CANADA'S COOLEST CITIES

TECHNICAL REPORT

Alison Bailie • Claire Beckstead

May 2010

the PEMBINA institute

25 years
of Sustainable Energy Solutions

Canada's Coolest Cities

Mitigating Climate Change through Urban Form and Transportation Planning in Canada's Largest Urban Areas

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The Pembina Foundation for Environmental Research and Education is a national registered charitable organization that enters into contractual agreements with environmental research and education experts, such as the Pembina Institute, to deliver on its work.

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About the Pembina Institute

The Pembina Institute is a national non-profit think tank that advances sustainable energy solutions through research, education, consulting and advocacy. It promotes environmental, social and economic sustainability in the public interest by developing practical solutions for communities, individuals, governments and businesses. The Pembina Institute provides policy research leadership and education on climate change, energy issues, green economics, energy efficiency and conservation, renewable energy, and environmental governance. For more information about the Pembina Institute, visit www.pembina.org or contact info@pembina.org. Our engaging monthly newsletter offers insights into the Pembina Institute's projects and activities, and highlights recent news and publications. Subscribe to Pembina eNews: http://www.pembina.org/enews/subscribe.

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Acknowledgements

The authors thank municipal staff at the Cities of Calgary, Edmonton, Montreal, Ottawa, Toronto, and Vancouver for their assistance in providing information and reviewing the results.

The authors would also like to thank Howaida Hassan for data collection and analysis; Sam Talbot for translation and interviews; Pierre René de Cotret for translating the Montreal case study. Thanks to Daniel Bouchard, Karel Mayrand, Mark Winfield and Todd Litman for reviews and valuable suggestions.

The Pembina Foundation wishes to thank the W. Garfield Weston Foundation and numerous individual donors for their generous support, which enabled the sustainable energy experts at the Pembina Institute to prepare this publication.

Canada's Coolest Cities

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Canada's Coolest Cities

Canada's six largest urban areas provide homes and jobs for almost 15 million people, nearly half of our population. Transporting these citizens to and from work, school, health care, shopping and other destinations consumes energy, which in turn contributes to environmental problems, in particular climate change. Fortunately, there are many opportunities to design urban areas and develop transportation policies that will result in lower energy use for personal transportation.

Canada's Coolest Cities examines what Montreal, Ottawa, Toronto, Calgary, Edmonton and Vancouver are doing to encourage low-carbon transportation choices, such as walking, cycling, taking public transit and travelling shorter distances.

Cool Research

The study included information for each urban area, consisting of data from public sources plus findings from interviews between Pembina and staff at the different cities. The numeric data measure both the uptake of low-carbon transportation options and the residential density of urban areas in 2006. The interviews provided insight into initiatives underway that would not yet be reflected in the data and more understanding of the challenges faced by municipal staff.

Canada's Coolest Cities covers Canada's six largest Census Metropolitan Areas (CMAs) and the core city within each CMA. A CMA is a Statistics Canada definition for the metropolitan region that covers multiple municipalities. CMAs are similar to, but not exactly the same as, other designations for the urban areas such as MetroVancouver and the Greater Toronto Area. The CMA definitions are used because they are clearly defined by Statistics Canada, the main source of data for this project. Because the CMAs cover much larger areas than individual cities, the data for a CMA captures more of the transportation behaviour.

Cool Findings

The successes and challenges identified through the research are summarized below, covering all six urban areas. More details on the findings for each of the urban areas are provided in the six case studies that are companions to this report. The case studies, one for each urban area, can be found at http://communities.pembina.org.

Successes

The interviews and data highlighted positive initiatives in all urban areas, particularly at the municipal government level. The common success across the core cities included:

- *Measuring and reporting greenhouse gas (GHG) emissions*: All cities were able to provide GHG emissions by sector (buildings, transportation and other) for historic years, or were in the process of finalizing this information. Unfortunately, the cities did not have a common measurement approach or common years for reporting data.
- *Setting reduction targets for greenhouse gas emissions*: all cities but one had stated targets for reducing greenhouse gas emissions (City of Ottawa is currently updating their targets). Many of the targets are consistent with levels identified by the International Panel on Climate Change as fair reductions for industrialized countries.

In addition to common success, the interviews with staff highlighted individual success stories and opportunities to learn from each other. These successes are referred to as Cool Factors in the report and are shown in Table 1.

Table 1. Cool Factor by core city

City	Cool Factor
Vancouver	World's Greenest City by 2020 – this initiative included key targets such as (a) Reduce GHG emissions by 33% from 2007 levels, (b) Make the majority of trips (over 50 per cent) on foot, bicycle and public transit
Edmonton	LocalMotion Challenge – This neighbourhood-based initiative encouraged residents to try eco-friendly forms of transportation and has been very successful. Residents reduced GHG emissions by four tonnes per person
Calgary	imagineCalgary – In 2007, the City of Calgary finished imagineCALGARY, which engaged more than 18,000 Calgarians in a conversation about the future of the city. This is still the largest visioning process ever undertaken by a city
Toronto	Transit City – The City of Toronto's *Transit City* will include seven new light rail rapid transit lines, connecting high-density apartment clusters in outlying areas. These areas have the level of density to make transit successful, while the neighbourhoods will be renewed with fresh mixed-use development.
Ottawa	Hybrid diesel-electric buses – OC Transpo, the City of Ottawa's transit service, has added 177 hybrid buses to its fleet. Each hybrid bus is estimated to reduce GHG emissions by 38%, compared to a low-sulphur diesel bus.
Montreal	BIXI Bike Share – The City of Montreal introduced Canada's first self-service bike rental network, BIXI, in 2009. The City also plans to double its network of bike lanes in seven years.

Challenges

Common challenges were also identified as part of the research. One key finding is that between 2001 and 2006, population grew much faster in the larger metropolitan area than in any of the core cities. People are moving to the suburbs. The data showed that CMAs also had lower fractions of commuters using transit, biking or walking than the core cities. These findings signal challenges for reducing greenhouse gas emissions from personal transportation in large urban areas: while the more dense areas are developing infrastructure and programs to encourage low-carbon transportation choices, population in moving to areas that typically have high automobile-dependency. Solving this challenge presents an opportunity for municipalities within a CMA to work together and with regional and provincial governments

to develop and implement solutions co-operatively.

A common concern from the interviews is that staff are generally not connecting specific actions (decisions and plans that they develop as part of their jobs) to greenhouse gas emission reductions. The staff interviewed recognized that having more people living in complete, compact communities and using low-carbon modes of transportation could help reduce GHGs. However, few cities had a system or requirement to estimate the the size of the impacts of these actions.

Cool Recommendations

The analysis highlights five key actions for successfully overcoming barriers: Measure, Estimate, Implement, Share and Evaluate. These actions have been undertaken to some degree already by each urban area. The next steps are to coordinate these actions to reduce GHG emissions across the full urban areas. The solutions will be unique to each urban area and will ideally be developed by citizens, local government staff and elected officials. Table 2 summarizes the key actions.

Table 2. Five key actions

MEASURE	Develop systems for consistent, frequent estimates of GHG emissions from urban personal transportation and ensure results are readily available to City departments and to the public.
ESTIMATE	Provide estimates of future GHG emissions for any significant infrastructure or policy development.
IMPLEMENT	Ensure current land-use and transportation plans are implemented and develop additional initiatives to meet GHG reduction targets.
SHARE	Explore opportunities for increasing participation of multiple departments and across municipalities in formal decision-making and informal information sharing.
EVALUATE	Track progress toward meeting GHG reduction targets and estimate the impact of infrastructure and policies post-implementation.

All levels of government need to be involved in enacting the solutions. Municipal and regional governments can start and co-ordinate many of these actions. Provincial and federal governments also have a strong role to play in supporting municipalities by providing leadership and funding for developing compact communities and low-carbon transportation choices.

1. Introduction

> "Cities account for 75% of global carbon emissions, the fight against climate change will therefore be won or lost in cities…"
>
> *— C40 Summit Communiqué, second C40 Large Cities Climate Summit, New York City, May 2007*

Canada's six largest urban areas[1] provide homes and jobs for almost 15 million people, nearly half of our population. Transporting these citizens to and from work, school, health care, shopping and other destinations consumes energy, which in turn contributes to environmental problems, in particular climate change. Fortunately, there are many opportunities to design urban areas and develop transportation policies that will result in lower energy use for personal transportation.

Our research looks at the question: "What are Canada's large cities doing now to encourage low-carbon choices for personal transportation?" Examples of low-carbon choices include walking, cycling, taking public transportation and travelling less.

The study consists of six case studies, one for each of Canada's largest urban areas, and this technical report. The case studies were completed for Toronto, Montreal, Vancouver, Ottawa, Edmonton and Calgary. Each case study covers the wider metropolitan area, including suburbs, with special consideration for the major city within the metropolitan area. The technical report covers the research approach, findings across the different urban areas and recommendations.

Municipal and other local governments have the opportunity and responsibility to take action on reducing greenhouse gas (GHG) emissions, especially those from transportation within their boundaries. According to a recent report from the Federation of Canadian Municipalities, municipalities have indirect control or influence over personal and freight transportation (excluding marine, rail and non-road transportation), which accounted for 133 million tonnes of carbon dioxide equivalent (CO_2e) in 2006 — almost 20% of Canada's total GHG emissions.[2]

The amount of energy consumed for personal transportation in cities depends on their design — in particular the locations of homes, jobs and services, plus the options for travelling among these locations. Transportation and land-use planning and policies can help decrease energy consumption, save money, limit negative environmental impacts and make communities more livable.

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[1] In Canada, most of the large urban areas comprise a number of separate cities, each with its own municipal government. We use "urban area" to refer to the regions of multiple cities with close economic and transportation ties. See Chapter 2 for more on definitions.

[2] Federation of Canadian Municipalities, *Act Locally – The Municipal Role in Fighting Climate Change*, http://www.fcm.ca/english/View.asp?mp=1&x=1235.

Through zoning and other land-use decisions, and by providing infrastructure and supportive policies for public transit and other low-carbon transportation modes, municipal governments can influence the future urban form, where people choose to live and work, and how they travel.

For this analysis, we reviewed statistics to look at past performance and interviewed staff in the cities to discover current initiatives. The study highlights success stories, summarizes data on personal transportation and urban form that help limit GHG emissions, and provides insights into opportunities for improvements in Canada's largest urban areas.

Our research showed that municipal governments in large urban areas in Canada are undertaking many projects and policies to encourage reductions in GHG emissions. However, while individual projects have been successful, GHG emissions from personal transportation have continued to increase. Higher population growth in the suburbs, leading to increased dependency on automobiles, is occurring in all large urban areas in Canada. This trend appears to be preventing the successful projects and initiatives from making a real difference in reducing GHG emissions.

The successes of each city need to be seen as first steps in the right direction. Next steps will be to replicate these projects and initiatives throughout the larger urban areas, ensure that actions identified in transportation and land-use plans are implemented, and continue to monitor and evaluate progress toward GHG reduction goals.

1.1 Objectives

The objectives of the project, *Canada's Coolest Cities,* are to:

1. Evaluate the achievements of Canada's six largest urban areas in promoting urban form and transportation systems that meet the needs of citizens while reducing energy consumption and greenhouse gas (GHG) emissions from personal transportation.
2. Investigate the challenges that the urban areas face in pursuing this objective and explore potential solutions.
3. Provide recommendations for sustainable transportation solutions for our urban areas.

1.2 Climate Change Science

The ultimate objective of the UN Framework Convention on Climate Change, which has been ratified by virtually all countries in the world, is to "avoid dangerous anthropogenic interference with the climate system" — in other words, to avoid dangerous climate change. Many municipalities in Canada support this objective and have started to take action by setting reduction targets for greenhouse gas emissions and understanding the impacts of climate change in their environments.

1.2.1 Science-based Reduction Targets

Countries and cities have been responding to the threat of impacts from climate change by setting targets to reduce GHG emissions for decades. Annual global release of GHG emissions is

estimated to have increased 24% between 1990 and 2004.[3] Setting targets provides measurable goals for governments, businesses and individual to work toward in their efforts to mitigate climate change.

To be useful, targets need to reflect the earth's natural systems; what levels of GHG emissions can the environment withstand? Climate scientists have reached broad consensus that more than 2°C of average global warming above the pre-industrial level would constitute a dangerous level of climate change.[4] "The Intergovernmental Panel on Climate Change, the world's leading climate science body, has shown that to have a chance of not exceeding the 2°C limit, industrialized countries need to reduce their combined emissions of greenhouse gases (GHGs) to 25–40 per cent below the 1990 level by 2020, if they are to make a fair contribution to the necessary cuts in global emissions."[5]

These reductions are large — many urban areas have much higher GHG emissions now than in 1990. Deep, long-lasting change will be needed to achieve these goals, but it must be acknowledged that the cost of *not* reducing GHG emissions is extraordinarily high. In his 2006 review of the economics of climate change, former World Bank chief economist Sir Nicholas Stern estimated that the "costs and risks" of uncontrolled climate change are equivalent to a loss in global GDP of at least 5% and up to 20% or more.[6]

1.2.2 Potential Impacts in Canada

The most comprehensive review to date of climate change in Canada was published by the federal government in 2008. The study, the work of 145 authors and over 100 expert reviewers from across governments, academia and non-profit organizations, found that a changing climate is already evident in every region of Canada. These impacts are projected to worsen in the future. The report outlines likely impacts over the coming decade and highlights key areas of vulnerability for Canada in a world with moderate climate warming .[7]

If global warming is limited to 2˚C above pre-industrial levels — a degree of warming widely regarded as a dangerous threshold[8] — Canada will still face significant impacts, with average

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[3] B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer, eds., *Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, (Cambridge University Press: Cambridge, United Kingdom and New York, NY, USA, 2007).

