ENERGY

IN MANITOBA

Manitoba
Building for the Future

Introduction

Manitoba is currently a net importer of non-renewable energy but is poised to become a Canadian leader in the production and consumption of renewable energy. ***Energy in Manitoba*** describes Manitoba's past and present energy generation and consumption data. This report is not a plan or strategy for the future. Readers looking for this detailed information should refer to ***Green and Growing*** - an overview of Manitoba's green initiatives or ***Kyoto and Beyond***, Manitoba's 2002 climate change strategy, currently being updated.*

Manitobans are reducing fossil fuel consumption through greater energy efficiency and renewable fuel production. This will help improve our economy and preserve our environment for future generations.

* These publications can be found on the Manitoba government website at **www.gov.mb.ca**.

Overview of Energy Use in Manitoba

Manitoba must continue to aggressively pursue the development of economically feasible, energy efficiency measures and alternative energy sources to reduce the province's dependence on imported fossil fuels. According to Statistics Canada, about 74 per cent of the energy consumed by Manitobans in 2004 was imported and non-renewable. The remaining 26 per cent was renewable hydro-generated power produced in Manitoba (see Figure 1).

In 2004, 98.3 per cent of the domestically produced electricity was hydro-generated in Manitoba. The remaining 1.7 per cent was generated by coal and natural gas. On average, since 1980, 98 per cent of the domestically produced electricity has been renewable, hydro-generated power in Manitoba.

To stem the increase of fossil fuel consumption in the transportation sector, Manitoba is pursuing biofuel infrastructures for ethanol and biodiesel. Existing hybrid vehicles and developing technologies, like plug-in hybrid electric vehicles (PHEVs) and hydrogen fuel cells, will also help reduce our reliance on fossil fuels.

Improved energy efficiency measures such as progressive building codes and standards, as well as initiatives like PowerSmart, the EnerGuide Program and the Manitoba Earth Power Program, provide significant opportunities to reduce our consumption of fossil fuels.

Manitoba, with its abundant wind and hydro resources, is well-positioned to become a leader in renewable energy production in Canada. Additional sales of electricity to Ontario will complement our existing export market and provide greater opportunities to develop wind and hydroelectric projects in this province.

Figure 1: Energy Consumption by Fuel, 2004

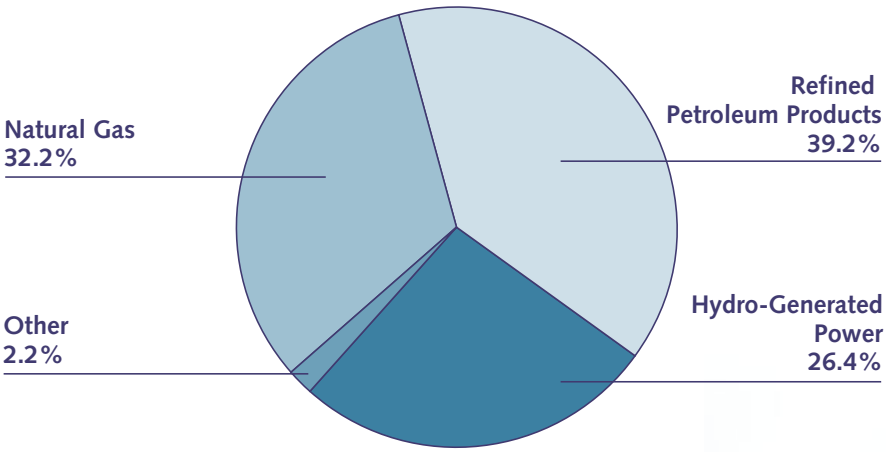


Figure 2: Energy Consumption, 1980-2004
(Projections to 2010)

