

GREENHOUSE GAS MANAGEMENT PLAN

**2019–2030
CIVIC OPERATIONS
SUMMARY REPORT
FOR POLICY MAKERS**

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Edmonton

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CONTEXT

Climate change has emerged as the next unprecedented social, economic, and environmental challenge facing society today. It poses a serious threat to quality of life, jobs, and the physical and natural assets. Scientists believe that the human-induced production of greenhouse gas (GHG) emissions since pre-industrial times have already surpassed the Earth's "carrying capacity" of natural systems, and pose significant future risks to human well-being. As such, if GHG emissions are not reduced soon, human society is expected to be impacted by more floods, wind-storms, heat waves, and wildfires which can erode social systems, impact natural resources, and limit the ability to respond and recover. Furthermore, climate change impacts are expected to have serious negative effects on global economic growth and development.

PARIS AGREEMENT

The Paris Agreement is an agreement within the United Nations Framework Convention on Climate Change (UNFCCC) dealing with greenhouse gas emissions mitigation, adaptation and finance starting in the year 2020. The language of the agreement was negotiated by representatives of 196 parties (including Canada) at the 21st Conference of the Parties of the UNFCCC in Paris and adopted by consensus on 12 December 2015.

Analysis conducted as part of the development of Edmonton's Adaptation and Resilience Plan suggests that Edmonton will not be immune to these climate impacts. Data already suggests that average winter temperatures in the Edmonton region have increased approximately four degrees celsius over the last 100 years and as the globe, including Edmonton, continues to emit greenhouse gases at the rate it currently is, that trend is expected to continue. Even to update Edmonton's drainage infrastructure to accommodate recent changes in the observed precipitation patterns is expected to cost in the range of \$2.6 billion. Expected local environmental and economic impacts do not end there, further fuelling the need to urgently address the global emissions loading and for Edmonton to take leadership action to reduce its own carbon footprint.

At the same time, there is great opportunity in advancing a low carbon world; increased economic diversity, utility savings, more efficient operations, clean energy and air; and comfortable, durable buildings.

City Council has acknowledged the urgency of addressing climate change through the unanimous support of Edmonton's Community Energy Transition Strategy in 2015. The Community Energy Transition Strategy outlines over 150 actions that can be taken to reduce Edmonton's overall community greenhouse gas footprint with a target of reducing emissions 35% below 2005 levels by 2035. As part of the Community Energy Transition Strategy, the City

commits to leading climate change action by investing in deep carbon reductions in its civic operations.

City Council has reiterated its commitment to taking a leadership role in climate change mitigation when it signed on to the Global Covenant of Mayors. The Global Covenant of Mayors for Climate & Energy is an international alliance of cities and local governments with a shared long-term vision of promoting and supporting voluntary action to combat climate change and move to a low emission, resilient society. By committing to the Covenant, Edmonton is required to set targets, create concrete action plans to achieve those targets, and maintain monitoring, measuring and reporting mechanisms to ensure it is on track to the achievement of the goals.

Recently, Edmonton City Council has advanced even further in its commitment to the achievement of a low carbon future when it led the development of the Edmonton Declaration. This protocol document was an agenda item at an international Mayor's Summit held immediately prior to the Intergovernmental Panel on Climate Change's first ever **Cities and Climate Change Science Conference** that occurred in Edmonton in March 2018. Among other things, the Edmonton Declaration is a call to action for Cities to look at developing and implementing plans that are aligned with the Paris Agreement target of reducing emissions to a level that will maintain global average temperature increases to 1.5 degrees Celsius.

PAN CANADIAN FRAMEWORK

To demonstrate Canada's commitment to the Paris Agreement, the federal government led the collaborative development of The Pan Canadian Framework for Clean Growth and Climate Change – a collective plan to grow the economy while reducing emissions and building resilience to adapt to a changing climate. The plan aims to reduce greenhouse gas emissions by 30% below 2005 by 2030 and was endorsed by eight provinces (including Alberta) and three territories in fall 2016.

more than what is outlined by the federal government in the Pan Canadian Framework for Clean Growth and Climate Change as well as what has been outlined in the first two scenarios of this plan. As new courses of action emerge and innovations enter the marketplace, continuous evaluation of the GHG management plan will occur with advice provided by stakeholders. The long term goal of carbon neutrality must continue to underlay decisions being made in the evolution of this plan as it is implemented.