[4] Climate Change Research Centre, University of New South Wales, "Bali Climate Declaration by Scientists," (2007) http://www.ccrc.unsw.edu.au/news/2007/Bali.html. This limit has also been recognized by the leaders of the world's major economies. See G8 Summit 2009, *Declaration of the Leaders of the Major Economies Forum on Energy and Climate* (2009). http://www.g8italia2009.it/static/G8_Allegato/MEF_Declarationl.pdf.

[5] M. Bramley, P. Sadik and D. Marshall, *Climate Leadership, Economic Prosperity: Final report on an economic study of greenhouse gas targets and policies for Canada* (Pembina Institute and David Suzuki Foundation, 2009) http://pubs.pembina.org/reports/climate-leadership-report-en.pdf.

[6] N. Stern, 2006. *The Economics of Climate Change: The Stern Review*. *Executive Summary (short)*. HM Treasury. http://www.hm-treasury.gov.uk/sternreview_summary.htm.

[7] D.S. Lemmen, F.J. Warren, J. Lacroix, and E.Bush, eds, *From Impacts to Adaptation: Canada in a Changing Climate 2007* (Government of Canada, Ottawa, ON, 2008) http://adaptation.nrcan.gc.ca/assess/2007/pdf/full-complet_e.pdf.

[8] Climate Change Research Centre, University of New South Wales, "Bali Climate Declaration by Scientists," (2007) http://www.ccrc.unsw.edu.au/news/2007/Bali.html. This limit has also been recognized by the leaders of the

temperatures rising from 2˚C to 6˚C depending on the region. If global emissions continue to rise beyond this decade, more extreme impacts would be expected, as temperature change is very likely to exceed 2°C.[9]

Canada will see a number of significant changes across all provinces to its climate, distribution of species and ecosystems, and challenges facing urban and rural human communities in a 2°C warmer world. Some of the impacts that large urban areas will need to develop adaptation plans for include:[10]

- **Human health impacts.** Higher temperatures increase the potential for smog formation and for ambient air concentrations of pollen. Such increases in air pollution can have detrimental effects on human health, exacerbating existing medical conditions and affecting the most sensitive members of society. Mortality associated with increased summer temperatures is projected to double in Ontario. A 15–25% mortality increase due to air pollution effects is also projected for the province.
- **Increasing precipitation** . British Columbia and the prairies will see increases of up to 5%, while in Ontario and Atlantic Canada annual increases of approximately 9.5% are projected. In Arctic Canada precipitation may increase up to 20%. However, it is important to note that these changes are driven by increases in precipitation during the winter and spring seasons, and therefore will not ameliorate increased water demand in the summer months for a number of drought-prone regions of the country.
- **Increasing drought severity and water shortages.** Although annual precipitation is projected to increase in most provinces overall, the timing of this precipitation, coupled with declines in snow bank accumulation, earlier spring thawing, greater evapo-transpiration, and receding glaciers, are all expected to contribute to an increase in water shortages and in the frequency and severity of drought conditions. In the prairie regions projections for stream flow for several of the region's rivers are predicted to decline between 4–13%, and similar causes are predicted to decrease stream flow in parts of British Columbia by 10–25%. Water demand by crops in these regions is also predicted to increase due to the warmer summer temperatures, longer growing season and greater evapotransporation. In British Columbia, where a large proportion of energy demand is also met through hydroelectric generation, there will be an increasing need to implement alternative energy sources and improve water use efficiency to meet the water needs of the agricultural, urban centers and hydroelectric sectors.
- **Increases in extreme summer temperatures.** In Ontario, for example, the number of days at or above 30°C are predicted to double.

world's major economies. See G8 Summit 2009, *Declaration of the Leaders of the Major Economies Forum on Energy and Climate* (2009). http://www.g8italia2009.it/static/G8_Allegato/MEF_Declarationl.pdf.

[9] R.K. Pachauri and A. Reisinger, eds., *Climate Change 2007: Synthesis Report*, Summary for Policymakers (Geneva: IPCC, 2007). http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf.

[10] All figures are drawn from Lemmen et al, *From Impacts to Adaptation,* with globally-averaged warming of 2˚C above pre-industrial levels.

- **Sea-Level Rise.** Coastal cities will face the impacts of sea-level rise. For example, analysis of Roberts Bank–Fraser Delta area in Greater Vancouver indicate a sea-level rise of 0.23 to 1.02 m by 2100. This sea-level rise could cause increased risk of more frequent flooding, marsh erosion, and predation of shore birds. To develop adaptative plans that account for uncertainty, complex risk analysis, and multiple concerns will require carefully designed stakeholder processes. Processes could take 5 to 10 years to adequately account for the technical information and multiple risks, which is longer than common for community processes.

1.3 Structure of Report

Canada's Coolest Cities is presented in a series of six case studies and this technical report.

This Technical Report provides the research approach (Chapter 2), findings from the core cities (Chapter 3), findings from the entire urban areas (Chapter 4) and overall recommendations (Chapter 5). The case studies, one for each of Canada's six largest urban areas, provide more information on the findings for the core city and its surrounding urban area. The case studies can be accessed at http://communities.pembina.org.

2. Which Cities? How to Measure Cool?

As noted in the previous section, this project looks at the actions being undertaken by Canada's six largest urban areas to reduce greenhouse gas emissions through transportation and land-use planning. This section outlines the scope of this project, which cities were chosen and why, and the approach for assessing the cities. The first step is to provide key concepts and the definitions used throughout this report. People use terms such as "cities" and "land-use" in many different ways in general conversation. To be clear for this report, we provide the following definitions.

KEY CONCEPTS AND DEFINITIONS

Census Metropolitan Area (CMA): "Area consisting of one or more neighbouring municipalities situated around a major urban core. A census metropolitan area must have a total population of at least 100,000 of which 50,000 or more live in the urban core." This definition was developed by Statistics Canada for collecting and reporting data from the Census, the primary data source for this case study.

Urban Area: we use this as a general term encompassing both cities and CMAs.

City: general definition for large municipality, governed by local government.

Core City: the city in each metropolitan area corresponding to the name of the CMA, which usually has the largest fraction of population of all municipalities.

Transportation Planning: medium- to long-term planning for future transportation systems, including infrastructure for cars, trucks, public transportation, walking and cycling.

Land-Use or Urban Form Planning: medium- to long-term planning for future land development, including residential, commercial, institutional, industrial, open space and mixed use areas.

Greenhouse Gas (GHG) Emissions from Personal Transportation: this report focuses on greenhouse gases emitted during the operation of vehicles for transporting people. Governments have not agreed upon a standard scope or measurement procedure for GHGs from personal transportation in urban settings. We report the GHG emissions as provided by reports and city staff members. Further effort will be required for all cities to produce comparable estimates of these GHG emissions.

2.1 Choosing Urban Areas

2.1.1 Census Metropolitan Areas (CMAs)

For this report, we have focused on Canada's six largest Census Metropolitan Areas (CMAs) and the core city within each CMA. The six largest CMAs each have a population of more than one million and in 2006 accounted for 45% of Canada's population. These six urban areas had combined population growth of 7.9% from 2001 to 2006, greater than Canada's total population growth of 5.4%. Through the work of Statistics Canada and its census, the CMAs are clearly defined regions and have consistent data collection every five years.[11] Because the CMAs cover much larger areas than individual cities, the data for a CMA captures more of the economic and social connections of the residents of any individual city. These social and economic connections are directly tied to the transportation needs of residents and can be either barriers or opportunities for taking action to reduce GHG emissions.

2.1.2 Core City

Much of the action to reduce GHG emissions from personal transportation, however, takes place within individual cities. Each city has the power to implement zoning policies that can influence the distance residents travel to work, school, to obtain services or to be entertained. Cities also have authority over cycling and walking infrastructure and policies related to public transit.[12] Thus, we also evaluated the actions being undertaken by cities within the CMAs to better capture what is happening for Canada's urban residents. Our resources limited the extent to which we could include all cities within the largest CMAs so we focused on one city within each CMA.

Table 3 lists the municipalities and other local governments within each of the CMAs in this report. The six core cities for this report are also identified.

[11] Definitions of CMAs can be found at Statistics Canada, "Definitions and Notes," 2006, http://www40.statcan.gc.ca/l01/cst01/defcmas-eng.htm?returnfile=demo05a-eng.htm

[12] In Canada, public transit service planning and provision is sometimes undertaken by municipal departments (Ottawa, Calgary and Edmonton) and in other cases by regional authorities with subsidiary companies (e.g. Vancouver, Toronto and Montreal).

Table 3. Census Metropolitan Areas and the municipalities in their boundaries

Census Metropolitan Area (CMA)	Municipalities (Census Subdivisions) within CMA	Core City used in this report
Vancouver	Anmore, Barnston Island 3, Belcarra, Bowen Island, Burnaby, Burrard Inlet 3, Capilano 5, Coquitlam (City), Coquitlam 1 (Indian Reserve), Coquitlam 2 (Indian Reserve), Delta, Greater Vancouver A, Katzie 1 (Indian Reserve), Katzie 2 (Indian Reserve), Langley (City), Langley (District Municipality), Langley 5 (Indian Reserve), Lions Bay, Maple Ridge, Matsqui 4, McMillian Island 6, Mission 1, Musqueam 2 (Indian Reserve), Musqueam 4 (Indian Reserve), New Westminster, North Vancouver (City), North Vancouver (District Municipality), Pitt Meadows, Port Coquitlam, Port Moody, Richmond, Semiahmoo, Seymour Creek 2, Surrey, Tsawwsassen, Vancouver, West Vancouver, White Rock, Whonnock 1	City of Vancouver
Edmonton	Alexander 134, Beaumont, Betula Beach, Bon Accord, Bruderheim, Calmar, Devon, Edmonton, Fort Saskatchewan, Gibbons, Golden Days, Itsaka Beach, Kapisiwin, Lakeview, Leduc, Leduc County, Legal, Morinville, New Sarepta, Parkland County, Point Alison, Redwater, Seba Beach, Spring Lake, Spruce Grove, St. Albert, Stoney Plain (Town), Stoney Plain 135 (Indian Reserve), Strathcona County, Sturgeon County, Sundance Beach, Thorsby, Wabamun (Village), Wabamun 133A (Indian Reserve), Wabamun 133B (Indian reserve), Warburg	City of Edmonton
Calgary	Airdrie, Beiseker, Calgary, Chestermere, Cochrane, Crossfield, Irricana, Rockyview No.44, Tsuu T'ina Nation 145 (Sarcee 145)	City of Calgary
Toronto	Ajax, Aurora, Bradford West Gwillimbury, Brampton, Caledon, Chippewas of Georgina Island First Nation, East Gwillimbury, Georgina, Halton Hills, King, Markham, Milton, Mississauga, Mono, New Tecumseth, New Market, Oakville, Orangeville, Pickering, Richmond Hill, Toronto, Uxbridge, Vaughan, Whitchurch-Stouffville	City of Toronto
Ottawa-Gatineau	Cantley, Chelsea, Clarence-Rockland, Denholm, Gatineau, L'Ange-Gardien, La Pêche, Ottawa, Pontiac, Russell, Val-des-Monts	City of Ottawa
Montreal	Baie-D'Urfé, Beaconsfield, Beauharnois, Beloeil, Blainville, Bois-des-Filion, Boisbriand, Boucherville, Brossard, Candiac, Carignan, Chambly, Charlemagne, Châteauguay, Coteau-du-Lac, Côte-Saint-Luc, Delson, Deux-Montagnes, Dollard-Des Ormeaux, Dorval, Gore, Hampstead, Hudson, Kahnawake, Kanesatake, Kirkland, L'Assomption, L'Épiphanie (Ville), L'Épiphanie (Paroisse (municipalité de)), L'Île-Cadieux, L'Île-Dorval, L'Île-Perrot, La Prairie, Laval, Lavaltrie, Les Coteaux, Les Cèdres, Longueuil, Lorraine, Léry, Mascouche, McMasterville, Mercier, Mirabel, Mont-Royal, Mont-Saint-Hilaire, Montréal, Montréal-Est, Montréal-Ouest, Notre-Dame-de-l'Île-Perrot, Oka, Otterburn Park, Pincourt, Pointe-Calumet, Pointe-Claire, Pointe-des-Cascades, Repentigny, Richelieu, Rosemère, Saint-Amable, Saint-Basile-le-Grand, Saint-Bruno-de-Montarville, Saint-Colomban, Saint-Constant, Saint-Eustache, Saint-Isidore, Saint-Joseph-du-Lac, Saint-Jérôme, Saint-Lambert, Saint-Lazare, Saint-Mathias-sur-Richelieu, Saint-Mathieu, Saint-Mathieu-de-Beloeil, Saint-Philippe, Saint-Placide, Saint-Sulpice, Saint-Zotique, Sainte-Anne-de-Bellevue, Sainte-Anne-des-Plaines, Sainte-Catherine, Sainte-Julie, Sainte-Marthe-sur-le-Lac, Sainte-Thérèse, Senneville, Terrasse-Vaudreuil, Terrebonne, Varennes, Vaudreuil-Dorion, Vaudreuil-sur-le-Lac, Verchères, Westmount	City of Montreal

Source: Statistics Canada. 2006. CMA Community Profiles, Census Subdivisions. Statistics Canada (accessed January 8, 2010).

2.1.3 Population of Census Metropolitan Areas compared with core cities

Figure 1 shows the population of each CMA and city in 2006. The population of each CMA will have some influence on opportunities and challenges for implementing actions to reduce GHG emissions. The Toronto, Montreal and Vancouver CMAs each have populations that exceed two million with large differences among the three. Ottawa-Gatineau, Edmonton and Calgary CMAs each have populations of approximately one million. Other influences on opportunities and challenges are historical growth patterns, existing road and public transit infrastructure and natural environment limits (or lack of limits), such as water bodies and mountains.

