Retrieved from http://www.uncclean.org/sites/default/files/inventory/unep28062016_climate_finance_for_cities_and_buildings-a_handbook_for_local_governments-2014carbon_finance_for_cities_and_buildings.pdf
- Roberts, D. (2016). The New Climate Calculus: 1.5°C = Paris Agreement, Cities, Local Government, Science and Champions (PLSC2). *Urbanisation*, 1(2),

- 71–78. <https://doi.org/10.1177/2455747116672474>
- Romero-Lankao, P. (2012). Governing Carbon and Climate in the Cities: An Overview of Policy and Planning Challenges and Options. *European Planning Studies*, 20(1), 7–26. <https://doi.org/10.1080/09654313.2011.638496>
- Roy, J., Ghosh, D., Ghosh, A., & Dasgupta, S. (2013). Fiscal instruments: crucial role in financing low carbon transition in energy systems. *Current Opinion in Environmental Sustainability*, 5(2), 261–269. <https://doi.org/10.1016/j.cosust.2013.05.003>
- Schwartz, E. (2016). Local solutions to a global problem? : Canadian municipal policy responses to climate change. University of British Columbia. Retrieved from <https://open.library.ubc.ca/clRcle/collections/ubctheses/24/items/1.0300060>
- Stanbrough, L., Stratton-Short, S., & Hewitt, B. (2017). Future cities: Building infrastructure resilience.
- Stone, B., Vargo, J., & Habeeb, D. (2012). Managing climate change in cities: Will climate action plans work? *Landscape and Urban Planning*, 107(3), 263–271. <https://doi.org/10.1016/j.landurbplan.2012.05.014>
- Swilling, M., Robinson, B., Marvin, S., Hodson, M., United Nations Environment Programme, & International Resource Panel. (2013). City-level decoupling: urban resource flows and the governance of infrastructure transitions.
- Tagliapietra, S., & Zachmann, G. (2016). Going local: empowering cities to lead EU decarbonisation. Bruegel Policy Contribution Issue No. 221 2016. Retrieved from <http://aei.pitt.edu/id/eprint/82180>
- UN Habitat. (2015). Guiding principles for city climate action planning.
- United Nations Human Settlements Programme (Ed.). (2011). *Cities and climate change: global report on human settlements, 2011*. Washington, DC: Earthscan.
- United Nations Human Settlements Programme (Ed.). (2013). *Planning and design for sustainable urban mobility: global report on human settlements 2013*. Abingdon, Oxon: Routledge.
- Urban age program. (2008). *Integrated city making- Governance, planning and transport*. Retrieved from http://v0.urban-age.net/0_downloads/ICM_Detailed_Report.pdf
- Wiseman, J., Edwards, T., & Luckins, K. (2013). Post carbon pathways: A meta-analysis of 18 large-scale post carbon economy transition strategies. *Environmental Innovation and Societal Transitions*, 8, 76–93. <https://doi.org/10.1016/j.eist.2013.04.001>
- Evaluating Residential Energy, Emissions and Cost Scenarios for Prince George’s Official Community Plan: <https://www.toolkit.bc.ca/Resource/Evaluating-Residential-Energy-Emissions-and-Cost-Scenarios-Prince-George%E2%80%99s-Official-Community-Plan>
- Data Issues and Promising Practices for Integrated Community Energy Mapping: <http://www.nrcan.gc.ca/energy/offices-labs/canmet/publications/19118>

Appendix 1: Findings from the research summaries

This Guide was developed following a process of research on municipal energy and emissions processes in municipalities, and an investigation of programs and frameworks that support this work. Case studies were prepared for 15 energy and emissions planning programs, protocols, methodologies and frameworks (PPMFs), based on academic papers and reports, and interviews with staff directly involved in the development and application of the PPMFs. Table 60 lists the PPMFs analyzed.

Table 61. Programs, protocols, methodologies and frameworks evaluated for the Guide.³²

	Urban	Rural	Community-wide		Application in Ontario
Federation of Canadian Municipalities Partners for Climate Protection (PCP)					73 municipalities
Ontario Ministry of Energy Municipal Energy Plan (MEP)					20 applicants (33 municipalities)
BC's Climate Action Charter					
ICLEI's ClearPath					
California's Local Government Operations Protocol (LGOP)					
The Climate Registry					
Global Greenhouse Gas Protocol					11 municipalities
BC Bill 27					
California's SB 375					
Compact of Mayors					11 municipalities
Carbon Neutral Cities Alliance					1 municipality
C40 Cities					1 municipality
Climate Action Revenue Incentive Program (CARIP)					
Municipal Climate Change Action Program (MCCAP)					
Broader Public Sector GHG Reporting					444 municipalities
Applicable to Ontario Municipalities					
Not applicable to Ontario Municipalities					

A similar approach was used to develop case studies for the energy and emissions planning work of 15 municipalities, detailing the development of GHG inventories, setting emissions reduction targets, and preparing community energy and emissions plans. The municipalities represented diverse contexts and sizes, and are recognized for leadership in community energy and emissions planning (Figure 1).

³² This table refers to whether or not a PPMF can be applied to Ontario municipalities. In some cases the general approach, for example of SB 375, could be applied in Ontario.



- | | | |
|------------------------|--------------------|-----------------------|
| 1 London, ON | 6 Toronto, ON | 11 North Cowichan, BC |
| 2 Burlington, ON | 7 Halton Hills, ON | 12 Seattle, WA |
| 3 Guelph, ON | 8 Markham, ON | 13 San Francisco, CA |
| 4 East Gwillimbury, ON | 9 Boston, MA | 14 Calgary, AB |
| 5 Wawa, ON | 10 Surrey, BC | 15 Red Deer, AB |

Figure 30. Municipalities analyzed in the process of developing the Guide.

A third step used concept analysis (qualitative data analysis, QDA) in which textual data is mined in order to identify key concepts and to code (label) data sources. The analysis identified, examined and interpreted patterns to determine connections between concepts and themes such as mitigation, adaptation, land-use planning, economy, finance, health, and employment. QDA was used to evaluate climate action plans, community energy plans, and Official Plans.



Figure 31. A word cloud representing the most frequent terms used in fifteen Official Plans and land-use plans. In most cases, plans do not consider climate change mitigation.

The Guide authors contributed their extensive experience in community and municipal corporate energy and emissions planning work. The team of authors includes individuals with more than thirty years of practice in the field and preparation of dozens of projects on the subject across Canada and beyond.

PPMF SCAN – OBSERVATIONS

No additional technical guidance on GHG inventories is required. While GPC is emerging as the international standard for GHG inventories and is being utilized in Ontario already, the guidance may be overly complex for smaller municipalities, particularly at the BASIC+ level. Similarly LGOP is also relatively complex. PCP, which is seeking to harmonize with the GPC, provides guidance on completing both corporate and community-wide inventories that is more accessible to smaller municipalities. The PCP Tool further decreases the effort involved by providing

some automated functions. GPC, LGOP and PCP provide clear documentation of the processes and equations involved in completing a GHG inventory that are directly applicable to Ontario municipalities.

Table 63. Table: Guidance on completing an inventory.

	Corporate	Community-wide
Higher complexity.	LGOP.	GPC (BASIC+).
Lower complexity.	PCP.	PCP (aiming for GPC alignment in 2018).

1. There are relatively complex questions around boundaries and transportation, in terms of which GHG emissions to account for. GPC provides guidance on difference approaches and the Guide can provide additional insight on these approaches. However, it is recommended that options be maintained for municipalities in order to utilize the best approach given a particular context. GPC also provides two levels of reporting, BASIC and BASIC+ and it is recommended that the Guide maintain both options for municipalities.
2. PPMFs do not provide guidance on data sources in Ontario. With the exception of PCP, the PPMFs reviewed do not provide specific and detailed guidance on sources of data to support the preparation of inventories or target-setting for Ontario municipalities. PCP provides some data, as well as streamlined calculations in the PCP tool, but additional guidance on the availability and strengths and weaknesses of data sources would be useful.
3. It is challenging to identify which PPMFs are most applicable. The number of PPMFs means that it can be difficult for municipalities to navigate which option is more appropriate for a particular context and to understand the requirements of each PPMF and how they relate to each other. For example, the five milestones of the PCP overlap with the requirements of the Compact of Mayors, an overlap which the PCP is seeking to address.
4. The co-benefits of climate action are increasingly emphasised. C40 and CNCA have provided insight on co-benefits of climate action with respect to economic development, health impacts, livability and equity. A framework for evaluating co-benefits is described by C40, but methods for evaluating co-benefits are not addressed by any of the PPMF.
5. Integration of land-use planning/policy is not generally addressed. Just two of the PPMFs directly relate to the GHG impacts of land-use planning/policy, and of these two, SB 375 is the most mature in terms of the sophistication of the results and evaluating performance. However, despite extensive discussion in the literature on the importance of land-use planning/policy as an intervention in preventing lock-in of high-carbon development, there is not commensurate focus within the PPMFs evaluated for this research summary. In particular, there is no guidance on how to evaluate the impact of land-use planning/policies on GHG emissions. The focus of this Guide is therefore prescient in seeking to provide guidance on the GHG implications of land-use policy.
6. The value and purpose of energy mapping is not addressed. The MEP program includes energy mapping, but there is limited content on the purpose of energy mapping, methods for developing energy maps, and

what constitutes an energy map.

7. There is limited guidance on target setting. With the exception of SB 375 and Bill 27, GHG targets are not related to land-use policy. In the case of Bill 27, the requirement is simply to have a target and supporting actions. SB 375 goes a step further and requires evidence as to how the target will be achieved using transportation modelling. C40's Deadline 2020 also explores the importance of land-use policy in achieving short-term GHG targets. Beyond these examples, the PPMFs do not provide guidance on how to ensure that land-use policies reflect the GHG target and vice versa.
8. There is a need to for guidance on implementation strategies. There is limited guidance on strategies and actions with which GHG targets can be achieved. For example, what policies or actions are most effective? What are the possible governance strategies? Are there financing strategies that can unlock climate action?
9. There is a need for guidance on monitoring and evaluation. PCP, Compact of Mayors and the Climate Action Charter have comprehensive mechanisms for monitoring the performance of municipalities at the macro level. However, the PPMFs do not provide explicit strategies as to how the municipality can monitor and evaluate progress.
10. Some PPMFs provide funding, but broader strategies are required. In terms of planning, both MEP and PCP provide funding. Funding opportunities for implementation are also available through the GMF. However, other funding strategies such as revolving loan funds and green or climate bonds are not described by the PPMFs.

JURISDICTIONS SCAN OBSERVATIONS

1. GHG inventories need to be standardized. There are multiple reasons why establishing GHG inventories are problematic. From the perspective of the province, different protocols are used, different sources of emissions are tracked, different methods for calculating the emissions are used and different data sets are used. The consequence is that it is difficult to evaluate the impact of major investments in energy and emissions planning or implementation. From the perspective of municipalities, the process is too complex or too ambiguous, data collection is too onerous or is incomplete and there is insufficient staff capacity.
2. GHG inventories need to be transparent. It is difficult to access GHG inventories from many municipalities, even if they have completed them, and if the inventory is completed, there is insufficient detail to understand the method, calculations and data sources behind the inventories.
3. Guidance is required to set targets that are integrated with land-use plans. Several municipalities have incorporated climate change considerations into Official Plans, but these policies are not always aligned with their GHG targets. Guidance is also required on the best way to integrate climate change planning in municipal land-use plans (e.g. integrate considerations throughout the plan, or dedicate a section in the plan to climate change).

4. Energy and emissions planning needs to be a core service of municipalities. In some cases energy and emissions planning activities have declined, following political shifts, which can endanger a major public investment. Other municipal services such as transportation and engineering are isolated from these shifts because they are regarded as a core municipal service.
5. The number of PPMFs is confusing but PCP is an important program for municipalities. Most Canadian municipalities are actively engaged with PCP for the five milestone road map, a peer network, financial resources and guidance. Municipalities are frequently engaged in multiple PPMFs with associated costs; it is difficult to determine which PPMFs are most appropriate for a particular context.
6. Mechanisms to evaluate the impact of actions to reduce GHG emissions need to be developed. It is difficult to attribute GHG emissions reductions to specific actions or policies both for the municipality and for the province.
7. Guidance on the relationship between the energy and emissions plan and Official Plan is required. Currently, these two plans represent parallel planning activities, which may or may not cross over depending on timing and staff interest. The Guide can provide insight on a formal relationship similar to that of a transportation plan and the Official Plan.
8. Provincial mandates empower existing leaders within municipalities. One of the key driving forces for climate action are existing leaders within the municipal structure. Provincial mandates for reporting, actions or other purpose allow these leaders to increase the level of activity within the municipality.
9. Grant funding enables energy and emissions plans/municipal energy plans. Municipalities tend to apply to either the Green Municipal Fund or the MEP program for resources to complete an energy and emissions plan or municipal energy plan.
10. Grant funding is important for implementation. While many municipalities have dedicated staff, they have access to limited discretionary funding and are dependent on grants for the development and deployment of programs.
11. There is a need for performance incentives. There is no requirement or mandate for municipalities to achieve their GHG target, and they are therefore less likely to take those targets seriously, either when the target is being identified or when it is being implemented.
12. The level of short-term ambition is constrained by resources, history and vision, whereas the level of long-term ambition is high. Pilot projects are needed to stimulate the ambition of municipalities, to demonstrate how to scale up projects and programs.
13. Municipal governance structures vary. The responsibility for energy and emissions planning is located in different departments in different municipalities and the scope of work varies considerably. There is a need for guidance on possible structures and mandates for municipalities of different sizes.

