FIVE-YEAR REPORT ON

Energy IN MANITOBA

2009-2014

Manitoba

Preface

What's in this report?

Energy in Manitoba is a report on Manitoba's energy sector. It provides data on the consumption, production, and supply of energy in the province, and provides examples and comparisons with other jurisdictions to help put those data into perspective. It also provides information on the impacts that result from our relationship with energy.

The goal of this report is to explain current and emerging trends in Manitoba and across North America, so that we can prepare for future energy challenges and make informed decisions about how to address them. Historical data is provided throughout the report, with an emphasis on the period from 2010 to 2015.

Where do these data come from?

Most of the information in this report was collected from publicly-available online sources. Many of the data were collected from Statistics Canada's *CANSIM* database of social and economic information and from Natural Resources Canada's *Comprehensive Energy Use Database*. A complete list of the data sources can be found at the end of the report.

Where can I find more information?

See Natural Resources Canada's *Energy Markets Fact Book* for the broader Canadian perspective on energy. (http://www.nrcan.gc.ca/energy/publications/6539).

For more information on Manitoba government initiatives relating to energy, contact:

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Glossary

Some of the information in this report is presented using technical language. In order to get the most out of it, the following glossary of terms is provided:

- A **Watt (W)** is a unit of power (usually electric power), meaning the rate of energy produced or consumed per unit of time. A smart phone might consume power at a rate of about 5 W, while a microwave oven might consume at a rate of about 1,500 W (1.5 kW). The **nameplate generation capacities** (maximum output under ideal conditions) of Manitoba's hydroelectric dams range between and 10 MW and 1.34 GW.
- A **Watt-hour (Wh)** is a unit of energy (usually electricity). It signifies the total energy that would be produced or consumed in a full hour at a rate of one watt. An energy-efficient refrigerator might consume somewhere between 400 and 700 kWh in a year. Manitoba Hydro generated about 35 TWh of electricity in the year ending March 31, 2015.
- A **Joule (J)** is also a unit of energy. It is a standard unit that can be used to measure and compare electric energy with other kinds of energy, such as chemical (contained in fuels) and thermal (heat). It takes about 350 kJ to boil a litre of water, and cars typically get about 32 MJ out of a litre of gasoline.
- **Degree-days:** One way of assessing the amount of energy needed for heating and cooling in a particular community is to calculate its total annual degree-days. Degree-days are the difference between that day's average temperature and a base value of 18°C. By adding up all of the degree-days in a year, you can get an idea of how much work heaters, boilers, and air conditioners have to do in order to keep the air and water at a comfortable temperature in the buildings in that community.
- **Fossil fuels** are non-renewable, carbon-rich fuels that occur naturally as solids (ex: coal), liquids (ex: crude oil), or gases (ex: natural gas). They are most often burned in order to harness their chemical energy; however, this process also leads to the emission of air pollution and greenhouse gas.
- **Greenhouse gas (GHG):** One of the most common ways of assessing the impact of human activity on the environment is by tracking the amount of GHG emitted. Human activity that increases the amount of GHG in our atmosphere disturbs the natural balance of our environment and is having significant negative impacts on human life in many ways. While there are different kinds, carbon dioxide (CO_2) is the most common form of GHG emitted as a result of human activity, so we typically measure all of our emissions as an equivalent to tonnes of carbon dioxide **(tonnes CO_2e)**. A typical personal motor vehicle might emit somewhere around 5 tonnes CO_2e annually.

Metric prefixes

The numbers and quantities expressed in this report are quite large. To make them easier to manage, the following standard metric prefixes are used throughout:

kilo (k) – one thousand (1,000)

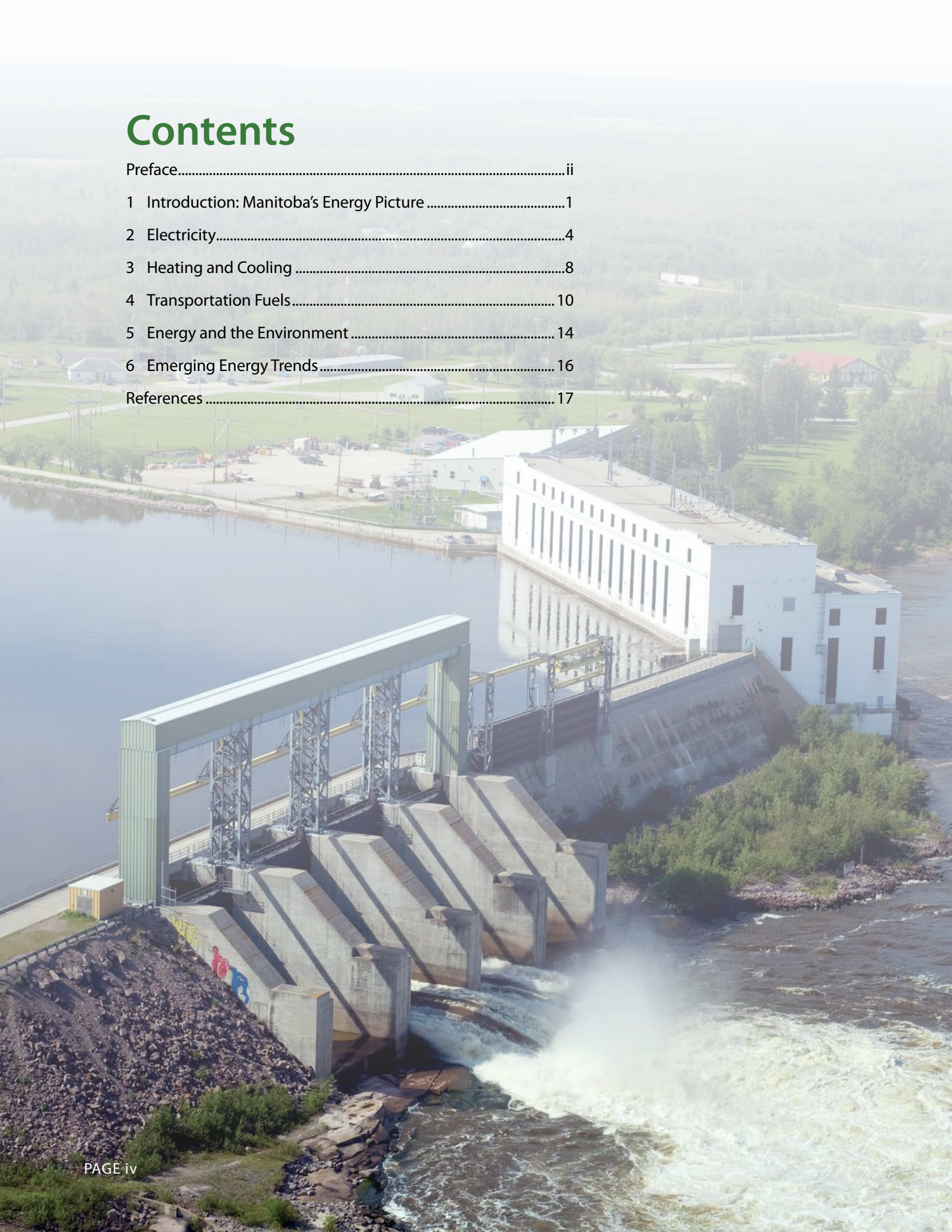
mega (M) – one million (1,000,000)

giga (G) – one billion (1,000,000,000)

tera (T) – one trillion (1,000,000,000,000)

peta (P) – one quadrillion (1,000,000,000,000,000)

Contents



1 Introduction
Manitoba's Energy Picture

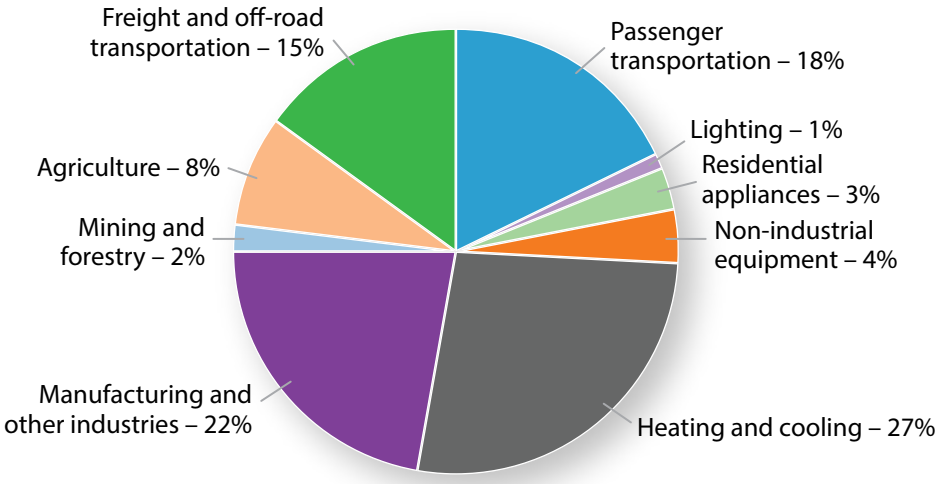
Energy is all around us and it is a central part of our daily lives, yet most of us don't think much about it.