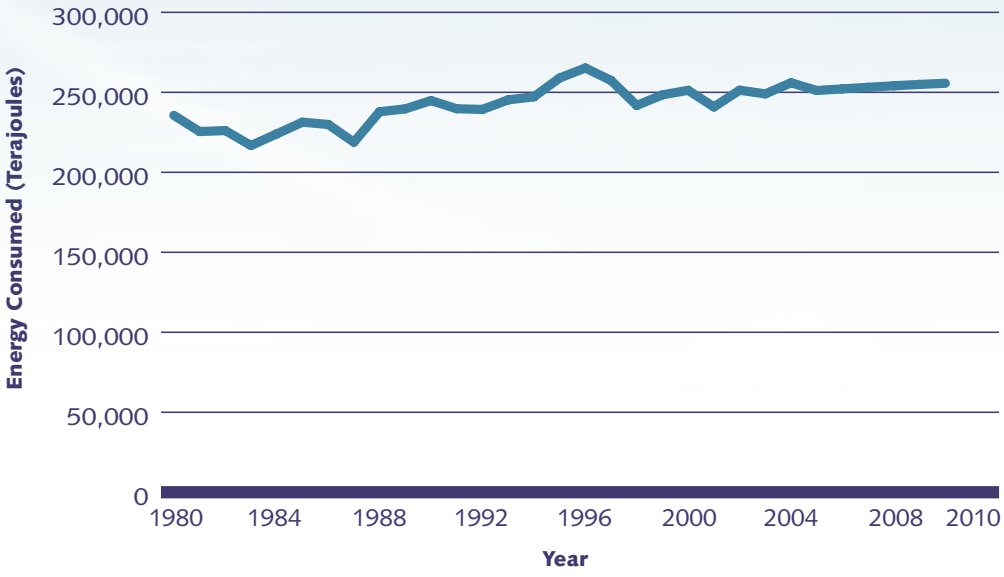
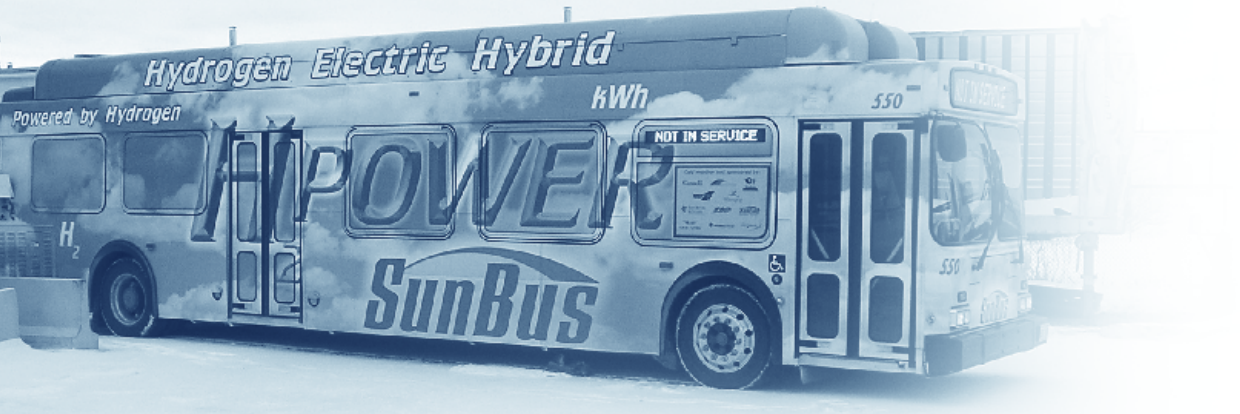


Figure 2 shows the total energy consumption in Manitoba from 1980 to 2004 and the projected energy consumption to 2010.

There has been an increase in total energy consumed from 235,600 terajoules (TJ) in 1980 to 255,973 TJ in 2004. Energy consumption peaked in 1996 at 265,203 terajoules (TJ). The decrease in energy consumption since 1996 can be partially explained by a dramatic drop in natural gas consumption in the province's pipeline sector. Warmer weather in the past decade has also reduced our overall energy requirements.

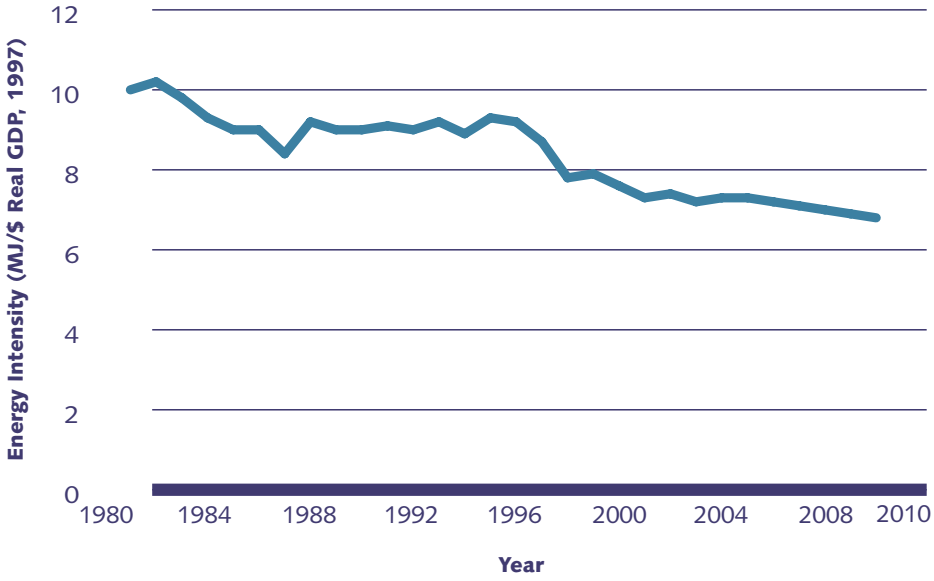
Energy consumption projections take into account existing consumption trends and anticipated changes in energy technology (ex: geothermal heat pump technology, hybrid and plug-in hybrid electric vehicles as well as hydrogen-fuelled vehicles), future increases in hydro-generating capacity, wind energy development, energy efficiency measures and the onset of biofuels like biodiesel and ethanol in gasoline. Manitoba's projected energy consumption in 2010 is approximately 255,000 TJ.



