SUSTAINABLE ENVIRONMENT COMMISSION

Steve McGeehan
Commission Chair
sec@ci.moscow.id.us

Regular Meeting
~Minutes~

Kyle Steele
Staff Liaison
208-883-7133

https://www.ci.moscow.id.us/551/Sustainable-Environment-Commission

Tuesday **March 16, 2021**	**6:00 PM**	**Mayor's Conference Room** **206 E. 3rd St.**

The meeting was called to order at 6:01 p.m.

PRESENT: Tina Hilding (Virtual); Marley Pankratz (Virtual); Amber Ziegler (Virtual); Natalie Wiley (Virtual); Kristin Haltinner (Virtual)

ABSENT: Victoria Seever; Jassen Bluto; Steve McGeehan-Chair; Jamal Lyksett (Virtual)

STAFF: Jenifer Rossini, Administrative Assistant (Virtual); Kelli Cooper. Environmental Education and Sustainability Specialist (Virtual); Sandra Kelly (Virtua); Kyle Steele, Staff Liaison (Virtual)

OTHERS: David Hall (Virtual); Russ Moore (Virtual)

REGULAR AGENDA

1. **Approval of Sustainable Environment Commission February 16, 2021 Minutes (ACTION ITEM)**
   Minutes presented for approval.

   PROPOSED ACTIONS: Approve minutes as presented; approve minutes with amendments; or provide staff further direction.

   Amber moved, Natalie second to approve the minutes as presented.

   Roll Call Vote: Ayes: Unanimous. Nays: None. Abstentions: None. Motion carried.

2. Public Comment and Response to Previous Comments (limited to 10 minutes)

Members of the public may speak to the Commission regarding matters NOT on the agenda or currently pending before the Commission. Please state your name and city of residence for the record and limit your remarks to three (3) minutes.

David Hall (Moscow, Latah County) gave an update on the status of the new highway (E2 alignment) being proposed over Paradise Ridge. He says the Army Corps of Engineers is still reviewing the second application submitted by the Idaho Transportation Department. He also emailed a document to the Commission in response to a question that was asked at the December meeting. This document is available upon request SEC@ci.moscow.id.us.

Russ Moore (Moscow) proposed an agenda topic for April's meeting. He is working to create a new education program: master recyclers and composters.

3. Farmers Market Table

Discuss the opportunity to table at the Moscow Farmers Market. This is an opportunity to share with citizens any initiatives, programs, and special projects that the SEC is involved with and receive public feedback. If the SEC wishes to staff a table, the form indicating the desired date must be submitted by April 1.

PROPOSED ACTIONS: Discuss, select a date, and take such other action as deemed appropriate.

The Commission will propose June 5th and 12th as well as September 11th and 18th.

4. Greenhouse Gas Goal Setting

Kelli will present the Greenhouse Gas Goal Setting framework and would like feedback from the commission.

PROPOSED ACTIONS: Receive the report and take such other action as deemed appropriate.

The City did meet the greenhouse gas goal to reduce the emissions 20% by 2020. Kelli went into further detail about the plan for the upcoming greenhouse gas reduction goal. She presented a few new ideas for achieving the new goal and outlined potential projects to further curb these emissions; building/facilities, streetlights/traffic signals, employee commute, solid waste, water and wastewater. She talked about the possibility of using wind and solar energy at the Water Reclamation and Reuse Facility due to the fact that this facility has one of the highest carbon footprints. Also, the framework developed for the Government operations can be used for community inventory when the framework is completed. Kyle stated they are planning to present an overview of the 2020 Greenhouse Gas Goal to City Council on April 19th. Afterwards, they are planning a workshop to delve deeper into the fundamentals of creating this Goal. It was also mentioned about the City installing electric charging stations for vehicles and Kelli said that may be in the near future if the Cities fleet moves to electric.

This presentation is available by contacting SEC@ci.moscow.id.us.

REPORTS

1. **City Sustainability Report- Kelli Cooper**

Pollinator Summit went very well with positive feedback received and great attendance. Going forward there will be smaller events scheduled; gardening classes for pollinators, Palouse Prairie Charter School is creating seed packets and Moscow High School will be building bee nesting boxes for sale. Kelli hasn't been able to be in the classroom due to COVID so she is working on developing vinyl wraps to be installed on classroom drinking fountains to promote water conservation.

2. **Moscow High School Subcommittee Report- Ilan Carter**

They have been thinning the sapling pine trees at Phillips Farm to help create a forest savannah ecosystem as well as continuing to build bee boxes around the park and are planning to sell them. They are also planning to build a trail thru the wetlands at Phillips Farm. The group has been working on getting letters from local business in support for achieving 100% renewable energy

by 2045; a resolution they have been working with the Sierra Club to create. They met and presented individually with Council members and the resolution was unfavorable to most of the Council.

3. Climate Action Working Group (CAWG)-Tina Hilding

CAWG met with the Transportation Commission to get their input on what steps they would like to see for the climate action mitigation and/or adaptation plan. They will meet with Human Rights Commission on April 20th. There are currently six developments in Moscow and this is the right time to start talking about climate action mitigation. The Commission asked for more time to discuss this matter. They also discussed how they can discourage single occupancy driving, electric car charging stations in new construction apartment buildings, and the challenge of public transportation within the City.

CAWG will also meet with the local League of Women's Voters soon.

ANNOUNCEMENTS

palousestandingpeople.com is a new group of people on the Palouse looking to re- wild the Palouse with native trees and plants.

David asked if the Commission had any questions about the idea of a water use budget he introduced a few months back.

UPCOMING EVENTS / MEETINGS

1. Next Commission meeting is April 20, 2021

ADJOURN

The meeting adjourned at 7:17 PM

Steve McGeehan, Chair


BURLINGTON, VT
CLIMATE ACTION PLAN

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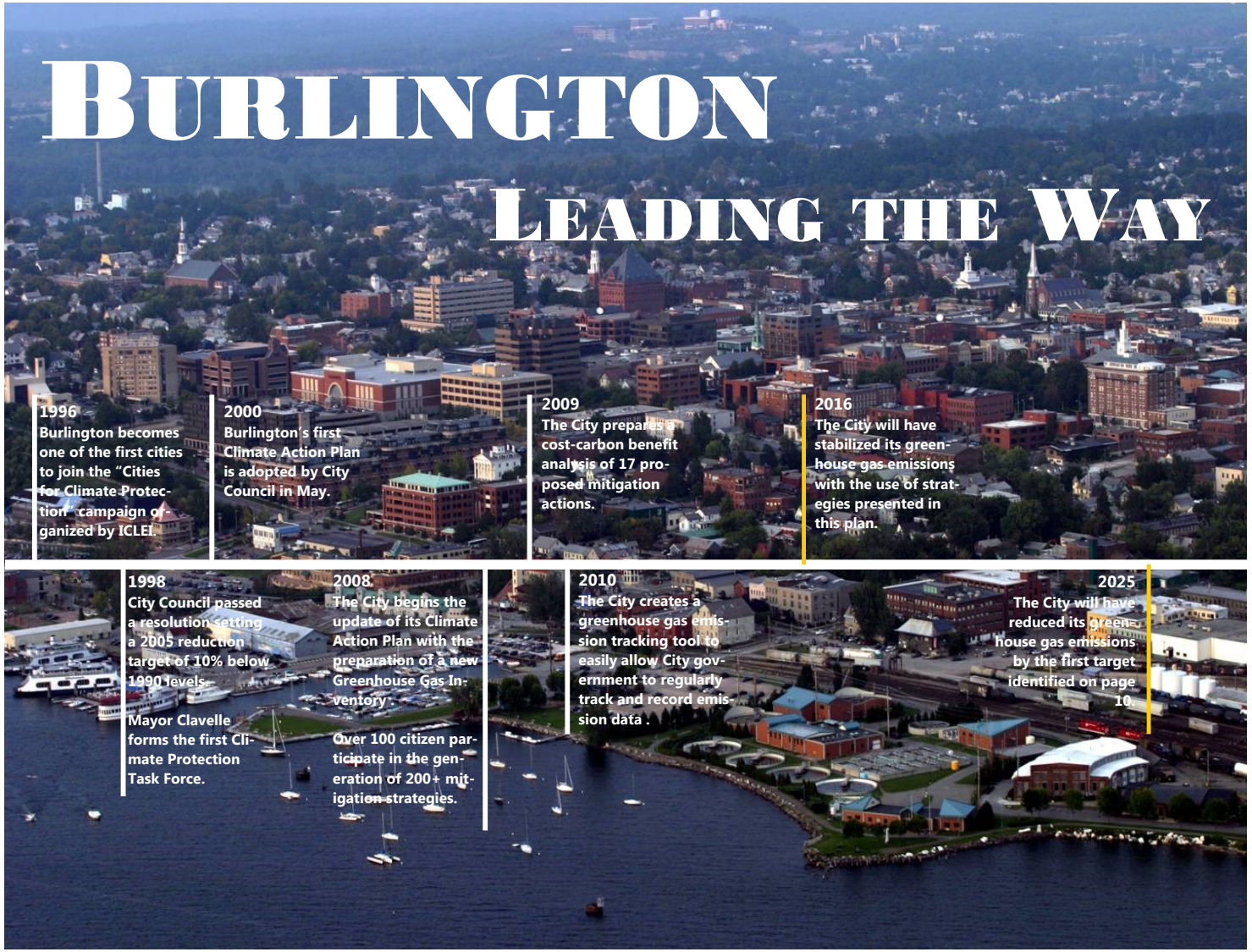
What is a Climate Action Plan?

A climate action plan is a detailed and strategic framework for measuring, planning, and reducing Green House Gas (GHG) emissions and related climatic impacts. Municipalities design and utilize climate action plans as customized roadmaps for making informed decisions and understanding where and how to achieve the largest and most cost-effective emissions reductions that are in alignment with other municipal goals. Climate action plans, at a minimum, include an inventory of existing emissions, reduction goals or targets, and analyzed and prioritized reduction actions. Ideally, a climate action plan also includes an implementation strategy that identifies required resources and funding mechanisms.

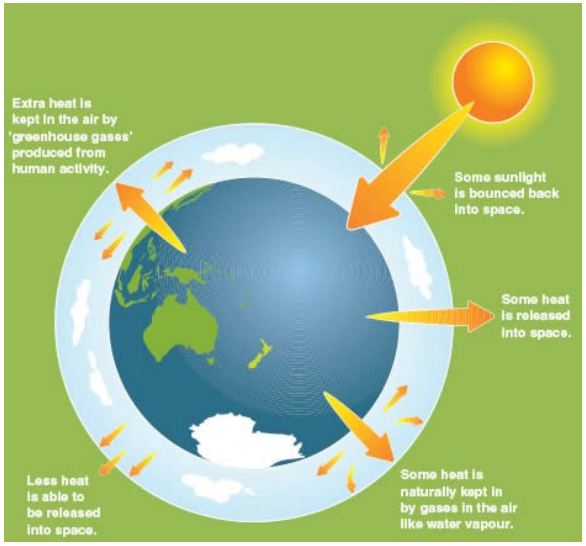
What is this plan about?

This document provides an overview of Burlington's Climate Action Plan - how it was created, why it is necessary, and what are its goals. Supporting research, documentation, and steps that city officials, individuals, and organizations can take to implement change are available at www.burlingtonvt.gov/cap/.


BURLINGTON
LEADING THE WAY
1996
Burlington becomes one of the first cities to join the "Cities for Climate Protection" campaign organized by ICLEI.
2000
Burlington's first Climate Action Plan is adopted by City Council in May.
2009
The City prepares a cost-carbon benefit analysis of 17 proposed mitigation actions.
2016
The City will have stabilized its greenhouse gas emissions with the use of strategies presented in this plan.
1998
City Council passed a resolution setting a 2005 reduction target of 10% below 1990 levels.
Mayor Clavelle forms the first Climate Protection Task Force.
2008
The City begins the update of its Climate Action Plan with the preparation of a new Greenhouse Gas Inventory.
Over 100 citizen participate in the generation of 200+ mitigation strategies.
2010
The City creates a greenhouse gas emission tracking tool to easily allow City government to regularly track and record emission data .
2025
The City will have reduced its greenhouse gas emissions by the first target identified on page 10.

Why we care?

What is climate change ?



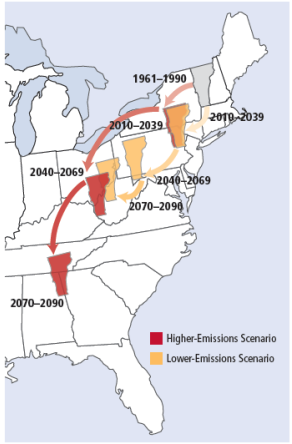
The greenhouse effect is the process by which the atmosphere traps some of the sun's energy, warming the Earth and moderating our climate. A human-driven increase in 'greenhouse gases' has enhanced this effect artificially. These greenhouse gases include carbon dioxide, produced by burning fossil fuels and through deforestation, methane, released from agriculture, animals and landfill sites, and nitrous oxide, resulting from agricultural production plus a variety of industrial chemicals.

Vermont's Changing Climate

From the Lake Champlain shore to the Connecticut River Valley, the climate of Vermont is changing. Records show that spring is arriving earlier, summers are growing hotter, and winters are becoming warmer and less snowy. These changes are consistent with global warming, an increasingly urgent phenomenon driven by heat-trapping emissions from human activities.

New state-of-the-art research shows that if global warming emissions continue to grow unabated, Vermont can expect dramatic changes in climate over the course of this century, with substantial impacts on vital aspects of the state's economy and character. If the rate of emissions is lowered, however, projections show that many of the changes will be far less dramatic. Emissions choices we make today—in Vermont, the Northeast, and worldwide—will help determine the climate our children and grandchildren inherit, and shape the consequences for their economy, environment, and quality of life.

Temperature. Average temperatures across the Northeast have risen more than 1.5 degrees Fahrenheit (°F) since 1970, with winters warming most rapidly—4°F between 1970 and 2000. If higher emissions prevail, seasonal average temperatures across Vermont are projected to rise 9°F to 13°F above historic levels in winter and 7°F to 14°F in summer by late-century, while lower emissions would cause roughly half this warming.



Migrating State Climate

Changes in average summer heat index—a measure of how hot it actually feels, given temperature and humidity—could strongly affect quality of life in the future for residents of Vermont. Red arrows track what summers in Vermont could feel like over the course of the century under the higher-emissions scenario. Yellow arrows track what summers in the state could feel like under the lower-emissions scenario.

Precipitation and winter snow. The Northeast region is projected to see an increase in winter precipitation on the order of 20 to 30 percent. Slightly greater increases are projected under the higher-emissions scenario, which would also feature less winter precipitation falling as snow and more as rain.
Heavy, damaging rainfall events have already increased measurably across the Northeast in recent decades. Intense rains struck the region in 2011 during Irene, for example, causing widespread flooding. The frequency and severity of heavy rainfall events is expected to rise further under either emissions scenario.

Drought. In this historically water-rich state, rising summer temperatures coupled with little change in summer rainfall are projected to increase the frequency of short-term (one- to three month) droughts, particularly if higher emissions prevail. By late-century, for example, short-term droughts are projected to occur annually under the higher emissions scenario (compared with once every two years, on average, historically), increasing stress on both natural and managed ecosystems.

Impacts of Climate Change on Vermont and Burlington

IMPACTS ON WINTER RECREATION

Snow and cold temperatures mean big business for the Green Mountain State. Ski areas provide recreation for residents and visitors along with thousands of jobs, and contribute more than $1.1 billion a year to the state's economy. Winters are already changing, and may look and feel profoundly different over the course of the century.

Snowmobiling. Vermont is part of a six state network of snowmobile trails totaling 40,500 miles and contributing $3 billion a year to the regional economy. Snowmobiling relies almost entirely on natural snowfall. Projected losses in natural snow cover and the impracticality of snowmaking on this vast system mean that the snowmobiling season could decline dramatically by late-century.

Skiing. Milder winters are expected to shorten the ski season, and the state's ski areas may no longer be viable by late-century.

Lake ice. Ice fishing and pond hockey are winter favorites in Vermont. However, global warming will render lake ice cover increasingly thin and shorten its duration. Ice cover duration on Lake Champlain has already declined in recent decades.

IMPACTS ON FORESTS AND AGRICULTURE

Forests cover nearly 80 percent of the Vermont landscape. The state's forest-related manufacturing, recreation, and tourism sectors contribute more than $1.4 billion to the state's economy and provide jobs for many residents. These woodlands also provide wildlife habitat, protect watersheds, conserve soil, and store carbon. Climate change has the potential to dramatically alter the character of Vermont's forests.

Agriculture has long been a vital part of Vermont's character and economy. Global warming will present both opportunities and challenges to Vermont's growers. For example, increases in the frequency of short-term drought could necessitate increased irrigation and operational costs, while a longer growing season could benefit those farmers seeking to invest in warmer weather crops that are currently hard to grow.

By late-century, increasing summer temperatures and heat stress could depress the yields of some of Vermont's economically important cool-weather crops. Northward expansion of agricultural pests and weeds are expected to further impede crop production during this time frame, and potentially pressure farmers to increase their herbicide and pesticide use (or, in the case of organic farms, invest more heavily in labor-intensive weed and pest control).

IMPACTS ON HUMAN HEALTH

From more intense summer heat waves to deteriorating air quality, the effects of global warming are expected to increase the risk of a number of health problems.

Extreme heat. While Burlington residents are accustomed to the occasional summer heat wave, the number of hot days is projected to increase substantially in much of the state by late-century, with some areas experiencing temperatures over 90°F on more than half of July days. Very hot days are not only unpleasant but also dangerous, as they increase the risk of heat stress and even death.

Air quality. Higher temperatures and increasing levels of carbon dioxide (CO_2) in the air are also expected to have significant impacts on human health, which could include development or reproductive harm, asthma attacks, lung cancer, wheezing and coughing, shortness of breath, cardiovascular harm, lung tissue redness, swelling, etc.

Vector-borne disease. Mosquitoes and ticks carry West Nile virus (WNV) and Lyme disease-causing bacteria, and spread them to animals and humans. Projections for the Northeast of warmer winters, hotter summers, and more frequent summer dry periods punctuated by heavy rainstorms can set the stage for more frequent WNV outbreaks.

IMPACTS ON INFRASTRUCTURE AND LAND

In the last decades, the frequency and severity of storm events have increased tremendously and in Burlington more specifically we have seen increased flooding. Think of the Lake Champlain flooding and Irene in 2011, and Hurricane Sandy in 2012. Such flood events equate to ***higher levels of stormwater*** and have a direct impact on our water infrastructure in the City. During major storm events the waterfront wastewater treatment plant cannot always handle the increased flow in areas of the city where the wastewater and stormwater systems are combined. This means that untreated wastewater is sent directly to the Lake. Given the age of our infrastructure, these major storm events threaten their integrity and we should expect to see more unanticipated breaks, wash-outs and flooding.

Bank erosion is another impact of more severe flooding. Damage that the Burlington bike path and many lakeshore properties quickly come to mind when remembering the 2011 events. The cost to repair and/or replace eroded banks create an additional burden on individuals, city finances and the cost often has to ultimately be paid for by citizens.

Limited recreation opportunities from decreased water quality or physical constraints due to flooding have also been more frequent, i.e.: beach closures, prohibited swimming and/or boating, limited bike path use, etc.

Climate Change and Equity

Equity and inclusion are a high priority for the City of Burlington. To respond to the complex and intertwined issues of climate change and social equity. the City must put forth a clear and unyielding effort to promote inclusion in all decision and policy-making processes, while at the same time applying an equity lens to implementation strategies in order to create an integrated response that goes far beyond reducing carbon emissions. Addressing social equity will, in turn, help foster strong, resilient natural systems and neighborhoods. Some areas for consideration include:

- How can the City of Burlington build a more diverse and multi-disciplinary climate action stakeholder group?
- By evaluating emissions mitigation strategies with attention to issues of equity, how might planning and implementation of infrastructure and behavioral emissions reduction projects be enhanced?
- In what ways does a more inclusive set of active stakeholders create a more effective and innovative emissions reduction program?
- What are the synergies between equity and inclusion goals and climate action goals and how do these crossovers advance a community culture of sustainability?
- How can the City of Burlington help ensure the safety and health of all of its citizens in the face of a changing climate?

The City of Burlington has identified five key areas, which present pressing equity issues either presently or in the future. These issues will be explored in the future to create a more comprehensive and transparent plan of action.

Housing
- Disparate concentrations of wealth in relation to floodplains and green space
- Individuals' financial ability to adapt and respond to climatic changes
- Access to energy efficient homes – including heating, cooling, and weatherization

Infrastructure and Transportation
- Individuals' proximity to affordable, reliable public transportation
- Distance from town center and shopping centers proportional to levels of income and wealth

Extreme Weather Events and Impacts
- Flooding and tree falls
- Effects of extreme weather on livability, comfort, and crime

Food Security
- Stability and viability of long-term, local agriculture
- Access to and affordability of fresh, local foods
- Community garden placement and supporting resources
- Home garden and composting education

Participation, outreach, and education
- Equitable community involvement in policy and decision making process such as zoning and land use planning
- Build on the work of the diverse stakeholders through a climate action education designed to engage and inform all members of the community

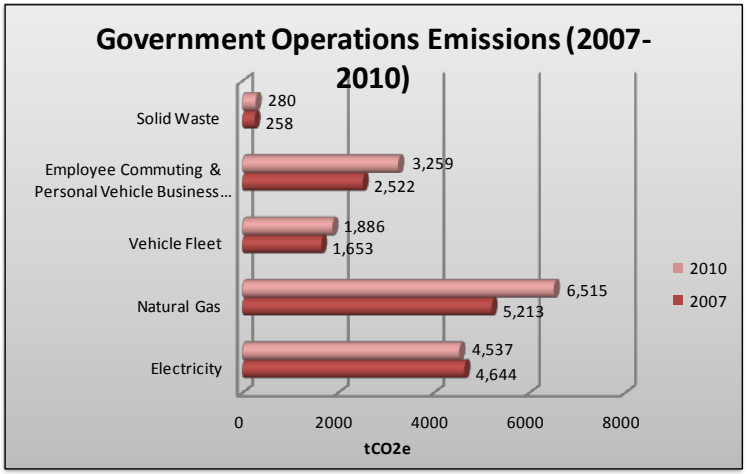
The City of Burlington, through its climate mitigation and adaption efforts, has already begun developing a comprehensive, integrated plan of action to respond to and deal with the issues of climate change and equity.

Where Are We Now with Government Operations Emissions?

Snapshot in time

While based on extensive research and analysis, the Burlington Climate Action Plan represents a snapshot in time using the best information available today. The greenhouse gas emissions inventory results depicted below and in the next few pages are always changing. The 2007 and 2010 inventories were prepared using the International Local Government Greenhouse Gas (GHG) Emissions Analysis Protocol developed by the Climate Registry and ICLEI. It is our hope to update this information every 3 years to track progress.

The City of Burlington's government operations generated 14,290.7 tCO2e in 2007, increasing by 15% to 16,476.9 in 2012. This translates to an increase in cost from $4.5 million in 2007 to approximately $4.9 million in 2010 (a 7% rise).



While electricity usage and emissions have decreased between 2007 and 2010, every other generation source has increased, with employee commute being highest (a 29% increase).

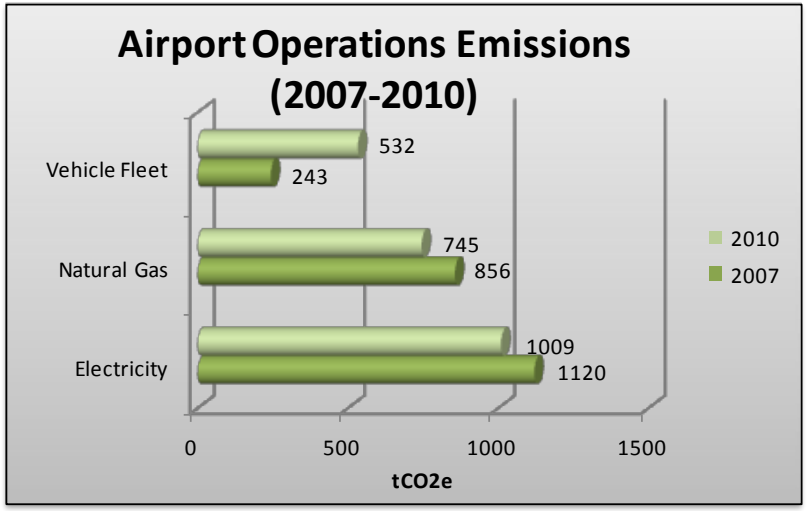
- In 2007, the City Government consumed around 21 million kWh of electricity, emitting 4,643.8 tCO_2e. This decreased by 2% in 2010 to around 20 million kWh and 4,537.2 tCO_2e.
- In 2007, the City Government consumed over 965,000 CCFs of natural gas, emitting 5,213.4 tCO_2e. This increased by 25% in 2010 to over 1.2 million CCFs and 6,514.8 tCO_2e.
- The City Government's vehicle fleet consumed around 184,000 gallons of diesel, biodiesel, and gasoline (23,957.1 MBTU) in 2007, emitting 1,653.3 tCO_2e, which increased by 14% in 2010 when over 210,000 gallons (27,323.2 MBTU) were consumed and 1,885.9 tCO_2e were generated.
- With over 5.9 million miles driven for commuting purposes in 2007 and over 420,000 miles driven in personal vehicles for business travel, employee commuting & personal vehicle business travel emitted 2,521.9 tCO_2e. The average commute distance was 11 miles (one way) in 2007 and 78% of employees drove alone to work. In 2010, nearly 8.0 million miles were driven for commuting purposes and around 330,000 miles were driven in personal vehicles for business travel. Employee commuting & personal vehicle business travel generated 3,259.0 tCO_2e, a 29% increase from 2007. The average commute distance rose to nearly 13 miles (one way) in 2010, and 75% of employees drove alone to work.
- The City Government disposed over 1,600 tons of land filled waste in 2007, which generated 258.2 tCO_2e. This increased to nearly 1,750 tons of land filled waste in 2010 and 280.0 tCO_2e.

These results show that by improving the energy efficiency of city-owned buildings and encouraging city workers to use alternative ways of commuting to work, the city can have a strong impact on reducing annual GHG emissions. These types of initiatives would also have a direct impact on costs/savings both for the City and its staff.

Where Are We Now with the Airport's Emissions?

The City of Burlington's Airport generated 2,219.4 tCO_2e in 2007, increasing by 3% to and 2,287.2 tCO_2e in 2010. This translates to a cost of $963,300 in 2007, decreasing by 2% to $947,339 in 2010. For more information on data, inputs and assumptions, please see appendices A and B.

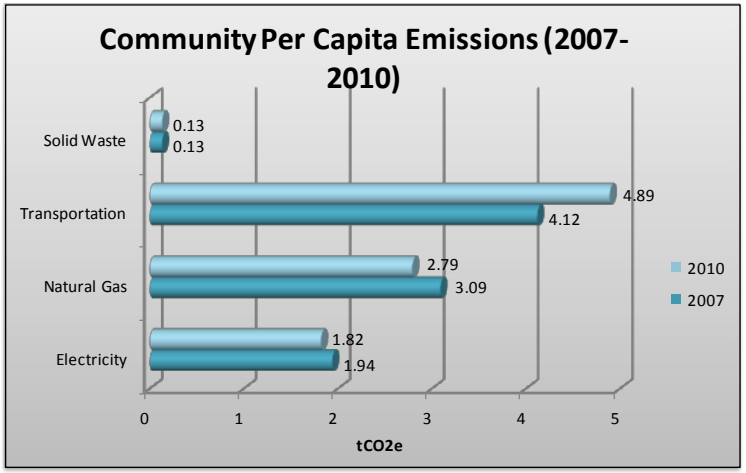
- In 2007, the Airport consumed over 5.1 million kWh of electricity, emitting 1120.1 tCO_2e. This decreased by 10% in 2010 to around 4.6 million kWh and 1,009.2 tCO_2e.
- In 2007, the Airport consumed nearly 160,000 CCFs of natural gas, emitting 856.1 tCO_2e. This decreased by 13% in 2010 to around 138,000 CCFs and 745.1 tCO_2e.
- The Airport's vehicle fleet consumed around 25,000 gallons of diesel, biodiesel, and gasoline (3,493.3 MBTU) in 2007, emitting 249.2 tCO_2e. In 2010 these figures increased to over 48,000 gallons (6,517.2 MBTU) consumed and 543.5 tCO_2e generated. This presents an increase of 218%.
- The Airport spent over $963,000 in 2007, decreasing by 2% to just over $947,000 in 2010.



Since these numbers were calculated, the airport has undertaken aggressive energy efficiency efforts. Projects include: replacing incandescent taxiway lighting with LEDs; replacing terminal, roadway, and parking lot lighting with CFL and LEDs; replacing parking garage lighting with LEDs; replacing aging air conditioning and heating equipment with high efficiency units; and replacing terminal air handling units with high efficiency units. The airport has also upgraded manual equipment controls to digital.

Where Are We Now with Community Emissions?

As a Community, Burlington generated 380,762.3 tCO_2e in 2007, increasing by 6% to 404,778.6 tCO_2e in 2010. This translates to a cost of over $78.9 million in 2007, decreasing by 4% to $76.0 million in 2010. In order to account for population growth in the future and allow for relative comparison between inventories, a per capita emission analysis is most helpful. The graph to the right presents the community inventory results per capita for both 2007 and 2010. The table below presents the total emissions for the community.



- In 2007, the Community consumed over 360.6 million kWh of electricity, emitting 79,664.2 tCO_2e. This decreased by 4% in 2010 to around 346.2 million kWh and 76,474.4 tCO_2e.
- In 2007, the Community consumed nearly 23.4 million CCFs of natural gas, emitting 126,496.0 tCO_2e. This decreased by 7% in 2010 to nearly 21.7 million CCFs and 117,242.6 tCO_2e.
- With over 259 million vehicle miles traveled (VMT) in 2007, Community transportation emitted 169,102.0 tCO_2e. This increased by 24% in 2010, when 320 million VMT were driven and 205,487.0 tCO_2e were generated. Transportation is the largest source of emissions generated by the Community. In short, emissions increased by almost a quarter since 2007.
- The Community disposed of nearly 34,375 tons of landfilled waste in 2007, generating 5,500.1 tCO_2e. This increased by 1% to 34,841 tons of landfilled waste in 2010 or 5,574.6 tCO_2e.

Of the total Community GHG emissions, 44% was generated by Community transportation in 2007, and 51% in 2010, indicating that a reduction in annual vehicle miles traveled (VMT) in Burlington could have the biggest impact on our emissions reduction target.

Community - 2007 and 2010 Total Emissions

Source	2007 GHG Emissions (tCO_2e)	Percent of Total 2007 City Emissions	2010 GHG Emissions (tCO_2e)	Percent of Total 2010 City Emissions
Electricity	79,664.2	21%	76,474.4	19%
Natural Gas	126,496.0	33%	117,242.6	29%
Transportation	169,102.0	44%	205,487.0	51%
Solid Waste	5,500.1	1%	5,574.6	1%
TOTAL	**380,762.3**	**100%**	**404,778.6**	**100%**

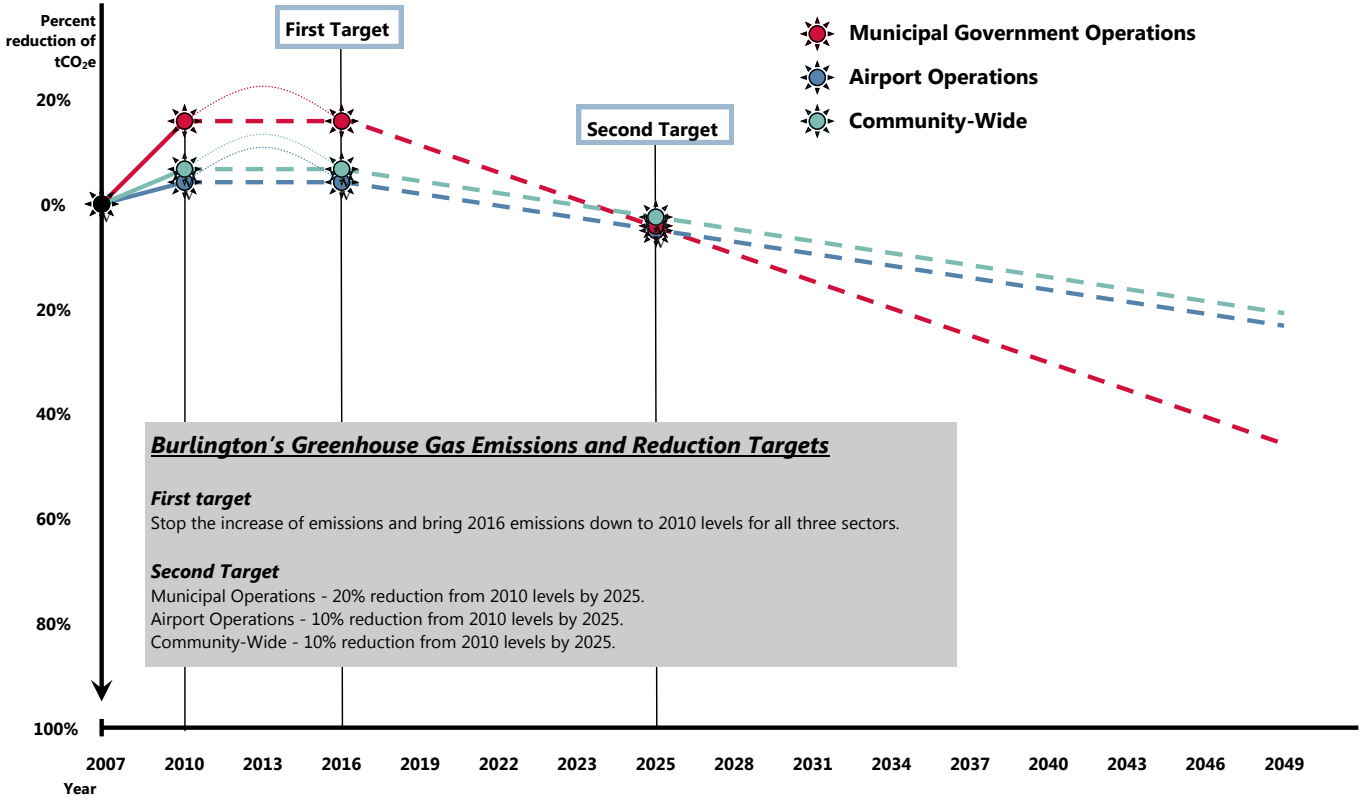
Please note that percentages may not add up to 100% due to rounding.

