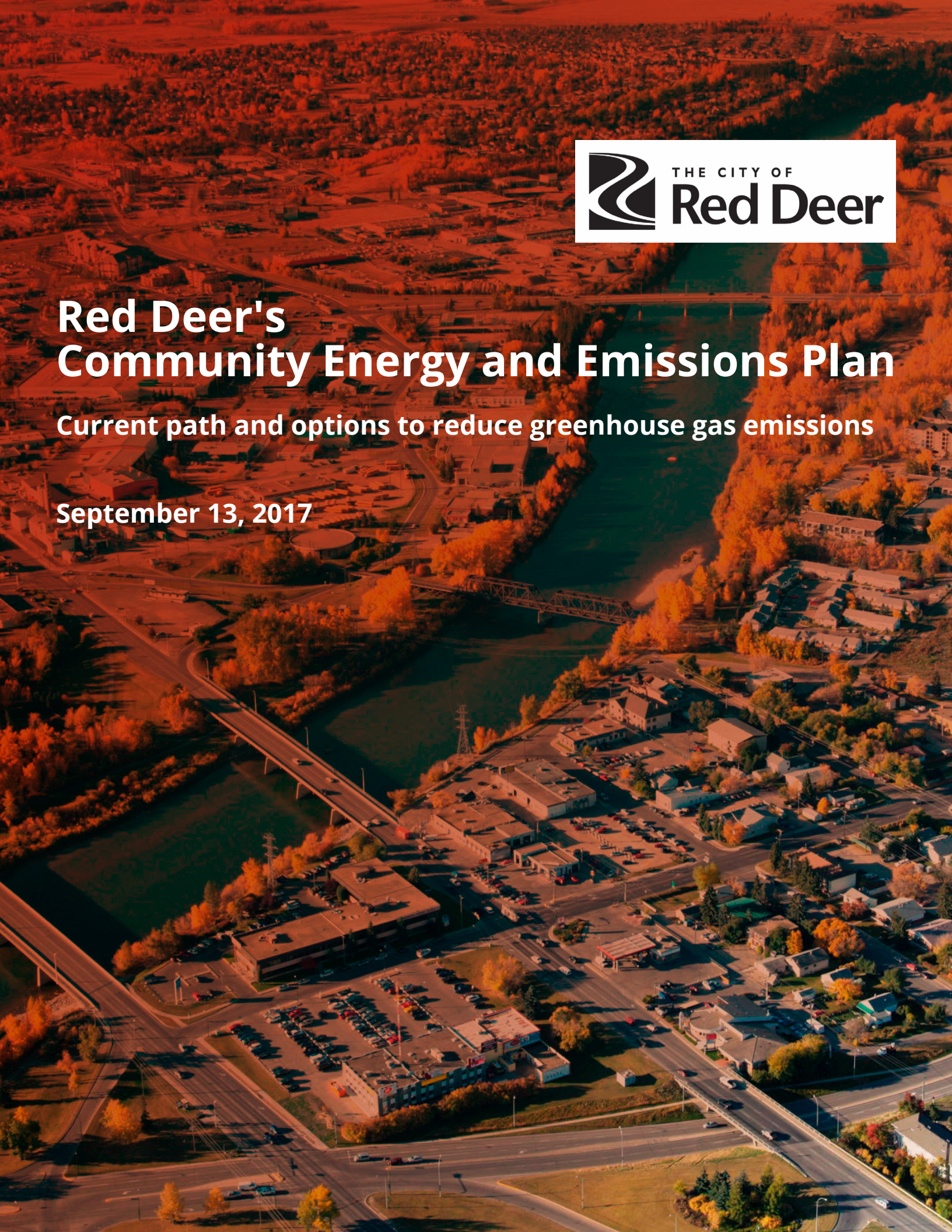

THE CITY OF Red Deer

Red Deer's Community Energy and Emissions Plan

Current path and options to reduce greenhouse gas emissions

September 13, 2017

Prepared in partnership with:

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Executive Summary

A Community Energy and Emissions Plan (CEEP) is a tool that helps define community priorities around energy consumption in order to improve efficiency, cut emissions, and drive economic development. These plans offer many benefits including local economic development, cost savings, improving the local environment, building community resilience, and health and social benefits. Over 180 communities in Canada, representing 50 percent of the Canadian population, have such plans.[1]

Fulfilling direction set in the Environmental Master Plan (EMP), the completed CEEP will establish a community-wide energy use and emissions inventory, establish emissions reductions targets, and identify policies and actions to achieve those targets. Created with input from stakeholders and the community, the CEEP will identify ways to manage our future by producing and using energy more wisely, building efficient homes, travelling in energy efficient ways, producing less waste, and better addressing the waste that we do produce.

This document is a first step to a complete CEEP. It provides a baseline from which to measure progress, forecasts energy use and emissions through 2035, and outlines high-level options to reduce emissions.

CEEP Goals:

1. Red Deer will support the long-term quality of life, health, and mobility of residents, while partnering with its businesses and institutions, through energy and emissions actions.
2. Red Deer's buildings will become more efficient and its neighbourhoods even more livable.
3. Efficient and convenient mobility options will be increasingly available.
4. How resources are used and disposed of will become increasingly efficient.
5. Energy production and use will become increasingly sustainable and resilient.
6. Red Deer will deliver innovative and pragmatic energy and emissions solutions, creating a more prosperous and sustainable city.

In 2010, Red Deer's total community energy use was 11.96 million gigajoules. On its Current Path, the expected energy consumption of the city by the year 2035 will be 21.62 million gigajoules, an 81% increase in energy use. The population increase in this time is predicted to be 74% over 2010 levels.

Using this energy in 2010 resulted in 1.683 million tonnes of carbon dioxide equivalent (tCO2e) in emissions. The expected energy use in 2035 results in a predicted 67% increase to 2.794 million tonnes.

Options for Red Deer's energy and emissions future include maintaining our Current Path, and Moderate and Ambitious Scenarios for change. The Current Path would see Red Deer maintain its current land use, transportation and energy plans. The Ambitious Scenario meets the Intergovernmental Panel on Climate Change recommendations for emissions reduction targets. Implementing the Moderate Scenario would curb increases in energy use and emissions, but they would still increase. In this report, scenario options are analysed for costs, savings and increased employment opportunities.

1 QUEST's Community Energy Planning: The Value Proposition, Environmental, Health and Economic Benefits (Feb. 2016), p.5. http://gettingtoimplementation.ca/wp-content/uploads/2016/02/Full-Report_ValueProposition_OnlineVersionFeb92016.pdf

Table 1. Summary of energy use and emissions produced for Red Deer's 2010 baseline year and scenarios.

Scenario	Energy (millions of gigajoules)	Energy % change over 2010 levels	Emissions (millions of tonnes CO2e)	Emissions % change over 2010 levels
2010 (baseline)	11.96	—	1.683	—
Current Path	21.62	81%	2.794	67%
Moderate Effort	15.79	32%	1.859	10%
Ambitious Effort	13.32	11%	0.853	-50%

This document outlines the facts about our current energy use and GHG emissions, and high-level options for the future. The next steps in the process of developing the CEEP are to choose an emissions reduction target and determine the associated suite of actions to achieve it, including timeline and costs.

1: Introduction

With the Community Energy and Emissions Plan, Red Deer is joining a global movement of municipalities taking action on climate change while also increasing the quality of life, economic opportunities, and energy and transportation choices of their residents. With a population predicted to grow steadily and Federal and Provincial action being taken, Red Deer is at a critical time in its energy and emissions decision making that is well supported locally, federally, provincially and globally.

1.1 Context

Global Context

The global scientific consensus is that the activities required to live our day-to-day lives are having direct consequences to our environment and climate.[2] Burning fuel to run cars, power buildings, operate factories, and light our streets releases greenhouse gases into the Earth's atmosphere, altering the Earth's ability to naturally regulate the climate. Our global climate functions are determined by the trapping and reflecting of heat from the sun, as well as by circulating heat through the atmosphere and oceans. When this capacity is altered, so too is the Earth's climate. This ultimately results in large-scale changes to weather patterns, including increases in storms, droughts, extreme weather events, as well as an overall increase in the average temperature of the Earth.[3] This not only affects us when buildings, crops, and cities are damaged or destroyed by these events—it also threatens the ecosystems that produce the air we breathe and the resources we use.

It is for this reason that all levels of governments all over the globe are making efforts to track and minimize their greenhouse gas emissions. Such inventories track carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4) emissions, which are deemed to be the three main types of greenhouse gases that cities can most control. Gases are measured in tonnes released into the atmosphere, and are converted into equivalents of carbon dioxide (tCO_2e).[4]

National and international municipal organizations are rallying to the challenge of emissions reduction and climate change mitigation, recognizing that they have an important contribution to make to climate protection. According to the Federation of Municipalities (FCM), up to half of Canada's greenhouse gas (GHG) emissions are under the direct or indirect control or influence of municipal governments, and cities can cut emissions from municipal operations and in the broader community.[5]

Federal Context

Canada signed and ratified the Paris Agreement in 2016, joining 195 countries in their commitment to keep global temperature increase under 2 degrees Celsius, with a goal of constraining it to 1.5 degrees. In March 2016, the First Ministers committed to putting Canada on a credible path to meet or exceed our national target of reducing greenhouse gas (GHG) emissions by 30 percent below 2005 levels by 2030. The First Ministers agreed that this will require transitioning to a low-carbon economy by adopting a range of measures, including carbon pricing, adapted to the specific circumstances of each province and territory. Under the new Pan-Canadian Carbon Pricing Plan, all Canadian jurisdictions will have carbon pricing in place by 2018. In order to accomplish this, Canada will set a benchmark for pricing carbon emissions—set at a level that will help Canada meet its greenhouse gas emission targets, while providing greater certainty and predictability to Canadian businesses.[6]

2 More details on the relationship between climate change and greenhouse gases at: www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter01_FINAL.pdf

3 Ibid.

4 For more information on GHGs and the Federation of Canadian Municipalities' Partners for Climate Protection GHG inventories, please see www.fcm.ca/Documents/reports/PCP/Developing_Inventories_for_Greenhouse_Gas_Emissions_and_Energy_Consumption_EN.pdf

5 The Federation of Canadian Municipalities' Partners for Climate Protection has more information on the role of cities in addressing climate change: www.fcm.ca/home/programs/partners-for-climate-protection/about-climate-change.htm

6 Government of Canada: http://news.gc.ca/web/article-en.do?nid=1132149&_ga=1.198090543.1234685879.1480105518

Other recent announcements from the federal government include:

- A commitment to phase out traditional coal-fired power generation by 2030, and increased funding for clean electricity generation.[7]
- The submission of Canada's Mid-Century Long-Term Low-Greenhouse Gas Development Strategy to the United Nations Framework Convention on Climate Change (UNFCCC), which describes various pathways for innovative and creative solutions for Canada and its Provinces and Territories to achieve their Paris Agreement commitments.[8]
- Development of a Pan-Canadian Framework on Clean Growth and Climate Change that addresses clean technology, innovation, and jobs; carbon pricing mechanisms adapted to each province's and territory's specific circumstances and in particular the realities of Canada's Indigenous peoples and Arctic and sub-Arctic regions; specific mitigation opportunities; and, adaptation and climate resilience.[9]
- 2016 federal budget announcements:[10]
    - Support a suite of federal climate change adaptation programs related to science, health, northern and Indigenous communities, and key economic sectors ($129.5 million);
    - Enable the National Research Council to develop climate-resilient building and infrastructures codes and guides ($40.0 million);
    - Support the Federation of Canadian Municipalities in helping local governments conduct climate risk assessments and planning ($75.0 million);
    - Significant funding commitments have also been made for green infrastructure and public transit.[11]

Provincial Context

The Government of Alberta has also made recent climate-related commitments. The Climate Leadership Plan is Alberta's plan to take action on climate change and protect the province's health, environment and economy. Its policies and actions include:[12]

- Applying a carbon levy to heating and transportation fuels such as diesel, gasoline, natural gas and propane beginning in 2017.
- Phasing out coal-fired power plant energy generation by 2030.
- Replacing one-third of coal-fired power plant energy generation capacity with renewable energy by 2030.
- Adding 5,000 MW of renewable energy capacity by 2030.
- Capping oil sands emissions via a $30/tonne carbon price for oil sands facilities and an annual maximum emissions limit of 100Mt.
- Reducing methane gas emissions from Alberta's oil and gas operations by 45% by 2025.

The Government of Alberta is working with municipalities in these transitions, stating commitments to:[13]

- Integrate guidance to municipal governments on climate change in the current review of the Municipal Government Act;
- Make high quality data available for community energy and emissions inventories, and work with municipalities to develop and transfer best practices; and
- Expand green infrastructure investments and/or increasing provincial infrastructure grant flexibility to support transit oriented development, active transportation options and public transit.

7 Government of Canada: http://news.gc.ca/web/article-en.do?mthd=index&crtr.page=1&nid=1157989
8 Government of Canada: http://unfccc.int/files/focus/long-term_strategies/application/pdf/canadas_mid-century_long-term_strategy.pdf
9 Prime Minister's Office: http://pm.gc.ca/eng/news/2016/03/03/communique-canadas-first-ministers
10 Government of Canada: http://www.climatechange.gc.ca/default.asp?lang=En&n=2B2A953E-1
11 Government of Canada: http://www.budget.gc.ca/fes-eea/2016/docs/themes/infrastructure-en.html
12 Government of Alberta: http://www.alberta.ca/climate-leadership-plan.aspx
13 Government of Alberta Climate Leadership Report to Minister: http://www.alberta.ca/documents/climate/climate-leadership-report-to-minister.pdf, p72

Local Context

These Provincial and Federal trends are paralleled by some City planning policy creation and actions locally, most notably Red Deer's Environmental Master Plan (EMP, 2011). The EMP identifies 19 metrics to track progress towards its goals, two of which are to measure and reduce greenhouse gas (GHG) emissions for The City of as a corporation and for Red Deer as a community. The City has been tracking its corporate-side energy and emissions, and making efforts to reduce them, since 2013.

Citizen support for climate change and environmental action in Red Deer has been consistently demonstrated through responses to a benchmarking survey in the fall of 2015 as well as to questions asked in the annual Environmental Services Customer Satisfaction Survey. Replies indicate that residents support The City taking action on climate change. Between 2011 and 2015 residents consistently rank the importance of addressing climate change between 3.43 and 3.8 out of 5, with 5 being very important.

Red Deer's population is steadily increasing—there are over 34,000 more residents today than there were in the year 2000. The city's population surpassed 100,000 in 2015 and is expected to more than double from 2010 levels by 2050.[14] Accommodating an increasing population provides an opportunity to create sustainable housing, transportation, infrastructure, and energy systems that also have co-benefits such as improved health outcomes, economic development, and more resilient energy distribution systems.

The status quo for accommodating population growth in Red Deer mimics the paths Calgary and Edmonton (and most Canadian and American cities) have typically taken over the past 70 years, which is to expand outwards through suburban development—a land-use form that is recognized for its energy inefficiency, greenhouse gas emissions intensity, and high maintenance costs.[15] Calgary and Edmonton are largely 'locked-in' to this style of development, which they are now seeking to address through their recent energy and emissions plans: Calgary's Community GHG Reduction Plan (2011) and Edmonton's Community Energy Transition Strategy (2015)—similar plans to Red Deer's Community Energy and Emissions Plan (CEEP).

Part of Red Deer's current development strategy includes densifying some core urban areas (Riverlands), and has infill and increased density objectives and goals in a variety of City planning documents. The larger development pattern in the city mimics the historic paths of Edmonton and Calgary, however.

Red Deer's Municipal Development Plan (MDP) recognizes and starts to address these issues. The CEEP will add detail to the high-level policies identified in the MDP, such as:

5.10 Redevelopment and Intensification: ... reviews of potential redevelopment and intensification opportunities in the established areas...

5.17 Efficiency of Land Use: ... promote intensification of the urban areas by ensuring its design guidelines and specifications encourage the efficient use of land.

5.18 Infill Development: ... support infill residential and commercial development on vacant or underutilized parcels of land in established areas, particularly along major transit routes.

7.3 Promoting the Development of Town Centres: ... in strategic locations on the transit network ... as mixed use focal points with higher density housing, schools, institutional uses and ... appropriate commercial uses.

7.6 Encouraging Transit Oriented Development (TOD): ... by promoting higher density development in proximity to transit stops and along transit corridors, managing parking to encourage walking and transit use...

9.12 Environmental Sustainability Initiatives and Trends: ... investigate and incorporate ... initiatives and trends such as eco-friendly retrofit building programs to help ensure long-term land use and sustainable development...

10.7 Inclusion of Non-residential Land Uses: ... design of new neighbourhoods shall be encouraged to include compatible non-residential uses, such as local commercial services that serve the needs of area residents...

