# Hamilton and Burlington Low-Carbon Scenario Summary 2016 to 2050

COMPLETED AS PART OF THE BAY AREA CLIMATE CHANGE OFFICE,
CENTRE FOR CLIMATE CHANGE MANAGEMENT AT MOHAWK COLLEGE
GREENHOUSE GAS INVENTORY AND FORECAST

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SSG SUSTAINABILITY SOLUTIONS GROUP

whatIf?

# TERMS AND ACRONYMS

| ACRONYM | DESCRIPTION |
|---|---|
| BAU | Business as usual |
| BF | Blast furnace |
| CDD | Cooling degree day |
| DMA | Data, methods and assumptions |
| GHG | Greenhouse gas |
| GJ | Gigajoule |
| HDD | Heating degree day |
| HELP | Home Energy Loan Program |
| ICI | Institutional, commercial and industrial |
| LC | Low-carbon |
| LIC | Local improvement charge |
| MWh | Megawatt hour |
| OBC | Ontario Building Code |
| PACE | Property assessed clean energy |
| PJ | Petajoule |
| PV | Photovoltaics |
| RNG | Renewable natural gas |
| TGS | Toronto Green Standard |

# CONTENTS

# A LOW CARBON FUTURE

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

This report summarizes the findings of a study to model low-carbon scenarios for Hamilton and Burlington, and to identify a pathway for the cities to meet their respective GHG emissions reductions goals.

Both Hamilton and Burlington are projected to grow over the study period (2016-2050), and this growth is accompanied by increased energy demands, employment, housing, and transportation. This growth underpins the analysis of both the Business-as-Usual (BAU) and the low carbon (LC) scenarios modeled for the cities.

A low-carbon future for both Hamilton and Burlington requires changes across all aspects of the community, including new and existing buildings, transportation, industry, and waste management. In order to model these changes, a catalogue of actions was developed, based on research of best practices of municipal actions. In total, 21 actions were identified for Burlington, and 23 were identified for Hamilton. These actions are modelled sequentially to maximize real-world interactions between them, and compared with the BAU scenario in order to identify the key actions that will help the Bay Area advance a low carbon future.