14. Programs to cultivate leadership will increase the success of energy and emissions plans. Leadership by Mayors and CAOs was identified as a key driver in a number of municipalities. Organizations such as QUEST and Clean Air Partnership provide peer learning opportunities but there is no program that provides context and inspiration to mayors and CAOs. The BC Municipal Climate Leadership Council is an example of such an effort.
15. Co-benefits are emerging as an important strategy to broaden the constituency of support. The term health was found in many of the energy and emissions plans, indicating that municipalities are beginning to see the crossover. Despite the leadership of several municipalities, the impact on the economy and employment of climate action is not well understood.

Appendix 2: Sample terms of reference³³

Introduction and purpose

The municipality is developing a Community Energy and Emissions Plan (CEEP) to assess current and forecasted greenhouse gas (GHG) emissions and energy use based on projected growth, to review and refine existing GHG and energy reduction targets, and to establish an implementable framework of actions to lead the community towards reaching the identified targets.

This CEEP will be an integrated, community-wide plan with analysis and actions addressing the following key community sectors: land-use, buildings, transportation, energy management, waste management and urban forestry. Community and corporate energy and GHG emissions will be addressed.

A community health and equity lens will explore varying demographic and socio-economic implications of climate change, and potential barriers to climate action. This perspective will build awareness of the important connection between land-use and transportation planning, climate action and community health. This community health and equity lens will also inform the triple bottom line evaluation of options and the development of effective climate actions that consider the needs of diverse community populations.

Background

Climate change presents very real and far reaching challenges for our environment, social well-being, and economic resiliency. At the same time, uncertainty about the long term availability and pricing of current energy sources poses growing concerns and rising costs for residents. Recognizing that transportation and buildings are the two major contributors of community GHG emissions and energy consumption, municipalities and local governments have an important role to play in managing their impact on climate change, and driving energy efficient, sustainable community plans and programs.

To be successful in achieving significant reductions in community GHGs as our community grows over time, the municipality needs to be guided by an integrated, long-term implementation strategy. The CEEP will provide a long-term roadmap for the municipality to achieve GHG reductions that match regional and provincial government commitments. Besides GHG reduction – building efficiency measures, sustainable transportation shifts, renewable energy generation and other opportunities arising from CEEP implementation will enable significant energy cost savings. GHG reduction and renewable energy technologies continue

³³ Adopted from a Request for Proposals from the District of North Vancouver.

to advance and are becoming more cost competitive. Development of a CEEP is timely and will better position the municipality to be ready for, and to adapt to, alternative energy with appropriate planning and infrastructure systems. Current and future redevelopment in our emerging centres presents an urgent need for a CEEP to prevent missed opportunities for change.

Project goals and objectives

It is anticipated that the CEEP will identify a strategic pathway for achieving the following goals:

- » Establishing a progressive, impactful and coordinated approach to reducing the municipality's greenhouse gas emissions, conserving energy and reducing community energy costs;
- » Building organizational capacity and strengthening integration of GHG reduction and renewable energy management solutions into municipal programs and decision making;
- » Establishing a clear role for the municipality in leading change towards an energy efficient and low carbon community that promotes social, economic and environmental health;
- » Increasing community awareness and resilience, inspiring innovation and climate action; and
- » Fostering a supportive environment for emerging energy technologies and jobs.

Key objectives for the CEEP project include:

- » Apply a unique community health lens to the project and build an understanding of the important connection between land-use and transportation choices, climate action, and community health.
- » Employ an effective communication strategy to present and gather input on key interim CEEP phases to build community awareness and interest, and to promote successful implementation of the CEEP.
- » Build an understanding of the current and projected energy use and GHG emissions for each of the aforementioned key community sectors.
- » Work with the municipality and key community stakeholders to develop challenging, yet achievable, community GHG and energy reduction targets to 2050 that are guided by the local opportunities and constraints and the results of GHG modelling.
- » Employ modelling, mapping and other tools to test and visually illustrate potential CEEP actions for different community sectors and land-use typologies.

- » Embed triple bottom line and integrated systems principles, and the community health lens into the CEEP to capture the diverse spectrum of community interests, and to facilitate integration of sustainable solutions across different disciplines, departments and demographics.
- » As one of the key outcomes of the CEEP process, develop a prioritized action plan to guide integration of climate actions into existing municipal programs and to leverage funding for implementation. Identify opportunities for immediate action to establish success and build momentum for CEEP implementation and monitoring.
- » Facilitate completion of Partners for Climate Protection Milestones 1–3.
- » Learn from and build on the collective municipal experience in preparing and implementing CEEPs, and contribute new ideas and creative solutions for sharing with other local governments.

Scope

The CEEP project is anticipated to unfold under the following key phases:

- Stage 1: Preparation
- Stage 2: Inventories
- Stage 3: Target setting
- Stage 4: Actions and alternative scenario development
- Stage 5: Implementation
- Stage 6: Monitoring and evaluation

Specific work to be completed under each key project phase is described below.

Stage 1: Preparation

1. Conduct background research to develop an understanding of the local, regional and legislative context for the CEEP.
2. Work with the Municipality to review established and emerging community GHG and energy inventory protocols, and establish a practical GHG and energy inventory methodology that can be readily be replicated by municipal staff as part of regular CEEP monitoring efforts.
3. Review the current policies, bylaws and other planning policies, programs and reports undertaken by the municipality towards advancing energy sustainability and GHG emission reductions.
4. Review actions already being undertaken by the municipality to reduce GHG emissions and energy use.
5. Meet with interdepartmental staff to build an understanding of municipal plans and programs, to facilitate access to available municipal and other data sources, and to gather information to help inform and shape the situational analysis.

6. Gather demographic and socio-economic information and community health data from Stats Canada, VCH and other available sources. Build an understanding of the important connection between land-use and transportation choices, climate action and community health. Explore the varying demographic and socio-economic implications of climate change and potential barriers to climate action.

Stage 2: Inventories

1. Develop a current and projected emissions and energy profile for the municipality and provide a high level understanding of where the municipality is currently heading in terms of energy management and GHG emissions reduction.
2. Use population and economic growth projections to estimate and quantify the forecasted overall and per capita community GHG emissions and energy demand to 2030 and 2050 per the “business as usual” approach (in the absence of coordinated, impactful CEEP implementation). Compare this to the Official Plan target for community GHG reduction.
3. Work with the interdepartmental staff and community stakeholders to identify the key community climate and energy aspirations, priorities (across the identified community sectors) and a vision to 2050 to inform development of the CEEP.
4. Support the launch and posting of CEEP project information on the municipality’s website and through social media.

Stage 3: Target setting

1. As informed by the low carbon and sustainable energy aspirations and priorities (to be explored in Stage 1) and the results of modelling and impact analysis (in Stage 1), identify new community GHG reduction and energy management targets to 2050.
2. Lead a workshop with the interdepartmental staff team on the modelling, impact analysis, trade-offs and target setting. Work with the municipality to engage community stakeholders and Council on the same.

Stage 4: Actions and alternative scenario development

1. Conduct a review of sustainable community energy management and GHG reduction tools and best management practices, and consider their potential for application within the community context, across the suite of identified community sectors, and community demographics. Consideration should be given to, but not limited to: land-use and transportation planning, energy efficient building strategies (for new and existing buildings), transportation demand management, waste management, energy conservation and renewable energy generation, regulatory tools, development permit area guidelines, financial tools, senior government legislation and political advocacy, public education and awareness.

2. Identify a potential set of coordinated actions towards achieving community climate action and sustainable community energy priorities and objectives across the identified community sectors.
3. Using an established and recognized modelling tool (such as a community energy and emissions model), assess and measure the relative GHG reductions and energy savings to be gained from individual actions, or combinations of actions where appropriate. Quantify the estimated energy and GHG emissions savings from each combination of actions.
4. Using triple bottom line and integrated systems concepts and a community health and equity lens, assess the social, economic and environmental costs/benefits, impacts and trade-offs of potential actions. Use this information to foster a discussion on trade-offs and preferred actions with staff and key community stakeholders.
5. Explore and evaluate different opportunities for action within distinct land-use types and urban geographies (e.g. town centres, village centres, corridors, single detached neighbourhoods, and rural areas) and to meet the needs of diverse community populations. Use mapping and/or other visual tools to illustrate findings.
6. Based on the findings from previous phases, identify a short-list of cross-cutting actions that will enable the municipality to achieve the identified community GHG reduction and energy management priorities and targets.

Stage 5: Implementation

1. Compile, review and integrate results of public and stakeholder engagement.
2. Identify current and planned municipal actions towards GHG emissions and energy reduction, as well as deep or “breakthrough” actions requiring innovation, collaboration, and action by senior levels of government, businesses, and residents necessary to reach 2050 targets.
3. Develop an implementation plan outlining short-, medium-, and long-term prioritized actions for each of the identified community sectors. For each action consider the key implementation steps, ease of implementation, sphere of municipal influence, estimated implementation timelines and costs. Ensure that recommended actions reflect the social, economic and environmental analysis from previous phases and consider the needs of diverse community populations.
4. Identify potential barriers to successful implementation of community climate mitigation and sustainable community energy objectives and recommended strategies to mitigate these barriers. Identify key departments, organizations, stakeholders, and community groups whose involvement and/or expertise is needed to enhance implementation of the CEEP action plan.
5. Consolidate key findings from previous phases into a succinct, visual and implementable Draft CEEP. Include the results of comprehensive analysis,

technical details, and background information in an Appendix or as a separate document(s).

6. Enable circulation of the Draft CEEP to interdepartmental staff and community stakeholders for review and comment.
7. Present the Draft CEEP to the Executive Management Team for review and comment.
8. Receive Council, stakeholder and staff input on the Draft CEEP and refine accordingly.
9. Work with the municipality to implement an effective public engagement strategy on the Draft CEEP.
10. Incorporate results of public input received and prepare the final CEEP report for Council consideration of approval.

Stage 6: Monitoring and evaluation

1. Develop a monitoring framework with key metrics and indicators for measuring progress towards implementation of the CEEP and achieving the identified community GHG emissions and energy reduction targets. These indicators should complement and build on the targets and indicators in the Official Plan.
2. Present the draft implementation plan and monitoring framework for review and discussion by municipality staff, community stakeholders and Council.

Responsibilities

The municipality will allocate interdepartmental staff resources to help support the success of the CEEP.

>> As specified.

Public and stakeholder engagement

Community stakeholders can add value to the CEEP project by contributing industry knowledge and business-minded thinking, as well as new perspectives and ideas relating to GHG and energy reduction opportunities and technologies. The Proponent will work with the municipality to develop a refined list of relevant community stakeholders, and to develop a strategy for hosting a series of stakeholder workshops at key stages in the CEEP project.

Public engagement on the CEEP will enable information exchange, build awareness, and inspire action and behavioral change towards a more energy efficient and low carbon community. The Proponent will work with the municipality to develop an effective public engagement and communications strategy which may include a combination of:

- » Creative ways to work with community partner to build community

energy and awareness of the need for climate action and the measures individuals, households and businesses can take to effect change.

- » Launching a dedicated CEEP project web page on the municipality's website to highlight the CEEP progress, present interactive web content, and ways to get involved in the CEEP process.
- » Social media and other community outreach (such as brochures and displays at existing community events and venues) linking opportunities to provide input to the CEEP through an online survey.
- » Visual tools and videography to relay key messages in a meaningful and engaging manner.
- » Connecting with citizen-based municipal advisory committees to gain feedback at various stages in the CEEP project.

Timeline

- » As specified, between 1 and 2 year duration.

Appendix 3: Sample data request

DATA REQUEST			BASE YEAR 2011	PROJECTION 2012–2051
DEMOGRAPHICS & ECONOMICS				
	Population	# persons	Total by zone	Total by zone
	Households	# households	Total	Total
	Employment	# jobs (place of work)	Total by: Employment by sector (naics/nocs) AND zone; municipal employees broken out	Total by: Employment by sector (naics/nocs) AND zone; municipal employees broken out
BUILDINGS & PROPERTIES				
	Parcel fabric	For the municipality	2011 & MOST RECENT 1. GIS: Parcels fabric shapefile 2. MPAC assessment roll number to parcel ID lookup table. Any other attributes associated with parcels in existing GIS shapefile are helpful	
	Building footprints	For the municipality	2011 & MOST RECENT GIS: Building footprints shapefile (anything available) Any other attributes associated with building footprints in existing GIS shapefile are helpful	

DATA REQUEST			BASE YEAR 2011	PROJECTION 2012–2051
	Property assessment roll	For the municipality	2011 & MOST RECENT MPAC tables: GENERAL, Structure (Region/ Municipality should have these tables already) MPAC custom order data request (see list of fields) Key fields: Property code, structure code, building footprint area, number of storeys, total floorspace area, number of units, year built	
	Residential (dwellings)	# dwelling units	Total by structural type AND by zone. The recommended structural categories are single-detached, double/row, low-rise apartment, high-rise apartment and mobile home.	Total by structural type AND by zone AND by development type (greenfield / infill / redevelopment)
	Non-residential	sqm floorspace, # buildings	Total by Sector / industry AND by zone. Suggested sectors are office building, medical office, elementary or secondary school, nursing or residential care facility, warehouse, hotel or motel, hospital, food or beverage store, non-food retail store and other.	Total by Sector / industry AND by zone
LAND-USE				
	Municipal boundaries		GIS: Regional and municipal boundaries (CD & CSDs?)	

