FRAMING OUR FUTURE

AN

ENERGY & EMISSIONS

PLAN FOR CANADA'S CAPITAL REGION

Ottawa

Ville de Gatineau

NCC CCN Canada

The Project Partners

City of Ottawa
City of Gatineau
National Capital Commission

Lead Consultant

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An Executive Summary of this Plan is available in French. The City of Ottawa will translate the Plans in their entirety once they are received by Council.

Un sommaire exécutif de ce plan est disponible en français. La Ville d'Ottawa fera traduire intégralement les plans une fois qu'ils auront été reçus par le Conseil.

Foreword

Choosing our Future is an initiative of the City of Ottawa, in partnership with the City of Gatineau and the National Capital Commission, to guide Canada's Capital Region towards a more sustainable, resilient and liveable future. Inspired by goals for economic prosperity, social well-being, culture and identity and a healthy environment, *Choosing our Future* proposes strategies that position the Region to thrive in a changing world.

Almost every aspect of our communities will likely change over the next 50 years. The forces of change include a shifting global economy, resource scarcity and rising energy prices, a changing climate, new population dynamics, and unforeseeable events such as ice storms and other natural disasters. New technologies will change everything from how we communicate with each other to how we heat our homes. While many of the changes ahead are unclear, we can make choices today that build more sustainable communities, resilient in the face of change and offering residents a highly desirable quality of life.

Three Plans[1] were developed to guide the Partners:

- The *Sustainability and Resilience Plan* is an overarching plan that identifies a long-term vision and set of goals which speak to all dimensions of sustainability—economic, social, cultural and environmental. A set of strategies outlines the broad directions to be pursued to achieve these goals over the long-term, while examples of actions show specific ways to implement the strategies now and in the future.
- An *Energy and Emissions Plan*, a sub-plan of the *Sustainability and Resilience Plan*, focuses on increasing renewable energy and reducing energy demand. It describes a comprehensive approach to reducing greenhouse gas emissions through land use as well as strategies for buildings, energy supply, transportation and waste. This plan also provides direction on reducing energy costs for citizens, businesses and institutions.
- The *Risk Prevention and Mitigation Plan*, also a sub-plan, combines sustainability planning with long-term risk management. It assesses the effects of long-term risks on our communities and describes how the *Sustainability and Resilience Plan* mitigates or prevents them. It then considers the vulnerabilities we may still face and recommends additional measures for Ottawa's emergency management program.

These Plans build on the spirit of cooperation shared by the Partners in the initiative. They are intended to provide a common framework to guide the Partners' decisions on major plans, policies and programs going forward. The Plans are also a call to action—an invitation to organizations, businesses and individuals across the Region to get involved in the process of making the transition to a more sustainable community.

1 Available at http://www.ottawa.ca

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Executive Summary

Introduction

The *Energy and Emissions Plan for Canada's Capital Region* charts a course towards a more sustainable energy future, one in which the Region is less vulnerable to rising and volatile energy prices, less reliant on fossil fuels such as oil and gas, and produces fewer related greenhouse gas emissions. Exciting opportunities will emerge as technology, land use and transportation planning, and creativity come to bear on addressing the Region's energy and emissions challenges. Many of these opportunities can be seen in seeds of success already sown across Canada's Capital Region as energy conservation, renewable energy development, and green buildings take hold.

The Plan is underpinned by a commitment to strengthen sustainability, resilience and liveability across Canada's Capital Region. It includes strategies from the *Sustainability and Resilience Plan* for land use, transportation, and waste, and more fully develops strategies for buildings and energy supply. This integrated approach recognizes that many actions achieve multiple objectives. Policy and planning opportunities for efficient land use and walkable neighbourhoods not only reduce the need for travel and related gasoline consumption and emissions, but also improve air quality and opportunities for health and fitness through active transportation. Spending less on energy potentially redirects money into the local economy while development of renewable energy and the green building sector supports local jobs and innovation.

Goals

The *Choosing our Future* initiative which also includes a *Sustainability and Resilience Plan* and a *Risk Prevention and Mitigation Plan* has established 12 high-level goals, many of which relate to energy and emissions. The *Energy and Emissions Plan* focuses on two in particular.

Climate Change: The Region adapts to a changing climate

The Region makes deep emission reductions and ensures that it can adapt to deal with the impacts of climate change.

Energy: Energy demand is reduced and supplied from green, renewable sources

Energy is used efficiently and responsibly in the Region and comes from a diverse portfolio of resources that

are renewable and low-impact, and contribute to local economic development. The Region also manages demand for energy through community planning, transportation initiatives, and building design.

Other high-level goals that relate to energy sustainability and emission reduction support strategies related to:

- Green, Healthy Housing Options;
- Sustainable Land Use and Transportation; and
- Waste Reduction.

Meeting the Challenge: A Low Carbon, Sustainable Energy Region

The challenge in meeting these goals is significant but not insurmountable. If residents, businesses and institutions continued to live, work, travel and consume as they have over the last 20 years, our growing population would consume 60% more energy than we do today and energy spending would double by 2050. Under this business-as-usual scenario, greenhouse gas emissions would likewise increase 30% by 2060.

This plan, however, looks to current best practices from across North America. Under the best practice future residents and businesses could avoid a doubling in energy spending, saving $2.5 billion annually. By 2060, emissions in core community sectors would be 40% below 2007 levels. Early action could drive a 20% reduction in emissions by 2020.

Strategic directions, informed by best practices, across all major community energy and emission sectors chart a course towards a more sustainable energy future:

Encourage High Performance Buildings

- Strengthen energy retrofit opportunities in residential and commercial buildings
- Improve energy and emission performance of new buildings

Promote Low Carbon and Renewable Energy Supply

- Strengthen opportunities for small-scale renewable energy
- Facilitate development of cost effective, low emission, high efficiency district energy
- Examine large scale renewable energy development

Manage Growth and Development

- Maintain a compact region
- Build complete communities and neighborhoods, well served by transit
- Encourage design excellence

Encourage Sustainable Mobility

- Support integrated land use and transportation systems
- Expand mobility options through investments in cycling, transit and walking infrastructure
- Facilitate the transition to vehicles using alternative power

Manage Materials and Solid Waste

- Reduce, reuse, recycle, and recover energy sustainably from waste

By implementing actions related to these strategic directions, a more sustainable and secure energy future can be developed. Example actions are outlined in each sector to illustrate how each strategy could be advanced. These include a mix of actions that are already underway, could be enhanced or initiated in the future.

The Plan proposes several catalyst projects which combine strategies across sectors and the three Plans. These projects can be initiated in the short-term and demonstrate the inter-relationship between sectors and our built environment, society, culture and the economy. These projects provide learning and innovation opportunities, can build knowledge and

capacity in the community today and are typically scalable or replicable.

This plan represents a starting point, building on existing initiatives and short-term opportunities that position the Region for a longer-term future as we monitor progress, identify new opportunities, and adapt to a changing and evolving world.

Over the Plan's life, additional technologies, practices and government policies as diverse as renewable energy technology breakthroughs and carbon pricing will emerge, providing additional opportunities for energy savings and deeper reductions in GHG emissions.

Call to Action

This plan is a call to action across the Region to get involved in making the transition to a more sustainable, lower carbon energy future. The three Partners have laid the groundwork for a sustainable future and are committed to making progress based on this Plan. Success will only be possible when the Plan is also embraced by businesses, organizations, neighborhoods and citizens.

Low carbon energy supply

Low carbon energy supply refers to energy production which reduces reliance on fossil fuels—oil, coal and natural gas—for energy. Examples include producing electricity through hydro or solar power, heating homes with geo-exchange systems, and use of biomass or biofuels.

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1 Introduction

Canada's Capital Region will face a number of challenges over the next few decades related to secure access to energy and rising energy prices. In these challenges are opportunities to create more sustainable, resilient, and liveable communities with cleaner air, more sustainable energy use, more active residents, and increased local prosperity. Our response to rising and unstable energy prices, constrained fossil fuel supply, and the impacts associated with energy use such as greenhouse gas emissions, will help define how liveable, resilient and prosperous the Region will be.

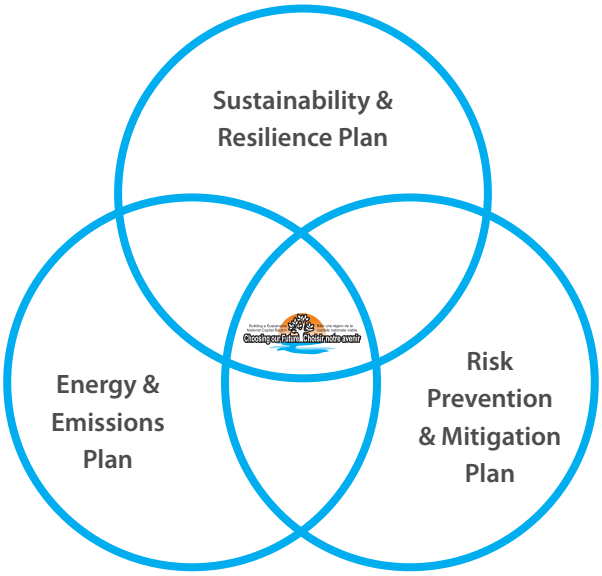
This Plan charts a course that will protect the Region from rising energy prices, and help reduce fossil fuel dependency and related greenhouse gas emissions. Strategic directions are outlined across the major community sectors over which municipalities have greatest influence:

- Land Use;
- Transportation;
- Buildings;
- Energy Supply; and
- Solid Waste.

The Plan has a 50-year horizon with examples of short-term actions that would position the Region to achieve ambitious end-state sustainability goals. Underpinning the Plan are current initiatives across the Region already advancing sustainable energy and emission reductions. This Plan is also about preparing for future change as technology and practices continue to evolve. Transformative developments such as completion of a Light Rail Transit System in Ottawa, use of low or zero emission vehicles, and net zero energy housing are on the horizon. Continuous improvement and transformation will mean that new action opportunities will emerge in future years as this Plan is implemented.

1.1 Approach

Beginning in 2008, the three Partners worked together on a vision and long-term goals for a sustainable, liveable, and resilient region and strategies to achieve it Three Plans have been produced through this process: a *Sustainability and Resilience Plan*, a *Risk Prevention and Mitigation Plan*, and an *Energy and Emissions Plan*.



Development of all three Plans shared a common five-step process:

1. Defining our sustainability challenge through exploration of long-term change in areas such as climate change and energy supply;
2. Establishing our Vision including guiding goals and principles for energy and emissions reduction;
3. Exploring possible approaches through initial modeling of energy and emissions and an expert workshop focusing on energy and emissions challenges and opportunities;
4. Choosing our path forward which refined an initial set of strategic directions and actions through review and a workshop with regional energy experts; and
5. Developing our Plan for Action through the three inter-related Plans.

Sustainability, Liveability, and Resilience

Three themes informed development of each Plan.

Sustainability is commonly defined as meeting the needs of the present without comprising the ability of future generations to meet their needs.

At the core of the sustainability challenge is the need to manage our consumption of resources so that we can continue to prosper and ensure the quality of life now and in the future. Sustainability has four interrelated dimensions—economic, cultural, social, and environmental.

Liveability refers to the quality-of-life experienced by residents, employees, and visitors. It includes a community that is safe, secure, beautiful, and healthy, and supports neighbourhood interactions and opportunities for recreation, cultural expression and entertainment.

Resilience is the capacity of a system such as a city or region to withstand stress and/or undergo change and still retain its basic function and structure. Stresses can take many forms including sudden changes in ecological, economic and social conditions, such as major disasters, economic shocks (e.g. the withdrawal of a major employer in the Region), or substantial increases in energy prices.

1.2 Report Structure

The Plan has five parts:

Part 1 – Introduction: outlines the vision and objectives and situates the Plan within the *Choosing our Future* initiative;

Part 2 – Context: Explores energy and climate security, local -senior government sphere of influence, and places the Plan within the context of long-term goals;

Part 3 – Where we are today: provides an overview of current energy use and emissions as illustrated through an emissions mapping tool;

Part 4 – Strategies and Actions: is the essence of the Plan with well defined strategies, example action opportunities to illustrate possibilities, and policy and practice insight to support implementation across each major sector:

Land use

Transportation

Buildings

Energy supply

Waste

Example Actions are outlined in each sector to illustrate how each strategy could be advanced. These include a mix of actions that are already underway, could be enhanced or should be initiated; and

Part 5 – Implementation: provides some practical guidance on how to move from planning to action. Cross cutting measures outline priorities that cut across sectors and line departments. A series of catalyst projects to kick start action are outlined.

The Appendix includes *Zone Specific Energy Strategies* to support unique opportunities across the diverse neighborhoods; and *Performance Indicator Highlights* outlining the key assumptions used as modeling inputs as well as the energy and emission projections, i.e. the model outputs.

A separate Technical Report includes detailed modeling methodology and detailed assumptions and modeling results.

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2 Context

The *Energy and Emissions Plan* has been developed within an appreciation of the local and global imperatives impacting local communities and this Region in particular, an understanding of the responsibility and influence of all levels of government in taking action, an examination of emerging challenges and opportunities, and a reflection on the principles and goals of the Region. These issues are explored below.

2.1 Rationale for Action

There are several compelling reasons to forge a stronger sustainable energy path and reduce greenhouse gas emissions in Canada's Capital Region:

1. **Energy Security:** Rising demand and an increasingly constrained supply of easy-to-access energy is expected to steadily increase energy costs and price volatility, compromising long- term local energy security;
2. **Climate Security:** Taking action on energy security will reduce greenhouse gas emissions and contribute to a global effort to avoid the long-term consequences of a changing climate, consequences that will otherwise impact heavily on local governments and local communities; and
3. **Integrated Sustainability:** Well crafted policies and plans to advance sustainable energy and reduce greenhouse gas emissions have many benefits: local job creation and economic development, reduced congestion, healthier lifestyles, more liveable neighbourhoods.

ENERGY SECURITY

Canada's Capital Region is facing growing demand for energy, and with it similar long-term energy security challenges confronting most regions of the world. The International Energy Agency's (IEA) *World Energy Outlook 2008* indicates global energy demand will increase 45% between now and 2030.[1] As demand is rising, easily accessible, low-cost supply is diminishing. In particular, the supply of fossil fuel based energy, notably oil upon which we are most dependent, is limited. While there are differing estimates of timelines involve, the idea that we are beginning to reach peak levels of oil production, whereby the ability of existing production and the estimate of technically or economically feasible new production can no longer

1 International Energy Association. World Energy Outlook 2008 Fact Sheet: Global Energy Trends.

meet growing demands, has become one of the concerns driving long-term energy policy planning. The IEA outlook for 2011 continues to project growing demand and emphasizes the need to invest today in measures to reduce demand on conventional sources of energy, as well greenhouse gas emissions.[2]

In both Ontario and Quebec the fastest growing energy sector is transportation. Transportation accounts for roughly one-quarter of energy use in the Region (see Section 3.2). Supplies of many conventional energy forms, notably oil, are declining, and new sources have higher production costs because of their relative accessibility and/or technical production challenges. The U.S. Energy Information Administration estimates oil prices will increase by 40% –130% by 2020, rising to $115 – 185 per barrel.[3]

Electricity demand in Canada continues to increase, with current supply and future prospects differing across provinces. Ontario's current electricity is a mix of nuclear, hydro, coal and natural gas and a significant share of infrastructure in need of replacement or refurbishment. Ontario is committed to meeting a growing demand and to honouring a commitment to phase out four coal-fired plants. It now has a definitive plan, including nuclear plant renewal, import agreements, notably with Quebec. Ontario's Green Energy Act also provides an ambitious framework for meeting a larger share of demand with low-impact, renewable electricity.

Electricity prices in Ontario are high compared to Quebec. Quebec's electricity supply is dominated by large-scale hydro and its prices are amongst the lowest in North America, with power continuing to be a major export. Both jurisdictions currently rely on large, centralized power plants for electricity generation.

With increasingly constrained and costly oil, pressure to reduce greenhouse gases and air pollution, and ongoing technological innovations, the transportation sector may be steadily electrified. Middle of the road projections of electrical vehicle adoption are only 3% of passenger vehicles by 2020 but increase to 30% by 2040.[4] This could require a large increase in electricity production across North America, creating increased demand, and potential supply shortfalls. The pace of electrification will be influenced by policy from all levels of government to create the infrastructure, e.g. charging stations, smarter grids, and plug-in requirements in garages and key public areas.

These energy security challenges will be felt locally by residents and businesses facing rising costs to heat, cool and power homes and businesses. Transportation costs may also increase, particularly for those that are car-dependent. The cost of goods imported over long distances—most of what we consume—will also rise.

CLIMATE SECURITY

Scientific evidence shows the climate is changing, and attributes most of this change to the surge in greenhouse gases from the combustion of fossil fuels—e.g. oil, coal and gas—to meet our energy needs. The Intergovernmental Panel on Climate Change has concluded that global emissions need to be reduced and to reach levels 50% – 85% below 2000 levels by mid-century if we are to avoid tipping points with dangerous disruptions such as agricultural collapses, water shortages, droughts, and sea level rise.[5]

The economic consequences are also increasingly clear. Commissioned by the British Government and authored by former World Bank Chief Economist Nicholas Stern, the *Economics of Climate Change* estimated the costs of reducing greenhouse gas emissions to a safe level amount to one percent of global gross domestic product, compared to a potential loss of up to 20% of global GDP if we do

2 International Energy Agency. World Energy Outlook 2011. Executive Summary

3 Energy Information Administration 2009. Annual Energy Outlook, p. 161.

4 BC Hydro 2010 - Electric Load Forecast 2010 to 2030. Appendix 4. Electric Vehicles

5 IPCC. Climate Change 2007: Synthesis Report. http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm

nothing. In his study, Stern concluded, "The benefits of strong, early action on climate change outweigh the costs."[6]

Communities are especially vulnerable to a changing climate due to an extensive infrastructure supporting high concentrations of people and economic activity. The Insurance Bureau of Canada data show costs of property damage from natural catastrophes doubling every 5 to 10 years and has attributed much of this growth to climate change.[7] In such emergencies, local governments are on the front lines.

Impacts projected for Canada's Capital Region include:

- More frequent and intense rainfall causing flooding in vulnerable areas;
- Heat waves and droughts; and
- Changing food costs and availability resulting from disruptions to global agriculture.

INTEGRATED SUSTAINABILITY AND QUALITY OF LIFE

The strategies and actions outlined in this Plan will provide benefits beyond reducing energy use and emissions. These are referred to as "co-benefits". For example:

- Residents will experience less air pollution as congestion is reduced and vehicle emissions are lowered;
- Deploying readily available building technologies will improve indoor air quality, and, in turn, improve human health and productivity;
- Neighbourhoods with parks, walking infrastructure, meeting places, and lively mixed-use nodes will be more liveable for residents, enhancing fitness and social well being;
- Avoided energy spending will potentially re-direct a larger portion of household and business expenditures on regional activity; and
- Sustainable energy production and green building technologies will be a new source of revenue and jobs for area residents.

To leverage these opportunities, this Plan takes advantage of cross-cutting opportunities and an integrated approach to community energy solutions addressing transportation, land use, waste buildings and energy in a systemic manner, while also advancing sustainability, liveability and resilience.

2.2 Taking Action: A Shared Responsibility

All levels of government have an important role to play in establishing a more sustainable energy future. This schematic illustrates the areas where different levels of government have the ability to take the lead or support the efforts of other levels in community-related emission activity.

Senior levels of government have greater ability to finance major new programs, such as incentives to retrofit existing buildings, or fund new infrastructure such as public transit as well as regulate building and vehicle performance, and industrial activity. The fastest growth in emissions in Canada is, in fact, now in the

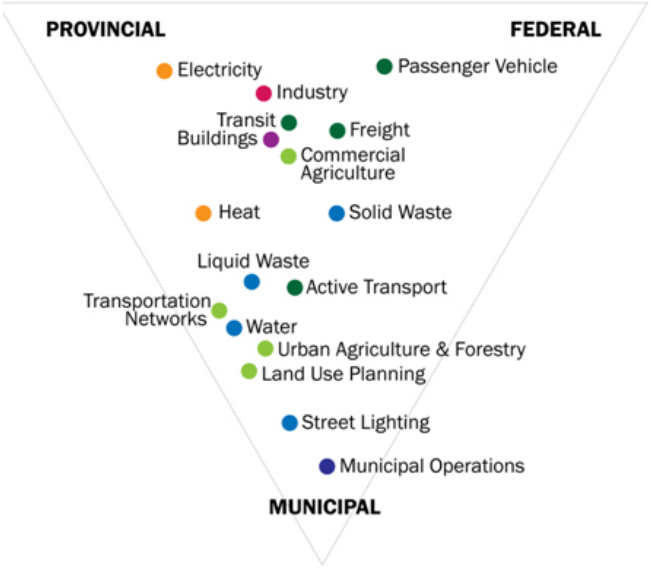

Figure 1: Spheres of Influence

6 HM Treasury. Stern Review on the Economics of Climate Change. http://www.hm-treasury.gov.uk/sternreview_index.htm

7 Insurance Bureau of Canada. (May 4, 2003) Hurricane Juan insurance tab tops $113 million: points to need for preventive measures.

industrial sector. Half of the country's emissions are emitted by several hundred large industrial emitters over which most municipalities have no control.

