The City of Lethbridge

Energy Conservation Master Plan and Strategy

April 2021

Acknowledgements

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Definition of Terminology

Climate Resilience: the ability to prepare for and respond to trends and disruptions that result from a changing climate.

Energy Efficiency: Using less energy to provide the same level-of-service.

Energy Intensity: A measure of a facility or service's energy usage, typically represented through the amount of energy used per square metre for facilities or the amount of energy per unit of service or good produced for services.

Greenhouse Gas: A gas that traps the sun's heat in the atmosphere. When these gases are released into the atmosphere, light from the sun is trapped in the atmosphere instead of being reflected back into space and the planet becomes warmer than it would be otherwise. Greenhouse gases include carbon dioxide (CO_2), Methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Release of these gases is typically measured in tonnes of carbon dioxide equivalents (tCO_2e).

Photovoltaic (PV): Often referred to as "solar", photovoltaic systems are any device that utilizes the photoelectric effect to convert incident sunlight directly into electricity.

Renewable Energy: Renewable energy is energy that is naturally replenished as it is used. It can include sources such as biomass, solar, wind, or water.

Executive Summary

1.1 BACKGROUND

As part of the Operating Budget 2019-2022, City Council proposed and approved a New Initiative (N-84, Energy Efficiency Master Plan & Strategy), which tasked the administration to develop an energy efficiency master plan as a roadmap that would support the City of Lethbridge's transition towards technologies and practices which improve energy efficiency (use less energy to provide the same level-of-service) for corporate assets (facilities, vehicles (fleet), and equipment) and operations.

This Energy Conservation Master Plan and Strategy (the Plan) has been developed to meet the Council initiative and is intended to provide the overall framework, direction, and goals to improve energy efficiency within the corporation as it relates to water services, electricity provision, waste management and fuel use (electricity, natural gas, gasoline and diesel).

1.2 INDUSTRY CONTEXT

In addition to aligning with municipal plans and programs such as the Corporate Strategic Plan[1], Council's 2017-2021 Strategic Plan[2] , and the City of Lethbridge's Environment Policy[3], energy efficiency programming is also aligned with federal goals.

Most policy guidance at the federal level aims to reduce greenhouse gas (GHG) emissions, which relates directly to energy efficiency (less energy use equates to fewer GHG emissions). Yet, the extent to which they are correlated depends on the amount of carbon in the energy sources being used. The predominant federal regulations targeting energy efficiency are the National Energy Code for Buildings (NECB) and the Energy Efficiency Regulations (EER). The NECB provides a minimum level of compliance for new construction, while the EER focuses on providing standards for a range of industrial and household building processes. These regulations are not comprehensive and are focused on households and commercial equipment rather than being aimed at municipalities directly.

There are no provincial targets for improving energy efficiency in municipal operations or reducing GHG emissions from municipal operations. Previous provincial plans, such as Alberta's Climate Leadership Plan[4], launched in 2015, focused attention on the electricity, the oil and gas sectors, with no targets established specifically for municipalities.

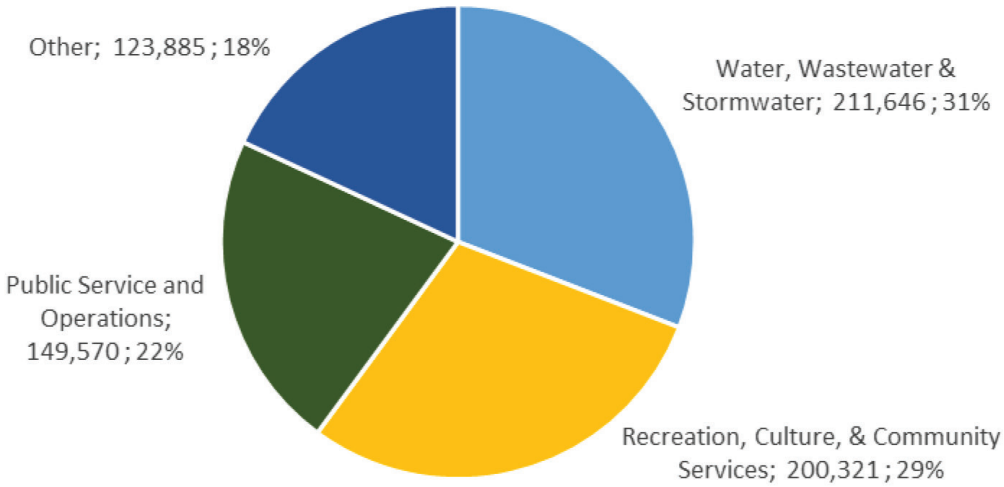
Funding for municipalities for energy efficiency and renewable energy programming is available through the Municipal Climate Change Action Centre, Emissions Reduction Alberta, and the Federation of Canadian Municipalities' Green Municipal Fund. Further funding opportunities may become available in the future, however, the current funding environment is somewhat limited.

1 Lethbridge Corporate Strategic Plan
2 Lethbridge Council Strategic Plan
3 Lethbridge Environment Policy
4 Alberta's Climate Leadership Plan

1.3 ENERGY ANALYSIS

While there are opportunities to improve energy efficiency among each end user and for each energy source, identifying and targeting the largest energy users will be an important step towards reducing total energy consumption. In the analysis of current energy use within City operations, a clear pattern emerges that shows a small number of end users, facilities, or vehicle classes making up the largest shares of energy consumption. Concentrating efforts on creating initiatives to target the largest energy users typically provides the greatest opportunity to improve energy efficiency for the City.

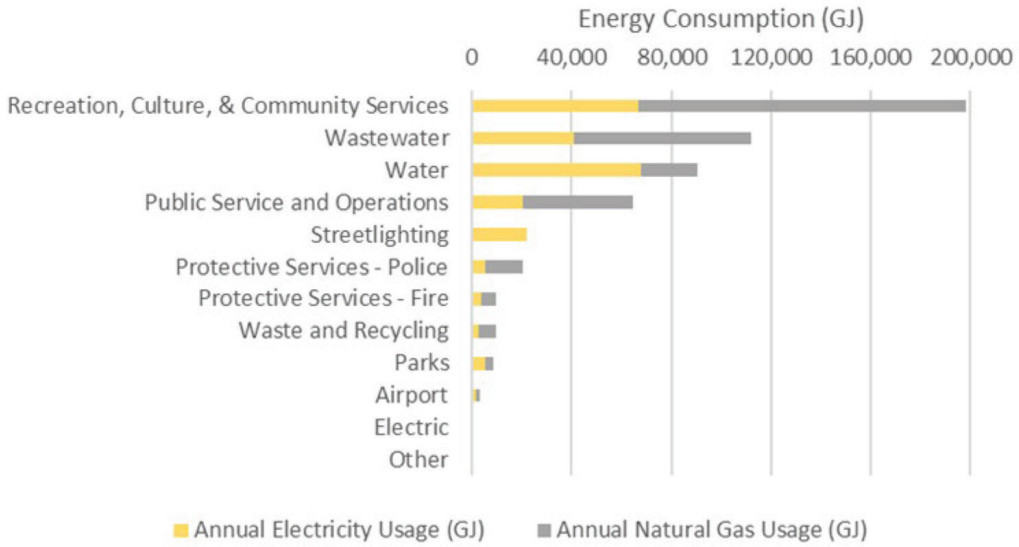
Energy Consumption by End User in 2018 (GJ)



The largest users are Water, Wastewater, & Stormwater at 31% of total energy use, followed by Recreation, Culture & Community Services at 29% and Public Service and Operations at 22%. The other business units make up the remaining 18% of energy use.

City energy use is divided between electricity and natural gas for stationary energy use, and gasoline and diesel for vehicles and equipment. 79% of City energy use is natural gas and electricity, which is used by facilities and utilities, while the remaining 21% of City energy use is fuel consumed by vehicles and equipment.

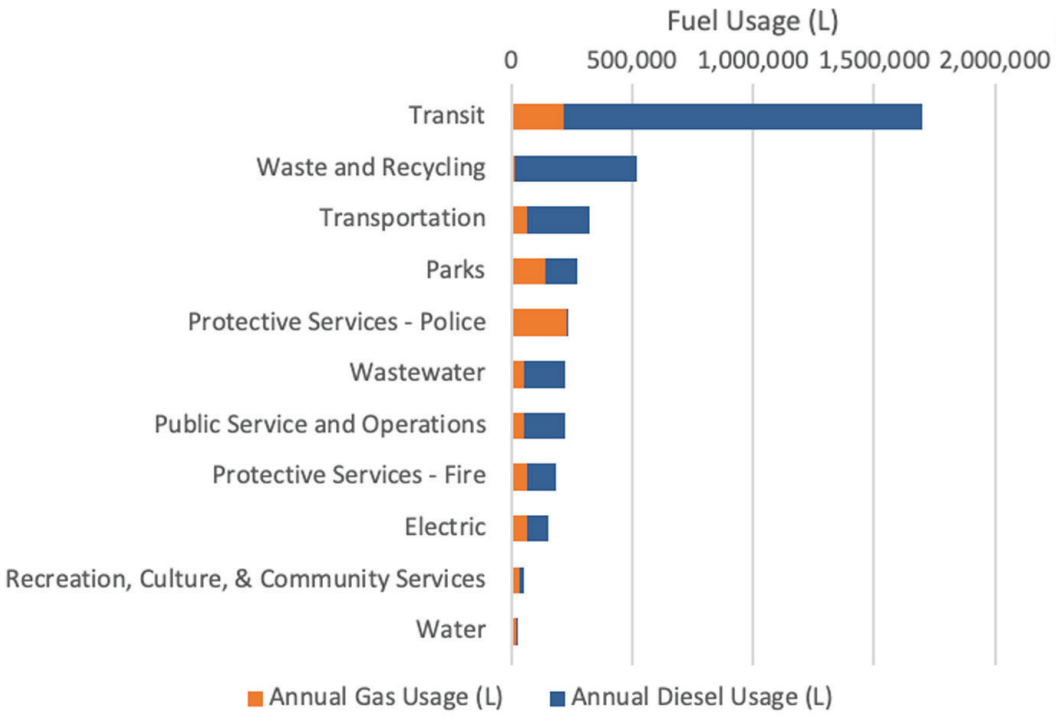
Energy Use by End User in 2018



A small number of business units make up the bulk of electricity and natural gas use. Recreation, Culture & Community Services followed by Water, Wastewater, & Stormwater (broken out into “water” and “wastewater” processes in Figure 4-3 to separate out their differing fuel makeups for informational purposes), and Public Service and Operations are the

largest energy users. Together these top three end users make up 80% of all energy usage. Each end user gets the majority of their energy used by sites and facilities from natural gas, except for water treatment, streetlighting, and parks, which get the majority of their energy from electricity.

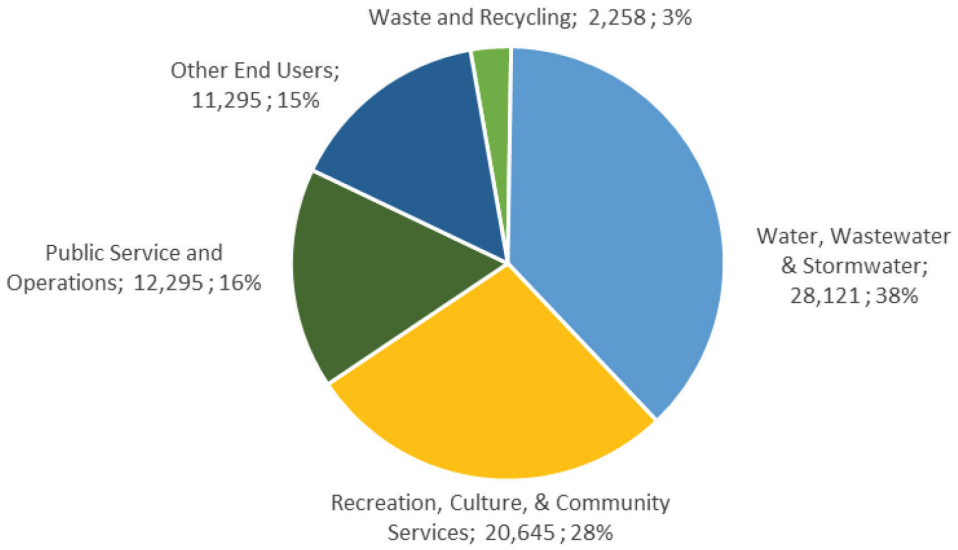
Fuel Usage by End User in 2018



The top three business units make up 65% of all fuel consumption. Transit makes up 44% of total mobile fuel use by volume of fuel, followed by Waste & Recycling Utility at 13% of fuel use and Transportation at 8% of fuel usage. Diesel is the primary fuel used for fleet operations at 76% of the total volume of fuel use, with gasoline making up the remaining balance.

While reducing greenhouse gas emissions is not the primary goal of the Plan, energy efficiency measures are closely linked to greenhouse gas reductions. Reducing energy use and switching to less carbon-intensive energy sources are the two primary ways of reducing greenhouse gas emissions. As with energy consumption, a small subset of business units makes up the majority of emissions.

Emissions by End User in 2018 – Excluding Landfill Gas (tCO_2e)

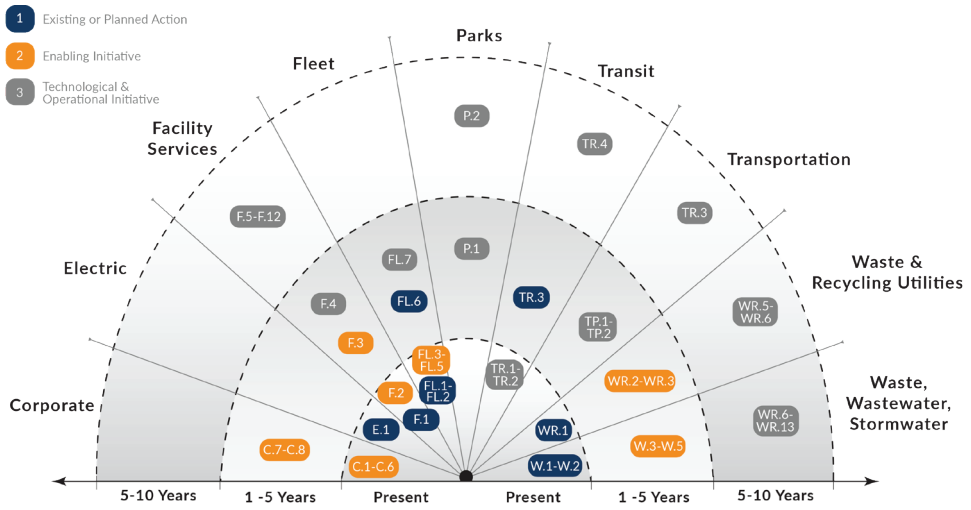


1.4 INITIATIVES & BEST PRACTICES

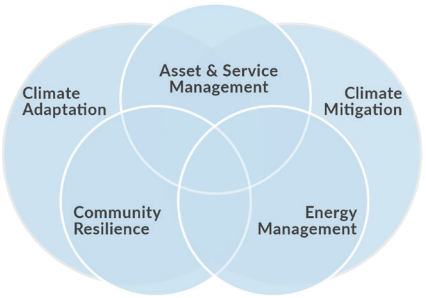
Energy efficiency initiatives were developed based on industry best practices and through workshops and discussions held with respective City business units. The proposed initiatives have been separated into two categories:

1. **Existing and Planned Initiatives** which have been identified in the City of Lethbridge's 2019 Corporate Sustainability Report and the 2020 Partners for Climate Protection Corporate Milestone Report;
2. **Enabling Initiatives** that remove the behavioral, cultural, or organizational barriers to technological and operational energy conservation measures, or further incentivize new initiatives. These actions build on current Corporate Sustainability initiatives and compliment the on-going Partners for Climate Protection initiatives; and
3. **Technological and Operational Initiatives** which are strategies to improve the energy efficiency of a particular facility, system, or process.

To help meet these targets, a timeline focused on the next 10 years is suggested for the proposed initiatives. A detailed, corresponding list of initiatives is provided in Appendix C.



1.5 ENERGY EFFICIENCY STRATEGY



Improving the City's energy efficiency will be an on-going effort. To build an energy efficiency culture, understanding and strengthening the ties between energy efficiency and these closely related conversations and goals will be vital. Energy efficiency should be integrated into a wider conversation about energy management, asset and service management, as well as community resilience goals and desired outcomes. Each of these conversations are situated within the recognition that environmental, social and economic risks and uncertainty are becoming increasingly complex and integrated strategies are required to mitigate the implications and improve decision-making. The implications of these risks and uncertainties are widespread and significant, requiring a response that increases community resilience (the community's ability to respond) to deliver sustainable community services.

Energy efficiency will touch each of these areas, incorporating improvements to a large number of stakeholders. Understanding these interconnected considerations can help strengthen the ties between energy efficiency and the City's other related policies, strategies, and tactics.

1 Introduction

1.1 Background

The City of Lethbridge (City) serves a community of over 100,000 residents. The City is one of the warmest and sunniest cities in Canada, with a vibrant history, a university, college, plentiful green space and beautiful scenery. Lethbridge prides itself on being a healthy, attractive, and economically viable city, providing an excellent quality of life for its residents which includes providing sustainable services.

As part of the Operating Budget 2019-2022, City Council proposed and approved a New Initiative (N-84, Energy Efficiency Master Plan & Strategy), which tasked the administration to develop an energy efficiency master plan as a roadmap that would support the City of Lethbridge's transition towards technologies and practices which improve energy efficiency (use less energy to provide the same level-of-service) for corporate assets (facilities, vehicles (fleet), and equipment) and operations. The initiative should also identify priority initiatives and would explore the feasibility of implementing pilot programs to test new technologies within the City and the community.

