



EDMONTON'S COMMUNITY ENERGY TRANSITION STRATEGY

A framework for reducing greenhouse gas emissions, increasing energy efficiency and promoting resilient energy systems in Edmonton

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FOREWORD

How can I prepare for or even shape the dramatic developments in the global energy system that will emerge in the coming years? This question should be on the mind of every responsible leader in government, business and civil society. It should be a concern of every citizen.

Jeroen van der Veer, former Chief Executive, Royal Dutch Shell plc

Across Canada, Edmonton is rapidly becoming known as an energy sustainable city. Over the past decade, we have launched innovative community projects that conserve energy, use energy more efficiently and reduce greenhouse gas (GHG) emissions. Our most widely recognized successes include: (a) expansion of Edmonton's LRT network, (b) planning, design and development of world-class sustainable communities like Blatchford, The Quarters, Downtown and transit oriented developments, (c) introduction of energy efficient street lighting technologies, (d) advancement of infill strategies, (e) establishment of a large commercial-scale waste-to-biofuels facility and (f) advancement of *fresh*: Edmonton's Food and Agriculture Strategy.

Edmonton's Community Energy Transition Strategy responds to City Council's goal for Edmonton to go even further to become "the nation's leader in setting and achieving the highest standards of environmental preservation and sustainability both in its own practices and by encouraging and enabling the practices of its partners." Equally, it responds to three of the twelve Council-approved goals in the City of Edmonton's environmental strategic plan, *The Way We Green*:

- » Goal: Edmonton's sources and uses of energy are sustainable.
- » Goal: Edmonton is resilient to disturbances that could affect its energy supplies and distribution systems.
- » Goal: Edmonton is a carbon-neutral city.

Achieving these goals is vital to our quality of life and our aspiration to be a great global city. Moreover, their achievement will help protect us from major climate and energy risks and position us for exciting opportunities as the world transitions to cleaner energy. The energy sustainable Edmonton reflected in this strategy includes:

- » Energy literate citizens with energy conserving lifestyles;
- » World-class energy efficiency in all types of buildings;
- » World-class energy efficiency in industrial processes;
- » A strong shift to active and public transportation as preferred modes of travel;
- » An urban form that is carefully designed to avoid unnecessary energy use and optimize free energy from the sun;
- » Greener electricity from Alberta's electricity grid and local generating facilities;
- » A greater portion of electricity produced close to where it is used through district energy systems, combined heat and power systems and renewable and alternative energy technologies; and
- » Increased electrification of Edmonton's transportation system with passenger vehicles, buses, light trucks and trains powered by clean electricity.

Edmonton's Community Energy Transition Strategy points Edmonton to an energy sustainable future. It is a framework for policymakers to take action.

EXECUTIVE SUMMARY

At a time when many of the world's most innovative communities are striving to build low-carbon economies, *Edmonton's Community Energy Transition Strategy* is about participating in this movement. While Edmonton will continue to play an important role in developing Alberta's resource industries, at the same time it will be transitioning to a low-carbon, energy sustainable future. These two paths are not at odds. Rather, they reflect the pragmatic thinking of an energy city that understands the essential need for fossil fuels in the world's current energy mix, but at the same time knows the world must find ways to reduce its dependence on carbon.

Edmonton's Community Energy Transition Strategy contains:

- » **A diagnosis** of the energy and climate challenges we face along with the related opportunities (Part 2);
- » **Twelve Strategic Courses of Action** for addressing challenges and opportunities (Part 3); and,
- » **An Eight-Year Action Plan** establishing the first step (2014-2017) and signaling the second step (2018-2021) of Edmonton's energy transition journey (Part 4).

More than 80% of the world's energy and 95% of Edmonton's come from fossil fuels, i.e., coal, oil and natural gas. *Edmonton's Community Energy Transition Strategy* takes the position that this considerable dependence exposes us to three main risks:

- » **Risk:** The world could become more energy constrained as global demand for energy increases and production of fossil fuels becomes more challenging. In the long-term, much higher energy prices could be the result.
- » **Risk:** Based on society's current rate of greenhouse gas (GHG) emissions, a majority of the world's scientists agree Earth's long-term average temperature could increase 3.6°C to 5.3°C compared to pre-industrial levels. An increase of this magnitude (most of which is expected to occur in this century) would have severe social, economic and environmental consequences world-wide.
- » **Risk:** The Edmonton region is currently not meeting air quality standards set for fine particulate matter (PM2.5) with fossil fuel combustion being a significant contributor. Continuation of this condition poses both health and economic risks.

While *risk* is an important driver of this strategy, equally important is the opportunity awaiting communities that can respond proactively. The strategy aims to position Edmonton to participate in what is potentially one of the greatest economic opportunities of all time as the world transitions to renewable energy technologies, greater energy efficiency, distributed energy systems and more energy-conserving lifestyles.

This strategy (i.e., modelled as the Low Energy/Carbon Case) responds to these risks and opportunities with actions that will reduce Edmonton's GHG emissions, reduce energy use per person, improve energy efficiency in all sectors, diversify our energy mix and make our energy systems more resilient. In particular:

- » By 2035, the Low Energy/Carbon Case will reduce Edmonton's GHG approximately 23% below levels that would otherwise be expected under the business-as-usual scenario (i.e., the Reference Case). This reduction equates to a GHG emissions reduction of approximately 35% below 2005 levels (i.e., the baseline year that is commonly used to express GHG reductions). This reduction will be achieved through:

- Programs that promote energy conservation, energy efficiency and renewable energy uptake in buildings. (6% reduction from Reference Case)
 - Programs that promote efficiency conservation and energy efficiency in heavy industry. (3% reduction from Reference Case)
 - Programs that promote energy conservation and energy efficiency in vehicles. (2% reduction from Reference Case)
 - Programs that promote greater infill and density in Edmonton's urban form. (4% reduction from Reference Case)
 - Efforts that accelerate the greening of Alberta's electricity grid. (8% reduction from the Reference Case).
- » By 2035, the Low Energy/Carbon Case will limit total energy consumption to a 1% increase from 2009 levels, as opposed to an 11% increase that would occur otherwise under the Reference Case. Holding Edmonton's total energy consumption to a 1% increase with a much larger population equates to a 25% reduction in energy use per person by 2035.
- » By 2035, the Low Energy/Carbon Case will make Edmonton's energy system more resilient by: (a) generating approximately 10% of Edmonton's electricity locally, (b) effectively advocating for the greening of Alberta's electricity grid, (c) encouraging the establishment of combined heat and power systems (CHP) and district energy systems (DE) where economically feasible and (d) encouraging a shift from gasoline and diesel-powered vehicles to electric vehicles.

In developing this strategy, ten possible community-scale programs were modeled to better understand their costs and benefits, including:

- » **Program 1** would encourage higher energy efficiency performance and conservation in *new homes*.
- » **Program 2** would encourage renewable energy uptake in *new homes*.
- » **Program 3** would encourage energy efficiency retrofits and conservation in *existing homes*.
- » **Program 4** would encourage renewable energy uptake in *existing homes*.
- » **Program 5** would encourage higher energy efficiency performance and conservation in *new large/ICI buildings*.
- » **Program 6** would encourage renewable energy uptake in *new large/ICI buildings*.
- » **Program 7** would encourage energy efficiency retrofits and conservation in *existing large/ICI buildings*.
- » **Program 8** would encourage renewable energy uptake in *existing large/ICI buildings*.
- » **Program 9** would encourage energy efficiency improvements to *industrial facilities and processes*.
- » **Program 10** would encourage the purchase of *private passenger vehicles with electric drive trains*.

Edmonton's Community Energy Transition Strategy proposes that Edmonton be ready by 2018 to begin implementing those programs with Benefit/Cost ratio of 2.5 or greater (i.e., Programs 2, 3, 5, 6, 8, 9 and 10). Programs with Benefit/Cost ratios of 1.0 to 2.4 will be delayed until 2022 or beyond (i.e., Programs 1, 4 and 7).

The strategy explains that significant new sources of government funding will also be needed to advance these programs, including funding for education and awareness, capacity building, financial incentives and program administration. During the period 2018-2021, government funded costs to implement these programs will total approximately \$25-30 million a year. The strategy does not identify sources of funding at this time. Rather, as part of the 2014-2017 Action Plan, it recommends that the City of Edmonton collaborate with the Government of Alberta and other stakeholders to develop common funding strategies and detailed programs that can be implemented Province-wide.

Although the costs of these investments are significant, their benefits are even greater. By 2035, *Edmonton's Community Energy Transition Strategy* is expected to deliver a net present value of approximately \$2.5 billion. This means energy cost savings to building, industry and vehicle owners will be at least \$2.5 billion greater than their net investment cost. Net present value is even greater (i.e., \$3.4 billion) when the social cost of GHG reductions is assigned a value.

Edmonton's Community Energy Transition Strategy contends that this level of government involvement is essential. Although the world is expected to become more energy efficient in

coming years, it is extremely likely that these gains will be offset by greater energy consumption from growing populations and economies. As a result, energy efficiency improvements that are happening naturally will not be enough to: (a) limit the long-term rise in average global temperature to 2°C (called for by science), nor (b) significantly reduce our dependence on fossil fuels.

Edmonton's Community Energy Transition Strategy assigns responsibility to the City of Edmonton for leading the strategy's ongoing implementation and maintenance. Although municipal government has limited control over Edmonton becoming an energy sustainable city, the City of Edmonton is better positioned than any other entity to coordinate and lead this complex community effort. However, to have credibility in the role, the City will need to **lead by example** in its own operations. This will mean meeting or exceeding the high energy transition standards that need to occur community-wide. The Strategy identifies multiple ways the City will continue to demonstrate leadership.

The strategy recognizes the uncertainty we face today in achieving energy transition goals that are decades away. As we proceed with the first step of Edmonton's energy transition journey, we understand the need for flexibility. While the tactics outlined in this strategy represent our best thinking today, we expect these ideas will evolve over time as: (a) new technologies, solutions and information emerge and/or (b) social, economic and environmental conditions change. The strategy applies a cautious and flexible approach to energy transition - careful not to place all our eggs in one basket or take high risk positions that could lock in sub-optimal solutions for the long-term. This *dynamic* steering approach includes: (a) continual surveillance of risks, opportunities and performance, (b) timely feedback loops, (c) continual evaluation of next-steps and (d) ability to alter course quickly as new risks and opportunities arise.

The Eight-Year Action Plan is organized into seven Opportunity Areas: (1) energy use in buildings, (2) generation of electricity and heat, (3) energy use in industry, (4) land use, transportation and development, (5) water and waste water, (6) waste reduction and recycling and (7) leadership. Within these Opportunity Areas, 49 Focus Areas are identified.

As well, the action plan sets out two, four-year steps: 2014-2017 and 2018-2021. The first step (2014-2017) identifies actions that will be pursued. The second step (2018-2021) signals future actions that are anticipated, including a number of community-scale energy efficiency and renewable energy programs. Step One of this journey (2014-2017) focuses on: (a) creating organizational, leadership, partnership and financial conditions for long-term success, (b) leading by example in City operations and (c) better understanding and preparing for large community-scale programs that will be launched in Step Two (2018-2021).

Edmonton's Community Energy Transition Strategy begins with a question posed by the former Chief Executive of Royal Dutch Shell (Jeroen van der Veer) which he believes should be on the mind of every responsible leader in government, business and civil society: ***"How can I prepare for, or even shape, the dramatic developments in the global energy system that will emerge in the coming years?"*** This strategy is Edmonton's answer to that question.



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PART 1

Introduction

PART 1

Introduction

1.1 Purpose

Edmonton's Community Energy Transition Strategy is a risk management strategy designed to make Edmonton an energy sustainable city, including actions that will:

- » Reduce Edmonton's greenhouse gas (GHG) emissions to levels consistent with limiting the long-term rise in the average global temperature to 2°C;
- » Increase energy efficiency and energy conservation in all sectors;
- » Ensure Edmonton's energy delivery systems (for electricity and natural gas) are resilient to shocks and disturbances from climate change; and
- » Position Edmonton to participate in what is possibly one of the greatest economic opportunities in history.

An energy sustainable city is one that meets these criteria.

1.2 Mandate

Over the past 20 years, Edmonton City Council has expressed strong support for energy sustainability, including:

- » Endorsing the ICLEI Local Governments for Sustainability Declaration on Climate Change and the Urban Environment (1993);
- » Endorsing the City's involvement in the Federation of Canadian Municipalities' Partners for Climate Protection Program (1995);
- » Approving the City's first greenhouse gas (GHG) emissions reduction plan for City operations (1999);
- » Approving a community GHG reduction plan in 2001 called Carbon Dioxide Reduction Edmonton (CO2RE);
- » Setting targets (in *The Way Ahead*) to reduce GHG emissions from City operations;
- » Supporting the Alberta Urban Municipalities Association (AUMA) resolution for climate change initiatives (2007) which states: "*A global reduction in emissions of greenhouse gases is necessary to slow climate change and reduce the risks to human health, the physical environment, economy and quality of life.*"

In July 2011, City Council approved Edmonton's environmental strategic plan, *The Way We Green*, which contains 12 goals for making Edmonton an environmentally sustainable and resilient city. Four of these goals focus on energy and climate change:

- » Goal: Edmonton's sources and uses of energy are sustainable.
- » Goal: Edmonton is resilient to disturbances that could affect its energy supplies and distribution system.
- » Goal: Edmonton is a carbon-neutral city.
- » Goal: Edmonton is resilient to disturbances from climate change.

In 2014, City Council approved twelve Council Outcomes including:

- » **The City of Edmonton's operations are environmentally sustainable** (with one of the Measures being City Operations Greenhouse Gas Emissions); and
- » **Edmonton is an environmentally sustainable and resilient city** (with one of the Measures being Community Greenhouse Gas Emissions).

Edmonton's Community Energy Transition Strategy is a response to these directions from City Council.

1.3 Strategy Development Process

The Way We Green identifies climate change (mitigation and adaptation) and energy (sustainability and resilience) as Edmonton's top environmental challenges. This determination was based on generally accepted scientific advice that global GHG emissions must be reduced by 50-85% below year 2000 levels by 2050 in order to prevent dangerous levels of climate change and address concerns about Edmonton's significant dependence on fossil fuels. Although *The Way We Green* set goals for Edmonton to become a carbon-neutral, sustainable and energy resilient city, it did not explain specifically how these goals would be achieved. In order to arrive at specifics, the City of Edmonton applied a three-phase strategy development approach.

Strategy Development: Phase One

The purpose of Phase One was to understand Edmonton's potential to reduce its community GHG emissions and energy use. In 2012, an external consultant (HB Lanarc) was retained to model these possible reductions. Under the business-as-usual scenario (i.e., the Reference Case) it was estimated that Edmonton's GHG emissions would decline slightly from 2009 to 2035.

In search of a strategy that might bring about significant reduction, a Low Energy/Carbon Case was also modeled. This scenario considered a variety of cost-effective initiatives which currently are not part of the City's policy framework. Modelling results showed it was hypothetically possible for Edmonton to make significant reductions in GHG emissions and fossil fuel dependence by mid-century. However, it would require:

- » **Accelerating the greening of Alberta's electricity grid** (with all new electricity generation in the province being a combination of renewable energy and highly efficient natural gas combined heat and power plants).
- » **Attracting a greater portion of Edmonton's growth to existing/mature neighbourhoods** (with 40% of new population growth occurring in existing neighbourhoods along with significant expansion of transit networks).
- » **Improving the energy efficiency of local industry** (with an emphasis on more energy efficient motors, pumps and equipment used in industrial processes).
- » **Increasing the uptake of distributed energy generations** (with greater uptake of solar heat, solar power, district energy and combined heat and power technologies).
- » **Increasing energy efficiency of buildings** (with new buildings exceeding building code requirements and existing building stock undergoing higher rates of energy retrofits).
- » **Reducing gasoline and diesel used in vehicles** (with greater uptake of electric vehicles and a shift away from gasoline and diesel).

While Phase One concluded it was hypothetically possible to reduce Edmonton's GHG emissions by 50% by 2044, it was also noted that this outcome would require new policy directions. As well, it was recognized that considerable control over these initiatives resided with the Province, industry and property owners. Modelling results and related recommendations are contained in a report titled *Edmonton's Energy Transition Discussion Paper* (edmonton.ca/energytransition) which was used to inform Phase Two.

