



Low carbon futures in Canada – the role of urban climate change mitigation

Briefing on urban energy use and greenhouse gas emissions



Prepared by Ralph Torrie, Torrie Smith Associates

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Stockholm Environment Institute
U.S. Center – Seattle Office
1402 Third Avenue, Suite 900
Seattle, WA 98101
USA
Tel: +1 (206) 547-4000
Web: www.sei-international.org

Author contact: Ralph Torrie, rtorrie@torriesmith.com

Editor: Carrie Lee (SEI)
Cover design: Cathleen Schaad
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EXECUTIVE SUMMARY

Canada is one of the least densely populated countries on Earth, and yet 81% of the Canadian population live in urban centres. The country covers an area that is only slightly larger than China or the United States, but has a population of 36 million, ten times smaller than the population of the US and 40 times smaller than the population of China. With 90-95% of the population growth occurring in urban areas, an additional 13 million urban dwellers are projected by 2060. In Canada, urbanization took place simultaneously with the transition from an agriculturally based economy to an industrial economy fuelled by exponential growth in the production and consumption of fossil fuels and hydroelectricity.

Greenhouse gas emissions in Canada totaled 715 Mt CO₂e in 2012, or 20.6 t CO₂e per capita¹, making it among the most greenhouse gas intensive economies in the world. The greenhouse intensity reflects both North American patterns of affluent, sprawling, automobile dependent, post-industrial urban communities, as well as the hinterland, energy-intensive, exported-oriented primary extraction and processing industries, including oil and gas. And yet, emissions per capita and emissions per dollar of GDP have been declining as the overall structure of the economy has continued to trend toward less energy intensive activities and the energy efficiency of buildings and vehicles has continued to improve.

Urban GHG emissions make up 42% of Canada's total emissions. This is smaller than one might expect for a country that is 81% urbanized for two primary reasons. First, it reflects the fact that Canada's most GHG intensive industrial activities (e.g. mining, oil and gas production) do not generally make a significant contribution to urban greenhouse gas emissions because they are located outside urban areas and are destined largely for export markets. Second, the average carbon intensity of electricity is relatively low in the hydro-rich populated provinces of British Columbia, Quebec and Manitoba.

Urban emissions are on the decline in Canada, driven by reductions in per capita consumption of both fuel and electricity. Over the past 25 years, per capita greenhouse gas emissions in Canada's urban areas have declined by about 20%, while the urban population has increased 30% over the same period.² While these trends have not yielded the deep emission results that would be required to put Canadian cities on track for a very low carbon future, they do reaffirm the capability of urban centres to deliver fairly rapid and widespread change in the level and pattern of energy use. These trends suggest that much larger abatement potential could be achieved with more intensive urban climate change mitigation strategies.

Local government engagement is necessary for Canada to successfully transition to a low carbon future. In Canada today, nearly 300 municipalities with a collective population of 26 million (90% of Canada's urban population) are members of Partners for Climate Protection, jointly run by the Federation of Canadian Municipalities and ICLEI – Local Governments for Sustainability. The early and widespread commitment to emission reductions by Canadian local governments is remarkable considering they have neither the mandate nor the resources to take a leadership role on climate change mitigation. Participation in the Partners for Climate Protection partnership provides needed capacity building support for effective local climate mitigation, nevertheless there remains a stumbling block for municipalities that do not have the resources or in-house expertise to carry out a comprehensive emissions inventory or climate action

¹ Environment Canada, "National Inventory Report: Greenhouse Gas Sources and Sinks in Canada, 1990--2013, Part 3" Canadian government submission to UN Framework Convention on Climate Change, accessed via link at <http://www.ec.gc.ca/ges-ghg/>. For urban greenhouse gas emissions, see box "Defining Urban GHG Emissions".

² National and urban population data from Statistics Canada, Table 004-0126 Socioeconomic overview of the farm population, population distribution for rural and urban centres of the farm and non-farm population", CANSIM Table 004-0126, accessed at www5.statcan.gc.ca/cansim/home-accueil?lang=eng. nc

plan. Reported follow through to ensure cities successfully make progress towards developing and implementing a climate action plan has been limited, indicating that assistance from national and provincial levels of government, via resourcing is an opportunity to assist with implementation.

Local governments have direct or indirect control over 40-50% of greenhouse gas emissions. Widespread and rapid uptake of new technologies for using energy more efficiently, for substituting low-GHG biofuels (where available) and renewable energy sources, and for establishing the new electricity grid will all require the active involvement of Canada's municipalities. Municipalities govern the concentrated markets and relatively dense settlement patterns in which new techniques and technologies can spread quickly, so long as financial and logistical innovations can be developed and effectively deployed. Further, to achieve a low carbon future will require supplementing the technical fixes that have characterized the first generation of climate change mitigation with breakthrough strategies for meeting human needs and wants with less energy. The role of local government will be essential in this transition.

As one example of the kinds of transitions that could transpire, recent analysis by Quest Canada has identified the potential to reduce Canada's urban GHG emissions by 5-12% by 2050 (13 – 35 Mt CO₂e) through the implementation of integrated public policies that promote urban densification, transportation mode shift, utilization of waste heat for district heating and cooling, and renewable energy generation.³ This analysis projected an increase in GDP of 0.3-0.9% if these policies were implemented resulting from reduced capital, labor and energy requirements within the transportation, building and domestic energy supply sectors. Over the 2008-2012 period, municipalities in Canada that have begun implementing their climate action plans have invested at least \$2.3 billion in over 800 emission reduction measures to achieve ongoing annual emission reductions of more than 1.8 million tonnes.⁴

Encouragingly, we are beginning to see a shift in the focus of local governments from asking "How can we reduce the carbon intensity of our community?" to "How can we plan, design and build a low carbon, sustainable community?" This shift from a remedial to an anticipatory approach to the challenge of reducing emissions opens the door to deep integration of the low carbon objective into the community's social, economic and land use planning and investment strategies. It is a question that can only be answered locally with local data, local knowledge, and in response to local circumstances and opportunities. Growing commitments to the Compact of Mayors, a global initiative launched at the UN Secretary-General's Climate Summit in September of 2014,⁵ with a focus on data transparency and locally viable actions, may indicate that Canadian cities are taking this opportunity seriously.

In particular, Vancouver, Toronto and Markham are among a group of leading Canadian cities that form a vanguard of Canadian municipalities that are developing detailed and quantitative scenarios of what transitions to truly low carbon cities might look like, and these efforts are opening a new phase in urban climate change mitigation in Canada that promises to go further and achieve more than the initial approaches that have dominated the first generation of climate change response policies.

³ Jaccard, M.K., E. Miller, D. Cavens. 2010. The capacity for integrated community energy solutions policies to reduce urban greenhouse gas emissions. Final Technical Report. Prepared for Quality Urban Energy Systems for Tomorrow (QUEST). Prepared by M.K. Jaccard and Associates, University of Toronto - Cities Centre, University of British Columbia – Institute for Resources, Environment and Sustainability. Available at: <http://www.questcanada.org/sites/default/files/publications/Final%20Full%20Study%20Report.pdf>

⁴ Partners for Climate Protection, "National Measures Report", from 2009 through 2013, ICLEI and FCM, available at <http://www.fcm.ca/home/programs/partners-for-climate-protection.htm>.

