Energy & Sustainability Framework

Energy & Emissions Reduction Action Plan

SSG SUSTAINABILITY SOLUTIONS GROUP
January 2022

REGINA

Land Acknowledgement

The City of Regina acknowledges we are on the traditional lands of the Treaty 4 Territory, a Treaty signed with 35 First Nations across Southern Saskatchewan and parts of Alberta and Manitoba, and the original lands of the Cree, Salteaux, Dakota, Nakota, Lakota, and the homeland of the Metis nation.

The City of Regina owes its strength and vibrancy to these lands and the diverse Indigenous Peoples whose ancestors' footsteps have marked this territory as well as settlers from around the world who continue to be welcomed here and call Regina home.

Indigenous communities across the globe hold knowledge and solutions that are integral in the fight against climate change.

The projects and initiatives resulting from the implementation of this Framework must be equitable, must benefit and respect everyone who lives here, and must aim to protect, sustain, and nurture our natural environment, which we all depend upon for survival.

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And many members of the community.

Disclaimer

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A Note on the Impact of Coronavirus (COVID-19)

The analysis in this document was completed as COVID-19 was spreading rapidly in Canada, but doesn't include detailed considerations for changes in population, transportation, housing, and office building needs that have or may result from the pandemic. Even so, the analysis continues to be relevant not only because the climate crisis persists, but also because this document provides solutions that can stimulate the economy during pandemic-induced economic challenges and changes. The solutions the report recommends, ranging from retrofits to investing in renewable energy, are designed to decrease emissions and increase energy efficiency while creating jobs.

In the context of COVID-19, here are some key points to consider:

- The pandemic is a global health crisis that has radically transformed societies and economies, resulting in tragedy and disrupting work and home life everywhere.[1]
- Nearly two years into the pandemic, the impact of COVID-19 on people, workplaces, and the economy, as well as the duration of those impacts, presents many uncertainties. The recovery and 'new normal' will be affected by a combination of factors such as the evolution of the pandemic, the design of public policy responses, and the continuing response by global institutions.
- A decline in activity has resulted in a short-term reduction in GHG emissions but concentrations of GHG emissions in the atmosphere continue to climb and global temperatures continue to increase.[2] The pandemic has also disrupted international efforts to address climate change.
- In the short term, the impacts of COVID-19 both challenge and reinforce actions outlined in the Framework.
- As Canada initiates efforts to recover from the impact of the coronavirus, there is an opportunity to stimulate the economy with investments that simultaneously address the climate crisis. This Framework describes an investment opportunity that will generate jobs, stimulate businesses, reduce GHG emissions, and provide benefits for the community and the City.

[1] World Health Organisation (2020). World health statistics 2020: monitoring health for the SDGs, sustainable development goals. Retrieved from: https://apps.who.int/iris/bitstream/handle/10665/332070/9789240005105-eng.pdf

[2] World Meteorological Organisation (2020). The Global Climate in 2015-2019. Retrieved from: https://library.wmo.int/doc_num.php?explnum_id=10251

Abbreviations

BAP – Business-as-planned scenario

City – The City of Regina municipal corporation/government

city – The broader Regina community

CO2 – Carbon dioxide

CO2e – Carbon dioxide equivalents

GHG – Greenhouse gas

ICI – Industrial, commercial, and institutional sector

LCS – Low-carbon scenario

NPV – Net present value

RNG – Renewable natural gas

PV – Photovoltaic

VKT – Vehicle kilometres travelled

A glossary of terms can be found in Appendix A.

Units

GHG emissions
1 MTCO2e = 1,000,000 tCO2e

One megatonne of carbon dioxide equivalents is equal to one million tonnes of carbon dioxide equivalents.

Energy
1 MJ= 0.001 GJ

1 TJ= 1,000 GJ

1 PJ= 1,000,000 GJ

1 GJ= 278 kWh

1 MWh= 1,000 kWh

1 GWh=1,000,000 kWh

A Letter from the Mayor

The future presents great opportunities for Regina. But to ensure our future is sustainable and provides the safety and quality of life that our residents deserve, we realize that actions are needed now to acknowledge and mitigate the impact of climate change.

That is why Regina City Council voted unanimously to join municipalities around the world in committing to become a 100 per cent renewable city by 2050. This Energy & Sustainability Framework outlines the actions we need to take to achieve this goal and gives us a plan for a sustainable future. From urban forests to transportation networks, building construction and natural habitat preservation, cities play an important role in determining how we grow and interact with ourselves and the natural environment.

Globally, cities are responsible for an estimated 75 per cent of energy consumption and an equivalent share of greenhouse gas emissions. City leaders recognize the responsibility to lead by example. Regina joins cities such as Vancouver, Munich, Sydney, Hamburg, San Francisco, Barcelona, San Diego, and Malmö in pursuing a 100 per cent renewable goal. Some such as Reykjavik and Burlington, Vermont have already achieved that goal in at least one sector.

Regina's Energy & Sustainability Framework focuses on climate change mitigation by recommending actions that will reduce community-wide energy consumption, improve energy usage and transition to renewable or low-carbon energy sources in order to achieve net-zero carbon emissions by 2050. These actions are significant, far-reaching and necessary, yet they are achievable if we stay committed to working together and focusing on the promise of a sustainable future for the generations that follow.

A plan of this nature is foundational to Regina's growth and prosperity over the coming decades and owes much to the residents, stakeholders, consultants and staff that contributed to its creation. Community engagement was a crucial piece of this work and I want to personally thank everyone who played a part in the discussions and consultations that helped inform this important document. There is much work ahead and a part for each of us to play as we move toward a renewable Regina.

Mayor Sandra Masters

A Letter from City Administration

Mayor Masters and City Councillors,

Regina was established more than a century ago on a treeless grass prairie. Today, we enjoy a community with a lush urban forest of more than 500,000 hand planted trees. This is just one example of the visionary and determined spirit that has shaped our city and that we will embrace as we work toward a more sustainable future.

The Energy & Sustainability Framework and Action Plan outlines a bold, achievable path for Regina to become a renewable, net-zero community by 2050. The Framework will mitigate climate change by reducing emissions, changing the way we use energy, and shifting to renewable or low-carbon energy sources.

The City's consulting partners at Sustainability Solutions Group (SSG) engaged with a broad and inclusive range of stakeholders to assist in creation of the Framework. This work included a community inventory and projections for future energy use and emissions based on current data and projected growth. SSG has identified seven 'Big Moves' that will make Regina renewable by 2050 and serve as themes of the work ahead. Within those moves, the Framework outlines 31 recommended actions that are based on available and emerging technology used in other cities, as well as existing and anticipated federal legislation that will impact consumer markets and industry development. These actions, if fully implemented, provide an opportunity for Regina to reduce its emissions by 52 per cent and energy use by 24 per cent as early as 2030.

The environmental benefits of these changes are significant, as are the potential economic returns. Regina is positioned to recover its investments considerably faster than some other municipalities. The Framework's actions lead to a projected net return on investment by 2030 with an overall financial return of $21 billion by 2050.

2050 is still many years away, but we need to start making changes right now. Our journey begins with the Framework as a pathway and continues as we develop strategies, programs and initiatives to implement, all the while remaining committed to reaching our 2050 goal and creating a sustainable future for Regina residents.

Sincerely,

Louise Folk,
Chief Transformation Officer

A Note from the City of Regina

The Energy and Sustainability Framework provides the City of Regina with a low-carbon pathway to make informed decisions that mitigate climate change, support continued growth, and ensure a sustainable future for our community. The Framework outlines actions to achieve reductions in greenhouse gas emissions and change the way we use and source energy, while collective benefits for our environment, economy, community well-being and quality of life. These actions guide the City of Regina as it goes about setting policies and programs, making necessary investments, and establishing partnerships that will help achieve our target of becoming a renewable, net-zero emissions community that is known for its vibrancy, inclusivity, and resiliency.

Executive Summary

Regina, like cities around the world, is confronting the climate crisis. With each passing year, the window to take action to limit global warming and climate change to a level that will avoid the most catastrophic impacts is closing. Action must now occur at a scale and pace that will present both challenges and opportunities for Regina. Regina is acting now and planning ahead to seize opportunities relating to the energy transition, and to mitigate and address challenges that lie ahead in making that transition.

Regina's Commitment

In 2018, City Council voted unanimously for Regina to become a one hundred per cent renewable energy community by 2050. This means using renewable energy for transportation, heating and cooling, and power. It demonstrates Regina's commitment to the energy transition from fossil fuels to renewables happening across the world.

In October 2020, Council tasked City staff with pursuing the development of a community-wide Energy and Sustainability Framework to lay the groundwork for the transition to renewables, while decreasing greenhouse gas emissions. Council broadened their scope at this time to have staff investigate actions focused on land-use and transportation planning, development and building permit guidelines, energy-efficient building design, transportation demand management, waste management, energy conservation, regulatory tools, financial tools, advocacy for legislative change, and public education and awareness. This broader assessment of the community's emissions and energy use across all sectors is in line with the Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories, the global best practice for measuring and reporting on emissions at the community scale.

This Energy and Sustainability Framework (the "Framework") charts a pathway for responding to the climate crisis. Its recommendations align with the Intergovernmental Panel for Climate Change's (IPCC) recommended pathway by reaching net-zero emissions by 2050 and by more than halving Regina's community greenhouse gas emissions by 2030. According to the IPCC, this is the pathway required to limit global temperature rise to below 1.5 degrees Celsius, the threshold for avoiding the most devastating impacts of climate change.

The Framework outlines opportunities available to all sectors of Regina's community. It underscores the need to reduce energy use where possible and drastically increase energy efficiency before and while transitioning to renewable energy sources. This will minimize emissions, decrease the burden on utility systems, and maximize the financial return and co-benefits such as equity and job creation. For Regina to reach its targets, it will be key for the community to complete all of the actions on the schedule and in the order presented in the implementation timeline. Reaching the interim 2030 target of a 50 per cent decrease in GHG emissions by 2030 over 2016 levels will set the community on a pathway for reaching its 2050 net-zero emissions and one hundred per cent renewable energy goals.

Developing the Framework

The Framework was developed using the six major steps outlined below:

1. **Preparation:** Understanding the local context in Regina and collecting local data, including population data, buildings data, and utility data.
2. **Inventory:** Conducting baseline energy use and emissions modelling to understand Regina's current energy and emissions profile. Conducting additional energy use and emissions models to illustrate how we can expect the energy and emissions profile to change between now and 2050 based on current policies and practices.
3. **Target-setting:** Using Regina's 2050 net-zero goal, best practices energy and emissions planning, and local engagement to determine the pathway to get there.
4. **Actions and scenario**: Developing a set of actions and an overall low-carbon scenario with actions that are timed and sequenced for Regina to achieve its target. Assessing the financial impact of the low-carbon scenario.
5. **Implementation:** Designing an implementation guide based on local context and best practices that outlines the programs, policies, initiatives, and infrastructure that will allow Regina to implement the low-carbon actions and achieve its target.
6. **Monitoring and evaluation:** Designing a monitoring and evaluation structure that will allow the City and community to adapt and improve over time.

Current Emissions and Energy Use

Greenhouse gas and energy-use inventories were completed as one of the first milestones in developing the Framework. The inventories calculate the GHG emissions and energy use in a baseline year across each sector in the community including residential, commercial, municipal, transportation, industry, and waste. The findings for the 2016 baseline year[3] were:

- 5.4 megatonnes of CO2e emissions across the community
- 23.5 tonnes of CO2e emissions per capita (compared to the national average of 19.2)[4]
- 71.3 PJ of energy use across the community
- 319 GJ of energy use per capita (compared to the national average of 363 GJ)

The major sources of emissions in 2016 were the industrial sector (34 per cent), transportation (24 per cent), commercial (17 per cent), and residential (16 percent). Municipal operations made up just over one and a half per cent of total community emissions. By fuel type, natural gas made up 36 per cent of total community emissions, while grid electricity accounted for 20 per cent and gasoline for 16 per cent.

The major energy-use sectors in 2016 were industrial (43 per cent), transportation (26 per cent), residential (16 per cent), and commercial (15 per cent). Municipal government operations made up one per cent of total community energy use. By fuel type, natural gas made up the majority of energy use at 56 per cent, while gasoline for vehicles made up 18 per

[3] Note that 2016 is the baseline year because it is the most recent Census year, which provides the best data for providing a scenario.

[4] Note that Canada is a high-emitting country, with less than 0.5 per cent of the global population and nearly two percent of the world's emissions.

cent. Grid electricity made up less than eight per cent. End uses for energy were dominated by industrial processes, transportation, and space heating in buildings.

Key Findings From the Business-as-Planned Scenario

The business-as-planned scenario illustrates the energy-use and GHG emissions trajectory in Regina if the community takes no additional action on climate change beyond the activities that are already underway or planned. The scenario accounts for current plans, policies, legislation, and regulations at municipal, provincial, and federal levels, along with changes in population and jobs in Regina but not pledges, promises, or ideas that have not yet been endorsed, passed through legislation, or budgeted for. The results from the business-as-planned scenario included:

- Emissions dropping slightly and then returning to 5.4 megatonnes CO2e by 2050;
- Emissions per capita decreasing from 23.5 tonnes of CO2e per person to 14 by 2050;
- Energy use increasing from 71 PJ to 84 PJ by 2050; and
- Energy use per capita decreasing from 319 GJ to 220 GJ.

Decreased energy use and emissions reductions in the business-as-planned scenario are largely due to increasingly efficient new buildings and switching to electric vehicles. This downward trend is being negated by increases in population and job growth that result in additional energy use and emissions production. The result is a relatively stable emissions trajectory that will not meet Regina's goal.

Developing a Low-Carbon Pathway

The results of the business-as-planned scenario indicate that significant additional actions and efforts are needed in Regina to meet the community emissions reduction and one hundred per cent renewable energy targets. A low-carbon scenario was developed and modelled by considering locally relevant context, including opportunities and constraints, best practices from other communities, and input from stakeholders. The process identified seven key areas, known as the seven Big Moves, for action that are necessary to achieve the target:

1. **Building retrofits:** Current buildings must be approximately 50 per cent more efficient, on average, than what they are today;
2. **Clean heating:** Current and new buildings need to use more efficient and cleaner space- and water-heating systems;
3. **Net-zero new construction:** New construction must not be a source of GHG emissions;
4. **Renewable energy generation:** Renewable energy must be increased drastically at the building and community scale to meet Regina's energy needs in a clean and sustainable way;
5. **Low-emissions vehicles:** Low-emissions vehicles, including electric vehicles, must replace gasoline- and diesel-powered vehicles;

6. **Increasing active transportation and transit use:** Active transportation and transit use must displace some single-passenger vehicle trips; and
7. **Cleaning and re-energizing industry:** The industrial sector needs to reduce its emissions to be economically competitive in the future.

Additional moves, representing smaller decreases in GHG emissions were also identified, including enhancing composting and recycling programs and intensifying land use.

The Big Moves and additional moves are composed of 31 discrete actions that must be completed for the low-carbon pathway to be realized. Twenty-three of these actions need to be underway or in the planning stages by the end of 2023.

Table 1. Low-Carbon Actions.

ACTION	DESCRIPTION
1.1 Deep Retrofits— residential, pre-1981 construction	Achieve 50% thermal (building envelope) efficiency increase and 10% electrical savings in 100% of buildings by 2030
1.2 Deep Retrofits— residential,1981–2016 construction	Achieve 50% thermal (building envelope) efficiency increase and 10% electrical savings in 100% of buildings by 2035
1.3 Deep Retrofits— ICI	Achieve 50% thermal (building envelope) efficiency increase and 10% electrical savings in 100% of buildings by 2035
2.1 Switch to clean fuels in existing buildings— residential	Add air-source heat pumps and electric water heaters to 100% of buildings when current systems reach end of life
2.2 Switch to clean fuels in existing buildings – ICI buildings	Add air-source heat pumps and electric water heaters to 100% of buildings when current systems reach end of life
2.3 Switch to clean fuels in all new construction – air-source heat pumps	Add air-source heat pumps and electric water heaters to 100% of new buildings without ground-source heat pumps starting immediately
2.4 Switch to clean fuels in all new construction – ground-source heat pumps	Add ground-source heat pumps and electric water heaters to 15% of new buildings starting immediately
3.1 All new residential construction is net-zero by 2030	The percentage of new buildings constructed to net-zero standards reaches 50% of new construction by 2026 and 100% of new construction by 2030
3.2 All new ICI buildings are built to National Energy Building Code	All new commercial and industrial buildings are built according to the National Energy Building Code tiers beginning in 2023

ACTION	DESCRIPTION
4.1 Maximize rooftop solar PV on new buildings	New builds will install solar PV (supplying 50% of the building's base load) to maximize rooftop solar potential, starting immediately
4.2 Maximize rooftop solar PV on existing buildings	Existing buildings will add solar PV in line with retrofit schedule (supplying 50% of the building's base load) to maximize rooftop solar potential
4.3 Meet energy needs through local energy generation—solar PV	Add 1915 MW of solar PV in community solar farms by 2035
4.4 Meet energy needs through local energy generation—solar PV	Add 475 MW of wind-generating capacity in community wind farms by 2035
4.5 Meet energy needs through local energy generation—geothermal heating at University of Regina	Convert the district energy system at the University of Regina to geothermal by 2030
5.1 Electrify vehicles—personal-use	80% of new light-duty, personal-use vehicles purchased are electric by 2025 100% are electric by 2030
5.2 Electrify vehicles—ICI use	80% of new light-duty, ICI-use vehicles purchased are electric by 2025 100% are electric by 2030
5.3 Electrify medium- and heavy-duty trucks, or purchase hydrogen-fueled*	100% of medium- and heavy-duty truck purchases are electric or hydrogen-fueled* by 2045 *green hydrogen
5.4 Electrify transit	100% of new City transit buses are electric
6.1 Expand transit service	Expanded service is offered to encourage a 25% transit mode share by 2025
6.2 Transportation demand management	Employ car-free zones, increased parking rates, car and bike-share programs, and work-from-home measures to reduce demand for personal-use vehicles, starting with pilot projects in 2023
6.3 Increase active transportation	Continue to develop active transportation system to reach 50% of short trips being active by 2050
7.1 Industrial efficiencies	Industrial process improvements will increase energy efficiency by 30% between now and 2045

ACTION	DESCRIPTION
7.2 Industrial energy shift— renewable natural gas and hydrogen	The industrial sector will shift away from natural gas towards hydrogen and renewable natural gas
7.3 Industrial process heat shift—electrification	50% of process heat electrified by 2050
7.4 Primary industry implements net-zero targets	Primary industry reduces methane and employs carbon sequestration to reach net-zero emissions by 2050
8.1 Waste and wastewater improvements	Increase methane capture to 95% by 2025 After 2025, the WWTP uses all available biogas/RNG from capture 10% reduction in water/wastewater consumption (behaviour change)
8.2 Recycling program	Increase recycling rates to meet 65% waste diversion by 2030
8.3 Organic compost program	95% of organics waste is composted by 2030
8.4 Landfill gas capture	Expand landfill gas capture program to reach 40%
8.5 Spatial densification— residential	Adapt the City's growth plan to allocate growth as follows: 15% new population to city centre; 50% to intensification areas—specific zones along transit nodes; and 35% to new neighbourhoods
8.6 Spatial densification—commercial	Adapt the City's growth plan to allocate growth as follows: 15% new population to city centre; 50% to intensification areas—specific zones along transit nodes; and 35% to new neighbourhoods

These 31 actions are further broken down into programs, initiatives, policies, and infrastructure investments that will drive their implementation. Wherever possible, attention to co-benefits, such as increased air quality, increased water quality, local economic development, and opportunities to implement actions in an equitable manner, have been highlighted.

The low-carbon pathway cannot be implemented by Regina's municipal government alone. In fact, it cannot be implemented by any one single individual, entity, business, or sector at all. It will require significant effort and investment from all sectors, other levels of government, utilities, community members and businesses. While the Framework focuses on actions the municipal government can take, it identifies opportunities for partnership and collaboration and notes where community education and leadership from other sectors are required.

During the development of the Framework, thousands of person-hours were dedicated to engagement. A Community Advisory Group, composed of community-wide organization and sector representatives, was involved in every stage of the Framework development. Interviews and focus groups were held with individuals with specialized knowledge and expertise. City of Regina staff members from across departments learned about the Framework and provided input on how actions could impact and align with other planning efforts and operations. The community was engaged through outreach by City staff and on the City's online public participation platform, through a community forum, a community survey, and through a student forum. This type of outreach, engagement, and collaboration needs to continue and evolve as the community sets out to implement the Framework.

The Framework responds to much of what was heard through engagement activities. This includes:

- Actions must consider equity effects;
- The municipal government must act as a leader, partner, and convener;
- Action must start now to demonstrate ambition and commitment;
- Innovation and new technologies must be considered;
- Communication and education from the municipal government is key; and
- Residents need support to take action.

Financial Modelling

Typically, implementing a low-carbon pathway can have a positive economic impact in a community with new jobs and industries being created and individuals saving money on energy costs in the long term. As the world moves toward the energy transition, those who do not participate may be left behind with industries and economies that are no longer relevant. Additionally, allowing the world to warm beyond 1.5˚C will lead to an increase in severe weather events and the costs associated with them.

Regina is no exception to this trend. Implementing Regina's Framework is projected to generate a net financial benefit of over $18 billion across the community by 2100 compared to continuing on the business-as-planned trajectory. Between 2022 and 2050, this is a cumulative total of 120,000 person years of employment. At its height, the Framework will generate an annual net financial benefit of two billion dollars.

Moving Forward

Implementing the Framework is critical to Regina's community health and wealth. It is an investment opportunity at an unprecedented scale that will generate positive impacts throughout every sector in the community. It will also take enormous effort and investment by every sector in the community and requires the leadership and endorsement of Regina's municipal government. The work must start now and must be monitored and adapted over the coming years to achieve the goals laid out by Regina City Council.

Contents

Introduction

A Call to Action

Climate change is an unprecedented threat to global social, economic, and environmental systems. It poses risks to human health, public safety, infrastructure, livelihoods, and the world's biodiversity and ecosystems. As the earth continues to warm due to human-caused greenhouse gas (GHG) emissions, the risks increase in frequency and severity.

In an attempt to curb emissions and limit the impacts of climate change, 196 countries signed the Paris Agreement in December 2015, during COP21. Signatories of this legally binding international treaty on climate change agreed to limit global warming to well below a 2°C and preferably to a 1.5°C increase above pre-industrial levels.[5] Despite these commitments, current global GHG emissions levels put the world on a trajectory towards 3°C or more of warming.[6] Nationally, Canada has committed to reducing greenhouse gas by 45 per cent below 2005 levels by 2030.[7] Canada has not reached any of its previous climate targets and has one of the highest levels of GHG emissions per capita in the world.

Despite global shortcomings in attempts to significantly reduce greenhouse gas emissions and amidst increasing scientific evidence of unprecedented and irreversible changes in the climate system, a recent report by the Intergovernmental Panel on Climate Change (IPCC) provides evidence that it is still possible to limit the most catastrophic impacts of climate change.[8] Local governments and communities are on the forefront of creating the changes required to slow climate change by developing and implementing localized solutions that meet the needs of their communities and the broader global community.

[5] United Nations Framework Convention on Climate Change. (2015). The Paris Agreement. Retrieved from: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[6] United Nations Climate Change. (18 February 2021). New UNEP Synthesis Provides Blueprint to Urgently Solve Planetary Emergencies and Secure Humanity's Future. Retrieved from: https://unfccc.int/news/new-unep-synthesis-provides-blueprint-to-urgently-solve-planetary-emergencies-and-secure-humanity-s

[7] Government of Canada. (July 12, 2021). Government of Canada confirms ambitious new greenhouse gas emissions reduction target. Environment and Climate Change Canada, Press Release. Retrieved from: https://www.canada.ca/en/environment-climate-change/news/2021/07/government-of-canada-confirms-ambitious-new-greenhouse-gas-emissions-reduction-target.html

[8] Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. (2021). Climate Change 2021: The Physical Science Basis. Cambridge University Press. In Press.

About Regina

Regina is the capital city of Saskatchewan and the province's second-largest city by population. It is the commercial hub for the southern part of the province and is the home of the University of Regina. It is located in south-central Saskatchewan along Wascana Creek within the Moist Mixed Grassland Ecoregion.

Regina had a total population of over 220,000 at the time of writing. The City of Regina's Official Community Plan projects significant population growth over the next 25 years, reaching well over 300,000 during that time frame.

> "The Energy & Sustainability Framework is Regina's community plan to help slow climate change and leverage new opportunities to create a more resilient, healthy, and wealthy community."

Historically, Regina's economy has been rooted in agriculture, natural resources, and manufacturing, along with tourism. Since the 1950s, oil and gas has become a significant part of Regina's economy. Regina's economic reliance on the natural resources and agriculture industries creates an imperative to act on climate change—both to ensure that changes in local climate and severe weather events do not disrupt economic activity and to ensure that as the world transitions to new forms of energy production and consumption, Regina has the trained workforce, knowledge, and capabilities to continue supplying energy, products, and services.