Energy Efficiency

Since 2000, more than 70,000 homeowners have benefited from a number of new energy efficiency programs, including low-interest loans (on-bill financing), EnergGuide home visits and a new Manitoba Earth Power Program offered by Manitoba Hydro. The province is considering replacing its high-efficiency gas furnace incentives with a change to its Building Codes. This would make high-efficiency furnaces mandatory by 2008.

Figure 3: Energy Intensity, 1981-2004
(Projections to 2010)



Energy Intensity Dropping

Energy intensity indicates the amount of energy consumed per unit of activity. The energy intensity is the ratio of energy consumption per dollar of real gross domestic product (GDP). Real GDP is the total value of goods and services produced by the provincial economy, not including inflation.

Figure 3 shows the energy intensity trend from 1981 to 2004, with projections to 2010.

The energy intensity in 1981 was 10 megajoules/$ (MJ/$) real GDP. By 2004, the indicator had decreased to 7.3 MJ/$ real GDP. This represents a 27 per cent improvement in the energy intensity over a 24-year period. The projected energy intensity for 2010 is 6.8 MJ/$ real GDP, a seven per cent decrease over 2004 levels. An increase in the electricity consumed by large, energy-intensive, industrial users as a result of a widening rate gap between Manitoba and its neighbours, could increase the energy intensity.

Improvements in energy efficiency through the application of superior building science, the capture of waste heat in industrial and commercial applications, and the introduction and/or increased use of energy-efficient technologies (ex: hybrid vehicles, wind energy, geothermal heat pump technology), help reduce energy intensity.

Energy Consumption by Sector

Transportation Sector

The transportation sector is the largest energy-consuming sector* in Manitoba, accounting for 27 per cent of the total energy consumed. Approximately 99 per cent of the energy requirements for on-road transportation are met with refined petroleum products. In the near future, this sector could experience a decrease in fossil fuel consumption through improved vehicle efficiencies and the growing acceptance of hybrid vehicles.

Figure 4: Gasoline & Diesel Consumption, 1980-2004
(Projections to 2010)

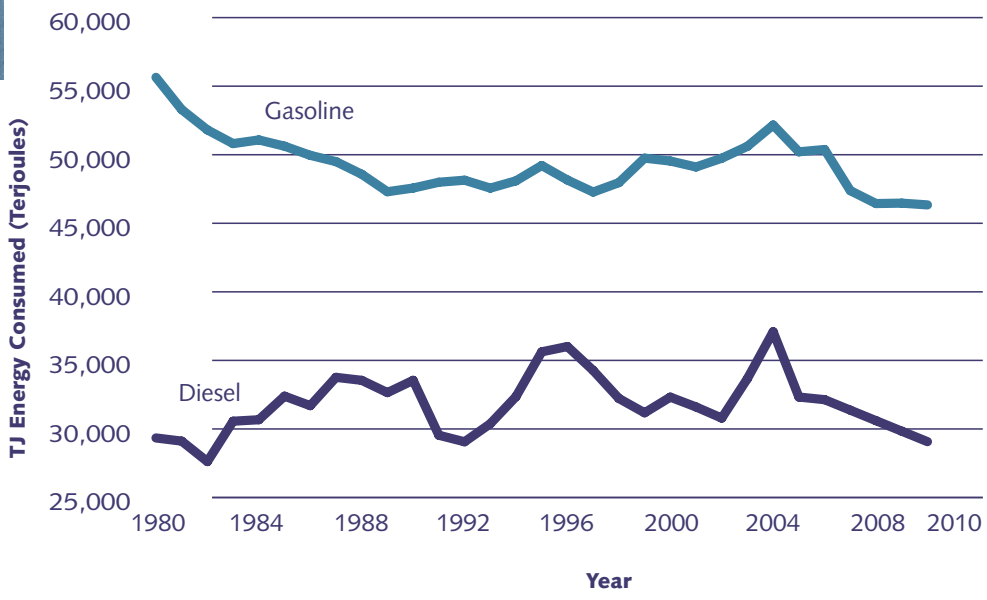


Figure 4 shows the gasoline and diesel consumption trends for Manitoba from 1980 to 2004, with projections to 2010. The significant decline anticipated for both fossil fuels (beginning in 2007/2008), can be directly attributed to the introduction of Manitoba's proposed ethanol fuel mandate, combined with increasing biodiesel production and consumption.