While energy produced from biomass may not always be carbon neutral, the Climate Protection Protocol (the standard GHG tracking tool used by cities around the world) does not require that GHG from biomass be integrated into overall calculations. That said, should this change and biomass be included in an updated Protocol, Burlington will include this information when it collects future data.

The US Environmental Protection Agency reports that 2012 McNeil's Total Facility CO2e Emissions (excluding Biogenic CO2) were 8425 metric tons and McNeil's measured Biogenic CO2 was 344,501 metric tons.

Where Are We Going?

Now that we have a sense of where our current emissions levels are, it is important to set emission reduction targets that are realistic considering where we have been and considering that emissions have increased between our two inventories. The chart below illustrates specific reduction targets for government operations, airport operations, and the community respectively. The first target requires leveling off the growth of emissions by 2016 and bring them back to 2010 levels. The second target involves an actual reduction of the 2010 emission levels by 2025.



How Can We Reduce Our Emissions?

In the fall of 2008, the city launched a lengthy community process, reflective of Burlington's participatory decision-making and community involvement history. Between September 2008 and February 2009, over 100 community volunteers and City staff gathered in eight working groups to develop emissions mitigation strategies under seven of the following eight themes. This work resulted in over 200 recommendations that were shared and vetted with the public at the December 2008 Legacy Town Meeting.

Each of the top strategies presented in this plan were carefully evaluated and chosen with the following criteria in mind:

- GHG Reduction Effectiveness
- Financial Performance/Cost Effectiveness
- Existing Implementation Capacity
- Available Funding/Financing
- Technical Feasibility
- Public Interest/Support
- Existing Momentum/Champion
- Local/Regional Economic Impact

Through this evaluation, 39 strategies rose to the top and are included in this plan as the first steps to take to reduce our emissions.

Most recently, with the development of planBTV-Downtown & Waterfront and other initiatives, the City added one more theme/goal that is central to reducing our impact on climate change. ***Compact mixed-use development*** considerations have proven to be one of the most effective ways to affect our generated emissions at a community level.

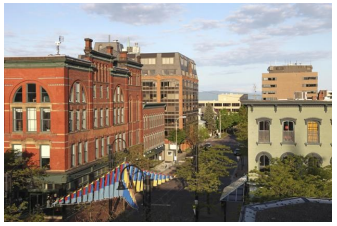
The following pages of the plan present the overarching goals for each themes as well as the related proposed strategies.

Goal: Promote compact mixed-use development.

Strategies

- Promote an active and vibrant downtown and waterfront core
- Promote compact mixed-use development in neighborhood activity centers
- Expand housing choices and grow the housing supply to create more live/work opportunities
- Expand transportation choices and the Complete Street system
- Incentivize urban infill development in the city core and dense activity centers through zoning
- Incentivize energy efficient building siting, design and operation through zoning
- Expand the comprehensive stormwater management system to incentivize low impact development technologies
- Create a more predicable development permitting process

In Burlington, our urban fabric is compact and actively encourages mixed uses. As we work to make it even better we have the potential to further reduce pollution and congestion, enhance social interaction, improve the efficiency and effectiveness of public service delivery, and create more vitality when compared to a more suburban development pattern. Studies of residential developments have found that high-density development emits less than half as much GHG per capita as low-density development. Particularly, the National Academy of Sciences, in a recent study chartered by Congress, has found that compact mixed-use development is likely to reduce Vehicle Miles Traveled (VMT) and could directly and indirectly reduce energy use and greenhouse gas emissions.



planBTV-Downtown & Waterfront, recently developed by the City, clearly articulates the need for more housing in our downtown, more housing that is affordable to everyone. This additional housing will in turn allow more people to live closer to their workplace and services, therefore reducing their need to drive on a daily basis. Urban dwellers typically have lower energy costs and a smaller carbon footprint. Neighborhood activity centers, located throughout the city, also provide opportunities for bringing housing, shopping, working, playing and transportation choices closer together so it is easier for Burlingtonians to walk or bike. Connecting these nodes with frequent and convenient transit will ultimately create an overall more efficient and inclusive transportation system.

Recent storm events are indicative of why we need to re-think how we manage our stormwater. Here it's more about how we adapt to climate change. Turning "grey streets to green streets" will not only improve the management of stormwater but also actively encourage more trees and plantings which have an important role in the sequestration of CO_2 and reduce the urban heat island effect. Green roofs and walls on our buildings are a great stormwater management tool which also helps to reduce heating and cooling costs.

Climate Factoids

Transit Accessible households use ~93 million fewer BTU's annually than their auto-dependent suburb counterparts (Jonathan Rose Companies, 2011)

Reducing a homes size by half (2,200 to 1,100 sqft) reduces its GHG emissions by ~36% (OR Dept. of Environmental Quality, 2010)

A typical SF home consumes an average of 108.4 million BTU's per year, while a multi-family building with at least 5 units uses only 54.4 million BTU's per year (US Energy Information Administration, 2005)

Goal: Reduce community-wide vehicle miles traveled (VMT) by 10% per capita by 2025.

Strategies

- Improve bicycle and pedestrian infrastructure
- Integrated transportation system improvements
- Create a downtown Transportation Management Association
- Price parking to maintain 85% utilization
- Develop infrastructure for fuel-efficient vehicles
- Develop a citywide bike/pedestrian plan

Burlingtonians are busy people: they commute to work, run errands, visit health care providers, and travel to recreate and play. Currently, fifty-one percent of the city's greenhouse gas emissions are produced by cars, trucks and buses. (This inventory excludes emissions from air travel, an approach that mirrors that of most cities.) To lower emissions, a high-quality transportation system, including a robust public transit network, and amenities to support biking, walking, and car sharing, are key. This, coupled with support for alternative fuel vehicles, such as a network of charging stations for the area's nascent but growing electric vehicle population, will greatly reduce GHGs.

Public Transit Solutions

Burlington is fortunate to have a variety of players involved in broadening our transportation options beyond the single occupancy vehicle. The Chittenden County Transportation Authority (CCTA) offers regular transit services to Burlington and surrounding communities. During the time this plan was written, CCTA daily ridership continued to grow. For example, ridership climbed 3.2% between 2010 and 2011, providing 2,510,959 total rides on their fixed-route service. More specifically, ridership on the Montpelier LINK increased by 21%, the Middlebury LINK by 10%, and the St. Albans LINK Express by 9% respectively. Continuing to work with CCTA on the expansion and increase of frequency of service in Burlington and beyond is crucial to reducing future greenhouse gas emissions.

Walking, Biking and Carsharing

Walking and biking are transportation choices that promote health and emit no or very few greenhouse gases. Burlington will reduce emissions if more stakeholders walk and bike and, use services such as CarShareVT. The "co-benefits" of these transportation options also make these appealing alternatives to single occupancy vehicle use. For example, research shows that carsharing can reduce overall household costs, and of course, walking and biking are important for overall physical health and well-being.

The IBM Smarter Cities Challenge Report proposes recommendations supporting the strategies of the Climate Action Plan:

- Enable electric vehicle (EV) sharing

See the Smarter Cities Report for more information

Goal: Reduce the amount of municipal vehicle miles traveled (VMT) by 10% by 2025.

Strategies

- Develop a government alternative employee commuting program
- Develop a government vehicle retirement and replacement program.
- Develop a government vehicle sharing/fleet management program

Although community-wide transportation generates the bulk of greenhouse gases (or approximately 205,000 tCO2e), 5,000 tCO2e are attributed to City operations, and staff commuting to work.

To help reduce emissions, while opening up needed parking and alleviating congestion, the City provides regional and local transit passes to all interested employees. The City has partnered with Local Motion on bike-commute trainings several bicycles available to staff for work-related travel. CarShare Vermont, one of the nation's first non-profit car sharing operations, is available to staff who drive for work. Offering the use of fuel efficient CarShare Vermont vehicles allows employees options beyond the city fleet, car rental, or personal vehicle use for work-related travel. And personal CarShare membership frees up city staff to take public transport to work by allowing them car share access during the day for private errands during the lunch hour.

To date, the City owns three compressed natural gas (CNG) recycling trucks. CNG emits far fewer particulates into the air, making it a more environmentally sound fossil fuel substitute. And because Burlington owns its own CNG filling station, it's less expansive to fill up CNG vehicles than similar vehicles that use standard gasoline. The Burlington Electric Department also recently purchased a biodiesel hybrid truck, a much more fuel efficient alternative. Still, the City should also consider every opportunity to better manage its vehicle fleet, ensuring that all vehicles are used to their full potential and that a larger proportion of the fleet uses more energy efficient and environmentally friendly fuels. This is especially true as new cars and trucks are purchased and old ones are phased out. An analysis of the current fleet usage and efficiency could provide opportunities for reduction of the fleet and increased fuel efficiency all the while reducing City operations.

Goal: Develop zoning, planning, and economic development policies that support local food production.

Strategies

- Develop public-private partnerships and infrastructure to support processing, preserving and storage of locally produced foods.
- Create and implement a policy for raising non-domesticated animals

By continuing to expand and grown Burlington's range of local food choices, we're not only reducing greenhouse gas emissions from the transportation of food from farm to plate, we're strengthening regional food security, building the local economy, and improving community health. Indeed the "co-benefits" of local food production, processing and consumption make the support of local food systems a winning proposition.

Fortunately, Burlington has a plethora of local food players. The Friends of Burlington Gardens, the Intervale Foundation, New Farms for New Americans, and Burlington's Parks and Recreation Department are just a few working on and supporting local food production and consumption. The Sustainable School Food Project, and the Burlington School Food Project, are working on education and to bring local food into area schools. Groups including UVM's Extension Service and Sustainable Agriculture Program, and the Urban Agricultural Task Force are addressing issues around policy, zoning, and research.

To create a more consistent supply of local products and enhance the local food supply chain, there needs to be a variety of places and means to market local farm products. The City already benefits from a seasonal farmers' markets, local grocery stores like City Market, and activities at the Intervale Food Hub. There is the additional opportunity for farm stands, a year-round market hall, street vendors selling locally-produced foods using and promoting local food products, specialty food retail outlets, joint marketing, and festivals celebrating local foods.

More attention is needed on the development of a robust public-private infrastructure to support additional processing, preserving and storage. Not only will this open up new ways and means to enjoy local food year round, these value-added activities can help spur economic development while lowing greenhouse gas emissions from the transportation of food. And while some work has gone into the support of non-domesticated animal production, there is still work to be done.

Goal: Increase energy efficiency in buildings.

Strategies

- Require new residential construction to be Vermont Energy Star for Homes (VESH) qualified
- Fully implement BED Advanced Metered Infrastructure (AMI) program
- Require new commercial construction to follow Core Performance guidelines
- Implement the "PACE" (Property Assessed Clean Energy) Program for residential properties and explore expansion to commercial properties
- Implement a deep energy efficiency program for government buildings
- Replace existing streetlights with LEDs
- Create a green roof policy and incentive program
- Revise and implement the Time of Sale ordinance
- Implement the Environmental Preferable Purchasing (EPP) Policy city-wide

Improving energy performance of city's buildings is a key goal of the plan. Achieving this will require a concerted effort by government and it's many public and private partners, including single and multi-unit property owners . Not only does increased building efficiency — and the efficiency of our infrastructure such as our City's streetlights — result in financial savings, it can help spur the local economy by creating employment opportunities.

Burlington's current success in energy efficiency can be attributed to two main players — Vermont Gas Systems (VTGas) and the Burlington Electric Department (BED). Working in tandem, VTGas and BED offer residents, businesses, and other Burlington-based entities ways to reduce energy use in buildings. Nationally recognized, BED's energy efficiency programs are the result of a bond to fund energy efficiency programs that supported program activities through 2002. Since 2003, BED customers (like all other Vermont electric customers) pay a small monthly Energy Efficiency Charge (EEC) that supports efficiency programs. When these funding sources are considered along with customers' direct costs, about $42 million has been invested in BED's energy efficiency efforts over the last 22 years. This includes about $19.3 million spent by BED and another $22.6 million in matching expenditures by BED customers. The overall effect has been dramatic. Annual electricity consumption in 2012 was 5.3 percent lower than in 1989. Energy efficiency investments save Burlington consumers $15.4 million of retail electric costs annually.

And now, with Advanced Metered Infrastructure being put in place throughout the city, property owners will have the power to better manage their energy consumption. This, coupled with the new commercial "PACE" program, Burlington stakeholders will have even more opportunities for efficiency and the creation of more renewable energy options.

The IBM Smarter Cities Challenge Report proposes recommendations supporting the strategies of the Climate Action Plan:

- Making Burlington synonymous with green technology
- Leveraging the Smart Grid (Advanced Metered Infrastructure)
- Promote energy efficiency execution (E3)
- Create a coordinated communication plan for "Burlington - the green tech city"

See the Smarter Cities Report for more information

Goal: Increase the use of cleaner and renewable energy sources.

Strategies

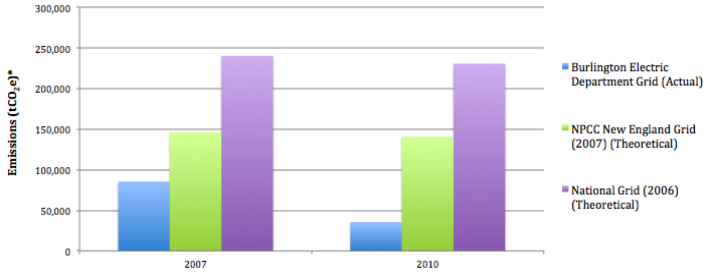
- Study feasibility of McNeil district heating project
- Implement additional "Solar on Schools" projects
- Implement BED "Renewable Energy Resource Rider" program
- Implement a "Solar City" project on municipal buildings
- Develop methane gas capture and CHP potential at City's wastewater treatment plants

To reduce our greenhouse gases, Burlington should strive for higher efficiency from our existing energy sources and continue to work towards its goal of 100% renewable power. Work on this front will not only reduce emissions, but protect us from the whimsical forces of the traditional energy market.

City Market Solar Panels

As a municipal department for the City of Burlington, Burlington Electric Department has a long history of sourcing electricity from clean power mixes. This is reflected in the lower emissions from the Burlington Electric Department Grid, shown in blue in the graph below. Generating electricity with fossil fuels contributes to climate change. BED has long been a leader in renewable energy development. BED's 2012 Integrated Resource Plan established a goal to continue seeking long-term renewable resources to fill the remaining supply gap without substantial rate impacts. Since the 2012 IRP was filed in September, 2012, BED has executed a five-year contract for energy from small existed hydro facilities, received approval to exercise the option and started discussions to pursue purchasing the Winooski One hydro facility, and the Georgia Mountain Community Wind Project in Georgia Vermont has come on line and begun delivering energy. Purchasing the Winooski One hydro facility will meet another 8 - 9% of the city's annual energy needs.

City of Burlington - 2007 and 2010 Electricity Emissions by Grid



The 2007 Burlington Electric Department Grid emissions were applied to the 2007 usage and the 2010 Grid emissions were applied to the 2010 usage. For theoretical purposes, the emissions factors for the regional grid, the NPCC New England Grid (2007), shown in green below, and the National Grid (2006), shown in purple in the graph below, were applied to the 2007 and 2010 usage. The NPCC New England Grid provides cleaner electricity than the National Grid, but not as clean as the Burlington Electric Department Grid.

Under Mayor Weinberger's initiative, on November 13, 2012, the City Council passed a resolution to waive all building, electrical, plumbing and zoning permit fees associated with the installation of solar photovoltaic panels and thermal hot water equipment for a period of one year. This is aimed at reducing barriers for such installations as well as strengthening Burlington's commitment clean and locally generated energy.

The IBM Smarter Cities Challenge Report proposes recommendations supporting the strategies of the Climate Action Plan:

- Optimize the Joseph C. McNeil

See the Smarter Cities Report for more information

Goal: Increase carbon storage and sequestration with additional forest and tree coverage.

Strategy

- Increase the Urban Tree Canopy (UTC)

Research indicates that carbon sequestration — or the process by which carbon is captured and stored to avoid release into the atmosphere — is a sound and viable way to reduced greenhouse gasses. Because trees sequester carbon, Burlington is fortunate to have an extensive tree canopy, approximately 40% of Burlington's land cover mass. Not only do trees sequester carbon, Burlington's urban forest, a mosaic of planted landscapes and what remains of the native forest, is a reflection of the city's health, well being, and livability. It is an important part of Burlington's character, giving the City a special sense of place.

Our tree canopy also offers additional benefits. The air and water are cleaner because the trees and plants remove pollution from the air and reduce run-off. Open spaces and urban stream corridors define a sense of space in our communities while providing a quiet respite from hectic urban life. Neighborhoods with tree-lined streets offer shade and protect us from inclement weather. Shoppers frequent shaded business districts where trees help save energy, reduce noise, and soften the hard edges of structures and paved areas.

Burlington has several key players, including Branch Out Burlington (BOB), working to protect, expand and grow our tree canopy. A volunteer organization, BOB's goal is to promote a vision of a city graced by a variety of beautiful and healthy trees, and a citizenry actively involved with the perpetual expansion and preservation of our urban forest.

Goal: Reduce the amount of waste sent to landfills

Strategies

- Implement a residential organics collection program
- Explore a residential Pay As You Throw (PAYT) program
- Require recycling bins at all public facilities and events
- Increase the use of reusable shopping bags
- Work to consolidate trash haulers by neighborhood or district
- Require all major construction and demolition projects to submit waste management plans

Burlington produces an estimated 34,000 tons of waste annually. To reduce the amount of waste we generated as a community along with the associated environmental costs of transportation, individuals, government, and the private sector must work together. Much of this effort will need to focus on behavior change, and encouraging stakeholders to not only comply with mandatory recycling, but to compost and think critically about reducing waste at the point of purchase.

The waste reduction goal also requires that Burlington restructure its methods of garbage pickup and transport. Currently, residences and businesses contract with haulers directly to pick up trash and compostable materials; the City picks up recyclables. New approaches are being explored to reduce the amount of driving currently required to pickup waste, including consolidating trash hauling by district or neighborhood.

And while the majority of trash is generated at the community level, over 1,600 tons is generated by City government. To reduce this, the City of Burlington recently implemented a waste reduction program in all City buildings, including composting. By simply composting brown paper towels in the staff's City Hall restrooms, approximately 2,400 gallons of waste will be diverted from the waste stream annually.

Landfill in Moretown, VT

Moving Forward

The Burlington Climate Action Plan identifies a coordinated set of strategies that everyone who lives in, works in or visits Burlington can adopt to help reduce our city's carbon footprint and enhance our quality of life. It is a call to action for each of us to be thoughtful, persistent and committed.

Most of the strategies in the Plan will provide net benefits to residents, businesses and other organizations. While we recognize that these are aggressive goals, they can be achieved by working together, spending money wisely, accomplishing multiple objectives with existing programs and harnessing new funds from federal, state and local government, along with utilities, foundations and corporations. As we move forward, each strategy must be continuously assessed and monitored. To help with that process, the City's Green Team has been formed to review performance against our goals and to recommend revisions, adjustments and improvements.

Timely and efficient implementation this plan will require regular updates of our greenhouse gas inventory so that progress can be tracked, allowing the City to evaluate and re-evaluate the effectiveness of the strategies. It is also essential to note that current strategies might change or new strategies might surface depending on emerging technology, change in financial and staff resources, and as our commitment to climate planning grows. These continuous efforts mean that the Climate Action Plan is a work-in-progress, requiring on-going time, diligence, and effort.

The goal and strategies identified below have been developed and added to ensure a seamless and constant implementation of the strategies identified in this plan:

GOAL: Ensure the Implementation of the Climate Action Plan (CAP) Through Constant Coordination with Stakeholders and Regular Annual Assessment of the City's Progress.

- Develop a progress assessment structure that would include: annual progress report format, GHG emissions inventory 3-year update and periodical revisit of all strategies' relevance.
- Create a **Sustainability Coordinator** position responsible for the management and implementation of Burlington's Climate Action Plan. This position will involve assessing progress as well as overseeing the involvement of partner agencies such as the City's Green Team.
- Empower the City's Green Team to take on the implementation of the Climate Action Plan in conjunction with the Sustainability Coordinator.

Our Strategies in Details

In order to achieve our reduction targets, we've got to get to work. The next step is to prioritize, with guidance from the City Council and other leaders, the following strategies — and then get started on implementation. Some will have limited up front cost, while others will require a substantial investment. In the end, however, most will bear financial rewards in the reduction of maintenance and operation costs.

NOTE: These recommended strategies came out of a public process and are not necessarily an exhaustive list nor are they completely defined and detailed. Further refinement should be expected based on actual needs and opportunities at the time of implementation.

Compact Mixed-Use Development	Leader
Promote an active and vibrant downtown and waterfront core - planBTV-Downtown & Waterfront presents a good framework for the promotion of a vibrant downtown. Ensure that the ideas outlined in planBTV are implemented.	All City Departments
Incentivize urban infill development in the city core and most dense activity centers through zoning - Continue to ensure that zoning regulations incentivize and allow for compact mixed-use development to occur in neighborhood activity centers.	Planning & Zoning Dept.
Expand housing choices and grow the downtown housing supply to create more live/work opportunities - Remove existing regulatory barriers to the development of more housing downtown and provide additional incentives through regulations, programs, etc.	Planning & Zoning Dept.
Expand transportation choices and the Complete Street system - Implement the 2011 Transportation Plan to the greatest extent possible, ensuring that a Complete Street approach is taken for every reconstruction or redesign project.	Dept. of Public Works
Incentivize energy efficient building siting, design and operation through zoning - Develop a form-based code that will ensure efficient building design and siting, and continue to require the use and implementation of the Energy Code.	Planning & Zoning Dept.
Expand the comprehensive stormwater management system to incentivize low impact development technologies - Develop and implement additional stormwater management policies for new development and find ways to incentivize their use.	Dept. of Public Works
Create a more predictable development permitting process - Develop a form-based code that improves the development review and permitting process, increasing its predictability for developers.	Planning & Zoning Dept.
Community Transportation	**Leader**
Improve bicycle and pedestrian infrastructure - Build upon the Complete Streets guidance integrating on-street bicycle and pedestrian facilities into all future infrastructure improvements to City streets.	Dept. of Public Works
Integrated transportation system improvements - Build upon the City's Transportation Plan to implement several improvements of an integrated transportation system including the creation of a downtown transit center, Park and Ride and Auto Intercept lots to capture cars before they enter City neighborhoods, and increased frequency of transit in corridors servicing downtown and auto intercept facilities.	Dept. of Public Works
Create a downtown Transportation Management Association (TMA) - Develop a downtown transportation management association that plans, develops, and manages all employee transportation and parking programs, infrastructure, and related facilities. The goal of the TMA would be to offer and improve cost-effective and convenient alternative transportation services while simultaneously reducing travel demand and traffic congestion and improving air quality.	TBD

COMMUNITY TRANSPORTATION	LEADER
Price parking to maintain 85% utilization - Increase parking rates to market-based rates and to maintain an 85% parking utilization rate. This action will better relate parking supply with demand, increase the likelihood of available spaces, reduce traffic congestion, improve air quality, and increase revenues for the City.	Dept. of Public Works
Develop infrastructure for fuel-efficient vehicles - This proposed action would develop infrastructure and incentives for fuel-efficient vehicles. This might include charging stations for electric and electric-hybrid vehicles and fueling stations for CNG and other alternative fuel vehicles.	Dept. of Public Works
Develop a Citywide Bike/Pedestrian Plan - This proposed action would build upon the City's North/South Bike Plan by taking a more comprehensive look at the City's existing bike/pedestrian infrastructure and designing and implementing necessary improvements.	Dept. of Public Works
GOVERNMENT TRANSPORTATION	**LEADER**
Develop a government alternative employee commuting program - Reduce government employee commuting miles by encouraging employees to commute through emissions-free modes (telecommuting, walking, and biking), as well as less impactful modes (car pooling, ridesharing, and mass transit). It would also include incentives such as a parking cash-out program.	City Green Team
Develop a government vehicle retirement and replacement program - Retire 5% of the government's vehicle fleet and replacing 25% of the gasoline-powered vehicles with hybrids; retire twelve vehicles and replace 62 gas-powered vehicles with hybrids over a five year period.	Dept. of Public Works
Develop a government vehicle sharing/fleet management program - Includes vehicle acquisition, assignment and maintenance with a focus on cost-effectiveness and emissions reduction. Could also include other functions, such as vehicle financing, driver management, speed management, fuel management, health and safety management, regulatory compliance, and validating green initiatives.	Dept. of Public Works
LOCAL GARDENS, FARMS AND FOOD PRODUCTION	**LEADER**
Develop public-private partnerships and infrastructure to support processing, preserving and storage of locally produced foods - Develop public-private partnerships and infrastructure for the processing, preserving and storage of locally produced foods.	TBD
Create and implement a policy for raising non-domesticated animals - Create and adopt a clear and consistent policy for raising non-domesticated animals, for egg, meat, and milk production, in city neighborhoods and urban agriculture areas.	TBD
ENERGY EFFICIENCY IN BUILDINGS	**LEADER**
Require new residential construction to be Vermont Energy Star for Homes (VESH) qualified - Require new residential construction to be Vermont Energy Star for Homes (VESH) qualified. VESH are designed and built using best practices to save energy by reducing air leaks and thermal bypass, and by requiring high efficiency heating and appliances.	Burlington Electric Dept.
Fully implement BED Advanced Metered Infrastructure (AMI) program - BED is in the process of installing smart meters in all buildings in the City of Burlington. Smart meters will provide data to BED and its customers in 15 minute intervals, and offer two-way communication. This better data can then be used to achieve increased efficiency.	Burlington Electric Dept.
Require new commercial construction to follow Core Performance guidelines - Require new commercial construction to follow Core Performance guidelines, a program offered by BED, and Vermont Gas. Core Performance is a prescriptive guide to reduce energy use in commercial buildings by 20-30%.	Burlington Electric Dept.

Energy Efficiency in Buildings	Leader
Implement the "PACE" Program for residential properties and explore expansion to commercial properties - The PACE program will allow residential property owners to access long term municipal financing to make eligible energy efficiency and renewable energy improvements to their buildings. By opting into a special tax assessment district, property owners pay for these improvements via property taxes over a period up to twenty years.	Burlington Electric Dept.
Implement a deep energy efficiency program for government buildings - Perform deep energy efficiency improvements in all municipal buildings. Deep energy retrofits would include extensive renovations to existing structures that use the latest in energy-efficient materials and technologies and results in significant energy reductions.	Burlington Electric Dept.
Replace existing streetlights with LEDs - Continue to replace all existing streetlights (approximately 3,300) with LEDs over a 10-year period.	Dept. of Public Works
Create a Green Roof policy and incentive program - Create incentives to encourage that all new flat roofs at or under 30 degree-pitch, both private and public have to be vegetated. If old roofs have to be retrofitted, the building owner may be able to receive public financial support for a green roof.	Dept. of Public Works
Revise and implement the Time of Sale ordinance - Build upon the existing residential rental housing time of sale energy efficiency ordinance by applying it to all residential and commercial buildings. Furthermore, it proposes that, as a condition of sale, all buildings must receive an energy inspection and rating that is available to prospective buyers.	Code Enforcement Office
Implement the Environmental Preferable Purchasing (EPP) Policy city-wide - Fully implement the City's existing environmental purchasing policy, requiring that it be applied to all procurement decisions city-wide.	City Green Team
Renewable Energy Resources	**Leader**
Study the feasibility of McNeil district heating project - Use McNeil power plant as a heat source for a district heating system that would improve McNeil's efficiency, make use of some of its waste heat, and provide heat to consumers at a relatively low and predictable price.	Burlington Electric Dept.
Implement additional "Solar on Schools" projects - Put solar PV panels on the City of Burlington schools' roofs. The panels on seven schools will be owned and operated by a private third-party development partner who can take advantage of federal and state tax credits, which the City cannot.	School District
Implement BED "Renewable Energy Resource Rider" program - Encourage residents and businesses to install solar PV panels. This is achieved through setting a predictable and stable rate above the retail cost of electricity, and therefore above the rate for standard net metered production.	Burlington Electric Dept.
Implement a "Solar City" project on municipal buildings - Install solar photovoltaic panels on appropriate city-owned buildings with the goal of providing 1MW aggregate power and helping to minimize the occurrence of peak load.	Burlington Electric Dept.
Develop methane gas capture and Combined Heat and Power (CHP) potential at City's wastewater treatment plants - Fully develop the potential for capturing methane gas and generating electricity and/or heat from the City's decentralized waste water treatment facilities.	Dept. of Public Works
Urban Forestry and Carbon Sequestration	**Leader**
Increase the Urban Tree Canopy (UTC) - This proposed action would increase the urban tree canopy (UTC) by planting a total of 588 trees per year and by maintaining the existing urban tree canopy. This would be achieved both on public and private property.	Parks Department

WASTE REDUCTION AND RECYCLING	LEADER
Implement residential organics collection program - Collect residential organic food waste (no yard waste) to be composted and would be modeled after the existing City residential recycling program, thus having a similar infrastructure and cost profile.	Dept. of Public Works
Explore a residential Pay As You Throw (PAYT) program - Change the current residential collection payment system to a system in which residents pay per unit of trash collected. Programs like these result in a decrease of solid waste, as well as overall cost savings to participants. The current physical system would remain the same.	Dept. of Public Works
Require recycling bins at all public facilities and events - Require that recycling bins are available and maintained at all public facilities and events.	Parks & Recreation Dept.
Increase the use of reusable shopping bags - Create incentives for increase usage of reusable shopping bags and the complementary reduction of disposable plastic bags.	Businesses
Work to consolidate trash haulers by neighborhood or district - Consolidate trash haulers by neighborhood or district, thereby limiting the number of trucks driving through the city, reducing vehicle miles and congestion, and improving air quality.	Chittenden Solid Waste District (CSWD)
Require all major construction and demolition projects to submit a waste management plan - Require construction and demolition (C&D) projects to submit a waste management plan. Such a plan would include: waste recycling, salvage or reuse goals; estimated types and quantities of materials or waste generated from the project site; proposed and intended disposal methods for these materials; and detailed instructions for subcontractors and laborers on how to safely separate or collect the materials at the job site.	Planning & Zoning Dept.