Although the regulatory powers of municipal governments are more limited, local government decisions can still influence approximately half of GHG emissions in Canada.[8] This influence is seen in land use, transportation, waste management, and housing form and density, as well as their own corporate buildings and fleets.

In Canada's Capital Region, the National Capital Commission is also a major player in federal land use and planning decisions. As the single largest employer, the federal government and its decisions on office location and design help shape regional travel patterns and employee opportunities to walk, cycle or take transit and determine specific building energy performance and energy supply opportunities.

Local governments can facilitate change by raising awareness and facilitating community and business actions among a range of stakeholders.[9] Of all levels of government, local governments have the most direct relationship with citizens through the services they deliver.

At the same time, local governments only have indirect influence on most of these emissions. They can establish the preconditions that influence behavior, but ultimately residents, businesses and institutions determine how much heat and power is used in their homes and offices, and how they get around.

2.3 Provincial Policy Context

While the Partners have important influence over energy and greenhouse gas emissions in Canada's Capital Region, provincial governments also play a critical role through programs and through important legislative context for local action.

8 Torrie, Ralph. (1998) Municipalities Issue Table Foundation Paper prepared for the Canadian Government's National Climate Change Process

9 REN21, ISEP and ICLEI 2009. Global Status Report on Local Renewable Energy Policies – Working Draft, 12 June 2009.

ONTARIO

In Go Green: Ontario's Action Plan on Climate Change, the Province has committed to reducing GHGs by 6% from 1990 levels by 2014, 15% by 2020 and 80% by 2050. According to the 2010 figures, Ontario's total GHG emissions for 2008 exceed Ontario's 1990 base year emissions by 8 per cent. This 18-year rise is attributed primarily to rising transportation and a growing building stock heated and powered by fossil fuels.[10]

The province's Green Energy Act (GEA), enacted in 2009, is designed to help create a culture of energy conservation and is an ambitious, long-term renewable electricity policy framework. The GEA established a Feed-In Tariff that guarantees stable

10 Environmental Commissioner of Ontario. 2010. Annual Greenhouse Gas Progress Report 2009/2010: Broadening Ontario's Climate Change Policy Agenda. Toronto: The Queen's Printer for Ontario. pp. 4-8 "http://www.ecoissues.ca/index.php/Broadening_Ontario%27s_Climate_Change_Policy_Agenda_Numbers_to_Date"

Ontario conservation and efficiency highlights:

- **The Home Energy Audit program that pays up to $150 for the audit and up to $5000 in retrofit rebates.**
- **Establishment of the Building Code Energy Advisory Council (BCEAC) to provide strategic advice to the Minister on energy conservation issues related to the Building Code, to implement the GEA.**
- **Ontario has also established the highest provincial building efficiency standards in Canada. In 2012 new homes will require higher performing windows and furnaces, and additional insulation. They must meet EnerGuide 80 and have flexibility for meeting this standard. Large buildings will meet the ASHRAE 90.1 2001 standard or the Model National Energy Code plus an Ontario-specific supplementary standard.**

prices for power generated from renewable sources over long time-frames. The prices are designed to cover project costs and allow for a reasonable rate of financial return over the life of the energy contract for both small and large-scale renewable energy systems. Overall, the GEA has removed significant administrative and financial barriers to renewable electricity supply in Ontario. The Act also begins to prepare Ontario for electric cars.

Between Go Green¸ the Green Energy Act, public transit commitments, efforts to constrain sprawl, and ongoing building energy efficiency and conservation work, Ontario has some strong commitments to make deep emission reductions and become a sustainable energy consumer and producer.[11]

QUEBEC

In 2006, Quebec developed a comprehensive provincial Climate Action Plan with concrete emission reduction targets and an adaptation agenda. In 2009, it updated its target to 20% reduction below 1990 levels by 2020, in line with the European Union's targets.

As part of the New England Governors and Eastern Canadian Premiers Climate Consensus, Quebec has also made a commitment to work with other regional governments and to strive for a 75% – 85% reduction by mid-century.[12]

The Province of Quebec has an Energy Strategy—launched in 2006—with the objectives of strengthening energy security, maintaining low cost power, promoting economic development, and empowering First Nations.[13]

2.4 Challenges and Opportunities

The twin challenges of energy security and a changing climate pose risks for Canada's Capital Region over the next decade and century. Many of the underlying

Quebec climate and energy agenda highlights

- **Hydroelectric Development:** First and foremost, accelerate hydroelectric development with the aim of 4,500 MW of generating capacity involving an investment of $25 billion.
- **Building energy conservation:** Financing energy efficiency retrofits for individuals, industries, institutions, companies and municipalities.
- **New buildings:** Adopting EnerGuide 80 for new home and deploying smart meters.
- **Wind power:** Meeting the equivalent of 10% of the province's peak demand by 2015.
- **Renewable fuels:** Supporting low carbon ethanol from cellulose rather than grain.
- **Fuel efficient vehicles:** Adopting California's aggressive Low Carbon Fuel Standard, bypassing the federal government.
- **Municipal climate planning:** Support municipalities taking GHG emission inventories and action on climate change in their own operations and the broader community.
- **Public Transit:** Significant new investment in public transit, including an innovative Green Fund that matches dollar for dollar municipal spending on operating public transit.
- **Industry:** Along with BC and Ontario, Quebec will join with other North American jurisdictions in establishing a cap and trade system for large industry.
- **Carbon Tax:** Although very modest, Quebec had North America's first hydrocarbon tax.

11 In addition, Ontario, along with Quebec and BC, will be moving to reduce emissions for large industry with a cap and emissions trading regime under the Western Climate Initiative.

12 http://www.newenglandclimate.org/background.htm

13 http://www.mrnf.gouv.qc.ca/english/publications/energy/strategy/energy-strategy-2006-2015-summary.pdf

forces are beyond the control of the Cities of Ottawa and Gatineau and the NCC. However, local action to reduce energy demand and advance renewable energy supply can reduce vulnerability in Canada's Capital Region.

Major opportunities and challenges are identified in the table below.[14]

14 Trends, opportunities, and challenges for buildings and energy have been identified during consultations in 2009 and 2010.

Table 1: Major Opportunities and Challenges for Canada's Capital Region

Sector	Key Challenges	Key Opportunities
ALL SECTORS	• Population growth generally puts upward pressure on energy demand, greenhouse gases, and waste generation • In an increasingly interdependent world, there is greater vulnerability to "sudden shocks" or unforeseen events (e.g. floods, oil price spikes)	• Improving efficiency in building and transportation technologies can lower *per capita* emissions, reducing the impact of population growth • Focused transit-oriented, walkable, mixed-use and multi-family development in central areas can offset population growth emissions because of big transportation and building performance gains.. • Demand reduction and local energy supply can help to balance the system and to make the Region more resilient
BUILDINGS	• Low energy prices discourage investment in alternate energy supplies* • Most business, institutional, and residential buyers focus on initial capital cost rather than long-term operating cost. Upfront cost of green buildings and renewable energy therefore remain a significant barrier • Engineers, contractors, developers, planners, and consumers may not have the experience and knowledge needed to advance renewable energy and building efficiency • Programs in Ontario have focused on electricity and not heat due to supply constraints and Provincial targets	• Increasing energy prices and stronger regulations are beginning to drive improvements in building efficiency, especially thermal efficiency • Residential developers are responding to market demand by offering energy efficient products and materials (such as Energy Star appliances and certified green buildings) • A growing body of knowledge is available to educate and train employees and consumers. Educational institutions and professional associations are beginning to focus on energy efficiency and renewable energy • Extensive conservation programs delivered by utilities have had some success • Increased understanding and recognition of longer-term savings in operating expenses which can justify initial capital investments

* Natural gas is a low-cost source of energy in both Quebec and Ontario; electricity prices in Quebec are among the lowest in the world

Sector	Key Challenges	Key Opportunities
ENERGY SUPPLY**	• Increasing demand is exceeding conventional low-carbon supplies (Hydropower) • Other forms of renewable energy (such as solar) remain expensive relative to conventional energy	• Low-carbon energy supply technologies for individual buildings, neighbourhoods, and large-scale generation are increasingly viable • As demand for renewable energy increases and technology improves, prices are reduced • Emissions from building energy use in Ottawa will decrease substantially as Ontario's grid uses more renewable energy • Canada's Capital Region has one of the largest district energy systems in the world serving federal buildings and complexes. This system is in need of upgrades which open up opportunities for decarbonization and expansion
LAND USE ***	• Increasing population and cultural preferences for single-detached homes create pressure to expand outwards, leading to more vehicle use, biodiversity loss, and pressure on agricultural land	• Demographic transition and cultural preferences are increasing demand for smaller homes with easy access to services. Smaller homes consume less energy *per capita*. Emissions from focused transit-oriented, walkable development in central business areas can offset population growth
TRANSPORT	• Increasing population and the continued reliance on the car lead to increases in transportation emissions	• Rising fuel prices and senior government regulations are driving improvements in vehicle efficiency so emissions will lower *per capita* as vehicles are replaced. Changing land-use patterns and improved cycling and transit infrastructure (such as new rapid transit and LRT) support alternative transportation modes
SOLID WASTE	• Increasing waste generation *per capita*	• Increasing share of waste diverted (recycling and composting) and capturing landfill gas will reduce GHG emissions.

** Energy supply decisions (e.g. technologies and fuel types) impact energy efficiency and greenhouse gas emissions in buildings. (This Plan confines transportation energy supply options to electricification)

*** Land use decisions (e.g. growth locations, building types, densities and land use mixes) impact energy consumption and greenhouse gas emissions in buildings and transportation.

2.5 Principles and Goals

Based on an understanding of the issues, challenges and opportunities, a set of principles and goals was developed to guide the *Energy and Emissions Plan*, along with the other two Plans.

Long-Term Thinking To ensure that our communities are resilient and that we can sustain our ecosystems and quality of life for generations to come, we will consider the long-term implications of our actions and decisions and prepare ourselves for changes to come.

Local and Global While the sustainability and liveability of our communities is important, we will not forget that our actions and choices have impacts elsewhere, and we will act accordingly. While we recognize that we will continue to be part of a global community, we will work towards greater self-reliance as an important facet of resilience in the face of change.

One Planet We recognize that there is no reasonable substitute for many of nature's services, such as purifying water, cleaning air and providing renewable resources. Therefore, we will live within the Earth's capacity to support us with resources and to absorb our waste. We will live off the interest of natural capital rather than deplete it.

Integration of Systems Each decision will reflect an understanding of the interconnections among the economy, society, culture and environment. We will design systems and structures that achieve multiple objectives.

Diversity and Creativity We recognize the inherent value of every person and the value of diverse perspectives. We will support opportunities for all residents to lead healthy, creative, and fulfilled lives.

Learning and Cooperation We will pay attention to how human and natural systems work and collaborate with one another to develop shared solutions. We will recognize those businesses and individuals who work toward sustainability.

The goals are illustrated in **Figure 2.**

While most of these goals relate in some way to energy and emissions, the *Energy and Emissions Plan* focuses with more detail on two of the goals:

CLIMATE CHANGE: THE REGION ADAPTS TO A CHANGING CLIMATE

The Region makes deep emission reductions and ensures that it can adapt to deal with the impacts of climate change.

ENERGY: ENERGY DEMAND IS REDUCED AND SUPPLIED FROM GREEN, RENEWABLE SOURCES

Energy is used efficiently and responsibly in the Region and comes from a diverse portfolio of resources that are renewable and low-impact, and contribute to local economic development. The Region also manages demand for energy through community planning, transportation initiatives, and building design

Reducing energy use and emissions also relies directly on:

- Housing options that are green;
- Walking, cycling and transit as first options for transportation: and
- Reducing waste towards zero.

While contributing to many of the other goals such as economic prosperity through reduced energy expenditures and health and quality of life through actions which, for example, improve air quality.

Building upon these principles, the following goals describe long-term success for a sustainable, liveable, resilient Capital Region.

Figure 2: Overview of the Goals for a Sustainable, Liveable, Resilient Region

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3 Energy & Emissions Profile

Charting a course towards sustainable energy and a lower emissions future starts with an understanding of current conditions and the potential and opportunities involved in taking action.

3.1 Energy and Emission Modeling Methodology Overview

Current and future energy and emissions have been calculated using the Community Energy and Emissions Modeling and Planning tool (CEEMAP).

CEEMAP is based on several interactive models incorporating the key indicators that drive energy use and greenhouse gas emissions. These indicators are used as model inputs. They include the major community energy and emission sectors over which local governments have significant influence, including:

- Socio-economic data, e.g. residential and employment population;
- Land use & community design, e.g. location and density of commercial and residential buildings;
- Transportation technology & patterns, e.g. number and type of automobiles, transit routes and frequency;
- Building Type & Performance, e.g. single-detached or multi-unit home type, building energy rating, retrofit rate;
- Heat & Electricity Supply, e.g. electricity from grid or other district energy technology, building-scale renewable energy; and
- Solid Waste Management, e.g. waste composition and mass, management practice.

This modeling exercise focused primarily on sectors over which municipalities have significant control and excluded activities over which they have less influence (e.g. large industrial emitters and agriculture).

The first step in the process was to establish a baseline against which future changes are compared. The Base Year is selected based on the best available data—in this case 2007. Values for the indicators are then projected into the future based on the nature and intensity of strategies assumed to be in place at the time.[15]

15 CEEMAP can generate and compare current and future energy and emission profiles based on conditions at these times. The energy and emission base year inventory focussed on the traditional community sectors over which local governments have most influence. The inventory is based on the best information and assumptions for a common base year (2007). Municipal Partners are developing more detailed and complete inventory data which will then be used to track progress and update emission strategies over time.

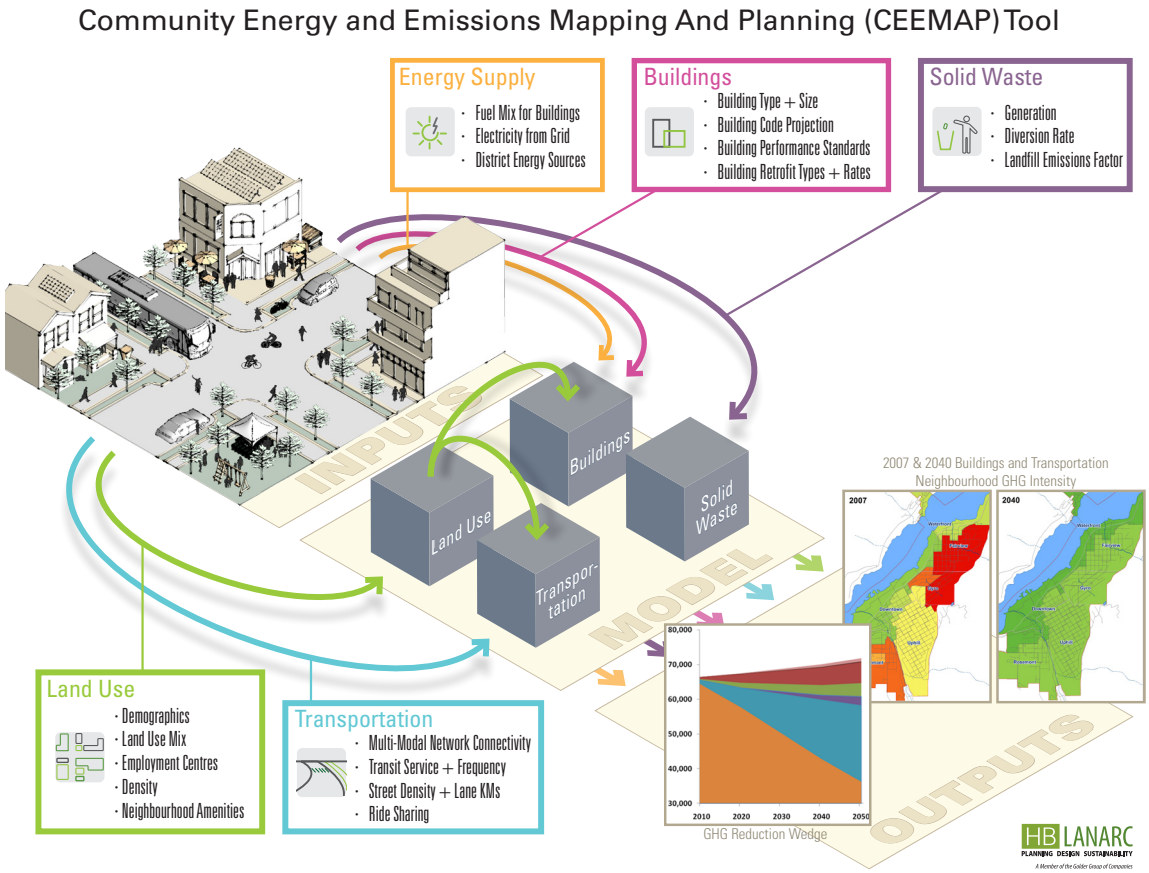

Figure 3: CEEMAP Tool

CEEMAP also considers the impact of senior government policies on community activity. Future provincial building code updates, for example, will change the energy efficiency of future buildings and vehicle tailpipe standards will change the performance of the vehicle stock. CEEMAP then examines the relationship between these indicators to calculate energy and emissions (i.e. model outputs) at future milestones. For the Energy and Emissions Plan, 2040 and 2060[16] are the major milestones selected.

Outputs from the model include not only energy use and emissions by sector, but also related indicators such as average vehicle kilometers travelled (VKT). Maps are produced for some indicators using Geographic Information Systems (GIS). A separate technical report is available which further describes the model details.

16 2060 is the final planning horizon for *Choosing our Future.*

Two Possible Futures

As well as the 2007 base year, two futures for the Region were also modeled. Each future assumed the population of the Region would increase 50% over the next 50 years, based on estimates prepared for the project.[17] The two futures differed on their strategic directions and in turn a wide variety of assumptions such as building performance and energy supply, location of growth, density, housing types, and development around transit stations.

The assumptions used are meant to illustrate a potential mix of strategic directions and future outcomes based on an understanding of the variables that influence energy and emissions. The model is not prescriptive and assumptions should not be viewed as specific targets. It is also likely that different priorities

17 Urban Futures 2009. A Context for Change Management in the National Capital Region. Demographic Projections for the national Capital Region in the 21st Century. Figures are adjusted to reflect the Ottawa projection to 2031 in the 2003 Ottawa Official Plan.

or strategic emphases will emerge over time, requiring partners to adapt to emerging opportunities to arrive at similar future end points.

Two Possible Futures

Historical Trend Future: This future was developed as a reference case. It extended the Region's historic trends for energy consumption and greenhouse gas emissions into the future. It assumes no intervention is made to address energy and emissions by the Cities of Gatineau and Ottawa, nor by federal and provincial governments. This future is defensible but highly approximate. In terms of land use and transportation it reflects the not-so-distant past of the 1980s and 1990s, before Smart Growth thinking began to influence more compact and complete development.

Best Practices Future: This future reflects local and regional adaptation of best practices carried out by leading municipalities across North America. The strategies in this future were developed in consultation with the public, stakeholders and City staff during consultations and are consistent with the strategies proposed in the Sustainability and Resilience Plan. The impact of major senior government policy changes are also incorporated, notably building codes and vehicle tailpipe standards.

The Best Practices future illustrates a compelling picture of opportunity and suggests a pathway towards a more sustainable energy future based on the Strategic Directions in Section 4.

Additional details about the methodology used to develop the baseline and project future changes is found in a complementary technical report: *Energy and Emission Plan Modeling and Mapping Methodology*.

3.2 Energy and Emissions Baseline

This section provides a brief overview of energy and emissions in Canada's Capital Region (CCR), using the base year of 2007.[18,19] The profile focuses on those areas over which the National Capital Commission and the Cities of Ottawa and Gatineau have the most influence, and therefore does not include all sources of energy use and emissions.[20]

The building sector is responsible for an estimated three-quarters of the energy consumption in the Region (**Figure 5**). There is little difference in this regard between Ottawa and Gatineau. However, because electricity is from hydro-electric sources in Gatineau, buildings have much lower emission intensity than in Ontario. Emissions also include a small proportion from solid waste, which is not related to energy use—these emissions are from methane produced during the decomposition of organic waste in a landfill.

The relative price of power in Ontario and Quebec influences the choice of heating technologies and energy supply; there is more natural gas heat in Ontario and electric baseboard heat in Quebec.[21] Similar patterns are present when comparing Commercial & Institutional buildings

The amount of energy used per square metre of building space—called energy intensity—is a useful measure of building efficiency. Energy intensity is greater in Quebec[22] compared with Ontario, meaning

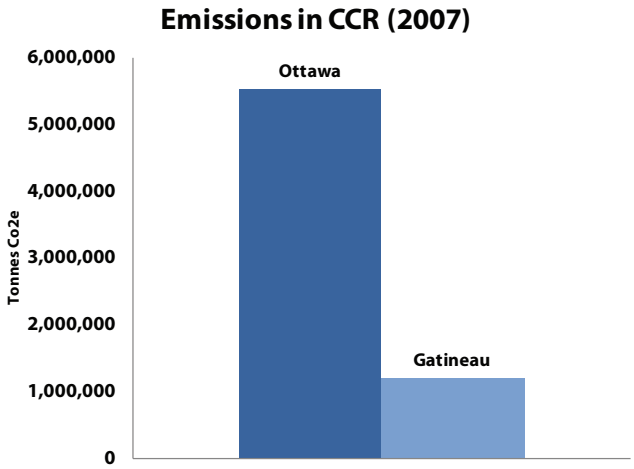

Figure 4: Emissions in CCR (2007)

Due primarily to its much larger population base, Ottawa is responsible for far more emissions than Gatineau/MRC.