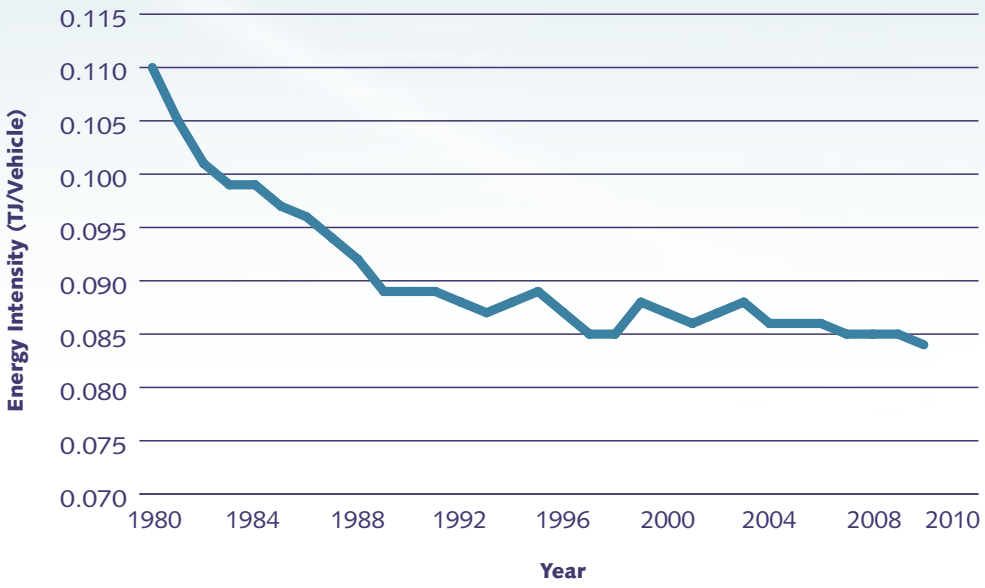
The consumption of gasoline has increased steadily since 1989, due to the considerable rise in larger vehicles like SUVs and vans in the 1990s. There is a projected decrease in gasoline consumption after a 10 per cent gasoline-ethanol mix is mandated in the province. Hybrid vehicles will also help reduce gasoline consumption.

Because it depends largely on the trucking economy, the amount of diesel being consumed is more erratic than gasoline consumption. Even so, conventional diesel consumption is expected to decrease from 2006 to 2010 with the emergence of biodiesel. Projections of high fossil-fuel prices make biodiesel an increasingly attractive alternative. As a result, a rapid increase in the production and consumption of biodiesel is expected over the next few years. The province is currently considering a number of significant investments in biodiesel production.

Passenger-vehicle energy intensity is the ratio of annual gasoline consumption to the number of passenger vehicles. Figure 5 shows this trend from 1980 to 2004, along with projections to 2010.

* Does not include pipelines.

Figure 5: Passenger Vehicle Energy Intensity, 1980-2004
(Projections to 2010)



In 1981, the passenger-vehicle energy intensity was 0.110 terajoules/vehicle (TJ/vehicle). By 2004, this indicator had dropped to 0.086 TJ/vehicle, a 22 per cent improvement over this time period. Most of the gains in energy intensity occurred from 1980 to 1989, showing a 19 per cent improvement in passenger-vehicle energy intensity. From 1990 to 2004, there were no significant improvements in fuel efficiency or in the passenger-vehicle energy intensity. The beginning of the downturn in the rate of improvement of fuel efficiency, coincides with a sharp drop in world fossil fuel prices in the mid-to-late 1980s.

Due to the onset of dramatically increased oil prices in 2003, North America is experiencing declining SUV sales. The passenger-vehicle energy intensity will likely improve with a shift to more fuel-efficient passenger vehicles. More efficient transportation technologies such as hybrids, followed by PHEVs and hydrogen fuel cell technology, will also help reduce the energy intensity for this sector. Passenger-vehicle energy intensity projections from 2005 to 2010 incorporate the emergence of hybrid technology in North America, and show a marked downward trend in energy intensity, and as a result, fuel consumption in the transportation sector.

Industrial Sector

The industrial sector accounts for 20 per cent of the total energy consumed in Manitoba. From 1980 to 2004, this sector experienced a slight increase in energy consumption. Natural gas was the largest fuel source for the industrial sector (43 per cent) until the mid-1990s, when electricity surpassed natural gas as the predominant energy source. Since then, natural gas consumption has decreased to 40 per cent in the 1990s and early 2000s. This sector's demand for electricity, on the other hand, has increased from 33 per cent of total consumption in the early 1980s to 45 per cent in the late 1990s and early 2000s. The demand for refined petroleum products dropped from 15 per cent of total energy consumption in the early 1980s, to eight per cent in the late 1990s and early 2000s.