This Energy Conservation Master Plan and Strategy (the Plan) has been developed to meet the Council initiative, and is intended to provide the overall framework, direction, and goals to improve energy efficiency within the corporation as it relates to water services, electricity provision, waste management and fuel use (electricity, natural gas, gasoline and diesel).

While energy efficiency is closely related with greenhouse gas (GHG) emissions reductions and is situated within larger discussions about transitioning to renewable energy sources and climate change mitigation, the core focus of the Plan is the reduction of energy use within the City. Cost reductions and GHG reductions will be considered throughout the Plan, but the primary key performance indicator is the reduction in energy usage for corporate assets, vehicles, and operations.

1.2 Report Overview

This Energy Conservation Master Plan and Strategy (the Plan) provides the overall framework, direction, and goals for energy conservation and efficiency at the City of Lethbridge ("the City") for all type of energy usage (electricity, natural gas, gasoline, and diesel). Embracing energy efficiency measures can help the City save money in municipal operations, increase investment in the local economy, and contribute towards meeting Council's greenhouse gas emissions targets of a 40% reduction in emissions from 2018 levels.

The Plan outlines:

- A current state and historical review of energy use and energy efficiency measures in the corporation.
- A review of the strategic context of the Plan.
- A review of energy efficiency initiatives and best practices that have been successful in other jurisdictions.
- An implementation strategy outlining governance, reporting, and implementation timelines.

Although there are opportunities for energy conservation for all sites, facilities, and business units across the corporation, some opportunities offer greater potential reductions than others. This Plan is focused on the areas with the highest potential for energy use reduction.

The Plan identifies technological and operational initiatives which have been successful in similar municipalities, as well as a range of best practices which can act as "enabling" measures to support energy efficiency management. These initiatives will require further detailed investigation and analysis, which may include completion of several targeted energy audits, to validate the anticipated energy conservation measures.

2 Context and Purpose

2.1 Strategic Linkages Between Levels of Government

Energy efficiency policy and regulations are closely linked and often embedded in climate and energy policy and regulations. Understanding energy and climate policy at different levels of government can help to understand which policies will directly or indirectly impact the City's energy conservation goals. As a result, while some of the policies and regulations in the next sections focus on energy efficiency explicitly, other will focus on climate and energy, with energy efficiency focused on indirectly.

2.1.1 Municipal Context

All municipal plans and programs must adhere to the Corporate Strategic Plan's Strategic Goals and Vision statement.[5] Any energy efficiency programming must be agile, innovative in a changing environment, and work towards creating a thriving community. This goes hand-in-hand with the Community Vision of Council's 2017-2021 Strategic Plan to "continue to work together to ensure that Lethbridge demonstrates active leadership in environmental stewardship and innovation"[6] . Improving energy efficiency throughout the City's operations is an important part of continuing environmental stewardship and innovation.

Under the City of Lethbridge's Environment Policy, "The City is committed to taking a responsible leadership role in the efficient use of natural resources"[7], including the sources of energy the City uses. This Plan aims to take action on "promoting continuous improvement with respect to environmental goals and targets" and to "support efforts to minimize Lethbridge's ecological footprint by using natural resources efficiently".

The Plan advances the City's commitments under the Partners for Climate Protection (PCP) program and Corporate Sustainability (CST). Both the PCP program and CST have the goals of reducing greenhouse gas emissions and improving energy efficiency throughout City operations.

Environment Lethbridge supports energy efficiency and related initiatives that could provide a platform to support City initiatives. Utility providers are also stakeholders in energy efficiency and partnering or collaborating with them would provide opportunities to align energy efficiency initiatives.

2.1.2 Provincial Context

There are no provincial targets for improving energy efficiency in municipal operations, nor for the reduction of GHG emissions from municipal operations. Previous provincial plans, such as Alberta's Climate Leadership Plan[8], launched in 2015, focused attention on the electricity, the oil and gas sectors, with no targets established specifically for municipalities. Within Alberta's Climate Leadership Plan, there is a target to reduce methane emissions by 45% by 2025, but this target and the accompanying directives are aimed solely at the oil and gas sector[9].

The most important recent change in provincial climate policy is the replacement of the Carbon Competitiveness Incentive Regulation (CCIR)[10] with the Technology Innovation and Emissions Reduction (TIER) Regulation[11] in January 2020. TIER and CCIR both aim to reduce emissions in facilities with emissions of 100,000 tonnes of CO2e or greater per year by requiring the purchase of carbon-offsets or payment into a compliance fund. Under CCIR, emissions reduction obligations were determined by class-based facility benchmarks; under TIER, emissions reduction obligations are determined by choosing either the 2013-2015 weighted

5 Lethbridge Corporate Strategic Plan
6 Lethbridge Council Strategic Plan
7 Lethbridge Environment Policy
8 Alberta's Climate Leadership Plan
9 Reducing Methane Emissions
10 Carbon Competitiveness Incentive Regulation
11 Technology Innovation and Emissions Reduction Regulation

average emissions intensity of the that same facility or the benchmark of a similar high-performance facility[12], with the required payment into the compliance fund at a rate of $30 per tonne of emissions above the benchmark performance.

The only City facility that will fall under these regulations is the landfill, which emitted 98,679 tCO_2e in the most recent 2019 greenhouse gas benchmark, and is expected to exceed 100,000 tCO_2e in 2020.

Funding for municipalities for energy efficiency and renewable energy programming is available through the Municipal Climate Change Action Centre, and Emissions Reduction Alberta. Further funding opportunities may become available in the future, but in the present the current funding environment is somewhat limited. The Alberta Energy Efficiency Alliance is also another resource that provides information and programs that support energy efficiency in the Province.

2.1.3 Federal Context

The predominant federal regulations targeting energy efficiency are the National Energy Code for Buildings (NECB) and the Energy Efficiency Regulations (EER). The NECB provides a minimum level of compliance for new construction; while the EER focuses on providing standards for a range of industrial and household building processes. These regulations are not comprehensive and are focused on households and commercial equipment rather than being aimed at municipalities directly. Most policy guidance at the federal level is aimed at reducing greenhouse gas (GHG) emissions, which relates directly to energy efficiency (less energy use equates to fewer GHG emissions), yet the extent to which they are corelated depends on the amount of carbon in the energy sources being used.

In 2015, Canada committed to the Paris Agreement - a binding treaty which falls within the United Nations Framework Convention on Climate Change to reduce emissions adopted by 189 countries[13]. The Paris Agreement is a commitment to accelerate a transition to a sustainable low-carbon future, to limit global average temperature rise to well below 2 °C above pre-industrial levels, and to pursue efforts to limit the global average temperature increase to 1.5 °C. As part of the Paris Agreement, Canada agreed to reduce emissions by 30% below 2005 levels by 2030, and agreed to a long-term goal of reducing emissions by 80% by 2050. This has since been increased to 32-40% reductions by 2030, and a 100% reduction by 2050 in Canada's most recent climate plan, A Healthy Environment and a Healthy Economy[14].

The Pan-Canadian Framework on Clean Growth and Climate Change was developed in part as a step towards implementing the commitments made in the Paris Agreement. The core goals of the Framework are to meet the emissions reductions committed to while growing the economy and improving the resilience of society in the face of climate change. This plan was expanded on in December 2020 with the federal government's most recent climate plan, A Healthy Environment and A Healthy Economy. The primary initiative in this plan that impacts municipalities is the government's commitment to procuring 5,000 zero-emission electric transit and school buses[15]. In addition to this funding, it was announced that the federal carbon tax will continue to increase from $40 per tonne in 2021 to $170 per tonne in 2030. A price on carbon will impact energy costs, potentially changing payback periods for energy efficiency initiatives. The Government of Alberta has voiced opposition to the federal carbon tax. In February 2020, the Alberta Court of Appeal ruled the federal carbon tax unconstitutional[16], and a Supreme Court hearing was adjourned without decision in September 2020. The future of carbon pricing in Alberta going forward is uncertain.

12 Technology Innovation and Emissions Reduction Regulation Factsheet
13 Paris Agreement
14 A Healthy Environment and a Healthy Economy
15 Although the response to COVID-19 was discussed in this plan, no specific new funding was made available to municipalities as part of that response.
16 Globe & Mail: Alberta Court Rules Carbon Tax is Unconstitutional

Funding for municipalities for energy efficiency and renewable energy programming is available through the Federation of Canadian Municipalities' Green Municipal Fund. Further funding opportunities may become available in the future, but in the present the current funding environment is somewhat limited. Efficiency Canada is also another resource that provides information and programs that support energy efficiency.

2.2 Purpose

The scope of this Energy Conservation Master Plan and Strategy (Plan) is to provide guidance to improve energy efficiency for the corporation as it relates to electricity, natural gas, and fuel (gasoline and diesel) use by identifying priority initiatives and creating a plan to guide their implementation. While the energy efficiency initiatives proposed will contribute towards meeting the City of Lethbridge's GHG mitigation targets, these targets are not the primary focus of the Plan - energy reduction is the key performance indicator of the Plan. As a result, the analysis and recommendations are tailored towards energy efficiency potential and the accompanying cost savings, with greenhouse gas mitigation potential a supplemental perspective.

The key City's Business Unit stakeholders are:

- Electric
- Facility Services
- Fleet
- Parks
- Transit
- Transportation
- Water, Wastewater and Stormwater
- Waste & Recycling Utilities: Corporate Sustainability

The scope of the analysis and proposed initiatives and guidance is confined to these business units. The list of which facilities or sites fall within each business unit is located in Appendix B. Residential and private commercial and industrial building energy use is not in scope for the Plan.

3 Assets in Scope

There are 183 City owned and leased sites or facilities in scope ("sites" is treated as a catch-all term for any energy consuming location which would not be considered a stand-alone facility, such as pump stations or lift stations). The City fleet has 1,138 vehicles and pieces of equipment across the various business units. Note that some energy uses, such as "Streetlights and Traffic Signals" may be grouped together into a single "asset class" and treated as a single "site" rather than treating each as an individual site or facility.

The assets in scope include:

Table 3-1
Number of Assets in Scope

Business Unit	Number of Sites and Facilities	Replacement Value ($M)	# of Vehicles & Equipment
Airport	5	$51	
Electric	4	$341	73
Other	5	-	
Parks	48	$155	233
Protective Services – Fire	4	-	58
Protective Services – Police	3	-	148
Public Service and Operations – Excluding Transit and Transportation	16	-	119
Transit		$37	119*
Transportation		$657	110
Recreation, Culture & Community Services	46	$492	58
Waste and Recycling	5	$37	67
Water, Wastewater & Stormwater	44	$959	83

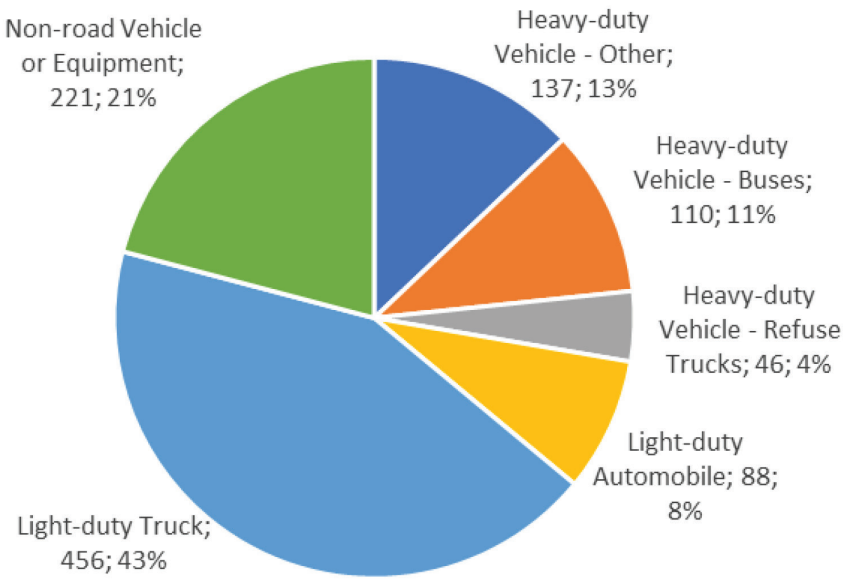
Replacement values are sourced from Tangible Capital Asset (TCA) data in the Asset Management Plan and include City owned buildings and their associated components.

Of the facilities in scope, 17 had an energy audit conducted in 2017 and are listed in Appendix A. These facilities received a comprehensive list of proposed recommendations to improve their energy efficiency and are not included in the analysis of the initiatives and best practices below. The recommendations proposed in these energy audits have already been adopted or rejected by the City and further analysis would be redundant.

A full list of City facilities and the business units to which they belong is provided in Appendix B.

The largest share of vehicles in the fleet is light-duty trucks (43%), followed by heavy-duty vehicles such as buses or refuse trucks (28%), while light-duty automobiles make up a small share of the total fleet (8%). Non-road vehicles and equipment like mowers, forklifts, or utility trailers make up the remaining fleet (21%).

Figure 3-1
Vehicle Class Breakdown - 2018



4 Energy Analysis

4.1 Data Limitations and Analysis Assumptions

The City of Lethbridge has monthly energy use, fuel use and fuel purchase data for 2014 to 2019. Electricity, natural gas, and vehicle fuel usage and emissions are broken down by business unit. The energy use is broken out by individual sites and facilities, as well as vehicle class. From this data, energy use for water treatment, wastewater treatment, waste & recycling collection, and streetlighting can be found as well. Vehicle fuel use is broken down by business unit and vehicle class.

The base year for analysis is 2018, to correspond with the City's GHG reduction target base year.

Since energy use data only extends to 2019, facility energy use impacts due to the COVID-19 pandemic has not been included in this analysis.

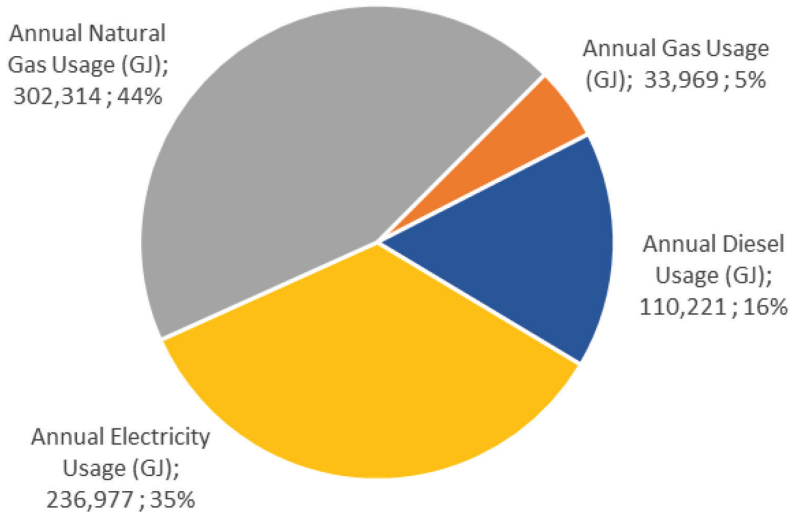
4.2 Energy Consumption

While there are opportunities to improve energy efficiency among each end user and for each energy source, identifying and targeting the largest energy users will be an important step to reduce total energy consumption. In the analysis below, a clear pattern emerges in that a small number of end users, facilities, or vehicle classes make up the largest shares of energy consumption. Concentrating efforts on creating initiatives to target the largest energy users typically provide the greatest opportunity to improve energy efficiency for the City.

4.2.1 Total Energy Use

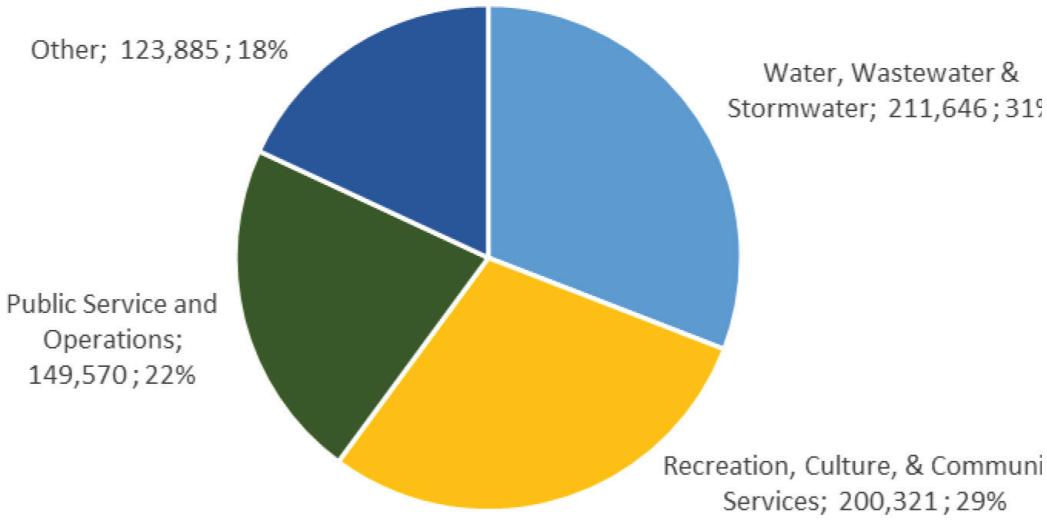
Between electricity, natural gas, and vehicle fuels, the City of Lethbridge used 685,411 GJ of energy in 2018, see Figure 4-1.

Figure 4-1
Energy Consumption by Energy Source in 2018 (GJ)



79% of City energy use is natural gas and electricity which is used by facilities and utilities, while the remaining 21% of City energy use is fuel consumed by vehicles and equipment.