DATA REQUEST			BASE YEAR 2011	PROJECTION 2012–2051
	Zoning		2011 & MOST RECENT GIS: Including zoning codes & descriptions. Typically transportation zones provide a high enough resolution to capture walking and cycling and municipalities already track population and other data for these zones. Small municipalities that do not have transportation zones may use census tracts or dissemination areas.	
	Energy infrastructure		2011 & MOST RECENT GIS: Energy infrastructure; including district energy infrastructure, NG network, PV installations, utilities, pipelines, EV charging.	GIS: Future planned energy infrastructure.
	Land Cover		2011 & MOST RECENT GIS: Agricultural (include type- crop, dairy, etc.), forest (include status- woodlot, protected, or indicate that you don't have this), urban forest (street trees, shrubs, green roofs), roads, parks, vacant, etc.	GIS: Future land- use, growth, and/or zoning (per current OCP maps)
ENERGY				
	Natural gas	GJ preferred; cubic metres (m ³)	2011–2016 (annual) Total natural gas consumption by as much sectoral and geographic detail as possible; from all natural gas providers. Cost (\$/m ³) by sector.	

DATA REQUEST			BASE YEAR 2011	PROJECTION 2012–2051
	Electricity	kWh	2011–2016 (annual) Total electricity consumption by as much sectoral and geographic detail as possible; from all electricity providers. Cost (\$/kWh) by sector.	
	Fuel oil	GJ preferred; volume ok	2011–2016 (annual) Total fuel consumption by as much sectoral and geographic detail as possible. Cost (\$/GJ or \$/vol.) by sector.	
	Gas and diesel sales	litres	2011–2016 (annual) Total sales (L) by fuel type.	
	Centralized electricity capacity	MW	2011–2016 (annual) by zone, by technology, by fuel	
	Centralized electricity generation	kWh	2011–2015 (annual) by zone, by technology, by fuel	
	Centralized electricity generation fuel use	GJ	2011–2016 (annual) by zone, by technology, by fuel	
	Decentralized electricity generation (excluding district energy); this is generation that is not grid connected	kWh (elec); GJ (preferred) or volume for fuel use	2011–2016 (annual) Total electricity generated by decentralized plant by zone by fuel/technology types; fuel use by type. Decentralized electricity capacity (MW).	Planned decentralized electricity generation, and/or future expected load, by location, technology, fuel
	District energy and network	kWh (elec); GJ (preferred) or volume for fuel use	2011–2016 (annual) DE plant capacity and generation by fuel/technology type; fuel use by type; electricity generated from CHP; location of DE system & plant.	Planned DE systems/expansion, and/or future expected load, by location, technology, fuel

DATA REQUEST			BASE YEAR 2011	PROJECTION 2012–2051
	Energy costs			
	Residential energy-consuming stocks		zone, fuel type, and stock type water heater types: conventional, solar, on demand, heat pump heat system types: oil, gas, electric, heat pump, combinations air cond types: room, central, heat pump	
TRANSPORTATION				
	Zones (traffic)		GIS: Traffic zones Any additional zone systems used for transportation modelling by the City	
	Household travel survey		Confirm that the Transportation Tomorrow Survey is the survey used for regional transportation modelling.	
*	Modelled origin-destination trip matrix	person trip	24hr (not peak hour). By origin zone, destination zone, trip purpose, primary mode (auto, transit, active modes). Modelled zone-to-zone mode share matrices, if available separates from trip matrices.	24hr (not peak hour). By origin zone, destination zone, trip purpose, primary mode. Modelled zone-to-zone mode share matrices, if available separates from trip matrices.
	Distance matrix	km	Zone-to-zone road network distance matrix.	
	Vehicle fleet		2011 Vehicle registration counts for Passenger and Commercial vehicles (MTO) in the region.	

DATA REQUEST			BASE YEAR 2011	PROJECTION 2012–2051
	Corporate vehicle fleet		2011–2016 (annual) By body type (car, light truck); fuel type; technology type (internal combustion, hybrid, electric); weight class	
	Local and regional (in-boundary) transit system		2011–2016 (annual) Route/network GIS files; Fleet by type (subway, commuter train, bus, streetcar); VKT; energy/fuel use; vehicle fuel consumption per km.	Projected transit VKT by vehicle type (consistent with projected OD trip matrix)
	School bus fleet		2011–2016 (annual) Fleet by fuel type; VKT; fuel consumption.	
	VKT	km	2011–2016 (annual) Any existing studies or estimates of regional VKT (traffic count based or other).	
WASTE				
WASTEWATER	Wastewater BOD concentration	g BOD / m ³	BOD concentration by plant	
	Wastewater Nitrogen concentration	mg / L	N concentration of effluent by shed	
	Wastewater treatment volume	m ³ / year	Effluent volume discharged by plant; Influent volume by plant	
	Wastewater treatment system	-	Treatment shares (central vs. septic connections)	
		tonne / m ³	Sludge (biosolids) generated per influent volume by plant	
		-	Methane recovery fraction by plant; if recovered, where is recovered methane used, and in what sector?	

DATA REQUEST			BASE YEAR 2011	PROJECTION 2012–2051
WASTE	Solid waste produced	tonne / year	2011-2016 (annual) By waste type AND by sector	
	Waste disposal routing		2011–2016 (annual) Fraction of waste generated within city handled within city boundary & handled outside of city, by type	
	Solid waste facilities capacity	tonne	Waste handling facilities capacity (within and outside of city boundary), by facility type	Planned capacity additions, decommissions, technology improvements
	Solid waste facilities	-	% capacity used up by landfill in base year	
		tonne / year	2011–2016 (annual) Quantities of waste taken in by handling facilities within boundary, by facility type. What percentage of waste taken in by handling facilities is imported?	
		-	2011–2016 (annual) Methane recovery fraction by handling facilities; where is recovered methane used?	
	Diversion rates	-	2011–2016 (annual) Recycling and compost diversion rates for residential and ICI waste.	Projected recycling and compost diversion rates for residential and ICI waste.
WATER				
	Water treatment energy use	GJ or kWh / year	2011–2016 (annual) Total energy consumed by water and wastewater treatment plant, by fuel, by location	
	Water distribution energy use	GJ or kWh / year	2011–2016 (annual) Total energy consumed by water and wastewater distribution systems	

DATA REQUEST			BASE YEAR 2011	PROJECTION 2012–2051
INDUSTRY				
	Industrial processes & product use		Any information on industrial processes, production levels & emissions; by location	
	Waste heat		GIS: locations of waste heat producers, amount of waste heat	

Appendix 4: GPC Reporting

The GPC has been designed to allow city inventories to be aggregated at subnational and national levels.

The framework gives cities the option of selecting between two reporting levels: BASIC or BASIC+. The BASIC level covers scope 1 and scope 2 emissions from stationary energy and transportation, as well as scope 1 and scope 3 emissions from waste. BASIC+ involves more challenging data collection and calculation processes, and additionally includes emissions from IPPU and AFOLU and trans-boundary transportation.

For more detailed descriptions, see:

World Resources institute, C40 Cities, & ICLEI. (2014). [Global protocol for community-scale greenhouse gas emissions inventories](#).

Sectors and sub-sectors	Scope 1	Scope 2	Scope 3
STATIONARY ENERGY			
Residential buildings	✓	✓	✓
Commercial and institutional buildings and facilities	✓	✓	✓
Manufacturing industries and construction	✓	✓	✓
Energy industries	✓	✓	✓
<i>Energy generation supplied to the grid</i>	✓		
Agriculture, forestry, and fishing activities	✓	✓	✓
Non-specified sources	✓	✓	✓
Fugitive emissions from mining, processing, storage and transportation of coal	✓		
Fugitive emissions from oil and natural gas systems	✓		
TRANSPORTATION			
On-road	✓	✓	✓
Railways	✓	✓	✓
Waterborne navigation	✓	✓	✓
Aviation	✓	✓	✓
Off-road	✓	✓	
WASTE			
Disposal of solid waste generated in the city	✓		✓
<i>Disposal of solid waste generated outside the city</i>	✓		
Biological treatment of waste generated in the city	✓		✓
<i>Biological treatment of waste generated outside the city</i>	✓		
Incineration and open burying of waste generated in the city	✓		✓

Sectors and sub-sectors	Scope 1	Scope 2	Scope 3
<i>Incineration and open burying of waste generated outside the city</i>	✓		
Wastewater generated in the city	✓		✓
<i>Wastewater generated outside the city</i>	✓		
INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU)			
Industrial processes	✓		
Product use	✓		
AGRICULTURE, FORESTRY AND OTHER LAND USE (AFOLU)			
Livestock	✓		
Land	✓		
Aggregate sources and non-CO ₂ emission sources on land	✓		
OTHER SCOPE 3			
Other Scope 3			

✓	Sources covered by the GPC
	Sources required for BASIC+ reporting
	Sources included in Other Scope 3
	Sources required for BASIC reporting
	Sources required for territorial total but not for BASIC/BASIC+ reporting (<i>italics</i>)
	Non-applicable emissions

Appendix 5: Sector-specific Considerations for Inventories

The following section offers guidance on methods for calculating GHG emissions using an activity-based approach so that the factors which drive GHG emissions are more apparent. The GPC separates GHG emissions accounts according to geographic locations or scope. Scope is not addressed in the calculations below and for guidance on how to report according to the three scopes, refer to the GPC.

Stationary Energy

Buildings (residential, commercial, institutional), manufacturing and construction industries, and power plants are considered stationary energy users. Stationary energy use emissions are calculated in three steps:

» **Step 1: Data collection**

Total natural gas and electricity consumption from utilities by year and, if possible, separated by rate class/building type. May be also separated by postal code.

Buildings by type and floor area, from MPAC or municipal records.

» **Step 2: Build a simple spreadsheet of building energy consumption (Table 23).**

Table 64. Stationary energy emissions calculations.

Sector	Formula	Fuels	GHG Emissions	Data sources
Residential buildings.	# of buildings * m ² /dwelling * GJ/m ² * kgGHG/GJ (EF) for each fuel.	Natural gas, electricity, heating oil, propane, wood, other.	CO ₂ , CH ₄ , NO ₂	The number of dwellings by type and the area of the dwellings (m ²) can be sourced from the Municipal Property Assessment Corporation (MPAC). GJ/m ² and the emissions factors are provided in a data table in the appendix.
ICI buildings.	# of buildings * m ² /building type * GJ/m ² * kgGHG/GJ (EF) for each fuel	Natural gas, electricity, heating oil, propane, wood, other.	CO ₂ , CH ₄ , NO ₂	Floor area can be sourced from MPAC by building type. GJ/m ² and the emissions factor are in a data table in the appendix.

» **Step 3: Calibrate the results for total natural gas and electricity consumption.**

There will be a difference between the totals provided by the energy utility (step 1) and the results from step 2. Adjust the GJ/m² to align the totals with those provided by the utility. It is important to confirm that the definitions of residential buildings and ICI buildings from MPAC align with those from the utilities. There is no similar data available for wood or propane use, so localized assumptions must be made. If there is municipal-owned district energy, add its fuel consumption to the totals provided by the utilities prior to calibration.

Fugitive Emissions

There primary sources of fugitive emissions within the municipal boundary is the natural gas distribution system. The natural gas utility can provide the fugitive emissions volume.

Table 65. Fugitive emissions calculations.

Sector	Formula	Fuels	GHG emissions	Data sources
Natural gas distribution.	GJ * kgCH ₄ /GJ (distribution loss factor).	Natural gas.	CH ₄	Natural gas utility.

Transportation Emissions

Transportation emissions can be estimated through GIS-based trip modelling and/or through fuel use and vehicle data analysis. The latter approach involves three steps:

- » *Step 1:* Procure gasoline and diesel use totals from a third party (e.g. Kent Group. Does not include private fuelling facilities).
- » *Step 2:* Calculate total fuel consumption and vehicle kilometres travelled (VKT) of vehicles. The number of vehicles by type and average fuel efficiency is sourced from the Ministry of Transportation. VKT may be available from municipal transportation modelling or a provincial average can be used.

Table 66. On-road transportation emissions calculations.

Sector	Formula	Fuels	GHG emissions	Data sources
Residential vehicles.	# of vehicles * km/vehicle * litres/km * kg GHG/litre	Gasoline, diesel, propane.	CO ₂ , CH ₄ , NO ₂	The number of vehicles by type is available from Ministry of Transportation. Fuel efficiency data is included in a data table in an appendix. Emissions factors are included in the appendix.
Commercial vehicles.	# of vehicles * km/vehicle * litres/km * kg GHG/litre	Gasoline, diesel, propane, natural gas.	CO ₂ , CH ₄ , NO ₂	

- » *Step 3:* Calibrate the result. Some residential and commercial fuel used will be purchased outside of the municipal boundaries, while some fuel supplied within the municipal boundary will be purchased by users outside the boundary. The municipality will need to judge whether or not the third party fuel numbers should be adjusted. The km/vehicle number should be

adjusted so that the on-road calculation aligns with the adjusted third party fuel use result.

Emissions from railways, water-borne transportation, aviation and off-road transportation calculations will vary by municipality. See the GPC for guidance on these sources.

Solid Waste Emissions

There are two main approaches to calculating solid waste emissions, called 'first order of decay' and 'the methane commitment model'. The former is described in GPC, the latter is calculated in three steps:

- » **Step 1:** Determine the per capita annual residential waste tonnage. Subtract any recycled, composted or otherwise diverted waste.
- » **Step 2:** Identify waste composition and calculate the degradable organic carbon (see Equation 8.1 in GPC) and methane generation potential (Equation 8.4).
- » **Step 3:** Identify the fraction of methane recovered by flaring or energy recovery ("frec"). The oxidation factor (OX) is either 0.1 for well-managed landfills or 0 for unmanaged landfills.