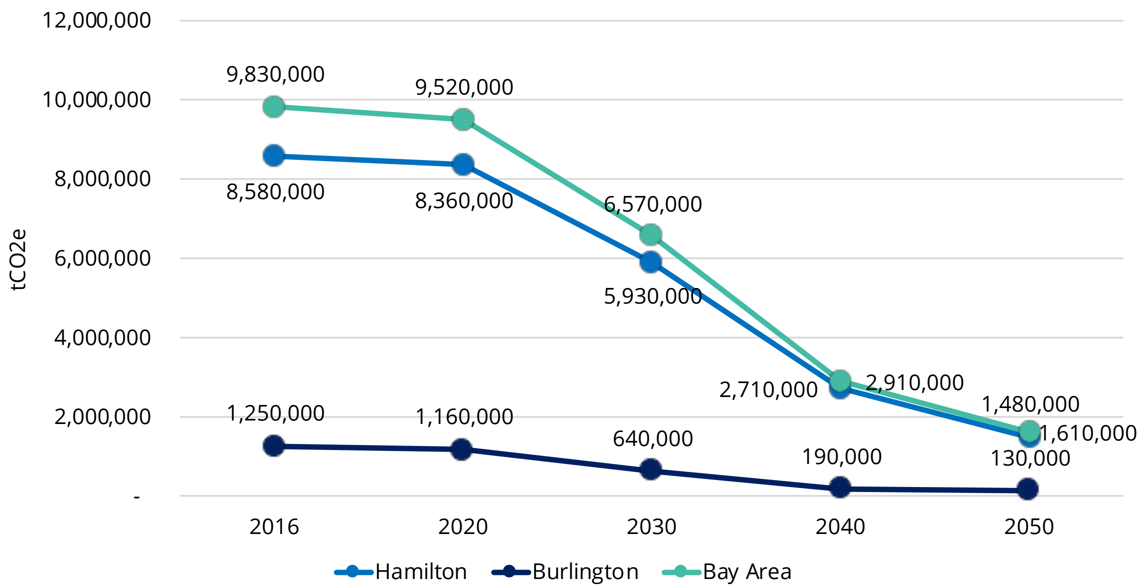


*Figure 1. GHG targets for the Hamilton, Burlington and the Bay Area.*

# BURLINGTON: A 90% DECREASE IN GHG EMISSIONS BY 2050

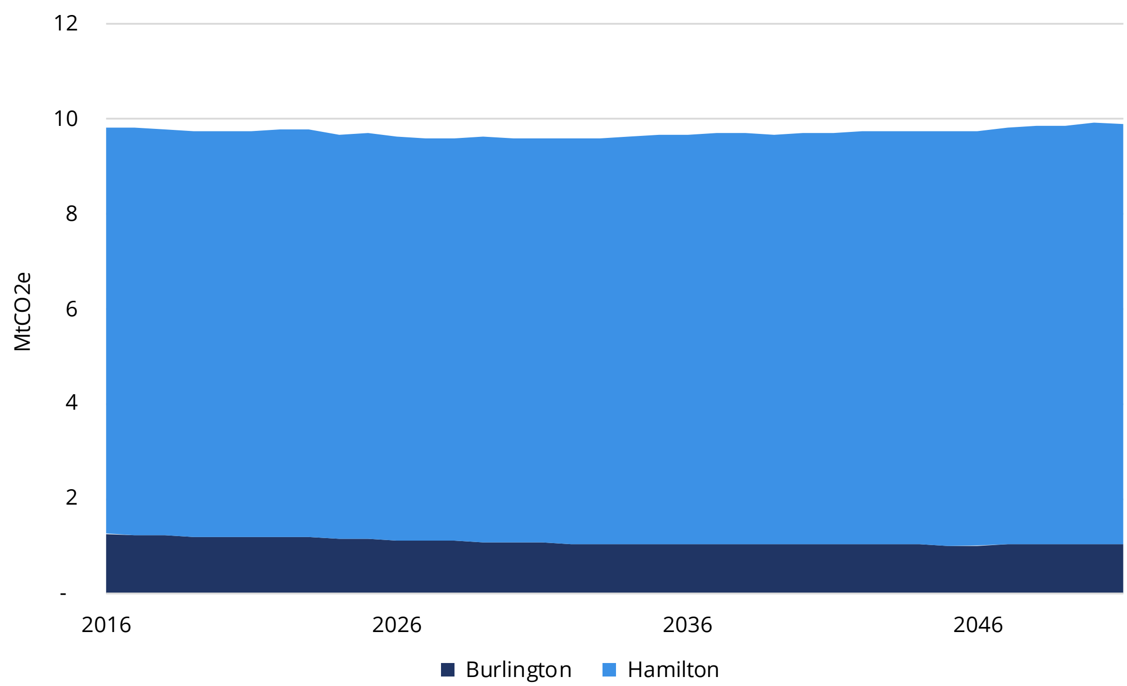


*Figure 2. Projected LC energy consumption (PJ) by sector, Burlington, 2016-2050.*