14 Based on further extrapolations from The City of Red Deer Economic Development Strategy (2013), p.85.
15 City of Calgary (2009). *The Implications of Alternative Growth Patterns on Infrastructure Costs*. p.i.

10.9 Infill and Intensification in Established Neighbourhoods: Intensification shall be encouraged in established neighbourhoods through residential and mixed use infill projects...

16.1 Coordination of Land Use and Transportation: ... with the objective of minimizing travel distances and managing transportation demand, including encouraging the use of alternatives that do not rely on single occupant passenger vehicles.

16.8 Use of Public Transit: ... encourage the use of public transit... by ... Giving priority to the location and operation of transit facilities in major destinations.

16.15 Transportation Demand Management: ... investigate and implement appropriate Transportation Demand Management techniques to moderate growth in single occupancy automobile traffic...

By carefully considering its development, energy and emissions options, The City and its residents can plan for an energy-secure, low emissions future that also helps protect the high quality of life for all in the city.

1.2 The Community Energy and Emissions Plan

A Community Energy and Emissions Plan (CEEP) is a tool that helps define community priorities around energy consumption in order to improve efficiency, reduce emissions, and drive economic development. These plans offer many benefits including local economic development, cost savings, improving the local environment, building energy resilience, and health and social benefits. Over 180 communities in Canada, representing 50 percent of the Canadian population, have such plans.[16]

Fulfilling direction set in the Environmental Master Plan (EMP), the completed CEEP will establish a community-wide energy use and emissions inventory, establish reduction targets, and identify policies and actions that will achieve those targets. Created with input from the community, the CEEP will identify ways to manage our environmental future by producing and using energy more wisely, building efficient buildings, travelling in energy efficient ways, producing less waste, and better addressing the waste that we do produce.

This document is a first step to a complete CEEP. It provides a baseline from which to measure progress, forecasts energy use and emissions through 2035, and outlines high-level options to reduce emissions.

The CEEP will operate in coordination with existing City plans and strategies that govern land-use, transportation, housing, waste, and energy. Some of these plans are statutory documents while others provide policy and action guidance. The CEEP will provide recommendations to address a variety of civic and community elements simultaneously, ensuring they are all working towards the same outcomes. The CEEP's major application will be to inform and fortify the policies and actions enacted under these other plans and frameworks. Figure 1 summarizes some key City policies and plans related to the CEEP.

The CEEP will operate in conjunction with Red Deer's Corporate GHG Emissions Inventory—an energy and emissions approach for municipal operations. The corporate inventory is updated every year with energy use and emissions data tracked by The City. The Corporate GHG Emissions Inventory includes energy used by and emissions from:

- Energy use at facilities (electricity and natural gas use by heating, ventilation, air conditioning, lights and other equipment);
- Energy use for treatment and transport of water, wastewater and landfill waste;
- Energy use from community lighting (streetlights, traffic lights, park and parking lot lights);
- Decomposition of wastewater and landfill waste (methane gas); and
- Diesel and gasoline use by City owned or operated vehicle fleet.

16 QUEST's Community Energy Planning: The Value Proposition, Environmental, Health and Economic Benefits (Feb. 2016), p.5. http://gettingtoimplementation.ca/wp-content/uploads/2016/02/Full-Report_ValueProposition_OnlineVersionFeb92016.pdf

All of these emissions will also be accounted for in the CEEP. Since the CEEP accounts for all energy used and emissions for the entire community, The City's corporate emissions are included. The Corporate GHG Inventory is different because identifies areas where The City has direct control, whereas The City does not have direct control over all energy use and emissions for the entire community.

The CEEP will be a long-term planning document to help the citizens of Red Deer reduce energy use and GHG emissions. As a community plan, many of its actions will be taken in coordination with partners such as businesses, community groups, individuals, and institutions. The joint efforts of these partnerships are what will ensure the success of the actions and policies resulting from the CEEP. The CEEP was created from inclusive, thoughtful community collaboration—it is natural that its successes will also be anchored in community stewardship.

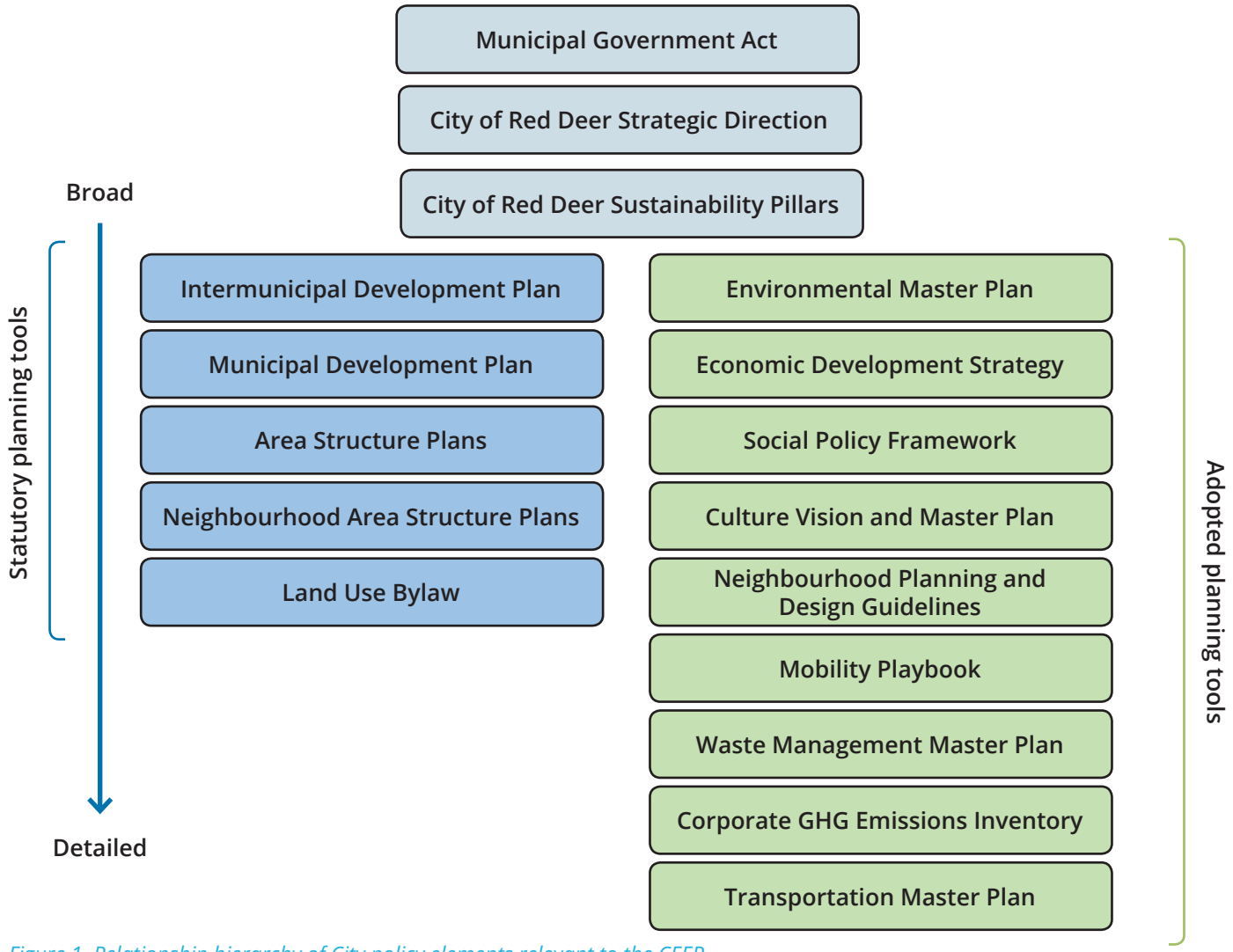


Figure 1. Relationship hierarchy of City policy elements relevant to the CEEP.

Rationale for Developing a CEEP

Continued Quality of Life

Although it may be hard to imagine that there will come a time when a car trip across town will take more than fifteen minutes, this will change as the population increases in suburban areas, generating more single vehicle use. Even for those currently living a quick drive from work and their favourite amenities, increased traffic from the expanding suburbs will result in greater traffic delays.

Designing compact, complete communities can maintain and enhance quality of life for residents, as is recognized by many policies in Red Deer's Municipal Development Plan. These types of communities provide opportunities for more efficient transit routes, active transportation options, and easier access to services. Long distances and distributed destinations associated with sprawled development create a dependence on personal automobiles, which often means infrastructure and corresponding maintenance is added to accommodate an ever-growing number of vehicles. Furthermore, it is very costly for public transit to service dwellings spread out over a large area.[17] Designing compact, complete communities will help Red Deer continue to be that, "... modern city that still retains its small town charm," in its Identity Narrative.

The MDP—whose vision hinges on quality of life—includes policies that can result in reduced energy use and emissions: land-use intensification and efficiency, transportation oriented development, coordination of land-use and transportation, and transportation demand management, to name a few.

Reducing Energy Use and Greenhouse Gas Emissions

Strategic land-use planning lays the framework for significant energy use and emission reductions into the future. Land-use decisions determine transportation patterns, building design, public infrastructure, and energy supply systems for fifty to hundreds of years into the future. This effect is known as 'path dependence' or 'lock-in': one decision significantly influences future decisions and our ability to change what has already been decided. Recognizing this, community planning can be directed by a simple maxim: 'Whatever lasts longest is most important.'[18]

Land-use planning determines the long-term energy and emissions characteristics of a community, such as the way people move around and where people live, work and play. It is important for City departments and developers to work together to holistically consider urban form, aesthetic, green space, proximity to amenities, home design, and transportation to create vibrant, functional communities where people want to be.

Reducing Municipal Costs

Municipal costs are significantly lower in a community with low GHG emissions. A study for The City of Calgary compared a scenario of continuing current policies (the 'dispersed' scenario) with one that intensifies population and jobs in existing areas (the 'dense' scenario). The 'dense' scenario would cost 25% less to build, and would be cheaper to operate and maintain. Its water and wastewater systems would cost 55% less than in the 'dispersed' scenario. Similar savings were found for road construction, transit costs, fire stations, recreation centres and schools.[19] These municipal costs are typically paid for with tax revenues. Keeping municipal costs down helps to prevent property tax and municipal services tax increases.

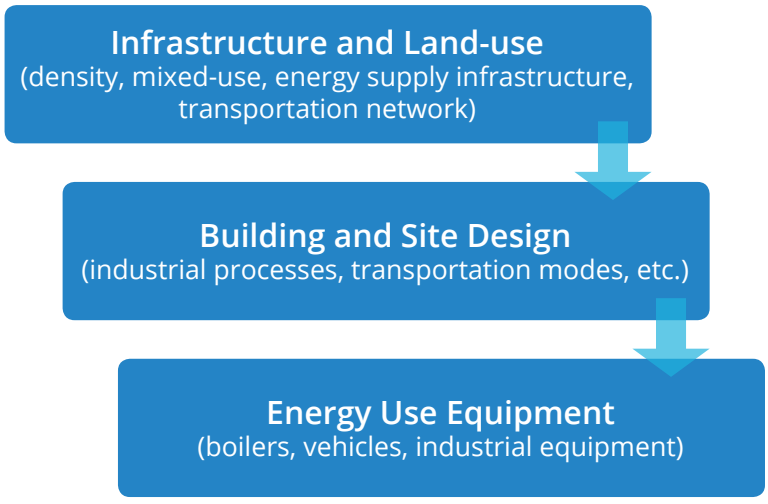


Figure 2. Hierarchy of energy use planning priorities.

17 Leibowitz, S., & Margolis, S. (2009). Path Dependence, Lock-in and History. Journal of Law, Economics and Organisation, 11(1), p.205-226.
18 Jaccard, M.,et al. (1997). From equipment to infrastructure: community energy management and GHG emission reduction. Energy Policy, 25(13), 1065-1074.
19 Study performed by IBI Group for the City of Calgary (2009), p.i: http://www.reconnectingamerica.org/assets/Uploads/planitcalgarycoststudyanalysisaprilthird.pdf

Reducing Energy Costs for Residents

Energy prices can also be volatile and unpredictable, depending on global supply and demand, natural disaster occurrences, and the global political climate. In general, the average cost of energy in Alberta is expected to increase steadily over the next few decades.[20] These price increases translate into greater household spending on energy use. In 2010 (the CEEP baseline year), home energy spending accounted for 3.3% of household expenditures on average while household transportation spending accounted for 14.4%.[21] Policies and incentives to increase the energy efficiency of new homes, increased housing density to decrease energy demand, and land-use that encourages low energy demand (e.g. energy efficient building arrangements, transit use, neighbourhood walkability) will help to keep home energy bills low and make them resilient to increases and spikes in energy costs.

Furthermore, Alberta's new Carbon Levy means that every unit of fossil fuel saved not only saves the cost of that fuel but also saves the associated Carbon Levy cost. Reduced travel distances for every snow plow, lawn mower and garbage truck will result in cost savings.

Improving Health Outcomes

A community that reduces GHG emissions will also improve public health outcomes like heart disease, hypertension, stroke, diabetes, obesity, osteoporosis and depression by:[22]

- Supporting higher levels of physical activity;
- Increasing public transit use;
- Improving traffic safety;
- Reducing air pollution;
- Reducing noise pollution; and
- Enhancing social interactions.

Building a Green Economy

The idea of a green economy has grown in prominence as a solution to both the economic slowdown and environmental challenges. The United Nations Environment Program (UNEP) defines the Green Economy as "low-carbon, resource efficient, and socially inclusive. In a green economy, growth in income and employment are driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services".[23] A report by UNEP estimated that 2.3 million people are employed in jobs related to renewable energy worldwide.[24]

The Alberta Government's Climate Leadership Plan has a focus on renewable energy and green jobs citing expected job increases in energy efficiency retrofitting, renewable energy, and transit expansion and sustainable transportation infrastructure sectors. It estimates that in the renewable energy sector, 3,000 new local jobs in sectors such as skilled trades, construction, retail sales, professional services, and manufacturing will be created.[25] A report prepared for the Government of Alberta by Dunsky Energy Consulting estimates that 15,000 new jobs could be created in the provincial energy efficiency sector alone.[26] There is a huge job market opportunity in this sector.

20 National Energy Board, Canada's Energy Future (2016), p.5: https://www.neb-one.gc.ca/nrg/ntgrtd/ftr/2016/2016nrgftr-eng.pdf

21 Statistics Canada: http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/famil130j-eng.htm

22 Frank, L., Kavage, S., and Litman, T. (2008). Promoting public health through Smart Growth. p.5. http://www.vtpi.org/sgbc_health.pdf

23 UNEP, Pathways to Sustainable Development and Poverty Eradication (2011), p16. http://web.unep.org/greeneconomy/sites/unep.org.greeneconomy/files/field/image/green_economyreport_final_dec2011.pdf

24 UNEP (2008). Green jobs: towards decent work in a sustainable, low-carbon world. Produced by Worldwatch Institute, p.7. http://wedocs.unep.org/bitstream/handle/20.500.11822/8825/UNEPGreenJobs_report08.pdf?sequence=3&isAllowed=y

25 Alberta Climate Leadership Report to Minister, Executive Summary, p.25. http://www.alberta.ca/documents/climate/climate-leadership-report-to-minister-executive-summary.pdf

26 GHG Savings and Energy Efficiency High-Level Opportunity Analysis in Alberta (2015), p.9. http://www.aeea.ca/pdf/energy-efficiency-scenarios-for-alberta.pdf

CEEP Purpose

The CEEP will help define community priorities around energy consumption in order to improve efficiency, cut emissions, and drive economic development. It aligns with The City's vision and mission statements, and stems from the Environmental Master Plan's direction to set targets to reduce community GHG emissions and create a climate change adaptation and mitigation plan.

City Vision

Innovative Thinking

Inspired Results

Vibrant Community

City Mission

The City of Red Deer works together to provide leadership and sustainable municipal services for our community.

Environmental Master Plan Vision

Red Deer actively enhances its rich natural environment and minimizes its ecological footprint through City leadership, community collaboration and active stewardship. Red Deer is a leading example of a resilient and sustainable community in which urban and natural systems are effectively integrated to the benefit of both.

From these statements and stakeholder and community input, the CEEP's goals and objectives were set.

CEEP Goals

1. Red Deer will support the long-term quality of life, health, and mobility of residents, while partnering with its businesses and institutions, through energy and emissions actions.
2. Red Deer's buildings will become more efficient and its neighbourhoods even more livable.
3. Efficient and convenient mobility options will be increasingly available.
4. How resources are used and disposed of will become increasingly efficient.
5. Energy production and use will become increasingly sustainable and resilient.
6. Red Deer will deliver innovative and pragmatic energy and emissions solutions, creating a more prosperous and sustainable city.

