Participant Handbook 2012

Citizens' Panel on Edmonton's Energy and Climate Challenges

Centre for Public Involvement

ALBERTA CLIMATE DIALOGUE

UNIVERSITY OF ALBERTA FACULTY OF EXTENSION

THE CITY OF Edmonton

The Citizens' Panel in a nutshell

You will:

- **Learn** about the challenges of climate change and energy vulnerability.
- **Decide** how Edmonton should respond to these challenges based on your and others' priorities and values.
- **Develop recommendations** for City Administration and City Council.

You will meet six times over the course of eight weeks, from 9 am – 4 pm each day:

October 13: Meet the other participants. See how it would feel to live in different energy and climate futures. Talk about the values that come up for you.

October 20: Build your understanding of energy and climate challenges facing Edmonton. Hear different perspectives about what we should do about these challenges. Look at values that participants may share.

October 27: Learn more about how Edmontonians could change their uses of energy, and about how City of Edmonton policies could support this.

November 3: Look at obstacles to changing our energy use. Consider advantages and disadvantages of different policies.

November 17: Firm up recommendations that the Panel wants to make to the City. Spend more time on recommendations that still need work.

December 1: Make sure you and other participants are OK with a draft of the Panel's report to the City. Think about whether there are next steps for Panel participants. Reflect and celebrate.

About this Handbook

This Handbook is a resource for you and other members of the Citizens' Panel on Edmonton's Energy and Climate Challenges. It provides information that we hope you will find useful as you develop recommendations for the City on how to deal with the challenges of climate change and energy vulnerability.

Another important resource for the Citizens' Panel is the City's ***Discussion Paper on Edmonton's Energy Transition***. This Discussion Paper is detailed and technical, but provides more information about key ideas than is in this Handbook. We summarize and simplify Discussion Paper content in this Handbook using **red print**. We also tell you where to look in the Discussion Paper to find more on specific topics.

Last year the City hired the Pembina Institute and HB Lanarc to develop possible strategies for making Edmonton energy sustainable and carbon neutral. They developed the Discussion Paper with the help of an expert panel as well as representatives from business, government, and community organizations. The Discussion Paper makes recommendations that you will be considering on the Citizens' Panel:

- Reduce the GHG intensity of the provincial electricity grid (e.g. retiring existing coal plants at the end of their economic lives)
- Increase the density of mature neighbourhoods
- Reduce energy use in large industrial facilities
- Increase the uptake of distributed energy generation (e.g. more solar heat and power, local natural gas plants producing both heat and power)
- Increase the energy efficiency of buildings
- Reduce gasoline and diesel used in vehicles

The City has not yet decided whether to follow the Discussion Paper's recommendations.

You may want to glance through the Handbook and the Discussion Paper before October 13 to get a sense of what's in them.

Please don't worry if some of the material here is new or confusing. Everyone on the Citizens' Panel brings valuable knowledge and experience. You'll be learning all the way through the Panel, and many things will become clearer as we go. What's more, the facilitators and support staff of the Citizens' Panel are here to support your learning. We will provide lots of ways for you to get clearer on things. Please tell us if you have a question—if you're confused then lots of other participants probably are too, and we will do our best to help out.

This Handbook was developed by a team from Alberta Climate Dialogue and the Centre for Public Involvement, two organizations that are helping to design and deliver this Citizens' Panel. The lead authors were Lyndsay Hobbs, David Kahane, Kristjana Loptson, Ian Moore, and Greg Powell. They had help from Eric Abrahams, Laurie Adkin, Fiona Cavanagh, Sue Cole, Jacquie Dale, Gloria Filax, Emily Huddart Kennedy, Mary Pat Mackinnon, Jesse Row, Geoff Salomons, David Sauchyn, and the City of Edmonton's Office of Environment. A 'Reference Group' of ten citizens as well as a group of stakeholders reviewed a draft of the Handbook and offered valuable feedback.

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What are climate change and energy vulnerability?

In July 2011 Edmonton City Council adopted an environmental strategic plan called *The Way We Green*. The plan recognizes that environmental responsibility is important for the well-being of our society, economy and our quality of life.[1] The air, land, water, climate, and biodiversity around us all are affected by where we get our energy and how we use it (our 'energy system'). The *Way We Green* focuses on building **sustainability** and **resiliency** into our energy system.

Endnotes

Throughout this Handbook you will find numbers like this one that explain the sources for text that comes before the number, or places to go for more information. This is the first endnote so it is numbered "1". If you flip to the Endnotes tab and locate #1 you'll find more information about what you just read.

*[**Reminder:** text in **red** is taken or paraphrased from the Discussion Paper.]*

- **Sustainability:** our society's ability to endure over a prolonged period as an integral part of Earth's natural systems.
- **Resilience:** the ability of our city to withstand and bounce back intact from environmental disturbances.

Reflection Question:

Different people have different definitions of sustainability and resilience. What do these words mean to you?

The Way We Green identifies two main risks to our current energy system: **climate change** and our **energy supply.**

Climate change

It is well accepted that burning fossil fuels is changing the Earth's climate. The predicted impacts of the current climate change trend include:

- **Water shortages** for over one billion people.
- **Food shortages** for hundreds of millions of people.
- Hundreds of millions of people permanently **displaced**.
- The **extinction** of up to 40% of species.
- More expensive and extreme **weather**.
- The permanent **loss of up to 20% of Gross Domestic Product** worldwide.

Edmonton and Edmontonians will not be immune to these impacts. Direct impacts on Edmonton's climate are expected to include more severe storms, floods, droughts, diseases and heat stress, and a loss of species.

Edmonton is also likely to be affected by climate change-related events happening **around the globe**, such as natural disasters, conflict, public health epidemics, increasing numbers of climate refugees, and economic disruptions.

Energy supply

It is generally agreed that the **price of oil** will continue to **climb** and to have **unpredictable swings** in price. While some may welcome an increase in oil prices, it will hurt people and businesses in Edmonton that don't directly benefit from higher oil prices. In addition, increasing price spikes are historically followed by **tough economic times**—in the last 40 years, any time oil prices have doubled, a recession has followed.

Fortunately, there are a number of ways for these risks to be managed and even reduced. The opportunities identified within the Discussion Paper could reduce energy use by 50% and greenhouse gas (GHG) emissions by 80% by 2050—cost effectively.

The City and its residents can change energy sources and reduce GHG emissions in many ways that are **cost competitive** with or less expensive than conventional energy systems. For example, Transit Oriented Development (TOD); fuel efficient vehicles; lower emission power plants, buildings, and industrial facilities; and reduced reliance on fossil fuels (e.g. oil, natural gas, and coal) can make a community more resilient, sustainable, affordable, economically successful, healthy, and vibrant, but does call for trade-offs.

[For more on climate change and energy supply see the tab "About climate change and energy vulnerability" and the Discussion Paper, pages A26-A40]

Climate change mitigation vs. adaptation:

Many of the effects of climate change are already being felt around the world. It is important to distinguish between **two equally important goals**:

- **Adaptation**: adjustments made by natural and human systems to prevent, moderate, cope with, or take advantage of the consequences of climate change.[2]
- **Mitigation** (of climate change): human action that reduces greenhouse gas emissions and/or finds ways to keep greenhouse gases out of the atmosphere.[3]

Because this Citizens' Panel is about energy use, **we will focus on mitigation**.

Overview: Five key energy opportunities for Edmonton

1. Alberta's electricity grid

Reduce the amount of electricity generation that uses **coal** and therefore the greenhouse gas (GHG) intensity of Alberta's electricity. This would mean increasing the percentage of electricity generated from low-emitting **renewable sources** like wind farms and from natural gas combined heat and power plants.

The provincial government manages the electricity grid, but the federal government is in the process of developing emission regulations for power plants.

Building new natural gas power plants and large-scale wind farms is **cost competitive** with building new coal-fired power plants. Carbon capture and storage and nuclear power are considered to be more expensive options.

Feeling Lost?

Some of the terminology used in this section and elsewhere in the Handbook (e.g. "natural gas combined heat and power plants") will be unfamiliar. We don't expect you to come to each meeting of the Citizens' Panel with a thorough understanding of the concepts. As the Panel progresses you'll have plenty of opportunities to view presentations and ask questions to clarify the things you don't understand. Our job is to provide you with the information you want and need to make the best recommendations for the City, so **please don't hesitate to ask for help**.

2. Edmonton's urban form and transit

We could reduce GHG emissions by creating **more compact neighbourhoods** that combine commercial and residential uses. Things like pedestrian- and bike-friendly neighbourhoods and enhanced public transit would allow people to drive less and use active modes of transportation more often.

Municipal governments bear primary responsibility for planning and developing cities including designing and constructing transportation infrastructure. The federal government plays a role in funding public transit and transportation infrastructure and the province is responsible for coordinating planning of the entire region.

Getting decisions about **urban form** and **transportation systems** right is particularly important because their impacts are both expensive and last for a very long time. For example, deciding the placement of a road will affect community design and transportation requirements for many decades. Also, changing the overall form of a city takes a long time because only a small portion of a city is built or changed every year.

Quality of life, including the quality of public space, how much time people spend travelling each day, air quality, and even access to services and employment all depend on how communities and transportation systems are developed.

3. Heavy industry

Increasing the **energy efficiency** of existing industrial facilities and encouraging new economic development that focuses on energy efficient businesses would reduce Edmonton's GHG emissions.

The federal government and some provinces have implemented energy efficiency standards for equipment. Broader emission regulations like Alberta's Specified Gas Emitters Regulation already affect industries, while other regulations are under development.

Improving energy efficiency often entails **high initial costs**. While some of these costs may be passed down to consumers in the short term, the **savings from lower energy use** generally reduces everyone's overall costs in the longer term. Although some businesses lack the financing, expertise, or time to make these changes, government support and/or regulations can help overcome these barriers.

4. Buildings

New and existing buildings can reduce their GHG emissions by increasing their **energy efficiency** and by **generating their own renewable energy**. The current update to the National Building Code now includes energy efficiency related code requirements for the first time. The City of Edmonton is currently responsible for building code inspections and approvals within the city.

Energy efficiency upgrades for buildings generally increase purchase costs, but energy savings over time more than make up for the increased purchase cost. Solar energy is currently more expensive than conventional energy sources but the cost of photovoltaics has dropped rapidly over the past few years and is expected to be cost competitive with conventional electricity sources in the future.

Building occupants often find energy efficient buildings to be more comfortable as they feature reduced temperature swings and increased natural light. Energy efficient buildings are often water efficient as well.

Because buildings last for 40 years or longer, constructing buildings that require a lot of energy today might prevent us from meeting energy use and emissions targets 40 years from now. Research in the UK has shown that retrofitting existing housing stock, along with more stringent standards for energy efficiency in new buildings, can make a very substantial contribution to reducing GHG emissions.

5. Vehicles

An energy efficient vehicle typically saves its owner money over its lifetime compared to a similar vehicle with lower fuel efficiency. **Electric vehicles** are currently more expensive to purchase than comparable conventional vehicles, but users save money on fuel. Increasing the efficiency of **gasoline- and diesel-powered vehicles** and the use of electric vehicles would reduce Edmonton's GHG emissions. The federal and provincial governments have set vehicle emission standards in the past, but no Canadian municipality has done so yet.

[For more information on these five areas see the Discussion Paper, pages 12-23]

Reflection Questions:

Which of the five energy opportunities described in this section do you think has/have the most potential to significantly reduce greenhouse gas emissions? Are there areas that might be especially difficult to change?

How these opportunities could lower Edmonton's emissions

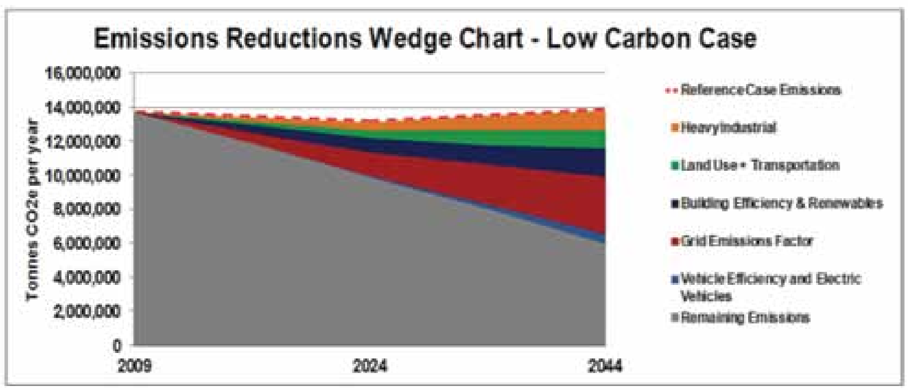
The Discussion Paper recommends that Edmonton take advantage of these five energy opportunities to reduce its GHG emissions and become more energy resilient. You and other members of the Citizens' Panel will be seeing whether you agree.

The Discussion Paper lays out a **Low Carbon Case** that uses these opportunities to reduce GHG emissions as much as its authors consider feasible. The next graph shows emissions reductions in each opportunity area if the Low Carbon Case is successfully implemented.

The graph compares the Low Carbon Case to the **Reference Case**. The Reference Case is business as usual: Edmonton stays on its current path, ignoring even current City plans to change this path.

The red dotted line shows emissions expected in the Reference Case (business as usual). The coloured wedges show the emissions reductions that are expected in each opportunity area by the year 2044 if there is a successful shift to the Low Carbon Case.

The Low Carbon Case would reduce Edmonton's emissions 57% compared to the Reference Case. The graph shows that the most significant reductions are expected to occur from changes to the electricity grid.



Potential emissions reductions from Edmonton's five key opportunity areas. *[Discussion Paper, page 31]*

You may have a different opinion on the opportunities described above, or you may see other opportunities for reducing GHG emissions and increasing energy resilience. We hope that you will share your own ideas as the Citizens' Panel proceeds.

Reflection Question:

Can you think of any additional ways Edmonton can improve the sustainability and resiliency of its energy system?

How will this Panel work?

What will this Citizens' Panel do?

About 60 Edmonton residents will deliberate about the challenges of climate change and energy vulnerability. **This Panel will work together to advise the City on how to shape future energy use**. Please use this Handbook and the *Discussion Paper on Edmonton's Energy Transition* to learn more about the topics. The *Discussion Paper* was developed by experts in consultation with representatives from businesses, governments, community organizations, and City Administration. This Handbook summarizes and adds to the information in the Discussion Paper.

You will work together over six Saturdays to develop recommendations and a **Final Report**.

- Expert facilitators, project staff, and researchers will support your work.
- Presenters and resource people will provide further information and respond to questions to help ensure you have the information you need to participate.
- The Final Report will be developed by a Writing Committee made up of 6-8 volunteers from the Citizens' Panel. This committee will make sure that the Final Report reflects overall participant recommendations and experiences and that it is in the voice of participants. The Writing Committee will meet between the fifth and sixth Panel sessions and also about three times after the sixth session. A short application form for the Writing Committee will be handed out at the first session of the Citizens' Panel.

The City is especially interested in learning:

- How serious the challenges of climate change and energy vulnerability are to panellists, and how this changes over the course of the Citizens' Panel.
- To what extent panellists support the recommendations about energy transition from the Discussion Paper, including:
    - How much they agree or disagree on particular implementation steps.
    - What would make these steps more acceptable.
    - Where they have concerns or cautions.
- How fast and how drastic energy transition actions should be, according to citizens' values and priorities.
- Additional recommendations or advice that panellists would like to see included in the implementation plan that will be brought to City Council.

The City is bringing together this Citizens' Panel because it needs to understand **what citizens want** to do about climate change and energy vulnerability once they spend some time learning about the issues. This is a chance for you to participate as a citizen in important City decisions. And it is a chance for the City to innovate in how it involves citizens in democratic decisions.

Reflection Questions:

What does being a citizen mean to you? How is this Citizens' Panel different from the usual ways you get involved as a citizen?

What difference will this Citizens' Panel make?

The Way We Green sets ambitious but broad goals for energy transition and community greenhouse gas reduction. The next step is for the City of Edmonton Office of Environment to develop a more detailed Implementation Plan for municipal energy use. City Council will discuss the **Implementation Plan**, make changes if they wish, and then vote on whether to adopt it.

Administration has committed to **taking the recommendations of the Citizens' Panel seriously** as they develop the Implementation Plan. They will **publicly explain** how the recommendations of the Citizens' Panel were used in shaping the Implementation Plan presented to City Council. **City Council will receive the Citizens' Panel Final Report** alongside the Administration's Implementation Plan.

How will we decide together?

The City of Edmonton has **a long history of citizen involvement**. In 2005 the City of Edmonton passed a public involvement policy. In recent years, the City has also experimented with new forms of citizen involvement that bring together diverse Edmontonians to learn about issues, exchange perspectives, reflect on values and priorities, and make recommendations that shape policy. These processes involve both **dialogue** and **deliberation**.

Dialogue is a structured conversation in which diverse people explore ideas together, share their views, and learn from one another. The point of dialogue is not to convince others that you're right, but to expand your knowledge, listen to others, and consider different perspectives. Dialogue allows us to think about public issues in new ways and to build common ground with others.

Dialogue is different from debate. **Debate** tries to find a winner and a loser. But complex problems like climate change and energy vulnerability don't always have a right and a wrong answer.

Debate	Dialogue
• Objective is to win • Listening to find flaws to prove the other side wrong • Defends personal assumptions • Criticizes others' point of view • Searches for weaknesses and flaws in the other people's positions • Jumps to judgment • Seeks an outcome that agrees with your position	• Objective is to find common ground • Listening to understand other people's views and why they hold them • Explores and tests personal assumptions • Examines all points of view • Searches for strengths and value in the other people's positions • Suspends judgment • Seeks an outcome that creates new common ground

Deliberation takes an extra step and asks people to make choices by weighing competing values and priorities, and by thinking through pros and cons. The key features of effective deliberation are good communication, respectful listening, and thoughtful and collaborative decision-making.[4]

A citizens' deliberation brings together a group of people from all parts of society to make well-informed and well-reasoned decisions. Deliberation is a meaningful, inclusive, and democratic way of making decisions. It is an active form of citizenship that directly involves citizens in decision-making.

Reflection Questions:

How do you usually make decisions with your family, friends, or coworkers? How is that process similar to or different from 'deliberation'?

