Natural Resources Canada
Ressources naturelles Canada

ecoENERGY
an ecoACTION initiative

Industrial Consumption of Energy (ICE) Survey

Summary Report of Energy Use in the Canadian Manufacturing Sector 1995–2008

October 2010

Canada

To obtain additional copies of this or other free publications on energy efficiency, contact:

Energy Publications
Office of Energy Efficiency
Natural Resources Canada
c/o St. Joseph Communications
Order Processing Unit
1165 Kenaston Street
PO Box 9809 Stn T
Ottawa ON K1G 6S1

Tel.: 1-800-387-2000 (toll-free)
Fax: 613-740-3114
TTY: 613-996-4397 (teletype for the hearing-impaired)

Cat. No. M144-154/2008 (Print)
ISBN 978-1-100-52048-3

Cat No. M144-154/2008E-PDF (On-line)
ISBN 978-1-100-16427-4

Natural Resources Canada's Office of Energy Efficiency
Leading Canadians to Energy Efficiency at Home, at Work and on the Road

Recycled paper

Table of contents

List of Figures

List of Tables

1 Executive summary

The Industrial Consumption of Energy (ICE) survey is an annual survey of Canada's Manufacturing sector. This summary report examines energy consumption patterns for the Canadian Manufacturing sector using the results of the 2008 ICE survey.

The following are some of the key findings from the 2008 ICE survey:

- The 2008 energy consumption of the Manufacturing sector was 5 percent, or 116 petajoules (PJ), lower than in 2007. From 1995 to 2008, the Manufacturing sector's energy use decreased by 8 percent (or 193 PJ).
- The Manufacturing sector's energy intensity declined 26 percent, from 19 megajoules per dollar of GDP (MJ/$GDP) to 14 MJ/$GDP, from 1995 to 2008.
- In 2003, electricity overtook natural gas as the most used energy source in the manufacturing sector. Several factors may explain the increasing demand for electricity compared with natural gas, including (1) natural gas prices, which rose significantly over the period and made electricity a relatively more attractive fuel in certain industries and (2) structural changes in the manufacturing sector, including growing energy demand from electricity-intensive industries (such as the Primary Production of Alumina and Aluminum industry, NAICS 331313) and declining demand for natural gas from other industries (such as the Paper Manufacturing subsector, NAICS 322).
- Although there are 21 subsectors within the Manufacturing sector, more than 90 percent of all energy consumption of the sector in 2008 was from only seven subsectors. The following are key findings among these seven subsectors:
  - The Petroleum and Coal Product Manufacturing subsector was the only subsector that experienced an increase in energy intensity over the 13-year period (from 1995 to 2008).
  - From 1995 to 2008, the Petroleum and Coal Product Manufacturing subsector had the largest increase in energy use of the seven selected subsectors – increasing 79 PJ (or 27 percent).
  - The Paper Manufacturing subsector's energy consumption declined by 313 PJ (or 35 percent) between 1995 and 2008. This was the biggest decrease among the seven selected subsectors.

2 Introduction

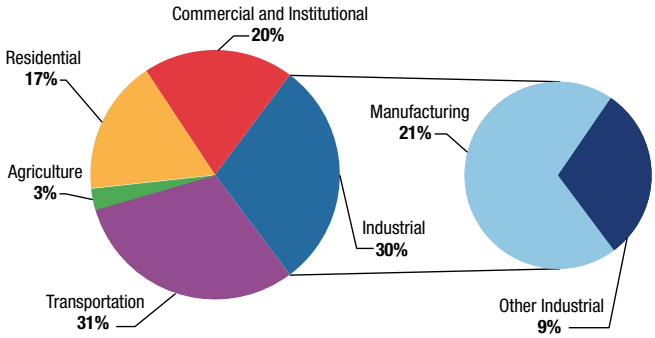
Every year, Statistics Canada conducts the Industrial Consumption of Energy (ICE) survey, which collects energy use data from establishments[1] in Canada's Manufacturing sector.[2] The ICE survey is currently co-sponsored by the Office of Energy Efficiency (OEE) of Natural Resources Canada (NRCan) and Environment Canada. The survey is an essential tool for monitoring the evolution of energy consumption by manufacturing industries and therefore helps fulfill part of the OEE's mandate to strengthen and expand Canada's commitment to energy conservation and energy efficiency.

This summary report examines energy consumption patterns for the Canadian Manufacturing sector using the results of the 2008 ICE survey. The estimates are based on the North American Industry Classification System (NAICS) and include all 21 subsectors of the Manufacturing sector (NAICS 31 to 33).[3]

Other initiatives that gather information on energy use by the Manufacturing sector include the annual *Report on Energy Supply and Demand in Canada* from Statistics Canada, the annual report from the Canadian Industry Program for Energy Conservation, reports produced by the Canadian Industrial Energy End-Use Data and Analysis Centre at Simon Fraser University and NRCan's *Energy Use Data Handbook* and *Energy Efficiency Trends in Canada*.

Figure 1 illustrates how Canada's secondary energy consumption of the residential, agricultural, commercial, industrial and transportation sectors was distributed in 2008.[4]

Figure 1. Canada's secondary energy consumption 2008



This report was prepared by François Le Morvan, Samuel Blais was the project manager, and overall direction was provided by Andrew Kormylo, of the Demand Policy and Analysis Division of the OEE. An electronic version of this report is available at **oee.nrcan.gc.ca/statistics**.

For more information on this report or on the OEE's services, contact

Office of Energy Efficiency
Natural Resources Canada
580 Booth Street, 18th floor
Ottawa ON K1A 0E4
E-mail: euc.cec@nrcan-rncan.gc.ca
Web site: oee.nrcan.gc.ca

Note to readers: Statistics Canada regularly revises the ICE survey estimates to improve their quality constantly. Also, this year's report uses a different source for the gross domestic product (GDP) estimates. Therefore, some of the results in this report may differ slightly from previous versions.

Due to rounding, the numbers in this summary report may not add up to the totals shown in the tables or to 100 percent, where applicable.

[1] See Appendix A, Glossary, for a more in-depth description.

[2] See Appendix B, North American Industry Classification System.

[3] See Appendix A, Glossary, for a definition and Appendix B, North American Industry Classification System, for details.

[4] Source: Report on *Energy Supply and Demand in Canada*. The Report's data exclude non-energy use, which forms part of the data for the Manufacturing sector.

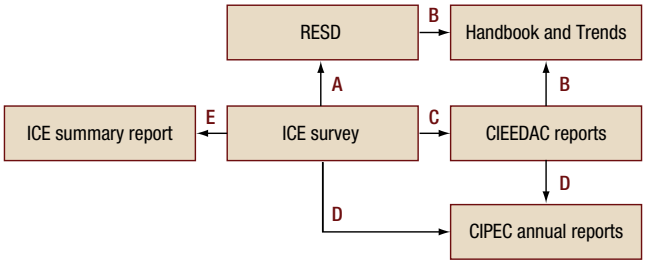
3 Overview of industrial energy data links

The Government of Canada, and Natural Resources Canada (NRCan) in particular, have worked with Canadian industry for more than 30 years to promote energy efficiency in industrial practices. The availability of good quality data on industry's energy consumption is essential to effectively monitor the energy efficiency of the Industrial sector.

NRCan works with various data sources to publish information on energy use in all sectors of the Canadian economy. For additional data, analysis and reports on the Industrial sector, consult the following:

- Industrial Consumption of Energy (ICE) survey
- *Report on Energy Supply and Demand in Canada* (RESD)
- Canadian Industry Program for Energy Conservation (CIPEC)
- Canadian Industrial Energy End-Use Data and Analysis Centre (CIEEDAC)
- Demand and Policy Analysis Division (DPAD) of NRCan

Figure 2. Canada's secondary energy consumption 2008



A Several supply and demand surveys, including the ICE survey, feed into the *Report on Energy Supply and Demand in Canada* (RESD).

B The *Energy Use Data Handbook and Energy Efficiency Trends in Canada* (Handbook and Trends), produced by the OEE of NRCan, use data from the RESD and from CIEEDAC reports to produce estimates.

C CIEEDAC uses ICE survey estimates to produce some of its reports. CIEEDAC also collects data through its Petroleum Refining survey and uses data obtained through various industry associations for comparison with ICE data.

D CIPEC uses CIEEDAC reports in combination with ICE survey estimates to produce its annual report.

E All energy use data in this summary report come from ICE survey estimates.

Figure 2 illustrates the links between the industrial data sources and publications, which are explained in the following sections. These explanations include a brief description and history of the data activities. Note that the definition of the Canadian Industrial sector can differ among the data sources. Therefore, caution should be used when comparing data from these sources.

The relationship between the ICE survey and the RESD has been changing continually. Over the years, the ICE survey has improved to the point that it has become a reference for energy consumption data in the Manufacturing portion of the Industrial sector. As a result, the ICE survey will be the sole data source used by the RESD in the upcoming years for the Manufacturing sector. Previously, the RESD relied mostly on Statistics Canada's disposition surveys (information from energy producers). This is a major change, and it means that Statistics Canada will have just one estimate for the energy use of the Manufacturing sector.

3.1 Industrial energy data: Sources and publications

3.1.1 Industrial Consumption of Energy Survey

Although entitled the Industrial Consumption of Energy survey, data published from the ICE survey does not cover the entire Industrial sector, but rather the Manufacturing portion only. Indeed, mining (including oil and gas extraction), forestry and construction are not included in the ICE survey estimates for efficiency reasons, because several data initiatives already gather information on these sectors.

Historically, the Industrial sector has been one of the largest final consumers of energy in the Canadian economy. Statistics Canada has conducted the ICE survey since 1977.

The ICE survey was established as a quarterly survey, but in 1995, an annual component was added so a detailed breakdown of the Manufacturing sector's energy consumption could be produced at a national level. The ICE data for 1995 to 2000 were collected according to the Standard Industrial Classification (SIC) system and were converted to the North American Industry Classification System (NAICS)[5] as part of a backcast in 2001.

In 2001, the sample size was increased, which made available more disaggregated NAICS-level data. In 2003, the quarterly component of the survey was cancelled. Today all data are collected on an annual basis. Recently, the ICE data dating back to 1995 were revised to update the electricity consumption estimates.

The methodology used to conduct the ICE survey is provided in Appendix C.

3.1.2 Report on Energy Supply and Demand in Canada

The *Report on Energy Supply and Demand in Canada* (RESD), which is produced by Statistics Canada, is the official report on the energy supply and demand balance in Canada. The report presents data on energy consumption, production, trade and conversion by sector and by province and territory.

The RESD began in 1976 as a quarterly report and became an annual report in 2004. Over time, the RESD expanded to include more variables. Thirteen supply and demand surveys provide information for the RESD, and an input/output energy model is used to produce the estimates.

The RESD is a key source of information used by NRCan and Environment Canada to assess the progress of improvements in energy efficiency, assess Canada's greenhouse gas (GHG) emissions and fulfill international reporting commitments. NRCan also uses data from the RESD to monitor and analyze trends in energy use and efficiency in the Canadian economy and to run national forecasting models of energy use and related emissions.

3.1.3 Trends and Handbook

The Demand Policy and Analysis Division (DPAD) of the Office of Energy Efficiency (OEE) at NRCan publishes reports on energy use in Canada. In particular, Canada's secondary energy consumption by end-use is outlined in DPAD's *Comprehensive Energy Use Database*. The Industrial portion of the *Comprehensive Energy Use Database* is generated by the Industrial End-Use Model. *Energy Efficiency Trends in Canada* (the Trends) and the *Energy Use Data Handbook* (the Handbook) are the two main annual publications based on these data.

The Trends publication assesses factors influencing changes in energy use and related changes in GHG emissions for five sectors of the Canadian economy: Residential, Commercial/Institutional, Industrial, Transportation and Electricity generation. Its companion document, the Handbook, provides a statistical overview of the data behind the Trends analysis.

The aggregate industrial energy use data presented in the Handbook and the Trends analysis are taken from the RESD, and the disaggregated data are derived from the CIEEDAC database, which is based on ICE data. In addition to energy use data, these reports provide data on GHG emissions and information on major activities and indicators that influence energy use.