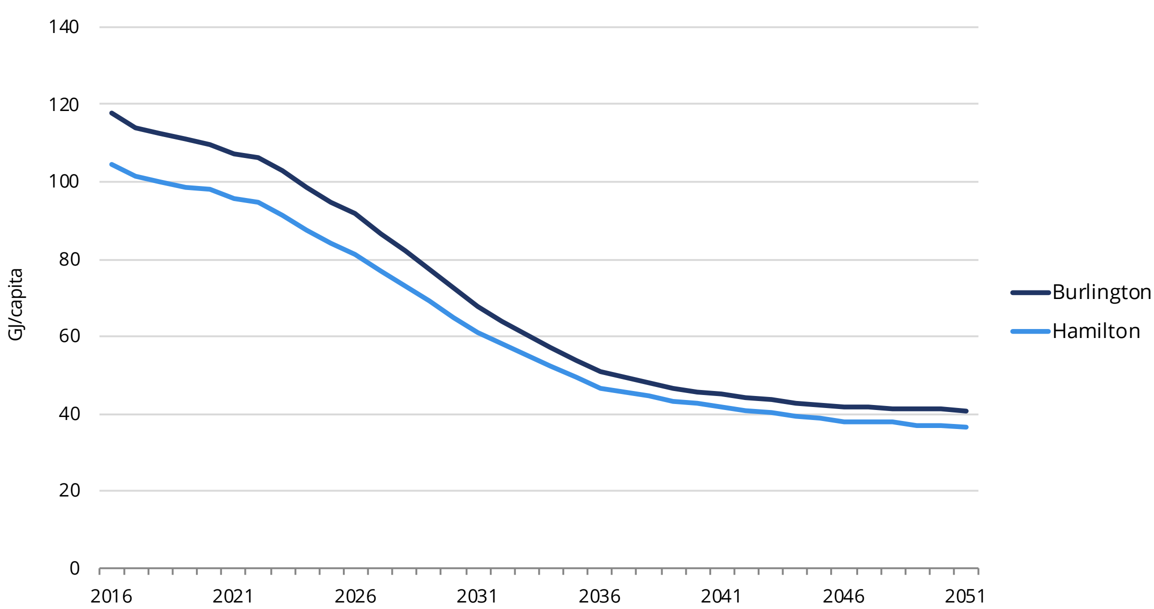


*Figure 3. Projected LC emissions ($MtCO_2e$) by sector in Burlington, 2016-2050.*

In the low carbon scenario, the largest reduction in energy use comes from the transportation sector (62% decrease over the BAU in 2050), followed by the residential sector (52% decrease over the BAU in 2050).

Improvements to vehicle efficiency standards drive some of the decrease in transportation energy use in the BAU scenario, but the majority of the energy savings are from the electrification of the personal and commercial vehicles. A smaller reduction occurs from reduced vehicle use as a result of an increase in transit use and walking and cycling.

Building retrofits, improvements in the efficiency of new buildings, increased use of heat pumps and solar hot water, and electrification all contribute to the reduction in energy use in homes.

## TOTAL GHG EMISSIONS DECLINE FROM 1.25 MILLION $tCO_2e$ IN 2016 TO 130,000 $tCO_2e$ IN THE 2050 LC SCENARIO, A DECREASE OF 90%.

All sectors show a reduction in GHG emissions ranging from 55% in waste, to 96% in transportation. Energy efficiency measures combined with the shift to electricity as a fuel source are the primary drivers of reductions in GHG emissions.

The low carbon scenario illustrates a shift from carbon-intensive fuel sources, specifically gasoline (42% of 2016 emissions) and natural gas (37% of 2016 emissions), to low or zero emissions sources. As a result of the shift to electricity, GHG emissions from electricity increase by 31% from 2016 to 2050 in the low carbon scenario.