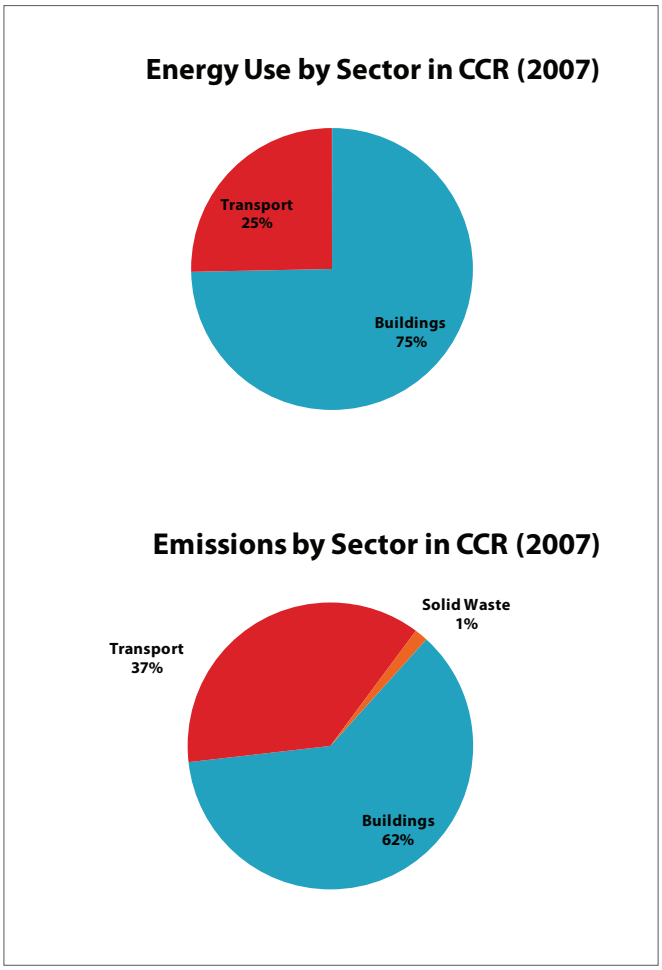

Figure 5: a & b: Energy Consumption and Emissions Share (2007)

18 Energy use and emissions were modeled using the methodology described in 3.1 above. Results for energy use and emissions consumption will be significantly different depending on the method used.

19 Energy and emission data for the City of Ottawa and the City of Gatineau were compared against these results as part of the analysis in 2010. Subsequently, the municipalities have prepared inventories of their own with different methodologies and additional sectoral coverage, and using original utility data. These recently developed inventories can be the basis for monitoring progress.

20 For example, aviation, industrial, and agricultural emissions, water and wastewater are not included.

21 Natural Resources Canada, Comprehensive Energy Use Database 1990-2008, 2010, http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive_tables/index.cfm?attr=0

22 *Ibid*

more energy is consumed per unit of building area. This difference can likely be attributed to lower energy costs in Quebec, as higher energy prices generally stimulate more efficient buildings.

ENERGY COSTS

Annual spending on transportation fuels and heating and electricity in buildings in Canada's Capital Region is estimated at over $2 billion in 2007 or about $1,800 per capita.[23] Most of this spending leaves the community, going to electricity and oil and gas sectors.

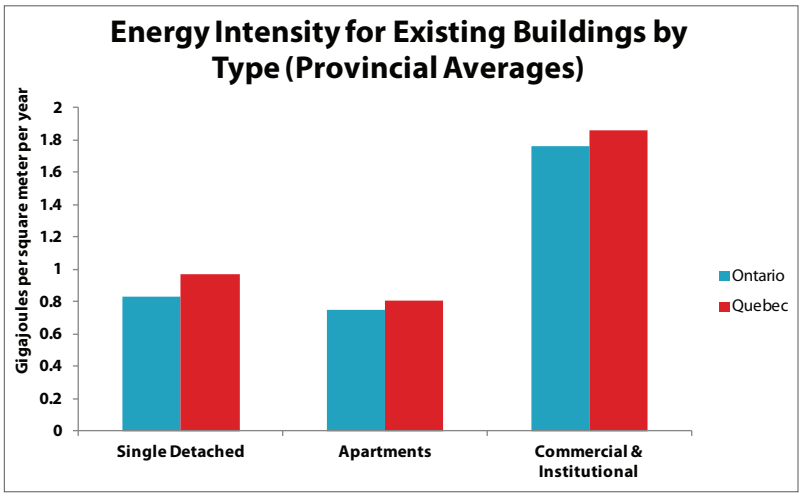

Figure 6: Energy Intensity for Existing Buildings by Type

23 This is using 2007 energy consumption and expenditures. It would be higher today given rising energy consumption and prices. Assumptions and data sources are listed in Section 4.1: Projected Energy Savings.

Table 2: Total Energy & Emissions by Fuel Type in CCR (2007)

Fuel type	Consumption (original units)	Energy Consumed (gigajoules)	Emissions (Tonnes CO2e)	Emissions Factors (kg of CO2e per gigajoule)
ELECTRICITY*	11,410,000 Megawatt-hours	41,070,000	1,500,000	36
NATURAL GAS	52,981,000 Gigajoules	52,980,000	2,700,000	51
GASOLINE	918,473,000 Litres	31,870,000	2,500,000	78
TOTAL	n/a	125,900,000	6,700,000	n/a

* It is important to note that the emissions factor for Quebec's electricity is approximately 10% that of Ontario's grid electricity.

For simplicity, diesel fuel is included in equivalent units of gasoline
The emissions factor for electricity is a weighted average for Quebec and Ontario's grid

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4 Strategies & Actions

The path towards a sustainable, lower carbon energy future in Canada's Capital Region involves strategic action across all major energy and emission sectors, as well as integrating energy and emission analysis into existing land use and infrastructure planning. This Plan lays out best practices in transportation, buildings, energy supply, and solid waste. Land Use is addressed because it influences energy dynamics in transportation, building energy demand and building energy supply.

These sectors include performance highlights and high-level strategies informed by current best practices, as well as example actions, outlining more specifically measures the Partners may take to implement these strategies. Beyond 2020 opportunities that are not commercially tenable today are also identified for consideration by the Partners to facilitate planning as their potential is better defined. Seeds of Success identifies leadership by public, private and social sectors across the Region upon which these strategies will be built.

Land Use, Transportation and Solid Waste sectors are addressed in greater detail in the *Sustainability and Resilience Plan*.

The sectoral strategies are preceded by an overview explaining the aggregated energy and emission reduction potential of all the strategic directions.

4.1 Energy and Emission Overview

Best practices to reduce energy use and reliance on fossil fuels will also lead to lower GHG emissions. **Figure 7** shows that a 40% reduction of GHG emissions from 2007 levels could be achieved across the Region in 2060 by implementing the strategic directions and actions described in subsequent sections, along with senior government actions also identified by section. Overall emissions in 2060 are estimated at less than half the level that would be generated if the Region followed historical trends. Through early action and application of best practices this decade, reductions in the order of 20% could be achievable by 2020.

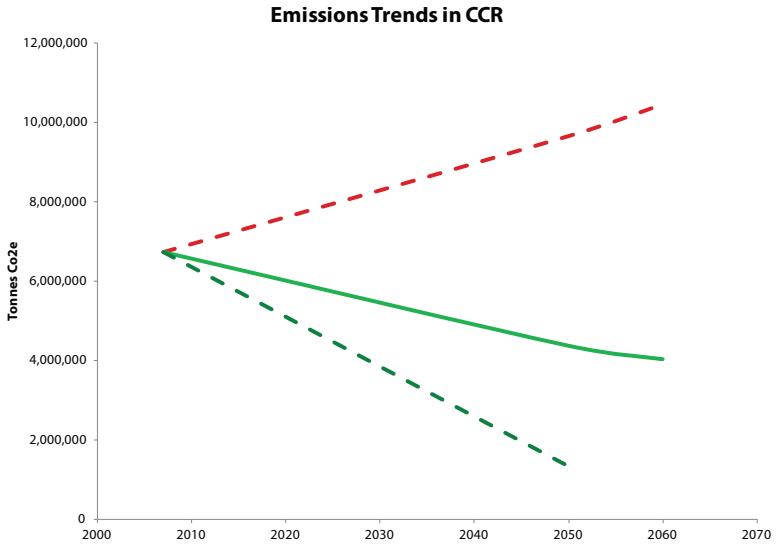


Figure 7: Best Practice and Historical Trend Projection

This chart (**Figure 7**) shows a Best Practice and Historical Trend projection, and a projection of an 80% reduction trajectory. The 80% reduction trajectory is used as a reference for the emission reductions necessary globally to avoid climate changes. This 80% reduction goal is an approximation based on the balance of scientific evidence from the Intergovernmental Panel on Climate Change. It also the long-term emission reduction target held by the Provinces of Ontario and Quebec, along with other governments around the world. Provincial action would encompass many sectors not represented in this plan (e.g. manufacturing, cement, aluminum, oil and gas production). Compared with the community sectors in this plan, emissions in some of these other sectors are growing more rapidly and are more cost-effective to reduce.

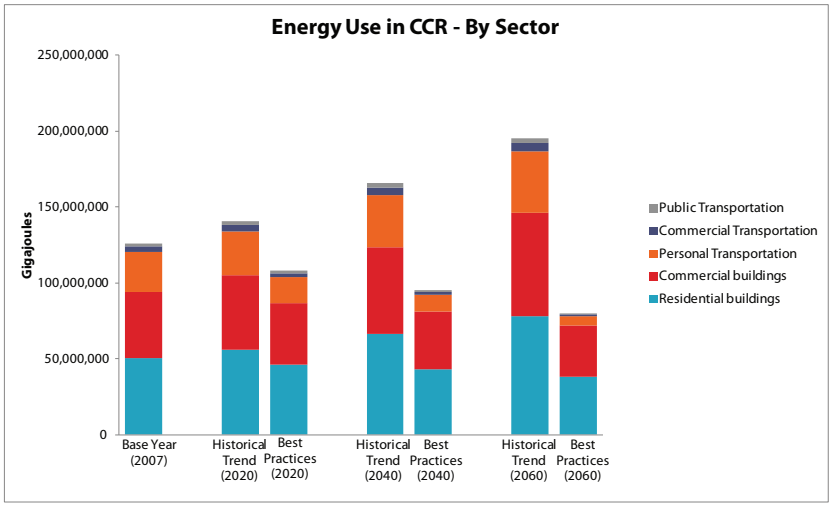


Figure 8: Regional Energy Use Base Year, and projection of Historical Trend and Best Practices

Figure 8 and **Figure 9** (*left*) compare energy use and emissions in the Region for the Historical Trend and Best Practices. Buildings continue to consume the greatest share of energy in both futures, strongly influenced by population growth, but overall energy and emissions are reduced by the projected impacts of best practices.

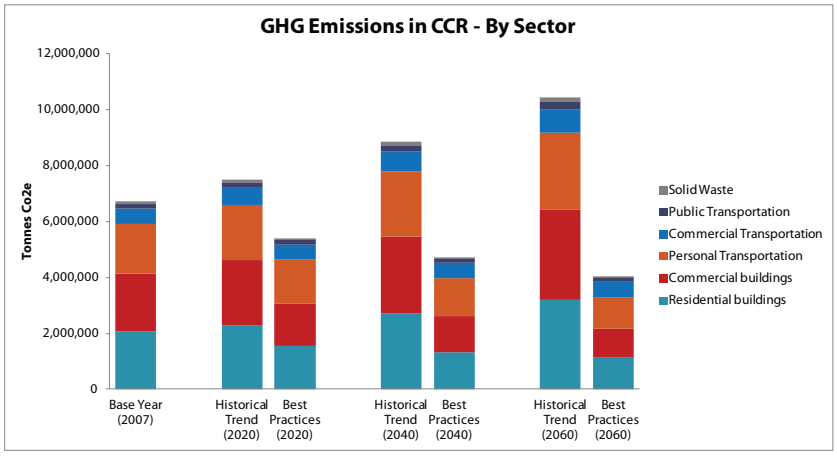


Figure 9: Regional GHG Emissions Base Year, and projection of Historical Trend and Best Practices

MAJOR STRATEGY WEDGES

The potential for emission reductions over time are captured in the wedge diagram in **Figure 10** below.

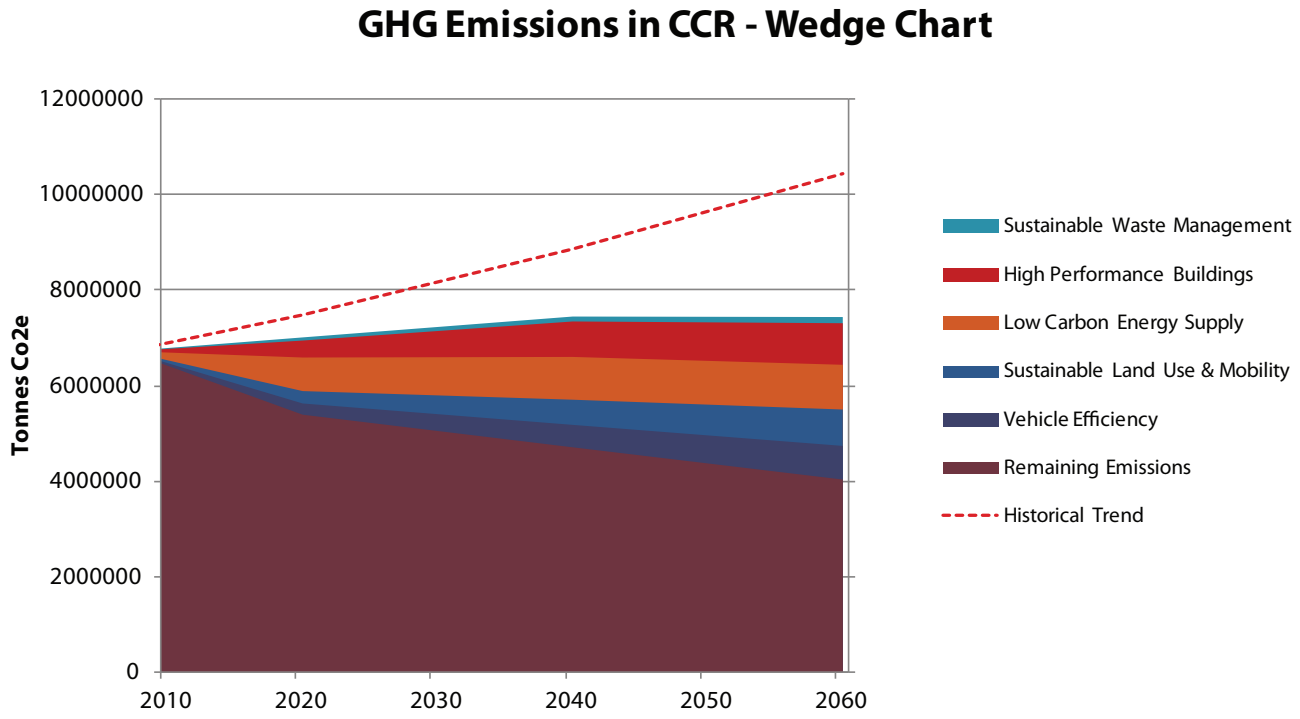


Figure 10: Major Strategy Wedges driving GHG emission reductions in Canada's Capital Region.

The topmost trajectory, the **Historical Trend**, provides a projection of what would happen if emissions today increased with population growth, and no policies that change greenhouse gas emissions were implemented after 2007. The difference between the top line of Historical Trend and the next line, Sustainable Waste Management, results from the turnover and replacement of buildings and vehicles up to new efficiency standards. As the turnover of buildings and vehicles is gradual, population growth is more-or-less balanced by gains in efficiency. The result is that emissions, in the absence of further provincial and local government policies, are likely to increase by only 10% over the next 50 years, despite substantial population growth.

The second wedge, **Sustainable Waste Management,** reflects the strategies discussed in the waste sector. This is a relatively small portion of overall emissions.

High Performance Buildings include Provincial efforts to improve energy efficiency through building codes and local government efforts to encourage new green buildings, building energy retrofits and building-scale renewable heat. Strategies within the building sector are aimed at improving envelope performance (insulation), building-scale renewable heat and energy retrofits.

Low Carbon Energy Supply, strongly influenced by the Green Energy Act in Ontario, could greatly reduce emissions from Ottawa buildings. Although Provincial incentives are critical to increasing the supply of renewable energy in Ontario, municipal strategies can promote renewable heat and electricity. District Energy is also included in this wedge, but has a relatively smaller emissions impact.

Sustainable Land Use and Mobility is largely driven by the Cities of Gatineau and Ottawa and their authority for land use planning. Building and transportation energy and emission management is strongly influenced through compact and mixed-use development.

Vehicle Efficiency is driven by improvements in technology, and most importantly tailpipe standards by senior governments, as well as additional low emission vehicle strategies locally. If senior government policies are not implemented, this wedge would shrink and the overall level of emissions could increase substantially.

Remaining Emissions represents residual emissions if the best practices outlined in each section are implemented. Over time, strategies and actions will evolve and it would be possible to further reduce remaining emissions. Strategic directions and actions will need to continue to advance and adapt as technology evolves and the regulatory environment changes.

PROJECTED ENERGY EXPENDITURES

	Base Year 2007	Historical Trend 2040	Best Practices 2040	HT-BP 2040 Difference
OTTAWA	**$1,600,000,000**	**$4,550,000,000**	**$2,250,000,000**	**$2,300,000,000**
GATINEAU/MRC	**$430,000,000**	**$730,000,000**	**$420,000,000**	**$310,000,000**
REGION	**$2,040,000,000**	**$5,280,000,000**	**$2,680,000,000**	**$2,600,000,000**

Note: Spending is inflation-adjusted to 2007. The increase in spending is driven by projected increases in the prices of electricity, natural gas and gasoline, and population growth (see footnotes in this section for sources).

Although energy prices (especially oil/gasoline prices) fluctuate significantly, the long-term trend is generally large increases in the cost of energy.

Energy prices are expected to at least double over the next 30 years (see **Figure 11**).[24,25] Average

24 The exception is electricity prices in Quebec, which are expected to remain relatively flat over time.

25 Projections are based on the best available data at the time of Plan preparation. Current and future energy prices fluctuate significantly based on demand, supply, as well as regional and often global economic, social, political, and environmental dynamics. Primary sources for projections:
Ontario Energy Board, Electricity Prices, http://www.oeb.gov.on.ca/OEB/Consumers/Electricity/Electricity+Prices
Natural Resources Canada, Average Retail Prices, http://www.nrcan-rncan.gc.ca/eneene/sources/natnat/index-eng.php
Ontario Long-Term Energy Plan, http://www.mei.gov.on.ca/en/pdf/MEI_LTEP_en.pdf
Réseau Intégré Plan d'Approvisionnement 2011-2020, www.bape.gouv.qc.ca/sections/mandats/eole_saint-valentin/.../DB5.pdf
Energy Information Administration, Annual Energy outlook, 2010, http://www.eia.gov/oiaf/archive/aeo10/index.html

household spending could increase from $2,800 to over $4,000 over this period if the Historical Trend were to continue, an increase of nearly 50%. By contrast, spending under Best Practices is approximately one half of spending under Historical Trend. On a household basis, spending under Best Practices may actually be lower than base year as efficiency savings are projected to outweigh energy price increases. On a regional basis, this amounts to savings of more than $2.5 billion annually by 2040. Most of this spending leaves the Region now to support power generation elsewhere so savings could potentially be redirected toward spending in the regional economy.[26] Significantly more spending than today would support local energy-related construction and renewable energy sectors.

These results are illustrated in the following maps showing building energy demand and per capita GHG emissions as calculated by the CEEMAP model.

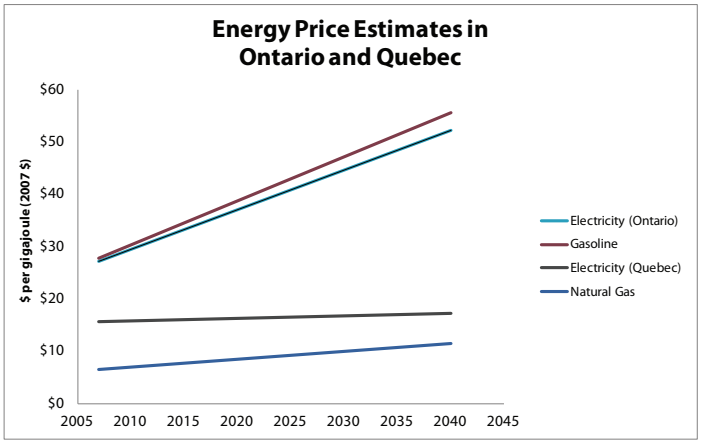


Figure 11: Energy Prices Estimates

In reality, prices for natural gas and gasoline are volatile and change substantially from day to day. These straight-line projections indicate the values used for energy price modeling in this report.