Climate Change Impacts

Regina has already started to experience the impacts of climate change, with an increase in average temperatures, more days over 30°C in the summer, and wetter springs and winters. With these changes, there is an increased risk of extreme weather events, including longer and more intense heat waves and more flash floods. In the summer of 2021, during the development of the Energy & Sustainability Framework (the "Framework"), Regina experienced what is thought to be the worst drought on record for the region,[12] severe flooding due to heavy rainfall,[13] and air quality warnings due to wildfires in northern

[9] Prairie Adaptation Research Collaborative (n.d.) SaskAdapt. https://www.parc.ca/saskadapt/community-assessments/regina.html

[10] Economic Development Regina. (2021). Multiple Sector's Drive Regina's Economy. https://economicdevelopmentregina.com/sectors

[11] Canadian Plains Research Centre, University of Regina. (2016). The Encyclopedia of Saskatchewan, Oil and Gas Industry. https://esask.uregina.ca/entry/oil_and_gas_industry.jsp

[12] Sorokon, K. (August 12, 2021). Saskatchewan could be facing its worst drought on record. 980 CJME. https://www.cjme.com/2021/08/12/saskatchewan-could-be-facing-its-worst-drought-on-record/

[13] Davenport, C. and Rattray, T. (June 11, 2021). 'This is a lot of water': Several Regina roads flooded following heavy rain. CTV News. Retrieved from: https://regina.ctvnews.ca/this-is-a-lot-of-water-several-regina-roads-flooded-following-heavy-rain-1.5466535

Saskatchewan.[14] According to the Climate Atlas of Canada, Regina can continue to expect increases in average temperature, increases in the number of extremely hot days (over 34°C), and increased variability in rainfall patterns.[15]

Climate Change Mitigation Efforts in Regina

In October 2020, City Council approved the following recommendation from the 2018 motion:

"Direct the Administration to develop a community-wide Energy & Sustainability Framework and Action Plan that includes:

> "In 2018, the City of Regina's City Council voted unanimously to become a renewable energy community by 2050, which means using 100 per cent renewable energy for transportation, heating and cooling, and power."

a. Community- and municipal-wide action plans, with timelines and targets to achieve a renewable Regina by 2050;

b. Actions focused on land-use and transportation planning, development and building permit guidelines, energy-efficient building design, transportation demand management, waste management, energy conservation, regulatory tools, financial tools, advocacy for legislative change, as well as public education and awareness;

c. Community engagement throughout the development and implementation;

d. A regular and ongoing progress reporting framework that includes community reporting at regular intervals; and

e. A preliminary estimate of the financial and economic impacts associated with implementing an action plan."

City staff also clarified that a 100 per cent renewable energy target was best achieved through a broader approach to 1) conserve energy where practical, 2) improve energy efficiency, and then 3) add renewable energy. The broader approach aims to minimize costs and maximize benefits and measures success through emissions reductions associated with reduced energy use and added renewables in the community.

Prior to the development of this Framework, climate change mitigation actions were outlined in several City policy and planning documents. The Official Community Plan (OCP) states a policy goal to:

[14] Coleman, C.. (August 9, 2021). Regina, Saskatoon spend a combined 186 hours blanketed in wildfire smoke so far this year. CBC News. Retrieved from: https://www.cbc.ca/news/canada/saskatchewan/regina-saskatoon-spend-a-combined-186-hours-blanketed-in-wildfire-smoke-so-far-this-year-1.6134396

[15] Climate Atlas of Canada (July 10 2019). Climate Atlas of Canada, version 2 (July 10, 2019), using BCCAQv2 climate model data. https://climateatlas.ca/

“Build a resilient city and minimize Regina’s contributions to climate change.”

The OCP outlines several actions to achieve this policy goal, including promoting more energy-efficient new construction; improving Regina’s air quality, including reducing corporate and community GHG emissions; monitoring changes in climate and their impact on the city, and developing mitigation strategies; and encouraging the reduction of GHG emissions through the use of alternative energy sources.

In June 2019, a staff report outlined that the City Administration was continuing to explore action the City of Regina could take including:

- Pursuing the generation of an additional four (4) MW of renewable electricity (currently the City produces one (1) MW of renewable energy through the landfill gas-to-energy generator);
- Transitioning all City vehicles to those that use renewable energy; and
- Transitioning to renewable methods of heating City facilities.

Charting a Path to Regina’s Renewable Energy Future

With a target in place, the next key step in realizing the opportunities relating to emissions and energy-use reduction, including lower utility bills, a more connected community, and better air quality, is to build a pathway to get there. To do this, a deep exploration and understanding of the local context and global best practices is critical.

Becoming a 100 per cent Renewable, Net-Zero City
Regina is taking a broad approach to addressing climate change. This Framework outlines actions that:

1. Reduce energy consumption;
2. Improve energy usage and efficiency; and
3. Switch fossil-fuel-driven systems to renewable and low-carbon energy sources.

Renewable energy methods like wind and solar cannot produce energy at the same scale as burning fossil fuels. Part of why fossil fuels are so attractive is that they produce incredible power from small amounts; however, they produce this power at the cost of the planet’s livable climate.

With this in mind, the path to Regina’s renewable energy future requires two shifts:
1) the community needs to reduce unnecessary energy consumption and drastically improve its energy efficiency as a precursor to making renewables cost-effective and viable, and
2) the community needs to switch from systems that burn fossil fuels to those that use renewable energy.

Technologies that use electricity are generally more efficient than their fossil-fuel-driven counterparts. As such, switching to electricity-powered technologies like electric heating and electric vehicles will do much of the work required to improve the city's energy efficiency.

A switch to electricity-powered technology—when that electricity is generated using renewables—has the added benefit of drastically reducing greenhouse gas emissions.

But electricity is not the only solution for Regina. Regina is a cold-climate city with a productive industrial sector. Solutions that meet the needs of residents and businesses will include, at the very least, interim shifts to low-emissions fuels including renewable natural gas and green hydrogen.

To reach its goal of becoming a 100 per cent renewable energy community with net-zero emissions by 2050, Regina needs to chart a path. The path needs to accommodate its unique circumstances and local context and set the community up for success. Such a shift does not happen overnight, and it does not happen without direction. This Framework charts that path and identifies the actions that must be taken to follow it.

> "Undertaking an energy and emissions reduction strategy is about more than fixing a problem. It is about creating a healthy system, including a community and economy that is healthy for Regina's residents."

The City carried out a robust engagement process and a set of emissions, energy-use, and financial modelling exercises to chart a path that is tailored to Regina's unique community and its needs.

The engagement process (Section Two) provided opportunities for interested stakeholders, including the public, to contribute to the path's development and kept people informed of key decisions.

The first energy-use and emissions modelling exercise (Section Three) investigated how the community uses energy today and what the resulting emissions are. This a crucial step in understanding the current energy-use and emissions patterns in the community and establishes the baseline from which future targets and actions can be developed. Further energy-use and emissions modelling was then completed to create a business-as-planned scenario. The business-as-planned scenario used the baseline data and other locally relevant data to project how that energy use and its related emissions could plausibly change into the future if the community were to take no action to improve efficiency or reduce emissions other than the actions already planned. This includes City policies and plans, such as intensification targets, federal targets such as the mandatory electric vehicles sales targets, and community-wide building retrofit rates, which are currently estimated to be 0.5 percent of the building stock per year.

The second energy-use and emissions modelling exercise (Section Four) involved modelling a series of actions aimed at improving energy efficiency, reducing reliance on fossil fuels,

and subsequently reducing emissions across the community. The exercise produced multiple nuanced scenarios that explored more and less aggressive pathways. The City chose a scenario for Regina based on opportunities and constraints within the community and guided by stakeholder input and IPCC recommendations.

To identify what would be required to fully chart the path, the City developed a financial analysis of the best-fit scenario, known as the low-carbon pathway (Section Five) and then devised an implementation plan (Section Six).

Overall, this Framework details the path Regina has charted to reach its 100 per cent renewable energy and net-zero emissions goal. It represents nearly a year of iterative analysis and engagement. If followed, this path is estimated to reduce Regina's energy use by 38 per cent, and reduce its emissions by 97 per cent by 2050. It will result in Regina's contribution to global warming aligning with recommendations outlined in the Paris Agreement—keeping global warming below 2°C above pre-industrial levels and moving towards limiting warming to 1.5°C.

While addressing climate change adaptation is outside the scope of this Framework, the City acknowledges that participating in limiting global warming and climate change is one way adaptation impacts and costs can be limited. This plan focuses on climate change mitigation, or addressing the cause of climate change (human-driven emissions) to avoid greater changes in the climate and the need for more adaptation in the future.

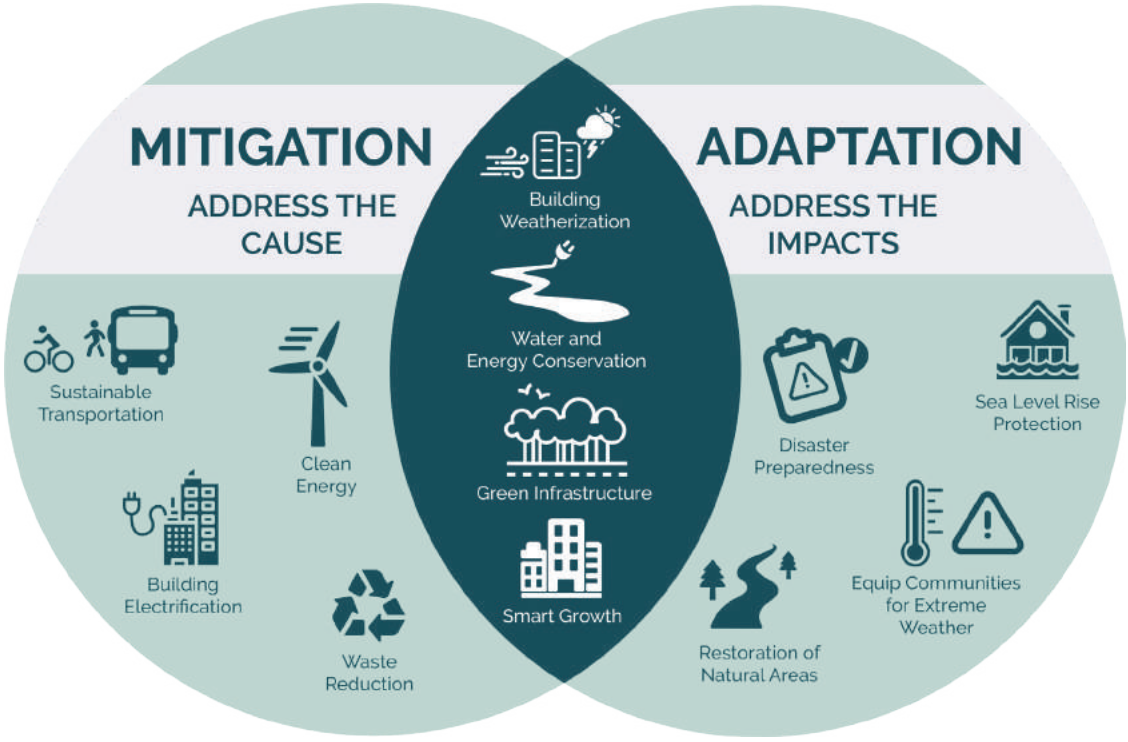


Figure 1. Adaptation and mitigation actions comparison.

A Community Lens

Although the endorsement of this Framework rests with Regina's City Council, it required extensive input from the community to ensure that the unique conditions, constraints, and community voices in Regina were heard and understood. This plan is influenced by input from:

- A Community Advisory Group made up of community members from different sectors;
- An Internal Advisory Committee made up of cross-departmental staff from the City of Regina;
- Discussions with Regina's residents using a variety of outreach techniques and formats;
- Research on best practices; and
- The consultant's expertise from working with other municipalities across Canada.

A detailed overview of engagement activities can be found in Appendix B.

Community Advisory Group and Focused Engagement

A Community Advisory Group (CAG) was formed at the outset of the Framework development. The CAG members were chosen by the City and included representation from across public institutions, utilities, industry, businesses, not-for-profit organizations, and Indigenous partners. The CAG's mandate was to inform the development of the plan and to ensure it reflects a range of community interests. Members engaged in workshops and reviews of project outputs at key stages in the planning process and provided individual feedback that represented their organization and/or sector. The CAG met four times during plan development. Participants provided feedback that helped refine the low-carbon actions and low-carbon pathway outlined in this Framework.

The CAG workshops were supported with six focus groups that included CAG members and other key stakeholders and subject matter experts in the community and five one-on-one interviews with key stakeholders and subject matter experts from the CAG. These engagements informed stakeholders of the state of the project and solicited input on low-carbon actions.

The CAG and other focused engagement opportunities provided insight into key considerations for the development and implementation of the Framework. Themes that emerged from these groups included the following:

Partnership is key: The majority of the individuals who participated in the CAG and in focused engagement opportunities are already addressing climate change in their organizations and/or sectors and are actively seeking ways to do more. Many noted ways the City could improve its partnerships with sectors and organizations by collaborating on pilot projects; providing clear direction on policies and regulations; taking feedback on how policies and regulations impact different sectors and adjusting accordingly; being an ongoing convener of interested and affected parties; and simply being a champion of climate action in the community.

Leadership from the City: Many of the participants and their organizations look to the City of Regina to show leadership in the community through its actions. This includes the City reducing energy use and emissions in its own operations and assets, and communicating transparently about its progress. For some, it also means the City being an advocate to higher levels of government for stronger action and incentives.

Communication and consideration are imperative: The focused engagement invited in a diversity of organizations and perspectives. And with this diversity came different opinions, levels of readiness, and support for different actions. However, all participants were clear that they want ongoing communication and clarity from the City. They expect the City to consider the various impacts their decisions will have, whether they be on costs to businesses, intergenerational justice, or services offered to residents.

Broader Community Perspectives

Soon after the project kick-off, the City launched a project website to inform the public about timelines and opportunities for engagement. Throughout the lifecycle of the project, residents were able to post their ideas for a low-carbon future on the Be Heard Regina public participation platform, ask questions to the project team, and share their vision for a low-carbon Regina.

The Be Heard Regina platform hosted a community survey during the low-carbon action development phase of the project and physical copies were available at City Hall. During this phase, a student forum and public forum were also held to provide an opportunity for members of the public to share their hopes and concerns around the Framework and the focus areas for GHG reductions and their feelings about climate change.

Input from the participants highlighted not only different perspectives on the impacts of energy and emissions reductions goals but key concerns held in the community around barriers to implementation and the opportunities participants saw in the community. Themes that emerged included:

Fear of inaction: Participants expressed concern that inaction would result after the development of the Framework. They cited several factors that could lead to inaction, including a lack of political will (at all levels of government); influence by industry (the oil and gas sector in particular); lack of public knowledge, understanding, and interest; difficulties in achieving the required behaviour change; and a general lack of urgency around the issue from both the public and politicians.

In particular, youth viewed a lack of action and urgency in an existential way and expressed fears about their future and human existence. This highlights a need for ongoing communication, transparency, engagement, and partnership, and for the City to maintain momentum for the Framework by implementing quick wins and pursuing implementation immediately.

Social equity: Participants expressed their concerns that climate change and the transition to a low-carbon community will not impact everyone in the community equally. Both could amplify existing inequities. Participants acknowledged both the impacts of climate change on vulnerable individuals and groups, including youth and those living on low and fixed incomes, and the need to ensure that these groups can benefit from the implementation of the Framework. This highlights the need to develop solutions that are tailored to different sections of the population to respond to differing needs.

Accessible transit and transportation for all: Participants across engagement opportunities highlighted the barriers that community members without access to personal vehicles face in travelling throughout the city and how the current transit and transportation system encourages personal vehicle use for those who can afford it. Participants highlighted the opportunity that exists to improve the transit and transportation systems to decrease emissions while creating more livable, accessible, and just communities.

Leadership from the City: Many community members who participated in engagement opportunities noted their desire for the City of Regina to take a leadership role. Similar to the feedback from focused engagement, participants want to see action in City vehicles and buildings, and they want the City to be a strong voice for climate action in the community.

Support to take action: An overwhelming majority of participants stated their need for support to take climate action in their own lives. According to the survey conducted, the majority of respondents are looking for financial support to help them make energy-efficient upgrades in their homes, switch to cleaner fuel sources, add renewables, and purchase low-emissions vehicles. Many respondents are also seeking more information to understand the best choices for their home and lifestyle. They want to know which solutions work well in Regina, and they are looking for help finding the goods and services they need.

A Final Note on Engagement

This summary does not and cannot account for the many nuances and insights shared during the thousands of person-hours dedicated to engagement during the development of the Framework. City staff have retained detailed records of all of the engagement activities and will continue to use the valuable information collected as the implementation of the Framework begins.

In particular, the focused engagement reveals those who are ready and willing to work closely with the City and within their own organizations to help reach the goals laid out in the Framework. The broader public engagement provides a preliminary understanding of the opportunities and challenges that may present themselves as implementation begins and how community members wish to be supported. Both processes provided an opportunity to exchange ideas and engage with the City and other community members. If sustained through ongoing engagement opportunities, the relationships built during this process can contribute greatly to implementation of the Framework.

Regina's Business-as-Planned Energy Future

In Regina, residents, businesses, and the City use energy to keep the lights on and the engines running. In turn, these energy sources release greenhouse gas emissions into the atmosphere.

The municipal government has started planning to improve energy efficiency and reduce GHG emissions in its operations. Plans include transitioning City vehicles to electric and shifting to renewable methods of heating City facilities. The City is also promoting the construction of more energy-efficient buildings and has acted as a partner on a recent grant application for a net-zero development with affordable units within the community.

There are also factors outside the municipal government's control that will affect the community's energy use and GHG emissions toward 2050. For example, the Federal Government has mandated improvements to vehicle fuel efficiency standards. They have also mandated that all new cars and light trucks sold in Canada will be electric by 2035.

As the climate warms, Regina will experience fewer colder days, and as such, the city will need less energy to heat homes and buildings. Conversely, the provincial electricity grid is one of the most carbon-intense in Canada. The provincial electric utility, SaskPower has a stated goal of decreasing emissions from the grid by 50% by 2030 and working towards net-zero by 2050. These goals have not been captured in the business-as-planned scenario because a detailed and funded pathway for reaching these goals is not yet in place.[16]

A Snapshot of Regina's Current Energy Use and Emissions

Energy

Regina's total energy use in the base year of 2016 was 71.3 PJ. Industry makes up nearly half of the city's energy consumption, or 43 per cent. Transportation in the city makes up the next largest share at 26 per cent. Though municipal operations make up only 1.3 per cent of Regina's energy consumption, this sector is also the one over which the municipal government has the most control.

[16] SaskPower. (2021). Our Power Future, Emissions. SaskPower. https://www.saskpower.com/Our-Power-Future/Powering-2030/Emissions

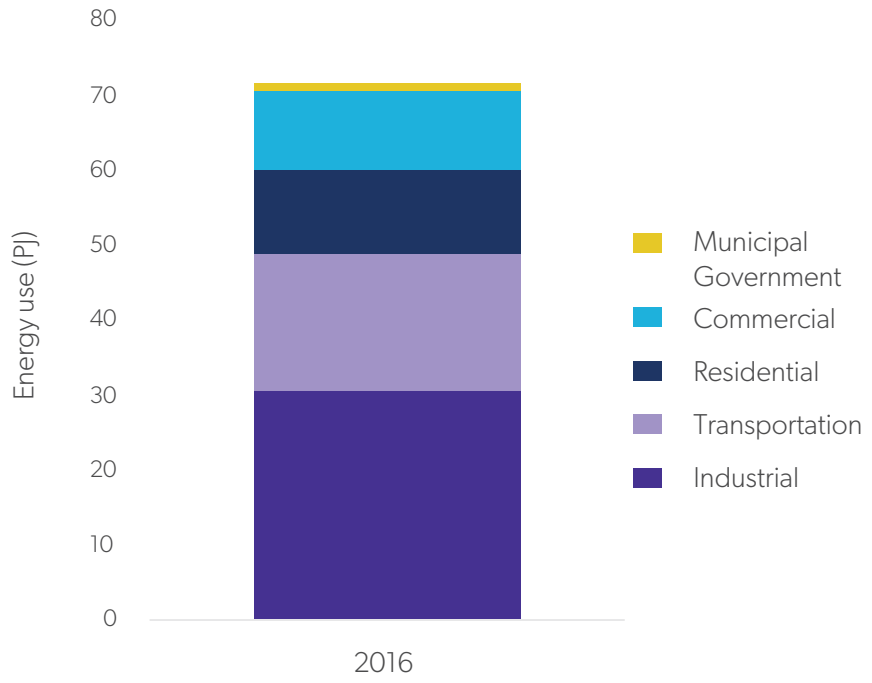
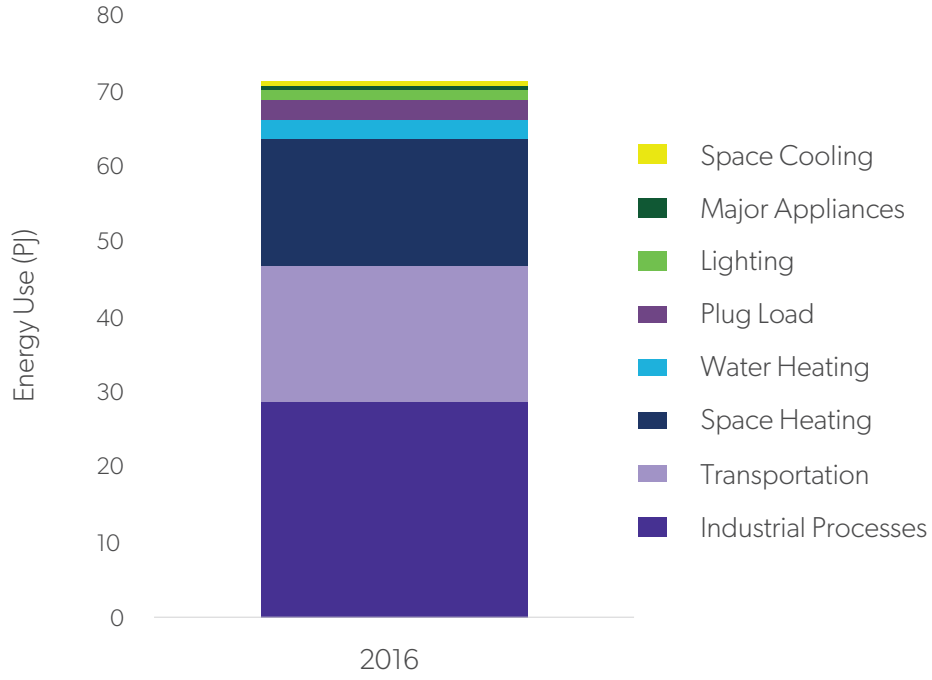


Figure 2. Regina's base-year energy use by sector.

Three major end uses make up 90 per cent of energy use: industrial processes, space heating, and transportation. Industrial processes make up 40 per cent of Regina's energy use and almost all of this use is centralized in buildings. Transportation makes up 26 percent of energy use and includes personal- and commercial-use vehicles. Space heating makes up 24 per cent of all energy use. Space heating in commercial and residential buildings contributes to 10 per cent and 11 per cent of Regina's overall energy use, respectively.



What are industrial processes?
Industrial processes turn raw materials such as mined metals, minerals, and crude oil into usable products such as sheet metal, heating oil, or diesel. The manufacturing process also creates by-products, waste, and emissions as materials are converted from their raw form to a usable product. This is because industrial processes require energy, and sometimes water, chemicals, and other inputs to create the desired outputs.

Industrial processes, space heating, and transportation directly burn fossil fuels for energy. In fact, fossil fuels accounted for 82 per cent of all energy use in Regina in the base year.

Industrial processes and space heating both rely on natural gas. The natural gas used in industrial buildings makes up 43 per cent of all energy consumption in buildings and 32 per cent of overall energy use. The natural gas used to heat residential homes makes up 17 per cent of all building-related energy use and 13 per cent of energy use overall.

Transportation relies on gasoline and diesel, which, when combined, make up 25 per cent of energy use. Most private vehicles on the road are light trucks and SUVs. The gasoline used in light trucks makes up 44 per cent of transportation-related energy use and 10 per cent of energy use overall.

Only 8 per cent of Regina's energy use comes from grid electricity.

Calculating Regina's Base Year
To project Regina's future GHG emissions, a calibrated base year was developed that represents current activities across multiple sectors, including population, transportation, buildings, energy, agriculture, and land use. This scenario uses 2016 as its base year because demographic information derived from the Statistics Canada Census describes people and their activities within Regina and forms the basis of the model. The most recent Census was completed in 2016. Additional baseline data, such as utility data, from 2017 to 2021 was used in the business-as-planned scenario, where provided.

Determining the Impact of Business-as-Planned
The activities described above were combined with expected population growth and modelled until 2050 to develop **a scenario that illustrates the GHG emissions in Regina if the community takes no additional action on climate change beyond the activities that are already underway or planned**. This scenario is called the business-as-planned (BAP) scenario. Low-carbon actions were modelled in a second future scenario—the low-carbon scenario (LCS)—to identify a pathway to reach Regina's net-zero emissions target.