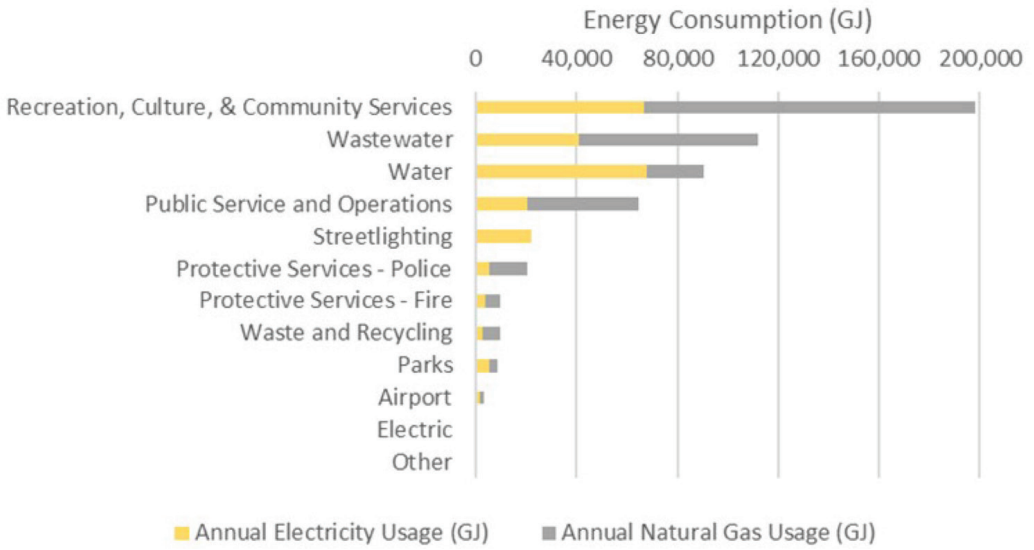
Figure 4-2
Energy Consumption by End User in 2018 (GJ)



4.2.2 Electricity & Natural Gas Use

In 2018, the City of Lethbridge used 65.8 million kWh of electricity and 237,000 GJ of natural gas, for a total of 539,291 GJ of combined energy use or 131.6 million equivalent-kWh of combined energy use. Energy consumption by business unit in 2018 is given in Figure 4-3:

Figure 4-3
Energy Use by End User in 2018



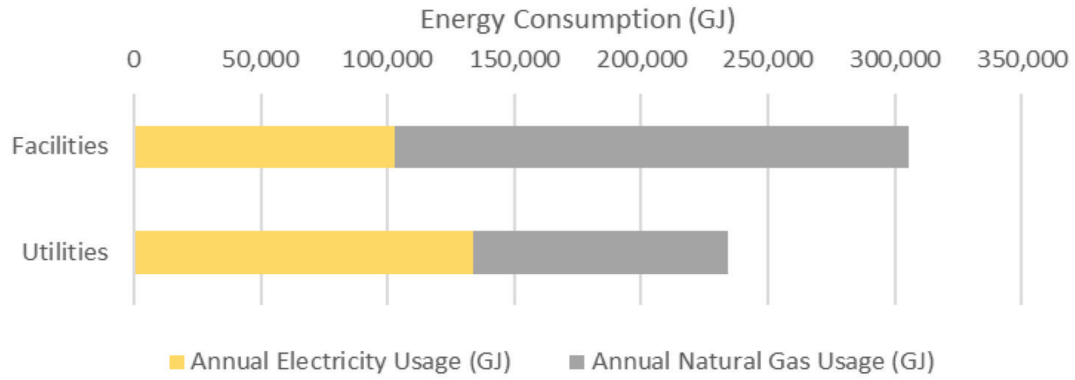
A small number of business units make up the bulk of electricity and natural gas use. Recreation, followed by Water, Wastewater, & Stormwater (broken out into "water" and "wastewater" processes in Figure 4-3 for illustration purposes), and Public Service and Operations are the largest energy users. Together these top three end users make up 80% of all energy usage. Each end user gets the majority of their energy used by sites and facilities from natural gas, with the exception of water treatment, streetlighting, and parks which get the majority of their energy from electricity.

Energy use for sites & facilities can be broken down by energy used for utilities purposes or for facility operations. Utilities includes: electric, streetlighting, waste & recycling utilities, and water, wastewater & stormwater processes, while Facilities includes energy use for operating the remaining facilities that are not considered utilities. (See Figure 4-4 on following page.)

Facilities operations and utilities processes warrant equal focus. Processes make up 43% of electricity and natural gas consumption. Facilities, which includes energy use for the remaining end users, makes up 57% of natural gas and electricity usage.

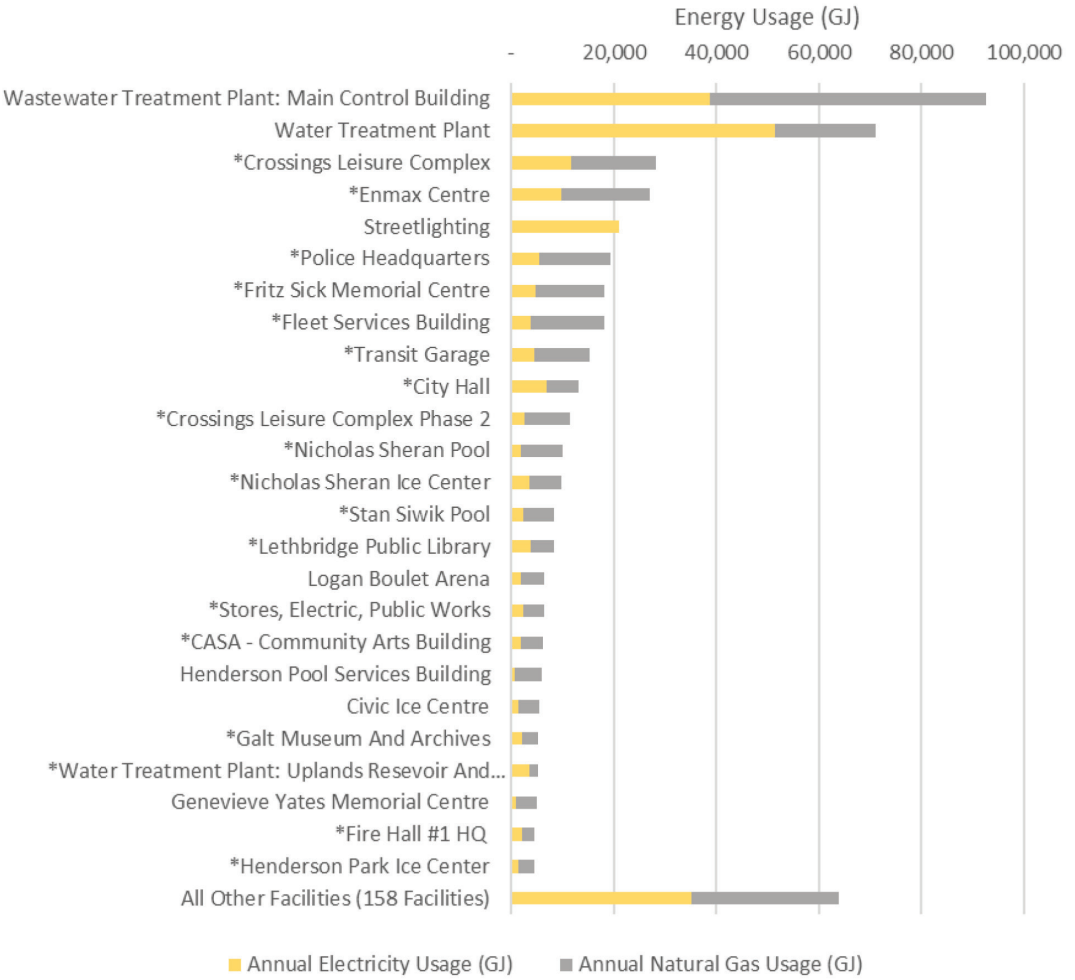
Energy usage can be further broken down by site. While there are 183 different sites with energy use data, the top 25 facilities or sites account for 87% of total facilities or site energy use.

Figure 4-4
Energy Usage by End User in 2018



The top 25 sites are shown in Figure 4-5, with sites which have already received an energy audit denoted with an asterisk.

Figure 4-5
Energy Usage by Site in 2018



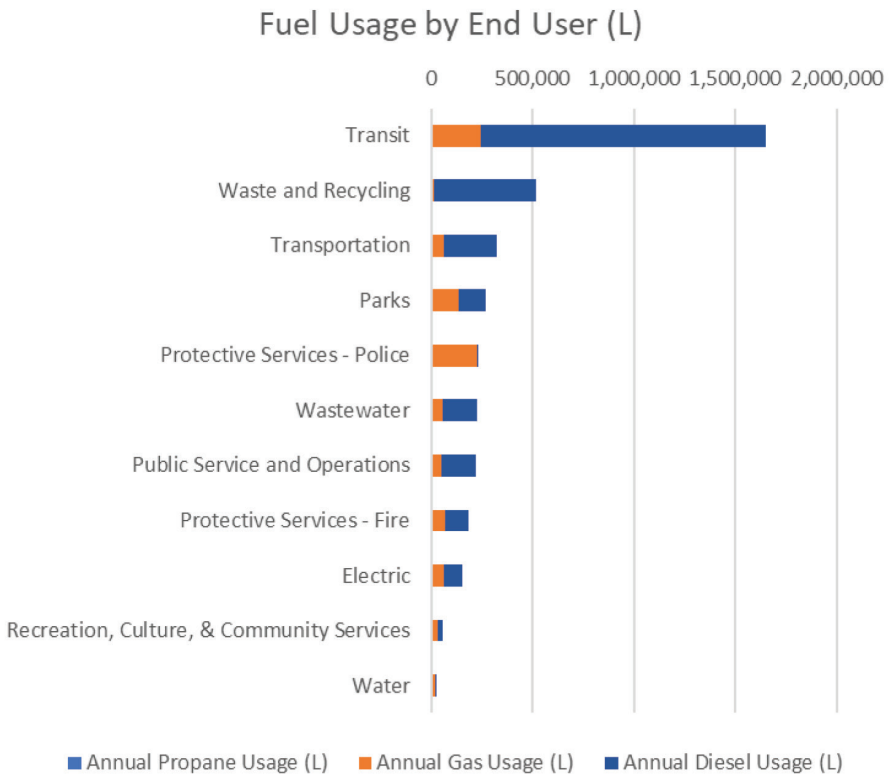
The top 25 energy users are water treatment plants, wastewater treatment plants, or recreation, leisure, and sports centres. The remaining 158 facilities in the inventory make up just 13% of total energy usage. Typically, the most energy intensive sites get most of their energy from natural gas. Of the 25 most energy intensive sites, 16 have already undergone an energy audit in 2019 and are in the process of implementing energy efficiency measures. These facilities which have already received an audit make up 42% of the City's total combined electricity and natural gas consumption. Other than the Water, Wastewater, and Stormwater sites, the remaining facilities in the top 25 energy users that did not receive an energy audit are: the Logan Boulet Arena, the Henderson Pool Services Building, the Civic Ice Centre, and the Genevieve Yates Memorial Centre.

4.2.3 Mobile Fuel Use

The majority of mobile fuel use is gasoline or diesel, with a negligible amount of propane fuel (less than 0.01% of fuel use annually) used by Recreation, Culture & Community Services for two Zambonis and two forklifts (the remaining Zamboni fleet is powered by natural gas). This includes all non-stationary fuel use in City operations, both for vehicles and equipment. As is typical, a small set of business units account for the majority of fuel consumption.

Fuel use by business unit in 2018 is shown in Figure 4-6 with Transit, and Transportation broken out of Public Service and Operations.

Figure 4-6
Fuel Usage by Business Unit in 2018

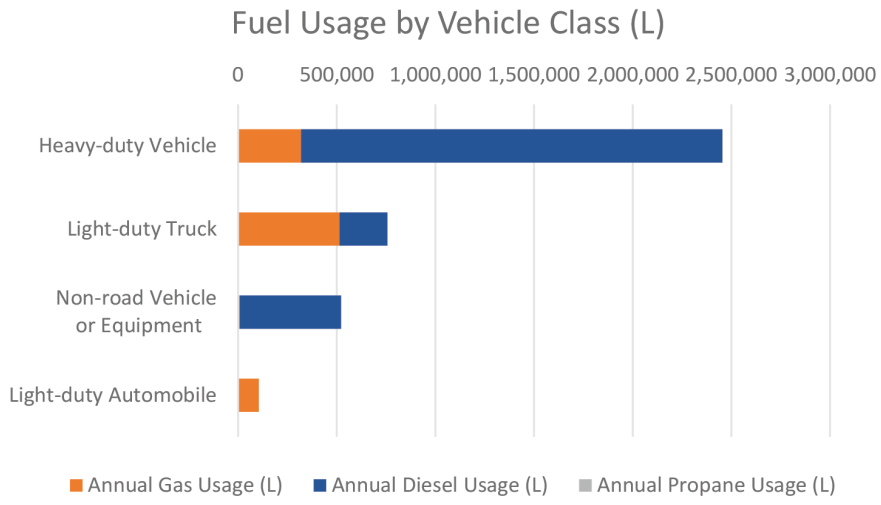


The top three business units make up 65% of all fuel consumption. Transit makes up 44% of total mobile fuel use by volume of fuel, followed Waste & Recycling Utility at 13% of fuel use and Transportation at 8% of fuel usage each. Diesel is the primary fuel used for fleet operations at 76% of total volume of fuel use, with gasoline making up the remaining balance.

Fuel use broken down by vehicle class is shown in Figure 4-7.

Heavy-duty vehicles consume 64% of total fuel use by volume, followed by light-duty trucks

Figure 4-7
Fuel Use by Vehicle or Equipment Class in 2018



at 20% and non-road vehicles (loaders, graders, excavators, brush chippers, back-mounted leaf blowers, etc.) at 13%. Light-duty automobiles make up the remaining 3%. Busses and garbage trucks are the largest fuel users in the heavy-duty vehicle category. The specific type of heavy-duty vehicles being used varies from business unit to business unit, and different strategies will be needed to address heavy-duty vehicle fuel use depending upon the operational requirements of the vehicles. Light-duty trucks share more overlap between business units, with many business units sharing the same makes and models of truck. .

4.3 Energy Rates & Contracts

The City of Lethbridge has entered into the energy contracts listed below. The energy rates in these contracts are the rates used to assess the cost effectiveness of the initiatives in Section 5 and may not reflect future contract renegotiations and rates. These rates will impact simple payback calculations for all initiatives.

EI7y

The City signed a 3-year electricity contract with Enmax which started in 2020. The contract is a fixed rate of $0.05638/kWh with additional delivery and demand charges. An estimate cost per kWh of $0.06/kWh has been assumed for simple payback calculations.

Natural Gas

The City's natural gas contract with Direct Energy expired at the end of the 2020 calendar year. Since there is some uncertainty about what the new rate will be, a value of $5/GJ has been assumed for simple payback calculations.

Mobile Fuels

The City purchases fuel through a group purchasing organization, RMA Fuel, and is based on the rack rate. Rates from 2019 average $1.02 for gasoline and $0.97 for diesel. These values have been used for simple payback calculations.

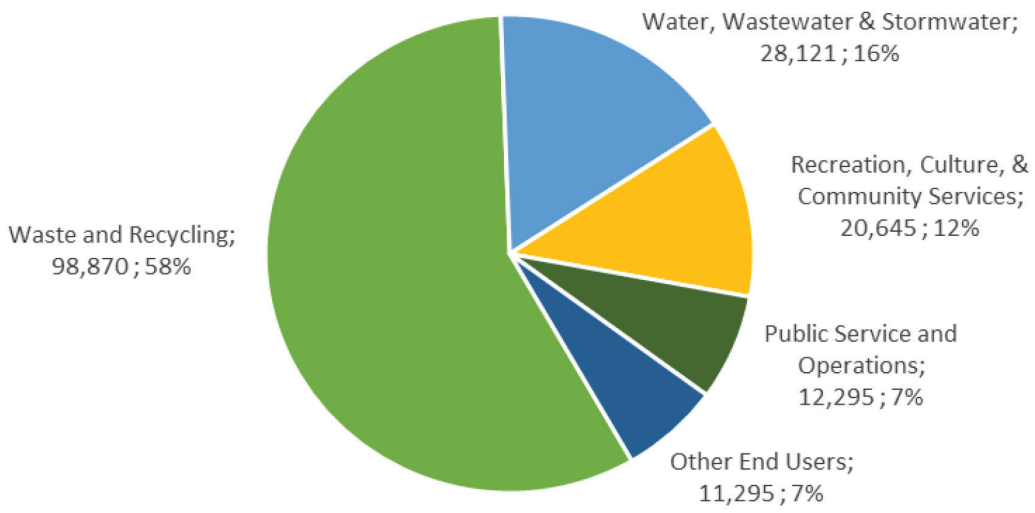
4.4 Greenhouse Gas Emissions

While reducing greenhouse gas emissions is not the primary goal of the Plan, energy efficiency measures are closely linked to greenhouse gas reductions. Reducing energy use and switching to less carbon-intensive energy sources are the two primary ways of reducing greenhouse gas emissions. As with energy consumption, a small subset of business units makes up the majority of emissions.

Total corporate emissions in 2018 were 165,708 tCO_2e and are shown by Business Unit in Figure 4-8 on the following page.