Other innovative dialogue and deliberation projects in Edmonton

- The 2008 Edmonton **Citizen Panel on the Budget** was a collaboration between the City of Edmonton and the University of Alberta. Diverse Edmontonians learned about and discussed City of Edmonton budget priorities. Forty-nine citizens participated in six sessions, supported by an issue guide that reflected multiple perspectives.[5]
- The **Centre for Public Involvement** (established in 2011) is a formal partnership between the City of Edmonton and the University of Alberta to build public involvement in Edmonton and beyond.[6]
- A diverse and representative group of 66 Edmontonians participated in the City wide **Food and Agriculture Citizens' Panel** in 2012. In five sessions, citizens developed potential strategies and directions for the City of Edmonton.[7]
- The Office of the City Clerk is working with the Centre for Public Involvement on an **Internet Voting Project** (2012-2013), including a Citizen Jury, online engagement, and stakeholder roundtables to see if Internet voting is viable for the City of Edmonton.

Citizen dialogue and deliberation are especially well suited to the complex and sometimes controversial issues of **climate change** and **energy vulnerability**. Whichever energy path we choose as a city, there will be benefits, sacrifices, and a need for compromise. If we want to find solutions that are **fair and workable**, we need to make sure that different interests and perspectives are at the table.

The City of Edmonton has worked with Alberta Climate Dialogue (ABCD) and the Centre for Public Involvement (CPI) to develop, design, and carry out this Citizens' Panel. An expert group of citizen involvement researchers and practitioners has worked with the City to support you in this Panel. Together, we will make sure that we capture the lessons learned here to improve future citizen involvement work in Edmonton and beyond. You will see signs of this throughout the Panel:

- You'll be asked to complete questionnaires before, during, and after the Panel.
- You'll meet researchers interested in the Panel.
- You'll have a chance to influence our research and participate in our reflections.

This team of researchers and practitioners is also here to support you in finding all of the information you need to make informed recommendations. **If you don't understand something in this Handbook, the Discussion Paper, or in one of the sessions, please don't hesitate to ask**. If you're feeling confused, other participants are probably confused about the same thing. Telling the Panel facilitators or support staff what's puzzling you will help everyone.

At-a-glance agenda for Citizens' Panel

All sessions start at 9 am and finish at 4 pm Lunch is provided.

Session	Agenda	Objectives
October 13		
Morning	Welcome and introductions; orientation to issues and process	To get to know each other and the purpose of our work together
Afternoon	Exploring possible energy & climate change futures (two scenarios) and what's important to you as you consider those futures	To begin to learn about the issues To start to surface values and concerns
October 20		
Morning	Presentation on energy and climate science. Examining the nature of complexity and scientific uncertainty.	To deepen understanding of the key issues and the complex nature of their interactions and impact
Afternoon	Panel presentations providing different perspectives on energy and climate issues. Presentation on values. Activity to explore common values.	To learn about different values and perspectives people bring to the issues. To begin to develop a shared set of values important to the Citizens' Panel.
October 27		
Morning	Presentation of current Edmonton energy context. Overview of the Discussion Paper. Small group discussions to understand the activities and goals recommended in the Discussion Paper.	To provide information critical to the panelists' deliberations and provide the opportunity for panelists to ask questions.
Afternoon	Continued small group work on activities and goals. Process to explore how the panellists' key values relate to the proposed goals.	To do an initial assessment of the proposed goals and how they align with panellists' values and priorities.

Session	Agenda	Objectives
November 3		
Morning	Presentation on the psychology of climate change action. In-depth small group dialogues on Discussion Paper goals and activities.	To develop a greater understanding of internal barriers and fears that we all face around climate change. To begin deliberation on goals and activities.
Afternoon	Continued small group dialogues, with sharing back in plenary.	To fully deliberate and determine common ground, divergences, and acceptable trade-offs.
November 17		
Morning	Plenary work exploring the deliberation results to date and the emerging recommendations. Process to identify areas for further or new deliberation.	To deepen our understanding of the interaction between the goals and activities. To explore the potentials tradeoffs involved in making recommendations.
Afternoon	Small group dialogues on areas requiring further deliberation. Plenary report backs and determination of new and revised recommendations and rationales.	To refine the emerging recommendations and develop new ones if needed. To clarify common ground and core values for the Citizens' Panel report.
December 1		
Morning	Activity to review and refine the Citizens' Panel draft report (recommendations, conditions, advice & values rationale)	To verify and clearly articulate key recommendations and values/rationale critical to those recommendations. To better understand areas of divergence.
Afternoon	Action planning Next steps Reflection & celebration	To identify opportunities for action both by City and panellists. To celebrate the Panel's journey and share insights.

Why work on energy policy at the municipal level?

Municipal policy impacts our daily lives. For example:

- The layout of roads and buildings, parks, schools, and businesses influence where we go and how we get there.
- Housing options in Edmonton are influenced by the decisions made by our city government. Home availability and affordability affect where we can live.

The term **'policy'** can be vague and confusing, but it doesn't need to be. **Public policies** are made by governments. They set intention and direction, they lay out goals, and they put the pieces in place for achieving these goals. Public policy usually involves some combination of legislation, taxation, regulations, standards, rules, fees, programs and other mechanisms.[8] A lack of regulation on a particular issue may also be an intentional policy decision.

Public policies impact and **influence many important aspects of our lives**: security, education, health care, employment, the environment (including clean water and air), transportation, and culture and leisure.

Energy policy is public policy that uses legislation, regulations, rules, standards, fees, and programs to shape our use of energy. Energy policies influence all kinds of areas of our lives—from agriculture to transportation to buildings to food—in all kinds of ways.[9]

How is public policy created in Edmonton?

Public policy making in Edmonton is complex. Elected officials determine which policies should be developed, while civil servants ('Administration') are responsible for most policy development. Administration develops proposals and City Council votes on whether to make them policy. City Council is made up of a mayor and 12 city councillors, each representing an area of the city called a **ward**.[10]

Many City decisions affect Edmonton's energy use. Many relevant City departments (e.g. Financial Services and Utilities, Sustainable Development, and Transportation Services) have been involved in creating *The Way We Green* and the Discussion Paper that is the basis for our Panel's work.

Other groups like businesses, community leagues, and non-governmental organizations were also involved in the creation of these documents. Administration will continue to meet with these groups to gather their perspectives. These groups' input will be weighed alongside the Citizens' Panel's recommendations.

How do decisions by the City relate to those at other levels of jurisdiction?

In Canada, political decisions are made at the **federal, provincial, and municipal** levels. For example:

- Cities are in charge of areas like waste and recycling, water, public transit, business licensing, parking, fire protection, and land use planning approvals.
- Municipal and provincial governments share responsibility for things like building standards. These are set by the province and enforced by the municipality.
- On other issues, all three levels of government are involved.[11]

Federal, provincial, and municipal levels of government all play a role in energy use. For example:

- The federal government is responsible for federally owned land, international transportation and high security areas, such as ports and nuclear power plants.
- Provinces are responsible for regulating emissions from industry.
- Municipal governments are responsible for key decisions about how city land is developed and used, whether buildings are approved, and how transportation is planned.

International negotiations and agreements are also important factors when it comes to energy use and climate change.

Four Edmontonians' stories

Climate change and **energy vulnerability** affect Edmontonians—and people around the world—in different ways.

People's perspectives vary as well. For some, climate change and energy vulnerability are **problems requiring urgent action** from all levels of government. For others, these challenges offer **economic opportunities** in a faltering global economy. There are many different opinions.

In what follows, we imagine **four different Edmontonians' lives in the context of climate change and energy vulnerability**. As you explore issues of energy and climate change, it may be useful to think about Natalie, Lee, Jack, and Taylor.

These four characters reflect a diversity of backgrounds, ages, genders, and beliefs. They are not intended to represent all Edmontonians, but they should get you thinking about the diversity of interests, values, and perspectives in our city.

Natalie

How she lives:

- Natalie is **25 years old** and lives alone in a **rental apartment** in Garneau. She hopes to have at least a couple of children and is saving to buy a home.
- She recently graduated with a degree in Chemistry from the University of Alberta and started a job at a medium-sized company downtown.
- She comes from a three-generation Ukrainian **farm family** that grows red fife wheat on a quarter of land to the south-east of Edmonton. Her family on the farm are beginning to experience the negative effects of **drought**, and the potentially positive effects of a **longer growing season**.

- She **considers herself an environmentalist** and is very aware of the social and environmental impacts of her purchases and behaviours. She grows some of her own food in a community garden near her apartment. She travels by bike in the summer and public transit in the winter. She buys as many goods as she can second-hand and from local sources.

How she thinks about climate and energy issues:

- She believes that global warming is a real threat and that **humanity has only a short time to change course** or climate change may become irreversible.
- She thinks that it is important for each of us to live sustainable lives. She's aware that **government choices shape individuals' decisions**. She sees, for example, that a lot of what her family does on the farm is shaped by government subsidies and regulations. She notices that her choice to use public transit depends on the City maintaining good quality transit services.
- Natalie thinks that **strong government action is the only way to avoid the worst of climate change**. In her view, public opinion already supports stronger policy on climate change than we're seeing. She thinks that government should educate and lead the public.

Jack

How he lives:

- Jack is **52 years old**, widowed, and has two children. He **owns a bungalow** on the north side.
- Jack is a member of the **Athabasca Chipewyan First Nation**. He moved to Edmonton twelve years ago to work as a **pipefitter** for an oil services company.
- He's proud of his 21-year-old son who's attending MacEwan University and is encouraging his 18-year-old daughter at NAIT to learn about alternative energy jobs.
- He's **working to save for a comfortable retirement**, but already finds it challenging to make ends meet. The **rising costs** of gas for his truck and heating for his home don't help.

How he thinks about climate and energy issues:

- Jack works for an oil company and has a good standard of living. He wants this **prosperity** to continue.

- Jack cares a lot about the land. His grandparents passed along a **deep sense of connection to other living beings**.
- He's aware of changes to the environment. Members of his family still gather and hunt food off the land and they tell him about how migration patterns and food sources are changing.
- He's **sceptical of all of the chatter about climate change**. He's not sure that human beings can have that much impact on the natural world.
- He tells his kids that the world around us is always changing. Our role is to **adapt** as well as we can.

Lee

- Lee is **42 years old**. She recently **immigrated to Canada** with her husband, mother, and two school-aged children.
- One important reason for moving was the increasingly extreme weather in Thailand that was threatening the family's well-being and prosperity. She has many **friends and family still in Thailand** who becoming are more and more **vulnerable to natural disasters**.
- Lee and her family live in a **rental** duplex on the east side of Edmonton, where her husband Minh works in a warehouse. Lee stays close to home to care for her elderly mother.
- Lee is worried about the effect of rising food and energy prices on her family. Although she and her husband hope to be able to support their children through university, they are **having trouble making ends meet** on a single income.

How she thinks about climate and energy issues:

- Lee's religious beliefs and her life experience make her very sensitive to the welfare of the least well off.
- She follows debates in Edmonton on climate change. It bothers her that people keep talking about what's best for Edmontonians or Albertans without thinking about **how climate change affects people in other parts of the world**.
- Lee sees the wealth of Edmonton and Alberta, and knows that the ways people here earn money and live their lives have a high carbon footprint relative to many other parts of the world. According to her values, **Edmonton has an obligation to reduce its GHG emissions**, even if this is costly.

Taylor

- Taylor is **33 years old**. He was born in the Beverly neighbourhood and now **shares a house** with his common-law partner, Jordan, in the Windermere neighbourhood in southwest Edmonton.
- He is an assistant manager at a department store in West Edmonton Mall and **commutes by car** along Anthony Henday Drive.
- When they built their house they added some **energy saving features** like triple glazed windows, a high efficiency furnace, and low energy appliances. Taylor calculates that these will have paid themselves off in the next three or four years, after which they'll save on heating and electricity costs.
- He **loves the outdoors**. He and Jordan often transport their bikes to the river valley for weekend rides, or up to the mountains for longer trips.
- Life's feeling good to Taylor: he and Jordan have two incomes and the freedom to enjoy what they love.

How he thinks about climate and energy issues:

- Taylor has always been a strong believer in **free markets**. The government should provide services that the market can't, but otherwise it should stay out of people's lives.
- He thinks that **people should be able to make their own choices** when it comes to the environment. He sees more and more people thinking about sustainability when they shop.
- Taylor believes that humans are part of what is causing climate change, but he has a lot of **faith in human ingenuity**. He believes we'll find the technologies we need to lessen climate change and adapt to its impacts.
- He believes governments should **save money and keep taxes low**. If there are environmental benefits to these cost savings, that's a bonus.

Reflection Questions:

How are Natalie, Lee, Jack, and Taylor similar to you and different from you? What do you like about their views about energy and climate issues? What do you disagree about?

As you develop your recommendations as a Citizens' Panel, think about how each of these characters might feel about your decisions.

Two scenarios for Edmonton's energy future

Governments, businesses, and other organizations often use **scenarios—** or stories of what the future may look like—to help inform their decisions. Often, scenarios are **not meant to predict what is most likely** to happen, but are used to describe a **range of possible futures.**

Here are two scenarios that show what life may be like in Edmonton if:

1. No effort is made by the municipal government to change the way energy is used and where it comes from.

   or

2. Most opportunities to change the way energy is used and where it comes from are aggressively pursued by the municipal government.

'Experiencing' these scenarios can **help you decide** what you want to do now and in the future to **avoid certain risks** or **realize certain advantages** of each scenario. Each scenario includes **trade-offs** that are important for you to consider.

The idea isn't to choose between the scenarios. They are meant to be a **starting point** for conversation about what you like and don't like about each one, and what is important to you as you consider the future.

Note:

Both scenarios are written assuming that the **price of oil continues to climb** and the **climate continues to change** as identified in Appendix A of the Discussion Paper.

These two changes are considered the biggest energy-related challenges that the world will face over the next 30 to 50 years. It is useful to explore the pros and cons of the two scenarios presented below within this context.

Scenario 1: No effort is made by the municipal government to change the way energy is used and where it comes from

Note:

This scenario is based on the Reference Case described in the Discussion Paper.

Energy use in Edmonton in 2044 is **not much different than 2012**. People still mostly drive to get around, use natural gas to heat their homes, and get electricity from the provincial grid.

Planning and building **new developments** has been relatively easy over the past few decades, as not much has changed to the style of our neighbourhoods over that time. The **inner city** has added a few more people over the years (15% more than in 2012), but the number of people in most neighbourhoods isn't much different than in 2012. Most people continue to live in new neighbourhoods.

Since Edmonton's population is now **1.2 million people**, the average commute to work or school is further than in 2012 and **traffic congestion** has also gotten worse every year over the past 30 years.

Edmontonians use a little less energy per person than in 2012 as building standards and vehicle efficiencies have improved moderately, but everyone is **paying more** as gas prices have almost doubled since 2010 (not including inflation).

While a lot of Edmontonians are **profiting from higher oil prices**, a noticeable number of people are doing worse. Whenever gasoline or electricity prices rise, there are more and more stories about people needing to choose between getting to work, heating their homes, and feeding their families. This includes many on **fixed incomes**. As always, more people **struggling to make ends meet** has led to more crime and higher costs for health care and social programs.

In contrast, Edmonton also has a relatively **high percentage of people living in houses** (as opposed to townhouses and apartments) and **owning cars** compared to other major cities around the world. Edmonton neighbourhoods are **spread out** with plenty of parking, open space, and wide roads.

Edmonton has also continued to have **large industrial facilities** developed within its City limits. This has made it easy for the city to take advantage of Alberta's growing oil sands industry to **create new jobs**, **attract new residents**, and **increase its tax base** (residential, commercial, and industrial).

Despite little change to business-as-usual growth in the city, Edmonton's **greenhouse gas (GHG) emissions actually went down between 2012 and 2020**. This is mostly because a few of the older coal-fired power plants in the province reached the end of their lives. New power plants in the province are mostly run on natural gas.

GHG emissions eventually increased, however, driven by population and industrial growth. With climate change getting worse every year, the **pressure for Edmonton and Alberta to reduce emissions** has never been greater. A majority of Edmontonians, Albertans, Canadians and people globally are calling for emissions to be reduced as changes to weather, fresh water supplies, sea levels, and croplands get worse every year. The **cost of emitting greenhouse gases continues to rise** as governments around the world put in place policies to encourage or require reductions.

To reduce emissions in Edmonton, it will likely be best to **buy and bring in technologies and expertise from other jurisdictions** that have already been working to reduce emissions. It will likely take decades to reduce our emissions to levels that are considered safe.

Scenario 2: Most opportunities to change the way energy is used and where it comes from are aggressively pursued by the municipal government

Note:

This scenario is based on the Low Carbon Case described in the Discussion Paper.

In some ways, energy use in Edmonton in 2044 is very different than in 2012. In other ways, the changes are hardly noticeable.

While buildings with suitable roofs have had **solar water heating panels** installed, natural gas is still the most common source of heat. Similarly, while buildings with suitable roofs have had **photovoltaic panels (PV)** installed, most electricity still comes from the provincial grid. Importantly, although solar panels were more expensive than fossil fuels 30 years ago, by 2044 their popularity had **eliminated this cost difference.**

The City has been actively engaged with the provincial government over the provincial electricity grid. Partly because of this, the electricity coming from the provincial grid now **comes largely from a combination of natural gas, renewable energy, and coal with carbon capture and storage**. While carbon capture and storage has increased the price of electricity, it has only had a modest impact. This is because the costs of new natural gas power plants and wind farms are comparable to the cost of a new coal-fired power plant.

All of these **extra costs have been more than offset** because our buildings and vehicles are smaller and more efficient than they used to be. This includes a **shift to more electric vehicles** on the road than gasoline vehicles. Even with very high energy prices both locally and globally, the **average Edmontonian spends less on energy now** than they did in 2012.

Edmontonians now also use a lot more public transit than in 2012. Our **LRT is five times longer** than 30 years ago and one quarter of Edmontonians live within walking distance of a station (compared to 5% in 2012). There was intense debate over routes as the LRT expanded.

More people now live in each Edmonton neighbourhood. Inner city neighbourhoods have 30% more people than in 2012 and city-wide there are now more townhouses and apartments than houses. This has meant less personal space for the average Edmontonian, but more services and a greater investment in public spaces in each community. People generally walk more in these areas, and this has **changed the feel of neighbourhoods**, and seems to be improving the overall health of Edmontonians.