The following document presents three possible GHG reduction pathways and highlights the recommended approach noted above.

With this context in mind, Edmonton embarked on the development of an updated Greenhouse Gas Management Plan for its civic operation. The plan identifies the significant opportunities there are to both reduce carbon emissions while also maximizing the return on the financial investment through utility savings. The result is a re-imagining of both how it manages its civic assets as well as the infrastructure it is investing in including a critical look at evaluating the sources of its electricity and how greener, cleaner sources might be procured.

Past policy directions recognize Council's wishes to take a leadership role in setting and pursuing targets that are nation leading with respect to climate change. This document outlines three scenarios and recommends that The City of Edmonton pursue **Scenario 2: The Accelerated Pan Canadian Scenario**: which outlines a pathway and commits The City of Edmonton to reduce GHGs by 50%, below 2005 levels, by 2030. Through deep analysis the actions outlined under this scenario have been confirmed to be both achievable and cost effective while also leading to deep carbon reductions in civic operations. Attaining the GHG reductions outlined in Scenario 2 will require the City's civic operations to reduce their GHG emissions by 237,000 tonnes of carbon dioxide equivalent (tCO₂e). This would be accomplished by leveraging energy efficiency and GHG reduction opportunities in five key areas: building energy retrofits, street lights, solar/PV tied to city buildings, electric busses, and through green electricity purchases.

It is acknowledged that the achievement of reductions coincident with the Paris Agreement will likely require

GREENHOUSE GAS QUANTIFICATION METHODOLOGY

Calculating corporate municipal GHG emissions can be complex due to the wide variety of how City services are delivered, and by who delivers them (e.g. contractors). To be relevant, GHG inventories must reflect the operations of a City and the way in which it interacts with the community. At the same time, it is important that the analysis conforms to international standards for reporting to ensure consistency and comparability. To this end, the City's 2016 corporate GHG inventory has been prepared in accordance with The Climate Registry (TCR) General Reporting Protocol (Version 2.1, January 2016), an internationally recognized best practices guidance document (herein referred to as the Protocol) for preparing GHG inventories. This inventory was used to estimate future year GHG emissions for the purposes of setting an appropriate GHG reduction target for the City.

Following the Protocol, an "operational control" approach was used to identify which GHG emission sources the City has operating control over, and thus should be included in the GHG inventory. For example, although the Protocol identifies wastewater and water treatment as an operational aspect of a City, these GHG emission sources are not included in Edmonton's GHG inventory as the responsibility for these operations fully resides with EPCOR. Should the City wish to influence EPCOR's performance in this area, it would be through its role as shareholder and not through its GHG management plan. Table 1 shows the sectors in which data was compiled and reported for the City's GHG emissions inventory.