Strategy Development: Phase Two

In what was widely considered to be a best practice in public engagement, a citizen's panel was formed in September 2012 to understand the extent to which Edmontonians supported the Low Energy/Carbon Case outlined in the Phase One discussion paper. Fifty-six demographically and attitudinally different Edmontonians, reflective of Edmonton's overall population, came together *"to discover whether we as Edmontonians want our city to become low carbon, whether we consider the Discussion Paper to provide a good map for getting there and how much we support particular actions proposed in it."*

Working together over the course of six Saturdays between October 13 and December 1, 2012 (in a process developed and delivered by Alberta Climate Dialogue, the Centre for Public Involvement and the University of Alberta), panel members deliberated on this question and produced a report titled *Citizens' Panel on Edmonton's Energy and Climate Challenges*.

Its two key recommendations were:

- » **That the City of Edmonton take the measures needed to become a low carbon city by 2050** (92% of panel members expressed support for this recommendation); and,
- » **That the City of Edmonton implement the following six goals and associated actions proposed in Edmonton's Energy Transition Discussion Paper** (panel members expressed 94% support for this recommendation):
 - Reduce the GHG intensity of the provincial electricity grid;
 - Increase the proportion of development undertaken to create compact, mixed-use, transit-oriented neighbourhoods within already developed areas of the city;
 - Reduce the energy use in industrial facilities through energy efficiency and a focus on industrial developments with lower energy use;
 - Increase the uptake of distributed energy generation (e.g. solar heat and power, and natural gas combined heat and power plants) through barrier removal, capacity building, incentives and regulations;
 - Increase the energy efficiency of buildings (new and old) through capacity building, incentives and regulations; and
 - Reduce the amount of gasoline and diesel used in the vehicle fleet through capacity building, incentives and regulations.

As well, the report stressed the following conditions should be followed by the City in implementing its recommendations:

- » Weigh the costs and benefits of each energy transition action;
- » Use public and transparent decision making processes so citizens are confident that energy transition decisions serve the public good;
- » Link City leadership to citizen education; and
- » Recognize and promote multiple reasons for energy transition.

The Panel's Report was presented to City Council's Executive Committee on April 15, 2013 for information. The Committee was advised that the Citizens' Panel recommendations would be strongly considered in developing *Edmonton's Community Energy Transition Strategy* along with further consultation with business, industry and government organizations.

Strategy Development: Phase Three

Phase Three included computer modeling to refine Phase One energy and GHG reduction estimates and better understand the economics of community-scale programs and initiatives that would deliver these reductions. It was estimated that:

- » By 2035, the Low Energy/Carbon Case would reduce Edmonton's GHG emissions by 23% below levels that would otherwise be expected under the Reference Case (Figures 1 and 2). Moreover, this reduction would be approximately 35% less than 2005 emissions (i.e., the baseline year that is commonly used to express GHG reductions). This reduction would be achieved through:
 - Programs that promote energy conservation, energy efficiency and renewable energy uptake in buildings. (6% reduction from Reference Case)
 - Programs that promote efficiency conservation and energy efficiency in heavy industry. (3% reduction from Reference Case);
 - Programs that promote energy conservation and energy efficiency in vehicles. (2% reduction from Reference Case)
 - Programs that promote greater infill and density in Edmonton's urban form. (4% reduction from Reference Case)
 - Efforts that accelerate the greening of Alberta's electricity grid. (8% reduction from the Reference Case)

- » By 2035, the Low Energy/Carbon Case will limit total energy consumption to a 1% increase from 2009 levels, as opposed to an 11% increase that would occur otherwise under the Reference Case. Holding Edmonton's total energy consumption to a 1% increase with a much larger population equates to a 25% reduction in energy use per person by 2035.
- » By 2035, the Low Energy/Carbon Case will make Edmonton's energy system more resilient by: (a) generating approximately 10% of Edmonton's electricity locally, (b) effectively advocating for the greening of Alberta's electricity grid, (c) encouraging the establishment of combined heat and power systems (CHP) and district energy systems (DE) where economically feasible and (d) encouraging a shift from gasoline and diesel-powered vehicles to electric vehicles.

FIGURE 1 Edmonton's Future Greenhouse Gas Emissions – Two Scenarios

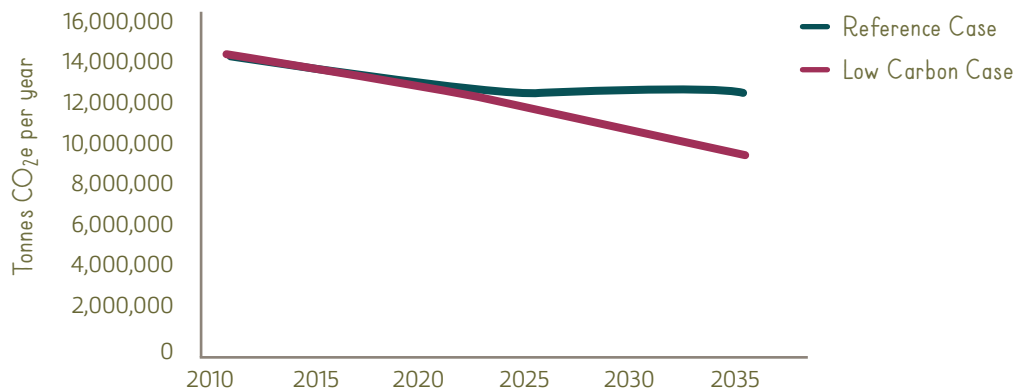
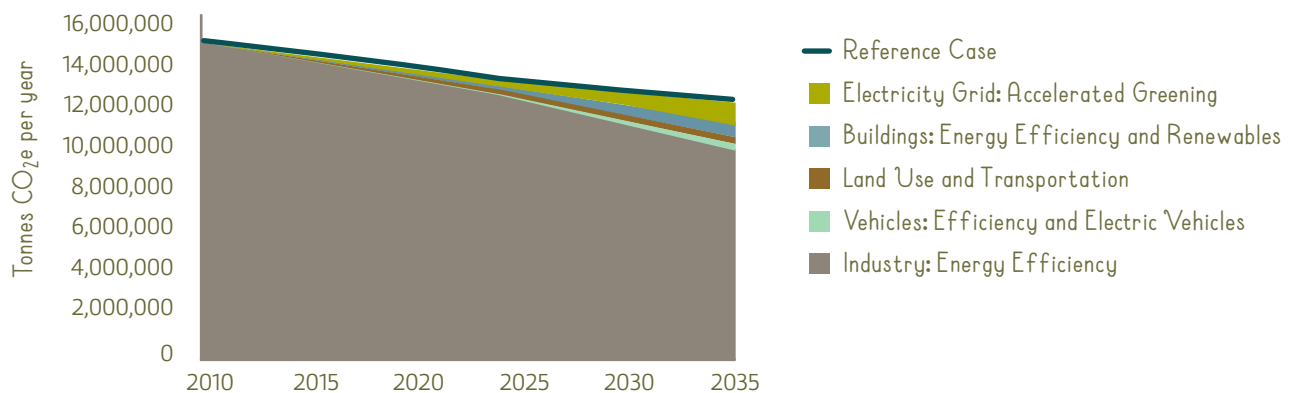


FIGURE 2 Low Energy/Carbon Scenario – Emissions Reduction Wedge Chart



This document, *Edmonton's Community Energy Transition Strategy*, represents the combined results of Phases One, Two and Three. It contains:

- » A diagnosis of the energy and climate challenges and opportunities we face globally and locally (Part 2);
- » Twelve Strategic Courses of Action for addressing these challenges/opportunities in coming decades (Part 3); and
- » An Eight -Year Action Plan establishing the first step (2014-2017) and signaling the second step (2018-2021) of Edmonton's energy transition journey (Part 4).

PART 2

The Diagnosis

PART 2

The Diagnosis

2.1 Three Hard Truths

Many of the world's largest energy companies and energy monitoring agencies regularly produce and share their long-term global energy outlooks. These projections typically include information about the world's current and future energy production, supply and demand. In most cases, time horizons are 20 or 25 years, with few forecasts venturing beyond 2040. Recognizing that the world's energy future is uncertain, many of these forecasts take the form of scenarios, with multiple scenarios developed to reflect multiple possible outcomes. In some cases, forecasters go further by offering advice to policy-makers on how to address future energy challenges.

Amongst these forecasters, there is considerable agreement about the world's current and future energy scenarios. Although each forecast says it in a slightly different way, these outlooks can be summed up in what Royal Dutch Shell calls Three Hard Truths.

Hard Truth #1

The world's demand for energy is growing fast. By the middle of this century there could be over nine billion people using twice as much energy as we use today.

The world's annual energy consumption is approximately 25 times greater today than 1800 and twice as high as 1971. According to most energy forecasts, global, national and local energy consumption will continue its steep climb:

- » BP (formerly British Petroleum) anticipates global energy consumption will be 36% higher in 2030 than 2011 with virtually all the growth (93%) coming from non-OECD countries.
- » Both the International Energy Agency (IEA) and ExxonMobil anticipate a 35% increase in energy demand by 2035 (but caution it could double without energy efficiency gains).
- » The U.S. Energy Information Administration anticipates a 56% increase in energy demand by 2040.
- » Royal Dutch Shell anticipates energy consumption increases ranging from 87% to 113% by 2050.
- » The National Energy Board anticipates Canada's end-use energy demand will increase 40% from 2010 to 2035.
- » Alberta's Electricity System Operator anticipates Alberta's electricity load will grow at an annual average of 2.7% until 2032.

Of the 170,645 TJ of energy consumed in Edmonton in 2012, natural gas provided the main source of energy (42%) followed by gasoline, diesel fuel and electricity (Figure 3).

FIGURE 3 Edmonton's Energy Consumption by Energy Type (2012)



This energy was used in four general sectors: residential buildings, commercial buildings, industry and transportation. The transportation sector was the biggest energy user (41.8% of all energy used in Edmonton) followed by large/commercial buildings (22.5%), residential buildings (19.4%) and industrial buildings and processes (16.2%) (Figure 4).

FIGURE 4 Edmonton's Energy Consumption by Category (2012)



Hard Truth #2

Global energy supply will struggle to keep pace. There are still large amounts of hydrocarbons in the ground, but what's left tends to be concentrated under very deep oceans, very thick ice or very difficult governments.

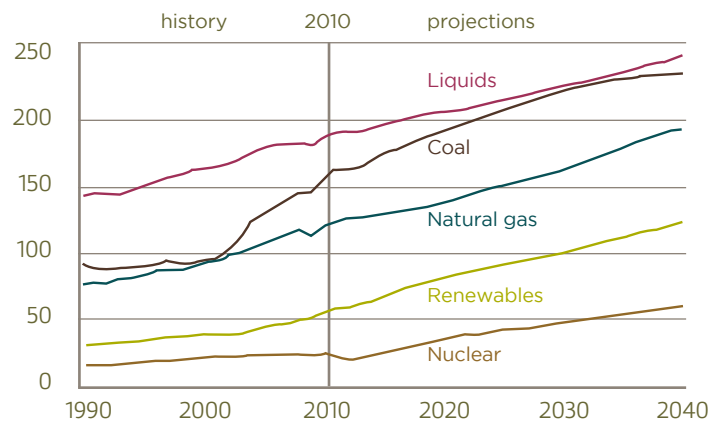
Over the past century, fossil fuels have provided most of the world's energy. In 1973, 94.1% of the world's energy came from fossil fuels. In 2012, this figure stood at 81.3% with 36.1% from oil, 25.7% from natural gas and 19.5% from coal.

Predicting the world's future fossil fuel production and supply requires technical analysis and forward thinking about where this energy will come from. Despite the many uncertainties, forecasters generally agree the world's energy mix will remain heavily weighted toward fossil fuels in coming decades:

- » The IEA anticipates that fossil fuels will constitute 76% of the world's energy mix by 2035; and
- » The U.S. Energy Information Administration anticipates that fossil fuels will constitute 78% of the world's energy mix by 2040 (Figure 5).

FIGURE 5 World Energy Mix 1990 to 2040 (projected)

Source: U.S. Energy Information Administration



What lies beyond 2040 in terms of fossil fuel supplies and production is less certain. Estimates of existing oil, natural gas and coal are typically reported in two categories – reserves and resources. Reserves are proven volumes of energy types that are exploitable at today’s prices using today’s technology. Their recovery is highly certain. Resources include: (a) proven amounts of energy types that cannot currently be exploited for technical and/or economic reasons and (b) unproven but geologically possible energy resources that may be exploitable in the future. As such, there is less confidence surrounding the eventual recovery of these energy sources.

Table 1 contains information from the German Federal Institute for Geosciences and Natural Resources (GFIGNR) estimating the number of years of oil, natural gas and coal on the planet if it were exploited at 2011 rates of consumption. Years of reserves are calculated by dividing estimated reserve quantities by the amount of production that occurred in 2011. Similarly, years of resources is calculated by dividing estimated resource quantities by the amount of production that occurred in 2011.

Looking first at oil, there are approximately 54 years of oil reserves and 92 years of oil resources worldwide, based on 2011 rates of production, i.e., a total of 146 years. However, 146 years of remaining oil resources (based on 2011 levels of consumption) may be an overly optimistic estimate because: (a) according to the world’s largest energy companies, future rates of oil consumption will be considerably higher than 2011 levels and (b) there is considerable uncertainty surrounding the recoverability of estimated oil resources.

Turning to natural gas, the world has approximately 58 years of natural gas reserves and 173 years of natural gas resources based on 2011 rates of production, i.e., a total of 231 years. As with oil, 231 years of remaining natural gas resources (based on 2011 levels of consumption) may be an overly optimistic estimate because: (a) future rates of natural gas consumption are expected to be considerably higher than 2011 levels and (b) there is considerable uncertainty surrounding the recoverability of estimated natural gas resources.

For the purpose of this strategy, we understand that the world has an abundant supply of coal and that its ongoing supply is not a constraint. The major challenge with coal however is that its consumption at anticipated levels would likely result in the world overshooting its long-term target to limit the rise in the average global temperature to 2°C.

TABLE 1 World Energy Reserves-to-Production and Resources-to-Production Ratios (end-2011) Source: German Federal Institute for Geosciences and Natural Resources

	Crude Oil (years)	Natural Gas (years)	Coal (years)
Years of Reserves (based on 2011 rate of use)	54	58	127
Years of Resources (based on 2011 rate of use)	92	173	2,787
Total Remaining Reserves and Resources (based on 2011 rate of use)	146	231	2,914

Reserve and resource-to-production ratios have also been published by the IEA for oil, natural gas and coal. For the sake of brevity, they are not presented here. However, they are very close to the GFIGNR estimates in Table 1.

While it appears the world is becoming more energy constrained, fossil fuel energy remains abundant in Alberta. In 2012, Alberta accounted for 76 percent of Canada’s oil production and 70 percent of natural gas production. Applying data published by Alberta’s Energy Resources Conservation Board (ST98-2013), Alberta has 437 years of crude bitumen (which could change significantly with expanded exports), 15 years of crude oil, 17 years of natural gas and thousands of years of coal (based on estimates of these fuels’ remaining recoverable potential divided by 2012 production rates). This does not include large quantities of crude oil and natural gas that exists in shale and siltstone that may eventually become recoverable. According to the Alberta Energy Regulator, *"no attempt has been made to consider the recoverable quantity that exists in five of the most significant formations. While it is too soon to tell what part will be commercially recovered, it is likely that only a very small percentage is recoverable today. More time will be needed to have a clear picture on recoverability."*

Based on this analysis, *Edmonton’s Community Energy Transition Strategy* assumes Edmonton is not vulnerable to fossil fuel supply shortages and that Albertans will have access to these resources long into the future (including the timeframe of this strategy). At the same time, the strategy assumes that energy prices in Edmonton will continue to be determined through competitive market forces that could pose price risks in an energy constrained world.

Hard Truth #3

Without a change in global policies, environmental stresses will continue.