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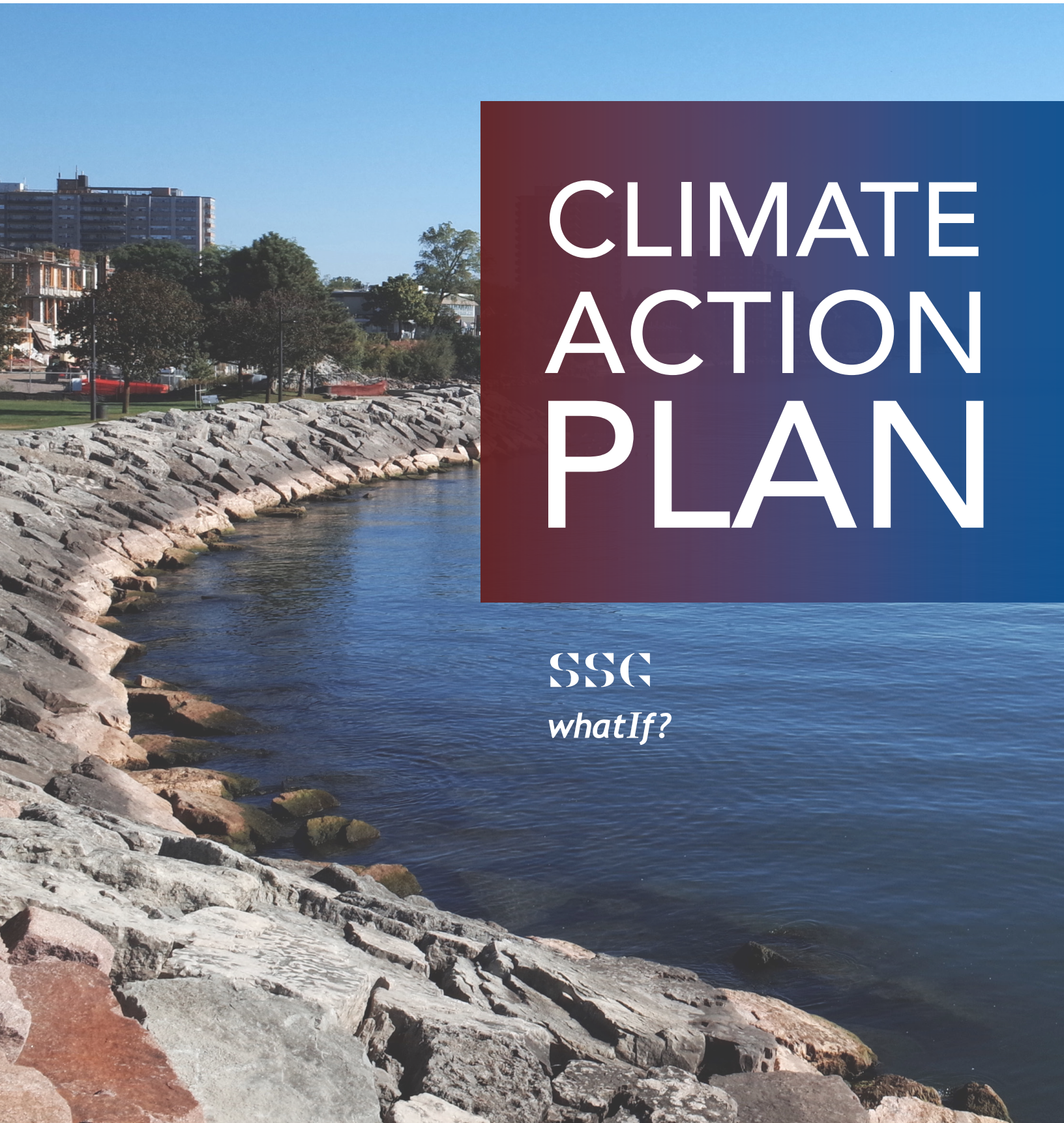
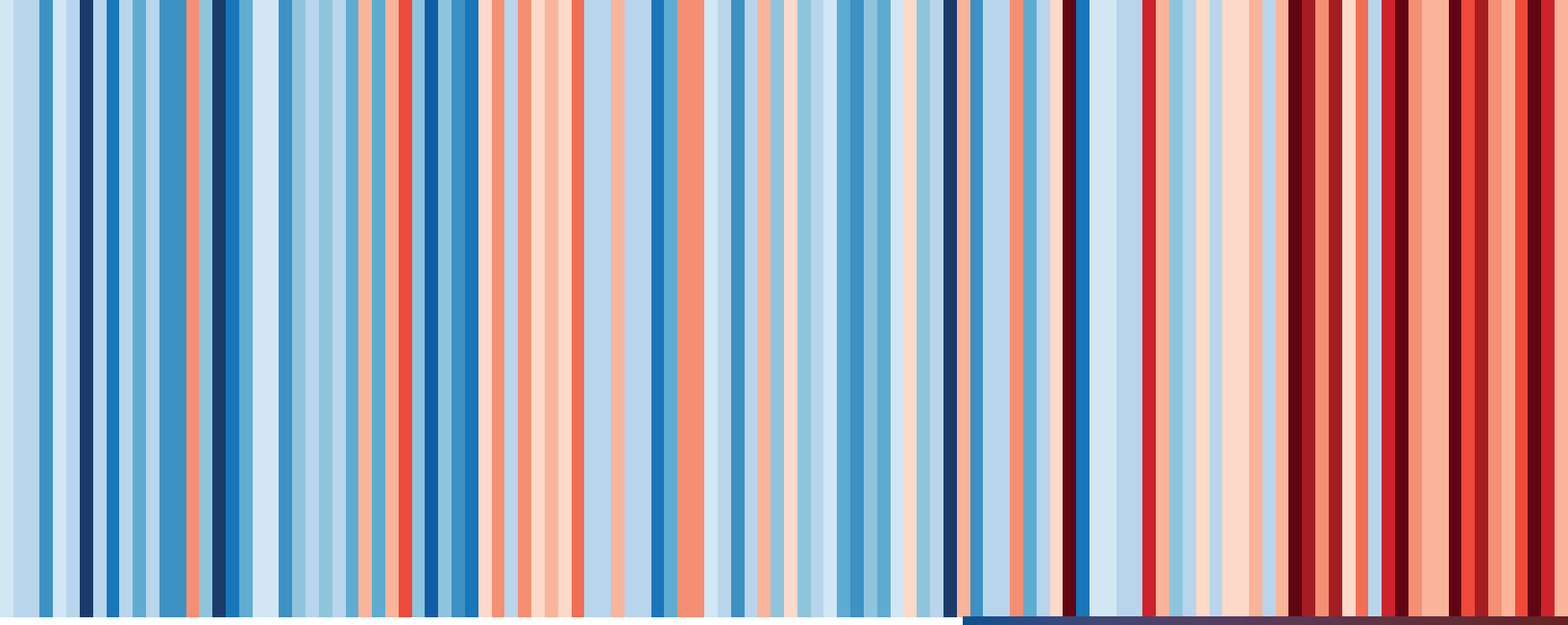
CITY OF Burlington



CLIMATE ACTION PLAN

SSG

whatIf?



Warming Stripes for Canada from 1901-2018. Annual average temperatures for Canada from 1901-2018 using data from Berkeley Earth. Source: showyourstripes.info

Disclaimer

This analysis has been undertaken to identify a low carbon energy pathway for the community of Burlington. Reasonable skill, care and diligence have been exercised to assess the information acquired during the preparation of this analysis, but no guarantees or warranties are made regarding the accuracy or completeness of this information. This document, the information it contains, the information and basis on which it relies, and factors associated with implementation of the pathway are subject to changes that are beyond the control of the authors. The information provided by others is believed to be accurate, but has not been verified.

The population and employment projections that inform the analysis are based on information from the June 26, 2015 Region Official Plan Consolidation to 2031 at the time the document was published, and further projections from 2031 to 2050 are an estimate for the purpose of the Burlington Climate Action Plan, and were developed by the authors of this report for this exercise, and do not constitute projections for the purposes of land use planning.

This analysis includes high level estimates of costs and revenues that should not be relied upon for design or other purposes without verification. The authors do not accept responsibility for the use of this analysis for any purpose other than that stated above and does not accept responsibility to any third party for the use, in whole or in part, of the contents of this document.

This analysis applies to the City of Burlington and cannot be applied to other jurisdictions without analysis. Any use by the City of Burlington, project partners, sub-consultants or any third party, or any reliance on or decisions based on this document, are the responsibility of the user or third party.

Glossary

Term	Definition
Adaptation (to climate change)	Adjusting to actual or expected climate impacts to reduce negative effects on people, society, infrastructure, and the environment
Air Source Heat Pump	An efficient system to transfer latent heat from outside of a building to inside the building, or vice versa, typically using electricity as a fuel source
BAU	Business as Usual
BCAP	Burlington Climate Action Plan
CO_2e	Carbon dioxide equivalent, a standardized measurement of greenhouse gases based on the warming potential of given gases compared with carbon dioxide
District Energy	A network of hot and cold water pipes that are used to heat and cool connected buildings more efficiently than if each building had their own heating/cooling systems
GHG	Greenhouse gases
Ground Source (Geothermal) Heat Pump	A central heating or cooling system that transfers heat to or from the ground, where the earth is used as a heat source and sink.
$KtCO_2e$	Kilotonne carbon dioxide equivalent; equal to 1,000 tonnes
LCS	Low carbon scenario
LIC	Local improvement charge
Mitigation (of climate change)	Human interventions to reduce the sources and enhance the sinks of GHGs
$MtCO_2e$	Megatonne carbon dioxide equivalent; equal to 1,000,000 tonnes
PACE	Property Assessed Clean Energy is a funding mechanism that allows individuals to make upgrades to their property.
RNG	Renewable natural gas
Solar thermal	Solar thermal technologies capture heat energy from the sun, and use it for heating or to produce electrical energy
Solar PV	Solar photovoltaic technologies produce electricity from solar radiation
VKT	Vehicle kilometres travelled

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EXECUTIVE SUMMARY

Climate change is the defining challenge of our time. The way in which societies confront this challenge over the coming decade will determine whether we have a safe and sustainable world, for now and into the future. In April 2019, the City of Burlington joined other Canadian and global municipalities in their declarations of a climate emergency. This declaration sets a strong direction for the City and the community to mitigate GHG emissions. It acknowledges the necessity to act now to avoid further economic, ecological and societal impacts, and resolves that Burlington will

1. Address the operations of the corporation of the municipality as well as the functioning of the entire community; and
2. Include a plan for a thorough and complete consultation with stakeholders and the community; and
3. Increase action and ambition for the City's climate change-related activities; and
4. Include performance metrics to track progress and timelines for achieving key deliverables/major milestones, and a strategy to report back publicly on progress.

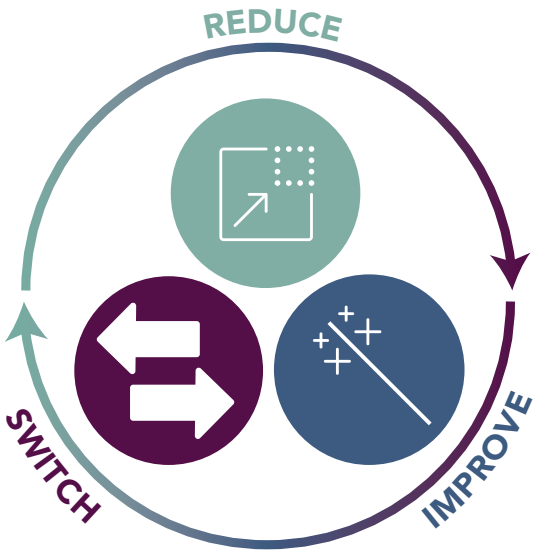
The leadership of City Council in declaring a climate emergency in response to the climate change concerns expressed by citizens is consistent with the shift among municipalities worldwide to take bold action to reduce emissions while creating resilient, high quality of life, and prosperous communities.

The City is undertaking numerous policies and initiatives to address the impacts of climate change, and to reduce the energy consumption and greenhouse gas (GHG) emissions of the City's operations and the community. In 2018, Burlington partnered with the City of Hamilton to complete the Bay Area Climate Change Inventory and Forecast, which accounted for the energy use and GHG emissions of Hamilton and Burlington in 2016, and projected future energy use and GHG emissions to 2050 both in a Business-as-Usual (BAU) scenario, and as a Low Carbon Scenario (LCS). The Climate Action Plan incorporates the LCS as a pathway and evaluates the financial opportunities, programs and policies to enable the pathway.

The modelling of the LCS used for this analysis represents one possible pathway for a low carbon future for the City of Burlington. Changes in the timing, scope, and scale of implementation will affect the real-world results, as will changes in technology that could not be captured in this model. The actions for the LCS pathway are summarized in Table 2.

Transitioning the Energy System

A framework of **reduce, improve and switch** is used to help frame the actions in the LCS. This approach is adapted from similar approaches such as the well-known Reduce-Reuse-Recycle (from the waste sector) and Avoid-Shift-Improve[1] (from the transportation sector). The focus is first on reducing or avoiding consumption of energy, second, on improving the efficiency of the energy system (supply and demand), and third, on fuel switching to low carbon or zero carbon renewable sources. This approach minimizes the cost of the energy transition by avoiding installing capacity that is not subsequently required as a result of energy efficiency measures.



In terms of reduction, overall energy consumption in the City declines from 127 GJ/capita/year in 2016 to 56 GJ/capita/year by 2050, indicating a more efficient use of energy. Electric vehicles are much more efficient than combustion-powered vehicles, and so the adoption of electric vehicles is a major contributor to the greater efficiency and lower conversion losses in the LCS. Additionally, the reduction in heating degree days reduces the need for building heating, and is not matched by the increase in cooling degree days requiring more frequent building cooling.

A second aspect of community energy and climate action planning includes prioritizing interventions in terms of a hierarchy based on what lasts longest, and are therefore most difficult to change.[2] The first priority is land use planning and infrastructure, including density, mix of land uses, energy supply infrastructure and transportation infrastructure. The second is major production processes, transportation modes and buildings, including industrial processes choice of transportation modes, and building and site design. The final priority is converting to energy-using equipment including for transit vehicles, motors,

1 GIZ. (2011). *Sustainable urban transport: Avoid-shift-improve*. Retrieved from http://www.sutp.org/files/contents/documents/resources/E_Fact-Sheets-and-Policy-Briefs/SUTP_GIZ_FS_Avoid-Shift-Improve_EN.pdf

2 Jaccard, M., Failing, L., & Berry, T. (1997). From equipment to infrastructure: community energy management and greenhouse gas emission reduction. *Energy Policy, 25*(13), 1065–1074.

appliances and HVAC systems.

This hierarchy explicitly concentrates the efforts on spheres of influence where there are fewer options to intervene in the future and it decreases the emphasis on the easier interventions which are likely to have greater short term returns.

Boosting Burlington's Economy

In the short term, annual energy-related expenditures in the LCS are somewhat higher than in the BAU scenario, as the up-front investments in efficiency and renewables required to significantly reduce GHG emissions generate savings over the long term. By 2029, the savings from these investments result in the annual net costs of the LCS dropping below the BAU scenario out to 2050. After 2029, the gap between the LCS and BAU continues to widen, and by 2050 the annual savings from the LCS reach $600 million. By 2050, the cumulative savings from the LCS as compared to the BAU scenario reach $6.7 billion and are still growing.

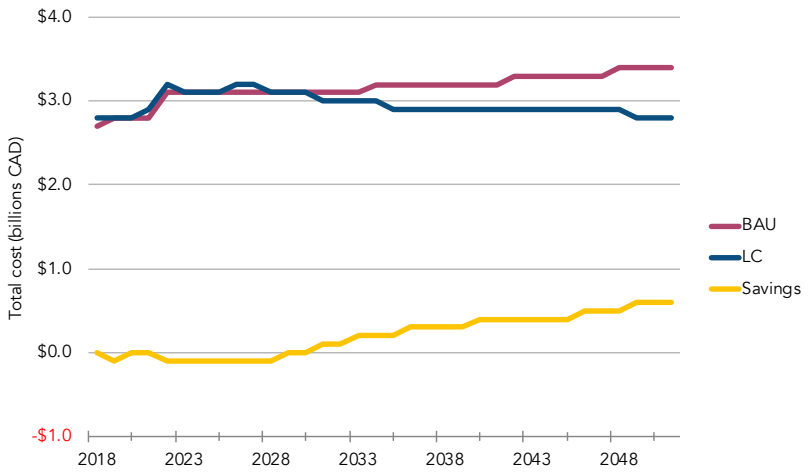


Figure 1. Total annual costs in the BCAP scenarios, 2016 CAD.

Additionally, the investments required result in new job opportunities. 21,300 person-years of employment are created between 2020 and 2050 in the LCS pathway, with 5,600 of those person-years in the renewable energy sector. Annual person-years by category can be seen in the following chart.

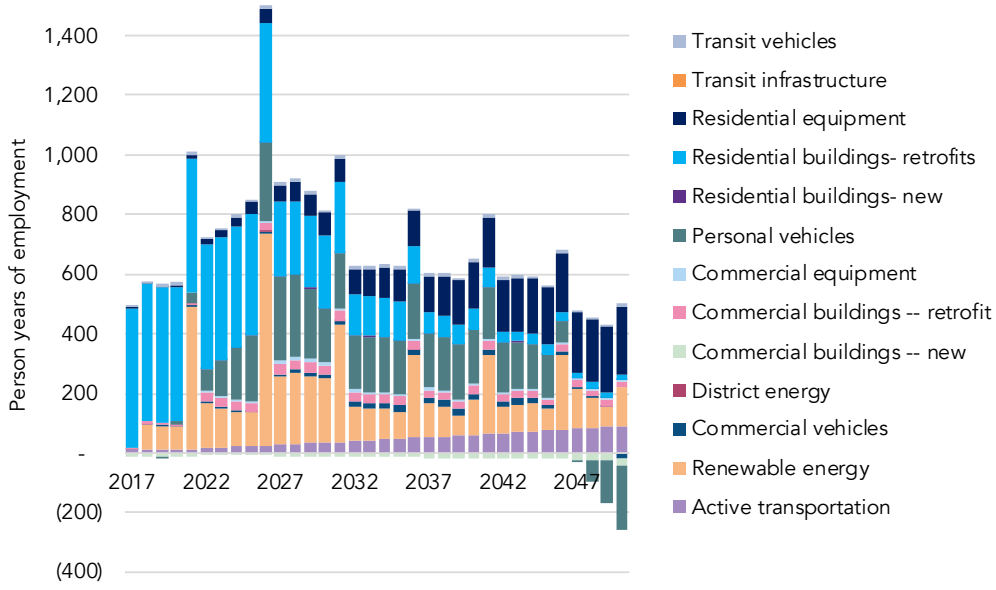


Figure 2. Employment generation in Burlington for the LCS pathway. Personal vehicles show negative values at the end of the period because EVs need less maintenance.

The Role of the Public Sector

Despite a compelling economic case for many of the actions incorporated within the LCS, these actions are not being advanced by the private sector, for a variety of reasons. The public sector has three key roles in overcoming these barriers to enable the implementation of the BCAP:

1. Identify the implementation strategies that maximize social benefits;
2. Create enabling conditions for private sector participation, for those cases in which private sector participation maximizes social benefit; and
3. Provide support for, or directly deliver those actions which are not delivered by the private sector.

A mapping process was undertaken to identify programs or policies that will support or enable the actions identified in the LCS. In most cases, each program can support multiple actions.

Table 1. Short-term implementation program actions

Programs	Description
Program #1: Burlington Low Carbon New Building Guideline: Enhanced energy performance for new buildings.	Staff will update the existing Sustainable Building and Development Guidelines, researching best practices in other jurisdictions and legislative authority. It will include a tiered set of performance measures that will require, incentivize and/or encourage new buildings to be built to a low carbon standard. Financing mechanisms will be explored.
Program #2: Burlington Deep Energy Retrofit Program: Transforming existing buildings.	The deep retrofits program will transform the energy efficiency of existing buildings. Staff will assess best practices in other jurisdictions, including a financing package which may utilize the LIC (Local Improvement Charge) or PACE (Property Assessed Clean Energy) mechanisms. Stakeholders will be engaged, including utilities, senior government agencies, industry and post secondary institutions. Partnerships and collaborations with third parties will also be considered. Retrofits may be targeted to groups of buildings, such as neighbourhoods, or sectors (restaurants, grocery stores, etc.) to generate economies of scale. Renewable energy will also be eligible under the program including solar PV and thermal (for hot water), air and ground-source heat pumps, and energy storage.
Program #3: Renewable Energy Co-operative: Stimulating local renewable energy projects.	The cooperative is a partnership between local groups, agencies and individuals to invest in local renewable energy projects. The co-operative will advocate for, develop, commission and finance projects, depending on which strategy is appropriate to a particular context. Different technologies and approaches will be considered, including district energy, solar, storage and geothermal. Financing options will be researched and may come from community bonds, loans and grants from various levels of government.

Programs	Description
Program #4: Integrated Mobility Plan: Transit service improvements to reach mode share targets.	The Integrated Mobility Plan (IMP) will develop an innovative strategy that supports future mobility planning with an emphasis on **people movement.** The Plan will be cognizant of the city's current demographics, recognizing the unique mobility needs of an aging population, while looking towards the future through a lens that focuses on maximizing the people-carrying capacity of our transportation network compared to road expansion. The resultant strategy will position Burlington to respond to technology changes and emerging mobility options, while balancing the needs of our citizens and providing equitable mobility in a safe, reliable and sustainable manner. The IMP will enable council and city administration to make future decisions relating to mobility and prioritize funding in a manner that ensures future success and continued livability.
Program #5: Electric Mobility and Equipment: Encouraging the adoption of electric mobility and equipment.	A technical working group will be established with representatives from relevant organizations and stakeholders. The working group will develop a strategy to support infrastructure investments, education and outreach, and municipal policies to support electric mobility options. Electric mobility may include electric vehicles, bikes, scooters and other means of mobility. Electric equipment may include landscaping equipment such as lawn mowers, trimmers and leaf blowers, as well as others where relevant.
Program #6: Waste Reduction Initiative: Engaging the community.	Waste management is primarily delivered by the Region of Halton, and is therefore outside of the direct influence of the City. The City will support the region to engage the community to first reduce waste and secondly, properly divert waste.

Programs	Description
Program #7: Industrial Innovation Program: Reducing energy demands by industry.	This program will support organizations that work with local businesses to improve energy efficiency in their operations and identify opportunities for the City to incentivize energy efficiency in the industrial sector..

Tracking Progress

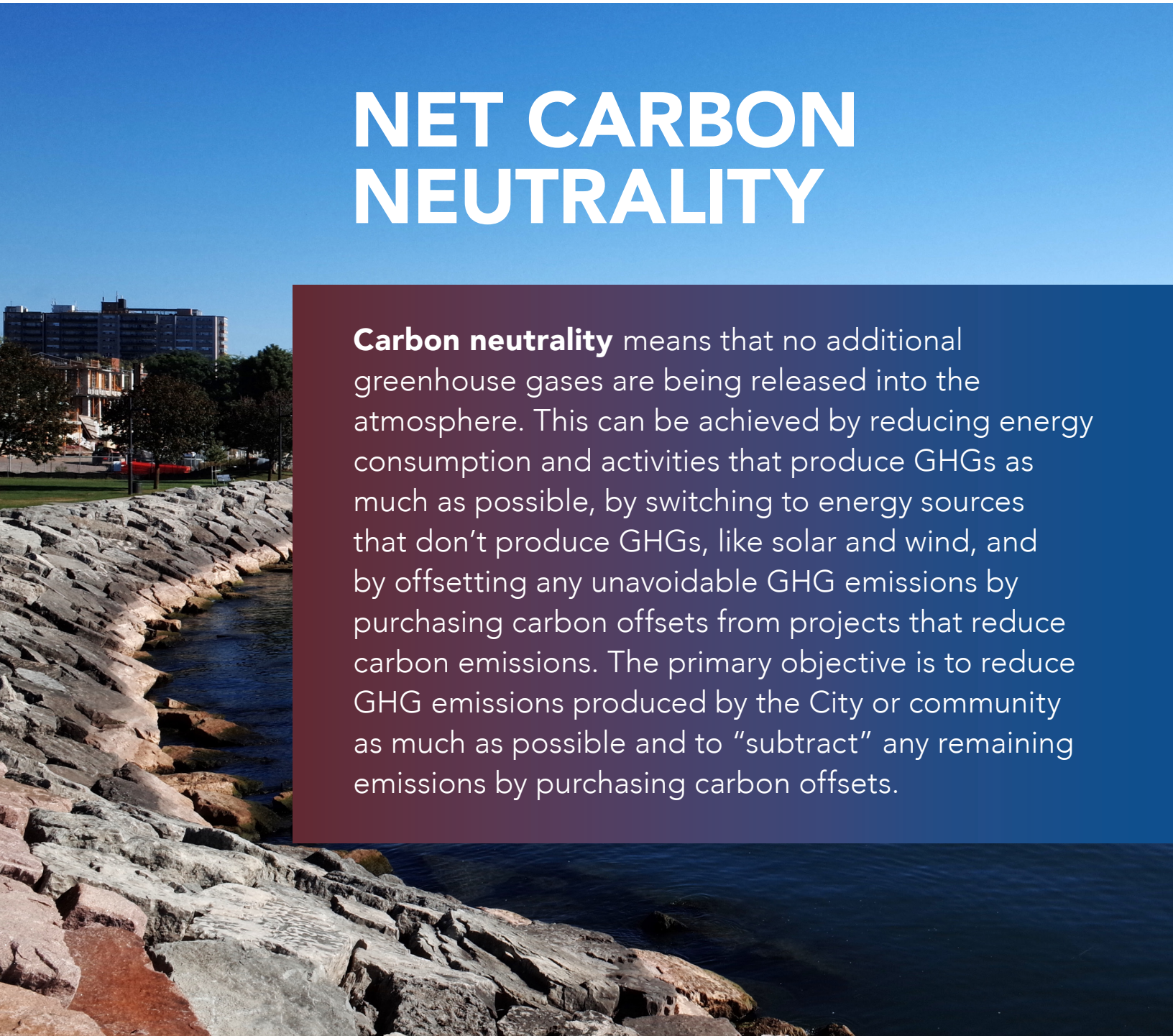
Tracking the effectiveness of the programs in the BCAP helps to manage the risk and uncertainty associated with the efforts, as well as external forces such as evolving senior government policy and new technologies which can disrupt the energy system. Key motivations for monitoring and evaluation include the following:

- Identify unanticipated outcomes.
- Adjust programs and policies based on their effectiveness.
- Manage and adapt to the uncertainty of climate change.
- Manage and adapt to emerging technologies.

Specific activities which have been identified to support the implementation of the BCAP include an annual work plan and review, an annual indicator report, an update of the GHG inventory every two years and an update of the BCAP every five years.

INTRODUCTION

This document represents the first phase of the Climate Action Plan for the community of Burlington, with a focus on mitigating greenhouse gases (GHGs) and reducing energy consumption. The City has set a goal in its Strategic Plan to work towards being a net carbon neutral community. The second stage of this Climate Action Plan will focus on climate adaptation, identifying ways for Burlington to improve its resiliency and adapt to the changing climate. Phase 2 will be completed by early 2021.



NET CARBON NEUTRALITY

Carbon neutrality means that no additional greenhouse gases are being released into the atmosphere. This can be achieved by reducing energy consumption and activities that produce GHGs as much as possible, by switching to energy sources that don't produce GHGs, like solar and wind, and by offsetting any unavoidable GHG emissions by purchasing carbon offsets from projects that reduce carbon emissions. The primary objective is to reduce GHG emissions produced by the City or community as much as possible and to "subtract" any remaining emissions by purchasing carbon offsets.

The City of Burlington

The City of Burlington covers 186 km^2 at the northwestern end of Lake Ontario. The city is in the Regional Municipality of Halton, at the western end of the Greater Toronto Area, within the intensively developed Greater Golden Horseshoe area of Southern Ontario.

For the purpose of this plan, population growth in Burlington was modelled to increase from 189,000 people in 2016 to 219,000 by 2050, an increase of 16%. The total number of jobs in 2016 was 86,000 and by 2050, this is projected to increase to 98,000[3].

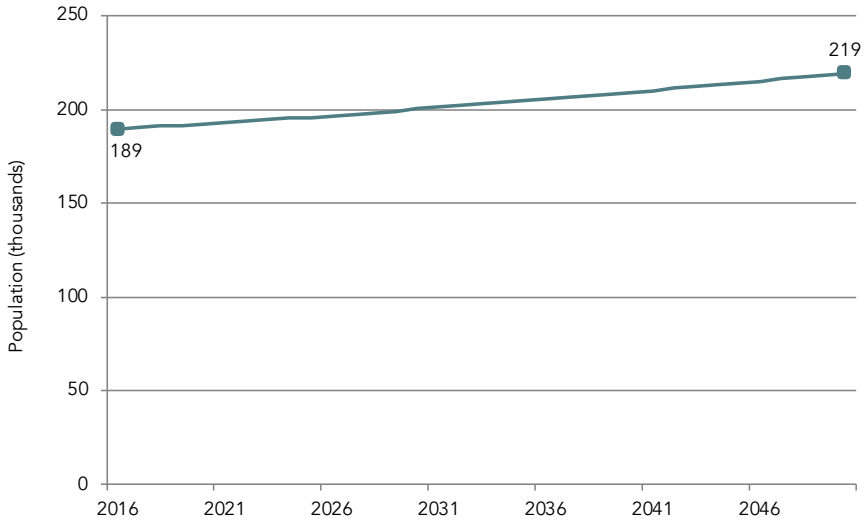


Figure 3. Population growth in Burlington from 2016-2050[4]

Like many municipalities in the region, Burlington has a diversity of industries and employers, including manufacturing, financial services, food processing and packaging, IT, life and earth sciences, manufacturing and fabrication, and transportation.[5] No one of these industries dominates the energy use and emissions production in Burlington.

Burlington has a humid continental climate with four distinct seasons over which the temperature fluctuates greatly from mid-summer to mid-winter. The climate is greatly affected by Lake Ontario, resulting in cold winters, and noticeable variability in the weather over short distances.[6]

3 Methods and assumptions for these baseline numbers and projections are found in Appendix A, at the end of this document.

4 Population growth projection as outlined in the Bay Area Climate Change Inventory and Forecast, 2018, adjusted for census undercount.

5 Economic Development Burlington. Major Employers. Accessed Oct 2019: https://bedc.ca/major-employers/

6 https://en.wikipedia.org/wiki/Burlington,_Ontario

Climate Change and Burlington

The City of Burlington is already experiencing the impacts of climate change, including the ice storm that hit the region in December 2013, the localized flooding in 2014, large and unpredictable winter storms in 2019, and an increase in invasive species.[7]

The city is expected to see more days above 30°C, increasing from an estimated 29 days in 2020 to 48 days in 2050, accompanied by an increased number of heat waves, and the heat waves will last longer. Cold days are expected to steadily decrease over time and the mean temperature is expected to increase. Total annual precipitation will increase slightly, but the region will see more days with heavy precipitation (20 mm or more), increasing from 7 days a year in 2020, to 9 days a year by 2050. This precipitation will also shift to more freezing rain and ice in winter. The frost-free season will expand, which will extend the growing season, but also result in changes to pests and invasive species success, and changes to precipitation patterns which can change crop planting patterns and crop success.[8] More frequent higher intensity storms are expected, which will increase stress and wear on current infrastructure designed to handle the more predictable storms in the past. The impacts of climate change will affect people, infrastructure, industry, and natural systems within Burlington.

7 City of Burlington, 2019. City of Burlington Climate Emergency Declaration. Accessed Oct 2019: https://www.burlington.ca/en/live-and-play/resources/Environment/Climate-Emergency/Final-Burlington-Climate-Emergency-Declaration-12-pt-font.pdf

8 Canadian Climate Atlas, 2019. Climate Atlas Report Municipality: Hamilton. Accessed Oct 2019: https://climateatlas.ca/data/city/451/hwlen_2030_85/line

Climate Impacts	Variable[9]
Heat	Increased average temperature More hot days (above 30C) More hot nights (above 20C) More and longer heat waves
Cold	Fewer days below 0C Fewer freeze-thaw cycles
Precipitation	Increased annual precipitation Increased heavy precipitation days (more than 20mm)

A Call to Action

In April, 2019 the City of Burlington declared a climate emergency. This declaration acknowledges the necessity to act now to avoid further economic, ecological and societal impacts, and resolves that Burlington will

1. Address the operations of the corporation of the municipality as well as the functioning of the entire community;
2. Include a plan for a thorough and complete consultation with stakeholders and the community;
3. Increase action and ambition for the City's climate change-related activities; and
4. Include performance metrics to track progress and timelines for achieving key deliverables/major milestones, and a strategy to report back publicly on progress.

Burlington's Strategic Plan for 2015-2040 includes three Key Strategic Directions with direct or indirect impacts on GHG emissions:

1. A City that Grows: this reflects the vision for smooth well-planned growth for the city

    - Development of mixed-use areas and employment lands are a priority. *More people who live in Burlington also work in Burlington.*

9 Ibid.

- Active transportation and public transit are developed throughout the city, including downtown with pedestrian-focused streets.
- Incentives for energy-efficient buildings are provided, including the renovation of existing buildings.

2. A City that Moves: maximizing the efficiencies and strategic growth of transportation networks and infrastructure

   - Development of walkable neighbourhoods.
   - Connection improvement between public transit and active transportation systems.
   - Automobiles are replaced by these modes where possible.

3. A Healthy and Greener City: the city recognizes that climate change is a significant issue, and is working with the community and all levels of government toward the goal of the Burlington community being net carbon neutral

   - Every resident of Burlington lives within a 15 to 20-minute walk from parks or green spaces.
   - The City's operations are net carbon-neutral (by 2040).
   - The City's urban forest and tree canopy has increased and continues to thrive.
   - District energy, microgeneration, and storage technologies will be explored.

Council's 2018 – 2022 workplan, From Vision to Focus, also provides key initiatives which relate to the Climate Action Plan. Priorities include the completion of this plan to address the climate emergency declaration; completion of the Burlington Transit 5-year Business Plan and the Integrated Mobility Plan, among other actions.

The 2020 – 2024 Burlington Transit Business Plan will guide the implementation of transit service improvements over the next five years. This plan includes goals to increase transit use: " Over the five year life of this business plan, transit mode share is targeted to reach 8.3 percent by 2024, translating to 6,356,818 annual rides (a 98 percent growth in ridership from 2019; or 19.6 percent per year."

The Burlington Official Plan, still in the final approval phases, outlines the long-term vision of Burlington, regulating both the public and private sectors on land use, development, and resource management within the City of Burlington, with

the goal of a cohesive community vision. Within this Plan, the City aims to:

1. Increase community resiliency to climate change through mitigation and adaptation measures, and through the maintenance and restoration of the Natural Heritage System;
2. Work towards the goal of the city community being net carbon neutral; and
3. To enhance air quality.