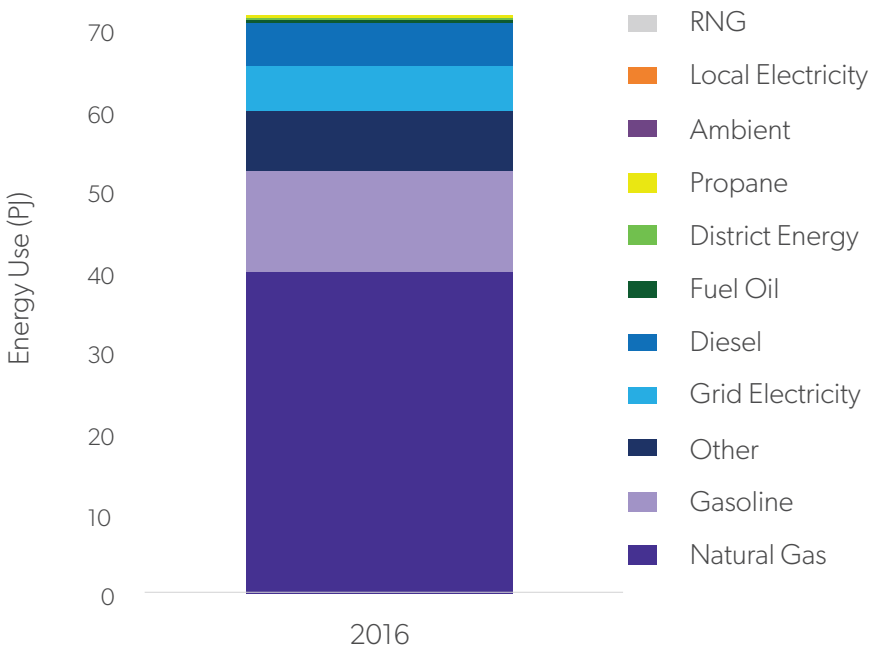


Figure 4. Regina's base-year energy use by fuel type.

At 32 per cent, natural gas consumption in industry makes up the largest share of Regina's overall energy use. Natural gas use in commercial and residential sectors combined makes up the next largest share at 23 per cent. Gasoline use accounts for three-quarters of transportation energy use and makes up 18 per cent of total energy use in the community.

Emissions

In the 2016 baseline year, Regina emitted nearly 5.3 MtCO2e. The industrial sector is the largest emitter, contributing 34 per cent of emissions. Almost all of these emissions are tied to primary industry and industrial processes carried out in buildings.

Space heating in residential and commercial buildings each contribute to an equal share of emissions. They each make up 11 per cent of all building emissions and eight per cent of emissions overall.

Transportation makes up 24 per cent of all emissions. Light trucks and SUVs make up 47 per cent of all transportation-related emissions and 11per cent of emissions overall.

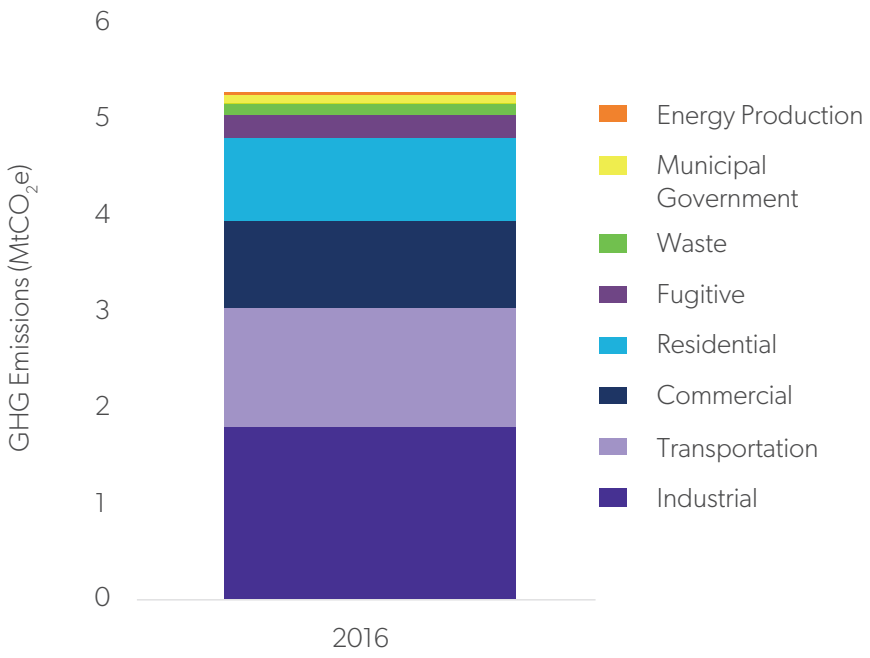


Figure 5. Regina's base-year emissions by sector.

Natural gas use contributes to 36 per cent of the city's base-year emissions. Most of the natural gas use in Regina is devoted to space heating in buildings. This includes significant use in the commercial, residential, and industrial sectors. Natural gas use in industrial buildings contributes to 30 per cent of buildings-related emissions and 20 per cent of base-year emissions overall.

What are fugitive emissions?
In this analysis, fugitive emissions are the emissions that result from the transportation and distribution of natural gas. During the transportation and distribution processes, small amounts of emissions from methane leak into the atmosphere from valves, casings, and pipes.

Gasoline use makes up 68 per cent of transportation-related emissions and diesel use makes up 32 per cent.

Heavy trucks have a significant effect on Regina's emissions. Diesel use in heavy trucks constitutes 11 per cent of transportation emissions and nearly three per cent of total base-year emissions.

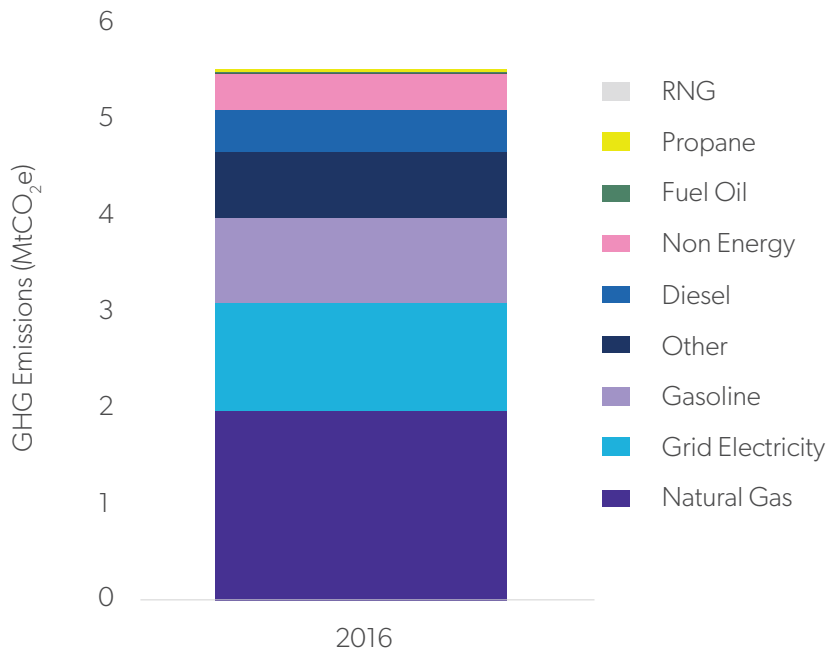


Figure 6. Regina's base-year emissions by fuel type.

Activity from industry dominates Regina's emissions; however, natural gas use in the commercial and residential sectors also make up substantial shares. These sectors offer significant opportunities for improved energy efficiency and a shift to renewable sources. The same is true for diesel and gasoline-powered cars and light trucks. As all sectors move toward improved energy efficiency and renewables, the GHG emissions associated with these sectors will decrease significantly.

The Business-as-Planned Scenario

In some cases, community members and sectors across Regina have already taken steps to improve energy efficiency and mitigate GHG emissions into the future. This includes taking advantage of retrofit programs, building more efficient buildings, purchasing renewable energy, and driving electric vehicles. Although these are commendable steps, more action needs to be taken and actions need to be adopted at a broader scale across the community to meet the one hundred per cent renewable energy goal and contribute to the slowing of climate change by decreasing GHG emissions.

To reach these goals, it is key to first understand the scope of the challenge. The business-as-planned (BAP) scenario defines this scope.

In the business-as-planned scenario, existing municipal, provincial, and federal policy changes are modelled in conjunction with Regina's projected population, housing, and employment growth and the projected climate change effects that will be felt in the region. Any real data available for dates between 2016 and 2021 was considered in the development of the business-as-planned scenario. **No additional energy efficiency or low-carbon efforts are introduced beyond those that are planned, endorsed (via legislation, regulation, and/or policy), and have committed capital and/or operational funding**.

This scenario paints a picture of what Regina could look like if the community continues with its current plans without any adjustments or additional action.

Changing Demographics

Demographics are an important driver of energy consumption and GHG emissions. In Regina, the population and other key demographics are expected to grow. For example, the population is projected to increase from nearly 224,000 in 2016 to more than 382,000 in 2050. Personal vehicle ownership, households, and the number of jobs in Regina are expected to grow at a similar pace.

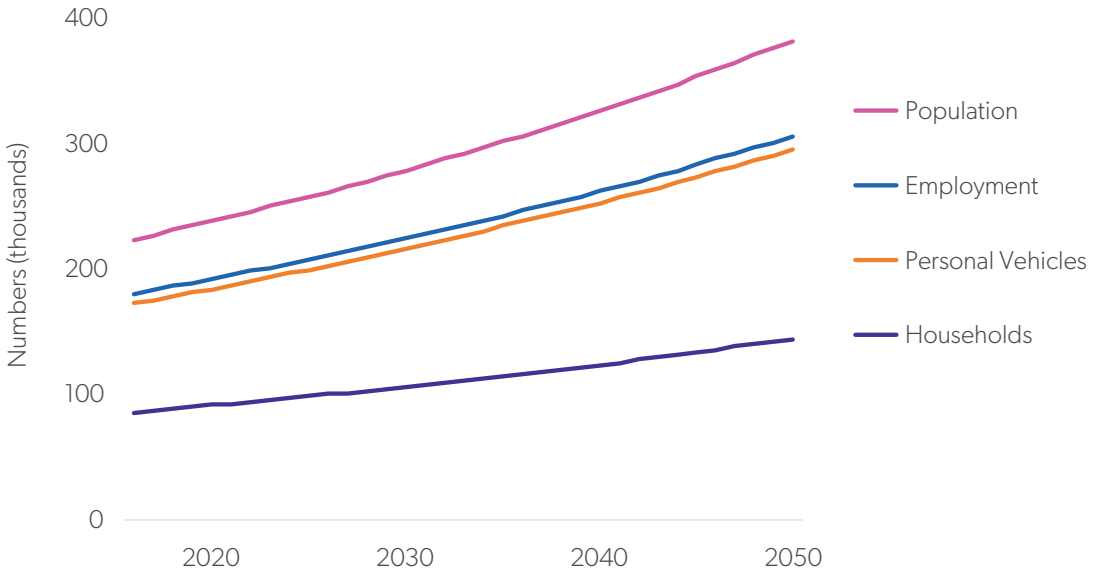


Figure 7. Projected demographic changes in Regina up to 2050.

Despite this projected growth, per capita energy use is expected to decrease by 31 per cent by 2050, dropping from 319 GJ per person to 220 GJ. This decrease accounts for increased energy efficiency measures in the transportation and buildings sectors.

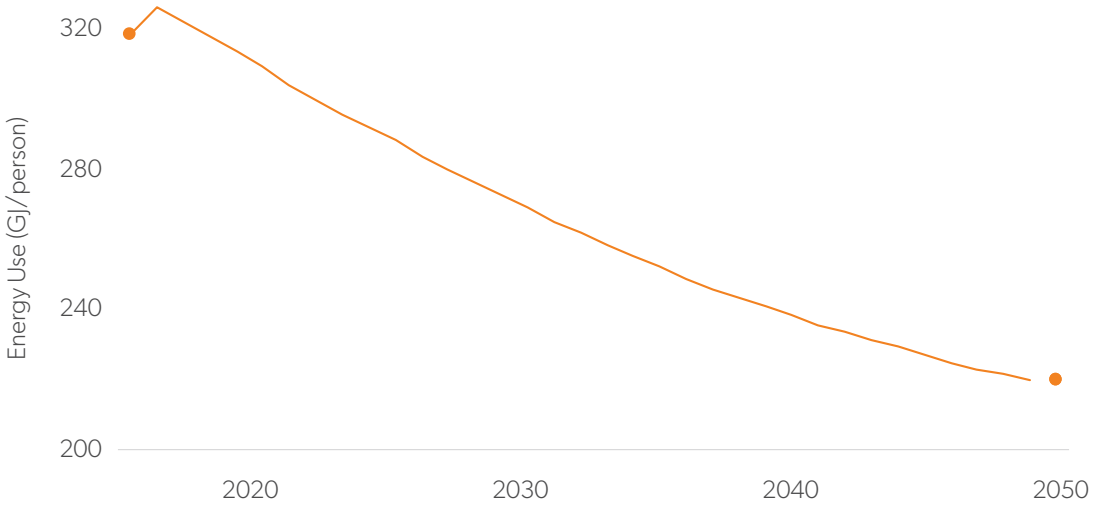


Figure 8. Projected per capita energy consumption in the business-as-planned scenario.

The same can be said for Regina's GHG emissions. Per capita emissions drop from 24 tCO2e in 2016 to 14 tCO2e in 2050. Efficiencies, slight decreases in grid emissions, and slight shifts toward renewable energy reduce the amount of fossil fuels being burned to power the community, so, per capita, Regina's GHG emissions decrease.

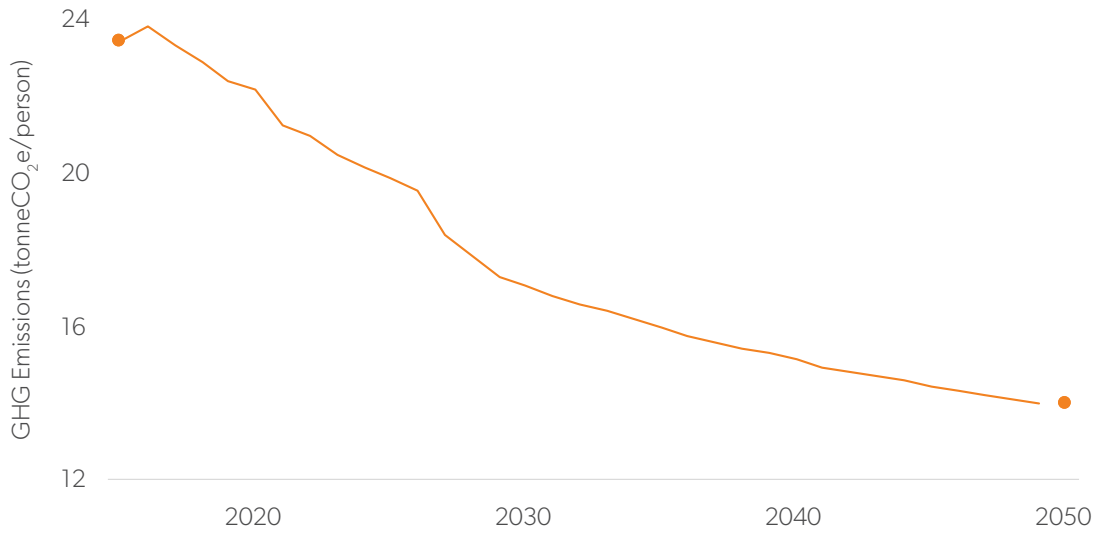


Figure 9. Projected per capita emissions in the business-as-planned scenario.

Though promising, these shifts alone are not enough to reach Regina's goals. As per capita energy use and related emissions decrease, the population grows, which counteracts the improvements in terms of overall energy use and emissions.

Increasing Energy Use

Regina's business-as-planned scenario is a story of slowly increasing cumulative energy use. Even if the 4 MW of local renewable energy were generated in the community, it would still not be enough to meet the community energy needs in the business-as-planned scenario.

In 2016, the community used 71 PJ of energy, and in 2050, it is projected to use 84 PJ, an 18 per cent increase. Despite the introduction of new technologies that reduce the energy needed to power the community, an increased population puts the opposite pressure on the city's energy needs.

Though industry's total energy use increases by 2.4 per cent, its share of overall community energy use declines from 43 per cent to 37 per cent. These improvements in industrial energy use are counteracted by increases in the commercial, residential, and municipal sectors, which each increase by just over 50 per cent. A slight uptick in electric vehicle adoption means that energy use from transportation decreases by about one per cent.

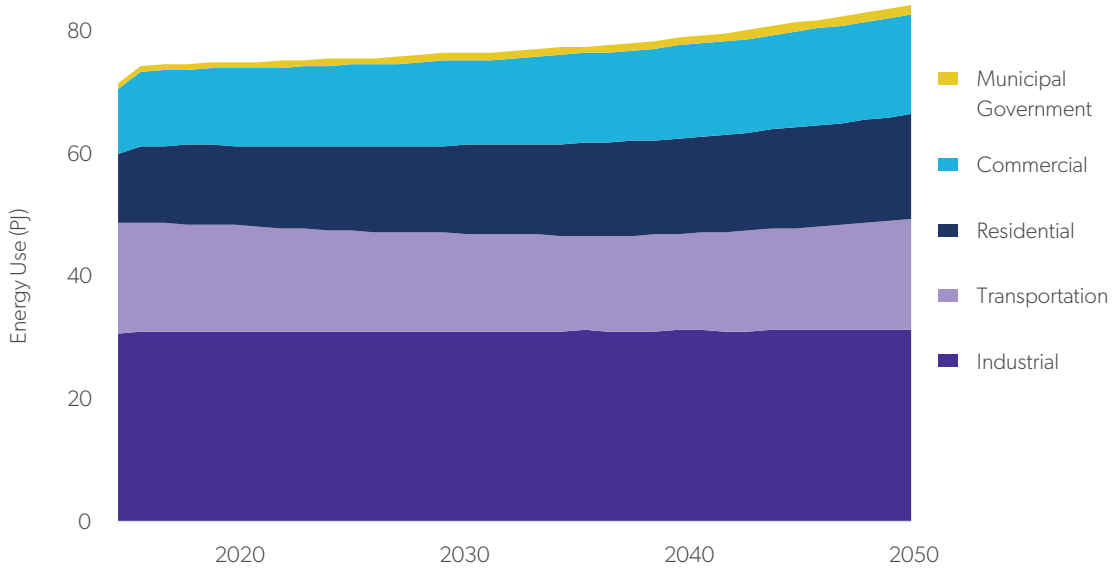


Figure 10. Energy use by sector from 2016 to 2050 in the business-as-planned scenario.

Increases in energy use in industrial processes are modest compared to increases in energy use in other sectors. More substantial increases in energy use by end use are driven by a growing population. Energy use in plug load and major appliances increases by 79 per cent and 90 per cent, respectively, which reflects more households charging more devices and running more washers and refrigerators, even though they are expected to become more efficient. Space heating also increases by 44 per cent despite a decrease in overall heating degree days over time.

What is plug load?
Plug load is the energy used by products plugged into a wall outlet in a building. Plug load can be decreased by purchasing more efficient products that need to be plugged in,and by unplugging appliances and other devices when not needed.

Space cooling experiences the most drastic increase. Climate change means warmer summers, which will lead to an increase in air conditioning. Combined with an increase in population, by 2050, space cooling energy use will increase by 367 per cent and will make up nearly three percent of total energy use.

Energy consumption in transportation drops by one percent as more people purchase electric vehicles. Conversely, the number of heavy trucks required to service a larger community will more than double by 2050. This results in the energy efficiency gains made across the transportation sector due to the increase in electric vehicles and more stringent efficiency standards for diesel vehicles to be counteracted by the 14 per cent increase in energy needed to power additional heavy trucks.

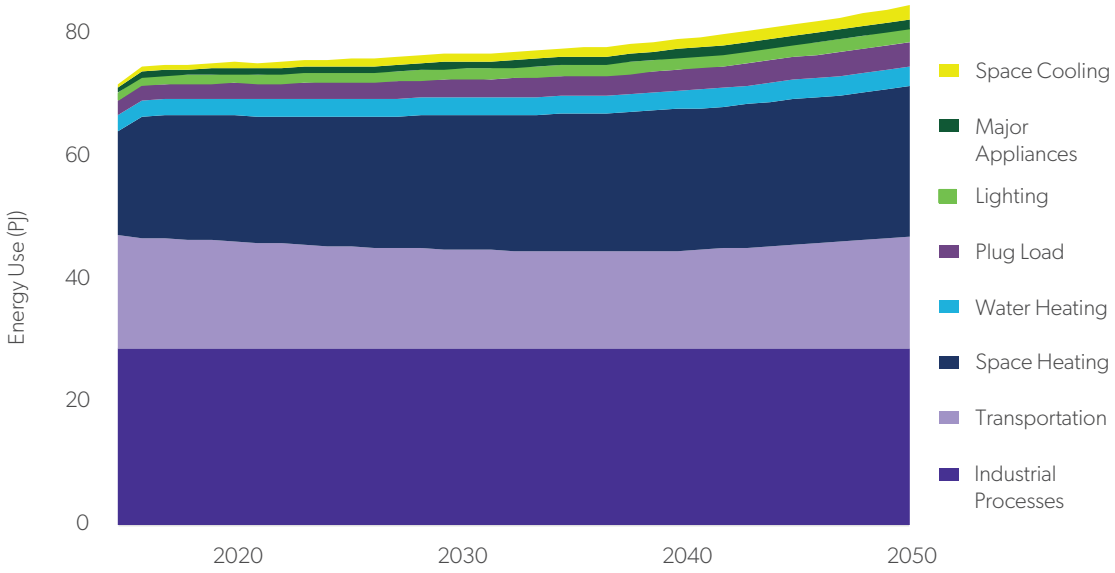


Figure 11. Energy use by end use from 2016 to 2050 in the business-as-planned scenario.

In the business-as-planned scenario, energy from natural gas increases by 20 per cent, but its share of overall energy use remains the same.

The share of energy being drawn from the electricity grid nearly doubles from eight per cent in 2016 to 14 per cent in 2050. This 108 per cent increase in energy use from grid electricity is driven in part by modest gains in electrification in buildings. For example, of all the energy used in residential homes, only 20 per cent comes from grid electricity in 2016. By 2050, this amount increases to 25 per cent. This is reflected by a drop in the share of residential energy coming from natural gas, which drops from 78 per cent in 2016 to 73 per cent in 2050.

The increase in grid electricity use is also driven by the number of cars and light trucks that have been converted to electric. As a result, energy use from gasoline drops. In 2016, gasoline makes up 18 per cent of energy use, but by 2050, it makes up 13 per cent. Gasoline energy use drops by 16 per cent overall while diesel use increases by 10 per cent overall. The diesel use increase is due to more heavy trucks being required to service the needs of a growing population.

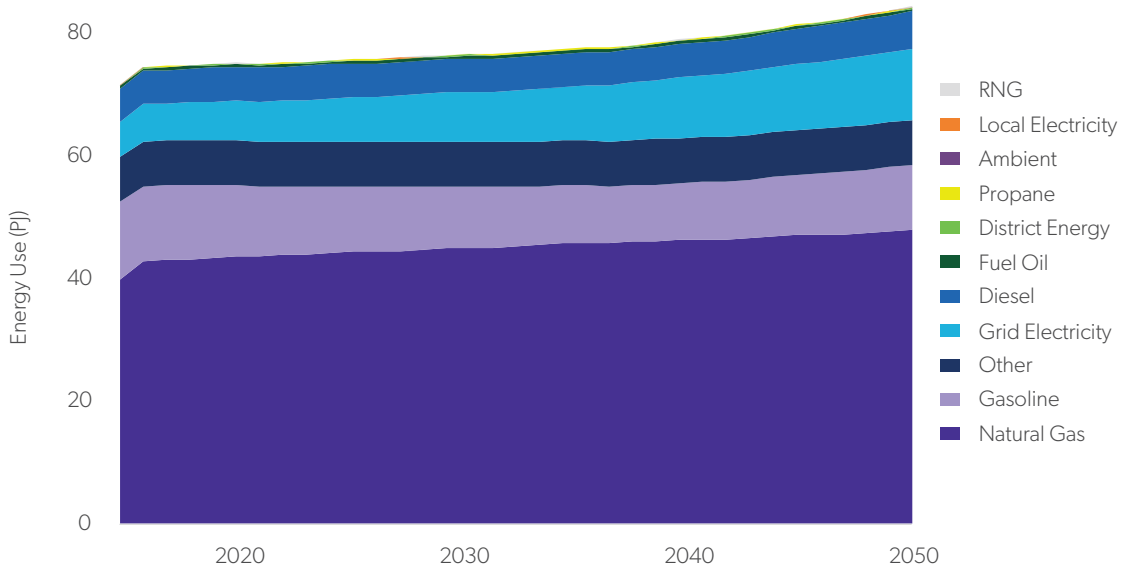


Figure 12. Energy use by fuel from 2016 to 2050 in the business-as-planned scenario.

Rising GHG Emissions

Regina's total annual emissions increase slightly between 2016 and 2050, from nearly 5.3 MtCO2e to just over 5.3 MtCO2e.

Emissions from the commercial, residential, and transportation sectors decrease substantially through the early 2030s. These decreases are primarily due to building code requirements driving greater efficiency in new buildings, modest energy retrofits to existing buildings, and a slight uptick in electric vehicle use.

After the mid-2030s, Regina's population growth counteracts much of the benefits of these advances. Ultimately, emissions from the commercial, residential, and transportation sectors decrease by nine per cent, one per cent, and two per cent, respectively.

Emissions from industry stay nearly steady across the next three decades, increasing by about one per cent by 2050.

At 138 per cent, waste emissions undergo the most drastic increase. This jump is driven by the increased waste generated by a larger population with no new plans to divert or reuse waste beyond the City of Regina's 65 per cent diversion rate goal for the residential sector set in 2011.