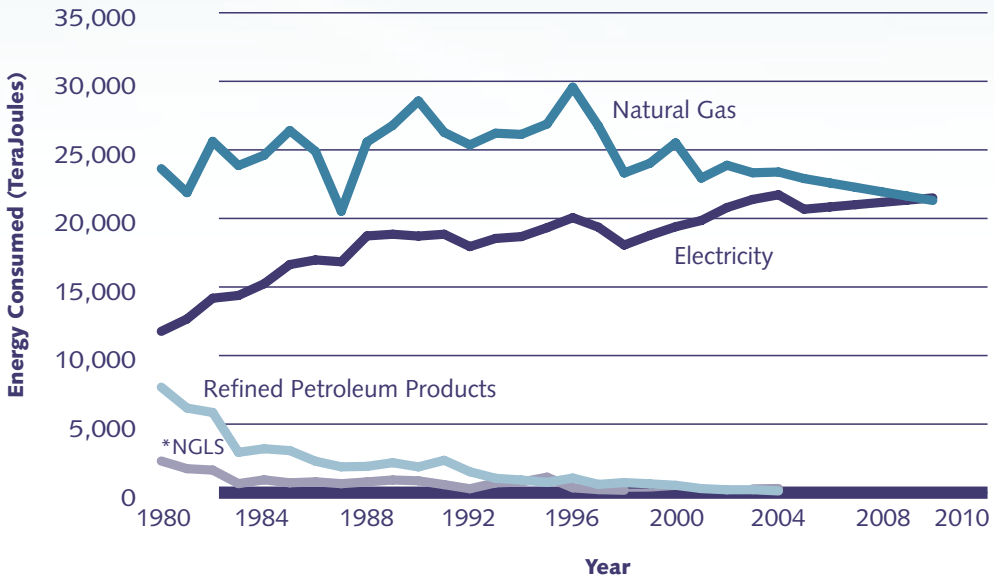
Commercial Sector

The commercial sector accounts for 19 per cent of the total energy consumed in Manitoba. This includes all service industry facilities in the private and public sectors. Since the early 1980s, natural gas has consistently provided 60 per cent of commercial energy requirements. The period from 1993 to 2004 shows a 23 per cent increase in electrical consumption, from 11,320 TJ to 13,936 TJ.

Residential Sector

The residential sector accounts for 18 per cent of the total energy consumed in Manitoba. Figure 6 shows annual residential energy consumption from 1980 to 2004, along with projected consumption to 2010.

Figure 6: Residential Fuel Source, 1980-2004
(Natural Gas & Electricity Projections to 2010)

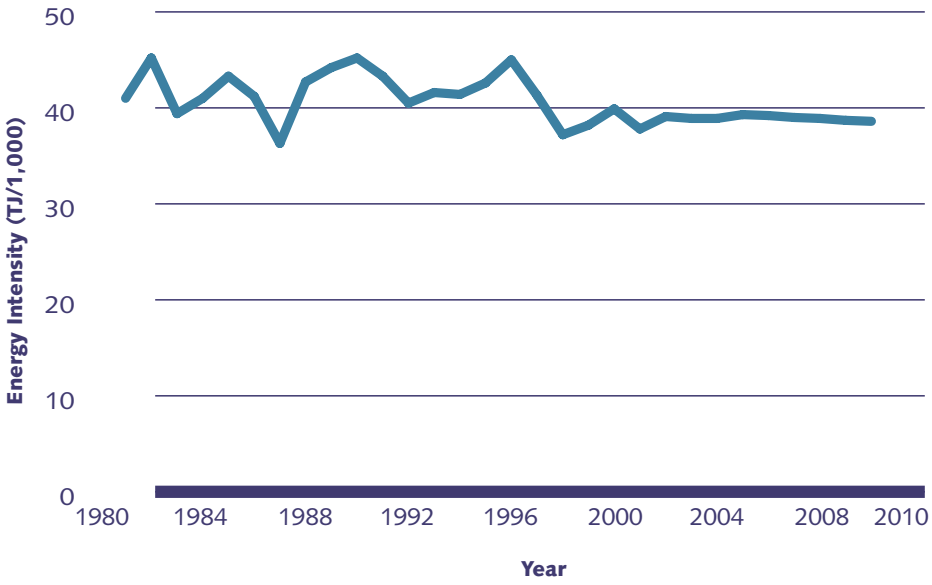


*Natural Gas Liquids

Refined petroleum products and natural gas liquid consumption have dramatically decreased since the early 1980s. Nevertheless, regardless of their high economic and environmental costs, these are still the fuels of necessity for some remote communities.

Natural gas consumption experienced an increase from 23,631 terajoules (TJ) in 1980 to 28,567 TJ in 1990. From 1990 to 2004, natural gas consumption decreased by 18 per cent (5,183 TJ). Meanwhile, electricity consumption experienced a steady increase from 11,766 TJ in 1980 to 21,725 TJ in 2004. The decrease in natural gas use since 1990 contributed to a 16 per cent increase in electrical consumption (3,013 TJ). The application of geothermal heat pump technology is included in the electrical consumption projections.

Figure 7: Residential Energy Intensity, 1980-2004
(Projections to 2010, in Terajoules per 1,000)



The residential energy intensity is the ratio of residential energy consumption to population. Figure 7 shows this trend from 1981 to 2004, along with projections to 2010.

In 1981, the residential energy intensity was 41 TJ/1,000. By 2004, this value had dropped to 38.9 TJ/1,000, a five per cent improvement over this time period. The residential energy intensity has been decreasing since 1990. This is likely due to improvements to residential building codes implemented in 1994, and efforts by homeowners to improve the energy efficiency of their homes.