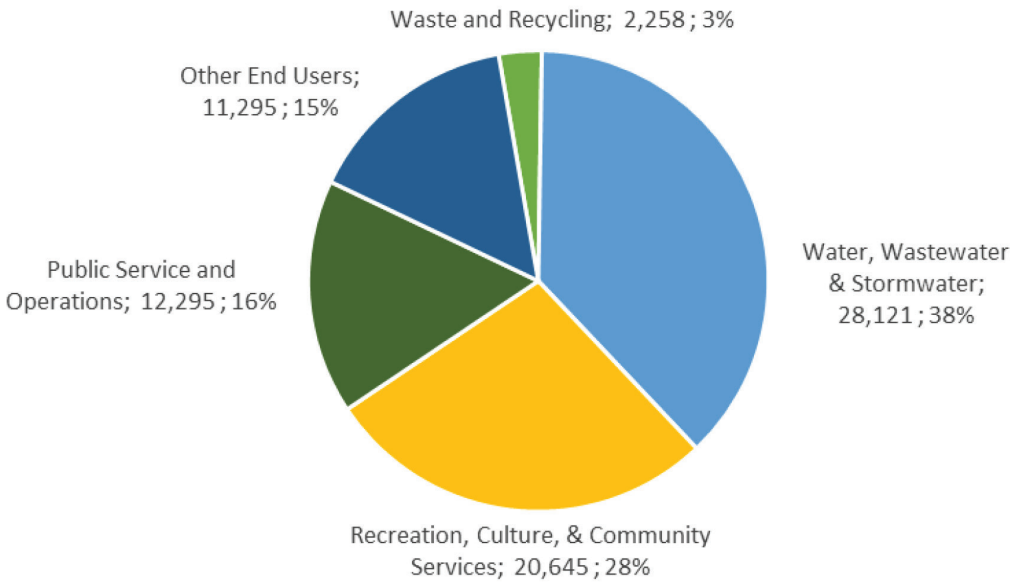
While Waste & Recycling Utilities makes up only 4% of total organizational energy use, they make up 58% of all operational emissions from energy use. The bulk of these emissions from Waste & Recycling Utilities come from landfill gas generated as a by-product of organics decomposition in the landfill rather than from energy use. The top four end users, Waste and Recycling Utilities, Water, Wastewater & Stormwater, Recreation, Culture & Community Services, Public Services and Operations (including Transit and Transportation) make up 93% of total City emissions.

Figure 4-8
Emissions by Business Unit in 2018 Including Landfill Gas (tCO_2e)



Total operational emissions (total emissions excluding landfill gas emission) in 2018 were 74,613 tCO_2e and are shown by Business Unit in Figure 4-9:

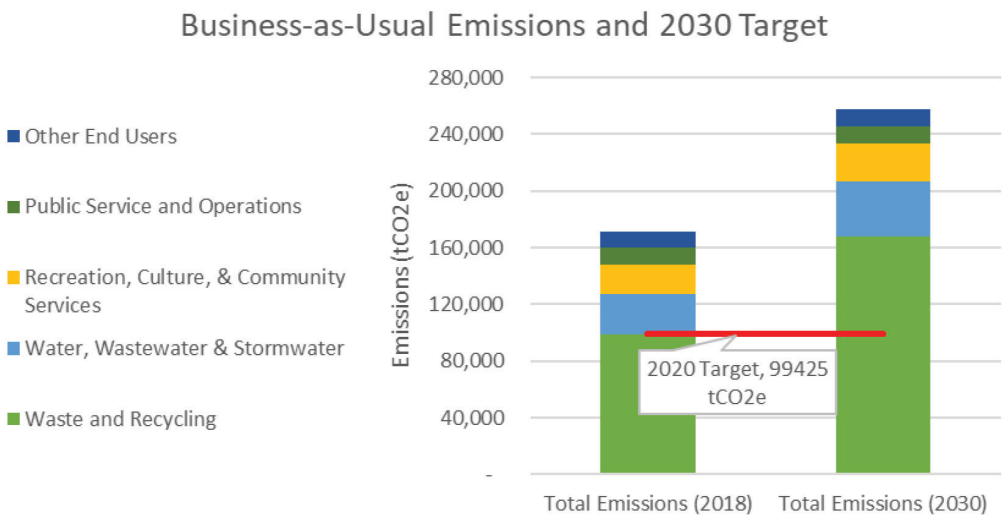
Figure 4-9
Emissions by End User in 2018 – Excluding Landfill Gas (tCO_2e)



When excluding landfill gas and considering only operational emissions, Waste and Recycling Utilities shrinks to only a fraction of operational emissions, at 2%. Water, Wastewater & Stormwater, Recreation, Culture & Community Services, and Public Services and Operations (including Transit and Transportation) play a larger role, at a combined 82% of operational emissions.

The new emissions targets set by Council on March 2, 2020 for a 40% reduction in corporate emissions from a 2018 baseline, including emissions from landfill gas and the previous 20% target are indicated in Figure 4-10 along with projected 2030 emissions with and without emissions reduction initiatives.

Figure 4-10
Projected Emissions by End User With 2030 40% Reduction Target



Emissions are projected to increase 35% from 165,708 tCO_2e in 2018 to 224,309 tCO_2e in 2030. Energy efficiency and greenhouse gas reduction initiatives are needed to bring emissions below the 2030 target of 99,425 tCO_2e.

5 Initiatives & Best Practices

Understanding the type and magnitude of energy use across the City is an important first step to identify opportunities for energy efficiency. This section contains an overview of energy efficiency initiatives to be considered that could reduce energy consumption. Each initiative is summarized with an estimated order-of-magnitude cost to implement, estimated energy reduction opportunity and corresponding GHG reduction potential. Initiatives that are selected for potential implementation should be further evaluated to validate the costs, estimated savings and level of change required to implement.

5.1 Existing Initiatives

The City of Lethbridge's 2019 Corporate Sustainability Report and the 2020 Partners for Climate Protection Corporate Milestone Report previously identified 11 initiatives summarized in **Table 5-1** below. Although these initiatives were primarily focused on reducing greenhouse gas emissions, they also contribute to energy efficiency and have been included to acknowledge the progress made to-date.

Table 5-1
Existing Initiatives Summary Table

Initiative Number	Business Unit	Initiative	Date of Implementation	Estimated Emissions Reductions (tCO_2e)
E.1	Electric	Conservation Voltage Reduction	2019	1,859
F.1	Facility Services	Building Efficiency Retrofits	Ongoing	1,300
FL.1	Fleet Services	Fuel Efficient Emergency Vehicles	2020-2030	39
FL.2	Fleet Services	Green Fleet Policy	2020	865
FL.6	Fleet Services	Electric/CNG Vehicle Conversion	2023-2030	924
TR.3	Transit	7 Electric Buses with Charging Infrastructure	2020-2030	917
WR.1	Waste & Recycling Utilities	Landfill Gas Capture System	2020-2021	67,418
WR.3	Waste & Recycling Utilities	Residential Organics Collection	2023	4,887
W.1	Water, Wastewater & Stormwater	WWTP Cogeneration System	2020-2030	11,374
W.2	Water, Wastewater & Stormwater	Cured-in-Place Piping	2019	1,500

Actions included in these existing initiatives have not been duplicated in the proposed initiatives below, nor have their emissions reductions.

5.2 Energy Efficiency Initiatives for Consideration

Energy efficiency initiatives were developed based on industry best practices and through workshops and discussions held with respective City business units. The proposed initiatives can be separated into two types:

1. **Enabling Initiatives** which remove the behavioral, cultural, or organizational barriers to technological and operational energy conservation measures, or further incentivize new initiatives. These actions build on current Corporate Sustainability initiatives and complement the on-going Partners for Climate Protection initiatives; and
2. **Technological and Operational Initiatives** which are strategies to improve energy efficiency of a particular facility, system, or process.

Table 5-2 provides a summary of the proposed initiatives by business unit, combined with the previously identified existing initiatives to provide an overall "master list" of initiatives. Some of these initiatives may impact multiple business units, particularly corporate-wide ("Corporate") initiatives and "Facility Services" initiatives which will impact business units operating those facilities. The initiatives have been listed by the business unit responsible for implementing them and the initiative type, and assigned an initiative number according to their business unit in ascending order by: Existing or Planned Initiatives, Enabling Initiatives, and finally Technological and Operational Initiatives.

Table 5-2
Energy Efficiency Initiatives Master List

Initiative #	Business Unit	Initiative Type	Initiative
C.1	Corporate	Enabling	Energy use gamification across BU's
C.2	Corporate	Enabling	Including efficiency metrics and targets in staff performance plans
C.3	Corporate	Enabling	Annual reporting on Efficiency Performance to Council
C.4	Corporate	Enabling	Energy benchmarking within Business Units
C.5	Corporate	Enabling	Alternative work strategies (telecommuting, shared offices and hoteling, emphasis on virtual meetings)
C.6	Corporate	Enabling	Develop internal Community of Practice to share knowledge, insights, lessons
C.7	Corporate	Enabling	Internal energy efficiency fund - awarded by competition
C.8	Corporate	Enabling	Adopt technological and data solutions to better monitor energy usage.
E.1	Electric	Existing or Planned	Conservation Voltage Reduction
F.1	Facility Services	Existing or Planned	Building Efficiency Retrofits
F.2	Facility Services	Enabling	Smart Commissioning of new facilities
F.3	Facility Services	Enabling	Creating baselines for energy usage at facilities which have not previously undergone an energy audit.
F.4	Facility Services	Technological and Operational	On-site solar (Medium Installation)
F.5	Facility Services	Technological and Operational	Active controls - heat
F.6	Facility Services	Technological and Operational	On-site solar (Large Installation)
F.7	Facility Services	Technological and Operational	On-site solar (Small Installation)
F.8	Facility Services	Technological and Operational	Heat Recovery
F.9	Facility Services	Technological and Operational	Lighting retrofits
F.10	Facility Services	Technological and Operational	Active controls - lighting
F.11	Facility Services	Technological and Operational	Building envelope sealing and window retrofits
F.12	Facility Services	Technological and Operational	Air Source Heat Pumps and HVAC Improvements
FL.1	Fleet	Existing or Planned	Fuel Efficient Emergency Vehicles
FL.2	Fleet	Existing or Planned	Green Fleet Policy
FL.3	Fleet	Enabling	Performance Dashboarding
FL.4	Fleet	Enabling	Vehicle right-sizing
FL.5	Fleet	Enabling	Fleet right-sizing
FL.6	Fleet	Existing or Planned	Electric/CNG Vehicle Conversion
FL.7	Fleet	Technological and Operational	Driver training
FL.8	Fleet	Technological and Operational	Fleet tire pressure program

Initiative #	Business Unit	Initiative Type	Initiative
FL.9	Fleet	Technological and Operational	Electric Vehicles for light duty fleet (Pilot)
P.1	Parks	Technological and Operational	Non-potable water use for irrigation
P.2	Parks	Technological and Operational	Automatic Irrigation Control
TR.1	Transit	Technological and Operational	Bay door operational improvement
TR.2	Transit	Technological and Operational	On-demand transit
TR.3	Transit	Existing or Planned	7 Electric Buses with Charging Infrastructure
TR.4	Transit	Technological and Operational	Route optimization
TP.1	Transportation	Technological and Operational	Optimizing snow removal routes and schedules
TP.2	Transportation	Technological and Operational	High efficiency lighting in parking lots
TP.3	Transportation	Technological and Operational	Adaptive Streetlight technology (illuminating only active areas, or by the movement of pedestrians and vehicles)
WR.1	Waste & Recycling Utilities	Existing or Planned	Landfill Gas Capture System
WR.2	Waste & Recycling Utilities	Enabling	Creating baselines for energy usage for the materials recovery facility
WR.3	Waste & Recycling Utilities	Enabling	Education and outreach initiatives to reduce community waste generation, and as a result reduce the total energy use of waste & recycling facilities
WR.4	Waste & Recycling Utilities	Existing or Planned	Residential Organics Collection
WR.5	Waste & Recycling Utilities	Technological and Operational	Optimizing waste collection routes
WR.6	Waste & Recycling Utilities	Technological and Operational	HVAC Upgrades - Waste & Recycling Utilities
W.1	Water, Wastewater, Stormwater	Existing or Planned	WWTP Cogeneration System
W.2	Water, Wastewater, Stormwater	Existing or Planned	Cured-in-place Piping
W.3	Water, Wastewater, Stormwater	Enabling	Creating baselines for energy usage for the wastewater treatment plant
W.4	Water, Wastewater, Stormwater	Enabling	Creating baselines for energy usage for the water treatment plant.
W.5	Water, Wastewater, Stormwater	Enabling	Education and outreach initiatives to reduce community water use, and as a result reduce the total energy use of water and wastewater treatment plants.
W.6	Water, Wastewater, Stormwater	Technological and Operational	Peak shaving opportunities - Water + Wastewater

Initiative #	Business Unit	Initiative Type	Initiative
W.7	Water, Wastewater, Stormwater	Technological and Operational	Aeration system optimization and blower upgrades - Wastewater
W.8	Water, Wastewater, Stormwater	Technological and Operational	Process optimization - UV disinfection
W.9	Water, Wastewater, Stormwater	Technological and Operational	HVAC Upgrades - Wastewater
W.10	Water, Wastewater, Stormwater	Technological and Operational	High-lift pump station optimization - Water
W.11	Water, Wastewater, Stormwater	Technological and Operational	HVAC Upgrades - Water
W.12	Water, Wastewater, Stormwater	Technological and Operational	Raw water pumping optimization - Water
W.13	Water, Wastewater, Stormwater	Technological and Operational	Reduce leakages - Water

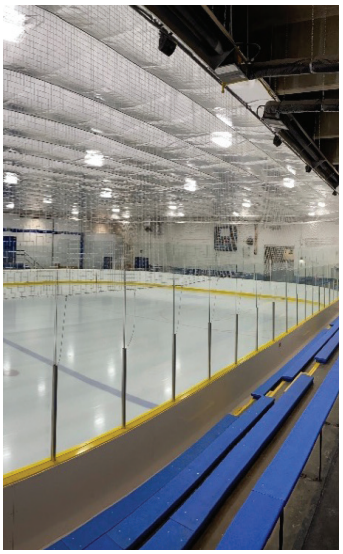
5.3 Enabling Initiatives

The enabling initiatives aim to remove the behavioral, cultural, or organizational barriers to technological and operational energy conservation measures, or further incentivize new initiatives. These actions build on current Corporate Sustainability initiatives and complement the on-going Partners for Climate Protection initiatives. **Table 5-3** on the following page provides a summary of the proposed enabling initiatives with the following section providing an overview of the enabling initiatives.

5.3.1 Energy Audits

Before moving forward with any of the initiatives below, detailed energy audits on the facilities or processes potentially related to energy efficiency measures should be conducted. The audits will inform more detailed estimates of potential energy reductions and cost savings from the Technology and Operational Initiatives.

Energy audits should be conducted for the largest energy users which have not already received an energy audit. These include:



- The water treatment plant;
- The wastewater treatment plant,
- The materials recovery facility,
- The four remaining Recreation, Culture & Community services facilities in the top 25 energy users:
  a. The Logan Boulet Arena,
  b. The Henderson Pool Services Building,
  c. The Civic Ice Centre,
  d. The Genevieve Yates Memorial Centre

The expected cost of these audits is approximately $100,000 each for the water and wastewater treatment plants, $50,000 for the materials recovery facility, and $50,000 altogether for the four remaining recreation, culture, and community services facilities.

A summary of all the enabling initiatives has been included in Table 5-3 following as reference.

Table 5-3
Enabling Initiatives Summary Table

Initiative Number	Business Unit	Initiative
C.1	Corporate	Energy use gamification across BU's
C.2	Corporate	Including efficiency metrics and targets in staff performance plans
C.3	Corporate	Annual reporting on Efficiency Performance to Council
C.4	Corporate	Energy benchmarking within Business Units
C.5	Corporate	Alternative work strategies (telecommuting, shared offices and hoteling, emphasis on virtual meetings)
C.6	Corporate	Develop internal Community of Practice to share knowledge, insights, lessons
C.7	Corporate	Internal energy efficiency fund - awarded by competition
C.8	Corporate	Adopt technological and data solutions to better monitor energy usage.
F.2	Facility Services	Smart Commissioning of new facilities
F.3	Facility Services	Creating baselines for energy usage at facilities which have not previously undergone an energy audit.
FL.3	Fleet	Performance Dashboarding
FL.4	Fleet	Vehicle right-sizing
FL.5	Fleet	Fleet right-sizing
WR.2	Waste & Recycling Utilities	Creating baselines for energy usage for the materials recovery facility
WR.3	Waste & Recycling Utilities	Education and outreach initiatives to reduce community waste generation, and as a result reduce the total energy use of waste & recycling facilities
W.3	Water, Wastewater, Stormwater	Creating baselines for energy usage for the wastewater treatment plant
W.4	Water, Wastewater, Stormwater	Creating baselines for energy usage for the water treatment plant.
W.5	Water, Wastewater, Stormwater	Education and outreach initiatives to reduce community water use, and as a result reduce the total energy use of water and wastewater treatment plants.

5.3.2 Corporate Enabling Initiatives

Corporate-wide Enabling Initiatives are intended to improve the capacity of business units to implement the Technological and Operational Initiatives given below, as well as encourage buy-in of further energy efficiency measures.

The primary means to change the culture around energy efficiency and encourage business units to account for energy efficiency in their planning and operations is to improve the accountability of staff for specific energy efficiency goals and targets. At a strategic level, this can include annual reporting by business units to Council on energy efficiency performance. At a more tactical level, including energy efficiency metrics and targets in staff performance plans would be a strong motivator and allow management to track staffs' and their own performance and the success of the initiatives they are responsible for over time.

Energy efficiency benchmarking can be undertaken across all business units. Whether this is benchmarking facilities within the City's inventory against each other, or benchmarking against Natural Resources Canada's national databases, this provides facility owners with targets and highlights areas of potential improvement.

Corporate Sustainability could undertake further initiatives like establishing an internal energy efficiency fund or launching energy gamification programs to increase the participation of business units in energy efficiency programs. Holding competitions for the energy efficiency fund or encouraging friendly, game-based competition to reduce energy use would encourage staff to think about energy efficiency in their business unit's operations.

Improving energy efficiency before new projects are undertaken and new facilities are built will be important to improving long-term energy efficiency of the City. Ensuring that there is smart commissioning of new facilities will streamline the commissioning process

and reduce the need for costly energy efficiency retrofits further into the facilities' lives. Creating an internal Community of Practice would allow for better sharing of best practices between business units. Ensuring that knowledge related to energy efficiency can propagate throughout the City will better prepare business units to plan and implement their own initiatives.