The **upfront cost** of these changes has been **less in some cases** (e.g. the cost of housing has gone down) but **higher in others** (e.g. LRT expansion, higher efficiency standards for buildings, and solar panels). These higher costs were controversial but have been **more than offset** by lower operating costs because these systems use less energy and, in the case of LRT, less money is being spent on expanding the road network.

Another change that Edmonton has experienced over the past 30 years is a strong push by the City government to **attract businesses that aren't big energy users**. While there have been some market forces pushing in this direction, it has taken effort and some risk-taking to attract and support these businesses. Moving away from energy-intensive industrial facilities (e.g. refineries) was controversial at the time and was seen by some as government interference in the marketplace.

While the changes made over the past 30 years haven't always been easy or successful, **Edmonton is now recognized as a global leader in sustainable living**. Along the way, there have been requests from around the world for the City of Edmonton, Edmonton businesses, and other local organizations to share their products, services, and expertise in reducing emissions. Edmonton's leadership in this area has been recognized and valued by others. Globally, however, there is **still more work to be done** to reduce the considerable impact that climate change is having on the world.

About climate change and energy vulnerability

What does recent research say about climate change and energy vulnerability?

Recent findings around climate change:

- According to the 2007 Assessment Report by the Intergovernmental Panel on Climate Change (IPCC), the current warming of the climate system is **"unequivocal."** Eleven of the twelve years between 1995 and 2006 were among the warmest years on record. Average water vapour content in the atmosphere has increased since the 1980s. Mountain glaciers and snow cover in both hemispheres have declined on average, contributing to a **rise in sea level**.[12]

- Paleoclimatic studies (studies that look at historical climate trends using geological evidence) provide evidence that **warming in the last half century is abnormal** compared to the previous 1,300 years. Furthermore, the IPCC says it is very *unlikely* that the warming of the past 50 years is due only to known natural causes and is *likely* caused by human activity.[13]

- The **Government of Canada** agrees that there is a very strong body of evidence, based on a wide range of indicators, that climate change is occurring. Although climate change can be caused by both natural processes and human activities, the recent warming is **largely due to human activity.** The potential impacts of climate change are far-reaching, affecting our economy, infrastructure, and health, the landscapes around us, and the wildlife that inhabit them.[14]

- A statement by the National Academies of Science from the G8+5 countries says that the **need for urgent action** to address climate change is now indisputable.[15]

Recent findings around energy vulnerability:

- The IPCC in the 2011 "Special Report on Renewable Energy Sources and Climate Change Mitigation" defines **energy security** as robustness against (sudden) disruptions of energy supply. Put simply, this means having available and reliable energy sources at all times. Current energy supplies are dominated by fossil fuels (e.g. oil and natural gas) whose **price volatility** can have significant impacts on security. National security concerns about the global availability of fossil fuels have been a major driver for a number of countries to consider renewable energy.[16] Because many countries import their fossil fuels, increased use of renewable energy can be used to reduce dependence on limited foreign suppliers of fossil fuels.

- The UK Energy Research Centre has determined that there is considerable risk of **conventional oil reaching a peak** by 2020 based on a large quantity of geological evidence.[17] While technical solutions may allow for increased production of unconventional resources, substitution and greater efficiency, there is uncertainty about the underlying cost of this decline in conventional output.[18]

- The IPCC recommends a move towards **diversifying energy sources and including renewables** to gain greater energy security. Renewable energy sources—solar radiation, wind, falling water, waves, tides and stored ocean heat, heat from the earth, and biomass—and technology are **already widely available**.[19]

What is "energy vulnerability"?

When **energy prices rise quickly**, many people **struggle to balance budgets** and make ends meet. Someone who normally pays $100 each month for electricity and heat and suddenly has to pay $150 a month might have difficulty finding the money, for example. Or a small business that normally pays $2,000 a month to deliver goods and suddenly has to pay $3,000 each month might be in serious financial trouble. Hospitals, schools, and universities in Alberta have in the past been forced into deficit situations by rising energy costs.

Energy price changes **disproportionately affect low income earners**. If a household spends 10% of its annual income on natural gas, electricity, gasoline, and diesel, energy price fluctuations would affect this household much more than a middle income household that spends 5% of its income on energy. This vulnerability to energy price fluctuations is called **"energy vulnerability."** When energy prices go up significantly in a short period, households that are "energy vulnerable" may find it hard to meet basic needs like paying rent or buying groceries.

Just over half of Edmonton households are vulnerable to energy price fluctuations because they spend at least 10% of their income on energy. Depending on the future price of energy and the choices the City makes about future energy use (ranging from the 'Reference Case' to the 'Low Carbon Case'), energy vulnerability **could range from 24% to 69%** of households.

[For more information on "Energy Vulnerability" see the Discussion Paper, pages 37-39. The Discussion Paper also has a lengthy and carefully sourced section with questions and answers on energy supply and demand in the next 40 years: see pages A9-31]

Reflection Questions:

In your view, how big a problem is energy vulnerability for your family? For people you know? What about for Edmonton as a whole?

Why do energy prices change so much?

Predicting energy prices is very hard, and prices vary a lot from one month to another or from one year to another.

- Estimates of world petroleum supplies are approximations and many countries don't share estimates.
- Technological advances allow us to get more oil from a reservoir than we could get even ten years ago, meaning that we can access "unconventional" reserves of oil and gas. This increased supply can lower prices.
- Demand for petroleum varies and makes it complicated to predict prices. While some demands seem stable (e.g. heavy industrial equipment will likely depend on diesel for a long time) others are more sensitive to price changes (e.g. some people take the bus more when gasoline prices are high).
- Other energy demands are completely unpredictable (e.g. if Northeastern North America has a cold winter, the demand for natural gas increases and prices go up).

[For a look at some expert forecasts related to future energy prices see the Discussion Paper, pages A24-A26]

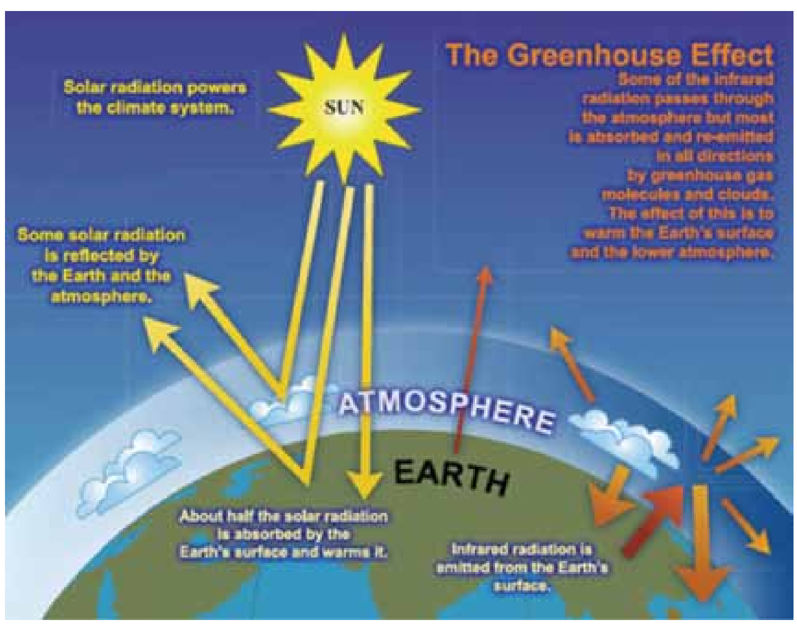
What is “climate change”?

- **Weather** describes temperature, precipitation, relative humidity, the likelihood of extreme weather events, and prevailing wind patterns for a given region **at a specific time**.
- **Climate** refers to long-term averages of these conditions. Climate change, then, refers to **changes in weather conditions over the course of many years.**

What is the greenhouse effect?

Greenhouse gases (GHGs) like water vapour, carbon dioxide, nitrous oxide, methane, and ozone in Earth’s atmosphere **trap heat** that would otherwise be reflected by Earth back into space. Water vapour in the atmosphere is responsible for most of the greenhouse effect and maintains Earth’s average temperature at about 15°C. Without the greenhouse effect, the average temperature at Earth’s surface would be too cold to sustain life. The greenhouse effect keeps Earth warm, but **relies on a delicate balance between the energy entering and leaving the atmosphere**.

The following figure illustrates the greenhouse effect, showing the path of the Sun’s energy. The Earth and the atmosphere reflect some of the energy back into space, but some of the energy is trapped and absorbed by greenhouse gas molecules in order to maintain the warm temperature of the Earth. This ideal greenhouse effect is **thrown off balance** by the addition of more greenhouse gases into the atmosphere.



An idealized model of the natural greenhouse effect[20]

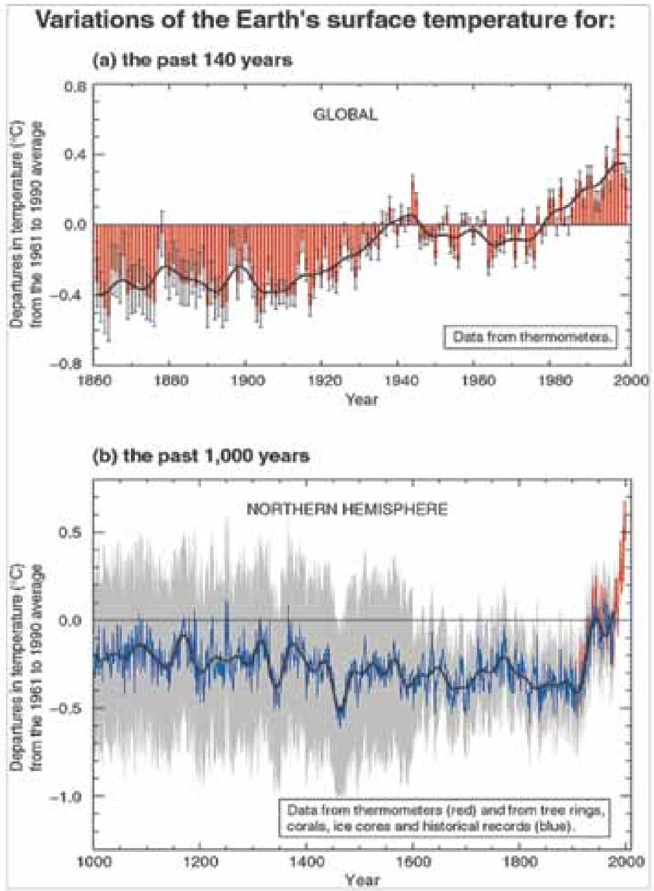
What is the theory of human-made (anthropogenic) global warming?

Human activities like **burning fossil fuels** disrupt Earth's energy balance by producing excess GHGs that **accumulate in the atmosphere**. Increased concentrations of GHGs trap more energy than needed to maintain a stable temperature on Earth. This results in a **rise in Earth's average temperature**.

Fossil fuels are formed by natural processes over millions of years. When we burn fossil fuels (e.g. oil, natural gas, and coal) they produce energy that can be used to generate electricity, heat buildings, and power engines. This process—known as combustion—also releases GHGs into the atmosphere. While plants and trees absorb carbon dioxide during photosynthesis, animals and decomposing plants also emit carbon dioxide into the atmosphere. When carbon dioxide emissions and photosynthesis are in balance, life can thrive. However, when this balance is exceeded and excess carbon dioxide is emitted, GHGs over-accumulate in the atmosphere and Earth's temperatures increase.

Water vapour, released when we breathe or burn hydrocarbons, moves quickly in and out of the atmosphere. Despite this, water vapour plays a significant role in **amplifying** the greenhouse effect through a process referred to as **climate feedback**. As Earth's average temperature gets hotter, more and more of our surface water evaporates. The resultant increased concentration of water vapour in the atmosphere then **leads to further warming**.[21]

Climate models show that GHG emissions from human-made sources are the strongest factor in current climate change. While other things like energy from the Sun contribute to warming, they do not account for the speed and extent of current climate change.[22] In other words, extensive burning of fossil fuels beginning in the 1800s and continuing to the present day has led to increased GHGs in the atmosphere and higher average global temperatures. The following figures show the world's temperature variations over the last 140 and 1,000 years. As you can see in these graphs, average global temperatures in recent years have been higher than previously experienced, indicating a **warming trend**.



IPCC Climate Change: the scientific basis (2001)[23]

[For more on the science of climate change in Alberta see the Discussion Paper, page A33-36]

What impacts will climate change have?

Impacts in Alberta

The Prairies will benefit from **warmer and longer crop growing seasons** as a result of climate change. Unfortunately, they may also experience an increase in **water scarcity and droughts**. The major prairie rivers originate from snow packs and glaciers in the Rocky Mountains. As climate change causes these glaciers to retreat and snow packs to melt earlier in the year, stream flows across the region will decline further. Population growth will also increase the demand for water resources (e.g. for purposes of irrigation, oil and gas extraction, and municipal use). Because the prairies are already naturally dry, these climate impacts lead freshwater scientists to talk about a **potential water crisis** in Canada's western prairie provinces.[24]

Extreme weather events like drought and flooding are expected to become more frequent and intense as the climate changes, causing an economic burden on the Prairie Region. Climate variability is costly—the drought of 2001-2002 in the Prairies caused a $3.6 billion drop in agricultural production. The economic costs from extreme weather events since 1996 have been greater than for all previous years combined—hundreds of millions to billions associated with flooding, wind, hail ice storms, hurricanes, and wildfires. *[Discussion paper, page A37]*

The warming of Alberta's climate may also bring more **pests**. Recent warm winter temperatures have allowed the mountain pine beetle to spread into Alberta. The pine beetle has badly damaged British Columbia's forestry sector and poses a similar threat to Alberta's. Mosquito and tick populations will also grow because of milder winters and summer droughts. This could lead to the spread of diseases like **West Nile virus** and **Lyme disease**.

As the next section indicates, impacts of climate change in other parts of the world will also affect Edmontonians.

Reflection Questions:

Which impacts of climate change do you think will affect you and your family most directly? Which impacts worry you the most?

[For more on the potential impacts of climate change in Alberta see the Discussion Paper, page A36-A40]

Impacts beyond Alberta

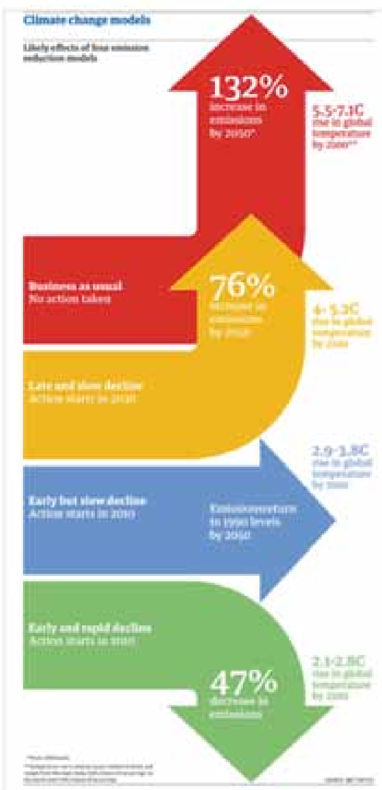
Climate change also has significant **national and international impacts**. The Intergovernmental Panel on Climate Change (IPCC) says that many **millions more people are likely to be flooded** every year due to sea level rise by the 2080s.[25] Coastal Canadian cities like Vancouver, Montreal, and Halifax will feel the direct impacts of sea level rise and Alberta may experience a population increase as **people come here to escape flooding**. This would put pressure on Alberta's resources and services.

Droughts, crop failure, and floods overseas may also lead to **conflict, famine, and mass migrations**, especially in places that are particularly vulnerable to climate change (i.e. areas with naturally hot and dry climates).

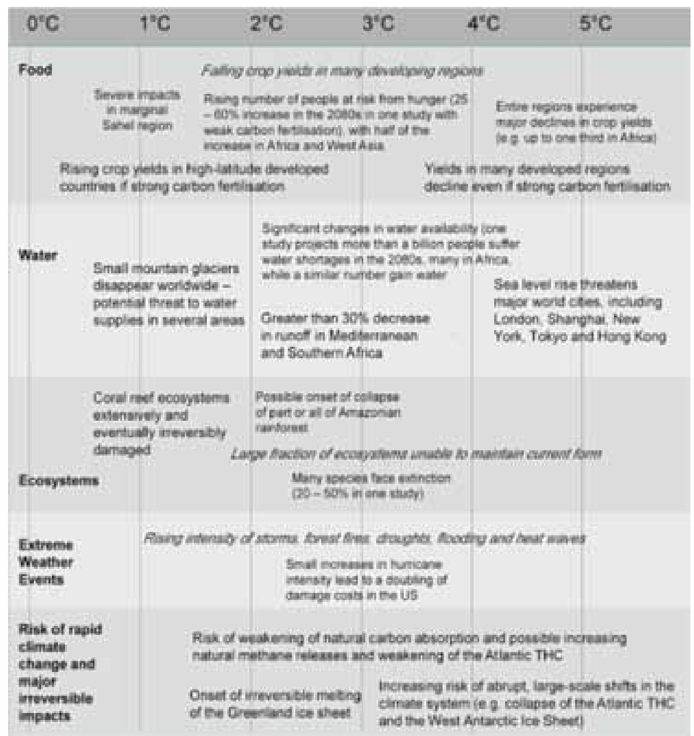
The following two figures demonstrate the potential temperature rises associated with different emissions scenarios, as well as the major impacts these different temperature rises could have.

The figure on the left shows the likely temperature increases that will result from four different emissions scenarios. Each arrow represents a different course of action (business as usual, late and slow reduction plan, early but slow reduction plan, and an early and rapid reduction plan). Along with each course of action is the likely amount of emissions reductions or increases (%), and the expected global temperature increases that will result from each emissions level. The figure on the right provides some of the impacts associated with temperature increases that will affect humans and ecosystems.

For example, with a "Late and slow decline" (yellow arrow), we can expect a 76% increase in emissions and a 4-5.2°C rise in global temperature. Some of the impacts that go along with a 4°C rise in temperature include major crop declines, sea level rise that threatens major coastal cities such as New York City and Tokyo, and increased risk of abrupt, large-scale shifts in the climate system such as the collapse of large ice sheets.