26 The Jobs Connection: Energy Use and Local Economic Development http://www.localenergy.org/pdfs/Document%20Library/The%20Jobs%20Connection.pdf

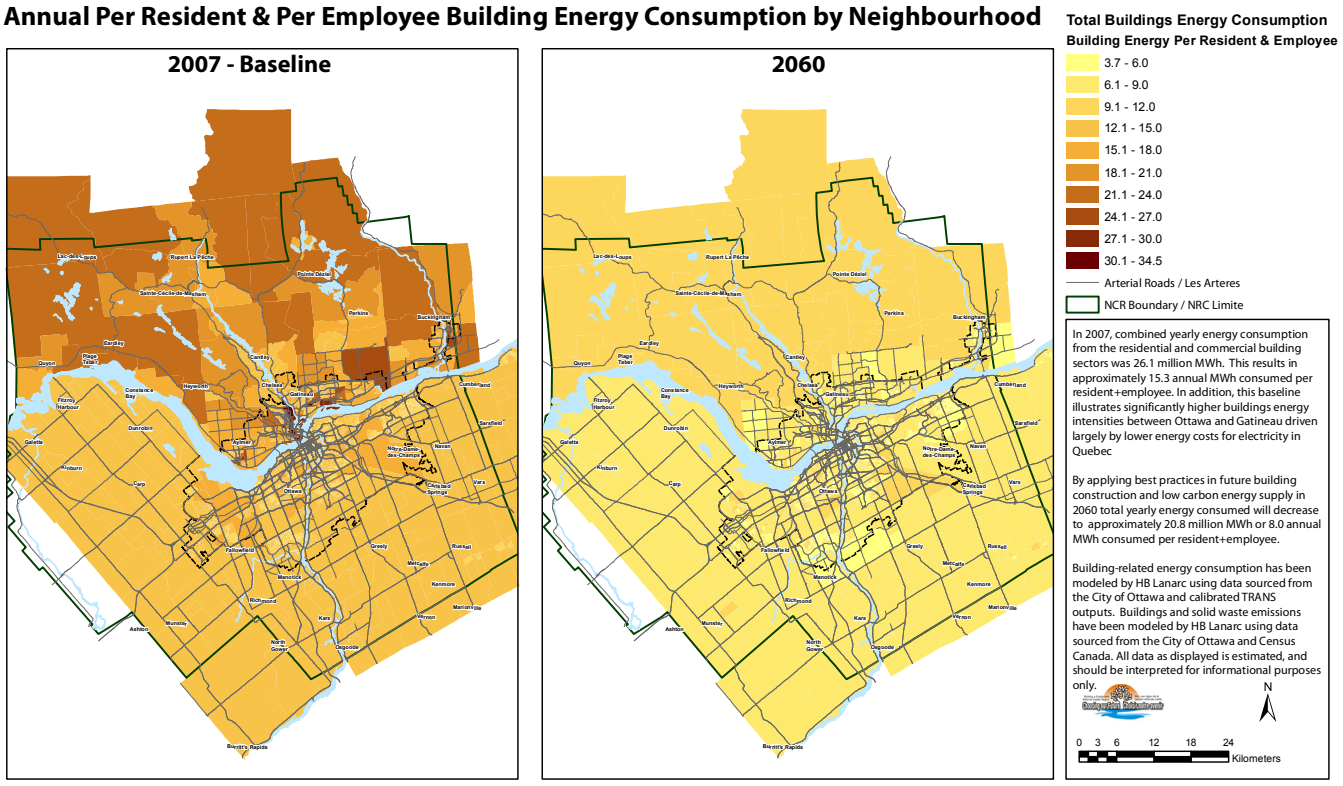


Figure 12: Building Energy Consumption by Neighbourhood

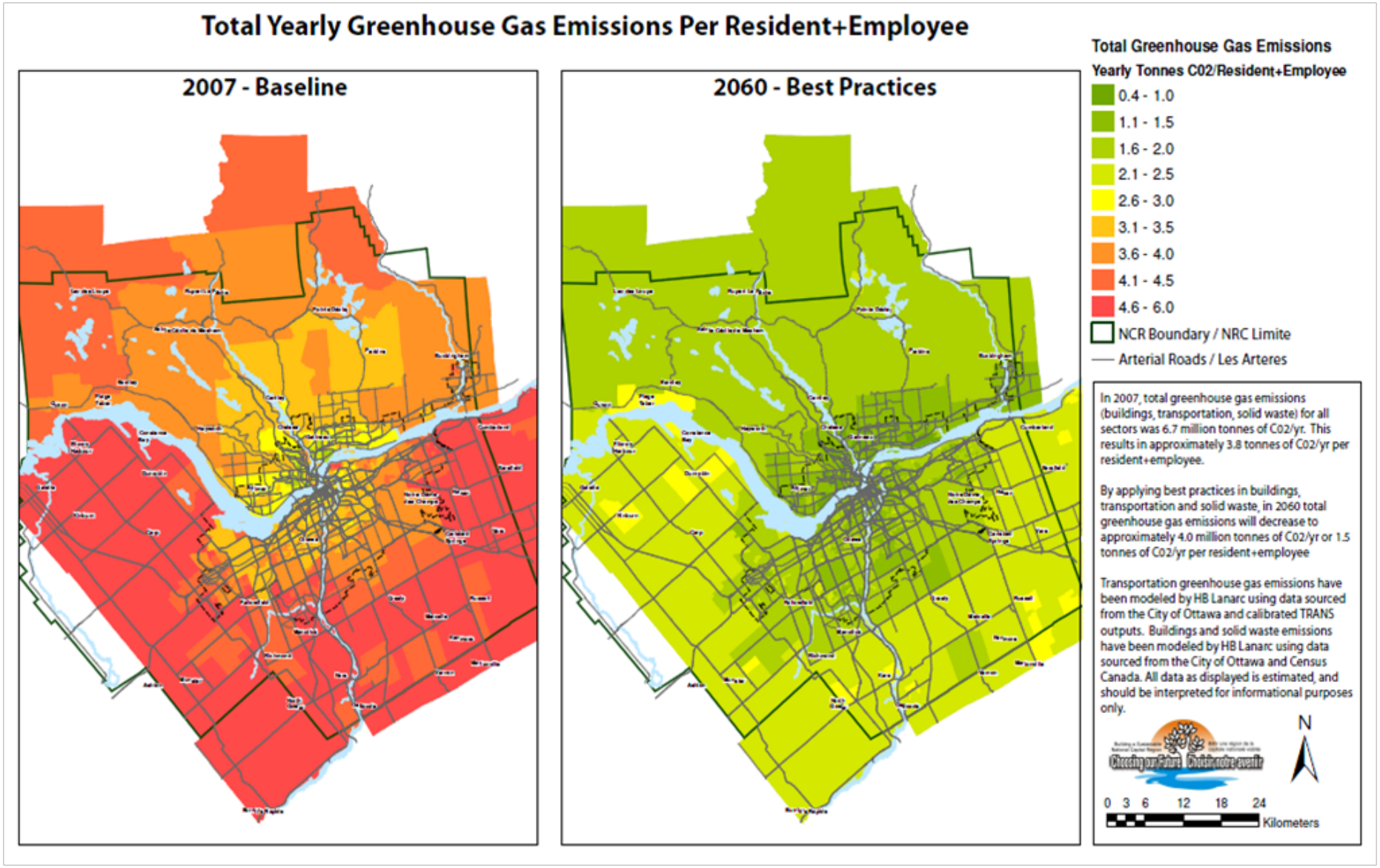


Figure 13: Total Annual GHG Per Resident and Employee:

These maps illustrate emission differences by neighbourhood in both 2007 and 2060. The "neighbourhood" unit is relevant in that housing type (single detached or some kind of attached), density, and mixed-use all can impact transportation and building emissions.

4.2 Land Use

An energy-efficient Region in 2060 could look quite different than the one we see today. Many neighbourhoods maintain their single-detached residential character, but their main thoroughfares are lined with a mix of apartments, townhouses, offices, shops and services where most everyday needs can be met. Other nodes have redeveloped as higher density housing, offices and retail around rapid transit stations. New urban districts are emerging, each with a distinct character defined by the activity of its core: an important medical facility, sports complex or university campus; a green commons; a farmers' market or restaurant district; a government campus re-designed to open into its surroundings. Today's suburbs have similarly changed, especially as walkable new cores develop on former commercial sites.

This land use future creates a pattern that will maximize building energy performance, low carbon transportation, and low carbon energy supply. Energy use decreases in this form of development because less energy is required per occupant to heat and cool smaller dwellings and in a higher density community with a mix of uses, transit, walking and cycling is more attractive than driving and trip distances are reduced. Complete, compact neighbourhoods also offer greater potential for high efficiency district energy systems. These opportunities are summarized in the 4 D's of land use and energy emissions (*below*).

Land Use, Energy, Emissions

Land use planning strongly influences energy and emission performance in transportation, buildings, and energy supply. Land use planning has been an important factor in communities that have made deep emission reductions. Land use is also the sector where local government influence is greatest.

Table 3: Four D's of Land Use and Energy & Emissions

Land Use Decisions	Transportation Implications – Examples	Buildings & Energy Supply Implications – Examples
DESTINATION (BUILDING & SERVICE LOCATION)	• Distances between origins and destinations influence travel times and effort, and in turn modal decisions and fuel consumption • Distances between origins and destinations influence transit service, costs and, in turn, use	• Co-location of heat sources (e.g. intense refrigeration-related activity such as rinks and grocery stores) and heat users (e.g. pools and breweries) permit heat sharing
DIVERSITY (BUILDING TYPE & MIX)	• A mix of residential, commercial and institutional buildings increases walking, cycling and transit use by increasing origin-destination accessibility	• Smaller home sizes can reduce per person energy and emission intensity • Shared walls in multi-unit homes (e.g. duplex, townhouse) improve thermal performance • A mix of residential, commercial and institutional buildings permits balancing of loads, influencing district energy viability
DENSITY	• More, mixed-use development increases walking, cycling and transit use	• Higher density developments establish a base load to support district energy
DESIGN	• Aesthetically enjoyable public spaces and neighbourhoods increase walking and cycling • Design can influence neighborhood layout which in turn influences transit service effectiveness and costs	• Building orientation towards sun, landscaping, window size and design influence thermal performance

These neighbourhoods also offer other benefits. Housing affordability and choice improve when communities offer a mix of unit types and sizes. Less time is spent travelling, at lower cost and greater human health benefits than by private automobile. Well-designed development with public and private greenspace and outdoor social and recreational space is also attractive and highly liveable. Residents and businesses are buffered from energy price volatility.

PERFORMANCE HIGHLIGHTS[27]

Patterns of land-use and development encourage more compact building forms. In the Best Practice future:

- Overall housing mix shifts to one-third single detached in 2060 from about one-half in 2007, because of increased construction of apartments and other multiple-unit buildings;
- Much of the new housing is built through intensification, infill and redevelopment of vacant sites or sites used for another purpose. The density of dwellings (units per hectare) almost doubles by 2060; and
- This development pattern means much of the growth to 2060 can be accommodated within the current urban boundaries. Fewer buildings are constructed on greenfield (undeveloped) sites.

These changes will play out in energy and emission performance in buildings and transportation.

27 Numerical performance projections are outlined in Appendix 1.

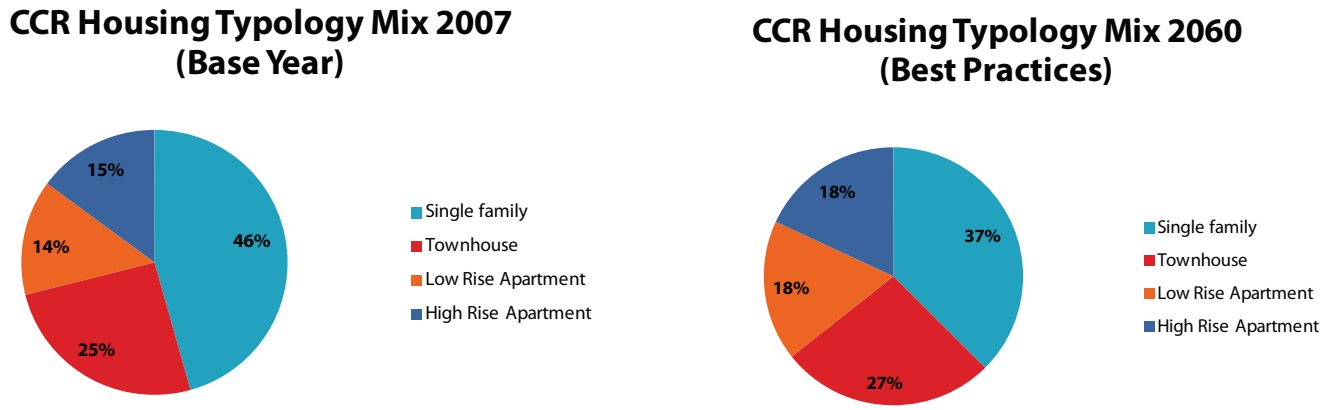


Figure 14: Housing Mix Over Time

Best Practices encourage a more even balance of single-detached and multi-unit housing. These shares are measured relative to the total stock of buildings.

STRATEGIES & ACTIONS

Current initiatives are already shifting the Region towards a more sustainable path. The Ottawa Official Plan is based on sustainability guiding principles and compact/ mixed-use development. One-third of new urban dwelling units were created through intensification between 2007 – 2010. The Gatineau Plan d'urbanisme specifies creating complete urban villages and intensification areas around public transit.

More focussed growth and mixed-use is required, to support deep emission reductions and create the land use context for a sustainable energy future. Strategic directions most relevant for energy and emissions are summarized below and described in more depth in the *Sustainability and Resilience Plan*.

1. Maintain a compact region

The overall form and pattern of the Region's settled areas is perhaps the most important sustainability and resilience consideration. A compact settlement pattern makes transit and active transportation modes more efficient and attractive and results in reduced energy use and transportation emissions. Example actions that support this strategy include:

- Continue to pursue current policies to minimize urban boundary expansions; and
- Continue to invest in existing roads, water, wastewater, transit facilities, and other infrastructure so that it can support redevelopment.

2. Build complete neighbourhoods and communities

Complete communities allow people to meet most of their daily needs within their neighbourhood. These complete communities centre around higher-density mixed-use areas on the expanding network of rapid transit stations. With less need to travel to meet needs, transportation energy costs and emissions can be reduced. Example actions include:

- Implement plans for distinct neighbourhoods in and around the downtown areas of Ottawa and Gatineau with a variety of housing, well-designed open space, and convenient services; and
- Continue to involve communities in plans and proposals for development that increase the range of services and employment opportunities.

3. Redevelop office areas on the rapid transit system including federal office complexes as mixed-use nodes

Rapid transit stations represent the best opportunity to develop truly complete and compact areas with excellent transit service. Federal office complexes and employment areas on or near rapid transit stations are prime candidates for this type of redevelopment. These nodes could accommodate significant growth, increase rapid transit viability, create liveable neighbourhoods clustered around jobs, and provide opportunities for community or district energy systems. Example actions include:

- Continue to pursue redevelopment of areas on rapid transit systems; and
- Explore opportunities for building-scale and large community energy systems in these areas.

4. Retrofit the suburbs

Much of the developed area of 2060 is already developed, so today's challenge is how to recreate low density areas so that they can accommodate more households and support walking and cycling. This will involve looking at existing suburbs and finding opportunities to enhance some of these areas to create more complete, attractive and energy-efficient neighbourhoods. The biggest challenge will be to change the street and block pattern—the longest-lasting feature of our land use decisions—to increase linkages and shorten distances between destinations. On the 50-year horizon, land-extensive office and shopping areas may become obsolete and opportunities may arise to rebuild these areas as unique places. Example actions include:

- Over time, transform post-war suburbs into more convenient, pedestrian, and bike friendly neighborhoods with street pattern connections for active transportation and direct access to good transit services;
- Continue to intensify town centres focused around rapid transit stations; and
- Encouraging low profile infill development and density in the form of secondary suites and small apartments.

5. Protect the integrity of rural areas

The option of living in the rural area is part of the Region's appeal. While the most growth in the Region occurs through the development of urban lands, rural lifestyles should also remain a viable option. This rural growth should be focused in existing villages. Country lot subdivisions also accommodate rural housing, but are more land-intensive than villages and produce a greater reliance on the private automobile with the resulting increase in transportation emissions. Example actions include:

- Growth that is moderate, focused and sensitively designed; and
- Allow for a broader range of commercial services and home-based businesses in villages.

6. Improve greenfield development

Even with a strong overall intensification agenda, there may still be demand for new housing to be built on undeveloped land. Greenfield development is usually, by its very nature, less sustainable than infill and intensification because it requires new land and servicing and reliance on the private automobile. Greenfield development should be held to the highest standards of design and environmental performance. Example actions include:

- Use of design standards for environmental performance and energy efficiency, such LEED-ND (Leadership in Energy and Environmental Design – Neighborhood Development); and
- Provide quality public transit and transit-supported development early in the development of new communities to establish transit as the preferred mode of travel.

7. Encourage design excellence

Intensification works best when it is well-designed. As the Region grows and some areas densify, the overall quality of design must improve if neighbourhoods are to remain attractive. The Region needs to value its unique qualities and physical assets and make them the basis of its future. There are different "places" within the Region—the urban core, older urban neighbourhoods, new suburbs, arterial commercial streets, and the farms, rural acreages and villages. These elements should be preserved and celebrated in any plans to manage growth in the future. Urban design also provides good opportunities for reducing energy use and sensitively incorporating building-scale renewables. Example actions include:

- Continue to develop use of design advisory panels, peer review, and design guidelines; and

- Leverage the expertise in universities and colleges in the Region by forming partnerships to address urban design issues and implement advanced building technologies.

4.3 Transportation

Transportation is the fastest growing source of energy use and related greenhouse gas emissions. Land use and transportation are inextricably linked. The distance, frequency, mode and experience of trips is strongly shaped by land use. Transportation infrastructure such as roads, sidewalks, street furniture and bike networks, and public transit network and facilities also strongly influences transportation patterns.

In the 2060 projection, the convenience and comfort of active and low-carbon transportation modes is enhanced and claims a larger share of local trips. Street corridors could combine transit, car, and active transportation modes to serve residences and shops; intensifying land uses along these corridors with a mix of higher-density residential development and job-related land uses would provide the population base needed to support more efficient and effective transit. Neighbourhoods would be designed as complete communities with home, work, shops, and leisure activity located in convenient proximity to each other.

Rapid transit systems would link communities to hubs, link hubs to one another, and then link to the greater urban region. The mix and balance of land uses would allow many residents to live a comfortable walking distance of daily needs, supporting active modes of travel. Cycling lanes would thread through the surrounding areas, putting most homes within 5 kilometers (about a half hour of cycling) from transit and community facilities.

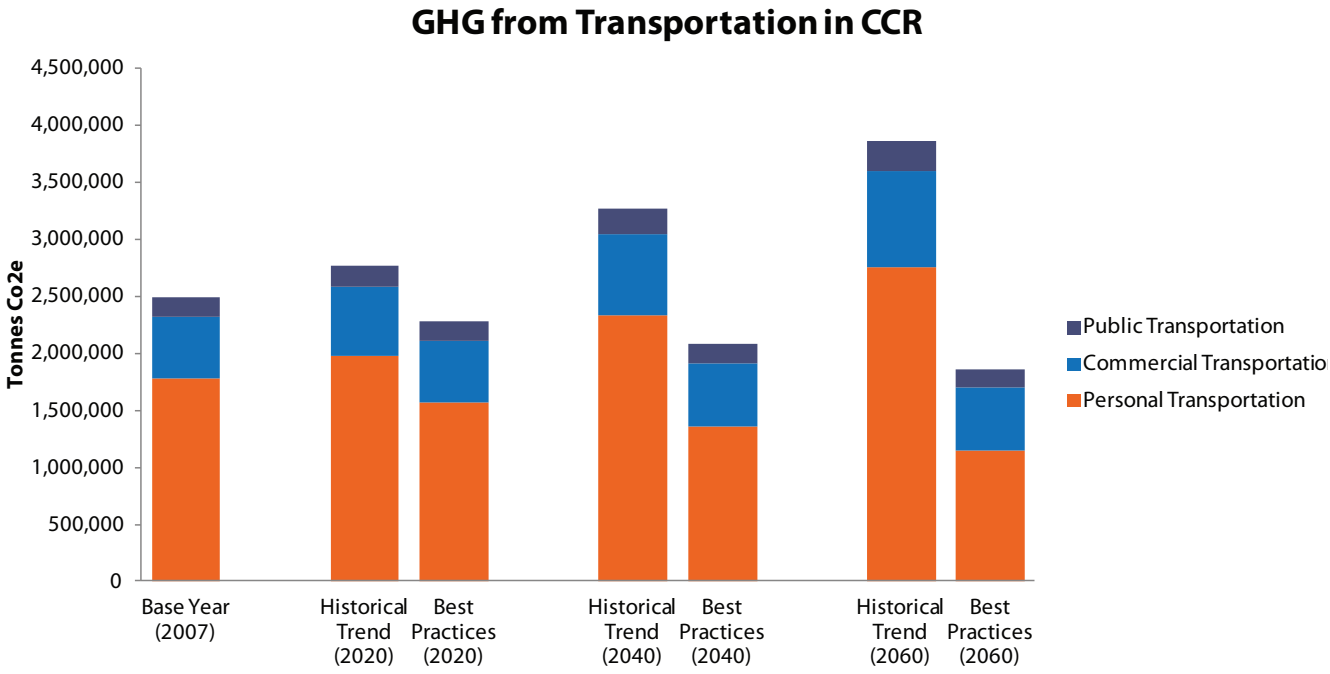


Figure 15: Emissions by Mode Over Time

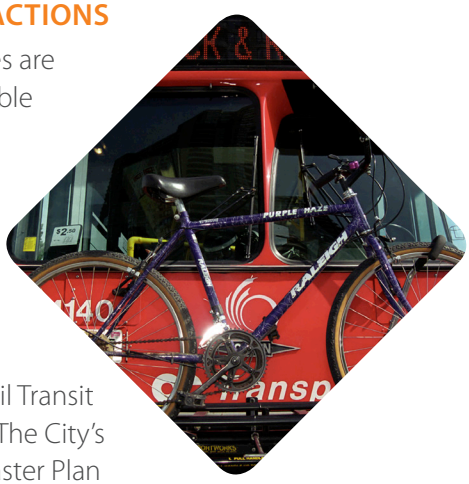
Commercial transportation emissions are highly approximate.