⁵ See <http://www.compactofmayors.org/>

1. CITIES AND GREENHOUSE GAS EMISSIONS IN CANADA

Canada is an urban nation.

Canada is one of the least densely populated countries on Earth, and yet also one of the most urbanized. It covers an area that is only slightly larger than China or the United States, but has a population of 36 million, ten times smaller than the population of the U.S. and 40 times smaller than the population of China. Fully 81% of the Canadian population live in urban centres in the southern most parts of the country.

The urban transition took place in Canada simultaneously with the transition from an agriculturally based economy to an industrial economy and fueled by exponential growth in the production and consumption of fossil fuels and hydroelectricity. By 1971, 75% of the population lived in urban centres and 95% of the net growth in population continues to be in urban population centres. Forecasts of total population range from 40 million to 63 million by 2060 (Figure 1).⁶ The medium projections in Figure 1 reflect steady, essentially linear growth of about 300,000 per year for the next several decades, with the total population reaching 50 million around 2060. With 90-95% of population growth occurring in urban areas, this implies an additional 13 million urban dwellers by 2060, by which time the urban share of the nation's population will have risen to 85%.⁷

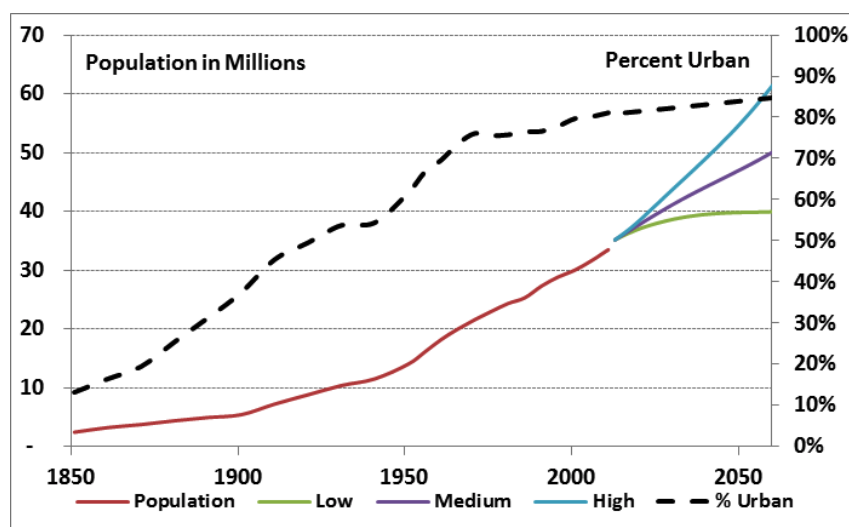


Figure 1. Historical and Projected Population (Total and Percent Urban) of Canada from 1850 – 2050. The urban transition was essentially complete in Canada by 1970 but the urban portion of the population continues to increase, with immigration driving growth projections and with 90-95% of projected population growth in urban areas.⁸

⁶ The fertility rate has dropped below the natural replacement level, and as a result, projections of the country's future population are highly sensitive to assumptions about net immigration.

⁷ Population projections are from Statistics Canada, CANSIM Table 052-0005, "Projected population, by projection scenario, age and sex, as of July 1, Canada, provinces and territories, annual", retrieved from <http://www5.statcan.gc.ca/cansim/home-accueil?lang=eng>

⁸ Statistics Canada CANSIM data. Historical data from Table 384-5000, projections from Table 052-0005. Both accessed at www5.statcan.gc.ca/cansim/home-accueil?lang=eng.

DEFINING “URBAN”

In this discussion, we adopt Statistics Canada’s convention of an urban area as one with a population density of at least 400 persons per km and containing at least 1,000 people. Three sizes of urban population centres are defined as follows:

- Small population centres, with a population between 1,000 and 29,999
- Medium population centres, with a population between 30,000 and 99,999
- Large urban population centres, with a population of 100,000 or more.

As shown in the table below, 81% of Canada’s population is urban according to the above definition, but 69% if centres smaller than 30,000 are excluded, and just 60% if centres smaller than 100,000 are excluded.

Broadly defined, Canada’s urban population comprises hundreds of local communities and corresponding local governments, but most of the urban population reside in a relatively small number of larger centres called Census Metropolitan Areas.⁹ Over 80% of Canada’s population live in cities, and 80% of Canada’s urban population live in the ten largest CMA’s (Appendix). All of the cities except for one have set municipal government GHG emission targets, and 10 out of 13 jurisdictions have set community GHG emission targets (Table 1).

As with most things Canadian, there are large and important regional variations in settlement patterns, as shown in Table 2. The population is unevenly distributed amongst the southern provinces, and the urban portion of the population also varies by province, from a low of 46% in Prince Edward Island (still essentially an agrarian economy) to 86% in Ontario and British Columbia (both largely post industrial economies now, with 75% or more of provincial product generated in the service sectors). The population is concentrated in the central provinces of Ontario and Quebec, the west coast province of British Columbia, and the oil and gas producing province of Alberta. In Atlantic Canada, barely 50% of the population is urban, compared to 65-75% in the prairie provinces of Saskatchewan and Manitoba and 80-85% in the most populous provinces of Quebec, Ontario, British Columbia and Alberta.

⁹ A Census Metropolitan Area (CMA) is defined as one or more neighbouring municipalities situated around a core with a total population of at least 100,000 and an urban core population of at least 50,000.

Table 1. Partners for Climate Protection Membership and Milestone Status of Canada's 10 largest Census Metropolitan Areas.

CMA	Province	Population			Partners for Climate Protection Members	Milestone Status ¹⁰	
		in 2001	in 2014	% change		Municipal Govt.	Community
Toronto	Ontario	4,882,782	6,055,724	24%	Yes	3	3
Montréal	Quebec	3,532,719	4,027,121	14%	Yes	3	1
Vancouver	British Columbia	2,074,543	2,470,289	19%	Yes	5	5
Calgary	Alberta	977,834	1,406,721	44%	Yes	5	4
Edmonton	Alberta	962,323	1,328,290	38%	Yes	5	4
Ottawa - Gatineau	Ontario/Quebec	1,110,344	1,318,122	19%	Yes- Yes	5 - 0	5- 0
Québec	Quebec	703,960	799,632	14%	Yes	3	3
Winnipeg	Manitoba	695,868	782,640	12%	Yes	4	1
Hamilton	Ontario	689,072	765,228	11%	Yes	5	2
Kitchener-Cambridge-Waterloo	Ontario	431,559	506,858	17%	Yes-Yes-Yes	1-3-3	3-3-3

Table 2. Regional Variations in Canada's Urban and Rural Population in 2011¹¹.