Likely effects of four global emission reduction models
UK MET Office



Expected impacts of climate change
Stern Review: The economics of climate change[26]

The impacts of climate change **vary by region**. Here are some examples of likely (and current) impacts associated with business as usual emissions:[27]

- The Niger River in **Africa** already has less water than before. 75-250 million people will likely face increased water shortages by 2020. The yield of rain-fed crops could be halved in some African countries.
- In South, East, and Southeast Asia, the heavily populated mega deltas will be at greatest risk of increased flooding. In these same regions, diseases associated with floods and droughts (e.g. cholera) are expected cause even more deaths.

- Ecologically rich places in **Australia and New Zealand** like the Great Barrier Reef and Queensland Wet Tropics will lose significant biodiversity by 2020. Australia will also continue to experience prolonged droughts.
- **Europe** is facing health risks from heat waves and forest fires. Extreme summer temperatures in southern and central Europe in 2003 killed an estimated 50,000 people, and the 2010 heat wave in the Russian Federation may have killed as many as 15,000.
- In **Latin America**, it is predicted that by mid-century the eastern Amazon rainforest will be gradually replaced by savannah as logging operations continue and higher temperatures reduce moisture in the soil. Fewer trees and more grass will kill off species and reduce biodiversity.
- Less snow, more winter flooding and reduced summer river flows in **North America** are expected to put a strain on already overused water resources in the western mountain regions.
- Shrinking sea ice, glaciers and icecaps in the **Polar Regions** will harm many species and traditional ways of life. Permafrost thaw will have impacts on buildings, roads, and other infrastructure, as well as cause frozen methane—a GHG—to be released from the ground.
- The rise of sea levels is expected to aggravate the effects of floods, storm surges, erosion and other coastal hazards on **small islands**, threatening the livelihoods of residents.

Reflection Questions:

How do you think that current and future impacts of climate change in other parts of the world might affect you?

How quickly and how much do emissions need to fall?

According to the 2007 Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), global temperatures have risen an average 0.74°C over the past century. In order to avoid the severe impacts of climate change that exceed our ability to adapt, **global warming should be restricted to 2°C.**

In order to achieve this, **global emissions must peak sometime between 2010 and 2020**, and fall to a median level of 44 Gt of CO_2 equivalents by 2020. The emissions reductions required by developed nations are 20 to 40% below 1990 levels by 2020, and further reductions of 80 to 95% by 2050. *[Discussion Paper, page A41]*

What matters for climate change is the accumulated amount of greenhouse gases in the atmosphere. CO_2 stays in the atmosphere for more than a century. This means that **for every year that passes without decreases in global emissions we have less time in which to reduce emissions**.[28]

Climate science points to a further reason for concern: once climate change reaches a certain point it is likely to cause **feedback loops**. Higher temperatures lead to greater releases of greenhouse gases, which lead to yet higher temperatures. For example, if the Arctic permafrost melts it will release methane stored in the ice, which will increase the rate of global warming.

The concern is that these feedback loops **will continue to increase global temperatures to catastrophic levels**, independently of human action. This accelerated warming could also lead the planet's climate to tipping points or thresholds **beyond which climate change is abrupt and irreversible**. We may have a relatively short amount of time—10-20 years—in which to alter our emissions in order to **stabilize** the climate.

Many experts argue, therefore, that dramatic changes to our carbon footprints are required on a very short timeline. There are also **economic reasons to move quickly**: the International Energy Agency suggests that the world will have to spend an extra $500 billion to cut carbon emissions for each year it delays action on global warming.[29] So a reduction of emissions may be important to both prevent climate impacts and save money.

Some, however, question the wisdom of investing in greenhouse gas reductions in Edmonton. Although *The Way We Green* commits the City to GHG reductions, it does mention some **reasons offered on the other side**:

- Canada generates less than 2% of total human-caused greenhouse gas emissions (even though Canadians are recognized as having one of the largest carbon footprints per person in the world) .
- Whatever reductions Edmonton achieves will be relatively insignificant on a global level.
- Aggressive reductions could reduce the competitiveness of Edmonton's economy.[30]

Reflection Questions:

How important do you think it is for Edmonton to reduce its emissions?
How much should we be doing, and why?

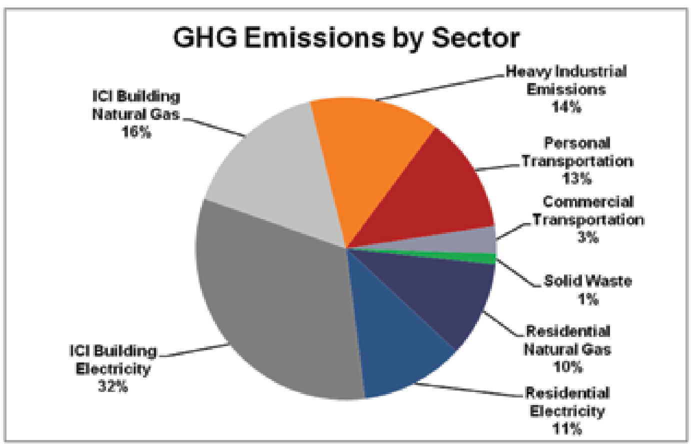
[In thinking about Edmonton's responsibility to reduce GHG emissions you may want to know what's being done already—here and in other places. For more on this see the section later in this binder called "What are we already doing about climate change?"]

How much is Edmonton emitting now?

Canada's per capita carbon dioxide (CO_2) emissions are **among the highest** in the world; in 2008 Canada ranked 13th in the world in per capita emissions with 16.3 metric tons emitted per capita. Other northern nations such as Russia (12.0 metric tons per capita), Finland (10.6 metric tons per capita), and Sweden (5.3 metric tons per capita) all had lower per capita emissions than Canada.[31]

In 2009, sources within Edmonton were responsible for 13.7 million tons of CO_2 equivalents. *[Discussion Paper, page 10]* Canada's total emissions were 690 million tons of CO_2 equivalents, so Edmonton was responsible for 2% of Canada's emissions.[32] At that time, Edmonton had just over 2% of Canada's population.

Different sources of energy produce different amounts of greenhouse gas (GHG). The following figure breaks down the **sources of Edmonton's greenhouse gas emissions**. (ICI stands for "industrial, commercial, and institutional.")



[Discussion Paper, page 12]

As you can see, the **electricity and natural gas used for buildings** produce the highest amounts of GHG emissions. Other significant sources of GHG emissions include residential electricity and natural gas, heavy industry, and personal transportation. The five areas for opportunity (electricity grid, urban form and transit, heavy industry, buildings, and vehicles) were chosen because of the high emissions levels generated by these sectors.

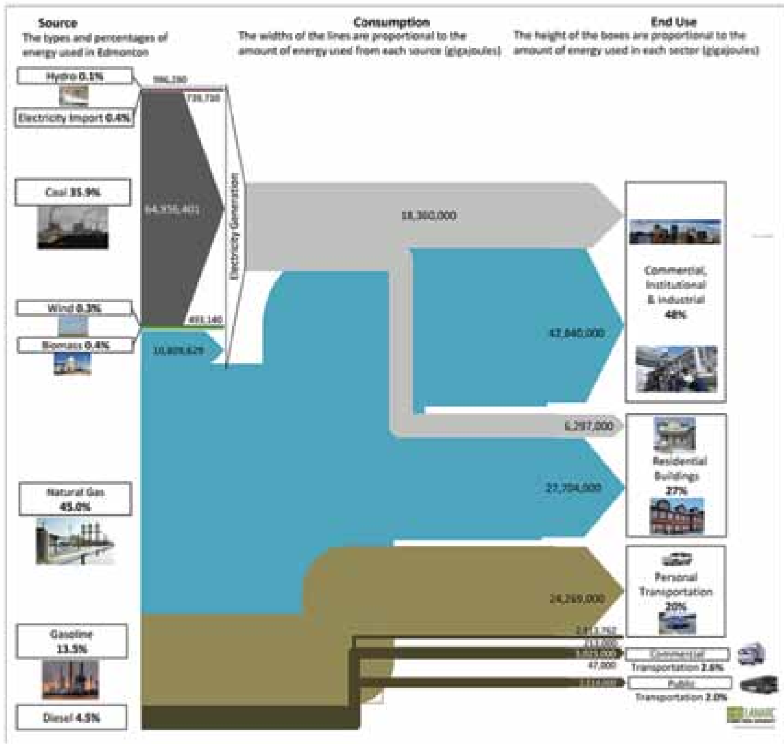
[For more on Edmonton's energy use and GHG emissions see the Discussion Paper, pages 9-12. For information on what Edmonton and other jurisdictions are already doing to mitigate climate change see the section later in this binder labeled "What are we already doing about climate change?"]

Edmonton's energy present and possible energy futures

How do we use energy in Edmonton right now?

The following figure shows where Edmonton's energy comes from and what it is used for.

Primary energy sources (where the energy is coming from) are on the left and energy demands (what the energy is used for) are on the right. The coloured arrows in the middle show the amount of each type of primary energy that is changed into usable kinds of energy (such as electricity). White space in the middle section shows where energy is lost during conversion. The large amount of white space between coal and its end use shows that a lot of energy is lost during the process of burning of coal to generate electricity.



[Discussion Paper, page 11]

Natural gas provides almost half of the energy used in Edmonton (the blue part of the figure): most of this is used in residential and commercial buildings for space and water heating, though some is used to generate electricity. **About another 37% of Edmonton's energy comes from electricity**, which is mostly generated by burning coal. 13.5% of Edmonton's energy comes from gasoline and is used to power vehicles. About 4.5% of Edmonton's energy use comes from diesel and is mostly used in large vehicles like trucks and buses. Low GHG emitting **renewable energy sources, including hydro, wind, and biomass, make up less than 1% of the energy Edmonton uses**.

In our homes, offices, and businesses we use electricity for appliances, electronics, furnace fans, air conditioning, and lighting. Most of the electricity in Alberta is generated by burning coal, which produces relatively high levels of greenhouse gas (GHG) emissions for every unit of energy produced compared to most other sources of energy. Because of this, electricity is responsible for more than 43% of the GHG emissions, even though it accounts for only 20% of the energy used (remember, a lot of electrical energy is lost in conversion) in Edmonton. *[Discussion Paper, page 12]*

What do all these numbers mean?

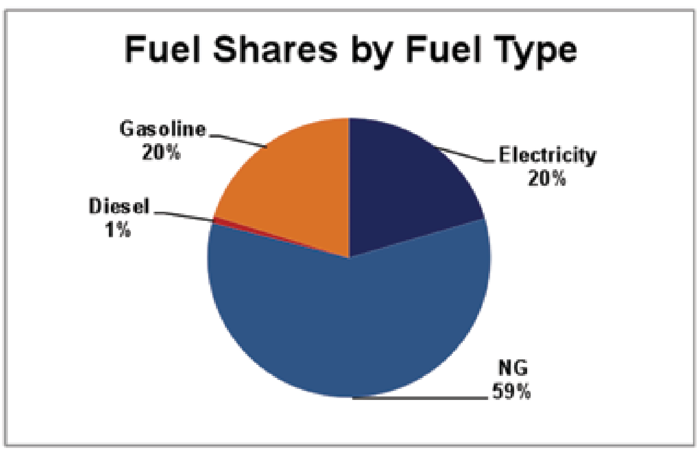
It can be confusing trying to understand energy supply and use. How much of each type of energy we use? How much is lost when we convert it to useable energy? How intensively does each energy source produce greenhouse gases? These are not simple matters to explain or understand.

Do your best to take in what you're reading, but don't worry if you don't get a lot of it at first. Things will make more sense as we go, and there will be lots of chances to ask questions and seek clarification. What's more, different people will contribute different things to the Panel: you don't need to become an energy expert to add value to the discussion.

Please do raise any questions you have about these things at the Panel's sessions or to the Panel's support staff.

Energy use in Edmonton (2009) – excluding heavy industry:

The following graph shows energy use in Edmonton, but does not include heavy industry. Like the last figure, this graph demonstrates that natural gas is the most used form of energy. Electricity (generated by both coal and natural gas) and gasoline are also significant sources of energy in Edmonton.



[Discussion Paper, page 10]

Reflection Questions:

How much do you or your household spend on energy each month? Do you and your family make an effort to reduce your energy use? If so, how?

Three possible carbon futures

Edmonton faces choices about how much energy we will use, whether we continue relying on fossil fuels for most of our energy, and whether we should move to lower emitting and/or renewable sources of energy.

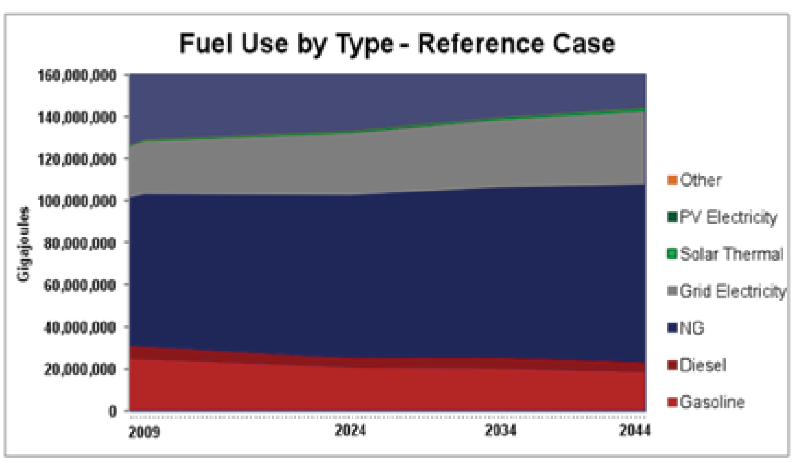
This section lays out different pathways into the future—what the Discussion Paper calls the **Reference Case**, the **Reduced Carbon Case**, and the **Low Carbon Case**. This Citizens' Panel will make recommendations based on these pathways.

The Reference Case

The Reference Case represents the "business as usual" path for Edmonton's energy mix:

- **Continuing current land development patterns** (17% of new population growth occurs in developed areas of the city).
- Increasing building code and vehicle efficiency standards in line with, but not beyond stated government policy.
- Electric vehicle uptake **in line with projected national trends**.
- Reducing the GHG intensity of the provincial electricity grid **based on current market forces**.
- Increasing GHG emissions from heavy industrial facilities like refineries and cement plants **at the same rate as city-wide job growth**. *[Discussion Paper, page 25]*

Under the Reference Case, Edmonton's fuel use will include a lot of natural gas (blue section of graph) as well as electricity coming mainly from coal-fired facilities (grey section of graph), and very low proportions of solar thermal, photovoltaic, and other sources of low greenhouse gas emitting energy.



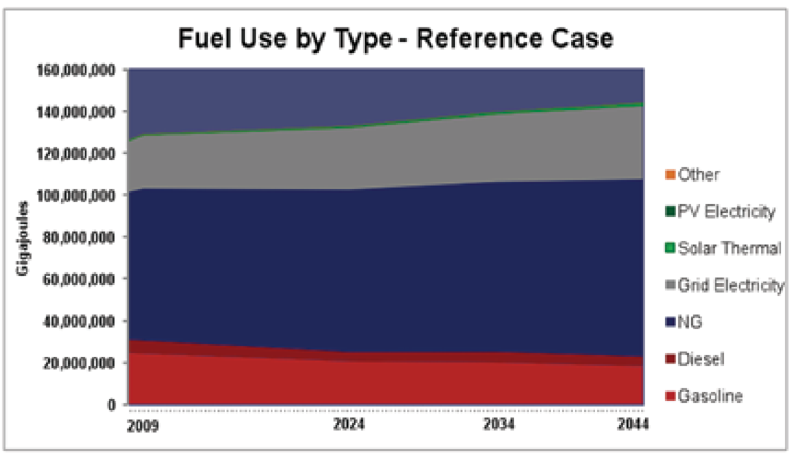
[Discussion Paper, page 24]

The Reduced Carbon Case

The Reduced Carbon Case describes what to expect if **currently existing plans are successfully implemented and increased over time** (e.g. the Municipal Development Plan, the transportation plan, expected energy efficiency regulations). We would expect to see:

- **Locating more population growth in the inner city**. According to *The Way We Grow* (Edmonton's Municipal Development Plan), 25% of new population growth would happen in developed areas of the city.
- Following through on the **transportation targets** offered in *The Way We Move* (Edmonton's recently approved transportation plan).

If Edmonton successfully implements existing plans like *The Way We Move* and *The Way We Grow*, it will still rely heavily on natural gas (blue section of graph) and coal-generated electricity (grey section of graph) for the majority of its energy:



[Discussion Paper, page 26]

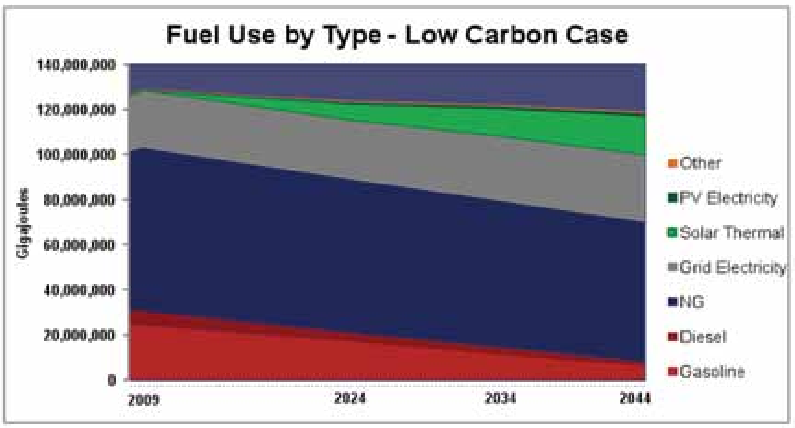
The Low Carbon Case

This case sets out the energy mix path expected if **all of the energy transition options are implemented to a high but achievable level**. Under the Low Carbon Case presented in the Discussion Paper, Edmonton's energy use in 2044 would be less than its present energy use. Edmontonians would use less than half the gasoline they currently use, largely because they would rely less on their cars. We would expect to see:

- Edmontonians using less fossil fuel and more low-emitting renewables than now.
- Less energy being wasted during conversion from primary energy to usable energy (e.g. from burnable coal to usable electricity).