Manitobans depend on energy for a wide variety of applications (see Figure 1A). Modern energy systems are necessary for our natural resources sector, food production, manufacturing and distribution of all sorts of products. We need electricity to light our homes, heat energy for warmth, and transportation energy to move people and products. The energy we use in Manitoba comes from several sources, and the way we use it has significant economic, environmental and social effects.

Figure 1B (on page 2) shows where our energy comes from and how we use it. The following chapters of this report will expand on the information in Figure 1B by focusing on **electricity** (chapter 2), **heating and cooling** (chapter 3), and **transportation** (chapter 4).

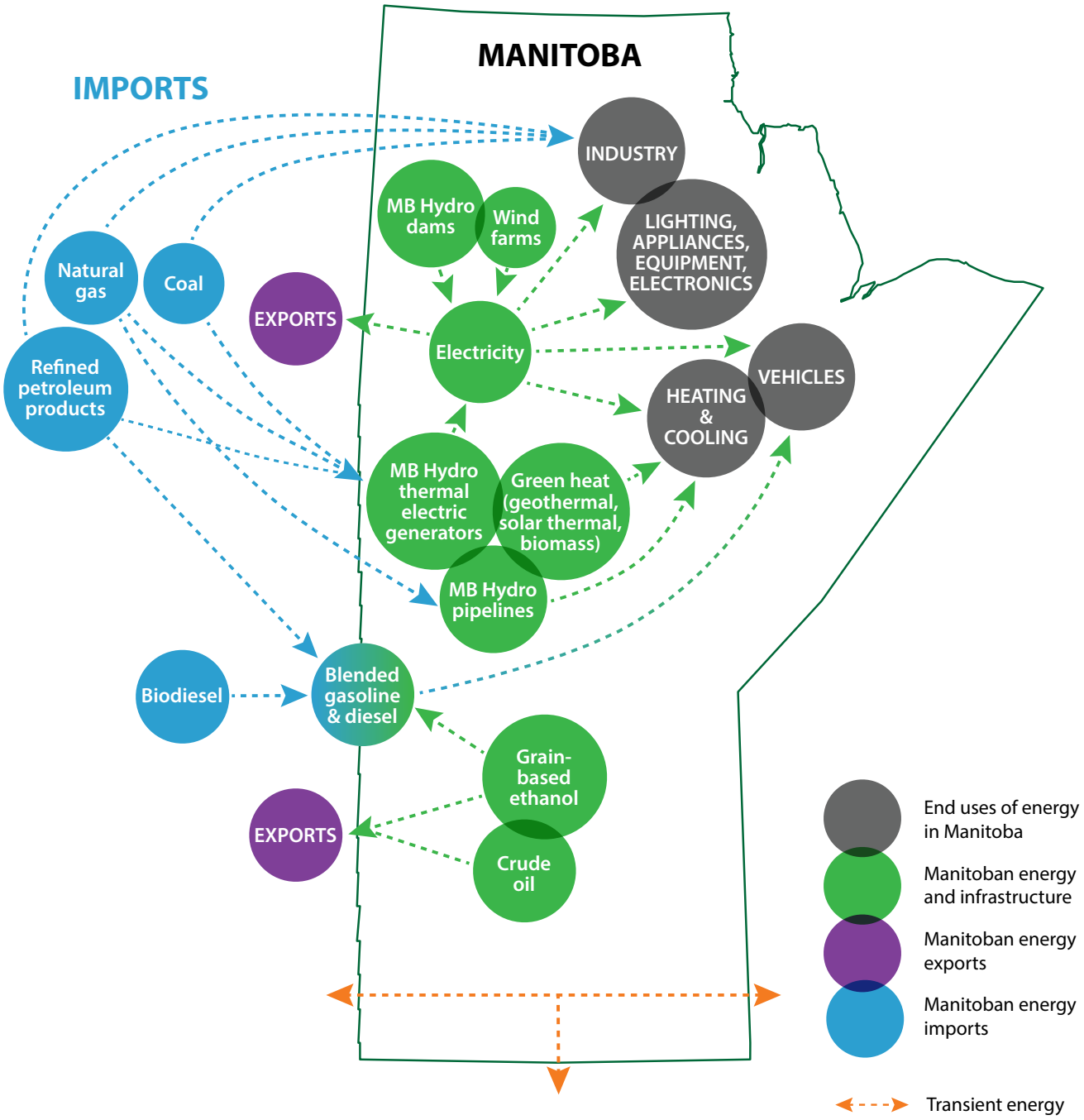
Chapter 5 will discuss the effects of our relationship with energy on **the environment**. Chapter 6 concludes by identifying energy trends that will bring both challenges and opportunities for Manitoba.

Figure 1A. End Uses of Energy in Manitoba*



* Five-year average (2008-2012) data.

Figure 1B. Manitoba's Energy Sector



'Transient energy' refers to energy products that flow through Manitoba without being produced or consumed here. These are made up mostly by petroleum, coal and natural gas that are transported by pipeline or by rail.

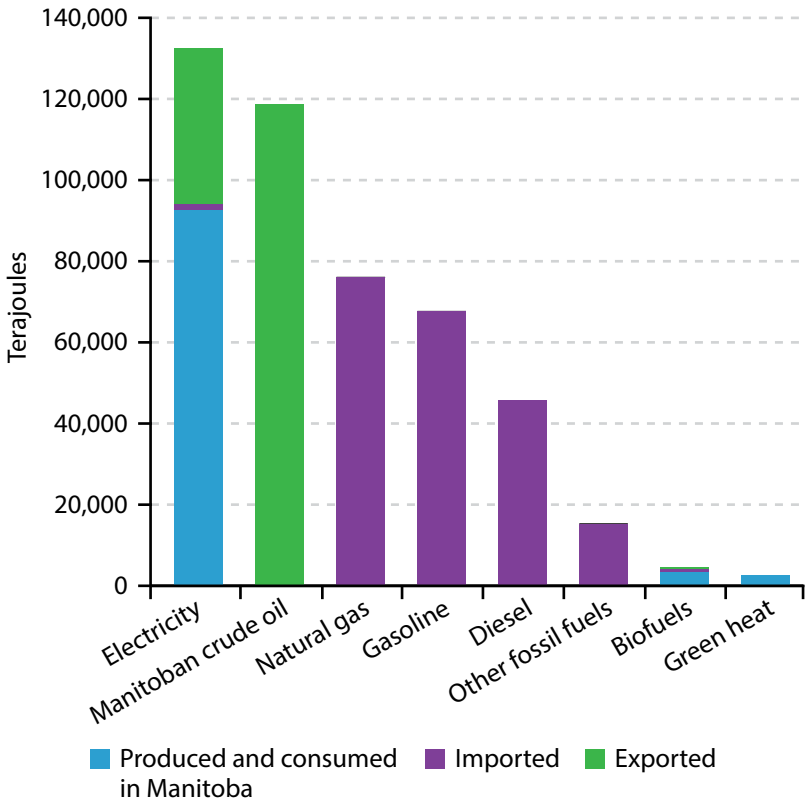
Sizes are not to scale.