Finally, in line with the Digital Transformation Master Plan[17], IT systems and business processes can be created or expanded on to better capture and track energy usage. This can include increased metering and sub-metering at City facilities, linking metering to SCADA systems, or integrating smart building systems with corporate-wide energy tracking and management tools. This would require resources and coordination across business units, but would enable the City to establish energy related targets, better track its energy use, understand trends, assess and report progress and performance.

5.3.3 Business Unit-Specific Enabling Initiatives

While the majority of business-unit specific energy efficiency initiatives will be technological and operational in nature, there are some enabling initiatives that should be considered to support other initiatives.

Ensuring that the fleet as a whole and the vehicles in the fleet are the minimum size able to meet operational demands can significantly reduce the fuel use of fleet operations. A review of operational demands and current fleet capacity should be undertaken to inform fleet purchasing decisions. Performance dashboarding for use by management and operational staff can assist with performance tracking, identifying areas of improvement for troubleshooting, and can inform decision-making.

As discussed in Section 5.1.2, Facilities can ensure that all facilities go through a smart commissioning process where buildings are commissioned for optimal energy performance through a combination of diagnostics tools and quality-focused business processes which take place throughout the lifecycle of a building. A quick-win for facilities would be to ban energy inefficient personal space heaters in City facilities.

Water, Wastewater & Stormwater and Waste & Recycling Utilities can continue existing education and outreach campaigns to reduce community water use and waste generation and where needed create new ones, with the intent of reducing water and waste volumes processed, thereby cutting the energy use of the water, wastewater, and waste & recycling facilities. Such campaigns support Lethbridge's Environment Policy to use natural resources efficiently.

5.4 Technological and Operational Initiatives

The Technological and Operational Initiatives below are broken down by business unit. Each initiative has an estimate of the energy reductions, cost of implementation, cost savings, ease of implementation, and GHG reductions.

A table summarizing all the Technological and Operational Initiatives along with key methodological assumptions can be found in Appendix C.

5.4.1 Facilities

Facilities initiatives are focused on reducing natural gas and electricity use in City owned and leased facilities. The top 25 sites and facilities by energy use make up 87% of all stationary energy use (i.e. total energy use excluding fleet). The recommended initiatives only target these top 25 facilities. Furthermore, 17 of the facilities in the top 25 sites facilities have already received energy audits and recommendations for energy improvement measures. Excluding the five utilities sites, this leaves four remaining Recreation, Culture & Community services facilities in the top 25 energy users: the Logan Boulet Arena, the Henderson Pool Services Building, the Civic Ice Centre, and the Genevieve Yates Memorial Centre. While

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the Genevieve Yates Memorial Centre has been recently renovated, recommissioning opportunities are often identified even for newer facilities. The Civic Ice Centre is approaching the end of its service life and decommissioning still may be several years away. Based on this timeline, these initiatives may still be viable.

The energy efficiency initiatives proposed below are focused on these four remaining buildings. Accountability for these initiatives should be established to determine whether responsibility lies with Facilities, or with the end user of a facility. The initiatives are summarized below with preliminary implementation cost, cost savings, energy savings, and annual GHG savings estimates:

Table 5-4
Facilities Technological and Operational Initiatives Summary Table

Initiative Number	Initiative	Estimated Implementation Cost	Estimated Annual Cost Savings	Estimated Annual Energy Savings	Estimated Annual GHG Savings (tCO_2e)	Simple Payback Period	Ease of Implementation
F.5	On-site solar (Medium Installation)	$800,000 - $1,600,000	$44,000 - $81,000	728,000 kWh - 1,352,000 kWh	550 - 1,020	19 Years	Moderate Changes
F.6	Active controls - heat	$350,000 - $650,000	$28,000 - $53,000	1,582,000 ekWh - 2,939,000 ekWh	280 - 530	12 Years	Moderate Changes
F.7	On-site solar (Large Installation)	$3,200,000 - $6,400,000	$175,000 - $324,000	2,912,000 kWh - 5,408,000 kWh	2,200 - 4,080	19 Years	Complex or Significant Changes
F.8	On-site solar (Small Installation)	$200,000 - $400,000	$11,000 - $20,000	182,000 kWh - 338,000 kWh	140 - 250	19 Years	Moderate Changes
F.9	Heat Recovery	$100,000 - $200,000	$6,000 - $11,000	331,000 ekWh - 616,000 ekWh	60 - 110	18 Years	Moderate Changes
F.10	Lighting retrofits	$900,000 - $1,800,000	$31,000 - $58,000	521,000 kWh - 968,000 kWh	390 - 730	30 Years	Minimal Changes
F.11	Active controls - lighting	$900,000 - $1,800,000	$31,000 - $58,000	521,000 kWh - 968,000 kWh	390 - 730	30 Years	Moderate Changes
F.12	Building envelope sealing and window retrofits	$20,000 - $40,000	$1,000 - $1,000	39,000 ekWh - 72,000 ekWh	7 - 13	30 Years	Moderate Changes
F.13	Air Source Heat Pumps and HVAC Improvements	$300,000 - $600,000	$6,000 - $12,000	346,000 ekWh - 643,000 ekWh	60 - 120	50 Years	Moderate Changes

To reduce natural gas consumed for heating a mix of complementary strategies can be adopted. This can include active controls for heating, heat recovery systems, air source heat pumps and HVAC improvements, and building envelope improvements such as window retrofits and increased insulation.

While not strictly an energy efficiency measure, exploring the continued use of solar for City facilities can offset a significant amount of grid energy use.

F.5, F.7, F.8 Solar Installations – These systems can be mounted on suitable rooftops at medium or large sized facilities or can be constructed as larger standalone outdoor installations. Preliminary estimates were performed for three installation sizes: small (10m x 10m), medium (20m x 20m), and large (40m x 40m) installations.

F.6 Active Heating - Active heating systems can decrease temperatures during times of low-use through the use of smart thermostats, upgraded sensors, or centralized controls over heating and cooling systems.

F.10 Lighting Retrofits - Inefficient interior and exterior incandescent and fluorescent lights can be replaced with energy efficient LEDs with longer lifespans.

F.11 Active Lighting – Active lighting control systems can turn off or on lighting in response to occupancy using motion sensors, daylight sensors, or other centralized control systems.

F.9 Heat Recovery - Heating and cooling demands on HVAC systems can be reduced by recovering waste heat rejected from a variety of building processes. Waste heat can be collected from ventilation systems, boilers, or refrigeration units. Captured and reused waste heat can reduce the need for natural gas through preheating.

F.12 Building Envelope Sealing - Retrofits to building envelopes can improve facility insulation and reduce air leakage. Sealing the areas around windows, doors, and gaps at transitions between walls and floors or roofs can significantly improve heating efficiency.

F.13 Air Source Heat Pumps - Air source heat pumps absorb heat from outside air and release it inside the building as hot air, in hot water-filled radiators, through underfloor heating or for domestic hot water supplies.

5.4.2 Fleet

Fleet initiatives are focused on reducing the total amount of diesel and gasoline used by City vehicles. These initiatives target all vehicles in the fleet. Actions targeting business unit specific vehicles are given below in those business units' sections. The initiatives are summarized below with preliminary implementation cost, cost savings, energy savings, and annual GHG savings estimates:

Table 5-5
Fleet Technological and Operational Initiatives Summary Table

Initiative Number	Initiative	Estimated Implementation Cost	Estimated Annual Cost Savings	Estimated Annual Energy Savings	Estimated Annual GHG Savings (tCO_2e)	Simple Payback Period	Ease of Implementation
FL.7	Driver training	Minimal	$109,000 - $202,000	109,000 L - 202,000 L	270 - 500	<1 Year	Minimal Changes
FL.8	Fleet tire pressure program	Minimal	$81,000 - $150,000	81,000 L - 150,000 L	200 - 370	<1 Year	Minimal Changes
FL.9	Electric Vehicles for light duty fleet	$3,000,000 - $6,000,000	$74,000 - $137,000	74,000 L - 137,000 L	180 - 340	43 Years	Complex or Significant Changes

Fuel use can be reduced across the fleet by implementing driver training programs and fleet tire pressure programs. Small fuel savings from individual vehicles can add up over time to large savings.

FL.7 Driver Training Programs - Operational staff can receive training on strategies to reduce fuel usage while driving (accelerating, braking, idling, etc.). This initiative is most effective when fuel usage can be tracked using real-time fuel monitoring systems, and presented through performance dashboarding, allowing managers to identify areas in need of improvement. Training programs of this kind in other Canadian municipalities have seen 10% decreases in fuel used[18], and in Lethbridge have already resulted in a 4% reduction in fuel use.

FL.8 Tire Pressure Programs - Ensuring tires are properly inflated can improve fuel efficiency, with some municipalities seeing improvements of up to 5%[19]. Regularly checking tire pressure can also reduce tire wear in addition to improving fuel economy. While some business units, such as Transit already monitor tire pressure, this is a practice that can be extended to the entire fleet or light and heavy-duty vehicles.

FL.9 Light Duty Electric Vehicles - Transitioning the light-duty fleet towards efficient electric vehicles has a high initial capital cost, but is an effective way to reduce gas and diesel use. A portion of the subsequent fuel savings are replaced by the costs of grid-supplied electricity;

18 https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-transportation/greening-freight-programs/smartdriver-training-series/21048
19 https://theicct.org/sites/default/files/publications/ICCT_tireefficiency_jun2011.pdf

however, these costs are often significantly lower than the costs of fuel. The total cost of ownership for electric vehicles may be substantially lower than for non-electric vehicles as they see decreased costs for fueling and maintenance over their lifetimes. In future years as electric light-duty trucks become available on the market, exploring transitioning the existing light-duty truck fleet to electric trucks would be worthwhile to reduce fuel use and fuel costs as well as reduce maintenance costs over the operating lives of those vehicles.

5.4.3 Parks

Parks initiatives are focused on reducing potable water use for irrigation, and as a result decreasing the amount of electricity used for water treatment and pumping. The initiatives are summarized below with preliminary implementation cost, cost savings, energy savings, and annual GHG savings estimates:

Table 5-6
Parks Technological and Operational Initiatives Summary Table

Initiative Number	Initiative	Estimated Implementation Cost	Estimated Annual Cost Savings	Estimated Annual Energy Savings	Estimated Annual GHG Savings (tCO_2e)	Simple Payback Period	Ease of Implementation
P.1	Non-potable water use for irrigation	Variable	$2,000 - $3,000	25,000 kWh - 46,400 kWh	20 - 30	Variable	Low Changes
P.2	Automatic Irrigation Control	$150,000 - $300,000	$5,000 - $8,000	75,000 kWh - 139,000 kWh	60 - 100	35 Years	Moderate Changes

Potable water use can be decreased through automatic irrigation controls, and greater use of non-potable water for irrigation.

P.1 Non-potable Water Use - Making use of a larger volume of non-potable water for irrigation where possible will reduce water treatment energy use. As of 2019, 59% of water used for irrigation in City parks and greenspaces is treated water. Not all irrigation systems can cost effectively or energy effectively transition to non-potable water use. The energy reductions and cost effectiveness of non-potable irrigation systems will depend, in part, the location of each respective park, as energy use for pumping from alternate water sources must be considered against the energy savings from using treated water. Further studies will be needed to determine where non-potable water use can be utilized.

P.2 Automated Irrigation Controls - Automated irrigation systems allow for better monitoring and tracking of irrigation in City parks and greenspaces and can decrease over-watering.

5.4.4 Transit

Transit initiatives are focused on reducing fuel use for busses, as well as operational improvement to transit garages. Unless otherwise stated, these initiatives apply to the entire transit fleet. The initiatives are summarized below with preliminary implementation cost, cost savings, energy savings, and annual GHG savings estimates:

Table 5-7
Transit Technological and Operational Initiatives Summary Table

Initiative Number	Initiative	Estimated Implementation Cost	Estimated Annual Cost Savings	Estimated Annual Energy Savings	Estimated Annual GHG Savings (tCO_2e)	Simple Payback Period	Ease of Implementation
TR.1	Bay door operational improvement	Minimal	$3,000 - $6,000	167,000 ekWh - 306,000 ekWh	30 - 50	<1 Year	Minimal Changes
TR.2	On-demand transit	$70,000 - $130,000	$59,000 - $110,000	59,000 L - 110,000 L	150 - 270	1 Year	Complex or Significant Changes
TR.4	Route optimization	$35,000 - $65,000	$59,000 - $110,000	59,000 L - 110,000 L	150 - 270	1 Year	Moderate Changes

In addition to the Fleet initiatives, Transit fuel usage can be further reduced through a move towards on-demand transit as well as through route optimization. These are complex changes and fuel efficiency will need to be evaluated against other goals and service targets.

TR.1 Bay Door Operational Improvements - In addition to vehicle fuel efficiency initiatives, a small but low-cost initiative to reduce natural gas use is to ensure that bay doors are not left open unnecessarily to reduce heat lost.

TR.2 Route Optimization - Fuel efficiency can also be part of a larger conversation around optimizing transit routes. Any changes to routes which reduce the number of vehicle-kilometres travelled or reduce the numbers of times a bus starts, stops, or idles will improve fuel efficiency.

TR.4 On-demand Transit Use - While fuel efficiency is not the primary driver of the move towards on-demand transit, reducing the number of busses dispatched will also reduce fuel in addition to the primary gain of lower operating costs.

Electric busses and charging infrastructure are covered under an existing initiative.

5.4.5 Transportation

Transit initiatives are focused on reducing fuel use for snow removal vehicles, as well as reducing energy use for outdoor lighting. The initiatives are summarized below with preliminary implementation cost, cost savings, energy savings, and annual GHG savings estimates:

Table 5-8
Transportation Technological and Operational Initiatives Summary Table

Initiative Number	Initiative	Estimated Implementation Cost	Estimated Annual Cost Savings	Estimated Annual Energy Savings	Estimated Annual GHG Savings (tCO_2e)	Simple Payback Period	Ease of Implementation
TP.1	Optimizing snow removal routes and schedules	$10,000 - $20,000	$1,000 - $1,000	500 L - 900 L	1 - 2	15 Years	Moderate Changes
TP.2	High efficiency lighting in parking lots	$250,000 - $500,000	$21,000 - $38,000	345,000 kWh - 641,000 kWh	260 - 480	13 Years	Minimal Changes
TP.3	Adaptive Streetlight technology (illuminating only active areas, or by the movement of pedestrians and vehicles)	$500,000 - $1,000,000	$86,000 - $159,000	1,429,000 kWh - 2,654,000 kWh	1,080 - 2,000	6 Years	Complex or Significant Changes

TP.1 Optimizing Snow Removal Routes - In addition to the Fleet initiatives, Transportation fuel usage can be further reduced by optimizing snow removal routes and schedules. When optimizing snow removal routes fuel efficiency will need to be evaluated against other goals and service targets but there may be opportunities to find fuel efficiency savings by reducing excess travel time to and from garages, collection points and snow dumps.

To reduce electricity consumption, strategies targeting lighting can be implemented. These strategies include replacing the remaining non-LED lights in the streetlight network (primarily in City-owned parking lots) and adaptive streetlighting.

TP.2 High Efficiency Lighting - The remaining non-LED streetlights, primarily the remaining non-LEDs in parking lots or along pedestrian pathways can be replaced to bring these lights in line with the rest of the network.

TP.3 Adaptive Streetlighting - Adaptive streetlighting includes retrofitting existing streetlights with new technology and systems to dynamically control the activation of streetlights. Streetlights can turn off during off-peak hours and automatically brighten when vehicles, cyclists and pedestrians are detected. This results in a decrease in energy use and emissions, as well as a decrease in light pollution. Adaptive streetlighting will need to balance energy savings with the needs and safety concerns of the community. “Sensitive” areas, like crosswalks and pedestrian paths, can be optimized to mitigate safety concerns.

Table 5-9
Waste & Recycling Technological and Operational Initiatives Summary Table

5.4.6 Waste & Recycling Utilities

Waste & Recycling Utilities initiatives are focused on reducing energy used for heating in the Materials Recovery Facility, as well as reducing fuel use for waste collection. The initiatives are summarized below with preliminary implementation cost, cost savings, energy savings, and annual GHG savings estimates:

Initiative Number	Initiative	Estimated Implementation Cost	Estimated Annual Cost Savings	Estimated Annual Energy Savings	Estimated Annual GHG Savings (tCO_2e)	Simple Payback Period	Ease of Implementation
WR.5	Optimizing waste collection routes	$20,000 - $40,000	$8,000 - $15,000	8,000 L - 15,000 L	20 - 40	3 Years	Low Changes
WR.6	HVAC Upgrades - Waste & Recycling Utilities	$25,000 - $50,000	$3,000 - $5,000	158,000 ekWh - 294,000 ekWh	30 - 50	9 Years	Low Changes

WR.5 Optimizing Waste Collection Routes - In addition to the Fleet initiatives, Waste & Recycling Utilities fuel usage for waste collection trucks can be further reduced by optimizing waste collection routes and schedules. When optimizing waste collection routes fuel efficiency will need to be evaluated against other goals and service targets, but there may be opportunities to find fuel efficiency savings by reducing excess travel time to and from garages, collection points and landfills.

WR.6 HVAC Upgrades for the Materials Recovery Facility - HVAC upgrades to the Materials Recovery Facility (pictured) can reduce electricity and natural gas consumption at the site. This can include active controls for heating and cooling, upgraded filters, or VRF systems. An energy audit of the facility should be performed to further explore the potential for energy savings at this facility.

5.4.7 Water, Wastewater & Stormwater

Water, Wastewater & Stormwater initiatives are focused on reducing energy used during water treatment and distribution, and wastewater treatment and collection. Water and wastewater infrastructure are two of the largest energy uses in the City, making up a combined 31% of total City energy consumption. Any gains in the energy efficiency of water and wastewater processes will have a significant improvement on total City energy usage. Energy audits for the water and wastewater treatment plants are an important first step in better assessing the effectiveness of the different initiatives proposed. The initiatives are summarized below with preliminary implementation cost, cost savings, energy savings, and annual GHG savings estimates (see Table 5-10 on the following page).