Agricultural Sector

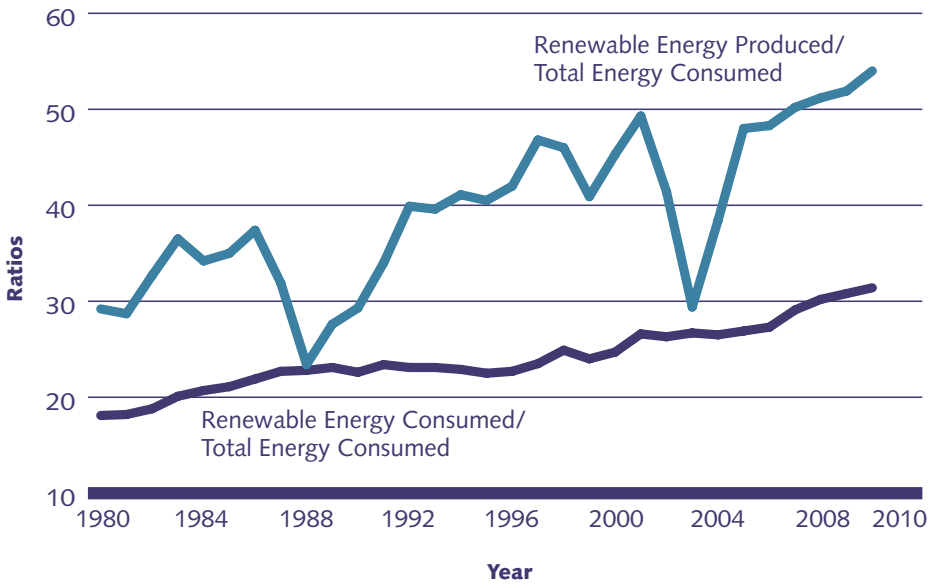
The agricultural sector consumes nine per cent of the total energy in Manitoba. This sector has experienced an increase in consumption from 15,256 TJ in 1980 to 23,716 TJ in 2003. Refined petroleum products consistently account for over 72 per cent of the energy requirements in agriculture. Electricity provides approximately 25 per cent of this sector's energy requirements.

Renewable Energy

Although fossil fuel consumption is still dominant in Manitoba, encouraging energy-consumption trends are developing around renewable or green energy. Potential renewable energy sources include hydro-generated power, earth energy, biofuels, solar and wind power.

With the exception of a limited amount of ethanol production, hydro-generated power has been the primary source of renewable energy in Manitoba to date. The ratio of renewable energy consumed to total energy consumed can be used to evaluate trends in renewable energy. Figure 8 provides a historical account of this ratio, with projections to 2010.

Figure 8: Renewable Energy Trends, 1980-2004
(Projections to 2010)



In 1980, the ratio of renewable energy consumed to total energy consumed was 18 per cent. By 2004, that ratio had increased to 27 per cent. By switching from non-renewable energy sources to hydro-generated power, biofuels, and wind, and factoring in energy efficiency improvements, projections show a 30 per cent ratio of renewable energy consumed to total energy consumed, by 2010.

The widespread use of hybrid vehicles, hydrogen fuel cells and geothermal heat-pump systems, along with fuel switching from non-renewable to renewable energy sources, will have a positive impact on the ratio of renewable energy consumed and produced to total energy consumed.

Another method of measuring renewable energy trends is the ratio of renewable energy produced to total energy consumed. From 1980 to 2002, this ratio increased from 29 per cent to 41 per cent. Much of this growth is attributable to greater exports of hydro-generated power. Figure 8 shows significant declines in renewable energy produced to total energy consumed, in the late 1980s and in 2003. During these periods, Manitoba experienced drought conditions and significant reductions in hydro-electric capacity.

Energy efficiency improvements, along with fuel switching from non-renewable energy sources to renewable hydro-generated power, have resulted in an average 0.6 per cent annual increase in the ratio of annual energy produced to total energy consumed from 1980 to 2002.

Switching from non-renewable energy sources to hydro-generated power, biofuels, and wind, along with energy efficiency improvements, are projected to produce a 50 per cent ratio of renewable energy produced to total energy consumed, by 2010. The construction and commissioning of three new hydroelectric generating stations (Wuskwatim, Keeyask/Gull and Conawapa) is expected to increase the ratio of renewable energy produced to total energy consumed to 70 per cent by 2020.

Integrating Wind with Hydro-generated Power

Wind-generated electricity can be effectively integrated with hydro-generated power in Manitoba. When winds are blowing, wind turbines produce electricity, enabling hydro dams to retain higher reservoir levels and, therefore, conserve hydro-generated power. When the winds are calm, stored water is released to generate additional hydro-generated power, offsetting the reduction in wind-generated output.

The geographic distribution of wind farms results in less overall wind-generating down-time and improved wind system predictability. Preliminary studies show there are strong wind resources across widely dispersed areas of Manitoba.

The 99 megawatt (MW) St. Leon wind farm located in southwestern Manitoba is this province's first wind farm. Over the next decade, a number of subsequent wind farms are expected to be developed, collectively producing 1,000 MW of electrical power.