All of the electricity we use in Manitoba is produced right here and we export the surplus to our neighbours in Saskatchewan, Ontario and the United States. All of our petroleum products, mostly gasoline, diesel fuel, and natural gas, must be imported from other jurisdictions. Figure 1C shows the balance between local production and imports. Despite producing lots of electricity and crude oil in Manitoba, two-thirds of the energy we consume here must be imported from other provinces or from the U.S.

Producing the energy we need and delivering it to where we need it plays a significant role in Manitoba's economy. The energy sector employs nearly 20,000 Manitobans (nearly three per cent of our workforce), and represents almost six per cent of the province's gross domestic product (GDP).

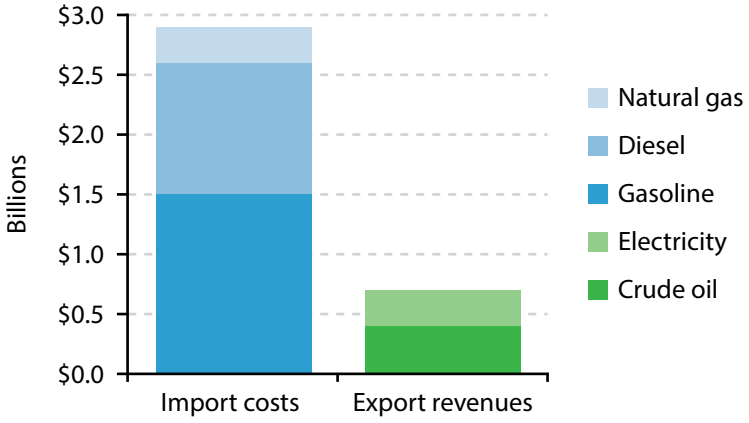
However, among energy-related activities, importing fossil fuels continues to have the biggest impact on our economy (see Figure 1D). In fact, Manitoba's energy sector has a trade deficit of nearly $2½ billion every year, and this deficit is expected to grow as energy costs continue to rise.

Figure 1C. Manitoba's Energy Balance*



* 2013 data. Other fossil fuels include: gas plant natural gas liquids, aviation gasoline, aviation turbo fuel, kerosene, stove oil, light fuel oil, heavy fuel oil and coal.

Figure 1D. Manitoba's Energy Balance in Dollars*

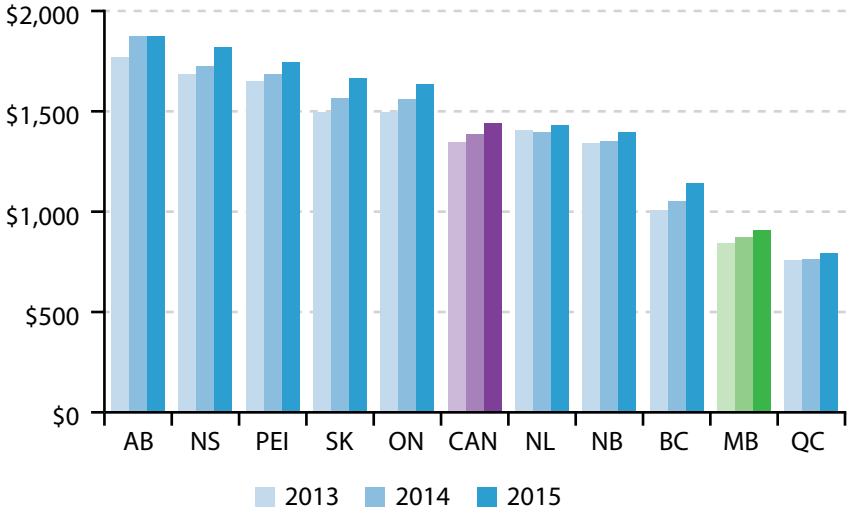


* 2013 data. Electricity exports represent Manitoba Hydro's net export revenues (total electricity export revenues minus expenditures on imported fossil fuel and electricity) for the year ending March 31, 2013.

2 Electricity

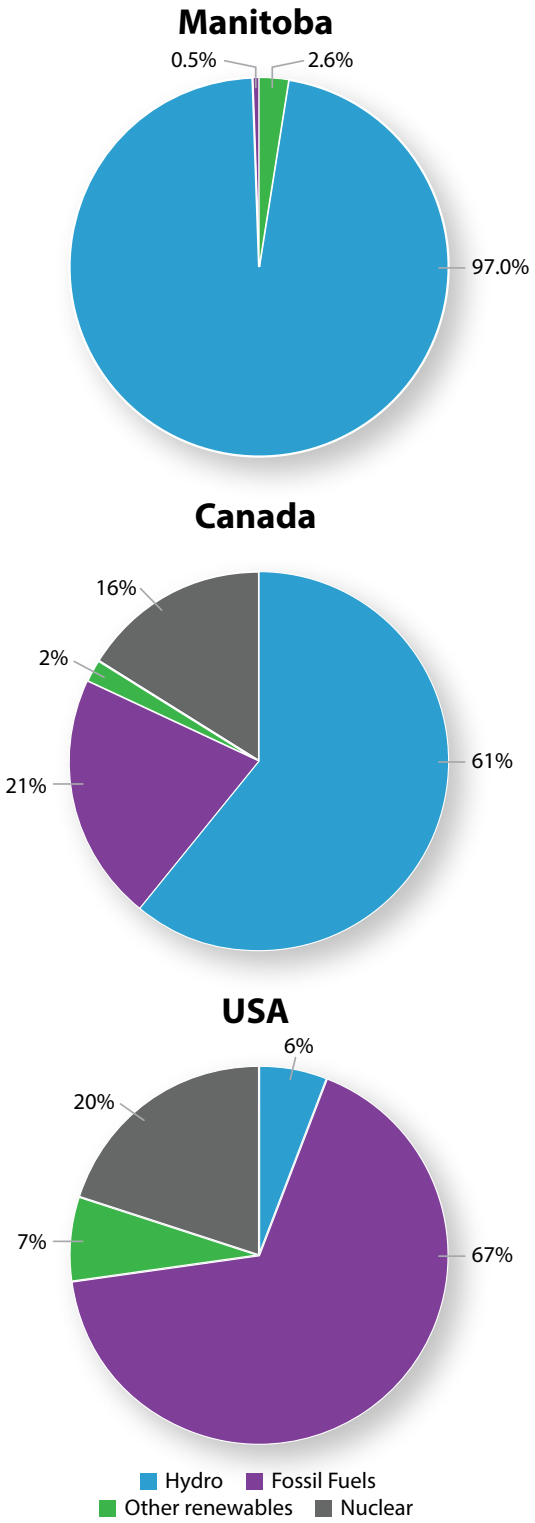
One of Manitoba's greatest energy advantages is our abundance of clean low carbon electricity. In addition to these environmental benefits, Manitobans have also benefitted from some of the lowest electricity rates in North America (see Figure 2A). This is partly because much of the cost to produce our electricity is offset by our electricity exports, and partly thanks to past investments in reliable, long-term hydroelectric generation projects. There are currently 15 dams operating in the province and a 16th, Keeyask, is expected to come online in 2021.

Figure 2A. Average Annual Residential Electric Bills*



* Data for the year ending March 31. For comparison purposes, costs calculated by multiplying average electricity rates in each province by the amount of energy consumed by the average Manitoban non-electric heat residence.

Figure 2B. Electricity Generation Mixes*



* Manitoban and Canadian data are for 2014. USA data are from 2013. "Other renewables" in Manitoba represents wind power only.

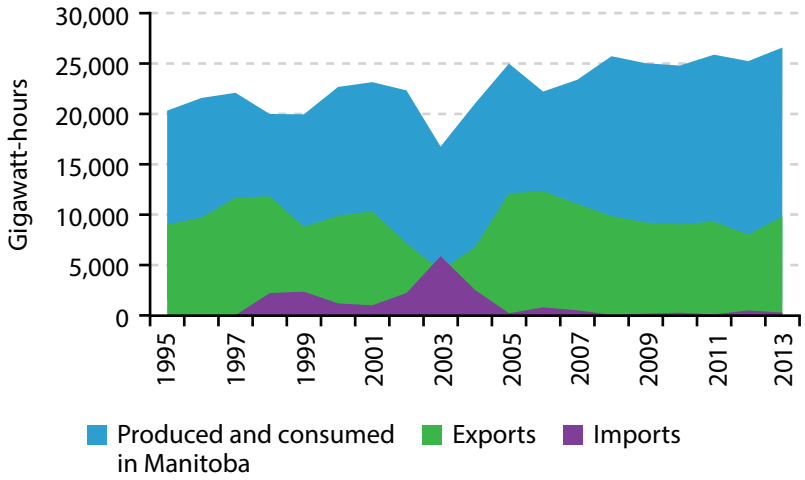
Those hydro dams are part of another big Manitoban energy advantage: that our electricity has been almost entirely produced from renewable energy sources for half a century (see Figure 2B).