	Population Centres					Percentage Shares			
	Urban			Rural	Total	Urban			Rural
Province	Small Urban	Medium Urban	Large Urban	Rural	Total	Small	Medium	Large	
Newfoundland (NF)	139,705	-	161,965	205,595	507,265	28%	0%	32%	41%
Nova Scotia (NS)	187,015	30,605	292,410	396,140	906,170	21%	3%	32%	44%
New Brunswick (NB)	125,005	153,985	105,005	351,840	735,835	17%	21%	14%	48%
Quebec (QU)	933,490	669,470	4,618,035	1,511,525	7,732,520	12%	9%	60%	20%
Ontario (ON)	1,156,160	934,290	8,785,675	1,775,670	12,651,795	9%	7%	69%	14%
Manitoba (MB)	154,265	44,885	657,880	317,310	1,174,340	13%	4%	56%	27%
Saskatchewan (SK)	203,140	67,420	407,650	330,540	1,008,750	20%	7%	40%	33%
Alberta (AB)	563,925	392,420	2,022,720	588,915	3,567,980	16%	11%	57%	17%
British Columbia (BC)	503,420	520,750	2,699,985	600,305	4,324,460	12%	12%	62%	14%
Canada	3,988,200	2,855,105	19,751,325	6,151,880	32,746,510	12%	9%	60%	19%

¹⁰ Partners for Climate Protection has five milestones to reflect the status of member's progress: milestone 1 – creating a GHG emissions inventory and forecast; milestone 2 – setting an emissions reduction target; milestone 3 – developing a local action plan; milestone 4 – implementing the local action plan or a set of activities; milestone 5 – monitoring progress and reporting results. City level data available at: <http://www.fcm.ca/home/programs/partners-for-climate-protection/members.htm>

¹¹ Data from Statistics Canada, Table 004-0126 Socioeconomic overview of the farm population, population distribution for rural and urban centres of the farm and non-farm population", CANSIM Table 004-0126, accessed at www5.statcan.gc.ca/cansim/home-accueil?lang=eng.

GHG emissions in Canada are a contrast of improved energy efficiency of the overall economy with the growth of energy-intensive extraction and processing industries.

Greenhouse gas emissions in Canada totaled 715 Mt CO₂e in 2012, or 20.6 t CO₂e per capita, placing it among the most greenhouse gas intensive economies in the world.¹² The greenhouse intensity reflects both North American patterns of affluent, sprawling, automobile dependent, post-industrial urban communities, as well as the hinterland, energy-intensive, exported-oriented primary extraction and processing industries, including oil and gas. The shift in oil production from sweet crude to bitumen in the last twenty years has been the single largest upward pressure on the greenhouse gas intensity of the economy, along with continued trends toward more driving, larger cars, and bigger houses. And yet, emissions per capita and emissions per dollar of GDP have been declining as the overall structure of the economy has continued to trend toward less energy intensive activities and the energy efficiency of buildings and vehicles has continued to improve.

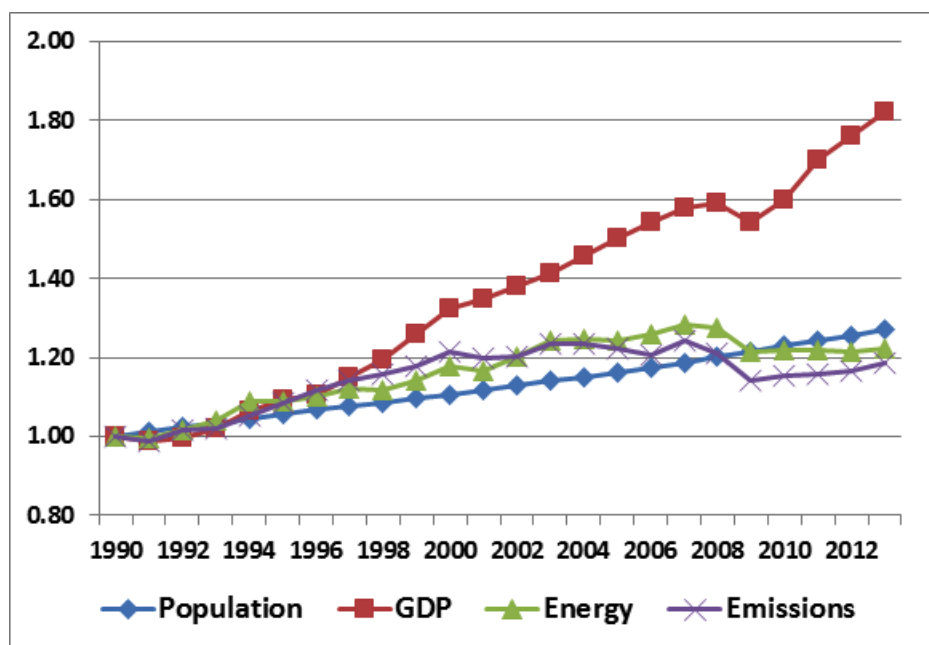


Figure 2. Growth Trends through 2013 for Canadian Population,¹³ GDP,¹⁴ Domestic Primary Energy¹⁵ and Greenhouse Gas Emissions¹⁶ (including non-energy emissions) relative to 1990 (1990 = 1.0).

¹² Canadian GHG inventory data are taken from Environment Canada, National Inventory Report: Greenhouse Gas Sources and Sinks in Canada, 1990-2013, Part 3” Canadian government submission to UN Framework Convention on Climate Change, accessed via link at <http://www.ec.gc.ca/ges-ghg/>.

¹³ Population data extracted from Statistics Canada, Table 384-5000, “Data on long-run provincial and territorial economic performance, annual”, accessed at <http://www5.statcan.gc.ca/cansim/a26>.

¹⁴ GDP data from Statistics Canada, CANSIM tables 384-0002 and 379-0028, accessed at www5.statcan.gc.ca/cansim/home-accueil?lang=eng.

¹⁵ Energy data from Statistics Canada, “Supply and demand of primary and secondary energy in terajoules, annual” CANSIM Table 128-0016, accessed at www5.statcan.gc.ca/cansim/home-accueil?lang=eng.

¹⁶ Greenhouse gas inventory data from Environment Canada, National Inventory Report: Greenhouse Gas Sources and Sinks in Canada, 1990-2013, Part 3” Canadian government submission to UN Framework Convention on Climate Change, accessed via link at <http://www.ec.gc.ca/ges-ghg/>

In Figure 3, Canada's energy related greenhouse gas emissions (using 2009 data) are allocated to their respective end use sectors, including a residual sector to account for the significant share of Canada's emissions associated with the production of oil and gas fuels for export (primarily American) markets. The large share of Canada's emissions associated with industrial processes and freight transportation reflects the dichotomy mentioned above: notwithstanding the urbanized and largely post-industrial economies that characterize most Canadian communities, mining, smelting, pulp and paper, oil and gas production and other primary processing industries contribute disproportionately to total greenhouse gas emissions.

The oil and gas industry has been particularly important in Canada's economy for the past 25 years, and especially so for the producing provinces of Alberta, Saskatchewan, and Newfoundland and Labrador. While its direct contribution to national GDP is a relatively modest 6-7%, there are indirect benefits throughout the Canadian economy; the surplus generated by oil and gas exports dominates Canada's balance of trade, and the investment it has attracted in recent years has dwarfed all other non-residential investment in the national economy. The recent downturns in the outlook for both oil and gas exports from Canada's producing provinces have implications throughout the Canadian economy, including for Canada's cities.