Manitoba Hydro's development plans include the following hydroelectric generating stations:

- Wuskwatim – rated at 200 MW
- Keeyask/Gull – rated at 620 MW
- Conawapa – rated at 1250 MW

Geothermal Heat Pump Technology

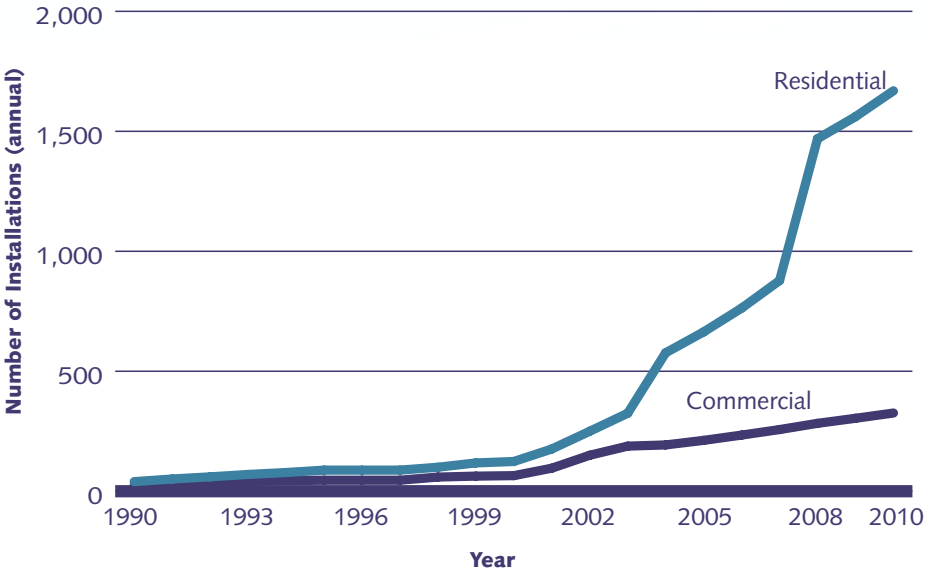
An ever-increasing number of large commercial and municipal buildings, arenas, schools and homes in Manitoba are considering geothermal heat pump systems for space heating and water heating, and for air conditioning. Manitoba has Canada's strongest supply infrastructure for geothermal heat pump technology. This includes a growing list of geothermal heat pump installers, manufacturers and suppliers in Manitoba and a leading-edge Earth Power Program developed by Manitoba Hydro.

A strong awareness of geothermal heat pump technology exists in Manitoba. This awareness will undoubtedly cause a greater distribution of earth power systems and accelerate the displacement of natural gas for space heating. Figure 9 is a historical account of the annual number of geothermal heat pump installations in Manitoba from 1990 to 2004, with projections to 2010.

Figure 9 projects a significant period of growth in the sales and installations of geothermal heat pumps in Manitoba. Should the initiative prove to be economically feasible, the proposed Waverley West Geothermal Initiative could contribute significantly to the installations of residential geothermal heat pumps in Manitoba. This initiative is expected to use geothermal heating and cooling systems in a large development that is proposed for southwest Winnipeg. The impact of the development is included in Figure 9.

Construction of the first phase of the Waverley West development could begin in 2007. This initiative has the potential to establish Manitoba as a world leader in geothermal heat pump technology.

Figure 9: Manitoba Geothermal Heat Pump Installations, 1990-2004
(Projections to 2010)



Biofuels: Ethanol and Biodiesel

Husky Oil has operated an ethanol plant in Minnedosa since 1980. The plant annually produces 10 million litres of ethanol. The ethanol produced from the plant is used in E10, a 10 per cent ethanol to 90 per cent gasoline blend.

Manitoba will soon be mandating E10 sales in 85 per cent of gasoline sold in the province. Higher ethanol-to-gasoline blends, like E85, will be phased in over time. Ethanol produced from Manitoba grain crops has the potential to displace a significant amount of imported gasoline in Manitoba.

Biodiesel is produced from vegetable oils, used cooking oils or rendered animal fats. Low-level biodiesel blends have a positive impact on the performance of diesel engines. Biodiesel is currently being produced in Arborg and Rapid City. The Province of Manitoba's biodiesel strategy is expected to support the production of up to 85 million litres of biodiesel by 2010. Biodiesel could eventually displace a significant amount of imported diesel in Manitoba.

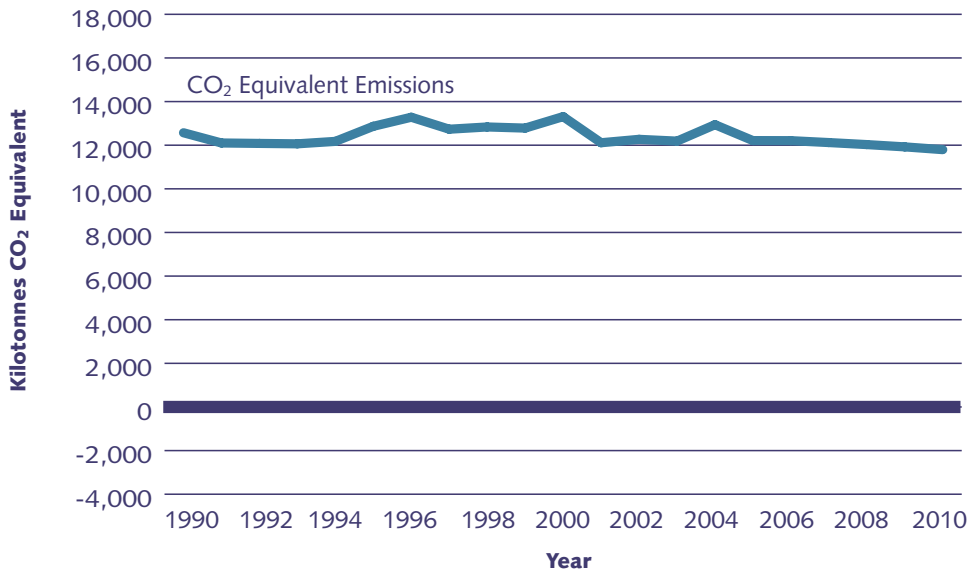
Carbon Dioxide Emissions from Energy Consumption