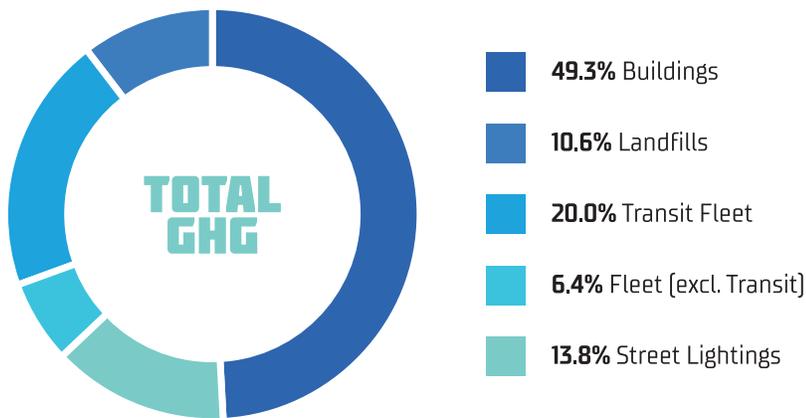
Table 1. City Reporting Sectors

REPORTING CATEGORY	EMISSION SOURCES
 Buildings and Other Facilities	Includes stationary and fugitive emissions (air conditioning refrigerants) as well as GHG emissions from electricity
 Streetlights	Includes GHG emissions from electricity related to street lighting, and traffic lights, including crosswalk signals, pathway lighting, etc.
 Vehicle Fleet	Includes mobile combustion and fugitive emissions (air conditioning refrigerants) as well as GHG emissions from electrified mobile equipment operated by the City
 Transit Fleet	Includes mobile combustion and fugitive emissions (air conditioning refrigerants) as well as GHG emissions from electricity for electrified transit equipment operated by the City (e.g. LRT)
 Solid Waste	Includes stationary and fugitive emissions as well as GHG emissions from electricity use at City owned/operated landfills and disposal facilities

2016 CORPORATE GHG EMISSIONS PROFILE

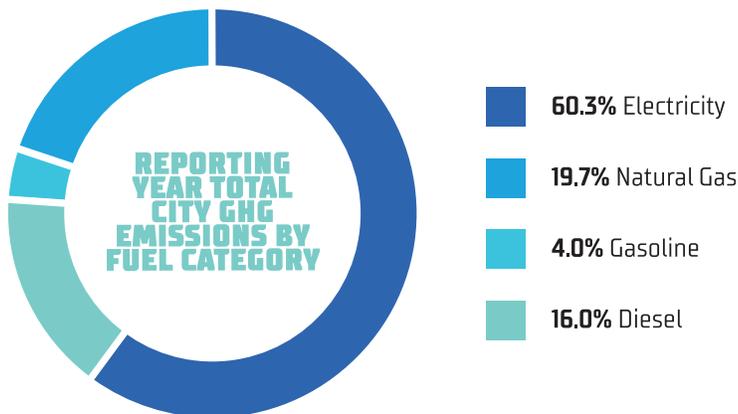
For the 2016 reporting year, approximately 49% of the City's corporate GHG emissions came from buildings and facilities like recreation centers and pools; 26% came from transportation which includes corporate service vehicles as well as transit fleet; 14% came from the operation of streetlights and traffic signals; and, 11% came from the decomposition of waste at City operated landfills (Figure 1).

Figure 1. GHG Emissions By Sector



In 2016 more than 40% of Alberta's generation capacity was natural gas-fired and 51% was coal-fired. This led to over 60% of the City's corporate GHG emissions to come from electricity use in buildings, and to power streetlights and transit vehicles (LRT) (Figure 2). Diesel and gasoline used in the operation of fleet, equipment, and other transit vehicles accounted for 23% of the GHG inventory. Lastly, natural gas use to heat buildings contributed 16% to the total GHG inventory.