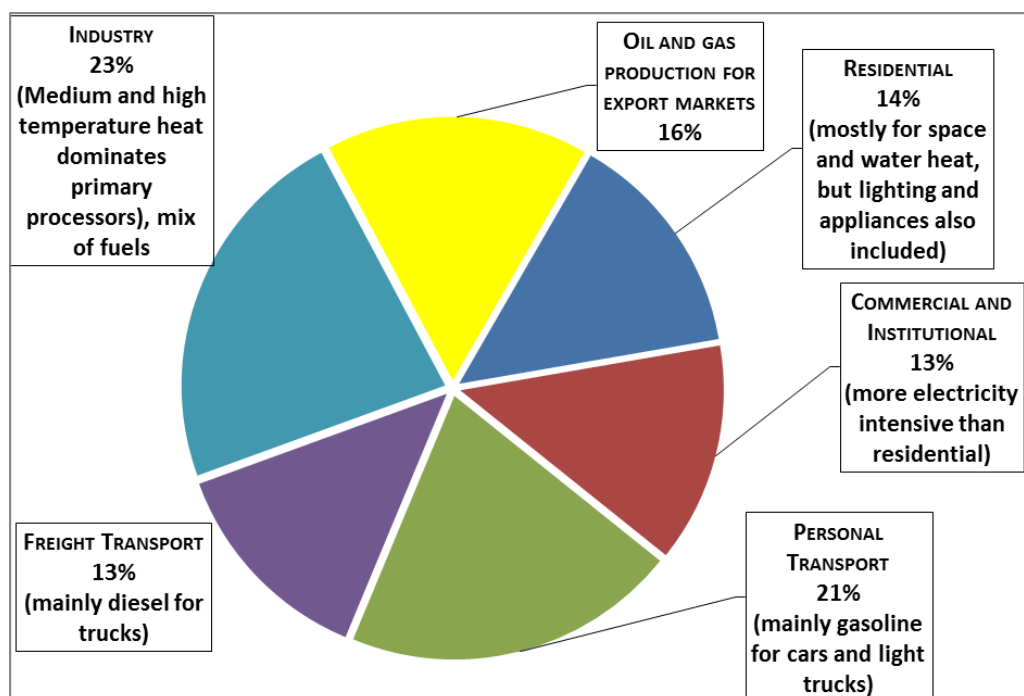


Figure 3. Sources of energy-related greenhouse gas emissions in Canada by end-use sector. In this frame, emissions from both electric power production and fossil fuel production are allocated to their respective end-use sectors. Emissions of the fossil fuel industry are pro-rated between the domestic end-use sectors and a residual sector that reflects the emissions from this industry associated with production for export (primarily U.S.) markets.¹⁷.)

¹⁷ Data from Canada's national inventory report, op. cit., with pro-rating and aggregate sector allocations by author, utilizing national energy balances from Statistics Canada, "Supply and demand of primary and secondary energy in terajoules, annual" CANSIM Table 128-0016, accessed at www5.statcan.gc.ca/cansim/home-accueil?lang=eng

National and provincial targets will continue to be missed unless there is a step change in the intensity and effectiveness of climate change mitigation at the national, provincial and local government levels.

Canada officially reneged on its Kyoto target of reducing emissions to 6% below 1990 levels by 2012, or to 576 Mt CO₂e. In 2012, Canada's actual emissions were 17% above 1990 levels. Canada's "Copenhagen target" is to reduce emissions to 17% below 2005 levels by 2020.¹⁸ That target would put emissions at 622 Mt CO₂e, close to 1992 levels. This national target will be very challenging to attain as it would require a drop in emissions of more than 100 Mt CO₂e in the next five years. Recently, the government announced yet another target of reducing emissions to 30% below 2005 levels by 2030, or to 524 Mt CO₂e, 200 Mt CO₂e below current levels and about 15% below 1990 levels.¹⁹ In recent years, however, the federal government has not provided climate policy leadership, deferring instead to provincial government targets and policies for GHG reduction. Provincial targets for greenhouse gas emission reductions by 2020 range from returning to 1990 levels by 2020 (New Brunswick, Prince Edward Island) to as much as 12% below 1990 levels for British Columbia, 15% below 1990 levels for Ontario and 20% below 1990 levels for Quebec. Many if not most of these targets will be missed unless there is a step change in the intensity and effectiveness of climate change mitigation.

Per capita urban GHG emissions in Canada are on the decline.

Urban GHG emissions from direct and indirect energy production sources make up 42% of Canada's total emissions (see Box, "Defining Urban GHG Emissions"). This is smaller than one might expect for a country that is 81% urbanized. It reflects the fact that Canada's most GHG intensive activities (industrial chemical production, mining and smelting, petroleum production, pulp and paper production, agriculture, freight transport) do not occur in urban areas (nor are their products consumed in Canada's urban areas, since most are exported).

Electricity and energy production issues for urban areas tend to be somewhat smaller in Canada than in many other industrial economies because the average carbon intensity of electricity is relatively low. The national average greenhouse gas intensity of electricity is about 200 grams/kW-hour, about equivalent to the end use emissions of natural gas combustion. There are however large provincial variations; the hydro-rich provinces of British Columbia, Quebec and Manitoba have almost no carbon content in their provincial electric grids, whereas Alberta, Saskatchewan and Nova Scotia still rely heavily on coal-fired generation and have electricity carbon intensities three to four times the national average.

¹⁸ Environment Canada, "Progress Toward Canada's Greenhouse Gas Emissions Reduction Target", March 2015, accessed at <https://www.ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=CCED3397-1>

¹⁹ Environment Canada, "Government of Canada announces 2030 emissions target", May 15, 2015. Accessed at http://news.gc.ca/web/article-en.do?nid=974959&_ga=1.253054090.2044659384.1443019536.

DEFINING "URBAN GHG EMISSIONS"

Urban GHG emissions are defined here as the Scope 1 and Scope 2 greenhouse gas emissions that come under the direct or indirect control or influence of urban governments, defined follows:

- **Scope 1: Direct emissions.** The direct emissions from fuel use that takes place within urban population centres, including for residential and commercial buildings and general manufacturing establishments, personal and freight transportation vehicles (mostly cars and trucks), methane emissions from landfills, wastewater treatment and waste incineration. Energy use by heavy energy-intensive industries is not counted as urban energy use even though such facilities are sometimes located within urban boundaries.
- **Scope 2: Indirect energy production emissions.** The emissions that take place at power plants to supply urban electricity needs, and the share of the emissions of the fossil fuel industry associated with the production, refining and delivery of fuels for domestic consumption in urban population centres.
- **Scope 3: Indirect energy consumption emissions.** The estimated share of emissions from agriculture for providing the domestic, urban population with food, and a share of the emissions from manufacturing and long distant freight transport estimated to be dedicated to serving domestic urban markets.