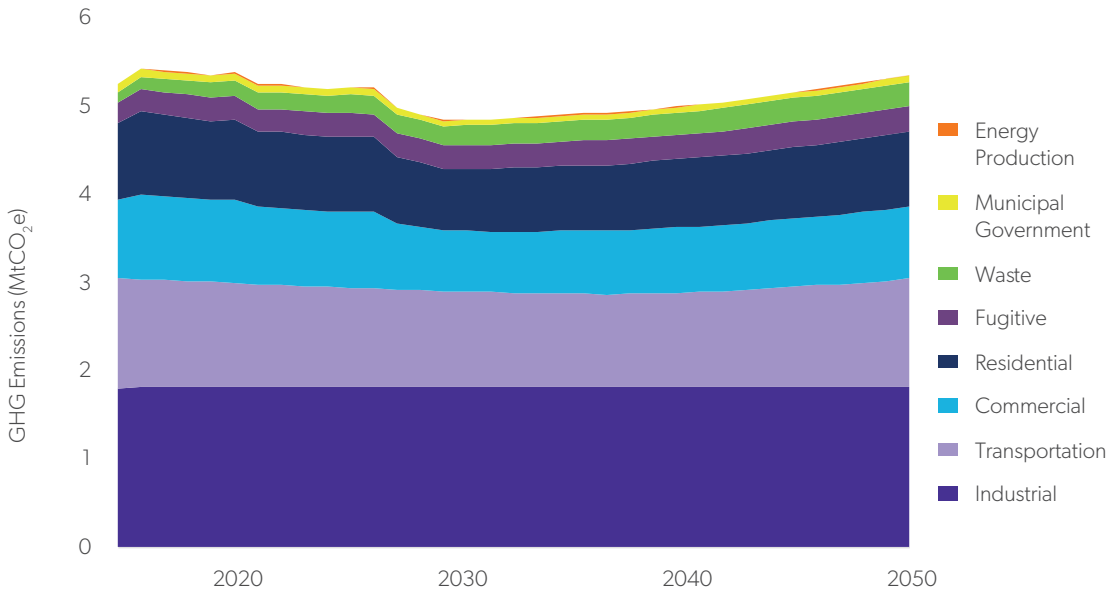


Figure 13. Regina's emissions by sector in the business-as-planned scenario.

Emissions from all fuel types increase in the business-as-planned scenario except for gasoline and grid electricity. Emissions from gasoline drop by 16 per cent as more people opt for electric vehicles. The 38 per cent drop in emissions from grid electricity is driven by SaskPower's efforts to reduce their own emissions.

The emissions reductions associated with these actions are most apparent between now and the early 2030s. Similar to energy use, they are counteracted by the pressures of a larger city over time.

Emissions from natural gas increase by 20 per cent because the city's larger population requires more dwellings and more commercial spaces, which require more natural gas to heat space and water.

Additionally, emissions from waste and non-energy sources increase by nearly 60 per cent as Regina produces more garbage. Their share of total emissions also increases as emissions from other sources drop. In 2016, waste and non-energy sources make up seven per cent of total emissions, but by 2050, they make up 10 per cent.

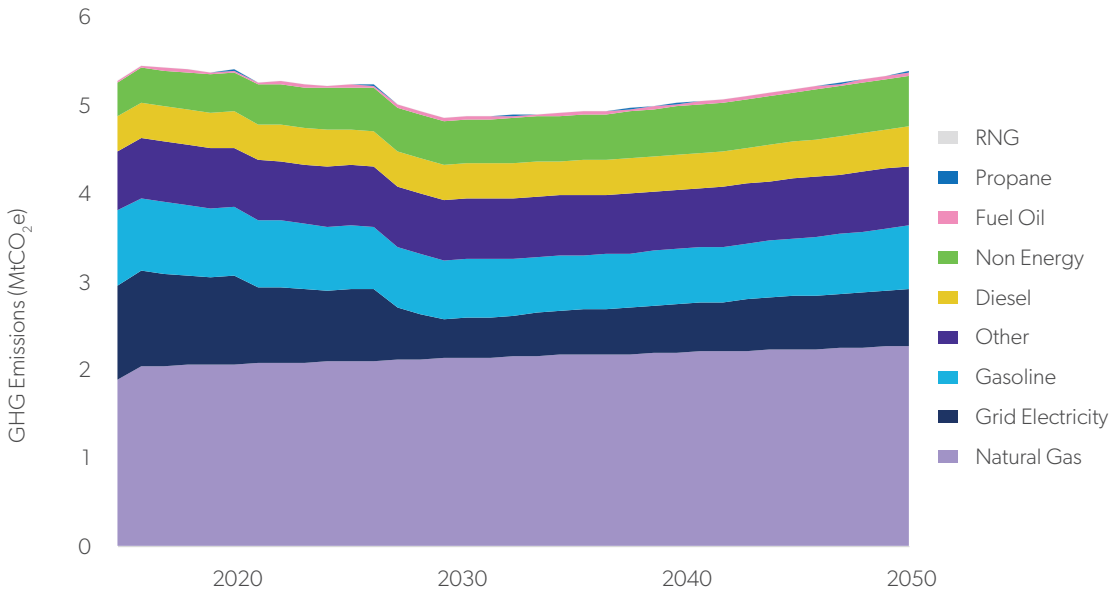


Figure 14. Regina's emissions by fuel in the business-as-planned scenario.

Emissions from natural gas in the industrial sector dominate other emissions sources throughout the business-as-planned scenario.

Key Business-as-Planned Indications

In summary, the business-as-planned scenario highlights that without further action and attention, emissions will not decrease and the City's 2030 and 2050 emissions targets will not be realized. It highlights the major assets and activities that will need to be addressed including industrial processes, vehicle fuel use, and buildings. It further highlights that changes will need to be made in all sectors in the community including industrial, transportation, commercial, residential, and municipal. In each of these sectors, there are opportunities to take action and imagine a new emissions and energy-use pathway.

Designing Regina's Low-Carbon Future

Creating a Pathway

No one person, organization, or sector can design a new future for an entire community. It takes commitment and input from lots of people from different sectors to design that future and to chart the path to reach it.

Actions recommended in the Framework reflect both the magnitude of the challenge to reach Regina's 2030 and 2050 targets and Regina's unique context, opportunities, and constraints that will shape the community's pathway to those targets. Feedback and insights from stakeholder groups and members of the public were key in defining the local context and identifying opportunities and constraints.

Were the actions viable? Were they ambitious enough? Were they too ambitious? Who might benefit from them the most? Whose needs are going unmet?

This led to the actions being refined, while still considering global best practices in emissions reductions pathways.

The low-carbon actions were then modelled in a sequence to maximize and build on their benefits. The sequence took into consideration energy efficiency, emissions reductions, and community co-benefits. The result of modelling the actions this way is a low-carbon scenario (LCS) that contrasts the business-as-planned (BAP) when comparing energy use and emissions.

Community Co-Benefits
Community co-benefits are benefits that are additional to the primary objective. In this case, the primary objectives are emissions and energy-use reductions and an increase in renewable energy use. Co-benefits associated with the actions that help achieve these objectives include job creation, enhanced equity, and better air and water quality.

For example, increasing transit service and offering free transit to some riders encourages the use of transit over a personal vehicle, which reduces emissions. It may also provide a more accessible and convenient service to individuals who cannot afford their own vehicle or are unable to drive.

Co-benefits are highlighted in the Implementation Overview and Implementation Guide portions of the Framework.

This scenario describes which actions to take and when in order to reach net-zero in Regina by 2050.

Alternatives Considered

The project team considered energy-use and emissions modelling results and stakeholder feedback on less aggressive and more aggressive pathways to meet the 2050 target. The pathways included nearly all of the same actions but explored the impact of completing the actions in longer and shorter timeframes.

The less aggressive pathway explored was almost as aggressive as the federal government's current emissions reduction goal (45 per cent reduction by 2030 and net-zero by 2050). This scenario did not maximize Regina's potential for local renewable energy or the industrial sector's capacity to adapt to new opportunities. It also carried the risk of not being aggressive enough to attract external funding and investment because it did not quite meet the Federal target. The federal target is also subject to change with the release of the IPCC's Sixth Assessment and as new requirements to meet or exceed the 1.5˚C global warming threshold are determined. Recently, the federal target shifted from a 40 per cent reduction in emissions to a 45 per cent reduction by 2030, highlighting the fluidity of the target over time with heightened awareness and new knowledge.

Consideration was given to a more aggressive approach to reducing emissions. A fair-share, science-based target is the emerging best practice for emissions reductions goals. The target sees cities in wealthy nations commit to reducing emissions to 2.9 tonnes per capita by 2030. This would amount to around an 84 per cent reduction in total emissions in Regina by 2030. While Regina acknowledges this best practice and strives to work towards it, the actions required to meet this goal are not feasible at this time due to local constraints, such as industrial and commercial sectors that will need more than nine years to adapt to new market demand, find suitable alternatives and technologies, and retrain workers to avoid adverse impacts on Regina's economy and labour force. A target this aggressive would also require retiring some assets, such as vehicles, before their natural end of life. Although the technology to make this shift exists, the availability of electric vehicles and charging infrastructure may not. Additionally, an action this aggressive creates the need for significant incentives for electric vehicles and/or regulations that tax or prohibit gasoline and diesel vehicles. This can create a burden for individuals on a low or fixed income who may be taxed for being unable to afford an electric vehicle.

The City will continue to collaborate with utility providers, other levels of government, training and labour representatives, and local industry to understand barriers and solutions to move closer to a 1.5º C fair-share pathway.

The Seven Big Moves

To reduce emissions and move toward 100 per cent renewable energy, there are seven Big Moves the community needs to take. These moves combine measures to limit the amount of energy the city needs and then meet those needs with renewable energy. To limit energy use, the measures eliminate unnecessary energy consumption and maximize energy efficiency. Then, renewable energy and low-carbon sources of energy are brought on to supply power. By reducing the need for energy first, Regina can decrease the amount of energy that must be generated in and for the community.

Retrofit Buildings

Energy use in buildings accounts for 69 per cent of GHG emissions in Regina. Emissions include those resulting from heating and cooling spaces, lighting, and electricity used to run appliances and equipment in homes, schools, offices, and industrial warehouses. To reach net-zero in Regina, all existing buildings in the community will need to be retrofitted to be more energy-efficient. This includes upgrading the building envelope to have more efficient windows and doors and more and/or better insulation. In addition to reducing energy use and emissions, retrofitting buildings can create savings in utility costs. Completing building retrofits can be labour-intensive, so it also generates jobs in the community.

Clean Heating

Most of the emissions from buildings in Regina currently come from natural gas used for space and water heating. For new and retrofitted buildings, energy systems will need to be converted to limit emissions. Switching to efficient electric systems like heat pumps is key because grid electricity can be decarbonized with the addition of renewable energy at the individual building or community scale. Like other energy efficiency upgrades, switching to clean heating can reduce utility bills because heat pumps are more efficient than most other heating systems. This means they can warm or cool a space with less energy and using less energy translates to utility savings.

Net-Zero New Construction

Ensuring that new buildings are not sources of carbon emissions is key to reaching an ambitious emissions reduction target. Buildings and the systems within them (e.g. heating and cooling systems) are long-lasting assets. If buildings that are carbon-emitting continue to be built in the community, the resulting operational emissions are ‘locked in’ over the span of 25 years or more. To meet the target outlined in this Framework, costly upgrades would be required to retrofit before the buildings’ heating, cooling, and other essential systems are at end of life. To avoid mid-lifecycle upgrades to increase efficiency and mitigate the risk of regulations that will require efficiency upgrades during the lifecycle, it is better to invest in low-emissions buildings now. This also allows building owners and/or tenants to begin generating operational savings from lower utility bills right away and maximizes other co-benefits such as indoor air-quality.

Emissions Lock-in

Emissions lock-in refers to a situation in which prior decisions relating to GHG emitting assets or technologies lock the asset owner or community into a particular emissions pathway. These decisions often constrain future decision-making for reducing GHG emissions because the costs of replacing a GHG-emitting asset of technology before it is due to be replaced can be very expensive.

For example, if a new community centre is built using a GHG emitting heating and cooling system, it is likely that system will stay in place for several decades because replacing the system would be costly, and it is difficult to justify replacing a large, expensive system early, from a financial perspective.

Widespread lock-in already exists in most communities, due to historical decisions that were made prior to widespread concerns about emissions and climate change. Now that we know better, and have low-emissions technologies, we can do better by committing to low-emissions technologies in all new buildings and assets.

Renewable Energy Generation

One of the most significant low-carbon transition opportunities the community can pursue is to increase renewable energy generation. Moving to these sources will allow the community to decrease emissions from the electricity grid, which is directly related to emissions levels from electricity use in homes and businesses and in electric vehicles. It also maximizes the emissions reduction benefits of building retrofits and fuel-switching. Transition to renewable energy generation can be achieved by investing in individual and community-scale wind and solar power.

Low-Emissions Vehicles

Regina, like many Canadian cities, is heavily reliant on individual automobile trips to get around. The transportation sector makes up 23 per cent of community emissions on a yearly basis. While the city cannot avoid all vehicle trips, there are viable alternatives to gasoline-fueled vehicles. The technology continues to evolve for battery electric vehicles while prices decrease. Other technologies such as hydrogen vehicles are in rapid development. Both solutions require new infrastructure to support their widespread adoption. Other benefits of low-emissions vehicles are that they are more efficient than gasoline- and diesel-powered vehicles, so they use less energy overall, and the ongoing operation and maintenance costs tend to be lower.

Increase Active Transportation and Transit Use

While low-emissions vehicles can help reduce emissions, increasing active transportation and transit use are also important strategies to help us reduce transportation emissions. A well-thought-out active transportation and transit network can help keep congestion low as the population increases, promote active and healthy lifestyles, and complement urban intensification and mixed-use developments while decreasing emissions.

Clean and Re-Energize Industry

Regina's industrial sector represents one-third of energy consumption and GHG emissions in the community. The City must continue its positive dialogue with industry stakeholders to encourage industry to consider their energy transition and to collaborate on solutions to mitigate the economic risk associated with the transition to a low-carbon economy.

An Alternative Future

The low-carbon scenario is achieved through the implementation of the seven Big Moves and additional actions identified in the Implementation Overview section. It paints a very different picture of a possible future.

In the low-carbon scenario, per capita energy use is expected to decrease by nearly 64 per cent by 2050. That amounts to a drop from 319 GJ per person to 117 GJ per person.

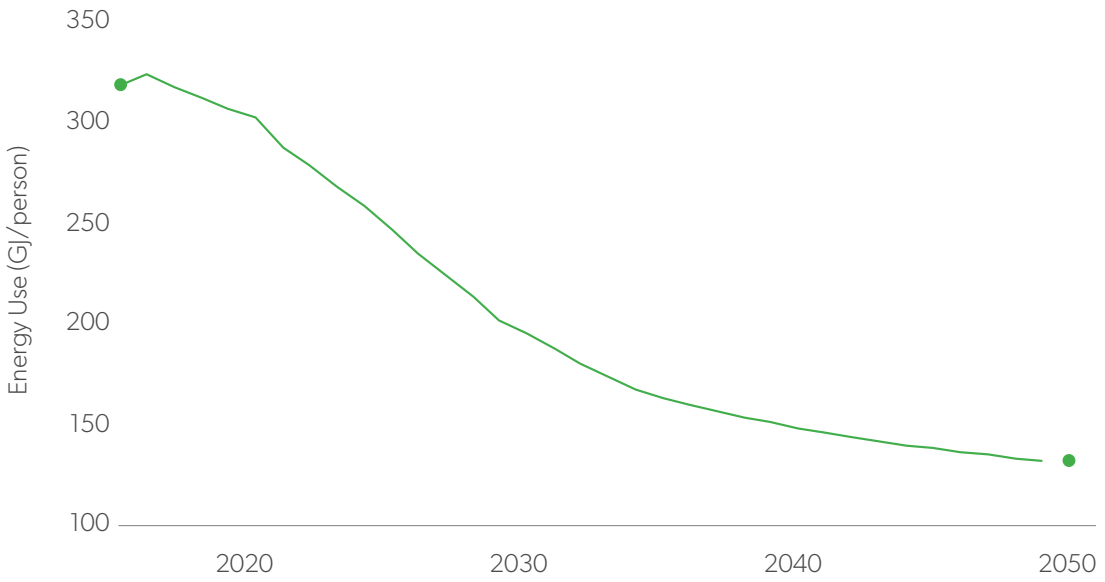


Figure 15. Projected per capita energy consumption in the low-carbon scenario.

Emissions per capita fall at an even greater rate than energy use. Between 2016 and 2050, emissions per capita decrease from nearly 24 tonnes/CO2e per person to 0.4 tonnes/CO2e per person or more than a 98 per cent reduction.

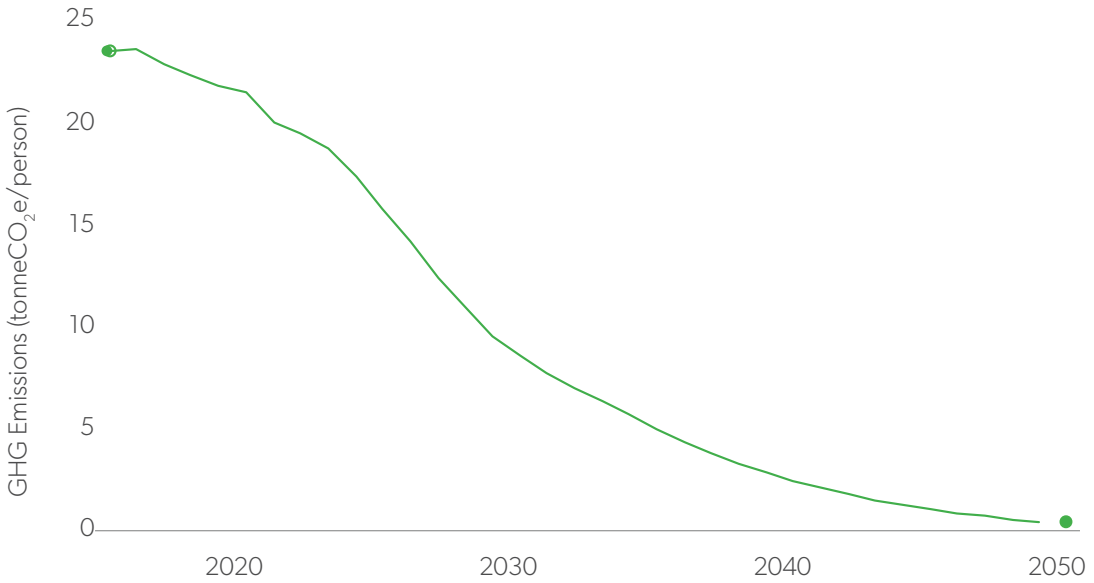


Figure 16. Projected per capita emissions in the low-carbon scenario.

Overall, energy consumption in Regina drops from more than 71 PJ in 2016 to less than 45 PJ in 2050. This represents a total decrease of nearly 38 per cent. This decrease is reached before 2040 and is marginally impacted by population growth out to 2050.

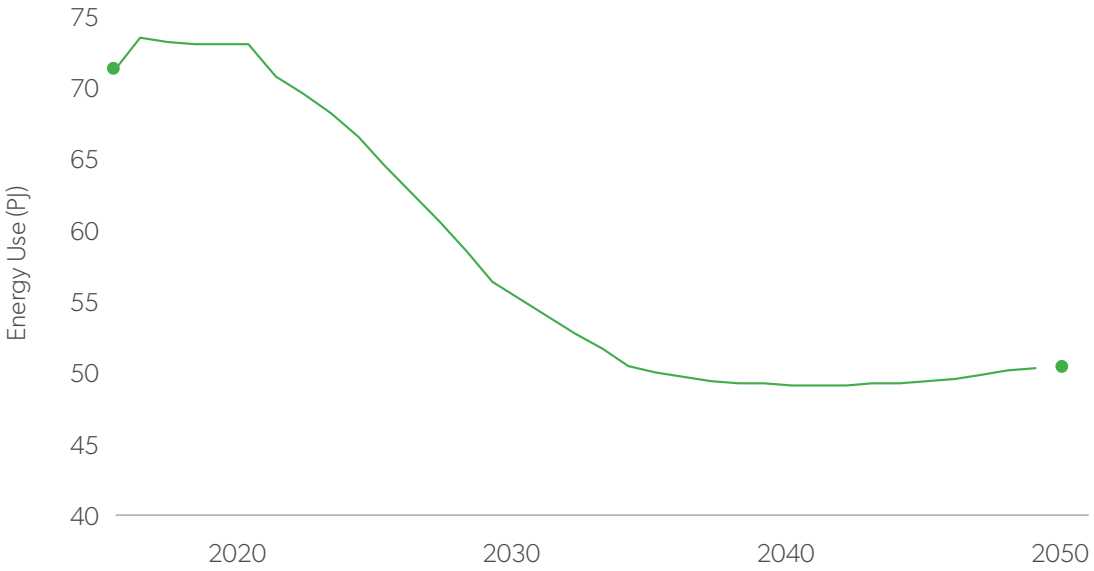


Figure 17. Projected total energy consumption in the low-carbon scenario.

Emissions decrease by 97 per cent, from nearly 5.3 MtCO2e in 2016 to under 0.2 MtCO2e by 2050. This leaves a small gap between what can be achieved through the actions laid out in this Framework and net-zero. This is expected to be accounted for over time through new technology and adaptive management practices.

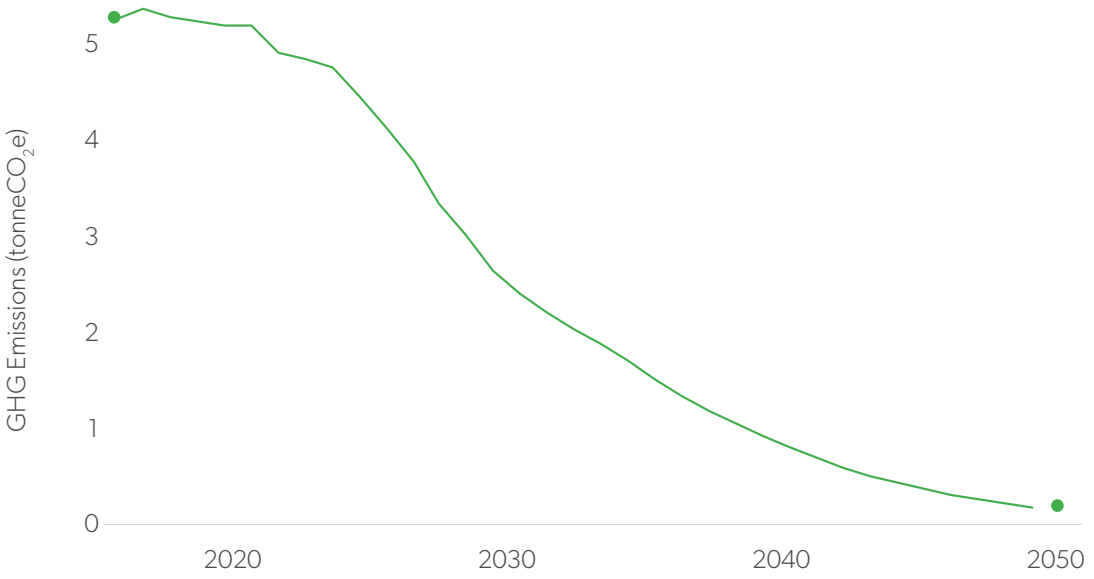


Figure 18. Projected total emissions in the low-carbon scenario.

Decreasing Energy Use

Energy use is decreased in the low carbon scenario, making the use of renewables to power the community more feasible. This is true both in terms of costs and the space required to build renewable energy sources within Regina.

Energy use decreases drastically in the transportation, commercial, residential, and municipal sectors as new energy-efficient technologies and practices are introduced. The reductions are 66 per cent, 39 per cent, 23 per cent, and 44 per cent, respectively. Technologies and practices include more efficient new builds, building retrofits, the introduction of efficient electric heat pumps, and the adoption of electric vehicles.

Industrial energy use decreases by 2.5 per cent as efficiency in industrial processes increases and buildings become more efficient.

Overall, energy use decreases by nearly 38 per cent.

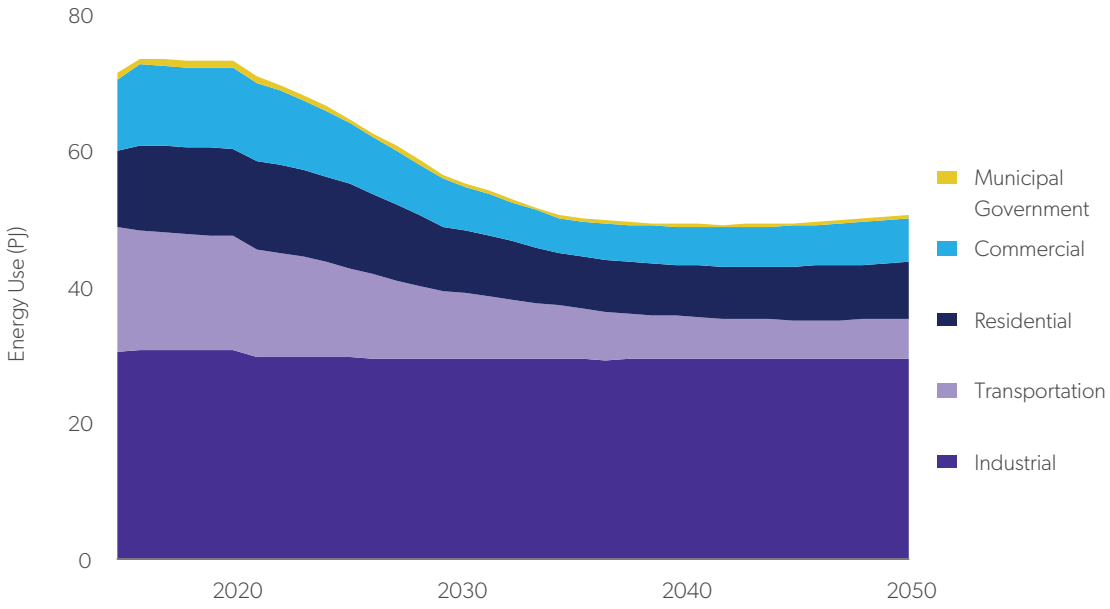


Figure 19. Projected energy use by sector in the low-carbon scenario.