There are also wind farms in Manitoba, located near St-Léon and St-Joseph. Manitoba Hydro has long-term agreements with both of these independently-owned and operated projects to purchase the electricity they generate.

In addition to these renewable sources of electricity, Manitoba Hydro operates six electric generators that run on fossil fuels. The two largest are located in Brandon (natural gas and coal[1]) and Selkirk (natural gas). The remaining four are smaller, diesel-powered generating stations that serve remote northern communities that are not connected to the rest of Manitoba's electricity grid (Brochet, Lac Brochet, Shamattawa and Tadoule Lake).

One of the ways that we keep electricity affordable in Manitoba is by generating more than we need and exporting the excess to neighbouring provinces and states (see Figure 2C). Manitoba Hydro's current total generation capacity is 5,700 MW, or 122 per cent of the province's peak demand for electricity in 2015.

Figure 2C. Manitoba's Electricity Balance



[1] The last coal-powered electricity generating station is currently only used in an emergency. Manitoba has plans to fully phase out coal electric generation in 2018.

Figure 2D. Electricity Consumption (per person)

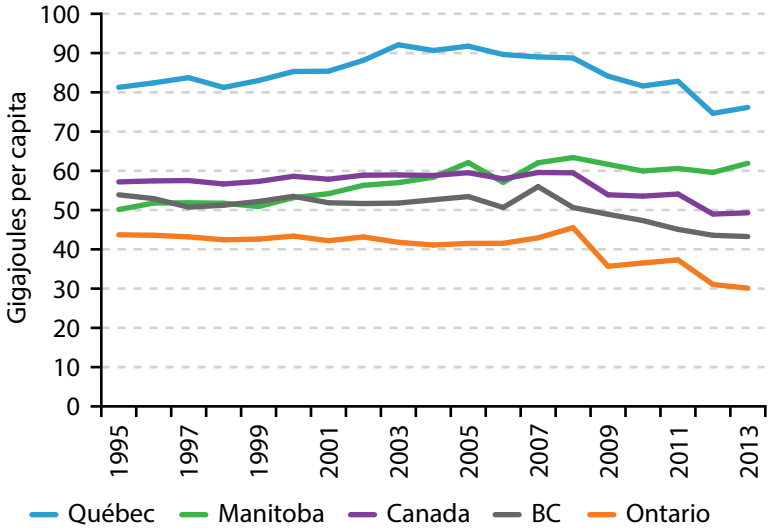
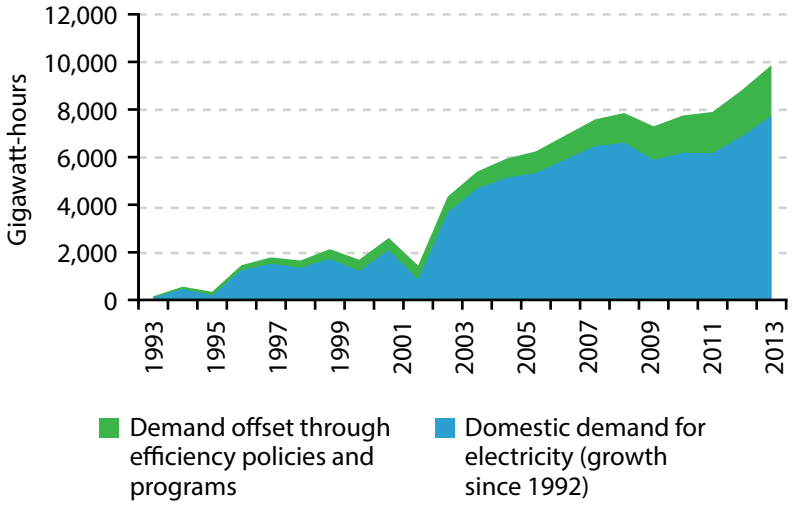


Figure 2E. Manitoba's Electricity Efficiency Savings

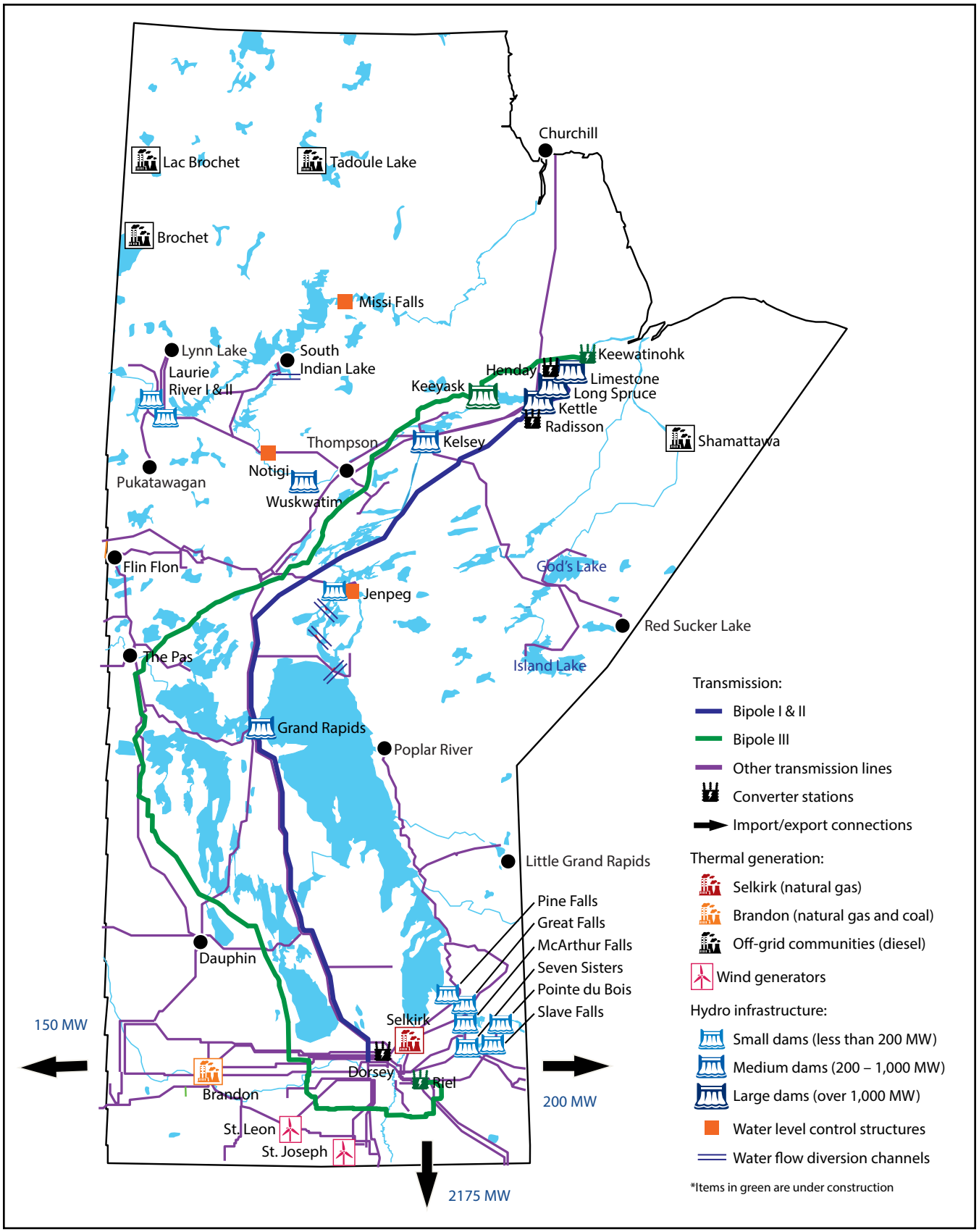


As our population grows, so does our demand for electricity. Provinces where electric space heating is more common, like Manitoba and Québec, tend to consume more than others (see Figure 2D).