Figure 2. GHG Emissions by Fuel Source



PATHWAY TO CLIMATE ACTION

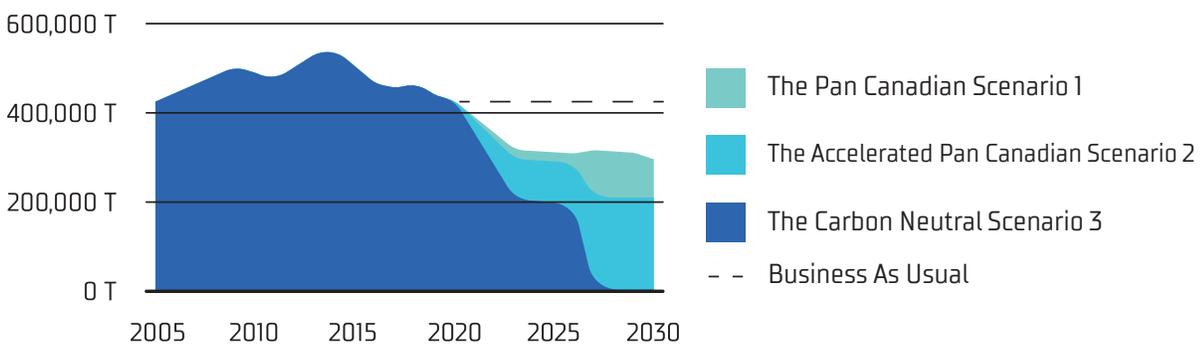
CURRENT APPROACH TO ADDRESSING CORPORATE EMISSIONS HAS FALLEN SHORT

Between 2005 and 2016, corporate GHG emissions have increased by 24.7%. This increase in GHG emissions is not atypical for many Cities during this period; emissions increase as City services expand to meet the needs of a growing population. However, if absolute targets are to be achieved, the future state requires the reduction in emissions to occur at a faster rate than the growth of emissions. While many GHG reduction projects are currently underway, the City's population is growing and is projected to increase by more than 20%¹ by 2030. As Edmonton's population grows the demand for civic services will also increase and will result in increased GHG emissions. Based on the City's current pace, Edmonton's corporate GHG emissions are projected to only grow 6% by 2030. The relatively low forecasted increase is attributable to the expected reduction in carbon intensity of the Alberta grid. Without the savings resulting from the province's greening grid the City's emissions would grow significantly more than 6%.

To reduce the City's civic operations GHG emissions, significant action must be taken to improve energy efficiency, increase renewable and low-carbon fuel sources on-site, and a commitment to procure green electricity. To assess the potential GHG reductions and financial implications of the actions available to Edmonton, this report forecasts a "Business as Usual" (BAU) GHG emissions to 2030, and explores three GHG reduction scenarios to estimate what the City's GHG profile would look like in 2030 after a series of actions were implemented (see Figure 3). The three reduction scenarios are:

- **Scenario 1: The Pan Canadian² Scenario** where we achieve a 30% reduction in 2005 GHG emissions by 2030
- **Scenario 2: The Accelerated Pan Canadian² Scenario** where we achieve a 50% reduction in 2005 GHG emissions by 2030
- **Scenario 3: The Carbon Neutral Scenario** where we achieve carbon neutrality for all of City operations by 2030

Figure 3. Trajectory of GHG Emission Reduction Scenarios Relative to Business As Usual



1. Interpolated from from Capital Region Growth Plan (2016)

2. Pan Canadian: refers to alignment with the Government of Canada's Pan Canadian Framework for Clean Growth and Climate Change's 2030 target.

CARBON-NEUTRAL

Refers to achieving net zero carbon emissions by balancing a measured amount of carbon released with an equivalent amount sequestered or offset, or buying enough carbon credits to make up the difference.

The three reduction scenarios feature a variety of technologies, policies, and strategies such as:

- City-Owned Building Energy Efficiency Retrofits
- Installation of Microgeneration Solar Photovoltaics on City-Owned Buildings & Properties.
- LED Street Light Replacements
- Purchase of Electric Busses to Replace Diesel Powered Busses
- Purchase of Renewably Generated (Green) Electricity.

There is a high value in using a mixed portfolio approach. While operational improvements are important for decreasing the overall GHG production of the City's civic operations, there are limitations to GHG savings that can be obtained while maintaining current, as expected service levels and structural safety of facilities. Purchasing renewable electricity provides the City with

a strong pathway towards GHG reduction targets while supporting the development of the local renewable energy industry (both in the Edmonton region but also in the greater Alberta context).

The GHG reduction impacts on an absolute and per person basis, for each of the Scenarios, are presented in the following table.

Table 2. Summary of GHG Planning Scenarios

VARIABLE	BUSINESS-AS-USUAL (BAU) SCENARIO	THE PAN CANADIAN SCENARIO	THE ACCELERATED PAN CANADIAN SCENARIO	THE CARBON NEUTRAL SCENARIO
GHG Required Reduction by 2030 from 2005 levels Target [%]	None	30%	50%	100%
Total estimated GHG Reductions by 2030 (tCO2e) from proposed City Initiatives*	29,500	151,200	247,000	452,300

*the total tCO2e will be reducing by other means at the same time as the City works on their initiatives, these include reduction in emissions from closed landfills, and the greening of the grid. These values are closely aligned with the targeted % values.