Due to increases in population and usage, energy use increases for major appliances (115 per cent), lighting (42 per cent), and plug load (50 per cent). Energy consumption for space cooling increases by 44 per cent due to an increase in population and an increase in cooling degree days as the climate warms. It is important to note that these end uses make up a smaller proportion of energy use overall compared to the business-as-planned scenario.

Energy use for water heating and space heating decreases by 71 per cent and 55 per cent as efficient electric technologies become more prevalent.

Transportation energy use decreases by 66 per cent as more electric cars are introduced. Electric cars not only emit fewer GHGs but they are at least three times more efficient than gas- and diesel-powered vehicles.

Energy use from industrial processes decreases by 2 per cent as they become more efficient.

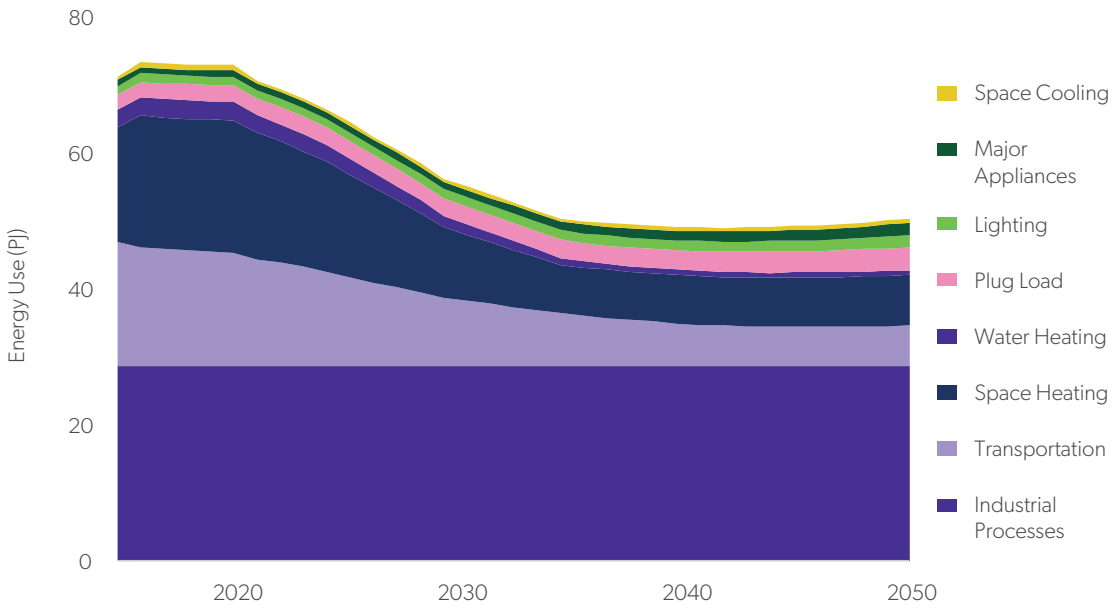


Figure 20. Energy use by end use from 2016 to 2050 in the low-carbon scenario.

New energy sources, including hydrogen, local electricity (renewables), and renewable natural gas are introduced. Energy use from propane, grid electricity, and gasoline is phased out as local electricity from renewables replaces these sources. Energy use from all other sources, including district energy, fuel oil, diesel, and natural gas decrease. The respective decreases are 62 per cent, 37 per cent, 81 per cent, and 99.4 per cent.

In 2016, local electricity was nearly non-existent, but by 2050, it makes up 46 per cent of energy use. Hydrogen gradually comes online after 2035 and increases to 37 per cent of energy use by 2050.

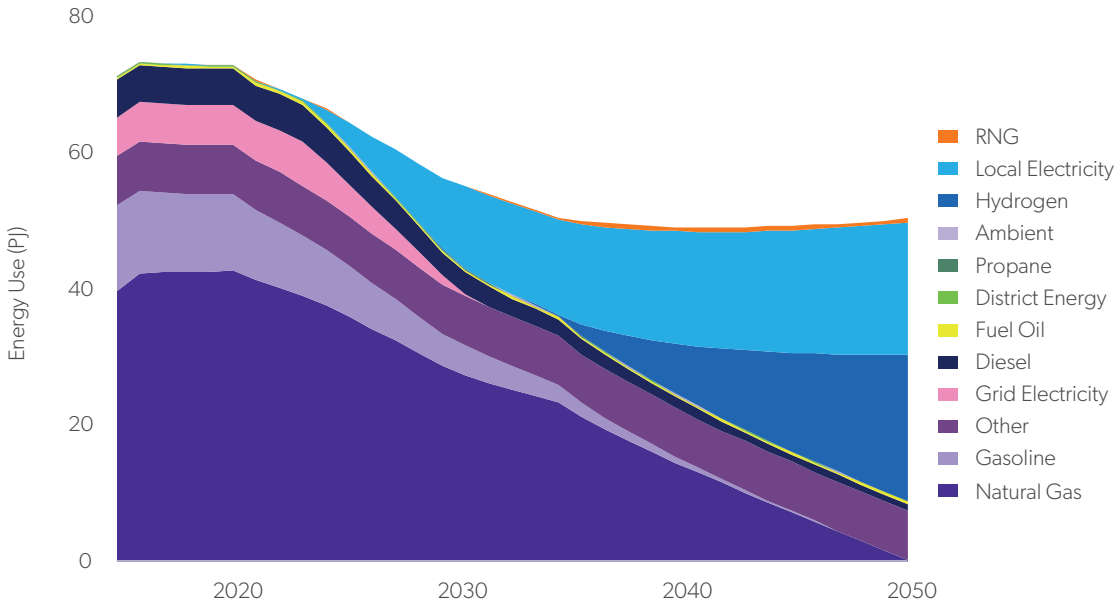


Figure 21. Energy use by fuel from 2016 to 2050 in the low-carbon scenario.

In 2050, natural gas used in industry is replaced mostly by hydrogen with a small amount of renewable natural gas. Gasoline in the transportation sector is mostly replaced by local electricity. The natural gas and grid electricity in the residential, commercial, and municipal sectors are largely replaced with local electricity generated from renewable sources.

Declining GHG Emissions

Regina's total annual emissions drop drastically between 2016 and 2050, from nearly 5.3 MtCO2e to well under 0.2 MtCO2e.

Emissions from all sectors decrease significantly in the low-carbon scenario. Emissions from the energy production, municipal, and commercial sectors are eliminated completely.

Emissions from fugitive, residential, transportation, and industrial emissions fall by well over 90 per cent in each sector.

Only solid waste remains a challenge; it only decreases by 48 per cent between 2016 and 2050, even with a 65 per cent capture of recyclables in the residential and ICI sectors, a 95 per cent organics diversion rate, and landfill gas capture increasing to 40% by 2035. Due to the massive decrease in other sectors, waste goes from representing two per cent of community emissions in 2016 to 39 per cent of emissions in 2050. In real terms, emissions from waste are decreased from 0.12 MtCO2e in 2016 to 0.06 MtCO2e in 2050.

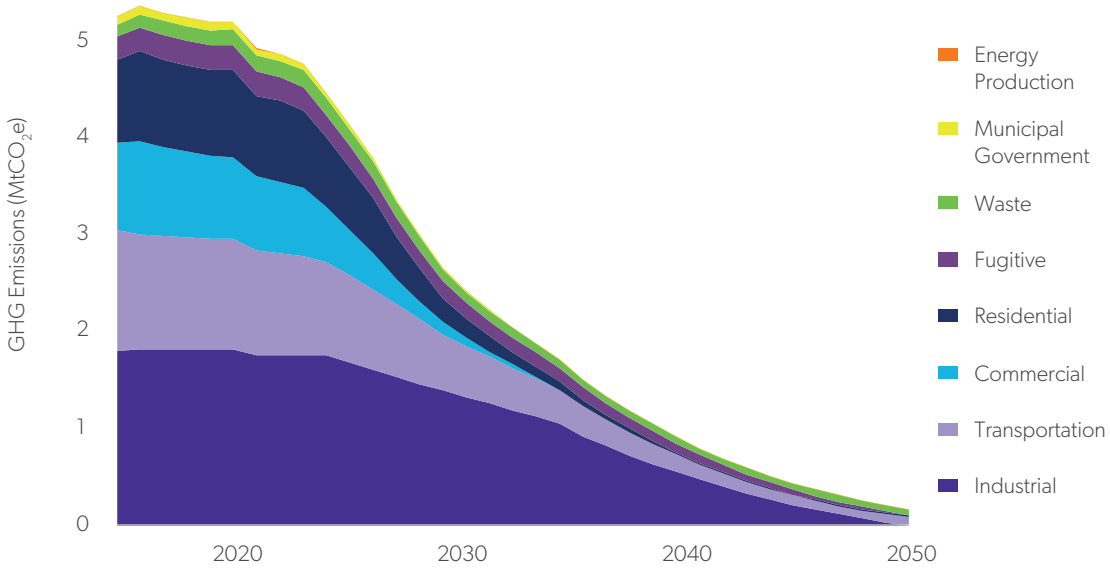


Figure 22. Regina's emissions by sector in the low-carbon scenario.

Emissions from all fuel types decrease in the low-carbon scenario. This is because higher emissions energy sources are phased out, including grid electricity and natural gas. They are replaced by lower-emissions sources including solar PV and wind generation, green hydrogen, and renewable natural gas.

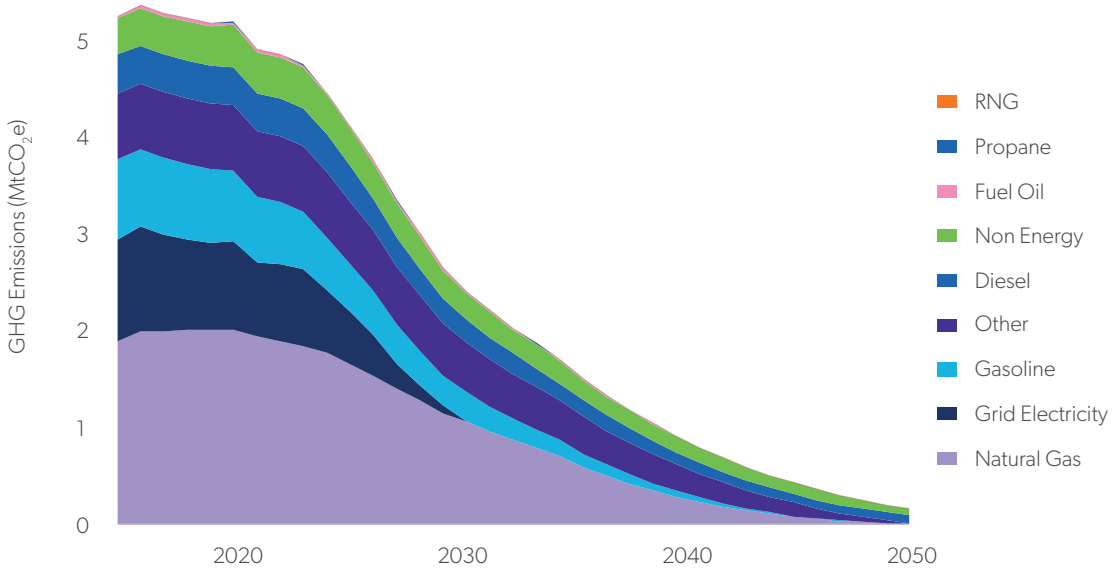


Figure 23. Regina's emissions by fuel in the low-carbon scenario.

The decreases are evident in each sector as the community switches to low-emissions fuels.

Key Low-Carbon Scenario Indications

The low-carbon scenario describes a very different future than the business-as-planned scenario. In the low-carbon scenario, emissions decrease 98% over the 2016 baseline. Every sector is nearing or has reached net-zero emissions, and energy use is drastically decreased without sacrificing daily convenience or lifestyle. This scenario highlights what it looks like to take advantage of the opportunities for emissions and energy-use reduction in Regina. A lot of hard work will be required to make this scenario a reality. The Big Moves, described in the next section, highlight the major components required to turn this scenario into a reality.

Emissions Reductions by Big Move

The Big Moves represent broad actions that must be taken to significantly decrease emissions in Regina. The table describes these actions in more detail and illustrates the relative impact of each Big Move on GHG reductions. The wedge diagram (Figure 30) illustrates the emissions reductions associated with each of the modelled actions from 2020 to 2050.

Table 2. Summary of emissions reductions by Big Move.

BIG MOVE	CUMULATIVE GHG REDUCTION (MTCO2E) 2016-2050	CONTRIBUTION TO TOTAL EMISSIONS REDUCTIONS
BUILDING RETROFITS	10,714	12%
CLEAN HEATING	7,932	9%
NET-ZERO NEW CONSTRUCTION	5,457	6%

RENEWABLE ENERGY GENERATION	21,257	23%
LOW EMISSIONS VEHICLES	10,126	11%
INCREASE ACTIVE TRANSPORTATION & TRANSIT-USE	4,282	5%
CLEAN AND RE-ENERGIZE INDUSTRY	25,305	27%
ADDITIONAL ACTIONS	7,131	8%

[1] Relative to the 2050 Business-as-Planned scenario emissions.

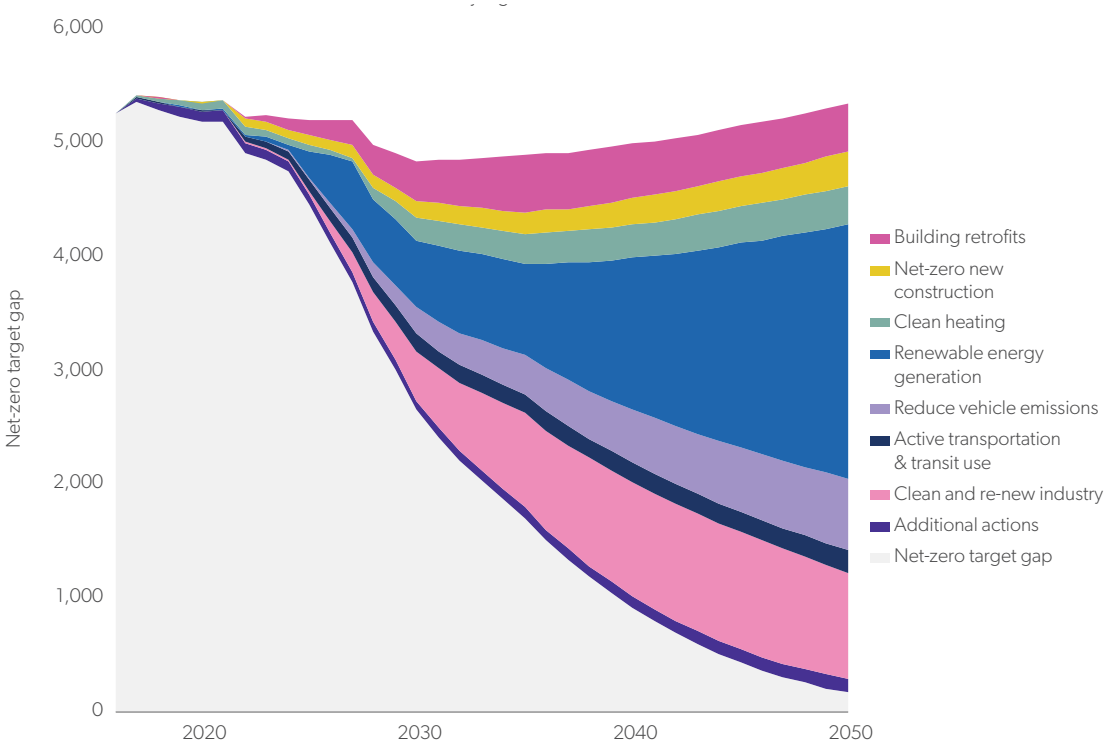


Figure 24. Emissions reductions by Big Move.

Measuring the Impact

Fully implementing the actions outlined in the Big Moves would result in a 52 per cent reduction in emissions and a 24 per cent reduction in energy use in Regina by 2030 and a 97 per cent reduction in emissions and a 38 per cent reduction in energy use by 2050. This can happen while Regina's population grows by the projected 25 per cent between 2016 and 2030 and 71 per cent between 2016 and 2050. By 2030, per capita emissions would be nine tonnes per person, and that would drop to 0.4 tonnes per person by 2050.

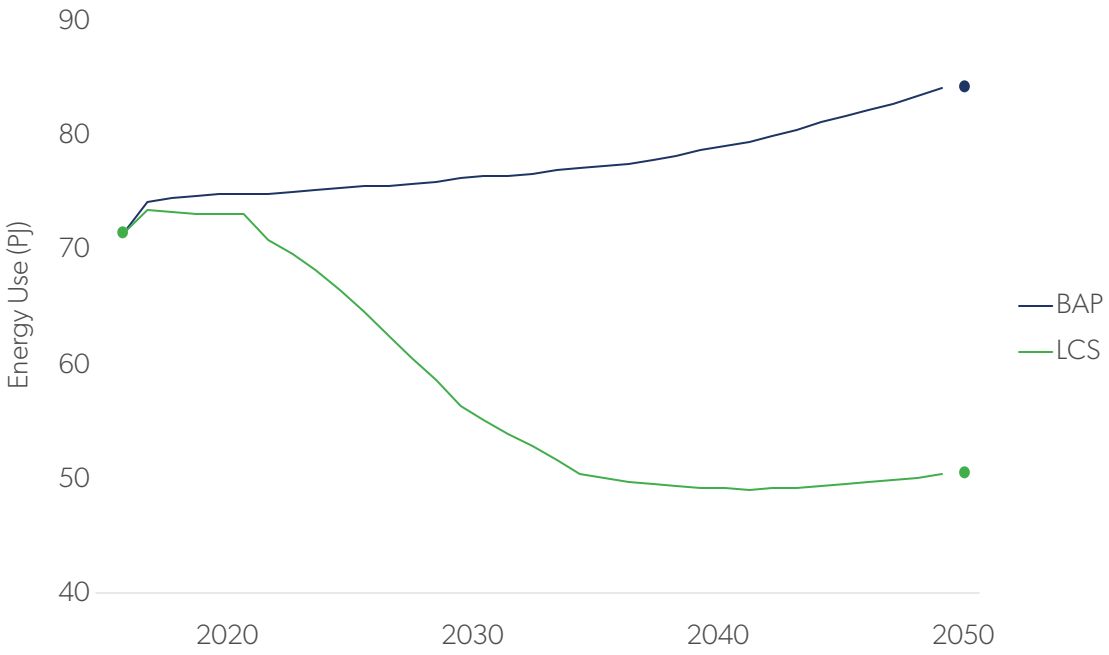


Figure 25. Regina's energy use in the business-as-planned and low-carbon scenarios.

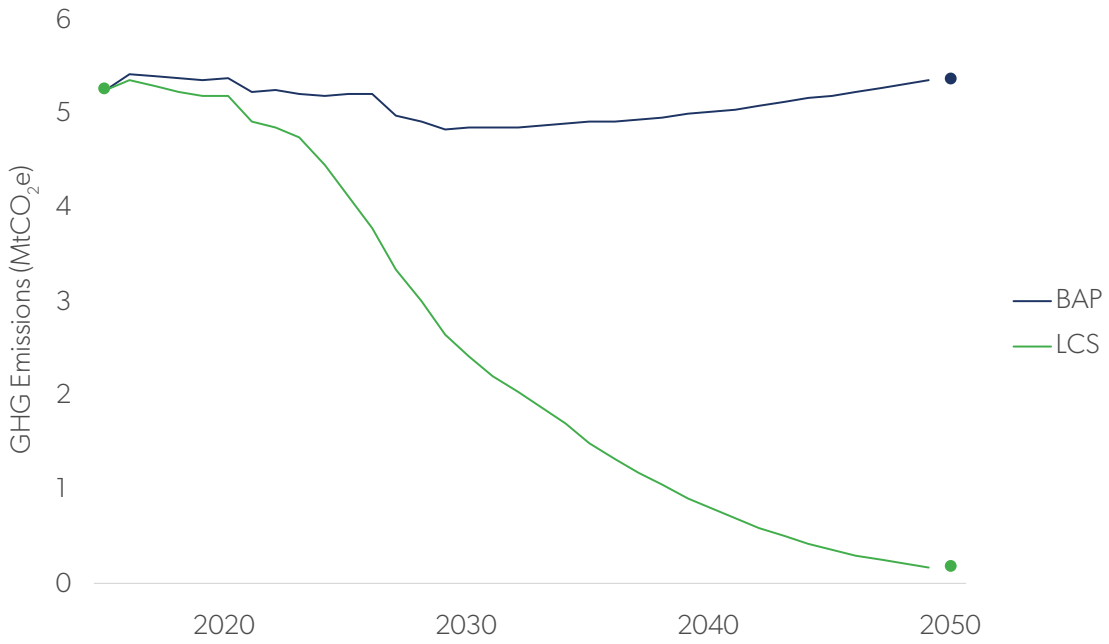


Figure 26. Regina's emissions in the business-as-planned and low-carbon scenarios.

The pathway is in line with Regina's contribution to keeping global warming to within reach of the 1.5˚C threshold. This in alignment with the Intergovernmental Panel for Climate Change's (IPCC) recommended pathway by reaching net-zero emissions by 2050 and by more than halving Regina's community greenhouse gas emissions by 2030. According to the IPCC, this is the pathway required to limit global temperature rise to below 1.5 ˚C.

In terms of emissions reductions, and in the context of the climate emergency, pathways to net-zero are crucial. Continuing with business as planned for the next decade or more and then curbing emissions to net-zero just before the deadline has a very different impact on the

cumulative emissions, or emissions over time, than taking aggressive action now. The former may lead to net-zero but push well beyond the 1.5 °C threshold, while the latter is more likely to stay within the threshold.

The Framework is developed as a pathway that starts reducing emissions right away to meet the interim 2030 goal of more than a 50 per cent reduction from the 2016 baseline. It is critical that the Framework is implemented both on the timeline and in the sequence laid out. The actions build on one another to maximize emissions and energy-use reduction opportunities and community co-benefits. The pathway sequencing also shapes the financial opportunities identified in the Framework. Although it may seem appealing to choose the actions that generate the best emissions reductions or financial payback, the results may not actually generate the same outcomes if the preceding actions are not completed as outlined. In other words, the sum of the actions is greater if completed as a pathway, than if actions are treated as standalone projects.

The selected pathway and associated actions laid out in the Framework balance best practices with Regina's local context and constraints and put the city on a pathway to contribute to between 1.5 and 2°C in global warming. If all regions of the world stay within this threshold, the planet would avoid the most devastating impacts of climate change.

Roles and Responsibilities Across Sectors

The City of Regina, as a municipal government, does not have direct influence over each sector that produces emissions within the community. The implementation overview section of the report outlines ways the City, as a contributor to the Framework, can collaborate with sectors and encourage change, but ultimately, meeting the target will require action on behalf of each sector and the community at large.

For example, the City does not control the emissions of the electricity grid. It can, however, work towards installing community solar farms and work with SaskPower to connect these to the grid. The City can also seek and provide financial and non-financial supports for the installation of rooftop solar PV to encourage uptake in residential and commercial sectors.

A broader example is the entire existing industrial sector. This sector makes up one-third of Regina's emissions, yet the City has very little influence over industry decisions that impact energy use and emissions. Industry decisions are, however, driven by different forces, including federal regulations and consumer demand.

During the development of the Framework, Federated Cooperatives Ltd., the largest contributor to Regina's industrial emissions, announced their intention to become a net-zero emitter by 2050. While precise actions are not all available for modelling at this time (assumptions were made in the Framework to reflect the technologies that could potentially be used in the industrial sector), this is an encouraging sign that industry is aligned with the goals of the Framework.

A Community Economic Opportunity

Implementing the Framework and transitioning to a low-carbon economy will require investments that are spread out across residents, businesses, institutions, the City of Regina, and other levels of government between now and 2050. Conversely, the actions will generate returns beginning immediately after implementation and provide an ongoing economic opportunity for the community.

The costs of investments overall will be greater than the savings they generate until 2028. After that point, savings and revenue outpace yearly investments. **Overall, implementing the Framework is projected to generate a net return of over 18 billion dollars across the community above the business-as-planned scenario by 2100**.

Implementing the Framework will also generate job growth in Regina. Implementation will create more than 120,000 person-years of employment between 2022 and 2050. This is equal to over 4,000 full-time equivalent jobs per year above the jobs that would be created in the business-as-planned scenario.