The most recent version of the Trends and the Handbook are available on the OEE Web site at **oee.nrcan.gc.ca/corporate/statistics/neud/dpa/data_e/publications**.

[5] See Appendix B for more information on NAICS.

3.1.4 Canadian Industrial Energy End-Use Data and Analysis Centre

Established in 1993, the Canadian Industrial Energy End-Use Data and Analysis Centre (CIEEDAC) plays an important role in industrial energy data management and analysis in Canada. With the aim of remaining competitive and meeting environmental obligations, several industries rely on CIEEDAC to obtain information on their energy consumption.

The industries covered in CIEEDAC's analysis for the Manufacturing sector are the same as those included in the ICE survey, although CIEEDAC publications also include certain industrial aggregations. The primary sources of data used for CIEEDAC activities come from Statistics Canada (ICE for the Manufacturing sector) and industry associations. CIEEDAC also collects data from its Petroleum Refining survey and from other industry organizations (e.g. cement data on Canadian facilities from the Portland Cement Association).

CIEEDAC reports present data and trends in energy consumption, production and energy intensity for the Industrial sector in Canada. Governments use information from publicly available CIEEDAC reports to support their programs and other activities. For example, the Canadian Industry Program for Energy Conservation (CIPEC) uses CIEEDAC reports as input into its analysis and publications. The Handbook also relies, in part, on data published by CIEEDAC.

More information on CIEEDAC and various reports are available at **www.cieedac.sfu.ca**.

3.1.5 Canadian Industry Program for Energy Conservation

The Canadian Industry Program for Energy Conservation (CIPEC) was created in 1975 as a voluntary partnership between the Government of Canada and industry to improve Canada's industrial energy efficiency. NRCan manages the program. Since its creation, CIPEC has helped companies cut costs and increase profits by providing tools, support and a policy framework to improve energy efficiency. CIPEC brings together industry associations and companies that represent more than 98 percent of industrial energy use in Canada.

CIPEC publishes an annual report that outlines the energy efficiency accomplishments of Canadian industry. The report features "success stories" of Canadian industrial companies to illustrate how they improved their energy efficiency. The CIPEC annual report also profiles 29 industrial task forces by noting their energy intensity improvements, targets and challenges.

To monitor progress of the Canadian Industrial sector's energy efficiency, CIPEC relies on ICE data, industry associations and CIEEDAC activities. Information on CIPEC, including CIPEC annual reports, is available at **oee.nrcan.gc.ca/industrial/cipec.cfm**.

4 Factors that can influence the Manufacturing sector's energy consumption

Several factors influence energy demand in the Manufacturing sector. These factors can work alone or in combination with others to increase or decrease the total energy demand. It is difficult to attribute the observed changes in manufacturing energy consumption to individual factors and even more difficult to produce an exhaustive list of these factors. Nevertheless, the following are some of the key factors that affect energy demand:

- **Activity**: This term refers to production, delivered services or other drivers of energy use in a sector (e.g. gross domestic product [GDP] – or physical outputs in the Industrial sector). Variation in production (activity) of an industry will have a direct influence on its energy consumption. If everything else remains constant, an increase in manufacturing output increases energy use.
- **Price effect**: If everything else remains constant, increases or decreases in production costs of a good, due to various reasons (e.g. exchange rate, depletion of resource), are expected to reduce or increase demand for the product. Consequently, the activity level of the specific industry or subsector will be affected.
- **Capacity utilisation and scale effect**: Increases or decreases in manufacturing production will cause excess capacity or the utilisation of human capital to vary. Economies of scale within a plant can be observed for marginal production. This means that the next unit produced will use less energy than the previous one because the fixed energy needs of the plant are spread over more units of output.
- **Change in the composition of the subsector**: Energy intensity varies across specific manufacturing processes and products within a subsector. Changes in the composition of a subsector based on industry outputs can impact the subsector's overall energy intensity.
- **Energy efficiency measures**: Industries usually undertake energy efficiency measures when the benefits of these actions outweigh the costs. For instance, using less energy for the production of goods gives an industry the ability to face higher energy costs, therefore enhancing its competitive position.

5 Energy consumption in the Manufacturing sector

The ICE survey collects energy use data from establishments that include all 21 subsectors of the Manufacturing sector (NAICS 31 to 33). These establishments primarily transform materials or substances into new products.

One way to define energy intensity in the Manufacturing sector is the energy use per unit of output, and it can be measured as the ratio of energy use to gross domestic product (GDP) in constant 2002 dollars. This ratio, which will be used throughout this summary report, provides a measure of the energy efficiency attained by a sector that is easily comparable over time and between sectors.

5.1 Energy intensity and total energy consumption in the Manufacturing sector

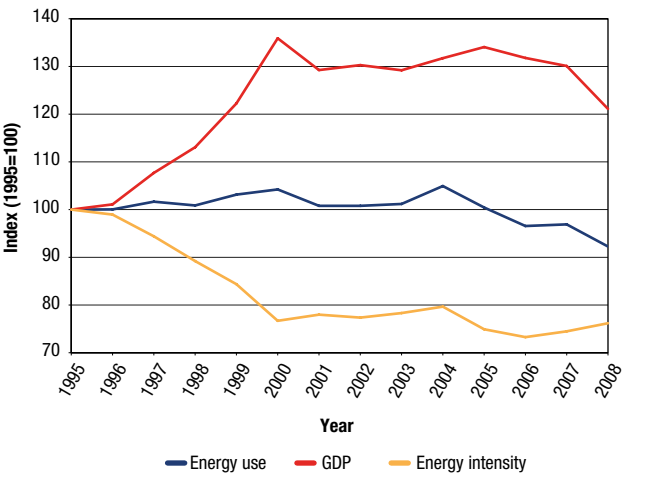
In 2008, the Manufacturing sector generated $169.9 billion in GDP, in constant 2002 dollars, and according to ICE estimates consumed 2299 petajoules (PJ) of energy. To put this into perspective, this amount is almost twice the energy consumed by all Canadian households (1336 PJ) in 2008.[6]

Figure 3 illustrates the indexed growth of energy intensity, energy use and GDP from 1995 to 2008. Between 1995 and 2000, despite significant growth in output, energy use in the Manufacturing sector was virtually unchanged, and therefore the energy intensity of the sector decreased substantially. From 2000 until 2003, there was little change in output and energy use and, consequently, in energy intensity. Between 2004 and 2006, energy intensity decreased because the sector's output grew while energy consumption went in the opposite direction.

Caught in the global economic downturn, the Canadian economy started deteriorating in 2008, which caused Canada to fall into recession by the end of the year.[7]

That chain of events explains, at least in part, the decrease in output between 2007 and 2008 (7 percent, from $182.5 billion in GDP to $169.9 billion in GDP). Energy use also decreased over this period but at a lower rate (5 percent, from 2414 PJ to 2299 PJ). The Canadian Manufacturing sector, which was operating at a higher capacity utilisation before the economic downturn, was likely benefitting from economies of scale, which disappeared when production dropped. The loss of these economies of scale might have contributed to the sector's increasing energy intensity.

Figure 3. Indexed growth of energy intensity, energy use and GDP for the Manufacturing sector, 1995–2008



Canada's Manufacturing sector used 8 percent less energy and produced 25 percent more output in 2008 than it did in 1995. The sector's energy intensity declined 26 percent, from 19 megajoules per dollar of GDP (MJ/$GDP) to 14 MJ/$GDP, over this period.

Between 1995 and 2008, the proportion of the subsectors that comprise the Manufacturing sector's GDP changed marginally. The Paper Manufacturing (NAICS 322)

[6] *Report on Energy Supply and Demand in Canada*, Table 1, line 44, Residential Energy Demand.

[7] Bank of Canada, press release, December 9, 2008, at www.bankofcanada.ca/en/fixed-dates/2008/rate_091208.html.

subsector's share of the Manufacturing sector's GDP diminished by 2 percent, while the Fabricated Metal Product Manufacturing (NAICS 332) subsector's share of GDP rose by 2 percent. However, significant restructuring occurred at the subsector level over this period.

5.2 Energy intensity and energy consumption by subsector

Figure 4 illustrates the energy intensity of the seven selected Manufacturing subsectors that consumed the most energy in 2008. First, note that the energy intensity varies across the selected subsectors. It ranges from close to 5 MJ/$GDP for the Food Manufacturing subsector (NAICS 311) to more than 116 MJ/$GDP for the Petroleum and Coal Product Manufacturing subsector (NAICS 324).

It is worth noting that Petroleum and Coal Product Manufacturing was the only selected subsector that experienced an increase in energy intensity over the 13 years. Also noteworthy is that the Wood Product Manufacturing subsector's energy intensity has increased significantly over the last three years. Further analysis of each selected subsector is provided in Section 6.

Figure 4. Energy intensity by selected subsectors, 1995–2008

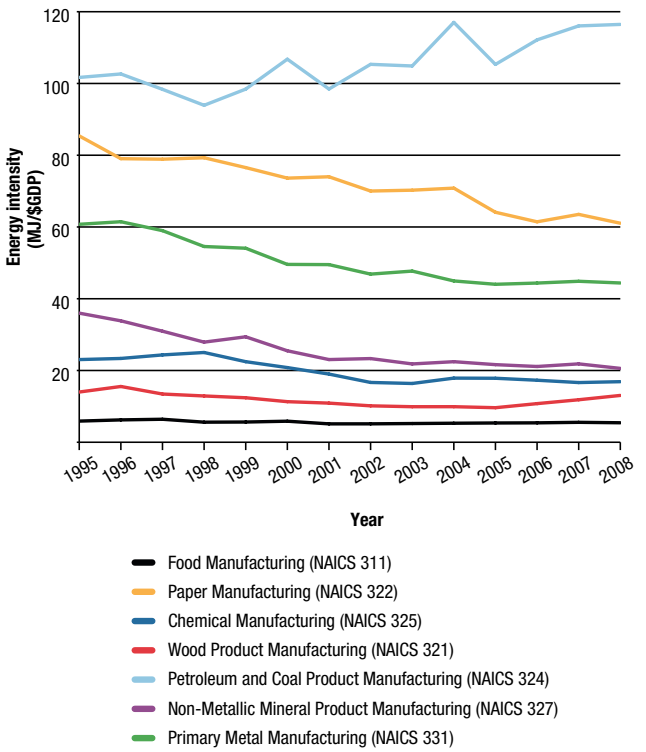
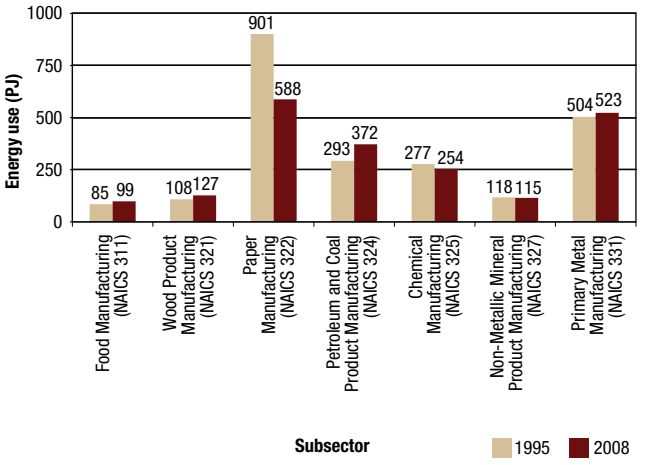


Figure 5 shows the energy use of the selected Manufacturing subsectors for 1995 and 2008. The two biggest changes in both levels and percentages were as follows: the Petroleum and Coal Product Manufacturing subsector had a 79-PJ (or 27 percent) increase, and the Paper Manufacturing subsector had a 313-PJ (or 35 percent) decrease.