The populations of core cities also vary widely with the City of Vancouver having the smallest population at 578,000; the cities of Ottawa, Edmonton and Calgary have populations that range from 730,000 to one million; with 1.6 million and 2.5 million residents respectively, the City of Montreal and City of Toronto are the largest. All data are for 2006.

The differences in population size and history of the cities and CMAs mean that direct comparisons of achievement can lead to inaccurate evaluations. We recognize this concern and have provided the analysis of our results by looking at the individual city/CMAs and their achievements over time as stand-alone case studies.[13] However, we also realized that comparing the data across CMAs and cities provides insights on challenges and opportunities. We provide results of comparisons in chapters 3 and 4.

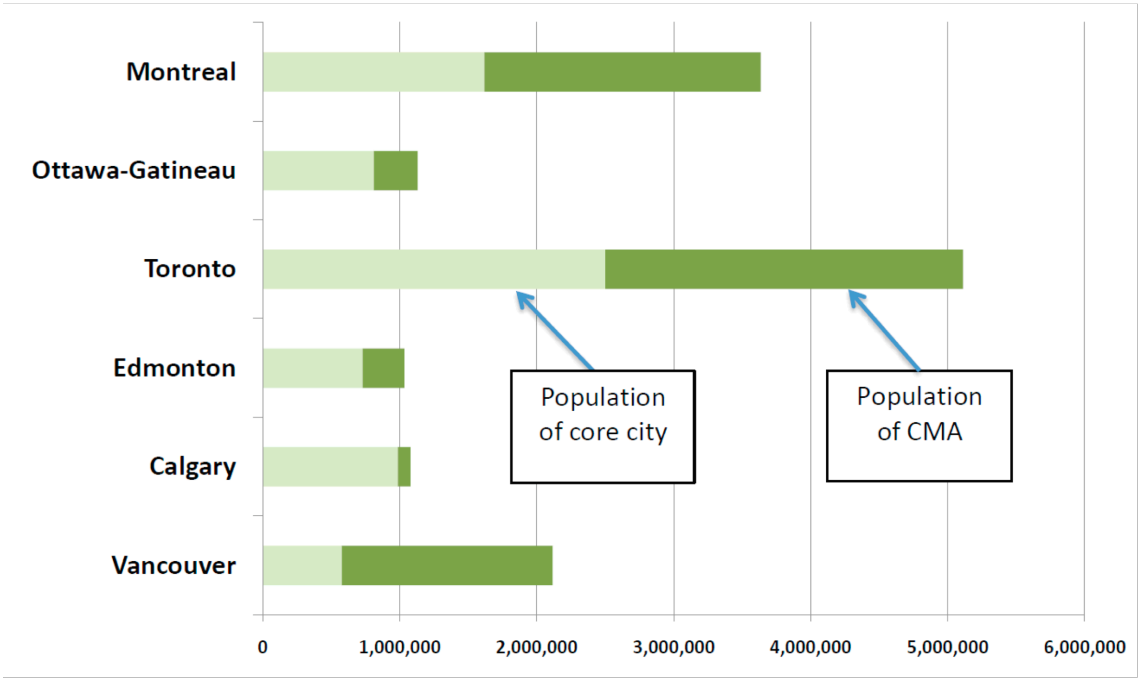

Figure 1. Population of Census Metropolitan Areas (CMAs) and core cities in 2006

Source: Statistics Canada, Census of Canada

[13] Case studies are available at http://communities.pembina.org.

2.2 Indicators of Cool

To evaluate the achievements of Canada's six largest urban areas in promoting urban form and transportation systems that lead to lower GHG emissions, we needed a set of criteria. We did not find a standard measurement tool for this evaluation, so we developed a set of indicators that would best meet the needs for this project. We scanned literature for commonly used measurements, reviewed municipal plans and initiatives to determine needs and objectives of municipalities, included Pembina's experience on opportunities to reduce GHG emissions, and then looked at what data and information were available.

Our goal was to identify indicators with strong links to GHG emissions, transportation and land-use. There are many potential indicators that could be considered, due to the complex relationship between these three elements. Travel behavior and resulting GHG emissions depend on many factors, including density (residential and employment), mix of residences and services, connectivity of roads, integration of different transportation modes, housing costs, parking costs and availability, and others.[14] The main filters in the choice of indicators for this project were availability of data 1) from public sources, 2) across all six urban areas, and 3) at the geographic scope that covers either the entire urban area or the entire city.

We gathered different indicators at the city and CMA scopes, as described in the next two sub-sections. For the core city scope, we focused on current activities by municipal governments, as collected through interviews with staff members, supplemented with data from city reports and Statistics Canada. Many of the city-based indicators are not directly comparable across the cities, due to differences in data collection. Instead they are intended to highlight the successes and provide an opportunity to share these and reflect on barriers. We did not have the resources to develop a comprehensive, objective system for gathering the qualitative data.

At the CMA scope, we focused on data that was collected using consistent and standard measurements over time and across the different urban areas. This led to five quantitative indicators, based on census data.

More information on the choice of indicators and the source of the data are provided in Appendix A.

2.2.1 Indicators at the Core City Scope

For each core city, we collected both quantitative and qualitative indicators. The quantitative indicators are reported in Table 4, along with notes on the use and limitations of each indicator.

[14] See, for example, T. Litman, *Land Use Impacts on Transport: How Land Use Factors Affect Travel Behavior* (Victoria Transport Policy Institute, 2010) www.vtpi.org/landtravel.pdf.

Table 4. Quantitative indicators used at the core city scope

Indicator	Link to GHG emissions and other notes
GHG emissions	Tracking GHG emissions would be the most direct measurement of progress for the project objectives. Understanding the issue is a first step in undertaking any change, so we consider reporting GHG emissions to be a key achievement. However, reporting GHG emissions from personal transportation at the urban scale is relatively new and standards have not been established in Canada. All of the cities and several CMAs reported GHG emissions from transportation for some years but we were not able to obtain comparable data across a consistent timeframe for all cities. Different cities used different measurements and scopes for personal transportation; comparisons across cities can be misleading.
GHG reduction targets	We found that all cities have established targets for future GHG reductions. These targets were for total GHG emissions, not specific to emissions from personal transportation. The targets provide an indication of the acceptance that each city has achieved regarding the urgency and action needed to address climate change.
Transit ridership and service	Public transit can reduce GHG emissions for travel in most large cities, especially if public transit systems operate efficient vehicles with high load factors. Data on transit ridership over time shows how the trend in ridership is changing. Data on service (number of transit vehicle kilometres and hours) indicates whether system is growing to meet urban area needs. Note that these data were available for all of the core cities except the City of Vancouver. The public transit data for Vancouver was collected at the CMA level rather than at the city level.
Distance of bike lanes	Bike lanes, either physically separated from motorized traffic or as designated areas on streets, can improve safety for cyclists and decrease one of the largest barriers identified by those who would like to bike more frequently. This indicator provides information on the extent to which cities are developing such bike facilities.
Commuting mode	As mentioned above, GHG emissions for travel depend strongly on the choice of mode: car (driver or passenger), public transit, biking or walking. The Census collects and provides this data at both city and CMA scales every five years. The census data should be used with caution, since it is self-reported.

We recognize that the quantitative indicators measure what has happened in the past. For land-use and transportation planning, this can mean several decades in the past. Many cities have begun taking action on reducing GHG emissions quite recently and the impacts of these actions

will take some time to be measurable. Also, as noted below, we identified elements that we were unable to obtain quantitative data for.

To help bridge some of these gaps, we interviewed city staff at the core cities. The goal of the interviews was to gather stories and reflections from individual members of municipal staff on the actions and capacity for further action on reducing GHG emissions from personal transportation. We did not have the resources to develop a comprehensive, objective system for gathering the qualitative data.

The categories of the questions are:

- *What is the current status of action to reduce GHG emissions in the municipality?*
- *Are there adequate resources for assessing and undertaking action?*
- *What level of teamwork, flexibility and adaptive management exists?*
- *Do staff feel they have community and political support?*
- *Do institutional arrangements help or hinder progress?*

The questions asked are provided in Appendix A.

2.2.2 Indicators at the Census Metropolitan Area Scope

At the CMA scope, we collected quantitative data based on information collected by the census. The indicators are shown in Table 5.

Table 5. Quantitative indicators used at the CMA scope

Indicator	Link to GHG emissions and other notes
Population moving into neighbourhoods with medium or high residential density	Increasing the number of people using buses, bikes and walking will require investments in transit service, bike and walking infrastructure. These investments are more cost-effective for neighbourhoods that have achieved a high level of density. Ideally, we would like to measure the density of both jobs and residences in neighbourhoods, plus the availability of services, as noted below. However, we were not able to obtain data beyond the residential density in a consistent form at the neighbourhood scale. Medium density is defined as more than 30 people per hectare. High density is defined as more than 100 people per hectare. See *Residential Density Indicators* section below for more information.
Commuting mode	As mentioned above, GHG emissions for travel depend strongly on the choice of mode: car (driver or passenger), public transit, biking or walking. The Census collects and provides this data at both city and CMA scales. The census data has limited application, though, since it is self- reported and prone to errors.
Commuting distance	The distance traveled for commuting will also impact GHG emissions. The census reports this data at the CMA scale. This is also a self-reported variable, and subject to error.

Transit ridership and service	Public transit can reduce GHG emissions for travel in most large cities, especially if public transit systems operate efficient vehicles with high load factors. Data on transit ridership over time shows how the trend in ridership is changing. Data on service (number of transit vehicle kilometres and hours) indicates whether system is growing to meet urban area needs. The public transit data for Vancouver was collected at the CMA level rather than the city level.

Residential Density Indicators

We wanted an indicator to represent whether the CMAs included communities with physical characteristics that encouraged people to travel by options with low-GHG emissions (e.g., by taking shorter trips or by walking, cycling or taking public transit). We were not able to find a comprehensive, standard indicator to measure this attribute. It is a complicated question, relating to access from homes to work, shopping, services, entertainment and other destinations. Access includes factors such as distance, ease of travel by different modes and quality of public transit. A number of indexes and indicators have been developed to answer such questions – such as Walk Score[15] or Land Use Mix.[16] But none of these indicators could be used as a comparable indicator across the CMAs or core cities in this report.

As a proxy, we focused on residential density by neighbourhood (measured as census tracts). This data was readily accessible from the Canadian census[17] and recent research suggets that increasing residential density leads to lower GHG emisisons.[18] We characterized all neighbourhoods as less than medium density, at least medium density or at least high density. We developed these terms for this report based on similar analysis by the Sightline Institute as part of its Cascadia scorecard.[19] Other studies use terms such as "compact" or "pedestrian-friendly." Table 6 provides more information on the categories.

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[15] Walk Score is a rating system that allows users to enter an address from one of 40 large cities in the United States or Canada. The system calculates the distance to different amenities (such as grocery stores, coffee shops, restaurants, cinemas and libraries). Walk Score then assigns a "score" from 1 to 100 for that address. See http://www.walkscore.com/

[16] R. Tomalty et al., *Ontario Community Sustainability Report* (The Pembina Institute, 2007.) The Land Use Mix is an index that reflects "the degree to which residential, industrial, commercial, government/ institutional and green (including parks) spaces are present." The index was based on data that were not publicly available for the CMAs or cities in this report.

[17] Census tract data found at Statistics Canada, "CMA Community Profiles, Census Subdivisions," (2006) http://www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-597/index.cfm?Lang=E.

[18] For example, a recent report by the Transportation Research Board (TRB) and the Board on Energy and Environmental Systems (BEES) of the United States focused on "establishing the scientific basis and making appropriate judgments about the relationships among development patterns, VMT, and energy consumption." The report notes that "Studies aimed at isolating the effect of residential density while controlling for sociodemographic and other land use variables consistently find that doubling density is associated with about 5 percent less VMT on average; one rigorous California study finds that VMT is lower by 12 percent." TRB and BEES, *Driving and the Built Environment: The Effects of Compact Development on Motorized Travel, Energy Use, and CO_2 Emissions*, Special Report 298, (Transportation Research Board, 2009) http://onlinepubs.trb.org/Onlinepubs/sr/sr298prepub.pdf.

[19] Clark Williams-Derry, "Cascadia Scorecard Project" (2009). In particular, see "Sprawl Indicator" webpage, http://scorecard.sightline.org/sprawl.html.

Table 6. Categories for residential density by neighbourhood

Category	Definition	Notes
Less than medium density	Fewer than 30 residents per hectare	Typical neighbourhoods would be suburbs with detached houses on small lots, with limited number of attached homes (townhouses, duplexes, small apartment buildings). Includes neighbourhoods with lower residential densities.
Medium density	At least 30 residents per hectare	Typical neighbourhoods have a mix of attached and detached houses. Examples of neighbourhoods with approximately medium density are: Vancouver: Oakridge Edmonton: Central McDougall Calgary: Coral Springs Toronto: Kingsway South Ottawa: Byward Market Montreal: Saint Henri
High density	At least 100 residents per hectare	Typical neighbourhoods have principally attached, multi-family houses with some detached houses. Examples of neighbourhoods with approximately high density are: Vancouver: Fairview Edmonton: Oliver Calgary: Connaught Toronto: Kensington Ottawa: The Glebe Montreal: District d'Hochelaga

Source: Neighbourhood categories based on Sightline Institute, 2008. *Slowing Down Greater Vancouver's smart-growth leadership slips*. Neighbourhood examples from Pembina Institute's analysis of census data.

The categories were chosen as proxies for residential densities associated with increased provision and use of low-carbon transportation modes. Medium density — 30 residents per hectare — reflects the minimum density needed for public transit frequency of at least 30 minutes.[20] High density — 100 residents per hectare — reflects the minimum density required for walking and cycling to flourish.[21]

[20] Data from IBI Group, *Central Okanagan Smart Transit Plan: Transit-Supportive Guidelines*, (Prepared for the Federation of Canadian Municipalities, 2008) 33 http://www.sustainablecommunities.fcm.ca/files/Capacity_Building_Transportation/SmartTransitPlan-TransitSupGdlines-PUB-e.pdf; and IBI Group, *Transit Supportive Land Use Planning Guidelines* (Toronto: Ontario Ministry of Transportation and Ministry of Municipal Affairs, 1992) section 2.2, 18, http://www.mah.gov.on.ca/AssetFactory.aspx?did=1179.