Specific water and wastewater processes can be optimized to provide the same performance with reduced energy use.

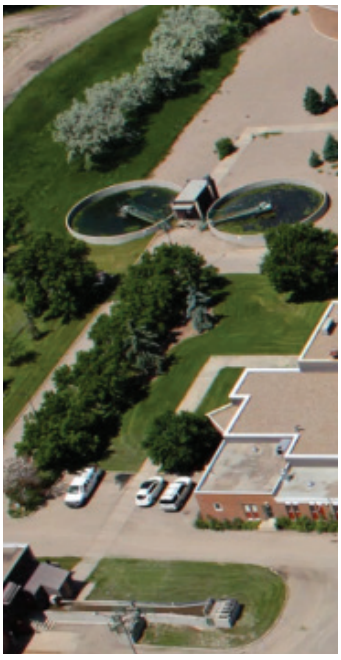
W.6 Peak Shaving Opportunities – Indirectly related to minimizing total energy usage, it is worthwhile to explore whether shifting pumping and processes to off-peak times could lower energy use and reduce demand charges during peak hours. This will require further study of operational requirements and demand charges to determine whether this type of peak-shaving is worthwhile.

W.7 Aeration System Optimization - For wastewater, aeration systems can be optimized. The aeration system can be analyzed to determine whether it is operating as efficiently as possible for the required level of treatment. Power monitoring, along with pressure and temperature monitoring can be installed and trended to improve energy and flow data. This improved flow data can allow the City to make more informed decisions on the blowers' operations.

W.8 Optimizing UV Disinfection - For water treatment, the ultraviolet disinfection system can be optimized through re-validation testing to reduce energy use while ensuring that dosage levels remain appropriate to meet water quality standards.

Table 5-10
Water, Wastewater & Stormwater Technological and Operational Initiatives Summary Table

Initiative Number	Initiative	Estimated Implementation Cost	Estimated Annual Cost Savings	Estimated Annual Energy Savings	Estimated Annual GHG Savings (tCO_2e)	Simple Payback Period	Ease of Implementation
W.6	Peak shaving opportunities - Water + Wastewater	Variable	Variable	Variable	Variable	Variable	Complex or Significant Changes
W.7	Aeration system optimization - Wastewater	$10,000 - $20,000	$13,000 - $25,000	221,000 kWh - 410,000 kWh	170 - 310	1 Year	Moderate Changes
W.8	Process optimization - UV disinfection - Water	$50,000 - $200,000	$13,000 - $38,000	210,000 kWh - 630,000 kWh	160 - 480	5 Years	Minimal Changes
W.9	HVAC Upgrades - Wastewater	$50,000 - $100,000	$4,000 - $7,000	222,000 ekWh - 412,000 ekWh	40 - 70	14 Years	Low Changes
W.10	High-lift pump station optimization - Water	$50,000 - $200,000	$6,000 - $21,000	105,000 kWh - 350,000 kWh	80 - 260	9 Years	Low Changes
W.11	HVAC Upgrades - Water	$50,000 - $100,000	$10,000 - $20,000	560,000 ekWh - 1,110,000 ekWh	100 - 200	5 Years	Low Changes
W.12	Raw water pumping optimization - Water	$50,000 - $200,000	$4,000 - $13,000	63,000 kWh - 210,000 kWh	50 - 160	15 Years	Moderate Changes
W.13	Reduce leakages - Water	Variable	$17,000 - $31,000	Variable	210 - 390	Variable	Low Changes



W.9 & W.11 HVAC Upgrades – HVAC improvements in the water and wastewater treatment plants could further reduce natural gas and electricity use. For water treatment, HVAC systems can be analyzed to determine the potential benefit of space temperature reduction in the process areas. This can also include measuring air contaminant levels and adjusting the ventilation rates to match the requirements of the process area to reduce HVAC energy consumption and costs. For wastewater treatment, HVAC system energy consumption can be reduced by optimizing the control strategy and installing VFDs to all constant-speed motors part of the air handling equipment.

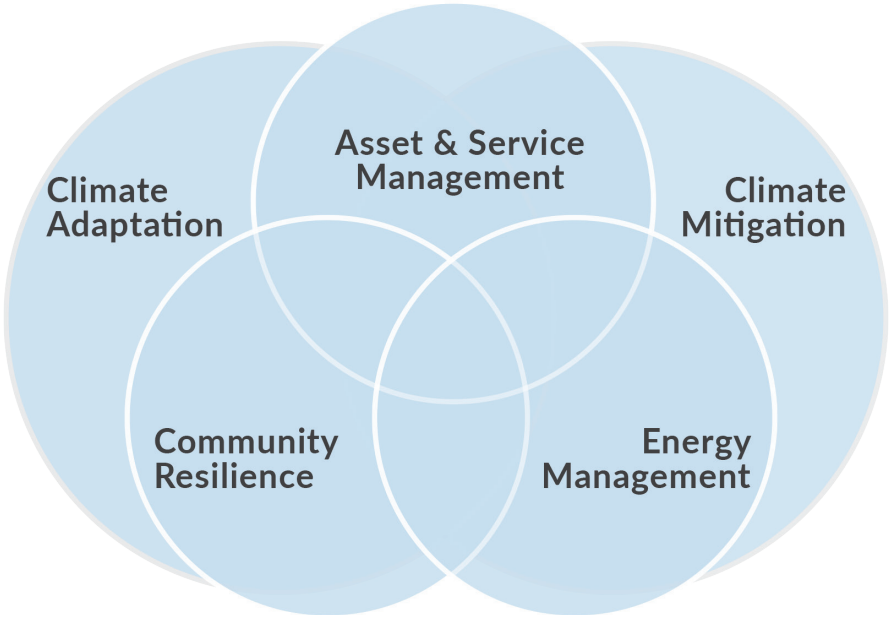
W.10 & W.12 Pumping System Optimization – Pumping systems can be further optimized. For the water treatment system, raw water pumping optimization and high-lift pump station optimization can be explored. Pumping often makes up a significant amount of treatment plant energy consumption, so any improvements in the equipment or operation could yield significant savings. This can include ensuring pumps are right-sized to meet operational demands or changes to the operational philosophy to ensure that pumps are running at levels appropriate to demand. Pump station optimization may also be an opportunity.

W.13 Minimizing Water Leakage – Finally, although water leakages in the plants themselves are low, during a plant-wide investigation opportunities to reduce leakage from relatively high-leakage processes and equipment may be identified. Any water lost through leakage after it is treated is unnecessary energy used during the treatment process (W.13).

6 Implementation Plan & Strategy

6.1 Intersections of an Energy Efficiency Culture

Energy efficiency should be integrated into a wider conversation about energy management, asset and service management, as well as community resilience goals and desired outcomes. Each of these conversations are situated within the recognition that the climate is changing. The implications of a changing climate are widespread and significant, requiring a response that increases climate resilience (responding to the impacts of a changing climate) and climate mitigation (reducing the drivers of climate change). Energy efficiency will touch each of these areas, incorporating a large number of stakeholders. To build an energy efficiency culture, understanding and strengthening the ties between energy efficiency and these closely related conversations and goals will be vital.



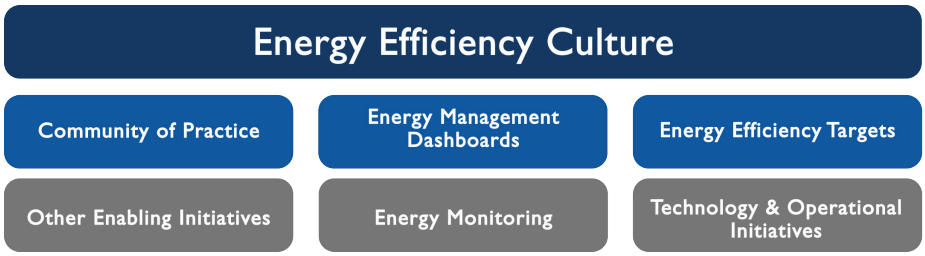
Underlying each of these areas, as a response to climate risk, are the interconnecting concepts of climate mitigation and climate resilience. The changing climate presents risk in two distinct ways: physical risk due to acute climate related hazards such as extreme weather or wildfire, and chronic hazards such as drought or water insecurity; and, transitional risk associated with the move away form fossil fuels and which includes risks related to changes in legal or reporting requirements, changes in technology, and reputational or social license concerns.

Climate resilience and adaptation focuses on improving communities' abilities to manage physical risk and reduce or withstand the impacts of climate change. Climate resilience can take many forms, from ensuring that communities are prepared for future extreme weather events, to ensuring that infrastructure is built to withstand changing weather patterns or maintain equivalent levels of service into the future, or to ensuring that natural resources like water and agricultural land are managed sustainably in a future where climactic trends may differ significantly. Climate mitigation focuses on taking actions to reduce transition risk through reducing the amount of greenhouse gases emitted, slowing the effects of climate change. This can include adopting more energy efficient technologies, switching to low-carbon energy sources, or capturing carbon before it enters the atmosphere. Energy efficiency is an important part of climate mitigation while also playing a role in climate adaptation and resilience, both of which are part of a larger climate program.

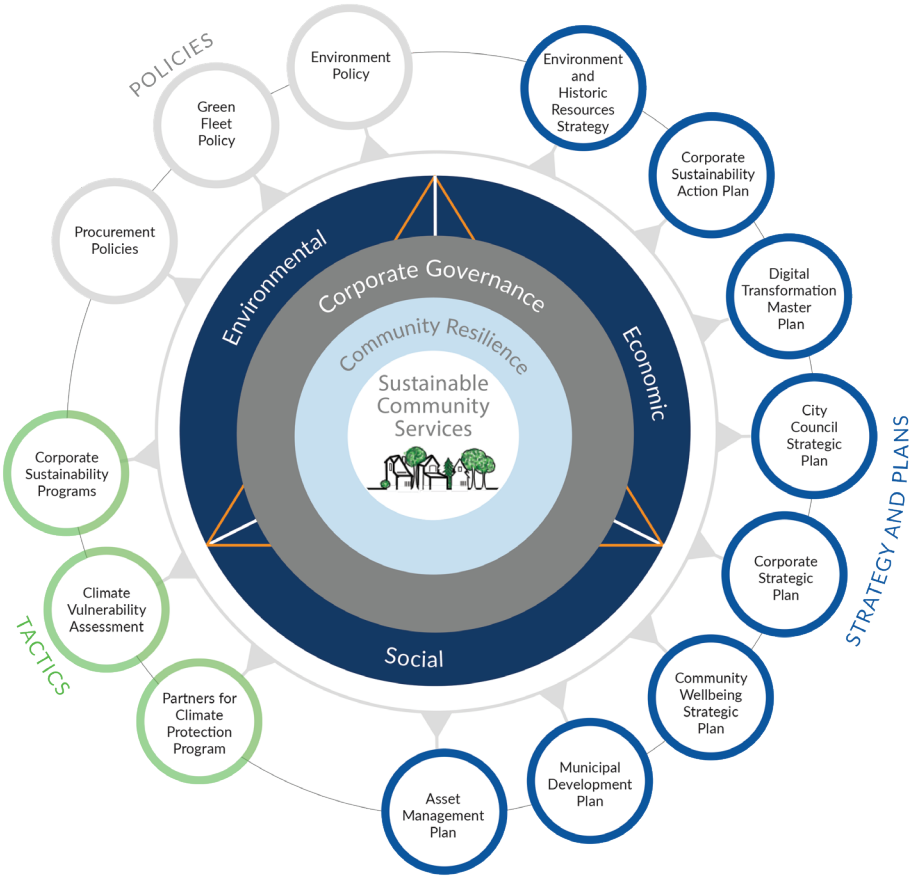
Within these larger climate considerations, energy efficiency is also a key aspect to energy management, since energy efficiency goals are directly related to GHG emissions and cost reduction goals. However, there may be circumstances where energy efficiency goals come

in conflict with emissions reductions or cost reduction goals. For example, an electric water heater could use more energy than its natural gas equivalent, but have substantially lower GHG emissions. Energy efficiency or GHG reduction projects might reduce energy usage or GHG emissions while having greater costs than an existing system, yet in some cases may reduce cost on their own right. Ensuring that policies and plans incorporate GHG emission, energy and cost considerations will allow for effective decision-making when the goals of energy efficiency, GHG emissions reductions, and cost do not naturally align.

Energy efficiency, likewise, plays a part in asset and service management. Energy efficiency projects often require input and judgement from strategic, tactical, and operational staff. Targets and metrics must be created with consultation between asset managers and service managers to ensure that energy efficiency goals can be pursued while being technologically feasible and the least disruptive to service delivery.



Each of these corporate considerations also intersect with community resilience, and community and environmental goals. Engaging with, and involving, the community on energy efficiency initiatives can help build an energy efficiency culture within the wider community as well. Hands-on experience with energy efficiency and GHG mitigation projects can help foster community resilience by raising awareness about the impacts of climate change on the community while showcasing the benefits of sustainable energy investments. Reduced demand for energy and local power generation also increase resilience through reduced reliance on larger systems, which can be prone to more disruption.



Understanding these considerations can help strengthen the ties between energy efficiency policies and plans with the City's other related policies, strategies, and tactics. The diagram below summarizes some of the most relevant polices, strategies & plans, and tactics or programs. Each fall within the interrelated contexts of sustainable community services, the importance of community resilience, and overarching corporate governance, all considering overall social, economic and environmental considerations.

6.2 Timelines

The 19 Enabling Initiatives are a priority and should be seen as foundational to enabling the success of Technological and Operational Initiatives to be implemented. While most of these initiatives can be pursued at any time, there are certain components critical to the success of these programs that always start with Starting with increased collaboration that underpins an energy efficiency culture followed by the establishment of clear and well defined targets, with actionable initiatives to realize them and meaningful monitoring and report practices.

Implementing these recommended initiatives will all contribute to the 2030 emissions target set by Council. However, as displayed in Figure 6-1, there still remains a gap to achieve this target.

Figure 6-1
40% GHG Reduction Target and Projected Emissions

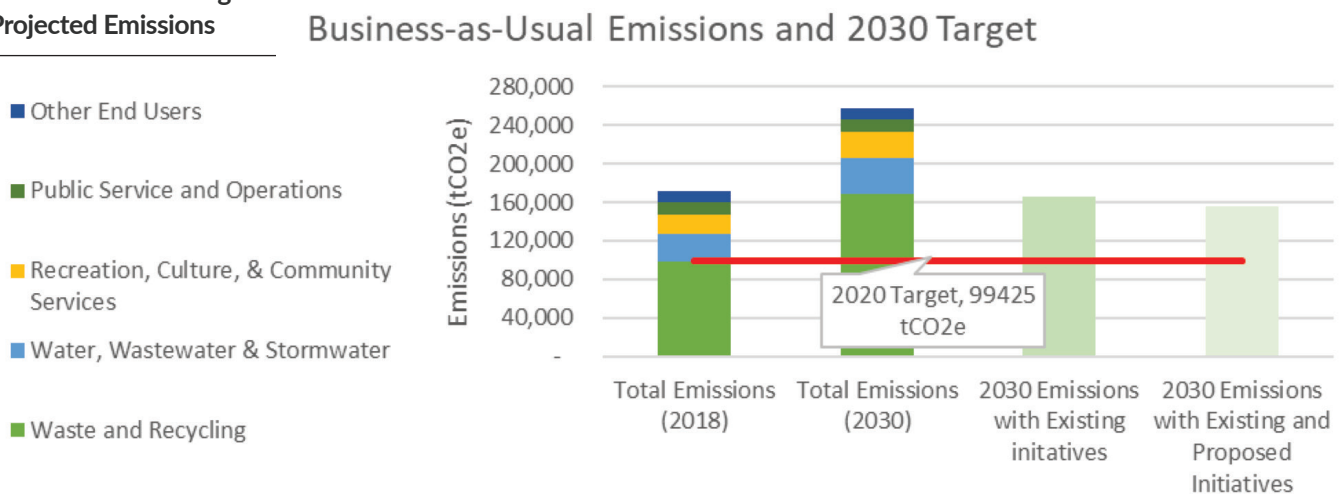
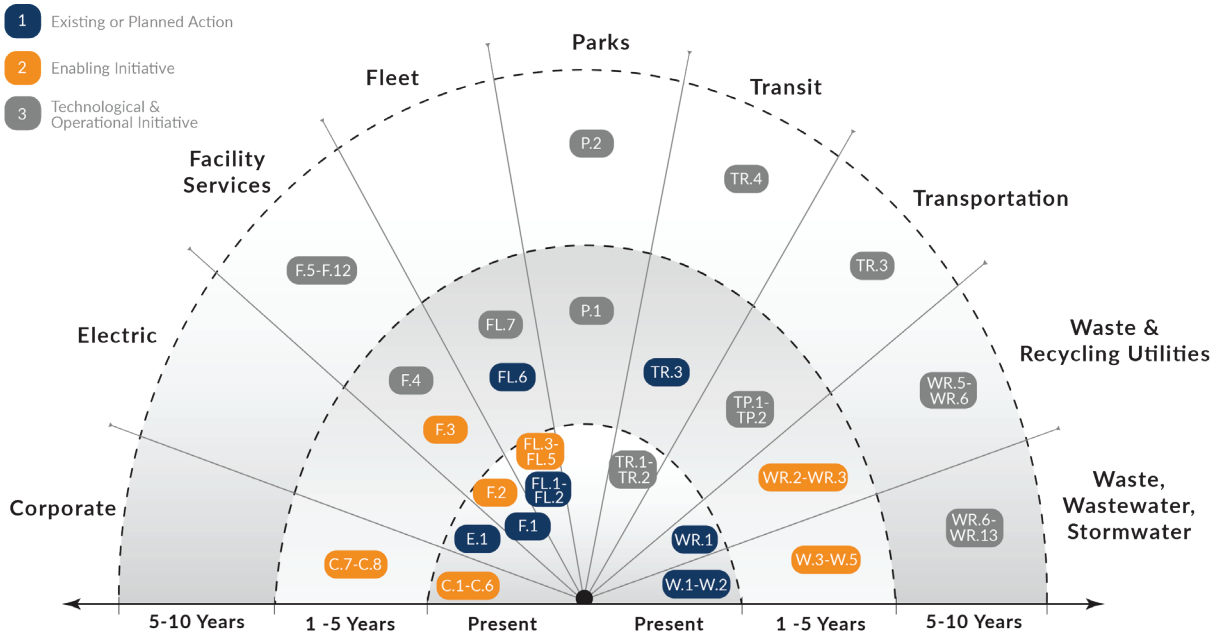


Figure 6-2
Implementation Timeline

To help meet these targets, a timeline is suggested for the proposed initiatives in Figure 6-2.