The City will reach these goals by designating Mixed Use Intensification Areas (Policy 8.1), encouraging development that promotes walking, cycling and transit, encouraging energy generation from renewable sources and the use of community energy storage, encouraging energy efficient buildings, developing a Climate Action Plan, and maintaining natural infrastructure and water resources (Policy 4.1).[10]

The Cycling Plan[11] and Integrated Mobility Plan complements the Official Plan, focusing on achieving the transit and active transportation goals outlined in the Official Plan, and on land use planning as it relates to cycling and walking infrastructure, transit, and transportation infrastructure. The Integrated Mobility Plan is under development and, when implemented, will result in safe, accessible transit and transportation options that allow for a variety of mobility options throughout the city.[12]

The Burlington Corporate Energy and Emissions Management Plan 2019-2024[13] was approved in 2019 with 65 actions to reach targets set for 2020, 2024 and 2040 for city operations (primarily buildings and fleet). Actions include electrification, solar PV expansion, geothermal, energy audits to identify deep energy retrofits, training and awareness. The City will update the Corporate Sustainable Buildings policy (for city buildings) in 2020 and the Community Sustainable Building and Development Guidelines (for private development) by 2021. In addition, the City has implemented numerous initiatives and actions to reduce corporate energy use and GHG emissions, including adding eight plug-in electric vehicles to the municipal fleet, adding 33 EV charging ports on city property, using geothermal heating and a green roof on the Joseph Brant Museum, and designing the City View Park Pavilion and the Skyway Area redevelopment to include renewable energy sources.

10 City of Burlington, 2019. Burlington Official Plan. Accessed Oct 2019: https://www.burlington.ca/uploads/21493/Doc_636610358428491805.pdf

11 City of Burlington, 2019. Cycling Plan. Accessed Oct 2019: https://www.burlington.ca/en/services-for-you/cycling-plan.asp

12 City of Burlington, 2019. Transportation Plan. Accessed Oct 2019: https://www.burlington.ca/en/services-for-you/Transportation-Master-Plan.asp

13 City of Burlington, 2019. The Burlington Corporate Energy and Emissions Management Plan 2019-2024. Accessed Oct 2019: https://www.burlington.ca/en/live-and-play/resources/Environment/Energy/Burlington-CEEMP-2019-2024.pdf

A Vision for the Future

What would Burlington look like in 2050 if the city follows the steps towards a low carbon future? Here, we share this vision of a sustainable, livable, and healthy Burlington.

Where we live in 2050

The house doesn't use much energy, just 20% of what houses use in 2015. The roof is covered with solar PV panels, with a capacity of 4 kW. The dwelling is heated with radiant floors, using waste heat from nearby industries transported through pipes underground; cooling is also provided in the summer through the same pipes.

Moving around in 2050

In most neighbourhoods in the City, it is easy to walk to a school, park, grocery store, restaurant and other key destinations. If you are going somewhere less than 5 km away, you are likely to cycle. Entire road lanes are physically separated for cyclists and cycling is integrated into the culture of the City. Cycling lanes/paths are plowed before vehicular roads in the winter because of the demand. A personal transportation planner from the City visited your household and helped you identify the best transportation options for trips for work and leisure, while saving money and increasing convenience. Private vehicles are easily accessible for all ages for trips that are too complex for transit and too far for walking or cycling. Transit is much more extensive than in 2016 with an enhanced bus and train system.

Going to work in 2050

Many more people will walk (17%), cycle (28%) and take transit (23%) to work and less will drive (32%). If they do drive, they are unlikely to own the vehicle, but will rely on shared electric and autonomous vehicles provided by the transit agency. Some people travel to work only four days a week. The workplace will incorporate more shared office spaces and flexible work location options, and floor space per employee will decline. Offices will be efficient, designed to high standards if new and retrofitted if not. Indoor air quality will be improved. The building will generate energy with solar PV on the roof and facades, and will likely be connected to a district energy system for heating and cooling.

Jobs in 2050

There are many new types of employment in 2050 and the low carbon transition is estimated to directly result in 21,300 new person-years of employment. A major new industry is focused on upgrading the energy efficiency of buildings. Companies involved in this industry undertake major construction projects, retrofitting one neighbourhood at a time. Businesses involved in the retrofits include expertise in finance, law, construction and engineering. Other sectors that grow significantly include renewable energy, particularly solar PV, energy storage and district energy.

A LOW-CARBON ACTION PLAN

Climate Change Inventory and Forecast

In 2018, Mohawk College, located in Hamilton, Ontario, partnered with the City of Hamilton and the City of Burlington to host the Centre of Climate Change Management (CCCM). The CCCM is a regional response to shared goals around climate change action and sustainability. The CCCM includes the Bay Area Climate Change Office (BACCO) which has a mandate to collaboratively implement Burlington's Climate Action Plan and Hamilton's Climate Change Action Plan.

A key part of this partnership was the development of a greenhouse gas inventory and forecast for each city. This inventory and forecast outlined a low-carbon pathway for the City of Burlington to reduce energy consumption and lower greenhouse gas emissions. This pathway included a series of actions, modelled in sequence, and a comparison of the outcomes of implementing this pathway to continuing current actions. This analysis serves as the foundation for the Burlington Climate Action Plan (CAP).

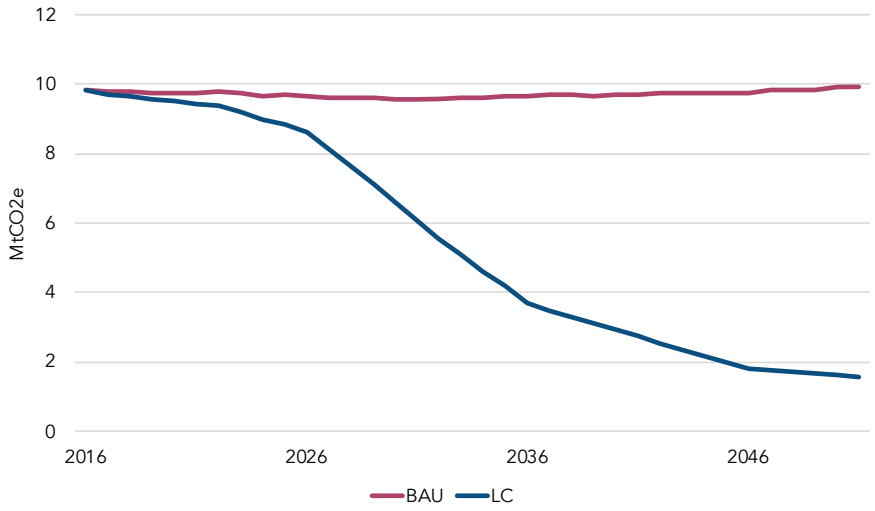


Figure 4. Total GHG emissions ($MtCO_2e$) for the Bay Area (Burlington and Hamilton).

Low-Carbon Plan

Two scenarios were developed in order to compare what might happen if no new policies or programs are implemented to what a low-carbon future could look like for Burlington. The Business as Usual (BAU) scenario represents current patterns of energy consumption and extrapolates these out until 2050, while accounting for population increases, federal fuel efficiency standards and the impacts of climate change on heating requirements in buildings. The low carbon scenario (LCS) is a composite of ambitious actions designed to reduce GHG emissions in Burlington through reduced energy consumption and switching to lower carbon solutions.

The assumptions and actions for both the BAU and LCS are summarized in Table 2, below.

Table 2. BAU and Low Carbon actions and assumptions for the City of Burlington.

City of Burlington	BAU assumption	LCS assumption
BUILDINGS		
New buildings growth		
Floor space	*Floor space per employee held constant.*	*Floor space per employee decreased by 25% by 2050 in offices.*
New buildings energy performance		
Residential	*Apply 2017 Ontario Building Code (OBC) levels of performance.*	*Incrementally increase the number of buildings that achieve passive house levels of performance to 100% by 2030.*
Industrial, commercial and institutional (ICI)	*Apply 2017 OBC levels of performance.*	*Incrementally increase the number of buildings that achieve passive house levels of performance to 100% by 2030.*
Existing buildings energy performance		
Retrofit homes built prior to 2017	*No retrofits.*	*98% of pre-2017 dwellings retrofit by 2050, with retrofits achieving thermal and electrical savings of 50%. Savings are greater for older buildings than newer buildings.*
Retrofits of commercial and industrial	*No retrofits.*	*98% of pre-2017 dwellings retrofit by 2050, with retrofits achieving average thermal and electrical savings of 50%. Savings are greater for older buildings than newer buildings.*

City of Burlington	BAU assumption	LCS assumption
Recommissioning of commercial and institutional buildings	*No retrofits.*	*Every building is recommissioned on a ten-year cycle, achieving energy savings of 15% on pre-2017 building stock.*
End use		
Space heating	*Baseline shares of heating systems are maintained.*	*Air source heat pumps are added to 40% of residential buildings and 30% of commercial buildings by 2050. Ground source heat pumps are added to 20% of residential and 25% of commercial buildings by 2050.*
Water heating	*Scale up to 10% of residential buildings by 2050, and 10% of commercial buildings by 2050. Achieves 50% of solar hot water load.*	*Scale up to 80% of residential buildings by 2050, and 50% of commercial buildings by 2050. Achieves 50% of solar hot water load.*
ENERGY GENERATION		
Solar PV	*Scale up so that 10% of all buildings by 2050 have solar PV systems which provide on average 30% of consumption for building electrical load for less than 5 storeys; 10% for multi-unit and commercial buildings.*	*80% of all buildings by 2050 have solar PV systems which provide on average 30% of consumption for building electrical load for less than 5 storeys; 10% for multi-unit buildings greater than 5 storeys and commercial buildings*

City of Burlington	BAU assumption	LCS assumption
Solar PV - ground mount	*0.5 MW per year between 2018 and 2050; ~20 hectares (ha).*	*5 MW per year between 2018 and 2050; ~120 ha.*
District Energy	*N/A*	*Zero emissions district energy is introduced into the downtown core by 2030.*
Energy storage	*No storage deployed.*	*250 MWh by 2050.*
Renewable natural gas	*No additional production.*	*Local production is maximized and additional renewable natural gas is imported to displace natural gas consumption in buildings.*
TRANSPORTATION		
Expanded transit	*Transit mode share remains constant.*	*Transit service and routes expanded; mode share impact as per other cities.* *Transit mode share increases to 20% of internal trips.*
Active modes	*Walking and cycling mode share remains constant.*	*Mode shift 50% of trips less than 1km to walking by 2050; mode shift 50% of trips between 1 and 5 km to cycling by 2050.* *Active mode share increases to 15% of internal trips.*
Electrify transit system	*No additional electrification.*	*100% electric transit system by 2040.*
Electrify municipal fleet	*No additional electrification.*	*100% of the fleet is electric by 2040.*

City of Burlington	BAU assumption	LCS assumption
Electrify personal vehicles	*~5% of personal use vehicles are electric by 2035; 10% by 2050.*	*100% of new passenger vehicles are electric beginning in 2030.*
Electrify commercial vehicles	*25% of the vehicle fleet is electric by 2050.*	*All commercial vehicles are electric by 2050.*
WASTE		
Waste generation	*Waste generation is held constant.*	*Waste generation is reduced by 50% per capita by 2050.*
Waste diversion	*Waste diversion rates are held constant.*	*Diversion rates are increased by 50% per capita by 2050.*

The Pathway

The GHG emissions trajectory for each of the scenarios is illustrated in Figure 5. Even in the BAU scenario, GHG emissions are reduced, primarily as a result of a decreased heating load due to climate change and the increased fuel efficiency of vehicles as a result of federal fuel efficiency standards. In the LCS, by 2050 annual emissions are 0.9 $MtCO_2e$ lower than in the BAU scenario, an 88% reduction, falling from 1.2 $MtCO_2e$ in 2020 to 0.1 $MtCO_2e$ in 2050.

Figure 5 shows the emissions reductions targets in 5 year intervals from 2025 to 2050 along the LCS curve for the City of Burlington.

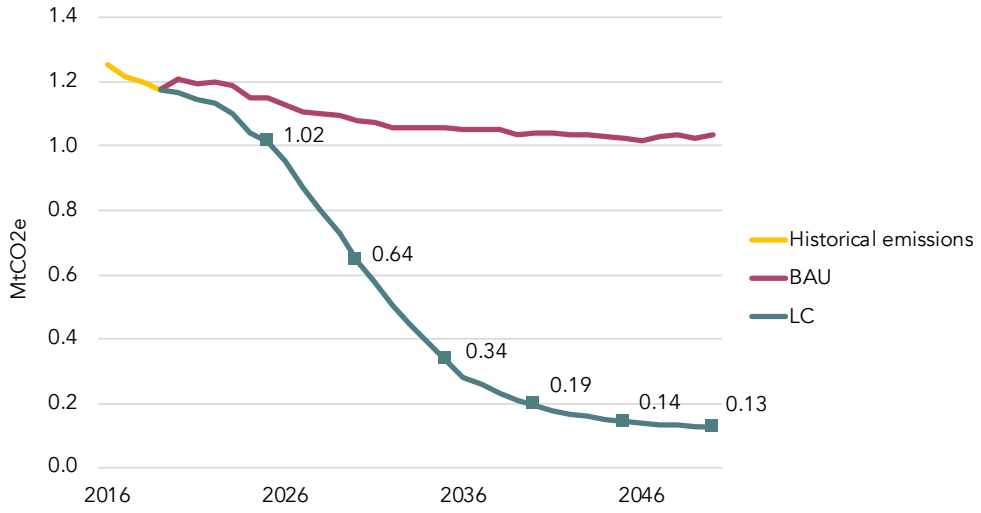


Figure 5. Annual GHG emissions for both scenarios, 2016–2050

The proportionate emissions reductions from each action are distributed on a year over year basis to generate a wedge diagram, illustrated below. The wedge diagram shows the contribution of each action to the overall LCS emissions reduction trajectory. As there are dependencies and feedback cycles between the actions, which are captured by the model, the wedge diagram is a simplified representation of the results.

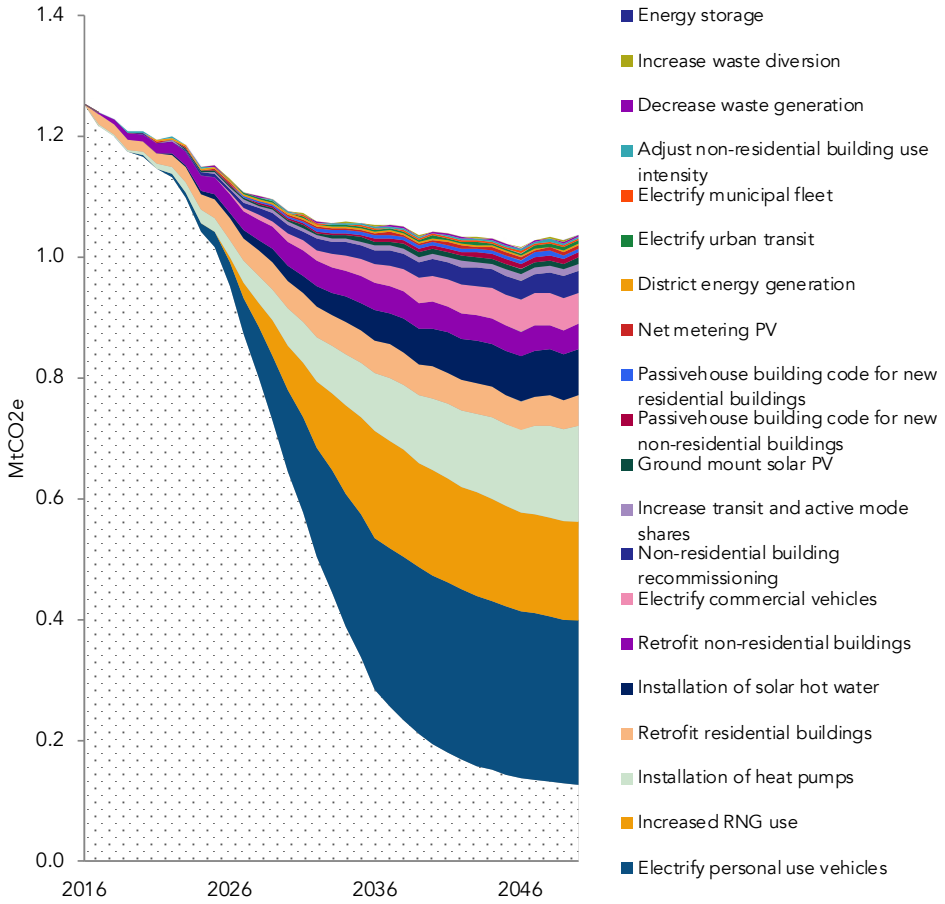


Figure 6. Emission reductions by action from 2016 baseline projected to 2050 for the City of Burlington.

Major opportunities for GHG reductions include switching personal use vehicles to electric vehicles, increased use of RNG captured from waste and other sources, efficiency requirements in new commercial, institutional and industrial buildings, the installation of heat pumps which displace natural gas with electricity, and installation of solar hot water for heating.

Table 3. Interim GHG reduction targets

Year	Annual GHG emissions (Mt CO_2e)	% decrease from 2016 baseline
2016	1.25	0%
2025	1.02	-19%
2030	0.64	-49%
2035	0.34	-73%
2040	0.19	-84%
2045	0.14	-89%
2050	0.13	-90%

GHG targets in the context of the global carbon budget

Burlington's Strategic Plan 2015-2040 states that the City will work toward being a net carbon neutral community, which was reiterated in council's Vision to Focus 2018-2022 document. Based on the analysis through the modelling process for this plan, the target year 2050 has been set for Burlington to become a net carbon neutral community, with an interim target of reducing emissions to 50% below 2016 levels by 2030. In order to meet the 2050 goal, the City will need to offset approximately 126 $ktCO_2e$ of emissions through purchasing carbon offsets, or through further actions to reduce emissions.

In simple words, the carbon budget is the total CO_2e left to emit in order to prevent dangerous levels of climate change. C40, a network of large cities in the world, developed an approach to allocate per capita emissions for cities, which is coherent with global carbon budgets that are likely to limit warming to 1.5 degrees and 2 degrees.

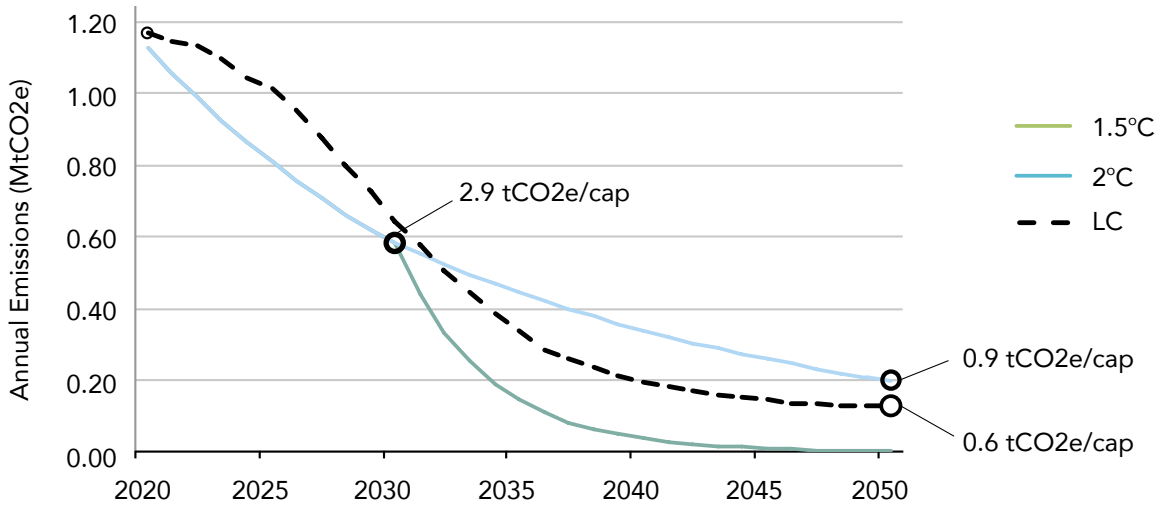


Figure 7. 1.5 and 2°C carbon trajectories for the City of Burlington

The total carbon budget for the City of Burlington between 2020 and 2050, which results from adding up all the annual budgets, is 11 $MtCO_2e$ for the 1.5°C scenario and 16 $MtCO_2e$ for the 2°C scenario. The results indicate that additional efforts beyond the LCS are required to reduce GHG emissions by 0.12 $MtCO_2eq$ (0.6tCO_2e/cap) for the 1.5°C pathway.

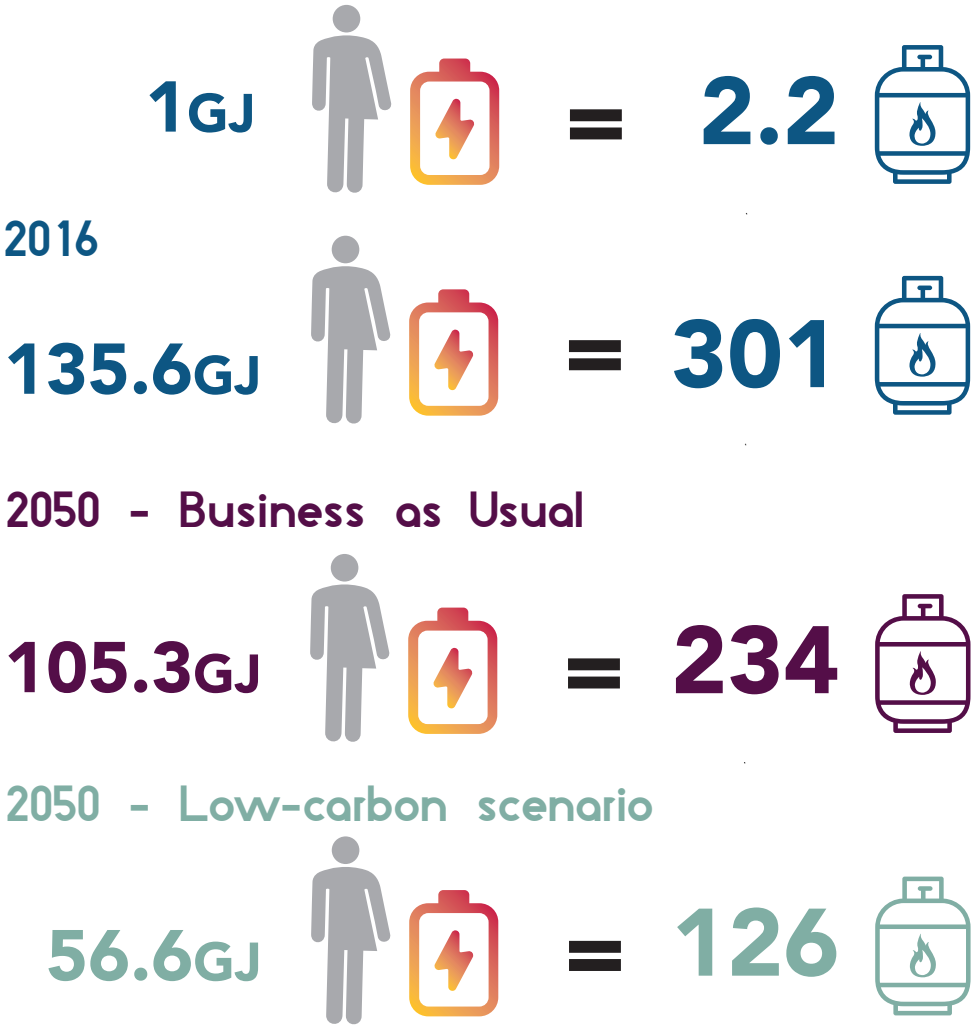
Table 4. Annual carbon budget results

Year	1.5 degrees [$ktCO_2e$]	LCS [$ktCO_2e$]	2.0 degrees [$ktCO_2e$]	BAU Scenario [$ktCO_2e$]
2016	1,253	1,253	1,253	1,253
2020	1,130	1,167	1,130	1,207
2030	580	644	580	1,077
2040	36	195	338	1,043
2050	2	126	197	1,037
2019- 2050	10,903	15,474	16,015	33,432

In the context of a climate emergency, the pathway to reach an emissions target is as critical to consider as the target, because the total emissions produced until 2050 will vary greatly depending on how quickly action is taken. In order to achieve the reductions needed to meet 1.5 C pathway, GHG emissions must be curtailed as soon as possible. If Burlington's current emissions patterns do not decrease, as shown in the BAU scenario, the carbon budget will run out in 8.5 years, the same amount of time as the remaining in the global carbon budget. The LCS reduces this total by 54% to 15.5 $MtCO_2e$, which is a slightly greater reduction than the 2°C budget of 16.0 $MtCO_2e$. For the 1.5°C target the carbon budget is 10.9 $MtCO_2e$; achieving this level of reduction requires actions beyond those considered in the BCAP.

Energy

Annual per capita energy use



Scenario	Energy per capita (GJ)	BBQ tanks[14]
2016	135.6	301
2050 BAU	105.3	234
2050 LCS	56.6	126

Emissions

14 1 standard 20 lb BBQ tank holds the equivalent of 0.45GJ of energy

Annual per capita emissions

2016

Approximately 0.64 times around the earth.

The circumference of the Earth in kilometers is 40,075 km

2050 Business as usual

Approximately the distance to Cairo, Egypt and back.

Cairo is about 9,258km from Burlington.

2050 Low-carbon scenario

Approximately the driving distance to Winnipeg, Manitoba.

The driving distance between Burlington and Winnipeg is 2170.54km.

Scenario	Emissions per capita (tCO_2e)	Km driven by average car[15]
2016	6.6	25,970
2050 BAU	4.7	18,490
2050 LCS	0.6	2,360

The LCS reduces emissions to 126,000 tCO_2e in 2050. This is equivalent to the

15 https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

emissions from 26,750 passenger vehicles driven for one year[16]. The 1.5 degree scenario described above would mean restricting 2050 emissions to 2,000 tCO_2e in 2050, which is equivalent to the emissions from 425 passenger vehicles driven for a year.

The Role of the Municipalities

The transition to a low-carbon energy system relies on municipalities.[17] Municipalities and regions in Canada have direct or indirect control over 40-50% of greenhouse gas emissions.[18] If municipalities are not built to stringent low carbon standards, land-use planning and infrastructure investments can lock in energy and GHG intensive patterns of development which inhibit or make cost prohibitive efficient and low carbon alternatives.[19] Alternatively, compact urban form increases the feasibility of district energy and the introduction or improvement of public transit, in addition to reducing the financial cost and the GHG impact of providing municipal services such as roads, water and wastewater conveyance, ambulance, fire protection, school transportation, and even provision of home-based health care.

Recognizing the role of municipalities, the Province has embedded climate change into land-use planning policy. Although the Provincial Policy Statement (PPS) of 2014 required consideration of climate change directly with respect to the impact of land-use patterns on GHG emissions, the new proposed PPS (under review) only refers to planning for the impacts of climate change. However, the new growth plan, A Place to Grow: a growth plan for the Greater Golden Horseshoe (2019) requires municipalities to develop policies in their official plans that will reduce greenhouse gas emissions, and address climate change adaptation goals. It encourages municipalities to develop strategies to reduce greenhouse gas emissions and address the impacts of climate change.

16 Ibid.

17 The Global Commission on the Economy and Climate. (2014). *Better growth, better climate: The new climate economy report*. Retrieved from http://newclimateeconomy.report/2014/wp-content/uploads/2014/08/NCE-cities-web.pdf; Seto, K. C., Dhakal, S., Bigio, A., Blanco, H., Delgado, G. C., Dewar, D., … others. (2014). Human settlements, infrastructure and spatial planning. Retrieved from http://pure.iiasa.ac.at/11114/; International Energy Agency. (2016). *Energy technology perspectives 2016: Towards sustainable urban energy systems*.

18 Torrie, R. (2015). Low carbon futures in Canada – the role of urban climate change mitigation: Briefing on urban energy use and greenhouse gas emissions. Stockholm Environment Institute. Retrieved from https://data.bloomberglp.com/dotorg/sites/2/2015/10/Low-Carbon-Futures-in-Canada.pdf

19 Erickson, P., & Tempest, K. (2015). *Keeping cities green: Avoiding carbon lock-in due to urban development*. Stockholm Environment Institute. Retrieved from https://www.sei-international.org/mediamanager/documents/Publications/Climate/SEI-WP-2015-11-C40-Cities-carbon-lock-in.pdf

Municipalities rely on funding programs from both the federal and provincial governments to support municipal investments and activities to reduce GHG emissions. The multiple roles of municipalities are as follows:

- **A leader:** Municipalities should show leadership with their own facilities, fleet, and activities in adopting and implementing low carbon actions.
- **A mobilizer:** Municipalities can engage people, municipalities and other organizations around a vision, goals, objectives and targets. Examples include a community engagement program and a bulk purchase of renewable energy on behalf of citizens.
- **An innovator:** Municipalities can directly or indirectly support innovation by reducing risk through investments, partnerships or policies that support low carbon projects or enterprises. An example is the provision of electric vehicle charging infrastructure.
- **A collaborator:** There are multiple opportunities for collaboration in the energy transition; with other levels of government, transit authorities, utilities, municipalities, regions, businesses, non-profit organizations, neighbourhoods and governments in other parts of the world. Collaboration can take the form of shared targets or policies or joint projects or investments. An example is a coordinated retrofit program between municipalities and utilities.
- **An investor:** Municipalities can use their access to low interest capital to make investments directly in areas such as building retrofits and renewable energy technologies. Alternatively, and in tandem, the City can enable investments by third parties. An example is local improvement charges as a way to finance building retrofits.
- **An implementer:** Through policies and incentives, municipalities can support businesses and households in the energy transition. An example is the implementation of a district energy system to supply thermal energy (heating and cooling) to a group of buildings.
- **An incubator:** Municipalities can cultivate the development of new technologies or applications that enable the low carbon economy by supporting and attracting new and existing businesses and creating a hub or ecosystem in which the businesses and organizations support each other. An example is a low carbon business park or incentives for different levels of building performance that stimulate innovation by builders.

BUILDING THE ECONOMY

Economic Impact

Reducing GHG emissions is positive for the economy. The economic impact of the LCS results from the stimulus created by the investments required to implement these actions, and the long-term savings in fuel and electricity costs. Jobs are created as new infrastructure is needed and new technologies are introduced and therefore new markets appear and grow.

In Burlington 21,300 person-years of employment will be created in total if the LCS pathway is followed, with 5,600 of those person-years in the renewable energy market. Annual person-years by category can be seen in the following chart.

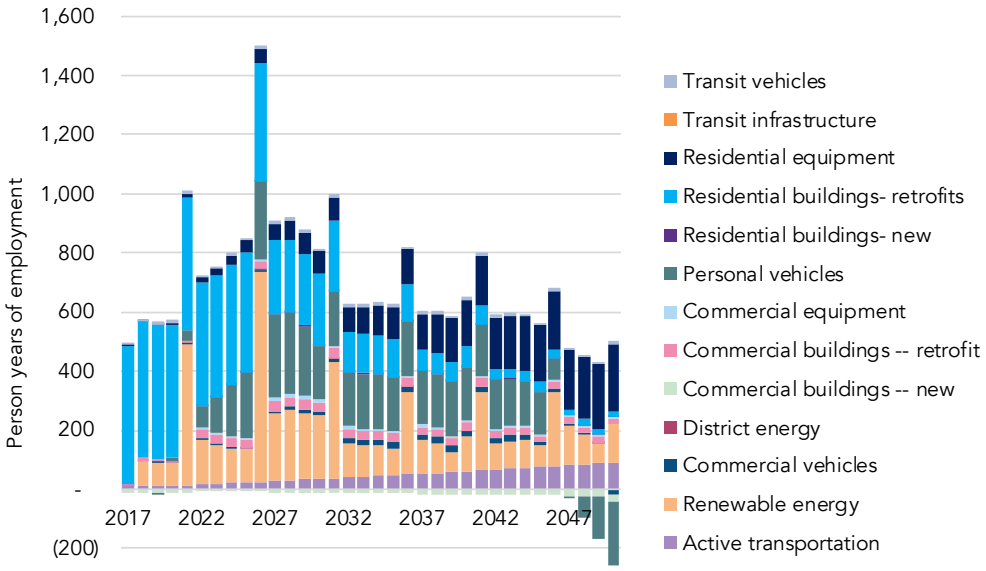


Figure 8. Employment generation in Burlington for the LCS pathway. Personal vehicles show negative values at the end of the period because EVs need less maintenance.

Likewise, given the approach of "Reduce-Improve-Switch", actions increasing the efficiency of energy use generates savings in the long term that are directly beneficial to households. In the BAU scenario, household energy expenditures are projected to decline because vehicles become more efficient due to national fuel efficiency standards and because of decreased heating requirements as the climate becomes milder due to climate change. The LCS involves shifting away from natural gas and gasoline to electricity, a more costly energy source. The increased cost of electricity, however, is more than offset by the increased efficiency of homes as required by building codes and of vehicles as a result of the efficiency of electric motors. By 2050, a household spends $2,700 on energy, just over half of the expenditures in the BAU scenario. Over the period between 2020 to 2050, the LCS saves households an average of $57,000 on energy expenditures.