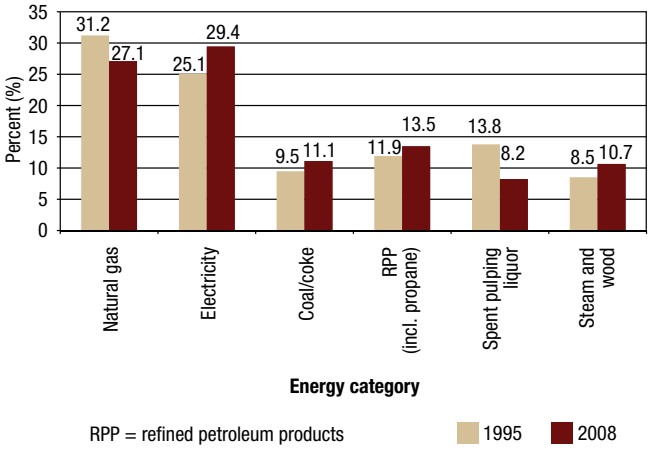
Figure 5. Energy use by selected subsectors, 1995 and 2008



5.3 Energy consumption by energy category

From 1995 to 2008, the energy consumed by the Manufacturing sector shifted from some energy sources toward others. As Figure 6 illustrates, the share of spent pulping liquor and natural gas decreased as electricity's share grew. The shares of the three other categories (coal/coke, refined petroleum products [including propane from natural gas] and steam/wood) increased somewhat.

Figure 6. Energy use by the Manufacturing sector by energy category, 1995 and 2008

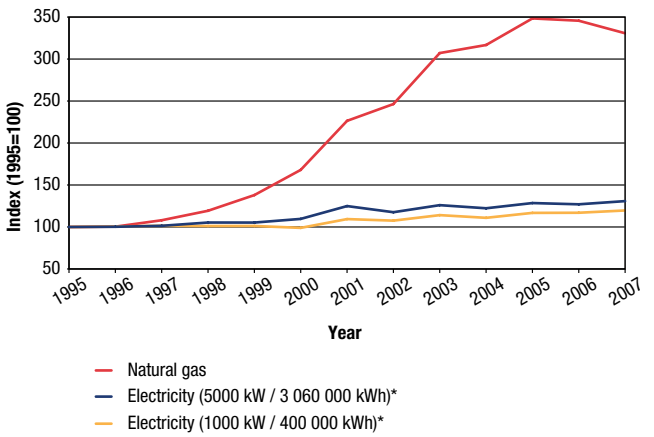


Note that, according to the ICE survey, spent pulping liquor is produced and used only by the Paper Manufacturing subsector. This subsector has been in decline since 2004, as shown by the drop in the subsector's GDP, from $12.0 billion in 2004 to $9.6 billion in 2008 (or 20 percent). This decline might explain, at least in part, the decreased use of spent pulping liquor since 2004 (a decrease of 37 percent). Similarly, refinery fuel gas[8] is produced and used exclusively by the Petroleum and Coal Product Manufacturing subsector – and almost entirely by the Petroleum Refineries industry (NAICS 32411).[9]

Electricity has replaced natural gas as the most used energy source since 2003. As shown in Figure 7, the rapid growth in the price of natural gas compared with that of electricity may help explain this energy source shift, which in turn influenced the Manufacturing sector's fuel mix. The rapid growth in the price of natural gas affected the relative prices of all fuel types and at least partially explains the growth in the use of coal/coke, refined petroleum products (including propane from natural gas) and steam/wood.

In addition to the price of fuels, the structure of a sector, in terms of production, contributes to the fuel mix. For instance, the increase in GDP of the Primary Production of Alumina and Aluminum industry (NAICS 331313), which is electricity intensive, contributed to the increase in the use of electricity.

Figure 7. Indexed growth of industrial natural gas and electricity prices, 1995–2007



*kW (kilowatt) refers to power draw, whereas kWh (kilowatt hour) refers to electricity consumption. kWh is equal to kW multiplied by hours of use.

As a complement to Figure 6, Table 1 illustrates the energy use by energy category for the Manufacturing sector in 1995 and 2008. The table shows that the use of steam and wood, electricity, refined petroleum products (RPP) and coal/coke as energy sources increased. These increases in energy consumption were more than offset by significant reductions in the consumption of natural gas and spent pulping liquor between 1995 and 2008. In fact, overall energy consumption in the sector fell by almost 8 percent over the period.

Table 1. Manufacturing sector's energy use by energy category, 1995 and 2008

Energy category	1995 Energy in PJ (%)	2008 Energy in PJ (%)	Growth (%)
Natural gas	777.8 (31.2)	622.8 (27.1)	–19.9
Electricity	624.7 (25.1)	676.6 (29.4)	8.3
Coal/coke	236.2 (9.5)	255.7 (11.1)	8.2
RPP (incl. propane)*	297.0 (11.9)	309.7 (13.5)	4.3
Spent pulping liquor	343.6 (13.8)	189.2 (8.2)	–44.9
Steam and wood	212.3 (8.5)	244.9 (10.7)	15.3
Total	**2 491.7 (100)**	**2 298.9 (100)**	**–7.7**

Note: Due to rounding, the numbers in the table may not add up.
*RPP = refined petroleum products

[8] Included in "refined petroleum products."

[9] See Appendix B, North American Industry Classification System.

The coal/coke and RPP categories comprise several types of energy sources. Table 2 further disaggregates these two energy categories. Although their shares of overall energy use by the Manufacturing sector remained relatively stable from 1995 to 2008, there was significant switching of energy sources within each of these categories.

In the coal/coke category, the use of coal and petroleum coke increased significantly. In the RPP category, the use of heavy fuel oil and propane decreased noticeably, whereas the use of refinery fuel gas increased 61 percent.

Table 2. Energy use by selected energy sources, 1995 and 2008

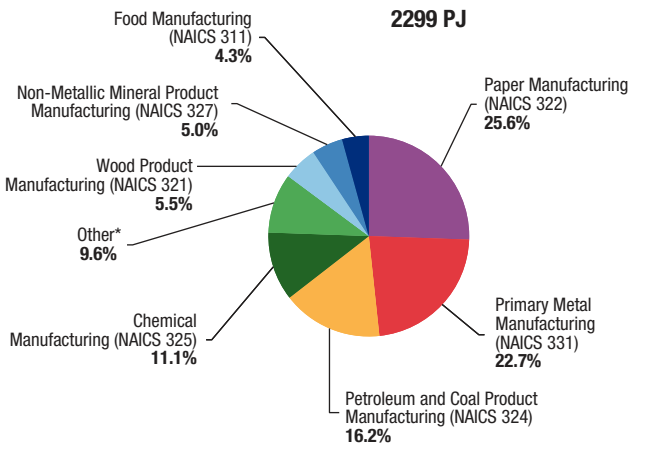
Energy category	Energy source	1995 Energy in PJ (%)	2008 Energy in PJ (%)	Growth (%)
Coal/coke	Coal	41.3 (17.5)	51.0 (20.0)	23.7
	Coal coke	102.9 (43.6)	99.6 (38.9)	–3.3
	Coke oven gas	27.4 (11.6)	25.9 (10.1)	–5.7
	Petroleum coke and coke from catalytic cracking catalyst	64.6 (27.3)	79.3 (31.0)	22.7
	Total, coal/coke	**236.2 (100)**	**255.7 (100)**	**8.2**
RPP (incl. propane)*	Heavy fuel oil	139.8 (47.1)	76.6 (24.7)	–45.2
	Middle distillates	17.2 (5.8)	18.1 (5.8)	5.2
	Propane	12.3 (4.2)	8.8 (2.9)	–28.3
	Refinery fuel gas	127.6 (43.0)	206.1 (66.5)	61.5
	Total, RPP (incl. propane)	**297.0 (100)**	**309.7 (100)**	**4.3**

Note: Due to rounding, the numbers in the table may not add up.
*RPP = refined petroleum products

6 Selected Manufacturing subsectors

Although there are 21 subsectors[10] in the Manufacturing sector, more than 90 percent of all energy consumption in 2008 was in only seven subsectors, as shown in Figure 8. These subsectors are Paper Manufacturing (NAICS 322), Primary Metal Manufacturing (NAICS 331), Petroleum and Coal Product Manufacturing (NAICS 324), Chemical Manufacturing (NAICS 325), Wood Product Manufacturing (NAICS 321), Non-Metallic Mineral Product Manufacturing (NAICS 327) and Food Manufacturing (NAICS 311). This section examines the seven subsectors.

Figure 8. Share of energy consumption in the Manufacturing sector, 2008



*Other includes NAICS 312, 313, 314, 315, 316, 323, 326, 332, 333, 334, 335, 336, 337 and 339.

6.1 Paper Manufacturing subsector (NAICS 322)

Establishments in the Paper Manufacturing subsector produce pulp, paper and paper products. The 2008 ICE survey estimated that this subsector consumed 588 petajoules (PJ) of energy, corresponding to nearly 26 percent of the Manufacturing sector's energy consumption – making it the largest energy-consuming manufacturing subsector in Canada.

6.1.1 Paper Manufacturing subsector's energy consumption, output and energy intensity trends

Figure 9 illustrates the indexed growth of energy intensity, energy use and gross domestic product (GDP) from 1995 to 2008 for the Paper Manufacturing subsector. It shows similar trends between energy use and the GDP as they rise and fall together over time. However, when the GDP grew 14 percent between 1998 and 2000, then grew 6 percent between 2001 and 2004, energy use increased only 6 percent and 2 percent over the same periods. Conversely, when the GDP fell 20 percent between 2004 and 2008, energy use declined 31 percent. The increasing gap between the two indicators resulted in a decrease of energy intensity over time.

From1995 to 2008, the Paper Manufacturing subsector's output decreased 9 percent, from $10.6 billion to $9.6 billion. At the same time, its energy consumption decreased 35 percent, from 901 PJ to 588 PJ. Consequently, the subsector's associated energy intensity diminished 28.0 percent, from 85 MJ/$GDP to 61 MJ/$GDP, which is a 2.4 percent annual decline over the period.

Of the seven largest manufacturing consumers of energy, Paper Manufacturing is the only subsector that had a decrease in GDP between 1995 and 2008.

[10]For a list of the 21 subsectors, see Appendix B, North American Industry Classification System.

Figure 9. Indexed growth of energy intensity, energy use and GDP for the Paper Manufacturing subsector, 1995–2008

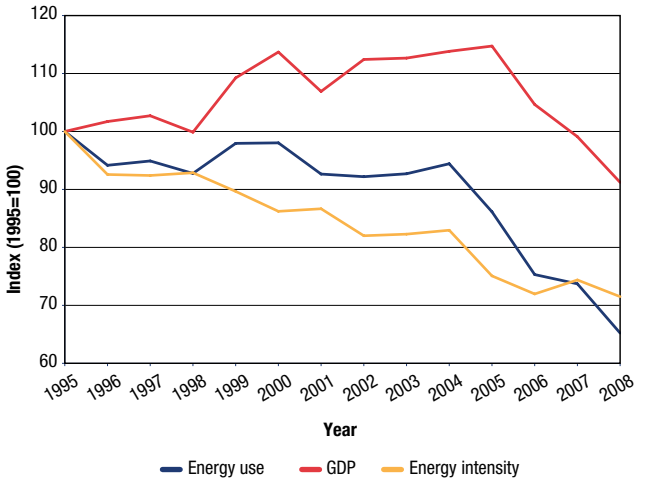
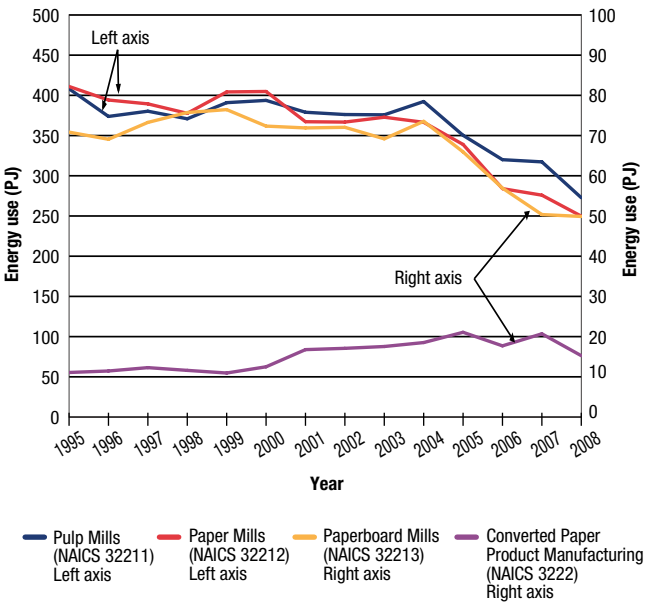


Figure 10. Energy use by the Paper Manufacturing industries, 1995–2008



Note: Due to the difficulties of presenting industry data of differing scales graphically, two axes are used. Pulp Mills and Paper Mills are measured against the left axis. Paperboard Mills and Converted Paper Products Manufacturing are measured against the right axis.