However, Manitoba continues to implement a series of initiatives in order to help us consume energy more efficiently, such as Manitoba Hydro's Power Smart programs. Over time, these initiatives reduce our per capita electricity consumption, freeing up more electricity for export and delaying the need to buy and install new generation and transmission equipment. So far, we have reduced our demand for electricity by over 2,000 GWh (see Figure 2E). To put that into perspective, that's more than half of the total annual power produced last year by all six of the hydro dams located on the Winnipeg River.

In addition to operating generating stations generators and delivering energy efficiency programs, Manitoba Hydro also maintains over 13,000 km of high-voltage transmission lines and 76,000 km of local distribution lines in order to deliver this electricity to consumers. That is more than enough power line to go around the Earth twice! Figure 2F (opposite) shows where Manitoba's electricity is generated and how it gets to us.

Figure 2F. Manitoba's Electricity Infrastructure



3 Heating and Cooling

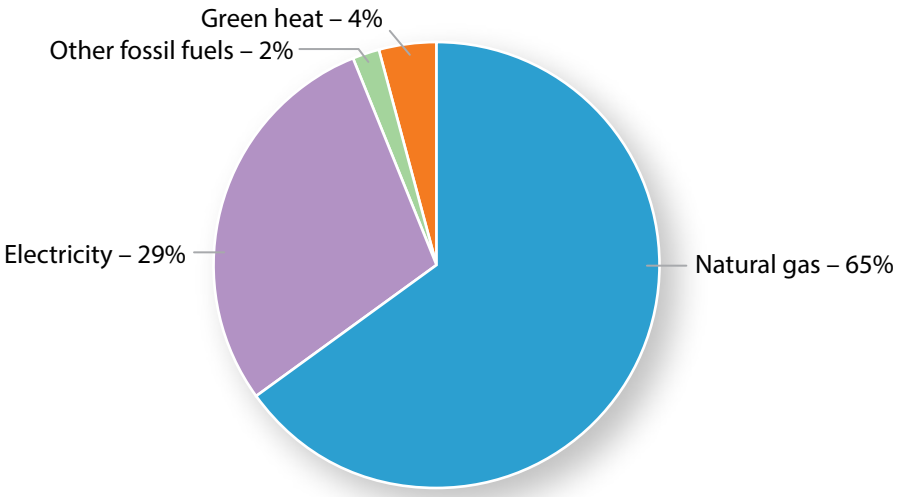
Over 70 per cent of the energy consumed in non-industrial buildings in Manitoba is used to keep the air temperature comfortable and provide hot water for our use. To do this, we use both renewable energy and conventional fossil fuels (see Figure 3A).

In Manitoba, we are working to reduce our dependence on fossil fuels by lowering our overall consumption of energy for heating and cooling, such as by retrofitting our buildings to improve their insulation performance. Through building codes, efficiency standards, and Power Smart programming, Manitoba's total energy efficiency savings equalled about 0.6 per cent of our demand for natural gas heating in 2014.

Many Manitobans are also switching from fossil fuel to renewable *green heat* options. These include installing geothermal heat pumps, solar thermal, and biomass technologies that provide heat from renewable energy sources, such as biomass residues (e.g.: waste wood) and the sun. Although natural gas is currently the dominant source of energy for heating, Manitoba continues to make substantial progress towards greater adoption of green heat.

For example, Manitobans are installing geothermal heat pumps at nearly three times the average per capita rate in North America (see Figure 3B). Existing geothermal installations in the province range from individual homes to large commercial buildings to entire

Figure 3A. Manitoba's Heating and Cooling Energy Sources*



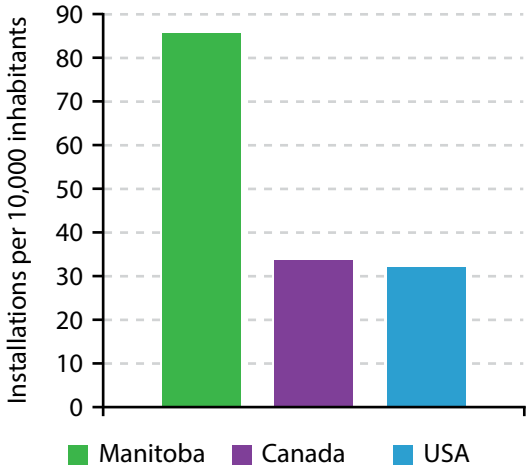
* 2012 data. Other fossil fuels include heating oil, light fuel oil, kerosene, heavy fuel oil, coal and propane.

neighbourhoods (where a single *district geothermal* system serves multiple buildings).

Manitoba has some of the greatest heating and cooling energy needs in North America. This is mostly because we have extreme seasonal temperature changes and long heating seasons. For example, Winnipeg's needs are more than double those of Vancouver (see Figure 3C).

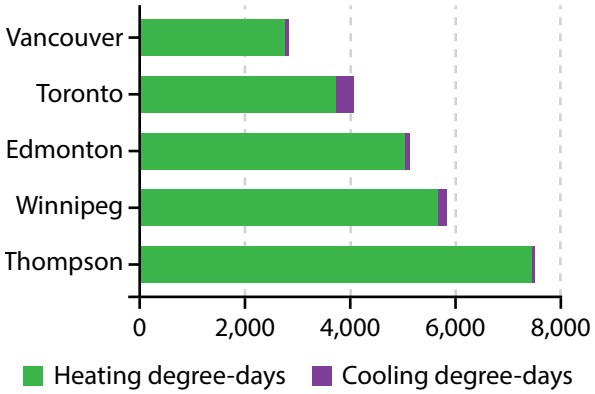
Despite these climatic conditions, Manitobans consume no more energy for heating and cooling than the Canadian average (see Figure 3D). This is largely because of relatively stringent regulation of the efficiency of buildings, furnaces and small boilers.

Figure 3B. Geothermal Heat Pumps*



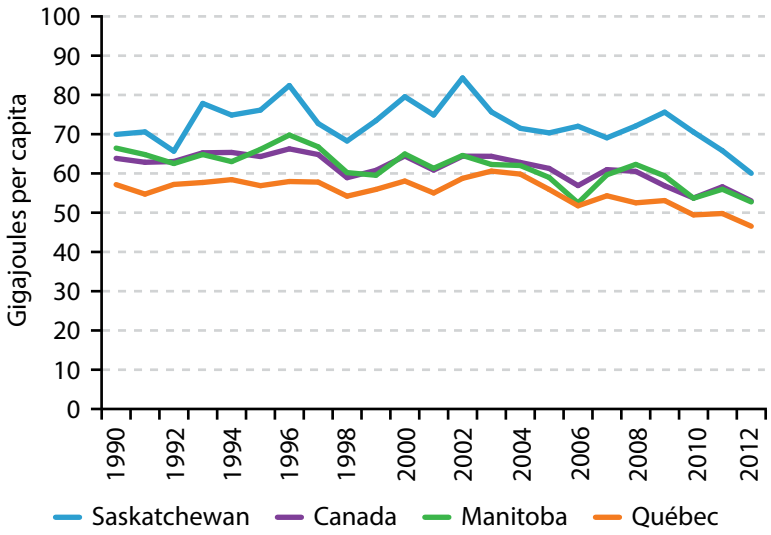
* 2011 estimates.

Figure 3C. Average Annual Heating and Cooling Needs*



* 25-year average (1990-2014).

Figure 3D. Heating and Cooling Energy Consumption*



* Heating and cooling energy consumption is for all residential, commercial, and institutional spaces (ex: does not include industrial spaces).

4 Transportation Fuels

Transportation is responsible for about one-third of total energy consumption in Manitoba, and we consume more every year as our population grows.

For this reason, more Manitobans are choosing alternative transportation modes such as riding a bike or taking the bus. Personal vehicles such as cars, SUVs, vans, and passenger trucks, which consume more than three-quarters of the energy used for passenger transportation in Manitoba, are becoming more fuel efficient. These trends have contributed to making the movement of people more energy-efficient in Manitoba (see Figure 4A).