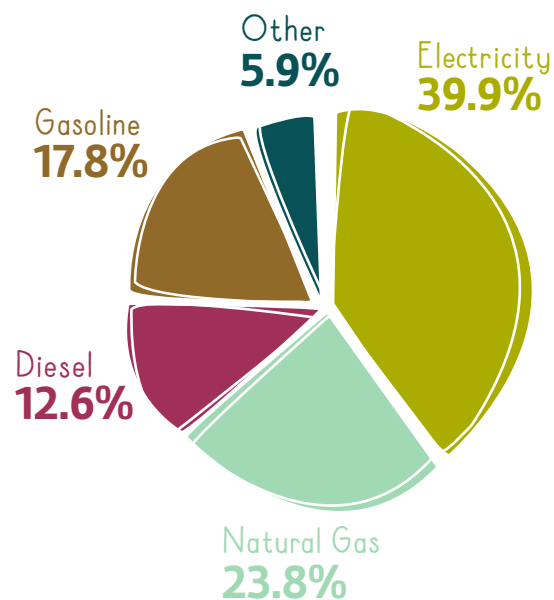
In 2013, the IEA published a special report titled *Redrawing the Energy-Climate Map*. Its key message (echoed by other energy companies, monitoring agencies and scientific organizations) was that the world is not on track to limit the long-term rise in the average global temperature of 2°C and that current policies are leading the world to a long-term average temperature increase in the range of 3.6°C and 5.3°C. Despite this dangerous trend, the IEA noted that the 2°C target was still technically feasible through global actions including:

- » Adopting specific energy efficiency measures (40% of the potential emissions savings).
- » Limiting the construction and use of coal-fired power plants (21% of the potential emissions savings).
- » Minimizing methane emissions from upstream oil and gas production (18% of the potential emissions savings).
- » Accelerating the partial phase-out of subsidies to fossil fuel consumption (12% of the potential emissions savings).

In 2010, Edmonton's GHG emissions totaled the equivalent of 15,270 kilotonnes of carbon dioxide (ktCO₂e) (Table 2). The transportation sector was the largest contributor followed by industry, large buildings, residential buildings and other. Electricity was the largest source of GHG emissions followed by natural gas, gasoline, diesel and other.

TABLE 2 Edmonton's 2010 GHG Emissions (ktCO₂e)

Source of GHG Emissions	GHG Emissions (2010) ktCO ₂ e	% of Total
Residential Buildings		
GHGs from Electricity	1,578	19.3%
GHGs from Natural Gas	1,376	
Large / ICI Buildings		
GHGs from Electricity	1,284	19.3%
GHGs from Natural Gas	1,667	
Industry		
GHGs from Electricity	3,225	25.0%
GHGs from Natural Gas	592	
Transportation		
GHGs from Diesel	1,920	30.4%
GHGs from Gasoline	2,720	
Other		
GHGs from Chemical Processes	750	5.9%
GHGs from Landfills	158	
TOTAL	15,270	100.0%



2.2 Managing Risk

Building on the Three Hard Truths in Section 2.1, *Edmonton's Community Energy Transition Strategy* takes the position that Edmonton's high dependence on fossil fuels exposes Edmontonians to five possible risks:

- » **Risk 1 (R-1):** The world could become energy constrained in the period 2014-2035 with energy supply unable to keep pace with demand (the consequence being much higher energy prices for Edmontonians).
- » **Risk 2 (R-2):** The world could become energy constrained beyond 2035 (from 2035 to 2099) with energy supply unable to keep pace with demand (the consequence being much higher energy prices for Edmontonians).
- » **Risk 3 (R-3):** World average temperature increase could exceed 2°C in this century (with Edmonton experiencing disruptions to its food, energy, social, economic and natural system).
- » **Risk 4 (R-4):** Local climate change could damage Edmonton's energy systems (with Edmonton experiencing energy system failures and disruptions).
- » **Risk 5 (R-5):** Continued high levels of fossil fuel consumption could diminish Edmonton's air quality (with health and economic consequences).

The risk ratings shown in Table 3 were arrived at by the City of Edmonton's Urban Planning and Environment Branch using a commonly used risk assessment methodology, best available information and input from informed stakeholder groups. Although there was general agreement amongst stakeholders regarding these ratings, agreement was not unanimous.

TABLE 3 Edmonton's Energy and Climate Change Risk Matrix

Source: City of Edmonton, Sustainable Development

Consequences for Edmonton	Extreme	Likelihood (based on business as usual)				
		Extremely Unlikely	Unlikely	Possible	Likely	Extremely Likely
Major	Moderate	Moderate	High (R-2)	High (R-3)	Critical	
Moderate	Low	Moderate	Moderate (R-1)	High	High (R-5)	
Minor	Low	Low	High (R-4)	Moderate	High	
Insignificant	Low	Low	Low	Moderate	Moderate	

- Critical
- High
- Moderate
- Low

As shown in the table, risks are assigned one of four possible risk ratings (Low, Moderate, High or Critical) based on a combination of: (a) their likelihood and (b) their consequences in Edmonton.

From a risk management perspective, Critical and High Risks are considered unacceptable - requiring appropriate preventive, corrective and adaptive actions. Although Moderate Risks are less urgent, additional controls are normally required depending on the circumstances. Low Risks require no further action apart from routine review.

Risk 1: Energy Constrained World 2014-2035

Edmonton's Community Energy Transition Strategy takes the position that Edmonton is exposed to a **Moderate Risk** relative to the world becoming more energy constrained over the next 20 years. This is based on the **Possible** likelihood of this risk occurring and the **Moderate** consequences that Edmonton might experience if it did occur.

A Possible likelihood rating was assigned based on industry consensus that world energy demand will increase sharply over the next quarter-century and perhaps double by 2050. Although the most likely scenarios indicate that energy supply will keep pace with demand, scenario planners also believe a possibility exists that supply could struggle to keep pace with demand.

A Moderate consequences rating was assigned based on the assumption that in an energy constrained world, higher world prices would translate into higher energy prices in Alberta (i.e., in line with Canada's National Energy Boards High Energy Price Scenario, which anticipates that by 2035 the price of oil could be 70% higher than 2011 and natural gas could be 137% higher than 2011 (real dollars)).

Communities wanting to mitigate this medium-term price risk can take steps to: (a) reduce energy use through energy efficiency and conservation and (b) reduce dependence on fossil fuels by investing in renewable and alternative energy sources.

Risk 2: Energy Constrained World Beyond 2035

Edmonton's Community Energy Transition Strategy takes the position that Edmonton is exposed to a **High Risk** with respect to the world becoming more energy constrained in years beyond 2035. This is based on the **Possible** likelihood of this risk occurring and the **Major** consequences that Edmonton might experience if it did occur.

These ratings were assigned based on industry consensus that nearly 80% of the world's energy will still be derived from fossil fuels in 2040. However, 80% of the world's energy mix in 2040 represents much more fossil fuel consumption than today. This ongoing dependence on fossil fuels poses a particular risk in years beyond 2040 because it is expected that much of the world's cheap and easily accessed oil and natural gas will be gone. In developing *Edmonton's Community Energy Transition Strategy* we found little guidance from the world's leading energy companies and monitoring agencies regarding price expectations beyond 2040. In the absence of game-changing energy sources or technologies, *Edmonton's Community Energy Transition Strategy* assumes price pressures would intensify. Just how high prices might go is uncertain, but represents a significant risk. This risk is particularly relevant to cities and organizations that make long-term investments in infrastructure that depend on moderately priced fossil fuel energy to be viable.

Communities wanting to mitigate this long-term price risk can take steps to: (a) reduce energy use through energy efficiency and conservation and (b) reduce dependence on fossil fuels by investing in renewable and alternative energy sources.

Risk 3: Climate Change

Edmonton's Community Energy Transition Strategy takes the position that Edmonton is exposed to a **High Risk** with respect to the world failing to limit the long-term rise in the average global temperature

to 2°C. This is based on the **Likely** probability of this risk occurring and the **Major** consequence that Edmonton might experience if it did. According to the International Energy Agency's warning, the world is currently on track to experience a long-term average temperature increase between 3.6°C and 5.3°C (compared with pre-industrial levels) with most of the increase occurring this century. There is broad scientific consensus that an increase of more than 2°C would have serious global consequences. This could mean a doubling of severe rainfall events (i.e. 70mm of water or more over a 24 hour period) in Edmonton by 2090. This is significant for Edmonton as large areas of the city are susceptible to overland and sewer backup flood risk. Even though climate change impacts will vary from region-to-region (with impacts likely to be more severe in some places than in Edmonton), *Edmonton's Community Energy Transition Strategy* takes the position there would be no winners if the world's average air temperature increased more than 2°C.

Communities wanting to mitigate this risk can take steps to: (a) reduce their own GHG emissions to levels that limit the long-term rise in the average global temperature to 2°C, (b) influence other jurisdictions to do the same and (c) implement adaptive measures. Communities taking this approach understand that many seemingly insignificant actions world-wide are needed to produce a significant global result.

Risk 4: Possible Disruptions to Edmonton's Energy Systems from Climate-related Disturbances and Shocks

Edmonton's Community Energy Transition Strategy takes the position that Edmonton's energy systems are exposed to a **Low to Moderate Risk** when it comes to climate-related disruptions over the next several decades. This assessment was the conclusion of a workshop hosted by the City of Edmonton in February 2014 that was attended by approximately 20 local energy system experts and City of Edmonton risk managers. The scope of their review was limited to natural gas and electricity systems, as these two commodities account for nearly 60% percent of all secondary energy use in Edmonton. Evaluation of Edmonton's natural gas system included consideration of transmission lines, storage, gate stations, distribution and end use. Evaluation of Edmonton's electricity system included consideration of power facilities, step-up transformers, transmission wires, step-down transformers, distribution lines and end use. Of the approximately 20 risks examined, the majority were scored as Low Risk with several receiving Moderate Risk rankings.

Communities wanting to mitigate this risk can take action to create redundancy in their energy systems, e.g., back-up methods of generating electricity in case of failure of another component.

Risk 5: Air Quality

Edmonton's Community Energy Transition Strategy takes the position that Edmonton is exposed to a **High Risk** with respect to the combustion of fossil fuels in the Capital Region and its impact on ambient air quality. This is based on the **Extremely Likely** probability of this risk occurring and the **Moderate** consequence that Edmonton would experience if it did.

Air quality in Canada is required to meet federally mandated Canada Wide Standards (CWS) and soon to be released Canadian Ambient Air Quality Standards (CAAQS) for four criteria air contaminants (ozone, particulate matter, sulphur dioxide and oxides of nitrogen). These standards are enforced through the Canadian Environmental Protection Act (CEPA). Currently, the Capital Region is exceeding the limits set for fine particulate matter (PM2.5) and has been ordered to develop a reduction strategy.

Fine particulate matter refers to airborne particles with an aerodynamic diameter of 2.5 micrometers or less (in comparison, paper thickness on average is 90 micrometers). It is created by both naturally occurring events and human activity. There are two types of PM2.5: (1) primary particulate matter emitted directly from sources such as industry and home heating and (2) secondary particulate matter created through chemical reaction in the atmosphere involving substances such as nitrogen oxide from vehicles.

PM2.5 is associated with a broad spectrum of acute and chronic illness such as lung cancer and cardiopulmonary disease. Worldwide, it is estimated to cause about 9% of lung cancer deaths, 5% of cardiopulmonary deaths and about 1% of respiratory infection deaths.

In addition to the rising health risks, high levels of PM2.5 pose a potential constraint to Edmonton's economic development. Given the high levels of PM2.5 in our airshed today, it could become increasingly challenging to approve new industrial facilities if they were to add to the problem. If Edmonton is going to make room for additional emissions from new industries, it may be necessary to reduce existing emissions from vehicles, buildings and existing industry.

2.3 Energy Transition – The Opportunity

The *diagnosis* to this point has focused on risks to Edmonton if the world becomes more energy constrained and impacted by climate change. Based on this diagnosis, the strategy takes the position that there is a high probability the world will need to find new energy sources to replace oil and natural gas in this century (as they become scarcer and more expensive). It also takes the position that growing environmental concerns will likely require us to transition from fossil fuels, particularly coal.

The challenge associated with replacing so much of our current energy mix with renewable and alternative energy sources is enormous. Arguably, it represents the most profound global transformation of the 21st Century. While *Edmonton's Community Energy Transition Strategy* points to future risks, an equally important message is that: (a) energy transition is the golden opportunity of our age, (b) those who respond to the challenge with innovative solutions will prosper most and (c) few places are better positioned than Edmonton (in terms of knowledge, experience and financial capacity) to lead and excel in this area.

Opportunity – Standard of Living

In developing this strategy, an extensive literature review was conducted to examine the benefits of energy transition in communities where sustainability strategies are being pursued. The intent of this review was to determine if a policy direction that supports lower energy and sustainability (including the promotion of sustainable transit; energy efficiency in residential, commercial, institutional and industrial facilities; mixed use and higher density residential development; and transit oriented development) would enhance a city's economy and make it a better place to live. Based on this literature review, there is strong evidence that sustainability (of which energy sustainability is a major part) and overall quality of life are closely correlated.

Observations from 27 major urban centers across North America showed that cities with higher levels of energy efficiency, reduced GHG intensity, increased penetration of “green” buildings, greater availability of sustainable transport options and higher levels of water conservation tend to have:

- » Higher rates of employment / lower rates of unemployment;
- » Higher GDP per capita;
- » Lower rates of violent crimes;
- » More graduates (higher levels of educational attainment);
- » Lower levels of perceived stress among residents (improved mental health);
- » A greater sense of community among citizens; and
- » Higher levels of investment in new commercial and institutional buildings.

Large North American cities that typically score the highest in terms of sustainability include San Francisco, Vancouver, Washington DC, Seattle, New York, Boston, Toronto, Ottawa, Denver and Philadelphia. Many smaller cities such as Portland, Oregon are also ranked high in this regard. In these great cities, sustainability and quality of life go hand-in-hand.

Opportunity – Global Reputation

Alberta's oilsands developments are facing resistance in today's global energy markets. Responding to this opposition, the Government of Alberta has undertaken communication efforts to correct misconceptions, build political support and achieve stakeholder acceptance, i.e. **social license**. This strategy takes the

position that Alberta can strengthen its environmental image world-wide by establishing the highest standards of energy conservation, energy efficiency and innovation in its communities (such as the ones proposed in this strategy). Moreover, the strategy anticipates the various types of expertise gained in becoming an energy sustainable province will be marketable to the world.

Opportunity – Increased Efficiency and Competitiveness

In January 2014, the Alberta Energy Efficiency Alliance published a paper titled *Energy Efficiency Potential in Alberta*. The paper made a strong case for increased energy efficiency in Alberta, noting a range of energy efficiency opportunities that were already economical and would provide positive returns for investors. The paper estimated these opportunities would collectively reduce provincial GHG emissions by 27Mt by 2020 (achieving half of the Province’s GHG reduction target) and save Albertans \$1.5 billion annually. The paper called on the Province to create an energy efficiency program with funding from the Climate Change Emission Management Fund.

This strategy accepts the position that many cost-effective energy efficiency opportunities exist in Alberta industry and that by capturing them, we will improve our ability to compete in world markets.

Similarly, there are many energy efficiency opportunities in our homes and large buildings with equally compelling business cases. Making these improvements today will make our community more efficient, with savings that can be put to use in more economically productive and socially meaningful ways.

As well, advancement of short-term opportunities such as solar power and long-term opportunities such as fusion energy will help to diversify Edmonton’s economy and place it at the forefront of emerging economies.



PART 3

Strategic Courses of Action

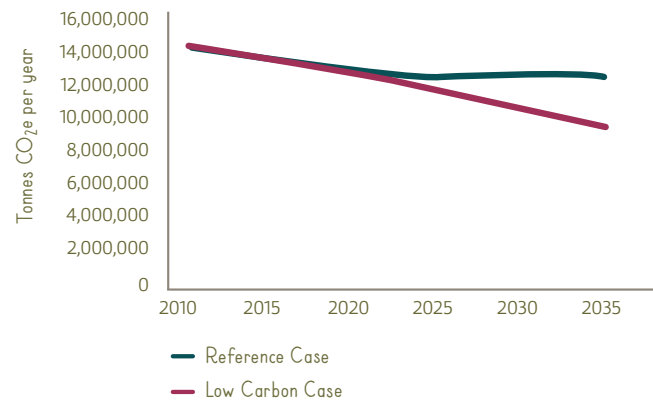
PART 3

Strategic Courses of Action

Edmonton's Community Energy Transition Strategy takes the position that over the next decade, energy and carbon price signals will not be high enough to motivate citizens and industry to make the investments (in energy efficiency, clean energy, distributed energy and conservation) that are needed to achieve Edmonton's energy transition goals. In order for Edmonton to become an energy sustainable city by 2050, it will be necessary for the City and other orders of government to intervene in the market using new policies, programs and actions.