Despite the significant decrease in GDP since 2004, energy use decreased faster. It is possible that this subsector's output was reduced by closing the most energy-intensive operations first, which would help explain the reduction in energy intensity since 2004.

In 2004, Paper Manufacturing was consuming 330 PJ more than the second most energy-consuming subsector. In 2008, this gap was reduced to only 65 PJ, due in large part to market conditions for Canadian paper products, as indicated by the decline in GDP.

6.1.2 Paper Manufacturing subsector's energy consumption trends by industry

Figure 10 illustrates the energy used by the industries that comprise the Paper Manufacturing subsector. The only industry that increased its energy consumption over the period is the Converted Paper Product Manufacturing industry (NAICS 3222). This industry accounted for only 3 percent of the energy use of the Paper Manufacturing subsector in 2008. All the remaining industries experienced a significant drop in energy consumption of 12 percent to 43 percent, mainly as a result of reduced output.

Although it was the only Paper Manufacturing industry with higher levels of energy consumption in 2008 versus 1995, Converted Paper Manufacturing had the largest drop (26 percent) of all Paper Manufacturing industries in energy consumption from 2007 to 2008. (The next largest decrease in energy consumption over this period was the Pulp Mills industry [NAICS 32211], at 14 percent.)

One explanation for the Converted Paper Manufacturing industry's decreased energy use might be the decrease in demand (and by extension, output) for paperboard containers and corrugated and solid fibre boxes, made primarily for the transportation and packaging of goods, that resulted from the economic slowdown in 2008.

6.1.3 Paper Manufacturing subsector's energy consumption by source

Table 3 lists the energy consumption by energy source for the Paper Manufacturing subsector in 1995 and 2008.

Table 3. Paper Manufacturing subsector's energy use by energy source, 1995 and 2008

Energy category	Energy source	1995 Energy in PJ (%)	2008 Energy in PJ (%)	Growth (%)
Electricity	Electricity	193.7 (21.5)	168.9 (28.7)	−12.8
Natural gas	Natural gas	156.5 (17.4)	70.5 (12.0)	−54.9
Coal/coke	Coal	2.4 (0.3)	X* (N/A)	N/A
RPP (incl. propane)**	Heavy fuel oil	63.9 (7.1)	20.1 (3.4)	−68.5
	Middle distillates	3.2 (0.4)	1.6 (0.3)	−51.6
	Propane	1.3 (0.1)	X* (N/A)	N/A
	Total, RPP (incl. propane)	**68.5 (7.6)**	**X* (N/A)**	**N/A**
Spent pulping liquor	Spent pulping liquor	343.6 (38.1)	189.2 (32.2)	−44.9
Steam and wood	Steam	9.1 (1.0)	18.3 (3.1)	101.6
	Wood	127.4 (14.1)	117.6 (20.0)	−7.7
	Total, steam and wood	**136.5 (15.1)**	**135.9 (23.1)**	**−0.4**
	Total	**901.1 (100)**	**587.7 (100)**	**−34.8**

Note: Due to rounding, the numbers in the table may not add up.
*Undisclosed value for confidentiality reasons.
**RPP = refined petroleum products

According to ICE survey estimates, Paper Manufacturing is the only subsector that produces and consumes spent pulping liquor. The demand for this type of energy, which is the most commonly used energy source in the subsector (32.2 percent, or 189.2 PJ, in 2008), decreased 45 percent (154 PJ) between 1995 and 2008. Since 2001, natural gas moved from the third most used energy source to fourth, after spent pulping liquor, electricity and wood. The use of wood and electricity decreased somewhat (12.8 percent and 7.7 percent respectively). Although steam remains one of the least used energy sources by the Paper Manufacturing subsector, it was the only energy source to increase in use from 1995 to 2008. The increasing use of steam combined with the significant drop in the use of refined petroleum products (RPP) contributed toward making the Paper Manufacturing subsector less greenhouse gas intensive.

6.2 Primary Metal Manufacturing subsector (NAICS 331)

The Primary Metal Manufacturing subsector includes establishments that perform smelting and refining of ferrous metals (those that contain iron, including iron-containing alloys such as steel) and non-ferrous metals (those that do not contain iron, such as aluminum and copper). Smelting refers to the "heat treatment of an ore to separate the metallic portion." Refining is "a separation process whereby undesirable components are removed to give a concentrated and purified product."[11]

The 2008 ICE survey estimates that the Primary Metal Manufacturing subsector consumed 523 PJ of energy, which is 23 percent of the Manufacturing sector's energy consumption, making it the second largest energy-consuming subsector in Canada's Manufacturing sector.

6.2.1 Primary Metal Manufacturing subsector's energy consumption, output and energy intensity trends

As was the case with the Paper Manufacturing subsector, the energy intensity of the Primary Metal Manufacturing subsector declined steadily over the period. This decline is due to a 42 percent increase in output over the period combined with stable energy use (only 4 percent growth). Between 1995 and 2008, this subsector saw its energy intensity decrease 27 percent, from more than 61 MJ/$GDP to 44 MJ/$GDP, or an average annual decrease of 2.6 percent. Figure 11 illustrates this downward trend.

[11] N.I. Sax and R.J. Lewis, *Hawley's Condensed Chemical Dictionary*, Tenth Edition (ISBN 0-442-28097-1).

Figure 11. Indexed growth of energy intensity, energy use and GDP for the Primary Metal Manufacturing subsector, 1995–2008

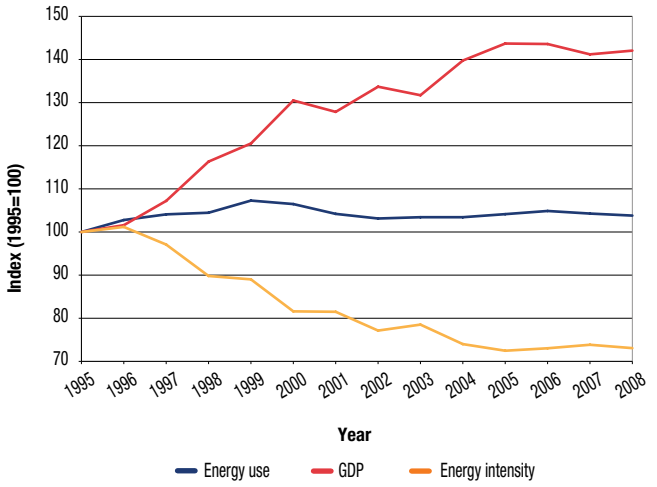
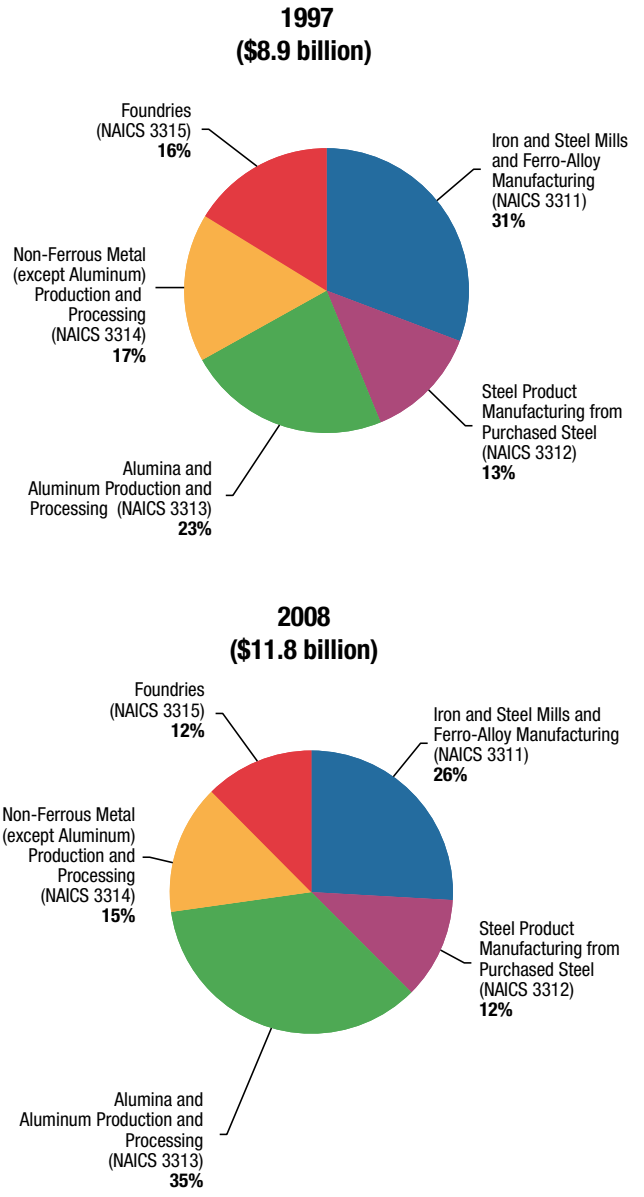


Figure 12. Distribution of GDP* of the Primary Metal Manufacturing subsector by industry, 1997 and 2008



* GDP at basic price in constant 2002 dollars.

Figure 12 illustrates the distribution of GDP among the Canadian Primary Metal Manufacturing industries for 1997 [12] and 2008. As this figure shows, the Primary Metal Manufacturing subsector experienced some structural changes over the period. The proportion of the Iron and Steel Mills and Ferro-Alloy Manufacturing (NAICS 3311) industry's GDP decreased 5 percentage points, from 31 percent to 26 percent. In contrast, the Alumina and Aluminum Production and Processing (NAICS 3313) industry's share of the subsector's GDP increased 12 percentage points. The latter was due to an almost two fold increase in the sales of manufactured goods[13] of the Primary Production of Alumina and Aluminum industry (NAICS 331313) between 1995 and 2008.

[12]The data for 1995 and 1996 data were not available for all industries.

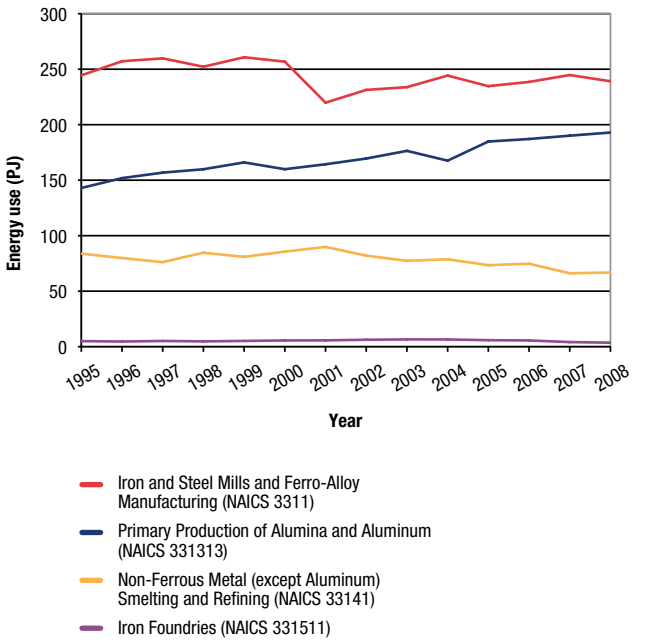
[13]See Appendix C, Sources (section C.3, "Other information mentioned in footnotes").

6.2.2 Primary Metal Manufacturing subsector's energy consumption trends by industry

Figure 13 illustrates energy use for the four largest industries in the Primary Metal Manufacturing subsector.[14] These four industries accounted for 96 percent of the subsector's energy use in 2008.

Even though energy use in the subsector remained relatively constant from 1995 to 2008, this was not the case at the industry level. Energy consumption of the Primary Production of Alumina and Aluminum industry (NAICS 331313) increased 35 percent. The Iron and Steel Mills and Ferro-Alloy Manufacturing industry (NAICS 3311) and the Non-Ferrous Metal (except Aluminum) Smelting and Refining industry (NAICS 33141) partially offset that increase with 2 percent and 20 percent reductions in their respective energy consumption.