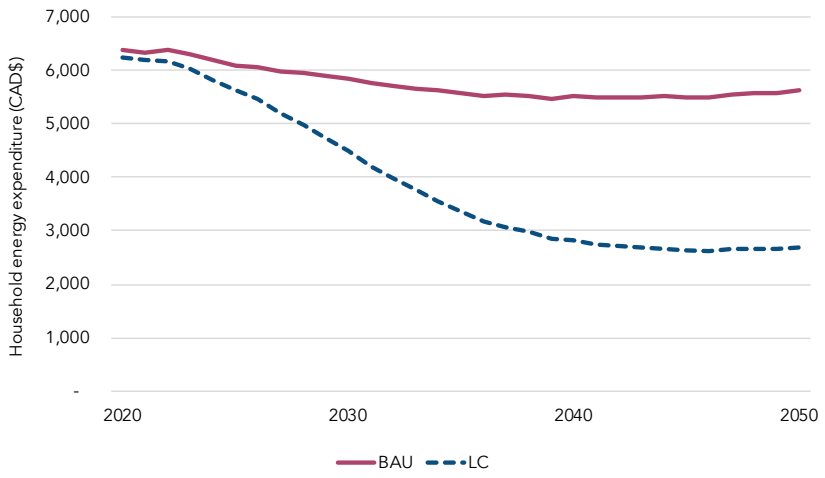


Figure 9. Annual household expenditures on energy for homes and transportation, 2020–2050

In terms of budget, in 2016, households, businesses and governments in Burlington spent a total of $700 million on fuel and electricity, and in a business-as-usual future this total is projected to slightly increase to $760 million by 2050, considering an increased population, efficiency gains, and increasing energy prices. The actions in the LCS reduce this total by 36% or $270 million. Beyond these savings, some of the actions in the LCS generate savings in other areas, such as reduced operating and maintenance costs. In total, the LCS reduces costs for the Burlington economy by approximately $6.7 billion in constant dollars on expenditures of $100 billion over the period. The savings occur as a result of reduced operating costs, primarily energy expenditures and lower cost of carbon.

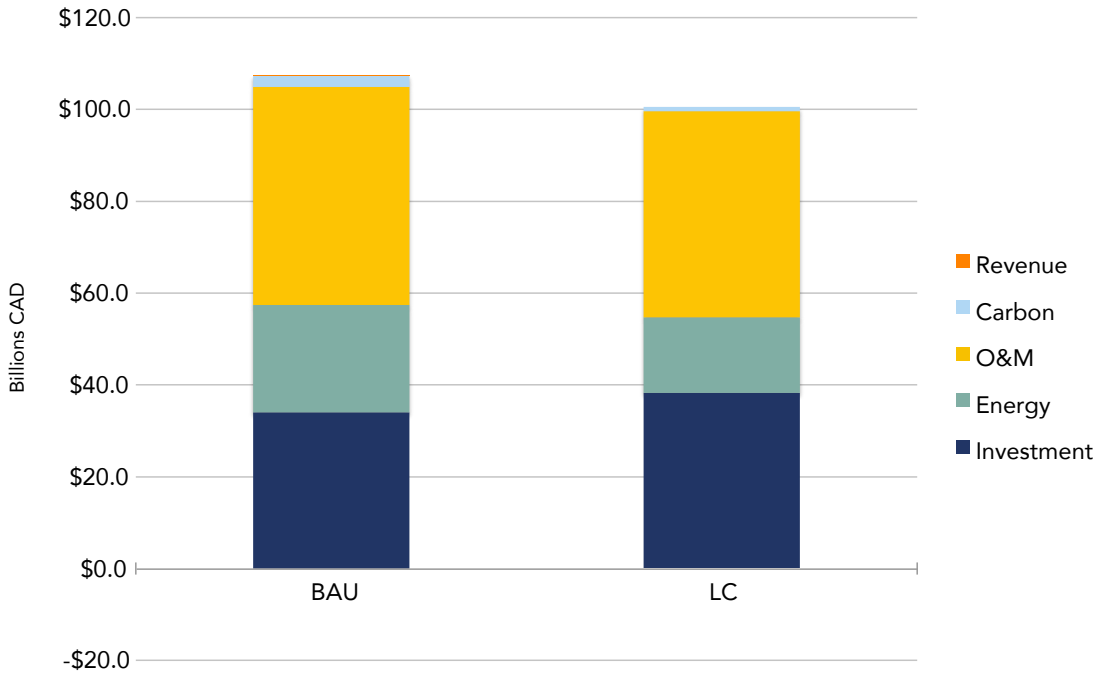


Figure 10. Total expenditures for all the period, for each scenario. Investment is increased in LCS but is offset with savings in energy and O&M.

The incremental investments to put Burlington in the LCS - about $125 million per year on average - can be compared with the $700 million per year that is already being spent on fuel and electricity, a figure that is projected to grow to $760 million per year in the business-as-usual outlook.

Investment Opportunities

Most of the actions evaluated are GHG reduction investment opportunities, in that the actions result in both GHG reductions and financial returns – a win-win situation. The exceptions are heat pumps, energy storage, and passive house building code for new non-residential buildings.

The marginal abatement cost curve (MACC) graph provides at-a-glance emissions reductions versus costs/savings for each LCS action. It is a measure of the cumulative cost or savings of reducing emissions for a particular action over the 2020-2050 time period.

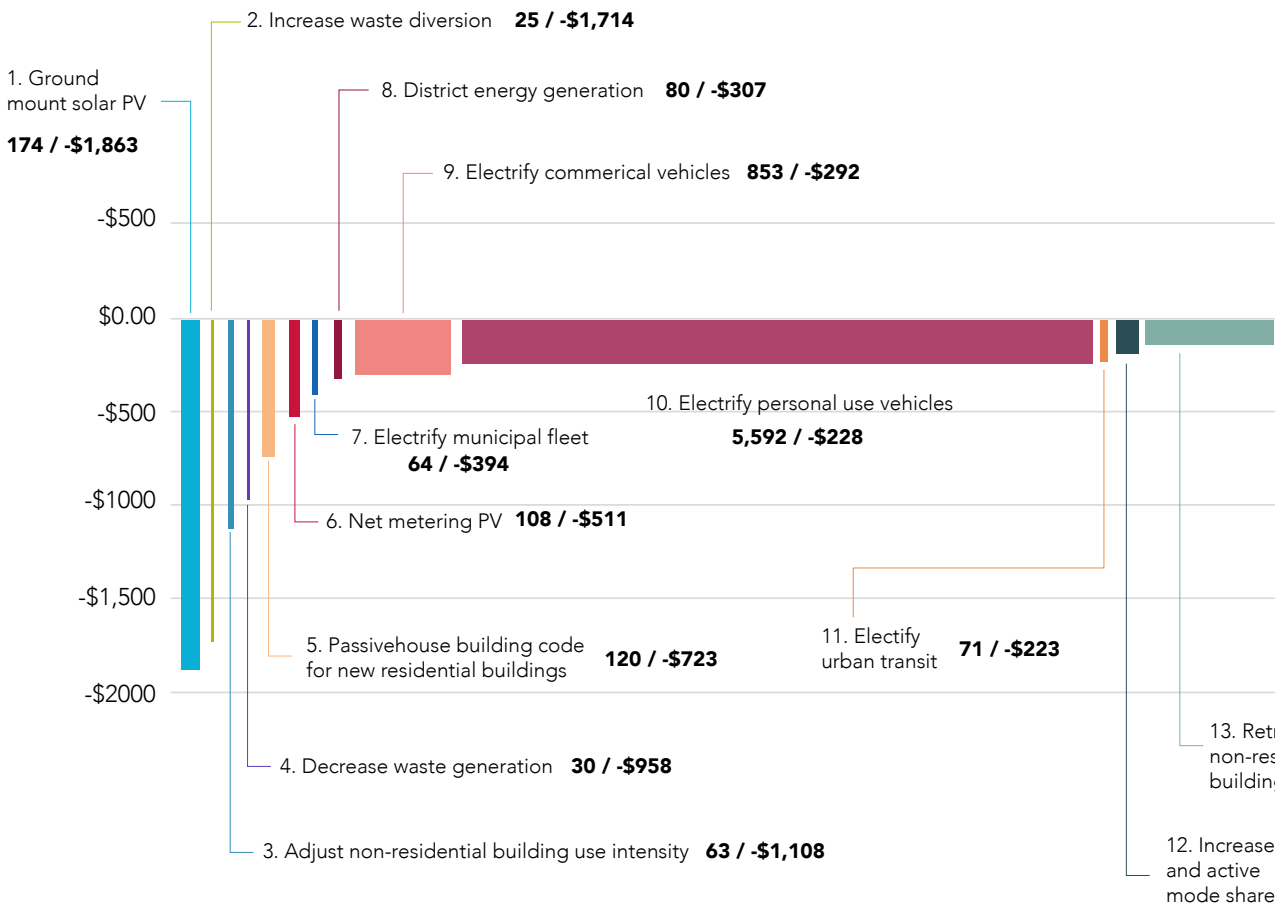
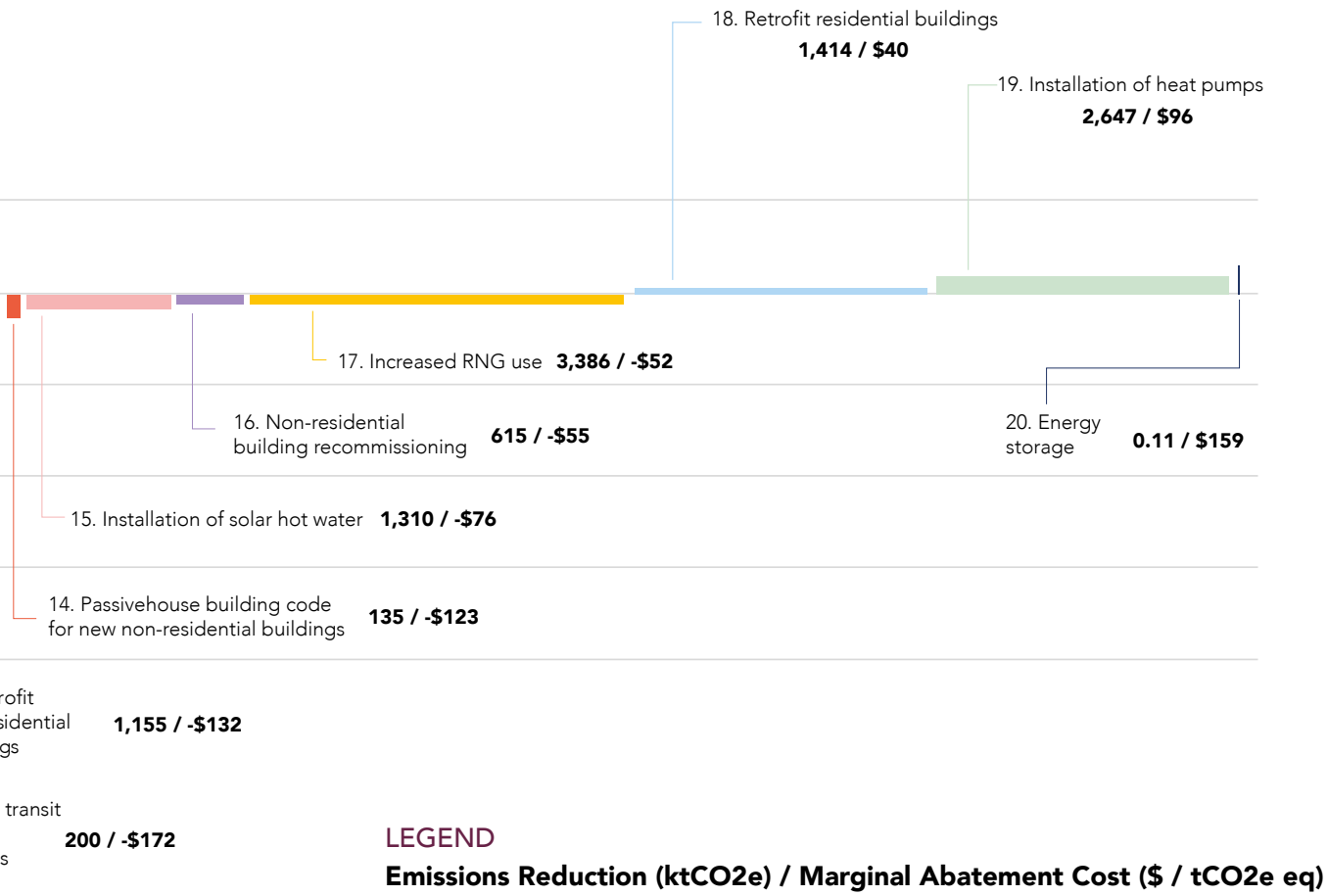


Figure 11. Marginal Abatement Cost Curve (MACC) for all the actions in the LCS. The width of the bars represents the cumulative ktCO2 reduction during all the LCS timeframe, while the height represents the cost in net present value per tCO_2e reduced.

The MACC divides the total costs or savings of an action, as represented by the net present value (NPV), by the total emissions reductions associated with that action over its lifetime. The result is a cost or savings per tonne of emissions reduced for each action.

An action costs money overall if its cost per tonne of emissions saved is positive. An action saves money if its cost per tonne of emissions saved is negative. The marginal abatement costs in Figure 11 are shown for all actions.

The amount of GHG reductions for each action varies considerably, and this is described in the implementation section below. An analysis of the internal rate of return (IRR) also indicated opportunities for investment, with actions ranging from 2.5% to greater than 20%.



IMPLEMENTATION

Burlington's role

With direct or indirect control over at least 40-50% of GHG emissions produced, municipalities have a unique influence over demands resulting in GHG emissions, and the pathway to a low or zero carbon future. Municipalities are integrated systems in which an action in one sector influences emissions in another sector. Influences include elements like the location and shape of buildings, building energy performance, renewable energy generation, district energy (heat density), and travel behaviours (i.e. whether destinations are accessible by walking, cycling or transit).

Municipalities also play a key role in implementing and facilitating the implementation of policies of higher levels of government, as illustrated in Table 4. Reaching the GHG emission targets outlined in this report assumes that the LCS will be implemented fully and on schedule, which will require that senior levels of government are supportive of the policies and funding required to enact the LCS.

Table 5. Municipal energy and emissions policy roles.[20,21]

Municipal government role	Municipal role examples	Corresponding national or provincial government role

Policy architect & leader: Primary body responsible for policy design, formulation, application, implementation and enforcement	• Land-use planning
	• Design/development of local transit systems or transportation policies
	• Development of infrastructure projects
	• Waste management regulations
		• Establish national policy frameworks
		• Enable municipal government action through:
		  • Capacity building and information sharing
		  • Access to funding
		  • Legal and policy alignment

Critical implementer: Responsible for key application, implementation, or enforcement actions related to a policy	• Building code implementation and compliance-checking • Implementation of regionally coordinated, cross-jurisdictional infrastructure projects or transportation policies	• Policy design and/or standard setting • Regional coordination • Enabling city government implementation role

20 Adapted from: Broekhoff, D., Erickson, P., & Lee, C. M. (2015). *What cities do best: Piecing together an efficient global climate governance*. Stockholm Environment Institute Seattle, WA, US. Retrieved from http://ledsgp.org/wp-content/uploads/2015/12/SEI-WP-2015-15-Cities-vertical-climate-governance.pdf

21 The regional government, Halton Region, is responsible for waste management and collection, and water and wastewater treatment and distribution.

Municipal government role	Municipal role examples	Corresponding national or provincial government role
Complementary partner: Undertakes separate, complementary actions that contribute to the effectiveness, uptake, penetration, or success of a policy led by higher levels of government	• Complementary information and outreach, green standards development and implementation, certification and incentive programs for improved building energy efficiency and reduced GHG emissions through urban design measures. • Permitting or active installation of electric vehicle charging stations • Permitting, tax incentives and/ or subsidies for commercial and residential distributed energy resources	• Policy design and/or standard-setting • Primary implementation and enforcement • Coordination/integration of actions within and across different levels of government • Enabling municipal government complementary actions (through capacity building, funding or legal reform).

Land-use planning and infrastructure investments shape patterns of development and their energy and emissions implications. This provides an opportunity for municipalities to make efficient low carbon alternatives affordable. Compact urban form increases the feasibility of district energy which requires greater energy demand concentrated in smaller areas. Further, this form can introduce more rapid and frequent public transit and reduce financial costs and GHG emissions resulting from increased municipal services such as roads, conveyance of water and wastewater, ambulance, fire protection, and even provision of home-based health care. Land use decisions, including density, urban form, and mixed uses, can therefore enable, inhibit or prevent the transformation to a low or zero carbon economy.

Recognizing all this, municipalities around the world are taking decisive action implementing climate solutions. Since the climate conference of parties (COP) in Copenhagen, the C40 Cities Climate Leadership Group estimates that cities

have taken 10,000 climate actions and have identified 2,300 high-impact actions that could save 450 $MtCO_2e$ by 2020.[22] In June 2017, in response to the U.S. President withdrawing from the Paris Climate Agreement, a bipartisan group of mayors from over 250 U.S. cities unanimously backed a commitment for the country's cities to run entirely on renewable energy sources by 2035.[23]

Programs

The BCAP represents a major new effort by Burlington to invest in the energy system, an investment that will result in dramatically reduced greenhouse gas emissions, lower energy costs for households and businesses, the creation of new businesses and jobs, reduced air pollution and other co-benefits.

Implementing the BCAP is a complex, multi-faceted endeavour with multiple partners and new programs that require:

- Financing and innovative financial instruments
- Training and mobilization of required human resources (e.g. building retrofits)
- Changes to municipal policies
- Infrastructure to support energy technologies such as EVs
- Innovative partnerships and business models
- Behavioural change to adapt to and implement the changes outlined in the LCS

In order to identify the programs and policies that will support implementation, the BCAP is governed by the following principles:

- **Leadership and Vision**. Provide the "big picture" of a future vision of a sustainable energy future for Burlington, and lead by example.
- **Engagement**. The objectives of the BCAP can only be achieved by the active engagement of the stakeholders that affect the level and pattern of energy use in the community.
- **Alignment**. Identify and exploit the alignment between BCAP objectives and stakeholder objectives.
- **Leverage**. Strategic use of local government financial, regulatory and planning resources to leverage accelerated progress toward BCAP objectives.

22 Hundreds of US mayors endorse switch to 100% renewable energy by 2035 https://www.theguardian.com/environment/2017/jun/26/hundreds-of-us-mayors-vow-not-to-wait-for-trump-on-clean-energy

23 This analysis refers to urban populations and not all local governments in Canada.

Based on these principles and the objectives identified in the stakeholder engagement process, seven programs of activity are identified which enable the GHG reductions identified as a result of the actions modelled in the LCS. The ability of the program to scale up over time and address multiple actions are also criteria which guided program development. Table 5 illustrates the relationship between the LC themes (bundled actions), the programs and cumulative GHG reductions associated with the relevant LC actions. A coordinated effort for the industrial sector needs to be developed between relevant industries, the gas utility and the IESO and municipal governments to reduce industrial emissions.

Table 6. Programs of activity[24]

Theme	Program	Cumulative GHG reductions in LCS compared to BAU, 2020-2050 ($ktCO_2e$)
New Buildings	Burlington Low Carbon New Building Guideline	318
Existing buildings	Burlington Deep Energy Retrofit Program	7,140
Energy End Use		
Energy Generation	Renewable Energy Cooperative	3750
Waste		
Transport	Integrated Mobility Plan	200
	Electric Mobility and Equipment Program	6,580
Waste	Waste Reduction Initiative	55
Industry	Industrial Innovation Program	TBD

24 Variation in totals is due to rounding.

A Note on Trees

The seven key program areas in this plan do not include an action area related to planting trees and protecting natural heritage resources in the community to support carbon sequestration. Trees do sequester carbon in varying quantities, based on the species and the age of the tree, however, research also shows that trees can only achieve so much, particularly in an urban context. Massive tree plantings on a global scale could also have an unintended impact on food security (reduced land for agriculture) and natural ecosystems.

In order to stabilize the climate, significant effort is required to reduce the use of fossil fuels. The seven program areas in this plan are focused on areas that will have the most impact in Burlington, transitioning from the use of fossil fuels with low carbon buildings, sustainable mobility options, increased use of renewable energy, reduced waste and innovation in industry.

While urban tree planting may not be the sole solution to reduce atmospheric carbon, there are several benefits delivered by trees, especially in an urban area, such as improving air quality and providing cooling resources, reducing the urban heat island effect and energy needed to cool buildings, and improving physical and mental health of residents. Trees also reduce erosion and slow down fast flowing water. The second part of the Climate Action Plan will focus on improving resiliency in the face of climate impacts such as rising temperatures and the increased frequency of severe storms and flooding events. Therefore, it is expected that actions related to tree planting will be included in the next phase of the Climate Action Plan.

Recognizing the importance of trees in Burlington, council has approved a tree canopy target of 35% by 2041 in the 2018 – 2022 Burlington Plan – 'From Vision to Focus'. The Urban Forestry Management Plan will be completed in 2020. Council has also recently approved a private tree by-law to protect trees on private property in the urban area and increased funding to support community tree planting.

Program 1: Burlington Low Carbon New Building Guideline

Objective: Increasing the performance of new buildings is more cost effective than trying to retrofit them after they have been constructed. Providing a clear pathway and incentives to the building industry gives certainty and stimulates innovation.

Design: Staff will update the existing Sustainable Building and Development Guidelines, researching best practices in other jurisdictions and legislative authority. The Guidelines will include a tiered set of performance measures that will require, incentivize and/or encourage new buildings to be built to a low carbon standard. Financing mechanisms will be explored that help reduce upfront costs.

City's Role: Update the Sustainable Development and Building Guidelines

Connections: From Vision to Focus (council work plan)

Timeline: 2021

Responsibility: Community Planning and Building and By-law Departments

Potential Partners for Collaboration: Other municipalities; Clean Air Partnership

References: Toronto's Green Standard; Passivhaus standards; Canada Green Building Council Net Zero standards.

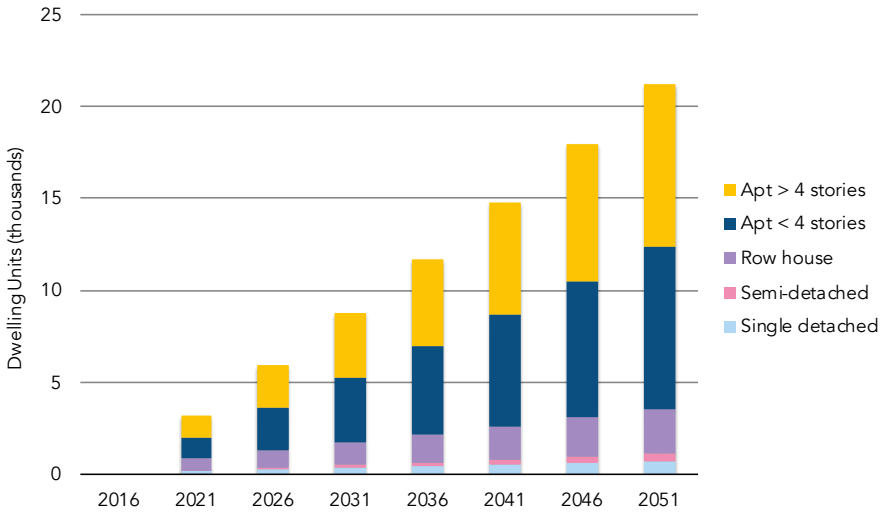


Figure 12. Residential dwelling units built to net zero energy, cumulative to 2051

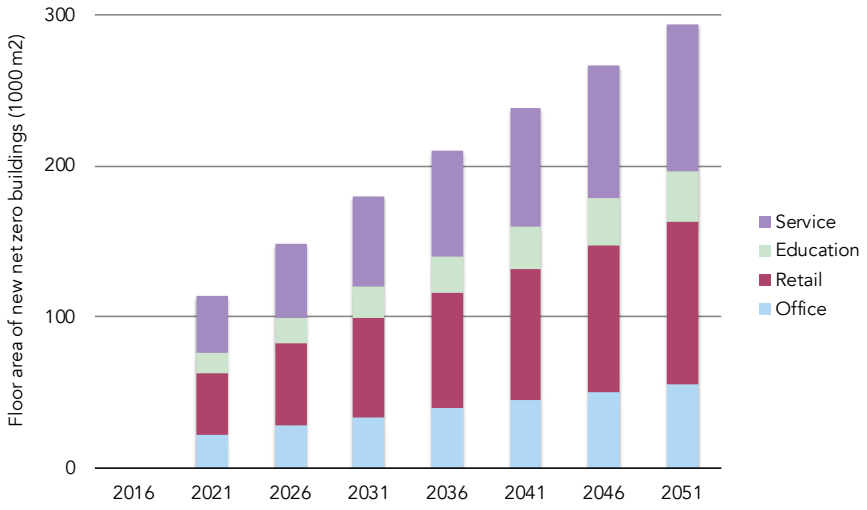


Figure 13. Commercial floor space that achieves net zero energy, cumulative to 2051

LCP Actions	Cumulative emissions reductions ($ktCO_2e$)	Percent of total GHG emissions	Incremental costs (2020–2050), 2016$, present value	Incremental savings (2020–2050), 2016$, present value	Net present value (2020–2050), 2016$, present value
1. Floor space per employee decreased by 25% by 2050 in offices.	63.0	0.3 %	$0	$-69.8 million	$-69.8 million

LCP Actions	Cumulative emissions reductions ($ktCO_2e$)	Percent of total GHG emissions	Incremental costs (2020–2050), 2016$, present value	Incremental savings (2020–2050), 2016$, present value	Net present value (2020–2050), 2016$, present value
2. Incrementally increase the number of net zero new homes to 100% by 2030.	119.8	0.7%	$154 million	$-240 million	$-86.3 million
3. Incrementally increase the number of multi-residential buildings which achieve Passivhaus levels of performance to 100% by 2030.					
4. Incrementally increase the number of ICI buildings which achieve Passivhaus levels of performance to 100% by 2030.	135.0	0.7%	$38 million	$-54 million	$-17 million

Program 2: Burlington Deep Energy Retrofit Program

Objective: The preferred scenario involves retrofitting nearly all the residential, commercial and institutional buildings in the City over a period of 30 years. This objective requires a new and enhanced focus on deep, whole-building retrofits, as well as a new industry and aligns with the Comprehensive Residential Retrofit program previously recommended in the Burlington Community Energy Plan.

Design: The deep energy retrofit program will transform the energy efficiency of existing buildings. Staff will assess best practices in other jurisdictions, including a financing package which may utilize the LIC (Local Improvement Charge) or PACE (Property Assessed Clean Energy) mechanisms. Stakeholders will be engaged including utilities, senior government agencies, industry and post secondary institutions. Partnerships and collaborations with third parties will also be considered. Retrofits may be targeted to groups of buildings, such as neighbourhoods or sectors (restaurants, grocery stores, agriculture, etc.). Renewable energy will also be eligible under the program including solar PV and thermal (for hot water), air and ground-source heat pumps and energy storage.

City's Role: Implementing agency to deliver program or partner/collaborate with a 3rd party to deliver program.

Connections: Former Community Energy Plan: Consider incentives or financing programs, such as using Local Improvement Charges to assist residents to finance retrofits.

Timeline: 2022

Responsibility: Sustainability staff

Potential Partners for Collaboration: Other interested municipal governments; utilities, builders and contractors; suppliers and retailers; architects; post-secondary institutions; Clean Air Partnership

References: City of Toronto HELP program; Guelph's GEERS program (pending approval); TRCA's work with York Region municipalities; The Clean Air Partnership's Climate Action Support Centre

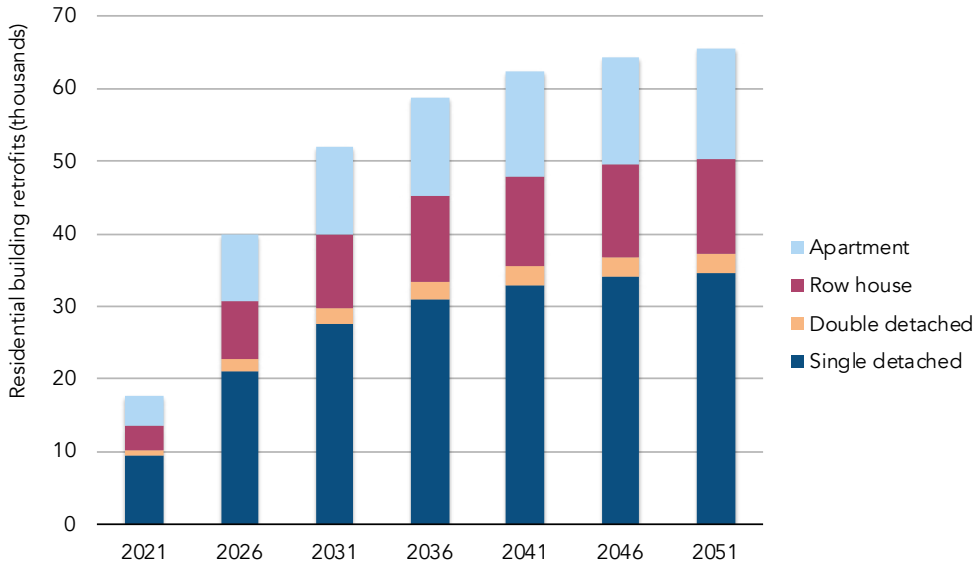


Figure 14. Number of dwellings retrofit in five-year increments, cumulative to 2050

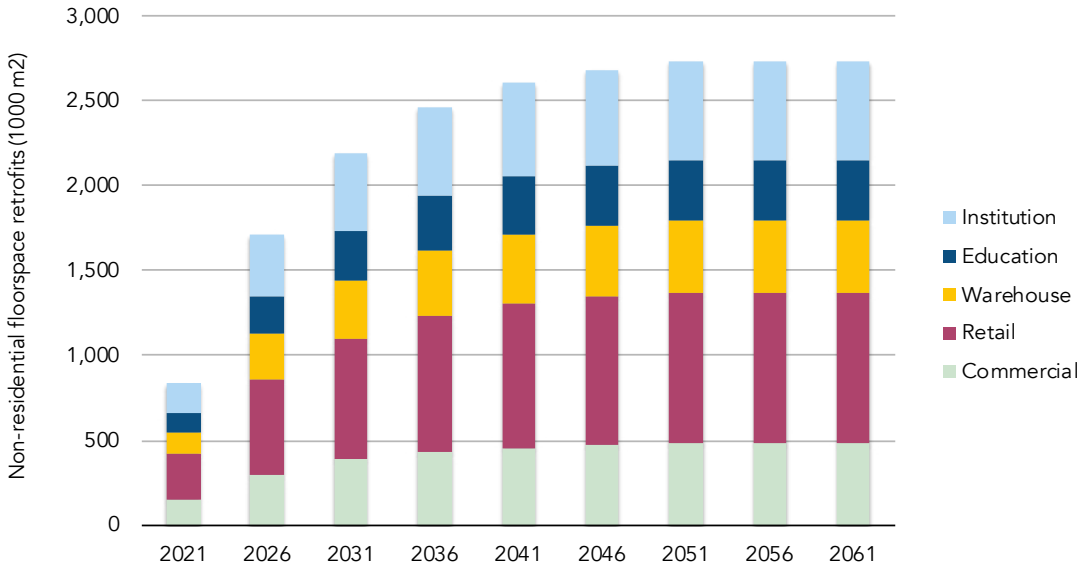


Figure 15. Non-residential floor space retrofit in five-year increments, cumulative to 2050

LCP Actions	Cumulative emissions reductions ($ktCO_2e$)	Percent of total GHG emissions (2018–2050)	Incremental costs (2020–2050), 2016$, present value	Incremental savings (2020–2050), 2016$, present value	Net present value (2020–2050), 2016$, present value
5. Retrofit old (pre-1980) homes	1,413.5	7.8	$605 million	$-547 million	$58 million
6. Retrofit new (post-1980) homes					
7. Retrofit non-residential buildings	1,154.6	6.4	$123 million	$-275 million	$-151 million
8. Non-residential building recommissions	615.1	3.4	$56 million	$-90 million	$-33 million
9. Installation of heat pumps	2,647.2	14.7	$372 million	$-118 million	$253 million
10. Installation of solar hot water	1,310.4	7.3	$93.2 million	$-193 million	$-99 million

Program 3: Renewable Energy Cooperative

Objective: The renewable energy cooperative will coordinate and advance the renewable energy objectives of the BCAP, using an entrepreneurial approach. In addition to the renewable energy mandate, the cooperative's mandate will include developing local expertise, stimulating the local economy and providing energy security and resilience.

Design: The co-operative is envisioned as a partnership with local groups, agencies and individuals to advocate for, develop, commission and finance projects, depending on which strategy is appropriate to a particular context. Different technologies and approaches will be considered, including district energy, increased use of renewable natural gas, solar PV, energy storage, biomass, and geothermal heating/cooling. Financing options will be researched and may come from community bonds, loans and grants from various levels of government.

City's Role: Collaborate with potential partners and facilitate the development of a co-op to operate as a 3rd party entity

Connections: Former Community Energy Plan – increase sustainable local energy generation in Burlington.