The financial impacts outlined in this framework identify the projected **investments and returns associated with low-carbon measures that are above and beyond those assumed in the business-as-planned scenario**. The financial analysis is developed at the low-carbon pathway level, meaning it **represents total costs across the community and does not allocate costs or savings specifically to the municipality or other sectors or investors**. Costs to the municipality are dependent on the degree to which the municipal government chooses to invest in certain actions and incentivize other sectors. Investigating all financial tools available to the municipal government and other community stakeholders, including individuals, businesses, and other levels of government, will be critical to the implementation of the Framework as capital costs and upfront investments are considered a primary barrier to climate action.

Framework Financials Overview

A financial analysis was undertaken for each of the actions that make up the low-carbon pathway. The analysis identifies the investment required, the net present value, the return on investment, marginal abatement costs, and the impact on employment.

The key concepts used to analyze the financial impacts of this Framework are outlined below.

Costs and Savings are Relative to the Business-as-Planned Scenario: The financial analysis tracks projected costs and savings associated with low-carbon measures that are above and beyond the assumed business-as-planned costs and investments.

Discount Rate: The discount rate represents the economic concept that money today is valued more than money in the future. Investments in a low-carbon future are evaluated with a three per cent discount rate.

What is a discount rate?
A discount rate assumes that money today is valued more than money in the future. An investment is considered viable by an investor if it generates a real rate of return equal to or greater than its discount rate. The discount rate varies with the type of investment or project, the duration of the investment, the risk involved, and the availability of capital.

The social discount rate is the discount rate applied when assessing the value to society of investments made for the common good. It is inherently uncertain and difficult to determine. Some argue that a very low or even zero discount rate should be applied in the evaluation of climate change mitigation investments—that is to say, we should not discount the future. In this project, low-carbon investments are evaluated with a three per cent discount rate, which is low for business, but appropriate for community benefits.

Net Present Value: The net present value (NPV) of an investment is the difference between the present value of the capital investment and the present value of the future stream of savings and revenue generated by the investment. Present value means that future dollars are discounted back to the current day.

Five aggregate categories are used to track the financial performance of the low-carbon actions in this analysis:

- Capital expenditures;
- Energy savings (or additional costs);
- Carbon cost savings (assuming the carbon price reaches $170/tonne CO2e in 2030 and is held constant thereafter);
- Operation and maintenance savings; and
- Revenue generation (associated with renewable energy production facilities).

Administrative costs associated with implementing programs, as well as any energy system infrastructure upgrades that may be required are excluded. Similarly, the broader social costs that are avoided from mitigating climate change are not included in this financial analysis.

Abatement Cost: The abatement cost of an action is the estimated cost for that action to reduce one tonne of GHG emissions. It is calculated by dividing the action's NPV by the total GHG emissions reductions (tCO2e) resulting from the action. For example, if a project has an NPV of $1,000 and generates 10 tCO2e of savings, its abatement cost is $100 per tCO2e reduced.

Amortization: The costs of major capital investments are typically spread out over a period of time. Amortization refers to the process of paying off capital expenditures (debt) through regular principal and interest payments over time. In this analysis, a 25-year amortization rate has been applied to all investments.

Energy and Carbon Cost Projections: Energy cost projections underlie the financial analysis. These projections were derived from:

- The Independent Electricity System Operator's (IESO) Long-Term Energy Plan (electricity);
- The US Energy Information Administration (propane); and
- Canada's Energy Regulator (all other fuels).

The financial analysis is sensitive to electricity and natural gas costs.

An escalating cost of carbon, based on federal regulation, was applied out to 2030. That cost peaks at $170/tCO2e in 2030 and is held constant thereafter.

Marginal Abatement Costs

Abatement costs are a key indicator of whether an action will generate a return over its lifetime. Negative abatement costs signify a financial return. The figure below summarizes the marginal abatement costs for actions in the framework. The width of each bar on the x-axis indicates the amount of GHG emissions each action/investment saves. Out of the 37 actions recommended for Regina, 23 have marginal abatement savings (generate a return), and 14 will have marginal abatement costs (generate a loss).

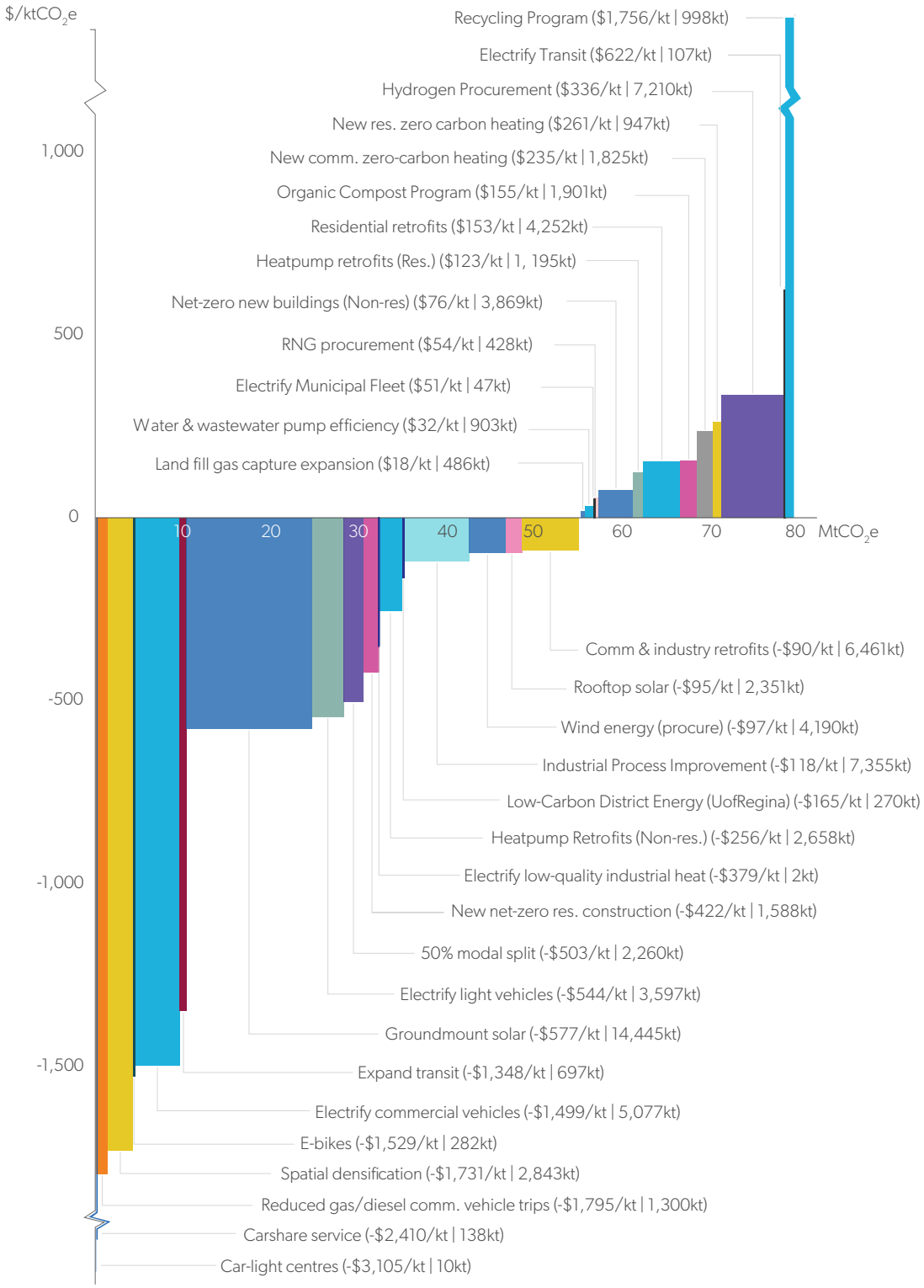


Figure 27. Marginal abatement cost curve.

The most expensive action per tonne of CO2e reduced is expanding the residential recycling program to reduce waste emissions. Expanding the recycling program to sufficiently contribute to emissions reductions in the solid waste sector will cost $1,756 per tonne of CO2e reduced.

The action with the largest return per tonne of carbon is limiting personal-use vehicles in the downtown. It will cost -$3,105 per tonne of CO2e reduced, or in other words, it will generate $3,105 in savings and revenue per tonne of CO2e reduced. Other traffic demand actions, such as introducing a car-share program, introducing an e-bike program, increasing parking fees, and expanding transit, also generate high levels of savings and/or revenues per tonne of CO2e reduced.

> "Implementing the low-carbon scenario now and in the near future will result in more than $18 billion in financial returns for the community."

Regardless of cost, each of the actions is required to meet the net-zero and 100 per cent renewables target. The actions are modelled in a sequence outlined in the Implementation Guide (Appendix D) to generate the emissions, energy-use, and financial results outlined in the Framework. **If the community chooses to only take the actions with the best payoff, they will not generate the same energy and emissions reductions and financial returns presented in the Framework.** For example, if a decision is made to increase solar and wind generation, which generates a net revenue in the community, before completing building retrofits and installing heat pumps, which have a net cost, the amount of renewable installations indicated in the plan will not meet the energy needs of the community and emissions from unclean grid electricity will remain.

Table 3. Summary of financial results (negative number = savings, positive number = cost).

FINANCIAL CONSIDERATION	CUMULATIVE, INCREMENTAL EXPENDITURES AND SAVINGS, 2022–2050	NET PRESENT VALUE (DISCOUNT RATE 3%), 2022-2050	NET PRESENT VALUE (DISCOUNT RATE 3%), 2022-2100
Capital investments [1]	$16.4 billion	$11.3 billion	$11.3 billion
Operations & maintenance savings [2]	-$5.5 billion	-$3.3 billion	-$4.0 billion
Energy cost savings	-$6.3 billion	-$4.5 billion	-$7.3 billion
Carbon price savings	-$10.3 billion	-$5.9 billion	-$7.3 billion
Revenue from local generation and services	-$17.2 billion	-$10.1 billion	-$11.7 billion
Net return of actions [3]	-$22.9 billion	-$12.5 billion	-$18.7 billion

[1] Does not include primary industry.

[2] Does not include returns from primary industry action.

[3] Net return will continue beyond 2050.

Capital Investments and Returns

Capital investments and returns for the low-carbon scenario were broken down by each of the seven Big Moves and completed for the overall scenario. The following table summarizes the investment categories that were calculated.

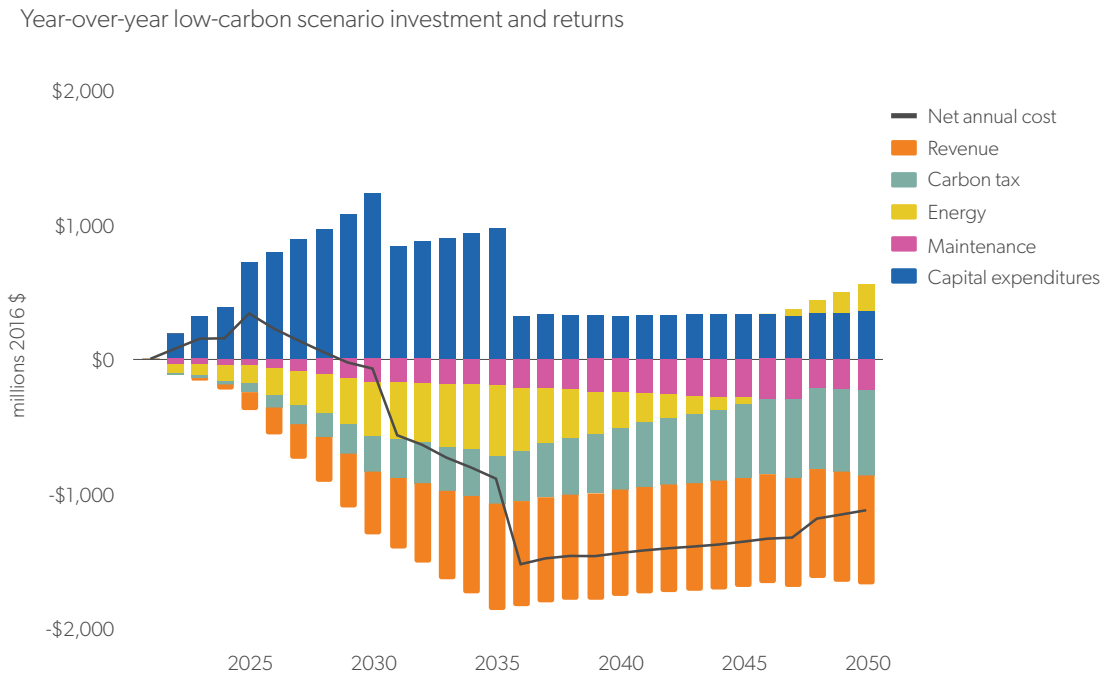


Figure 28. Year-over-year low-carbon scenario investment and returns.

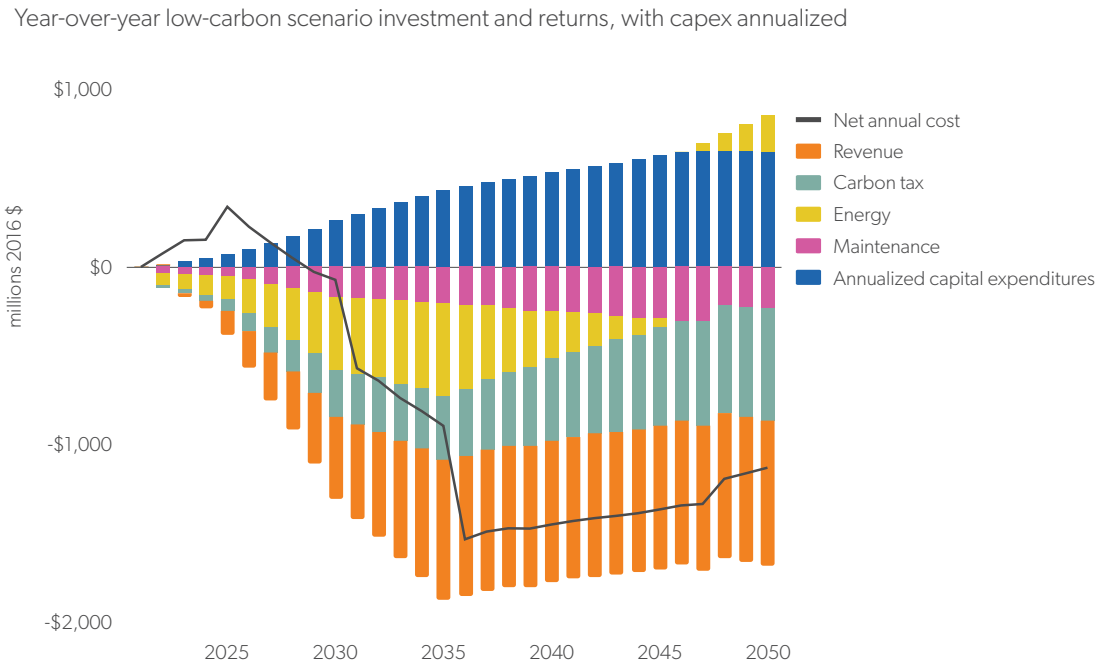
By 2050, **cumulative community capital investment** in low-carbon actions will be $11.5 billion and the cumulative net return will be $12.5 billion, even with the three per cent discount rate considered and capital investments subtracted. The net return by 2100 will be $18.7 billion. The savings include lower utility bills due to more efficient buildings, lower maintenance costs for electric cars compared to gas- and diesel-powered vehicles, and costs avoided from the carbon tax. Investments in local energy systems and assets such as community solar farms will also generate a revenue stream.

Because many of the actions are expected to begin in the 2020s, the investments during this decade are substantial. By 2028, the expected investment per year is around $1 billion, but the costs drop off sharply by 2035. As the investments increase, so does the payback, with a net return being generated by 2029.

Putting the Financials in Context
Regina Gross Domestic Product (2020): $15.8 billion (in 2012 dollars)
Regina GDP per capita (2020): ~$60,100 (in 2012 dollars)
Saskatchewan Gross Domestic Product (2018): $78.4 billion[17]
Regina capital budget—general and utility (2022): $255.3

In the most expensive year of implementation, the Framework would represent a capital expenditure equal to just under eight per cent of Regina's 2020 GDP. On an amortized basis, the most expensive year is equal to just over four per cent of the GDP.

If all investments are amortized over a 25-year period, capital expenditures are much lower throughout the 2020s, at less than one billion dollars over the timeframe versus more than five billion. Expenditures increase over time, whereas revenue and savings shrink slightly by



2049.

Figure 29. Year-over-year low-carbon scenario investment and returns, with capex annualized.

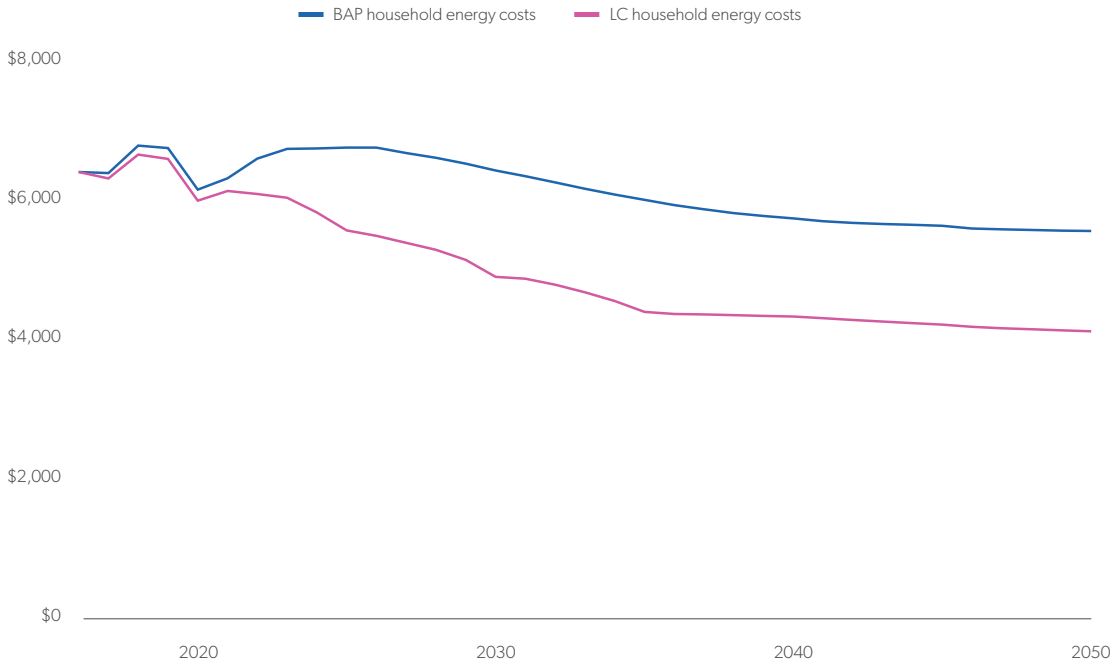
Capital expenditures by Big Move reveal that most costs are related to building retrofits and renewable energy generation. The costs for these activities occur in the implementation of the low-carbon pathway to achieve the GHG reductions and renewable energy targets desired.

Energy Costs and Savings

The energy costs in the business-as-planned scenario and low-carbon scenario tell two

[17] Conference Board of Canada (October 2021). Major City Insights: Regina. https://www.conferenceboard.ca/focus-areas/canadian-economics/major-city-insights/11312 (paywall).

differing stories. The business-as-planned scenario illustrates energy costs that decrease slightly over time as efficiencies are gained. The low-carbon scenario depicts much larger decreases in energy costs over time, although the pathway is not linear, illustrating the cumulative impact of actions as more and more are completed. Overall, the low-carbon scenario represents a 27 per cent reduction in household energy costs from the 2016 baseline while the business-as-planned scenario represents a 14 per cent reduction. In real terms, that



is a difference of $1446 per household per year between the two households in 2050.

Figure 30. Household energy costs—business-as-planned scenario versus low-carbon scenario.

Employment

The capital expenditures associated with implementing the Framework are expected to create net new employment opportunities.

Standard employment factors for each sector were used to identify the jobs created through economic activity. For each action, the employment sector is identified and the full-time equivalent jobs per million dollars in economic activity are identified.

Overall, implementation of the Framework is expected to generate over 120,000 person-years of employment between now and 2050. This is equivalent to over 4,000 full-time equivalent jobs per year existing in the community, beyond job projections in the business-as-planned scenario. Expanding transit will generate more sustained employment than any other action. Building retrofits and solar PV installations will create an employment boom over the next decade and a half.

Implementing the Framework

Regina has adopted an aggressive evidence-based approach to reach its net-zero by 2050 goal. The City acknowledges that the community needs to work toward limiting global warming to 1.5°C. This approach includes setting interim targets along the pathway to 2050 and readjusting the targets based on new information, technologies, and best practices as they become available.

Implementing the low-carbon pathway described in the Framework will require sustained effort across all sectors of the community, including residents, businesses, the municipal government, institutions, industry, and the not-for-profit sector. Support will be required from the Government of Saskatchewan, the Government of Canada, and other external funders.

There are 25 distinct actions relating to the seven Big Moves and six additional actions outside of the Big Moves that need to occur to implement the Framework. Each action will be implemented through a series of programs, initiatives, policies, and infrastructure investments. The following section provides a summary of each action and implementation mechanism, along with timing, costing, co-benefits, and expected GHG reductions and annual metrics. A more detailed Implementation Guide is provided in Appendix D.

The summary is organized as follows:

Table 4. Summary table describing the implementation indicators

ACTION	DESCRIPTION	GHG IMPACT	CO-BENEFITS	COST	IMPLEMENTATION MECHANISMS	TIMING	METRICS
The title of the action that helps achieve the Big Move. Identifies the sector or asset being addressed.	A description of the action that needs to be taken, including targets. This also describes what was modelled in the low-carbon scenario for the action.	Describes the cumulative GHG emissions reduction impact for each action compared to the business-as-planned scenario. Enabler: Enables the reduction of GHG emissions. Low: <1,000 ktCO2e Medium: 1,000–2,000 ktCO2e High: >2,000 ktCO2e	Co-benefits are community benefits that are expected to occur by implementing the Framework that go above and beyond GHG emissions reductions. There were three co-benefits in particular that stood out as important to community members during engagement. **(See descriptions in the following table).**	Costs are based on the upfront capital expenditure required to implement each action above and beyond the business-as-planned practice. Costs does not consider marginal abatement costs or the gain of the investment. $: <$1,000,000 $$: $1,000,000 - $100,000,000 $$$: $100,000,000 - $500,000,000 $$$$: $500,000,000 –$1,000,000,000 $$$$$: >$1,000,000,000	Policy: A policy developed by the municipality and approved by Council. Program: An ongoing effort by the municipality, with staff and financing to support the effort. Initiative: A study or project, undertaken by the municipality, private sector, not-for-profit sector, or other sectors, individually or collaboratively, with a specific focus, that is implemented for a set time period. Infrastructure: Investment in physical infrastructure by the municipality or private sector, not-for-profit sector, or other sectors, individually or collaboratively. Leading by example: An activity undertaken by the municipality that demonstrates leadership and/or feasibility to the community.	A start and completion date for the action. *Start date denotes when planning for the action begins.	The method and measurement unit for measuring the impact of the action taken. All metrics should be analyzed on an annual basis for those that are being actively implemented.

Co-Benefit Indicators

Equity is dependent on several factors. Some actions, like expanding transit, can enhance equity to some degree without additional intervention because better access for more people more often is beneficial. Other actions, such as building retrofits, require the implementation of noted programs, such as those for low-income and social housing.

Employment is based on Statistics Canada data for employment factors. Although an action may be rated low based on jobs per million dollars invested, the actual number of jobs may be significant due to the scale of the investment.

Cost effectiveness denotes whether an action has a net financial cost to reduce emissions, breaks even, or if it will generate a net return. It contextualizes the cost of an action because an action may have a high cost but also a high rate of return. Note that although some actions will have a net cost, they contribute to the realization of other actions that may have a net return and cannot be taken out of the implementation sequence without a cascading impact.

Table 5. Co-benefit descriptions.

CO-BENEFIT	ENABLER	LOW	MEDIUM	HIGH
Equity	No discernible direct effect associated with supporting action but positive outcomes may occur in concert with other actions.	Without intervention, this action may favour certain groups or create greater disparity between equity-seeking groups and other sections of the population.	This action is more likely to be implemented in the community fairly, but existing powerful groups may still be at an advantage.	This action contributes to enhanced equity.
Employment	Enables employment	0-5 person-years of employment per $million invested	5-10 person-years of employment per $million invested	>10 person-years of employment per $million invested
Cost effectiveness (CE)	–	This action will have a net cost.	This action will break even.	This action will have a net return/benefit.

BIG MOVE 1

Big Move One: Building Retrofits

Retrofitting buildings presents a significant opportunity to achieve reductions in energy consumption and GHG emissions and create local jobs. It is most cost-effective to decarbonize buildings by maximizing energy efficiency prior to adding renewables. Most programs currently retrofit one building at a time, however, in order to achieve the targets identified in the pathway, new approaches will be required. There are many efforts underway across Canada and beyond to undertake retrofits at scale by aggregating building retrofits both for bulk procurement and to achieve efficiencies in project delivery.

What are Energy Retrofits in Buildings?