Figure 13. Energy use by selected Primary Metal Manufacturing industries, 1995–2008



6.2.3 Primary Metal Manufacturing subsector's energy consumption by source

Table 4 shows the energy consumption by energy source for the Primary Metal Manufacturing subsector in 1995 and 2008.

Table 4. Primary Metal Manufacturing subsector's energy use by energy source, 1995 and 2008

Energy category	Energy source	1995 Energy in PJ (%)	2008 Energy in PJ (%)	Growth (%)
Electricity	Electricity	214.4 (42.6)	235.5 (45.0)	9.8
Natural gas	Natural gas	128.4 (25.5)	115.8 (22.1)	–9.9
Coal/coke	Coal	9.9 (2.0)	13.1 (2.5)	32.2
	Coal coke and coke oven gas	129.6 (25.7)	124.7 (23.8)	–3.8
	Petroleum coke	2.2 (0.4)	X* (N/A)	N/A
	Total, coal/coke	**141.7 (28.1)**	**X* (N/A)**	**N/A**
RPP (incl. propane)**	Heavy fuel oil	15.4 (3.0)	21.3 (4.1)	38.3
	Middle distillates	2.4 (0.5)	3.4 (0.7)	46.1
	Propane	1.1 (0.2)	1.0 (0.2)	–3.9
	Total, RPP (incl. propane)	18.8 (3.7)	25.7 (4.9)	36.9
Steam and wood	Steam and wood	0.4 (0.1)	X* (N/A)	N/A
Total		**503.8 (100)**	**523.0 (100)**	**3.8**

Note: Due to rounding, the numbers in the table may not add up.
*Undisclosed value for confidentiality reasons.
**RPP = refined petroleum products

Considering the large increase in energy use in the Primary Production of Alumina and Aluminum industry, it not surprising that electricity consumption grew between 1995 and 2008, as this industry is known to be electricity intensive.[15] Partially offsetting this increase in electricity consumption was the combined decrease in the use of natural gas, coal coke and coke oven gas.

[14] Due to data limitations for some industries, five- and six-digit NAICS code details are presented.

[15] John Nyboer and Adam Baylin-Stern, *A Review of Energy Consumption and Related Data – Canadian Aluminum Industries*, 1990 to 2008, p.2. Canadian Industrial Energy End-Use Data and Analysis Centre, 2010.

6.3 Petroleum and Coal Product Manufacturing subsector (NAICS 324)

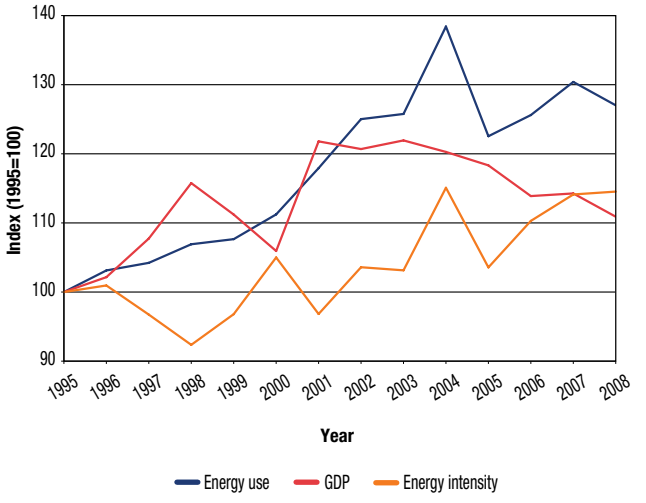
Establishments in the Petroleum and Coal Product Manufacturing subsector transform crude petroleum and coal into usable products. Petroleum Refineries (NAICS 32411) represents the main industry of the subsector in terms of energy use. The petroleum refining process separates various hydrocarbons contained in crude oil to produce many products, such as gasoline, diesel fuel oil, light and heavy fuel oils, and asphalt.

The 2008 ICE survey estimates that the Petroleum and Coal Product Manufacturing subsector consumed 372 PJ of energy, which is 16 percent of the Manufacturing sector's energy consumption – making it the third largest energy-consuming subsector in Canada's Manufacturing sector.

6.3.1 Petroleum and Coal Product Manufacturing subsector's energy consumption, output and energy intensity trends

Figure 14 illustrates the indexed growth of energy intensity, energy use and GDP for the Petroleum and Coal Product Manufacturing subsector from 1995 to 2008.

Figure 14. Indexed growth of energy intensity, energy use and GDP for the Petroleum and Coal Product Manufacturing subsector, 1995–2008



From 1995 to 1998, both output and energy use increased, the latter at a slower pace, causing the energy intensity to fall. Between 1998 and 2000, output fell as energy use kept rising. Between 2001 and 2007, GDP and energy use were fairly constant, with the exception of a one-year spike in energy in 2004. Finally, between 2007 and 2008, GDP and energy use decreased by 3 percent each, leaving energy intensity relatively unchanged.

Overall, Canada's Petroleum and Coal Product Manufacturing subsector used 27 percent more energy and produced 11 percent more output than it did in 1995.

Due to data limitations, it is not possible to accurately calculate the energy intensity of the industries that compose this subsector. However, because the Petroleum Refineries industry represents 95 percent of the subsector's energy consumption, it can be inferred that this industry made a significant contribution to the 15 percent growth in energy intensity of the subsector between 1995 and 2008.

Since 1995, the Government of Canada has introduced several regulations aimed at reducing air pollutants, including the *Sulphur in Diesel Fuel Regulations*, the *Sulphur in Gasoline Regulations* and the *Benzene in Gasoline Regulations*.[16] Meeting these regulations requires further refinement of crude oil, which in turn requires more energy. This may help explain the increase in energy intensity mentioned above.

6.3.2 Petroleum and Coal Product Manufacturing subsector's energy consumption trends by industry

The ICE survey collects information for only the Petroleum Refineries industry in the Petroleum and Coal Product Manufacturing subsector. The industry accounts for about 95 percent of all energy used to process petroleum and coal.

6.3.3 Petroleum and Coal Product Manufacturing subsector's energy consumption by source

Table 5 shows the energy consumption by energy source for the Petroleum and Coal Product Manufacturing subsector in 1995 and 2008.

[16]Environment Canada, Fuel Regulations, 2009. http://www.ec.gc.ca/energie-energy/default.asp?lang=En&n=1F4E5D8A-1.

Table 5. Petroleum and Coal Product Manufacturing subsector's energy use by energy source, 1995 and 2008

Energy category	Energy source	1995 Energy in PJ (%)	2008 Energy in PJ (%)	Growth (%)
Electricity	Electricity	17.3 (5.9)	22.8 (6.1)	31.6
Natural gas	Natural gas	51.0 (17.4)	62.1 (16.7)	21.8
Coal/coke	Coal	0.9 (0.3)	X* (N/A)	N/A
	Petroleum coke	48.4 (16.5)	51.0 (13.7)	5.4
	Total, coal/coke	**49.3 (16.8)**	**N/A (N/A)**	**N/A**
RPP (incl. propane)**	Refinery fuel gas	127.6 (43.6)	206.1 (55.4)	61.5
	Other RPP (incl. propane)***	47.0 (16.0)	27.5 (7.4)	-41.5
	Total, RPP (incl. propane)	174.7 (59.6)	233.6 (79.7)	33.7
Steam and wood	Steam and wood	0.6 (0.2)	X* (N/A)	N/A
Total, undisclosed values		**0.0 (0.0)**	**2.5 (0.7)**	**N/A**
	Total	**293.0 (100)**	**372.1 (100)**	**27.0**

Note: Due to rounding, the numbers in the table may not add up.
*Undisclosed value for confidentiality reasons.
**RPP = refined petroleum products
***Other includes heavy fuel oil, middle distillates and liquefied petroleum gas.

Due to the unavailability of certain 2008 data, it is not possible to determine changes in coal/coke and steam and wood use from 1995 to 2008. From available data, the only energy source that decreased from 1995 to 2008 was other refined petroleum products. All other energy sources increased over the period. The most significant increase occurred in refinery fuel gas – the most commonly used energy source in the subsector – which increased 61.5 percent (78.4 PJ) since 1995.

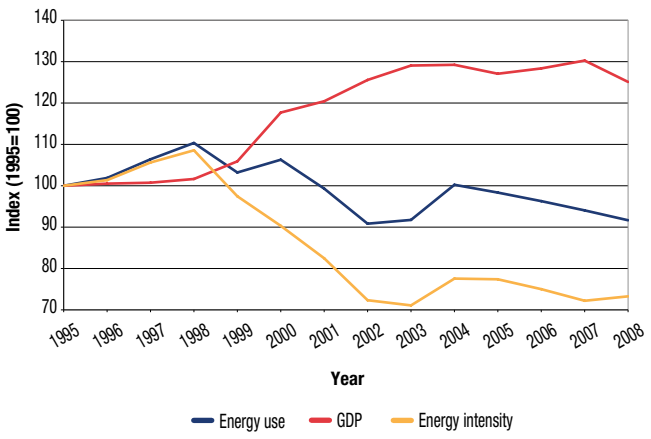
6.4 Chemical Manufacturing subsector (NAICS 325)

Establishments in the Chemical Manufacturing subsector (NAICS 325) manufacture chemicals and chemical products from organic and inorganic raw materials.[17] The 2008 ICE survey estimated that the Chemical Manufacturing subsector consumed 254 PJ of energy, corresponding to 11 percent of the Manufacturing sector's energy consumption – making it the fourth largest energy consumer in Canada's Manufacturing sector.

6.4.1 Chemical Manufacturing subsector's energy consumption, output and energy intensity trends

Figure 15 illustrates the indexed growth of energy intensity, energy use and GDP from 1995 to 2008 for the Chemical Manufacturing subsector. From 1998 to 2003, output in the subsector grew rapidly while energy consumption declined. These two factors yielded a significant decrease in energy intensity over the period. Since 2003, growth in GDP has been relatively flat. After a one-year increase, energy consumption decreased steadily from 2004 to 2008. This translates into decreasing energy intensity, albeit at a more modest rate.

Figure 15. Indexed growth of energy intensity, energy use and GDP for the Chemical Manufacturing subsector, 1995–2008



[17] For a detailed description of the 18 industries that comprise this subsector, refer to *North American Industry Classification (NAICS) 2007*, section NAICS 325, Statistics Canada, at www.statcan.gc.ca/pub/12-501-x/12-501-x2007001-eng.pdf.

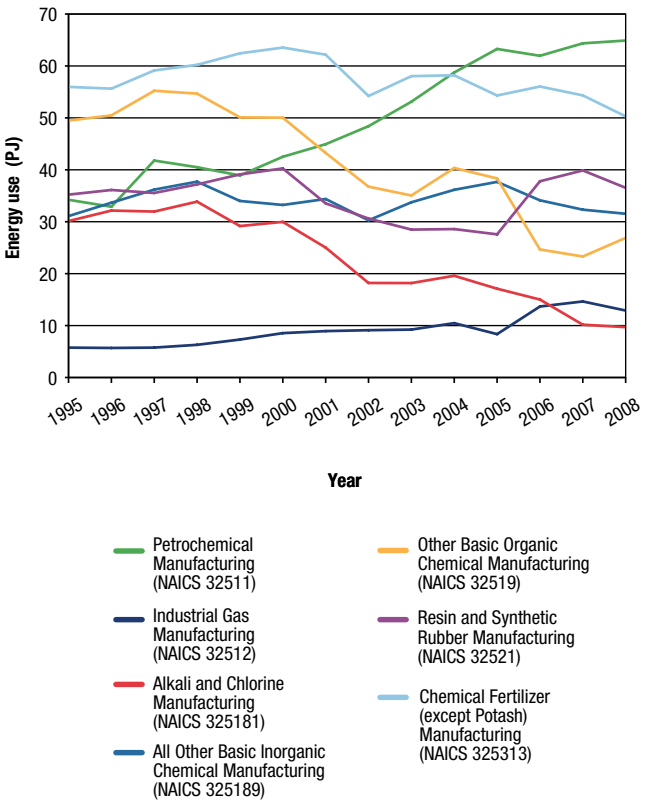
Over the 13 years, Canada's Chemical Manufacturing subsector increased its output by 25 percent while reducing its energy consumption by 8 percent. This resulted in a 27 percent decrease in energy intensity (an average annual decrease of 2.4 percent), from 23 MJ/$GDP to 17 MJ/$GDP.