Each of the following scenarios presented below are supported by the best available data and information on capital requirements, lifecycle cost benefit analysis, and further informed by extensive input and advice from City project planning, design, engineering, and project delivery staff.

Table 3. Impact of Actions in GHG Planning Scenarios (Totals over three budget cycles (2019-30))

GHG REDUCTION TARGET SCENARIO

	THE PAN CANADIAN SCENARIO (TONNES GHG REDUCED)	THE ACCELERATED PAN CANADIAN SCENARIO (TONNES GHG REDUCED)	THE CARBON NEUTRAL SCENARIO (TONNES GHG REDUCED)
 Building Retrofit	45,000	45,000	60,000
 Solar PV	10,000	10,000	15,000
 LED Street light	5,500	5,500	5,500
 Electric Bus	17,800	17,800	17,800
 Green Electricity	72,900 (50% of Electricity Consumption)	169,000 (100% of Electricity Consumption)	159,000 (100% of Electricity Consumption)
 Green Natural Gas	-	-	49,000
 Carbon Offsets	-	-	136,000
Total	151,200	247,000	452,300

THE 'BUSINESS-AS-USUAL' (BAU) SCENARIO

The core BAU forecast uses the City's most recent GHG emissions inventory (2016) and is driven by the anticipated increase in Edmonton's population. The BAU forecast assumes the following GHG reduction initiatives are already underway:

- Implementation of the new C532 Sustainable Building Policy, on 20-30 buildings, which requires a minimum 40% improvement in energy use as compared to the current building code
- Completion of a one time \$9 Million energy retrofit to City-owned buildings over 2015-18 budget
- Installation of on-site photovoltaic energy generation capacity on 20-30 City owned buildings and sites (equivalent to 1% of total corporate electricity use)
- Continued conversion of street light fixtures to LED (approximately 12,000 units)
- Deployment of 40 electric busses before 2023
- Waste diversion would be 90% prior to 2030.

Two other factors not directly related to City interventions include the year over year decrease in landfill gas emissions from the City operated landfills that are closed and the expected decrease in the carbon intensity of the provincial electricity grid due to the phasing out of coal plants and developing more renewable energy.

The resulting BAU forecast shows that corporate GHG emissions by 2030 are expected to be 6% higher than in 2005.

As noted, although the lowest cost option, the BAU scenario will result in an absolute increase in GHG emissions and results in missed energy reduction and cost-efficiency opportunities.

THE 'PAN CANADIAN' GHG REDUCTION SCENARIO

The Pan Canadian scenario reflects the City's current infrastructure, and incorporates the already planned changes that are expected to occur in the BAU scenario. This scenario captures many initiatives that Edmonton plans to implement, but has not yet due to a lack of available capital, resources, etc. Most notably, this scenario gets the City to a 30% reduction in GHG emissions below 2005 levels by 2030. The scenario is based on the following assumptions (in addition to the BAU assumptions noted in the prior section):

- Implementation of energy retrofits in 100 buildings
- Expansion of the solar PV program to achieve 20 MW capacity (equivalent to 6% of total corporate electricity use)
- Purchase of 440 electric buses to replace diesel busses
- Aggressive conversion of street light fixtures to LED (approximately 46,000 units).
- Purchase renewable electricity for up to 50% of corporate electricity consumption.

THE 'ACCELERATED PAN CANADIAN' GHG REDUCTION SCENARIO

The Accelerated Pan Canadian scenario provides a 50% reduction in GHG emissions below 2005 levels by 2030. This is obtained through the same tactics as the Pan Canadian Scenario with a change in the amount of purchased renewable electricity. The scenario is based on the following assumptions (in addition to the BAU assumptions noted previously):

- Implementation of energy retrofits in 100 buildings
- Expansion of the solar PV program to achieve 20 MW capacity (equivalent to 6% of total corporate electricity use)
- Purchase of 440 electric buses to replace diesel busses
- Aggressive conversion of street light fixtures to LED (approximately 46,000 units).
- Purchase renewable electricity for 100% of corporate electricity consumption.