The term energy retrofits can be used to describe a wide range of activities relating to upgrading energy-consuming systems in a building to reduce building energy-use. Minor energy retrofits can include activities such as upgrading lighting to LEDs and adding insulation. More extensive retrofits include replacing windows and doors, and updating heating and cooling systems with more efficient systems. In this Framework, the term building energy retrofits is used to describe a combination of activities, such as those listed above, that will result in thermal savings of at least 50 per cent and electrical savings of at least 10 per cent in buildings in Regina.

Big Move One: Building Retrofit Actions

Table 6. Building retrofit actions implementation summary table.

ACTION	DESCRIPTION	GHG IMPACT	CO-BENEFITS	COST	IMPLEMENTATION MECHANISMS	TIMING	METRICS
1.1 Deep Retrofits: residential, pre-1981 construction	Achieve 50% thermal (building envelope) efficiency increase and 10% electrical savings in 100% of buildings by 2030.		Equity: High (potential) Employment: Medium Cost Effective-ness: Low	$$$$$	Program: Develop deep retrofit programs for all buildings. Initiative: Pilot a bulk retrofit program.	Start: Immediately Completion: 2030	Number of homes retrofit
1.2 Deep retrofits: residential, 1981-2016 construction	Achieve 50% thermal (building envelope) efficiency increase and 10% electrical savings in 100% of buildings by 2035.		Equity: High (potential) Employment: Medium Cost Effective-ness: Low	$$$$$	Program: Develop deep retrofit programs for all buildings.	Start: Immediately Completion: 2035	Number of homes retrofit
1.3 Deep retrofits: ICI	Achieve 50% thermal (building envelope) efficiency increase and 10% electrical savings in 100% of buildings by 2035.		Equity: High (potential) Employment: Medium Cost Effective-ness: High	$$$$$	Program: Develop deep retrofit programs for all buildings. Leading by example: Retrofit municipal buildings.	Start: Immediately Completion: 2035	Number of buildings retrofit

BIG MOVE 2

Big Move Two: Clean Heating

Buildings can be decarbonized by fuel switching space-heating systems to electric heat pumps and water-heating systems to electric. Both actions are especially impactful when coupled with the use of renewable energy and building retrofits. In particular, building retrofits reduce the size of the heat pump required, because a well-insulated, efficient home requires less energy to stay warm or cool. Heat pumps for space heating are also highly efficient, as they generate the same heat as a natural gas heating system with one-half to one-third of the input energy.

In Saskatchewan, the electricity grid has a higher emissions factor than in most other provinces in Canada. As such, fuel switching to heat pumps increases emissions in the short term until the grid becomes cleaner and/or local renewable generation is built. Therefore, the strategy focuses on building efficiency first, and then recommends adding renewables and switching to electric space- and water-heating systems on a similar timeline. This enables deep emissions reductions in the medium term.

Case Study: Ground-Source Heat Pumps and Electric Air-Source Heat Pumps in Edmonton

The Westmount Presbyterian Church and North Glenora social housing projects in Edmonton have completed a net-zero project that combines new and old buildings.[18] Key to the success of the project has been the use of a geothermal system for space heating and air-source heat pumps for water heating. The system is twice as efficient as a conventional heating system, and no backup energy source is required. The builders credit an efficient building envelope, also completed during the retrofit and building, with negating the need for a backup heating system. Edmonton has an average temperature low of -15.1°C in February, which is comparable with Regina's average low of -16°C.

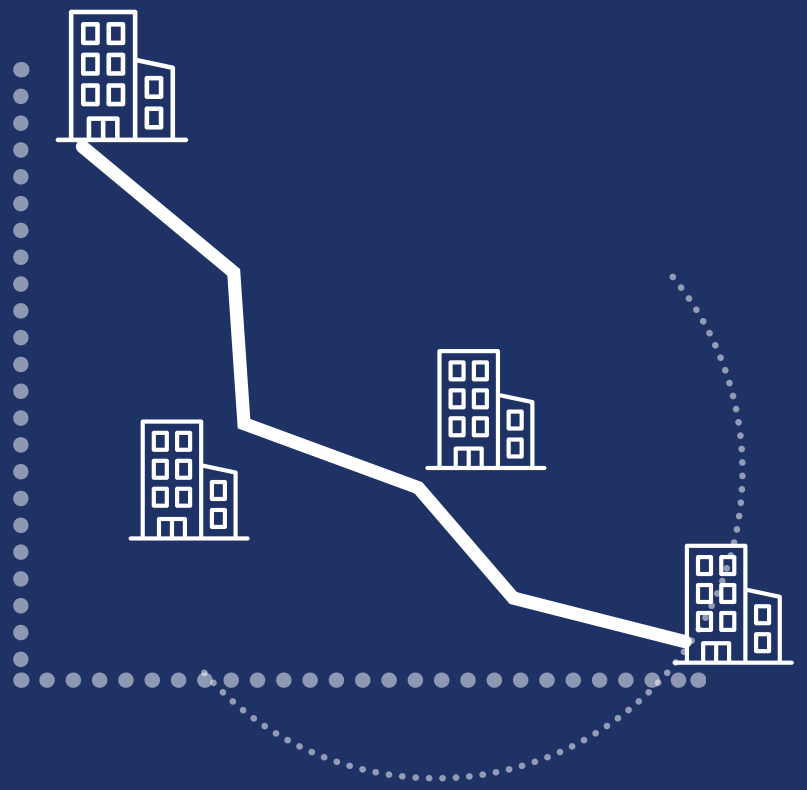
[18] Green Energy Futures. January 29 2018. 186. Canada's first net-zero church and social housing project (Online Blog). https://www.greenenergyfutures.ca/episode/canadas-first-net-zero-church

Big Move Two: Clean Heating Actions

Table 7. Clean heating actions implementation summary table.

ACTION	DESCRIPTION	GHG IMPACT	CO-BENEFITS	COST	IMPLEMENTATION MECHANISMS	TIMING	METRICS
2.1 Switch to clean fuels in existing buildings: residential	Add air-source heat pumps and electric water heaters to 100% of buildings when current systems reach end of life.		Equity: Enabler (supports lower energy use and costs) Employment: Low Cost Effectiveness: Low	$$$$$	Program: Develop fuel-switching programs for all buildings. Initiative: Educate community members about the benefits and feasibility of heat pumps in a cold climate.	Start: Immediately Completion: Ongoing (75% projected to be complete by 2035)	Number of systems replaced
2.2 Switch to clean fuels in existing buildings: ICI buildings	Add air-source heat pumps and electric water heaters to 100% of buildings when current systems reach end of life.		Equity: Enabler Employment: Low Cost Effectiveness: Low	$	Program: Develop fuel-switching programs for all buildings. Leading by example: Use heat pumps in City buildings and report on performance.	Start: Immediately Comple-tion: Ongoing (75% projected to be complete by 2035)	Number of systems replaced
2.3 Switch to clean fuels in all new construction: air-source heat pumps	Add air-source heat pumps and electric water heaters to 100% of new buildings without ground-source heat pumps.		Equity: Enabler Employment: Low Cost Effectiveness: Low	$$$$$	Program: Develop fuel-switching programs for all buildings.	Start: Immediately Completion: Ongoing	Number of systems installed
2.4 Switch to clean fuels in all new construction: ground-source heat pumps	Add ground-source heat pumps and electric water heaters to 15% of new buildings.		Equity: Enabler Employment: Low Cost Effectiveness: Low	$$$	Initiative: Pilot incentives for the installation of ground-source heat pumps.	Start: Immediately Completion: Ongoing	Number of systems installed

BIG MOVE 3



Big Move Three: Net-Zero New Construction

All provinces have agreed to adopt the Government of Canada's net-zero energy-ready building code for new residential builds by 2030. This makes planning for net-zero homes a necessity over the next decade, but there are also benefits to acting sooner. Regina is expected to grow significantly over the next decade, and encouraging net-zero new construction now means that fewer new buildings will be contributing to GHG emissions in the community, and fewer buildings will need to be retrofitted in the future. As buildings and building systems are long-lasting assets, choices made today will impact emissions in the community for decades to come and will either increase or decrease the burden on future generations. Increasing the proportion of net-zero builds over time can also prepare the workforce now for changes that will impact the whole industry by 2030. Other benefits include improved air quality as emissions decrease and lower utility bills associated with net-zero homes.

Net Zero Energy Ready (NZER) is a highly energy-efficient building that minimizes energy use such that on-site or community renewables or energy from a clean grid can be used to reach net-zero energy.

Net Zero Energy (NZE) is a building that uses an enhanced building envelope, solar orientation, and high-efficiency equipment to produce as much clean energy as it uses over the course of a year[19].

City in Action: Fire Station No. 4

The City of Regina Fire Station No.4 has received LEED Gold Certification. The project received 40 LEED points through its incorporation of a range of environmental initiatives including solar water heating, sun screens, and a glazed hose tower that doubles as a passive ventilation shaft to aid in cooling the building.

[19] What you need to know about the new building codes - Efficiency Canada.

Big Move Three: Net-Zero New Construction

Table 8. Net-zero new construction actions implementation summary table.

ACTION	DESCRIPTION	GHG IMPACT	CO-BENEFITS	COST	IMPLEMENTATION MECHANISMS	TIMING	METRICS
3.1 All new residential construction is net-zero by 2030	The percentage of new buildings constructed to net-zero standards increases from 2022, reaching 50% by 2026 and 100% by 2030.		Equity: Enabler Employment: Medium Cost Effectiveness: High	$$$$$	Policy: Create incentives for developers choosing net-zero buildings. Initiative: Create a net-zero neighbourhood. Program: Educate developers and builders on new building-code requirements and opportunities.	Start: Immediately Completion: 100% by 2030, ongoing after 2030	GHG intensity of new buildings (kgCO2e/m2)
3.2 All new ICI buildings are built to National Energy Building Code	All new commercial and industrial buildings are built according to the National Energy Building Code tier in line with code enhancements in 2023, 2025, 2027, and 2029.		Equity: Enabler Employment: Medium Cost Effectiveness: High	$$$$$	Program: Net-zero commercial and industrial buildings. Program: Educate developers and builders on new building-code requirements and opportunities.	Start: Immediately Completion: Ongoing	GHG intensity of new buildings (kgCO2e/m2)

BIG MOVE 4

Big Move Four: Renewable Energy Generation

Renewable energy generation makes a significant contribution to GHG reduction. It can take many forms, but all shifts to renewable energy require drastic changes that are challenging to scale up to meet current energy demand. However, when done in tandem with energy efficiency measures, renewable energy can meet much of Regina's energy needs while decreasing emissions.

Case Study: Cowessess First Nation

Cowessess First Nation, located 150 kilometres east of Regina, has been generating local renewable energy since 2013 and continues to expand its renewable energy assets. The community's first major project was a 800 kW wind project.[20] They won a 1 MW power purchase agreement with SaskPower through a competitive RFP process and also installed batteries to store energy to be used as needed. The second project, completed in 2018, was a 400 kW ground-mount solar installation. The project maxed out the power purchase agreement with SaskPower and leverages existing battery-based storage capability[21].

In 2021, Cowessess installed more than 800 solar panels with a capacity of 321 kW on five community buildings. The energy generated is expected to decrease annual energy costs by $20,000. Local labour was used to construct the solar panels[22].

In 2021, Cowessess and partner Renewable Energy Systems signed an additional 200 MW power purchase agreement with SaskPower. They are planning to install 40 wind turbines across 20,000 acres, which will produce enough energy to power 100,000 homes[23].

[20] Cowessess First Nation Energizes Their Community and The Grid - Industry West (industrywestmagazine.com)

[21] Cowessess First Nation Power Purchase Agreement | Profiles | Government of Saskatchewan

[22] Cowessess unveils new solar project, aiming to become greenest First Nation in Canada | CBC News

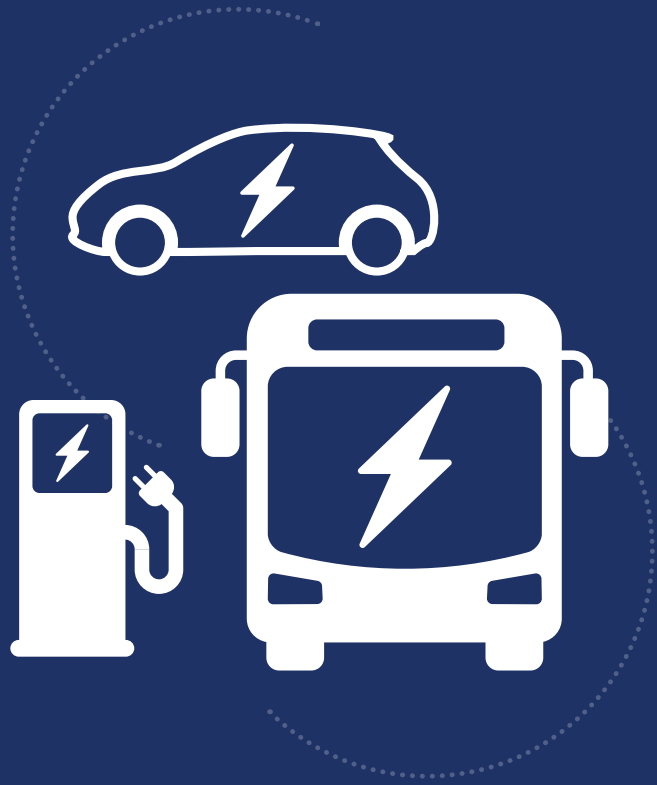
[23] Cowessess unveils new solar project, aiming to become greenest First Nation in Canada | CBC News

Big Move Four: Renewable Energy Generation Actions

Table 9. Renewable energy generation actions implementation summary table.

ACTION	DESCRIPTION	GHG IMPACT	CO-BENEFITS	COST	IMPLEMENTATION MECHANISMS	TIMING	METRICS
4.1 Maximize rooftop solar on new buildings	New builds will install solar PV (50% of building's base load) to maximize rooftop solar potential.		Equity: Low Employment: Low Cost Effectiveness: High	$$$$$	Program: Develop solar PV programs for all building sectors.	Start: Immediately Completion: Ongoing	kW of solar PV installed Number of solar installations
4.2 Maximize rooftop solar on existing buildings	Existing building will add solar PV in line with retrofit schedule (50% of building's base load) to maximize rooftop solar potential.		Equity: Low Employment: Low Cost Effectiveness: High	$$$$$	Program: Develop solar PV programs for all building sectors. Leading by example: add solar PV to municipal buildings.	Start: Immediately Completion: 2035	kW of solar PV installed Number of solar installations
4.3 Meet energy needs through local energy generation:solar PV	Add 1914 MW of solar PV in community solar farms by 2035.		Equity: Low Employment: High Cost Effectiveness: High	$$$$$	Infrastructure: Create solar farms.	Start: 2025 Completion: 2035	MW of solar installed
4.4 Meet energy needs through local energy generation: solar PV	Add 473 MW of wind-generating capacity in community wind farms by 2035.		Equity: Low Employment: Low Cost Effectiveness: High	$$$$$	Infrastructure: Create wind farms.	Start: 2025 Completion: 2035	MW of wind generation infrastructure installed
4.5 Meet energy needs through local energy generation: geothermal heating at University of Regina	Convert the district energy system at the University of Regina to geothermal.		Equity: Low Employment: Low Cost Effectiveness: Medium	$$$$$	Initiative: Work with the University of Regina to determine support and collaboration opportunities.	Start: 2025 Completion: 2030	GHG intensity of the university (kgCO2e/m2)

BIG MOVE 5



Big Move Five: Low-Emissions Vehicles

In order to meet or exceed Federal targets of 100 per cent of personal and light-duty vehicle sales being electric by 2035, and for Regina to meet the 100 per cent renewable target in its own plan, the municipal government needs to develop and implement a strategy to move toward low-emissions vehicles.

Changing the Pathway by Creating Low-Emissions Vehicle Targets

In 2021, the Government of Canada announced that all new light-duty cars and passenger trucks sales across the country will need to be zero-emission by 2035. This advances the government's previous target by five years. The Government of Canada has also noted its intention to develop interim 2025 and 2030 targets and to support the adoption of electric vehicle sales through incentives and investments in charging infrastructure.[24]

Case Study: EV Charging Requirements Bylaw

The City of Port Moody, British Columbia's zoning bylaw includes requirements for electric vehicle charging infrastructure in the community. Requirements for residential units include an energized outlet capable of Level 2 charging for each unit. For commercial parking, 20 per cent of spaces must include an energized outlet capable of Level 2 charging[25]. Public EV charging is also available throughout the city for a fee, and an app is available for individuals to find charging stations, start a charging session, and track savings.[26]

[24] Building a green economy: Government of Canada to require 100% of car and passenger truck sales be zero-emission by 2035 in Canada - Canada.ca

[25] Electrical Vehicle Charging Planning Requirements - City of Port Moody

[26] Electric Vehicle Charging Stations - City of Port Moody

Big Move Five: Low-Emissions Vehicles Actions

Table 10. Low-emissions vehicles actions implementation summary table.

ACTION	DESCRIPTION	GHG IMPACT	CO-BENEFITS	COST	IMPLEMENTATION MECHANISMS	TIMING	METRICS
5.1 Electrify vehicles: personal-use	100% of new light-duty, personal-use vehicles purchased are electric by 2030. 80% are electric by 2025.		Equity: Low Employment: Medium Cost Effectiveness: High	$$$$$	Infrastructure: Partner on the deployment of electric vehicle charging stations. Initiative: Educate the community about the feasibility of electric vehicles in Regina.	Start: Immediately Completion: 2030	New electric vehicle sales or registrations Number of EV charging stations
5.2 Electrify vehicles: ICI use	100% of new light-duty, ICI-use vehicles purchased are electric by 2030. 80% are electric by 2025.		Equity: Low Employment: Medium Cost Effectiveness: High	$$$$$	Infrastructure: Partner on the deployment of electric vehicle charging stations. Leading by example: Purchase electric vehicles for municipal fleet.	Start: Immediately Completion: 2030 City: no non-electric purchases after 2022	New electric vehicle sales or registrations Number of EV charging stations
5.3 Electrify medium- and heavy-duty trucks, or purchase hydrogen-fueled*	100% of medium- and heavy-duty truck purchases are electric or hydrogen-fueled* by 2045.		Equity: Low Employment: Medium Cost Effectiveness: High	$$$$$	Infrastructure: Keep up to date on the deployment of hydrogen and electric vehicle infrastructure.	Start: 2035 Completion: 2045	Low-emissions medium- and heavy-duty vehicle sales
5.4 Electrify transit	100% of new City transit buses are electric.		Equity: High Employment: Medium Cost Effectiveness: Low	$$$$$	Infrastructure: Purchase electric buses.	Start: 2024 Completion: 2039	% of transit vehicles electrified

* From green hydrogen sources

BIG MOVE 6

Big Move Six: Increase Active Transportation and Transit Use

Efforts to increase transit use, walking, and cycling will be critical to reducing emissions from transportation. They will also provide more co-benefits that relate to health and community well-being beyond those associated with the electrification of vehicles. The general path to an inclusive and less car-reliant community includes programs and initiatives led by the City that support transit and active transportation.

City in Action: Transit Master Plan

The City of Regina is completing its Transit Master Plan. The plan is expected to be released in the first quarter of 2022 and was developed on approximately the same timeline as the Energy and Sustainability Framework. Several meetings were held with the department leads for the Framework, the Transit Master Plan, and the consultants for each project. The groups shared draft actions outlined in each plan to align on actions that were complementary and met the objectives of each plan. The teams also shared data to strengthen both processes.

Moving forward, this is the type of cross-departmental and interdisciplinary collaboration that will ensure the City is able to align its plans and policies and effectively implement the Framework and other city commitments.

City in Action: Transportation Master Plan

Regina has already started thinking about enhancing active transportation and transit use in its Transportation Master Plan, released in 2017. Each of the four major targets in the plan are related to creating a sustainable transportation system, including:

1. Sustainable transportation;
2. Limited increase in vehicle kilometres travelled;
3. Improved transit service; and
4. Safer cycling and pedestrian environments.

The plan also contains explicit targets around shifting mode share to decrease single-occupancy vehicle trips.

Big Move Six: Increase Active Transportation and Transit-Use Actions

Table 11. Active transportation and transit-use actions implementation summary table.

ACTION	DESCRIPTION	GHG IMPACT	CO-BENEFITS	COST	IMPLEMENTATION MECHANISMS	TIMING	METRICS
6.1 Expand transit service	Offer expanded service to encourage a 25% transit mode share by 2025.		Equity: High Employment: High Cost Effectiveness: High	$$$$$	Program: Increase transit service. Initiative: Pilot free transit initiatives.	Start: 2024 Completion: Ongoing	Transit ridership
6.2 Transportation demand management	Employ car-free zones, increased parking rates, car and bike-share programs, and work-from-home measures to reduce demand for personal-use vehicles. This will reduce vehicle kilometres travelled by up to 25% in city centre and to increase mode share to active transportation by five per cent for trips under five kilometres in other areas of the city.		Equity: Medium Employment: Medium Cost Effectiveness: High	$$$$$	Initiative: Pilot car-free zones. Initiative: Pilot car and bike-share programs.	Start: Immediately Completion: Ongoing	Transportation emissions VKT/person
6.3 Increase active transportation	Continue to develop an active transportation system to reach 50% of short trips being active by 2050.		Equity: High Employment: Medium Cost Effectiveness: High	$$$$$	Initiative: Trails and active transportation promotion.	Start: Immediately Completion: Ongoing	Transportation emissions Mode split

BIG MOVE 7

Big Move Seven: Clean and Re-Energize Industry

The industrial sector is anticipated to be responsible for one-third of Regina's total emissions from 2016 to 2050 under a business-as-planned scenario. While the City has limited direct input on the operational choices of existing industry, industry energy and emissions profiles are being shaped by other factors. These factors include federal regulations and consumer demand. Increasing process efficiency can be explored by companies to reduce energy use expenditures. The City can facilitate this advancement by hosting working groups, sharing the best practices, and publicly showing support.

After efficiency measures, the industrial sector must consider alternative fuels. This is driven by carbon pricing, which compels some industries to electrify their process or choose fuels such as renewable natural gas or biodiesel.

Understanding the Sector: Primary Industry

Primary industry includes any industry that is involved with the extraction of natural resources from the earth so they can be converted to products used by people. In other words, the term primary relates to the interaction with natural materials, not with the size of the industry in the community. Primary industries that are present in Regina include oil and gas and mining. These industries support the community's economy and employ approximately one percent of the community's labour force.[27]

When industry already exists in a community, the local government has relatively little ability to control its activities because they are typically regulated by the federal government. This does not mean, however, that there is no movement in industry toward lowering emissions.

Federal regulations continue to evolve and are requiring primary industry to lower emissions. An example of this is the federal carbon tax. Industry, like all other businesses, is also influenced by consumer demand. As the world shifts towards renewable energy, there is lesser demand from consumers for fossil-fuel-based energy and products. Therefore, there is an economic and business imperative for industry to adapt and not be left behind.

In Regina, Federated Co-operatives Ltd. recently announced its plans to be a net-zero entity by 2050. This is a commendable target and a significant market signal, considering the co-operative's size, economic influence, and roots in the fossil-fuel industry.

[27] Communication with Economic Development Regina.

Big Move Seven: Clean and Re-energize Industry Actions

Table 12. Clean and re-energize industry actions implementation summary table.

ACTION	DESCRIPTION	GHG IMPACT	CO-BENEFITS	COST	IMPLEMENTATION MECHANISMS	TIMING	METRICS
7.1 Industrial efficiencies	Industrial process improvements will increase energy efficiency by 30%.		Equity: Enabler Employment: Medium Cost Effectiveness: Medium	$$	Program: Industry energy roundtable.	Start: 2023 Completion: 2045	Participation Recom-mendations implemented
7.2 Industrial energy shift: renewable natural gas and hydrogen	The industrial sector will shift to hydrogen and renewable natural gas by 2050.		Equity: Enabler Employment: Medium Cost Effectiveness: Low	$$$$$	Program: Industry energy roundtable.	Start: 2035 Completion: 2050	Participation Recom-mendations implemented
7.3 Industrial process heat shift: electrification	50% of process heat electrified by 2050.		Equity: Enabler Employment: Medium Cost Effectiveness: Medium	$	Initiative: Industrial waste heat feasibility study.	Start: Immediately Completion: 2050	GHG intensity of industry processing (kgCO2e/m2)
7.4 Primary industry implements net-zero targets	Primary industry reduces methane and employs carbon sequestration to reach net-zero emissions by 2050.	Unknown	Unknown	Unknown	Program: Industry energy roundtable.	Start: 2023 Completion: 2050	Participation Recom-mendations implemented

Additional Actions

Additional Actions

The seven Big Moves will eliminate the bulk of Regina's emissions by 2050, but there are additional actions that need to be taken to reach that goal. Emissions from waste will need to decrease and the City will need to increase population density and building intensification to support other actions in the plan.

City in Action: Waste Reduction

Landfill Gas Capture

Since 2017, the City of Regina has operated a 1MW gas engine/generator that uses the methane gas from waste decomposition at the landfill for power generation. This renewable energy source feeds SaskPower's grid and produces revenue for the City. The facility produces up to 7,800,000 kWh of electricity per year, enough to power over 1,000 homes, and it reduces greenhouse gas emissions by an estimated 30,000 tonnes per year or the equivalent of taking 8,000 cars off the road.

Curbside Composting Program

After a successful pilot program, a new curbside compost program will be launched throughout the community in 2023.