A similar approach is used for commercial waste except the calculation is based on floor space derived from MPAC data, as opposed to population. ICI waste data is typically difficult to access and may be extrapolated from waste audits of a selection of buildings, which is likely more accessible.

Table 67. Waste emissions calculations.

Sector	Formula	Data sources
Residential waste.	# of people * kg of waste/person * diversion factor * Lo * (1-frec) * (1-OX)	Waste management department.
Commercial waste.	m2 * kg of waste/m2 * diversion factor * Lo * (1-frec) * (1-OX)	Waste management department. ICI waste data is typically difficult to access in Ontario.

Agriculture, Forestry and Land-use

Tracking GHG emissions from agriculture, forestry and land-use is not required for the BASIC level of reporting under GPC, but can be reported under BASIC+. The Province of Ontario is currently completing a provincial land-use carbon inventory that may be able to support inventory calculations in this area. For detailed guidance on calculating these emissions see the the GPC.

Industrial Processes and Product Use

GHG emissions are produced from non-energy related industrial activities, such as the blast furnace in the iron and steel industry, and ammonia and other chemical products manufactured from fossil fuels and used as chemical feedstocks. In addition, products such as refrigerants, foams or aerosol cans also contain GHGs which can be released during use and disposal. For detailed guidance on calculating these emissions see the the GPC.

Appendix 6: A Synopsis of Co-benefits of Low Carbon Actions

Local governments that have successfully integrated energy and emissions actions into their planning and citizen/business engagement activities are realizing significant and multiple co-benefits in their communities. In many cases, actions that reduce GHG emissions also create a vibrant cityscape, improve public health outcomes, reduce municipal operating and capital costs, and support innovation.³⁴

Working with C40, LSE Cities has developed a five-sector framework for assessing co-benefits in health, mobility, resources, buildings and economy. The sectors align with municipal policy areas, drawing from a survey of 100 cities.³⁵ This framework is a standardized approach that can be used to assess co-benefits for a climate action plan.
LSE

Table 68. Framework for assessing co-benefits.

Strategic sectors	City goals (examples)	Policy actions (examples)	Co-benefits	Coordinated governance
Health.	Improve outdoor air quality.	Reduce vehicle use.	Reduced premature deaths and health problems.	Health, transport. Land-use, energy, digital, economy, air quality, buildings, tourism.
Mobility.	Reduce congestion.	Reduce vehicle use.	Increased economic efficiency, quality of life, air quality.	Transport, economy, land-use, digital, energy, education, tourism, air quality.
Resources.	Improve food security..	Promote agricultural production.	Increased economic efficiency, quality of life, air quality, green space. Improved resource management.	Food security, waste, water, health, land-use, transport, buildings, energy, education, disaster and emergency.
Buildings.	Reduce fuel poverty.	Increase building energy efficiency.	Cost savings	Buildings, energy, health, education.
Economy.	Support economic growth.	Establish cleantech business clusters and incentives	Innovation, productivity, SME growth in tech sector.	Economy, education, transport, buildings, digital, water, waste.

34 Kamal-Chaoui, L., & Robert, A. (2009). [Competitive cities and climate change](#).

35 Floater, G., Heeckt, C., Ulterino, M., Mackie, L., Rode, P., Bhardwaj, A., Huxley, R. (2016). *Co-benefits of urban climate action: A framework for cities*. LSE Cities.

MORE READING:

SSG. (2017). [Technical paper #4: Considerations of co-benefits and co-harms associated with low carbon actions for TransformTO.](#)

RESOURCE:

Floater, G., Heeckt, C., Ulterino, M., Mackie, L., Rode, P., Bhardwaj, A., ... Huxley, R. (2016). [Co-benefits of urban climate action: A framework for cities.](#) LSE Cities.

Economic Co-benefits

The transition to a low carbon economy represents a massive economic opportunity. One analysis suggests the global economic opportunity of investments in low-carbon urban actions is \$16.6 trillion³⁶—the financial savings resulting from energy savings and lower cost generation in transportation, buildings and waste sectors. Coordinated planning of land-use, transportation and infrastructure through strategies such as smart growth and transit oriented development can mobilize major private investment, increase municipal tax revenues and decrease municipal infrastructure spending.

Low carbon land-use policies can generate economic benefits for households, businesses and government in three categories: increased return on investment, cost savings, and quality-of-life improvements, as summarized in Table 8.³⁷

Table 69. *Economic co-benefits of low carbon land-use policies.*

Business	Household	Municipal & Regional	National
Return on Investments			
Access to new markets Reduced investment risks Construction & transit jobs Higher property values Productivity enhancements due to agglomeration	Enhance or preserve housing values Better access to jobs	Higher public revenues Reduced citizen opposition to development Private investment attraction Increased economic efficiency	More efficient use of transportation investments Construction & transit jobs

36 Gouldson, A. P., Colenbrander, S., Sudmant, A., Godfrey, N., Millward-Hopkins, J., Fang, W., & Zhao, X. (2015). [Accelerating low carbon development in the world's cities.](#)

37 These tables and examples are from: C. Kooshian and S. Winkelman, [Growing Wealthier: Smart Growth, Climate Change and Prosperity.](#) Center for Clean Air Policy, 2011.

Business	Household	Municipal & Regional	National
Savings on Expenditures			
Employee health care savings Better information & decision making Reduced parking requirements Reduced energy & water use	Travel cost savings Reduced energy & water use Health care savings Lower taxes for infrastructure services	Infrastructure savings (construction & operation) Reduced costs from urban decline Green infrastructure replaces grey infrastructure	Energy security Health care savings
Improved Quality of Life			
Quality places attract high quality workers Improved environment for small businesses	Better access to services Affordable housing Access to nature & recreation Increased physical activity	Reduced exposure to congestion Thriving public spaces Growth reflects community values Environmental conservation	Reduced emissions

MORE READING:

Gouldson, A., Colenbrander, S., McAnulla, F., Sudmant, A., Kerr, N., Sakai, P., ... Kuylenstierna, J. (2014). [The economic case for low carbon cities](#). *A New Climate Economy*.

Employment Co-benefits

The transition to a low carbon economy is expected to have four types of impacts on labour markets:³⁸

- » Additional jobs will be created in emerging sectors (e.g. electric vehicles and energy efficiency controls);
- » Some employment will be shifted (e.g. from fossil fuels to renewables);
- » Certain jobs will be eliminated (e.g. vehicle mechanics who specialize in gasoline motors); and
- » Many existing jobs will be transformed and redefined.

The transition will require massive infrastructure investment. This mobilization of public and private finance—up to \$3.2 billion per city in one estimate³⁹—requires many new jobs. For example, the International Energy Agency estimates that 8 to 27 jobs are created for each €1 million invested in energy efficiency.⁴⁰ Energy NorthEast (now Acadia Centre) found that efficiency programs in Canada return

38 Martinez-Fernandez, C., Hinojosa, C., & Miranda, G. (2010). [Green jobs and skills: the local labour market implications of addressing climate change](#). *Working Document*, OECD.

39 Gouldson, A., Colenbrander, S., McAnulla, F., Sudmant, A., Kerr, N., Sakai, P., ... Kuylenstierna, J. (2014). [The economic case for low carbon cities](#). *A New Climate Economy*.

40 International Energy Agency. (2014). [Capturing the multiple benefits of energy efficiency](#). Paris, France.

\$3 to \$5 in savings for every \$1 of program spending, and generate 30 to 52 job-years per million dollars of program spending.⁴¹

Low carbon technologies tend to be more labour intensive than high carbon activities, at least in the short term (Table 9). In the long term, as the cost of renewable energy decreases, the ratios may decline.

Table 70. Average employment over the life of a facility (jobs/MW).⁴²

	Construction, manufacturing, installation	O&M and fuel processing	Total employment
Solar PV	5.76–6.21	1.2–4.8	7.41–10.56
Wind	0.43–2.51	0.27	0.71–2.79
Biomass	0.40	0.38–2.44	0.78–2.84
Coal	0.27	0.74	1.01
Gas	0.25	0.70	0.95

Note: Ranges refer to the results of different studies. Employment is shown relative to the average installed capacity, correcting for differences in capacity factor. (Because renewable installations operate only 20% of the time, compared with 80% for fossil fuel plants, 4 MW of renewable capacity is needed to produce the same output as 1 MW of fossil fuel capacity).

Innovation Co-benefits

Actions that reduce emissions will stimulate innovation as enterprises reposition themselves and invest in research and development to provide new services, business models and markets. This process will trigger a process of technology diffusion, adaptation and experimentation.

Technological and social innovations are occurring rapidly and the community energy and emissions plan is an opportunity to identify and plan for innovation, ensuring that benefits are maximized for those who need it the most.

Table 71. Innovation examples.

Technological innovation	Techno-social innovation	Social innovation
Autonomous electric vehicles	Autonomous shared electric vehicles	Car-sharing
Decentralized energy generation (solar PV, renewable natural gas)	Energy co-operatives	Co-operative model

41 ENE. (2014). *Energy efficiency: Engine of economic growth in Canada*.

42 Fankhaeser, S., Sehleier, F., & Stern, N. (2008). *Climate change, innovation and jobs*. *Climate Policy*, 8(4), 421–429.

Technological innovation	Techno-social innovation	Social innovation
Energy storage	Heating and electricity district energy	Municipal utility (provides energy services)
Building energy monitoring	Energy services contract utility	Energy efficiency as a service

EXAMPLES:

[Toronto Renewable Energy Co-operative.](#)

[Southeast False Creek Neighbourhood Energy Utility.](#)

Co-Benefits to Municipal Finances

Low carbon development policies also benefit municipal finances. Compact, complete communities have lower emissions compared to their suburban sprawling counterparts and result in lower municipal capital and operation costs. An analysis in the US estimated direct cost savings for building road and utility infrastructure in smart growth developments relative to dispersed, car-dependent developments at between US\$5,000 and US\$75,000 per household unit.^{43 44}

Health and Social Co-benefits

The World Health Organization defines health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.”⁴⁵ Research indicates that climate change is leading to adverse physical and mental health effects.⁴⁶ The under-privileged, in particular, are at elevated climate change-induced health risks. Poor living conditions increase vulnerability to climate change and cause poor health status—further increasing climate vulnerability. Climate change mitigation actions will benefit overall population health, and will be especially beneficial to vulnerable populations.

43 Litman, Todd (2016). Understanding Smart Growth Savings. Victoria Transport Policy Institute.

44 IBI Group. (2009). *The implications of alternative growth patterns on infrastructure costs*. City of Calgary.

45 World Health Organisation. (2003). [WHO definition of health](#).

46 Barrett, B.; Charles, J.W.; Temte, J.L. Climate change, human health, and epidemiological transition. *Prev. Med.* 2014, 70, 69–75.

RESOURCE:

IndEco Strategic Consulting. (2016). [Health benefits of a low-carbon future](#).

RESOURCE:

Provincial Health Services Authority. (2014, March). [BC healthy built environment linkages toolkit](#).

EXAMPLE:

City of Seattle. (2016). [Seattle 2035–Growth and equity: Analyzing impacts on displacement and opportunity related to Seattle’s Growth Strategy](#).

Air Quality

Air quality can be improved by changing the technologies that produce and consume energy. Reducing emissions and airborne toxins such as nitrogen oxides (NO_x), sulfur dioxide (SO₂), particulate matter, and mercury lowers air pollution-related disease rates.⁴⁷ Several studies have concluded that substantive morbidity and mortality benefits would result from improved air quality, especially from the reduction of micro-particulates resulting from burning fossil fuels and firewood.⁴⁸ In outdoor environments, improved fuel-efficiency, increased use of public transit, and reduced numbers of combustion engine vehicles contribute to improved air quality and better health outcomes. It has been found that traffic-related air pollution even at relatively low concentrations in Ontario is associated with increased mortality from cardiovascular disease.⁴⁹ In indoor environments, improvements to ventilation systems and the use of less toxic building materials (e.g. insulation, wall panelling) improves air quality while reducing energy use.

47 Nemet, G.F.; Holloway, T.; Meier, P. Implications of incorporating air-quality co-benefits into climate change policymaking. *Environ. Res. Lett.* 2010, 5, 1–9.

48 Barrett, Bruce, Maggie Grabow, Cathy Middlecamp, Margaret Mooney, Mary Checovich, Alexander Converse, Bob Gillespie, and Julia Yates. “Mindful Climate Action: Health and Environmental Co-Benefits from Mindfulness-Based Behavioral Training.” *Sustainability* 8, no. 10 (October 17, 2016): 1040.

49 Chen, H., Goldberg, M. S., Burnett, R. T., Jerrett, M., Wheeler, A. J., & Villeneuve, P. J. (2013). Long-term exposure to traffic-related air pollution and cardiovascular mortality. *Epidemiology*, 24(1), 35–43.