PERFORMANCE HIGHLIGHTS[28]

In the CEEP model, emissions from transportation are estimated to decrease 27% by 2060 using Best Practices. This is due to a combination of higher vehicle efficiency and more non-automobile transportation (public transit, walking, cycling) supported by better infrastructure, and shorter travel distances due to land use changes. Performance improvements are based on the following changes:

- More extensive rapid transit and more focused growth doubles the population within 5 km of a rapid transit station in Ottawa and increases by a third in Gatineau/MRC;
- The average annual distance driven by residents in CCR is projected to decrease almost 7% by 2060. Reductions are more substantial in Gatineau/MRC than in Ottawa; and
- Construction of off-road cycling paths, mostly from current plans, doubles the number of metres of bicycle pathways per capita in Ottawa by 2060.

STRATEGIES & ACTIONS



Both municipalities are making considerable progress towards more sustainable transportation. The City of Ottawa is on track to open the first portion of an extensive Light Rail Transit network by 2018. The City's Transportation Master Plan includes targets and programs for active transportation. The City of Gatineau Rapidbus project (with adjacent bicycle paths) will connect Gatineau to downtown Hull, with links to Ottawa.

The federal government is also moving to implement vehicle fuel efficiency standards through the *Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations*.[29] These changes are reflected in future energy and emission projections. Increases in fossil fuel prices will also create market incentives for increased fuel efficiency.

Further progress can be made through the strategies described below and explored in more depth in the *Sustainability and Resilience Plan*.

1. Integrate land use and transportation systems

Land use and transportation of people and goods work together. Neighbourhoods with medium or higher densities of housing and jobs create the population needed to support quality transit service. A mix of shops and services in these areas enables residents and employees to walk or cycle short distances as part of their daily routine. Walking, cycling and transit are also supported by a pattern of small blocks that allows people to follow direct routes. Walking and cycling are further enhanced by design features such as wide sidewalks, bicycle lanes, landscaping, and other features that create attractive public areas. This pattern of development has been linked to reductions in vehicle trips and related reductions in GHG emissions of 24% – 50% as compared to low-density single-use residential developments and cul-de-sacs.[30] Examples of actions which could move us in this direction include:

- Transit-oriented development around stations;
- Design complete streets that serve all users and include transit and bicycle lanes and public meeting spaces; and
- Extend the network of streets closed on Sundays and encourage businesses and the public to use the space.

28 Numerical performance projections are outlined in Appendix 1.

29 http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=7DFF93CB-5188-4B89-83E6-AC8B3022C738

30 CMHC, 2000. Research Report – Greenhouse Gas Emissions from Urban Travel: Tool for Evaluating Neighborhood Sustainability

2. Expand mobility options

The design of streets is a major factor in our choice of transportation mode. If streets are directly connected to destinations, safe, comfortable and interesting, then walking, cycling and transit can become preferences. In addition to air quality improvement and reduced reliance on fossil fuels, walking and cycling can reduce obesity, improve cardiovascular fitness, and even improve mental health. Examples of actions which would contribute to this strategic direction include:

- Expand short-term bicycle rentals plus car-pooling and car-sharing;
- Ensure that public transit, pedestrian routes and public spaces are physically accessible to all users; and
- Help residents and visitors navigate by providing signs, e-communication links and maps that connect transit, cycling and pedestrian routes and that show major destinations.

3. Improve interprovincial connections

Led by the federal government, the Partners and other parties are currently evaluating possible bridge locations. A primary consideration in the evaluation is each location's suitability as a truck route. Examples of actions that support this strategy include:

- Build a new interprovincial bridge and reroute truck traffic from downtown Ottawa streets and neighbourhoods; and
- Continue to explore options for new rapid transit connections between Ottawa and Gatineau.

4. Facilitate the transition to vehicles using alternative power

Municipalities can facilitate the phase-in of low-emission vehicles. While lower on the sustainability hierarchy than active transportation and transit, low emission vehicles—including hybrids, full electric, natural gas, biomethane, biodiesel and electric scooters and bicycles—are an important opportunity for reducing emissions, particularly as the carbon intensity of the electricity supply is reduced.

Advancing a low carbon automotive sector will require action and coordination between governments, utilities, private industry and associations, and the development community. While evolution towards electric vehicles, for example, will be gradual, it is important to begin to assess options and prepare today for this future. Examples of actions that support this strategy include:

- **Higher Standards**: Encourage Federal and provincial improvements to vehicle efficiency standards;
- **Charging Facilities:** Research initiatives in other Canadian cities and elsewhere that encourage or require new multi-unit residential and commercial buildings to provide charging facilities for battery-electric and plug-in hybrid vehicles. Prepare a strategy to ensure that future development is in a position to accommodate battery-electric and plug-in hybrid vehicles;
- **Preparing the Electrical Grid:** Utilities will continue to examine and adjust to the implications of vehicle charging and future smart grid capacity and opportunities;
- **Preferential Parking:** Provide preferred parking spots and reduced parking rates in municipal parkades and street meters for low-emission vehicles;
- **Alternative Re-Fueling Stations:** Encourage new gas stations to include rapid electric vehicle charging infrastructure and alternative fuel; and
- **Green Fleets:** Continue to pursue transit vehicle emissions to near-zero and monitor developments and advances in fuel-cell technology and alternate vehicle power sources. Continue to improve municipal fleet efficiency by phasing out less efficient vehicles. Encourage commercial and institutional fleet operators to establish green fleet programs, include the use of low emission vehicles.

BEYOND 2020 OPPORTUNITY – ZERO EMISSION TRANSPORTATION

In the approach to 2060, the transportation sector could look different than today and be in a position to become a zero-emissions system. Garages could contain electric/plug-in hybrid vehicles and e-bikes with dedicated charging facilities. A smart grid fueled in part with renewable energy may allow a homeowner or business to switch from charging a vehicle to feeding the grid depending on the need and electricity price. Easy access to an electrified rapid transit system could be provided by neighborhood shuttles. Overall, the transportation system supports a cleaner, more convenient and more sustainable community.

While the technology to support this future is evolving, steps can be taken today to better prepare us for tomorrow. Many of these steps are embedded in the strategies and actions. The next series of Official Plan reviews will need to explicitly examine the potential to support this kind of transportation system through land use policies. Public agencies can become early adopters of zero-emission technology and provide required infrastructure at public facilities.

Electric Vehicle Energy & Emission Opportunities

Vehicle electrification (e.g. plug-in hybrid electric—PHEV—and full electric vehicles—EVs) is an opportunity to improve transportation energy efficiency, reduce greenhouse gases and other air pollutants, decrease oil demand, and reduce operation and maintenance costs. In the short-term, higher purchase prices and range limitations—compared to internal-combustion-engine (ICE) vehicles—will make EVs a niche market. Over 10-20 years, however, it is predicted that a combination of technological innovation, policy evolution and market forces will result in EVs becoming more common in commercial and residential sectors.

Efficiency and Emissions

EVs—especially those charged using low carbon, high efficiency power sources such as hydroelectricity—use energy more efficiently and are responsible for significantly fewer air pollutants than their ICE counterparts. A typical EV uses 0.0828 gigajoules (GJ) per 100 km traveled.[31] An average passenger vehicle on the road today uses 0.348 GJ per 100 km traveled.[32] In terms of greenhouse gas emissions EVs also look favourable. In Ontario a typical EV will be responsible for 39 grams CO2e per kilometer.[33] In Quebec a typical EV will be responsible for 1– 2 grams CO2e per kilometre; the average ICE passenger vehicle emits 237 grams CO2e per kilometre.[34]

Infrastructure

Electric and plug-in hybrid vehicles require special charging infrastructure at homes, businesses, transportation hubs and major transportation corridors. In anticipation of the wave of new vehicles that will be coming onto the roads, local and national authorities in coordination with vehicle manufacturers, utility companies and other interest groups have developed guidelines and codes for charging infrastructure. The Ontario government has set a target of one out of every 20 vehicles to be electrically powered by 2020. To support this target, Ontario has announced incentives. Purchasers can benefit from:

- Green licence plates, giving access to high occupancy vehicle (HOV) lanes, even with only one person in the vehicle.
- Access to public recharging facilities at GO stations and Ontario government parking lots. The Ontario Power Authority and other entities are working to ensure seamless integration of EVs with the grid through the installation of smart meters that can control the time of day that charging takes place and could eventually draw power from a plugged-in EV in the event of a power outage to provide emergency power. Regional governments, in partnership with utility companies and non-profit organizations are beginning to design and construct EV charging networks along important transportation corridors. The Washington State Electric Highway project aims to install public access charging stations every 65 – 100 kilometers along Interstate-5 from Oregon border to British Columbia by 2012.[35]

31 According to the United States Environmental Protection Agency (US EPA), the 2011 Nissan Leaf (full electric vehicle) uses 0.23 kW-h of electricity per kilometre traveled. 1 kW-h is equivalent to 0.0036 GJ.

32 Based on 10 litres gasoline per 100 km; 1 litre gasoline = 0.0348 GJ.

33 0.23 kW-h per km * 170 grams CO2e per kW-h (2008 Ontario grid average) = 39 grams CO2e. Quebec grid average electricity emission factor = 6 grams CO2e / kW-h

34 0.10 litres per kilometre * 2374 grams CO2e per litre of gasoline = 237 grams CO2e. (CO2e content of gasoline from: Environment Canada, National Inventory Report, 1990-2007: Greenhouse Gas Sources and Sinks in Canada (2009), Annex 12: Emission Factors, Table A12-11.)

35 For example, see: The EV Project, http://www.evproject.com

BEYOND 2020 OPPORTUNITY *cont'd*

Market Penetration

Every major car manufacturer plans to mass market EVs in North America within the next three years. Market analysis and modeling by utility companies, the Electric Power Research Institute and others has produced projections for EV sales and overall fleet composition over the next half-century. Ontario's target of 5% EVs by 2020 is in line with the projections for other leading jurisdictions in North America. BC Hydro's "Reference Case" for EV adoption predicts EVs will constitute 3% of passenger vehicles by 2020 in BC, increasing to 14% by 2030 and 28% by 2040.[36]

36 BC Hydro 2010 - Electric Load F(EVs)http://www.bchydro.com/etc/medialib/internet/documents/planning_regulatory/iep_ltap/2011q1/electric_load_forecast.Par.0001.File.Electric-Load-Forecast-2010-march-24.pdf forecast 2010 to 2030. Appendix 4. Electric Vehicles

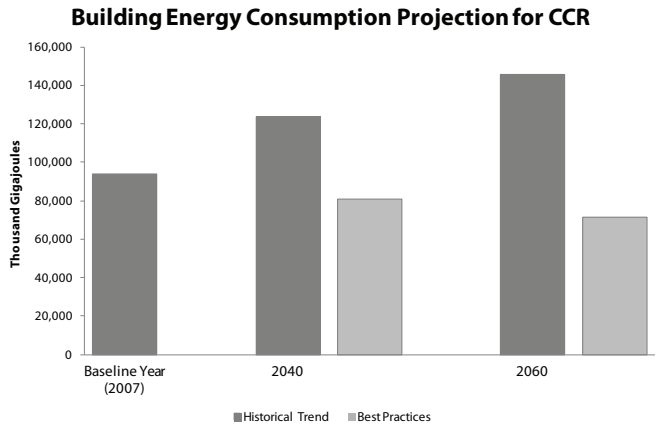
4.4 Buildings

Buildings are the largest source of energy consumption and GHG emissions in Canada's Capital Region. They also present major opportunities for lowering energy use and emissions simply by using existing technologies and practices, and changing behavior as building managers and occupants.

Over the last two decades, building innovations have advanced rapidly. Voluntary rating systems support performance improvements in the order of 25% beyond code, and some much greater than that.[37] Passive building design standards, common in parts of Europe, can reduce heating 80% – 90% across all building types, and total home energy requirements by 50% – 65%.[38] Some North American local and senior governments are exploring policies to eventually require near-net-zero energy buildings where as much or more energy than is required comes from on-site sources.

37 E.g. Energy Star, Novoclimat, and LEED

38 Common in Northern Europe, see: Intelligent Energy Europe. May 2006. Energy Saving Potential of Passive Houses.: //erg.ucd.ie/pep/pdf/Energy_Saving_Potential_2.pdf.



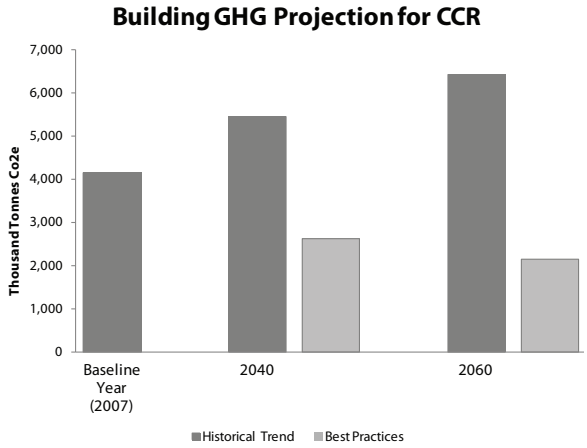


Figure 16: Building Energy & Emission Comparisons: Best Practices vs. Historical Trend

The majority of building energy and emissions in Ottawa over the next half century will come from existing buildings. Energy retrofits can typically improve performance of existing buildings by up to a third using well established technologies and construction practices.

Senior governments have authority over regulating building energy performance. A small but growing number of local governments are taking leadership on reducing building energy demand, recognizing they have authority over zoning tools that determine building type, for example, and can influence performance through the permit process, incentives, passive design guidelines, inspections, as well as training for staff and the building industry. Some are also playing a role in supporting building retrofits.

Thermal Efficiency Trends

The thermal efficiency of buildings has changed dramatically over time, underscoring the potential for energy retrofits. This chart shows single-detached home performance on a square meter basis over time. It also shows dramatic improvements are still possible to achieve standards such as those reflected in the Passivhaus Program.

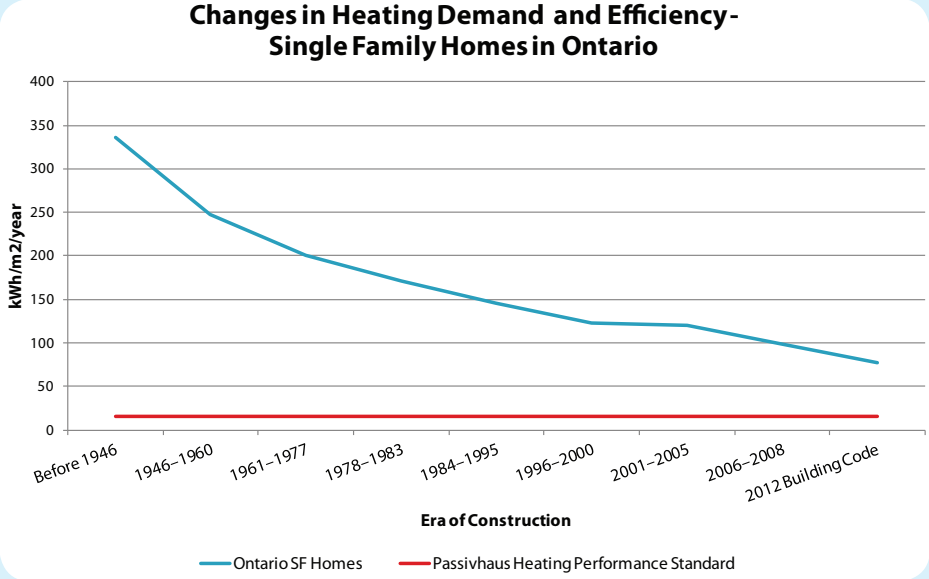


Figure 17: Changes in Heating Demand

Key considerations:

- Includes space and water heating
- 2006 Code in Ontario is EnerGuide 70 equivalent
- By 2012 houses will be required to achieve an EnerGuide 80 rating
- Passivhaus is approximately EnerGuide 90 equivalent (estimate based on comparing different "standards")
- This chart does not consider changes in building or household size. The former has grown significantly since WW II, and the latter has shrunk significantly, offsetting much of this gain in energy efficiency once it is calculated on a per capita basis.

Notes

- Historical performance data adapted from Natural Resources Canada, Comprehensive Energy Use Database, Table 33 http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive_tables/index.cfm?attr=0
- 2012 Code performance data adapted from Ontario Ministry of Municipal Affairs and Housing, The Building Code - Energy Efficiency And Barrier-Free Access, http://www.mah.gov.on.ca/Page7154.aspx
- Passivhaus data adapted from Passivhaus Institute: http://www.passiv.de/

PERFORMANCE HIGHLIGHTS[39]

Best practices adopted by the Region could result in a reduction in energy consumption by half and two-thirds in greenhouse gas emissions over the historical trend (*see* **Figure 16**)

These Best Practice performance improvements are based on the following assumptions:

- The average size of a new single-detached home has increased steadily since the 1950s, increasing per capita energy consumption. By 2040, the average size would decrease 5% relative to 2007 levels.
- New development is assumed to exceed Building Code standards by 20% by 2020, and continue to exceed each new code update through 2060.
- Annual energy retrofit rates are expected to rise to 2.5% by 2020 from an estimated 0.5% in 2007.

STRATEGIES & ACTIONS

The Partners and the private sector have established a solid foundation for advancing building energy performance in the Region. Over and above these efforts, the Province of Ontario is requiring increased energy performance improvements through the building code. This is projected to continue following a similar trend. Quebec is expected to shadow similar performance requirements by several years. These measures are reflected in energy and emission projections.

1. Strengthen retrofit opportunities in residential, commercial and institutional buildings

For decades to come, the greatest share of building energy use will be from buildings that exist today. Many older buildings can improve energy efficiency by a third through upgrades to the walls, windows, and air tightness, as well as optimizing HVAC, mechanical and electrical systems of larger, more complex buildings. Payback periods range from 2 to 12 years.

Seeds of Success

A variety of initiatives across the Region are already reducing building energy demand, including:

- **All three Partners have established corporate green building policies based on LEED certification, and have aggressive programs to reduce energy use including a Smart Energy program in the City of Ottawa which invests in the order of $2 million dollars/year in energy retrofits.**
- **Ottawa: Diverse demand side management programs are available for new and existing commercial, institutional and residential buildings. Programs are offered by the provincial government, Ontario Power Authority, Enbridge and Hydro Ottawa, the municipal utility. The City is developing a green building promotion program for private development.**
- **Gatineau: Diverse demand side management programs are available for new and existing commercial, institutional and residential buildings (e.g. Éconologis, Novoclimat, Rénoclimat). Programs are offered by the provincial government, Hydro Quebec, and gas utilities (e.g. Gaz Métro and Gazifère). The City has its independent programs, e.g. incentives for LEED certified homes.**
- **LEED Buildings: More than 160 buildings across Ottawa and Gatineau have been built or are in various stages of certification.**

39 Numerical performance projections are outlined in Appendix 1.

Existing senior government and utility retrofit support comes and goes, and may need to be supplemented to achieve retrofit targets. .

Measures to improve energy efficiency can be cost-effective because of the long-term savings in energy expenditures. There are, nevertheless, challenges for home and business owners.

- Lack of money to pay up-front for the full cost and unwillingness or inability to assume debt;
- A focus on the initial cost rather than the long-term savings—savings the owners may not realize if they move so an incentive to act sustainably is lacking;
- Concern about the reliability of new technologies and access to knowledgeable sales and service people.

Specific building types also have unique challenges:

- Inadequate management of heating, cooling and ventilation systems in large, complex residential, commercial and institutional buildings can waste a third of a building's energy;
- Landlords have little incentive to invest in energy efficiency because tenants pay the energy bills. Tenants have little interest because the benefits stay with the building owner.

Example Actions

- **Cool Roof, Cool City Campaign:** A changing climate is projected to amplify the urban heat island effect, whereby areas with concrete, asphalt and barriers to wind are warmer than surrounding areas. The urban heat island effect reduces comfort in urban environments, exacerbates air pollution problems, and ultimately effects human health. From an energy perspective, this is increasingly important as power demand peaks in the summer to meet air conditioning needs in buildings. Cool Roof Campaign measures could include:
  - » Green or light coloured roofs rather than (dark) asphalt shingles
  - » Green walls and light coloured materials on building exteriors
  - » Shading buildings through tree planting, reflective canopies, and building orientation
  - » Greening site design with plantings, reduced pavement, and increased permeability

- **Education & Outreach:** Building on existing programs, aggressive efforts can target residential and commercial audiences with promotion on energy efficiency, new technologies, existing retrofit programs, financial incentives, and local service providers. Use key leverage points, e.g. permitting office, local utility, local hardware stores. Special programs would target key constituencies (e.g. builders and developers, and landlords and real estate agents who could, in turn help strengthen consumer knowledge).
- **Building Manager Training:** Promoting training opportunities for building managers in larger commercial/institutional/multi-unit residential buildings, in partnership with building owners and managers, local colleges, and groups that now provide training. Models currently exist for these programs.
- **Green Landlord Partnerships:** Raise awareness and create incentives and partnerships to support retrofits in tenant-occupied, large commercial/ institutional/ multi-unit residential buildings.
- **End Energy Poverty Programs:** Target low-income households in private and social housing for support due to the high percentage of household spending on energy and low energy performance and practices in lower cost housing. Coordinate and build on existing efforts amongst municipalities, community

organizations, senior governments, housing providers, and utilities.