# HAMILTON: AN 83% DECREASE IN GHG EMISSIONS BY 2050

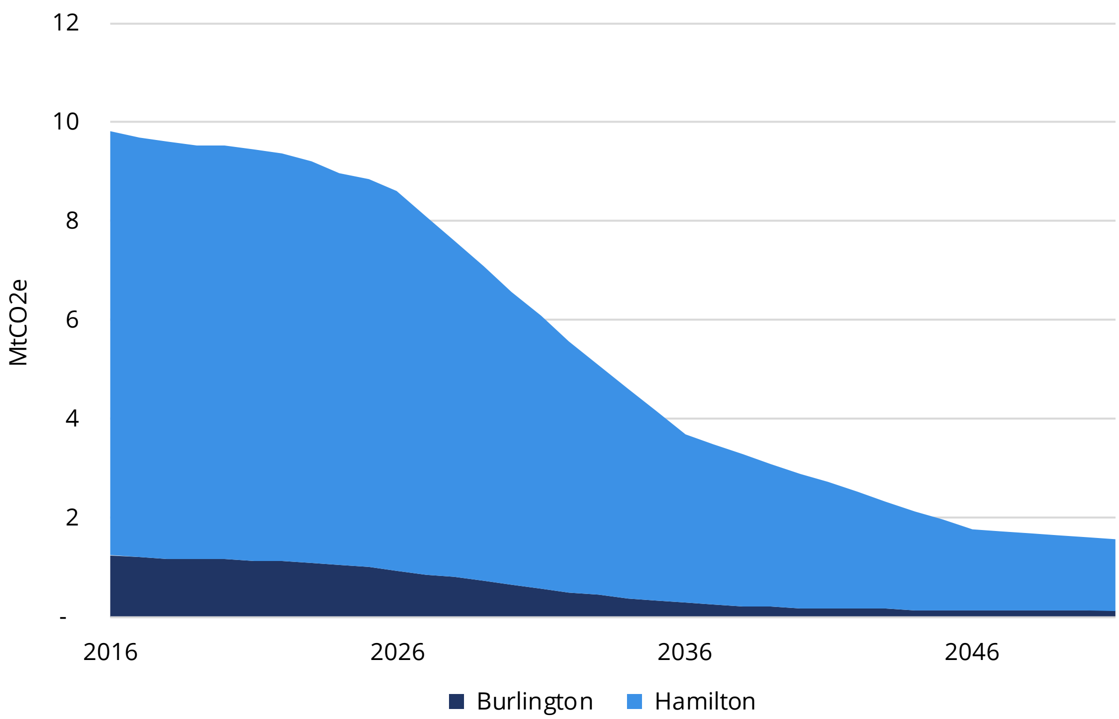


*Figure 4. Projected LC energy consumption (PJ) by sector, Hamilton, 2016-2050.*

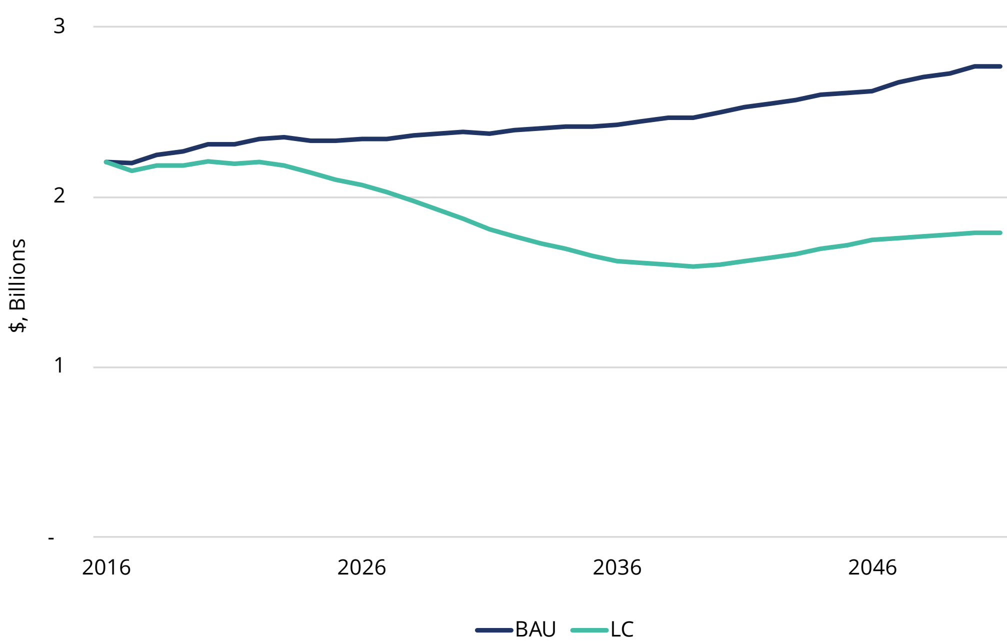


*Figure 5. Projected LC emissions ($MtCO_2e$) by sector in Hamilton, 2016-2050.*

Hamilton's energy use and GHG emissions are dominated by the steel industry. The industrial sector is the primary energy consumer in Hamilton, accounting for 63% of energy use in 2016. Efficiencies in this sector, including a switch to electric arc furnaces and increased use of lower carbon fuels, are the primary driver of the 40% decrease in energy consumption by 2050 in the LC scenario.

In the transportation sector, the majority of the energy savings are the result of electrification of personal and commercial vehicles and an increase in transit use and walking and cycling. Building retrofits, improvements in the efficiency of new buildings, increased use of heat pumps and solar hot water, and electrification of heating contribute to the reduction in residential energy use.

## TOTAL GHG EMISSIONS DECLINE FROM 8.6 $MtCO_2e$ IN 2013 TO 1.5 $MtCO_2e$ IN 2050 IN THE LOW CARBON SCENARIO, A DECREASE OF 83%.

All sectors except waste show a major reduction in GHG emissions ranging from 81% in industry to 94% in transportation. The waste sector shows an increase of 27% from 2016 to 2050 in the low carbon scenario, driven by population growth. This sector shows a reduction of 13% over the business as usual scenario because of reduced waste generation, and increased capture of methane.

The low carbon scenario illustrates a reduction in carbon-intensive fuel sources, specifically coal (50% of 2016 emissions), natural gas (30% of 2016 emissions) and gasoline (10% of 2016 emissions), and a switch to low or zero emissions sources. GHG emissions from electricity increase by 112% from 2016 to 2050 in the low carbon scenario because of the new electric loads in transportation and heating.