Active Transportation

Studies in Copenhagen⁵⁰ and Shanghai⁵¹ have shown that the relative risk of all-cause mortality was 30–40% less among those who cycled compared to those who did not use active transportation or get equivalent amounts of leisure time exercise. A 19% reduction in all-cause mortality risk has been shown to occur with 30 minutes of daily moderate-intensity activity, 5 days per week. When populations engaged in 7 hours of moderate activity weekly, the all-cause mortality risk dropped by 24% compared to those with no activity.⁵² All-cause mortality rates in moderately and highly active people have been found to be 50% lower than those with no activity. The same studies have found that cycling to work would also reduce all-cause mortality rates by 40%.⁵³

Active transportation may increase exposure to air pollution, leading to negative health consequences; however, a recent study has shown that the benefits of physical activity by far outweigh risks from air pollution.⁵⁴

Studies have shown that children who walk or bike to school are fitter than those who travel by car or bus, with 30% higher vigour in boys, and seven times higher in girls.⁵⁵ It is estimated that the doubling of people walking would reduce the risk to each individual walker by approximately one-third.⁵⁶ A review reported that public transport usage could increase physical activity by 8–33 minutes per day.⁵⁷

The Elderly

Increased access to public transportation can overcome mobility barriers experienced by those who do not drive.⁵⁸ For the elderly, the physical health implications of sprawl include less active lifestyles, respiratory issues and increased use of medication due to higher ozone levels and increased air pollution, and

50 Andersen LB, Schnohr P, Schroll M, Hein HO. All-cause mortality associated with physical activity during leisure time, work, sports, and cycling to work. *Arch Intern Med* 2000;160:1621-8.

51 Matthews CE, Jurj AL, Shu XO, Li HL, Yang G, Li Q, et al. Influence of exercise, walking, cycling, and overall nonexercise physical activity on mortality in Chinese women. *Am J Epidemiol* 2007;165:1343-50.

52 Woodcock, J., Franco, O. H., Orsini, N., & Roberts, I. (2011). Non-vigorous physical activity and all-cause mortality: systematic review and meta-analysis of cohort studies. *International Journal of Epidemiology*, 40(1), 121–138.

53 Andersen LB, Schnohr P, Schroll M, Hein HO. All-Cause Mortality Associated With Physical Activity During Leisure Time, Work, Sports, and Cycling to Work. *Arch Intern Med*. 2000;160(11):1621-1628.

54 Tainio, Marko, Audrey J. de Nazelle, Thomas Götschi, Sonja Kahlmeier, David Rojas-Rueda, Mark J. Nieuwenhuijsen, Thiago Hérick de Sá, Paul Kelly, and James Woodcock. "Can Air Pollution Negate the Health Benefits of Cycling and Walking?" *Preventive Medicine* 87 (June 2016): 233–36.

55 Voss C, Sandercock G. (2010). Aerobic fitness and mode of travel to school in English schoolchildren. *Med Sci Sports Exerc*. 2010 Feb;42(2):281-7.

56 Jacobsen, P. L. (2003). Safety in numbers: more walkers and bicyclists, safer walking and bicycling. *Injury Prevention*, 9(3), 205–209.

57 Rissel, C., Curac, N., Greenaway, M., & Bauman, A. (2012). Physical Activity Associated with Public Transport Use—A Review and Modelling of Potential Benefits. *International Journal of Environmental Research and Public Health*, 9(7), 2454–2478.

58 Jackson, R. and C. Kochitzky. (2010). Creating a Healthy Environment: The Impact of the Environment on Public Health. Centers for Disease Control and Prevention. *Sprawl Watch Clearinghouse Monograph Series*.

fatalities due to automobile accidents.⁵⁹ The isolation and weakened community networks resulting from sprawl can result in negative mental and social capital impacts.

A built environment designed for walking encourages physical fitness and exercise, increasing overall health among elderly people. Oxygen uptake and flexibility both increase with physical activity.⁶⁰ According to one author, “physical activity in the natural environment not only aids an increased life-span, greater well-being, fewer symptoms of depression, lower rates of smoking and substance misuse, but also increases the ability to function better at work and home”.⁶¹

Retrofitting buildings for energy efficiency can improve indoor temperature regulation, reducing the impact of summer heat on the elderly, a high-risk population in terms of developing severe heat stroke, heat exhaustion, fainting, swelling or heat cramps during a heat wave.⁶²

Children and Youth

Although they will bear the burden of climate change impacts, children and youth and the rights of future generations currently have little say in climate change-related policy. Empowerment and inclusion of children and youth in climate action decision-making processes encourages a sense of contribution, ownership and pride that in turn encourages sustained civic and community engagement. Taking action on climate change now will lessen the climate impacts burden on children and youth throughout their lives. Leaving climate change unaddressed would likely lead to shorter lifespans, increased risk of disease, increased risk of poverty, and increased risk of orphanhood for children.

Environmental Co-benefits

Environmental or natural capital typically includes three aspects:⁶³

- » Land: provides space for human and natural activities.
- » Subsoil resources: underground stocks of minerals, fossil fuels and water that provide flows of raw materials and energy.
- » Ecosystems: self-maintaining natural systems that provide ongoing flows of a wide variety of ecosystem goods and services (e.g. timber and carbon sequestration).

Energy sprawl is the potential habitat effect of different energy fuels and technologies. The land-use intensity of different energy sources varies significantly, from nuclear (1.9–2.8 km² /TWh/yr) to biofuels (320–375 km²/TWh/yr); in other

59 Frumkin, H. (2002). Urban Sprawl and Public Health. Public Health Reports, 117, 201-217.

60 Morris, N. (2003). Health, Well-being and Open Space. OPENspace: the Research Centre for Inclusive Access to Outdoor Environments. Edinburgh College of Art and Heriot-Watt University

61 Morris, 2003, p.17.

62 Frumkin, 2002.

63 Smith, Robert. (2016). [Comprehensive wealth in Canada- Measuring what matters in the long run.](#) International Institute for Sustainable Development.

words, nuclear energy generates significantly more energy per unit of area than biofuel energy. Emissions reduction actions that reduce energy consumption or generate renewable energy locally will reduce energy sprawl and habitat impacts. Emissions reduction actions that increase energy requirements—such as biofuel substitution—may increase energy sprawl. Following an emphasis on conservation, balanced energy production decision-making is required to ensure limited environmental impacts.

Developing low carbon, compact, complete communities—as opposed to sprawling ones—preserves natural areas and their ecosystems. These areas provide myriad services such as carbon sequestration, air pollution mitigation, human enjoyment, and enhanced human physical and mental well-being.⁶⁴

Additional services include more efficient land-use and resource management, protection of biodiversity and habitat, protection of soil health, water purification and retention, enhanced connectivity of fragmented landscapes and buffers against natural hazards.

⁶⁴ Stott, I., Soga, M., Inger, R., & Gaston, K. J. (2015). Land sparing is crucial for urban ecosystem services. *Frontiers in Ecology and the Environment*, 13(7), 387–393.

Appendix 7: GHG inventory assumptions

When quantifying a baseline level of emissions resulting from electricity consumption (e.g. for an inventory), an Average Emissions Factor (AEF) is recommended.⁶⁵ AEFs are derived by dividing the total emissions from electricity production in Ontario by the total quantity of electricity produced, and are reported annually in Canada's National Inventory Reports as Consumption Intensity. However, when estimating emissions reductions, a Marginal Emissions Factor (MEF) is recommended. This is because conserving grid electricity (whether via efficiency or displacing with renewables) is expected to conserve a different proportion of fuel than the average electricity mix.

1. Electricity Average Emissions Factors (g CO₂eq/kWh)

	2010	2011	2012	2013	2014	2015
	140	100	100	80	40	43

Source: Environment Canada, 2016.National Inventory Report

2. Energy use intensity, residential buildings, Ontario, 2012 (GJ/m²)

Dwelling type	Space heating	Water heating	Appliances	Lighting	Space cooling	Total
Single detached		0.46	0.14	0.06	0.02	0.71
Singled attached		0.37	0.15	0.07	0.02	0.63
Apartment		0.3	0.19	0.09	0.01	0.6
Mobile home		0.74	0.11	0.07	0.02	0.96

Source: Natural Resources Canada, Comprehensive Energy Use Database. Retrieved from: http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive/trends_res_on.cfm

3. Energy use intensity, commercial buildings, Ontario, 2012 (GJ/m²)

Building type	Space heating	Water heating	Auxiliary Equipment	Auxiliary Motors	Lighting	Space cooling	Total
Wholesale Trade	0.629	0.139	0.36	0.109	0.142	0.131	1.509
Retail Trade	0.641	0.139	0.353	0.111	0.145	0.144	1.532
Transportation and Warehousing	0.702	0.05	0.154	0.117	0.155	0.096	1.273
Information and Cultural Industries	0.62	0.133	0.345	0.104	0.136	0.135	1.474
Offices	0.57	0.106	0.263	0.09	0.121	0.107	1.257
Educational Services	0.631	0.135	0.351	0.106	0.139	0.129	1.491
Health Care and Social Assistance	0.941	0.263	0.524	0.16	0.209	0.207	2.303
Arts, Entertainment and Recreation	0.702	0.151	0.391	0.118	0.154	0.135	1.651
Accommodation and Food Services	0.899	0.254	0.505	0.153	0.2	0.194	2.205
Other Services	0.611	0.131	0.34	0.103	0.134	0.122	1.442

Source: Natural Resources Canada, Comprehensive Energy Use Database. Retrieved from: http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive/trends_com_on.cfm

⁶⁵ A guideline on how to use both emissions factors is: Toronto Atmospheric Fund (2017). [A clearer view on Ontario's emissions: Practice guidelines for electricity emissions factors.](#)

An additional reference for energy use intensities for non-residential buildings is: Energy Start Portfolio Manager (2018). [Canadian energy use intensity by property type](#).

4. Vehicle data

Cars On-Road Average Fuel Consumption (L/100 km)

	2011	2012	2013	2014
Motor Gasoline	8.5	8.4	8.4	8.3
Diesel Fuel Oil	6.7	6.7	6.8	6.8

Passenger Light Truck On-Road Average Fuel Consumption (L/100 km)

	2011	2012	2013	2014
Motor Gasoline	11.5	11.4	11.3	11.3
Diesel Fuel Oil	9.9	9.4	9.1	8.8

Medium Truck On-Road Average Fuel Consumption (L/100 km)

	2011	2012	2013	2014
Motor Gasoline	23	22.8	22.4	22.1
Diesel Fuel Oil	22.8	22.4	22.1	21.7

Heavy Truck On-Road Average Fuel Consumption (L/100 km)

	2011	2012	2013	2014
Diesel Fuel Oil	33.2	32.8	32.5	32.1

Average Distance Travelled per Year (km)

	2011	2012	2013	2014
Cars	16,580	16,364	15,951	14,938
Passenger Light Trucks	16,707	16,667	16,434	15,563
Freight Light Trucks	18,966	19,193	18,913	17,930
Medium Trucks	25,481	25,332	25,826	24,838
Heavy Trucks	92,773	90,602	91,988	91,279

Source: Natural Resources Canada, National Energy Use Database. Retrieved from: <https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP§or=tran&juris=ca&rn=60&page=0>

5. Mobile fuel emissions factors (kg/L)

	CO ₂	CH ₄	N ₂ O
Gasoline	2.2	0.00023	0.00047
Diesel	2.582	0.000068	0.00022
Natural gas	2.738	0.013	0.000086
Propane	1.515	0.00064	0.000028

Source: Government of BC (2016). 2016/2017 BC Best Practices Method for Quantifying Greenhouse Gas Emissions

6. Stationary fuel combustion

Fuel	Energy conversion factor	Energy conversion factor unit	CO ₂ (kg/GJ)	CH ₄ (kg/GJ)	N ₂ O (kg/GJ)
Natural gas	0.3885	GJ/m ³	49.58	0.001	0.0009
Propane	0.02531	GJ/L	59.86	0.0009	0.0043
Light fuel oil	0.0388	GJ/L	68.12	0.0007	0.0008
Heavy fuel oil	0.0425	GJ/L	74.26	0.0013	0.0015
Kerosene	0.03768	GJ/L	67.94	0.0007	0.0008
Diesel fuel	0.0383	GJ/L	67.43	0.0035	0.0104
Wood fuel- industrial (50% moisture)	0.009	GJ/kg		0.01	0.0067
Wood fuel- residential (0% moisture)	0.018	GJ/kg		0.8333	0.0089
Renewable natural gas	0.03885	GJ/m ³		0.001	0.0009

Source: Government of BC (2016). 2016/2017 BC Best Practices Method for Quantifying Greenhouse Gas Emissions

7. Global warming potential of major GHG gases

Gas	GWP-20 year	GWP- 100 year
CO ₂	1	1
CH ₄	84	28
N ₂ O	264	265
HCF-134a	3,710	1,300

Source: Myhre, G., D. Shindell, F.-M. Bréon, W. Collins, J. Fuglestedt, J. Huang, D. Koch, J.-F. Lamarque, D. Lee, B. Mendoza, T. Nakajima, A. Robock, G. Stephens, T. Takemura and H. Zhang, 2013: Anthropogenic and Natural Radiative Forcing. In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Appendix 8: Spheres of Influence Method

Determining the spheres of influence of the local government is crucial to establishing the areas in which the government can take action to reduce GHG emissions. Local governments will have more power to achieve emissions reductions in some areas over others. The following diagrams summarize an approach to establishing the local government spheres of influence.