CEEP Objectives

The Red Deer CEEP has several objectives in support of achieving the goals. This document addresses the first three objectives:

1. Measure community energy use and emissions production to establish a baseline from which to measure progress;
2. Forecast energy and emissions to the year 2035; and
3. Outline high level options for to achieve emissions reduction targets.

Next steps will be to:

4. Determine a community emissions reduction target to achieve by the year 2035, with input from the community;
5. With input from the community, create an action plan to achieve the target, with timeline and costs; and
6. Provide guidance on how CEEP action recommendations can complement existing plans and further be integrated into City policies and plans, and throughout the community for:

- Energy generation and use;
- Transportation and transit;
- Building and development;
- Land-use;
- Solid waste; and
- Water and wastewater.

2: Energy and Emissions Planning

2.1 Community Energy and Emissions Baseline and Current Path to 2035

The energy and emissions baseline is the starting point for CEEP development. It is an inventory of energy use, energy sources, and emissions volumes produced in a given year. The most complete energy and emissions related information for Red Deer is for the year 2010, and thus 2010 has been used as the baseline year. The baseline year serves as the starting point and comparison year for future emissions projections and scenario planning. The CEEP uses the Environmental Master Plan's 2035 target year as the target year for achieving its goals.

This report section details the energy and emissions baseline information and indicates some of the expected trends for this data. The projected information for 2035 serves as the Current Path Scenario, which is the direction headed assuming the plans The City currently has in place are implemented.

Population, Housing and Housing Mix[27]

Red Deer's population is expected to increase steadily, with over 66,000 new residents requiring 27,300 new homes by 2035.[28] It is expected that over 12.7 million square feet of new retail, commercial and office space will be built to service this population.[29] The majority of Red Deer housing stock is, and is expected to remain, single family homes. The mix of new housing being built to accommodate more population is consistent with the current housing stock.

	2010	2035
Population	90,084	156,696
Homes	38,685	65,988
People per household	2.33	2.38

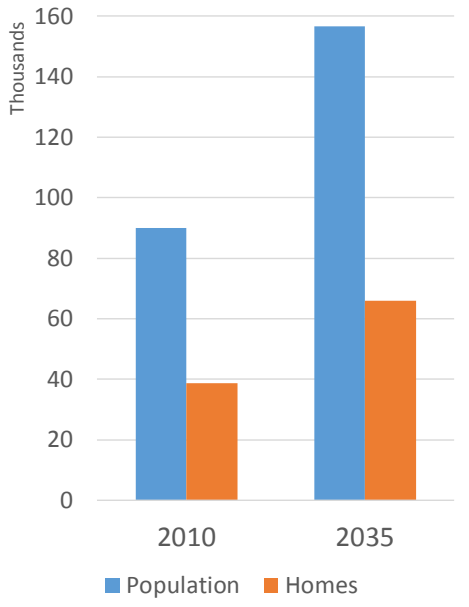


Figure 3. Population and housing baseline and trends.

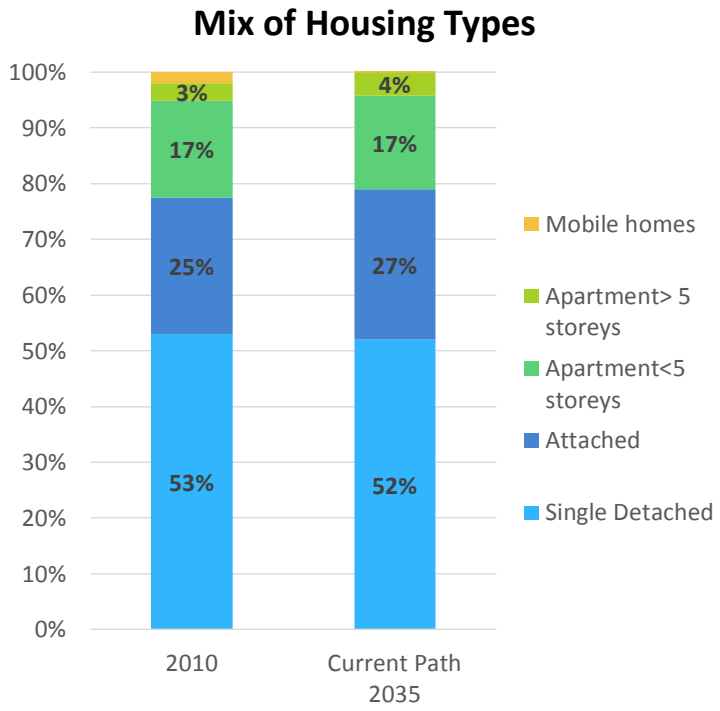


Figure 4. Housing mix baseline and expected mix.

27 2010 data from Red Deer Municipal Census 2010.
28 City of Red Deer Economic Development Strategy (2013), p.29.
29 Commercial floor space growth is assumed to be commensurate with the 2.2% per annum population increase, as per the Economic Development Strategy.

Transportation[30]

Transportation in Red Deer, as in most of Alberta, is overwhelmingly reliant on automobiles. The total distance travelled by all vehicles is expected to nearly double between 2010 and 2035 (Figure 5). Red Deer's Mobility Playbook makes recommendations to shift the mode split from cars to active transportation and transit. Even if all the recommendations in the Playbook were implemented, almost three-quarters of trips are expected to be made by vehicle in 2035 (Figure 6).

	2010	2035
Total	660M km	1,113M km

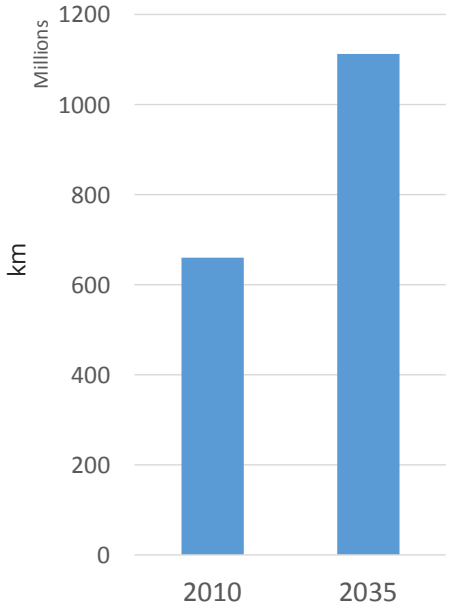


Figure 5. Vehicle kilometres travelled baseline and expected.

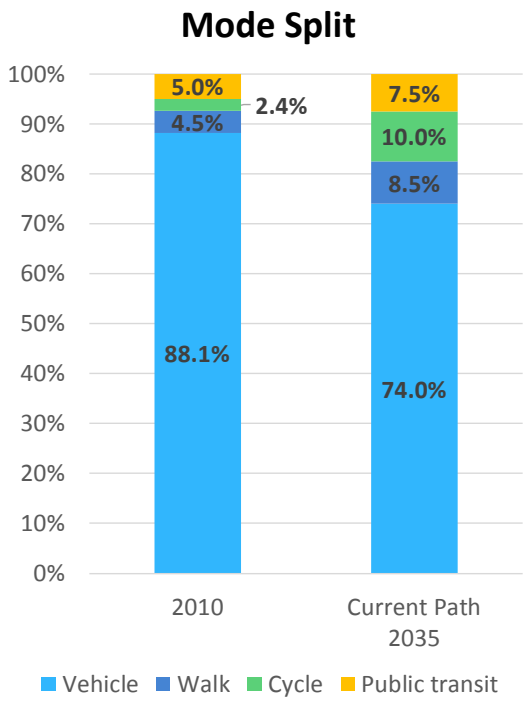


Figure 6. Transportation mode split baseline and 2035 expected split.

Agriculture and Forests

Much of the food we eat is imported— the average meal travels 1200 km from the farm to plate.[31] Transportation of food produces significant emissions.[32]

From GIS data, Red Deer currently has over 226,000 hectares (ha) of nearby farmland. It is estimated that the food eaten by people in Red Deer is 10% procured from local sources, and 90% from distant sources. The average person consumes 580 kg of food annually, which requires 0.524 ha per year on which to grow.[33] This means that, on average, 58 kg of a resident's annual food is sourced locally, using 0.05 ha of local farmland. The rest is imported. Using these values, the food Red Deerians consumed in 2010 is estimated to have generated almost 170,000 tCO2e of emissions. As food consumption grows with population increase, food-related emissions are expected to reach almost 300,000 tCO2e by 2035.

Forests absorb carbon dioxide, acting as a carbon sink. GIS data indicates Red Deer has approximately 1,150 ha of forested and green areas. This area is able to absorb a little over 4,000 tCO2e each year. The forest area is expected to increase by about 20% by 2035, as new trees are planted or grow on their own.

30 Data from Transit and Engineering Departments estimates, Red Deer Mobility Plan and Red Deer Transportation Master Plan. The 2035 mode shift targets in Figure 6 are based on The Mobility Playbook with input from the Transit Department and are viewed as ambitious.

31 David Suzuki Foundation. http://www.davidsuzuki.org/what-you-can-do/food-and-our-planet/food-and-climate-change

32 Foodshare Research in Action (2005). Fighting Global Warming at the Farmer's Market. p.9. http://foodshare.net/custom/uploads/2015/11/Fighting_Global_Warming_at_the_Farmers_Market.pdf

33 BC Ministry of Agriculture and Lands: BC's Food Self Reliance (2006). p.1. http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/strengthening-farming/800-series/820105-1_bcfoodselfreliance_report.pdf

Solid Waste and Wastewater[34]

Greenhouse gas emissions are created when organic materials—like food and yard waste—degrade. When these materials are buried in landfills where access to the air is restricted, they undergo anaerobic decomposition, which creates methane (CH_4)—a greenhouse gas 28 times more potent than carbon dioxide. Methane is able to seep from landfills up into the air. Similarly, wastewater contents degrade and release methane emissions.

In Red Deer, solid waste production in 2010 was 0.84 tonnes per person on average. This is expected to be reduced to 0.8 tonnes per person per year by 2035. The 2010 solid waste diversion rate was 11% and is expected to increase to 21% by 2035. Wastewater is expected to increase in step with population growth, on a per capita basis. The Current Path projections take into account Red Deer's plans to divert organics from the landfill with the Green Cart program, co-generation at the Wastewater Treatment Plant, and methane flaring at the Waste Management Facility.

	2010	2035
Solid Waste	75,924t	125,357t
Per Capita	0.84t	0.80t

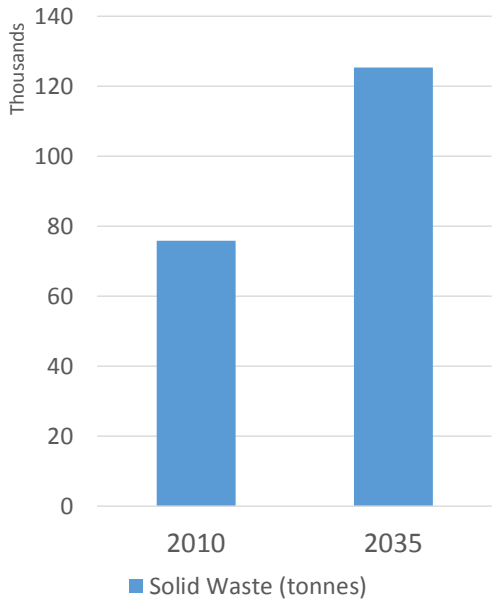


Figure 7. Solid waste production baseline and expected.

	2010	2035
Wastewater	14.2Mm^3	25Mm^3
Per Capita	157m^3	160m^3

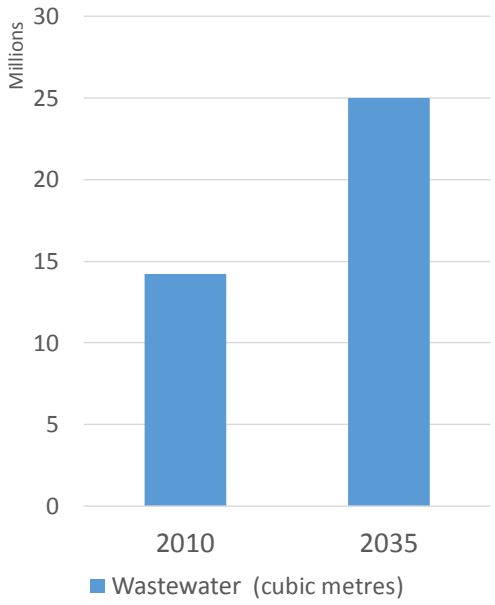


Figure 8. Wastewater treatment volumes, baseline and expected.

Electricity Generation[35]

Alberta currently has 16,261 megawatts (MW) of installed electricity generation capacity. Over half of Alberta's electricity is generated by coal-fired power plants. Almost two-fifths is generated by natural gas. The remaining 10% of electricity is generated by renewable sources and others (e.g. waste heat, fuel oil) (Table 2). Alberta, and Red Deer, are very reliant on fossil fuel-based electricity sources.

Table 2. Provincial electricity generation amounts by source.

Generation	Gigawatt Hour (GWh)	Generation Share By Fuel
Coal	41,378	51%
Natural Gas	32,215	39%
Hydro	1,745	2%
Wind	3,816	5%
Biomass	2,149	3%
Others (solar, waste heat, fuel oil)	318	0%
Total	**81,621**	**100%**

34 Red Deer Waste Management Master Plan and Environmental Services Department, p.78.
35 Government of Alberta Energy: http://www.energy.alberta.ca/Electricity/682.asp

Residential Energy Use[36]

Home energy use is one of the primary emissions sources in Red Deer. The vast majority of home energy is used for heating, which is typically supplied by natural gas in Alberta.[37] However, the proportion of electricity used in homes is predicted to grow, as we increase the number of electrical devices we use every day, as well as electric vehicles. Figure 9 shows the total residential energy use by source for homes in Alberta.

Currently, increasing electricity use will result in increased emissions due to Alberta's primarily coal-fired electricity sources. Though the current provincial government has initiated changes on this front, there is still opportunity for procurement of less carbon intensive electricity for the community—including natural gas-fired electricity production and renewable energy—more fully and on more assertive timelines. The use of wood stoves is expected to increase slightly.

Commercial Energy Use[38]

The majority of commercial energy use is derived from natural gas, but as with residential energy use the proportion of electricity used by businesses and industry is expected to increase. Propane (included in 'other') increases as well.

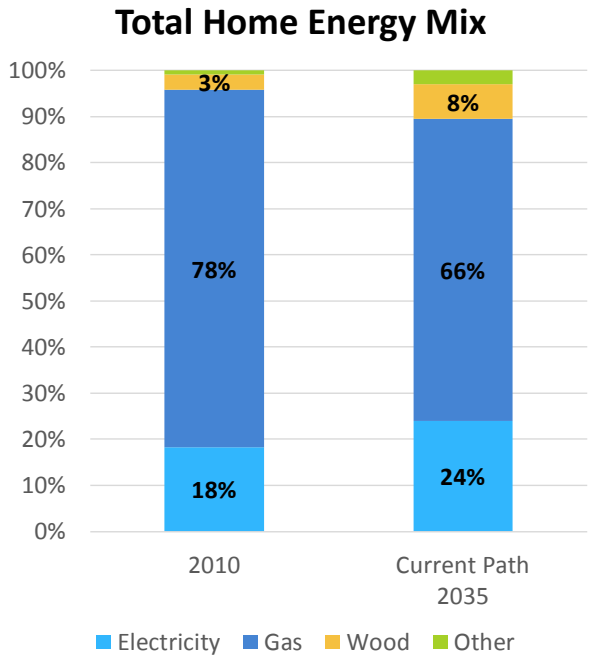


Figure 9. Residential energy use baseline and trends.

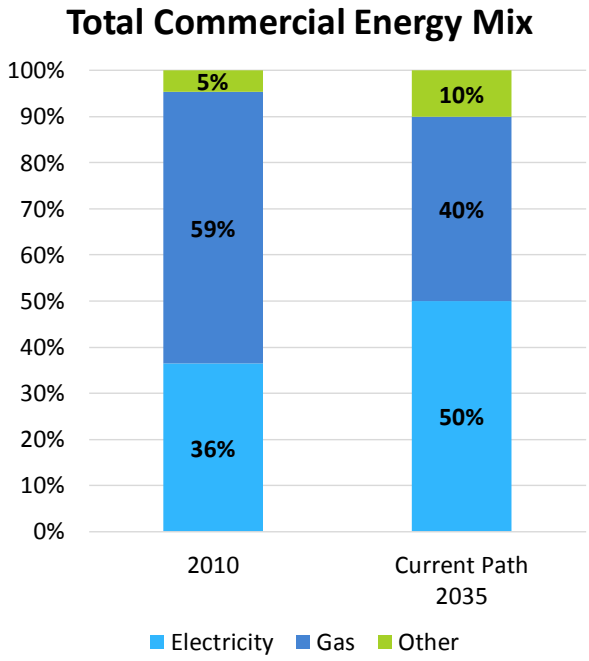


Figure 10. Commercial energy use baseline and trends.