Part 3 proposes twelve strategic courses of action that will be applied consistently in coming decades to achieve Edmonton's energy transition goals.

STRATEGIC ACTION 1: Edmonton will accelerate its energy transition efforts to become an energy sustainable city by mid-century.



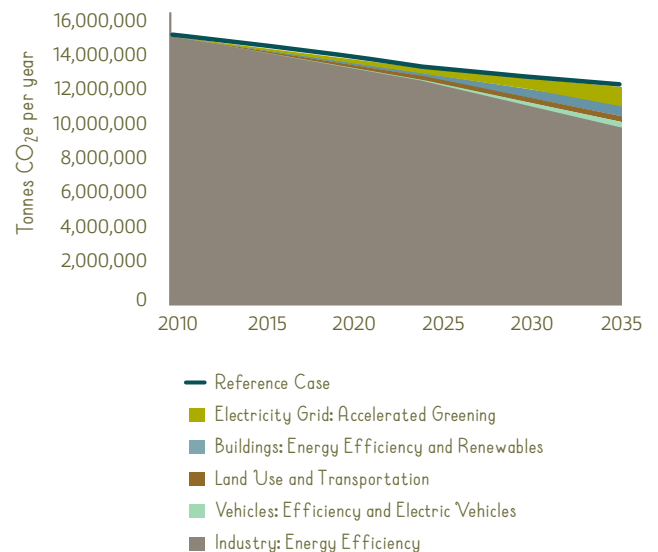
In developing *Edmonton's Community Energy Transition Strategy*, two different scenarios were modeled to understand how Edmonton's GHG emissions, energy use and energy mix would vary under different policy and development approaches. From this work, it was concluded the energy mix path Edmonton is on today (called the Reference Case scenario) would not deliver significant reductions in GHG emissions by mid-century nor significantly lessen our dependence on fossil fuels. However, when a hypothetical representation of what was possible in Edmonton using ambitious energy transition initiatives was modeled (i.e., the Low Energy/Carbon Case), it was concluded that it was possible to significantly reduce Edmonton's GHG emissions, limit the increase in total energy use and diversify Edmonton energy mix. While this Low Energy/Carbon scenario is theoretically achievable, it requires significant shifts in policy and removal of various constraining factors.

Based on this modeling, *Edmonton's Community Energy Transition Strategy* proposes the following targets that reflect an accelerated energy transition effort:

- » **Climate Change Mitigation:** Reduce community-based greenhouse gas emissions by 35% by 2035 (compared to 2005 levels).
- » **Energy Efficiency:** Reduce energy consumption by 25% per person by 2035 (compared to 2009 levels).
- » **Energy Resilience:** Generate 10% of Edmonton's electricity locally by 2035.

(See the full strategy at edmonton.ca/energytransition for more information on the modeling work that supports this strategy.)

STRATEGIC ACTION 2: Edmonton will focus its energy transition efforts on opportunities it controls and influences, including: 1) accelerating the greening of Alberta’s electricity grid, 2) attracting a greater proportion of Edmonton’s growth to established neighbourhoods, 3) improving energy efficiency of local industry, 4) increasing the uptake of distributed energy generation, 5) increasing energy efficiency in buildings and 6) reducing gasoline and diesel used in vehicles.



Modeling the Low Energy/Carbon Scenario confirmed deep emission reductions and reduced fossil fuel dependence were technically possible through the general measures discussed previously in Section 1.3, including:

- » Increasing the energy efficiency and the uptake of renewable energy in buildings could reduce GHG emissions 6% (below the Reference Case) by 2035.
- » Improving the energy efficiency of local industry could reduce GHG emissions 3% (below the Reference Case) by 2035.
- » Reducing gasoline and diesel used in vehicles could reduce GHG emissions 2% (below the Reference Case) by 2035.
- » Attracting a greater proportion of Edmonton’s growth to established neighbourhoods could reduce GHG emissions 4% (below the Reference Case) by 2035.
- » Accelerating greening of Alberta’s electricity grid could reduce GHG emissions 8% (below the Reference Case) by 2035.

Edmonton’s Community Energy Transition Strategy takes the position that while the City of Edmonton cannot directly control all outcomes, significant achievements are also possible through influence. Municipal and community influence are considered essential for overall success of this strategy.

STRATEGIC ACTION 3: Edmonton will achieve its energy transition goals and targets by: (a) avoiding wasteful energy and carbon-intensive practices, (b) improving energy efficiency and (c) replacing high carbon energy sources with low carbon sources where justification exists.



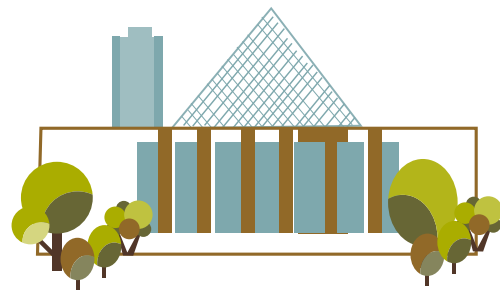
Although there are many energy transition initiatives a community can pursue, they typically fall within one of four general strategic approaches – Avoid, Reduce, Replace and Offset. These four approaches are sometimes seen as having different priorities based on their benefits and costs – with Avoid having the best benefit to cost relationship, followed by Reduce, Replace and Offset. *Edmonton’s Community Energy Transition Strategy* recommends investment in Avoid, Reduce and Replace strategies, but not in Offset strategies at this time.

- » **AVOID Strategies:** The most efficient unit of energy is the one that Edmontonians don’t use. In our personal lives, Avoid initiatives includes behavioural and lifestyle actions like turning off lights and electronics, turning down thermostats, walking instead of driving, downsizing homes and vehicles, reducing water consumption, generating less waste, etc. Similar actions are possible in institutions,

business and industry. Avoid strategies are also achieved through city design including outdoor lighting standards, transportation systems, policies that reduce our dependence on automobiles and greater density achieved through infill development strategies. These efforts produce a win-win by reducing GHG emissions (and total energy use) and saving people money.

- » **REDUCE Strategies:** This strategy involves improving the energy efficiency of vehicles, building envelopes, building operating systems, industrial processes and city infrastructure. Energy efficiency is sometimes described as the world’s most abundant, reliable, clean and least expensive energy source. Its supply is ubiquitous and it produces no pollution. While it is not free, it is usually cheaper than fuels and power generation.
- » **REPLACE Strategies:** This strategy involves replacing high carbon energy sources with low carbon sources and where possible switching to renewable energy sources (subject to availability, technical and regulatory constraints).
- » **OFFSET Strategies:** This strategy is often not pursued until a community has done everything it can to Avoid, Reduce and Replace. Given the abundance of Avoid, Reduce and Replace opportunities that exist today, *Edmonton’s Community Energy Transition Strategy* does not recommend offset strategies at this time. (Note: Carbon offset refers to situations where action is taken to reduce GHG emissions in one place to offset emissions that occur elsewhere.)

STRATEGIC ACTION 4: The City of Edmonton will take a lead role in supporting Edmonton’s energy transition efforts. In doing so, it will lead by example in its own civic operations.

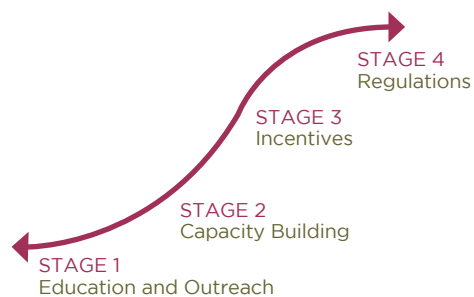


This strategic action assigns responsibility to the City of Edmonton for leading the ongoing implementation and maintenance of *Edmonton’s Community Energy Transition Strategy*. Although it has limited control in making Edmonton an energy sustainable city, the City of Edmonton is better positioned than any other entity to coordinate and lead this complex community effort.

In developing this strategy, stakeholders agreed the City should assume this central coordinating and leadership role. However, many stressed that to be credible in the role the City would need to **lead by example** in its own operations. This would mean meeting or exceeding the same high energy sustainability standards that are desired community-wide.

Section 4.7 of this strategy identifies key ways the City is currently leading and intends to further lead by example.

STRATEGIC ACTION 5: The City of Edmonton will apply a Market Transformation Approach to achieve the changes that are needed to become an energy sustainable city.



Although competitive market forces are driving energy efficiency improvements around the world, these improvements are being more than offset by population and economic growth. As a result, market-led energy efficiency and clean energy improvements happening today are not happening fast enough to: (a) limit the long-term rise in the average global temperature to 2°C and (b) reduce global dependence on fossil fuels. Essentially, there is a misalignment between what science is telling us (i.e., that there is a need for rapid energy transition by 2050) versus where the market appears to be leading us (i.e., relatively modest energy transition by 2050).

Edmonton's Community Energy Transition Strategy takes the position that special efforts are needed by governments to encourage citizens and businesses to invest in energy efficiency, energy conservation and clean energy solutions. To this end, it proposes a systematic, four-stage Market Transformation approach.

- » **Stage 1 (Education and Outreach):** Market transformation begins with a segment of the population understanding and valuing a particular opportunity (e.g., green buildings, renewable energy technology, energy efficient vehicles, etc.). Until there is a threshold of demand, there is no market. As a starting point for the community programs proposed in this strategy, Administration will ensure market awareness exists through education and outreach efforts.
- » **Stage 2 (Capacity Building):** A number of the energy transition initiatives proposed in the Eight-Year Action Plan (Part 4) involve new and emerging technologies. One of the greatest barriers to their widespread implementation is the ability of professional and trades people to incorporate them into everyday practice. Continuous learning is vital to the advancement of leading-edge, energy transition practices and technologies. Whatever the community program, *Edmonton's Community Energy Transition Strategy* will assess the industry capacity that currently exists and help to facilitate improvements that may be required.
- » **Stage 3 (Incentives):** In the early stages of a new market there is often uncertainty on the part of suppliers and consumers. Citizens are cautious about buying new technologies (e.g., solar panels, electric cars, net-zero homes, etc.) opting instead to wait-and-see. Similarly, suppliers of emerging technologies are cautious about entering markets where demand for emerging products is uncertain and/or volatile. In these early-market situations, incentives are often needed to help reduce the risks to early adopters and suppliers. At the same time, *Edmonton's Community Energy Transition Strategy* cautions that financial incentive programs are **not intended to become permanent programs**. Rather, their purpose is to increase market penetration to a point where the product/service becomes: (a) the preferred option (requiring no further incentives) or (b) a widely supported option (that may require some form of regulatory support). In proposing any financial incentive/rebate program, Administration will be clear about what the incentive is intended to accomplish, the amount of incentive funding that will be required and how the incentive program will eventually be phased out and replaced with a Stage 4 mechanism.
- » **Stage 4 (Regulations and/or Normal Market Forces):** In Stage 4, financial incentives are no longer required as the market is sufficiently mature. Awareness, capacity, demand and community support exist for the initiatives. In some cases, market forces alone will be sufficient to carry the initiative. In other situations, regulations may be needed. While regulations would have been premature in earlier stages, they are appropriate in Stage 4 based on the foundation that now exists.

The key point to understand about the Market Transformation Approach is that it is an integrated approach. Each stage is logically designed to create conditions that are necessary for success for the next stage. As such, this strategy urges it not be applied in a partial or fragmented way.

STRATEGIC ACTION 6: The City of Edmonton will determine the level and types of financial investment that are needed to achieve Edmonton's energy transition goals. It will take a lead role in finding solutions to advance initiatives that are economically justified.



This strategic action takes the position that an energy sustainable city can be an extremely sound, long-term community investment, delivering a range of social, economic, environmental and financial benefits. In developing this strategy, the Senior Economist of the consulting firm C3 (Dr. Richard Boyd) was engaged to develop a computer model for evaluating the economic and financial performance of ten possible energy transition programs as shown in Table 4 on page 30. They included:

Residential Buildings Programs

Program 1: This program would result in new homes being constructed to a higher energy efficiency standard than required by the Building Code along with an education/awareness program that would result in 10% more conservation than the Reference Case.

Program 2: This program would result in the uptake of renewable energy as part of the construction of new homes.

Program 3: This program would result in energy efficiency retrofits of existing homes along with an education/awareness program that would result in 10% more conservation than the Reference Case.

Program 4: This program would result in the uptake of renewable energy in existing homes.

Large / ICI Buildings Programs

Program 5: This program would result in new large buildings being constructed to a higher energy efficiency standard than required by the Building Code along with an education/awareness program that would result in 10% more conservation than the Reference Case.

Program 6: This program would result in the uptake of renewable energy as part of the construction of new large/ICI buildings.

Program 7: This program would result in energy efficiency retrofits of existing large/ICI buildings along with an education/awareness program that would result in 10% more conservation than the Reference Case.

Program 8: This program would result in the uptake of renewable energy in existing large/ICI buildings.

Industry Program

Program 9: This program would result in energy efficiency improvements to industrial facilities and processes.

Vehicles Program

Program 10: This program would result in the purchase of private passenger vehicles with electric drive trains.

Computer modeling revealed favourable economic performance for all ten programs. In all cases, long-term public and private benefits exceeded long-term public and private costs. Moreover, it was determined that all ten programs would require additional administrative and financial incentive support from government in order to encourage the larger investment by building, industry and vehicle owners. Modeling showed that over a four year period (2018-2021) government incentives and administration costs for these ten programs would total approximately \$60 million a year (or approximately \$60 per Edmontonian per year). However, these costs would be phased out over time as the desired improvements became the market norm.

Although all ten programs were economically positive, this strategy recommends a phased approach with respect to their implementation. Programs with Benefit/Cost (B/C) ratios equal to or greater than 2.5 would commence implementation by early 2018 (i.e., Programs 2, 3, 5, 6, 8, 9 and 10) while programs with B/C ratios less than 2.5 (i.e., Programs 1, 4 and 7) would be targeted for possible implementation in early 2022. Under this approach, over the four year period (2018-2021), government incentives and administration costs for the 7 front-runner programs would total approximately \$27.5 million a year (approximately \$30 per Edmontonian per year). Ideally this phased approach would reduce project risk by: (a) advancing programs that offer the best chances of success, (b) applying learnings from the first set of programs to the second set and (c) reducing 2018 start-up pressures.

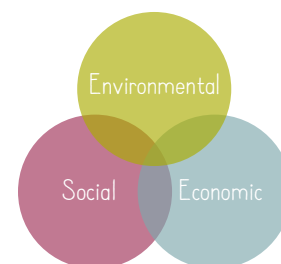
Funding for these community-scale programs would not be required immediately. Before community-scale programs could proceed, a variety of early-stage market transformation efforts would be undertaken, including a variety of education, awareness, capacity building and small scale pilot projects. Moreover, time would be needed to explore the possibility of province-wide application of these programs in partnership with the Province of Alberta and other Alberta municipalities. During 2015/16, Administration will also determine the most suitable funding sources for these new community investments.

TABLE 4 Summary of Modelling Results

Program	Potential Lifetime Reduction kt CO2	Potential Lifetime Energy Saving TJ	Net Present Value to 2035		Benefit /Cost Ratio (Public)	Program Costs (2018-2021) \$million (undiscounted)
			Private \$ million	Public \$ million		
Residential Buildings						
Program 1	18,500	177,000	\$675	\$860	2.4	\$103
Program 2*	400	9,000	\$70	\$70	3.2	\$3
Program 3*	10,300	82,000	\$265	\$500	6.3	\$27
Program 4	600	12,000	\$130	\$120	2.4	\$8
Large (ICI) Buildings						
Program 5*	15,500	50,000	\$230	\$625	4.1	\$16
Program 6*	500	11,000	\$90	\$90	3.6	\$4
Program 7	2,100	40,000	\$125	\$85	1.3	\$16
Program 8*	1,600	33,000	\$320	\$320	3.0	\$15
Industry						
Program 9*	5,100	99,000	\$575	\$645	5.1	\$44
Passenger Vehicles						
Program 10*	900	7,000	\$40	\$55	2.6	\$1
TOTAL	55,500 kt	520,000	\$2,520	\$3,370		\$237M (4 years) \$60M a year

* Program is recommended for community-scale implementation beginning no later than 2018.