Greenhouse Gas Emissions under the Direct or Indirect Control and Influence of Local Government in Canada.*

Summary of Urban Greenhouse Gas Emissions								
	Scope 1		Scope 2		Scope 3		Total	
	1990	2012	1990	2012	1990	2012	1990	2012
Residential Building Fuel Use	35.2	33.1	8.8	9.9	-	-	44.0	43.1
Commercial Building Fuel Use	24.4	26.4	6.1	7.9	-	-	30.5	34.3
Personal transportation	49.5	51.7	12.4	15.5	-	-	61.9	67.3
Freight transportation	29.3	45.6	7.3	13.7	25.2	39.9	61.8	99.1
Manufacturing, Construction Fuel Use	22.1	16.5	5.5	5.0	15.1	11.5	42.7	33.0
Wastewater, landfill emissions, waste incineration	15.3	17.1	-	-	-	-	15.3	17.1
Agriculture	-	-	-	-	24.7	28.8	-	-
Electricity, all sectors	-	-	52.4	53.0	-	-	52.4	53.0
Fossil fuel production, all sectors	-	-	-	-	-	-	-	-
Industrial process emissions	-	-	-	-	14.0	14.2	14.0	14.2
Total	176	190	93	105	79	94	323	361
As percent of national inventory	30%	27%	16%	15%	13%	14%	55%	52%
Scope 1 and 2 only							268	295
As percent of national inventory							45%	42%

*National inventory data, above conventions and author's assumptions. Urban allocation for Scope 1 pro-rated by population for residential buildings, personal transportation and wastes related emissions. Commercial buildings assumed to be 95% in urban areas, along with 25% of freight transportation energy use. General manufacturing emissions assumed to be 85% in urban areas. Scope 2 multipliers based on actual secondary/primary conversion rates, pro-rated for share of fossil industry to net exports.. Scope 3 based on author's estimates of share of non-Scope 1 agricultural, industrial and freight transportation energy use for domestic urban markets.

The urban share of national greenhouse gas emissions has declined partly as the result of efficiency gains in building and vehicle energy use, but also partly the result of factors beyond the urban sphere of influence. In particular, the phasing out of coal-fired power generation in Ontario has had a significant impact on emissions assigned to urban areas. The upstream intensity of fossil fuel production and

refining increased over this same period, reflecting the growth of bitumen in the production mix. But, at the same time fossil fuel exports outstripped domestic consumption growth, which reduced the share of urban energy use and emissions in the overall national total.

Between 1990 and 2012, Canada's population increased by 23%, with all the growth in urban areas. During that same period, greenhouse gas emissions increased by 18%, reflecting a modest overall decline in per capita emissions. However, if we focus only on urban GHG emissions, the story is quite different. Between 1990 and 2012, while the urban population increased by 30%, urban greenhouse gas emissions (Scope 1) increased only 8%, reflecting a 17% decline in per capita emissions.²⁰

Over this same period, the urban share of energy production emissions declined absolutely, reflecting the combined impacts of declines in per capita fuel and electricity use in urban areas and in the carbon intensity of electricity. The energy production emissions depend largely on the greenhouse gas intensity of the fossil fuel industry (which increased over the period) and the electric power industry (which declined over the period), both factors which remain largely beyond the control of local governments. Notwithstanding the continued importance of primary and secondary manufacturing in the national economy, two thirds of Canada's GDP is generated in the service sector and this activity is both urban-centred and electricity intensive. And yet, over the 1990-2012 period, while service sector GDP grew by 80% and urban population grew by 34%, urban electricity consumption grew by only 17%.²¹

While more research is required to refine these urban emissions estimates, the results are robust enough that we can confidently conclude that per capita greenhouse gas emissions (Scope 1 and 2) in Canada's urban areas have declined by about 20% over the past 25 years, almost enough to completely offset the 30% increase in urban population over the same period. While a decline in the greenhouse gas intensity of electricity has contributed to this trend, the primary driver of the reduced urban greenhouse gas intensity has been the decline in the per capita consumption of both fuel and electricity. Translated into greenhouse emission reductions, by 2013, we estimate that the drop in per capita emissions in Canada's urban areas equates to 70 Mt CO_{2e} per year, a 20% drop from business as usual and fully 10% of the total national GHG inventory in 2012.

While only a fraction of this reduction can be directly attributed to policies and programs implemented by local governments, it does indicate that the energy systems in urban areas are in a state of transition that is leading to lower greenhouse gas intensity. Per capita ownership of major energy using appliances has reached saturation levels even while the energy efficiency of these appliances has been improving. While per capita travel has increased and houses and cars have got bigger (both trends that may be about to slow

²⁰ National and urban population data as cited for Table 1: Statistics Canada, Table 004-0126 Socioeconomic overview of the farm population, population distribution for rural and urban centres of the farm and non-farm population", CANSIM Table 004-0126, accessed at www5.statcan.gc.ca/cansim/home-accueil?lang=eng. Greenhouse inventory data from Environment Canada as cited above: Environment Canada, National Inventory Report: Greenhouse Gas Sources and Sinks in Canada, 1990-2013, Part 3" Canadian government submission to UN Framework Convention on Climate Change, accessed via link at <http://www.ec.gc.ca/ges-ghg/>. For urban greenhouse gas emissions, see box "Defining Urban GHG Emissions".

²¹ Canadian GDP data from Statistics Canada, "Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS), annual" CANSIM Table 379-0031, accessed at www5.statcan.gc.ca/cansim/home-accueil?lang=eng. Electricity consumption data from Statistics Canada, "Supply and demand of primary and secondary energy in terajoules, annual" CANSIM Table 128-0016, accessed at www5.statcan.gc.ca/cansim/home-accueil?lang=eng, urban share pro-rated by same rules used for urban GHG emissions in "Defining Urban GHG Emissions" (see box).

down and even reverse), this has been more than offset by energy efficiency improvements in housing, vehicles and home appliances, and a modest resurgence in public transit ridership. Notwithstanding the burgeoning growth of the service sector, particularly in Canada's largest cities, commercial floor area has grown only half as quickly and, when combined with energy efficiency improvements in all aspects of commercial building design and operation, greenhouse gas emissions have been held in check. While these trends have not yielded the emission results that would be required to put Canadian cities on track for a low carbon future, they do reaffirm the capability of urban centres to deliver fairly rapid and widespread change in the level and pattern of energy use, and they suggest the possibility of the much larger potential that could be achieved with more intensive urban climate change mitigation strategies.

2. LOCAL GOVERNMENT CLIMATE CHANGE MITIGATION IN CANADA

Over 90% of Canada's urban population resides in member communities of the Partners for Climate Protection (PCP).

In Canada, local governments have a long history of stepping up to the climate change challenge. After hosting the International Conference on the Changing the Atmosphere in 1988, Toronto was the first city in the world to set a greenhouse gas emissions target.²² It also established \$25 million endowment -- the Toronto Atmospheric Fund (TAF) -- to invest in greenhouse gas emission reductions and local air quality improvement. Over 25 years later, TAF continues to provide leadership and build on its successful track record of innovation, including the development and demonstration of innovative financial tools for raising the additional capital needed to bring new buildings to the highest level of energy efficiency and sustainability.

Toronto is also Member #1 and the original home of the worldwide Cities for Climate Protection Program in which cities commit to reducing greenhouse gas emissions from their own operations and from the community-at-large through a five milestone process:

- 1 Complete an inventory of current and projection of future emissions
- 2 Adopt an emission target
- 3 Develop an action plan for meeting the target
- 4 Implement the plan, take specific emission reduction measures
- 5 Monitor results and report

In Canada the program is known as Partners for Climate Protection (PCP) and is jointly run by the Federation of Canadian Municipalities and ICLEI. As shown in Figure 4, the membership of PCP includes 90% of Canada's urban population, nearly 300 municipalities with a collective population of 26 million.²³

²² Linstroth, T. and R. Bell. 2007. *Local Action: The New Paradigm in Climate Change Policy*. University of Vermont Press. Burlington, Vermont.