36 NRCAN Office of Energy Efficiency data for Alberta: http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=ab&rn=1&page=0
37 Statistics Canada indicates that 91% of home heating in Alberta is supplied by natural gas. http://www.statcan.gc.ca/pub/11-526-s/2013002/t002-eng.htm
38 NRCAN Office of Energy Efficiency data for Alberta: http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=ab&rn=1&page=0

2010 Baseline Energy and Emissions

The context described for the 2010 population, housing mix, transportation mode split, solid waste tonnage, wastewater volume, and energy generation and use establishes the baseline energy and emissions for the 2010 baseline year. In 2010: 11,960,000 gigajoules of energy was used (Figure 11) and 1,683,000 tonnes of emissions were produced (Figure 12).

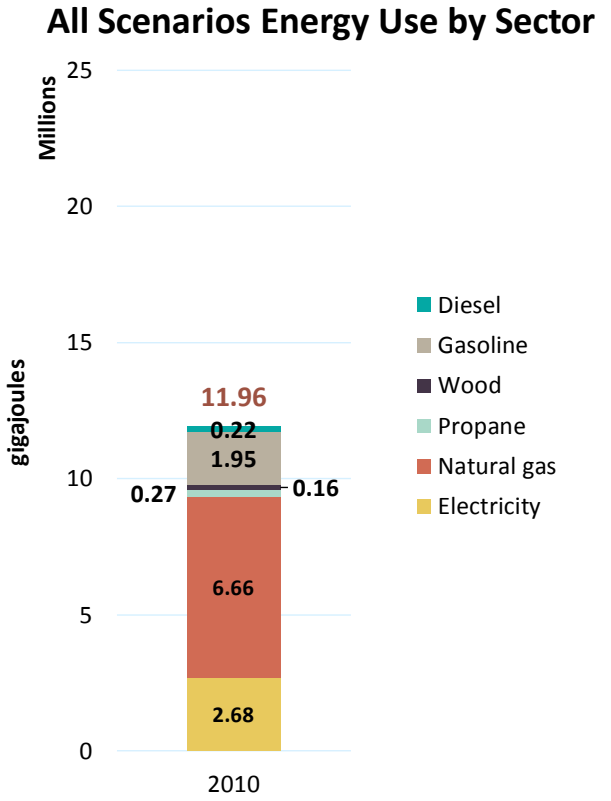


Figure 11. Baseline year energy use by sector.

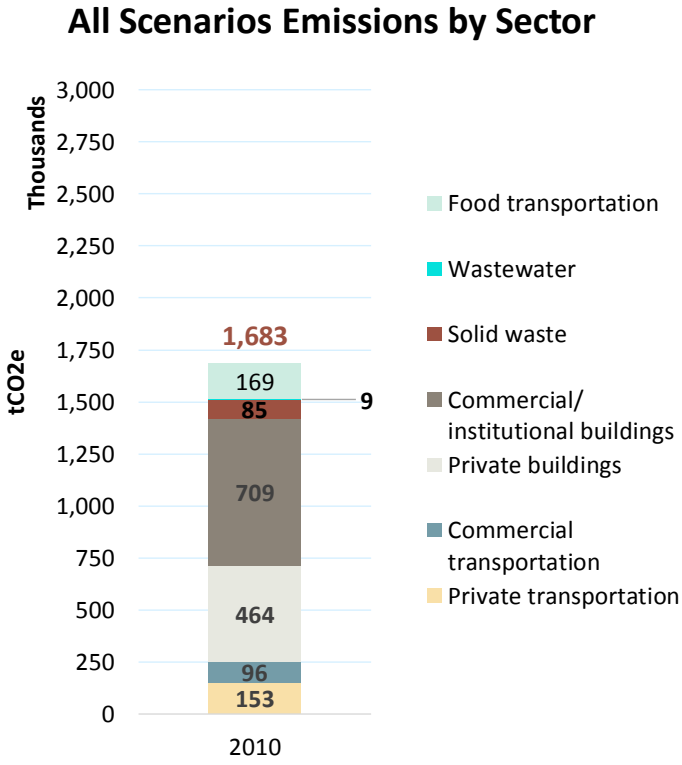


Figure 12. Baseline year emissions by source.

2.2 Current Energy and Emissions Path

The trends projecting from the baseline data form Red Deer's Current Path energy and emissions scenario. Table 3 summarizes the key features of the this scenario. This scenario will occur if The City's currently adopted plans pertaining to land use, development, transportation mode choices, waste reduction and diversion are implemented, and if expected energy efficiency measures and energy production changes occur, including the phase out of coal-fired electricity initiated by the provincial government.[39]

Table 3. Current Path scenario assumptions and outcomes.

	Current Path
Total personal vehicle use	12% reduction from 2010 levels
Coal-fired electricity reliance	30% reduced reliance on coal-fired electricity from 2010 levels
Natural gas-fired electricity use	Unchanged
Solid waste diversion	10% increase from 2010 levels
Wastewater production	No change in per capita volume
New buildings energy efficiency (all building types)	No changes beyond current building code
Existing buildings energy efficiency (all building types)	No changes to existing building stock
Primary new residential development type	Majority of new housing is suburban greenfield, single family homes
Consumption of local food (<100 miles)	No change (10% of food is from local sources)
Forested area (carbon sink)	20% increase from 2010 levels
Resulting total energy use	81% increase from 2010 levels
Resulting greenhouse gas emissions	67% increase from 2010 levels

Figure 13 shows the projection of Red Deer's total energy consumption. In 2010, Red Deer's total community energy use was 11.96 million gigajoules. It is expected that the total energy consumed in 2035 will be 21.62 million gigajoules—an 81% increase.[40] Although energy use increases with increased population, the projected energy used in 2035 cannot be attributed solely to population growth. This is an indication that the city will grow less efficient and use more energy on its Current Path.

Total emissions projections are displayed in Figure 14. Total community emissions are expected to increase from 1,683 Megatonnes CO2e (MtCO2e) in 2010 to 2,808 MtCO2e by 2035—an increase of 1,125 MtCO2e (+67%).[41]

As the largest energy consumers, buildings are responsible for the majority of Red Deer's emissions. This is mostly due to the use of natural gas for heating, and electricity produced by natural gas and coal-fired power plants. Vehicle use is the second largest emissions producer. Buildings and vehicle-associated emissions grow as Red Deer's population grows, building more homes and putting more cars on the road. Emissions from solid waste stay roughly constant, balancing between increasing with population and decreasing from improved diversion. Food related emissions increase in proportion to increasing population, with the assumption that the rate of local food (<100 miles) consumption remains constant at 10%. There is some increased carbon absorption from a 20% increase in forest area. Red Deer's wastewater system uses a modern tertiary wastewater treatment process that can flare methane or capture it for use in its boilers instead of expelling it into the atmosphere, which can greatly reduce wastewater emissions. Wastewater volumes—and thus its emissions—are tied to population.

39 A 30% reduction is assumed here as a conservative estimate of coal phase-out.

40 As modelled by Sustainability Solutions Group's GHGProof energy, emissions and land-use model.

41 Tonnes of carbon dioxide (tCO2e) is a measure used to express various greenhouse gas emissions as a common metric. Tonnes carbon dioxide equivalent volumes include carbon dioxide, methane, sulphur dioxide and nitrous oxide greenhouse gases. 1 Megatonne = 1 million tonnes.

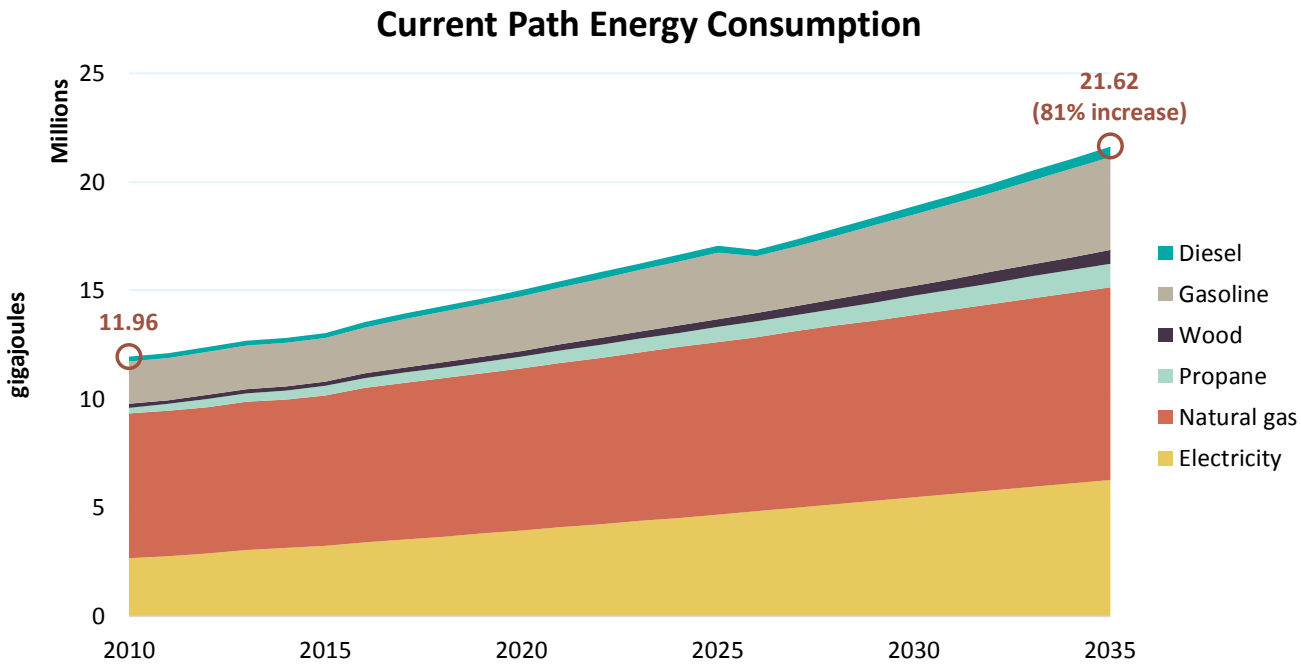


Figure 13. Projected total energy consumption from 2010 to 2035.

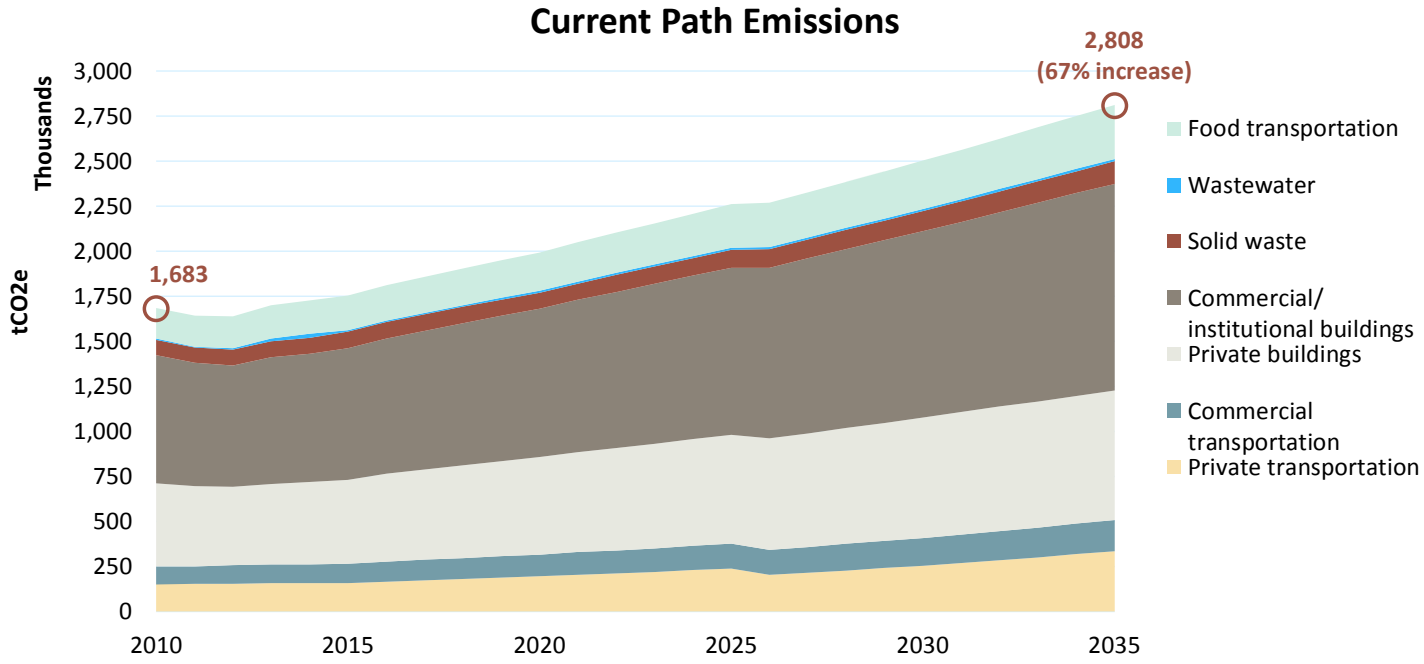


Figure 14. Red Deer's Current Path community emissions.

The slight dip in the graphs starting in 2025 represents the decrease of gasoline use as planned federal vehicle fuel efficiency standards come into effect. Gasoline use continues to increase after this as more cars are expected to be on the roads due to increased population.

Red Deer's Current Path outlook is similar to many cities across Canada. The result of land-use decisions favouring personal vehicles and fossil fuel based energy production, these cities face a common challenge in reducing their emissions and energy use while maintaining or improving quality of life for residents. Some examples of cities' emissions reductions targets with populations and/or geographies similar to Red Deer are found in Table 4 and displayed in Figure 15.[42]

Table 4. Sample municipal emissions reduction targets.[43, 44, 45, 46, 47, 48, 49, 50]

Municipality	Base year	Base year emissions (tCO2e)	Target year	Reduction target
Red Deer	2010	1,670,000	2035	TBD
Kamloops, BC	2007	615,587	2020	-40%
Thunder Bay, ON	2005	1,436,726	2017	-10%
Kelowna, BC	2007	794,539	2020	-33%
St. Albert, AB	2008	711,303	2020	-6%
Grand Prairie, AB	2015	1,703,651	TBD	TBD
Edmonton, AB	2005	16,058,597	2035	-35%
Calgary, AB	1990 2005	~12,000,000 ~15,800,000	2036 2050	-50% -80%

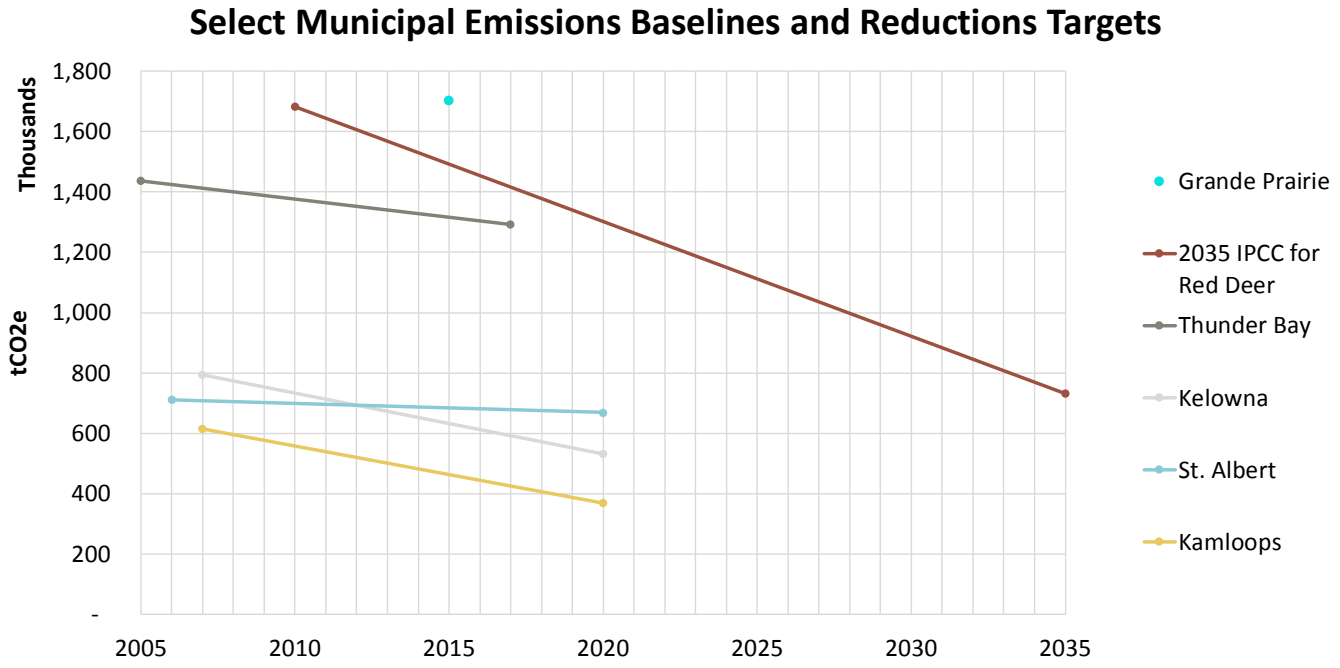


Figure 15. Comparison of several cities' base year emissions levels and target emissions reductions.