STRATEGIC ACTION 7: The City of Edmonton will apply best management practices to ensure its investment and operating decisions are aligned with Edmonton’s energy transition goals. When making decisions, the City will (where appropriate): (1) conduct triple-bottom-line analyses (to understand social, economic and environmental implications of decisions), (2) conduct financial life cycle analyses to understand costs and benefits of investment options over their life spans, (3) include the cost of carbon and other externalities in these analyses and (4) apply consistent, conservative methodologies for estimating future energy prices.



The Ways (i.e., Live, Green, Prosper, Grow, Move and Finance) contain many goals that are best understood and managed as a whole. Together, they represent the great city we are all striving to build. Managing our social, economic and environmental goals in an integrated way ensures the decisions we make not only achieve their most immediate goal, but are also the best overall solutions for achieving co-benefits in terms of the City’s many other goals. This strategic action is designed to ensure energy transition goals are considered whenever major decisions are made by the City. The Eight-Year Action Plan (Section 4.7.12) speaks more to this item.

STRATEGIC ACTION 8: The City of Edmonton will strive, where possible, to achieve Edmonton's energy transition goals in partnership with other municipalities and the Province of Alberta.



Many Alberta communities have set goals to be environmentally sustainable. Like Edmonton, they are striving to reduce GHG emissions, improve energy efficiency and become more energy resilient. This vision is also shared by the Province of Alberta:

- » The Province's energy strategy (*Launching Alberta's Energy Future*) describes clean energy production and wise energy use as desired outcomes;
- » The Province's climate change strategy identifies the greening of Alberta's energy production as a key theme; and
- » The Province intends to make Alberta the national leader in energy efficiency and sustainability (Priority 2.3 of Alberta Environment & Sustainable Resource Development Business Plan 2013-2016).

This strategic action recognizes the enormous opportunity that exists for Alberta stakeholders (government, business, institutions and citizens) to work more closely in achieving common visions and goals. This could include the development of common: (a) education and outreach programs, (b) capacity building programs, (c) incentive programs and (d) regulations.

STRATEGIC ACTION 9: The City of Edmonton will create and provide ongoing support for a community leadership body that will play a key role in leading Edmonton's Community Energy Transition Strategy.



Achieving energy transition goals on a community scale requires strong community leadership and support. As explained by the United Nations Environment Program (in its paper titled *Towards a Green Economy – Pathways to Sustainable Development and Poverty Eradication*), “only a coalition of actors and effective multilevel governance can ensure success of green cities. The most important fundamental enabling condition is the coalition of actors from the national and local state, civil society, the private sector and universities who are committed to advancing the green economy and its urban prerequisites, and placing it centrally within the top strategic priorities for the city. The central task of this coalition is to promote the idea of a long term strategic plan for the city.”

This strategic action calls for the creation of a central coalition of community leaders and stakeholders to guide the implementation and maintenance of this strategy. The Eight-Year Action Plan (Section 4.7.18) speaks more to this item.

STRATEGIC ACTION 10: The City of Edmonton will apply the advice of the Citizens' Panel on Edmonton's Energy and Climate Challenges: (a) weighing the costs and benefits of each energy transition action, (b) using public and transparent decision making processes so that citizens are confident that energy transition decisions serve the public good, (c) linking City leadership to citizen education, and (d) recognizing and promoting multiple reasons for energy transition.

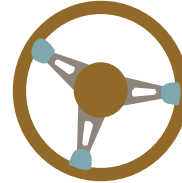


As previously discussed in Section 1.3, in September 2012 a Citizens' Panel was formed “to discover whether we as Edmontonians want our city to become low carbon, whether we consider the Discussion Paper to provide a good map for getting there, and how much we support particular actions

proposed in it.” In its report titled *Citizens’ Panel on Edmonton’s Energy and Climate Challenges*, edmonton.ca/city_government/environmental_stewardship/citizens-panel-energy-climate.aspx, the Panel recommended: That the City of Edmonton take the measures needed to become a low carbon city by 2050.

This strategic action establishes the Panel’s advice within the strategy, giving priority to the principles of financial prudence, project transparency and citizen engagement.

STRATEGIC ACTION 11: The City of Edmonton will pursue the goals in Edmonton’s Community Energy Transition Strategy using a dynamic/adaptive steering approach.



This strategy recognizes the uncertainty we face today in achieving energy transition goals that are decades away. As we proceed with the first step of Edmonton’s energy transition journey, we understand the need for flexibility. While the initiatives outlined in this strategy represent our best thinking today, we expect this thinking will evolve over time as: (a) new technologies, solutions and information emerge and/or (b) social, economic and environmental conditions change. As such, the strategy applies a cautious and flexible approach to energy transition, careful not to place all our eggs in one basket nor take high risk positions that could lock in sub-optimal solutions. Moreover, it calls for a dynamic steering approach that includes: (a) continual surveillance of risks, opportunities and performance, (b) timely feedback loops, (c) continual evaluation of next-steps and (d) ability to alter course quickly as new information and opportunities emerge.

As such, Step One of Edmonton’s energy transition journey (2014-2017) is focused on: (a) creating organizational and financial conditions for long-term success, (b) leading by example in City operations and (c) better understanding and preparing for the large community scale investments that will be required in Step Two (2018-2021).

STRATEGIC ACTION 12: The City of Edmonton will work collaboratively with Federal/Provincial governments to address Federal/Provincial legislation and policies that are barriers to Edmonton’s energy sustainability goals, and encourage Federal/Provincial legislation and policies that support Edmonton’s energy sustainability goals.



While the low price of fossil fuel energy is seen as the greatest barrier deterring society from pursuing energy conservation, energy efficiency and renewable energy, in some cases, Federal and Provincial laws and policies also act as deterrents. These include policies that permit coal burning power plants to operate deep into the 21st century, financial and tax incentives that favour fossil fuel industries and regulations that sometimes deter the uptake of renewable energy technologies. This strategic action ensures the City of Edmonton will continually monitor Federal and Provincial legislation and policies to identify possible legal and policy barriers and work constructively to resolve them.



PART 4

Eight-Year Action Plan

PART 4

Eight-Year Action Plan

Edmonton's Community Energy Transition Strategy takes the view that it is impossible for us today to design every step of Edmonton's long-term energy transition journey. There is simply too much uncertainty surrounding future technologies, geo-political conditions, the economy, citizen expectations, international laws and agreements, energy supply and demand, etc. Given this view, this document should be seen as the first steps of a multi-decade, multi-step journey.

The Eight-Year Action Plan comprises two, four-year steps: 2014-2017 and 2018-2021. The first step (2014-2017) identifies actions that will be pursued. In situations where actions are currently unfunded, this funding will be requested as part of the 2016 and 2017 operating budgets to be funded through tax levy. The second step (2018-2021) signals future actions that are proposed, including a number of community scale energy efficiency and renewable energy programs. Again, a number of tactics are identified as being unfunded. It is anticipated that much of the funding required for this second step will need to come from other orders of government. Identification of these programs several years in advance of their initiation allows time that is needed to develop their detailed design, determine appropriate sources of funding and engage stakeholders as required. Equally, it signals to Edmontonians the changes that are on the way.

It is intended that *Edmonton's Community Energy Transition Strategy* will be updated every four years to clearly reflect actions that will be pursued in the coming four years and signal actions that are anticipated in years five to eight, i.e., a revolving action plan.

The first step of the journey (2014 to 2017) focuses on: (a) creating conditions for long-term success, (b) leading by example in City operations in order to gain the experience and credibility needed to lead the community and (c) understanding and preparing for the large community-scale investments that will be required in the next step (2018-2021). Moreover, it takes a cautious and flexible approach to energy transition, careful not to place all of our eggs in one basket nor take high risk positions that could lock in sub-optimal solutions for a long time.

The Eight-Year Action Plan identifies seven Opportunity Areas:

- » Energy Use in Buildings (Section 4.1)
- » Generation of Electricity and Heat (Section 4.2)
- » Energy Use in Industry (Section 4.3)
- » Land Use, Transportation and Development (Section 4.4)
- » Water and Waste Water (Section 4.5)
- » Waste Reduction and Recycling (Section 4.6)
- » Leadership (Section 4.7)

These Opportunity Areas are further divided into 49 Focus Areas, and within them, approximately 150 Tactics.

The status of each tactic is indicated using the following symbols:

- » ■ Currently Doing
- » ■ Will Do
- » ■ Proposed

Black dots (•) specify the year(s) in which a tactic will be undertaken.

Organizational entities responsible for leading implementation effort are identified using the following abbreviations:

<p>ABCtech: Alberta Council of Technologies</p> <p>CLT: Corporate Leadership Team</p> <p>CP: Current Planning Branch</p> <p>DS: Drainage Services</p> <p>EEDC: Edmonton Economic Development Corporation</p> <p>ETS: Edmonton Transit</p> <p>EWSI: EPCOR Water Services Inc.</p>	<p>FS: Fleet Services Branch</p> <p>FSU: Financial Services and Utilities</p> <p>IGA: Intergovernmental Affairs</p> <p>LRTDC: LRT Design and Construction</p> <p>PMMS: Project Management and Maintenance Services Branch</p> <p>RDC: Roads Design and Construction</p> <p>REHES: Real Estate, Housing and Economic Sustainability Branch</p>	<p>SCC: Shaw Conference Centre</p> <p>SD: Sustainable Development</p> <p>TO: Transportation Operations</p> <p>TP: Transportation Planning</p> <p>UPE: Urban Planning and Environment Branch</p> <p>WMS: Waste Management Services</p>
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In situations where proposed tactics are unfunded, the unfunded cost is indicated.

In developing this Eight-Year Action Plan, some stakeholders suggested the City simplify the plan by focusing on a smaller number of tactics, i.e., the 20% of tactics that would deliver 80% of the results. While this type of approach would be preferable, strategists felt it was not well suited to energy transition. The strategy takes the position that there is no small set of tactics for becoming an energy sustainable city and that many small tactics are required across many fronts. In other words, a full scale community effort is required that engages every sector and every citizen in multiple ways.

This Action Plan creates an accountability framework around each of these many possible solutions – placing each on a track that is designed to evaluate and capitalize on their potential.

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	

Opportunity Area: Energy Use in Buildings

Approximately 40% of the energy used in Edmonton is used in buildings (19% in residential buildings and 23% in large/ICI buildings). Moreover, approximately 40% of Edmonton’s GHG emissions originate from buildings (19% from residential buildings and 19% from large/commercial buildings). The greening of Edmonton’s building stock is possible through a variety of tactics involving government, building owners and occupants.



4.1.1 Core Programs: *Develop core programs that support energy efficiency in all types of buildings.*

■ A: Establish a long-term awareness and education campaign to inform citizens about the benefits of green buildings.		•	• \$500K	• \$500K	• \$500K	• \$500K	• \$500K	• \$500K	UPE
■ B: Establish a demonstration program showcasing products, services and behaviors that achieve energy efficiency in buildings.	•	•	•	•	•	•	•	•	CP
■ C: Expand the City of Edmonton’s Green Building Recognition Program – recognizing excellence in new and existing residential buildings, large buildings and industrial buildings.	•	•	•	•	•	•	•	•	CP
■ D: Conduct a comprehensive review of City policies, bylaws and processes to identify and address possible barriers to green buildings in Edmonton.		•							CP
■ E: Establish more sophisticated tools and databases for evaluating energy use in Edmonton buildings.	•	•	•						UPE
■ F: Work with energy retailers, energy distributors and regulators to provide customers with better information to evaluate energy use in their buildings. Evaluate opportunities for more informative utility bills and visible metering in homes.	•	•	•						UPE
■ G: When negotiating for Charter City powers, evaluate possible new authority to establish high energy efficiency standards in Edmonton’s new and existing buildings.		•	•						UPE IGA

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	
4.1.2 New Homes: Encourage high energy efficiency standards in new buildings where economically justified.									
<ul style="list-style-type: none"> A: In partnership with the Canadian Home Builders' Association (Edmonton Region) and Edmonton Real Estate Board, establish a voluntary energy labeling pilot program for new homes in Edmonton (using EnerGuide labelling). 		•	•	•	•	•	•	•	UPE
			\$200K	\$200K	\$200K	\$200K	\$200K	\$200K	
4.1.3 New Homes: Encourage the Province of Alberta to update Alberta's construction codes in a timely manner to ensure high energy efficiency standards in Alberta buildings.									
<ul style="list-style-type: none"> A: Advocate to the Province of Alberta for timely adoption of the National Model Construction Codes. 		•	•	•	•	•	•	•	UPE IGA
4.1.4 Existing Homes: Encourage and support tactics that will reduce energy use in existing homes.									
<ul style="list-style-type: none"> A: Establish a Green Renovation Program for existing homes in Edmonton (Program 3, see Table 4). Apply a comprehensive market transformation approach that includes outreach, capacity building, incentives and regulations. Explore opportunities to involve the Provincial government, key stakeholders and other municipalities. Present a detailed business case for a pilot project (that can be expanded to community scale as required) to City Council for approval. 		•	•	•	•	•	•	•	UPE
					\$7M*	\$7M*	\$7M*	\$7M*	
<ul style="list-style-type: none"> B: Evaluate the costs and benefits of a web-based information tool for informing citizens about the thermal efficiency of Edmonton's building stock. 		•							CP
<ul style="list-style-type: none"> C: In partnership with Canadian Home Builders' Association (Edmonton Region) and the Edmonton Real Estate Board, establish a voluntary energy labeling pilot program for existing homes in Edmonton. 		•	•	•	•	•	•	•	UPE
			\$200K	\$200K	\$200K	\$200K	\$200K	\$200K	
4.1.5 New Large Buildings: Encourage high energy efficiency standards in new large buildings where economically justified.									
<ul style="list-style-type: none"> A: Establish a Green Building Checklist for new large buildings detailing green building features the City of Edmonton wishes to encourage on a voluntary basis. 		•	•	•	•	•	•	•	UPE CP
<ul style="list-style-type: none"> B: Establish a Green Construction Program for new, large buildings (Program 5, see Table 4) to encourage priority actions in the Green Building Checklist (Tactic A). Explore opportunities to involve the Provincial government, key stakeholders and other municipalities. Present a detailed business case for a pilot project (that can be expanded to community scale as required) to City Council for approval. 		•	•	•	•	•	•	•	UPE
					\$4M*	\$4M*	\$4M*	\$4M*	

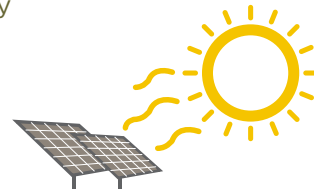
* A significant portion of this funding will need to be provided by other orders of government.

TACTICS	2014-2017				2018-2021				Lead	
	14	15	16	17	18	19	20	21		
4.1.6 Existing Large Buildings: Encourage and support tactics that will reduce energy use and greenhouse gas emissions in existing large/ICI buildings.										
<ul style="list-style-type: none"> A: Design a Green Renovation Program for existing, large buildings in Edmonton (Program 7, see Table 4) for implementation in 2022. Apply a comprehensive market transformation approach that includes outreach, capacity building, incentives and regulations. Explore opportunities to involve the Provincial government, key stakeholders and other municipalities. Present a detailed business case for a pilot project (that can be expanded to community scale as required) to City Council for approval. 						•	•	•	•	UPE
<ul style="list-style-type: none"> B: Establish and implement a re-commissioning program for City-owned buildings. In partnership with the Building Owners and Managers Association of Edmonton (BOMA Edmonton). As justified, expand it to include voluntary re-commissioning of large privately-owned buildings. 		•	•	•	•	•	•	•	•	UPE
<ul style="list-style-type: none"> C: In partnership with BOMA Edmonton, establish and implement a voluntary program for publicly reporting/disclosing energy consumption and GHG emissions of Edmonton's largest buildings. Lead by example with City of Edmonton's largest buildings. Assess the U.S. Environmental Protection Agency's ENERGY STAR Portfolio Manager as a tool for reporting and normalizing this information. 			• \$30K	•	• \$20K	•	•	•	•	UPE

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	

Opportunity Area: Generation of Electricity and Heat

Electricity comprises 16% of Edmonton’s energy mix and contributes approximately 40% of its GHG emissions. Production of electricity in Alberta results in high carbon emissions due to the extensive use of coal and the fact that simple cycle coal-fired plants are inefficient (with approximately 60% of the primary energy lost in the generation, plant operation and transmission processes). GHGs and other emissions could be reduced significantly by shifting to electricity produced solely from natural gas, wind, solar photovoltaic and biomass. As well, opportunities exist to generate a greater portion of our electricity locally using combined heat and power (CHP) and district energy (DE) systems. For example, full build-out of the DE system proposed for The Quarters would displace more than 63 kt of CO2 per year.