[21] Sightline Institute, *Slowing Down: Greater Vancouver's smart-growth leadership slips*. (2008). http://www.sightline.org/publications/reports/slowing-down/slowing-down-may-20.pdf.

2.2.3 Indicators that Were Not Included

The study was limited by the availability of data sources; the list of quantitative data is shorter than we had hoped. We are aware of numerous other elements of transportation and land-use that play a strong role in determining residents' travel behaviour and resulting GHG emissions.[22] Elements that we would like to measure in future evaluations include:

Table 7. Desired indicators not included in this report

Urban form/Land Use
• Distances from home to services, entertainment and other regular destinations. • Amount of land that is mixed-use (residential and commercial uses in close proximity to each other). • Integration of all transportation modes. • Parking provisions.
Transportation
• Mode choice for non-commuting travel. • Average annual car travel, disaggregated by type of trip. • Does public transit service (frequency and type) match travel needs? • Mix of vehicles used in large urban areas for personal and public transportation.

We were unable to find data for these elements with the time and resources available. Some of the data were simply not available. Some cities had measured some of the elements but the data were not available on a consistent basis from a single source and aggregated to the municipal or CMA level across the country. An indicator report is always an exercise in compromise between the ideal set of indicators and the set for which suitable data can be found.

[22] For examples of additional factors see TRB and BEES, *Driving and the Built Environment* and Litman, *Land Use Impacts on Transport*.

3. Overview and Findings from Cities

The findings from our research are presented in the next two chapters and in case studies for each city/CMA pair. Chapter 3 provides an overview of the findings for the core cities, mostly derived from the interviews with staff members in each city. This chapter focuses on the activities being undertaken by the cities that will help reduce GHG emissions though improved urban form and transportation planning. In Chapter 4, we compare the numeric results from the CMAs over time (2001 to 2006) and to each other. The CMA comparison highlights the challenges faced by Canada's large metropolitan regions in encouraging residents to live close to work and travel by low-carbon modes. The case studies (available at http://communities.pembina.org) provide the information we collected through data and interviews for the six CMA and core city pairs:[23] Vancouver, Edmonton, Calgary, Toronto, Ottawa-Gatineau and Montreal.

3.1 Findings From Interviews

Our interviews with staff at core cities highlighted numerous positive stories, several common goals and approaches and a few common concerns. Positive stories are reported in section 3.2. Common goals and concerns are summarized below, with a few quotes to directly illustrate the findings.

3.1.1 Common Goals and Approaches

We found that the staff at the core cities have common objectives of encouraging low-carbon transportation (walking, biking and public transit) and reducing GHG emissions. The cities also have similar approaches for reaching these objectives.

All of the staff interviewed had either explicit or implicit goals for decreasing the use of single-occupancy vehicles in the city. The staff in the six cities reported that both councils and the public are supportive of this goal. To help meet the goal, many cities are explicitly linking land-use and transportation departments in developing strategic plans for future growth of the cities. These cities recognize that both departments influence travellers' transportation choices and are hoping to develop more effective plans by working together.

Reducing GHG emissions is a stated goal for each of the cities and they have the following common approaches:

[23] See Chapter 2 for more information on CMAs and core cities reviewed in this report.

Measuring and reporting GHGs: all cities were able to provide GHG emissions by sector (buildings, transportation and other) for historic years. The cities did not have a common measurement approach so we do not compare these numbers directly in this report.

Setting GHG reduction targets: all cities had targets for reducing GHG emissions.[24] In each case, the GHG reduction target was set for the entire city, not for particular sectors.[25] The City of Montreal's target is 30% below 1990 levels by 2020 and the City of Toronto's target is 25% below 1990 levels by 2020. The City of Vancouver's target is 33% below 2007 levels by 2020 (their 2008 GHG emissions are approximately the same as their 1990 emissions, so this target is slightly stronger than City of Montreal's).[26] The targets for the Cities of Montreal, Toronto, Vancouver are within the range of reductions identified by IPCC as representing the fair of reduction effort for industrialized countries (see chapter 1). The GHG reduction target for City of Edmonton is slightly less than the range identified by IPCC, but more ambitious than Alberta's provincial and federal targets. We could not evaluate City of Calgary or City of Ottawa targets on the IPCC metric: City of Calgary does not have a community-wide target for 2020 and City of Ottawa was updating its GHG reduction targets at time of publication.

3.1.2 Common Concerns

A common concern noted in the interviews is that staff are generally not connecting specific actions (decisions and plans that they develop as part of their jobs) to GHG reductions. The staff interviewed recognized that having more people living in complete, compact communities and using low-carbon modes of transportation could help reduce GHGs. However, few staff had a system or requirement to estimate the GHG impacts of their plans and recommendations. Such estimates are complex and results will be uncertain, but estimating impacts can be an important means of understanding the connections and encouraging implementation of low-carbon urban form and transportation systems.

This finding is supported by a recent report from the Federation of Canadian Municipalities. It reports that while many municipal governments are recognizing the responsibility to act on climate change, much fewer are starting to move ahead with actions. By the end of 2009, 194 municipalities (representing 78% of Canadian population) had become members of the Partners for Climate Protection (PCP) program. The PCP program is a national network that commits the partners to reducing GHG emissions. However, only 13 of these municipalities (representing 12% of Canadian population) had begun to implement comprehensive GHG reduction plans.[27]

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[24] The City of Ottawa is in the process of setting a new greenhouse gas reduction target through the *Choosing our Future* long-term plan, an innovative joint planning initiative of the City of Ottawa, the City of Gatineau, and the National Capital Commission.

[25] The lack of sector-specific targets is not a problem for mitigating climate change overall; reducing GHGs from buildings leads to the same environmental benefit as reducing GHGs from transportation. However, sector-specific targets could help city departments and staff members to understand the connections between their jobs and responsibilities and the overall goal of reducing GHG emissions.

[26] City of Vancouver, *Greenhouse Gas Emissions Inventory Summary and Methodologies* (City of Vancouver, 2008) http://vancouver.ca/greenestcity/PDF/2008GHGInventoryMethodologiesDocument20091210.pdf

[27] Federation of Canadian Municipalities, *Act Locally*.

Staff in a few cities said they were concerned that the public's support for reducing GHG emissions may not translate to support for projects and initiatives that encourage compact communities and low-carbon transportation choices. Uncertainty about public responses or negative responses already received are limiting the larger implementation of projects and initiatives.

3.1.3 Responses to Interview Questions

The following quotes provide an indication of the findings from the interviews. As noted, the staff are highly engaged on finding solutions to urban transportation issues yet encountering challenges when considering GHG reductions.

Select Quotes from Interviews

"For the most part feedback from public engagement has been quite positive. Surveys show that citizens are strongly in favour of key directions of [the] plan. Obviously there will be some issues as you get into individual issues, but on the whole, public feedback has been largely in favour."

"We do not have explicit GHG targets [for transportation or land-use planning], but 'increase walking cycling, and transit' are stated as goals. Greenhouse gas objectives are implicit rather than explicit."

"Sustainability and climate change have both received much more political acceptance. What wasn't acceptable a few years ago is becoming more palatable."

"..have a number of transportation initiatives (for example, getting more ridership on transit system). But the words 'GHG reductions' isn't in any of those policies, and yet they are moving toward that direction [of reducing greenhouse gas emissions]."

"Our policies start with the recognition that the best way to reduce GHGs from personal transportation starts with the right land-use pattern for the city. Our land-use approach integrates land-use and transportation in a pretty progressive way. We have planners and engineers as part of the same project team on every project we work on. We have developed this internal culture, and we have the same definition of success."

"Land-use and transportation are part of one [planning] exercise. Even our transportation engineers say that the best transportation plan is a land-use plan."

"It's really important that the planned transportation system matches our goals, and that it doesn't drive our goals."

"GHG emissions have become part of any planning discussion we have."

"You have to have the political will and the staff follow-through in order to have the tough dialogues and to make the tough decisions."

"It helps to have strong leadership from the political leadership, at the staff level, from the community and from the private sector. Our current provincial government is setting very high goals and standards. Successive councils have always had a strong goal of sustainability. We benefit from a community that is quite aware and engaged."

"The level of government that has the most potential to address GHG emissions are the cities, and it's because cities control land-use, density and transportation."

"It's very hard for our policies to impact the community. We only have so many powers. We try to incorporate green policies in our Official Plans. We have no control over external emissions."

"Greenhouse gas reduction activities are not typically well funded. A lot of the processes to get funding are very cumbersome."

"It really helps to have the public support communicated to councilors. The internal leadership we have right now is [critical to] pushing sustainability initiatives."

"At the level of the city, there are not many things in place to reduce GHGs. We have focused on changing behaviour [i.e., transportation choices]."

"The provincial government has very generous funding programs for transportation plans. This is very important."

"When [..] plan was written the most important and basic principle was recognizing that addressing urban sprawl, which is a major contributor to why we generate GHG emissions, could be accomplished by making it inviting for people to live and work in higher density communities."

3.2 Cool Factors

Each of the cities is implementing actions and plans to help move toward a low-GHG future. Our interviews with staff highlighted many success stories and opportunities to learn from each other. For each city, we have highlighted one success story, referred to as its "Cool Factor;" these are summarized in Table 8 and more information is provided in the case studies for each urban area.

The Cool Factors cover a wide range of activities and are meant to highlight the many opportunities that local governments have to reduce GHG emissions through transportation and land-use initiatives. The City of Edmonton's success highlighted a neighbourhood-based initiative that produced measurable results and strong community support. The Cities of Ottawa and Montreal's Cool Factor involved innovative technology and access to technology (through diesel hybrid buses and shared bicycles, respectively). The Cool Factors in the Cities of Calgary, Vancouver and Toronto are their comprehensive plans with specific targets for achievement. ImagineCalgary is a 100-year vision for urban sustainability developed through a City-led process with input from more than 18,000 Calgarians. The City of Vancouver developed a plan to become the World's Greenest City by 2020, including 10 specific targets on economy, green communities and human health. City of Toronto's Transit City focuses on enticing more population to use public transit through fast, frequent and connected transit services. Each of the Cool Factors considers different aspects of the transportation and land-use system and each provides lessons for other cities to learn from.

Table 8. Cool Factor by core city

City	Cool Factor	Description and Notes
Vancouver	World's Greenest City by 2020	In Oct. 2009, the City of Vancouver launched the "Greenest City" initiative, which includes an action plan with the ten specific targets to be on track to becoming the world's greenest city. The 2020 targets most relevant to this study include: (a) Reduce GHG emissions by 33% from 2007 levels, (b) Make the majority of trips (over 50 per cent) on foot, bicycle and public transit, and (c) Every person lives within a five-minute walk of a park, beach, greenway or other natural space.

Edmonton	LocalMotion Challenge	The City of Edmonton is developing GHG reduction strategies by linking people. City staff are working together in developing strategic plans for transportation and land-use. One of the City of Edmonton's on-the-ground projects is the LocalMotion Challenge. This neighbourhood-based initiative encouraged residents to try eco-friendly forms of transportation and has been very successful. Residents of the neighbourhood reduced GHG emissions by four tonnes per person.
Calgary	imagineCalgary	In 2007, the City of Calgary municipal government finished imagineCALGARY, which engaged more than 18,000 Calgarians in a conversation about the future of the city. This is still the largest visioning process ever undertaken by a city. This process was followed by Plan It Calgary, the integrated new Municipal Development and Calgary Transportation Plans. These plans call for more compact and complete communities, plus greater transportation and housing alternatives.
Toronto	Transit City	The City of Toronto has strong climate targets, a climate plan with dedicated funding and is integrating land-use, energy and transit planning. The City of Toronto's *Transit City* will include seven new light rail rapid transit lines, connecting high-density apartment clusters in outlying areas. These areas have the level of density to make transit successful, while the neighbourhoods will be renewed with mixed-use development.
Ottawa	Hybrid diesel-electric buses	The City of Ottawa is reducing GHG emissions bus by bus. OC Transpo, the City of Ottawa's transit service, has been using hybrid diesel-electric buses since November 2008. By April 2010, 177 hybrid buses had been added to the fleet. These buses account for approximately 20% of OC Transpo's fleet of full-sized buses. Each hybrid bus is estimated to reduce GHG emissions by 38%, compared to a low-sulphur diesel bus.
Montreal	BIXI Bike Share	The City of Montreal introduced Canada's first self-service bike rental network, BIXI, in 2009. Bike stations are located at every Metro station and many other locations throughout the city. Riders can take a bike from one station and return it to any other station – making BIXI ideal for city trips. The City also plans to double its network of bike lanes in seven years.

3.3 Quantitative Findings

We collected data on a few key indicators for each city. In some cases the data we found are not directly comparable due to different measurement approaches, but we summarize the findings below.

3.3.1 Travel Choice by Commuters

We collected data on the travel choice of commuters in each city in 2001 and 2006; these results are shown in Figure 2. The City of Montreal had the highest achievement with just over 45% of commuters walking, biking or taking transit in 2001. This share increased only slightly (from

45.3% to 45.7%) from 2001 to 2006. Our interviews with staff at the City of Montreal indicate that the City has taken steps since 2006 to encourage public transit. According to the interview, transit service was considerably increased in 2007 and the transportation plan released in 2008 intends to increase non-automobile travel modes.

All other cities showed an increase in this indicator from 2001 to 2006, but achieved lower fractions of commuters using transit, walking or biking.