42 The target emissions volume indicated here is calculated from the Intergovernmental Panel on Climate Change (IPCC) recommendation of emissions decreases of 33% below 1990 levels by 2020 and 80% below 1990 levels by 2050.

43 City of Kamloops Information Package on Greenhous Gas Emissions (2010). p.8. http://www.kamloops.ca/sustainable/pdfs/SKP-GreenhouseGasEmissionsBackground.pdf

44 Thunder Bay 2011 Greenhouse Gas Emissions Report (2013). p.8. https://www.fcm.ca/Documents/reports/PCP/2015/Thunder_Bay_2011_Greenhouse_Gas_Inventory_Report_EN.pdf

45 City of Kelowna Community Climate Action Plan (2012). p.4. https://www.kelowna.ca/sites/files/1/docs/2012-06-12_climate_action_plan_final_public_version_reduced.pdf

46 City of St. Albert GHG Inventory Forecast and Targets Project (2010), p.1. https://stalbert.ca/city/environment/air-energy/greenhouse-gas-emissions/

47 Region of Waterloo website: http://www.regionofwaterloo.ca/en/aboutTheEnvironment/climatechange.asp

48 City of Grande Prairie Community Growth Committee Agenda, January 10, 2017, p.20: http://agendas.cityofgp.com/cache/2/mdunlb1xgl0xuaounmedumcc/19790221201704010418 2.pdf

49 Edmonton's Community Energy Transition Strategy (2015), p.1. https://www.edmonton.ca/city_government/documents/EnergyTransitionStrategy.pdf

50 Calgary Community GHG Reduction Plan (2011), p.3. http://ghgtoolkit.mccac.ca/wp-content/uploads/2011/08/Calgary_GHG_Plan_Nov_2011.pdf

2.3 Options for the Future

Emissions reduction targets were explored at four engagement workshops. Three emissions reduction benchmarks were discussed: Edmonton's, Calgary's and the Intergovernmental Panel on Climate Change's (33% reduction below 1990 levels by 2020 and 80% reduction below 1990 levels by 2050). Figure 16 shows these targets scaled to Red Deer emissions levels.

The engagement workshops hosted discussion on how Red Deer might achieve similar targets, with an exercise adding up the emissions reductions from sample actions to visualize the potential magnitude of effort required. The most popular emissions reduction strategies were renewable energy and energy efficiency related. The average emissions reductions achieved by workshop groups were 1.00 Mt by City staff, and 1.25 Mt by community members (average 1.125 Mt). There was agreement that the effort required to meet the sample targets are daunting. No one was of the opinion that no progress could or should be made towards reducing Red Deer's community emissions, although there was a common opinion that many Red Deer residents would be resistant to changes in transportation and land uses (e.g. housing density).

From the workshop discussions, two sample emissions reduction targets were chosen for further assessment (Figure 16). One was similar to the Edmonton, Calgary and IPCC benchmarks. Deemed the 'Ambitious Effort', this scenario set a target of 50% emissions reductions below 2010 levels by 2035 (to 0.853 MtCO2e). The second scenario considered an emissions reduction target sufficiently different from that of the Ambitious Effort. The primary difference between the two scenarios is the assumed extent of phasing out fossil fuel-fired electricity generation by 2035. This 'Moderate Effort' scenario set a target to restrict emissions growth to 10% above 2010 levels by 2035 (1.859 MtCO2e).

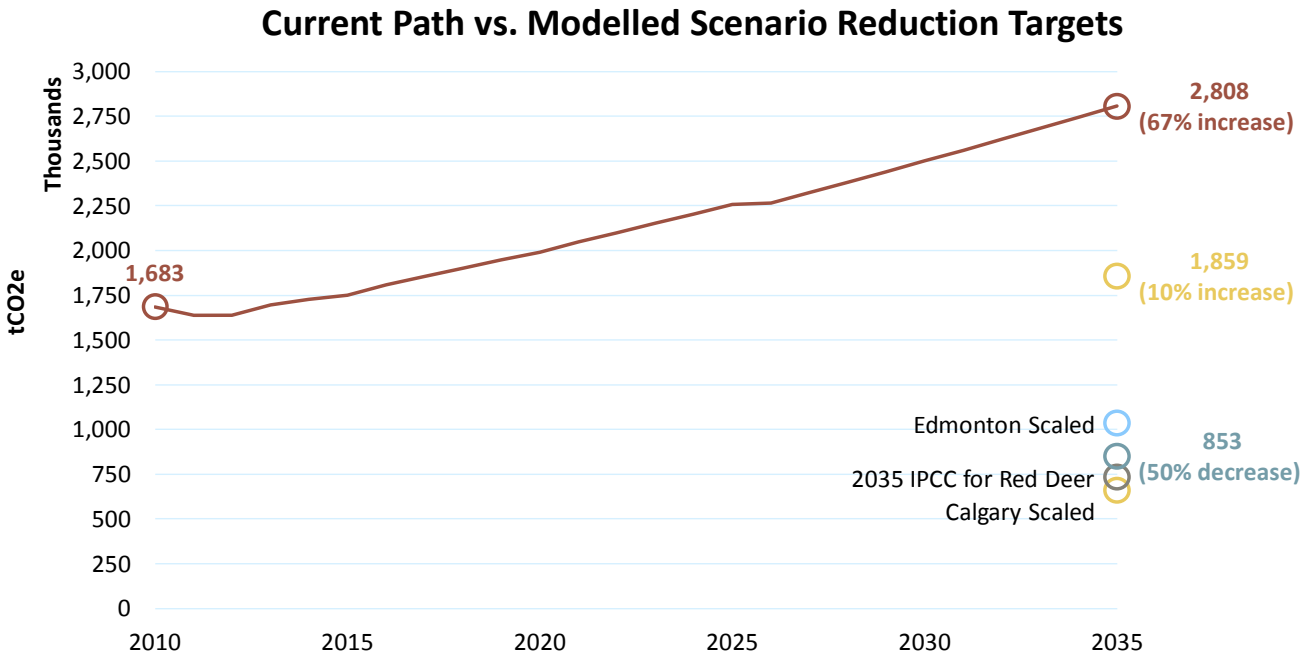


Figure 16. Moderate and Ambitious Effort scenario emissions reduction targets.

2.4 Scenario Analysis

To accurately assess the scope of the emissions reduction challenge, and to explore possible policy and action co-benefits and other effects, the Moderate and Ambitious Effort emissions reductions target scenarios were created and modelled using GHGProof, Sustainability Solution Group's open source land-use, energy and emissions model. GHGProof, uses the following inputs to create a baseline energy and emissions inventory:

Table 5. GHGProof modelling inputs.

Buildings	Transportation	Energy Supply	Land-use	Solid Waste
Building type mix and size	Vehicle registration: type and number	Utility data	Location of homes	Tonnage
Building code	Fuel efficiency	Energy generation types	Location of destinations	Diversion rates
Energy use and usage mix	Active transportation information	Carbon content of fuels	Land-use mix	Landfill methane production
Energy efficiency retrofit types and rates	Vehicle kilometres travelled		Density	
	Network connectivity		Demographics	
	Transit data			

Using educated assumptions about future trends for these inputs, GHGProof models the probable outcomes for a target year (e.g. 2035) for energy use, emissions production, and high-level finances.

Scenario Modelling Assumptions

Table 6 lists the assumptions modelled and the energy and emissions results by scenario.

Table 6. Scenario assumptions and results.

	2010 Baseline	Current Path 2035	Moderate Effort Scenario 2035	Ambitious Effort Scenario 2035
Percentage of trips made by car	88%	74%	68.5%	58%
Coal-fired electricity phase out	—	30% decrease from 2010 levels	55% decrease from 2010 levels	90% decrease from 2010 levels
Percentage of total home energy use supplied by electricity	18%	24%	26%	82%
Percentage of total commercial building energy use supplied by electricity	36%	50%	70%	75%
Percentage of total home energy use supplied by natural gas	78%	66%	66%	10%
Percentage of total commercial building energy use supplied by natural gas	59%	40%	25%	20%
Tonnes per capita of solid waste produced	0.84	0.8	0.67	0.65
Percentage of solid waste diverted from landfill	11%	21%	30%	35%
New buildings (all types) energy efficiency	—	None assumed	25% less energy use than buildings built in 2010	35% less energy use than buildings built in 2010
Existing buildings (all types) energy efficiency	—	None assumed	2% of building stock is retrofitted each year to use 25% less energy	5% of building stock is retrofitted each year to use 35% less energy
Primary new residential development type	Majority of housing is suburban greenfield, single family homes	Majority of new housing is suburban greenfield, single family homes	Total housing count has 10% fewer single family homes	Total housing count has 20% fewer single family homes
Consumption of local food (<100 miles)	10% of food is from local sources	10% of food is from local sources	20% of food is from local sources	40% of food is from local sources
Forested/green area (carbon sink)	1,150 ha	20% increase from 2010 levels	20% increase from 2010 levels	30% increase from 2010 levels
Resulting total energy use	—	81% increase from 2010 levels	32% increase from 2010 levels	11% increase from 2010 levels
Resulting greenhouse gas emissions	—	67% increase from 2010 levels	10% increase from 2010 levels	50% decrease from 2010 levels

The following figures visualize the differences between the modelled assumptions between the scenarios.

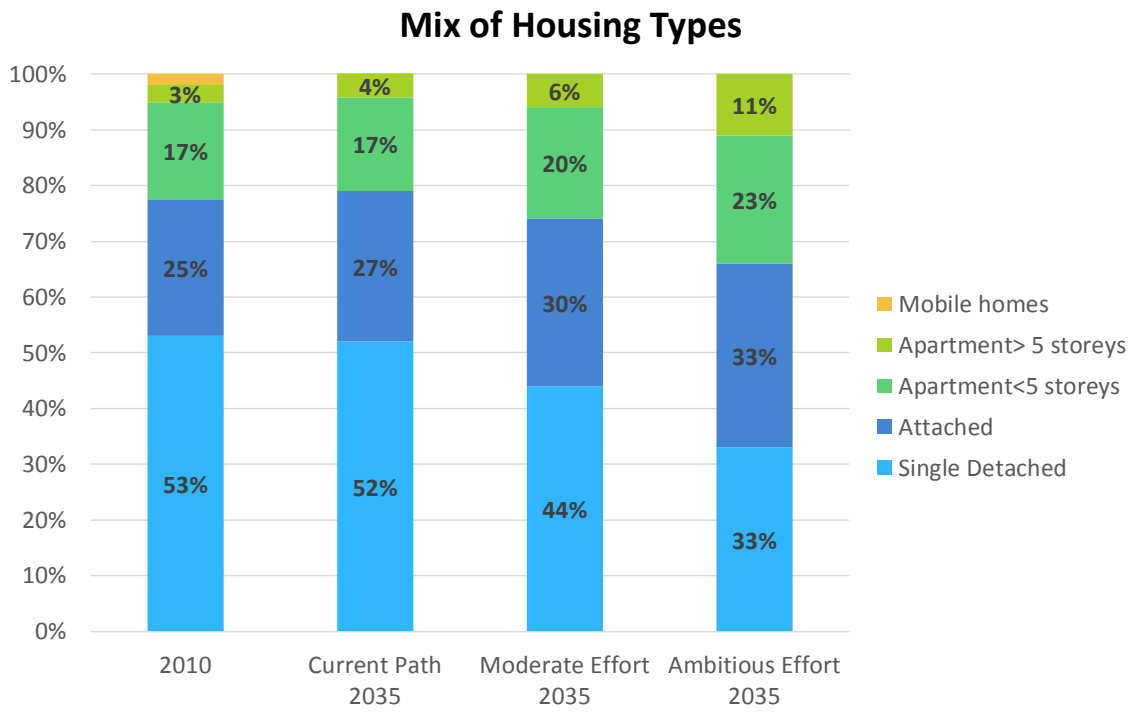
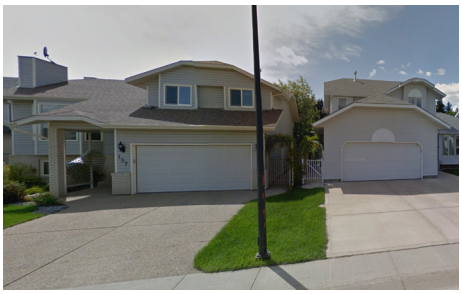


Figure 17. Scenarios comparison of housing mix.

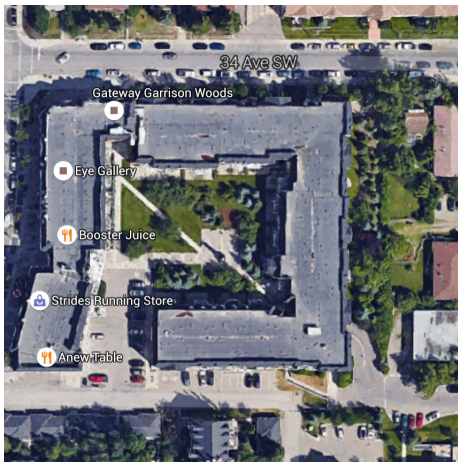


Location Clearview Meadows
Units/ha 16
Development Type:
Single family detached. Front/back yards and attached/detached garages.

Location Clearview Ridge
Units/ha **20-27**
Development Type:
Single family detached. Front/back yards and attached garages.

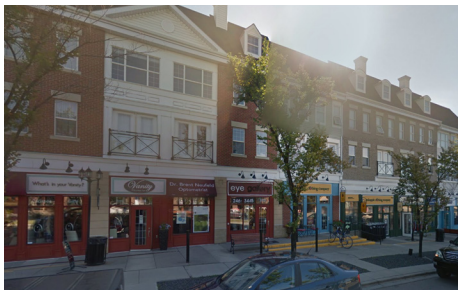
Figure 18. Sample single family housing densities in Red Deer.

For the **Current Path**, these styles of development will be predominant.



Location Oliver Village, Edmonton
Units/ha 225
Development Type:
7-storey multi-family apartments, underground parking.

Location McKenzie Towne, Calgary
Units/ha 25-40
Development Type:
2-4-storey multi-family apartments, at-grade parking.



Location Garrison Woods, Calgary
Units/ha 25-40
Development Type:
4-storey multi-family apartments, mixed-use buildings, underground parking.

Figure 19. Sample multi-family housing densities in Calgary and Edmonton.

Moderate Scenario: the total building stock has 10% more of these styles of housing than the Current Scenario.

Ambitious scenario: the total building stock has 20% more of these styles of housing than the Current Scenario.

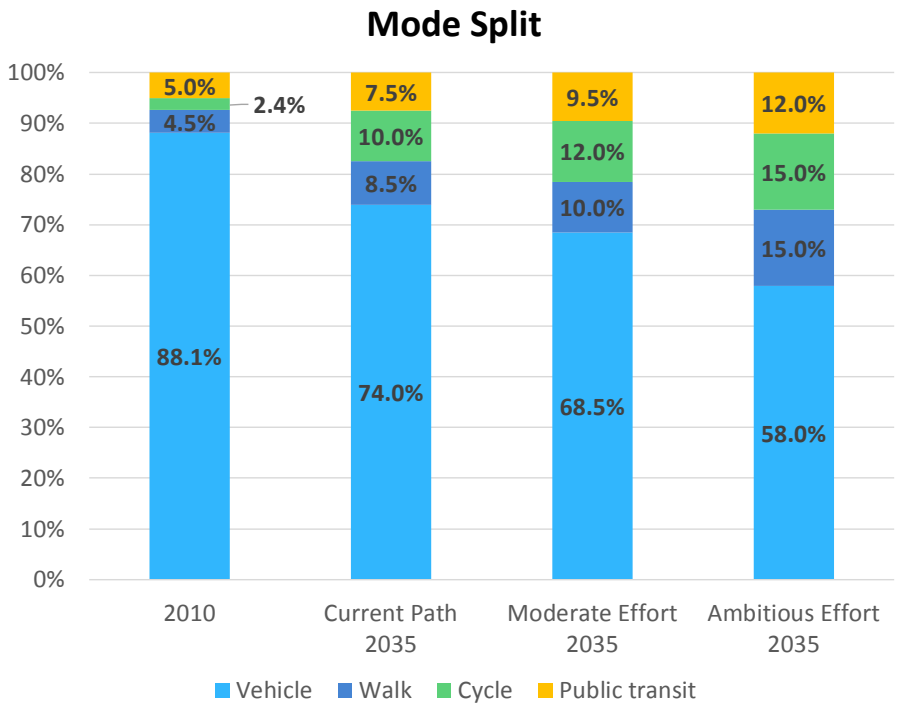


Figure 20. Current, future and possible transportation mode splits.