4.2.1 District Energy: *Understand the potential for district energy systems in Edmonton and establish these systems where economically justified.*

<p>■ A: Develop a feasibility study and business plan for district energy in the Quarters. As part of this study:</p> <ul style="list-style-type: none"> • Outline ownership/partnership options (for constructing, operating and maintaining the system) and recommend one that is best for the Quarters/Downtown. • Recommend a policy whereby City-owned and -leased buildings would be required to connect to the district energy system. 										REHES
<p>■ B: Conduct a city-wide district energy feasibility study, including:</p> <ul style="list-style-type: none"> • Establish energy intensity data on existing high density developments. • Establish energy intensity data for proposed new developments. • Identify significant sources of waste energy streams. • Create an energy intensity map for the entire city. • Establish ranking criteria for DE opportunities (energy density, available energy sources, land use forms and development timelines). • Screen and rank the potential DE opportunities. • Assess justification to proceed with development of detailed business cases for specific district energy systems. 										SD
<p>■ C: Develop business cases for priority district energy opportunities and present them to City Council for approval.</p>										SD

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	
<ul style="list-style-type: none"> D: Develop a business model for designing, constructing and operating district energy systems in Edmonton, including: <ul style="list-style-type: none"> Identify possible barriers to district energy (awareness, capacity, financial, regulatory). Recommend incentives, including density bonuses that will encourage owners of private buildings to connect to the system and/or construct new buildings to a district energy-ready standard. Recommend funding sources with consideration to: (a) gas tax rebate, (b) a portion of a local access fee and/or franchise fee, (c) CCEMC funding, etc. 			•	•					SD
<ul style="list-style-type: none"> E: In partnership with the Province of Alberta and other interested municipalities, conduct a study to understand the broad economic opportunities associated with wide-scale uptake of district energy infrastructure in Alberta, i.e., improvements in energy efficiency and creation of local construction, installation, maintenance and manufacturing jobs. 				•					SD
4.2.2 Combined Heat and Power: Understand the opportunities for combined heat and power (CHP) systems in Edmonton and encourage their installation where economically justified.									
<ul style="list-style-type: none"> A: Establish a CHP pilot program for City buildings/facilities with a goal to: <ul style="list-style-type: none"> Determine the economic feasibility of CHP in a variety of building/facility types, situations and scales. Evaluate the pros and cons of different ownership and operating arrangements. Showcase these projects to the community (as a way of creating greater awareness). Assess the justification for a community-scale program that would promote the uptake of CHP. 			• \$25K	• \$50K	• \$50K	•			PMMS
<ul style="list-style-type: none"> B: Establish a CHP literacy program targeting building owners, managers and tenants, including: sharing City of Edmonton CHP results and experiences, maintaining CHP information on the COE website and partnering with BOMA to deliver CHP workshops and information sessions. 		•	•	•					UPE
<ul style="list-style-type: none"> C: Subject to the outcome of Tactic A (above), establish a pilot program for advancing CHP in Edmonton using the four-phase market transformation approach. 			•	•					UPE
<ul style="list-style-type: none"> D: Assess the feasibility of a guideline/regulation that would encourage/require large buildings (exceeding certain heat and electricity loads) to conduct CHP feasibility assessments as part of their development approval process. 			•						UPE

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	
■ E: In partnership with the Canadian Home Builders' Association (Edmonton Region) and CHP suppliers, study the costs and benefits of micro-CHP technology and their possible applications.			•						UPE
4.2.3 Renewable Energy: Advance solar photovoltaic (PV) technology in Edmonton in accordance with recommendations made by Edmonton's Renewable Task Force in 2012.									
■ A: Establish programs to encourage uptake of solar PV technology in: (a) new homes (Program 2, see Table 4), (b) new large/ICI buildings (Program 6, see Table 4) and (c) existing large/ICI buildings (Program 8, see Table 4), including: <ul style="list-style-type: none"> • Undertaking education and awareness efforts to create demand for renewable energy technologies in new buildings. • Ensuring Edmonton's construction industry has the necessary capacity to support these programs. • Providing financial incentives to encourage the uptake of renewable technology in new buildings. Present a detailed business case for a pilot project (that can be expanded to community scale as required) to City Council for approval.	•	•	• \$300K	• \$600K	• \$5.5M*	• \$5.5M*	• \$5.5M*	• \$5.5M*	UPE
■ B: Conduct a review to identify barriers to renewable energy that may exist in municipal codes, policies and legislation. Develop strategies to address excessive barriers.	•	•							UPE
■ C: Develop a new Solar Combo permit to fast-track and standardize the process of applying, approving and inspecting the installation of building level solar PV and solar thermal systems.		•							CP
■ D: Establish a City procedure requiring major developments and redevelopments to achieve an optimal balance between population density and solar access using design features that may include: building placement, building shape, building orientation, roadway width, roadway orientation and building groupings.			• \$40K						CP
■ E: Establish a requirement for new buildings with solar access to be built solar-ready.		•	•						CP
4.2.4 Fusion Energy: Position Edmonton and Alberta to be the Canadian centre for a national fusion energy program.									
■ A: In partnership with government, industry and academic institutions, establish and maintain an Alberta Fusion Energy directorate aimed at taking a leadership role to position Alberta for the fusion future.		• \$1M**	• \$3M**	• \$4M**	• \$5M**	• TBD	• TBD	• TBD	ABCtech
■ B: Develop a strategy and business case for building the world's first inertial fusion energy (IFE) plant in Alberta.			•	•					ABCtech

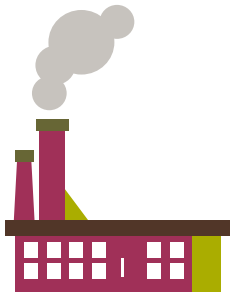
* A significant portion of this funding will need to be provided by other orders of government.

** It is anticipated that all of this funding would be provided by other orders of government.

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	

Opportunity Area: Energy Use in Industry

A range of national studies conducted in recent years indicate Canadian industries could reduce energy consumption by 13% (oilsands, conventional oil and gas, agriculture, forestry and construction) to 25% (manufacturing). Achieving this improvement is possible through a variety of government action carried out in partnership with industry.



4.3.1 Encourage Provincial Action: Advocate to the Government of Alberta for a comprehensive energy efficiency program targeting small and medium size industry in Alberta.

<p>A: Advocate to the Government of Alberta for a province-wide energy efficiency program aimed at small and medium-size industry (Program 9, see Table 4).</p>	•	•	•	•	•	•	•	•	•	UPE
					\$11M*	\$11M*	\$11M*	\$11M*		
<p>B: Advocate to the Government of Alberta to assess the justification for expanding the scope of the Specified Gas Emitters Regulation to include medium-size emitters and for the fee paid by emitters to be increased to levels that will serve as an effective incentive to improve energy efficiency.</p>		•	•	•						UPE

4.3.2 Eco Industrial Developments: Design and develop industrial areas to achieve high standards in energy efficiency and GHG emissions.

<p>A: Develop detailed energy efficiency and GHG emissions standards/expectations for:</p> <ul style="list-style-type: none"> The Edmonton Energy and Technology Park Area Structure Plan The Eco-Industrial Approach The Zoning Bylaw 12800, Section 970 Special Area Edmonton Energy and Technology Park 	•	•	•	•						SD
<p>B: Encourage higher energy efficiency standards in existing industrial developments by amending the Zoning Bylaw to include eco-industrial requirements for industrial re-zonings and major additions to existing industrial buildings.</p>		•	•	•						SD

4.3.3 Support Local Industry: Help local industries to be more energy efficient and more globally competitive.

<p>A: Pursue competitiveness within the Industrial Supply Chain, targeting Edmonton-based suppliers to achieve improvements in reducing GHG emissions.</p>		•	•	•						SD EEDC
<p>B: Assess the feasibility of creating and operating eco-districts in Edmonton's existing industrial areas as a way of bringing neighbouring companies together to collaborate on clean energy and energy efficient opportunities. Establish a pilot project (involving a number of neighbouring small and medium-size industrial companies) for this purpose.</p>		•	•	•						SD EEDC

* It is anticipated that all of this funding would be provided by other orders of government.

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	

Opportunity Area: Land Use, Transportation and Development

Research shows that energy used for transportation increases as a city becomes more spread-out and as housing, jobs, shopping, recreation and community destinations become more dispersed. Modeling performed for this strategy confirmed this relationship. It was determined that Edmonton could reduce its GHG emissions by 4% by 2035 (compared to the Reference Case) if it were able to attract a greater proportion of development to mixed-use and transit-oriented neighbourhoods within already-developed areas of the City (with the aim that by 2050, 40% of new development would be occurring in already developed areas of the city).



4.4.1 Residential Infill: *Encourage and actively facilitate development of more new housing in Edmonton's mature and established neighbourhoods.*

■ A: Implement Edmonton's Infill Roadmap, a two-year work plan to advance infill.		•	•						UPE
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4.4.2 Transit Oriented Development: *Capitalize on the opportunity for Transit Oriented Development (TOD) to accommodate growth in Edmonton's existing neighbourhoods.*

■ A: Implement the TOD Implementation Strategy in order to achieve the full TOD potential of existing and future LRT stations in a timely manner including: (a) completing two to four station area redevelopment plans (ARPs) at strategic location along the existing or future LRT network, (b) implementing approved station ARPs, (c) preparing the Transit Precinct Concept Plan for the Mill Woods Town Centre LRT and (d) changing zoning regulations to accommodate TOD.	•	•	•	•	•	•	•	•	UPE
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4.4.3 Transformational Mixed-Use Developments: *Capitalize on opportunities for transformational developments to accommodate growth in Edmonton's mature areas - Downtown, Blatchford, The Quarters and West Rosssdale.*

■ A: All: Establish a set of energy efficiency performance guidelines and criteria (supporting this strategy and consistent with the high energy standards anticipated for Blatchford Redevelopment) for general application in all new developments and redevelopments.		•	•						SD
■ B: All: Ensure that planning and plan implementation in the Downtown, Blatchford, The Quarters, West Rosssdale and TOD areas occur in a logical and coordinated way to expedite their overall development and avoid unnecessary competition and duplication of effort. Consider the value of staging these developments in ways that will avoid confusion and create synergy.		•							SD
■ C: All: Consider innovative tools for attracting growth to these projects including: (a) financial incentives and (b) tax incentives.		•							SD

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	
■ D: All: Evaluate opportunities for the City to take a stronger role in advancing these projects including: (a) developing City-owned lands, (b) assembling land for resale, (c) partnering on developments, (d) selling City-owned land at a discount to encourage prime projects, (e) using City funds to leverage private investment and (f) creating a City-owned, arms-length development corporation.		•							SD
■ E: In partnership with UDI and other development stakeholders, conduct periodic reviews to identify and evaluate development-related innovations that can reduce energy use (including innovations to increase density, reduce infrastructure, support mode shift, etc.)		•	•						SD
■ F: Downtown/Quarters: Explore measures to encourage the repurposing of surface parking lots in the Downtown and the Quarters.		•							SD
■ G: Downtown: (a) Design and construct a park at 105 Street and 102 Avenue, (b) develop and implement a communications plan to mitigate negative impacts of construction and to encourage Edmontonians to visit and explore Downtown, (c) construct a stormwater trunk pipe to provide improved drainage servicing to Downtown and partial sewer separation, (d) continue implementation of the additional phases of the Jasper Avenue New Vision Project (pending funding approval) and (e) undertake streetscape improvements to Downtown streets, beginning with 104 Avenue from 97 Street to 105 Street (pending funding approval).	•	•	•	•	•				SD
■ H: Downtown: In partnership with the Downtown Business Association evaluate the need for and possible scope of a Retail Strategy for Downtown.		•							UPE
■ I: Quarters: (a) Design and construct the New City Park Phase 1, (b) undertake streetscape improvements to create connectivity with the Downtown, (c) continue drainage upgrades and (d) undertake strategic land acquisitions.		•	•	•	•				REHES
■ J: West Rosedale: Undertake arterial road and intersection upgrades and make public realm improvements.	•	•	•	•	•				SD TP
■ K: West Rosedale: Establish an Integrated Heritage Interpretive plan.	•	•							UPE
■ L: West Rosedale: Stabilize the Rosedale Power Plant.	•	•							UPE

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	
4.4.4 Expand LRT: Encourage mode shift from single occupancy vehicles by expanding LRT.									
■ A: Implement the Long-Term LRT Network Plan including: (1) Metro Line to NAIT (slated to open end of 2015), (2) Valley Line from Downtown to Mill Woods (slated to open in 2020), (3) Valley Line from Downtown to West, (4) Capital Line NE, (5) Capital Line South and (6) Metro Line to the northern city limits.	•	•	•	•	•	•	•	•	LRTDC
■ B: Consider: (a) prioritizing transit and active transit above automobiles and (b) funding transit and active mode infrastructure ahead of roadway.					•				TP
4.4.5 Biking: Expand on-street biking facilities to make active transportation safer and more convenient.									
■ A: Complete public consultation for two routes (a) 83 Avenue from 112 Street to Mill Creek Ravine and (b) 102 Avenue from 136 Street to 95 Street. Undertake construction in 2015-16.	•	•							TD RDC
■ B: Assess the costs and benefits of a bike sharing program in high density areas as well as to and from transit centres and LRT stations.					•				TP
■ C: Consider strategies for significantly increasing biking infrastructure beyond what is currently planned.					•				TP
4.4.6 Sidewalks and Paths: Expand Edmonton's sidewalks and shared-use paths to make active transportation safer and more convenient.									
■ A: Continue to construct missing links of sidewalks and shared-use paths.	•	•	•	•	•	•	•	•	TP RDC
4.4.7 Pay-As-You-Drive Insurance: Evaluate and possibly advocate for automobile insurance premiums that are commensurate with distances traveled.									
■ A: Assess the costs and benefits of pay-as-you-drive insurance. Based on the outcome of this work, determine whether the City will advocate to the Province for changes to Provincial regulations that would permit its use in Alberta.		•	•						UPE
4.4.8 Transportation Marketing: Inform and influence Edmontonians about the advantages of sustainable transportation.									
■ A: Expand the 1 Day a Week social marketing campaign to encourage citizens to choose sustainable forms of transportation at least one day a week.			•						TP
■ B: Launch a Corporate Commuter Options program to help businesses encourage employees to commute sustainably, including the launch of a ride-matching tool.			•						TP

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	
4.4.9 Fuel Efficient Vehicles: Advocate for provincial programs that encourage citizens to purchase fuel efficient vehicles.									
■ A: Advocate to the Province of Alberta for incentives/programs to encourage: (a) the purchase of fuel efficient vehicles and (b) the retirement of old, polluting, inefficient vehicles.		•	•	•					UPE TP
■ B: Conduct a study to understand how Edmonton should prepare for electric vehicles in the community. As part of the study, assess infrastructure needs (e.g., charging stations throughout the community and in new buildings) and supporting bylaws.		•	• \$50K	• \$25K					UPE
■ C: Consider partnering with the Province of Alberta to increase the fuel tax or create a carbon tax for fuels to better reflect the externalities of fossil fuel powered vehicles.			•	•	•				UPE
4.4.10 Parking Strategies: Assess and implement parking strategies in commercial corridors and transit oriented development areas.									
■ A: Modernize existing coin operated meters with new pay-by-plate parking technology.		•	•	•					TO
■ B: Partner with Edmonton Transit to explore opportunities to increased use of park-and-ride lots during evenings and weekends for arena and special events. Consider strategic pricing strategies to promote transit and active modes of travel.		•	•	•	•				TO ET
■ C: Explore partnerships with businesses with large parking lots to use as temporary park and ride lots with ETS shuttles for special events.		•	•						TO, ET SD
■ D: Use real-time parking data to develop guidance program enabling customers to locate vacant parking stalls.		•	•						TO
■ E: Evaluate the feasibility of strategic parking supply restrictions, toll roads and congestion pricing for vehicles.					•				TP
■ F: Consider: (a) removing minimum and reducing maximum parking requirements for new developments and (b) unbundling parking spaces from apartment and condominium developments so residents recognize the cost of vehicle storage.			•						UPE
4.4.11 Car Sharing: Encourage car-share programs in Edmonton.									
■ A: Work with early entrants into Edmonton's emerging car-share market to remove barriers and facilitate their expansion to all parts of the city.	•	•	•	•					UPE
■ B: Create a City car-sharing policy to guide the development of Edmonton's car-sharing industry.		•	•						UPE
■ C: Evaluate the opportunity for City operations to use private car-share services to supplement and possibly reduce its own fleet services.		•	•						UPE

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	

Opportunity Area: Water and Waste Water

Water-related GHG emissions are mainly caused by energy used in the water treatment, transport and waste water treatment processes. About 0.5% of Edmonton’s community-wide GHG emissions are related to the treating and transporting of water. Similarly, large amounts of energy are used to treat waste water in the initial separation, organic solids breakdown and clarification processes.