THE 'CARBON NEUTRAL' GHG REDUCTION SCENARIO

This last scenario builds upon the 'Accelerated Pan Canadian Scenario' and further reduces the remaining tonnes through increased savings in building energy retrofits, increased PV installations on City owned buildings, the purchase of renewable natural gas to offset 100% of natural gas use in buildings, and purchase carbon offsets to address remaining GHG emissions from vehicle fleets. Most notably, this scenario gets us to a 100% reduction in GHG emissions below 2005 levels by 2030.

The scenario is based on the following assumptions (in addition to the BAU assumptions noted previously):

- Implementation of energy retrofits in 135 buildings
- Expansion of the solar PV program to achieve 30 MW capacity (equivalent to 9% of total corporate electricity use)
- Purchase of 440 electric buses to replace diesel busses
- Aggressive conversion of street light fixtures to LED (approximately 46,000 units).
- Purchase renewable electricity for 100% of corporate electricity consumption.
- Purchase renewable(green) natural gas for 100% of corporate gas consumption.
- Purchase carbon offsets to address remaining GHG emissions from vehicle fleets.

With respect to this scenario there are number of challenges related to renewable natural gas and carbon offsets that make the 'Carbon Neutral' GHG Reduction Scenario' more difficult to achieve by 2030.

The achievement of carbon reductions at this level through accelerated retrofitting of City buildings would require a potential restructuring of the City's current service delivery (e.g. greater periods of down time for civic operations to accommodate retrofits, increased operational impact associated with the implementation of these capital investments, etc.).

CARBON OFFSET/CREDIT

A reduction in emissions of carbon dioxide or greenhouse gases made in order to compensate for or to offset an emission made elsewhere.

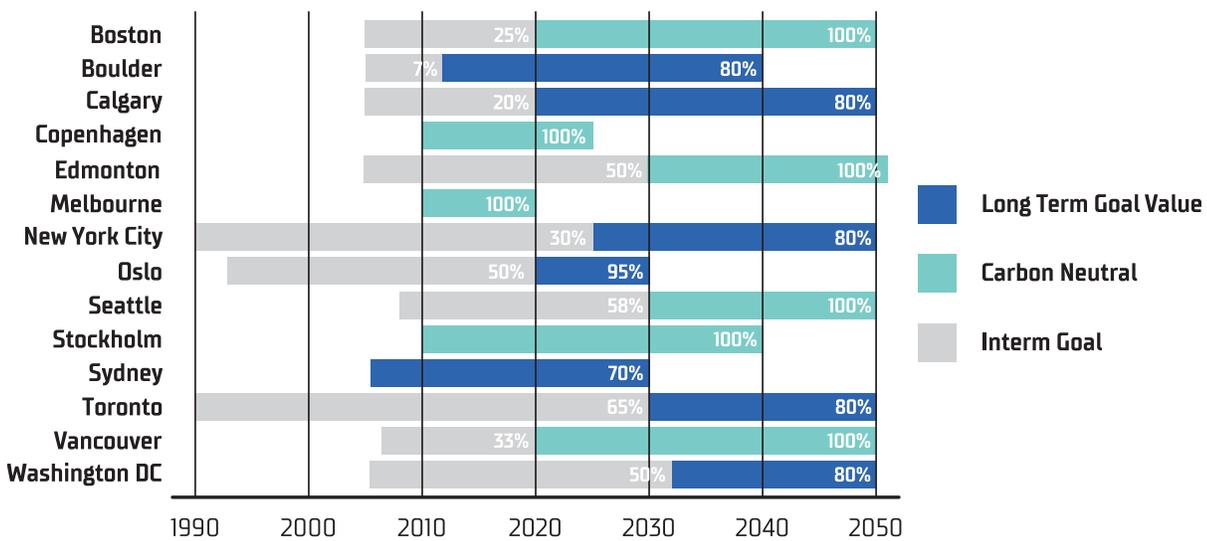
The market for renewable natural gas in Alberta is considered "emerging" as eligible gases (gas produced from decomposing organic waste from forestry, landfills, agricultural waste, and wastewater from treatment facilities) are typically combusted to generate electricity rather than added to the natural gas distribution system or converted to fuel for vehicle use. As such, any renewable natural gas that could be collected and invested in by the City is likely to come with a requirement for the City to assist in actively developing this emerging market in partnership with industry.