As the emissions and energy use reduction efforts grow more ambitious, trips are increasingly made via active transportation (biking, walking, etc.) and public transit. The scenarios assume an increase in transit frequency to meet the modelled demand.

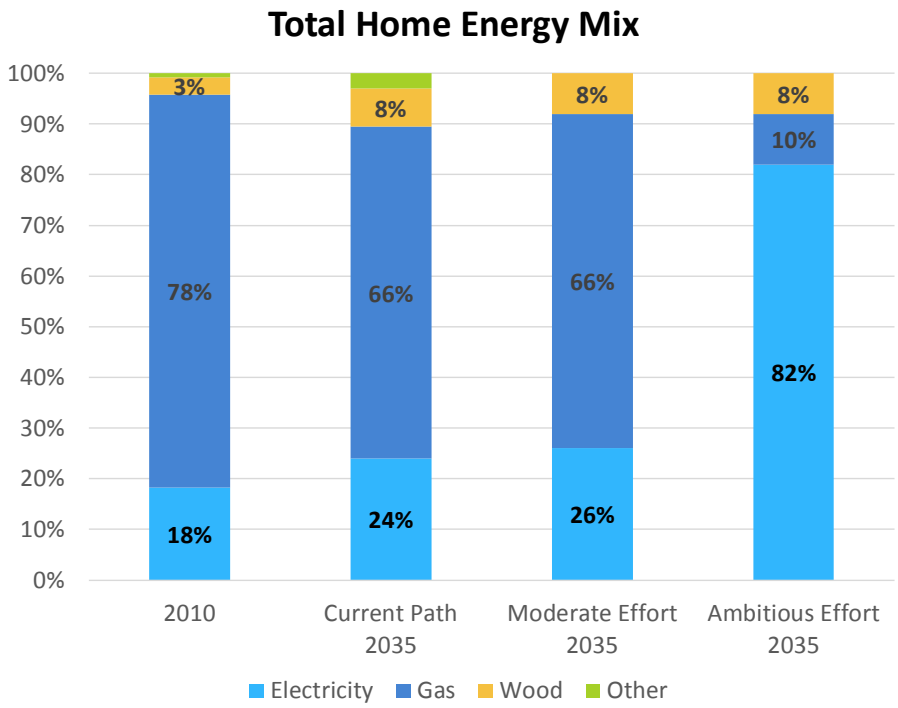


Figure 21. Residential energy mix scenario assumptions.

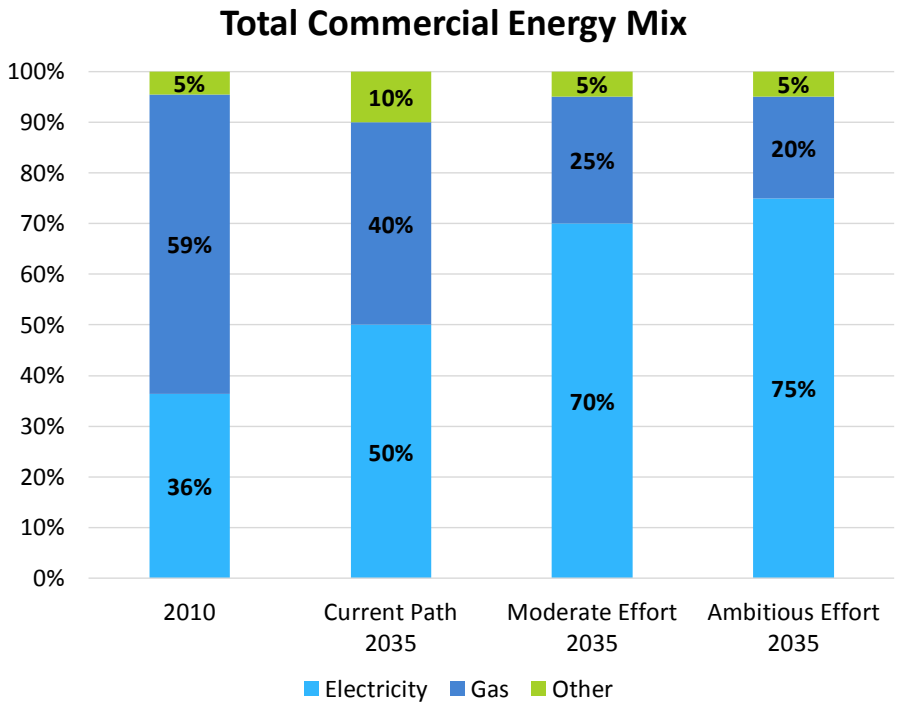


Figure 22. Commercial energy mix scenario assumptions.

The more ambitious the emissions reduction and energy efficiency efforts, the less dependence on natural gas use and electricity generation from fossil fuels (coal and natural gas) and the more reliance on renewable energy generation (which is assumed in the electricity use).

Modelled Energy and Emissions Projections

Modelling of these assumptions yields the following expected energy and emissions outcomes for the scenarios.

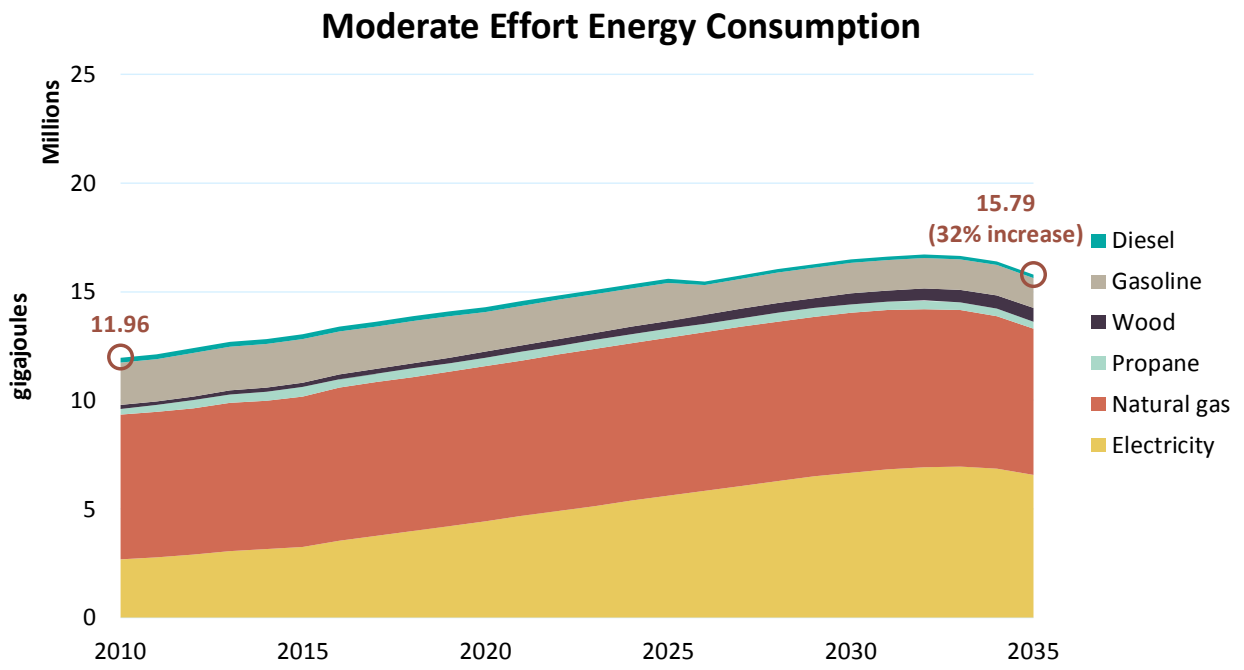


Figure 23. Expected energy use outcomes for the Moderate Effort Scenario.

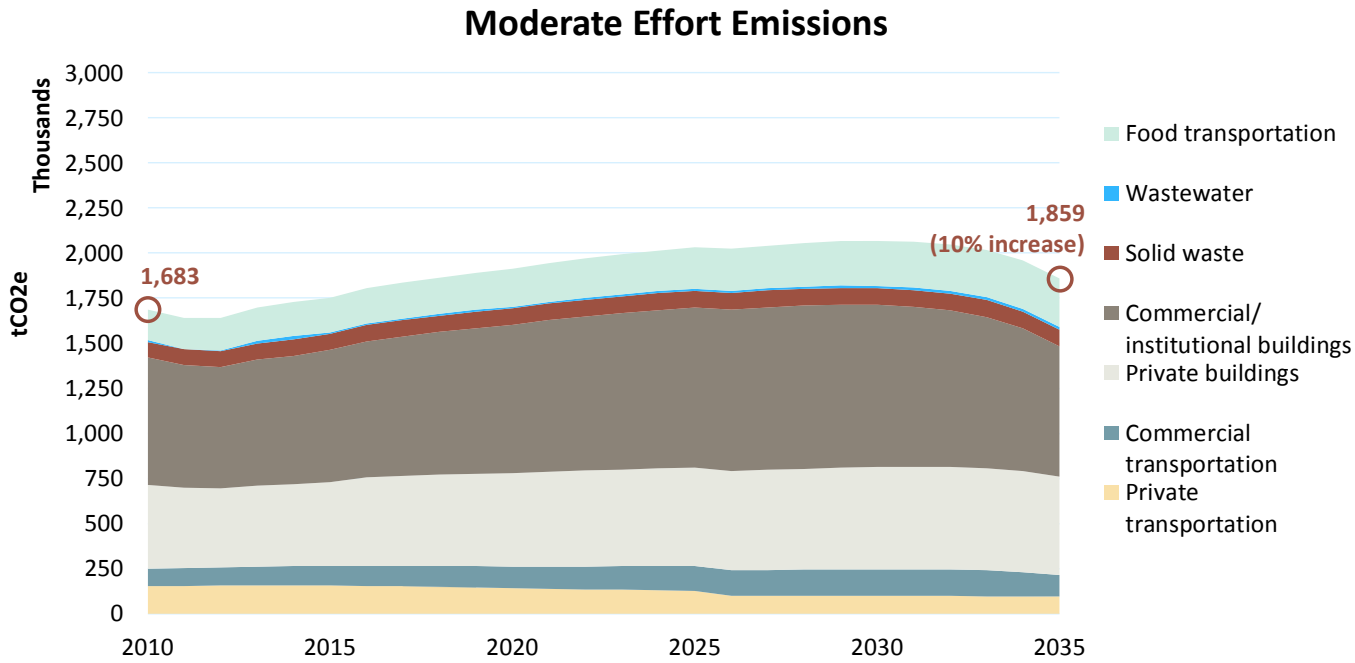


Figure 24. Expected emissions outcomes for the Moderate Effort Scenario.

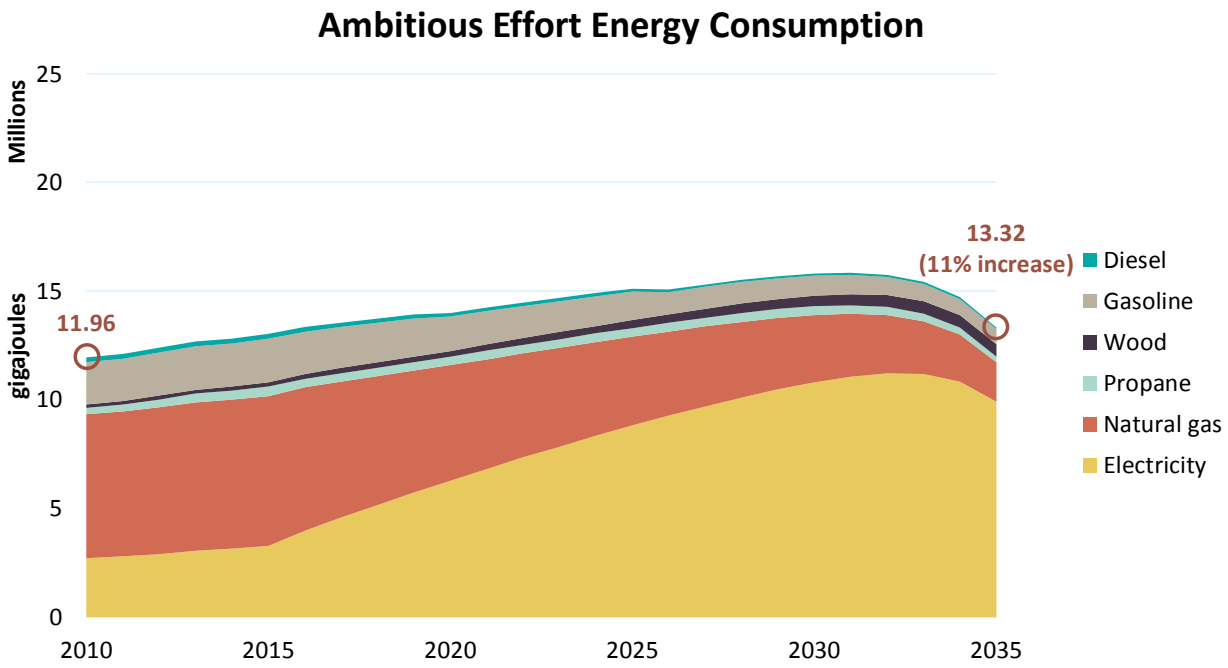


Figure 25. Expected energy use outcomes for the Ambitious Effort Scenario.

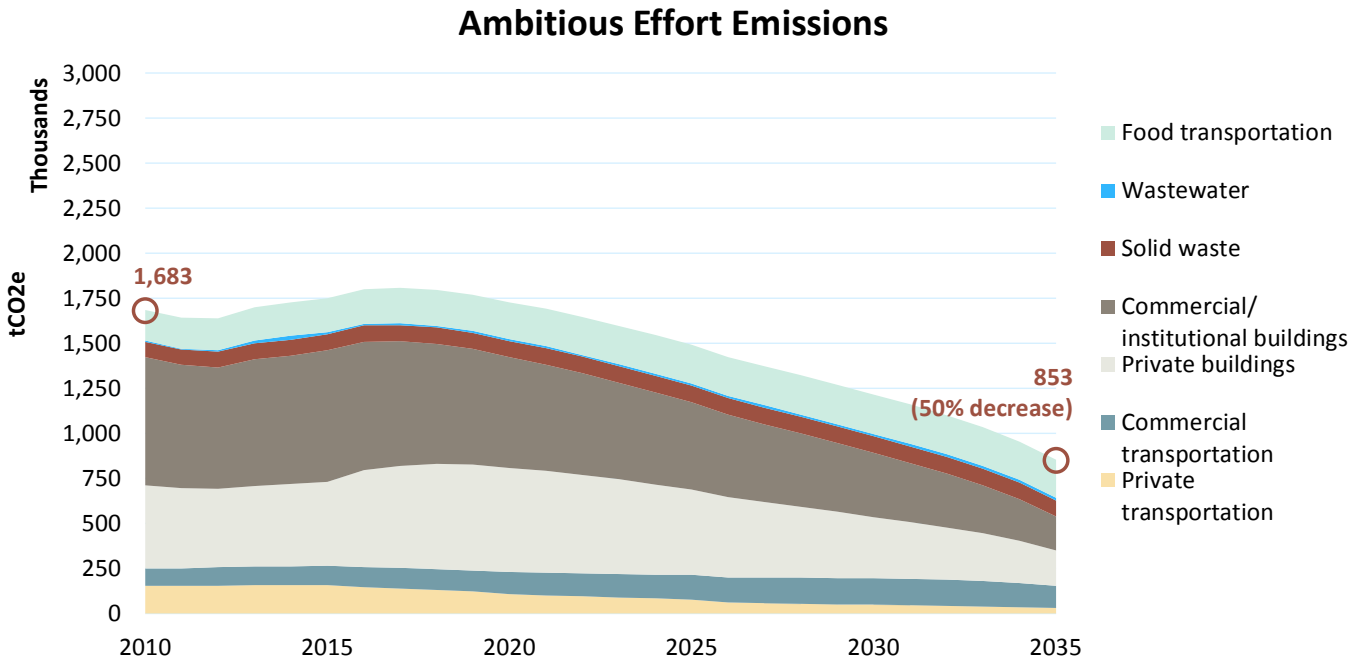


Figure 26. Expected emissions outcomes for the Ambitious Effort Scenario.