The share of commuters walking, biking or taking transit in both the cities of Toronto and Vancouver was more than 40% in 2006. It appears that increased public transit use between 2001 and 2006 was not quite matched by increased buses on the road (see section 3.3.3 below), potentially leading to increased crowding on popular routes. The interviews with city staff in both cities indicated plans to increase transit service and hopefully result in even stronger increases in public transit use. Vancouver increased its light rail system with the opening of the Canada Line in 2009, connecting the airport to downtown. The Greenest City action plan includes a 2020 goal to make the majority of trips (more than 50 per cent) on foot, bicycle or public transit.[28] The City of Toronto has plans to develop an extensive light rail system through its Transit City plan. Metrolinx, the region's transportation agency, has developed a Regional Transportation plan that would lead to at least 95% of the City of Toronto population living within two kilometres of a rapid transit by 2031.[29]

The City of Ottawa had just over 30% of commuters using alternatives to automobiles in 2001 and showed a small increase through 2006. According to the interviews, the City of Ottawa has tried to focus on improving transit in the region, and has been exploring the opportunities for light rail in the region. The City of Ottawa has also been attempting to reduce the GHGs from the transit fleet. The purchase of 177 hybrid diesel electric buses is expected to have a significant impact on GHGs.

Both the City of Calgary and the City of Edmonton had about 20% of commuters using walking, biking or taking transit. Each of the cities showed steady increases from 2001 to 2006, as the cities increased the amount of transit service. Our interviews with staff at both cities indicated each city had targets for increasing walking, biking and transit use and had strong public support for the transportation plans.

For this indicator we were able to include data from Copenhagen, Denmark, to reference achievement outside of Canada. In Copenhagen almost 70% of commuters walk, bike or take the bus.[30] This sets a high bar for Canadian cities to reach for in their goals of increased sustainability and decreased GHG emissions.

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[28] This goal is for all trips, both commuter and non-commuter.

[29] Metrolinx, *Modelling Methodology and Results for the Regional Transportation Plan* (2008) http://www.metrolinx.com/Docs/big_move/RTP_Backgrounder_Modelling.pdf..

[30] The data for Copenhagen and Canada may have been collected using different methods and may not be directly comparable. Examples of potential approaches include traffic counts, trip diaries and questions about "typical trips." Copenhagen data from *Copenhagen City of Cyclists: Bicycle Account 2008.* http://www.cphbikeshare.com/files/Bicycle%20Account%202008.pdf.

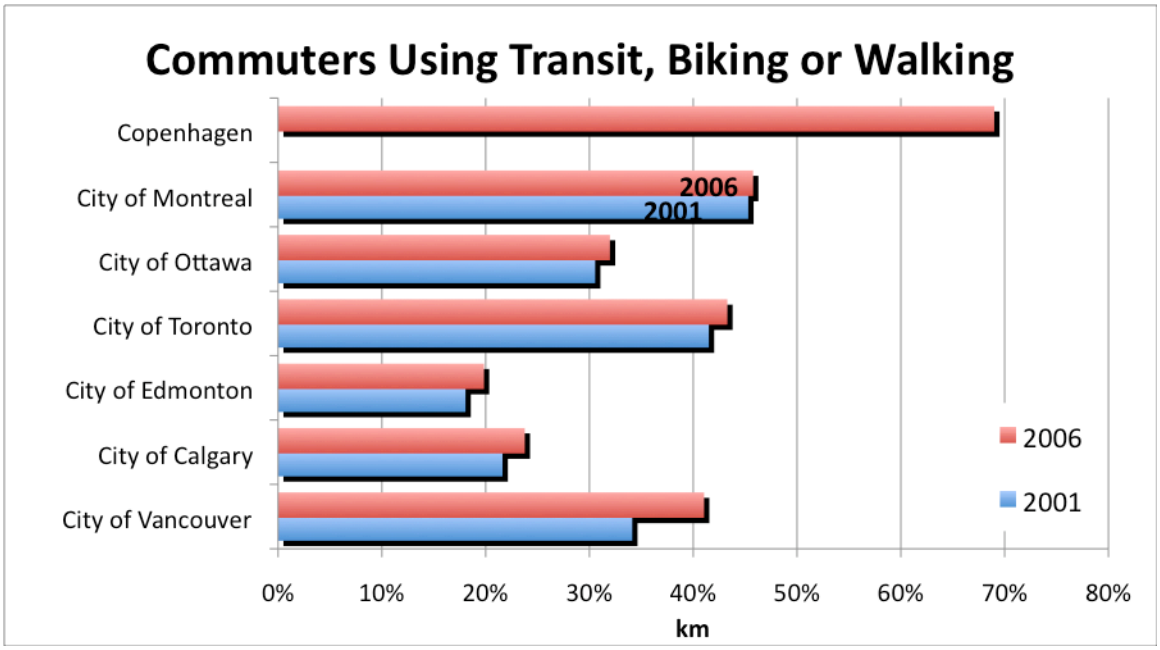

Figure 2. Fraction of commuters travelling by transit, biking or walking

*Note that in 2001 the City of Vancouver experienced a 128-day transit strike and the City of Calgary experienced a 50-day transit strike. For these two cities, the increase from 2001 to 2006 is larger than what would be expected without the transit strikes.

3.3.2 Bicycle Facilities

We report the distance of bike paths in each city as a proxy for access to safe and effective bicycle systems. The indicator does not directly measure the effectiveness of bicycle systems since many elements beyond distance of paths contribute to effectiveness. Other elements include whether paths provide useful connections from residences to work and other destinations, safety, lighting and ease of terrain. The data we collected are self-reported by each city and are intended to provide a general idea of the provisions for biking. Table 9 reports on the bike paths in each city.

Table 9. Bike facilities in each city

	On-Street Facilities (km)	Off-Street Facilities (km)	Total
City of Vancouver	347	68	415
City of Calgary	350	707	1,057
City of Edmonton	117	735	852
City of Toronto	250	168	418
Ottawa-Gatineau	283	258	541
Montreal			502

* For the City of Edmonton, 460 km of bike trails are unimproved trails in river valley.

All cities have installed a mix of on-street and off-street bike paths.

Staff at several cities highlighted goals for increased bicycle infrastructure as part of their transportation and land-use initiatives. Although the City of Toronto and City of Montreal have relatively low distances of bike paths, both of these cities have plans to significantly increase these in the near future. The City of Toronto has plans to add another 600 km[31] to their bike network while the City of Montreal is planning to add an additional 400 km[32]. The City of Edmonton plans to expand its extensive bike system by an additional 489 km over the next 10 years.[33]

The City of Montreal's cool factor is the BIXI bike share program. This program, modeled after an initiative in Paris, provides bicycles at convenient locations across the city. Citizens and visitors who sign up for the program can then "rent" a bike from one location and drop off at another. Rentals are done electronically allowing this service to be providing 24/7.

3.3.3 Public Transit Service

We obtained data for public transit in each city from the Canadian Urban Transit Association. The data are at the city-scope for all urban areas except Vancouver, which reports data from the metropolitan region rather than just for the City of Vancouver.

All cities have shown increases in the number of passenger trips since 2001. We were also interested in whether cities are increasing the number of buses and other public transit vehicles in their systems. Higher passenger trips without increases in transit service can lead to over-crowded buses and extended waiting times. Table 10 reports the change in transit service in each city between 2001 (or 2002) and 2006, and compares to growth in population and passenger trips. In 2001 the City of Vancouver experienced a 128-day strike and the City of Calgary experienced a 50-day strike. For these two cities, we report growth rates from 2002 to 2006.

Table 10. Public transit trips and service

Indicator*	Vancouver CMA**	City of Calgary	City of Edmonton	City of Toronto	City of Ottawa	City of Montreal
Passenger trips	28%	18%	30%	6%	8%	2%
Revenue vehicle kilometres	17%	11%	15%	-1%	8%	0%
Revenue vehicle	18%	11%	18%	2%	5%	1%

[31] City of Toronto, *City of Toronto Bike Plan: Shifting Gears* (City of Toronto, 2001) http://www.toronto.ca/cycling/bikeplan/pdf/bike_plan_full.pdf. City of Toronto. *Toronto Staff Report: Toronto Bike Plan – New Strategic Directions*. (City of Toronto, 2009) http://www.toronto.ca/legdocs/mmis/2009/pw/bgrd/backgroundfile-21588.pdf

[32] City of Montreal, *Montreal Transportation Plan.* (City of Montreal, 2008) http://ville.montreal.qc.ca/portal/page?_pageid=5957,40443575&_dad=portal&_schema=PORTAL.

[33] City of Edmonton, *Cycle Edmonton: Bicycle Transportation Plan. Summary Report* (City Of Edmonton, 2009) http://www.edmonton.ca/transportation/BicycleTransportationPlanSummaryReport.pdf.

hours						
Population growth***	6%	10%	10%	1%	9%	6%

* Change from 2001 to 2006 for all cities except Vancouver and Calgary. Vancouver CMA and City of Calgary data show change from 2002 to 2006, due to transit strikes in both cities in 2001 leading to data bias.

** Vancouver's data covers the majority of the Vancourver CMA, while other data is reported for the respective city.

** Population growth accounts for population in the transit service area as reported by transit provider to Canadian Urban Transit Association

Source: Canadian Urban Transit Association data

All cities and the Vancouver CMA report increases in passenger trips and vehicle hours (the time driven by public transit vehicles as an indicator of public transit service). The Vancouver CMA and City of Edmonton show the largest increase in passenger trips, and also the largest increases in public transit service (vehicle hours and kilometres). The data cannot tell us whether the provision of increased public transit leads to increased ridership or whether the cities are responding to higher ridership by providing more buses.

Increased public transit service offers a clear opportunity for provincial and federal governments to provide resources to help municipalities to meet sustainability and GHG reductions goals. The Federation of Canadian Municipalities report that 73% of Canadians polled feel federal government should provide more support for local public transit. [34]

3.3.4 Conclusions for Cities

The interviews with the staff in different cities highlighted a strong interest in improving transportation and urban form plans to encourage travel by walking, biking and public transit and more compact communities. These directions tend to reduce GHG emissions as well as increase public health and decrease overall costs of travel.[35] Most cities are investing in bike paths and providing increased public transit services. However, all cities are still struggling to incorporate GHG reductions directly with transportation and land-use planning. And the cities have not been successful in significantly reducing GHG emissions from personal transportation.

However, the cities that we interviewed and collected data on are not always typical of the larger urban areas that surround them. We focused on the "core cities," usually the cities with the most compact urban form and the best systems for public transit, biking and walking. We also collected data on the larger urban areas, the census metropolitan areas (CMAs, see Chapter 2 for definitions). In recent years, more population growth has occurred in the suburbs than in the core cities. Our overall findings for the CMAs are presented in Chapter 4.

We have also developed case studies for each of the CMA/city pairs. These case studies provide additional context for the quantitative and qualitative indicators that we collected. Each case study provides an overview of the urban area, reports the data (including additional information to what is provided in this report) and summarizes the findings and recommendations as a stand-alone document. The case studies are available at http://communities/pembina.org.

[34] Federation of Canadian Municipalities, *Act Locally.*

[35] IBI Group, *The Implications of Alternative Growth Patterns on Infrastructure Costs.* (Plan It Calgary, 2009). http://www.calgary.ca/docgallery/BU/planning/pdf/plan_it/plan_it_calgary_cost_study_analysis_april_third.pdf.

4. How Cool are the Metropolitan Areas?

Understanding GHG emissions from transportation in large urban settings in Canada cannot be accomplished by focusing exclusively on the core cities. As noted in Chapter 2 and experienced by many Canadians, suburban living is prevalent and growing. Lower residential density and dispersed job locations are typical in suburbs and can discourage low-carbon transportation options, such as public transit, walking or biking. Our findings indicate that Canada's large urban areas are finding it challenging to encourage higher residential density and increased use of public transit, walking and biking.

This section compares the data from CMAs covered in our analysis.[36] The geographic scope of the CMA captures the interconnections (people and goods traveling across city boundaries) that are missed when we only consider core cities. The CMAs contain more people, thus more transportation needs and more GHG emissions. As noted in Chapter 2, our findings do not provide a comprehensive picture of the achievements and activities from CMAs due to lack of data on a full range of indicators. However, comparisons of the data available provide insights when considering GHG emissions, land-use and transportation planning.

A major finding is that in Canada, the CMAs are growing faster than the core cities in every large urban area. This finding is shown in Figure 3. In every CMA and core city pair, the CMA (which includes the core city) has experienced a higher population growth than the core city. The greatest difference occurred in Toronto, where the Toronto CMA grew by 9.2% from 2001 to 2006, while the City of Toronto grew by only 0.9% in the same period.

The stronger population growth in the CMAs means that more people are living in the suburbs. The core cities are the most urban and central of the municipalities that make up the CMAs (see 2.1.2 for municipalities in the CMAs). This trend in metropolitan growth is often linked to neighbourhoods with lower residential densities, longer commute distances and greater automobile dependency. These elements lead to higher energy use and GHG emissions.[37] Our findings, shown in the following sections, also support these trends. The challenge now for Canada's large urban areas is to counter the final results and implement solutions that promote population and job growth, yet lead to actual reductions in GHG emissions from personal transportation.

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[36] See Chapter 2 for definitions of Census Metropolitan Areas. Chapter 3 summarizes the findings for core cities. Case studies available at http://communities.pembina.org present data and information from interviews for each city/CMA pair.

[37] For examples, see E. Miller and R. Soberman, *Travel Demand and Urban Form: An Issue Paper*, (Neptis Foundation, 2003) and Sightline's website on the *Cascadia Scorecard's* Spawl indicator, http://scorecard.sightline.org/sprawl.html.