4.5.1 Water Treatment and Distribution: *Maintain high energy efficiency performance in treating and distributing water.*

■ A: Complete booster mode upgrade to the Millwoods Reservoir. The expected outcome is energy savings by minimizing the loss of system pressure and not having to reboost from atmospheric pressure to system pressure.	•								EWSI
■ B: Seek opportunities to upgrade pumps and valves with higher efficiency ones in pump stations on regular life cycle replacement. The expected outcome is improved energy efficiency.	•	•	•	•					EWSI
■ C: Continue to rebuild and coat water treatment plant (WTP) pumps to reduce losses caused by rough surfaces. The expected outcome is improved energy efficiency of the highlift pumps.	•	•	•	•					EWSI
■ D: Continue to investigate and implement more efficient operational strategies to move water throughout the distribution system to meet customer demands.	•	•	•	•					EWSI
■ E: Pursue energy efficiency upgrades at the water treatment plant and reservoirs, for example LED lighting conversion, HVAC upgrades, building envelope assessments, etc.	•	•	•	•					EWSI

4.5.2 Water Conservation: *Continue to be a nation’s leader in water conservation.*

■ A: Continue operational efficiencies including system leak detection/water loss programs and ongoing watermain replacement programs.	•	•	•	•	•	•	•	•	EWSI
■ B: Continue to educate Edmontonians on wise water use through advertising and education campaigns (indoor, outdoor, leaks), school programs, print material, website and community outreach events.	•	•	•	•	•	•	•	•	EWSI
■ C: Continue to target water wasters through specific campaigns.	•	•	•	•	•	•	•	•	EWSI

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	
4.5.3 Waste Water Treatment: <i>Minimize energy use and GHG emissions from wastewater treatment.</i>									
■ A: Develop an Energy Management Plan for Gold Bar Waste Water Treatment Plant (WWTP).	•	•	•	•					EWSI
■ B: Report Gold Bar energy efficiency.		•	•	•	•	•	•	•	EWSI
■ C: Evaluate the feasibility of biogas co-generation in the Gold Bar WWTP.	•	•	•	•					EWSI
■ D: Complete OSTARA phosphorus removal facility at Clover Bar lagoons.									EWSI

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	

Opportunity Area: Waste Reduction and Recycling

The waste we produce has a variety of GHG effects. When buried in landfills, it eventually decomposes to produce GHGs such as methane and carbon dioxide. The main strategy in minimizing GHG emissions from waste is the avoidance of landfilling in the first place. A related strategy is to manage the methane gas emitted from old landfills. As well, using recycled materials to produce new products reduces the embodied energy in new products because of the reduced energy needed to extract, transport and process raw materials.



4.6.1 Utilize Residential Waste: Avoid GHG emissions by reducing the proportion and total amount of Edmonton's residential waste that is landfilled and utilizing it to its full potential.

■ A: Commission and ramp-up the Waste-to-Biofuels Facility.	•	•	•						WMS
■ B: Develop an Anaerobic Digestion Facility with the potential to divert 40,000 tonnes per year of organic solid wastes while producing heat and power.	•	•	•	•					WMS

4.6.2 Utilize Non-Residential Waste: Avoid GHG emissions by reducing the proportion and total amount of Edmonton's non-residential waste that is landfilled and utilizing it to its full potential.

■ A: The Waste-to-Biofuels Facility will utilize facility capacity by using non-residential waste.	•	•							WMS
■ B: Develop the future Anaerobic Digestion Facility to handle solid organic non-residential waste.	•	•	•	•					WMS
■ C: Advocate to the Province of Alberta for stronger regulations to reduce the landfilling of non-residential waste.	•	•	•	•					WMS

4.6.3 Reduce Waste Generation: Reduce the amount of waste generated by Edmontonians as a result of consumption, packaging or wasteful practices.

■ A: Continue the Grasscycling (Go Bagless) Program.	•	•	•						WMS
■ B: Continue the Backyard Composting Programs.	•	•	•	•					WMS
■ C: Expand public education and social marketing programs to encourage waste reduction and reuse among residents.	•	•	•	•					WMS
■ D: Work with other municipalities and business organizations to urge adoption of provincial and federal legislation that improves the recyclability of products and packaging.		•	•	•					WMS

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	

Opportunity Area: Leadership

The City is better positioned than any other entity in Edmonton to coordinate and lead Edmonton’s energy transition. However, in order for the City to have credibility in this role, it must lead by example with exemplary energy efficiency and GHG mitigation performance in its own operations. In addition to internal City of Edmonton leadership, leaders are needed from all sectors including government, civil society, arts, business, education, entertainment, etc. – with the aim of promoting *Edmonton’s Community Energy Transition Strategy* to all Edmontonians.



4.7.1 City Leadership - City-owned Buildings: *Minimize energy consumption in City buildings.*

<p>■ A: Develop/implement a formal corporate procedure defining best management practices for achieving energy efficiency in City buildings. Define energy management controls at all stages of the building life cycle ranging from the Concept Stage to the Decommissioning Stage. As part of this work, review the City Energy Policy against industry benchmarks including: (a) BOMA Energy Management Policy, (b) ASHRAE and (c) Green Globes.</p>			•	•						PMMS
<p>■ B: Update the Sustainable Building Policy to: (a) reflect industry acceptable energy efficiency requirement for new buildings, (b) establish a current state energy profile to identify energy efficiency and GHG emissions for existing building infrastructure, (c) incorporate current-state energy profile information to perform life cycle evaluation within the decision-making processes, (d) identify the minimum number of energy efficiency points that City buildings must obtain as part of a LEED application and (e) amend the energy efficiency performance target to 30% higher than the current MNECB standard.</p>			•	•						PMMS
<p>■ C: Establish and implement an energy education program for City operations stakeholders who have responsibilities that affect or influence the energy consumption in City infrastructure and assets.</p>	•	•	•	•	•	•	•	•	•	PMMS
<p>■ D: Establish asset life cycle to include impact of energy efficiency retrofits and rehabilitation changes to City infrastructure and assets. Complete development of facility asset management funding recommendations to CLT.</p>	•	•	•	•	•	•	•	•	•	PMMS

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	
■ E: Conduct daylight harvesting and LED lighting pilot projects. Complete effective baseline monitoring and reporting to determine outcomes and identify preferred profiles for equipment and services that should be utilized by client Branches for future building and rehabilitation projects.	•	•	•	•	•	•	•	•	PMMS
■ F: Optimize the building rehabilitation program by implementing higher efficiency mechanical and electrical facility systems. Also resolve structural deficiencies that cause thermal leakage and energy inefficiency.	•	•	•	•	•	•	•	•	PMMS
■ G: Build out the City Energy Management Opportunity Assessment (EMOA) framework to include best practice energy audits and energy inspections.	•	•	•	•	•	•	•	•	PMMS
■ H: Communicate the City's green building success stories.	•	•	•	•	•	•	•	•	PMMS
4.7.2 City Leadership - Renewable and Alternative Energy: Evaluate and pilot the use of distributed energy generation technologies in City operations to understand their larger scale application in City operations and the community.									
■ A: Establish and implement a program to evaluate the feasibility of micro-generation technology (e.g., solar photovoltaic, combined heat and power and others) in the City's existing buildings and infrastructure.		•	•	•					PMMS
■ B: Incorporate renewable and alternative energy considerations into the planning, architecture and engineering design of new buildings and the rehabilitation of existing buildings.		•	•	•					PMMS
■ C: Consider a shift to renewable energy through installation of solar panels on roadway infrastructure (e.g., bus stops, roadway surfaces, sidewalks, etc.).				•	•				SD TP
4.7.3 City Leadership - City-owned Residential Development: Encourage sustainable development on land the City develops.									
■ A: Continue to encourage higher levels of sustainability by increasing minimum standards (e.g., third party certification requirements) and adding new or innovative requirements (such as solar-ready, partial solar, net zero) on residential properties sold by the City.	•	•	•	•	•	•	•	•	REHES
■ B: Continue to encourage LEED or equivalent certification and sustainability standards on industrial and commercial properties sold by the City. Consider requiring innovations such as rain water retention systems, eco-friendly paving and drainage and solar (PV, thermal and passive) on industrial and commercial properties.	•	•	•	•	•	•	•	•	REHES

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	
4.7.4 City Leadership - Civic Accommodations: Adopt and apply civic accommodation standards that reduce energy use and GHG emissions, while achieving healthy and productive workplaces for City employees.									
■ A: Undertake a Sustainable Corporate Facility Strategy (SCFS) study to develop a framework to determine the best use of existing and future facilities. Apply this framework in the planning of new and retrofitted City facilities.	•	•	•	•	•				REHES
■ B: Conduct the Alternative Workstyles Study (Phase 2) to identify and implement suitable alternative work style strategies for City operations.	•	•	•	•	•				REHES
■ C: Commence the WORKshift certification process for the City of Edmonton including the development of related policies and guidelines.		•	•	•					REHES
■ D: Establish a Green Lease program for buildings the City leases that requires this space to meet green criteria or be improved over time to meet green criteria.		•							REHES
4.7.5 City Leadership - Public Transportation: Promote transit ridership growth and strive for energy efficiency throughout the transit system.									
■ A: Evaluate Edmonton Transit GHG emissions associated with the various technologies, equipment, vehicles and infrastructure used in the transit system.		•	•						ETS FS
■ B: Establish, implement and maintain an Edmonton Transit GHG Management Plan and GHG Inventory.		•	•						ETS
■ C: Implement Smart Bus Technology, allowing customers to utilize the system more effectively, thus increasing customer satisfaction and encouraging new riders.	•	•	•	•					ETS
■ D: Implement Smart Fare Technology allowing easier fare payment for customers.		•	•	•	•				ETS
■ E: Evaluate new bus technology for battery powered buses and necessary support infrastructure.	•	•	•	•	•	•	•	•	ETS FS
■ F: Purchase Green Energy to power the LRT system at 10% increments.			•	•	•	•	•	•	ETS
■ G: Utilize ETS land space to install wind and solar power generation to assist in powering Transit Centres and Transit Garages.		•	•	•	•	•	•	•	ETS

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	
4.7.6 City Leadership - Employee Commuting: Reduce single occupant vehicle (SOV) commuting by City employees. Build awareness surrounding the need and benefits of sustainable transportation.									
■ A: Promote the existing bike sharing program for City employees.	•	•	•	•	•	•	•	•	TP
■ B: Review the current free parking policy for City employees to determine its justification and opportunities for mode shifting. Consider the possibility of allowing employees to exchange their space for a transit pass or receive a monthly payout.		•							CLT
■ C: Implement and promote SmartMatchyeg, the City of Edmonton online ride-matching tool.	•	•	•	•					TP
■ D: Enhance infrastructure as per City worksite assessments to improve connections to sustainable transportation and end-of-trip facilities.	•	•	•	•					TBD
4.7.7 City Leadership - Municipal Fleet: Maintain a fleet of energy efficient and low-carbon vehicles and equipment to achieve their energy efficiency potential.									
■ A: Conduct a pilot involving 10 vehicles up-fitted with an integrated vehicle intelligence system to monitor driver behavior including speeding and idling.	•	•							FS
■ B: Improve driver participation in the Municipal FuelSense training program to shape driving behaviors conducive to saving fuel and reducing emissions.		•	•	•	•	•	•	•	FS
■ C: Accelerate the retirement of less fuel efficient on-road, heavy-duty vehicles with the most fuel efficient technology available for the application where justified.				•	•	•	•	•	FS
■ D: Accelerate the retirement of less fuel efficient passenger and light-duty trucks with the most fuel efficient technology available for the application where justified.		•	•	•	•	•	•	•	FS
■ E: Continue to monitor opportunities to implement CNG and hydrogen fuel cell technologies.	•	•	•	•	•	•	•	•	FS
■ F: Continue to monitor and assess the applicability of electric vehicles in Edmonton.	•	•	•	•	•	•	•	•	FS
■ G: Continue to work with client departments to purchase the right size of vehicle for the job.	•	•	•	•	•	•	•	•	FS
■ H: Revise the Sustainable Fleet Plan to reflect new and emerging technologies.		•			•			•	FS
■ I: Develop a fleet reduction strategy based on vehicle usage and operational requirements.		•	•					•	FS

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	
4.7.8 City Leadership - Road Construction and Maintenance: Use methods and materials that minimize the amount of energy used and GHGs emitted in the construction and maintenance of City roadways.									
■ A: Increase the amount of full depth reclamation performed on City roads.		•	•	•	•	•	•	•	RDC
■ B: Replace the existing asphalt plant with a modern, more efficient plant.		•	•	•	•	•	•	•	TO
■ C: Study the use of warm asphalt for construction and maintenance of City roads to determine its overall effectiveness with respect to durability, energy consumption, GHG emissions and cost.		•	•	•	•	•	•	•	TO
■ D: Compare resources and energy requirements to remove snow from: (a) arterial and/or collector road with on-boulevard snow storage versus (b) similar roads with no on-boulevard snow storage.		•	•	•	•	•	•	•	TP, RDC, TO
4.7.9 City Leadership - Roadway Lighting: Reduce the amount of electricity used to light roadways.									
■ A: Issue a request for information for an Energy Services Company delivery model in order to evaluate the benefits of this funding model as a way of accelerating the City's LED Street Light Conversion Program. Based on this information, recommend to City Council an appropriate financing model for an accelerated conversion program.	•	•							TO
■ B: Complete pilot projects (currently under way) to evaluate the costs and benefits of adaptive lighting technology. Based on pilot project results, determine the feasibility of its broader implementation across the city. Develop corresponding business and implementation plans.	•	•							TO
■ C: Seek approval from the Alberta Utilities Commission for implementing adaptive lighting technology for energy billing purposes.	•	•							TO
■ D: Develop a City Policy to address light generated from private property such as parking lots, commercial facilities and illuminated advertising.			•						SD
4.7.10 City Leadership - Traffic Flow: Expand Intelligent Transportation System (ITS) technology to optimize traffic flow.									
■ A: Complete the Yellowhead Trail ITS Corridor Management Project (utilizing a predictive and adaptive traffic control system to optimize traffic flow and provide incident management).						•	•	•	TO
■ B: Complete the 170 Street (Whitemud Drive to Yellowhead Trail) Corridor Optimization Project (utilizing advanced modeling techniques to optimize traffic signals).	•	•							TO

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	
■ C: Complete the 51 Avenue/111 Street and 40 Avenue/111 Street Adaptive LRT/Traffic Signal Optimization Project (utilizing leading-edge adaptive signal control that reacts to current traffic conditions).	•	•	•	•					TO
■ D: Complete the Whitemud Drive Variable Speed Limit Corridor Optimization Project (utilizing advanced modeling techniques to manage freeway speeds to avoid breakdown and stop-and-go conditions and increase safety).	•	•	•						TO
■ E: Complete the Calgary Trail and Gateway Boulevard Corridor Optimization Project (utilizing advanced modeling techniques to optimize traffic signals).	•	•	•						TO
■ F: Update the City's Traffic Management Centre's traffic management system, preparing it for current and future ITS technologies.		•	•						TO
■ G: Undertake analyses to quantify GHG reduction related to the ITS actions.	•	•	•	•					TO

4.7.11 City Leadership in Drainage: *Design, construct, operate and maintain Edmonton's drainage system in ways that minimize the impact on the environment, including the amount of energy used and GHGs emitted.*

■ A: Minimize energy consumption in Edmonton's drainage systems by ensuring: <ul style="list-style-type: none"> • Drainage-owned buildings are operated to minimize energy waste. • Drainage-owned vehicles and equipment are both energy efficient and low carbon emitting. • Operation schedules are well designed to use vehicles efficiently. • Work methods and materials are employed that minimize the amount of energy used and GHGs emitted. 	•	•	•	•	•	•	•	•	DS
■ B: Implement resource reuse and carbon sequestration practices: <ul style="list-style-type: none"> • Encourage rainwater harvesting for non-potable reuse and water reclamation to reduce energy consumption associated with potable water treatment. • Promote the use of green infrastructure that sequesters carbon in development projects. • Make efficient use of existing drainage infrastructure and materials for infill and redevelopment projects. • Investigate the possibility of utilizing biosolids in the Waste-to-Biofuels Facility. 	•	•	•	•	•	•	•	•	DS