Efficiency is also important in the transportation of freight by road, where Manitoba compares favourably to Canada (see Figure 4B).

However, our fuel consumption continues to grow even faster than our population in spite of these efficiencies (see Figure 4C). This is in part we are moving ourselves, and the products we consume, over longer distances than ever before.

Nearly all of our transportation needs (over 95 per cent) are currently met by burning imported fossil fuels such as gasoline and diesel (see Figure 4D). As shown in Figure 4E,

Figure 4A. Passenger Transportation Energy Efficiency

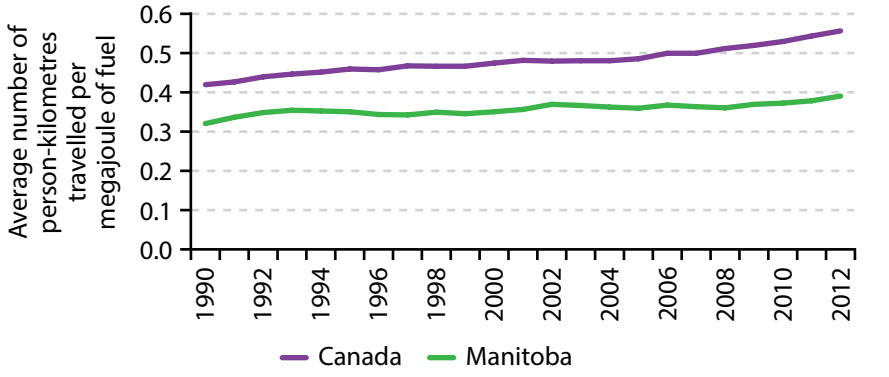


Figure 4B. Fuel Efficiency of Freight Transportation by Road

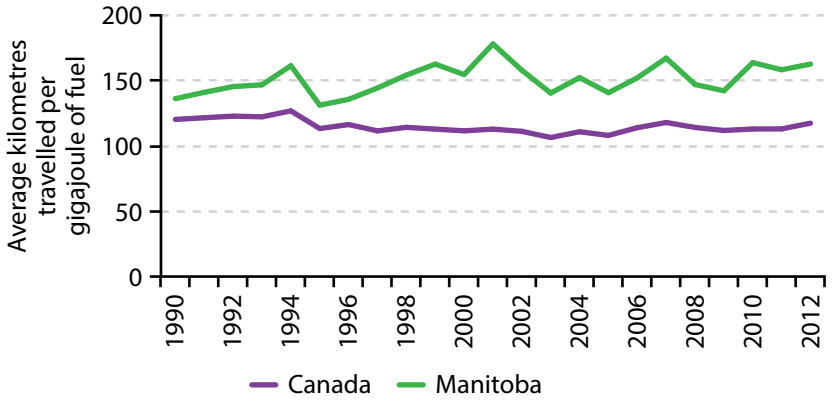


Figure 4C. Manitoba's Transportation Fossil Fuel Consumption

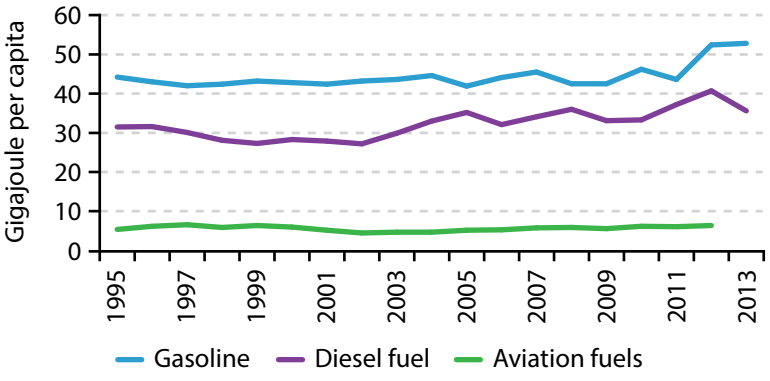
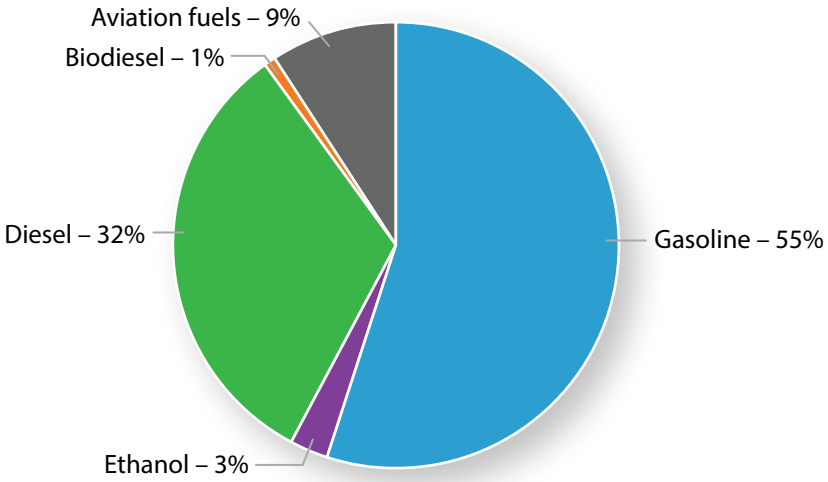
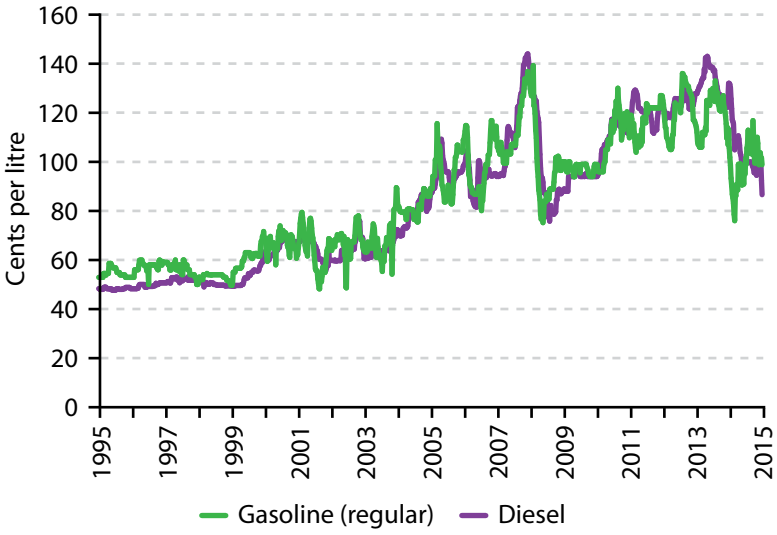


Figure 4D. Manitoba's Transportation Fuel Mix*



* 2012 data.

Figure 4E. Average Weekly Fuel Prices at Winnipeg Pumps



the cost of these fuels is both volatile in the short-term and steadily rising in the long term.

Supporting the adoption of active and public transportation options is one part of Manitoba's strategy for reducing our dependence on fossil fuels. Another is supporting the electrification of transportation. There were roughly 4,600 conventional hybrid-electric vehicles registered in Manitoba in 2015, as well as over 130 electric personal vehicles and five electric buses.

Biofuels are another low carbon alternative to fossil fuels that can be produced locally. In Manitoba, we are working towards capitalizing on our strong agricultural sector to produce made-in-Manitoba biofuels, including biomass and plant-based ethanol.

Manitoba has mandated minimum biofuel content in transportation fuels. Fuel suppliers in the province have been required to replace at

least 8.5 per cent of their gasoline available for sale with ethanol since 2008, and to blend two per cent renewable fuel content in their overall diesel sales since 2009 (see Figure 4F).

We produce more local ethanol in Manitoba than we consume using grain harvested by local farmers. However, we do not currently produce any biodiesel or renewable diesel alternatives, so we have to import it.

Figure 4G shows the infrastructure in Manitoba that is dedicated exclusively to extracting and transporting fossil fuels. Fossil fuels are increasingly transported using shared road and rail infrastructure, which are not shown here. For example, more than 150,000 rail cars were used to transport over 14 million tonnes of coal and petroleum to, from, or through Manitoba in 2012 alone.