Timeline: 2022

Responsibility: Sustainability Staff

Potential Partners for Collaboration: Burlington Hydro; Enbridge; IESOI BurlingtonGreen; Green Venture; Halton Region; The Atmospheric Fund; Renewable Energy Associations

References: Toronto Renewable Energy Cooperative; Ottawa Renewable Energy Cooperative; Oxford Community Energy Cooperative

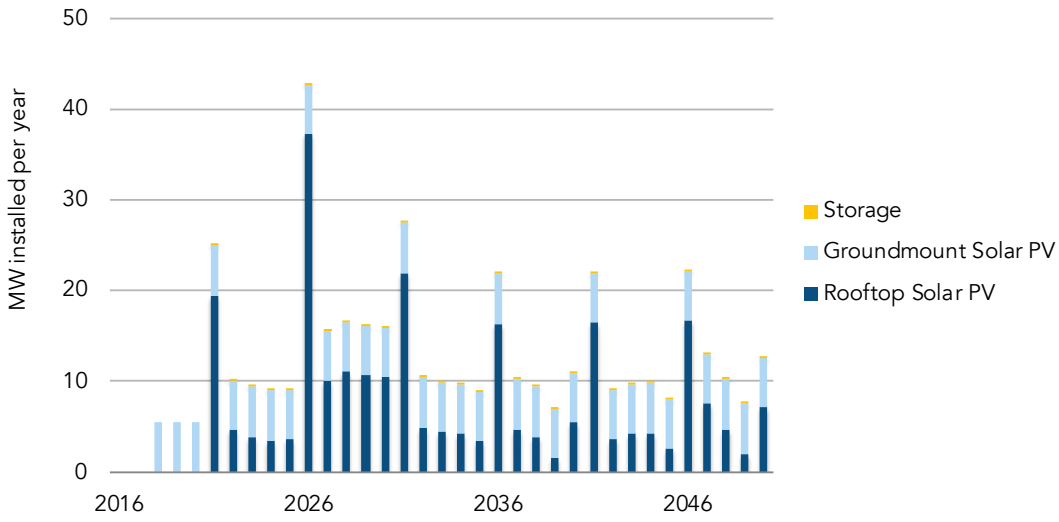


Figure 16. Annual renewable energy installations, 2018–2050

LCP Actions	Cumulative emissions reductions ($ktCO_2e$)	Percent of total GHG emissions (2018–2050)	Incremental costs (2020–2050), 2016$, present value	Incremental savings (2020–2050), 2016$, present value	Net present value (2020–2050), 2016$, present value
11. Net metering solar PV	107.6	0.6%	$169 million	$-224 million	$-55 million
12. Ground mount solar PV	174.0	1.0%	$129 million	$-453 million	$-324 million
13. District energy	79.8	0.4%	$13 million	$-38 million	$-24 million
14. Energy storage	0.1	0.0%	$312,000	$-296,000	$17,000
15. Increased RNG use, including maximizing RNG from waste streams	3386.0	18.8%	$3.1 million	$-181 million	$-178 million

Program 4: Integrated Mobility Plan

Objective: The Integrated Mobility Plan will develop an innovative strategy that supports future mobility planning with an emphasis on **people movement**. The Plan will be cognizant of the city's current demographics, recognizing the unique mobility needs of an aging population, while looking towards the future through a lens that focuses on maximizing the people-carrying capacity of our transportation network compared to road expansion. The resultant strategy will position Burlington to respond to technology changes and emerging mobility options, while balancing the needs of our citizens and providing equitable mobility in a safe, reliable and sustainable manner. The IMP will enable council and city administration to make future decisions relating to mobility and prioritize funding in a manner that ensures future success and continued livability.

Design: The desired outcome of this project is to develop a "road map" for the next 10-years while the city transitions from its suburban roots to an urbanized community; providing the framework for a future transportation network that successfully meets regional mode share targets and provides equitable access to mobility for all residents. Key challenges to be addressed include quantifying impacts of congestion (current and future impact if no shift to travel behaviour is achieved), how to mitigate impacts of traffic growth, and how to successfully achieve the mode share targets through the creation of an integrated transportation network.

City's Role: Strategic planning and operating transit system

Connections: From Vision to Focus- Increasing Burlington Transit service levels and growing overall ridership (1% annually). Burlington Transit's 5 year Business Plan; Integrated Mobility Plan; Cycling Plan; Rural Active Transportation Plan

Timeline: 2021- 20% modal split

Responsibility: Burlington Transit; Transportation Department

Partners for Collaboration:

Ministry of Transportation, Metrolinx, & Halton Region.

LCP Actions	Cumulative emissions reductions ($ktCO_2e$)	Percent of total GHG emissions (2018–2050)	Incremental costs (2020–2050), 2016$, present value	Incremental savings (2020–2050), 2016$, present value	Net present value (2020–2050), 2016$, present value
16. Expanded transit services to increase mode share	200.1	1.1%	$98 million	-133 million	$-34 million
17. Increased active transportation mode share					

Program 5: Electric Mobility and Equipment Program

Objective: Implement measures and policies to support electric mobility options in Burlington and electrify gas-powered equipment.

Design: A technical working group will be established with representatives from relevant organizations and stakeholders to develop a strategy to support infrastructure investments, education and outreach, and municipal policies to support electric mobility and equipment options. Electric mobility may include electric vehicles, bikes, scooters and other means of mobility. Electric equipment may include landscaping equipment such as lawn mowers, trimmers and leaf blowers, as well as others where relevant.

City's Role: Convert fleet, and implement infrastructure.

Connections: Former Community Energy Plan – Monitor electric vehicle market and investigate the feasibility of electric charging stations at city facilities, including downtown parking lots; Green Fleet Strategy.

Responsibility: Sustainability Staff; Transportation; Transit (bus fleet); Roads, Parks & Forestry; and Fire Departments

Potential Partners for Collaboration: Burlington Hydro; BurlingtonGreen (Make the Switch program)

References: City of Calgary EV Strategy; City of Toronto EV Strategy; Framework for Municipal Zero Emission Vehicle Deployment (Pollution Probe & Delphi Group)

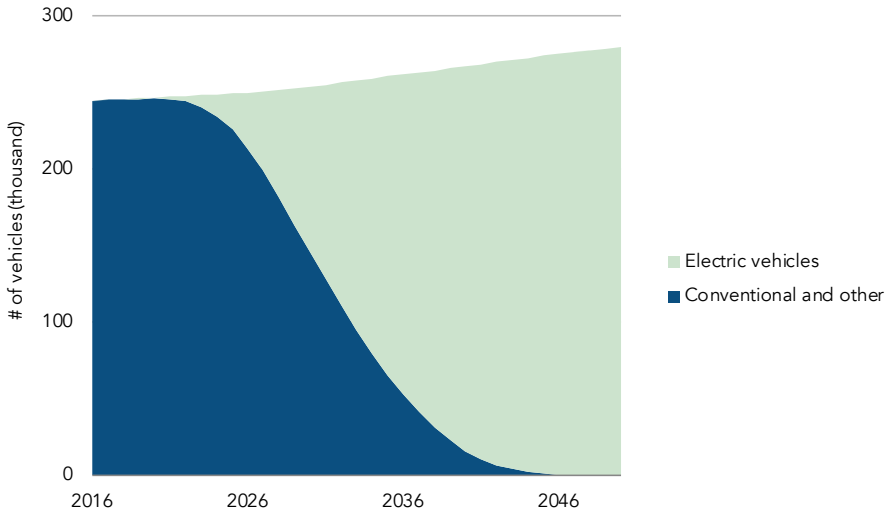


Figure 17. Conventional vs electric vehicles projection for Burlington, 2016–2050

LCP Actions	Cumulative emissions reductions ($ktCO_2e$)	Percent of total GHG emissions (2018–2050)	Incremental costs (2020–2050), 2016$, present value	Incremental savings (2020–2050), 2016$, present value	Net present value (2020–2050), 2016$, present value
18. Electrify urban transit	71.4	0.4%	$13 million	$-29 million	$-16 million
19. Electrify municipal fleets	63.9	0.4%	$17 million	$-42 million	$-25 million
20. Electrify light duty personal and commercial use vehicles	5,591.2	31%	$728 million	$-2.00 billion	$-1.27 billion
21. Electrify other commercial use vehicles	853.3	4.7%	$39 million	$-289 million	$-249 million

Program 6: Waste Reduction Initiative

Objective: Develop educational programs to increase waste diversion and reduce overall waste production by the community.

Design: Waste management services are primarily delivered by the Region of Halton. The city will support the region to engage the community to first reduce waste and secondly, properly divert waste

City's Role: Show leadership through its services and operations to reduce and divert waste

Connections: Halton Region is the lead jurisdiction for waste, Halton Region Waste Management Strategy

Timeline: Ongoing

Responsibility: Halton Region Waste Management; City of Burlington

Potential Partners for Collaboration: BurlingtonGreen

LCP Actions	Cumulative emissions reductions ($ktCO_2e$)	Percent of total GHG emissions (2018–2050)	Incremental costs (2020–2050), 2016$, present value	Incremental savings (2020–2050), 2016$, present value	Net present value (2020–2050), 2016$, present value
22. Decrease waste generation	30.1	0.2%	$0	$-29 million	$-29 million
23. Increase waste diversion	25.1	0.1%	$0	$-43 million	$-43 million

Program 7: Industrial Innovation Program

Objective: Support organizations that work with local businesses to improve energy efficiency in their operations Increase process motors and electrical efficiency by 50% by 2050

Design: TBD upon consultation with industry stakeholders.

City's Role: Facilitate support through the IESO and Enbridge

Timeline: Ongoing

Responsibility: IESO and Enbridge

Potential Partners for Collaboration: Burlington Economic Development Corporation; Sustainable Hamilton Burlington; BurlingtonGreen

IMPLEMENTATION OF PROGRAMS

The City of Burlington has identified three top priority program areas, out of the seven described above, to focus initial efforts, resources, and funding. Focusing on these three programs first will result in immediate GHG emissions reductions, and energy savings. Lessons learned through these initial projects will provide learnings and motivation as the focus of the City expands to include the remaining four programs. While the focus will be on the three top priority areas, work will continue on the other programs, including updating the Sustainable Development and Building guidelines, as well as developing an Integrated Mobility Plan.

The top priority areas are:

Program 2: Burlington Deep Energy Retrofit Program

Immediate focus for 2020 – 2022

- Work in partnership with the Bay Area Climate Change Council (BACCC) and community stakeholders on this topic.
- Support a roundtable discussion hosted by BACCC on this topic with local experts.
- Develop an implementation team of local experts
- Support the partnership of the IESO (Independent Electricity System Operator), AMO (Association of Municipalities of Ontario), the City of Toronto and the Clean Air Partnership in their efforts to develop a regional approach to deep energy retrofits in Ontario.
- Review options to utilize the Local Improvement Charge mechanism as other municipalities have done.
- Monitor the federal government's commitment to support deep energy retrofits in the 2020 budget.
- Increase awareness of residents and businesses – what is involved in a deep energy retrofit?

Potential funding sources and mechanisms

- The Federation of Canadian Municipalities received two contributions from

the Federal Government for two retrofit funding programs, the Community EcoEfficiency Acceleration ($300 million) and Sustainable Affordable Housing Innovation ($300 million). Details on these funds have not yet been released.

- Natural Resources Canada has been directed to develop a plan to improve energy efficiency and resiliency of homes, including up to $40,000 in interest free loans to homeowners and free energy audits.
- Municipalities can provide financing which is tied to dwellings as opposed to homeowners in order to align payments with avoided energy costs.

Implementation milestones

	Implementation milestone (cumulative)					
Action	2025	2030	2035	2040	2045	2050
Retrofit old homes (actions 5 & 6)						
# single detached dwellings retrofit	21,098	27,534	31,067	33,007	34,073	34,657
# double detached dwellings retrofit	1,638	2,138	2,412	2,563	2,646	2,691
# row house dwellings retrofit	7,924	10,341	11,668	12,396	12,797	13,016
# apartment dwellings retrofit	9,180	11,980	13,518	14,362	14,826	15,080
Total dwellings retrofit	39,841	51,993	58,665	62,329	64,340	65,445
Retrofit non-residential buildings (action 7)						
m^2 commercial floorspace retrofit	301,912	386,484	432,918	458,414	472,412	480,098
m^2 retail floorspace retrofit	557,639	713,845	799,610	846,701	872,556	886,752
m^2 warehouse floorspace retrofit	267,518	342,455	383,600	406,190	418,594	425,404
m^2 education floorspace retrofit	225,453	288,606	323,281	342,320	352,773	358,513
m^2 institution floorspace retrofit	362,376	463,884	519,618	550,220	567,022	576,247

	Implementation milestone (cumulative)					
Action	2025	2030	2035	2040	2045	2050
Total m^2 floorspace retrofit	1,714,898	2,195,274	2,459,028	2,603,844	2,683,357	2,727,014
Installation of heat pumps (action 9)						
# residential heat pumps installed	36,534	60,826	96,123	135,786	180,470	226,548
m^2 commercial floorspace served by heat pumps	528,479	891,151	1,232,238	1,611,632	1,999,754	2,334,506
Installation of solar hot water (action 10)						
# residential solar hot water systems installed	1,546	7,103	13,341	20,443	28,039	36,011
m^2 commercial floorspace served by solar hot water	763,358	1,277,317	1,833,330	2,280,611	2,307,408	2,334,506

Program 3: Renewable Energy Cooperative

Immediate focus for 2020 – 2022

- Host a roundtable of experts to discuss opportunities and barriers of expanding renewable energy in Burlington
- Create a task force of experts in the field
- Create a how to guide for homeowners for residential renewable energy installations
- Research the feasibility of developing a renewable energy cooperative in Burlington, consisting of individual members or organisational members (such as utilities and municipalities), or a combination of both (multi-stakeholder cooperative).

Potential funding sources and mechanisms

- In the start-up phase, the cooperative will require funding to establish the organisation and develop projects. For this purpose, the cooperative can solicit funds either as contributions or loans from its members
- For a renewable energy project, cooperatives will also borrow funds, which is paid back with revenues from selling the energy. Cooperatives can also

partner with other renewable energy developers on projects to reduce the financing requirement

- Other renewable energy cooperatives have raised funds by accepting investments from individual members or member organisations, depending on the structure

Implementation milestones

	Implementation milestone (cumulative)					
Action	2025	2030	2035	2040	2045	2050
Net metering solar PV (action 11)						
MW installed	35	115	154	186	217	255
Ground mount solar PV (action 12)						
MW installed	44	72	99	127	154	182
District energy (action 13)						
MW installed	1.0	1.5	2.0	2.0	2.0	2.0
Energy storage (action 14)						
MW installed	0.05	0.1	0.15	0.2	0.25	0.3
Increasing RNG use, including maximizing RNG from waste streams (action 15)						
GJ RNG consumed	2,242	1,267,950	3,700,399	5,360,067	5,978,959	6,163,563

Program 5: Electric Mobility and Equipment Program

Immediate focus for 2020 – 2022

- Host a roundtable of experts to discuss opportunities and barriers of electric mobility in Burlington
- Create a task force of experts
- Continue to support the expansion of charging infrastructure in Burlington
- Work with community stakeholders to engage the community
  - Test drive events with Plug'n Drive
  - Information about the benefits of EVs, e-equipment and e-bikes

Potential funding sources and mechanisms

- EV purchases for fleets can be integrated into asset planning and

incremental capital costs can be financed with a revolving loan fund, or by applying a life cycle costing purchasing policy that reflects lower operational costsIncentives for personal and commercial EVs can be provided through dedicated infrastructure (parking, lanes, charging locations) which can be incorporated into existing infrastructure budgets

- Strategies such as EV free zones can be financed through tariffs on non-EVs

Implementation milestones

	Implementation milestone (cumulative)					
Action	2025	2030	2035	2040	2045	2050
Electrify urban transit (action 18)						
% total vehicles as EV	9%	24%	39%	5%3	68%	82%
% new vehicles as EV	55%	100%	100%	100%	100%	100%
Electrify municipal fleet (action 19)						
% total vehicles as EV	8%	24%	46%	70%	88%	97%
% new vehicles as EV	30%	55%	80%	100%	100%	100%
Electrify light duty personal and commercial use vehicles (action 20)						
% total vehicles as EV	15%	50%	80%	96%	100%	100%
% new vehicles as EV	66%	100%	100%	100%	100%	100%
Electrify other commercial use vehicles (action 21)						
% total vehicles as EV	2%	5%	9%	15%	21%	26%

COMMUNITY ENGAGEMENT STRATEGY

Engagement and Communications[25]

The City of Burlington contracted LURA Consulting to facilitate public and stakeholder feedback on the BCAP. Over the summer of 2019, various opportunities were provided for engagement. Key engagement activities included: pop-up engagements at local events; online survey; in-person workshops with stakeholders and members of the public; and a drop-in open house.

In addition to facilitating and reporting on the engagement for the development of the Climate Action Plan (outlined above), LURA was also tasked with developing a Community Engagement Strategy for the implementation of the plan. The purpose of this strategy is to encourage and support the widespread adoption and implementation of the actions and programs outlined in the Climate Action Plan. Successful implementation of the Plan will require action from all of us - residents, businesses and government.

In total, 21 actions were identified for Burlington. Stakeholder and community engagement completed to date has focused on the program areas and related actions outlined below. These actions were selected for their relevance to the respective audiences and was not meant to indicate priority over other actions.

Program Area	Related Action(s)
Active Transportation / Transit	• Choosing sustainable transportation options like walking, cycling or transit

25 Lura Consulting BCAP Engagement Strategy, 2019.

Program Area	Related Action(s)
Electric Mobility	• Electrify commercial vehicles • Switching to electric vehicles (personal)
Existing Buildings	• Complete deep retrofits of commercial and industrial buildings • Use heat pumps and/or solar hot water in industrial, commercial and institutional (ICI) buildings • Retrofitting your home to be more energy efficient • Installing a heat pump or solar hot water heater at home
Renewable Energy	• Use solar PV for energy generation in ICI buildings

The following considerations were highlighted in stakeholder and public engagement sessions:

- Provide information on both how and why individuals/businesses should implement climate action, with a focus on capacity-building
- Develop and communicate the business case or return-on-investment associated with the suggested actions
- Highlight the benefits to the specific individual or business
- Preferred communications tactics included receiving information online (website, email, newsletters, social media) and via in-person events

Community Stakeholders

The City of Burlington is not acting alone in tackling climate change head-on. The Burlington community is made up of citizens, businesses, institutions, non-profits, faith-based groups, sports, arts and recreational organizations and many more. The following lists the key stakeholders who have been involved in the former Community Energy Plan and are now involved in the community Climate Action Plan.

Burlington Economic Development Corporation (BEDC) has a mandate to enhance the growth prospects of local companies and attract new firms to the community. Its focus is on growing the economic base to sustain a competitive and prosperous community.

Role: To foster synergies and look for opportunities with local businesses to improve energy efficiency and promote local technologies and services in the energy field.

BurlingtonGreen is a citizen led, non-partisan -registered charity that works to protect the environment, mitigate climate change and create a healthier, more environmentally responsible community through awareness, advocacy and action. BurlingtonGreen is known for their annual city-wide dual component Community Clean Up Green Up (tree planting) event, the greening of community events through proper waste sorting, their popular youth environmental network, Eco Film events, and many other initiatives.

Role: Engage the community in actions to reduce greenhouse gas emissions through its programs such as 'Eco Score' as well as 'Make the Switch' – which educates Burlington residents on the benefits of electric vehicles, taking public transit and installation of heat pumps.

Burlington Hydro Inc. (BHI) is a regulated local electrical distribution company (LDC) serving the City of Burlington with approximately 67,000 customers. Burlington Electricity Services Inc. (BESI) is its non-regulated sister company, engaging in sector related business activities such as EV charging stations.

Role: In 2017 BESI entered into an agreement with the City of Burlington to convert its street lighting to LED technology. BESI is also involved in expansion of electric vehicle charging infrastructure in the city, providing programs to homeowners (detached and townhomes) as well as working with multi-residential buildings.

Burlington Sustainable Development Committee is a volunteer citizen advisory committee to city council, established in 1990. This committee has two mandates – to provide advice and guidance to city council on planning and policy initiatives to support a sustainable development community. It also engages and educates the community on sustainability initiatives and actions through events, on topics such as green buildings, renewable energy, energy conservation, green living, and local food.

Role: Continue to provide advice and guidance to city council on sustainable development issues and engage and educate the community on issues related to climate change.

The Centre for Climate Change Management at Mohawk College (CCCM) is mobilizing support and facilitating solutions to reduce greenhouse gas emissions, and to adapt to the impacts of our changing climate. Through collaboration with decision-makers, influencers and passionate citizens, the CCCM is embarking on action to ensure a thriving, low-carbon economy.

Role: Continue to engage students, faculty, community and businesses through the following programs:

- Bay Area Climate Change Office
- Industry Partnership Initiative
- Campus Carbon Management Initiative
- Office of Campus Sustainability and Climate Change

Halton Catholic District School Board

There are 14 elementary schools and 3 secondary schools in Burlington under the jurisdiction of the Halton Catholic District School Board, delivering educational programs to students in Burlington.

Role: Engage and educate students about the impacts of climate change and actions that students and families can take. HCDSB schools participate in the Eco School program. Ontario EcoSchools is an environmentally educative program that aims to help school communities across the province to develop their ecological literacy and environmental practices. The goal of the program is for schools to reduce their eco footprints and to teach staff, students and parents to be environmentally responsible citizens. The school board can also show community leadership by improving the energy efficiency of the schools and implementing renewable energy projects where possible.

Halton Environmental Network (HEN)

HEN is an incorporated non-profit organization operating in Halton Region (Oakville, Burlington, Milton, Halton Hills). HEN supports and enhances the capacity for local climate action and environmental sustainability across our community. HEN brings together relevant parties to drive change and facilitates communication, cooperation, resources and alignment with Community members, Conservation Authorities, Non-profits, Faith-Based Organizations) Government, and Educational Sector.

Role: HEN engages the community through workshops, community educational outreach programs, and waste diversion and mitigation initiatives for organizations and businesses and at events.

Halton District School Board

There are 35 elementary schools and 9 secondary schools in Burlington under the jurisdiction of the Halton District School Board, delivering educational programs to students in Burlington. The board delivers other programs such as adult continuing education and night school at Gary Allan High School.

Role: Engage and educate students about the impacts of climate change and actions that students and families can take. HDSB schools participate in the EcoSchool program (see above under Halton Catholic District School Board).

McMaster University – Department of Engineering & McMaster Institute for Energy Studies

The research that the institute is involved in such as energy harvesting, thermal energy recovery, micro thermal networks and energy storage will help to support the development of smart community energy systems as Burlington grows and develops.

Role: Continue its research and relate the applicability to Burlington in future development and support pilot projects. The city will also support and participate in research projects where relevant to its strategic goals.

Region of Halton

The Region of Halton is the regional government and is responsible for providing services such as water and wastewater treatment, distribution and collection, waste management services, and health and social services, among others.

Role: The region has a leadership role to play on climate change by ensuring its own operations are delivered in an efficient way to reduce the overall carbon footprint. The region does extensive community outreach on areas related to waste reduction and diversion, water efficiency and conservation, and the linkages between climate change and health.

Royal Botanical Gardens

The Royal Botanical Gardens (RBG) is the largest botanical garden in Canada with 400 acres of display gardens. The RBG also shows stewardship by protecting and restoring 2,450 acres of nature sanctuaries containing environmentally sensitive habitats, where approximately 50 listed species-at-risk have made their home. It is actively involved in teaching and educating the public and school children about the importance of plants, nature and maintaining sustainable biodiversity, and how to be environmental stewards in their community.

Role: Continue to engage the public and school children on being environmental stewards to reduce the impacts of climate change, particularly on the natural environment and biodiversity.

Sustainable Hamilton Burlington

Sustainable Hamilton Burlington is a non-profit social enterprise serving the cities of Hamilton and Burlington. It works with local businesses and non-profit organizations to take leadership and adopt a sustainable approach to their operations through collaborative learning, measurable action and recognition of success.

Role: Continue to work in the business and non-profit sector to achieve positive change to reduce the collective carbon footprint and waste.

Enbridge

Enbridge Gas Inc. delivers natural gas to homes, businesses and industries in communities across Ontario.

Role: Enbridge delivers residential conservation programs as well as programs to businesses. Residential programs include a home reno rebate program, a low income 'weatherization' program, and support to builders to improve energy efficiency of new homes. Programs for businesses include incentives for energy efficiency equipment, incentives to help fund engineering feasibility studies, and building optimization programs to help improve building efficiency, among others.

Partnerships and Collaboration

Centre for Climate Change Management at Mohawk and The Bay Area Climate Change Office & Council

The Centre for Climate Change Management at Mohawk (CCCM) is a multi-sector partnership between the cities of Hamilton and Burlington, Sustainable Hamilton Burlington and Mohawk College. The governance model, particularly for the Bay Area Climate Change Office (BACCO) and Council supports the implementation of a community driven plan to grow the economy while reducing emissions and building resilience to adapt to a changing climate.

There are currently 15 member organizations and individuals on Bay Area Climate Change Council. A strength of the council is the diverse background and experience of the membership. The council will collectively promote the adoption of deep greenhouse gas emissions mitigation strategies and climate change adaptation initiatives, prioritizing the following actions:

- Advocating for the adoption of progressive climate change policies;
- Supporting deep energy retrofits for homes and residential buildings;
- Advancing transportation strategies to reduce greenhouse gas emissions; and,
- Collaborating on low carbon supply chain solutions to support access to local food and reduce waste throughout the food supply chain.

Halton Climate Collective

The Halton Climate Collective (HCC) was initiated by and is led by the Halton Environmental Network (HEN). The HCC is a group of local organizations focused on collectively transforming the community of Halton into a low carbon, climate resilient community. The purpose of the collective is to align actions and leverage expertise to reduce climate change, secure funding opportunities and promote a collective approach to addressing climate change. Organizations represented on the collective include:

- City of Burlington
- Conservation Halton
- Halton Environmental Network
- Town of Halton Hills
- Town of Milton
- Town of Oakville
- Halton Catholic District School Board
- Halton District School Board
- Region of Halton; and
- University of Waterloo

Sustainable Hamilton Burlington

Sustainable Hamilton Burlington is a non-profit social enterprise serving the cities of Hamilton and Burlington. It works with local businesses like Walker Emulsions, Wolseley Distribution and Zip Signs (Burlington businesses) and non-profit organizations to take leadership and adopt a sustainable approach to their operations through collaborative learning, measurable action and recognition of success. This includes supporting organizations in setting and working towards carbon reduction targets. The cities of Hamilton and Burlington are members of SHB in part to show leadership to other local organizations and businesses to improve sustainability and adopt a low carbon approach to their operations.

Clean Air Partnership and Clean Air Council

The Clean Air Partnership (CAP) is a charitable environmental organization launched in June 2000. CAP's mission is to help municipalities become sustainable, resilient, vibrant communities where resources are used efficiently, the air is clean to breathe and greenhouse gas emissions are minimized. The Clean Air Council is a program administered by CAP and is a network of 28

municipalities and health units from across Ontario. Since 2000, Clean Air Council members have been working collaboratively on the development and implementation of clean air, climate change, sustainability and resilience actions. The City of Burlington has been an active member on the Clean Air Council for several years.

QUEST Community Energy Planning and Implementation Network

QUEST (Quality Urban Energy System for Tomorrow) is a national non-government organization that works to accelerate the adoption of efficient and integrated community-scale energy systems in Canada by informing, inspiring and connecting decision makers. This organization commissions research, communicates best practices, convenes government, utility, and private sector leaders, and works directly with local authorities to implement on the ground solutions.

Participating in QUEST's Community Energy Planning and Implementation Network (CEPIN) provides Burlington the opportunity to network with peer municipalities on community energy planning, sharing best practices, lessons learned and other information, with access to senior levels of government and utilities on energy issues. The network assists Burlington staff to stay informed about changing policies and programs related to community energy planning as well as best practices being implemented by other organizations.

International Urban Cooperation Program

Burlington has been participating in the European Union's International Urban Cooperation program since 2017, partnered with Växjö, Sweden to share solutions to common challenges such as sustainable development, community energy systems and climate change. The program is part of a long-term strategy by the EU to foster sustainable urban development in cooperation with both the public and private sectors. Burlington and Vaxjo have been working together to share information and lessons learned on their respective areas of focus using an ecosystem approach to planning for urban parks and the redevelopment of an industrial area. Information is being shared through skype meetings and webinars on topics such as the fossil fuel free city; storm water management; tall wood buildings; and community engagement activities.

Showcase Cities and Global Covenant of Mayors for Energy and Climate Canada

The City of Burlington is one of 25 Canadian municipalities participating in the Showcase Cities Program. The program is designed to help municipalities make the transition to the Global Covenant of Mayors for Climate and Energy (GCoM - Canada).

GCoM Canada is a collaboration between the Federation of Canadian Municipalities, ICLEI Canada, C40 Cities, the Global Covenant of Mayors Secretariat and the International Urban Cooperation Project, supported by funding from the European Union. The initiative combines two leading domestic climate programs, the Partners for Climate Protection (PCP) and Building Adaptive and Resilient Communities (BARC) with the leading global climate program. The purpose of this collaboration is to further advance Canadian local climate action by adding value, international opportunities/profile and streamlined support and reporting for members.

Burlington has joined over 9,000 cities, representing more than 800 million people worldwide and over 10% of the total global population by committing to take part in the GCoM program.

MONITORING AND EVALUATION

Tracking the effectiveness of the actions in the BCAP helps to manage the risk and uncertainty associated with these efforts, as well as external forces such as evolving senior government policy, and new technologies which can disrupt the energy system. Key motivations for monitoring and evaluation include the following:

- Identify unanticipated outcomes.
- Adjust programs and policies based on their effectiveness.
- Manage and adapt to the uncertainty of climate change.
- Manage and adapt to emerging technologies.

Specific activities which have been identified to support the implementation of the BCAP include an annual work plan and review, an annual indicator report, an update of the GHG inventory every two years and an update of the BCAP every five years.

Table 7. Monitoring and evaluation activities

Activity	Purpose	Description	Frequency
1. Annual work plan and review	Review work to-date and set annual priority actions	Annual report with prioritized actions	Annual
2. Annual indicator report	Track effectiveness of actions	Annual report on set of indicators with an analysis of the results	Annual
3. Inventory	Update energy and GHG emissions profile	Re-calculate the GHG emissions and energy inventory	Every 2 years
4. Update the BCAP	Update the BCAP to reflect changing conditions	Review each action and the progress being achieved. Identify new actions.	Every 5 years

Annual Work Plan and Review

An annual work plan identifies all relevant activities to achieve the actions and policies in the plan, the responsible parties, the budget and the schedule. The results of the previous year's work plan should be reviewed to inform the development of subsequent work plans. The work plan is prepared by the BCAP coordinating body, as identified by the BCAP partners.

Annual Indicator Report

There are two aspects involved in the application of indicators: collecting data on indicators (monitoring) and interpreting the results of those indicators (evaluation). Over time, the City can also evaluate its effectiveness in embedding the knowledge and wisdom gained through this process into the organization.

From the perspective of the BCAP, there are multiple purposes for which data is collected: to evaluate the effectiveness of the actions, to evaluate the impact of the actions on the community, and to evaluate the uptake of the lessons from the evaluation.

The City can launch its implementation report on Earth Day each year.

Table 8. Types of indicators

Indicator Category	Question
1. Effectiveness indicators	Are the actions achieving their objectives?
2. Impact indicators	What is the impact of the actions on the community?

Effectiveness Indicators

These indicators are designed to evaluate whether or not policies or actions are having an effect; they vary from municipality to municipality according to the specifics of the community energy and emissions plan. The results of the indicators are then compared against the assumption in the modelling to monitor whether or not the community is on track with projections. Indicators should be developed for each policy or mechanism.

Impact Indicators

The City should develop a set of indicators that track macro trends and drivers of GHG emissions in the City. These are designed to be reported on each year.

Table 9. Indicators

Indicator	Trend	Data sources
Total new dwellings by type	An indication of the growth of the building stock.	Building permits
Average total floor area of new dwellings	An indication as to whether there is more or less floor space to heat or cool.	Building permits
Diversity of dwelling types	An indication of the types of dwellings and whether or not they have shared walls.	Building permits
Total new non-residential floorspace by type	An indication of the growth of the building stock.	Building permits
Total demolitions	An indication of the change in the building stock.	Demolition permits

Indicator	Trend	Data sources
Percentage of non-residential floorspace within 400m of a transit stop	An indication as to whether commercial development is occurring in areas more appropriate for walking, cycling and transit.	Building permits and GIS analysis
Number of new dwellings that are within 400m of a transit stop	Indication of transit accessibility.	GIS layers of transit and building footprint
Annual or monthly energy price by fuel (electricity, gasoline, diesel, natural gas) ($/GJ)	Energy costs are an important indicator of opportunities for energy savings and renewable energy, household, municipal and business energy costs.	Available from the utilities
Total energy consumption by sector for electricity (GJ)	An indication of trends in energy use in buildings.	Available from the utilities
Total solar PV installs (# of installations)	An indication of extent of decentralized renewable energy.	Building permits or utilities
Total gasoline sales ($)	An indication of GHG emissions from vehicles.	Available for purchase from Kent Group Ltd.
Total transit trips	An indication of whether non-vehicular trips are increasing.	Available from B.T. and Metrolinx

Indicator	Trend	Data sources
Length of physically separated cycling lanes, new cycling infrastructure, and new sidewalks	An indicator of opportunity for people of all ages to cycle and use active transportation modes.	City
Mode share	An indication of the use of transit/active transportation	City
Volumes of types of waste processed at recycling and waste management facilities	An indicator of uptake of waste diversion strategies, and of overwall waste production	Region
Number of EV, PHEV and BEV vehicle sales compared to total vehicle sales	An indicator of adoption EVs in the market	Province

CONCLUSION

The BCAP is a pathway to a low carbon future. This pathway requires new investments by the public sector, the private sector and households, and will stimulate a new economy.