²³ Data from Partners for Climate Protection web site: <http://www.fcm.ca/home/programs/partners-for-climate-protection.htm>

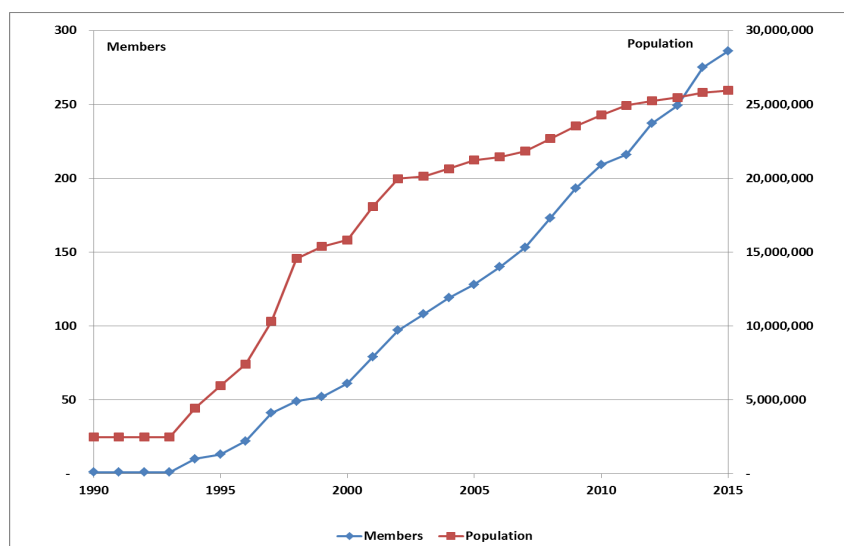


Figure 4. Growth of Partners for Climate Protection Campaign in Canada, 1990-2015²⁴

Increasingly Canadian local governments recognize energy and climate strategies as effective means to integrate their community priorities.

The early and widespread commitment to emission reductions by Canadian local governments is all the more remarkable considering that they have had neither the mandate nor the resources to take a leadership role on climate change mitigation. Canadian local governments are increasingly committed to community energy planning and local action plans for greenhouse gas mitigation because of the collateral benefits (or cobenefits) that such initiatives deliver, as shown in Table 3. Canadian local governments are focussed on economic renewal, public health and safety, greening their infrastructure, and creating employment for their citizens. Increasingly, they are recognizing community energy and climate change mitigation planning as effective strategies for integrating their priorities and for identifying and building the partnerships they need to achieve their goals.

Table 3. Reasons for Developing a Community Energy Plan²⁵

	Percentage of communities surveyed that identified this as a reason for developing a community energy plan:
Economic benefits	92%
Local environmental benefits (air quality)	63%
Community resilience	60%
Health benefits	59%
Social benefits	56%

²⁴ Partners for Climate Protection, www.fcm.ca/home/programs/partners-for-climate-prtection.htm

²⁵ Dale Littlejohn and Richard Laszlo, "National Report on Community Energy Plan Implementation", QUEST, Ottawa, February 2015. Retrieved from www.gettingtoimplementation.ca.

The Federation of Canadian municipalities recently published a document entitled “A Roadmap for Strong Cities and Communities”²⁶ that laid out the priorities that preoccupy Canada’s urban governments during the current federal election. It is a measure of the extent to which climate change has infiltrated the perspectives and the thinking of Canada’s local government leadership to note that pervasive references to climate change in the context of each of the five priorities included in the “Roadmap”.

- **Core municipal infrastructure** (roads, bridges, transit, water, wastewater treatment, storm water infrastructure) and support for asset management planning – all with direct and indirect implications to the level of greenhouse gas emissions in the community and the resilience of the community to withstand increased weather extremes.
- **Affordable Housing.** The housing affordability crisis facing many Canadian municipalities, which requires financing innovations and expanded training and apprenticeship programs in the construction trades for new housing and renovations, affords a clear opportunity for improved energy efficiency and lower emissions.
- **Security.** The impact of more frequent extreme weather events was included on a growing list of community safety and security issues facing local police forces.
- **Environmental Sustainability.** “Unless we unite to meet the challenge of climate change head on, mitigating and adapting to change will become more and more costly and increasingly difficult to achieve.”
- **Global Connectivity** In calling for a greater role for Canadian municipalities in promoting international trade and relations, the FCM singled out the need for international cooperation and collaboration on climate change: “Promote and disseminate the best local practices developed and implemented by thousands of municipalities to reduce GHGs”.

Notwithstanding the clear and widespread commitment to climate change mitigation among Canada’s local governments, and the growing realization among municipal leaders that community energy planning and climate change mitigation strategies can provide integrating frameworks for advancing other social and economic aspirations of the community, progress to date has been limited. The progress of these communities in achieving the program milestones is summarized in Table 4, for both their corporate (in-house) and community mitigation action plans.

²⁶ “Strengthening Canada’s Hometowns: A Roadmap for Strong Cities and Communities”, Federation of Canadian Municipalities, 2015. Retrieved from http://www.fcm.ca/Documents/reports/FCM/FCM_Roadmap_EN.pdf.

Table 4. Partners for Climate Protection Milestone Status²⁷

	Highest Milestone Achieved					
	0	1	2	3	4	5
	Join program	Inventory & forecast	Set emissions target	Develop action plan	Implement plan	Monitor progress, report results
Corporate Action Plan:						
No. of members	123	36	16	66	16	29
Population represented (millions)	4.4	1.2	0.6	10.6	1.5	7.7
Community Action Plan:						
No. of members	124	42	13	76	15	16
Population represented (millions)	3.9	6.3	1.2	9.0	2.8	2.8

Only 13% of PCP members have proceeded to implementation of their corporate action plan, and only 12% have proceeded to implementation of their community energy plan. Over 40% of members have yet to complete their inventory and forecast, and most of the rest have developed their plans but have not proceeded to implementation.

Municipalities have invested \$2.3 billion in over 800 emission reduction measures and achieve ongoing annual reductions exceeding 1.8 million tonnes.

Members of PCP are encouraged to document and report both the costs and the emission reduction impacts of measures that they do implement. To encourage participation, the documentation is not mandatory and while fairly rigorous reporting conventions have been developed, they are not always followed. The result is that for only a fraction of the emission reduction measures carried out by PCP members is there sufficiently detailed and documented data to facilitate aggregation and comparative analysis. Nonetheless, over the 2008-2012 period, the municipalities in Canada that have reached the implementation stage of their emission reduction strategies invested at least \$2.3 billion in over 800 emission reduction measures to achieve ongoing annual emission reductions of more than 1.8 million tonnes.²⁸ Initiatives, both domestic (such as the resolution of the Big City Mayors Caucus²⁹) and global (Compact of Mayors), which focus on data transparency and regular reporting of progress, aim to address this challenge.

The majority of the emission reduction measures reported by PCP members target municipal (or “corporate”) operations. They can usually be justified and financed by the financial savings they return to the local government, which makes their approval relatively easy. They can be implemented without requiring much if any public engagement. Most of the municipal measures are for energy efficiency improvements, and most of these target the municipalities existing and new buildings, with street and traffic lights, vehicle fleets, and water and waste water treatment facilities also contributing. Although energy efficiency measures account for 80% of building related emission reduction measures, rooftop solar and geothermal heating systems are significant, particularly where there is provincial government support for investments in such technologies. For example, through the city of Vancouver’s

²⁷ Data from Partners for Climate Protection, www.fcm.ca/home/programs/partners-for-climate-protection.htm.