Figure 4F. Manitoba's Biofuel Consumption

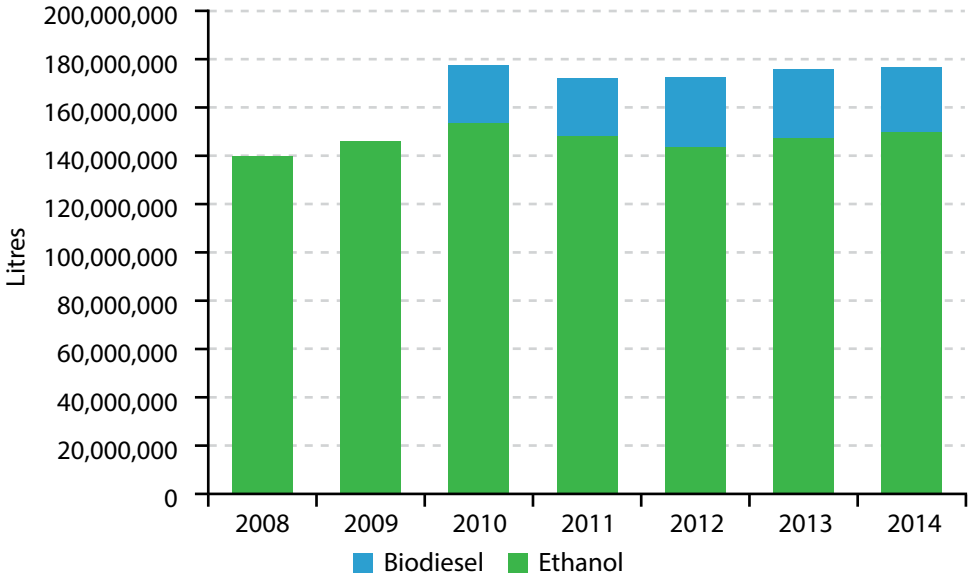
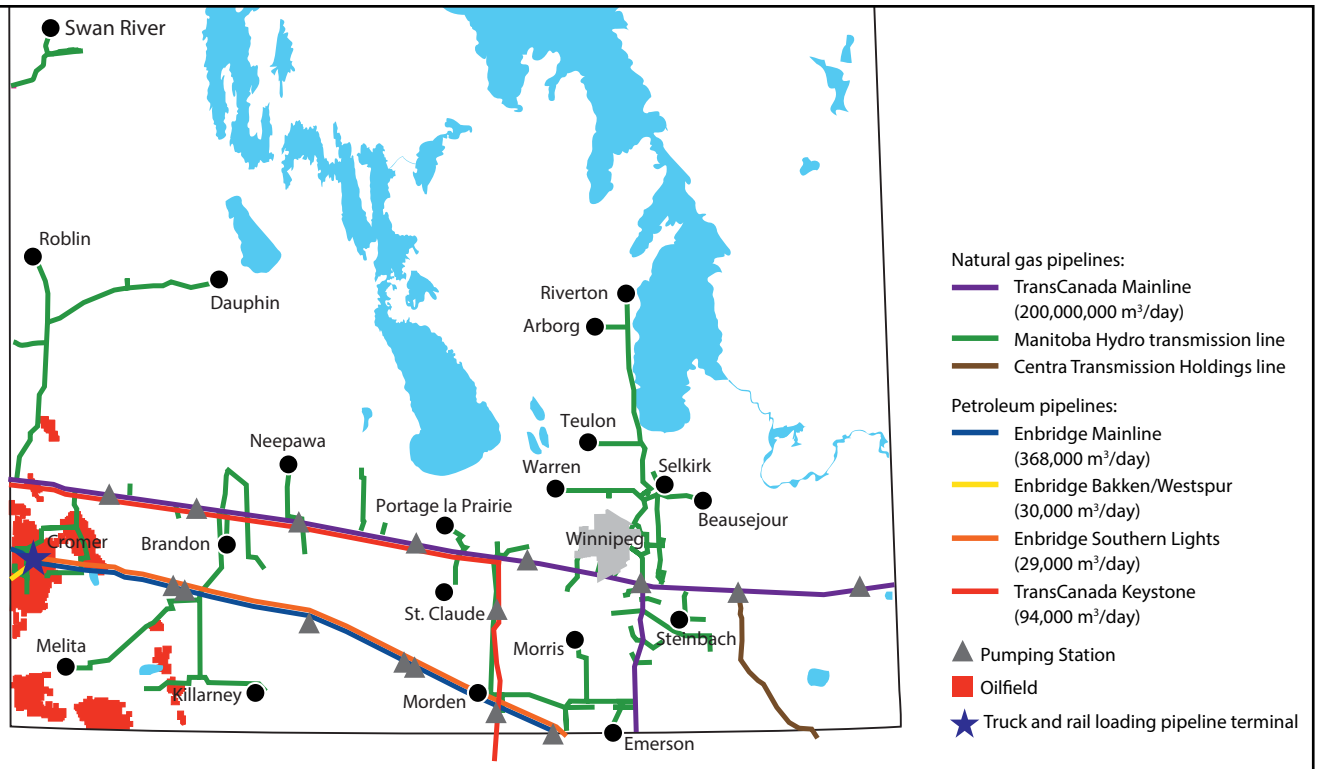


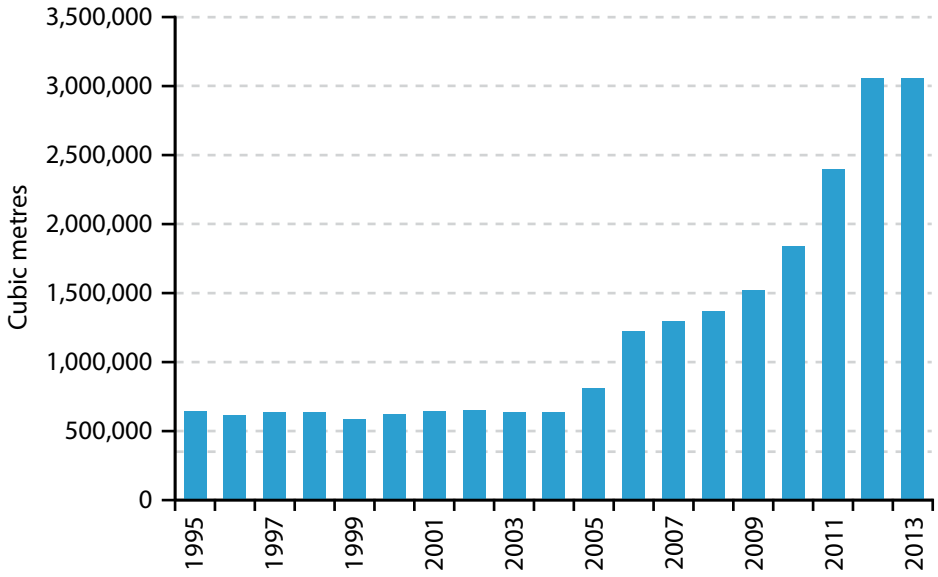
Figure 4G. Manitoba's Fossil Fuel Infrastructure*



* Natural gas pipelines have been included here, however it should be noted that natural gas is used primarily for heating in Manitoba, not for transportation.

There are crude oil extraction projects here in Manitoba (see Figure 4H).[2] However, we have no refineries in the province, so our crude must be shipped elsewhere to be processed into products we can use. As a result, all of the fossil fuels we consume in the province must be imported from another province or from the USA.

Figure 4H. Manitoba's Crude Oil Extraction



[2] Crude oil resources are regulated by Manitoba Petroleum Branch.