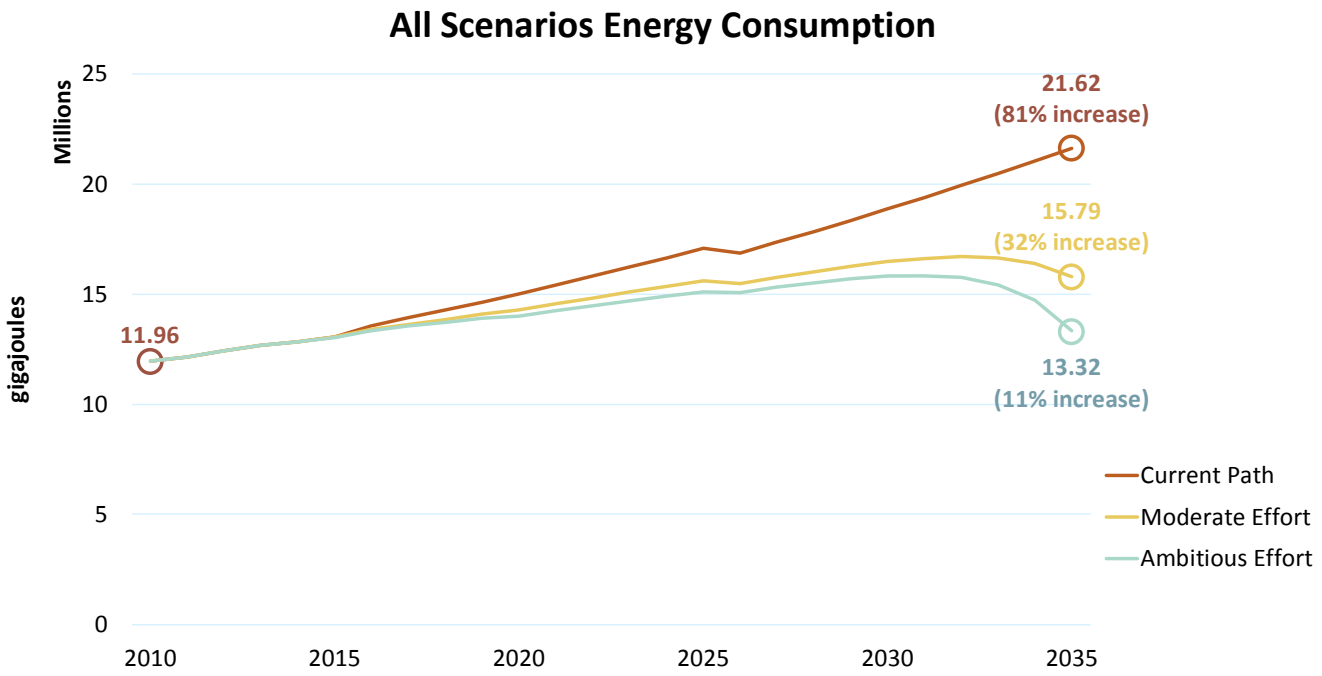


Figure 27. Expected energy use outcomes for tall Scenarios.

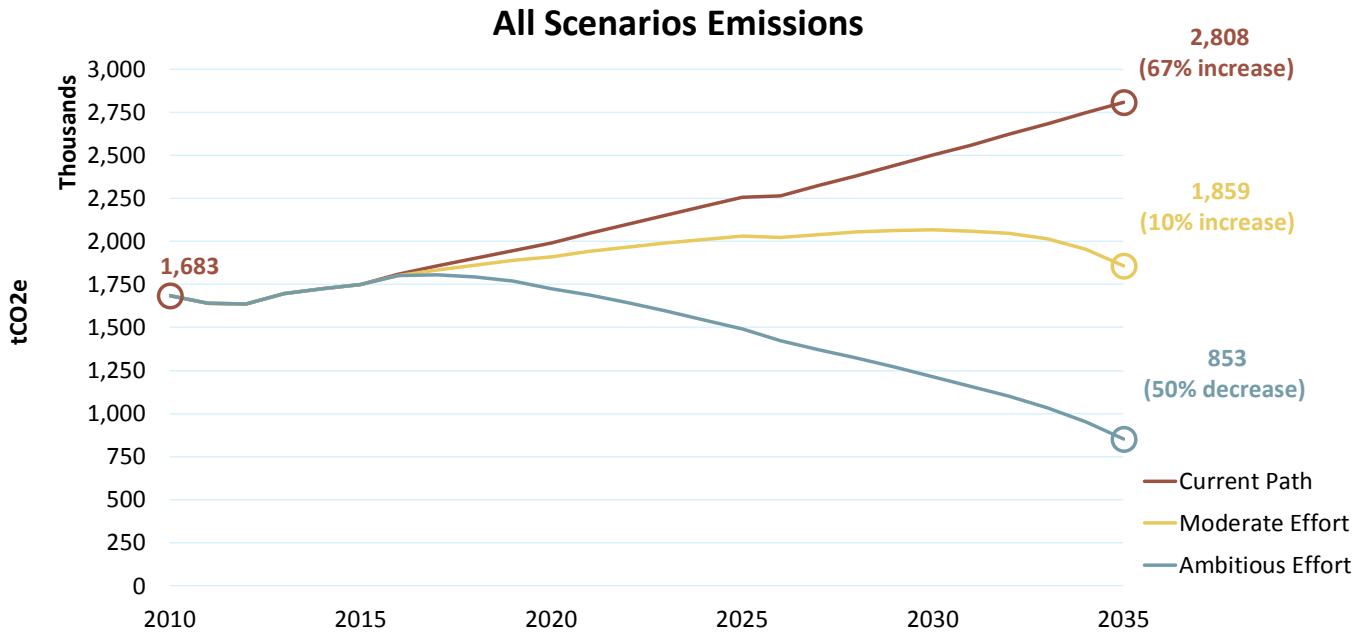


Figure 28. Expected emissions outcomes for tall Scenarios.

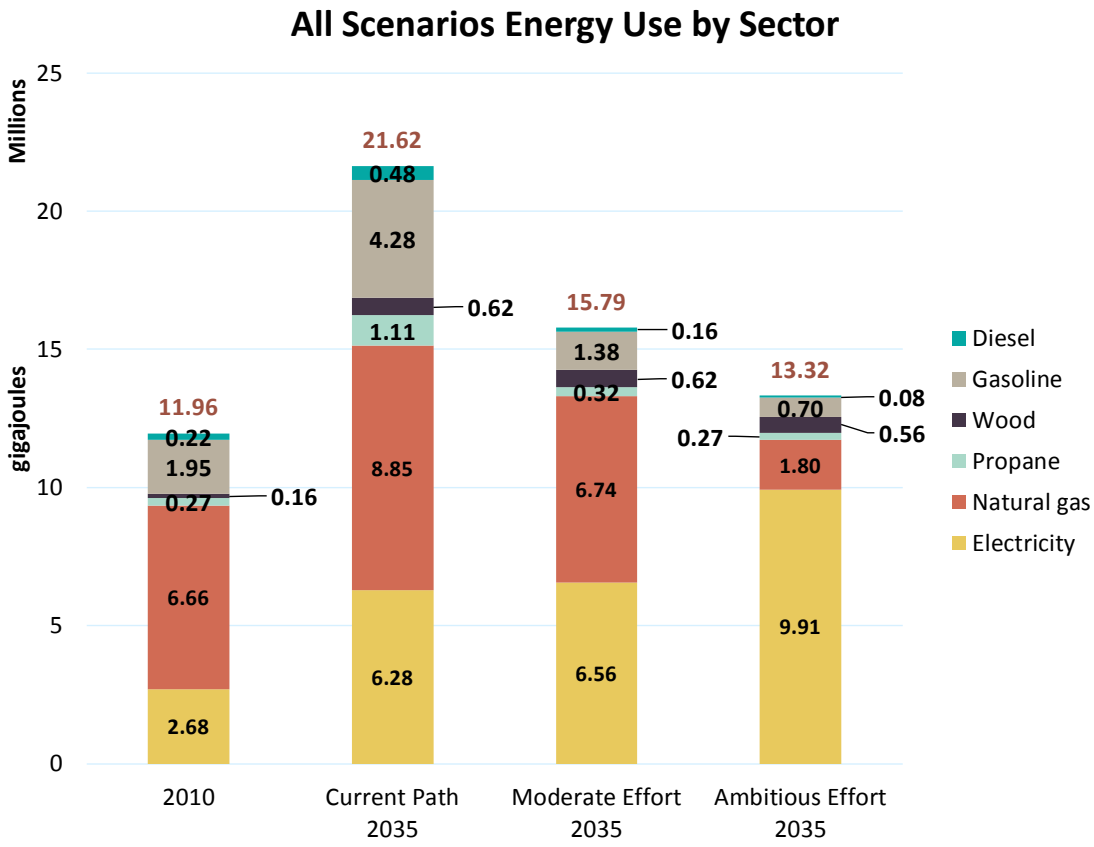


Figure 29. Comparison of sectoral energy use across the baseline and all scenarios.

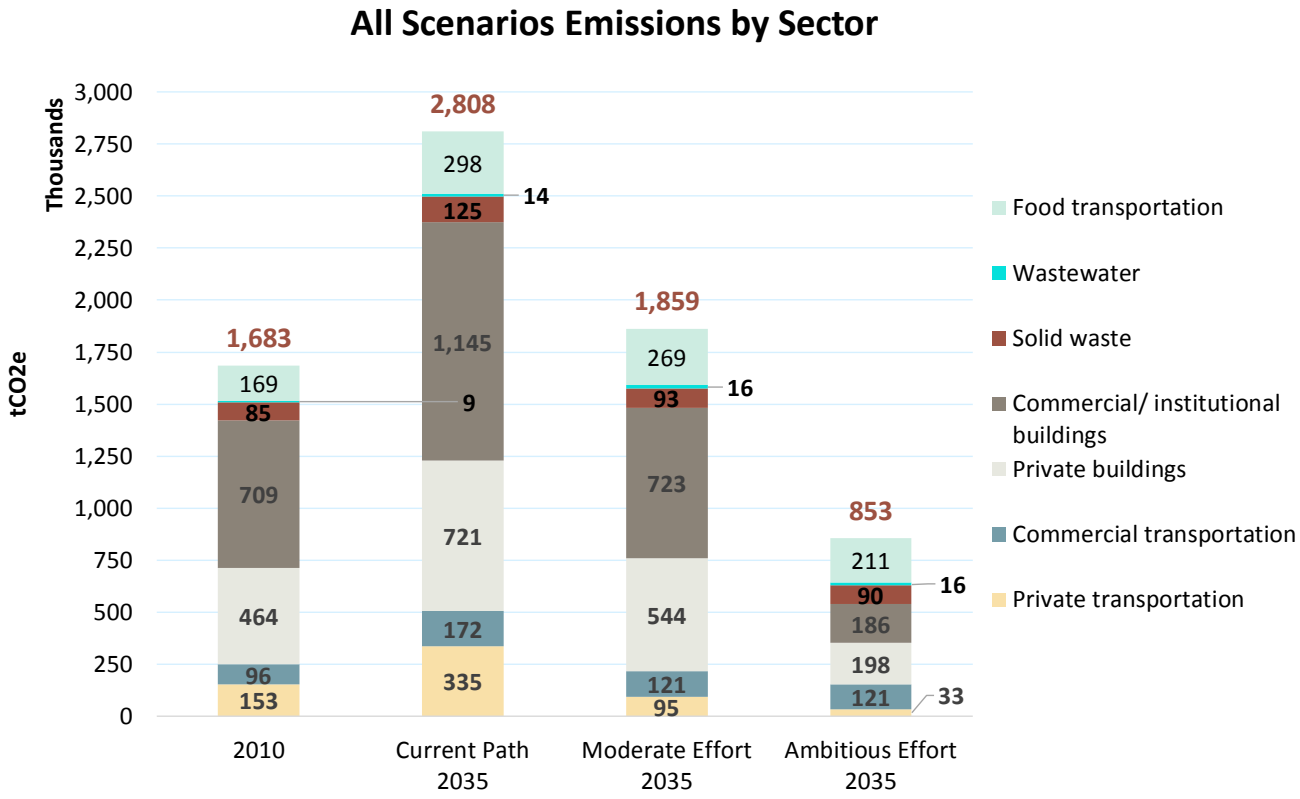


Figure 30. Comparison of sectoral emissions across the baseline and all scenarios.

As the population of Red Deer grows, the most prominent increase in emissions under the Current Path Scenario is in building energy use (commercial and residential, electricity and heating). Even though some coal-fired electricity generation is phased out, most of the building energy is still being supplied by natural gas (for electricity and heating). Transportation emissions also more than double: despite personal vehicle use decreasing, there are more cars on the road. Similarly, solid waste emissions increase with population, even though greater waste diversion (recycling, composting) efforts are realized. Greater food consumption, and thus food transportation related emissions, increase along with the population.

The Moderate Effort Scenario sees a curtailment of emissions from building energy, mostly due to decreased coal-fired electricity consumption and some increased building energy efficiency. Greater mode shift from vehicles to other modes of transportation decreases the transportation emissions slightly. Greater waste diversion successes curtail some solid waste emissions. An increased emphasis on consumption of local food products curtails some of the food transportation related emissions.

The Ambitious Effort Scenario sees reductions across most sectors, the greatest in building emissions. The majority of the buildings' emissions decrease is due to greatly phasing out coal-fired electricity generation and reducing natural gas use, shifting to renewable electricity. There are also emissions decreases due to greater building energy efficiency for both new (efficiency requirements) and existing buildings (retrofits). Greater housing density also contributes, with some smaller homes, the sharing of walls, and energy efficient buildings reducing energy consumption. A decrease in vehicle travel, accompanied by an increase in active transportation and public transit, decreases the transportation sector's emissions substantially. Part of the decrease in transportation emissions is attributable to a greater prevalence of complete, compact communities where live, work, play and retail uses are mixed. Even greater solid waste diversion (which could be lowered consumption plus increased recycling and composting) curtails the waste related emissions. Strong support for local food production and its consumption reduce the food transportation emissions substantially.

Scenario Economics

High Level Costs, Savings and Employment Analysis - Moderate Effort Scenario

To provide information on the economic ramifications of the policies and actions modelled in the two scenarios, GHGProof was used to model (at a high level) costs, savings and employment figures.

Figure 31 shows the costs of achieving the Moderate Effort Scenario's 2035 emissions target. Over the time span, investments and expenditures are made in areas like renewable energy, home and commercial building energy efficiency retrofits, waste diversion, local food production, etc. For each investment made, there is a return realized through energy efficiency. The investments and expenditures assumed here are not attributed to any one entity; the costs can be borne by anyone (municipality, industry, business, community, not-for-profits, etc.). The costs are distributed (i.e. levelized) across the 18 year time span, i.e. a capital cost for a project is not shown solely in the year of expenditure, but distributed over that year and the subsequent years of the project. The employment numbers are the number of jobs created as a result of the investments and expenditures across all industries considered.

In this cost distribution, almost $482M is invested over 18 years and over $1.6B is returned (i.e. more than net $1.1B return). The investments generate an estimated 983 jobs over the 18 years.

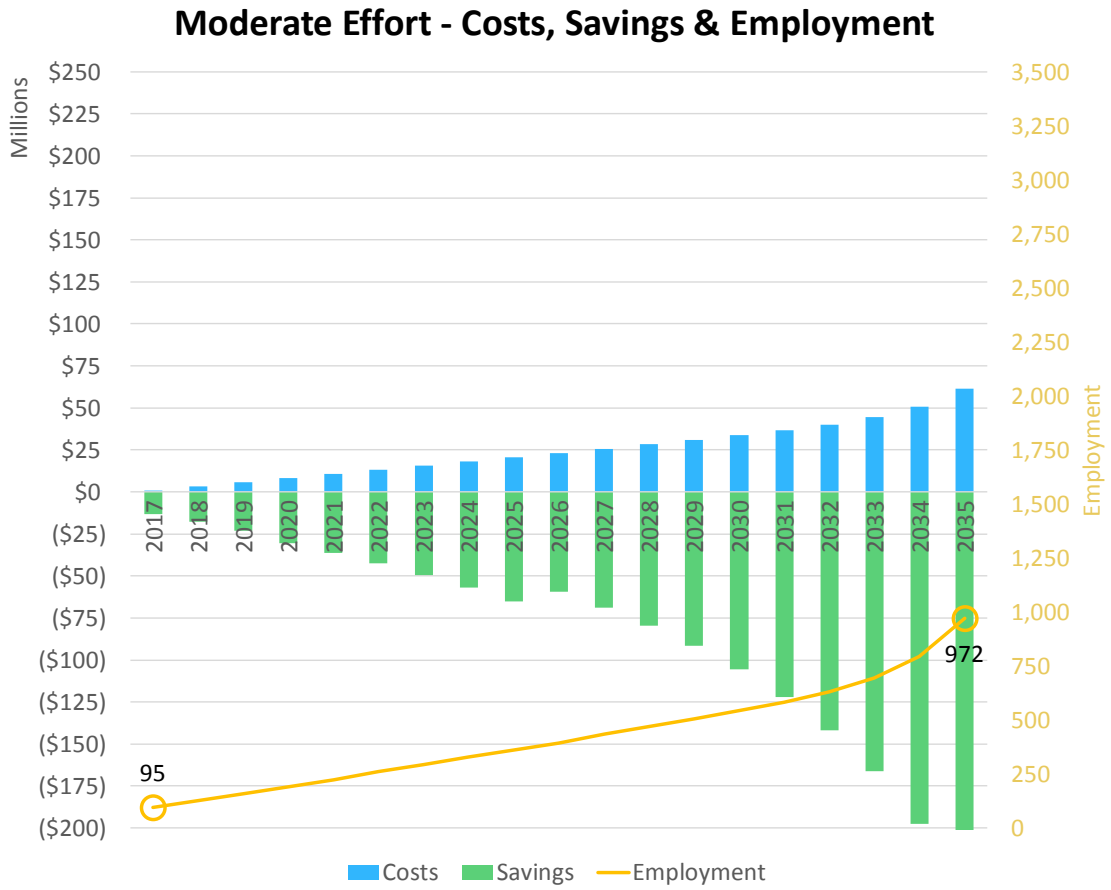


Figure 31. Expected outcomes for investment, savings and employment for the Moderate Effort Scenario.