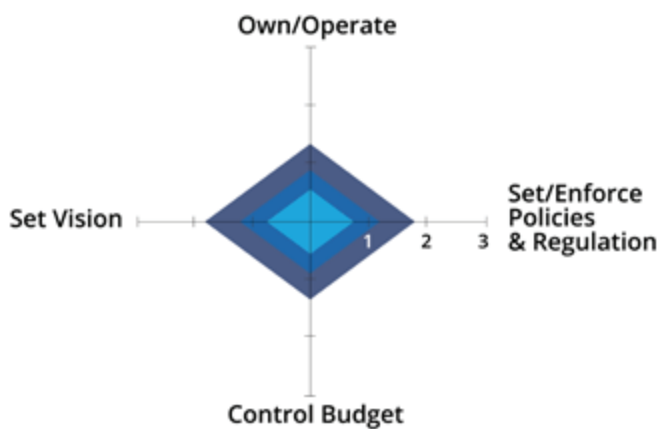


Figure 32. Assessment of municipal influence chart.

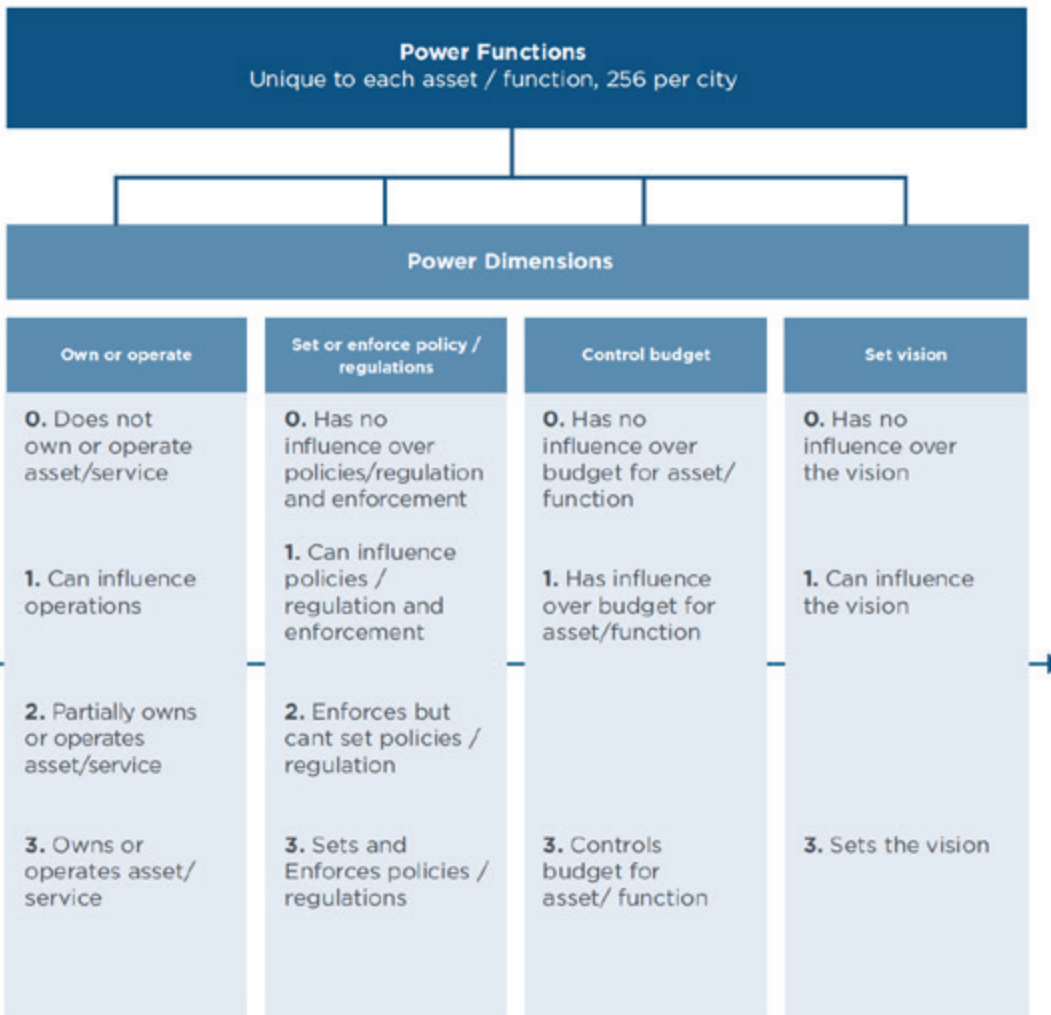


Figure 33. Influence assessment scoring criteria.

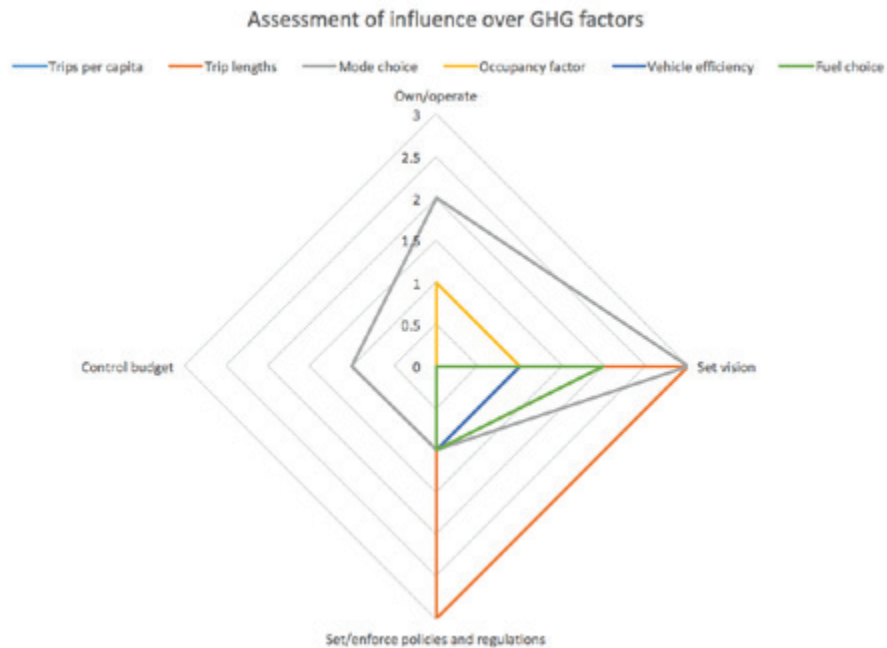


Figure 34. Sample assessment of municipal influence on transportation factors.

For example, Figure 33 illustrates the analysis of transportation factors using this framework, highlighting the fact that the primary areas of influence are trip length and mode choice, which the local government can influence through land-use planning and transit services. In contrast, it is challenging for the local government to influence trips per capita, fuel choice and occupancy factor. To influence these aspects, the local government needs to partner with other stakeholders and other levels of government.

Appendix 9: Energy and Emissions Models, Assumptions and Calibration

Table 72. Sample energy and emissions models.

Title	Creator	Description	Applicability	Co-benefits	Considerations
CityInSight	Sustainability Solutions Group and whatIf? Technologies	An energy, emissions, land-use systems-dynamics model used for generating scenarios.	Evaluate future land-use and technology scenarios.	Financial, transportation.	Open source, spatial analysis, GPC accounting framework, complex to apply.
Climate action for URBan sustainability (CURB)	C40 and World Bank	Tool for developing energy and emissions scenarios and evaluating actions.	Evaluate future technology scenarios.	Simple financial analysis.	Excel-based, not open source. Does not include spatial analysis.
Urban Footprint	Calthorpe Associates	Tool for developing future land-use scenarios.	Evaluate future land-use scenarios.	Financial analysis, public health, transportation, water use.	Open source, spatial. Does not include a detailed energy and emissions analysis, complex to deploy.
Envision Tomorrow	Fregonese Associates	Web-based scenario planning tool for evaluating growth patterns and future land-use decisions.	Evaluate future land-use scenarios.	Financial analysis, public health, transportation.	Open source, spatial, web-based platform. Does not include a detailed energy and emissions analysis.

Modelling Assumptions

Relevant streams: [Intermediate](#), [Advanced](#)

There is a significant lack of data for performing accurate energy and emissions modelling. For example, energy utility data is available spatially aggregated, and not normally available at the level of individual dwellings or by end-use. For transportation, there is limited information on the frequency and length of trips by walking, cycling or driving. These and other data limitations require the use of assumptions. Additionally, assumptions are required to project the impact of technological development, behaviour patterns, development patterns, and financial outcomes.

Data assumptions can be derived from scientific papers or other research endeavours (such as the outputs of other models), are measured in another

context than the one to which the model is being applied (*ex-situ*), or describe future conditions.

There are four methodologies that can be used to identify assumptions:

- » *Literature reviews.* Studies published in peer-reviewed journals and reports by recognized institutions can provide useful sources of assumptions. They must be contextualized and clearly cited.
- » *Regression analysis* is a statistical technique for estimating the relationship between variables, for example between density and VKT. The analysis will assess the statistical significance of the estimated relationships—a measure of the degree of confidence between the true relationship and the estimated relationship.
- » *Population surveys* are used to collect information in an organized and methodical manner using well-defined concepts, methods and procedures.
- » *Modelled assumptions.* The outputs of other models which have been validated can be used as assumptions and should be clearly sourced with information regarding the scenario in which the assumption was generated.

Extensive use of assumptions is required in this type of modelling, which implies a high level of uncertainty. This necessitates care in communicating the results appropriately.

Model Calibration

Relevant streams: *Intermediate, Advanced*

To be as accurate as possible, an energy and emissions model must be calibrated. This involves ensuring that the model outputs reflect observed data. For example, in the case of residential buildings, the calibration process involves:

1. Determining the number of dwellings by type from the census and MPAC.
2. Identifying the floor area of each dwelling type from MPAC data.
3. Assuming an energy use intensity for each dwelling type.
4. Calculating total energy consumption.
5. Comparing total energy consumption against total energy consumption reported by the utility.
6. Adjusting the energy use intensity until the outcome from the model matches the total reported by the utility.

Different modelling approaches use different techniques to align the modelled outcome with the observed data. Calibration should be applied to all outcomes for which there is observed data. In Ontario, this is primarily electricity and natural gas consumption, which is available from utilities. Observed data is not typically available for transportation energy consumption or other energy sources or fuels.

Appendix 10: Multi-criteria Analysis for Prioritization and Decision-making

MCA is a simple process that involves four key steps:

1. Identifying and characterizing the option(s);
2. Identifying relevant criteria (e.g. effectiveness, cost, carbon emissions);
3. Weighing criteria (where we ask “which criteria are more important, which are less important?”);
4. Scoring options against the criteria (on a scale, for example, 1–10, or “pass or fail” binary scores).

Table 73. Sample MCA calculation

Options		Criteria 1	Criteria 2	Criteria 3	Results
	Weight (0–1)	0.5	0.25	0.25	
Low carbon option A	Score (1–5)	1	2	3	
Low carbon option B		2	4	4	
Low carbon option C		4	5	5	

At each stage, value judgements are made about relevant criteria, about how we define what is “better” or “worse”, and about the degree to which we can trade off performance on one criteria in favour of performance on another. Recognizing that this is a process that involves value judgements is important: assessments are often presented as a purely technical matter, but this is inaccurate and misleading. On its own, MCA does not provide a clear answer to questions about “which option is best?”, or “is a project acceptable?”. Such questions involve value judgements, and no method can provide a clear answer without being based on these subjective values. Instead, these methods are best thought of as a framework for ordering preferences and judgements in a consistent and clear way. MCA is particularly relevant when there are multiple values to consider (social, environmental and economic values, for example). It facilitates the respect for, and acknowledgement of, different value systems by incorporating a range of perspectives. It also bridges the gap between technical knowledge and social values by permitting both quantitative and qualitative aspects.

Policy decisions result in winners and losers, thus it is important to check if a policy option seems preferable because some dimensions (e.g. the environmental) or some social groups (e.g. lower income groups or future generations) are not taken into account in the MCA.⁶⁶ There are three principles to ensure the integrity of the MCA process: be honest, be modest, and be cautious. Doing so will help balance the interests and rights of human beings and other species, of present and future generations, and of different social groups.

Application of MCA

Relevance: Low, medium, high

» Step 1: Characterizing the actions

Each of the actions will be described precisely and unambiguously, so that their intentions are easily understood.

» Step 2: Identifying relevant criteria

Criteria are developed in consultation with stakeholders and can be developed either prior to or during an MCA workshop. Criteria should reflect the performance of the options from different aspects, should be able to be clearly evaluated either qualitatively or quantitatively, and should reflect the essential characteristic of the objectives. If the MCA is being completed in a workshop setting, no more than 8 criteria should be used.

Table 74. Sample MCA criteria.

Criteria	Impact on GHG emissions	Impact on public health	Impact on employment	Impact on marginalized groups in the community	Impact on the economy	Difficulty of implementation
Method of assessment	Quantitative	Quantitative/qualitative	Quantitative	Qualitative	Quantitative/qualitative	Qualitative

Data will be available for some of the criteria as a result of the modelling activities; for other criteria, a qualitative assessment must be undertaken, which is based on the judgement of the participants.

» Step 3: Weighting criteria and aggregating scores

Each of the criteria will be weighted on a scale of 1 to 5, where 1 is least important and 5 is most important. The weighting process is dependent on the priorities of the municipality. If there is a significant focus on GHG emissions, this category would be weighted higher than considerations of implementation.

» Step 4: Scoring options against the criteria

The options are scored against the criteria in two ways:

1. The quantitative performance of the options derived from the modelling

⁶⁶ Kiker, G. A., Bridges, T. S., Varghese, A., Seager, T. P., & Linkov, I. (2005). Application of multicriteria decision analysis in environmental decision making. *Integrated Environmental Assessment and Management*, 1(2), 95–108.

work and other analysis. These results can be directly entered into the MCA and weighted on a scale of 1 to 5. In other words, for the category of GHG reductions, the action which achieves the greatest reductions is given a 5. The GHG reductions of other actions are divided by the one with the highest score and then multiplied by 5 to generate their score, a process of weighting.