Carbon offsets are a viable market driven solution, but like renewable natural gas and green electricity purchases, carbon offsets are investments over a specific period without direct financial return on investment. Compared to purchasing green electricity through longer term contractual agreements, there are numerous considerations in terms of offset quality and value, permanence, GHG estimation methods, additionality, the credibility and credit-worthiness of the supplier, and assurance over ownership of the GHG reductions. These factors create additional layers of procurement complexity and City monitoring for quality and outcomes. Carbon offset investments also often require considerable stakeholder education (the what, why, and how). Lastly, at present, there is a limited supply of locally created carbon offsets that would meet the City's requirements if the principles outlined were to be applied to these instruments as well as green electricity.

PATHWAY ANALYSIS: COMPARING THE APPROACHES

Cities are at the forefront of global action on climate change setting both ambitious commitments and targets while setting about the difficult task of reducing GHG emissions. The latest report from the C40 Cities Climate Leadership Group, ICLEI Local Governments for Sustainability, UN Habitat, and others, shows that most GHG reduction commitments are set for 2030 or 2050 and range from a 10% to 100% reduction.

Figure 4. Summary of Long-Term GHG Emission Reduction Targets[2]



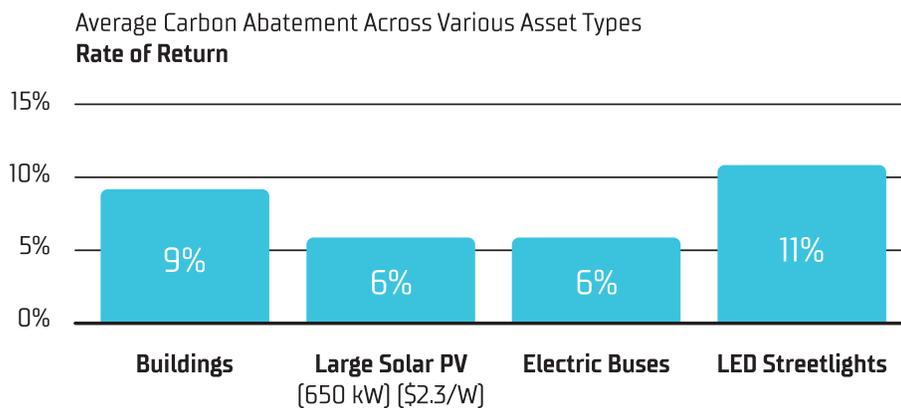
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Recognizing the role that cities can have in achieving significant and immediate GHG reductions to limit global warming by 2 degrees, through a minimum 50% reduction in greenhouse gases by 2050, the recommended approach is for the City to take a leadership position, and establish a 50% reduction target by 2030 with the 2050 goal of having carbon neutral operations (100% reduction) by 2050.

A detailed analysis supporting this recommendation shows that there is no substantial technological barrier that would prevent the City from achieving the proposed 2030 GHG reduction target of 50% of 2005 GHG emissions by 2030³. In all scenarios, the analysis found that the business case actions from a financial return on investment (FROI) standpoint, ranging from strongest to weakest, were building energy retrofits, LED street lights, electric buses, large microgeneration solar photovoltaics, and green electricity purchases. All energy reduction initiatives have a positive net present value benefit over a 20-year period. However, the procurement of green electricity, which is an investment in the overall community in a manner that supports the viability of renewable energy at multiple scales across the region and Alberta, does not have a positive net present value benefit as it is an overall cost (Figure 5).