Municipal interventions will be foundational. These efforts will unlock key strategies to advance the LCS, including creating policies to support district energy, land-use planning, supporting advanced building performance standards, financing retrofits and renewable energy, and education and support.

The low carbon pathway nearly achieves Burlington's GHG targets. New opportunities will need to be incorporated into the BCAP in order to address the gap between the City's GHG targets and the LCS.

Recommendation #1: The City and partners continue to test novel approaches and identify new strategies to reduce GHG emissions as part of the monitoring and evaluation of the BCAP.

Implementation focuses on six program areas. The transition requires efforts firstly to reduce energy consumption through high performance building codes and land-use planning, secondly to improve the energy system by retrofitting existing buildings, and thirdly to switch to renewable energy, primarily electricity and to a lesser degree renewable natural gas. The BCAP outlines specific actions and programs that will implement those actions.

Recommendation #2: The partners of the BCAP will develop a five-year implementation plan based on the six program areas identified in the BCAP.

The City of Burlington is not alone. Many other cities and regions around the world are exploring similar pathways, and there are opportunities to compare notes and learn from successes and challenges going forward.

Land-use policy will enable implementation. Energy and GHG gains that occur as a result of land-use planning are essentially free in that they require no investment and deliver a range of other co-benefits. Therefore, municipalities

should continue to advance intensification strategies as an enabling strategy to reduce GHG emissions. Other policies in the Official Plan will also support the delivery of the programs and the implementation of the actions.

Recommendation #3: The BCAP be both recognized and enabled by the forthcoming revisions of the Burlington Official Plan.

The BCAP is an economic development strategy. There are opportunities for new and existing businesses in the fields of heat pumps, building retrofits, renewable energy, district energy, energy storage and others yet to be determined.

Major investments are required. This transition requires significant capital investments, an additional amount of $4.3 billion for all the timeline of the LC pathway, compared with the BAU scenario. However, these investments are offset mainly by reduced fuel expenditures later on, reaching savings of $ 6.7 billion over the same period. The incremental capital costs of the LCS are 4% of the total expenditures made annually on buildings, transportation and waste management in the City.

Recommendation #4: Work with financial partners to develop a BCAP capitalization strategy.

The LCS actions modelled have varying return on investments and risk profiles. Some investments will be more suited to the public sector, whereas others will be more appropriate for private businesses. Determining which action is best associated with which entity has yet to be done but there are many promising investment opportunities.

New jobs will be created. The investments in the energy system will generate employment in building design, retrofits, district energy, renewable energy, electric vehicle manufacturing and other sectors. A total of 21,300 direct person years of employment will be created over the period as a result of the implementation of the LCS.

The low carbon pathway will evolve. As new technologies emerge and new approaches to deployment are developed, the approach to implementing the actions will change. The earlier the City of Burlington can undertake the investments contemplated in the pathway, the greater financial and environmental benefits will be for the community as a whole. Delay will result in, for example, increasing household energy costs for a longer period.

APPENDIX 1. MODELLING AND METHODOLOGY

Population and Employment Assumptions and Projections

City-wide population is modelled using the standard population cohort-survival method, disaggregated by single year of age and gender. It accounts for various components of change: births, deaths, immigration and emigration. The age structured population is important for analysis of demographic trends, generational differences and implications for shifting energy use patterns.

The 2016 population includes an estimated census undercount, based on estimates for the census undercount by age and gender. The Statistics Canada 2016 Census is used as the basis for this year.

The employment numbers are adjusted to reflect the place of work of employees.

The population and employment growth rates in the BPE (2011) were used to project to 2031, and held fixed from 2031-2050 (growth rates held fixed; not population and employment). The Regional Municipality of Halton Best Planning Estimates of Population, Occupied Dwelling Units, and Employment 2011-2031 for the City of Burlington were used for these projection estimates.

Carbon Budget Methods

In this context, a carbon budget for Burlington was developed using the per capita figures of 2.9 tCO_2e for 2030, and 0.9 tCO_2e and 0 tCO_2e for 2050 respectively, using the C40 report as reference.[26] A logistic function was used to extrapolate per capita GHG emissions between 2019 and 2030, and 2030 and 2050 using a convergence point of 2.9 tCO_2e in 2030, resulting in an annual per capita budget for CO_2e emissions. Future population projections were then multiplied against the per capita GHG emissions factor to generate total GHG emissions year over year.

Financial Modelling

The actions in the LCS require investments that result in savings and, in the case of local electricity generation, revenues; it is a classic case of pay now to save later. Incremental expenditures, (as compared with the business-as-usual case) in buildings, vehicles and other energy-related equipment and infrastructure increase costs in the short term in return for long term savings. By 2050, cumulative investment in the LCS reaches $38 billion with a present value in 2016 of $23.5 billion.

On the other side of the ledger are the fuel and electricity cost savings, the monetary value of the carbon reductions resulting from carbon pricing, and savings from a lower O&M cost. The largest contribution to the value of the LC comes from lower energy bills; by 2050, fuel and electricity expenditures in Burlington are a $0.4 billion per year lower than in the business-as-usual scenario. In that same category, cumulative savings reach $6.9 billion, with a present value in 2016 of $3.5 billion.

Carbon pricing effectively increases the value of fuel and electricity savings, and especially fuel savings, modestly in the first half of the program but more significantly in the later years as the effective carbon price increases. In 2050, the carbon "premium" from the LC reaches $99 million and the cumulative premium over the period totals $1.5 billion, with a present value of $0.7 billion.

Finally, the LCS pathway includes investments in local energy generation facilities in Burlington that generate a minor stream of revenue.

The above four categories of Investments, Energy Savings, Carbon Credits, and Energy Generation Revenue are summarized in Figure A1 below, which presents the LC scenario figures relative to BAU. On an annual basis, the investments

26 (C40, 2017, p. 40)

exceed the savings and revenues until the breakeven point in 2029 and then the net benefits begin to exceed the annual costs by an ever widening margin. By 2050, the annual net payback from the plan reaches $0.6 billion per year. By that point the cumulative investment reaches $4.3 billion as compared to the cumulative benefits of $6.8 billion. Additionally, as illustrated in Figure A2, the net present value of the costs and benefits of the Low Carbon Pathway is $2.9 billion.

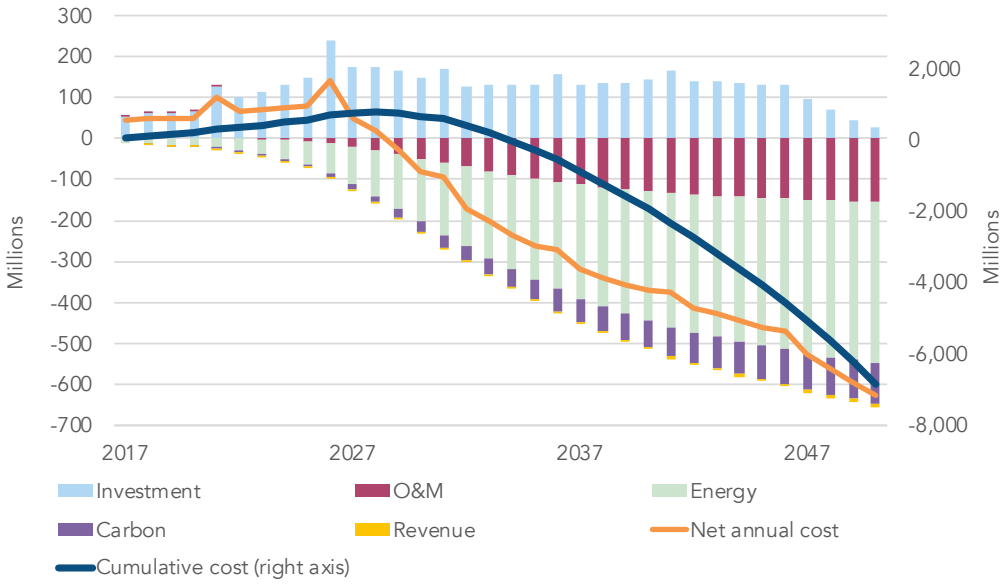


Figure A1. Expenditures, savings and revenues from the LCS, relative to business-as-usual. (Values are presented as costs in this figure, so expenditures are above the line and savings and revenue are below the line).

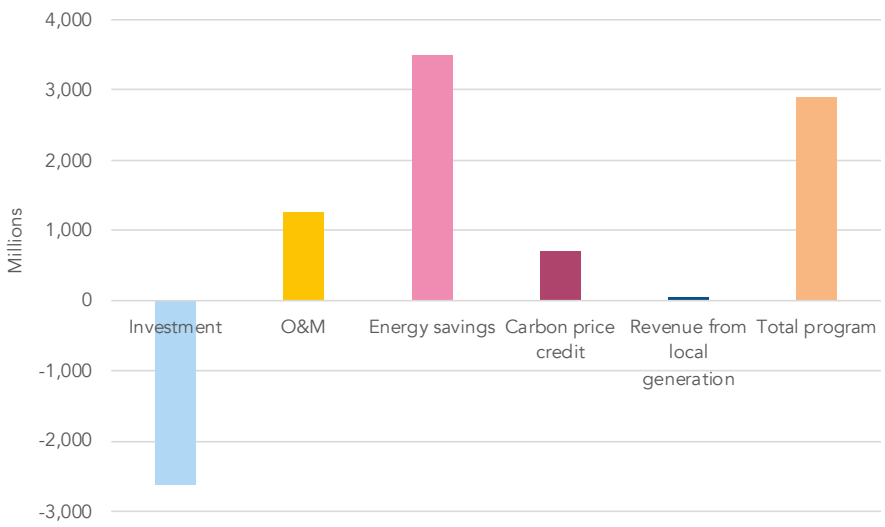


Figure A2. Net present value of expenditures, savings and revenues from the LCS, relative to the BAU scenario. (This figure shows present value, so costs are shown below the line, and revenues and savings above the line.)

Home Energy Retrofits and Heat Pumps

Residential retrofits to improve the building envelope, to reduce energy demand, and to switch to low- or zero-carbon fuel sources are an essential part of the low-carbon pathway for Burlington. Facilitation of the wide-spread adoption of these modifications may require support or incentives to encourage the level of uptake required to achieve deep GHG emissions reductions, as not all retrofits or conversions will be financially positive or neutral.

The cost of heat pumps, as well as other interventions, were assessed over the period from 2019-2050. Assumptions about the size and timing of installing heat pumps in commercial buildings are less accurate than for residential buildings; Burlington does not have a large commercial building stock.

Electricity price projections used in the modelling are obtained from Canada's Energy Regulator, and project that electricity will be more than ten times more expensive than natural gas in the future. Added to this is the complexity of

investment required in Ontario's electricity grid, which could result in even higher electricity prices. This increase is the primary driver of the additional cost for heat pumps combined with the capital cost, which is higher than a conventional boiler or furnace- the combination of low natural gas prices and low capital costs, make the financial case for heat pumps challenging. Ground-source and air-source heat pumps are bundled together in the modelling, which has the effect of lowering the costs of ground-source heat pumps, and raising the cost of air-source systems. Air-source heat pumps will have a better return on investment, and no hybrid or other heat pump types were evaluated.

The cost of retrofits in the model averages between $50,000 and $60,000 per unit, resulting in energy savings of 50% savings. This level of retrofit on one dwelling today will likely be more in the range of $80-$100,000, so the modelling assumption is based on the development of a retrofit industry that achieves economies of scale. Energy savings needs to be significant to provide a return on an investment of $60,000. Retrofits that result in energy savings of 20-30% can be more financially compelling, but once insulation in exterior walls and windows need to be replaced the return on investment is longer. Retrofit investment for the entire plan is $600 million while the savings are $550 million over a 30 year projection, with a margin of error associated with the assumptions for the modelling.

APPENDIX 2. ASSUMPTIONS TABLES

Electricity cost[27]

$ / kWh	Residential	Commercial		$ / kWh	Residential	Commercial
2016	0.1490	0.1222		2035	0.1704	0.1397
2017	0.1520	0.1246		2036	0.1705	0.1398
2018	0.1550	0.1271		2037	0.1706	0.1399
2019	0.1580	0.1296		2038	0.1709	0.1401
2020	0.1612	0.1322		2039	0.1710	0.1403
2021	0.1620	0.1329		2040	0.1712	0.1404
2022	0.1628	0.1335		2041	0.1762	0.1439
2023	0.1637	0.1343		2042	0.1770	0.1445
2024	0.1645	0.1349		2043	0.1779	0.1452
2025	0.1653	0.1356		2044	0.1787	0.1458
2026	0.1661	0.1362		2045	0.1796	0.1464
2027	0.1669	0.1369		2046	0.1804	0.1471
2028	0.1678	0.1377		2047	0.1813	0.1477
2029	0.1687	0.1383		2048	0.1821	0.1483
2030	0.1695	0.1390		2049	0.1830	0.1489
2031	0.1697	0.1392		2050	0.1839	0.1496

27 (National Energy Board, 2016)

$ / kWh	Residential	Commercial		$ / kWh	Residential	Commercial
2032	0.1698	0.1393				
2033	0.1700	0.1394				
2034	0.1702	0.1396				

Natural Gas cost[28]

$ / m3	Residential	Commercial		$ / m3	Residential	Commercial
2016	0.318	0.229		2035	0.369	0.274
2017	0.333	0.242		2036	0.370	0.275
2018	0.338	0.247		2037	0.372	0.276
2019	0.342	0.250		2038	0.373	0.277
2020	0.345	0.253		2039	0.374	0.278
2021	0.349	0.256		2040	0.375	0.279
2022	0.351	0.258		2041	0.383	0.284
2023	0.354	0.260		2042	0.385	0.286
2024	0.355	0.261		2043	0.387	0.287
2025	0.356	0.263		2044	0.389	0.289
2026	0.357	0.264		2045	0.391	0.291
2027	0.359	0.265		2046	0.393	0.292
2028	0.360	0.266		2047	0.395	0.294
2029	0.361	0.267		2048	0.397	0.295
2030	0.363	0.268		2049	0.399	0.297
2031	0.364	0.269		2050	0.401	0.298
2032	0.365	0.270				

28 (National Energy Board, 2016)

$ / m3	Residential	Commercial		$ / m3	Residential	Commercial
2033	0.366	0.272				
2034	0.368	0.273				

Gasoline cost[29]

$ / L			$ / L	
2016	1.17		2035	1.50
2017	1.21		2036	1.51
2018	1.25		2037	1.52
2019	1.26		2038	1.53
2020	1.29		2039	1.54
2021	1.31		2040	1.55
2022	1.33		2041	1.60
2023	1.35		2042	1.62
2024	1.36		2043	1.64
2025	1.38		2044	1.65
2026	1.39		2045	1.67
2027	1.41		2046	1.68
2028	1.42		2047	1.70
2029	1.44		2048	1.71
2030	1.46		2049	1.73
2031	1.47		2050	1.75
2032	1.48			
2033	1.49			

[29] (National Energy Board, 2016)

$ / L			$ / L	
2034	1.49			

Biogas Cost[30]

$ / GJ				
2016	$18.80		2035	$12.10
2017	$13.10		2036	$12.08
2018	$12.70		2037	$12.07
2019	$12.30		2038	$12.06
2020	$12.20		2039	$12.05
2021	$12.20		2040	$12.04
2022	$12.20		2041	$11.42
2023	$12.20		2042	$11.34
2024	$12.20		2043	$11.26
2025	$12.20		2044	$11.18
2026	$12.20		2045	$11.10
2027	$12.20		2046	$11.01
2028	$12.20		2047	$10.93
2029	$12.10		2048	$10.85
2030	$12.10		2049	$10.77
2031	$12.10		2050	$10.69
2032	$12.10			
2033	$12.10			
2034	$12.10			

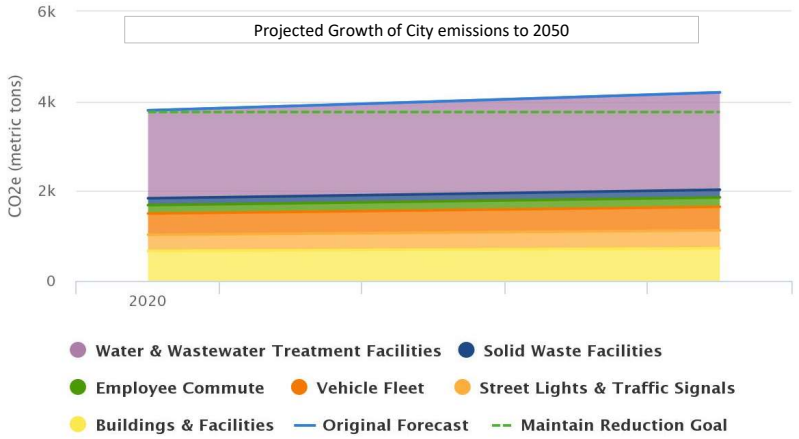
30 (Navigant consulting, 2016)

Carbon Price[31]

$ / tonne CO_2eq				
2019	20		2038	80
2020	30		2039	83
2021	40		2040	85
2022	50		2041	88
2023	52		2042	90
2024	53		2043	93
2025	55		2044	96
2026	56		2045	99
2027	58		2046	102
2028	60		2047	105
2029	61		2048	108
2030	63		2049	111
2031	65		2050	114
2032	67			
2033	69			
2034	71			
2035	73			
2036	76			
2037	78			

[31] (Office of the Parliamentary Budget Officer, 2016)

- Phillips Farm Work
    - We've been thinning sapling pine trees to help gradually create the forest/savannah ecosystem the park board wants
        - For 2 weekends we hosted a cut-your-own Christmas tree event to put the saplings to good use
    - We're continuing to build and put up bee boxes around the park, and we're planning on building many more to sell to the town, especially the people who attended the Native Pollinator Summit
    - There's been lots of trail brushing to do, and we're planning to start constructing a little boardwalk on the trail near the wetlands
- Sierra Club RF100
    - A slow-going campaign to get letters of support from businesses has been in progress since the summer - currently we're working with Buy Local Moscow to distribute the letter of support to more business owners
    - With Al and Michael Jennings, we met individually with city councilors to discuss a resolution in which Moscow would officially commit to 100% renewable energy by 2045
        - The resolution was unfavorable to most of the councilors - we're currently working on ways to show more support for the campaign, and Steven might have more details next month on how to change the resolution to fit the Councilors' standards



Planned & Potential Projects Key:

Effect
+ will reduce greenhouse gas emissions
- will increase greenhouse gas emissions

Expected Impact
* < 10 MT CO_2e
** 10 MT CO_2e < x < 80 MT CO_2e
*** 80 MT CO_2e < x < 120 MT CO_2e
**** > 120 MT CO_2e

Cost
$ < $1000
$$ $1,000 - $99,999
$$$ $100,000 - $999,999
$$$$ $1,000,000 +

Planned and Potential Projects that affect emissions by sector

Buildings & Facilities

Project	Description	Outcome	Effect	Expected impact	Cost	Planned for	Payback time	Notes
Indian Hills Park Restroom	Installation of a single user precast restroom facility at Indian Hills Park and association utility and pathway connections	Addition of restroom facilities at park in accordance with the park masterplan development; increased energy consumption	-	3 MTCO2e	$132,220.00	2022/2023		assumes similar consumption of friendship square bathroom
Lola Clye Park Restroom Construction	Installation of single user precast restroom facilitiy at Lola clyde Park and associated utility and pathway connections	Addition of restroom facilities at park in accordance with the park masterplan development; increased energy consumption	-	3 MTCO2e	$155,579.00	2026/2027		assumes similar consumption of friendship square bathroom
Itani Park Restroom	Installation of single user precast restroom facility at Itani Park and associated utility and pathway connections	Addition of restroom facilities at park in accordance with the park masterplan development; increased energy consumption	-	3 MTCO2e	$155,579.00	2026/2027		assumes similar consumption of friendship square bathroom
HLAC Pool Heater Replacement	Replacement of the pool heaters at the Hamilton Lowe Aquatics Center	Maintenance of facilities amenities to maintain user recreation opportunities and experience; increased energy efficiency of heaters leads to reduced energy consumption	+	8 MTCO2e	$109,922.00	2032		increase heater efficiency by 5 percent- opt for the higher effiency model during next replacement
Police Services Facility Project	Construction of a new 15,300 sq ft Police Services Facility including a 3,000 square foot outbuilding, secured parking area and associated site improvements	Improved and more efficient police services delivery to the community	-	50 MTCO2e	$8,148,787.00	ongoing		Will depend on elimination of old facility and how much more efficient the new building is compare to the old one; at least a slight increase in emissions is expected due to doubling the floor space.
Haddock Building Remodel Project	Remodel of the 7500 sq ft Haddock Building to house the Community Planning and Design staff that are currently located in the Mann Building and The Annex buildings	Project will provide necessary office, conference, reception and storage space for the operations of the Community Planning and Design staff;	-	5 MTCO2e	$475,700.00	2021		Will depend on elimination of old facility and how much more efficient the new building is compare to the old one; at least a slight increase in emissions is expected due to doubling the floor space.
Mann Building Remodel Project	Remodel of the Mann Building to stabilize exterior masonry cracking, install a new roof and other minor renovations to accommodate the Information Systems Department Staff that are currently housed in the Eggan Youth Center	Building Stabilization and extension of serviceable life; impacts to ghg tbd	+	12 mtco2e	$79,303.00	2021		Most efficient building in the city as it is; after remodel it will be occupied by fewer staff as well.
City Hall- Roof Replacement Project	Replacement of the existing metal roof on City Hall	Maintenance/Extension of building life; impacts to ghg tbd	+	12 mtco2e	$140,000.00	2026/2027		opportunity for increasing energy effiency; opportunity for solar-ready roof or solar install.
HIRC Parking lot Replacement Project	Replacement of deteriorating parking lot paving at the HIRC	Maintenance/Extension of building life; potential solar project	+	**	$233,398.00	2021/2022		opportunty for groundmount solar that provides electricity to HIRC/HLAC, can also provide added value to rec center patrons by shading their vehicles.
HIRC HVAC Replacement Project	Replacement of HVAC system reaching end of serviceable life at the Hamilton Indoor Recreation Center	Maintenance/Extension of building life; upgraded HVAC efficiency reduces energy consumption	+	3 mtco2e	$123,806.00	2023/2024		opt for more efficient models to maximize benefit to ghg inventory
HIRC Roof Replacement Project	Replacement of roofing shingles reaching end of serviceable life at Hamilton Indoor Recreat Center	Maintenance/Extension of building life; potential increase in energy efficiency; potential solar project;	+		$415,962.00	2033/2034		opportunity for increasing energy efficiency; making the roof solar ready and/or installing rooftop solar; Also look into cool roofs

Solar Project: HIRC/HLAC parking lot	Install solar on/at the HIRC/HLAC. Ground mounted system that creates shade structures in the parking lot.	Supplements Grid electricity, reducing emissions associated with grid energy consumption	+	80 mtco2e	$445,000.00	No current plans	12.5 years	solar project here would be highly visible to the public; any amount of energy produced would benefit ghg inventory; this project would be a full offset of HLAC electrical use
Solar Project: HIRC Roof	Roof mount on HIRC	Supplements Grid electricity, reducing emissions associated with grid energy consumption	+	36 mtco2e (avoided emissions)	$201,500.00	No current plans	12.5 years	solar project here would be highly visible to the public; any amount of energy produced would benefit ghg inventory
Solar Project: HLAC Roof	roof mount on HLAC	Supplements Grid electricity, reducing emissions associated with grid energy consumption	+	13 MTCO2e (avoided emissions)	$84,300.00	No current plans	14.5 years	solar project here would be highly visible to the public; any amount of energy produced would benefit ghg inventory
Solar Project: Police Station	Install 25kW solar system on the Police Station	Supplements Grid electricity, reducing emissions associated with grid energy consumption	+	9 MTCO2e (avoided emissions)	$88,000.00	No current plans		solar project here would be highly visible to the public; any amount of energy produced would benefit ghg inventory
Window Replacement: City Hall	upgrade windows at city hall to improve energy efficiency, while maintaining historic aspect of the windows	reduced consumption of natural gas for heating and electricity for cooling	+	51 mtco2	$$$	No current plans		increase building efficiency will decrease consumption; calculation assumes 20% savings of electricity and natural gas due to increased efficiency
Solar Project: Eggan	Install solar on Eggan up to 7kW system/24 panels	Supplements Grid electricity, reducing emissions associated with grid energy consumption	+	2.5 MTCO2e	$25,200.00	No current plans	20+	solar project here would be highly visible to the public; any amount of energy produced would benefit ghg inventory
Main Fire Station LED retrofit	upgrade lighting at Main fire station to LED	reduced electrical consumption	+	8 MTCO2e (avoided emissions)	$6,316.86	No current plans	1 year	While this is not a City owned building, we are responsible for its energy consumption. Working with the Volunteer Fire Department to make this change happen would benefit both parties.
Solar Project: East City Park Restroom	Install a 5kW solar system on the bathroom structure	reduce grid electrical consumption	+	2 MTCO2e (avoided emissions)	$9,764.00	no current plans	10 years	This project could be repeated at all City Parks as funds are available. A system this size would essentially run the bathrooms for free during summer months.
Building Envelope Assessments	Assess and repair building envelope issues that lead to increased energy consumption. I.E. drafty windows, drafty doors, drafty walls/spaces	increased energy efficiency which reduces energy consumption	+		Staff labor costs	no current plans		If done internally this could be a very low cost option to pursue; time could provide constraints but we could limit to 1 facility a year to reduce.
Solar Project: City Shop	install 100 kW/335 panel system on the roof of the shop.	reduce grid electrical consumption by 8%	+	3.2	$352,050.00	no current plans	14 years	estimates completed using Avista Watt Plan calculator
Solar Project: Water Shop								
Wind Project: HLAC/HIRC								

Streetlights & Traffic Signals

Project	Description	Outcome	Effect	Expected impact	Project Cost	Planned For	Payback Time	Notes
Paradise Path Lighting Project Phase I	Installation of energy efficient LED pathway lighting on Paradise Path from South Main to Berman Creekside Park	Enhanced pathway lighting to improve safety and expand use of the pathway system use during periods of limited daylight hours	-	0.25	$96,305.00	2021		Adding any new lighting, even LED, will increase elctrical consumption. Goal should be to minimize impact by using most energy efficient options and designs; may have community emission implications
Pardise Path Lighting Project Phase II	Installation of energy efficient LED pathway lighting on Paradise Path from Berman Creekside Park to pedestrian underpass at Styner Street and the Troy Highway	Enhanced pathway lighting ti improve safety and expand use of the pathway system use during periods of limited daylight hours	-	0.25	$96,305.00	2029/2030		Adding any new lighting, even LED, will increase elctrical consumption. Goal should be to minimize impact by using most energy efficient options and designs; may have community emission implications.
LED Conversion Project	Replacement of City-owned streetlights with new high-efficiency LED light fixtures	Reduction of energy use and associated greenhouse gas emissions and associated financial savings	+	109	$154,500.00	2019/2022		Convertying remaining City owned streetlights to LED would reduce electrical consumption, and reduce operating cost
Ghormley Pickleball Courts	Removal of existing serverely deteriorated tennis courts and construction of four new lighted pickleball courts and associated amenities	adding lighting increases energy consumption	-	0.25	$247,200.00	2021		Adding any new lighting, even LED, will increase elctrical consumption. Goal should be to minimize impact by using most energy efficient options and designs
Third & Sixth Street Safety improvement Project	Reconstruction of ADA non-compliant sidewalks and pedestrian ramps, curb extensions and corridor lighting improvements	Increased pedestrian safety and ADA compliance and accident reduction within the corridor;	+	1	$856,500.00	2021		opportunity to convert lighting to LED if it isn't already; for every 3100 kwh saved
South Couplet Beautification Project	Installation of street trees, landscaping, lighting and other streetscape improvements at the South Couplet intersection	Enahnced Pedestrian facilities, traffic calming and City beautification; added lighting will increase electrical consumption	-	1	$340,466.00	2022/2023		Wisescaping opportunity to reduce water needs; opportunity for wildlife benefits; additional lighting leads to increased energy consumption; for every 3100 kwh added
Lieuallen Beautification Project	Installation of street trees, landscaping, lighting and other streetscape improvements at the Lieuallen intersection	Enhanced Pedestrian facilities, traffic calming and City beautification; added lighting will increase electrical consumption	-	1	$169,107.00	2025/2026		Wisescaping opportunity to reduce water needs; opportunity for wildlife benefits; additional lighting leads to increased energy consumption; for every 3100 kwh added

South Main Beautification Project	Installation of street trees, landscaping, lighting and other streetscape improvements at the South Main and Palouse River Drive intersection	Enhanced Pedestrian facilities, traffic calming and City beautification; added lighting will increase electrical consumption	-	1	$175,597.00	2027/2028	Wisescaping opportunity to reduce water needs; opportunity for wildlife benefits; additional lighting leads to increased energy consumption; for every 3100 kwh added
Mountain View Beautification Project	Installation of street trees, landscaping, lighting and other streetscape improvements at the Troy Highway and Mountain View intersection	Enhanced Pedestrian facilities, traffic calming and City beautification; added lighting will increase electrical consumption	-	1	$129,426.00	2029/2030	Wisescaping opportunity to reduce water needs; opportunity for wildlife benefits; additional lighting leads to increased energy consumption; for every 3100 kwh added
Avista Streetlight Changeout	Convert remaining Avista-owned streetlights to LED; 278 lamps remaining	Reduced energy consumption	+	11.6	< $	2021	Costs the city nothing- pure savings through reduced consumption
Ballfields Lights change out	transitional all ballfield lighting to led	reduced energy consumption	+				

Vehicle Fleet								
Project	**Description**	**Outcome**	**Effect**	**Expected impact**	**Cost**	**Planned For**	**Payback Time**	**Notes**
402	2013 Ford Interceptor Sedan (avg MPG 22) transition to Hybrid SUV (34 mpg)	reduce fuel consumption	+	2 MTCO2e	$27,810.00	2020/2021		
403	2014 Ford Interceptor Sedan-(19 MPG) transtion to Hybrid model	reduce fuel consumption	+	2 MTCO2e	$27,810.00	2020/2021		
404	2014 Ford Interceptor SUV- (22 MPG) transition to Hybrid SUV (34 mpg)	reduce fuel consumption	+	2 MTCO2e	$27,810.00	2020/2021		
101	2013 Chevrolet Silverado 1500 (18.5 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$30,240.00	2025		
109	2012 Chevrolet 1/2 Ton Pickup -(21.5 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$29,430.00	2024		
110	2012 Chevrolet 1/2 Ton Pickup- (21.5 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$29,430.00	2024		
111	2011 Chevrolet 1500-(21.5)MPG transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$28,620.00	2023		
112	2015 Chevrolet Equinox-(27 MPG) transition to EV	reduce fuel consumption	+	2 MTCO2e	$40,120.00	2027		
114	2011 Ford E-450 (7.2 mpg) transition to EV	reduce fuel consumption	+	2 MTCO2e	$39,100.00	2026		
128	2012 Ford Escape-(25.5 MPG) transition to EV	reduce fuel consumption	+	2 MTCO2e	$37,060.00	2024		
130	2014 Chevrolet Silverado 1500-(21 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$31,050.00	2026		
137	2009 Bobcat transition to EV	reduce fuel consumption	+	2 MTCO2e	$37,060.00	2024		
204	2012 Chevrolet Silverado 1500-(18.5 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$29,430.00	2024		
205	2010 Chevrolet Silverado 1500-(18.5MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$27,810.00	2022		
207	2014 Chevrolet Silverado 1500-(21 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$31,050.00	2026		
208	2012 Chevrolet Silverado 1500- (18.5 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$29,430.00	2024		
310	2016 Chevrolet Equinox- (27 MPG) transition to EV	reduce fuel consumption	+	2 MTCO2e	$41,140.00	2028		
311	2009 Ford Ranger- (23.5 MPG) transition to EV	reduce fuel consumption	+	2 MTCO2e	$35,020.00	2021		
312	2014 Chevrolet Van- (16.5 MPG) transition to EV	reduce fuel consumption	+	2 MTCO2e	$39,100.00	2026		
313	2009 Ford Ranger-(23.5 MPG) transition to EV	reduce fuel consumption	+	2 MTCO2e	$35,020.00	2021		
314	2009 Cheverolet Colorado- (21 MPG) transition to EV	reduce fuel consumption	+	2 MTCO2e	$35,020.00	2021		
401	2017 Ford Interceptor SUV- (22 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$29,430.00	2024		
406	2017 Ford Interceptor SUV- (22 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$29,430.00	2024		
408	2016 Ford Interceptor SUV- (22 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$28,620.00	2023		
410	2015 Ford Interceptor SUV-(22 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$27,810.00	2022		
411	2014 Ford Interceptor - (22 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$31,050.00	2026		
413	2015 Ford Interceptor SUV- (22 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$27,810.00	2022		
414	2015 Ford Fusion-(30 MPG) transition to Hybrid/PHEV	reduce fuel consumption	+	2 MTCO2e	$31,860.00	2027		
421	2019 Harley FLHTP (44.2 mpg) transition to EV	reduce fuel consumption	+	2 MTCO2e	$36,040.00	2023		
482	2010 Chevrolet Malibu-(27.5 MPG) transition to Hybrid/PHEV	reduce fuel consumption	+	2 MTCO2e	$27,810.00	2022		
483	2014 Ford Fusion- (31 MPG) transition to Hybrid/PHEV	reduce fuel consumption	+	2 MTCO2e	$31,050.00	2026		
484	2013 Ford Fusion- (31 MPG) transition to Hybrid/PHEV	reduce fuel consumption	+	2 MTCO2e	$30,240.00	2025		
485	2012 Chevrolet Malibu- (27.5 MPG) transition to Hybrid/PHEV	reduce fuel consumption	+	2 MTCO2e	$29,430.00	2024		
486	2018 Ford Fusion- (28.5 MPG) transition to Hybrid/PHEV	reduce fuel consumption	+	2 MTCO2e	$34,290.00	2030		
504	2009 Ford 1/2 Ton Pickup- (17.5 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$27,810.00	2021		
505	2013 Chevrolet Equinox- (27 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$30,240.00	2025		
702	2015 Chevrolet Silverado 1500- (21 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$31,860.00	2027		
703	2015 Chevrolet Silverado 1500-(21 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$34,290.00	2030		
705	2009 Ford Ranger- (23.5 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$27,810.00	2021		

719	2015 Chevrolet Silverado 1500-(21 MPG) transition to Hybrid	reduce fuel consumption	+	2 MTCO2e	$32,670.00	2028	
901	2012 Ford Escape-(25.5 MPG) transition to EV	reduce fuel consumption	+	2 MTCO2e	$40,120.00	2027	
902	2015 Chevrolet Equinox-(27 MPG) transition to EV	reduce fuel consumption	+	2 MTCO2e	$43,180.00	2030	
907	2012 Ford Escape-(25.5 MPG) transition to EV	reduce fuel consumption	+	2 MTCO2e	$40,120.00	2027	

Employee Commute

Project	Description	Outcome	Effect	Expected impact	Cost	Planned For	Payback Time	Notes
Alternative Transportation incentive	Rewarding employees who use alternative transportation to get to work: carpool, bus, walking, biking, etc.	Reduced fuel use	+	*/**		not currently planned		Cost will depend on what type of program is implemented. examples: https://www.bestworkplaces.org/pdf/carpool_June07.pdf
Telecommuting	Expand/make permanent some telecommuting where possible and practical; Could also consider split time positions such as 3 days in office/2 days telecommute	Reduced fuel use	+	*/**	$0-$250	not currently planned		Potential for supplementation of internet costs of permanent telecommute employees. For partial telecommuting, costs would be associated with a secondary work station.
	ghg impacts assessment							

Solid Waste Facilities

Project	Description	Outcome	Effect	Expected impact	Cost	Planned For	Payback Time	Notes
Sustainable Purchasing Guideline update	Update sustainable purchasing guidelines	Reduced landfill waste	+	*	staff time	not currently planned		This was intended to be updated every 2 years when it was adopted.
Improved Waste Tracking	track percent full of all trash containers at city facilities; Pair with occasional waste audits	Improved data set for determining actual waste generated; data can be used to adjust volume of container	+/-	*/**	$	not currently planned	immediate savings if reductions are determined	This would improve accuraccy of our greenhouse gas inventories as well as give us insight into how well our recycling program is working. Add to Energy Star Portfolio Manager.