2. The options will then be evaluated qualitatively against the chosen set of criteria in a workshop setting or in another form of collaboration, again using a score of 1 to 5.

» Step 5: Initial results

The results for all options will be calculated by multiplying the criteria weightings with the scores (see Table 74).

» Step 6: Sensitivity analysis

Finally, the results are analyzed to ensure they reflect common sense. In the case that there are results which appear unusual, the scores are reviewed to ensure that they still make sense. A sensitivity analysis involves adjusting the scores of the options and the weighting of the criteria to evaluate how this impacts the order of priority.

Using the results of the MCA

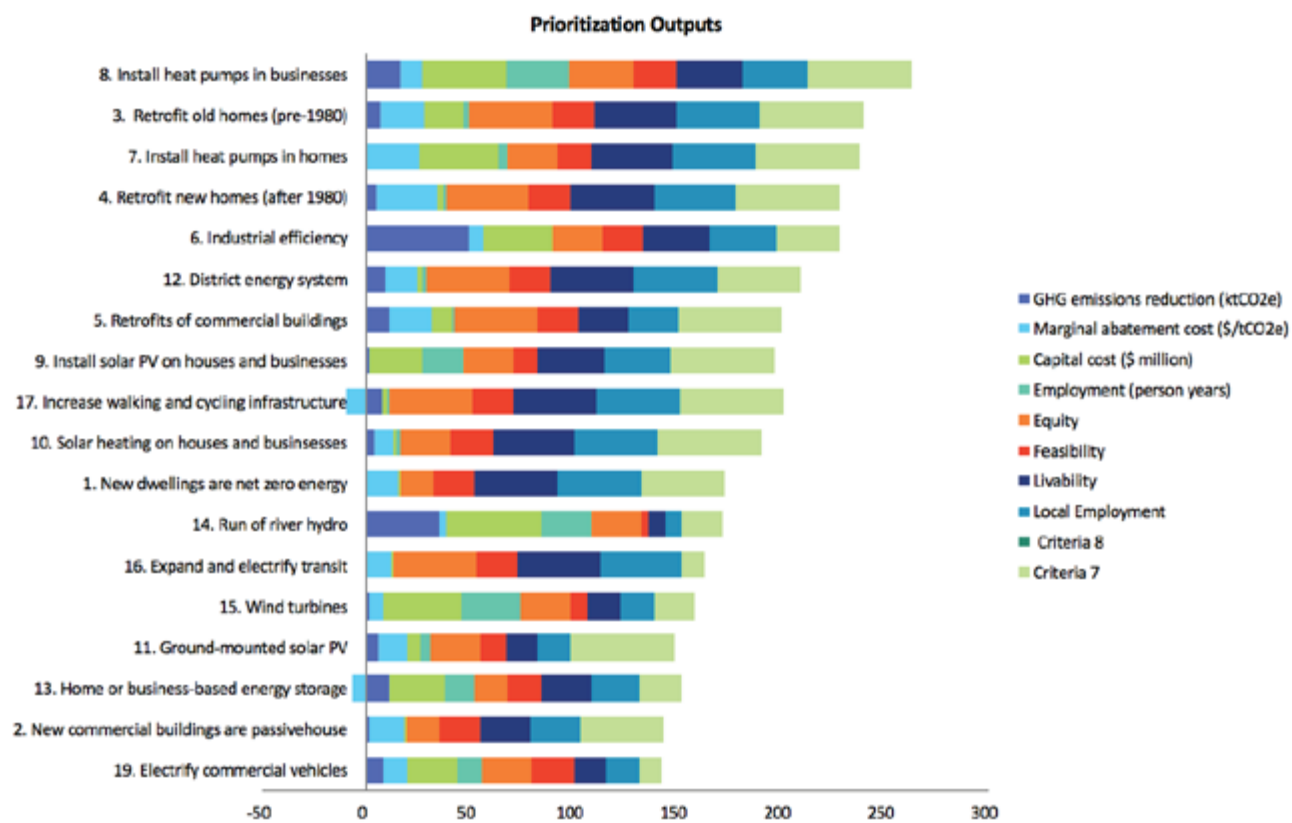


Figure 35. Sample results from an MCA

MCA sheds new light on the costs and benefits of the actions, including which actions may require greater implementation considerations, to ensure co-benefits are maximized. The MCA provides insight on which actions will be of most benefit to specific stakeholders, which can then be involved in the implementation process.

Appendix 11: Municipal Land-use Policies to Support GHG Mitigation in Ontario

Planning Act	Description	Potential Approaches to Addressing Climate Change
Provincial Plans (Section 1).	<ul style="list-style-type: none"> » Provincial plans defined in the Planning Act include a number of provincial plans established through respective legislation. 	<ul style="list-style-type: none"> » A planning decision including a decision by an appeal body in respect of the exercise of any authority that affects a planning matter shall conform with the provincial plans that are in effect on that date, or shall not conflict with them, as the case may be. » Comments, submissions or advice affecting a planning matter that are provided by the council of a municipality, a local board, a planning board, a minister or ministry, board, commission or agency of the government shall conform with the provincial plans that are in effect on that date, or shall not conflict with them, as the case may be. » All defined provincial plans include a range of policies from different perspectives and for different geographical areas addressing climate change.
Official Plans (Section 16).	<ul style="list-style-type: none"> » Official Plans describe municipal council's policies on how land should be used. An Official Plan deals mainly with issues such as: <ul style="list-style-type: none"> » where new housing, industry, offices and shops will be located; » what services like roads, watermains, sewers, parks and schools will be needed; » when, and in what order, parts of the community will grow; and » community improvement initiatives. 	<ul style="list-style-type: none"> » Many Ontario municipalities have incorporated climate change related policies into their Official Plans. » Bill 139, Building Better Communities and Conserving Watersheds Act, 2017. This Bill provides a strong legislative foundation and requires that all municipal Official Plans shall contain climate change policies that identify goals, objectives and actions to mitigate greenhouse gas emissions and to provide for adaption to a changing climate, including through increasing resiliency.

Planning Act	Description	Potential Approaches to Addressing Climate Change
<p>Community Improvement Plans (Section 28).</p>	<ul style="list-style-type: none"> » Community improvement plans (CIP) focus on the maintenance, rehabilitation, development and redevelopment of targeted areas. » Municipal councils must adopt Official Plan policies and a bylaw to designate a community improvement project area; and the community improvement plan policies adopted thereafter should specify relevant municipal programs and incentives and their eligible works, improvements, buildings or facilities. » Prescribed upper-tier municipalities may adopt CIPs dealing with prescribed matters to support higher density mixed-use development and redevelopment along existing or planned transit corridors, and infrastructure improvement and development (e.g. alternative energy systems and renewable energy systems, waste management systems, and water works, wastewater works, stormwater works and associated facilities). » Municipalities can make grants or loans within CIP project areas to help pay for certain costs; this could include establishing Tax-Increment-Equivalent Financing programs (TIEF). 	<ul style="list-style-type: none"> » Promote neighbourhood revitalization by incorporating a range of energy conservation approaches (e.g. community energy, green roofs and walls, solar panels, landscaping, etc.). » Help improve and develop new stormwater facilities to make communities more resilient to extreme weather events. » Support the building of bike lanes and related facilities.

Planning Act	Description	Potential Approaches to Addressing Climate Change
<p>Zoning By-Laws (Section 34).</p>	<ul style="list-style-type: none"> » Municipal zoning by-laws regulate land-uses and physical characteristics of land-use (e.g. building height, density, location and parking). » Zoning by-laws implement the objectives and policies of a municipal Official Plan. » Require council to pass zoning by-laws and zoning by-law amendments. » Can be used on a municipal-wide or site-specific basis. 	<ul style="list-style-type: none"> » Can ensure mixed-use and compact development, thus reducing greenhouse gas emissions; » Can place buildings and arrange building mass in a way that frames the public realm and promotes the use of renewable energy and energy conservation; » Can set a minimum building height which can contribute to safer, more compact, well-designed, walkable and vibrant streetscapes; » Can reduce development pressures on agricultural and resource areas; » May create shorter trip distances to employment and nearby services, and improve the viability of walking and cycling through mixed-use, compact form and reduced parking. » Can promote safe, compact, well-designed, walkable and vibrant streetscapes and communities, thus reducing greenhouse gas emissions; » Can establish an urban design standard to ensure compatibility with adjacent buildings and the surrounding neighbourhood; and » Can support intensification and transit supportive goals, thus reducing development pressure on green and open spaces and promoting active transportation.
<p>Site Plan Control (Section 41 and the City of Toronto Act Section 114).</p>	<ul style="list-style-type: none"> » Site Plan control is a permitting process that builds upon zoning to determine the appropriate design and functioning of a site, and requires Official Plan policies for set up. » A site plan control by-law must be passed by the municipality designating all or any part of the area shown in the Official Plan as a site plan control area. » Can regulate certain external building, site and boulevard design matters (character, scale, appearance, sustainable streetscape design). » Allows for limited conditions related to design matters. 	<ul style="list-style-type: none"> » Can help implement municipal urban design objectives; » Can improve design quality of sites, buildings, streetscapes and places; » May require sustainable design features to support energy efficiency, sustainable transportation options, water conservation, and improved air and water quality; and » May enable strategic tree planting to provide shelter from cold winter winds and provide shade in the summer.

Planning Act	Description	Potential Approaches to Addressing Climate Change
<p>Height and Density Bonusing (Section 37)</p>	<ul style="list-style-type: none"> » A process allowing buildings to exceed the height and density of development otherwise permitted by zoning by-laws in exchange for community benefits. » A municipality must have approved Official Plan policies related to bonusing in place. » A municipal council must pass a zoning by-law to authorize increases in height and density of a development in return for the provision of facilities, services, or matters specified in the by-law (sometimes referred to as community benefits). » Often negotiated between a developer and a municipality. 	<ul style="list-style-type: none"> » Many Ontario municipalities have considered a range of community benefits such as: » Local improvements to transit facilities; » Provision of pedestrian and cycling facilities; » Provision of parkland and/or park improvements; » Conservation of greenspace and urban forests; » Energy conservation and environmental performance measures; and » Enhancement of the natural heritage system.
<p>Plan of Subdivision (Section 51).</p>	<ul style="list-style-type: none"> » Plan of subdivision is a process of creating multiple lots. It requires plan approval from the approval authority. » The approval authority may impose conditions to the approval of a plan of subdivision, including requirements for land dedication or other requirements. 	<ul style="list-style-type: none"> » Planning approval authorities may assess subdivision design and layout having regard to matters such as street connectivity to support transit, cycling and walking, the conservation of natural resources, and the size, shape and orientation of lots to facilitate the efficient use and conservation of energy. » Can play a central role in creating compact, integrated neighbourhoods.
<p>Community Planning Permit System (Section 70.2)</p>	<ul style="list-style-type: none"> » Community Planning Permit System (formerly Development Permit System) combines zoning, site plan control and minor variance into one streamlined application and approval process. » It requires Official Plan policies and a community planning permit by-law in place, and may apply to all or part of a municipality defined as Community Planning Permit Area. » Allows municipalities to impose conditions which shall be outlined in permit by-laws and may be set out in agreements and registered on title. 	<ul style="list-style-type: none"> » Municipalities have the ability to impose a range of conditions on the issuance of a permit, provided that these conditions meet prescribed criteria. For example: <ul style="list-style-type: none"> » Conditions could include those related to vegetation removal and site alteration, as well as ongoing monitoring requirements to ensure public health and safety and protection of the natural environment; and » Conditions could include the provision of specified facilities, services or matters for specified density or height, including increases in these, provided that prescribed criteria are met.

Appendix 12: Sample Energy and Emissions Plan Contents

- A long-term **vision statement**, supported by clear objectives and targets, set in short, medium and long-term timescale and grouped into several strategic areas, sectors, or 'pillars'.
- An **introduction**, describing how the plan was developed, including public participation processes.
- A **description** of how the climate action plan links with other existing/statutory plans in the city, and other local socio-economic and environmental goals.
- A **description** of how climate action planning links to other national, regional goals, regulations, plans and processes.
- A **technical and scientific summary** including a statement on the science behind climate change and projections of climate impacts, and baseline assessments such as a greenhouse gas emissions inventory, a vulnerability assessment and health implications, or a local renewable energy potential assessment.
- An **overview** of existing adaptation or mitigation related initiatives.
- A **summary** of how actions were prioritized and other decisions were made, including the criteria used.
- **Sets of actions**, organized according to several **strategic areas** with corresponding goals, selected in accordance with criteria, and ensuring co-ordinated action.
- A **strategy for outreach, education, communication and dissemination**.
- A **framework for reporting** results and ensuring accountability.
- A **monitoring and evaluation framework**, along with key performance indicators, for measuring progress, updating actions.
- A **glossary** to explain unavoidable technical terms.
- Simple **graphics** used throughout to illuminate key findings, goals, and strategies.

Appendix 13: Sample Policies and Mechanisms for Implementing Low- Carbon Actions

The following table illustrates mechanisms and policies that municipalities can apply to implement the actions identified in their community's low carbon pathway, using a sample set of actions. This table addresses all of the levers a municipality has, from leveraging its own building assets to making investments in infrastructure, and from developing and implementing programs to applying regulations and policies.