6.4.2 Chemical Manufacturing subsector's energy consumption trends by industry

Figure 16 illustrates the seven industries for which data are available for the entire period. In 2008, these industries accounted for 92 percent of the Chemical Manufacturing subsector's energy use. The largest changes in energy consumption occurred in Industrial Gas Manufacturing (NAICS 32512), with a 124 percent increase, and Alkali and Chlorine Manufacturing (NAICS 325181), with a 68 percent decrease. In absolute terms, the Petrochemical Manufacturing industry (NAICS 32511) increased its energy consumption the most (31 PJ).

There do not appear to be any common trends in energy consumption across industries. Even within an industry, the trend is often not well defined. This could be caused, in part, by the volatility of the Chemical Manufacturing subsector. The NAICS classification system is based on the primary product produced by an establishment. In this particular subsector, production processes can be modified such that different products become the establishment's primary product, potentially moving that establishment from one industry to another at any given time. In addition, many other factors, such as increased energy efficiency and decreased production, can influence the yearly variation in energy consumption.

Figure 16. Energy use by selected Chemical Manufacturing industries, 1995–2008



6.4.3 Chemical Manufacturing subsector's energy consumption by source

Table 6 shows the energy consumption by energy source for the Chemical Manufacturing subsector in 1995 and 2008.

Table 6. Chemical Manufacturing subsector's energy use by energy source, 1995 and 2008

Energy category	Energy source	1995 Energy in PJ (%)	2008 Energy in PJ (%)	Growth (%)
Electricity	Electricity	71.6 (25.8)	75.0 (29.5)	4.7
Natural gas	Natural gas	177.4 (63.9)	151.4 (59.5)	–14.7
Coal/coke	Coal	0.0 (0.0)	X* (N/A)	N/A
	Coke and coke from catalytic cracking	0.7 (0.3)	X* (N/A)	N/A
	Total, coal/ coke	**0.7 (0.3)**	**X* (N/A)**	**N/A**
RPP (incl. propane)**	Heavy fuel oil	5.0 (1.8)	1.1 (0.4)	–77.3
	Middle distillates	1.2 (0.4)	0 ().4 (0.1)	–67.6
	Propane	0.3 (0.1)	X* (N/A)	N/A
	Total, RPP (incl. propane)	**6.5 (2.3)**	**X* (N/A)**	**N/A**
Steam	Steam	21.3 (7.7)	25.2 (9.9)	18.2
Wood	Wood	0.0 (0.0)	X* (N/A)	N/A
Confidential [Total, undisclosed values]		**0.0 (0.0)**	**1.3 (0.5)**	**N/A**
Total		**277.5 (100)**	**254.4 (100)**	**–8.3**

Note: Due to rounding, the numbers in the table may not add up.
*Undisclosed value for confidentiality reasons.
**RPP = refined petroleum products

Electricity and steam consumption increased by 5 percent and 18 percent respectively between 1995 and 2008. Natural gas consumption, which is the most widely used energy source in the Chemical Manufacturing subsector, decreased by 15 percent. Once again, the rapid increase in the industrial price of natural gas[18] may help explain this trend.

[18]Refer to Figure 7 in this report.

6.5 Wood Product Manufacturing subsector (NAICS 321)

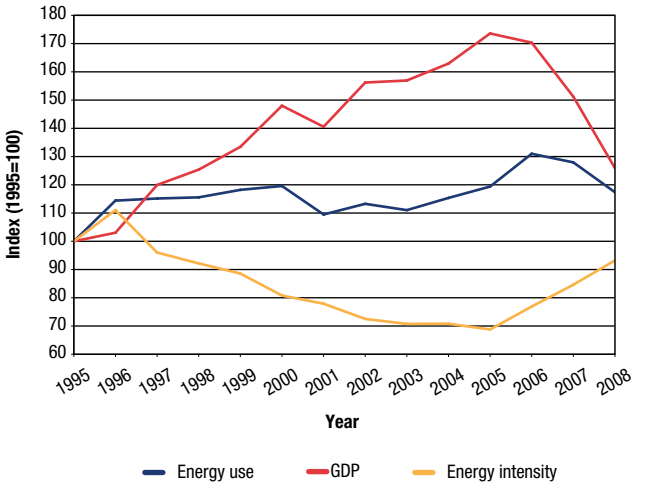
Establishments in the Wood Product Manufacturing subsector produce products from wood. They are engaged in such activities as sawing logs and making products that improve the natural characteristics of woods (veneers, plywood, etc.). The 2008 ICE survey estimated that this subsector consumed 127 PJ of energy, corresponding to 6 percent of the Manufacturing sector's energy consumption – making it the fifth largest energy-consuming Manufacturing subsector in Canada.

6.5.1 Wood Product Manufacturing subsector's energy consumption, output and energy intensity trends

Figure 17 illustrates the indexed growth of energy intensity, energy use and GDP from 1995 to 2008 for the Wood Product Manufacturing subsector. It shows a widening gap between GDP and energy use from 1997 to 2005. Indeed, when the GDP grew about 42 percent over the period, energy use increased by less than 4 percent. Between 2006 and 2008, the opposite situation happened: the GDP fell 26 percent, while energy use declined 10 percent.

The slow response in energy use to changes in production resulted in some large changes in energy intensity over the period. With the recent strong decline in GDP, this subsector's energy intensity has increased significantly since 2005. This is the opposite of what has been observed in the Paper Manufacturing subsector (see section 6.1). One explanation may be that despite decreasing production, few wood product plants have closed, thereby reducing the establishments' scale effects (for a description of scale effect, see Chapter 4).

Figure 17. Indexed growth of energy intensity, energy use and GDP for the Wood Product Manufacturing subsector, 1995–2008



Two distinct trends in energy use and GDP are observed, one from 1995 to 2005 and the other from 2005 to 2008. From 1995 to 2005, GDP grew by 74 percent (from $7.7 billion to $13.4 billion), while energy use increased 19 percent (from 108 PJ to 129 PJ). This resulted in a decrease in energy intensity of 31 percent (from 14.0 MJ/$GDP to 9.6 MJ/$GDP).

Between 2005 and 2008, the trends in energy use and GDP changed. GDP decreased by more than 27 percent (from $13.4 billion to $9.7 billion), while energy use decreased by a mere 2 percent (from 129 PJ to 127 PJ). The associated energy intensity, therefore, increased by 36 percent (from 9.6 MJ/$GDP to 13.0 MJ/$GDP).

Overall, from 1995 to 2008, the Wood Product Manufacturing subsector's output increased 26 percent (from $7.7 billion to $9.7 billion), while energy consumption increased 17 percent (from 108 PJ to 127 PJ). Consequently, the associated energy intensity decreased by 7.0 percent (from 14.0 MJ/$GDP to 13.0 MJ/$GDP).

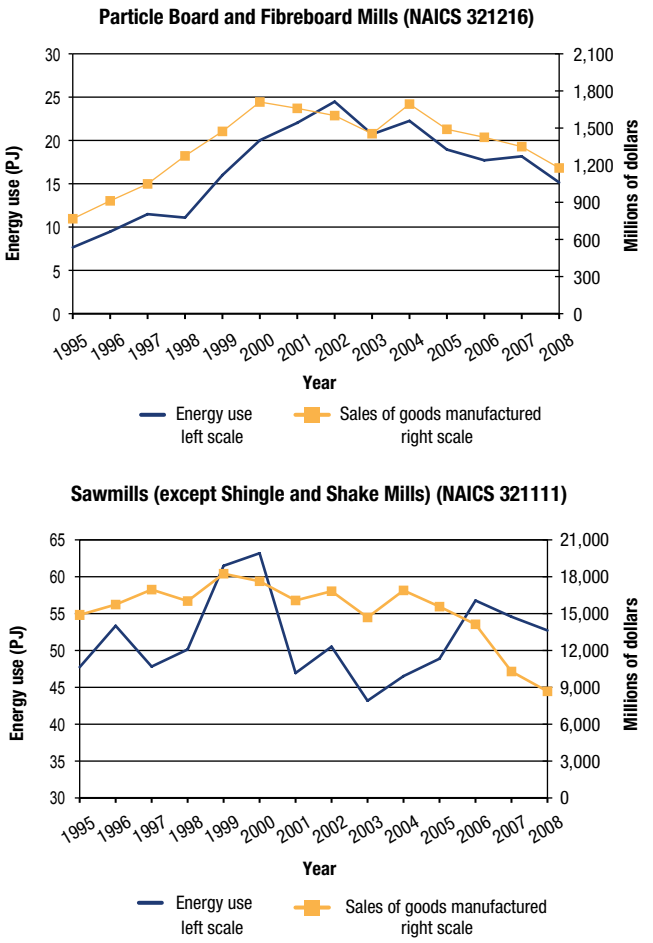
6.5.2 Wood Product Manufacturing subsector's energy consumption trends by industry

The ICE survey collects energy consumption data for only two Wood Product industries: Sawmills (except Shingle and Shake Mills) Manufacturing (NAICS 321111) and Particle Board and Fibreboard Mills (NAICS 321216). These two industries accounted for 53 percent of the energy use of the Wood Product Manufacturing subsector in 2008.

The variations in energy consumption in both industries appear to be caused by changes in production.

Figure 18 illustrates the interdependence between energy use and sales of goods manufactured for these two industries.[19]

Figure 18. Energy use by and sales of goods manufactured for selected Wood Product Manufacturing industries, 1995–2008



There is a correlation between sales of goods manufactured and energy use in the Particle Board and Fibreboard Mills industry from 1995 to 2008. This relationship, however, is less apparent in the Sawmills (except Shingle and Shake Mills) industry.

[19] See Appendix C, Sources (section C.3, "Other information mentioned in footnotes").

6.5.3 Wood Product Manufacturing subsector's energy consumption by source

Table 7 lists the energy consumption by energy source for the Wood Product Manufacturing subsector in 1995 and 2008.

Table 7. Wood Product Manufacturing subsector's energy use by energy source, 1995 and 2008

Energy category	Energy source	1995 Energy in PJ (%)	2008 Energy in PJ (%)	Growth (%)
Electricity	Electricity	21.0 (19.4)	26.4 (20.8)	25.9
Natural gas	Natural gas	29.5 (27.2)	21.7 (17.1)	-26.4
RPP (incl. propane)*	Heavy fuel oil	1.5 (1.4)	1.3 (1.0)	-16.5
	Middle distillates	4.7 (4.4)	4.4 (3.4)	-8.0
	Propane	0.8 (0.7)	1.7 (1.3)	107.2
	Total, RPP (incl. propane)	**7.1 (6.5)**	**7.3 (5.8)**	**3.3**
Steam and wood	Steam	0.04 (0.0)	1.7 (1.3)	4659.0
	Wood	50.7 (46.8)	69.9 (55.0)	37.9
	Total, steam and wood	50.7 (46.9)	71.6 (56.4)	41.2
Total		**108.2 (100)**	**127.0 (100)**	**17.4**

Note: Due to rounding, the numbers in the table may not add up.
*RPP = refined petroleum products

Since 2004, natural gas has moved from the second most used energy source to third, after wood and electricity. The use of electricity and wood increased (25.9 percent and 37.9 percent respectively). Wood, which is also the subsector's primary raw material, accounted for more than half the of the subsector's energy consumption in 2008. This makes Wood Product Manufacturing the subsector that uses wood the most intensively as a fuel source in the Manufacturing sector.