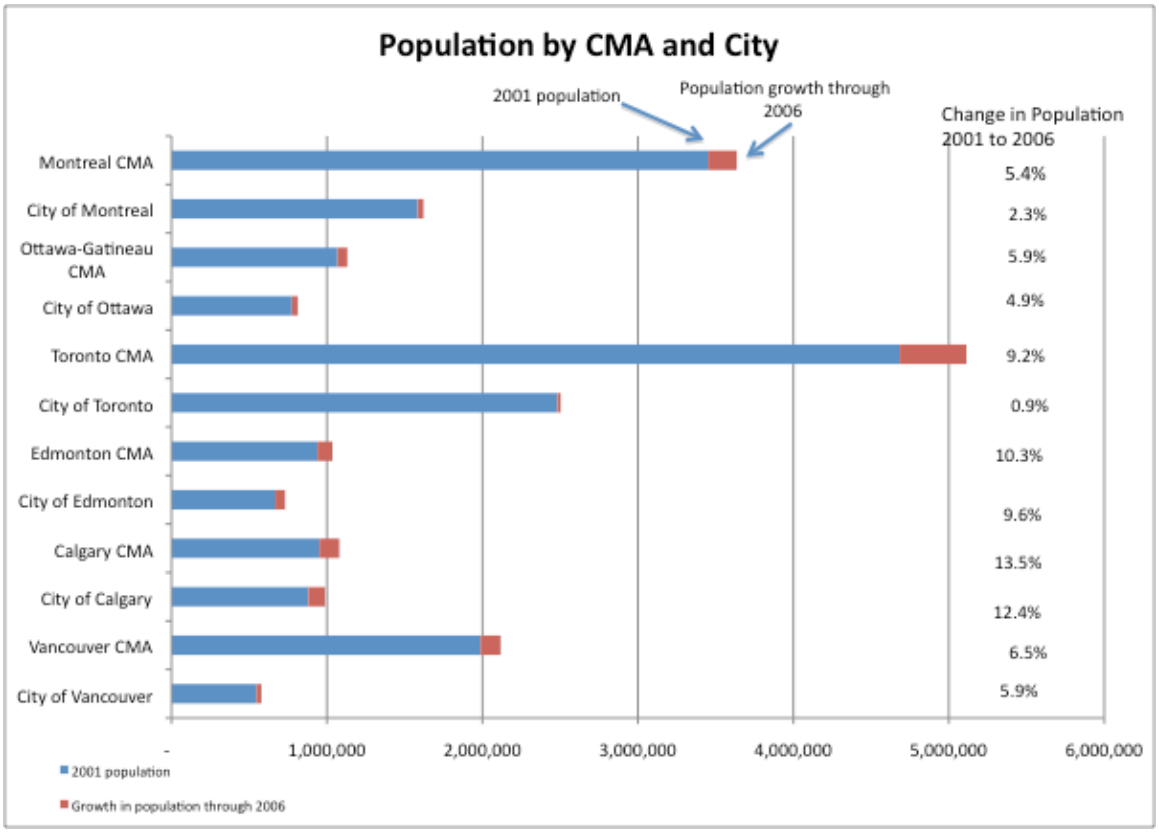

Figure 3. Population in 2001 and growth through 2006 for each CMA and core city

4.1 Overall Findings

Canada's six largest urban areas are not changing their urban design or implementing low-carbon transportation choices quickly enough to address the large GHG reductions needed to prevent serious impacts of climate change (see Chapter 1). Reducing GHG emissions from personal transportation requires both improvements in vehicle fuel efficiency and reductions in the amount of travel by vehicles, especially reductions in travel by single-occupancy vehicles. Several recent studies for Canada and the United States have highlighted the need to address travel by single-occupancy vehicles as part of the suite of actions to reduce climate change.[38]

We were unable to collect data on GHG emissions at the CMA level but we expect that GHGs from personal transportation have increased since 2001. Our research shows that the CMAs are struggling for success on indicators that influence GHG emissions in urban areas. None of the CMAs showed significant improvements in the fraction of people living in neighbourhoods with medium or high residential density. On average, commuters are travelling further in 2006 than in

[38] For examples, see C. Burda et al, *Driving Down Carbon* (The Pembina Institute, 2010) and Reid Ewing, Keith Bartholomew, Steve Winkelman, Jerry Walters and Don Chen, *Growing Cooler: The Evidence on Urban Development and Climate Change* (Urban Land Institute and Smart Growth America, 2007) www.smartgrowthamerica.org/gcindex.html.

2001. Growth is occurring in low-density neighbourhoods, which generally have fewer options for low-carbon transportation.

One promising indicator is that most CMAs increased the fraction of commuters using public transit, walking or biking. However, the CMAs lag behind the core cities in this indicator. And even with stronger success on encouraging commuters to use these lower carbon modes of transit, most of the core cities have seen increasing GHG emissions from personal transportation. Overall, we expect that the increased commuting distance and limited (or lack of) growth in medium- or high-density neighbourhoods will counter the benefits of increased commuting by low-carbon modes.

We present the data comparisons for each CMA by indicator in the following subsection, with some discussion on possible implications of the research. We did not have resources to interview all cities in each CMA or to collect data on indicators that were not available through public sources. Therefore, this report is limited in its ability to explain the "why" behind our findings.

4.2 CMA Comparisons

The CMA results are compared in this section to provide examples for urban areas to learn from each other. We measured and compared the six CMAs using four indicators, as reported in Table 11. The following sub-sections provide the results.

Table 11. CMA comparisons

Indicators
Fraction of population living in neighbourhoods with medium residential density (more than 30 people per hectare)
Fraction of population living in neighbourhoods with high residential density (more than 100 people per hectare)
Average distance traveled for commuting
Fraction of population walking, biking or taking transit for commuting trips

4.2.1 Fraction of Population Living in Neighbourhoods with Medium and High Residential Density

Creating compact, complete communities is an objective for many urban land-use initiatives across Canada. Such communities can achieve lower GHG emissions for personal transportation by concentrating services, employment and leisure activities. Residents have more opportunities to travel shorter distances and to use modes with lower GHG emissions, such as public transit, biking and walking.

Residential density is not the only indicator for compact, complete neighbourhoods, nor is it necessarily the best indicator. People living in a high-rise apartment that is isolated from their needs could drive in single-occupancy vehicles as much as or more than residents in a low-density suburban development. However, neighbourhoods with high residential density tend to

attract some concentration of jobs and services and can support frequent, rapid public transit at greater cost-effectiveness than less dense neighbourhoods.

Large Canadian CMAs have been moderately successful in developing neighbourhoods with medium residential density (greater than 30 people per hectare) but all CMAs have struggled to attract new population to these neighbourhoods between 2001 and 2006.[39] These results are shown in Figure 4. We judge the CMAs as moderately successful since three of the six CMAs (Vancouver, Toronto and Montreal) had more than 50% of residents living in such neighbourhoods in 2001. The Toronto CMA had the highest fraction, with 64% in 2001. However, all CMAs have a smaller fraction of their population in high-density neighbourhoods in 2006 than in 2001 — a trend in the wrong direction and an indication of the struggle to either develop neighbourhoods with at least medium density or attract residents to such areas.

NOTE: Staff at the City of Ottawa are concerned with undercounting in the 2006 Census. Estimates by the staff based on building permits and average population by type of residence show increases of approximately 4,425 people in the central and inner areas of the city between 2001 and 2006. Since many neighbourhoods in these areas would have more than 30 residents per hectare, the City of Ottawa estimates do not align with Statistics Canada results shown above. Statistics Canada is aware of this concern but were unable to provide further information at the time of this report.

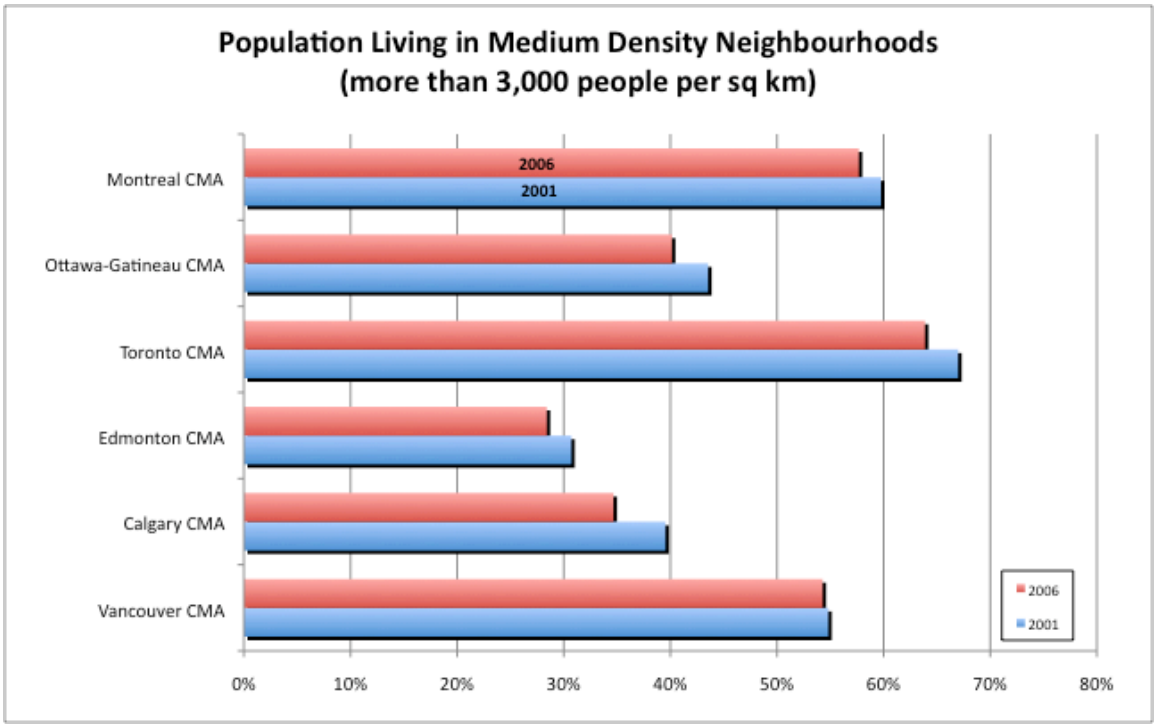

Figure 4. Populations living in neighbourhoods with medium residential density, by CMA

[39] 30 residents per hectare is considered the minimum density needed to support public transit with frequency of every 30 minutes. See Chapter 2 for more information on this indicator.

Canadian urban areas are seen as successful compared to municipalities in the United States in limiting sprawl. Although finding direct comparisons for data is challenging, a report by the Cascadia Institute managed to compare data on populations living in medium-density neighbourhoods among seven urban areas in the Pacific Northwest and found that Vancouver was the clear winner. Based on 2000/2001 data, Greater Vancouver had more than twice the share of population in compact neighbourhoods as any other urban area in the northwest. The report noted that Portland is recognized as a clear leader among American cities for increasing the share of population living in urban zones — but Vancouver out-performed even Portland.

Canadian CMAs experienced lower success in developing neighbourhoods with high residential density (more than 100 residents per hectare), [40] as shown in Figure 5. Less than 3% of residents in Ottawa-Gatineau, Calgary and Edmonton CMAs are living in such neighbourhoods. Montreal CMA achieved the highest fraction of population in neighbourhoods with high residential density at 16%. A larger concern is that the CMAs did not increase the share of population in high-density neighbourhoods. Vancouver and Edmonton CMAs were the only urban areas to increase the fraction of population in such neighbourhoods.

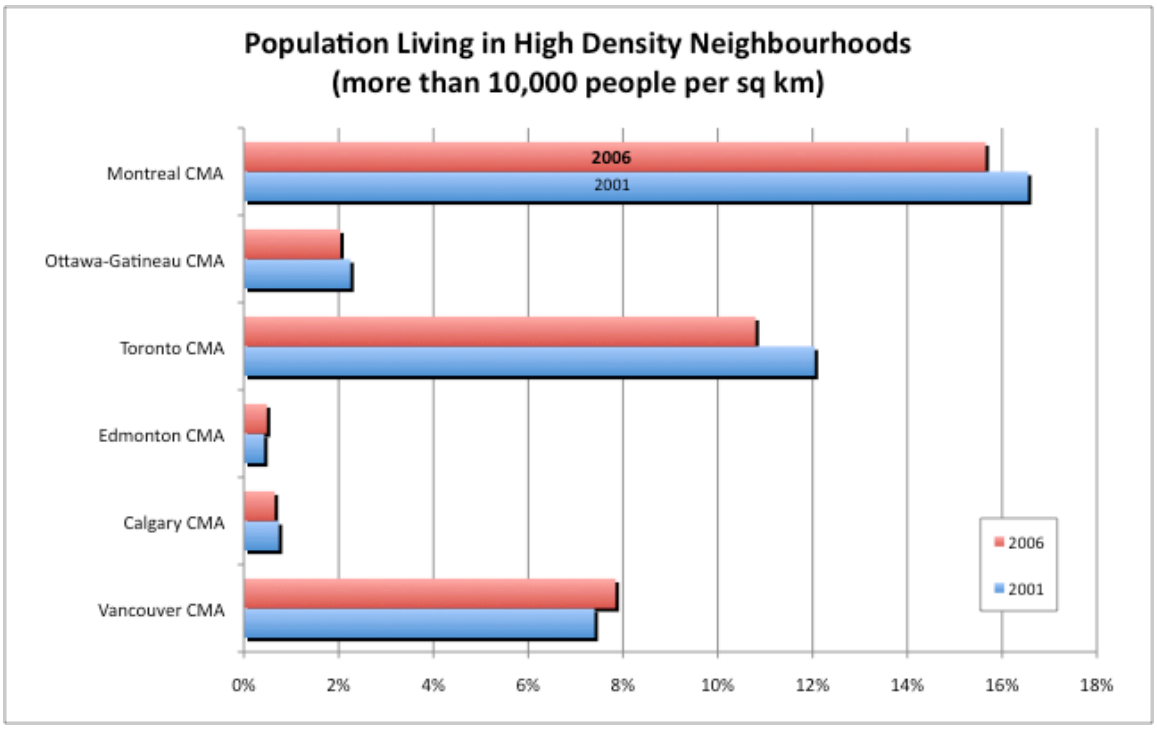

Figure 5. Populations living in neighbourhoods with high residential density, by CMA

See note on p.32 regarding Ottawa population figures.