Figure 5. Rate of Return of various Carbon Abatement options



Regardless of the scenario pursued, the analysis determined that building retrofits has a deployment rate that is largely impacted and constrained by the need to minimize building shutdown periods and disruption to City services and programming. The same types of issues (e.g., scalability, deployability, impact on internal capacity and resources) are true for solar photovoltaics, electric buses, and to a lesser extent, the replacement of LED street lights. The purchase of renewable natural gas, carbon offsets, and green electricity are deemed to be the best option for aggressive reductions in the City's GHG emissions as they are the least impacted by the above-mentioned constraints, but as noted previously are subject to supply constraints, and possible premiums.

On the basis that the BAU Scenario is not socially or politically acceptable for the City, and the Carbon Neutral Scenario is more applicable from a 2030-2050 standpoint, the two remaining options are the Pan Canadian Scenario or the Accelerated Pan Canadian Agreement Scenario. The latter Scenario, although logistically challenging to implement, passes both the test of achievability and is most aligned with the principles and policy directions previously outlined by City Council. All scenarios are presented in the following table for comparison.

3. This was confirmed by Stantec, who was engaged by the City to conduct a comprehensive review of all of the proposed actions in the plan and the detailed analysis supporting those actions.

Table 4. Financial Summary of GHG Planning Scenarios

VARIABLE	BUSINESS-AS-USUAL (BAU) SCENARIO	THE PAN CANADIAN SCENARIO	ACCELERATED PAN CANADIAN SCENARIO	THE CARBON NEUTRAL SCENARIO
GHG Reduction Target (%)	None	30%	50%	100%
Total GHG Reductions by 2030 (tCO ₂ e) from City Initiatives	29,500	151,200	247,000	452,300
Total Additional Funding between 2019-2030 (Today's dollars)	None	\$340 Million Capital \$2.4 Million/yr Operating	\$340 Million Capital \$8.25 Million/yr Operating	\$389 Million Capital \$19.9-23.8 Million/yr Operating
Net Present Value (NPV)	N/A	\$130 Million	\$76 Million	-\$154 Million to -\$78 Million

The proposed GHG reduction target of 50% by 2030, and associated plan of action will enable the City to implement and accelerate existing programs and policies to reduce energy use and GHG emissions, while transitioning to using lower-carbon and renewable energy sources. The plan will bring the City closer to achieving carbon neutral operations by 2050 which is a longer term goal consistent with policy direction outlined in documents such as The Way We Green and more aligned with achievement of reductions consistent with the Paris Agreement as well as commitments made through the Global Covenant of Mayors for Climate and Energy. Equally as important, while acting to address the issues of climate change, the City's actions will also result in numerous co-benefits to the broader Edmonton community including:

- Job creation and economic diversification related to renewable energy, industrial ecology, green buildings, smart grid development, district energy development, and alternative transportation;
- Improved quality of life through reduced air pollutants and particulates; and
- Improved return on investment of tax payer dollars due to energy efficiency, fuel reductions, and the use of renewable energy sources.

IMPLEMENTATION CONSIDERATIONS

While the City civic operations alone cannot prevent climate change, the City's leadership, and its dedicated focus to achieving a 50% reduction in greenhouse gases by 2030, will provide the necessary movement to limit global warming to 2.0°C, and ensure that the future generation have the same access to a sustainable future.

Implementation of this plan will need to be integrated, accountable and dynamic. The Plan will be governed by a cross-corporate implementation structure and will impact many City departments including Regional and Economic Development, Integrated Infrastructure Services, City Operations, Citizen Services, Financial and Corporate Services, and Urban Form and Corporate Strategy Development. An accountability process will also be developed with these departments to provide oversight for plan implementation, ongoing monitoring, and evaluation of the plan's progress including regular reporting to City Council on the overall progress of the actions. The fields related to green energy production and innovative techniques of demand side management are rapidly changing and necessitate an adaptive management approach to implementation and course correction of the plan over its lifetime.