- Retrofit Financing: Develop new initiatives to reinforce existing programs with locally driven, long-term retrofit financing. This could be through existing utility companies, a municipal building energy office or a non-profit, potentially with private lenders who would get a guaranteed return. Program administration costs could be recouped through energy savings. Early research could evaluate appropriateness of different financial instruments (e.g. on-bill financing and local improvement charges) for effectiveness and administrative burden.
- Tower Retrofits: Develop a targeted residential retrofit program focusing on this high energy intensity building sub-sector. The program would ideally simultaneously consider transit and active transportation enhancements.

2. Improve energy and emission performance of new residential and non-residential buildings

Applying up-to-date technologies and practices is an opportunity to avoid unnecessary growth in energy spending and greenhouse gas emissions. The incremental cost associated with energy efficient or green building continues to drop as supply and demand grows. Integrated design has in some cases permitted advanced performance with no cost premium. Higher initial costs pay back over time as operation and maintenance costs are reduced.

While progress is being made, ongoing challenges include:

- The "split incentive" for developers and builders who pay the cost for energy innovations but do not share the benefit of the energy savings benefit experienced by occupants and owners;
- Building owner/buyer predisposition to focus on first costs versus the combination of capital and operation and maintenance costs;
- Tenant disinterest in efficiency investment because they are likely not going to earn a return, and landlord inability to continually integrate energy expenditures;
- Technical know-how amongst building and construction professionals; and
- Municipal policies and procedures inadvertently making innovation difficult.

While authority to regulate higher performance currently rests with senior governments, municipalities have a range of tools they can apply to support higher performing buildings. Many of these action opportunities can, and are, being pursued today. Others require a longer-term effort and in some cases, additional authority.

Example Actions

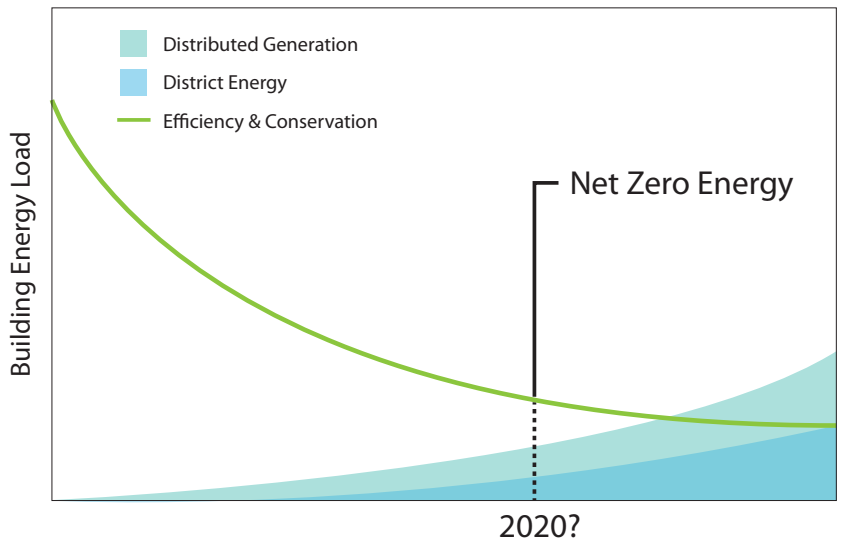
- **Promote Green Building in the Planning Process:** Negotiate higher building performance at key points in the development process (e.g. rezoning and permit application) and develop appropriate tools to achieve this (e.g. density bonusing policy, green building checklist, passive design guidelines). Recognize environmental performance through express/facilitated review and approval processes
- **Builder & Developer Training:** Strengthen training of builders and developers to design and build with a whole building perspective, improving performance at lower costs. Programs could include collaboration with education institutions, trade associations, and other potential partners.
- **Education and Outreach:** Education and outreach to key constituencies in the building sector from prospective buyers to builders.
- **Green Realtors:** An educational partnership with real estate agents to integrate energy costs and health benefits into promotion. Such a program could include promotion of energy rating/labelling during real estate transactions or marketing.

- **Policy Barrier Review:** Reduce municipal policy barriers inadvertently increasing the time and cost for high efficiency building construction.
- **Greater Legislative Authority:** Seek legislative authority from the provincial government to enact superior building performance policy municipally
- **One-Stop Conservation Shop:** Explore potential for phasing in a single-window through which all conservation programs from all levels of government and utilities for new and existing buildings could be accessed, including enhanced local services.
- **Cool Roofs:** Promote green as well as light coloured roofs that strengthen thermal performance, enhance liveability of employee/residential spaces, encourage gardening, protect biodiversity, and/or reduce urban heat island.
- **Incentives:** Supplement existing senior government and utility incentives with enhanced municipal ones (e.g. reduced permit fees and tax holidays), and encourage expansion of green loans (e.g. through a bank/credit union) and other innovative financing mechanisms that acknowledge green building benefits and payback.

BEYOND 2020 OPPORTUNITY – NET ZERO ENERGY

Net Zero Energy Buildings generate as much energy as they use. Such buildings can exist as a single-detached home. They can also involve the right combination of residential and commercial buildings where some have the energy supply infrastructure to generate much more energy than they need, notably heat, and adjacent buildings consume the surplus – a Net Zero Block or Net Zero Neighborhood. Shared energy infrastructure can often permit higher energy and environmental performance at lower costs. Residents and business owners will have much lower building operational costs and be less susceptible to energy price and supply issues. Net zero buildings are typically healthier as sustainable materials and improved indoor air quality often go hand in hand with net zero construction.

Establishing Net Zero Energy Buildings as a best practice in the Canada's Capital Region would involve ramping up building and site scale renewable heat and electricity, and dramatically reducing building energy demand in thermal performance, high efficiency lighting and appliances, and more conscientious habits by building occupants. Capacity building, incentives, partnerships and municipal staff project champions would all be important elements of a Net Zero Energy agenda.



4.5 Energy Supply

Around the world, heat and power from new, low-impact renewable technologies is growing as fast or faster than conventional sources. As conventional energy feedstocks become more constrained, and the costs of fossil fuels begin to be reflected in public policy, many new renewable technologies will achieve greater economies of scale and progressively lower prices.[40]

The strategic directions in this section are meant to assist development of cost effective, local, reliable, low impact energy supplies that reduce greenhouse gas emissions. This will also increase energy security, keep money in the community, and support local job creation in renewable energy sectors. More local energy production also helps mitigate risks and improves resiliency as the Region is potentially less reliant on central production and long range distribution of electricity which can be affected by a variety of factors such as extreme weather.

Reliable, low-carbon power development is a higher priority in Ottawa than Gatineau, given Hydro Quebec's abundant relatively low-cost, hydro-electric resources. The Ontario Government has a goal of increasing the share of renewable power (solar, wind, bioenergy) from less than 1% in 2003 to 13% by 2030. Ottawa, with its municipal utilities generating and distributing power, is well positioned to contribute to this opportunity, facilitating building scale renewables, and larger scale efforts. Given current technology and a marginal wind resource, the focus will likely be on solar in the short to medium term.

Although heating accounts for the majority of residential and commercial building energy use (**Figure 18**), Ontario and Quebec—like the rest of Canada—have no significant programs to promote efficient, low-carbon, heating. There are opportunities for cost effective local renewable heat promotion in Ottawa and Gatineau from neighbourhood-scale district heating and cooling to building-scale applications.

40 Renewable Energy Policy Network for the 21st Century., Global Status Report, 2010, http://www.ren21.net/Portals/97/documents/GSR/REN21_GSR_2010_full_revised%20Sept2010.pdf.

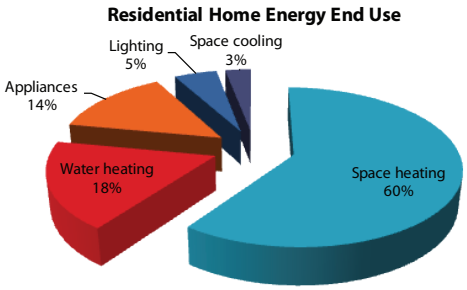


Figure 18: NRCan, 2007: Residential Energy End Use

PERFORMANCE HIGHLIGHTS[41]

Estimated emission reductions from the building sector are 50% in Ottawa and 33% in Gatineau by 2060 with the implementation of best practice strategies and actions. These performance improvements are based on the following assumptions:

- The percentage of new buildings connected to district energy across the Region increases to 16% in 2060 from 4% in 2020.
- Emissions from electricity generation and consumption in Ottawa are expected to decrease dramatically, dropping by more than 50% by 2020 and nearly 95% by 2060 when compared to 2007 levels.
- Emissions associated with the generation and consumption of electricity in Gatineau/MRC are also expected to decrease almost 85% by 2020. However, this is less significant than changes to Ontario's grid due to the already-high proportion of hydropower in Quebec.
- The share of new buildings with building-scale renewable heat or power is expected to reach 2.5% by 2020 and remain at that level through

STRATEGIES & ACTIONS

A growing effort is emerging in the Region to strengthen sustainable, local energy production. More action is still needed to achieve deep emission reductions and avoid unnecessary energy consumption and spending.

41 Numerical performance projections are outlined in Appendix 1.

LOW IMPACT RENEWABLES

There are a wide variety of potential renewable energy opportunities in the Region.

Biomass

Biomass has wide-ranging energy potential for heating, electricity generation and transportation fuels. Biomass is a renewable organic matter that can be sourced from waste wood, agricultural fibre sometimes waste or crops grown on marginal land, solid waste, liquid waste, and manure. Some biomass can be converted into a biogas through anaerobic decomposition, generating methane and carbon dioxide. Biomass can be combusted directly or gasified by adding heat without oxygen to generate hydrogen, carbon monoxide and methane. Production scales can be large heat and power operations, neighbourhood district energy systems or home heating with new energy efficient stoves.

Heat or heat and power operations maximize energy potential of biomass while power-only operations do not.

Biomass plants are typically characterized as carbon neutral. Readily available emission controls combined with good biomass management practices can keep air pollutants well below required limits. Other screens can ensure biomass meets high social and environmental sustainability principles. A challenge in developing biomass energy is the difficulty securing long-term, cost effective supply without guaranteed demand (i.e. a plant), and a guaranteed demand is difficult to secure without a secured supply. Governments can help coordinate and facilitate these guarantees.

Heat Pump Technologies: Geo, Water and Air Heat Exchange

Heat pumps move heat from one location (a source) to another (the sink). They can supply heating and cooling services. Thermal energy can be tapped from the ground, lakes, rivers, and the air. Although they require electricity, their efficiency—which increases the closer they are to their source temperature—permits heating and cooling with 25-50% less electricity than typical baseboard or natural gas heating or air conditioners. Heat pumps can be used in individual residential locations, large buildings, clusters as well as in district energy systems.

Geo-exchange systems tap the stable temperature of the earth through horizontal or vertical liquid-filled loops. Water systems operate similarly. Air-source systems do not benefit from the same relatively stable temperatures.

Challenges can include up-front expenses related to well drilling or loop laying, and the space required for the well fields supporting the system. Incentives are available at the federal level but pay-back periods still exceed what the market is willing to accept. As energy prices increase and drilling technology improves, this may change.

Solar

The sun is the ultimate source of wind, wave, hydroelectric, biomass as well as solar power. Passive design uses building orientation and materials to optimize solar energy use. Active solar systems convert the sun's energy into heat using thermal systems and power using photovoltaics.

While traditionally very expensive, photovoltaic electricity generation is rapidly growing due to the combined forces of design innovations, price reductions, the imperatives to reduce GHGs and air pollution, and public policy. The Green Energy Act in Ontario has offered a high premium for small-scale home and business development and commercial development. This incentive should be encouraged to the extent it continues to be available.

Solar thermal systems convert solar power to heat used for space conditioning and notably hot water. Solar thermal systems are cost competitive in many situations, notably for large volumes of hot water, and increasingly common. Senior government incentives have helped make these systems cost effective.

Waste Heat Recovery

Waste heat recovery involves capturing heat that is a by-product at an industrial, institutional or commercial process, e.g. skating rink, food processing plant, extensive commercial refrigeration (e.g. supermarket), pulp mill, cement plant, or sewage. Depending on the intensity of the heat and proximity and intensity of demand, waste heat can be turned into recycled thermal energy (hot water, industrial heat or space conditioning), mechanical energy (moving something), and electricity. There can be extensive waste heat in urban contexts.

Hydroelectrical Power Generation

As noted in the seeds of success, some local hydroelectrical development is centred on the Ottawa River. While potential for major expansion of this source for renewable energy is limited within the Region itself, technological improvements in smaller scale run-of-the–river generation may allow for additional installations along, for example, the Rideau River. Some potential has been identified at sites such as Black Rapids and Burritts Rapids in fact, there is already interest in a small scale installation through a community effort in the Village of Burritt's Rapids.

LOW IMPACT RENEWABLES *continued*

Wind Power

With current technology and the strength of the local resource, wind power opportunities are limited in the Region. As a result, interest in commercial scale wind farms has been limited. Micro wind installations also have limited economic application although technological advances such as cylindrical system rather than traditional turbine configurations are beginning to make urban and small scale rural applications more economic, with less potential impact on surrounding properties.

Seeds of Success

A variety of initiatives across the Region are beginning to advance low carbon energy supply. They focus on Ottawa, reflecting Ontario's supply constraints and cost of power.

- **Arnprior Solar Generating Station:** The station generates 20 MW of electricity with 312,000 panels.
- **City of Ottawa and Energy Ottawa:** Installing solar photovoltaics on 20 City rooftops, and creating a renewable campus with solar fields, waste-to-energy, and landfill gas energy generation.
- **Ottawa-Carleton District School Board:** Installed 13 10 kW solar systems. Planning to lease space on 69 schools for systems of 50 to 250 kW. The program could generate >6,600 kW.
- **Ottawa Housing Corporation:** Installed 29 10kW systems, an 8,000 sq ft. solar wall , and two 20 collector solar thermal systems.
- **Beaver Barracks:** This central geothermal installation will use a hot and cold water network of pipes and heat exchangers to provide warm and cool air to five buildings and over 240 residences.
- **R.O Pickard Centre Waste Retreatment Plant:** City of Ottawa utilizes digester gas from the treatment process to generate 2.4 MW of electrical energy for powering the treatment process.
- **1000 Solar Rooftop Challenge:** A collaboration of Ottawa citizens, businesses, and non-profits formed to promote solar photovoltaic and thermal systems onto homes and businesses. There is also a community energy cooperative (Sustainable Ottawa Community Energy Co-op). In 2010, a community project to promote/facilitate solar domestic hot water (Solar H2Ottawa) was completed.
- **Energy Ottawa:** Operates two run-of-river hydroelectric stations at Chaudiere Falls, generating 110 GWh annually. They do not interrupt river flow and are EcoLogo-certified by Environment Canada.

BEYOND 2020 OPPORTUNITY – NET ZERO NEIGHBOURHOODS

New developments and communities are likely to increasingly take advantage of technologies and opportunities to, through a combination of high energy efficiency construction and on-site renewable, extend the concept of net-zero housing to the community scale. To date, some communities have been targeting this standard such as One Planet Communities developed by BioRegional. Developments such as Dockside Green in Victoria and Sonoma Mountain Village north of San Francisco have successfully designed community renewable energy systems which significantly augment energy self-reliance.

When fueled by local renewable supplies and designed to permit feedstock flexibility, such communities are more resilient to rising transportation and distribution costs, and conventional supply shortfalls.

This potential can be explored through the Demonstrating Sustainability catalyst project (*see* Section 5.2).

1. Promote small-scale renewable energy projects

Small-scale renewables include heat or power for new and existing buildings at the building or site scale. Power opportunities focus on Ottawa given costs and power availability relative to Gatineau. Some technologies like solar domestic hot water are established and cost effective, particularly with incentive programs from senior levels of government.

Example Actions

- **Micro-FIT Promotion:** Enhance promotion of renewable power through Ontario's micro-feed in tariff programs while it exists.
- **Local Renewable Energy Framework:** Conduct a high level evaluation of the potential for small scale renewable in the Region and share the outcome with community organizations, homeowners, and building owners and managers. Identify potential municipal tools to promote and support smalls scale renewables. The framework would emphasize renewable heat such as solar thermal, heat pump technologies, energy star wood biomass applications, small scale run of the river hydro installations, and lead to education, training, promotion, incentives and regulations. This action could also be used to build connections and synergies among government, green technology sectors/ suppliers, and utilities.

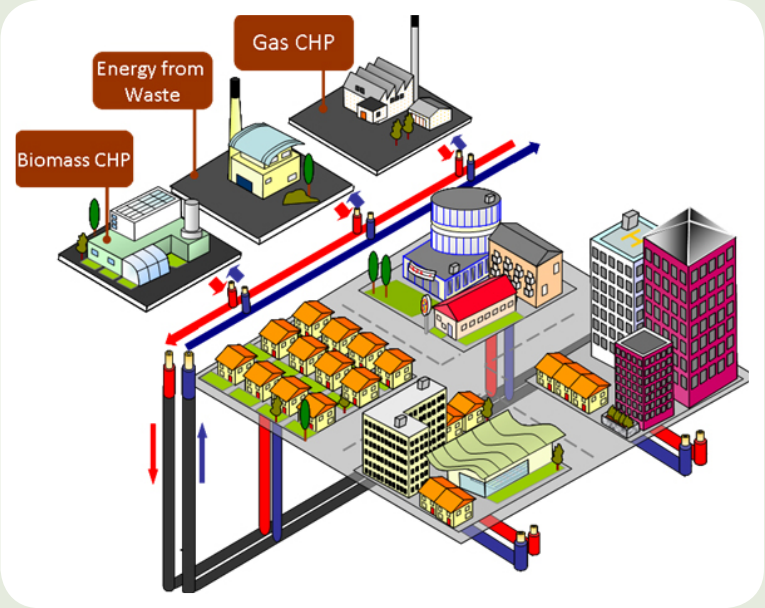
- **Solar Ready:** Develop a strategy that educates, promotes, incents and eventually requires new buildings to include measures such as piping and wiring that will make it easy to add solar panels at a later date (thermal in Gatineau, and thermal and PV in Ottawa). The strategy could involve training of trades, developing solar ready guidelines, collaborating with the solar industry, examining precedents in other jurisdictions, and crafting effective incentives.
- **Renewable Integration into Municipal Planning:** Review municipal land and infrastructure planning processes to identify opportunities for integrating renewable heat and power development, e.g. scoping public land adjacent to possible building sites for geothermal fields or PV installations, incorporating geothermal analysis into road work or projects which result in excavations.

2. Facilitate development of cost effective, low emission, high efficiency district energy projects

Under the right conditions, district energy can

DISTRICT ENERGY BUSINESS CASE BASICS

Under the right conditions, district energy can provide cost effective energy services, high energy and environmental performance, and manage risk from energy commodity price volatility.



Good systems generate heat at a high efficiency central plant or a series of mini plants, replacing less advanced boilers and furnaces in multiple buildings. Heat is distributed through a network of pipes and is returned to be re-heated. Cooling can be similarly provided. Some systems can generate electricity. These combined heat and power (CHP) plants involve combustion.

Many systems, notably older ones like those operated by Public Works in Canada's Capital Region, are fuelled predominantly by natural gas. Newer systems often incorporate renewable fuels including waste heat from sewage or industrial activity, wood, biogas from agricultural waste, solar hot water, or ground or water heat pumps or a combination thereof, and may still use natural gas during periods of peak demand. A growing number of older natural gas systems across North America are being retrofitted to accommodate renewable fuels.

Four factors determine the viability of new District Energy Systems.

1. **High, concentrated heat demand,** typically from significant floor space or high building density or potentially a building that requires large heat demand like a brewery.
2. **Balanced load** based on different buildings requiring heat at different times of day to avoid peaks. This usually requires "mixed-use" developments. Strategic co-location of buildings that require heat, e.g. swimming pools, and those that generate heat, e.g. ice rinks, can facilitate this.
3. **Integrated and rapid build out** normally starting with one large or several large new buildings with additional ones added quickly in succession, subsequently permitting HVAC system retrofits of some existing buildings. Infrastructure development should be timed to permit heat distribution piping deployment simultaneously with water infrastructure, roads and/or telephone lines.
4. **Cost effective, secure energy supply** to minimize long-term business risks. This could include a design that permits diverse feedstocks that are ideally renewable.

If some criteria are strong, the strength of others is not as critical. If many or all of the criteria are only modestly met, other options may be preferable for improving energy and emission performance in a cost effective manner.