6.3 Public and Internal Engagement

The City has a clear mandate for encouraging public engagement through the Public Participation Policy[20]. This encourages the engagement of the public and City employees in the activities of the organization. Two of the initiatives directly related to public engagement to gain support for minimizing waste generation and reducing water consumption. Both of these initiatives have direct impacts on the energy use and operational costs of the City of Lethbridge, but communications should also emphasize the benefit for individual customers.

Customer engagement surveys - Engagement activities related to energy efficiency can be incorporated into existing engagement forums including customer satisfaction surveys which can be used to raise awareness and begin to understand customer priorities. Specific questions could be incorporated into satisfaction surveys that ask for example to what extent customers support the City's initiatives to improve energy efficiency across the corporation. And to what extent customers feel enabled to take their own action on improving energy efficiency in terms of waste generation and water consumption.

Council and open house forums - In addition, Councillors may be encouraged to talk to citizens about the City's energy efficiency challenges and encourage public participation and feedback on the City's initiatives. Open forums or open house events are also a good opportunity for the City to communicate its energy efficiency initiatives and may be completed in conjunction with other engagement initiatives such as engaging citizens about levels of service expectations. In the near-term, due to COVID-19 the number of in-person events will be significantly lower. Making use of online forums like getinvolvedlethbridge.ca to solicit citizen input will be particularly important.

Social media and printed communications - Communications materials incorporated with tax billing information tend to be less effective although this is often the first route of engagement with communities. Today, social media platforms have taken over as being the most common and more effective platform for engagement and the City should incorporate communications on energy efficiency in its social media activities.

Internal Engagement - In the course of this work, Associated conducted five stakeholder workshops with representatives from different City of Lethbridge Business Units to gather information and to increase buy-in for the project. Members of Facilities, Electric, Transit, Fleet, Transportation, Water, Wastewater & Stormwater, Waste & Recycling Utility, and Parks participated in guided discussions as part of a series of virtual workshops to discuss their current energy efficiency and emissions reductions initiatives, the progress of their respective initiatives, and the direction they would like to see the Energy Conservation Master Plan & Strategy take. In addition to the guided discussion in the workshops, representatives of the Business Units completed a workbook to gather input about the goals and guiding principles of the Plan and to confirm the scope of activities to be considered in the Plan. This feedback from the stakeholder workshops and workbooks was captured and incorporated into the Plan and informed the development of the initiatives above.

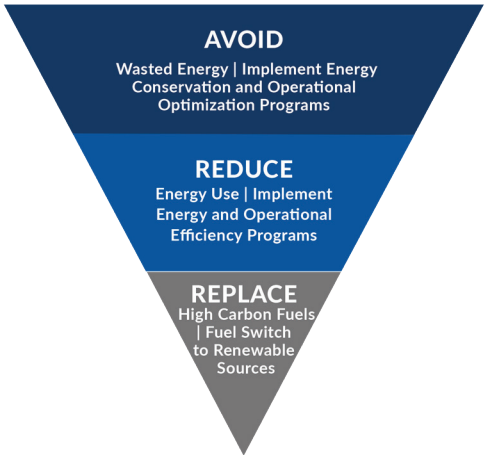
6.4 Business Processes

Key to achieving any of the energy efficiency objectives is creating a business-as-usual¬ mindset that not only encourages the consideration of energy efficiency opportunities but incorporates it as a key consideration in the process of running the municipality.

Decision making and prioritization process – operational and capital promotion and decision-making processes should be modified to include consideration of energy efficiency opportunities and impacts (right along side consideration of climate change risks, operational and capital cost implications of decisions or other impacts). This can be as simple as a qualitative prompt on business case forms or a systematic process for evaluating the energy

20 Public Participation Policy

impacts of each identified capital investment need. Decision makers will need to encourage this behaviour and enforce taking it seriously through the governance processes for decision making.



Systematic process for evaluating and prioritizing energy opportunities – Energy specific initiatives may be subjected to further rigour to justify what can be significant investment needs that may generate equally significant benefits. Return on Investment (ROI) or payback ratios should be evaluated and challenged. Initiatives with shorter paybacks should clearly be prioritized and a potential threshold of five years may be considered. An estimate of payback has been included in the initiatives indicated in this study however, further evaluation of the costs and potential benefits will significantly influence these numbers.

Synergies of investment – Synergies between energy efficiency initiatives and other investment needs should be maximized wherever possible. The Asset Management Plan indicates that approximately $375M of asset investment need is already in backlog (as of 2019) and a further $127M of assets will become due for renewal by 2025. While the confidence in the size and impact of the backlog may be limited, it represents an opportunity to incorporate energy efficiency initiatives with a very low premium over and above the existing asset replacement values. Coupled with potential funding opportunities from federal government the benefits may also be realized on renewal needs directly.

6.5 Monitoring & Reporting

Figure 6-3
ISO 55001 Energy Management

A number of the identified initiatives are founded on the ability to baseline, monitor and report on energy usage. This not only provides visibility of energy usage but allows more robust decisions to be made and actions to be taken. The effectiveness of any action including the initiatives identified in this report can then be measured and with continuous improvement principles in mind (see the Strategic Energy Management processes in Figure 6-3), improvements can be made to this action plan.

Frequency of reporting - Energy should be monitored and tracked internally at least on a monthly basis. As the information is collated the organization will begin to draw more insight and be able to make more use of the information provided. The initial collection of robust energy information may initially be limited, however, over time the systems and processes for collection, analysing and surfacing information will improve. This is in line with the Digital Transformation Master Plan and the enabling initiative to create or expand on systems to capture and track energy usage.

Reporting technology - Reporting systems may draw on technology such as Excel, Power BI, or Tableau to allow for interactive dashboards where users can drill down into trends or breakdown energy usage by business unit, facility, activity and fuel type and compare with similar periods in previous years. The choice of specific reporting technology will depend in part on the experience of staff making use of that technology, and it is recommended that staff make use of tools they would be comfortable adopting and working with, rather than pushing for the most advanced tools which may see less uptake.

Resources to support monitoring - The initial establishment of monitoring and reporting systems will require resources to collate and champion the information in a consistent manner and may require the development and use of technology. Spreadsheets should be used as a first iteration to allow the City flexibility and evaluate the right data and metrics for surfacing and reporting.

Energy metrics and targets - Key metrics for reporting should be determined in part by the availability of data, but could include absolute and normalized energy consumption metrics such as total kWh consumed in the period as well as kWh/m^2 (energy use intensity) for facilities or as appropriate for the service line (e.g. per property, per capita). For services, metrics such as energy intensity per unit of water or wastewater treated or fuel used per kilometre for fleet vehicles can be used to measure performance. These metrics should be determined in conversation with the Business Units that would be responsible for tracking them. Once metrics are decided upon, appropriate targets, absolute or normalized, can be decided upon. These targets most often take the form of annual reduction targets at a rate consistent with meeting long-term targets. Understanding historical energy trends before setting targets can help inform whether the targets are reasonable (setting high targets on business units which are already performing well or have recently taken efforts to reduce their energy usage significantly may be perceived as unreasonable).

6.6 Governance

Championing the objective to achieve energy efficiencies will require collaboration and governance that seeks to uphold the mechanisms for encouraging energy consideration. This will require knowledge sharing forums that are able to operate across business units as a community of practice, coordination roles potentially within each business unit and centrally to coordinate efforts and reporting on initiatives and governance roles to challenge and champion investment decisions.

Governance Committee – The capital investment committee should be enhanced with a mandate to incorporate energy efficiency considerations in investment evaluation and decision making. A stage-gating process to control investment delivery and release of investment funds should incorporate the communication of energy commitments by project teams. These governance committees may be enhanced through the inclusion of an energy champion on the committee if a champion does not already exist.

Climate and energy efficiency Community of Practice – A Community of Practice should be established to allow knowledge sharing and collaboration among and across business units with regards opportunities. The Community of Practice also supports development opportunities for staff to learn about other business unit activities and develop a broader understanding of energy management across the municipal organization. As energy efficiency is a part of a larger conversation about climate risk and community resilience, expanding the community of practice beyond only energy efficiency is recommended.

Energy Coordinator – A central role for energy coordination and reporting will be essential to support a community of practice and effectively report on energy efficiency gains across the corporation.

6.7 Purchasing Policy

The City's procurement policy should be expanded to include consideration of energy efficiency when evaluating procurement of related capital and operating expenditures. The recently ratified Green Fleet Policy includes these types of considerations and should be expanded for all procurement. The City could also create an energy efficiency policy, however, most municipalities have broader energy policies or incorporate energy efficiency into other policies (green building policies, water efficiency policies, climate change/emissions policy,

etc.). The advantage to a broader policy is that it can also incorporate GHG emissions and other environmental considerations as well. Vancouver's Low Carbon Energy Systems Policy is an example of such an approach[21].

6.8 Assumptions and Uncertainties

It is anticipated that during the implementation of initiatives outlined in this plan the regulatory landscape and mechanisms to support energy efficiency will change radically.

Regulatory Landscape - Section 2 of this plan highlighted the desire by the Federal Government to achieve net zero emissions by 2050. This objective is highly likely to change given changes in political aspirations of the government of the day, however, the global pressure to maintain emissions reductions will remain – the geophysical basis for climate change cannot be ignored, so the driver to reduce emissions will remain. The currently achieved 1.5% reduction in emissions over the 2005 baseline will come under increasing scrutiny, and pressure may be put on provincial and municipal jurisdictions to drive greater emissions cuts. This may provide opportunities for municipalities to leverage funding to achieve these emissions goals. Municipalities will need to be able to provide a clear case for the benefits of these projects if they wish to remain competitive for funding for climate mitigation projects. In the same vein, municipalities must also be prepared to assess their exposure to climate impacts to remain competitive for resilience investment and major funding applications (e.g. Climate Lens requirements to qualify for federal infrastructure funding).

Economic Landscape - With the COVID-19 pandemic, the Canadian economy is highly volatile, creating significant uncertainty in the energy sector and the overall economic outlook for the next 2-3 years. The Canadian economy will continue to be buoyed by economic stimulus in the short-term, and it remains to be seen what the recovery will entail once we emerge from restrictions still enforced as a result of the pandemic. The 2020 Speech from the Throne[22] gave an indication of the Federal Government's focus and highlighted several key messages such as fiscal sustainability and taking action on extreme risks from climate change. Some key excerpts from the speech include:

- The Government will immediately bring forward a plan to exceed Canada's 2030 climate goal. The Government will also legislate Canada's goal of net-zero emissions by 2050.
- As part of its plan, the Government will:
  - Create thousands of jobs retrofitting homes and buildings, cutting energy costs for Canadian families and businesses;
  - Invest in reducing the impact of climate-related disasters, like floods and wildfires, to make communities safer and more resilient;
  - Help deliver more transit and active transit options;
  - And make zero-emissions vehicles more affordable while investing in more charging stations across the country.
- Additionally, the Government will:
  - Transform how we power our economy and communities by moving forward with the Clean Power Fund, including with projects like the Atlantic Loop that will connect surplus clean power to regions transitioning away from coal;
  - And support investments in renewable energy and next-generation clean energy and technology solutions.

Opportunities exist for funding support which should be monitored and tracked frequently to identify applicable funding to support this Plan.

21 Low Carbon Energy Systems Policy, City of Vancouver
22 2020 Speech from the Throne

Social and Technological Landscape - The current global pandemic has created far reaching impacts and is intricately linked to other global issues including climate change and the impact humans are having on the environment and the move towards our current social systems. However, the pandemic has also created opportunities especially in relation to the way people work and collaborate with each other and the information we can share without being physically present in a particular location. There is a huge amount of uncertainty about how the current technological landscape will persist into the post pandemic years however, it is assumed that the technological innovation that has been driven by the current situation will persist and the social drive towards a cleaner, greener future will only get stronger.

Closure

This report was prepared for The City of Lethbridge to provide a clear and bold direction on how to achieve a comprehensive, sustainable Energy Efficiency program for the Corporation for the next 10 years. This report also provided an overview of the City's current energy efficiency initiatives and detailed the major findings from the stakeholder engagement workshops that were conducted.

The services provided by Associated Engineering Alberta Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,
Associated Engineering Alberta Ltd.

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Project Engineer

Appendix A

Facilities Which Have Undergone an Energy Audit

Business Unit	Facility
Recreation, Culture & Community Services	Crossings Leisure Complex
Recreation, Culture & Community Services	Enmax Centre
Protective Services - Police	Police Headquarters
Recreation, Culture & Community Services	Fritz Sick Memorial Centre
Public Service and Operations	Fleet Services Building
Public Service and Operations	Transit Garage
Public Service and Operations	City Hall
Recreation, Culture & Community Services	Nicholas Sheran Pool
Recreation, Culture & Community Services	Nicholas Sheran Ice Center
Recreation, Culture & Community Services	Stan Siwik Pool
Recreation, Culture & Community Services	Lethbridge Public Library
Public Service and Operations	Stores, Electric, Public Works
Recreation, Culture & Community Services	CASA - Community Arts Building
Recreation, Culture & Community Services	Galt Museum and Archives
Protective Services - Fire	Fire Hall #1 HQ and ECC
Recreation, Culture & Community Services	Henderson Park Ice Center
Recreation, Culture & Community Services	Labor Club Ice Centre

Appendix B Complete Facilities List

Facilities

Facility User	Facility
Airport	Lethbridge Airport Carpentry Building W-39
	Lethbridge Airport Field Electrical Centre W-51
	Lethbridge Airport Fire Hall - Decommissioned
	Lethbridge Airport Maintenance Garage
	Lethbridge Airport Pumphouse W-52
	Lethbridge Airport Terminal
Other	Chinook Country Tourist Information Centre
Parks	Blackwolf Irrigation Pumphouse
	Botterill Bottom Park Maintenance Building
	Brewery Gardens Parks Depot
	Canyons Irrigation Pumphouse
	Chinook Lake Park Irrigation Pumphouse
	Chinook Tourist Park Washroom and Storage
	Couleecreek Park Irrigation Pumphouse
	Crossings Self Cleaning Washroom
	Crossings Wet Pond Irrigation Pumphouse
	Elks Picnic Shelter and Washroom
	Fairmont Park Irrigation Pumphouse
	Galt Gardens Pergola
	Galt Gardens Water Feature
	Gyro Park Building
	Henderson Lake Park
	Henderson Lake Pump Station
	Henderson Park Electronic Sign
	Henderson Park Horseshoe and Picnic Complex
	Henderson Park Irrigation Pumphouse
	Henderson Park Maintenance Depot
	Henderson Park Picnic Shelter #2 (Kiwanis)
	Henderson Park Shoreline Pavilion
	Henderson Park Washroom 1 (West)
	Henderson Park Washroom 2 (East)
	Indian Battle Park Washroom 1 (Baroness)
	Indian Battle Park Washroom 2 (Alberta)
	Indian Battle Park Washroom 3 (Horse Shoe)
	Indian Battle Park Washroom 4 (Elks)
	Irrigation
Parks	John Martin Recreation Area Building
	Lakeview Sportsfield Building
	Legacy Park Belvedere Open-Air Stage
	Legacy Park Irrigation Pumphouse
	Legacy Park Maintenance Depot
	Legacy Park Skatepark Plaza
	Lethbridge Sports Park Irrigation Pumphouse
	Nicholas Sheran Park Irrigation Pumphouse
	Nicholas Sheran Park Maintenance Depot
	Nicholas Sheran Park Picnic Shelter and Washroom
	Parks LNID Irrigation Canal Pump
	Pavan Park Pumphouse
	Peenaquim Park Clubhouse
	Popson Park Picnic Shelter
	Rotary Picnic Shelter
	South Side Parks Depot
	Sunridge Park Irrigation Pumphouse
	Ted Petrunia Community Services Building
	William Pearce Park Irrigation Pumphouse
Protective Services - Fire	Fire Hall #1 HQ and ECC
	Fire Hall #2
	Fire Hall #3
	Fire Hall #4
Protective Services - Police	Police Headquarters
	Police Rifle Range Clubhouse
	Police Rifle Range Washroom
Public Service and Operations	City Hall
	Facility Services Maintenance
	Fleet Services Building
	Fuel Depot
	Old Courthouse
	Parking Meter Repair Shop
	Parks Compressor Storage Building
	Public Operations Trailers
	Public Operations Westside Depot
	Public Operations Westside Sand/Salt Storage Facility
	Public Operations Westside Satellite Yard
Public Service and Operations	Railroad Crossings
	Sand/Salt Storage Facility
	Stafford Centre
	Stores, Electric, Public Works
	Transit Garage
	Transit North Side Transfer Terminal and Washroom