- **Solar energy** providing electricity and heat, and some heat being **pumped from the ground** into buildings in place of using natural gas.
- **Most vehicles powered by electricity, and Edmonton more compact** than it is now.
- **Alberta's electricity sources changed from mainly coal to a mixture of mainly low emitting fuels** (e.g. wind, solar, biomass, combined heat and power, high-efficiency natural gas plants, and coal plants that capture carbon dioxide).

[For more on the methods used to model these different cases see the Discussion Paper, pages C1-C21]

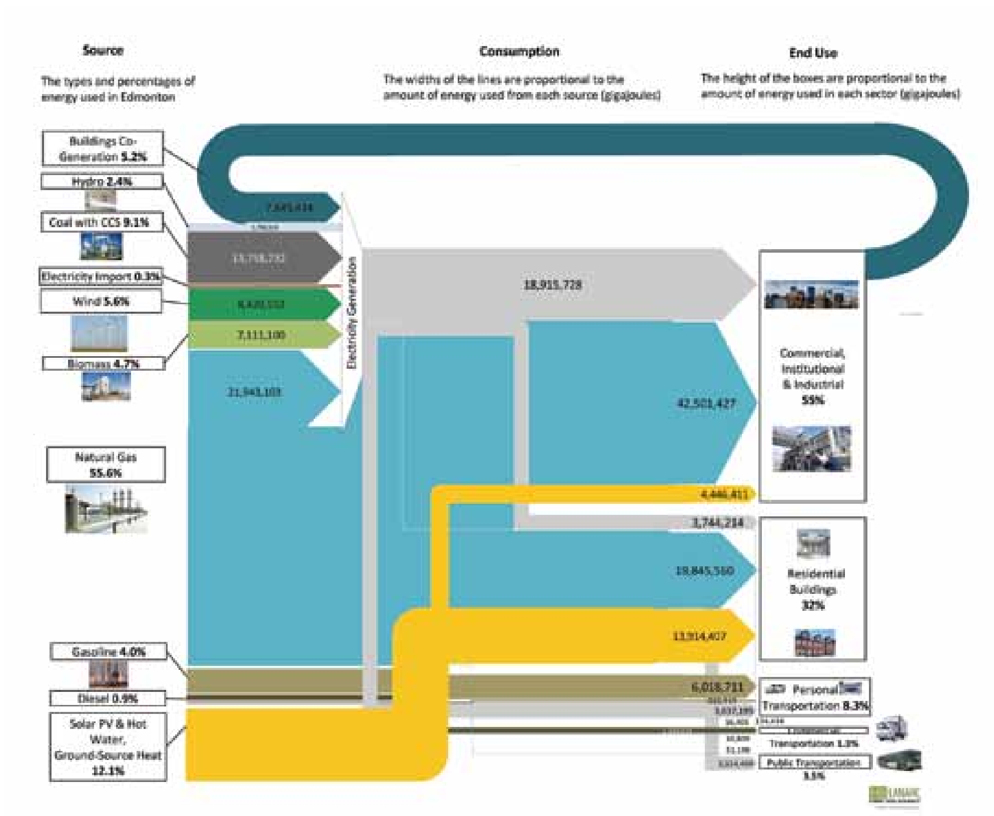


[Discussion Paper, page 28]

As you can see from the graph, the Low Carbon Case will lead to a greater diversity of energy sources. Edmonton's fuel use will still include natural gas (blue section) as well as electricity coming mainly from coal-fired facilities (grey section), but will also have more energy coming from low-emitting sources like solar thermal and photovoltaic (PV).

The next figure breaks down Edmonton's energy supply and use under the Low Carbon Case. Primary energy sources (where the energy is coming from) are on the left and energy demands (what the energy is used for) are on the right. The coloured arrows in the middle show the amount of each type of primary energy that is changed into usable kinds of energy (such as electricity). As compared to the previous figure that showed Edmonton's current energy use, this figure shows the increased use of a diversity of energy sources.

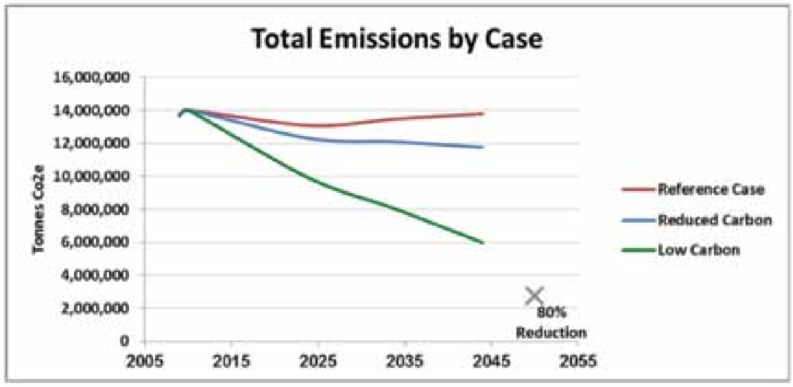
More solar PV, ground-source heat, and other low emitting energy sources would be used for both residential and commercial buildings. Use of coal and gasoline would decrease, and more renewable energy sources such as wind and hydro would be used.



[Discussion Paper, page 29]

Comparing the three cases

Using less fossil fuel energy would reduce Edmonton's GHG emissions significantly. The following chart shows the **differences in expected emissions reductions between the three scenarios**. In 2044 under the Low Carbon Case, Edmontonians would emit approximately 50% less GHGs than if we stay on the Reference Case path. (CO_2e stands for 'carbon dioxide equivalent'.)



[Discussion Paper, page 31]

Reflection Questions:

What are your initial thoughts about the three cases? Does one case seem more appealing than the others? Why?

The expected emissions reductions shown in the above graph are a result of reductions in five key areas of opportunity.

This table shows us what share of emissions reductions would be accounted for by each of the five areas of policy action that were described earlier:

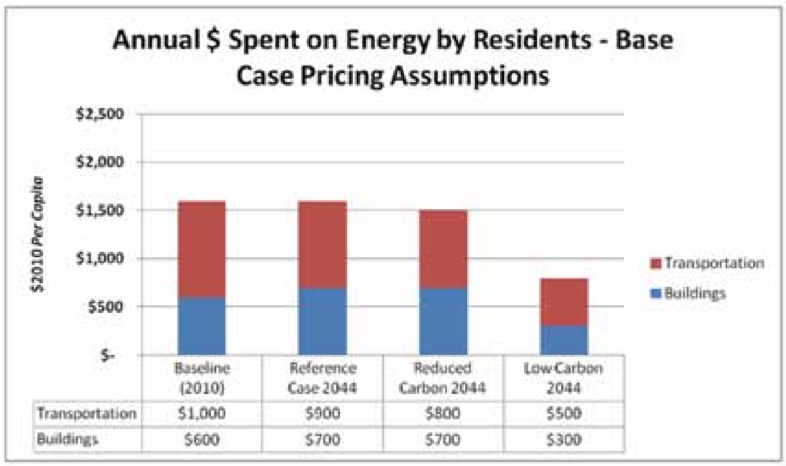
Emissions reductions achieved relative to the Reference Case		
	Reduced Carbon Case	Low Carbon Case
Provincial Electricity Grid	6%	24%
Land Use + Transportation	3%	8%
Heavy Industry	3%	8%
Buildings	2%	12%
Vehicles	1%	4%
Total	**14%**	**57%**

[Discussion Paper, page 32]

The next two charts show how different paths affect the future energy costs faced by Edmontonians.[33]

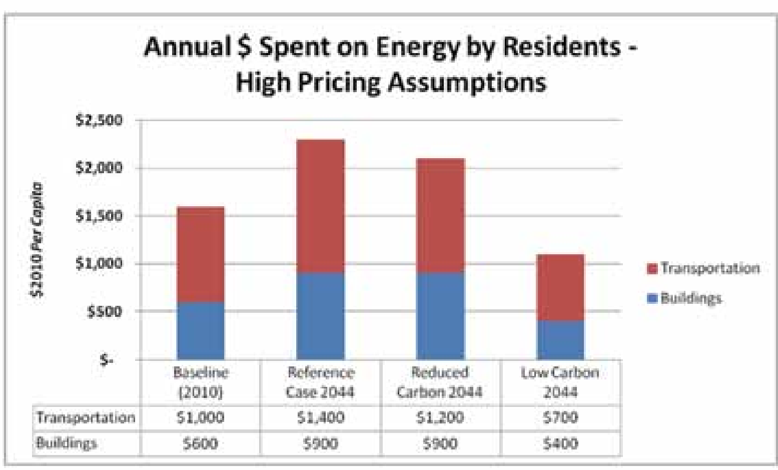
The first chart shows **what residents would expect to pay based on expected future energy prices** (the base case). The red portion of the bar represents spending on transportation, and the blue is how much you are likely to spend on building energy (for example, heating your home).

If energy prices remain relatively stable (base case), **under the Reference Case, Edmontonians will spend approximately $1,600 per year on energy (in 2010 dollars) by 2044**. If Edmonton achieves the **Low Carbon Case, residents would spend only about half as much on energy**, meaning that you would save about $800 per year. This price reduction would make a big difference for people who are energy vulnerable (people who spend more than 10% of their income on energy).



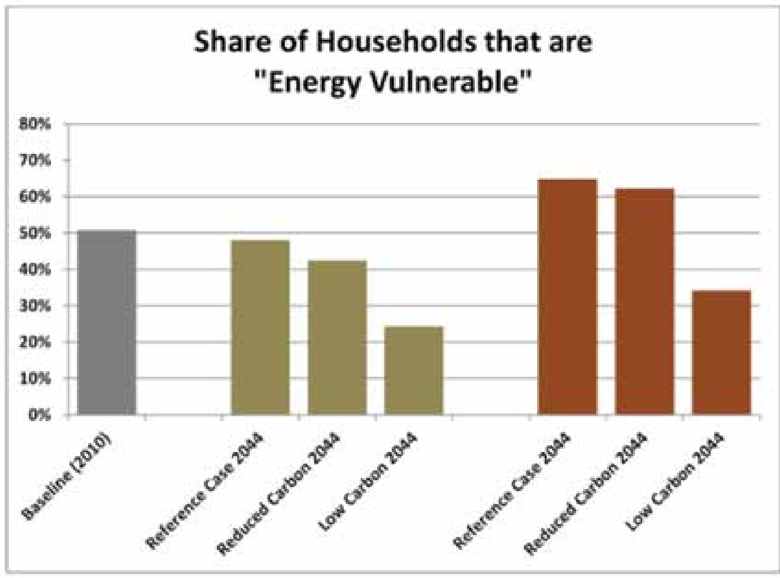
[Discussion Paper, page 36]

The following chart shows expected energy costs if prices rise quickly (the high case). Again, the Low Carbon Case provides significant energy savings for consumers as compared to both the Reference Case and the Reduced Carbon Case.



[Discussion Paper, page 37]

Currently, **a little over 50% of all Edmonton households are energy vulnerable**. This means that they spend more than 10% of their income on energy. Assuming base case pricing, the Low Carbon Case would reduce the number of energy vulnerable households by approximately half. The next chart shows the proportion of households that would be vulnerable to energy price increases if prices remain stable (the base case) and if prices rise quickly (the high case):



[Discussion Paper, page 39]

Whether energy prices remain the same or become more expensive very quickly, the Low Carbon Case is estimated to decrease the number of energy vulnerable households much more significantly than either the Reference Case or the Reduced Carbon Case.

Five opportunity areas under each of the three carbon cases

This table summarizes what would have to happen in each of the five opportunity areas in order to achieve each of the three different carbon "cases":

	Reference Case	Reduced Carbon Case	Low Carbon Case
Alberta's electricity grid	Most of the growth in electricity supply for Alberta would come from new natural gas power plants.	Use existing renewable technologies like wind, biomass, and biogas. This would reduce emissions from electricity production by 21% compared to the Reference Case in 2044.	Phase coal out early; use combined heat and power (CHP); use renewable technologies like solar PV, wind, biomass and biogas; heavily promote energy efficiency. This would reduce emissions from electricity production by 81% compared to the Reference Case in 2044.
Urban form and transit	17% of population growth occurs in existing neighbourhoods and 83% occurs in new neighbourhoods. This is the same as is currently happening in Edmonton. The rapid transit network would be twice as long and the population density of mature neighbourhoods increases by about 15% compared to current levels.	25% of population growth occurs in existing neighbourhoods and 75% in new neighbourhoods, which is in line with the recently approved Municipal Development Plan, *The Way We Grow*. The rapid transit system would be four times longer and the population density of mature neighbourhoods increases by 21% compared to current levels, consistent with Edmonton's *The Way We Move*.	40% of population growth occurs in existing neighbourhoods and 60% in new neighbourhoods. The rapid transit system would be five times longer and the population density of mature neighbourhoods increases by 31% compared to current levels.
Heavy industry	GHG emissions from existing large industrial facilities do not change significantly from current levels and new large industrial facilities are created at the same rate as job growth within the city.	Existing industrial facilities would improve their efficiency by 10% and very large heavy industry is created at half the rate of job growth within the city (i.e. industrial growth still occurs, but it is more focused on businesses that are not very large energy users).	Existing industrial facilities would improve their energy efficiency to the highest levels currently considered economically possible (25%) and business growth in the city does not add to the GHG emissions from this category of heavy industry. Significant changes to current policies, including regulation and incentives, would be necessary.

	Reference Case	Reduced Carbon Case	Low Carbon Case
Buildings	Buildings would use 50% of the energy they currently use, partly because of changes to the National Building Code and partly because of rising energy prices. The current rate of building retrofits would continue.	Buildings would use 47.5% of the energy they currently use—moderately less than they would under the Reference Case.	Buildings would use only 15% of the energy they currently use due to a more advanced building code, requiring retrofits at the time of sale and solar panels on nearly every roof with good exposure to the Sun.
Vehicles	Fuel efficiency would improve at its current rate and would be 6.6L/100km. 20% of the vehicles in Edmonton would be electric.	Fuel efficiency would be the same as the Reference Case (6.6L/100km) and 31% of the vehicles in Edmonton would be electric.	Fuel efficiency would improve to 6.1L/100km and 67% of the vehicles in Edmonton would be electric.

[For more information regarding these five areas see the Discussion Paper, pages 12-23. For greater detail on the future energy mix in Edmonton see pages B8-41. For examples of options for energy transition from other jurisdictions see pages B42-53]

The Discussion Paper's recommendations

The Discussion Paper's recommendations will be a key point of reference for the Citizens' Panel. These are found on pages 42-51 of the Discussion Paper.

Thinking about risk, uncertainty, and values

Risk and uncertainty

Because none of us can predict the future, we must manage our lives in ways that help us to **prepare for events whose likelihood is small or uncertain.**

We assess and prioritize risks every day by putting on a seat belt when we drive, locking our doors when we leave home, or buying health and property insurance. We hope to avoid unpleasant events and calamities like car accidents, burglaries, and illness, but they could occur and we want to be prepared.

The future is uncertain, but **we can make informed estimates** based on risk factors, similar to the way that a doctor uses your family medical history to assess your health-related risks.

Reflection Question:

What are some of your strategies for managing risk and uncertainty in your own life?

What are the risks associated with climate change?

Climate change may create **increased risks** to public health and safety, both worldwide and locally:

- Exposure to extreme heat, air pollutants, mould spores, and increased transmission of infectious diseases may increase the likelihood of **illness** and death. Heat can also **worsen existing medical conditions**, resulting in increased demands on our health care system.[34]
- Climate change may also increase the frequency of **extreme weather events**, such as storms, floods, droughts, and other natural disasters. Such events could lead to injury, loss of life and substantial damage to property and infrastructure.
- These risks may affect the stability of our **food supply**, our **transportation networks** and our overall **economic productivity** and **well-being**.[35]

Reflection Questions:

What is your reaction to these climate change risks? How important is it to manage these risks, given that we can't know exactly how severe they are?

[For more information on climate change's impacts see the tab "About climate change and energy vulnerability"]

Pascal's Wager as one way of thinking about risk

Assessing risk always involves some uncertainty. The philosopher Blaise Pascal developed a helpful method, called Pascal's Wager, for **making decisions when there is uncertainty**. In the case of climate change we are uncertain about whether actions intended to mitigate climate change will significantly reduce its impacts.

Pascal's Wager breaks a situation down into (1) whether we act or not, and (2) whether action is effective or not. This creates four possible scenarios:

	Act to mitigate climate change	Don't act to mitigate climate change
Our actions can significantly reduce climate impacts	• We **implement changes** to our energy systems (e.g. energy efficiency, more compact neighborhoods, less coal power generation) • Climate impacts are significantly **less severe** than if we'd done nothing	• We **don't change** our energy systems • Climate impacts are **more severe** than if we'd acted
Our actions can't significantly reduce climate impacts	• We **implement changes** to our energy systems (e.g. energy efficiency, more compact neighborhoods, less coal power generation) • We **don't affect** climate impacts	• We **don't change** our energy systems • We **don't affect** climate impacts

Reflection Question:

Think through the positives and negatives of each of the four possibilities. Does it seem best to act or not act?

We may not all agree that acting to reduce the impact of climate change is necessary. **Even if we did agree** that we should take action, we might not agree on **what type of action** to take, or **who should be responsible** for taking action.

Thinking about what we hold dear and most want to protect might help us decide how best to prepare for an uncertain future. This means that we must **reflect on our values.**

Values

Values are what we believe is important and worthwhile to a **good life**. Values help guide our decisions about how to live. Our values are determined by our own experiences and the values held by those around us.

Preferences, interests, and values are not the same:

1. **Preferences** are our **likes and dislikes**, which are not always based on reasons or justifications. I like beer, you like wine. I think windmills look cool, you think they're ugly.
2. **Interests** are based on **what we each stand to gain or lose**. A new LRT line to Mill Woods may give me a great way to get to work, so getting it built seems to be in my interest. But a new LRT line may lead to disruptive construction near your home, so it may not seem to be in your interest.

3. **Values** are based on our **sense of right and wrong**. They are influenced by our experiences, groups we belong to, religious beliefs, traditions, and culture. In Canada, certain values are reflected in our laws and justice system, the curriculum we teach in schools, our governments, the ways we build our cities and towns, and all the other ways we organize ourselves to live together.
4. When we make decisions, we may be motivated to protect ourselves and our family, the environment, or others whom we have not met. Because different people's preferences and interests often run up against each other (I want the LRT line, you don't want noisy construction), we tend to rely on our values. **Values help us decide which preferences and interests should take priority within a community**.