6.6 Non-Metallic Mineral Product Manufacturing subsector (NAICS 327)

Establishments in the Non-Metallic Mineral Product Manufacturing subsector (NAICS 327) "cut, grind, shape and finish granite, marble, limestone, slate and other stone; mix non-metallic minerals with chemicals and other additives; and heat non-metallic mineral preparations to make products, such as bricks, refractories, ceramic products, cement and glass." [20]

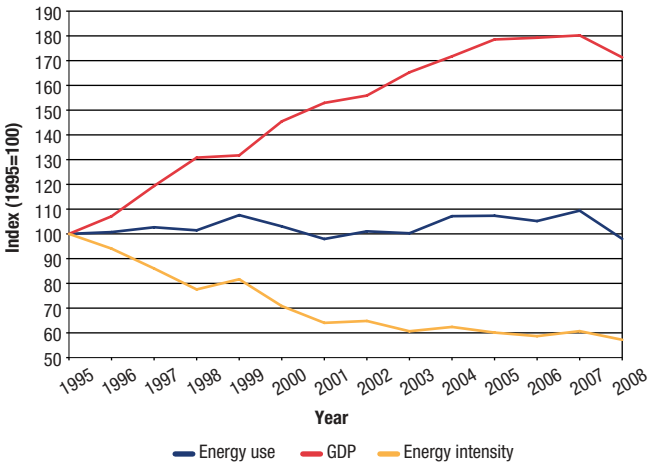
According to 2008 ICE survey estimates, the sixth largest energy consumer in the Manufacturing sector was Non-Metallic Mineral Product Manufacturing. In 2008, this subsector consumed 115 PJ of energy, which accounted for 5 percent of the sector's energy consumption.

6.6.1 Non-Metallic Mineral Product Manufacturing subsector's energy consumption, output and energy intensity trends

Figure 19 illustrates the indexed growth of energy intensity, energy use and GDP from 1995 to 2008 for Non-Metallic Mineral Product Manufacturing. Between 1995 and 2006, despite significant growth in output (79 percent), the subsector's energy use was relatively constant (5 percent increase), yielding a strong decrease in energy intensity (41 percent). After 2006, the energy intensity remained constant because both GDP and energy consumption decreased at a similar pace.

[20] *North American Industry Classification (NAICS) 2007*, at stds.statcan.gc.ca/naics-scian/2007/cs-rc-eng.asp?criteria=327.

Figure 19. Indexed growth of energy intensity, energy use and GDP for the Non-Metallic Mineral Product Manufacturing subsector, 1995–2008



From 1995 to 2008, Canada's Non-Metallic Mineral Product Manufacturing subsector increased its output by 75 percent while reducing its energy consumption by 2 percent. This resulted in a 43 percent decrease in energy intensity (an average annual decrease of 4.4 percent), from 37 MJ/$GDP to 21 MJ/$GDP.

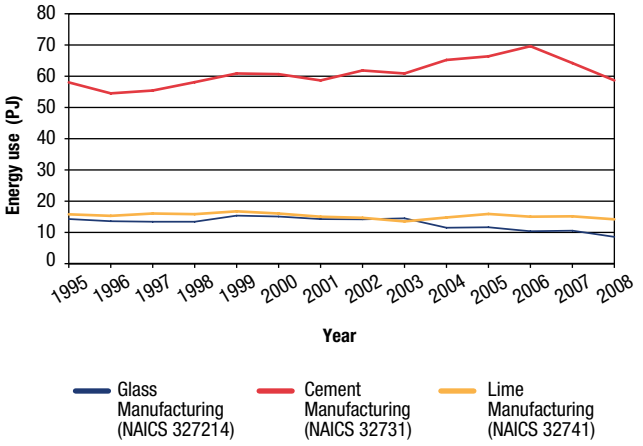
6.6.2 Non-Metallic Mineral Product Manufacturing subsector's energy consumption trends by industry

Figure 20 illustrates the three industries for which energy consumption data are available for the entire period. In 2008, they accounted for 71 percent of the subsector's energy consumption. Over the period, all three industries saw their energy consumption either stay the same or decrease.

The largest decrease in energy consumption occurred in Glass Manufacturing (NAICS 327214), where consumption declined from 14 PJ to 9 PJ between 1995 and 2008, a 40 percent decrease.

Energy used by Cement Manufacturing (NAICS 32731) increased by 1 percent over the period, after a 20 percent increase between 1995 and 2006 and a 16 percent decline afterwards. These variations in energy consumption were caused, at least in part, by a 37 percent increase in GDP between 1997 [21] and 2006 and a 4 percent decrease afterwards.

Figure 20. Energy use by selected Non-Metallic Mineral Product Manufacturing industries, 1995–2008



[21] GDP data for Cement Manufacturing (NAICS 32731) were not available for 1995 and 1996.

6.6.3 Non-Metallic Mineral Product Manufacturing subsector's energy consumption by source

Table 8 shows the energy consumption by energy source for the Non-Metallic Mineral Product Manufacturing subsector in 1995 and 2008.

Table 8. Non-Metallic Mineral Product Manufacturing subsector's energy use by energy source, 1995 and 2008

Energy category	Energy source	1995 Energy in PJ (%)	2008 Energy in PJ (%)	Growth (%)
Electricity	Electricity	16.5 (14.0)	15.6 (13.6)	–5.0
Natural gas	Natural gas	54.5 (46.3)	35.1 (30.5)	–35.6
Coal/coke	Coal	27.3 (23.2)	34.8 (30.2)	27.4
	Coke from coal	0.5 (0.4)	0.7 (0.6)	45.4
	Petroleum coke	13.3 (11.3)	24.7 (21.4)	85.1
	Total, coal/coke	**41.1 (34.9)**	**60.2 (52.2)**	**46.4**
RPP (incl. propane)**	Heavy fuel oil	3.8 (3.2)	0.9 (0.8)	–25.5
	Middle distillates	1.2 (1.0)	2.3 (2.0)	84.6
	Propane	0.3 (0.2)	X* (N/A)	N/A
	Total, RPP (incl. propane)	**5.3 (4.5)**	**N/A (N/A)**	**N/A**
Steam	Steam	0.1 (0.1)	X* (N/A)	N/A
Wood	Wood	0.1 (0.1)	X* (N/A)	N/A
	Confidential [Total, undisclosed values]	**0.0 (0.0)**	1.2 (1.0)	N/A
Total		**117.6 (100)**	**115.3 (100)**	**–2.0**

Note: Due to rounding, the numbers in the table may not add up.
*Undisclosed value for confidentiality reasons.
**RPP = refined petroleum products

Unlike many subsectors that have been substituting natural gas for electricity, Non-Metallic Mineral Product Manufacturing witnessed a decline in the use of both energy sources (5 percent and 36 percent respectively). These declines were almost offset by an increase in the use of coal/coke. Within this category, the largest increase occurred in petroleum coke, which increased by 85 percent between 1995 and 2008.

It is not possible to know the energy consumed for the propane, steam and wood categories, due to confidentiality. However, it can be deduced that at least one of these categories must have had a significant increase. When aggregated, the use of these three energy sources provided 0.5 PJ of energy in 1995 and 1.2 PJ in 2008, a 140 percent increase.

6.7 Food Manufacturing subsector (NAICS 311)

Rounding out the top seven energy-consuming manufacturing subsectors is Food Manufacturing. Establishments in this subsector are primarily engaged in producing food for human or animal consumption. The 2008 ICE survey estimated that this subsector consumed 99 PJ of energy, corresponding to 4 percent of the Manufacturing sector's energy consumption.

6.7.1 Food Manufacturing subsector's energy consumption, output and energy intensity trends

Figure 21 illustrates the indexed growth of energy intensity, energy use and GDP from 1995 to 2008 for the Food Manufacturing subsector.

With the exception of two plateaus, one from 1995 to 1997 and one from 2001 to 2005, GDP in the Food Manufacturing subsector increased more or less constantly over the 13 years. Energy use, after spiking in 1997 and 2000, started increasing constantly in 2003, at a pace somewhat faster than that of GDP. Energy intensity decreased between 1995 and 2001 with notable spikes in 1997 and 2000, which correspond to the aforementioned spikes in energy consumption. Since 2001, energy intensity in this subsector has been relatively stable.

Figure 21. Indexed growth of energy intensity, energy use and GDP for the Food Manufacturing subsector, 1995–2008

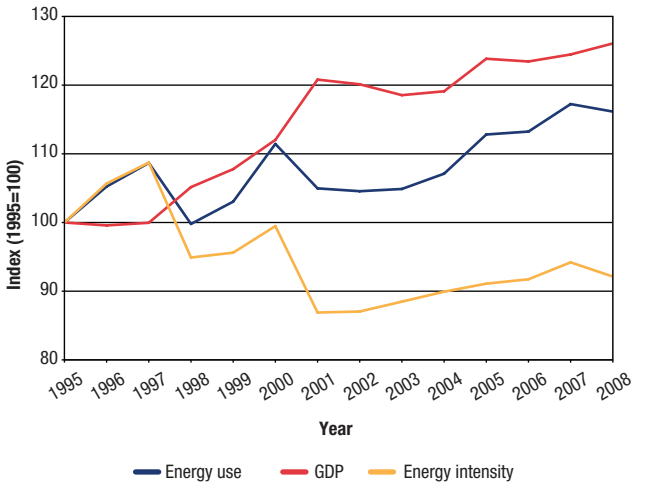
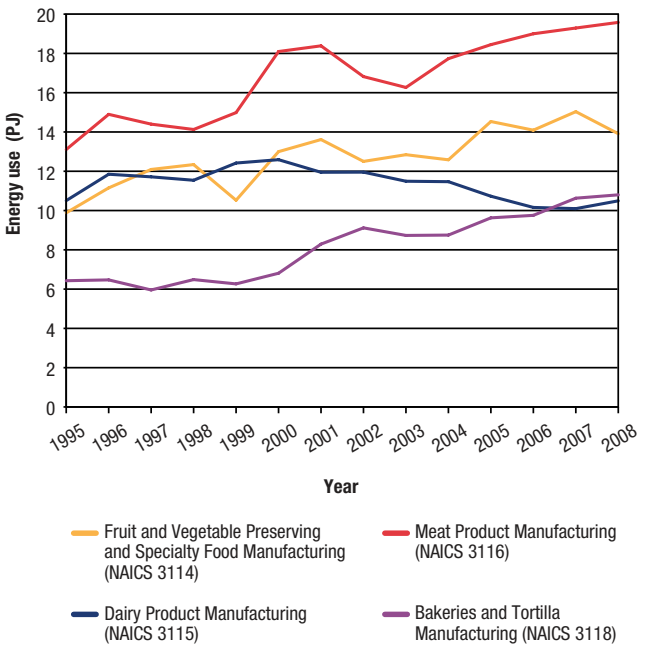


Figure 22. Energy use by the selected Food Manufacturing industries, 1995–2008



From 1995 to 2008, the Food Manufacturing subsector's output increased 26 percent, from $14.4 billion to $18.2 billion, while energy consumption increased 16 percent, from 85 PJ to 99 PJ. Consequently, its associated energy intensity diminished 8 percent, from 5.9 MJ/$GDP to 5.4 MJ/$GDP.

6.7.2 Food Manufacturing subsector's energy consumption trends by industry

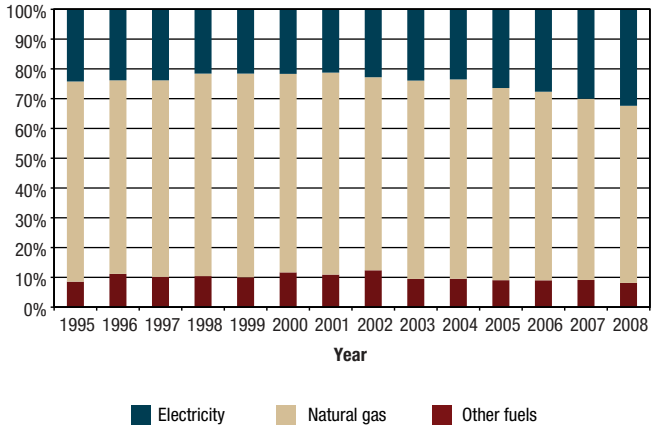
Figure 22 illustrates the growth in energy use by selected Food Manufacturing industries. The four industries presented accounted for 56 percent of the energy consumption of the Food Manufacturing subsector in 2008.