Action	Local Government Spheres of Influence				
	<i>Own or operate</i>	<i>Control budget</i>	<i>Set or enforce regulations or policies</i>	<i>Set vision</i>	
	<i>Sample Policies or Mechanisms</i>				

LAND-USE

1	Concentrate development in areas appropriate for district energy and amenity and transit accessibility.	Location of municipal amenities (recreation centres, libraries, etc).		Bylaws, bonusing, settlement area boundaries, development permits.	Official Plan, supporting planning documents.
2	Sustainable community design and development.	Location, design and operation of municipal amenities.		Secondary plans.	Official Plan, supporting planning documents. Local improvement charges: High performance building incentives.

Action	Local Government Spheres of Influence				
	Own or operate	Control budget	Set or enforce regulations or policies	Set vision	
	Sample Policies or Mechanisms				

Sample municipal Official Plan language:
Policies:

The following goals shall apply in the urban area:

- » Enhance the sense of community pride and identification by creating and maintaining unique places.
- » Provide and create quality spaces in all public and private development.
- » Create pedestrian oriented places that are safe, accessible, connected, and easy to navigate for people of all abilities.
- » Create communities that are transit-supportive and promote active transportation.
- » Ensure that new development is compatible with and enhances the character of the existing environment and locale.
- » Create places that are adaptable and flexible to accommodate future demographic and environmental changes.
- » Promote development and spaces that respect natural processes and features and contribute to environmental sustainability.
- » Promote intensification that makes appropriate and innovative use of buildings and sites and is compatible in form and function to the character of existing communities and neighbourhoods.
- » Encourage innovative community design and technologies.
- » Create urban places and spaces that improve air quality and are resistant to the impacts of climate change.

TRANSPORTATION

2	Enhanced transit.	Transit authority.	Bylaws, bonusing.	Official Plan, Transportation Plan.	
3	Transportation demand management.	Transit authority programs.	Personal transportation planning.		
4	Enhanced walking and cycling infrastructure.	Bike share programs.	Physically separated bike lanes.	Community Improvement Plan.	
5	Increased adoption of electric vehicles.	Municipal fleet; public charging stations.	Electric vehicle incentives.	Require electric vehicle chargers for new construction and major renovations; parking policy.	Transportation Plan.

Sample municipal Official Plan language:
Policies:

- » Promote the use of transit and provide a pedestrian-oriented and bicycle oriented development pattern.
- » Promote the integration of transit and active transportation modes into the early stages of new development.

Action	Local Government Spheres of Influence				
	Own or operate	Control budget	Set or enforce regulations or policies	Set vision	
	Sample Policies or Mechanisms				

BUILDINGS

6	Required advanced energy performance.	Municipally owned building performance requirements.	Local improvement charges: High performance building incentives.		
7	Retrofit homes.	Municipally owned utility.	Local improvement charges.		Partnership with utilities or private sector.
8	Retrofit commercial buildings.				
9	Re-commission buildings.				

Sample municipal Official Plan language:
Policies:

- » Encourage development proposals that include energy efficient neighbourhood and/or building design and practices in all new development.
- » Require environmental designs and retrofits of buildings and infrastructure in buildings to reduce energy consumption.

ENERGY SYSTEM

10	Solar PV in new buildings.	Municipally owned utility.	Local improvement charges: Financial incentives.		Community energy and emissions plan.
11	Solar PV retrofits.				
12	Introduce zero carbon district energy systems.		Local improvement charges, Community Improvement Plans.		
13	Install electric heat pumps .		Incentives.		
14	Install distributed energy storage.				
15	Increase renewable natural gas use.		Community choice aggregation.		

Action	Local Government Spheres of Influence				
	Own or operate	Control budget	Set or enforce regulations or policies	Set vision	
	Sample Policies or Mechanisms				

Sample municipal Official Plan language:
Alternative and renewable energy policies:

- » Council shall promote best practices and innovation in energy conservation and renewable energy systems.
- » Council shall work with the Region, local utilities and other stakeholders to advance energy conservation, demand management and local generation efforts, as well as the development of renewable energy systems.
- » Council, in coordination with the Province, the Region and other stakeholders, shall investigate suitable criteria for the construction and use of renewable energy systems.
- » Council may permit on-site alternative energy systems for residential, commercial, institutional and industrial buildings and work with the Region to develop associated design requirements.
- » Council shall review the alternative and renewable energy policies in this Plan as energy standards and technologies for alternative energy systems and renewable energy systems evolve.
- » Council shall prepare a Town-wide Community Energy Plan to detail energy use requirements and establish a plan to reduce energy demand and consider the use of alternative and renewable energy generation options and district energy systems, and will ensure that communities are designed to optimize passive solar gains.

INDUSTRY

16	Increase industrial process efficiency.	Municipally owned utility.			Official Plan.
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Sample municipal Official Plan language:

Energy Conservation:

Energy conservation refers to reducing the amount of energy used to support everyday activities. Energy conservation shall be achieved through community and site planning, building design, and use of energy-efficient materials, appliances, and landscaping. The Town shall:

- » Promote energy conservation and efficiency through new construction and upgrades to Town-owned facilities, and through the procurement of vehicles, equipment, and supplies.

FREIGHT

17	Transition to zero emissions vehicles.	Municipal fleet requirements.	Incentives, charging stations.	Congestion zone, parking policies.	Official Plan, Transportation Plan.
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Sample municipal Official Plan language:

- » Support the adoption of zero emission vehicles by supporting the establishment of fueling and recharging stations and include in City fleet

WASTE

18	Increase waste diversion rates.	Waste management program.			Waste management plan.
19	Generate biogas from wastewater.	Municipal utility.			

Action	Local Government Spheres of Influence				
	Own or operate	Control budget	Set or enforce regulations or policies	Set vision	
	Sample Policies or Mechanisms				

Sample municipal Official Plan language:
Policies:

- » Engage the community in the pursuit of measures, including the undertaking of pilot projects, to address climate change, improve air quality, promote energy and water conservation, pursue the use of renewable energy sources, and generally improve environmental quality.

The objectives of the Region are:

- » Evaluating and implementing cost-effective resource recovery techniques including the use of recycled wastes and waste byproducts such as methane gas as an energy source

AGRICULTURE, FORESTRY & NATURAL HERITAGE

20	Increase carbon sequestration areas.		Urban forestry & wetland restoration programs.	Green belt, parks, urban forest.	Official Plan.
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Sample municipal Official Plan language:

- » The City will work to improve air quality and energy efficiency, to reduce greenhouse gas and fuel emissions, and to mitigate and adapt to climate change through land use and transportation policies related to:
 - » maintaining, restoring and enhancing the urban forest and Natural Heritage System;
 - » supporting local agriculture and food production.
- » Urban forests are fundamental to address climate change. Development shall protect and enhance the urban forest to absorb carbon dioxide from the atmosphere by:
 - » Preserving mature trees and, when removal of existing mature trees is necessary as part of the development process, the applicant will replace the lost tree cover to the satisfaction of the Municipality;
 - » Mitigating heat island effects of development by ensuring an appropriate use of material and landscaping to provide shading; and
 - » Providing street trees and other landscaping as part of the development proposal within the public right-of-way.

In addition to some of the sample municipal Official Plan language provided, municipalities may consider broader sample policies for an Official Plan that will support the implementation of the Guide.

For example, a general Official Plan policy:

- » In order to achieve a sustainable community, and human and ecosystem health, climate change and air pollution must be addressed. Climate change and air pollution impacts are caused primarily by burning fossil fuels, resulting in the emission of greenhouse gases and air pollutants. These impacts can be reduced through sustainable, effective and efficient land use and transportation policies that reduce air and greenhouse gas

emissions.

- » To develop sustainable, compact and complete communities incorporating healthy active living, excellence in community design, efficient infrastructure, housing choices for all, and facilities and services meeting community needs, including a range of travel choices.

More specific policy direction could be provided which relates to:

- » Municipal GHG targets which align with the Province of Ontario targets and/ or are determined through Stage 3;
- » Integration of the GHG emissions targets into other policies and strategies including transportation, economic development, infrastructure and municipal services;
- » Engaging with neighbouring municipalities, conservation authorities, other levels of government, non-governmental organizations, private businesses and other partners to identify and implement cooperative opportunities for GHG emissions reductions;
- » Maximizing the benefits of programs, policies and mechanisms designed to reduce GHG emissions on social equity, poverty alleviation, health, noise, reconciliation with First Nations, local economic development, community resilience and other co-benefits;

Considering the impact of its policies and programs on future generations, so that decisions made today do not undermine the quality of life of those to come;

- » Promoting and supporting public and private education and awareness of air quality and climate change, associated health impacts, and linkages to transportation and land use development in the municipality.
- » Cultivating and supporting proposals for technological or social innovation that achieve GHG emissions reductions and enhance co-benefits.
- » Monitoring regularly the performance of, the reduction in greenhouse gas emissions and other air pollutants generated both through the preparation of annual or biannual inventories and through reporting on secondary indicators.
- » Updating its community energy and emissions plan every five years and ensure that these policies are synchronised with the updates.

These sample policies are intended to provide illustrative examples of how municipal Official Plans can be updated to reflect implementation of the Guide. Municipalities are in the best position to determine the policy direction that will be integrity into municipal planning and decision making based on the size, context and complexity of their community.

Appendix 14: Funding resources

Support for community energy and emissions plans

Organisation	Description
Federation of Canadian Municipalities (FCM) Municipalities for Climate Innovation Program.	Municipalities for Climate Innovation Program (MCIP) provides funding, training and resources to help municipalities adapt to the impacts of climate change and reduce greenhouse gas (GHG) emissions.
Federation of Canadian Municipalities (FCM) Green Municipal Fund.	Through GMF, FCM supports initiatives that demonstrate an innovative solution or approach to a municipal environmental issue, and that can generate new lessons and models for municipalities of all sizes and types in all regions of Canada.
Urban Sustainability Directors Network (USDN).	The USDN administers an innovation fund for USDN members and their partners in collaborating to identify and develop high-impact solutions that advance urban sustainability.
Ontario Ministry of Energy Municipal Energy Plan Program .	The Municipal Energy Plan Program provides funding to develop a plan that will help the community improve energy efficiency, reduce energy consumption and greenhouse gas emissions, study the impact of future growth on energy needs and foster renewable energy production and economic development.

Support for infrastructure investments

Organisation	Description
Infrastructure Ontario.	Infrastructure Ontario's loan program provides affordable, long-term financing to public sector clients enabling them to modernize and renew their infrastructure.
Canada Infrastructure Bank.	The Canada Infrastructure Bank will strategically invest at least \$35 billion over the next decade, and will draw in additional private-sector capital that would not have otherwise been invested in public infrastructure.
Green Ontario Fund.	The Green Ontario Fund is a not-for-profit provincial agency that invests proceeds from Ontario's carbon market into climate actions that help people and businesses reduce greenhouse gas emissions and use cleaner technology to power their homes and workplaces.

Appendix 15: Data sources for the GHG inventory

The following are key data sources for a GHG inventory in Ontario.

Theme	Category	Source
Energy.	Electricity.	Electricity utilities will provide electricity consumption by sector: Residential, Industrial, Commercial and Institutional <50 kW, and > 50kW, street lighting.
	Natural gas.	Natural gas utilities will provide natural gas consumption by sector-residential, commercial and industrial, at the Forward Sortation Area (first three digits of the postal code).
	Fuel oil.	Fuel oil usually has multiple retailers, which can be surveyed. A provincial proxy can be sourced from the Comprehensive Energy Use Database from Natural Resources Canada.
	Propane.	Propane usually has multiple retailers, which can be surveyed. A provincial proxy can be sourced from the Comprehensive Energy Use Database from Natural Resources Canada.
	Biomass.	Provincial proxies for biomass can be used and adjusted according the local context. The proxy can be sourced from the Comprehensive Energy Use Database from Natural Resources Canada.
	Gasoline.	Kent Group Ltd. provides fuel sales data for municipalities in Ontario. Fuel sales data captures both local sales and pass through sales.
	Diesel.	
	Renewable energy.	Local utilities will provide data on capacities of solar and wind under Feed-In-Tariff (FIT) and microFIT programs.
Industry.	GHG emissions.	Greenhouse gas emissions from Large Facilities is available from Environment Canada's Reported Facility Greenhouse Gas Data website.
Buildings.	Public sector energy and GHG emissions.	Energy use by facilities owned by municipalities, municipal service boards, school boards, universities, colleges and hospitals is available from Ministry of Energy's Broader Public Sector,
	Building stock.	Detailed building characteristics (floor space, storeys and type) are available from the Municipal Property Assessment Corporation.
Transportation.	Number of vehicles.	Ministry of Transportation will provide vehicle registration data at the Forward Sortation Area (first three digits of the postal code)
	Fuel efficiency.	Fuel efficiency by vehicle type is available from Natural Resources Canada's Fuel Consumption Guide.

Theme	Category	Source
	Vehicle kilometres travelled.	Data on transportation patterns for municipalities in the Greater Toronto and Hamilton Area is available from the Data Management Group at the University of Toronto.
	Transit.	Data on fuel consumption from transit is available from municipal or regional transit agencies.
Solid waste.	Composition and diversion rates.	Waste totals and diversion rates are typically available from the municipality that provide waste management services for the residential sector. Commercial waste data is not widely available.
Liquid waste.	Volume and treatment.	Liquid waste and treatment method is typically available from the municipality.
Agriculture.	Land-use, livestock.	The agricultural census from Statistics Canada provides detailed accounts of agricultural activity for different geographic areas.