Sometimes we will have multiple, conflicting values. When we need to make difficult choices it helps to identify our competing values and weigh the pros and cons of each to determine what to choose.

Examples of competing values

- **Individual liberty and choice**: we each should be allowed to do as we wish so long as we aren't harming others.
- **Equity**: society should be regulated to reduce inequalities of power, opportunity, and/or outcome between people. We might also value equity between this generation and future generations.
- **Efficiency**: we should organize society so that we maximize overall well-being for the lowest cost possible (even if this means some having more than others).

Sometimes the choice about which values to prioritize comes easily, other times it may be less clear. Our political and legal systems lay down some rules about priorities (e.g. the Canadian Constitution states that certain individual liberties cannot be overridden in the name of the common good).

We can also try to find a solution that accommodates many people's values. For example, you like energy efficiency ratings on household appliances because it contributes to a healthier environment, and I like it because it saves me money on my electricity bill. Even though we hold different values (you value environmental protection and I value economic efficiency), putting energy efficiency ratings on appliances satisfies both your values and mine.

A key part of your work in this Citizens' Panel will involve reflecting on your values and priorities, communicating these to others, and using what you hear from others to better understand your own positions and make recommendations.

Reflection Questions:

What do you consider to be your most important values? How have these changed over the course of your life?

What values do people bring into the discussion of energy policy?

People hold a variety of values regarding energy policy. These can both complement and conflict with each other. Here are some examples to get you thinking:

1. "It's important that the municipal government be as **efficient** as possible with our tax dollars: we should only make changes if they will save us money."
2. "We don't need to constantly buy and consume things to make us happy. **Consuming less** energy could actually be a route to **greater well-being.**"
3. "We should protect the environment for ourselves and our children, but **we have to balance this with keeping the economy strong.**"
4. "We need to act now and reduce our greenhouse gases to prevent potential environmental disasters, even if their probability is uncertain. **We shouldn't take chances** with our own and our descendants' lives."
5. "All of nature is a gift of the creator. All beings are connected and are part of an interconnected whole. We are part of the natural world and must help to **protect and sustain** it."
6. "The job of government is to protect **freedom of choice**. Government shouldn't be telling me where to live or what to drive or spending my money on things I don't value."
7. "The impacts of climate change affect some people more than others. Even if we are not as directly affected as others, we must **protect the less advantaged.**"
8. "Edmonton needs to show real **leadership in energy transition** even if we're not certain of the consequences. Even if it doesn't make a difference, I want to be able to tell my grandkids that we did what we could to combat climate change."
9. "We must base energy policy decisions on expert review of the science, and weigh the pros and cons of different options. This is a **technical question** and the government should follow **expert advice**."
10. "Government should focus on the l**ong term benefits to all Edmontonians**, even if a particular energy policy disadvantages a particular group or industry in the short term."

Reflection Questions:

What beliefs and values do you think inform each of these statements? Which of these statements could co-exist, and which are at odds? Do any of them reflect your own values?

What do we know about Edmontonians' views on energy and environment?

The City did a survey of citizens in 2010 as part of *The Way We Green*:[36]

- Over half of respondents believe that Edmontonians do not live in a way that is sustainable.
- 93% of respondents agreed that significant lifestyle changes are necessary in order to make Edmonton environmentally sustainable.
- 94% believe that the City must continue with efforts to engage and educate citizens on environmental sustainability.
- Notably, changes to energy systems found strong support among citizens with 99%, 98%, and 96% of respondents agreeing that Edmonton must promote energy-efficient buildings, energy efficient forms of transportation, and renewable energies, respectively.
- 54% support City climate change adaptation initiatives.

Why we don't always act on our values

There are many potential barriers or constraints that can make it harder to act in a manner that is consistent with your values. Examples of common constraints include:

- Lack of time
- Not knowing what the "right" thing to do is
- Not having the power to make the choice you want
- Not having enough money
- Not being supported by those around you

Because of constraints like these, the way we act can sometimes seem at odds with our values. This is called the **value-action gap**.

There also can be psychological obstacles to acting in accordance with our values as we understand them. **The ways we act aren't always based on conscious decisions**. We can act based on habits, what we see others doing, or whatever feels easiest. Social influences have a powerful effect on how we act: if we were in another setting we might act very differently.[37]

Psychologists talk about **denial**, the way we can tend to block out or ignore gaps between how we think we should act and how we do act because it challenges our identity and is upsetting to think about.[38]

One metaphor for thinking about how conscious and unconscious forces shape our behaviour is an **iceberg**. Beneath our conscious reasons for acting are psychological dynamics that shape our thoughts and behaviours in ways that we don't usually notice or understand. One useful role of deliberation can be to make us more conscious of what lies 'below the waterline' for ourselves and others.

Reflection Questions:

Can you think of a time when your actions did not accurately reflect your values? What was going on 'below the waterline'? What do you think caused you to act the way you did?

Our society has a major value-action gap when it comes to reducing our dependence on fossil fuels. Polls show that the vast majority of Canadians are concerned about climate change, and yet as a country we are not doing as much as we could.[39]

There are probably many reasons for this value-action gap:

- Our **energy use is deeply embedded in how we live**. It isn't easy to change our habits, or to give up things we enjoy, even if we think that we should.
- Changing our behaviours can be challenging, especially **when we feel powerless** or don't think that our behaviours alone will make a difference.

- Because change can be emotionally difficult, many of us **resist changes in the present** even when we know that they would benefit us in the long-term.
- Alberta's economy currently is heavily dependent on the fossil fuel sector. Many Albertans worry that reducing our dependence on fossil fuels could **negatively affect government services** by reducing revenues. Similarly, many Albertans fear that **reducing greenhouse gas emissions could reduce the prosperity of the province**.

Signals and incentives provided by government policies and investments **can nudge us toward less dependence on fossil fuels** (e.g. speedy and frequent public transit options) **or toward greater dependence** (e.g. neighbourhoods where long trips are needed to get groceries).

Public policies can shift incentives so that our collective behaviours align more consistently with our beliefs and values about how the world should be and how we should behave. Some of the energy policies that we are discussing in this Citizens' Panel may be ways of nudging us to better realize our values as well as our interests.

Reflection Question:

Can you think of a government law, regulation, or incentive that helps you to live up to your values?

Deciding what scientific and technical information to trust

As you dig deeper into the issues of climate change and energy vulnerability you'll come across information and perspectives from many different groups and individuals. **How do you decide which claims to trust?**

Here are some **questions you can ask about fact-based claims** that you read or hear during the Citizens' Panel:

- **What is the source?** Finding this out sometimes requires doing some digging, because one source may draw on another source, or the source of the information may not be identified. Often we are expected to assume that a statement coming from a think-tank, for example, is authoritative because it is backed up by research. But it is important to learn something about the think-tank, like who funds it and whether it promotes a particular interest or ideology. We can ask the same questions about a publication, a television network, or a website.
- **Does the source of the information have an interest that we can identify?** Having an interest in what one is arguing or claiming does not invalidate the argument or the factual claims. But it is important for us to be able to identify the interests that motivate the information we are getting, alerting us to the biases that may be influencing what information has been presented or left out.
- **What are the qualifications of the author of the information?** Is the person making the claims or offering the opinion actually knowledgeable about the issue? What is the basis of his or her knowledge?

- **What is the quality of the evidence?** Did the author make very selective use of evidence, or did the author take into account all of the evidence available and consider other arguments or explanations before coming to a conclusion? Certain journalists, editorial writers, bloggers, media commentators, and even academic authors may select facts that support the stories they want to tell, leaving out evidence that contradicts their version of the truth.

- **Are any checks in place to screen out questionable or insufficient research?** Scientists submit summaries of their research to journals that usually have transparent standards for deciding what to publish. The work is reviewed by two or more "peers" (other experts in the same field of research). If they find the research to be sufficiently thorough and supported by evidence, they will "OK" the paper for publication. If not, it goes back to the authors for revision or is rejected. We say that there is a "scientific consensus" when a large body of research points to similar conclusions about the characterization or explanation of a phenomenon.

Another useful tool for assessing this is the CARS Checklist for Research Source Evaluation (http://www.richmond.ac.uk/content/library/information-literacy/the-cars-checklist.aspx).

Although some of the information presented in this Handbook comes from the mainstream science of climate change, traditional and non-scientific forms of knowledge can also be legitimate sources of information. Aboriginal elders, farmers, ranchers, fishers, and naturalists all have knowledge of climatic change drawn from their traditional knowledge, experiences, and observations over time. Many of us are becoming more aware of changes in weather (such as more frequent extreme weather events or unpredictability) that affect our lives in many ways.

Throughout this Handbook you will find superscript numbers (e.g. [1, 2, 3]) that refer to the Endnotes section at the back of this binder. Each endnote shows you the source(s) used for the passage of text just before the number. A variety and balance of sources were used in the creation of this Handbook, and almost all are from government or peer-reviewed research.

Scientific method and scientific uncertainty

What are scientific inquiry and peer review?

Scientific inquiry is a process of **continual interaction between scientists** around the world. As scientists conduct experiments and publish their results, the scientific community—people with post-secondary degrees in the sciences—is asked to verify what they've done. This process is known as **peer review**. The scientific community **raises questions and conducts tests** to verify or challenge the results of individual scientific experiments.

Scientific knowledge about climate change is continually subject to peer review. As scientists specializing in the various areas related to climate change (e.g. meteorology, glacial geology, oceanography) develop hypotheses and conduct experiments, their results are **reviewed by other climate experts**. For example, in an effort to understand how today's atmospheric concentration of CO_2 differs from 1000 years ago, a group of climate scientists could travel to the Arctic to measure the CO_2 found in ice cores deep underground. After getting results, the researchers would **write a paper** that explains their experiment and analyzes these results. This paper would then be **submitted for publication** in a peer-reviewed journal like the *Bulletin of the American Meteorological Society or the Journal of American Science*.

Next, the editors of the journal would look at the paper and decide if it's ready to be peer-reviewed by others within the scientific community. If they consider the paper ready, two or three climate scientists will receive the paper to **verify or challenge its claims**. This process is **anonymous**—the authors don't know who the reviewers are and the reviewers don't know who the authors are. Reviewers look for things **that might cast doubt on the author's claims**, like bad data, faulty calculations, flawed experimental design, or misinterpretation of results. Afterwards, each reviewer writes an evaluation of the paper and submits it to the editors. Based on these evaluations, the editors can **reject or accept** the paper. The editors can also request that the scientists who submitted the paper do further work.

If a paper survives this initial peer review it gets published. This doesn't mean that the paper's claims are entirely correct. Once it is published, **other scientists continue to verify or challenge its claims**. They do this by attempting to replicate the findings in their own experiments, writing their own papers, and submitting these papers to the peer review process in other journals. A poor or even fraudulent paper can get published. However, the process creates conditions that make the acceptance of such papers unlikely. And because scientific review continues after a paper gets published, **bad data or inaccurate analyses are likely to be revealed** over time.

Scientific knowledge that **survives** this extensive process of peer review can be described as an **accepted theory or view**. This is because particular results have survived repeated testing by scientists around the world.

What is scientific uncertainty?

Like other things in life, scientific theories include some degree of **uncertainty**. For instance, although we take medication to treat our illnesses, there's no guarantee they will work or be without unexpected side effects. Although we understand many scientific phenomena as **facts**, there will always be some degree of uncertainty and some future experiment could always prove things to be otherwise. In general, **the more complex an issue is, the more uncertainty there will be.**

Climate science is one of the more complex fields of science. While some of the variables (e.g. greenhouse gases, reflection of energy by the Earth's surface, and prevailing wind patterns) are generally well understood, others (e.g. cloud formation, ocean circulation, and local wind irregularities) include a lot of uncertainty.

Making decisions when there is uncertainty is complex and difficult. For instance, when choosing to insure your car or purchase a warranty for your computer, deciding the level of protection you need depends on the likelihood that something will need repair. While some people take a **"better safe than sorry"** approach, others prefer to save their money until they know for certain that something bad will happen.

Within the large body of scientific research on climate change and its effects, **there will always be a degree of uncertainty** about how quickly global average temperatures will rise, or what the consequences will be. Scientists do not have all of the knowledge needed to make accurate predictions, in part because what happens in the future will depend on actions taken by governments and others now. Furthermore, scientists do not have a perfect understanding of the complex feedback effects described earlier in this handbook. **There is consensus, however, that the evidence for human-caused climate change is persuasive and that many predicted outcomes are already occurring.**

Introduction to modeling

There are two ways scientists can test the theory of anthropogenic (or human-caused) global warming: using computer **models** that simulate Earth's climate or **measuring** Earth's average surface temperature as greenhouse gas concentrations rise or fall over time. While the challenges of predicting weather are well known (the reason why weather forecasters are often the butt of jokes), predicting climate change—changes in weather patterns over a long period of time—is even more difficult.

In the case of modeling, scientists test the theory of anthropogenic climate change by **comparing past surface temperatures with those simulated by models**. They adjust each of the variables related to climate (e.g. energy from the sun, reflection of energy by the Earth's surface, and greenhouse gas concentrations) until the computer simulation matches the recorded data. To date, the only variable that allows the computer simulation to match the recorded data is **the concentration of greenhouse gases in the atmosphere**. For example, changes in the Sun's energy alone do not account for the temperature changes the Earth has experienced. Indeed, returning to the peer-review process described above, the theory of anthropogenic global warming has not been disproven to date.

Advances in computer modeling have allowed scientists to test hypotheses without having to run large-scale experiments that may take lifetimes to complete. In the case of climate change, **scientists attempt to account for all the variables that affect the climate:** greenhouse gas emissions; water vapour in the atmosphere; how reflective the surface of the Earth is; aerosols; aircraft contrails; and solar irradiance. They hypothesize a relationship between these variables, temperature, wind, and rainfall and then run the model. They compare the model's results to climate data that have been measured directly or through secondary methods like tree rings or ice cores. If the model's results don't match the data, the modellers then recalibrate the model's variables.

Glossary

Acronyms

- **AUMA** Alberta Urban Municipalities Association
- **BAU** Business as usual
- **CCS** Carbon capture and sequestration
- **CFLs** Compact fluorescent lights
- **CHP** Combined heat and power
- **COP** Conference of the Parties
- **CO_2e** Carbon dioxide equivalent
- **CO_2RE** Carbon Dioxide Reduction Edmonton
- **DE** District energy
- **G8** Group of Eight nations
- **G8+5** Group of Eight plus Five
- **GDP** Gross domestic product
- **GHG** Greenhouse gas
- **GSHP** Ground source heat pumps
- **Gt** Gigaton
- **HVAC** Heating, ventilation, and air conditioning
- **ICI** Industrial, commercial, and institutional
- **IPCC** The Intergovernmental Panel on Climate Change
- **LED** Light-emitting diode
- **LRT** Light rail transit
- **MT** Megaton (one million tons)
- **NGO** Non governmental organization
- **UNEP** United Nations Environment Program
- **UNFCCC** The United Nations Framework Convention on Climate Change
- **WMO** World Meteorological Organization

Definitions

- Definitions in **blue** are based on the IPCC's "Glossary of Terms."[40]
- Definitions in **grey** are based on "Campus Conversations: Climate change and the campus."[41]

Adaptation: Initiatives and measures to reduce the vulnerability or increase the resilience of natural and human systems to actual or expected climate change impacts. Various types of adaptation exist, for example, anticipatory and reactive, private and public, and autonomous and planned. Examples are rising river or coastal dikes, retreating from coastal areas subject to flooding from sea level rise or introducing alternative temperature-appropriate or drought-adapted crops.

Anthropogenic: Related to or resulting from the influence of human beings on nature.

Biodiversity: The number of different kinds of plant and animal species that live in a region. On land, tropical rain forests have the highest biodiversity.

Biogas: A gas that is produced from organic matter. This organic matter ranges from municipal solid waste to dead plant and animal matter. Biogas is primarily composed of methane and carbon dioxide. When ignited it can be used as a source of energy as it burns cleanly (similar to liquefied petroleum gas or compressed natural gas).

Biomass: Plant or animal matter that can be converted into renewable energy products, such as biofuels.

Business as usual: A model of the future where predictions are made based on assumptions that policy and operating conditions remain as they are today.

Cap-and-trade: A market-based regulatory scheme used to decrease emissions.

Carbon capture and storage: The processes of capturing carbon dioxide that would otherwise stay in the atmosphere and storing it deep underground. Carbon dioxide can be captured directly from smokestacks or from the surrounding air and then liquefied by compression. Liquefied carbon dioxide is then injected into a deep geological structure underground such as a spent oil or gas field or saline reservoir.

Carbon dioxide (CO_2): CO_2 is a naturally occurring gas and a by-product of burning fossil fuels or biomass, of land use changes and of industrial processes. It is the principal anthropogenic greenhouse gas that affects Earth's radiative balance.

Carbon dioxide (CO_2e) equivalent: A method of measuring the potential impact of various greenhouse gases on global warming by comparing their emissions. For example, one million metric tons of methane produces the equivalent emissions of 21 million metric tons of carbon dioxide, so the potential of methane to contribute to global warming over a 100 year period is measured at 21.[42]

Carbon Footprint: A measure of total greenhouse gas emissions caused directly and indirectly by a person, organization, event, or product.[43]

Climate: The average pattern of weather in a place. While weather may change substantially from day-to-day, changes in climate usually happen gradually over many years.

Climate change: A change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties. This change persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes, external forcings, or persistent anthropogenic changes in the composition of the atmosphere.

Climate Change and Emissions Management Fund: A Government of Alberta program intended to drive innovation, remove barriers and incentivize energy efficiency and the use of renewable and alternative energy sources by giving Alberta companies a March 31, 2008 deadline to reduce the intensity of their GHG emissions by 12%. Companies were given three options for accomplishing this: improving the energy efficiency of their operations; buying carbon credits; or paying $15 into the Climate Change and Emissions Management Fund for every ton emitted over their reduction target.

Combined heat and power (CHP): A method of energy production that uses the excess heat produced from power generation for industrial purposes, water heating or space heating. Also referred to as cogeneration.

Cost–benefit analysis: Monetary measurement of all negative and positive impacts associated with a given action. Costs and benefits are compared in terms of their difference and/or ratio as an indicator of how a given investment or other policy effort pays off.