²⁸ Partners for Climate Protection, “National Measures Report”, from 2009 through 2013, ICLEI and FCM, available at <http://www.fcm.ca/home/programs/partners-for-climate-protection.htm>.

²⁹ <http://www.fcm.ca/home/media/news-releases/2015/canadas-big-city-mayors-make-united-call-for-climate-action.htm>

neighbourhood energy strategy to meet the City's 2020 GHG reduction goals, a thermal energy utility was constructed to capture and utilize waste heat from a sewage treatment plant to provide space and hot water heating to new neighbourhood buildings.³⁰ The utility is city owned and city funded, but will provide a return on investment to City taxpayers.

Municipal government emissions represent only 8% of total urban greenhouse gas emissions in Canada, and most of that is related to landfill gas and waste management, not to the fuel and electricity consumption of municipal operations. As such, the emphasis on improving the energy efficiency of local government operations can have only a limited impact on community greenhouse gas emissions. However, in addition to the financial benefit to local government of these measures, they have the very important additional benefit of contributing to the understanding, credibility and capacity that is required for a local government to play a leadership role in community wide greenhouse gas mitigation.

The largest single measures pertaining to municipal operations are usually landfill gas capture and/or utilization projects, with annual emission reductions in the range of 100,000 tonnes CO₂e or more not unusual. Where the landfill gas can be sold or utilized to displace fossil fuels, or where carbon offset credits are available, these measures can provide a profitable solution to a costly problem (methane emissions from landfills).

The growing understanding and capacity of Canadian local governments is ripe for achieving much larger outcomes

Another telling pattern in cities throughout Canada is how types of measures being implemented as part of the municipal government "corporate" plan are not necessarily emblematic of the measures being taken in community climate action plans. Municipal government measures tend to be actual investments in techniques and technologies for reducing greenhouse gas emissions through greater efficiency, adoption of renewable energy, and capture and utilization of landfill gas. In contrast, the largest share of community measures are education and awareness programs where emission impacts are indirect and extremely difficult to quantify and verify.

Community greenhouse gas emissions are over ten times larger than emissions from corporate operations, and if only energy-related emissions are included then the community emissions are 40-50 times larger than those from municipal government's own energy use. As a result, even modest levels of success in reducing community greenhouse gas emissions can yield larger results than higher success rates that target only municipal operations, a point that is reflected in the annual reports of the PCP in which the largest single measures are typically among those that target community emissions.

The sophistication, emission reduction impact, and integrated collateral benefits of greenhouse gas reduction measures undertaken by Canadian cities have all been increasing as experience, capacity and understanding of community energy systems continues to grow. For example, when completed Vancouver's city-wide *District Energy Strategy* will reduce emissions by an estimated 122,000 tonnes per year. The City of Laval's GHG offset program requires developers to pay an "offset fee" in proportion to the carbon footprint of their project, resulting in emission reductions of 62,000 tonnes CO₂e annually.³¹

³⁰ City of Vancouver. 2015. Neighbourhood Energy Strategy. Available at: <http://vancouver.ca/home-property-development/neighbourhood-energy-strategy.aspx>

³¹ Summaries of Vancouver and Laval projects are from Partners for Climate Protection, "National Measures Report 2012", Federation of Canadian Municipalities and ICLEI – Local Governments for Sustainability, 2012. Accessed at

In British Columbia, communities that have signed the Climate Action Revenue Incentive Program (CARIP) and committed to reducing their GHG emissions can receive up to 100% of the carbon tax they have directly paid for investment in emission reduction measures.³² Ontario is about to launch a cap-and-trade program, creating additional opportunities for local governments to apply offset investment funds to innovative emission reduction initiatives.

The total emission reduction impact of initiatives being taken by Canadian local governments is undoubtedly much greater than the 1.8 Mt CO₂e per year that the PCP is able to confidently document, perhaps even two or three times greater. And it is also important to note that while still a small contribution compared to total urban emissions (which are nearly 300 Mt CO₂e) or even to the estimated impact of the trend to lower per capita emissions in Canadian cities (70 Mt CO₂e per year by 2015, compared to a 1990 baseline), that the widespread membership and the sheer volume of measures and experimentation taking place within the PCP represents a growing foundation of understanding and capacity in Canadian local governments. Recent analysis by Quest Canada has identified the potential to reduce Canada's urban GHG emissions by 5-12% by 2050 (13 – 35 Mt CO₂e) through the implementation of integrated public policies that promote urban densification, transportation mode shift, utilization of waste heat for district heating and cooling, and renewable energy generation.³³ This analysis projected an increase in GDP of 0.3-0.9% if these policies were implemented resulting from reduced capital, labor and energy requirements within the transportation, building and domestic energy supply sectors. This is ripe for achieving much larger outcomes if the municipalities can build on the success they are achieving and if the barriers to accelerated implementation can be identified and cleared away.

3. NEXT STEPS TO ACCELERATE IMPLEMENTATION OF URBAN ACTION IN CANADA

Local government efforts to reduce greenhouse gas emissions are a relatively recent addition to the urban policy agenda. Few policy-driven GHG emission reductions have yet been realized and, collectively, we are just beginning to truly appreciate the rationale for local action on climate change and understand the necessary conditions (and barriers that must be overcome) for successful local government action. The objective of absolute reductions in community-wide greenhouse gas emissions does not fit easily into established patterns of urban governance. Nor is it a legal responsibility of local governments in Canada, where federal and provincial governments have responsibility for energy and the environment.

For Canada, a low carbon future requires that greenhouse gas emissions are brought to and maintained below 125 Mt CO₂e by 2050 from their current level of about 700 Mt CO₂e. Emissions haven't been this low in Canada since before World War II. This is not to suggest low carbon futures will look like the past – they will not -- but to underscore that the transition to a future in which fossil fuels play a much smaller role in the economy will be transformative.

Barriers to accelerated local climate change mitigation may include: limited staff and financial resources, absence or limitations of local jurisdictional authority, and insufficient partnerships and support from

http://www.fcm.ca/Documents/reports/PCP/2013/PCP_National_Measures_Report_2012_Five_Year_Edition_EN.pdf.

³² Summary of B.C. CARIP program from Dale Littlejohn, Eric Campbell et. al., "National Report on Policies Supporting Community Energy Plan Implementation", QUEST, Ottawa, July 2015. Retrieved from www.gettingtoimplementation.ca.

³³ <http://www.questcanada.org/sites/default/files/publications/Final%20Full%20Study%20Report.pdf>

community stakeholders and senior governments. In reviewing the Canadian experience with local climate change mitigation, there are three key insights that are critical to clearing the barriers to local action and accelerating local government climate change mitigation actions:

Recognize the Critical Role of Local Government in Climate Change Response Policy

Local governments have direct or indirect control over 40-50% of greenhouse gas emissions. Widespread and rapid uptake of new technologies for using energy more efficiently, for substituting biofuels and renewable energy sources, and for establishing the new electricity grid will all require the active involvement of Canada's municipalities. Municipalities govern the concentrated markets and relatively dense settlement patterns in which new techniques and technologies can spread quickly, so long as financial and logistical innovations can be developed and effectively deployed. Further, the very low carbon futures necessary will require that the technical fixes that have characterized the first generation of climate change mitigation strategies be supplanted with breakthrough strategies for meeting human needs and wants with less energy. The role of local government agencies will be essential in this transition.