This new service is part of the City's long-term solid waste management plan to send less waste to the landfill. The City is aiming to reach 65 per cent waste diversion by 2025. Based on the pilot, the City expects the composting program will drive the total waste diversion to over 50 per cent. The volume of waste disposed at the landfill is expected to decrease by approximately 24,000 tonnes per year, eliminating 10,820 tonnes of greenhouse gas emissions and extending the life of the City's landfill.

Additional Actions

Table 13. Additional actions implementation summary table.

ACTION	DESCRIPTION	GHG IMPACT	CO-BENEFITS	COST	IMPLEMENTATION MECHANISMS	TIMING	METRICS
8.1 Waste and wastewater improvements	Increase methane capture to 95% by 2030. After 2030, the WWTP uses all available biogas/ RNG from capture. 10% reduction in water/ wastewater consumption (behaviour change).		Equity: High Employment: Medium Cost Effectiveness: Medium	$$	Infrastructure: Methane capture expansion.	Start: 2027 Completion: 2030 (Ongoing once target met)	Methane capture rate
8.2 Recycling program	Increase recycling rates to meet 65% waste diversion by 2025.		Equity: Enabler Employment: Low Cost Effectiveness: Low	$$$$$	Program: Expand recycling program.	Start: Immediately Completion: 2025 (Ongoing once target met)	Diversion rate
8.3 Organic compost program	95% of capture of organics to compost by 2025.		Equity: Enabler Employment: Low Cost Effectiveness: Low	$$$	Program: Expand compost program.	Start: 2027 Completion: 2030 (Ongoing once target met)	Diversion rate
8.4 Landfill gas capture	Expand landfill gas capture program to reach 40%.		Equity: Enabler Employment: Low Cost Effectiveness: Medium	$$	Infrastructure: Landfill gas capture expansion.	Start: 2023 Completion: 2035	Landfill gas capture rate

ACTION	DESCRIPTION	GHG IMPACT	CO-BENEFITS	COST	IMPLEMENTATION MECHANISMS	TIMING	METRICS
8.5 Spatial densification: Residential	Adapt growth plan to allocate growth as follows: 15% new population to city centre. 50% to intensification areas—specific zones along transit nodes. 35% to new neighbourhoods.		Equity: Enabler Employment: Low Cost Effectiveness: High	$$	Policy: Review building density policies and bylaws.	Start: 2023 Completion: Ongoing	People per square kilometre
8.6 Spatial densification: Commercial	Adapt growth plan to allocate growth as follows: 15% new population to city centre. 50% to intensification areas—specific zones along transit nodes. 35% to new neighbourhoods.		Equity: Enabler Employment: Low Cost Effectiveness: High	$$$	Policy: Review building density policies and bylaws.	Start: 2023 Completion: Ongoing	People per square kilometre

Putting the Plan in Motion

The Energy and Sustainability Framework identifies a viable pathway for the City of Regina to reach its 100 per cent renewable and net-zero targets. The Framework demonstrates that the actions that drive emissions reductions are also good for the community. They contribute to a healthy economy, a more equitable city, and a place that continues to thrive in the future. The Framework is also ambitious. It requires swift action and a deep commitment to be realized. This will require the sustained effort of the City, community members, businesses, institutions, and all sectors of the community. What will result is a low-carbon, sustainable community that is ready for the future and is economically, environmentally, and socially responsible.

The City will need to dedicate staff time and annual budget dollars for implementation to be successful. It must collaborate with community stakeholders to ensure that the goals are reached. This must include, in the near term, determining the financial tools, funders, project leads, partnerships, and governance for each action and implementation mechanism. In particular, the City must determine the details of its role in implementing each action and communicate clearly on what else is needed from whom in the community.

The City must also commit to regular monitoring, reporting, and reviewing relating to the overall Framework and individual implementation actions and mechanisms. In particular, the City needs to commit to continuing to stay up to date on the latest best practices and technologies to decrease GHG emissions, using adaptive management to reprioritize actions in this Framework as lessons are learned through implementation and as conditions change over time, to track progress and report to the public annually and to revise the Framework every five years.

Additional information on implementation recommendations can be found in *Appendix D: Implementation Guide*.

Appendix A: Glossary

Adaptive management: Adaptive management is an iterative approach to project management that includes adjusting decisions, actions, and project implementations based on lessons learned, changing circumstances, and new information becoming available.

Air-source heat pump: A building heating technology that transfers heat from the outside air to heat or cool a building using a refrigeration system and process.

Baseline: The starting year for energy or emissions projections.

Building envelope: A building envelope is any building component that physically separates the interior and exterior of a building and shields the inside space from elements such as heat, cold, and precipitation. Building envelope components include windows, doors, walls, roof, and insulation.

Carbon budget: This term refers to three concepts: (1) an assessment of carbon-cycle sources and sinks on a global level through the synthesis of evidence for fossil-fuel and cement emissions, land-use change emissions, ocean and land CO2 sinks, and the resulting atmospheric CO2 growth rate. This is referred to as the global carbon budget; (2) the estimated cumulative amount of global carbon dioxide emissions that is predicted to limit global surface temperature to a given level above a reference period, taking into account global surface temperature contributions of other GHGs and climate forcers; (3) the distribution of the carbon budget defined under (2) to the regional, national, or sub-national level based on considerations of equity, costs, or efficiency.

Clean energy: Energy derived from renewable, zero-emissions sources.

Climate adaptation: Any initiative or action in response to actual or projected climate change impacts which reduce the effects of climate change on built, natural, and social systems.

Climate mitigation: Any policy, regulation, infrastructure, or other project-based measure that contributes to the reduction of greenhouse gas concentrations in the atmosphere.

CO2: A naturally occurring gas, carbon dioxide, or CO2, is also a by-product of burning fossil fuels (such as oil, gas, and coal), of burning biomass, of land-use changes (LUC), and of industrial processes (e.g. cement production). It is the principal anthropogenic greenhouse gas (GHG) that affects the Earth's radiative balance. It is the reference gas against which other GHGs are measured and therefore has a global warming potential (GWP) of one.

CO2e: Carbon dioxide equivalent, a standardized measurement of greenhouse gases based on the warming potential of given gases compared with carbon dioxide.

Co-benefits: Benefits that are additional to the primary objective. In this case, the primary objectives are energy efficiency and emissions reductions and co-benefits include job creation, enhanced equity, and better air and water quality.

Cooling degree days: The number of degrees that a day's average temperature is above 18°C, requiring cooling.

Decarbonization: The process by which countries, individuals, or other entities aim to achieve a zero-fossil-carbon existence. Typically refers to a reduction of the carbon emissions associated with electricity, industry, and transport.

Deep building retrofits: A whole-building analysis and construction process minimizing building energy use by 50% or more compared to the baseline energy use.

Density: A measurement of the population per unit area.

District energy systems: A network of hot and cold water pipes that are used to heat and cool connected buildings more efficiently than if each building had their own heating/cooling systems.

Energy efficiency: Using less energy to perform the same task.

Greenhouse gas (GHG): Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of terrestrial radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H2O), carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4), and ozone (O3) are the primary GHGs in the Earth's atmosphere. Moreover, there are a number of entirely human-made GHGs in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montreal Protocol. Beside CO2, N2O and CH4, the Kyoto Protocol deals with the GHGs sulphur hexafluoride (SF6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs).

Green hydrogen: Green hydrogen relies on surplus renewable electricity to generate hydrogen using electrolysis, which can then be combusted.

Grid electricity: Electricity that comes from an interconnected network of electricity from the point of generation to end consumers.

Ground-source heat pump: A building heating technology that transfers heat stored in the earth at a somewhat stable temperature into a building when it requires heating, and transfers heat out of a building into the ground when it needs cooling. Also referred to as a geothermal heat pump.

Heating degree days: Number of degrees that a day's average temperature is below 18 °C, requiring heating.

Intensification: Refers to land-use intensification and describes developing an area at a higher building density (units/sq km) than currently exists through development, redevelopment, infill, building expansion, and building conversion.

Lock-in: A situation in which the future development of a system, including infrastructure, technologies, investments, institutions, and behavioural norms, is determined or constrained ('locked in') by historic developments.

Low emissions: Low emissions is a term used to comparatively describe technologies and processes that produce much fewer GHG emissions than current conventional technologies and processes. There is no standard threshold for low emissions.

Net-zero emissions: Net-zero emissions are achieved when human-caused emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period. Where multiple greenhouse gases are involved, the quantification of net-zero

emissions depends on the climate metric chosen to compare emissions of different gases (such as global warming potential, global temperature change potential, and others), as well as the chosen time horizon.

Paris Agreement: The Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC) was adopted in December 2015, in Paris, France, at the 21st session of the Conference of the Parties (COP) to the UNFCCC. The agreement, adopted by 196 Parties to the UNFCCC, entered into force on 4 November 2016 and as of May 2018, it had 195 Signatories and was ratified by 177 Parties. One of the goals of the Paris Agreement is 'Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change. Additionally, the Agreement aims to strengthen the ability of countries to deal with the impacts of climate change.

Pathway: The temporal evolution of natural and/or human systems towards a future state. Pathway concepts range from sets of quantitative and qualitative scenarios or narratives of potential futures to solution-oriented decision-making processes to achieve desirable societal goals. Pathway approaches typically focus on biophysical, techno-economic, and/or socio-behavioural trajectories and involve various dynamics, goals, and actors across different scales.

Renewable energy: Renewable energy is energy that is derived from a source that is not depleted when used or is regularly replenished, such as wind or solar energy. Renewable energy is commonly used interchangeably with 'clean energy' and is understood to be derived from zero- or low-emissions energy sources.

Renewable natural gas: Methane captured from bacterial decomposition of sewage, manure, waste, plant crops, or other organic waste products. It can be used as a natural gas replacement.

Scenario: A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g. rate of technological change, prices) and relationships. Note that scenarios are neither predictions nor forecasts, but are used to provide a view of the implications of developments and actions.

Social cost of carbon: The net present value of aggregate climate damages (with overall harmful damages expressed as a number with positive sign) from one more tonne of carbon in the form of carbon dioxide, conditional on a global emissions trajectory over time.

Solar farm: A large-scale or centralized solar installation where photovoltaic panels are used to harvest the sun's energy. Solar farms are typically connected to the electricity grid, and energy from the farm is delivered to consumers as part of that system.

Solar photovoltaics: Solar photovoltaic technologies produce electricity from solar radiation.

Stranded assets: Assets exposed to devaluations or conversion to 'liabilities' because of unanticipated changes in their initially expected revenues due to innovations and/or evolutions of the business context, including changes in public regulations at the domestic and international levels.

Wind farm: A large-scale or centralized group of wind turbines that are used to harvest the energy from wind. Wind farms are typically connected to the electricity grid, and energy from wind farms is delivered to consumers as part of that system.

Appendix B: Summary of Engagement Opportunities

EVENT	OUTCOMES	PROJECT STAGE	FORMAT	LEAD FACILITATOR
Community Advisory Group				
Workshop 1: Introduction to the Process	To inform members of the CAG on: the group's role and opportunities for input throughout the project; the Framework objectives and milestones; the project approach and modelling process; and the engagement strategy. To consult members of the CAG on: identifying opportunities to engage the community.	Preparation (Data collection and local context)	Online workshop with presentation and Miro Board activity	SSG

EVENT	OUTCOMES	PROJECT STAGE	FORMAT	LEAD FACILITATOR
Workshop 2: Where We're Headed: Opportunities and Targets	To inform members of the CAG on: the current project stage (business-as-planned scenario development); the draft BAP outputs; and emergent themes from the BAP and context setting. To consult the CAG on: the principles and terms of reference for the CAG; low-carbon action preferences; and the City's current climate target.	Business-as-Planned	Online workshop with presentation and Miro Board activity	SSG
Workshop 3A: Low-Carbon Planning	To inform members of the CAG on: the final BAP outputs; the key steps for developing the low-carbon scenario; and additional opportunities to provide feedback (follow-up survey for CAG members). To consult members of the CAG on: the Big Moves and their associated targets.	Low-Carbon Scenario Development	Online workshop with presentation and Miro Board activity	SSG

EVENT	OUTCOMES	PROJECT STAGE	FORMAT	LEAD FACILITATOR
Workshop 3B: Low-Carbon Scenario Review	To inform members of the CAG on: the three low-carbon scenarios. To involve the members of the CAG in: identifying how the Big Moves will impact their organizations and/or sectors and providing feedback on the low-carbon scenarios.	Low-Carbon Scenario Development	Online workshop with presentation and roundtable discussion	SSG
Workshop 4: Framework Review	To inform members of the CAG on: the outputs and recommendations contained in the Framework.	Draft Development	Online presentation with question and answer period	SSG
Internal Advisory Committee				
Workshop 1: Introduction to the Process	To inform members of the IAC on: the group's role in developing the Framework; the Framework objectives and milestones; the current project stage (business-as-planned scenario development); the draft BAP outputs; and science-based targets. To consult members of the IAC on: a science-based target.	Low-Carbon Scenario Development	Online presentation with a poll question	SSG

EVENT	OUTCOMES	PROJECT STAGE	FORMAT	LEAD FACILITATOR
Workshop 2: Introduction to the Process	To inform members of the IAC on: the seven Big Moves and the low-carbon scenarios. To involve members of the IAC in: identifying how the Big Moves and scenarios will impact their work and providing feedback on the low-carbon scenarios.	Low-Carbon Scenario Development	Online presentation with roundtables on the big moves and scenarios	SSG
Workshop 3: Framework Review	To inform members of the IAC on: the outputs and recommendations contained in the Framework.	Draft Development	Online presentation with question and answer period	SSG

EVENT	OUTCOMES	PROJECT STAGE	FORMAT	LEAD FACILITATOR
Targeted Sector Engagement				
Focus Groups: Focus groups were held with representatives from six sectors/areas of expertise including: Renewable energy sector Buildings sector Transportation sector Industrial, manufacturing, and agriculture sectors Equity-seeking groups Labour and training groups The focus groups were held during the low-carbon action development phase of the project.	To inform participants about the objectives, scope, and timeline of the project. To consult participants about the Big Moves relevant to their expertise and their feedback on the actions, policies, and regulations the City can take to ensure goals are met.	Low-Carbon Scenario Development	Online focus group with short presentation and roundtable discussion Questions provided to participants in advance	SSG

EVENT	OUTCOMES	PROJECT STAGE	FORMAT	LEAD FACILITATOR
Interviews: Interviews were held with subject matter experts on areas of local expertise relevant to the development of the low-carbon actions. The interviews were held during the low-carbon action development phase of the project.	To inform participants about, scope, and timeline of the project. To consult participants about the Big Moves relevant to their expertise and their feedback on the actions, policies, and regulations the City can take to ensure goals are met.	Low-Carbon Scenario Development	Conversations via Zoom Questions provided to participants in advance	SSG
Community Outreach and Engagement				
Student Forum: A student forum was held with several high school classes during the low-carbon action development phase to better understand students' perspectives on opportunities and challenges relating to climate action planning and the development of the Framework.	To increase the understanding of City Council's commitment to net-zero; To inform future community planning and actions by understanding the benefits and challenges of the scenarios from youth and equity perspectives and the roles youth could play in bringing the final low-carbon scenario to life and to more generally build relationships between youth and City Hall, making civic government more accessible to them.	Low-Carbon Scenario Development	Online via Microsoft Teams with participation sheets distributed to classes and gathered after the event Short presentation provided and then an iterative Now, Wow, How activity Hosted by Ahne Studios and co-hosted by SSG	Ahne Studios

EVENT	OUTCOMES	PROJECT STAGE	FORMAT	LEAD FACILITATOR
Public Forum: A public forum was held during the low-carbon action development phase to better understand perspectives from interested and affected members of the public on opportunities and challenges associated with climate action planning and the development of the Framework.	To inform community members about the climate action planning process in order to understand how the ESF is being created. To involve members of the community in understanding the challenges and opportunities related to the ESF's Big Moves, from their perspectives and identifying how they would like to contribute to the success of the ESF.	Low-Carbon Scenario Development	Online via Microsoft teams Short presentation and then small breakout room discussions facilitated by SSG staff	SSG
Community Survey: A community survey was held to offer interested and affected community members with an opportunity for input that was self-guided and had a minimal time commitment.	To involve members of the community in commenting on challenges and opportunities related to the Big Moves, from their perspectives.	Low-Carbon Scenario Development	Survey available online via Regina's Be Heard platform and in-person at City Hall	SSG

EVENT	OUTCOMES	PROJECT STAGE	FORMAT	LEAD FACILITATOR
Be Heard Regina: The City leveraged this Be Heard Regina platform to allow community members to stay informed on the project, ask questions, and leave comments on what they could do to support the transition to a low-carbon community.	To inform community members about the Framework development process, milestones, and timeline. To consult community members on what they feel they can do to decrease emissions, their vision for the Framework, and the questions they have about the Framework.	Throughout the project	Online via Regina's Be Heard website	City
Presentations to Groups: Regina Public Schools Climate Change Education Community of Practice Miller High School Environmental Club Regina Energy Transition Group Public via an Earth Day presentation	To inform community members on the development of the Framework and major milestones.	Throughout the project	Online and in-person Presentations and Q&A	City
Direct Outreach: At the Farmers' Market	To inform community members on the development of the Framework and major milestones.	Throughout the project—16 sessions	Informal conversations and Q&A	City
Experiential Marketing: At multiple community events	To inform community members on the development of the Framework and major milestones.	Throughout the project	Invited subscribers to Be Heard Regina for further information to be shared	City

Appendix C: GPC Tables

					IN TONNES			
GPC REF NO.	SCOPE	GHG EMISSIONS SOURCE	INCLU-SION	REASON FOR EXCLUSION (IF APPLICABLE)	CO2	CH4	N2O	TOTAL CO2E
I STATIONARY ENERGY SOURCES								
I.1 Residential buildings								
I.1.1	1	Emissions from fuel combustion within the city boundary	Yes		419,815	287	2,412	422,514
I.1.2	2	Emissions from grid-supplied energy consumed within the city boundary	Yes		397,489	947	2,976	401,412
I.1.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes		33,716	80	252	34,048
I.2 Commercial and institutional buildings/facilities								
I.2.1	1	Emissions from fuel combustion within the city boundary	Yes		378,086	260	2,156	380,502
I.2.2	2	Emissions from grid-supplied energy consumed within the city boundary	Yes		549,880	1,310	4,116	555,306
I.2.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes		46,642	111	349	47,102
I.3 Manufacturing industry and construction								
I.3.1	1	Emissions from fuel combustion within the city boundary	Yes		1,770,503	739	7,292	1,778,534
I.3.2	2	Emissions from grid-supplied energy consumed within the city boundary	Yes		12,617	30	94	12,741
I.3.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes		1,070	3	8	1,081
I.4 Energy industries								
I.4.1	1	Emissions from energy used in power plant auxiliary operations within the city boundary	Yes		10,265	7	55	10,327
I.4.2	2	Emissions from grid-supplied energy consumed in power plant auxiliary operations within the city boundary	No	NR	0	0	0	0
I.4.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption in power plant auxiliary operations	No	NR	0	0	0	0
I.4.4	1	Emissions from energy generation supplied to the grid	No	NR	0	0	0	0
I.5 Agriculture, forestry and fishing activities								
I.5.1	1	Emissions from fuel combustion within the city boundary	No	NR	0	0	0	0

					IN TONNES			
GPC REF NO.	SCOPE	GHG EMISSIONS SOURCE	INCLU-SION	REASON FOR EXCLUSION (IF APPLICABLE)	CO2	CH4	N2O	TOTAL CO2E
I.5.2	2	Emissions from grid-supplied energy consumed within the city boundary	No	NR	0	0	0	0
I.5.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	No	NR	0	0	0	0
I.6 Non-specified sources								
I.6.1	1	Emissions from fuel combustion within the city boundary	No	NR	0	0	0	0
I.6.2	2	Emissions from grid-supplied energy consumed within the city boundary	No	NR	0	0	0	0
I.6.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	No	NR	0	0	0	0
I.7 Fugitive emissions from mining, processing, storage, and transportation of coal								
I.7.1	1	Emissions from fugitive emissions within the city boundary	No	NR	0	0	0	0
I.8 Fugitive emissions from oil and natural gas systems								
I.8.1	1	Emissions from fugitive emissions within the city boundary	Yes		52	239,627	0	239,679
II TRANSPORTATION								
II.1 On-road transportation								
II.1.1	1	Emissions from fuel combustion for on-road transportation occurring within the city boundary	Yes		1,089,906	2,348	9,067	1,101,322
II.1.2	2	Emissions from grid-supplied energy consumed within the city boundary for on-road transportation	Yes		34	0	0	34
II.1.3	3	Emissions from portion of transboundary journeys occurring outside the city boundary, and transmission and distribution losses from grid-supplied energy consumption	Yes		61,791	125	210	62,126
II.2 Railways								
II.2.1	1	Emissions from fuel combustion for railway transportation occurring within the city boundary	Yes		71,667	136	8,733	80,536
II.2.2	2	Emissions from grid-supplied energy consumed within the city boundary for railways	No	NR	0	0	0	0
II.2.3	3	Emissions from portion of transboundary journeys occurring outside the city boundary, and transmission and distribution losses from grid-supplied energy consumption	No	NR	0	0	0	0
II.3 Water-borne navigation								
II.3.1	1	Emissions from fuel combustion for waterborne navigation occurring within the city boundary	No	N/A	0	0	0	0
II.3.2	2	Emissions from grid-supplied energy consumed within the city boundary for waterborne navigation	No	N/A	0	0	0	0

					IN TONNES			
GPC REF NO.	SCOPE	GHG EMISSIONS SOURCE	INCLU-SION	REASON FOR EXCLUSION (IF APPLICABLE)	CO2	CH4	N2O	TOTAL CO2E
II.3.3	3	Emissions from portion of transboundary journeys occurring outside the city boundary, and transmission and distribution losses from grid-supplied energy consumption	No	N/A	0	0	0	0
II.4 Aviation								
II.4.1	1	Emissions from fuel combustion for aviation occurring within the city boundary	No	N/A	0	0	0	0
II.4.2	2	Emissions from grid-supplied energy consumed within the city boundary for aviation	No	N/A	0	0	0	0
II.4.3	3	Emissions from portion of transboundary journeys occurring outside the city boundary, and transmission and distribution losses from grid-supplied energy consumption	No	N/A	0	0	0	0
II.5 Off-road								
II.5.1	1	Emissions from fuel combustion for off-road transportation occurring within the city boundary	Yes		307	4	26	338
II.5.2	2	Emissions from grid-supplied energy consumed within the city boundary for off-road transportation	No	NR	0	0	0	0
III WASTE								
III.1 Solid waste disposal								
III.1.1	1	Emissions from solid waste generated within the city boundary and disposed in landfills or open dumps within the city boundary	Yes		0	96,545	0	96,545
III.1.2	3	Emissions from solid waste generated within the city boundary but disposed in landfills or open dumps outside the city boundary	No	N/A	0	0	0	0
III.1.3	1	Emissions from waste generated outside the city boundary and disposed in landfills or open dumps within the city boundary	No	N/A	0	0	0	0
III.2 Biological treatment of waste								
III.2.1	1	Emissions from solid waste generated within the city boundary that is treated biologically within the city boundary	Yes		0	0	0	0
III.2.2	3	Emissions from solid waste generated within the city boundary but treated biologically outside of the city boundary	No	N/A	0	0	0	0
III.2.3	1	Emissions from waste generated outside the city boundary but treated biologically within the city boundary	No	N/A	0	0	0	0
III.3 Incineration and open burning								
III.3.1	1	Emissions from solid waste generated and treated within the city boundary	No	N/A	0	0	0	0

					IN TONNES			
GPC REF NO.	SCOPE	GHG EMISSIONS SOURCE	INCLU-SION	REASON FOR EXCLUSION (IF APPLICABLE)	CO2	CH4	N2O	TOTAL CO2E
III.3.2	3	Emissions from solid waste generated within the city boundary but treated outside of the city boundary	No	N/A	0	0	0	0
III.3.3	1	Emissions from waste generated outside the city boundary but treated within the city boundary	No	N/A	0	0	0	0
III.4 Wastewater treatment and discharge								
III.4.1	1	Emissions from wastewater generated and treated within the city boundary	Yes		0	24,001	751	24,752
III.4.2	3	Emissions from wastewater generated within the city boundary but treated outside of the city boundary	No	NR	0	0	0	0
III.4.3	1	Emissions from wastewater generated outside the city boundary	No	N/A	0	0	0	0
IV INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU)								
IV.1	1	Emissions from industrial processes occurring within the city boundary	Yes		5,525	661	15	6,201
IV.2	1	Emissions from product use occurring within the city boundary	No	ID	0	0	0	0
V AGRICULTURE, FORESTRY AND LAND USE (AFOLU)								
V.1	1	Emissions from livestock within the city boundary	No	NR	0	0	0	0
V.2	1	Emissions from land within the city boundary	No	NR	0	0	0	0
V.3	1	Emissions from aggregate sources and non-CO2 emission sources on land within the city boundary	No	NR	0	0	0	0
VI OTHER SCOPE 3								
VI.1	3	Other Scope 3	No	N/A	0	0	0	0

TOTAL	5,255,098

Reason for exclusion:

N/A Not applicable; Not included in scope

ID Insufficient data

NR No relevant or limited activities identified

Other Reason provided under Comments

A Note about Appendix D

Appendix D is the implementation guide. It is a self-contained, separate document that accompanies this one.