Deliberative dialogue: Face-to-face conversations in which a group of people exchange ideas and perspectives about a particular issue in order to expand their knowledge, find common ground, and work collaboratively towards solutions.

Developed nations: See Global North.

Developing nations: See Global South.

Ecosystem: An open system of living organisms, interacting with each other and with their [non-living] environment, that is capable of self-regulation to a certain degree. Depending on the focus of interest or study the extent of an ecosystem may range from very small spatial scales to the entire planet.

Energy efficiency: The ratio of useful energy or other useful physical outputs obtained from a system, conversion process, transmission or storage activity to the input of energy (measured as kWh/kWh, tons/ kWh or any other physical measure of useful output like ton-km transported, etc.). Energy efficiency is a component of energy intensity.

Energy intensity: The amount of energy used by an appliance or an industry to produce a product or service. For example, a fluorescent light requires only 20 watts to produce the same amount of light as a regular 100 watt light bulb, so its energy intensity is 5 times lower. Reducing energy intensity is one way to increase energy efficiency and emit less carbon dioxide.

Energy security: The goal of a given country, or the global community as a whole, to maintain an adequate energy supply. Measures include: safeguarding access to energy resources; enabling development and deployment of technologies; building sufficient infrastructure to generate, store and transmit energy supplies; ensuring enforceable contracts of delivery; and maintaining access to energy at affordable prices for a specific society or groups in society.

Energy vulnerability: The extent to which an individual or society is vulnerable to adverse impacts of energy price increases.

Equity: Equity covers the incidence and distributional consequences of a policy, including fairness, justice and respect for the rights of indigenous peoples. The equity criterion looks at the distribution of costs and benefits of a policy and at the inclusion and participation of wide ranges of different stakeholders (e.g. local populations, independent power producers).

Feedback: The mechanism by which changes in one part of the earth-atmosphere system affect future changes in other parts of that system. In climate change, negative feedback work to slow down or offset warming while positive feedback work to speed up or amplify warming.

Fossil fuel: Coal, oil (from which gasoline is made), and natural gas are called fossil fuels because the chemical energy they contained is left over from plants and animals that lived long ago.

Geothermal energy: Accessible thermal energy stored in Earth's interior, in both rock and trapped steam or liquid water (hydrothermal resources), which may be used to generate electric energy in a thermal power plant, or to supply heat to any process requiring it. The main sources of geothermal energy are the residual energy available from planet formation and the energy continuously generated from radionuclide decay.

Global North: This term refers to the countries or regions that we used to call "the First World", and sometimes still call "the developed world". It is used to refer to the relatively wealthy countries of the globe, many of which are situated in the northern hemisphere.

Global South: This term refers to the countries or regions that we used to call "the Third World," indicating those having widespread poverty, inadequate basic services such as clean water, health care, access to electricity and communications, and education. These countries are often former colonies of the European states, which used them as sources of raw materials to fuel their own industrialization. Global South and Global North refer to a general distinction between the poorer and the wealthier nations of the world; this is a socio-economic boundary rather than an actual geographic one, although the majority of the world's poorest countries are in fact situated in the southern hemisphere.

Global warming: The phenomenon whereby Earth's average surface temperature increases. Colloquially, "global warming" and "climate change" are often used interchangeably.

Greenhouse effect: The process by which energy from the Sun is trapped under the atmosphere to cause warming. Light energy can easily pass in through the atmosphere. Once some of this light is absorbed by dark surfaces, the resulting heat energy has greater difficulty getting back out. Through the naturally occurring greenhouse effect, water vapour, ozone and carbon dioxide have kept temperatures on Earth moderate for several billions years. Today, people are adding more gases, which might increase the temperature.

Greenhouse gases: Any gas in the atmosphere that contributes to the greenhouse effect. These include carbon dioxide, methane, ozone, nitrous oxide, CFCs, and water vapour. Most occur naturally as well being created by people.

Grid (electric grid, electricity grid, power grid): A network consisting of wires, switches and transformers to transmit electricity from power sources to power users.

Gross Domestic Product (GDP): The cash value of all of the goods and services produced in a country in a particular time period. Often used as an indicator of the health of a country's economy.

Group of Eight (G8): A forum for the leaders of eight of the world's larger economies: France, Germany, Italy, Japan, the United Kingdom, the United States, Canada and Russia.

Group of Eight plus Five (G8+5): A forum for the leaders of the G8 plus five leading emerging economies (Brazil, China, India, Mexico and South Africa).

Intergovernmental Panel on Climate Change (IPCC): Committees of leading scientists from around the world whose task it is to periodically review and report on the state of understanding of the climate problem. The World Meteorological Organization and the United Nations Environment Program jointly established the IPCC in 1988. It was co-winner of the 2007 Nobel Peace Prize.

Kyoto Protocol: A binding agreement under the United Nations Framework Convention on Climate Change (UNFCCC) designed to help developed countries set targets for decreasing their greenhouse gas emissions. The protocol was adopted in 1997 during the 3rd meeting of the COP in Kyoto. The first implementation phase of the Protocol runs from 2008-2012. The Clinton administration signed the Kyoto Protocol, but the US Senate refused to ratify it.

Low Carbon Case: An energy pathway described in the Discussion Paper where Edmonton implements all feasible options to reduce greenhouse gas emissions and reduce energy vulnerability.

Megaton (MT): Unit used to measure greenhouse gas emissions. A MT = one million tons or 2,000,000,000 pounds.

Methane (CH_4): A greenhouse gas consisting of one molecule of carbon and four molecules of hydrogen. Pound-for-pound it produces between 5 to 10 times more warming than carbon dioxide. Methane is produced naturally from rotting organic matter. Human sources of methane include agricultural activities such as growing rice and raising livestock, landfills, coal mines, and natural gas systems.

Mitigation: Technological change and changes in activities that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce an emission reduction with respect to climate change, mitigation means implementing policies to reduce greenhouse gas emissions and enhance sinks. Renewable energy deployment is a mitigation option when avoided greenhouse gas emissions exceed the sum of direct and indirect emissions.

Mitigation (of disaster risk and disaster): The lessening of the potential adverse impacts of physical hazards (including those that are human-induced) through actions that reduce hazard, exposure, and vulnerability.

Mitigation (of climate change): A human intervention to reduce the sources or enhance the sinks of greenhouse gases.

National Building Code: A federal model building code that addresses the design, construction and renovation of new and existing buildings. Without provincial implementation it has no formal legal status.

Natural gas: Gas obtained from wells used as a fuel. While it contains many chemicals the principle component of natural gas is methane.

Offset (in climate policy): A unit of CO_2-equivalent (CO_2e) that is reduced, avoided or sequestered to compensate for emissions occurring elsewhere.

Paleoclimatic: The study of climate conditions and changes into the distant past using geological evidence like fossils, sediments, rock cores, and ice cores.

Path dependence: Outcomes of a process are conditioned by previous decisions, events and outcomes, rather than only by current actions. Choices based on transitory conditions can exert a persistent impact long after those conditions have changed.

Peak oil: A term used to describe the point in time when the rate of global petroleum production cannot go any higher, after which the rate of global petroleum production begins a terminal decline. Researchers in the energy field are divided over the timing of peak oil and whether or not it will ever be reached.

Per capita: A Latin term that means by or for each person. The term is used to describe an average "per person", often when calculating statistics. For example, "per capita income" is the amount of total income of a population divided by the total number of people in the population.

Photovoltaics (PV): The technology of converting light energy directly into electricity by mobilizing electrons in solid state devices. The specially prepared thin sheet semiconductors are called PV cells.

Policies: Policies are taken and/or mandated by a government—often in conjunction with business and industry within a single country, or collectively with other countries—to accelerate mitigation and adaptation measures. Examples of policies are support mechanisms for renewable energy supplies, carbon or energy taxes, and fuel efficiency standards for automobiles.

Primary energy sources: Energy embodied in natural resources (e.g. coal, crude oil, natural gas, uranium, and renewable sources). Primary energy is transformed into **secondary energy** by cleaning (natural gas), refining (crude oil to oil products) or by conversion into electricity or heat. When the secondary energy is delivered at the end-use facilities it is called final energy (e.g. electricity at the wall outlet), where it becomes usable energy in supplying services (e.g. light).

Reduced Carbon Case: An energy pathway described in the Discussion Paper where Edmonton fully implements all current City plans relating to energy use and GHG reduction.

Reference Case: An energy pathway described in the Discussion Paper where Edmonton carries on with "business as usual", which includes ignoring current City plans to change our energy use.

Renewable energy (RE): Any form of energy from solar, geophysical or biological sources that is replenished by natural processes at a rate that equals or exceeds its rate of use. Renewable energy is obtained from the continuing or repetitive flows of energy occurring in the natural environment and includes low-carbon technologies such as solar energy, hydropower, wind, tide and waves and ocean thermal energy, as well as renewable fuels such as biomass.

Resilience: The capacity to withstand and bounce back intact from environmental disturbances.

Risk factors: A variable that increases the likelihood of developing a disease, infection or injury.

Sea level rise: An increase in the average level of the ocean caused by expansion when water is warmed and by addition of more water when ice caps melt.

Solar energy: Energy from the Sun that is captured either as heat, as light that is converted into chemical energy by natural or artificial photosynthesis, or by photovoltaic panels and converted directly into electricity.

Sustainability: Our society's ability to endure over a prolonged period as an integral part of Earth's natural systems.

Sustainable development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Telecommuting: When an employee works from home or another location rather than commuting to a central place of work.

Trade-off: An exchange that involves a loss of one thing in return for a gain of another thing.

Transit-oriented development: Commercial or residential areas designed to be accessible by public transit.

Uncertainty: An expression of the degree to which a value or relationship is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. Uncertainty may originate from many sources, such as quantifiable errors in the data, ambiguously defined concepts or terminology, or uncertain projections of human behaviour. Uncertainty can therefore be represented by quantitative measures, for example, a range of values calculated by various models, or by qualitative statements, for example, reflecting the judgment of a team of experts.

Urban density: A measurement of the number of people inhabiting an area of urban land.

Urban form: The physical layout and design of a city.

Value-action gap: When an individual's values do not line up with their behaviour.

Values: The standards or principles that we use to determine what is ethically right or wrong, what we should or should not do.

Weather: The condition of the atmosphere at a particular place and time measured in terms in wind, temperature, humidity, atmospheric pressure, and precipitation (rain, snow, etc.). In most places, weather can change from hour-to-hour, day-to-day, and season-to-season.

EXTRAS

More details on our policy opportunities

At the tab called "Summary: Five key energy opportunity for Edmonton" we looked at five areas where Edmonton's policy choices will affect our future energy use:

1. Alberta's electricity grid
2. Edmonton's urban form and transit
3. Heavy industry
4. Buildings
5. Vehicles

This section summarizes the possible changes within each of these areas and looks at some important considerations when considering implementing these changes. There is much more detail on each of the five areas in the Discussion Paper.

Alberta's Electricity Grid		
Description	**Resulting energy use or emissions changes**	**Other considerations**
Wind Power		
Alberta has approximately 807 MW of installed wind capacity, which generated 2% of Alberta's power in 2010. Systems range all the way from the scale of a building or farm to big wind farms generating over 80 MW.	Approximately 20% of Alberta's electricity could come from wind power within the next 20 years. AESO has received applications for more than 11,000 MW in wind projects (it is unlikely that all projects will be developed).	Wind farms in Southern Alberta can be cost competitive with new natural gas or coal-fired generation. Intermittency is an issue that can be managed within the electric grid system.
Coal with Carbon Capture and Sequestration		
Carbon capture and sequestration (CCS) is the process where carbon dioxide from fossil fuel combustion or other industrial processes is captured before it is released to the atmosphere, compressed, transported and sequestered in geological formations.	CCS facilities at coal generating stations are predicted to be able to capture up to 70% to 90% of GHG emissions.	CCS is an emerging technology. Experts estimate that the impact of CCS on electricity prices would be 1 to 5 cents US/kWh.
Solar Photovoltaics (PV)		
Convert solar energy to electricity directly.	Large potential—a typical home in Edmonton can use solar PV to generate, on average, the same amount of electricity that the home will consume in a year.	Cost of solar PV in Alberta is $0.23/kWh
Nuclear		
Splitting the nucleus of a radioactive element, like uranium, releases a large amount of energy which can generate electricity.	Experts estimate that the life-cycle greenhouse gas emissions from nuclear power are similar to those of renewable energy.	Alberta has no existing nuclear facilities. Costs of nuclear power range from $0.03/kWh to $0.15/kWh
Municipal Landfill Gas and Biogas		
Organic matter that decomposes in the absence of oxygen creates biogas methane, which can be used to generated electricity or heat. At the municipal scale, landfills and wastewater treatment facilities can be significant sources of biogas.	Electricity generated from biogas is considered to be carbon neutral. Edmonton's Clover Bar landfill has been capturing biogas since 1992 and using this gas to create 4.8 MW of electricity since 2005. Edmonton's Gold Bar Wastewater Treatment Plant collects biogas, 70% of which is used to generate electricity and the remainder is burned.	Landfill gas capture and conversion to electricity can have a positive return on investment.

Edmonton's Urban Form and Transit		
Description	**Resulting energy use or emissions changes**	**Other considerations**
Land Use and Urban Design		
Decisions about where to situate homes, businesses, amenities and the infrastructure that connects them impacts personal transportation choices.	Mixing commercial uses and residential uses, supporting walking and cycling, and enabling access to a major transit system can reduce vehicle-kilometers traveled by 10-30%. Redeveloping existing land close to urban cores can bring the vehicle-kilometer reductions to 50%.	Research indicates that households located in automobile-dependent areas devote $8,500 to transport annually, while those in more compact, mixed communities spend less than $5,500 annually. Urban development patterns can significantly impact the capital and operating costs of road network infrastructure.
Compact and multi-family development forms.	High density development reduces energy and GHG intensity by half compared to low density development on a per capita basis.	Compact building forms (including smaller houses and more multi-family buildings) can increase the number of options for more affordable housing, and reduce the amount residents spend on energy.
Transit		
Investments in transit could include increasing the frequency of transit service, increasing the capacity of transit vehicles, and revising or increasing the number of routes to meet more people's transportation needs.	Creating a rapid transit bus corridor can reduce dependence on personal vehicles by 1-2%.	
Cycling		
Designated and grade-separated bikes lanes, improvements to signage and traffic signals, and bicycle parking and storage can increase cycling usage.	Adding 10km of cycleways per 100,000 residents can increase cycling usage by 5%.	Investments in cycling infrastructure can provide a 400-500% return on investment if health benefits and reduced parking costs are considered.
Walking		
Widening and levelling sidewalks, revising traffic signals, improving winter maintenance, shortening major maintenance cycles, and adding amenities like benches (and trees) encourage people to walk.	Improvements to walking infrastructure can reduce the number of vehicle-kilometers traveled by 10%.	As with cycling, investments in walking infrastructure can provide a 400-500% return on investment if health benefits and reduced parking costs are considered.

Telecommuting		
Opportunity and employer support enable people to avoid commuting to work.	In a future scenario where 50% of information workers telecommute four days per week, the U.S. and Japan both estimated their national energy savings to be 1%.	Telecommuting is generally associated with cost savings for both employees and employers except in cases of very high infrastructure costs coupled with relatively low usage.

Heavy Industry and Buildings		
Description	**Resulting energy use or emissions changes**	**Other considerations**
Efficient building cooling and heating		
Efficient building envelopes (walls, roofs, windows and foundations). Efficient heating, ventilation, and air conditioning (HVAC) units. Using south facing windows can increase free heat from the sun.	New houses: 25-75% energy reduction. Existing houses: 25% energy reduction. New large buildings: 25%, some up to 60% energy reduction. Existing large buildings: 25% energy reduction.	These measures will provide a positive return on investment. Adopting a new building code would have an immediate impact on all new buildings constructed, as would efficiency standards for heating and cooling equipment. Incentive and labeling programs can assist with market uptake of energy efficient building envelopes and technologies for both new and existing buildings.
Appliances, lighting, and other equipment		
Install energy-efficient appliances, lighting, and other equipment. The Energy Star ® rating helps to identify energy efficiency. Maximize use of natural light.	Energy efficient models of home appliances use as little as half the energy regular appliances use. Energy efficient computers and monitors use 75% less energy than regular models. Compact fluorescent lights (CFLs) and LEDs use less than a quarter the energy an incandescent light uses. Building designs that maximize natural light reduce energy demand for lighting by 17-40%.	Energy efficient home appliances normally save money over their lifetime but other non-economic barriers prevent people from using them. Commercial establishments can generate significant cost savings by upgrading to more efficient lighting systems. For example, the payback time on the upgrade to T8 fluorescent lamps compared to T12 lamps is less than a year.

Changing user behaviour		
Feedback systems like meters provide consumers with detailed feedback about energy consumption and end use patterns. Research suggests that feedback systems can successfully reduce energy use.	Direct feedback systems that provide information about energy consumption in real time at the point of use can reduce electricity consumption by 5 to 18% per household. Indirect feedback that is provided after consumption occurs— typically by a utility provider—has been shown to reduce energy consumption by up to 10% depending on the context and quality of the information provided.	Installing simple electricity display feedback systems can have a positive return on investment.
Combined Heat and Power and District Energy		
Capturing and using the heat that is normally lost during electricity production is called "combined heat and power", or CHP. CHP can be done on the scale of a single building or that of a large power plant. When multiple buildings or sites share an energy production facility, this is called "district energy" or DE.	These systems improve energy efficiency by reducing heat and/or distribution losses. Systems can use natural gas, biomass or renewable energy. CHP potential in Alberta: • 75—110 MW for micro-CHP • 8,000 MW on the scale of community or industrial facilities.	CHP and DE can be cost competitive for individual buildings. CHP is one of lowest cost options at the scale of a power plant. For DE or building CHP, the system must be appropriately sized to match heat/cooling demand, including potential changes.
Solar thermal		
Use the Sun's energy to heat a fluid like glycol on the roof of a building, then transfer the heat to water or space in the building.	Solar hot water systems in Edmonton can reduce hot water heating costs by as much as 30 to 40%.	Experts estimate the cost of solar hot water heating, a mature technology, at $15/GJ.
A Solar Wall (TM) preheats air as it enters a building's heating system without any mechanical or electrical input.	Building designs that maximize use of the Sun's energy passively can reduce heating demand by 50%.	Costs range from $0 -15/GJ.
Ground source heat pumps		
Ground source heat pumps (GSHP) use the Earth's energy to warm (or cool) a building by providing three times more heating or cooling energy than is used to run the pumps.	In Alberta, GSHPs tend to have similar GHG emission factors as a mid- to high-efficiency natural gas furnace, but the emissions reductions will be greater if the electricity grid becomes less GHG intensive through more renewables and greater efficiency.	Payback periods range from less than one year to approximately 10 years.