Facility User	Facility
Recreation, Culture, & Community Services	Animal Shelter
	Archmount Maintenance Building New
	Atso Towawwa Park Washroom and Storage
	Bowman Arts Centre
	Canola Harvest Field Concession
	Canola Harvest Field Stadium
	CASA - Community Arts Building
	Civic Ice Centre
	Crossings Branch Library West Lethbridge
	Crossings Leisure Complex
	Crossings Leisure Complex Phase 2
	Dave Elton Park Concession and Washroom
	Downtown Self Cleaning Washroom
	Enmax Centre
	Fort Whoop-Up Interpretive Building
	Fritz Sick Memorial Centre
	Galt Museum and Archives
	Genevieve Yates Memorial Centre
	George Vaselenak Miner's Library Grandstand
	Helen Schuler Nature Center
	Henderson Ball Park Additional Dressing Room
	Henderson Ball Park Clubhouse
	Henderson Ball Park Grandstand
	Henderson Park Ice Center
	Henderson Park Tennis Clubhouse
	Henderson Pool Services Building

Facility User	Facility
Recreation, Culture, & Community Services	Japanese Garden Tea House
	Japanese Garden Visitor's Centre
	Labor Club Ice Centre
	Lethbridge Indoor Soccer Complex
	Lethbridge Public Library
	Lethbridge Regional Park 'n' Ride Transit Terminal
	Lethbridge Sports Park Change Rooms
	Lethbridge Sports Park Washroom
	Lloyd Nolan Field Stadium
	Logan Boulet Arena
	Mountain View Cemetery Maintenance Quonset
	Mountain View Cemetery Portable Office Building
	Mountain View Cemetery Service/Office Building
	Mountain View Cemetery Site
	Multicultural Centre
	Nicholas Sheran Ice Center
	Nicholas Sheran Pool
	Royal View Cemetery Building
	Southern Alberta Art Gallery
	Stan Siwik Pool
	Westminster Community Centre
	YMCA Building

Utilities

Facility User	Facility
Electric	Electric Operations: Lay Down Yard
	Electric Operations: Old Switching Station West
	Electric Operations: Switching Station - 4 St S
	Radio Tower Communication Building
Streetlighting	Lighting (Corporate Utility)
	Lighting (Other Utility)
Waste and Recycling	Landfill Shop Building
	Materials Recovery Facility (MRF)
	Portable Trailer #18 (West Lethbridge Recycling Centre)
	Portable Trailer #19 (North Lethbridge Recycling Center)
	Sanitation Vehicle Storage Building

Facility User	Facility
Wastewater	Sewage Lift Station: 2 Ave N
	Sewage Lift Station: 39th Street
	Sewage Lift Station: 5 Ave N (Industrial)
	Sewage Lift Station: 9 Ave N
	Sewage Lift Station: Chinook Business Park
	Sewage Lift Station: Coulee Creek
	Sewage Lift Station: Lakeview
	Sewage Lift Station: Mayor Magrath Dr
	Sewage Lift Station: Paradise Canyon No. 1
	Sewage Lift Station: Paradise Canyon No. 2
	Sewage Lift Station: Paradise Canyon No. 3
	Sewage Lift Station: Paradise Canyon No. 4
	Sewage Lift Station: Parkview Trailer Park

Facility User	Facility
Wastewater	Sewage Lift Station: Prairie Arbour Est S
	Sewage Lift Station: Ridgewood Heights W
	Sewage Lift Station: Riverstone
	Sewage Lift Station: Satellite
	Sewage Lift Station: Southridge
	Sewage Lift Station: Tudor
	Sewage Lift Station: W.T.P.
	Sewage Surcharge Tank: (Sugar Bowl Park)
	Storm Water Lift Station: Cavendish
	Storm Water Lift Station: Fairmont Storm Pond
	Storm Water Lift Station: Parkside Storm Lift Pond
	Storm Water Lift Station: Shackleford Storm Pond
	Storm Water Lift Station: Sherring “B” Park
	Storm Water Lift Station: Sherring “C” Industrial Park
	Storm Water Lift Station: Wt Hill Storm Pond
	Storm Water Pump Station: 3905 9 Avenue

Facility User	Facility
Wastewater	Storm Water Pump Station: Churchill Park N
	Storm Water Retention Pond: Firelight Park
	Storm Water: North Lateral Syphon Outlet
	WWTP: Bridge Drive Syphon Chamber
	WWTP: Building #3a: Main Control Building
Water	North Regional Park Irrigation Supply Pumping Station
	WTP: Garry Dr Reservoir
	WTP: Mayor Magrath Dr Reservoir and Pump Station
	WTP: No. 2
	WTP: No. 3
	WTP: North East Reservoir and Pump Station
	WTP: Old Pumphouse and Reservoir (Booster Station)
	WTP: Southgate Reservoir and Pump Station
	WTP: Uplands Reservoir and Pump House
	WTP: West Reservoir and Pump House 210

Appendix C INITIATIVE TABLE

Initiative Number	Business Unit	Initiative	Description	Estimated Implementation Cost	Estimated Annual Cost Savings	Estimated Annual Energy Savings	Estimated Annual GHG Savings	Simple Payback Period	Ease of Implementation	Assumptions
F.5	Facility Services	On-site solar (Medium Installation)	On-site solar to replace grid-electricity usage - Medium installation	$800,000 - $1,600,000	$44,000 - $81,000	728,000 kWh - 1,352,000 kWh	550 - 1,020	19 Years	Moderate Changes	Based on in-house estimates of the cost of solar installation per kW in South Alberta at a nominal size of 20m by 20m.
F.6	Facility Services	Active controls - heat	Active heating systems to decrease temperatures during times of low-use	$350,000 - $650,000	$28,000 - $53,000	1,582,000 ekWh - 2,939,000 ekWh	280 - 530	12 Years	Moderate Changes	Based on retrofit costs of similar facilities for the four remaining facilities in the Top 25 energy users which did not receive energy audits, scaled by facility size.
F.7	Facility Services	On-site solar (Large Installation)	On-site solar to replace grid-electricity usage - Large installation	$3,200,000 - $6,400,000	$175,000 - $324,000	2,912,000 kWh - 5,408,000 kWh	2,200 - 4,080	19 Years	Complex or Significant Changes	Based on in-house estimates of the cost of solar installation per kW in South Alberta at a nominal size of 40m by 40m.
F.8	Facility Services	On-site solar (Small Installation)	On-site solar to replace grid-electricity usage - Small installation	$200,000 - $400,000	$11,000 - $20,000	182,000 kWh - 338,000 kWh	140 - 250	19 Years	Moderate Changes	Based on in-house estimates of the cost of solar installation per kW in South Alberta at a nominal size of 10m by 10m.
F.9	Facility Services	Heat Recovery	Reduce heating and cooling demands on HVAC systems by recovering heat from exhaust airflows	$100,000 - $200,000	$6,000 - $11,000	331,000 ekWh - 616,000 ekWh	60 - 110	18 Years	Moderate Changes	Heat recovery for the Logan Arena and Civic Ice Centre
F.10	Facility Services	Lighting retrofits	Replacing lighting with energy efficient alternatives, such as LEDs	$900,000 - $1,800,000	$31,000 - $58,000	521,000 kWh - 968,000 kWh	390 - 730	30 Years	Minimal Changes	Based on retrofit costs of similar facilities for the four remaining facilities in the Top 25 energy users which did not receive energy audits, scaled by facility size.
F.11	Facility Services	Active controls - lighting	Active heating systems to turn off or on lighting in response to occupancy and use	$900,000 - $1,800,000	$31,000 - $58,000	521,000 kWh - 968,000 kWh	390 - 730	30 Years	Moderate Changes	Based on retrofit costs of similar facilities for the four remaining facilities in the Top 25 energy users which did not receive energy audits, scaled by facility size.
F.12	Facility Services	Building envelope sealing and window retrofits	Retrofits to building envelopes to improve their facility insulation levels and reduce air leakage	$20,000 - $40,000	$1,000 - $1,000	39,000 ekWh - 72,000 ekWh	13-Jul	30 Years	Moderate Changes	Based on retrofit costs of similar facilities for the four remaining facilities in the Top 25 energy users which did not receive energy audits, scaled by facility size.
F.13	Facility Services	Air Source Heat Pumps and HVAC Improvements	Air source heat pumps absorb heat from outside air and release it inside the building as hot air, in hot water-filled radiators, through underfloor heating or for domestic hot water supplies	$300,000 - $600,000	$6,000 - $12,000	346,000 ekWh - 643,000 ekWh	60 - 120	50 Years	Moderate Changes	Air source heat pumps and HVAC improvements to the Gates Memorial Centre and Henderson Pool based on estimates for similar facilities, scaled by facility size.
FL.7	Fleet	Driver training	Training operational staff to provide strategies to reduce fuel usage while driving (accelerating, braking, idling, etc.)	Minimal	$109,000 - $202,000	109,000 L - 202,000 L	270 - 500	<1 Year	Minimal Changes	A 4% increase in fuel efficiency across the fleet based on previous City driver training programs. Cost will vary by number of operators trained.
FL.8	Fleet	Fleet tire pressure program	Ensuring tires are properly inflated to improve fuel efficiency	Minimal	$81,000 - $150,000	81,000 L - 150,000 L	200 - 370	<1 Year	Minimal Changes	A 5% increase in fuel efficiency across the fleet based on industry tire pressure program results. Excludes light duty fleet and transit vehicles which already have tire pressure programs.
FL.9	Fleet	Electric Vehicles for light duty fleet	Transitioning the fleet towards efficient electric vehicles to reduce gas and diesel use	$3,000,000 - $6,000,000	$74,000 - $137,000	74,000 L - 137,000 L	180 - 340	43 Years	Complex or Significant Changes	Based on replacing the 88 remaining gasoline light-duty autos at an estimated cost of $50,000 per vehicle. Note: the cost savings only reflect fuel costs, and do not account for the decreased cost of maintenance over the lifetime of the vehicle.
P.1	Parks	Non-potable water use for irrigation	Making use of non-potable water where possible for irrigation, indirectly reducing energy use for water treatment	Variable	$2,000 - $3,000	25,000 kWh - 46,400 kWh	20 - 30	Variable	Low Changes	Based on reducing potable water irrigation use by 10%, using the current energy intensity of water treatment. Costs will very based on geography and the availability of non-potable sources. Some savings will be offset by energy used for pumping from alternative water sources.
P.2	Parks	Automatic Irrigation Control	Automated irrigation systems to decrease excess energy use	$150,000 - $300,000	$5,000 - $8,000	75,000 kWh - 139,000 kWh	60 - 100	35 Years	Moderate Changes	Based on installing automatic irrigation controls in 15 parks that primarily use potable water for irrigation.
TR.1	Transit	Bay door operational improvement	Ensuring that bay doors are not left open when it is unnecessary to do so, reducing the demand for heating	Minimal	$3,000 - $6,000	167,000 ekWh - 306,000 ekWh	30 - 50	<1 Year	Minimal Changes	Operator training to ensure bay doors are closed. Savings based on a 5% decrease in heating costs for the fleet building.
TR.2	Transit	On-demand transit	Operating on routes only when there is demand for service. Reducing the number of off-peak busses while maintaining comparable level of service through 'ride-hailing' style apps.	$70,000 - $130,000	$59,000 - $110,000	59,000 L - 110,000 L	150 - 270	1 Year	Complex or Significant Changes	Assuming a 5% reduction in fuel usage for the transit bus fleet. Fuel efficiency will scale with the number of routes and vehicles operating on-demand services and the hours of on-demand service. Fuel efficiency will need to be evaluated against other goals and service targets.

Initiative Number	Business Unit	Initiative	Description	Estimated Implementation Cost	Estimated Annual Cost Savings	Estimated Annual Energy Savings	Estimated Annual GHG Savings	Simple Payback Period	Ease of Implementation	Assumptions
TR.4	Transit	Route optimization	Develop service improvement options for routes and schedules with the goal of providing more effective and energy efficient transit services.	$35,000 - $65,000	$59,000 - $110,000	59,000 L - 110,000 L	150 - 270	1 Year	Moderate Changes	Assuming a 5% reduction in fuel usage for the transit bus fleet following route optimization. Costs based on the costs of a study to evaluate and implement new routes. Fuel efficiency will need to be evaluated against other goals and service targets.
TP.1	Transportation	Optimizing snow removal routes and schedules	Develop service improvement options for routes and schedules with the goal of providing more effective and energy efficient snow removal services.	$10,000 - $20,000	$1,000 - $1,000	500 L - 900 L	2-Jan	15 Years	Moderate Changes	Assuming a 5% reduction in fuel usage for snow plowing vehicles following route optimization. Costs based on the costs of a study to evaluate and implement new routes. Fuel efficiency will need to be evaluated against other goals and service targets.
TP.2	Transportation	High efficiency lighting in parking lots	Upgrading remaining streetlighting in parking lots with high efficiency alternatives	$250,000 - $500,000	$21,000 - $38,000	345,000 kWh - 641,000 kWh	260 - 480	13 Years	Minimal Changes	Based on 5% of the total streetlight portfolio being upgraded from 1000W HPS to LED. This comes to 750 streetlights with a 60% energy saving per streetlight replaced. Costs based on a similar LED replacement project recently completed.
TP.3	Transportation	Adaptive Streetlight technology (illuminating only active areas, or by the movement of pedestrians and vehicles)	Technology and systems to deactivate lights when no activity is detected and activate when movement is detected.	$500,000 - $1,000,000	$86,000 - $159,000	1,429,000 kWh - 2,654,000 kWh	1,080 - 2,000	6 Years	Complex or Significant Changes	Costs will be highly variable based on the number of street or path lights the technology is applied to (e.g. park pathways only vs. roads only vs parking lots only vs. some combination). Energy savings are estimated at 35%. Cost estimate is based on the capital costs of implementing similar initiatives in other cities, scaled by the number of streetlights. Cost and cost savings are estimated for the technology being implemented in 50% of the system.
WR.5	Waste & Recycling	Optimizing waste collection routes	Planning waste collection routes to reduce driving between destinations	$20,000 - $40,000	$8,000 - $15,000	8,000 L - 15,000 L	20 - 40	3 Years	Low Changes	Assuming a 5% decrease in fuel usage for waste collection vehicles following route optimization. Estimated costs based on only the study to evaluate and implement new routes. Fuel efficiency will need to be evaluated against other goals and service targets.
WR.6	Waste & Recycling	HVAC Upgrades - Waste & Recycling Utilities	Building HVAC systems to reduce energy use	$25,000 - $50,000	$3,000 - $5,000	158,000 ekWh - 294,000 ekWh	30 - 50	9 Years	Low Changes	Based on the cost of ventilation upgrades in similar facilities, scaled by facility size.
W.6	Water, Wastewater, Stormwater	Peak shaving opportunities - Water + Wastewater	Shifting the energy requirements associated with pumping and processes to off-peak times to reduce demand charges	Variable	Variable	Variable	Variable	Variable	Complex or Significant Changes	Peak shaving costs and energy savings will depend on demand charges for the water treatment facility which were not available. Further exploration of this initiative is recommended.
W.7	Water, Wastewater, Stormwater	Aeration system optimization - Wastewater	Analyzing the aeration system to determine whether it is operating as efficiently as possible for the required level of treatment.	$10,000 - $20,000	$13,000 - $25,000	221,000 kWh - 410,000 kWh	170 - 310	1 Year	Moderate Changes	Based on similar improvements investigated at similar wastewater treatment facilities. Numbers have been scaled to the relative total treatment capacity.
W.8	Water, Wastewater, Stormwater	Process optimization - UV disinfection - Water	Optimizing UV disinfection dose through re-validation testing	$50,000 - $200,000	$13,000 - $38,000	210,000 kWh - 630,000 kWh	160 - 480	5 Years	Minimal Changes	Based on an average annual operation assuming 20kW per lamp, times 4 lamps, times 3 reactors operating all year (total estimated energy 2,100,000 kWh per year) and reducing the output by 10-30%.
W.9	Water, Wastewater, Stormwater	HVAC Upgrades - Wastewater	Upgrades to HVAC systems in the wastewater treatment plant to reduce energy use	$50,000 - $100,000	$4,000 - $7,000	222,000 ekWh - 412,000 ekWh	40 - 70	14 Years	Low Changes	Based on costs for similar HVAC improvements at other wastewater treatment facilities, scaled based on WWTP facility size.
W.10	Water, Wastewater, Stormwater	High-lift pump station optimization - Water	Optimizing raw water and high-lift pump station operations	$50,000 - $200,000	$6,000 - $21,000	105,000 kWh - 350,000 kWh	80 - 260	9 Years	Low Changes	Based on % of energy use and similar improvements at other water treatment facilities, scaled based on WTP total treatment capacity. Total pumping energy is estimated at 25% of total WTP energy use or 3,500,000 kWh per year. Estimate between 3 and 10% potential savings.
W.11	Water, Wastewater, Stormwater	HVAC Upgrades - Water	Upgrades to HVAC systems in the water treatment plant to reduce energy use	$50,000 - $100,000	$10,000 - $20,000	560,000 ekWh - 1,110,000 ekWh	100 - 200	5 Years	Low Changes	Based on costs for similar HVAC improvements at other water treatment facilities, scaled based on WTP facility size.
W.12	Water, Wastewater, Stormwater	Raw water pumping optimization - Water	Optimizing raw water pumps	$50,000 - $200,000	$4,000 - $13,000	63,000 kWh - 210,000 kWh	50 - 160	15 Years	Moderate Changes	Based on costs for similar improvements at other water treatment facilities, scaled by total treatment capacity. Total pumping energy is estimated at 15% of total WTP energy use or 2,100,000 kWh per year. Estimate between 3 and 10%.
W.13	Water, Wastewater, Stormwater	Reduce leakages - Water	Reducing leakage to optimize production and reduce energy use	Variable	$17,000 - $31,000	Variable	210 - 390	Variable	Low Changes	Based on an assumption of 20% reduction in leakage. The average of 2016-2018 annual real losses and current water treatment energy intensity were used to estimate energy savings. Costs to address leakage will vary significantly based on the location and process causing the leakage. This leakage is focused transmission or distribution mains, utility storage tanks, or service connections.