This study was not able to delve into the reasons for the decreased share of population in the high-density neighbourhoods at the CMA level, due to diversity of municipal governments and policies involved. We noted that recent municipal plans for several of the core cities acknowledge the benefits of increased density. For example, Vancouver's Greenest City action

[40] 100 residents per hectare is considered the minimum density needed for significant use of walking and cycling. See Chapter 2 for more information on this indicator.

plan notes that "there is an overarching issue that affects emissions from both buildings and vehicles: density. Land-use patterns are probably the single most important determinant of people's greenhouse gas emissions and their ecological footprints."[41] The City of Ottawa's transportation plan reports that its strategic directions include that "the City will shape development patterns by encouraging compact developments with a mix of uses, and by requiring supportive community and site design practices."[42] Other cities have similar language in their recent plans. Further research should consider the effectiveness of policies and initiatives on helping cities achieve their objectives and ensuring the municipalities throughout the CMAs are coordinating their efforts.

Most of the transportation and land-use plans in the large cities were developed with significant stakeholder input and our interviews with the city staff indicated that public supported the overall direction of the plans. Cities and regions can learn more on housing preferences through direct surveys. For example, a recent survey was conducted in the Toronto CMA to identify the degree to which people would accept different housing types. More than 50% of the respondents reported living in two-storey townhouses with large private backyards as "acceptable" or "may be acceptable."[43] Since medium-density neighbourhoods have a mix of attached and detached homes (see section 2.2.2), the survey findings support municipal plans to increase the growth of these neighbourhood types.

4.2.2 Average Distance Travelled by Commuters

The distance travelled by commuters influences their GHG emissions from personal transportation in two ways. Directly, the greater the distance travelled, the more GHGs emitted (for any mode choice that emits GHGs). Indirectly, commuters with shorter distances are more likely to consider walking, cycling or transit as options for their commute.

As shown in Figure 6, the average commute distance is similar across all the CMAs and the trend in most CMAs is increased commute distance, a trend that is counter to reducing GHG emissions. The Vancouver CMA had the lowest average commute distance of all CMAs in 2006 and was the only CMA to show improvement in this indicator from 2001 to 2006. The increase in average commute distance in all other CMAs indicates that people are living further from their jobs now than in the past.

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[41] David R. Boyd, *Vancouver 2020: A Bright Green Future, An Action Plan for Becoming the World's Greenest City by 2020*. (City of Vancouver, 2009). http://vancouver.ca/greenestcity/PDF/Vancouver2020-ABrightGreenFuture.pdf.

[42] City of Ottawa, *Transportation Master Plan.* (City of Ottawa, 2008) http://www.ottawa.ca/city_hall/master_plans/tmp/tmp_en.pdf.

[43] John Stillich and Sandeep Kumar Agrawal, Housing Alternatives Acceptability Study, (Sustainable Urban Development Association, 2008). www.trialsudasite.citymax.com/f/Final_FINAL_HAAS_Report1.pdf.

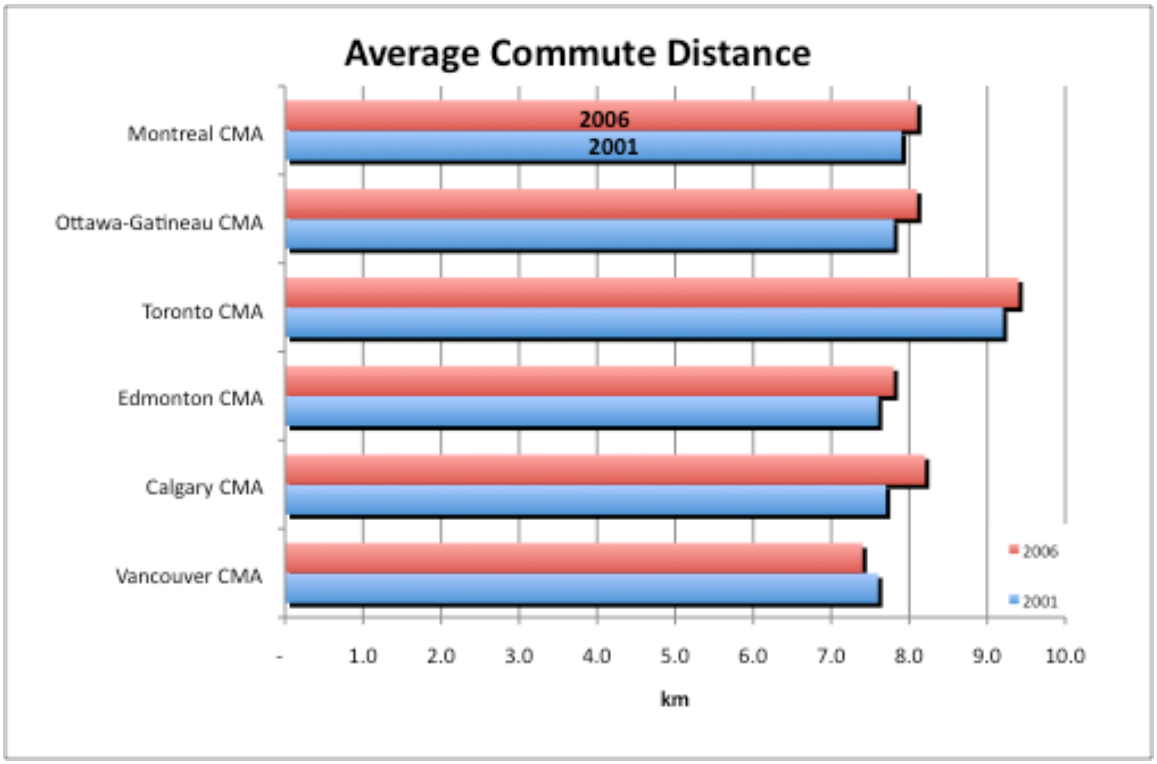

Figure 6. Average distance travelled by commuters, by CMA

The cause for increased commute distance was not identified in our work, but is likely related to the stronger population growth in municipalities outside of the core cities in each CMA. While further research on the cause of increasing commute distance in Canada's large CMAs could be helpful, significant research has already been completed that attempts to understand preferences for different housing choices. Several studies in Canada and the United States report that a significant fraction of the population is willing to trade off a large house for a shorter commute.[44] An important question is whether the housing supply exists for the population that desires a shorter commute and is willing to live in a smaller home.

4.2.3 Commuters Using Transit, Biking or Walking

Increasing the number of commuters using low-GHG transportation modes to get to and from work will contribute to overall GHG reductions. Biking and walking produce no GHG emissions and public transit can offer low-GHG emissions per passenger, depending on the number of passengers per vehicle. Large urban areas have some of the best infrastructure for public transit, biking and walking.

Canadian CMAs have had more success increasing the percent of commuters taking transit, walking and cycling than they have increasing populations in high-density neighbourhoods. Figure 7 shows that Montreal CMA had the highest share in 2006 at 29%, a marginal increase over its share in 2001. All CMAs were able to increase the share of people taking alternatives to automobiles for commuting trips, with Vancouver CMA seeing the greatest improvement.

[44] For examples of recent studies see Litman, *Where We Want To Be*.

Vancouver CMA data in 2001 may be slightly lower than expected due to a transit strike in that year.

Although these CMAs show increases through 2006, they will need to increase efforts to get on course for GHG reductions. None of the CMAs are yet reaching mode shares of greater than 50% from walking, biking and transit for commuting. Thus, the automobile remains the dominant form of transportation in urban areas.

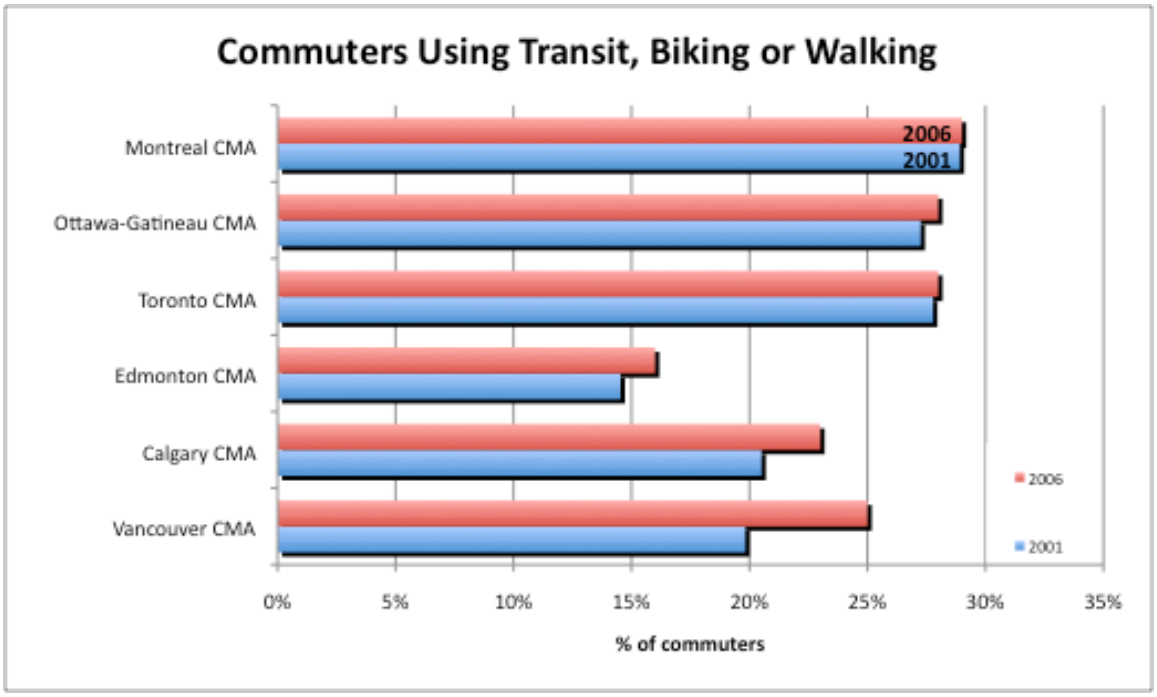

Figure 7. Share of commuters using transit, biking or walking, by CMA

In all cases in this study, the core cities are achieving greater shares of commuters using transit, biking or walking than the corresponding CMA. This result is seen by comparing the results by CMA (Figure 7) with the same results by city in the previous chapter (Figure 2). This finding points to opportunities for greater success at the CMA level by exploring ways for the municipalities outside the core to mimic the results of the core cities. Strong leadership and resources from provincial governments or regional bodies could help municipal governments reach this goal.

5. Getting Even Cooler

This project looked at the questions: "What are Canada's large urban areas doing to reduce GHG emissions from personal transportation?" and "What barriers are they facing in pursuing this goal?" We found that municipal leaders in large urban areas in Canada are undertaking many projects and policies to encourage reductions in GHG emissions. However, while individual projects have been successful, GHG emissions from personal transportation have continued to increase. Higher population growth in the suburbs, leading to increased dependency on automobiles, is occurring in all large urban areas in Canada. This trend appears to be preventing the successful projects and initiatives from making a real difference in reducing GHG emissions.

Our analysis highlights five key actions for successfully overcoming barriers: Measure, Estimate, Implement, Share and Evaluate. These actions have been undertaken to some degree already by each urban area. The next steps are to coordinate these actions to reduce GHG emissions across the full urban areas. The solutions will be unique to each urban area and will ideally be developed by citizens, local government staff and elected officials. Table 12 summarizes the key actions, while Table 13 provides recommended priorities for progress on all five actions.

Table 12. Five key actions

MEASURE	Develop systems for consistent, frequent estimates of GHG emissions from urban personal transportation and ensure results are readily available to City departments and to the public.
Consistent, frequent estimates of GHG emissions from urban personal transportation are not readily available to government staff and public. This information is needed to monitor progress, evaluate individual initiatives and plan for long-term objectives.	
ESTIMATE	Provide estimates of future GHG emissions for any significant infrastructure or policy development.
Local government staff (and elected officials and the public) often do not understand the impact of their actions and decisions on GHG emissions.	
IMPLEMENT	Ensure current land-use and transportation plans are implemented and develop additional initiatives to meet GHG reduction targets.
Reducing GHG emissions will only occur through implementation of policies, incentives, capital projects and other initiatives. The purpose of the other steps is to ensure the effectiveness of this step. The first step for most cities is to ensure that the actions identified in transportation and land-use plan are implemented. For most cities, these actions will move them in the direction of reaching GHG reduction targets, but further initiatives and policies are likely needed to reduce emissions at a rate that matches the targets.	
SHARE	Explore opportunities for increasing participation of multiple departments and across municipalities in formal decision-making and informal information sharing.
At least three concerns were revealed in this project. 1) Interviews indicate that land-use and	

transportation planning departments are increasingly working together, but there are fewer connections with other departments. 2) The numeric data indicate that core cities are making progress, but there's less success in larger urban areas. 3) Many cities report strong support from the public in setting goals for reducing GHG emissions, but the staff felt the support may vanish when cities propose initiatives focused on where people live and how they travel.	
EVALUATE	Track progress toward meeting GHG reduction targets and estimate the impact of infrastructure and policies post-implementation.
This report has highlighted many successful initiatives, strong GHG targets and examples of coordinated planning. To date, however, Canada's large urban areas continue to see increases in their GHG emissions from personal transportation. This step helps answer the questions of "Are we progressing fast enough?" and "Which initiatives are contributing the most to GHG reductions?"	