High Level Costs and Emissions Reduction by Strategy - Moderate Effort Scenario

Figure 32 shows the comparison of emissions reduced and costs or savings for a variety of potential emissions reduction actions in the Moderate Effort Scenario. It is an illustration of the emissions reduction performance and the cost effectiveness of different emissions reduction strategies. The total estimated cost of implementing a strategy for the community (not only the Municipality's capital and operating costs, but also investments by the private sector) and the estimated total savings from implementation are used here to calculate the costs or savings for each strategy. The depiction is a 'bang for your buck' quick reference. It is the average annual cost and emissions reduction, taken from the 18 year time period from 2017 to 2035.

The height of a bar indicates the cost or savings of taking the action. Bar width represents the amount of GHG reductions the strategy achieves. Note that the bar widths are illustrated relative to one another (i.e. there are no values along the horizontal axis). The best strategies to employ from a cost perspective are those whose graphed bars are in the negative along the vertical axis. The more negative the number, the greater the savings or payback. The best strategies to employ from an emissions reduction perspective are those whose graphed bars are wide along the horizontal axis; the wider the bar, the greater the emissions reduction. The most effective strategies from both perspectives are those that generate cost savings and have great emissions reduction impacts (i.e. the more negative and the more wide the graphed bar).

This analysis demonstrates that building compact, complete communities with transportation options provides the greatest emissions reductions for the least cost. This is because to change how communities are built is not costly to implement, like some technologies for energy generation might be, for example. Rather, it is a result of policy implementation, which doesn't require capital spending. The emissions reductions from this strategy are great, as energy efficiency increases in buildings, public transit becomes more viable, and walking and cycling to destinations is more viable. Building complete, compact communities with transportation options saves $280 per tonne of emission avoided. This is consistent with the hierarchy presented in Figure 2: attention to whatever lasts longest (i.e. land use, buildings and infrastructure) provides the greatest energy and emissions benefits.

Renewable energy production has the second greatest emissions reduction effect, but at a greater cost—$132 is spent per tonne of emissions avoided. Renewable energy systems are possible, but at a price. This is largely due to the inexpensiveness of natural gas. To supply the same amount of power as natural gas with renewables is currently costly.

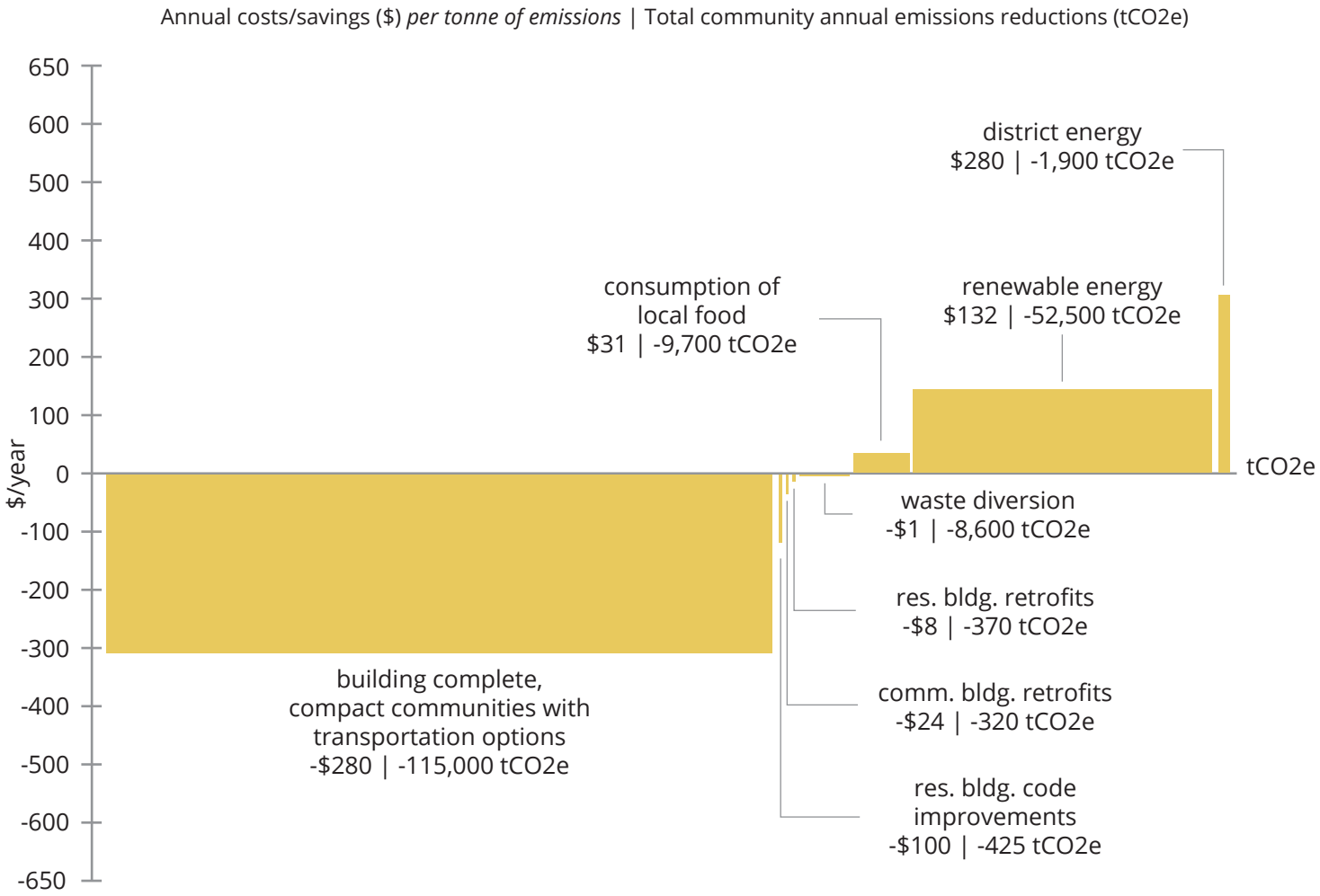


Figure 32. Costs versus emissions reductions for the Moderate Effort Scenario.

High Level Costs, Savings and Employment Analysis - Moderate Effort Scenario

Figure 33 shows the costs of achieving the Ambitious Effort Scenario's 2035 emissions target.

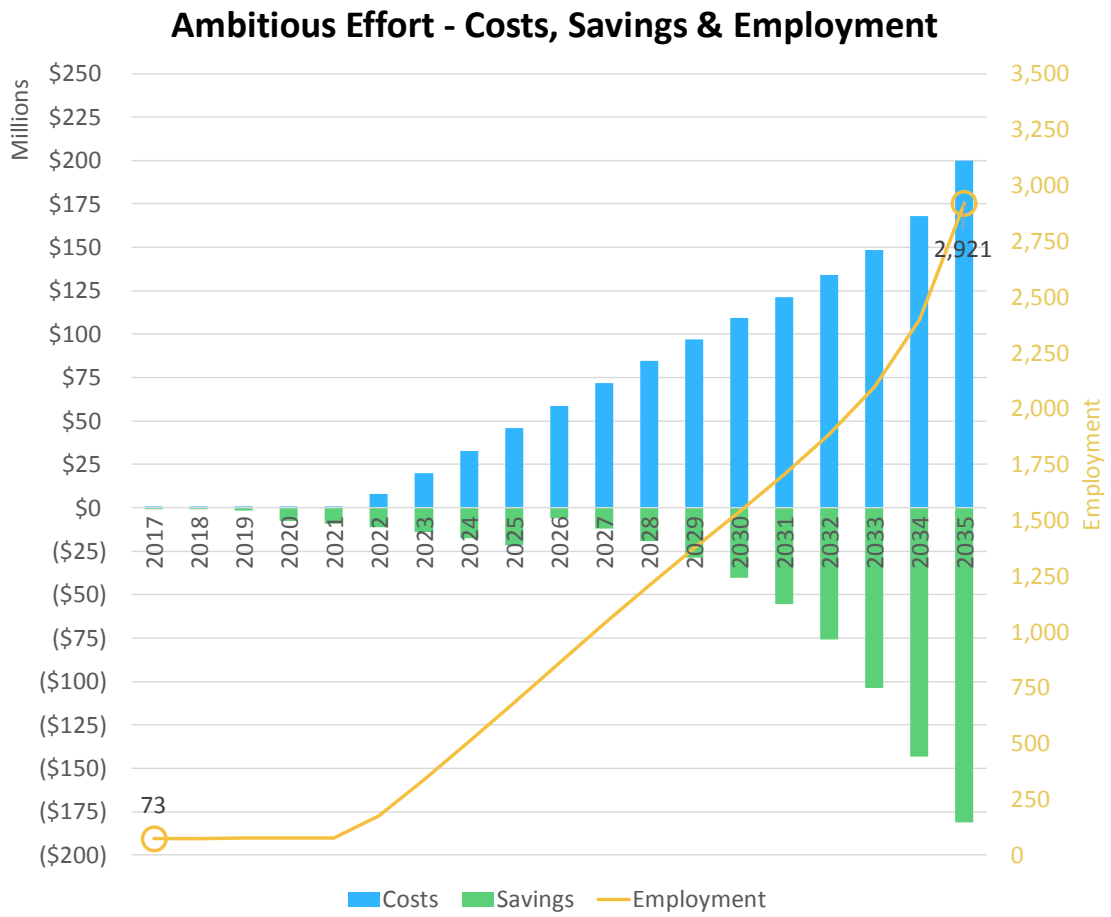


Figure 33. Expected outcomes for investment, savings and employment for the Ambitious Effort Scenario.

In the Ambitious Effort Scenario, a total of $1.3B is invested over 18 years, realizing a total return of $750M (i.e. net $550M expenditure). The investments create 2,921 jobs over the period.

Compared to the Moderate Effort Scenario in Figure 31, it is obvious that the Ambitious Effort Scenario incurs more costs. The bulk of the costs go towards switching from natural gas to renewable energy. As natural gas is very inexpensive, the costs to supplant fossil fuel energy with renewable energy is very great. The jobs created are far greater than those achieved in the Moderate Effort Scenario, as the employment effort required to achieve the Ambitious Scenario is substantial.

Figure 34 shows the emissions reductions and costs comparison graph for the Ambitious Effort Scenario. Remember that the bar widths are illustrated relative to one another (i.e. bar widths cannot be directly compared with those in Figure 32. The tCO2e values and costs can be directly compared, however).

Building complete, compact communities with transportation options is even more cost beneficial in this scenario. Every tonne of emissions avoided generates $425. The emissions reductions from renewable energies are great in this scenario, with 90% coal phase out and 75% natural gas phase out transitioning to renewables.

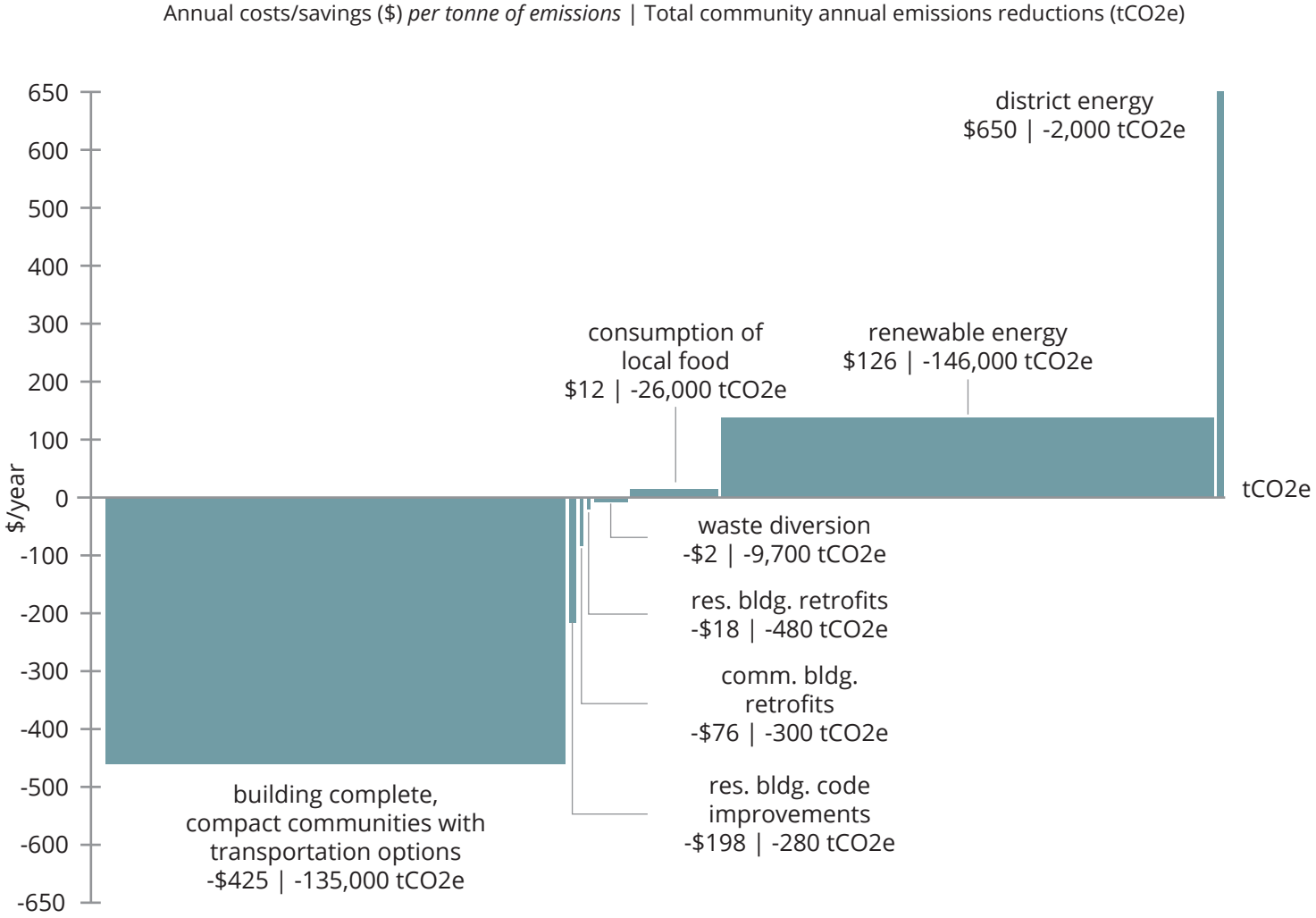


Figure 34. Costs versus emissions reductions for the Ambitious Effort Scenario.

3. Red Deer's Energy Future

The first steps of Red Deer's CEEP has been completed. This document outlines the baseline from which to measure progress, energy use and emissions forecasts through 2035, and high-level options to reduce emissions. We are now able to compare and contrast the energy and emissions outcomes of the modelled scenarios. From this, we can proceed to set targets and refine emissions reduction and energy efficiency policies and actions. These actions can be assessed for their capacity to support The City's vision, missions and goals, for the co-benefits they provide, and how they complement other planning and strategic efforts. Through these refinements and assessments, a final slate of recommended policies and actions can be generated, prioritized, and planned for implementation. The implementation plan will be replete with policy and action rationales, roles and responsibilities, timelines and prioritization, indication of community and business partnerships, estimation of funding required, and the potential sources of that funding. Once complete, Red Deer's CEEP will be ready for immediate implementation, bringing reduced emissions, increased energy efficiency, economic development, and continued high quality of life to Red Deer residents.