The consumption of non-renewable, fossil fuels contributes significantly to the production of greenhouse gas emissions. According to Environment Canada's *1990-2001 Greenhouse Gas Inventory,* the energy sector accounts for 59 per cent of Manitoba's greenhouse gas emissions.

Figure 10 shows estimates of the annual carbon dioxide (CO_2) emissions produced from fossil fuels in Manitoba's energy sector from 1990 to 2001, with projections to 2010.

The energy-related CO_2 emissions closely follow the energy consumption trends previously discussed (Figure 2). Energy consumption is projected to rise in the period from 2005 to 2010. The ratio of renewable to total energy consumed is also expected to rise as a result of energy efficiency measures, energy-efficient technologies and the widespread use of biofuels. The anticipated increase in the ratio of renewable energy consumed to total energy consumed will help reduce energy-related CO_2 emissions in Manitoba.

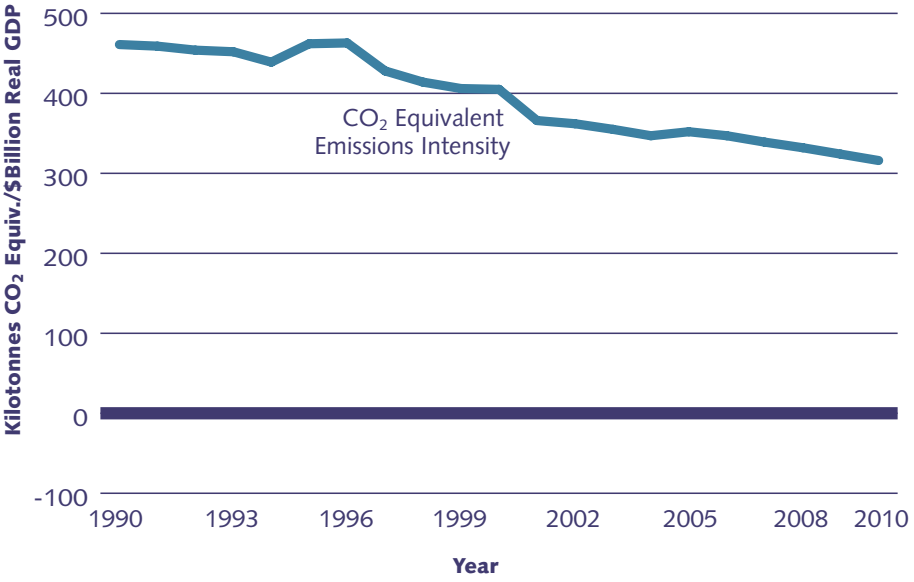
Figure 10: Energy-Related CO_2 Equiv. Emissions, 1990-2001
(Projections to 2010)



The CO_2 emissions intensity is the ratio of energy-related CO_2 emissions per $1 billion of real GDP. Figure 11 shows the CO_2 emission intensities from 1990 to 2001, along with projections to 2010.

The CO_2 intensity in 1990 was 461 kilotonnes (Kt) CO_2 equivalent/ $1 billion real GDP. By 2001, this indicator decreased to 366 Kt CO_2 equivalent/$1 billion real GDP, a 21 per cent improvement over a 12-year period. The projected intensity for 2010 is 328 Kt CO_2 equivalent/$1 billion real GDP, a 10 per cent improvement over 2001 levels.

Figure 11: Energy-Related CO_2 Equivalent Emissions Intensity, 1990-2001
(Projections to 2010)



Information Sources

The following information sources were used in this report:

- *Canada's Greenhouse Gas Inventory*, *1990-2001*, Environment Canada
- *Manitoba Hydro-Electric Board Annual Reports*: net exports of electricity with 1.05 coal conversion figure and median load forecast
- Manitoba Public Insurance Corporation (MPIC) passenger-vehicle data
- *Statistics Canada Annual Reports on Energy Supply-Demand in Canada*, Catalogue no. 57-003-XPB (1980 to 2003)
- Statistics Canada CANSIM 079-0001 *New Motor Vehicle Sales, by Province*
- Statistics Canada CANSIM 384-0002 and Catalogue no 13-213-PPB, *Real Gross Domestic Product, Expenditure-Based, by Provinces and Territories*
- Statistics Canada, *Census of Population* (last modified 2005-01-04)

MG5450 June 2006