# THE COSTS OF ENERGY AND CARBON

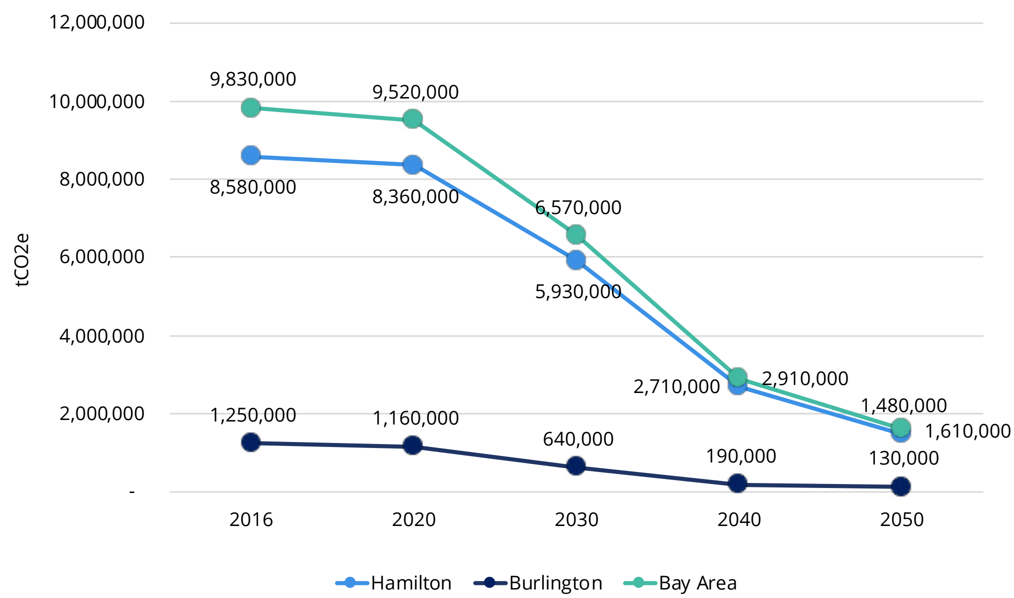


*Figure 6. Total energy expenditures for BAU and LC, Hamilton and Burlington, 2016-2050.*