The viability of district heating and cogeneration is often a question of economics. Rising marginal electricity costs and natural gas prices are likely to change the economics of providing heat and power. At some point, the economic value of peak-load electricity (typically provided by natural gas turbines) and rising gas costs may make such a high-quality fuel too valuable to be burned directly for low-grade space heat, and the waste heat from power generation too valuable to throw away. At a certain point, these energy services become valuable enough to balance the capital, design and operations costs of a combined heat and power district energy system.

System ownership and design, land use planning, and permitting are other important priorities to include in business planning.

Adapted from HB Lanarc for NRCan Community Energy and Emission Mapping Learning Materials.

provide cost effective energy services, high energy and environmental performance, and manage risk from energy commodity price volatility (*see District Energy Business Case Basics*).

District energy needs to be approached from the strength of solid feasibility and business case analysis. Opportunities in the Region are constrained by limited major industrial activity where waste heat and shared energy is more common. In addition, conventional gas powered systems may not currently achieve the energy efficiencies that can be found in well designed, distributed building systems. Retrofitting existing areas under current energy pricing can also present technical and economic challenges. However, with major institutional building demand and efforts to create higher density, mixed-use nodes, low carbon district energy may be able to play a strategic role in the Region's energy future.

Canada's Capital Region is already home to the greatest concentration of district energy systems in Canada, focussed in federal buildings, as well as other institutional settings such as universities and hospitals. These systems are generally old, high temperature, natural-gas fuelled steam systems—many of which are reaching the end of their service lives. There are two options for district energy development in the Region, discussed below.

1. *Decarbonization and extension of existing DE systems.* This opportunity exists with the Federal—Public Works and Government Services Canada—systems which are the most extensive and currently being considered for a comprehensive retrofit.
2. *Facilitating development of new low carbon DE systems.* Opportunities could exist in certain greenfield and intensification projects, and could be serviced by a municipal or private energy utility.

Example Actions

- **District Energy Policy and Planning Support:**
  - » Work with the Federal Government on renewal of the Federal District Energy system by:
    - ◊ Supporting exploration of enhancement of the Tunney's Pasture system to support a mixed-use node on the district energy system as well as other connection possibilities.
    - ◊ Participate in discussions related to pilot projects to move the system towards renewable energy such as biomass.
    - ◊ Identify opportunities to assist the renewal of the system during infrastructure projects such as road and sewer work.
  - » Establish parameters to screen for candidate sites for new district energy development and extension of existing service areas. Parameters include density, land use mix, intensification/greenfield considerations, and development phasing.
  - » Establish clear performance criteria for energy services including greenhouse gas, air pollution, full life cycle cost, and reliability; and critically evaluate energy supply options on a short and long-term basis.
  - » Work with stakeholders internally and externally (e.g. utilities, developers, neighbourhood associations, existing DE operators) to establish the land use and infrastructure planning and policy support to maximize opportunity and meet performance criteria, including Official Plan recognition, zoning, bylaws, development charges, mechanical and physical requirements for new buildings and retrofits, area plans, and coordinating and aligning infrastructure work (e.g. street, sewage and drinking water).
  - » Examine the optimal governance, operation, and financial arrangements for the City for

establishing new systems and connecting to existing ones.

- **District Energy Pilot:** Explore potential for a new district energy system as part of a major high sustainability, smart growth greenfield development as well as the intensification and revitalization of a major corridor or node.

3. Examine opportunities to develop large-scale renewable energy projects

Moving towards reliable, low carbon, low air pollution energy supply involves development of larger renewable heat and power systems that take advantage of a wide range of renewable energy technologies and feedstocks, including biomass, solar, air-water-and ground-source heat pumps, hydro, and waste heat recovery (*see* Low Impact Renewables).

Example Actions

- **Leveraging Land & Facilities:** Continue to expand efforts to leverage land and facilities for appropriate renewable installations in the public, private and non-profit sector. There are opportunities for renewable heat (notably geo-exchange), renewable power (notably solar photovoltaics), and potentially combined heat and power.
- **Biomass Scoping:** Explore potential for a sustainable biomass energy in the Region
  - » Quantify the potential sustainable biomass feedstocks available in the Region including landfill waste (notably paper and wood), waste wood (e.g. trees lost from the emerald ash borer), forest interface, agricultural fibre and manure, energy crops from marginal land, and sewage; evaluate potential demand; and examine the most appropriate technologies.
  - » Explore potential for a project that is sufficiently large with a guaranteed demand to secure, a stable, cost-effective supply. This project may be related and could be explored within the context of the district energy system refurbishment discussed above.
  - » Continue to build on current waste to energy efforts through initiatives such as Plasco and landfill gas to energy at Trail Road landfill
- **Energy Partnerships:** Explore partnerships with public, private and community groups to advance opportunities.
- **Waste Heat Recovery:** Explore waste heat recovery opportunities (supply and demand) and examine potential for a program to take advantage of this opportunity, complimenting the energy retrofit and new high efficiency building strategies.
- **Micro Hydro Development:** Continue to explore sustainable micro-hydro generation in the Region, notably on the Ottawa and Rideau rivers.
- **Renewable Energy Planning Integration:** Review municipal land and infrastructure planning processes to identify opportunities for integrating renewable heat and power development, e.g. scoping public land adjacent to possible building sites for geothermal fields or PV installations, incorporating geothermal analysis into road work or projects which result in excavations, neighbourhood/area development plan geotechnical analysis.
- **Neighbourhood Energy & Emission Planning Framework:** Support development of a Neighbourhood Energy and Emission Planning Framework that guides municipal staff and developers in maximizing medium-large scale renewable opportunities in green-field and infill development, including district energy. This could be pursued through the Sustainable Community Makeover catalyst project (See Section 5.2).

4.6 Manage Materials and Solid Waste

Management of materials and solid waste within cities has far-reaching environmental impacts, from 'upstream' impacts such as the extraction and processing of resources for manufacturing, to 'downstream' impacts such as pollution from waste disposal. Discarded materials include industrial by-products and waste, construction and demolition materials, land clearing materials, products and packaging and organic materials such as unconsumed food and yard waste. Many of these can be re-used, recycled or in some cases avoided altogether.

The introduction of green bin composting service in both Ottawa and Gatineau, in addition to other recycling programs, have boosted the percentage of residential waste diverted from landfills to 42% in Ottawa and 34% in Gatineau.

Major challenges in waste diversion include low waste diversion and recycling rates in multi-unit dwellings and in the industrial, commercial and institutional (ICI) sectors. Municipalities have little control over the ICI sectors, with regulations provided largely at the Provincial level and collection services contracted privately.

A CRADLE-TO-CRADLE (OR ZERO WASTE) APPROACH

When products are no longer of use we tend to recycle them or dispose of them as garbage. This traditional approach, often labelled as "cradle-to-grave," views waste as an inevitable by-product of production and consumption. However, waste "costs" us all, through higher prices for raw materials, money spent on diversion and disposal, the environmental impact of disposing waste, the health costs associated with hazardous materials, and the value lost when useful products are left in disposal sites.

A cradle-to-cradle or zero waste approach focuses on the opportunities that industry has to redesign products and processes to reduce waste before it is made, as well as designing products for greater re-use. By definition, a zero waste approach recognizes that almost all waste materials have some form of inherent value that can be recovered. Such an approach encourages the development of innovative ways to use the waste from one product as the needed material for another. This helps to build more sustainable methods of production and supports opportunities for industry to become sustainable.

Source: Toward a Zero Waste Future: Review of Ontario's Waste Diversion Act, Discussion Paper for Public Consultation, Ontario Ministry of the Environment, 2008.

PERFORMANCE HIGHLIGHTS[42]

Landfilled waste and greenhouse gases from waste would be almost eliminated by 2060 if best practices were adopted (*see* **Figure 19**). The following assumptions were made to make these projections:

- An increase in the diversion rate of waste (materials recycled or composted) to 85% in 2060 compared with an estimated 26% in 2007 for residential and non-residential waste; and
- An increase in landfill gas capture from 65% – 80% by 2020.
- A reduction of 15% in the total residential and non-residential waste generated each year through extended producer responsibility and better packaging.

STRATEGIES & ACTIONS

A great deal of progress has been made in this area through measures such as the organics collection methane gas capture, and take back programs. Partners are also working on long range waste management strategies including a 30-year plan for Ottawa which includes discussion of a more regional approach to waste.

Emission reductions in this sector also depend on senior government action:

- **Extended Producer Responsibility** (EPR) require producers, manufacturers and consumers to pay for the waste management

42 Numerical performance projections are outlined in Appendix 1.

costs of their products. EPR has been implemented in Ontario and Quebec for some products, including tires, oils, and electronics. By 2060, these programs are expected to expand. However, EPR is not generally associated with reductions in organic waste;

- **Reduced Packaging** legislation will reduce overall resource consumption. Organic packaging (especially cardboard) can end up in the landfill, and measures to reduce packaging waste can therefore reduce methane generation at landfills; and
- **Mandatory Landfill Gas Capture** legislation is also in place governing landfills over a certain size in both Ontario and Quebec, and these regulations have become increasingly stringent over time. These regulations will significantly reduce greenhouse gas emissions from solid waste.

The following strategies build on these efforts and the waste management hierarchy: reduce, re-use, recycle, recover energy from waste.

1. Focus on reducing waste generation as our first priority

A number of measures can be taken to reduce consumption, thereby reducing waste generated, and to re-think the definition of waste so that it is viewed as a valuable resource. Example actions associated with this strategy involve:

- Working with senior levels of government, municipal associations and industries to reduce packaging and adopt a cradle-to-cradle approach for waste management;
- Develop an education program for businesses, institutions , and individual consumers about making sustainable choices in the purchase of goods and services; and
- Establish a green certification programs for the ICI sector.

2. Aggressively divert residential waste to recycling, composting and re-use facilities

Municipalities in the Region have programs in place to divert most of our household waste from landfills, but not all households are able or willing to use them. Recycling and composting is especially difficult in apartments and townhouses initially designed without space for these facilities, or where there may be no neighbourhood pressure to recycle.

A key part of the strategy could be to focus on the virtual elimination of organics from landfills, which would dramatically reduce long-term landfill GHG emissions and allow energy, carbon, and nutrients to be recovered. Other example actions include:

- As markets for material such as wood and asphalt are found, restrict disposal at landfills and divert materials;
- Lead by example with corporate recycling efforts;
- Study feasibility of waste disposal centres to collect materials that could be recycled but are not part of the curbside program;

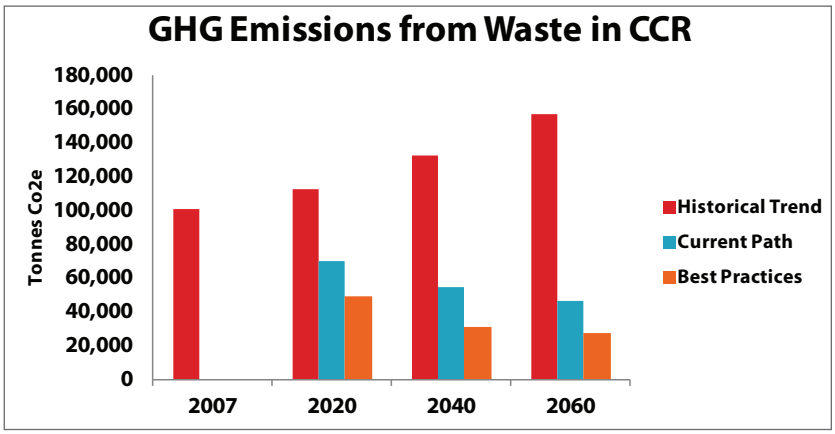


Figure 19: GHG Emissions from Waste in CCR

Emissions are expected to drop considerably if Best Practices are followed, influenced by a combination of waste diversion and landfill gas capture

- Continue support for landlords with information on diversion programs; and
- Continue to explore ways to recover or use residual waste including waste to energy.

3. Increase the municipal role in waste reduction and diversion in the ICI sector

The Industrial, Commercial, and Institutional (ICI) sector faces many of the same challenges as residential recycling: lack of space on-site to store materials; lack of compliance with policies within the organization to sort and recycle; and lack of markets for recycled goods to make it economically feasible for industry to recycle. Economic factors have a big influence on whether businesses recycle or not. Too often, business sees recycling as a cost, but there can be an economic opportunity with waste; especially if they develop ways to deal with their own waste (reduce or re-use internally). Example actions to support this strategic direction include:

- Explore collection and recycling of additional materials (possibly with the use of community drop-off depots);
- Expand municipal roles in the ICI Sector such as organics collection from restaurants and further educational and recognition efforts in this sector; and
- Continue to explore ways to recover or use residual waste including waste to energy.

Waste, Energy & GHGs

There are different sources of GHGs associated with waste. Most commonly, emissions are associated with landfills where anaerobic decomposition generates methane, a GHG 25 times more potent than carbon dioxide. Other waste management practices also result in emission increases or decreases, influenced by waste type, shipping distance and mode of transport. Emissions are also embedded in waste from extraction, processing and transport of products. A strong emission management plan for waste management will minimize GHGs by considering all of these emissions sources to determine the optimal management practice.

Waste and Embodied GHGs

Embodied CO2e per tonne of waste differs by material type:

Embodied CO2e per Tonne of Waste by Material Type

PLASTIC	Milled Lumber	Aluminum	Office Paper	Computer
2 T	2 t	8 t	8 t	56 t

Some waste types have relatively low material and GHG inputs, e.g. wood. There are also waste types that are so valuable (due to immense embedded material inputs and GHGs) that they should be prioritized for higher order management practices, i.e. not landfilled or combusted.

Waste Management Practices and GHGs

GHGs vary significantly by management practice and waste type. Recycling and reduction results in avoided virgin material inputs and emissions from extraction, processing and transportation. Combusting biogenic carbon (e.g. paper, wood) avoids potent landfill methane emissions and the emitted carbon is assumed to be re-absorbed by new trees. Combusting plastic is more GHG-intensive than landfilling.

Tonnes of CO2e by Waste Management Practice Per Tonne of Waste

	Recycling	Landfilling	Combustion
OFFICE PAPER	-3 t	+2 t	0 t
MILLED LUMBER	-2.5 t	+1 t	0 t
PLASTIC	-1.5 t	+0.1 t	+1 t

Notes
Numbers are rounded and include generic assumptions which are not specific to CCR. However, they remain useful for relative comparisons across different waste management practices.
Source: US EPA: http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_home.html .

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5 Implementation

This is a high level strategic plan for Canada's Capital Region. Its purpose is to provide guidance to the three partnering organizations (City of Ottawa, City of Gatineau and National Capital Commission) on integrating energy and emission management into major decisions, planning processes, policy development, and program and service delivery.

The Plan's long-term goals, principles and strategic direction will be used differently by each of the Partners. Each has different levels of jurisdiction and interest, therefore implementation of some strategies and specific actions will be more applicable to some partners than to others. The Partners will lead implementation within their organizations, recognizing that the partnership will continue on a number of strategic opportunities.

Each Partner will need to assess action opportunities and establish priorities based on the most cost effective energy/emissions management opportunities within their respective governmental and geographic jurisdictions. Independent action plans developed by each partner tailored to their unique needs and opportunities can transform the high level strategies into pragmatic opportunities.

It is also important to realize that best practices will evolve and technology will emerge that will likely facilitate further savings, reductions in energy use and GHG emissions. This Plan represents a starting point for continuous improvement and monitoring and adapting strategies.

5.1 Cross-Cutting Measures

Integrated community energy and emission solutions (ICES) require approaches that bring together elements from many of the strategic directions from all of the individual sectors discussed previously. ICES also supports co-benefits as solutions related to the broad range of community action—such as reducing reliance of fossil fuels and related transportation emissions—can lead to healthier lifestyles, improved air quality, and higher quality of life.

The following measures cut across traditional energy and emission sectors and line departments and extend out into the community. They are designed to foster alignment within the municipality, and consolidate support for the Plan and action on the strategies internally within the City, stakeholders in the community and the broader public. Several catalyst projects are grounded in the concept of ICES.

Integrated Community Energy Solutions (ICES)

To ensure the various elements of sustainable energy are integrated and maximize their impact and benefits, the Canadian Council of Energy Ministers have produced a road map for Integrated Community Energy Solutions (ICES). These solutions take advantage of the cross-cutting opportunities and synergies created when strategic energy directions encompass the full range of community measures, from land use, to transportation, to the more obvious measures related to energy use in buildings. The ICES road map has informed and will continue to provide direction for the strategic directions in this Plan.[43]

43 Council of Energy Ministers. Integrated Community Energy Solutions

Cross-Cutting Measure can:

- Strengthen Partners' institutional capacity and mechanisms to support implementation
- Consolidate support for the Plan and action on the strategies
- Maximize the Plan's co-benefits
- Ensure energy and emissions analysis is integrated into all stages of plans, projects, and programs

1. Integrate energy and emission planning into land use and infrastructure planning

Energy and emissions can be progressively integrated into the processes that shape the urban fabric at all scales of activity: building, site, neighbourhood, community, and region in all major sectors: buildings, transportation, waste, land use planning and urban design.

Example Actions

- **Integrated Community Energy & Emission Planning:** Advance integration of energy and emission analysis into existing planning processes, e.g. neighbourhood plans, Official Plans, transit and transportation plans, infrastructure servicing plans (sewage, water, waste, roads), and Corporate plans. Seek integration opportunities in policy and planning frameworks , e.g. planning protocols, bylaws, zoning, building and development permit procedures, design guidelines.
- **Sustainable Energy Hierarchy:** Apply this hierarchy in planning:
    1. Reduce energy demand;
    2. Use renewables; and
    3. Maximize fossil fuel efficiency.
- **Retrofit Optimization:** Explore energy and emission management opportunities in retrofits, revitalization and intensification as well as greenfield development.
- **Life Cycle Cost Analysis:** Promote life cycle cost analysis in cost-benefit analyses, focusing on energy and emission implications.
- **Urban Zone E&E Analysis:** Increase planning sensitivity to the unique energy and emission opportunities and constraints across different urban zones, e.g. urban core, town centre, inner suburb, outer suburb, rural (*see Appendix 1, Zone Specific Energy Strategies*)

2. Integrate energy and emissions into the annual budget process and capital planning

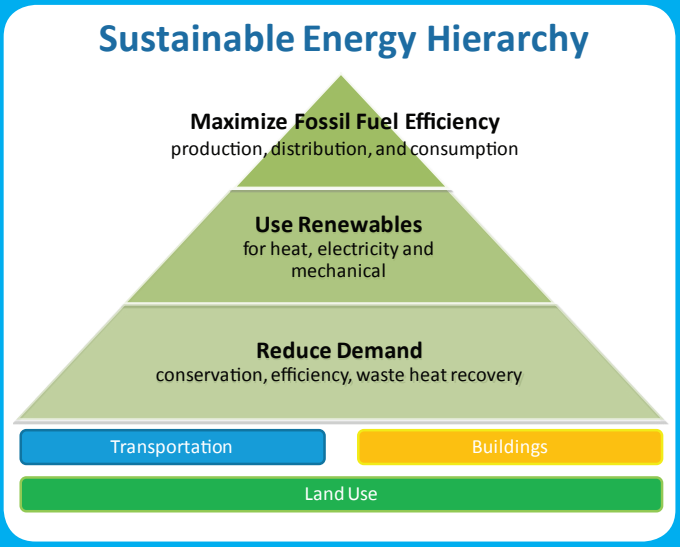
Develop procedures to facilitate decision making and enable staff and elected officials and the public to be informed of the impact of energy spending on long-term operation and maintenance costs, and the relative impact on community greenhouse gas emissions.

Example Actions

- **Capital Planning Carbon and Life Cycle Costing Analysis:** The capital planning process integrates life cycle cost and greenhouse gas implications of projects. These assessments could be qualitative in nature and eventually become high level quantitative assessments for large capital projects in the future.

Sustainable Energy Hierarchy

Planning and implementation should observe a sustainable energy hierarchy, emphasizing conservation and efficiency—i.e. demand management—first, followed by renewable energy generation, and then efficient use of fossil fuels. This hierarchy is based on the principle that it is most sustainable and cost effective to first reduce demand, then meet remaining demand with lower carbon energy sources.



The Sustainable Energy Hierarchy has supported sustainable energy in many areas. The concept was originally applied to buildings, energy supply and transportation fuels. However, it can equally be applied to broader transportation planning, the other major community energy sector. Land use planning strongly influences energy demand and supply opportunities—as discussed in the Land Use sector.

- **Carbon and Life Cycle Costing Analysis for Procurement:** Procurement processes require carbon and life cycle costing analysis in RFPs and tendering for capital projects greater than a prescribed threshold.
- **Annual Budget Carbon and Life Cycle Costing Analysis:** Submissions assess the GHG implications and life cycle costs of budget proposals, starting with qualitative assessments.

Cutting Costs and Cutting Carbon

Different capital investments options have different long-term cost implications for operation, maintenance and replacement. They can also drive or constrain greenhouse gas emission growth. Capital investments that are highly energy efficient or use renewable energy can be more costly initially than conventional investments but tend to be less expensive to operate and maintain. When life cycle costing is integrated into financial decisions, it often leads to lower long-term municipal costs and lower emissions for the municipality as well as residents and businesses. Incorporating life cycle costing and carbon quantification into municipal finance allows richer decision-making.

3. Strengthen education, outreach and capacity development

Effective education, outreach and capacity building will be necessary to make progress on this Plan.