Table 13. Recommended priorities for progress on all five actions

Each city and urban area will need to prioritize next steps and work co-operatively for effective implementation. Recommended next steps for all municipal governments based on the results from *Canada's Coolest Cities* are:

1. Track progress toward meeting GHG reduction targets from transportation and land-use policies.
2. Reward development of compact communities to limit sprawl in large urban areas. Implement these policies jointly with neighbouring communities to ensure the policies are effective for the regions)
3. Invest in low-carbon transportation choices (transit, walking and biking infrastructure.
4. Develop policies to encourage people to live close to work and services, encouraging low-carbon transportation options and reducing time spent behind the wheel.

Provincial and federal governments also have a strong role to play in supporting municipalities by providing leadership and funding for developing compact communities and low-carbon transportation choices.

To jump-start the next process of choosing and setting priorities on policies and initiatives, we provide the following examples for each key action.

Table 14. Example ideas for key actions

Ideas for MEASURING	• Share current approaches and develop one or more standard, consistent calculation methods across cities, regions and provinces. • Consider developing a central location that will review data, check calculations and be responsible for providing estimates to public. • Local governments need to collect data and share calculation approaches, to help determine one or more standard indicators. • Regional governments/bodies need to provide support especially for smaller local governments in collecting and reporting data. • Provincial/federal governments need to provide financial and other resources to support a standard approach and data centre.
Ideas for ESTIMATING	• Translate city-wide GHG reduction targets into elements that fit within the structure of the city departments.

	• Require staff to provide estimates of future GHG emissions as well as cost and estimates of other impacts for any infrastructure or policy development (change job descriptions to reflect new staff responsibilities). • Review and revise land use and transportation policies and procedures so they are aligned with and contribute to meeting municipal GHG targets. • Invest in professional development on methods for estimating GHG reductions and to clarify the impacts of the land-use zoning, transportation projects and other planning activities on GHG emissions. • Joint investment (across local governments and other government levels) in tools to provide GHG reduction estimates from urban transportation. • Regional bodies can help by providing resources, such as regional transportation analysis, to help municipalities understand trade-offs and take action on policies and initiatives to reduce GHG emissions from personal transportation.
Ideas for IMPLEMENTING	• Ensure the actions in current transportation and land-use plans are undertaken. • Design and reward development of compact communities that are less reliant on automobile travel. Rewards can include: o Reduced development charges and taxation for higher density neighbourhoods (reflecting lower utility, road, service and environmental costs for these communities). o Provide financial incentives for development that is close to rapid transit, in brownfields, intensified or encourages walking and cycling. o Expedite permitting approvals for development that is close to rapid transit, in brownfields, intensified or encourages walking and cycling. o Develop incentives and policies for people to live near where they work. • Introduce policies to limit sprawl and reduce time spent behind the wheel in large urban areas. Examples include: o Introduce urban containment boundaries and ensure they are enforced. o Zone for mixed use development with higher density. o Encourage low-carbon travel options through road pricing, carbon pricing, pay-as-you-drive insurance and financial incentives for taking transit. o Develop frequent, fast public transit (for example, the Canada Line in Vancouver) • For provincial governments: o Ensure funding supports development and infrastructure that help reduce GHG emissions. o Explore use of minimum population and job densities in certain areas (for example, see Places to Grow in Ontario).
Ideas for SHARING	• Explore opportunities for increasing participation of multiple departments in formal decision-making (for example, see recent planning processes by City of Calgary and City of Edmonton) and informal information sharing. • Additional connections could include engineering, operations and finance departments, plus with regional governments. • Reward or require collaboration between land-use, transportation and operations departments. • Work together across municipalities can be challenging and may need extra resources from provincial governments or regional bodies.

	• Public engagement strategies will benefit from sharing success stories (see Cool Factors in Case Studies). Public may need increased understanding of links between urban form, transportation and both environmental costs and livability goals.
Ideas for EVALUATING	• Local government staff will need to monitor GHG emissions and other indicators associated with new projects and initiatives • Findings from this step should be connected with the Measure and Share steps and shared throughout local government (staff and elected officials) and with other municipal, regional and provincial governments.

The challenge for cities in the next few decades is large and will require dedicated and cooperative resources — funding, staff, elected officials and the community. The successes of each city provided in this report need to be seen as first steps in the right direction. Next steps will be to replicate these projects and initiatives throughout the larger urban areas, ensure that actions identified in transportation and land-use plans are implemented, and continue to monitor and evaluate progress toward GHG reduction goals.

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The following are references for the technical report. For data in each of the case studies see the supplementary document *Canada's Coolest Cities: Case Study References.*

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Appendix A: Choice of Indicators

Objectives

The objectives of the project, *Canada's Coolest Cities,* are:

1. Evaluate the achievements of Canada's six largest urban areas in promoting urban form and transportation systems that meet the needs of citizens while reducing energy consumption and greenhouse gas (GHG) emissions from personal transportation.
2. Investigate the challenges that the urban areas face in pursuing this objective and explore potential solutions.
3. Provide recommendations for sustainable transportation solutions for our cities.

For our analysis, we considered the six largest CMAs in Canada: Calgary, Edmonton, Montreal, Ottawa-Gatineau, Toronto and Vancouver. For each CMA we are gathering a series of indicators to meet Objectives 1 and 2.

To define the indicators for *Canada's Coolest Cities*, we reviewed recent reports that provide sustainability comparisons across cities along with research on the use of indicators in the urban sustainability field. We developed a list of potential quantitative and qualitative indicators for meeting Objectives 1 and 2. We reviewed this list with external experts and refined it based on their input. The indicators described in this report are the result of that refinement and represent our approach for next steps in data collection and interviews.

Indicators for Objective 1

> *Evaluating the achievements of cities in reducing GHG emissions from personal transportation through urban form and land use planning.*

These indicators are intended to reflect the state of each city's current urban form and transportation systems. For the specific scope of this project, we have chosen a framework that combines "goal-based" (energy and GHG reductions) and "sectoral-based" (land use and transportation) indicators.[45] Our preference is to collect quantitative data from standardized collection source and we found six such indicators that help meet Objective 1. However, we found that many important indicators do not have standardized collection, or even standard definitions.

[45] See Tomalty, *The Ontario Urban Sustainability Report – 2007* for definitions of types of frameworks and indicators.

Table 15 contains a list of the quantitative indicators, along with descriptions, rationale for inclusion in this study and the data source for the indicators. Data for each indicator will be collected for 2001 and 2006 and the relative change or trend in each indicator will be evaluated.

Table 15. Quantitative indicators for Objective 1

Indicator	Description	Rationale	Data source
Population density	Total population divided by the municipality's urbanized land base.	Higher density can encourage provision of public transit and other services in neighbourhoods by reducing costs (per person-trip).	Calculations based on Statistics Canada Community Profile
Population moving into medium- or high-density neighbourhoods	Fraction of population change between 2001 and 2006 that occurred in neighbourhoods with at least medium or at least high residential density.	See above – this indicator provides a neighbourhood scale indicator that is missed by the overall population density of each CMA	Calculations based on Statistics Canada (Census)
Commuting mode	Percentage of labour force that commutes as a car/truck/ van driver vs. transit vs. cycling vs. walking.	A measure of the degree of dependence on single occupancy vehicles to commute to work.	Statistics Canada Analytical paper Work and Commuting in Census Metropolitan Areas, 1996-2001
Commuting distance	The median length of commute (in kilometres) to work.	An indicator of land use planning and energy use. Measures ease of commuters to switch modes.	Commute distance is a self-reported measure in the Census. The actual distance may vary substantially from reported distances. Statistics Canada
Regular service passenger trips	All passengers trips for which the fare system applies, including those paying full fare, reduced fare, riding free (e.g. employees, postmen, policemen), or with passes/tickets purchased by other agencies (e.g. school boards).	Measures the change in population taking transit	Canadian Urban Transit Association, based on statistics collected from transit systems that provide transit services to the public.

Revenue vehicle kilometres	Annual kilometres travelled by active revenue vehicles (buses, railcars, etc.) in regular passenger revenue service, including scheduled and non-scheduled service; does not include auxiliary passenger services (e.g. school contracts and charters.)	Changes in provision of public transit service	Canadian Urban Transit Association, based on statistics collected from transit systems that provide transit services to the public.
Revenue vehicle hours	Annual kilometres travelled by active revenue vehicles (buses, railcars, etc.) in regular passenger revenue service, including scheduled and non-scheduled service; does not include auxiliary passenger services (e.g. school contracts and charters.)	Changes in provision of public transit service	Canadian Urban Transit Association, based on statistics collected from transit systems that provide transit services to the public.
Distance of bike lanes	Kilometres of bike lanes, both on-street and off-street	Indicates support for bicycle safety, which can encourage more active transportation choices.	Reported by cities.

Table 16 lists the indicators that were important based on our literature and expert review, but where standard and accessible data was unavailable. During our interviews for Objective 2 (see below), we asked municipal staff if they collect this data or know of accessible data sources. The extent to which the data are collected and staff are aware of links between these indicators and greenhouse gas emissions in itself provides indication of challenges (see Objective 2).

Table 16. Additional desired indicators for Objective 1

Indicator	Description	Rationale	Challenges for Data Collection
GHG emitted per capita for personal transportation	Estimate in tonnes per person per year of GHG emissions	Direct measure of the question — although there will be uncertainty on the measurement accuracy. Even the absence or presence of these estimates will indicate the cities' concern for the issue	Potential sources: City estimates – may be difficult to find values that cover the entire CMA and are consistent across cities. Vehicle km or tonnes/capita – from Statistics Can

Parking policy	Minimum parking requirements for various types of developments and percentage of city they apply to.	An indicator of how much cities are accommodating cars vs. alternatives.	City staff
Land use mix	An index reflecting the degree to which residential, industrial, commercial, government/institutional and green spaces (including parks) are present.	Mixed land uses help reduce motorized transport and encourage walking and biking. Helps indicate personal transportation needs.	Some private data sources exist but expensive to collect for all six CMAs.
Total transport expenditures	Percent of spending on roads vs. transit vs. cycling vs. walking.	An indicator of the amount of new infrastructure dedicated to each transport mode.	Challenging to develop standard indicator since infrastructure funding comes from non-municipal sources and can be inconsistent from year to year.
Complete, compact communities	Number of people living in complete, compact communities	Complete, compact communities are designed to decrease the travel needs of residents.	There are multiple dimensions to these communities (distance to transit, access to services and shops) and difficult to define precisely.
Transportation Demand Management	Extent that TDM initiatives are present within the city.	Many TDM initiatives will lead to less travel or to mode choices that decrease GHG emissions.	Difficult to define TDM initiatives due to large range of potential actions and multiple objectives for implementation.

Indicators for Objective 2

Measuring capacity and identifying key barriers.

The information for these indicators were gathered through interviews with staff at the major municipalities in each CMA. Table 17 identifies the element of capacity, the questions the indicator is trying to measure and the rationale for including this in the study.

Table 17. Capacity indicators for Objective 2

Element of Capacity	Indicator Questions	Rationale
Adequate resources (financial, human and information resources)	Does the city have adequate staff to implement GHG emissions reductions? Does the city make use of external consultants, and can the city staff interpret the information they provide? Are appropriate information and technical resources available? Is there adequate funding to support GHG reduction activities?	The resources available to a city often determine the extent to which the organization has the capacity to integrate GHG emission reductions into the transportation and land use planning.
Teamwork, flexibility and adaptive management	Is there communication and collaboration between employees, departments, and external organizations? Does the city demonstrate flexibility, and an ability to acquire new information and adapt it to decision making?	Climate change is a dynamic process, and cities must be flexible to deal with the unpredictable challenges. This is also an issue that must be dealt with systematically, not within one department
Community and political support	Do the elected officials (and, by extension, the community) support activities that will reduce GHG emissions?	Municipalities are limited by the political will of the community and the elected officials.
Institutional arrangements	Has the province where the city is located set emissions reductions as a priority? Is the province/federal government providing funding or other resources to help the city.	Municipalities are limited by provincial and federal legislation and often have limited funds to apply to this issue.

The following table lists questions that were used during interviews with city staff to help answer the indicator questions identified above. This will help to determine the capacity (and barriers) to integrating emissions reduction planning into land use and transportation planning.

Table 18. Interview questions

Theme	Interview Questions
Current status of GHG reductions in the municipality	What policies and/or regulations are currently in place to reduce GHG emissions from personal vehicles? Does the municipality have specific emissions reduction targets for personal transportation? Or goals for land-use or transportation choice (eg. density targets, fraction of population commuting by transit/walk/cycle)? Explain how future GHG emissions are considered in your current land use

	and transportation planning. Have plans been developed to incorporate GHG estimates into current land use and transportation activities? Is this something you/your organization would be interested in undertaking? What kinds of resources/skills do you think this would require? Are GHG reductions a consideration when developing new land-use and transportation policies and procedures? Describe how GHG reductions have been incorporated into policies, procedures and regulations in the past.
Adequate resources	How many staff are specifically involved in reducing GHG emissions from personal transportation? What activities do they undertake? Do you feel confident that you have the best technical data and information resources to implement GHG reduction strategies and policies in transportation and land-use planning? How are current GHG reduction activities (including policy development) funded? Do you feel you have adequate resources to achieve significant GHG reductions?
Teamwork, flexibility and adaptive management	Have there been opportunities available to staff to upgrade their education and training with respect to techniques to reduce GHG emissions from transportation? Do you collaborate with other employees and other departments in your municipality to plan and implement GHG reduction strategies? Specifically, is there a high degree of collaboration and cooperation between the city's land use and planning departments? Do you consult with experts from other organizations/levels or external consultants for expertise in reducing GHG emissions?
Community and political support	Have the elected officials taken a leadership role in encouraging GHG emissions reductions through transportation and land-use? Provide examples. How has the municipality consulted with the wider community about changes to land-use planning or transportation policy? How prominent were GHG emissions within this consultation?
Institutional arrangements	Do you feel that the provincial government provides your municipality with adequate guidance, support and resources for emissions reductions at a municipal scale? Explain.