Vehicles		
Description	**Resulting energy use or emissions changes**	**Other considerations**
Vehicle Efficiency		
Building lighter vehicles and/or more efficient engines	Several countries have been able to increase fuel efficiency standards considerably above Canadian levels. Experience in the European Union shows that efficiency standards almost double those of the current Canadian standard can be achieved. Consideration is also being given to reducing fuel consumption in heavy-duty trucks by 20% through better engines and tires, and more aerodynamic trucks.	Analysis of proposed fuel efficiency standards for B.C. indicated savings for consumers of $5,000 over the life of the vehicle.
Drivetrain technologies		
Hybrid, electric and natural gas vehicles	Hybrid vehicles are 34 to 60% more efficient than conventional vehicles. Hybrid electric delivery trucks can reduce GHG emissions by 25% compared to conventional diesel delivery trucks. Electric vehicles—fully electric cars are 80 to 90% more energy efficient than conventional cars from a vehicle perspective, but overall energy efficiency depends on where the electricity comes from. Tailpipe emissions for electric vehicles are zero but upstream emissions depend on the source of electricity. Current emissions from charging electric vehicles in Alberta are similar to gasoline vehicles. These emissions are expected to come down as the make-up of grid electricity changes over time. Natural gas vehicles emit 25% less greenhouse gas than gasoline vehicles.	Hybrid vehicles typically cost $5,000 more than conventional vehicles, with a payback period of eight years from gasoline savings. Electric vehicles—Electric passenger vehicles can range in price from $11,000 to $110,000. In Alberta, a plug-in hybrid electric vehicle could save $1,070 to $1,542 in fuel costs per year. Natural gas vehicles—The expected payback for natural gas vehicles could be 2 to 30 years depending on the cost of gasoline, vehicle incremental cost and annual kilometers travelled.

Alternative fuels		
Ethanol can be blended with gasoline up to 10% and used in current gasoline engines. Some vehicles currently being sold can run on any blend up to 85% ethanol, but these fuel blends are not currently available in Edmonton. For biodiesel, up to a 100% blend can be used in most current diesel engines, although most manufacturers only provide warranties up to a 5% blend.	Adding 10% ethanol to gasoline can reduce life cycle greenhouse gas emissions by between 3.9 and 6.3% depending on the ethanol feedstock. Adding 5% biodiesel to diesel fuel can reduce life cycle greenhouse gas emissions by between 2.8 and 4.8% depending on the biodiesel feedstock.	The Government of Canada recently published an analysis of the cost impact of the proposed Renewable Fuel Standard requiring an average of 5% ethanol in gasoline. The most significant cost impact identified for consumers is that they would need to buy 1.1% more fuel to go the same distance as before, because a liter of ethanol has less energy than a liter of gasoline.
Vehicle operation		
Changes in vehicle operation include adjustment to driving behaviour and equipment to reduce idling. Idling of delivery vehicles can be reduced through the use of specialized equipment such as electrical plug-ins in loading bays, auxiliary power units on trucks to allow refrigeration units to continue running without using the truck engine, and onboard computers that help drivers with speed management, optimum shifting, optimum route selection and idle reduction.	Drivers can reduce their fuel use by up to 1% to 20% by using fuel-efficient driving techniques and keeping their car well maintained. Programs aimed at personal vehicles have achieved relatively low savings while those aimed at commercial fleets have been more successful. Plug-in refrigeration units have demonstrated fuel savings of over 60%. Onboard computers have been shown to reduce carbon emission by 13%.	Reduced fuel consumption through driving efficiency has a direct reduction in fuel costs and in wear and tear on a vehicle. If drivers employed more sensible driving practices (respecting speed limits, slower acceleration and braking), they could potentially save $600 per year. Hybrid trailer refrigeration units and onboard computers have a payback of 15 and 18 months, respectively.

[Discussion Paper, pages B1-B5]

What are we already doing about climate change?

In Edmonton

The Way We Green calls for a 50% reduction in greenhouse gas (GHG) emissions from **City operations** by 2020 (from 2008 levels) and a 17-20% reduction from the **entire Edmonton community** by 2020 (from 2008 levels). While in both cases the City's end goal is carbon neutrality, a target date has been set only for City operations (2040).

Similarly, over the past 20 years, Edmonton City Council has made a number of **other commitments** to addressing climate change:

- Endorsing the Local Governments for Sustainability Declaration on Climate Change and the Urban Environment (ICLEI 1993).
- Approving city membership in the Federation of Canadian Municipalities' Partners for Climate Protection Program (1995).
- Approving the city's first GHG emissions reduction plan for City operations (1999).
- Approving a community GHG reduction plan in 2001 called Carbon Dioxide Reduction Edmonton (CO_2RE).
- Setting goals (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."[44]

While these commitments are worth celebrating, it is important to note they do not put Edmonton on a path to achieving carbon neutrality at the rate **considered necessary by the leaders of the G8 countries** (an 80% reduction in GHG emissions by developed countries, compared with 1990 to 2005 levels, by 2050).

Measuring greenhouse gas reductions

- Greenhouse gas emissions are measured in megatons (MT). Each MT is equal to one million tons or 2,000,000,000 pounds.
- Greenhouse gas reduction targets are usually expressed in terms of a number of MT or a percentage.
- Sometimes targets refer to **intensity**: we find ways to extract a barrel of oil or drive a mile in a car, for example, with lower greenhouse gas emissions. But just because my car is more efficient **per mile** doesn't tell us how much greenhouse gas it will produce in total—that depends on whether I drive more or less. You can reduce the intensity of greenhouse gas emissions but emit more and more greenhouse gases.
- By contrast, **absolute** greenhouse gas reduction targets refer to the total amount emitted.
- Because total greenhouse gas emissions tend to go up each year, the ambition of a target depends on what year you take as your reference point. A target of 20% below 1988 levels is much more ambitious than 20% below 2008 levels.

In Alberta

Alberta was responsible for over half of Canada's emissions growth (52%) between 1990 and 2008. In January 2008, the Alberta government released a new Climate Change Strategy to build on 2002's climate change action plan. In addition to committing Alberta to reducing GHG emissions by 14% from 2005 levels by 2050, it also set out **three complementary strategies for addressing climate change**:[45]

1. Implementing carbon capture and storage (CCS) through the creation of the Alberta Carbon Capture and Storage Development Council, *The Carbon Capture and Storage Funding Act* (2010), and a $2 billion CCS funding program.
2. Greening energy production by using government funds combined with that contributed by industry to drive innovation, remove barriers, and incentivize energy efficiency and the use of renewable and alternative energy sources.
3. Conserving and using energy efficiently through goals such as the development of an Energy Efficiency Act, incentivizing energy efficient home improvements, and establishing energy efficiency standards and GHG emission reporting structures.

As a result of these programs, as well as initiatives by the federal government, municipalities, and the private sector, emissions have been reduced by Albertan industry by 6.5 million tons (MT) in 2008, 7.01 MT in 2009, 6.5 MT in 2010, and 10.1 MT in 2011 as compared to "business as usual" emissions levels.

In other provinces

Like Alberta, the rest of Canada's **provinces have set their own targets for reducing GHG emissions**. As each province's sources of GHGs and their overall contributions differ, provincial strategies also differ. Some provinces have aligned their provincial targets with those of the Government of Canada or international agreements like the Kyoto Protocol. Other provinces have sought to create their own targets. Here is a summary of these targets and the progress each province has made as of 2009.

Greenhouse Gas Emissions Targets by Province (in order of share of total emissions)

Province	Share of Canada's total emissions (2009	Interim target	2020 targe	2050 target	Emissions trends (1990-2009)
AB	34% (234 MT)	20 MT reduction by 2010	50 MT below business as usual (BAU)	200 MT below BAU	+37%
ON	24% (165 MT)	6% below 1990 levels by 2012	15% below 1990 levels	80% below 1990 levels	-7%
QC	12% (82 MT)	6% below 1990 levels by 2012	20% below 1990 levels by 2020	Not available	-2%
SK	11% (73 MT)	Not available	Not available	20% below 2006 levels	+69%
BC	9% (64 MT)	18% below 2007 levels by 2016	33% below 2007 levels	80% below 1990 levels	+28%
NS	3% (21 MT)	2.5 MT below 2009 levels by 2015	10% below 1990 levels	Up to 80% below 2009 levels by 2050	+11%
MB	3% (20 MT)	6% below 1990 levels by 2012	Under development	Not available	+10%
NB	3% (18 MT)	5.5 MT below 2007 levels by 2012	10% below 1990 levels	Not available	+15%
NL	1% (10 MT)	1990 levels by 2010	10% below 1990 levels	75-80% below 2001 levels by 2050	+3%
PEI	0% (2 MT)	Not available	10% below 1990 levels	Not available	-4%

In Canada

The Government of Canada has committed to reducing Canada's overall GHG emissions **by 17% below 2005 levels by 2020**, or from 731 MT to 607 MT.[46] In order to achieve this, the federal government has agreed to this target in the Copenhagen Accord and aligned its goals and strategies with those of the USA. In particular, the federal government has taken a **sector-by-sector approach** to climate action that includes:

- **Transportation**—setting standards, along with the USA, that will reduce emissions from passenger vehicles and light trucks by 25% below 2008 levels by 2016 and from heavy-duty vehicles by 23% from 2010 levels by 2018.
- **Electricity**—proposing regulations to reduce emissions from new and end-of-life coal-fired power plants.
- **Renewable fuels**—following through on a previous commitment to mandate that gasoline contain an average of 5% renewable content, as well as implementing a 2% renewable requirement for diesel.
- **Investments**—investing almost $3 billion in funding for CCS; $27 million for the Global Research Alliance, an initiative to help Canadian farmers increase their competitiveness while also reducing their emissions; and $148.8 million over the course of 2011-2016 on federal climate change adaptation programs.[47]

The most recent statistics for national emissions show Canada emitting 692 MT in 2010.[48] Canada's emissions target under the Kyoto Protocol (which expired in 2012) would have required Canada to emit only 555 MT this year.

International initiatives and agreements

Although scientists have been aware of the potential for human-created GHGs to influence the global climate for almost 200 years, an official **international response only began to take shape in the 1980s**. Two components of this response—the IPCC and the UNFCCC—are especially important.

The World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) formed the **Intergovernmental Panel on Climate Change** (IPCC) in 1988 to be the world's leading international body for the assessment of climate change. Today it includes about 2,500 climate scientists and experts. The IPCC's Assessment Reports are used in international climate negotiations, national climate change policies, by non-governmental organizations (NGOs), and more.

The **United Nations Framework Convention on Climate Change** (UNFCCC) is an international treaty created in 1992 at the Rio Earth Summit with the intent of stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous interference with the climate system.[49] Nearly every country on Earth is part of the treaty. Its annual meetings, known as a Conference of the Parties (COP), have led to the creation of international climate change agreements like the **Kyoto Protocol** and the **Copenhagen Accord**. These Conferences (COPs) have provided businesses, researchers, activists, NGOs, and local governments with an international stage to showcase their own initiatives and to push for progress outside of the formal UNFCCC framework.

As of today, **no legally binding international climate change agreement has been negotiated to replace or extend the Kyoto Protocol** after its 2012 expiry. In its place, 2009's COP15 produced the Copenhagen Accord—an international political agreement—calling for measures to prevent the average global temperature from rising more than 2°C above pre-industrial levels. Most recently, COP17 in Durban, South Africa produced an agreement that created a road map for the UNFCCC to negotiate a new legal agreement by 2015. Although this new agreement would—for the first time—include every member of the UNFCCC, it would not come into legal effect until 2020.

Endnotes

Throughout the Handbook you will find a number of superscript numbers (e.g. 1, 2, 3) that correspond with the endnotes found below. These endnotes provide you with additional comments from the authors about particular sections of the Handbook. They also provide you with the sources we used to provide the information presented throughout. A variety and balance of sources were used in the creation of this Handbook, and almost all are from government or peer-reviewed research.

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[3]Intergovernmental Panel on Climate Change (IPCC), 2007. *Annex I - Glossary*. Available: http://www.ipcc.ch/pdf/glossary/ar4-wg1.pdf [August 19, 2012]

[4]Canada's World, 2009. *Citizens' Dialogue - Canada in the World*. Available: http://www.canadasworld.ca/reports/dialoguere/nationaldi

[5]http://www.edmonton.ca/for_residents/public_involvement/citizen-panel.aspx

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[7]http://www.edmonton.ca/city_government/urban_planning_and_design/food-and-agriculture-public-involvement.aspx

[8]Oxford Canadian Dictionary

[9]The three paragraphs above are adapted from Canada's World, *National Dialogue Handbook*. Available: http://www.canadasworld.ca/reports/dialoguere/nationaldi [September 22, 2012]

[10]For a map of City of Edmonton wards and the Councilors who represent them see http://www.edmonton.ca/city_government/city_organization/city-councillors.aspx

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[12] IPCC. 2007. *Summary for Policymakers. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 5. Available: http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf [August 31, 2012]

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[14]Government of Canada, 2012. *Information on Climate Change*. Available: http://climatechange.gc.ca/default.asp?lang=En&n=F2DB1FBE-1 [August 31, 2012]

[15]*G8+5 Academies' joint statement: Climate change and the transformation of energy technologies for a low carbon future*, pp. 1. Available: http://www.nasonline.org/about-nas/leadership/president/statement-climate-change.pdf [August 31, 2012]

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[17]The UK Energy Centre, 2009. *Global Oil Depletion – An Assessment of the Evidence for a Near-Term Peak in Global Oil Production*, pp.164, Available: http://www.ukerc.ac.uk/support/Global%20Oil%20Depletion [September 22, 2012]

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[19]IPCC, 2011. Introduction. *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, pp. 190. Available: http://srren.ipcc-wg3.de/report/IPCC_SRREN_Ch01.pdf [August 31, 2012]

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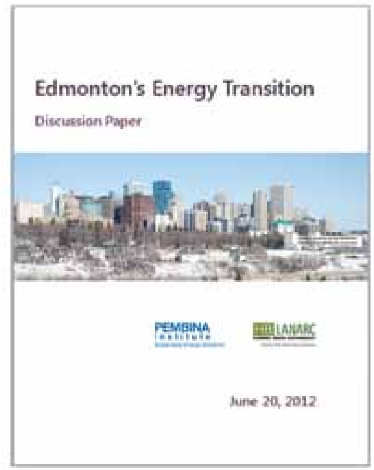
The Discussion Paper



Executive Summary

The Executive Summary provides a 4 page summary of the paper. It's an easy and quick way to read about the paper's highlights.

Section 1 – Introduction

The introduction to the paper and a summary of how the research was conducted.

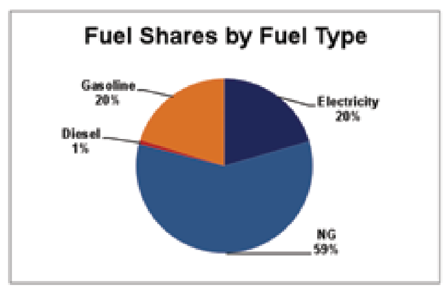
Section 2 – Future Challenges

This section presents a story of what the future may look like if:

- Oil prices continue to climb
- The climate continues to change as expected

Details on the research that was done for these stories are in Appendix A.

Section 3.1 – Current Situation



This section summarizes:

- How energy is used in Edmonton and where it comes from
- What GHG emissions come from this energy use

Section 3.2 – Options

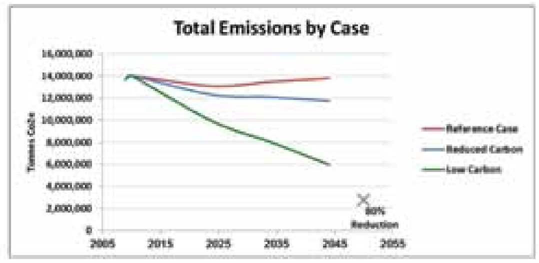
The top options for changing the way energy is used in Edmonton (and Edmonton's GHG emissions) are summarized here:

- Provincial electricity grid
- Urban form and transit
- Heavy Industry
- Buildings
- Vehicles

More information about each option is provided in Appendix B.

Provincial electricity grid			
Indicator description	Reference Case	Reduced Carbon Case	Low Carbon Case
Avg. grid emission factor	538 t $CO2_{eq}$/GWh	429 t $CO2_{eq}$/GWh	100 t $CO2_{eq}$/GWh

Section 3.3 – Results

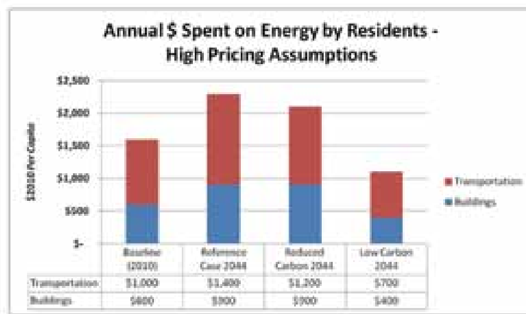


The modeling results are summarized here for three cases that were examined. These cases are:

1. Reference Case – Edmonton's current path (ignoring current City plans to change this path)
2. Reduced Carbon Case – assumes current City plans are fully implemented
3. Low Carbon Case – assumes all options are implemented

More details on the modeling are presented in Appendix C.

Section 3.4 – Cost Implications



Presents information on how each scenario is expected to impact how much money Edmontonians spend on energy.

Section 4 – Recommendations

Based on the results of the analysis, the consultants provided recommendations for what the City of Edmonton should do to get on a low carbon path.

Appendix A

Research regarding future energy availability and climate change impacts.

Appendix B

Research regarding different ways to change energy supply,use and GHG emissions.

Appendix C

Details on the modeling that was done for the three cases discussed in Section 3.