Water & Wastewater Treatment Facilities

Project	Description	Outcome	Effect	Expected impact	Cost	Planned for	Payback Time	Notes
SE Booster ATS and MCC Project	Replacement, repair and modernization of water production, distribution and storage facilities. Includes the Well #6 backup power generator and automatic transfer switch installation.	Enahnce reliability, reduced maintenance/operational costs and reduced energy use/consumption	+	1	$225,000.00	2021		For every 3100 kW-hr saved
Moser & Vista Pressure Zone Intertie	Moser and Vista pressure zone interconnection- Installation of 550' of 8" water main from Third Street to Jansen	Installation of new pressur main to interconnect the Moser and Vista high pressure zones to allow the decommission of the Moser water booster station that is reaching end of life; Decommissioning should lead to decreased electrical consumption	+	8.7	$102,318.00	2023		Decommission of moser booster reduces the
Booster Stations Phase II	Replacing two below-grade booster stations located on Indian Hills Drive and Ponderosa Drive	Replacement of water boosters stations reaching end of life and unable to provide required fire flow for the fire suppression; increased pump efficiency could result in reduced energy consumption	+	1	$1,740,700.00	2021		for every 3100 kW-hr saved
Well #6 Generator/ATS Installation Project	Replacement, repair and modernization of water production, distribution and storage facilities. Includes the Well #6 backup power generator and automatic transfer switch installation.	Enhance reliability, reduced maintenance/operational costs and reduced energy use/consumption	+	1	$175,000.00	2021		For every 3100 kW-hr saved
Well #6 Building Replacement	Project includes the reconstruction of the Well 6 building which is structural deficient due to wood rot and deterioration within the building walls	Replacement of deteriorated well house building to maintain safe and sanitary operating conditions; reduced energy consumption for heating but increased energy consumption for cooling	+/-	*	$225,000.00	2021		Too many variables to determine exact impact.
Well #10 Phase II	Development of Well #10 includeing the installation of pump, controls, backup power generation and all supporting systems and structures	Development of additional water source supply to meet State of Idaho production water source redundancy requirements	-	5.5	$1,411,630.00	2021		Because Well 10 is a redundancy of Well 9, its impact is expected to be minor due to the relatively small amount of energy required to maintain readiness and to heat/cool the building.
Well 2 & 3 Filter Plant Rehabilitiation	Project includes the rehabilitation of the sand filter system located within the Well 2&3 pump house. Project will include assessment of backwash water reclamation improvements to reduce water waste during backwash operations	Rehabilitation of existing sand filter system for wells 2 and 3 to maintain/improve water quality, allow continued use of recharging shallow aquifer source and reduce backwash water waste; reduced energy consumption due to reduced water consumption for backwash needs	+	1	$782,864.00	2026		For every 3100 kW-hr saved

South Lift Station Force Main Upgrade	Upgrade of south main force main new pressure main to allow for decreased velocities in the pipeline, lower pump hoursepower requirements, and pipeline redundancy which would allow continued lift station operation during pressure main maintenance or repair.	Reduced Horsepower requirements may reduce energy consumption	+	1	$600,000.00	2020		For every 3100 kW-hr saved
WRRF Phase V Project	Phase V improvements include treatment facility improvements to meet effluent discharge temperature standards to address current permit violations during warmer summer months. Options may include full land application or installation of chillers. It is anticipated to be largely funded with Revenue bond debt.	Chiller will increase energy consumption.	-	97	$$$$	2022/2024		For every 300,000 kW-hrs added
WRRF UV Treatment System Project	This project includes transition from chlorine disinfection to UV treatment to improve effluent to Class A to allow expanded effluent reuse and reduce residual chlorine levels	UV system will increase energy consumption, however eventual expanded reuse may reduce water pumping which decreases energy consumption	-/+	1	$5,375,666.00	2026/2028		For every 3100 kW-hr added
WRRF Energy Control and Supply Improvement Projects	This item includes various energy and controls repair, replacement and enhancements to increase energy conservation, redundancy and system controls; two parts	Reduced energy consumption	+	1	$220,000.00	2025/2027		For every 3100 kW-hr saved
Water Conservation Program	continued promotion and implementation of water conservation program to reduce water consumption	reduced energy consumption to pump water	+	1	$97,500.00	ongoing		for every 3100 kW-hr saved;
DOE SWIFT	Participation in SWIFT program through the Department of Energy which provides technical assistance to find energy efficiency improvements	reduced energy consumption; impacts tbd- dependent on energy savings elements identified	+		< $	2021-2022		Free program that could help staff identify energy conservation projects to be added to the CIP.
Solar Project: WRRF	install a solar array at the WRRF to help offset energy consumption; Options might include ground mounted system on site, ground mounted system	energy generation with reduced consumption from the grid	+	9 MTCO2e (avoided emissions)	$88,000.00	not currently planned		Based on 25KW system
Wind Project: WRRF	install wind turbine(s) to generate electricity to reduced consumption from the grid	energy generation to reduced consumption from the grid	+	3.2	$100,000.00	not currently planned	90 years at current prices	Based on a 10KW system which could produce up to 10,000 kWh per year; 2028

The Moscow Sustainable Environment Commission and US95-Thorncreek to Moscow

Status

The Idaho Transportation Board (ITD) has submitted a second application to the Army Corps for a permit under the Clean Water Act to begin construction. The Corps keeps asking ITD for more information to use in making a determination. At some point the Corps should issue a proposed decision – to grant the permit, to deny the permit, or to adjust ITD's plans. There should be a public comment period following this decision. We await notification of action and notice in the Federal Register. The Idaho Department of Environmental Quality has to weigh in as well.

The Clean Water Act permit does not address water and waterways alone. The Army Corps (under direction from the U.S. Environmental Protection Agency) essentially does its own Environmental Impact study (EIS). While this study seems to be focused primarily on water, as the name implies, other (environmental and non-environmental) impacts are reviewed as well. For instance, the tribal governments are again consulted and historical preservation issues are reviewed.

Usually, a determination of the "least environmentally damaging practicable alternative" (LEDPA) is made during the writing of the Final Environmental Impact Statement (EIS) under the NEPA process. For this project, that determination was postponed, to be done within the Clean Water Act permit process. It has been stated repeatedly in comments from various agencies and the public during the NEPA process that the eastern, E-2, alignment does not qualify as the LEDPA.

Some things that the City of Moscow should consider

It may seem that, as this project lies outside the current Moscow City limits, Moscow would not have much of a voice in the matter. However, it certainly affects the citizens of Moscow. And Moscow is growing to the South and likely will engulf some of this section of highway.

- Early on, designs required a truck escape ramp for alignment E-2 dropping into Moscow. No other alignments required a ramp. That requirement has silently disappeared, with no explanation that I have seen. This does not make the E-2 alignment appear to be safe.
- The E-2-Old US 95 junction at the south end of town will not have a traffic signal, and during every morning commute, 20% of the northbound traffic will be trying to make a left turn from old US 95 into the traffic that is racing downhill on E-2.
- Some agencies commented at the Draft EIS stage that E-2 does not comply with the either the Moscow or Latah County Comprehensive Plans ("States E-2 as being least compatible with the Moscow Comprehensive Plan" and "...we believe the DEIS needs to include a discussion of the conflict between the proposed action and both the City of Moscow and Latah County's master plans").

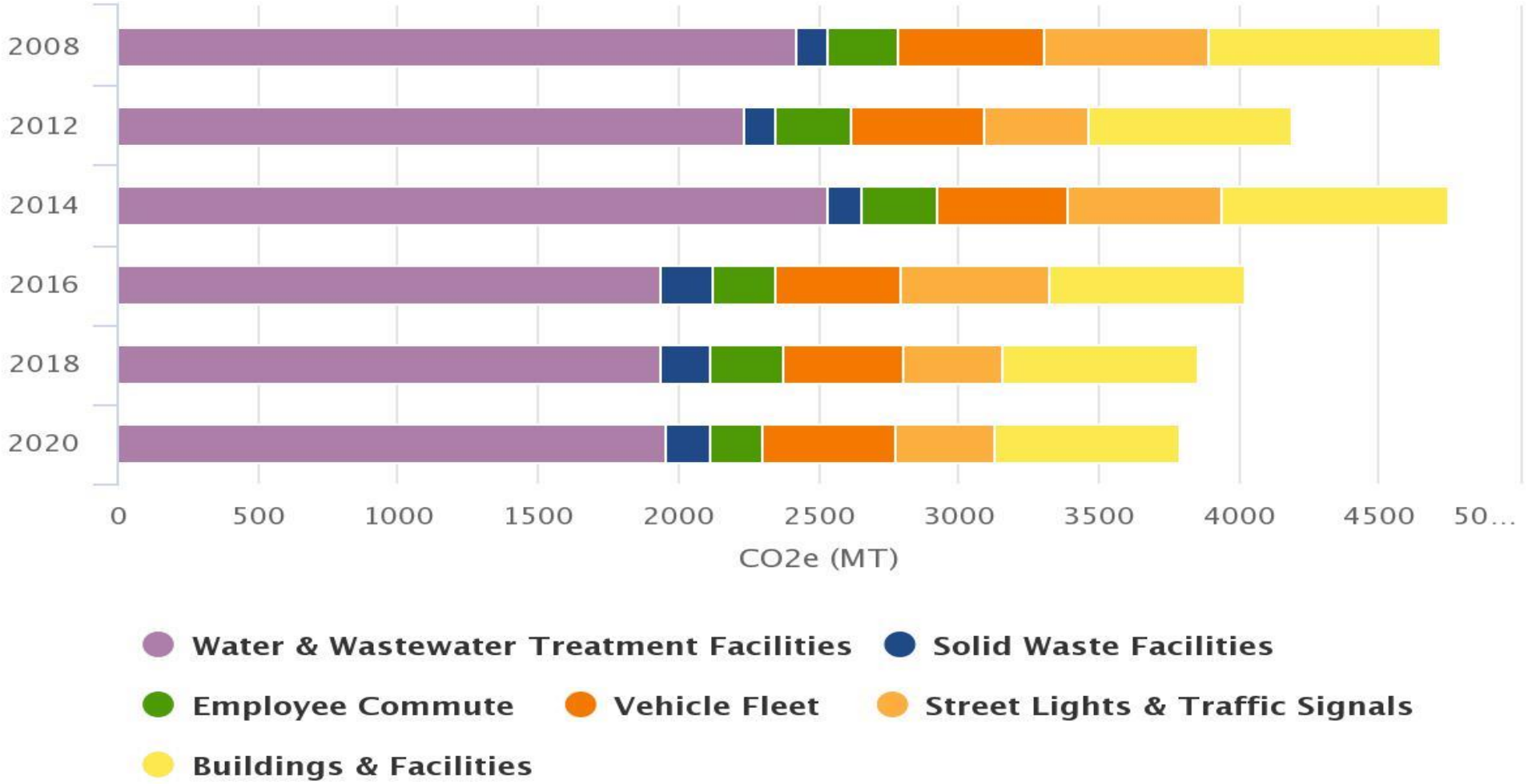
Moscow can can comment during the official comment period following the issuance of the Corps' decision. However, I'm sure that the City can comment before then as well. Early comments could lead the Corps along a better path.

David Hall, in response to a question from an SEC member at the December 15, 2020, SEC meeting

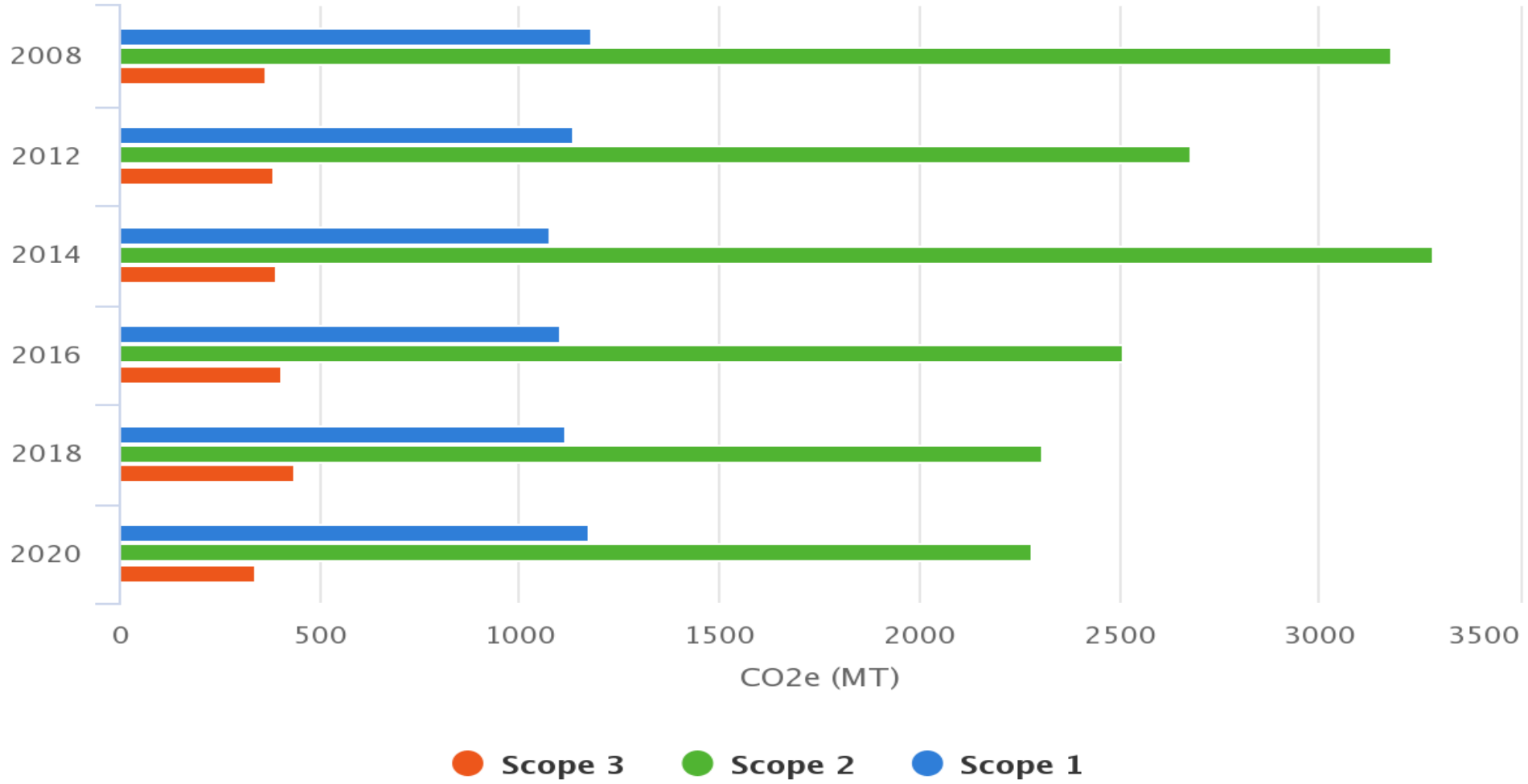
Greenhouse Gas Framework

Sustainable Environment Commission 3/16/2021

Inventories to Date



Comparison by Scope



Building the Framework

City of Moscow
Capital Improvement Program 2021-2030

Service Area:
Water

Department:
Water

Project Description:
Moser and Vista pressure zone interconnection - Installation of 550' of 8" water main from Third Street to Jansen.

Division/Program:
Water Line Improvements

Supporting Master Plan:
Comprehensive Water System Plan/Distribution Staff

Project Title:
Moser and Vista Pressure Zone Intertie

Project Number:
102-019

Project Need/Outcomes:
Installation of new pressure main to interconnect the Moser and Vista high pressure zones to allow the decommission of the Moser water booster station that is reaching end of life

Request Type:
New

Project Status:
Planned

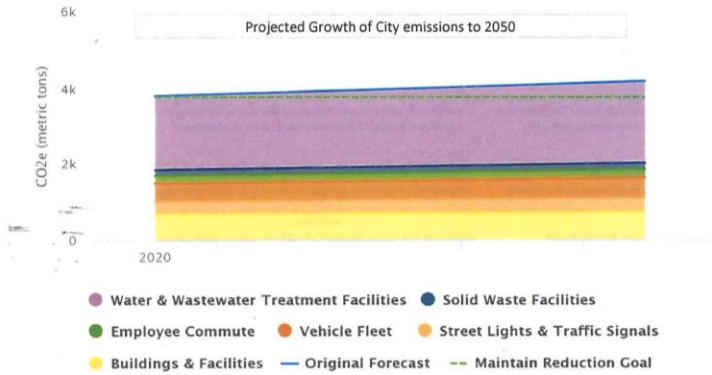
Project Cost Estimate: **Estimate Year:** 2019 **Construction Year:** 2023

Planning/Design:	$	City
Construction:	$ 90,908	$ 102,318

Projected Design Year: 2022 **Projected Construction Year:** 2023

	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030
Expenditure	$	$	$ 102,318	$	$	$	$	$	$	$
Revenue										
Capital Fund Accumulation	$	$	$ 102,318	$	$	$	$	$	$	$
General Obligation Debt										
Revenue Bond Debt										
State/Federal Grants										
Other Revenues										
Total	$	$	$ 102,318	$	$	$	$	$	$	$

Building the Framework



Planned & Potential Projects Key:

Effect
+ will reduce greenhouse gas emissions
- will increase greenhouse gas emissions

Expected Impact
* < 10 MT CO_2e
** 10 MT CO_2e < x < 80 MT CO_2e
*** 80 MT CO_2e < x < 120 MT CO_2e
**** > 120 MT CO_2e

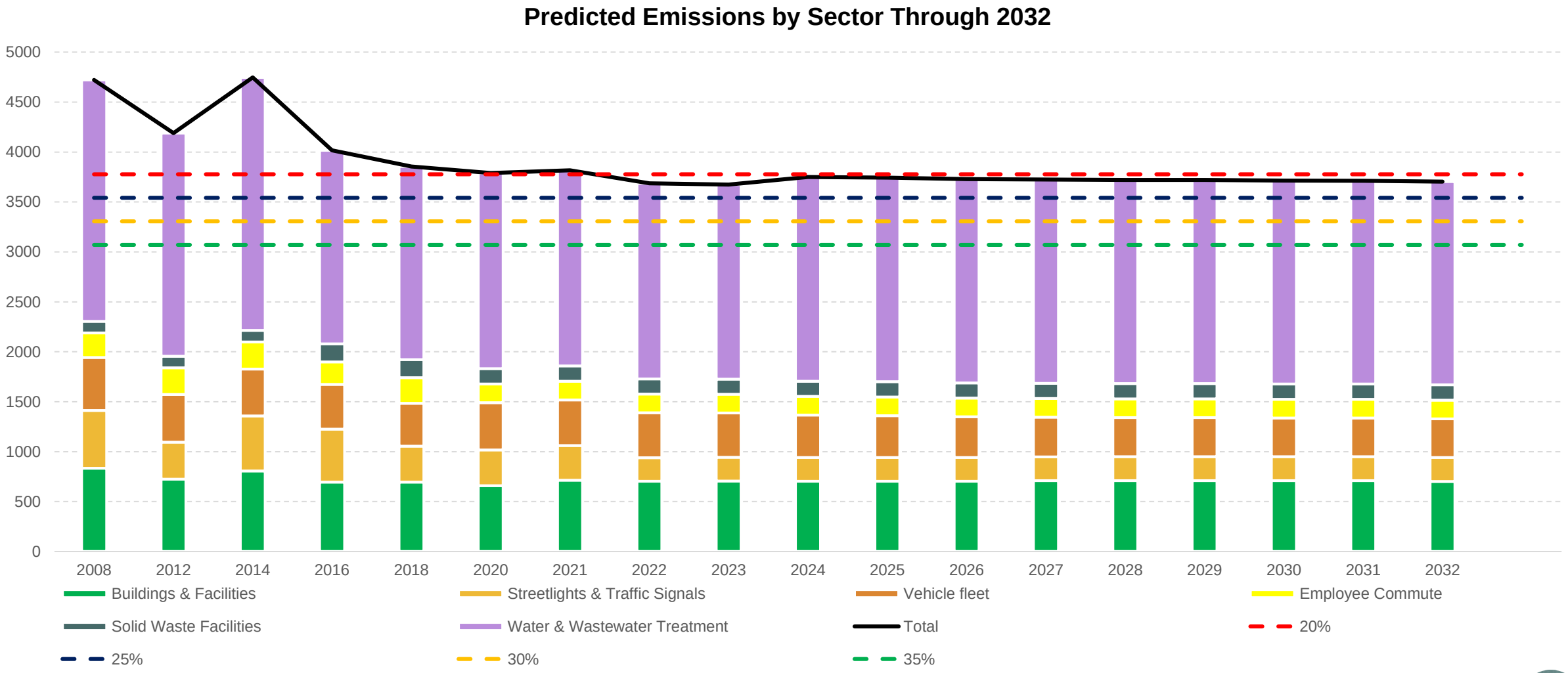
Cost
$ < $1000
$$ $1,000 - $99,999
$$$ $100,000 - $999,999
$$$$ $1,000,000 +

Planned and Potential Projects that affect emissions by sector

Buildings & Facilities

Project	Description	Outcome	Effect	Expected impact	Cost	Planned for	Payback time	Notes
Indian Hills Park Restroom	Installation of a single user precast restroom facility at Indian Hills Park and association utility and pathway connections	Addition of restroom facilities at park in accordance with the park masterplan development; increased energy consumption	-	3 MTCO2e	$132,220.00	2022/2023		assumes similar consumption of friendship square bathroom
Lola Clye Park Restroom Construction	Installation of single user precast restroom facilitiy at Lola clyde Park and associated utility and pathway connections	Addition of restroom facilities at park in accordance with the park masterplan development; increased energy consumption	-	3 MTCO2e	$155,579.00	2026/2027		assumes similar consumption of friendship square bathroom
Itani Park Restroom	Installation of single user precast restroom facility at Itani Park and associated utility and pathway connections	Addition of restroom facilities at park in accordance with the park masterplan development; increased energy consumption	-	3 MTCO2e	$155,579.00	2026/2027		assumes similar consumption of friendship square bathroom
HLAC Pool Heater Replacement	Replacement of the pool heaters at the Hamilton Lowe Aquatics Center	Maintenance of facilities amenities to maintain user recreation opportunities and experience; increased energy efficiency of heaters leads to reduced energy consumption	+	8 MTCO2e	$109,922.00	2032		increase heater efficiency by 5 percent- opt for the higher effiency model during next replacement
Police Services Facility Project	Construction of a new 15,300 sq ft Police Services Facility including a 3,000 square foot outbuilding, secured parking area and associated site improvements	Improved and more efficient police services delivery to the community	-	50 MTCO2e	$8,148,787.00	ongoing		Will depend on elimination of old facility and how much more efficient the new building is compare to the old one; at least a slight increase in emissions is expected due to doubling the floor space.
Haddock Building Remodel Project	Remodel of the 7500 sq ft Haddock Building to house the Community Planning and Design staff that are currently located in the Mann Building and The Annex buildings	Project will provide necessary office, conference, reception and storage space for the operations of the Community Planning and Design staff;	-	5 MTCO2e	$475,700.00	2021		Will depend on elimination of old facility and how much more efficient the new building is compare to the old one; at least a slight increase in emissions is expected due to doubling the floor space.
Mann Building Remodel Project	Remodel of the Mann Building to stabilize exterior masonry cracking, install a new roof and other minor renovations to accommodate the Information Systems Department Staff that are currently housed in the Eggan Youth Center	Building Stabilization and extension of serviceable life; impacts to ghg tbd	+	12 mtco2e	$79,303.00	2021		Most efficient building in the city as it is; after remodel it will be occupied by fewer staff as well.
City Hall- Roof Replacement Project	Replacement of the existing metal roof on City Hall	Maintenance/Extension of building life; impacts to ghg tbd	+	12 mtco2e	$140,000.00	2026/2027		opportunity for increasing energy effiency; opportunity for solar-ready roof or solar install.
HIRC Parking lot Replacement Project	Replacement of deteriorating parking lot paving at the HIRC	Maintenance/Extension of building life; potential solar project	+	**	$233,398.00	2021/2022		opportunty for groundmount solar that provides electricity to HIRC/HLAC, can also provide added value to rec center patrons by shading their vehicles.
HIRC HVAC Replacement Project	Replacement of HVAC system reaching end of serviceable life at the Hamilton Indoor Recreation Center	Maintenance/Extension of building life; upgraded HVAC efficiency reduces energy consumption	+	3 mtco2e	$123,806.00	2023/2024		opt for more efficient models to maximize benefit to ghg inventory
HIRC Roof Replacement Project	Replacement of roofing shingles reaching end of serviceable life at Hamilton Indoor Recreat Center	Maintenance/Extension of building life; potential increase in energy efficiency; potential solar project;	+		$415,962.00	2033/2034		opportunity for increasing energy efficiency; making the roof solar ready and/or installing rooftop solar; Also look into cool roofs

Forecast Based on Growth Projects



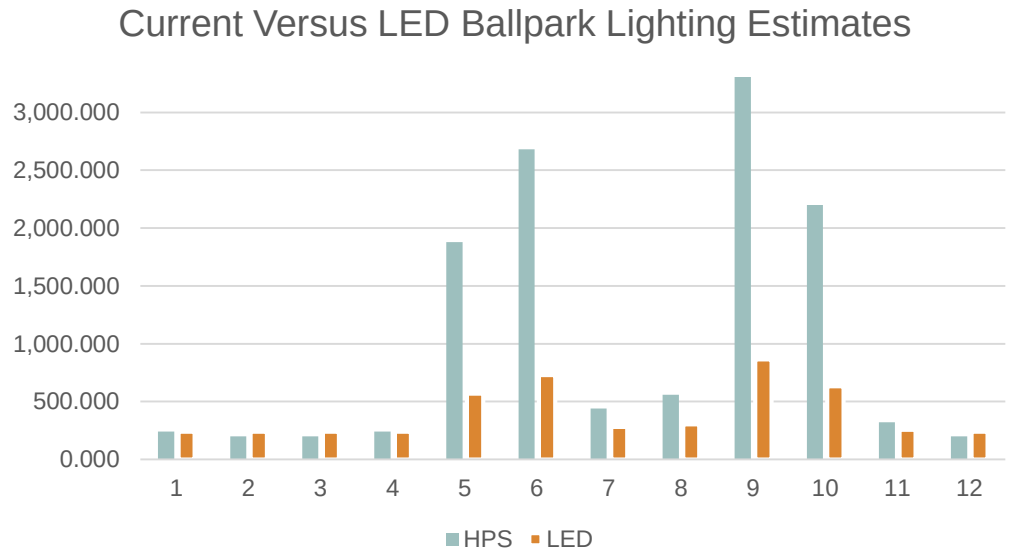
Potential Projects:
Buildings & Facilities

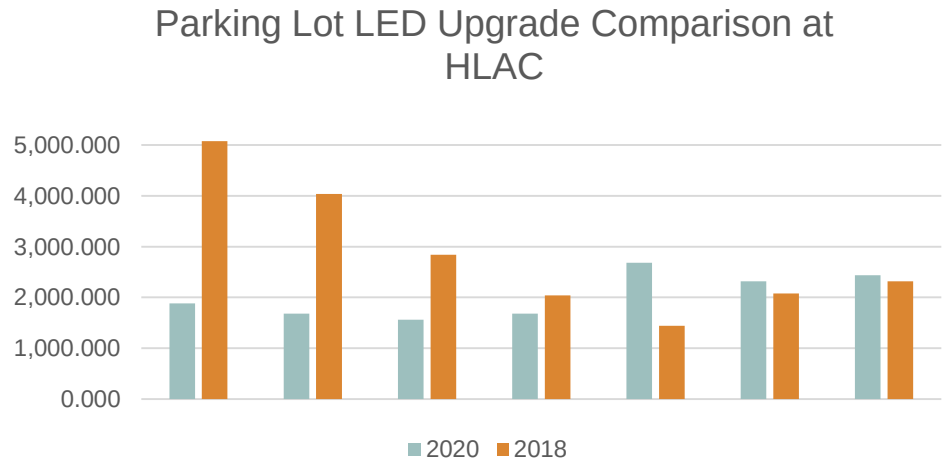
- Increased building efficiency
  - Complete any remaining LED retrofits
  - Complete building envelope assessments
    - Retrofits/repairs where needed and practical
  - HVAC systems
    - When upgrading, opt for higher efficiency units
- Solar installations
  - Evaluation of all City facilities, including park restrooms
  - Set percentage targets
- Wind
  - Where practical
  - May supplement solar

Potential Projects:
Buildings & Facilities

Facility	20% offset cost	GHG savings	40% offset cost	GHG savings	60% offset cost	GHG savings	80% offset cost	GHG savings
City Hall	$91,350	9.33 $MTCO_{2e}$	$184,800	18.67 $MTCO_{2e}$	$277,200	28.00 $MTCO_{2e}$	$351,750	35.53 $MTCO_{2e}$
Eggan Youth Center	$28,350	2.5 $MTCO_{2e}$	$57,750	6.04 $MTCO_{2e}$	$86,100	9.01 $MTCO_{2e}$	$115,500	12.08 $MTCO_{2e}$
Lena Whitmore Park	$4,200	0.43 $MTCO_{2e}$	$9,450	1.13 $MTCO_{2e}$	$13,650	1.64 $MTCO_{2e}$	$17,850	2.14 $MTCO_{2e}$

Potential Projects:
Streetlights & Traffic Signals





- Ballfield Lighting Upgrades
  - LED is up to 80% more efficient
- Parking Lot Lighting Retrofit or Replacement
  - Parks
  - Downtown

Potential Projects:
Employee Commute

- Telecommuting
  - Full time telecommute
  - Hybrid positions
- Alternative Transportation Incentive program
  - Carpooling
  - Biking
  - Walking

Potential Projects:
Solid Waste

- Sustainable Purchasing Guideline Update
  - Originally adopted in 2007
- Improved Waste Tracking Program
  - Facilitate Data-driven decisions
  - Refine and enhance our current recycling program

Potential Projects:
Water & Wastewater

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Department of Energy S.W.I.F.T Program
  - Technical assistance to identify energy efficiency improvements
- Solar Projects
  - Roof mount at wells 2,3,6,8,9,10
  - Ground mount or roof mounts at WRRF
- Wind Projects
  - WRRF
  - Supplemental at wells

Questions?

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