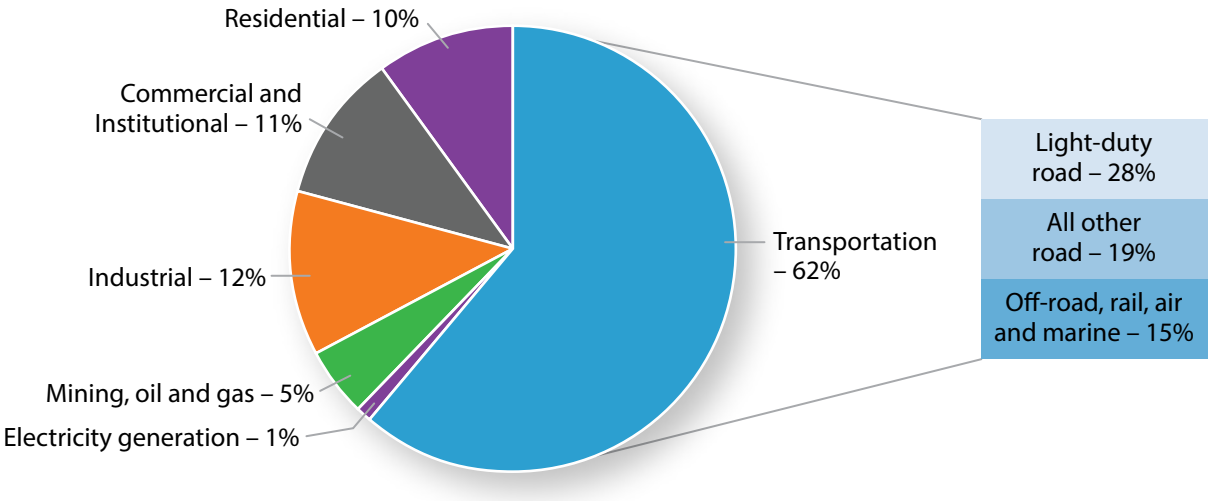
5 Energy and the Environment

Our production, distribution and use of energy has many important impacts on the environment we live in and on our health.

For example, in an average year in Manitoba, the fossil fuel industry reports at least one fire or explosion and about 100 oil spills and gas leaks. Hydroelectric dams also cause the flooding of land and the disruption of waterways.

Currently, one of the most common ways we try to assess the environmental impact of our activities is by estimating how much greenhouse gas (GHG) we emit, which is a key driver of climate change. Figure 5A shows where Manitoba's energy-related GHG emissions come from.

Figure 5A. Sources of Manitoba's Energy-Related GHG Emissions*

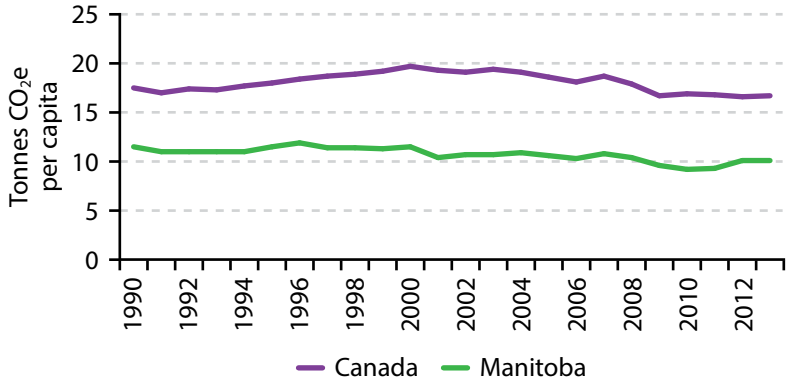


* Five-year average (2009-2013).

We are always looking for ways to reduce the impact of energy use on the environment. Figure 5B shows that Manitobans' per capita emissions are slowly decreasing, and that we consistently outperform the Canadian average.

The bottom line is that there are impacts on the environment when we produce energy, when we move it, *and* when we use it.

Figure 5B. Energy Related GHG Emissions



6 Emerging Energy Trends

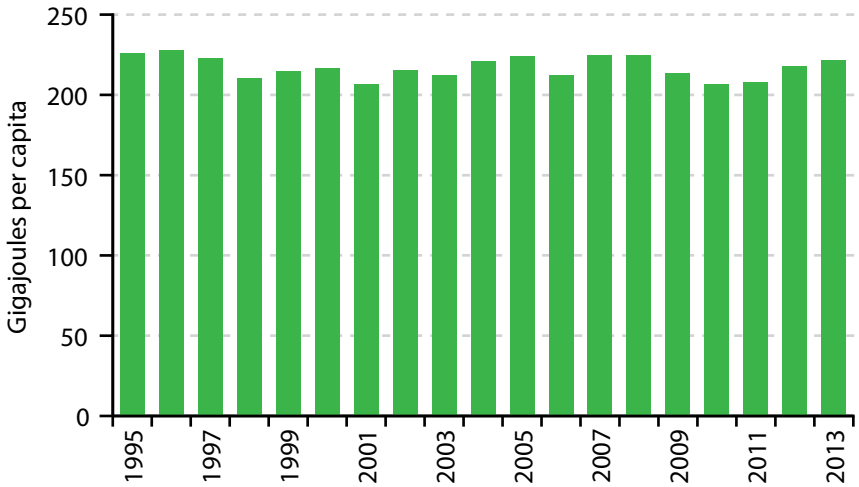
The energy sector is always changing. New technologies will become available and current technologies will become more efficient. Renewable alternatives will appear as non-renewable resources are depleted. More than ever before, we are aware of the negative impacts of our energy consumption on our environment and human health.

Perhaps the greatest challenge in Manitoba's near future is minimizing our consumption of non-renewable resources. Like most jurisdictions around the world, Manitoba is taking steps to minimize the negative social, economic, and environmental impacts associated with our dependence on fossil fuels in two ways.

Over the next five years, we can expect world prices for oil and gas to remain low. Renewable energy resources and technologies, such as advanced biofuels and electric vehicles, are expected to be used more and more. Manitoba's energy sector should be prepared for these types of market transformation, and the search for low carbon alternatives to non-renewable energy resources and conventional energy technologies.

Second, Manitoba's population is growing steadily, and this growth is expected to increase our overall energy demand. We can offset some of this growth in demand by becoming more efficient in our use of energy, however Figure 6A shows that our overall energy consumption has remained steady over time. More must be done to continue Manitoba's trajectory as a leading jurisdiction for energy efficiency and demand side management programs.

Figure 6A. Manitoba's Overall Energy Consumption



References

Chapter 1

End uses of energy in Manitoba

- Natural Resources Canada's *Comprehensive Energy Use Database*

Manitoba's energy balance

- Statistics Canada's *CANSIM* table 128-0016
- Manitoba Energy Branch

Economic impact of Manitoba's energy sector

- *CANSIM* tables 379-0030 and 383-0031

Manitoba's energy balance in dollars

- *CANSIM* tables 128-0017, 129-0003
- Natural Resources Canada's *Fuel Focus*
- Manitoba Hydro's annual reports
- Manitoba Petroleum Branch

Chapter 2

Electricity costs

- Manitoba Finance
- Manitoba Hydro's annual reports

Electricity generation

- *CANSIM* tables 127-0001, 127-0002, 128-0017
- U.S. Energy Information Administration's *Monthly Energy Review* table 7.2a
- U.S. Energy Information Administration's *Electric Power Annual* table 1.2
- International Energy Agency's *Key World Energy Statistics*
- Manitoba Hydro's annual reports

Electricity consumption

- *CANSIM* table 128-0006
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Chapter 3

Heating and cooling energy sources

- Natural Resources Canada's *Comprehensive Energy Use Database*
- Manitoba Energy Branch

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- Natural Resources Canada's *Comprehensive Energy Use Database*

Chapter 4

Transportation energy consumption and efficiency

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- Natural Resources Canada's *Comprehensive Energy Use Database*
- Manitoba Energy Branch
- U.S. Bureau of Transportation Statistics' *National Transportation Statistics* table 1-40M

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- Manitoba Public Insurance

Manitoba's fossil fuels

- National Energy Board *Canadian Pipeline Transportation System Energy Market Assessment*
- Manitoba Hydro
- Canadian Energy Research Institute's *Ribbons of Steel: Linking Canada's Economic Future*
- Manitoba Petroleum Branch

Chapter 5

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- Manitoba Petroleum Branch
- National Energy Board

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- Environment Canada's *National Inventory Report 1990-2013*
- U.S. *National Inventory Report 1990-2013*

Chapter 6

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- U.S. Energy Information Administration's *Monthly Energy Review* tables 2.1, 10.3, and 10.4
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Population estimates

- *CANSIM* table 051-0001
- Manitoba Bureau of Statistics
- U.S. Census Bureau


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