Education and outreach will be necessary to foster interest, awareness and overcome information gaps to make progress on many of the strategic directions.

Capacity building will be important to build the knowledge and skills to make the necessary changes. This includes bringing together public, private and social sector organizations within Ottawa and Gatineau and across the Region that work without considering energy and emissions or, if they are focusing on energy and emissions, do their work independently. There are significant opportunities for increasing cost effectiveness, strengthening programs and achieving synergies by sharing plans and strategic collaboration.

Example Actions

- **Education & Outreach:** As priorities are crystallized, develop a compelling outreach program that informs policy priorities and is, in turn, informed by it to maximize take up of initiatives.
- **Capacity Building:** Build the knowledge and skills necessary to advance low carbon communities; identify key constituencies inside local government and the community to advance this agenda; identify appropriate delivery agents and support program development.
- **Regional Energy and Emissions Working Group:** Establish a group of key stakeholders including government partners, utilities, development industry, and community energy groups

5.2 Catalyst Projects

Several catalyst projects are proposed to capture the imagination of the public and engage the business community, community groups and others. These catalyst projects have been developed within the broader *Choosing our Future* process and are also outlined in the *Sustainability and Resilience Plan*. Catalyst projects can create a focal point for action. As the word "catalyst" implies, these projects can accelerate the change process by providing learning and innovation opportunities, establishing new standards of practice and creating excitement in the community. They do this by building knowledge and capacity and demonstrating innovation.

The catalyst projects listed below are cross-cutting projects, addressing energy and emissions and other aspects of sustainability. These projects could be delivered by the Partners individually or collectively by a variety of public-private partnerships, and/or by different municipal departments.

DEMONSTRATING SUSTAINABILITY

Demonstrating sustainability means developing inspirational showcases for sustainability at all scales, from a plan to redevelop an obsolete commercial site to a vision for a new community. The years ahead will likely see development or redevelopment of large federal properties such as the former air force base Rockcliffe Park, construction of new municipal buildings, or revitalization of land around future rapid transit stations. The design of these projects offers potential opportunities to demonstrate sustainability in many dimensions, including:

- Green building design;
- Alternate energy systems;
- Mixed-use development;
- Provisions for pedestrians, cyclists, and transit;
- Cost-effective servicing and transportation strategies; and
- Attractive public spaces.

Developing leading-edge projects could inspire the public and private sectors in the design of future projects.

Potential projects could be identified through consultations with the development industry and other levels of government. Community plans and development proposals could be screened for their potential to develop more sustainability features, and funding provided if necessary to test the feasibility of new energy technologies or complete other studies. Two or three projects (and willing proponents) would be selected to receive incentives such as priority treatment in the development review process and advice and support in securing available grants. Municipal land could be used as the foundation for a public-private partnership. Once under way, the projects could be used as examples in regional discussions with industry, developers, students, public sector staff, utilities and others on sustainable development.

SUSTAINABLE COMMUNITY MAKEOVER

The community makeover brings home the sustainability challenge by asking communities how they could become more sustainable and working with them to deliver their priority ideas at

the community level. Working as a partnership, the municipality, local businesses, schools, cultural and recreation organizations and others would explore different ways a community could become more sustainable in any of the four dimensions: social, culture, economic or environment. Depending on local priorities, the partners could consider such elements as:

- Ways to increase walking, cycling and transit use by community members;
- An energy audit of the area to highlight how to reduce energy used in transportation and in commercial and residential buildings and identify the potential for renewable energy or district energy retrofits;
- Opportunities to increase residential or employment density, or mixed-use;
- Increase the amount of parks and public open space in the community and develop it for socializing, community gardens, public art or other purposes;
- Identifying and filling gaps in programs and services within the community; and
- Identifying and improving creeks, forests and other features in the community.

The project can serve to empower communities as well as yield real improvements in the community. Two or three pilot areas with potential would be selected so that a variety of components could be further developed. The pilot communities would complete a sustainability planning process that could include such elements as a community vision, design charrette, and priority-setting. Staff would help communities identify their own resources and link to existing public programs. The pilot projects could yield a suite of sustainability projects that could be made more generally available to communities after the pilot is complete

5.3 Monitoring and Reporting

To support continuous improvement and assess progress on strategic directions, it will be important to monitor key performance measures and update energy and emissions information. This process is already underway through the GHG inventory efforts of the municipal Partners.

As progress is measured and additional technologies and senior government actions emerge, additional reduction opportunities will present themselves. The strategies and performance expectations should be reviewed and updated on a regular basis. Reductions and energy savings that exceed the 40% scenario guiding the strategic directions outlined in the Plan are likely and in the longer term, necessary to ensure a sustainable future in Canada's Capital Region.

A wide diversity of indicators can be used to monitor progress and inform good policy, planning and development. The indicators below were used to inform development of this Plan and project the energy and emission performance changes. The Partners have data on many of these indicators and others may be cost effective and useful to collect for a range of planning and development priorities. From the list of indicators, Partners can identify the most appropriate set to monitor plan progress and implementation.

Land Use

- Distance to Central Business District – Neighbourhood
- Building type split – Neighbourhood
- Distance Driven – Neighbourhood
- Dwelling Density – Neighbourhood
- Job Density – Neighbourhood
- Land Use Mix (Resident: Job) – Neighbourhood
- Proximity to Food Retail, Parks, Transit – Neighbourhood

Transportation

- Modal Split for Work and School and Other Trips
- Bike Routes: Roads Ratio – Neighbourhood
- Distance Driven per Household – Neighbourhood
- Distance on Transit per Household – Neighbourhood
- Car Ownership per Capita – Neighbourhood
- Transportation Fuel (Total and Per Capita)
- Intersections per Road KM – Neighbourhood
- Sidewalk: Roads Ratio – Neighbourhood
- Transportation Spending

Buildings

- Thermal efficiency (beyond provincial code)
- Retrofit rate
- Energy expenditure (Total and Per Capita)
- Dwelling Size
- Commercial Building Size
- Energy consumption per capita

Energy Supply

- District Energy Service Area (square feet)
- Building scale renewable deployment rate (heat/power)
- Large scale renewable power generation
- GHG Factor in Electricity
- District Energy GHG Factor

Waste

- Total Waste (with recyclables) Per Capita
- Diversion Rate (recycling, composting, re-using)
- District Energy GHG Factor

Cross Cutting

- Energy Expenditures (Total and Per Capita)
- Energy Consumption (Total and Per Capita)
- Resident and Employee GHGs (Total and Per Capita)

5.4 Conclusion: A Call to Action

The Plan—shaped with input from a wide cross section of the public and expert stakeholders—is the beginning of a journey to establish this region as a leader in integrated community energy solutions.

A sustainable energy future and deep greenhouse gas reductions requires action on many fronts. While the challenges are significant, ingenuity, partnership, and a collective vision of the 21st century can transform these challenges into opportunities.

The strategies outlined in this Plan are crafted to make Canada's Capital Region more sustainable, liveable and resilient to the economic, social and environmental changes projected over the next 50 years.

Making progress will require concerted action by the Partners. It will also require engagement and collaboration with senior governments. Success, nevertheless, will only be possible when the Plan is embraced by businesses, organizations, neighbourhoods and citizens. This Plan is a call to action across the Region to get involved in the journey to a more sustainable, lower carbon energy future.

Appendix 1:
Zone-Specific Energy Strategies

Low carbon opportunities are not uniform across a City. Unique urban zones create unique opportunities for managing energy and emissions. These planning guidelines are a guide to maximizing low carbon opportunities by urban zone, right sizing the sector-specific strategies discussed above by zone.

- Urban Core
- Inner Urban
- Suburban
- Rural

URBAN CORE

These are the medium to high density residential, office commercial and residential, as well as retail areas. Transportation and building emissions are relatively low on a per resident basis, moderate on a per employee basis, and high in waste given lower recycling penetration in large buildings.

Big opportunities include:

- Pedestrian, bike, and transit infrastructure;
- Low carbon district energy;
- Building-scale renewable power (Ottawa);
- Strengthening the resident to employee ratio (influencing active transportation, transit propensity);
- High/mid rise building operator training;
- High/mid rise and commercial/institutional recycling; and
- Commercial and institutional food-related composting.

INNER URBAN

This zone is characterized by retail and medium density residential buildings in close proximity. Transportation emissions are moderate and building emissions are low on a per resident basis, moderate on a per employee basis, and moderate in waste given lower recycling penetration in mid/low rises and townhouses.

Big opportunities include:

- Sufficient key destinations (e.g. park, library, retail) to support walking and cycling;
- Sufficient residential to support retail success and strong transit;
- Pedestrian, bike, and transit infrastructure;
- Low carbon district energy;
- Building/site-scale renewable heat (and power in Ottawa);
- Mid/low rise building operator training; and
- Mid/low rise and commercial recycling.

SUBURBAN

These are the lower density, residentially-oriented areas. Transportation and building emissions are relatively high on a per resident basis and there are few jobs. Waste emissions are relatively low.

Big opportunities include:

- New key destinations (e.g. micro retail) to support walking and cycling and shorter driving distances;
- Increasing densities and land use mixes, particularly in town centres and around rapid transit;
- High efficiency automobiles;
- Building/site scale renewable heat (and power in Ottawa);
- Secondary suites, laneway housing and live-work homes; and
- Residential energy retrofits.

RURAL

The rural areas of the Region are those where homes and villages are interspersed with agriculture and forests. Transportation and building emissions are relatively high on a per resident basis. Waste emissions are relatively low.

Big opportunities include:

- High efficiency automobiles;
- Building/site scale renewable heat (and power in Ottawa);
- Residential energy retrofits;
- Sustainable forest and farm (soil) management to enhance carbon sequestration;
- Medium-scale solar PV and wind power generation (in Ottawa); and
- Sustainable wood and agricultural fibre production and processing.

Appendix 2:

Performance Indicator Highlights

These tables summarize key energy and emission performance indicators in the Region. The table is composed of indicators used as "model inputs" reflecting the nature or intensity of strategy described under each sector. CEEMAP (HB Lanarc's Community Energy & Emission Modeling and Planning tool) then takes an established relationship (function) with an input to calculate the "model outputs." This model is summarized in section 3.1, *Energy & Emission Modeling Methodology Overview*, and further details are in a separate technical paper: *Energy & Emission Plan Modeling & Mapping Methodology*.

Tables are organized according to geography/jurisdiction. Base year and future populations and dwelling units are provided below for reference

Jurisdiction	Population 2007	Population 2060	Dwelling Units[4] 2007	Dwelling Units[4] 2060
OTTAWA[1]	871,000	1,318,000	333,068	570,435
GATINEAU/MRC[2]	284,000	442,000	116,200	182,874
CCR[3]	1,155,000	1,155,000	449,268	753,309

1 Ottawa : City of Ottawa
2 MRC : Ville de Gatineau and Municipalités Régionales de Comté de La Vallée- de-la-Gatineau
3 CCR: Canada's Capital Region is comprised of the Cities of Ottawa and Gatineau, and MRC de La Vallée- de-la-Gatineau
4 Dwelling Units: Number of dwellings of all building types (apartment, townhouse/row house, and single family)

PERFORMANCE INDICATOR HIGHLIGHTS FOR LAND USE

Ottawa

Indicator	Explanation	Base Year (2007)	Historical Trend	Best Practices
MODEL INPUTS				
NEW GROWTH DENSITY(UNITS/ HECTARE)*	Higher density can decrease vehicle use	7.4	No change	13.4
DEVELOPMENT ON VACANT LAND AND NON-RESIDENTIAL LAND	Share of new dwellings built on vacant urban and village land and new urban land, plus redevelopment of non-residential land for residential uses.	64%		53%
INTENSIFICATION ON RESIDENTIAL LAND	Share of new dwellings built on developed residential land	36%	No change	47%
HOUSING MIX: NEW GROWTH (%)	Smaller building types increase density, and use less energy per occupant for heating and cooling	43% Single-detached 36% Townhouse 21% Apartment	Some increase in multi-unit building share	2020 onwards: 23% Single-detached 29% Townhouse 48% Apartment
MODELLED OUTPUTS				
ENERGY USE AND GHGS FROM BUILDINGS AND TRANSPORTATION	*Reflected in Buildings and Transportation sector emissions*			

* Units per gross ha of developed area, including roads but excluding open space.

Gatineau/MRC

Indicator	Explanation	Base Year (2007)	Historical Trend	Best Practices
MODEL INPUTS				
URBAN DENSITY: NEW GROWTH (UNITS/HECTARE)*	Higher density can decrease vehicle use	3.5	No change	5.7
DEVELOPMENT ON VACANT LAND AND NON-RESIDENTIAL LAND	Share of new dwellings built on vacant urban and village land and new urban land, plus redevelopment of non-residential land for residential uses	69%		43%
INTENSIFICATION ON RESIDENTIAL LAND	Share of new dwellings built on developed residential land	31%	No change	57%
HOUSING MIX: NEW GROWTH (%)	Smaller building types increase density, and use less energy per occupant for heating and cooling	54% Single-detached 24% Townhouse 22% Apartment	No change	2020 onwards: 35% Single-detached 29% Townhouse 36% Apartment
MODELLED OUTPUTS				
ENERGY USE AND GHGS FROM BUILDINGS AND TRANSPORTATION	*Reflected in Buildings and Transportation sector emissions*			

* Units per gross ha of developed area, including roads but excluding open space.

PERFORMANCE INDICATOR HIGHLIGHTS FOR TRANSPORTATION

Ottawa

Indicator	Explanation	Base Year (2007)	Historical Trend	Best Practices
MODEL INPUTS				
VEHICLE KILOMETRES TRAVELLED (VKT) PER YEAR	Distance each person travels on average by car, including only trips within the Region	6,814	Increasing	n/a See outputs
CYCLE PATH LENGTH (METRES PER CAPITA)	Length including both on-road and off-road multi-use bicycle paths	1.6	Increasing	3
POPULATION NEAR MASS TRANSIT (%)	Share of population within 5 km of rapid transit	16%	Increasing	33%
MODELLED OUTPUTS				
VEHICLE KILOMETRES TRAVELLED (VKT) PER YEAR	Reflects changes to land-use, cycling, transit infrastructure	n/a (This is an input)	Increasing	6,538
EMISSIONS FROM TRANSPORTATION (TONNES)	GHGs from fossil fuels and electricity used for vehicles	1,890,000	2,930,000	1,380,000

Gatineau/MRC

Indicator	Explanation	Base Year (2007)	Historical Trend	Best Practices
MODEL INPUTS				
VEHICLE KILOMETRES TRAVELLED (VKT) PER YEAR	Distance each person travels on average by car, including only trips within the Region	7,402	Increasing	n/a This is modelled. See outputs below.
CYCLE PATH LENGTH (METRES PER CAPITA)	Length including both on-road and off-road multi-use bicycle paths	2.2	No change	1.7
POPULATION NEAR MASS TRANSIT (%)	Share of population within 5 km of rapid transit	3.5%	No change	5%
MODELLED OUTPUTS				
VEHICLE KILOMETRES TRAVELLED (VKT) PER YEAR	Reflects changes to land-use, cycling, transit infrastructure	n/a (This is an input)	Increasing	6,106
EMISSIONS FROM TRANSPORTATION (TONNES)	GHGs from fossil fuels and electricity used for vehicles	600,000	930,000	480,000

PERFORMANCE INDICATOR HIGHLIGHTS FOR BUILDINGS

Ottawa

Indicator	Explanation	Base Year (2007)	Historical Trend	Best Practices
MODEL INPUTS				
SINGLE-DETACHED HOMES - AVERAGE BUILDING SIZE (SQUARE METERS)	More compact housing uses less energy for heating	167m^2 (1800ft^2)	Increasing	2020: maintain 167m^2 (1800 ft^2) 2040: reduce 5% 2060: maintain 5%
PERFORMANCE BEYOND BUILDING CODE (%)	Building efficiency. E.g. increased insulation	0%	0%	2020: increase to 20% 2040: maintain 20% 2060: maintain 20%
RETROFIT RATE (%)	% of existing buildings retrofitted each year to improve energy efficiency	~0.5%	~0.5%	2020: increase to 2% 2040: maintain 2% 2060: maintain 2%
MODELLED OUTPUTS				
BUILDINGS EMISSIONS (TONNES)	Total emissions from energy consumed in buildings	3,500,000		1,700,000
BUILDINGS ENERGY USE (GIGAJOULES)	Total energy consumed by buildings, by sector	67,000,000		52,000,000

Gatineau/MRC

Indicator	Explanation	Base Year (2007)	Historical Trend	Best Practices
MODEL INPUTS				
SINGLE-DETACHED HOMES - AVERAGE BUILDING SIZE (SQUARE METERS)	More compact housing uses less energy for heating	167m^2	Increasing	2020: maintain 167m^2 2040: reduce 5% 2060: maintain 5%
PERFORMANCE BEYOND BUILDING CODE (%)	Building efficiency. E.g. increased insulation	0%	0%	2020: increase to 20% 2040: maintain 20% 2060: maintain 20%
RETROFIT RATE (%)	% of existing buildings retrofitted each year to improve energy efficiency	~0.5%	~0.5%	2020: increase to 2% 2040: maintain 2% 2060: maintain 2%
MODELLED OUTPUTS				
EMISSIONS FROM BUILDINGS	Total emissions resulting from energy consumed in buildings, by sector	600,000		400,000
ENERGY USE IN BUILDINGS	Total energy consumed by buildings, by sector	27,000,000		20,000,000

PERFORMANCE INDICATOR HIGHLIGHTS FOR ENERGY SUPPLY

Ottawa

Indicator	Explanation	Base Year (2007)	Historical Trend	Best Practices
MODEL INPUTS				
DISTRICT ENERGY CONNECTIONS FOR NEW BUILDINGS (%)	Share of newly constructed large (high rise and commercial) buildings connected to a District Energy System	0%	No change	2020: increase to 4% 2040: increase to 8% 2060: increase to 16%
ELECTRICITY EMISSIONS FACTOR (GRAMS PER KWH)	Greenhouse gas emissions resulting from electricity generation	185	No change	2020: decrease to 80 2040: decrease to 40 2060: decrease to 12
BUILDING SCALE RENEWABLES FOR NEW BUILDINGS (%)	% of newly constructed units that include a renewable energy system (e.g. solar, geo-thermal)	0%	0%	2020:increase to 2.5% 2040: maintain 2.5% 2060: maintain 2.5% (~150 installations pr yr)
MODELLED OUTPUTS				
REFLECTED IN BUILDINGS SECTOR	*Reflected in Buildings sector emissions*			

Gatineau/MRC

Indicator	Explanation	Base Year (2007)	Historical Trend	Best Practices
MODEL INPUTS				
DISTRICT ENERGY CONNECTIONS FOR NEW BUILDINGS (%)	Share of newly constructed large (high rise and commercial) buildings connected to a District Energy System	0%	No change	2020: increase to 4% 2040: increase to 8% 2060: increase to 16%
ELECTRICITY EMISSIONS FACTOR (GRAMS PER KWH)	Greenhouse gas emissions resulting from electricity generation	12	No change	2020: decrease to 2 2040: maintain 2 2060: maintain 2
BUILDING SCALE RENEWABLES FOR NEW BUILDINGS (%)	% of newly constructed units that include a renewable energy system (e.g. solar, geo-thermal)	0%	0%	2020:increase to 2.5% 2040: maintain 2.5% 2060: maintain 2.5%
MODELLED OUTPUTS				
REFLECTED IN BUILDINGS SECTOR	*Reflected in Buildings sector emissions*			

PERFORMANCE INDICATOR HIGHLIGHTS FOR SOLID WASTE

Ottawa

Indicator	Explanation	Base Year (2007)	Historical Trend	Best Practices
MODEL INPUTS				
TOTAL WASTE GENERATED PR CAPITA PR YR (TONNES)	Solid waste including recyclable and compostable materials	0.87 tonnes	Increasing	2020: reduce 5% 2040: reduce 10% 2060: Maintain 10%
DIVERSION RATE (%) FROM RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL SOURCES	Share of waste diverted from landfill to other uses (recycling, composting, etc)	26%	No change	2020: increase to 65% 2040: increase to 80% 2060: increase to 85%
LANDFILL GAS CAPTURE RATE (%)	Amount of gas from landfill captured and used for energy generation	65%	No change	2020: maintain 65% 2040: increase to 80% 2060: Maintain 80%
MODELLED OUTPUTS				
SOLID WASTE EMISSIONS FROM LANDFILL (TONNES)	Remaining emissions after diversion & landfill gas capture	78,000	No change	22,000

Gatineau/MRC

Indicator	Explanation	Base Year (2007)	Historical Trend	Best Practices
MODEL INPUTS				
TOTAL WASTE GENERATED PR CAPITA PR YR (TONNES)	Solid waste including recyclable and compostable materials	0.82 tonnes	Increasing	2020: reduce 5% 2040: reduce 10% 2060: Maintain 10%
DIVERSION RATE (%)	Share of waste diverted from landfill to other uses (recycling, composting, etc)	17%	Increasing	2020: increase to 65% 2040: increase to 80% 2060: increase to 85%
LANDFILL GAS CAPTURE RATE (%)	Amount of gas from landfill captured and used for energy generation	65%	No change	2020: 65% 2040: 75% 2060: Maintain 75%
MODELLED OUTPUTS				
SOLID WASTE EMISSIONS FROM LANDFILL (TONNES)	Remaining emissions after diversion & landfill gas capture	23,000	No change	6,600