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	
<ul style="list-style-type: none"> C: Continue partnership and outreach programs that reduce energy use: <ul style="list-style-type: none"> Treat it Right®: Promote awareness of wastewater management practices that reduce energy consumption. Low Impact Development (LID): Work with various sectors to promote LID strategies to manage stormwater through mimicking natural processes. 	•	•	•	•	•	•	•	•	DS
4.7.12 City Leadership - Management Tools: Establish a consistent city-wide approach for making program and investment decisions using triple-bottom-line and life cycle costing methodologies.									
<ul style="list-style-type: none"> A: Establish and maintain City directives detailing: <ul style="list-style-type: none"> The City's approach to triple-bottom-line decision-making including quantitative and qualitative methods that will be used. The City's commitment to life cycle analysis as the preferred way of evaluating the costs and benefits of significant, long-term investments, including the specific methods that will be used. The City's approach to valuing externalities (e.g., the cost of carbon) as part of its decision-making processes. The City's approach to estimating the long-term cost of energy (e.g., electricity, natural gas, gasoline, diesel) when developing life cycle analyses for long-term investments. 		•	•						FSU
4.7.13 City Leadership - Chief Sustainability Officer Function: Assign responsibility for the implementation and maintenance of Edmonton's Community Energy Transition Strategy to a senior manager (or management body) with a clear mandate to work across all City departments.									
<ul style="list-style-type: none"> A: Create a Chief Sustainability Officer function with a broad, corporate-wide mandate for sustainability, including the implementation and maintenance of this strategy. 			• \$200K	• \$200K	• \$200K	• \$200K	• \$200K	• \$200K	SD
4.7.14 City Leadership - Financing: Establish funding/financing to enable the programs/tactics recommended in Edmonton's Community Energy Transition Strategy.									
<ul style="list-style-type: none"> A: In partnership with the Province, Alberta municipalities, major financial institutions and key stakeholders, identify and assess the feasibility of new financing arrangements to assist citizens with energy efficiency and clean energy investments (including arrangements such as property-assessed financing programs and on-bill tariff repayment financing programs). 		•	•						SD
<ul style="list-style-type: none"> B: Evaluate the feasibility of local access fees (levied on electricity consumption) and franchise fees (levied on natural gas consumption) as funding sources to incent green energy and energy efficiency improvements. 		•	•						SD FSU

TACTICS	2014-2017				2018-2021				Lead
	14	15	16	17	18	19	20	21	
■ C: Evaluate the feasibility and opportunity for wide-scale use of Energy Savings Agreement Financing to finance green energy and energy efficiency technologies in City operations.		•	•						SD FSU
4.7.15 City Leadership – Greenhouse Gas Inventory: Establish an accurate and reliable method for calculating Edmonton’s greenhouse gas emissions with a level of detail that will allow understanding of trends and development of GHG reduction programs.									
■ A: Refine the City’s methodology for calculating and analyzing Edmonton’s community GHG emissions.		•	•						UPE
■ B: Update the City Operations Greenhouse Gas Management Plan.		•	•						UPE
4.7.16 City Leadership - Environmental Management Systems: Manage the City’s GHG emissions and energy consumption as significant environmental aspects.									
■ A: Establish GHG emissions and energy consumption as significant environmental aspects within the City’s nine environmental management systems and manage them to the stringent requirements of ISO 14001.		•							UPE
4.7.17 City Leadership - Food and Agriculture: Advance a resilient food and agricultural system in Edmonton that reduces food-related energy use and greenhouse gas emissions.									
■ A: Implement <i>fresh</i> : Edmonton’s Food and Urban Agriculture Strategy.	•	•	•	•	•	•	•	•	UPE
4.7.18 Community Leadership: Establish a Board of prominent community champions to advise on the implementation of Edmonton’s Community Energy Transition Strategy and lead its public communications efforts.									
■ A: Establish a City Council committee/board to provide high profile community leadership and oversight over the implementation, maintenance and communication of <i>Edmonton’s Community Energy Transition Strategy</i> .		•	•						UPE
4.7.19 Community Leadership: Establish the Shaw Conference Centre as a place for Edmonton to showcase, display and test energy transition technologies, innovations and lifestyle.									
■ A: Establish a business plan and budget indicating how the Shaw Conference Centre will implement its vision to become an energy transition and sustainability showcase.		•	•						SCC

APPENDIX A

Definitions and Acronyms

DEFINITIONS

Biomass: Organic material such as wood, crop waste, municipal solid waste, hog fuel and pulping liquor processed for energy production.

Bitumen: A highly viscous mixture, mainly hydrocarbons heavier than pentanes. In its natural state it is not usually recoverable at a commercial rate through a well because it is too thick to flow.

Capacity: The maximum amount of power that a device can generate, use or transfer, usually expressed in megawatts.

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

Climate: The average weather over a long period of time – several decades, centuries or millennia.

Combined Heat and Power System: A system that produces electricity and heat simultaneously by burning a single fuel (also referred to as cogeneration).

CO₂e / carbon dioxide equivalent: A standard unit for measuring carbon footprints. The idea is to express the impact of each different greenhouse gas in terms of the amount of CO₂ that would create the same amount of warming.

Conventional Crude Oil: Crude oil which, at a particular point in time, can be technically and economically produced through a well using normal production practices and without altering the natural viscous state of the oil.

Conventional Natural Gas: Natural gas that is found in the reservoir and produced through a wellbore with known technology and where the drive for production is provided by expansion of the gas or by pressure from an underlying aquifer.

Demand-Side Management: The modification of consumer demand for energy through various methods such as financial incentives and education. Usually, the goal of demand side management is to encourage the consumer to use less energy.

District Energy System: Local, centralized energy systems that produce and distribute thermal energy (heating and/or cooling) for customer use.

Electric Load: The electrical energy that is consumed by a component, circuit, device, piece of equipment or system that is connected to a source of electric power in order to perform its function.

End-use Demand: Energy used by consumers in the residential, commercial, industrial and transportation sectors. This is also referred to secondary energy demand.

Energy: Although more technical definitions exist, in this strategy the term “energy” refers to the full range of energy sources we rely on to meet our wants and needs. It includes both renewable and non-renewable energy sources.

Energy Constrained World: This term is used throughout this strategy to describe a world in which there is not enough energy to meet all of society's needs, i.e., global demand for energy exceeds supply. In an energy constrained world, energy prices would be significantly higher than today (in real dollar terms), with far-reaching social and economic consequences.

Energy Efficiency: This term refers to how effectively energy is being used for a given purpose. For example, providing a similar (or better) level of service with less energy consumption on a per unit basis is considered an improvement in energy efficiency.

Energy Intensity: The amount of energy used per unit of activity. Examples of activity measures are households, floor space, passenger-kilometres, tonne-kilometres, physical units of production and constant dollar value of gross domestic product.

Energy Sustainable City: A city that meets the five criteria contained in the definition of energy transition.

Energy Transition: A risk management approach designed to: (1) diversify a community's energy mix and reduce its dependence on fossil fuels, (2) reduce greenhouse gas emissions to levels that are consistent with limiting the long-term rise in the average global temperature to 2°C, (3) ensure energy delivery systems (for electricity and natural gas) are resilient and durable to the forces of climate change, (4) increase self-sufficiency with respect to its electrical power and heating needs and (5) position itself to participate in what is potentially the largest economic opportunity humankind has ever experienced.

Fossil Fuel: Hydrocarbon-based fuel sources such as coal, natural gas, natural gas liquids and crude oil.

Generation (electricity): The process of producing electric energy by transforming other forms of energy. Also, the amount of energy produced.

Greenfield Development: A term used in construction and development to reference land that has never been used (e.g., green or new), where there was no need to demolish or rebuild any existing structures.

Greenhouse Gases (GHG): Gases such as carbon dioxide, methane and nitrogen oxide which actively contribute to the atmospheric greenhouse effect. Greenhouse gases also include gases generated through industrial processes.

Gross Domestic Product (GDP): A measure of economic activity within a country including the market value of all goods and services in a year within Canada's borders.

In Situ Recovery: The recovery of bitumen through the use of wellbores, generally in areas where depth of burial precludes surface mining operations.

Kilowatt-Hour (kWh): The commercial unit of electricity energy equivalent to 1,000 watt-hours. A kilowatt-hour can best be visualized as the amount of electricity consumed by ten 100-watt bulbs burning for an hour. One kilowatt-hour equals 3.6 million joules.

Leadership: A process of social influence that maximizes the efforts of others to achieve a goal.

Low Carbon City: A city that has a minimal output of greenhouse gases into the environment biosphere.

Low Energy/Carbon Case: Refers to one of the three scenarios modeled in developing *Edmonton's Community Energy Transition Strategy*. The Low Energy/Carbon Case estimates the energy mix and GHG emissions possible if all of the major opportunities identified in *Edmonton's Energy Transition Discussion Paper* were implemented.

Market Transformation: A four stage approach (including (1) awareness and education, (2) capacity building, (3) incentives and (4) regulations and competitive market mechanisms) designed to achieve a specific market outcome.

Mtoe: Million tonne of oil equivalent.

Natural Gas Liquids (NGL): Those hydrocarbon components recoverable from natural gas as liquids, including ethane, propane, butanes and pentanes.

Natural Step Canada: A non-profit organization founded in Sweden in 1989 by scientist Karl-Henrik Robèrt. Following publication of the Bruntland Report in 1987, Robèrt developed The Natural Step framework, setting out the system conditions for the sustainability of human activities on Earth.

Net Zero Building/Site: A building/site where the total amount of energy used on an annual basis is roughly equal to the amount of renewable energy created on the site.

OECD: An international economic organization of 34 countries founded in 1961 to stimulate economic progress and world trade. The organization is committed to democracy and market economy.

Oil Sands: Sand and other rock material that contains bitumen. Each particle of oil sand is coated with a layer of water and a thin film of bitumen.

Opportunity: An uncertainty that could have a positive effect leading to benefits or rewards. (Note: This definition is very similar to the definition of “risk”. In fact, opportunity could be seen as just another form of risk: a risk with a negative impact is a threat whereas a risk with a positive impact is an opportunity.)

Pay-As-You-Drive Insurance: Refers to vehicle insurance premiums that are based on the distance a vehicle travels during the policy term.

PM2.5: Refers to fine particulate matter which is airborne particles with an aerodynamic diameter of 2.5 micrometers or less (for comparison, paper thickness on average is 90 micrometers). It is created by both naturally occurring events and human activity. There are two types of PM2.5: (1) primary particulate matter emitted directly from sources such as industry and home heating and (2) secondary particulate matter created through chemical reaction in the atmosphere involving substances such as nitrogen oxide from vehicles.

Primary Energy: An energy form found in nature that has not been subjected to any conversion or transformation process. It is energy contained in raw fuels and other forms of energy received as input to a system. Primary energy can be non-renewable or renewable. It includes oil, coal, natural gas, uranium, solar energy, wind energy, falling and flowing water, biomass sources and geothermal.

Re-commissioning: Refers to a re-optimization process for existing buildings that have already been either commissioned or retro-commissioned. It ensures building equipment and systems are operating optimally to meet current occupant needs. It provides a rigorous investigation approach to identify problems and integration issues. Its primary focus is on identifying low cost operational improvements given the building’s current usage to obtain comfort and energy savings. It may be done alone or in concert with a retrofit program.

Real Dollars: Dollars that have been adjusted from a nominal value to remove the effects of general price level price changes over time.

Reference Case: Refers to one of the three scenarios modeled in developing *Edmonton’s Community Energy Transition Strategy*. The Reference Case represents the energy mix path Edmonton is currently on including: (a) continuation of the current land development patterns, (b) increased building code and vehicle efficiency standards in line with but not beyond stated government policy, (c) electric vehicle uptake in line with projected national trends, (d) GHG intensity of the provincial electricity grid decreasing as currently expected and (e) GHG emissions from heavy industry at the same rate as city-wide job growth.

Renewable Energy: Energy that comes from resources which are naturally replenished on a human timescale such as sunlight, wind, rain, tides, waves and geothermal heat.

Reserves: Reserves are estimated remaining marketable quantities of oil and natural gas and related substances anticipated to be recoverable from known accumulations, as of a given date, based on: analysis of drilling, geological, geophysical and engineering data; the use of established technology; and specific economic conditions, which are generally accepted as being reasonable and shall be disclosed.

Reserves-Proven: Proved reserves are those reserves that can be estimated with a high degree of certainty to be recoverable. It is likely that the actual remaining quantities recovered will exceed the estimated proved reserves.

Reserves-To-Production Ratio: The reserves remaining at the end of any year are divided by the production in that year, the result is the length of time that those remaining reserves.

Resilience: In the context of this strategy, resilience refers to the ability of Edmonton's energy system to persist (i.e., to absorb shocks and stresses and still provide safe, reliable and economic delivery of electricity and natural gas to consumers).

Resources (Oil and Natural Gas): In the context of this strategy, resources refer to the remaining total volume of recoverable oil and natural gas that is thought to exist. Resources include deposits not economical to extract at current oil and gas prices, but may become economical as prices rise. Resources also include an undiscovered component, which may have been bypassed in current wells or have yet to be found. Resources can also include an additional amount of oil and gas that may be recovered as technology improves beyond current capabilities.

Risk: Refers to the effect of uncertainty on objectives. (Note: According to this ISO 31000 definition, risk includes events that may or may not happen and uncertainties caused by ambiguity or lack of information.)

Social Cost Of Carbon: An estimate of the economic damages associated with a small increase in carbon dioxide emissions (conventionally one metric tonne).

Unconventional Crude Oil: Crude oil that is not classified as conventional crude oil (e.g., bitumen).

Unconventional Natural Gas: Natural gas that is contained in a non-traditional reservoir rock that requires significant additional stimulus to flow. It may be that the gas is held by coal, ice or shale or where the reservoir has an unusually low amount of porosity and permeability.

Social License To Operate: Refers to the level of acceptance or approval by local communities and stakeholders of mining companies and their operations. It is based on the idea that mining companies need not only government permission to operate but also social permission to conduct their business.

Solar PV: Photovoltaic cells (also known as solar panels) are semiconductors made up of silicon atoms that convert the sun's energy into electricity.

Transit Oriented Development: A type of urban development that is planned and integrated with a transit station at its core.

Weather: Something that happens on a daily basis in the atmosphere – air temperature, rain, snow, wind, etc.



ACRONYMS

BOMA Edmonton: Building Owners and Managers Association of Edmonton
CHBA: Canadian Home Builders Association
CHP System: Combined heat and power system
CLT: Corporate Leadership Team (City of Edmonton)
CNG: Compressed natural gas
COE: City of Edmonton
CP: Current Planning Branch (City of Edmonton)
DE System: District energy system
DS: Drainage Services (City of Edmonton)
EREB: Edmonton Real Estate Board
ET: Edmonton Transit (City of Edmonton)
EWSI: EPCOR Water Services Inc.
FS: Fleet Services Branch (City of Edmonton)
FSU: Financial Services and Utilities (City of Edmonton)
GBP: Green Building Plan
GFIGNR: German Federal Institute for Geosciences and Natural Resources
GHG: Greenhouse gas
ICI Buildings: Institutional, commercial and industrial buildings
IEA: International Energy Agency
IGA: Intergovernmental Affairs (City of Edmonton)
K: Thousand (dollars)
LRTDC: LRT Design and Construction (City of Edmonton)
M: Million (dollars)
MNECB: Model National Energy Code for Buildings
PMMS: Project Management and Maintenance Services Branch (City of Edmonton)
RDC: Roads Design and Construction (City of Edmonton)
RE: Renewable energy
REHES: Real Estate, Housing and Economic Sustainability Branch (City of Edmonton)
Solar PV: Solar photovoltaic
TBD: To be determined
TO: Transportation Operations (City of Edmonton)
TOD: Transit Oriented Development
TP: Transportation Planning (City of Edmonton)
UDI: Urban Development Institute
UPE: Urban Planning and Environment Branch (City of Edmonton)