Senior levels of government that are serious about climate change mitigation must actively encourage and support local government engagement. Experience in Canada shows that when and where climate change response policy becomes a priority of the federal or provincial government and is accompanied by support for local action plans, rapid progress will follow. When the federal government allocated federal gas tax revenue for local actions on climate change, it led directly to a surge of local initiatives across Canada. More recently, provincial governments in B.C. and Ontario have increased support for municipal energy and climate planning and initiatives. These have resulted in direct and positive impacts on local governments' ability to follow through on their stated commitments to reduce greenhouse gas emissions. Research by QUEST³⁴ identified more than 640 provincial policies that support either the development or implementation of community energy plans, and the two provinces with the greatest number of such policies -- Ontario and British Columbia -- are also the two provinces with the highest PCP membership and the largest reported greenhouse gas emission reductions.³⁵

Essential to Align Climate Change Mitigation with Other Local Government Policy Goals

Local governments throughout Canada have embraced climate change mitigation as a policy objective, even in the absence of any mandate or senior government support to do so, because they recognize that *what's good for climate change mitigation is good for the community*. Measures to increase energy efficiency, renewable energy, and local energy self-reliance generate substantial economic, employment, local environmental, and public health benefits in the community.

Measures to increase transit modal share and improve pedestrian access to amenities create more productive, livable and even safer communities. Measures to encourage densification of urban cores reduce infrastructure investment costs and help balance municipal budgets. Measures that lead to a cleaner, greener urban environment are essential to attracting and retaining residents and investors in the emerging, post-industrial city. All these and more so-called "collateral benefits" are actually the primary

³⁴ QUEST ("Quality Urban Energy Systems of Tomorrow") -- www.questcanada.org -- was established in 2007 to promote energy efficiency, cost savings, enhanced reliability and reduced greenhouse gas emissions in Canadian communities. It coordinates a national network of stakeholders that includes government, utilities, the energy industry, the real-estate sector, economic regulators, and the product and professional service sectors.

³⁵ Dale Littlejohn, Eric Campbell et. al., "National Report on Policies Supporting Community Energy Plan Implementation", QUEST, Ottawa, July 2015. Retrieved from www.gettingtoimplementation.ca.

motivators for local government engagement on the climate change mitigation file in Canada. The more such benefits can be demonstrated, documented and communicated, the greater will be the acceleration of local government action on climate change.

Local Solutions Require Local Capacity

Local circumstances matter, and effective local climate change mitigation requires new skills and expertise in local governments. Before policies can be devised for reducing urban greenhouse gas emissions through innovations in local government plans, budgets, bylaws, and policies, it is first necessary to understand how those instruments of local governance affect the level and pattern of emissions.

This is why the first step in any emission reduction strategy is so important – the community emission inventory and forecast. Gaining a quantitative understanding of community greenhouse gas emissions is the first step in “connecting the dots” between local government policies, plans and investments and the potential for the local government to affect community emission levels. It is a necessary capacity building exercise for effective local climate mitigation but it is often a stumbling block for municipalities that do not have the resources or the in-house expertise to carry out the emissions inventory. At this and later stages of the development of local government action plans, the most cost effective support that can be provided by senior governments or other local government partners is assistance in developing the knowledge and understanding required inside city hall to identify and pursue the uniquely local opportunities for climate change mitigation. Acceleration of local climate change mitigation has been greatest in Ontario and British Columbia where provincial government support has included not just an array of programs related to the implementation of specific measures (efficiency, renewable energy, etc.) but also support for local inventories and strategic planning.³⁶

Concluding Observation and a Look to the Future

Beyond the rapid dissemination of renewable energy and more energy efficient technologies and buildings, leading cities in Canada are beginning to shift their focus from asking “How can we reduce the carbon intensity of our community?” to “How can we plan, design and build a low carbon, sustainable community?” This shift from a remedial to an anticipatory approach to the challenge of reducing emissions opens the door to deep integration of the low carbon objective into the community’s social, economic and land use planning and investment strategies. It is a question that can only be answered locally with local data, local knowledge, and in response to local circumstances and opportunities.

While efficiency and renewable energy are necessary for achieving low carbon futures, they will not be sufficient for meeting deep emission reduction targets by 2050 unless accompanied by changes outside the energy system itself that allow human needs and aspirations to be met with lower energy service demands. Vancouver, Toronto and Markham are among a group of leading Canadian cities that form a vanguard of Canadian municipalities that are developing detailed and quantitative scenarios of what transitions to truly low carbon cities might look like, and these efforts are opening a new phase in urban climate change mitigation in Canada that promises to go further and achieve more than the remedial approaches that have dominated the first generation of climate change response policies.

³⁶ Dale Littlejohn, Eric Campbell et. al., “National Report on Policies Supporting Community Energy Plan Implementation”, QUEST, Ottawa, July 2015. Retrieved from www.gettingtoimplementation.ca.

4. APPENDIX

Table 5. Census Metropolitan Areas (CMA's) in Canada

CMA	Province	Population		
		in 2001	in 2014	% change
Toronto	Ontario	4,882,782	6,055,724	24%
Montréal	Quebec	3,532,719	4,027,121	14%
Vancouver	British Columbia	2,074,543	2,470,289	19%
Calgary	Alberta	977,834	1,406,721	44%
Edmonton	Alberta	962,323	1,328,290	38%
Ottawa-Gatineau	Ontario/Quebec	1,110,344	1,318,122	19%
Québec	Quebec	703,960	799,632	14%
Winnipeg	Manitoba	695,868	782,640	12%
Hamilton	Ontario	689,072	765,228	11%
Kitchener-Cambridge-Waterloo	Ontario	431,559	506,858	17%
London	Ontario	453,092	502,360	11%
Halifax	Nova Scotia	369,265	414,398	12%
St. Catharines-Niagara	Ontario	391,875	405,906	4%
Oshawa	Ontario	308,599	384,143	24%
Victoria	British Columbia	325,765	358,685	10%
Windsor	Ontario	320,946	333,937	4%
Saskatoon	Saskatchewan	231,077	300,634	30%
Regina	Saskatchewan	197,031	237,758	21%
Sherbrooke	Quebec	184,084	212,061	15%
St. John's	Newfoundland and Labrador	176,443	211,724	20%
Barrie	Ontario	155,337	200,416	29%
Kelowna	British Columbia	154,188	191,237	24%
Abbotsford-Mission	British Columbia	153,934	178,967	16%
Kingston	Ontario	152,774	168,353	10%
Greater Sudbury	Ontario	161,493	165,690	3%
Saguenay	Quebec	162,351	160,138	-1%
Trois-Rivières	Quebec	143,313	155,813	9%
Guelph	Ontario	129,198	150,946	17%
Moncton	New Brunswick	122,270	146,073	19%
Brantford	Ontario	128,504	143,074	11%
Saint John	New Brunswick	126,074	127,314	1%
Thunder Bay	Ontario	126,698	125,112	-1%

Peterborough	Ontario	115,323	123,270	7%
Total CMA Population		20,850,638	24,858,634	19%
Total Urban Population		23,908,211	30,007,094	26%
Total Canadian Population		29,186,286	35,515,700	22%