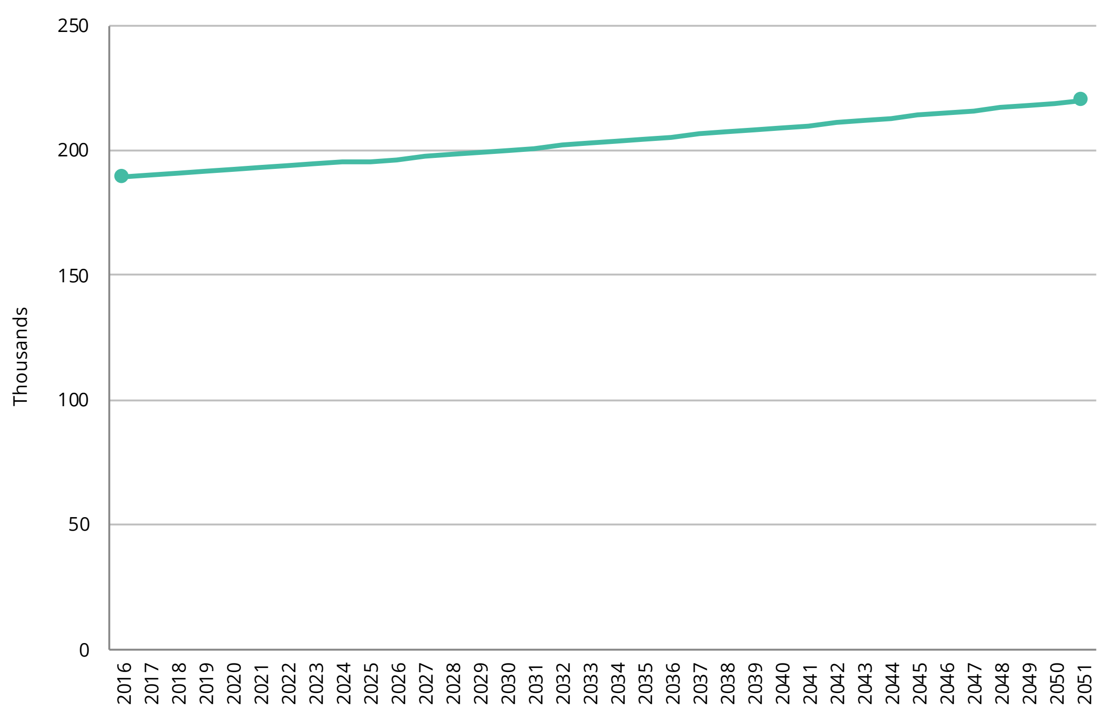


*Figure 7. Total costs of carbon emissions for BAU and LC, Hamilton and Burlington, 2016-2050.*

The transition to a low carbon economy represents is an economic opportunity. While many actions required to achieve a low carbon future will take investment, these expenditures are offset by savings in both the costs of energy, and in the costs of carbon emissions.

## IN MANY CASES, ACTIONS THAT REDUCE GHG EMISSIONS IN CITIES CORRESPOND OR DIRECTLY OVERLAP WITH ACTIONS THAT CREATE A VIBRANT COMMUNITY, IMPROVE PUBLIC HEALTH OUTCOMES, REDUCE MUNICIPAL OPERATING AND CAPITAL COSTS, AND SUPPORT INNOVATION; THESE ARE NO-REGRETS POLICIES.

Actions that reduce GHG emissions are synergistic with a wide range of other public goods, and in fact, these actions can be justified from the perspective of health or economic development outcomes. One review of more than a dozen studies on GHG mitigation policies found that the co-benefits of reduced air pollution—a single co-benefit—often equaled or exceeded the benefit of the GHG reduction itself.

The low carbon scenario will require a major effort by the municipalities, businesses and other partners in the Bay Area. This effort will lead to dramatically reduced GHG emissions, lower energy costs for households and businesses, the creation of new businesses, reduced air pollution and improved quality of life.

*Table 1. BAU and Low-Carbon actions and assumptions for the Bay Area*

| BAY AREA | BAU ASSUMPTION | LOW-CARBON 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 OBC levels of performance. | Incrementally increase the number of buildings that achieve Passive House levels of performance to 100% by 2030. |
| 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. |
| 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. |
| Solar 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 and 10% for multi-unit and commercial buildings. | 80% of all buildings by 2050 have solar PV systems that provide on average 30% of consumption for building electrical load for less than 5 storeys and 10% for multi-unit buildings greater than 5 storeys and commercial buildings. |

| BAY AREA | BAU ASSUMPTION | LOW-CARBON ASSUMPTION |
|---|---|---|
| Solar PV - ground mount | 0.5 MW per year between 2018 and 2050: ~20 ha. | 5 MW per year between 2018 and 2050: ~120 ha. |
| District Energy | N/A | 16.3 MW of district energy capacity added to the commercial and institutional buildings in the downtown core. |
| Energy storage | No storage deployed. | 250 MWh by 2050. |
| Renewable natural gas | No additional production. | Local production is maximised and additional renewable natural gas is imported to displace natural gas consumption in buildings. |
| **TRANSPORTATION** | | |
| Expanded transit | Transit mode share remains constant. | Transit mode share increases to 5% of internal trips. |
| Active modes | Walking and cycling mode share remains constant. | Active mode share increases to 10% of internal trips. |
| Electrify transit system | No additional electrification. | 100% of the transit system is electric by 2030. |
| Electrify municipal fleet | No additional electrification. | 100% of the fleet is electric by 2030. |
| Electrify personal vehicles | ~5% of personal use vehicles are electric by 2035; 10% by 2050. | 100% of new personal use 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 |
| **INDUSTRY* Hamilton Only** | | |
| Industrial efficiencies* | Baseline efficiencies are held fixed. | Increase process motors and electrical efficiency by 50% by 2050 |
| Steel industry production and inputs* | Production and inputs are held fixed | Production of steel is maintained at current levels (almost 4 million tons crude steel per year), but two out of three blast furnaces are shut down (one in 2030 and one in 2040) and production is moved from blast furnaces to electric arc furnaces. One blast furnace is still operating in 2051, and the electric arc furnaces are charged with 70% scrap/30% hot metal. Fuels in this case shift away from coal, coke, oil, to more natural gas and electricity. |