A portion of the fluctuation in the industries' energy consumption can be explained by variations in output, as measured by GDP. For instance, from 1995 to 2008, the Fruit and Vegetable Preserving and Specialty Food Manufacturing (NAICS 3114) industry's GDP increased by 46 percent, leading to an increase in energy use of 41 percent. Similarly, the Meat Product Manufacturing (NAICS 3116) industry's GDP and energy use increased by 55 percent and 49 percent respectively.

Figure 7 in Chapter 1 shows the acceleration of the increase in the price of natural gas, starting in 1999, thus making the price of electricity relatively cheaper. This change in relative energy prices corresponds to the energy-use pattern of the Dairy Product Manufacturing industry (NAICS 3115). Note that one year after the relative price change (i.e. in 2000), energy consumption in this industry has been on a steady, albeit modest, decline. This is the only Food Manufacturing industry to witness such a decline (0.1 percent compared with increases ranging from 41 percent to 68 percent).

As shown in Figure 23, which illustrates the share of electricity and natural gas in the subsector's total energy use, Food Manufacturing witnessed changes in the relative share of the two fuels since around 2001. From 2001 to 2008, natural gas consumption decreased by 3 percent (an average annual decrease of 0.4 percent), while electricity use increased by 69 percent (an average annual rate of 7.7 percent). This trend is even more apparent between 2004 and 2008.

Figure 23. Electricity, natural gas and other fuels' share of energy consumption in the Food Manufacturing subsector, 1995–2008



6.7.3 Food Manufacturing subsector's energy consumption by source

Table 9 lists the energy consumption by energy source for the Food Manufacturing subsector in 1995 and 2008.

Table 9. Food Manufacturing subsector's energy use by energy source, 1995 and 2008

Energy category	Energy source	1995 Energy in PJ (%)	2008 Energy in PJ (%)	Growth (%)
Electricity	Electricity	20.6 (24.2)	31.9 (32.4)	55.2
Natural gas	Natural gas	51.1 (67.2)	58.6 (59.5)	2.8
RPP (incl. propane)**	Heavy fuel oil	4.4 (5.2)	4.4 (4.4)	–1.4
	Middle distillates	X* (N/A)	2.0 (2.0)	N/A
	Propane	X* (N/A)	X* (N/A)	N/A
	Total, RPP (incl. propane)	**X* (N/A)**	**X* (N/A)**	**N/A**
Steam and wood	Steam	X* (N/A)	X* (N/A)	N/A
	Wood	X* (N/A)	X* (N/A)	N/A
	Total, steam and wood	**X* (N/A)**	**X* (N/A)**	**N/A**
Total		**84.9 (100)**	**98.6 (100)**	**16.1**

Note: Due to rounding, the numbers in the table may not add up.
*Undisclosed value for confidentiality reasons.
**RPP = refined petroleum products

Since 1995, natural gas, electricity and heavy fuel oil have made up approximately 95 percent of all energy used by Food Manufacturing. Natural gas is the most commonly used energy source, and it increased by 2.8 percent, from 51.1 PJ to 58.6 PJ from 1995 to 2008.

However, the increased use of electricity captured most of the subsector's energy consumption increase since 2004. Over the entire period, electricity use increased by 55.2 percent, from 20.6 PJ to 31.9 PJ. The use of heavy fuel oil remained constant around 4 PJ per year and accounted for roughly 4 percent of the yearly energy source share.

A Glossary

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

Energy source: Any substance that supplies heat or power (e.g. coal, coal coke, coke oven gas, coke from catalytic cracking catalyst, electricity, heavy fuel oil, middle distillates, natural gas, petroleum coke, propane, refinery fuel gas, spent pulping liquor, steam and wood).

Gross domestic product (GDP): The total value of goods and services produced within the border of a geographic area (Canada) during a given year. Also referred to as annual economic output or, more simply, output. To avoid counting the same output more than once, GDP includes only final goods and services – not those that are used to make another product. In this report, GDP figures are reported in constant 2002 dollars.

Petajoule: One petajoule equals 1×10^{15} joules. A joule is the international unit of a measure of energy – the energy produced by the power of one watt flowing for one second. There are 3.6 million joules in one kilowatt hour.

Establishment: As a statistical unit, is defined as the most homogeneous unit of production for which the business maintains accounting records from which it is possible to assemble all the data elements required to compile the full structure of the gross value of production (total sales or shipments, and inventories), the cost of materials and services, and labour and capital used in production. Provided that the necessary accounts are available, the statistical structure replicates the operating structure of the business. In delineating the establishment, however, producing units may be grouped. An establishment comprises at least one location, but it can also be composed of many. Establishments may also be referred to as profit centres.

North American Industry Classification System (NAICS): An industry classification system developed by the statistical agencies of Canada, Mexico and the United States. Created against the background of the North American Free Trade Agreement, it provides common definitions of the industrial structure of the three countries and a common statistical framework to facilitate the analysis of the three economies. NAICS is based on supply-side or production-oriented principles, to ensure that industrial data, classified to NAICS, are suitable for the analysis of production-related issues, such as industrial performance.

B North American Industry Classification System

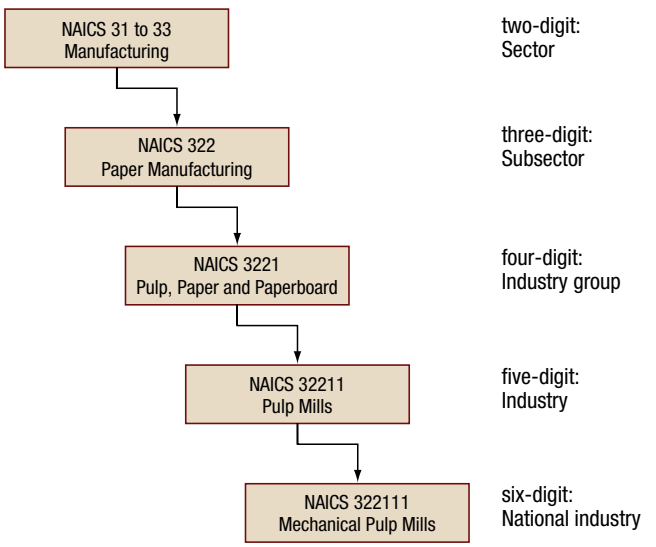
The North American Industrial Classification System (NAICS) is an industry classification that provides common definitions of the industrial structure of Canada, Mexico and the United States. Developed jointly by the statistical agencies of these three countries, NAICS was adopted in 1997 and revised in 2002 and 2007 to increase comparability among the three countries and to add new industries.

The NAICS numbering system is a six-digit code:

- first two digits designate the sector
- third digit designates the subsector
- fourth digit designates the industry group
- fifth digit designates the industry
- sixth digit can indicate another level of detail (to include additional detail, a country can create national industries and indicate that in the sixth digit)

Figure B.1 shows an example of the designation of the NAICS codes.

Figure B.1. Example of NAICS code designation



NAICS Canada 2007 consists of 20 sectors, 102 subsectors, 324 industry groups, 718 industries and 928 national industries. (It replaces NAICS Canada 2002.) Table B.1 lists the 20 sectors.

Table B.1. Sectors included in NAICS 2007

Sector	NAICS
Agriculture, Forestry, Fishing and Hunting	11
Mining, Quarrying, and Oil and Gas Extraction	21
Utilities	22
Construction	23
Manufacturing	31-33
Wholesale Trade	41
Retail Trade	44-45
Transportation and Warehousing	48-49
Information and Cultural Industries	51
Finance and Insurance	52
Real Estate and Rental and Leasing	53
Professional, Scientific and Technical Services	54
Management of Companies and Enterprises	55
Administrative and Support and Waste Management and Remediation Services	56
Educational Services	61
Health Care and Social Assistance	62
Arts, Entertainment and Recreation	71
Accommodation and Food Services	72
Other Services (except Public Administration)	81
Public Administration	91

The 7 three-digit NAICS codes (subsectors) analyzed in the Summary Report are as follows:

311 Food Manufacturing

This subsector comprises establishments primarily engaged in producing food for human or animal consumption.

Exclusion(s): Establishments primarily engaged in
- manufacturing beverages or tobacco (312, Beverage and Tobacco Product Manufacturing)

321 Wood Product Manufacturing

This subsector comprises establishments primarily engaged in manufacturing products from wood. Three industry groups in this subsector comprise establishments engaged in sawing logs into lumber and similar products, or preserving these products; making products that improve the natural characteristics of wood, by making veneers, plywood, reconstituted wood panel products or engineered wood assemblies; and making a diverse range of wood products, such as millwork.

Exclusion(s): Establishments primarily engaged in
- logging; and chipping logs in the field (113, Forestry and Logging)
- manufacturing wood pulp, paper and paper products (322, Paper Manufacturing)
- manufacturing wood kitchen cabinets and counters, and bathroom vanities (337, Furniture and Related Product Manufacturing)
- manufacturing wood signs and coffins (339, Miscellaneous Manufacturing)

322 Paper Manufacturing

This subsector comprises establishments primarily engaged in manufacturing pulp, paper and paper products. The manufacture of pulp involves separating the cellulose fibres from other impurities in wood, used paper or other fibre sources. The manufacture of paper involves matting these fibres into a sheet. Converted paper products are produced from paper and other materials by various cutting and shaping techniques.

324 Petroleum and Coal Products Manufacturing

This subsector comprises establishments primarily engaged in transforming crude petroleum and coal into intermediate and end products. The dominant process is petroleum refining, which separates crude petroleum into components or fractions through such techniques as cracking and distillation.

Exclusion(s): Establishments primarily engaged in
- manufacturing chemicals and chemical preparations from refined petroleum and coal products (325, Chemical Manufacturing)

325 Chemical Manufacturing

This subsector comprises establishments primarily engaged in manufacturing chemicals and chemical preparations, from organic and inorganic raw materials.

Exclusion(s): Establishments primarily engaged in
- field processing of crude petroleum and natural gas (211, Oil and Gas Extraction)
- beneficiating mineral ores (212, Mining and Quarrying [except Oil and Gas])
- processing crude petroleum and coal (324, Petroleum and Coal Products Manufacturing)
- smelting and refining ores and concentrates (331, Primary Metal Manufacturing)

327 Non-Metallic Mineral Product Manufacturing

This subsector comprises establishments primarily engaged in manufacturing non-metallic mineral products. These establishments cut, grind, shape and finish granite, marble, limestone, slate and other stone; mix non-metallic minerals with chemicals and other additives; and heat non-metallic mineral preparations to make products, such as bricks, refractories, ceramic products, cement and glass.

Exclusion(s): Establishments primarily engaged in
- beneficiating non-metallic minerals (212, Mining and Quarrying [except Oil and Gas])

331 Primary Metal Manufacturing

This subsector comprises establishments primarily engaged in smelting and refining ferrous and non-ferrous metals from ore, pig or scrap in blast or electric furnaces. Metal alloys are made with the introduction of other chemical elements. The output of smelting and refining, usually in ingot form, is used in rolling and drawing operations to produce sheet, strip, bars, rods and wire, and in molten form to produce castings and other basic metal products.

Exclusion(s): Establishments primarily engaged in
– manufacturing metal forgings or stampings (332, Fabricated Metal Product Manufacturing)

The remaining 14 three-digit NAICS codes (subsectors) belonging to the Manufacturing sector are as follows:

312 Beverage and Tobacco Product Manufacturing
313 Textile Mills
314 Textile Product Mills
315 Clothing Manufacturing
316 Leather and Allied Product Manufacturing
323 Printing and Related Support Activities
326 Plastics and Rubber Products Manufacturing
332 Fabricated Metal Product Manufacturing
333 Machinery Manufacturing
334 Computer and Electronic Product Manufacturing
335 Electrical Equipment, Appliance and Component Manufacturing
336 Transportation Equipment Manufacturing
337 Furniture and Related Product Manufacturing
339 Miscellaneous Manufacturing

For a complete description of the structure of the Manufacturing sector, visit Statistics Canada's Web site:

stds.statcan.gc.ca/naics-scian/2007/ts-rt-eng.asp?criteria=31-33

C Sources

C.1 Figures

Figure 1:
Statistics Canada (2010), *2008 Report on Energy Supply and Demand in Canada*, Table 2-1, "Primary and secondary energy, terajoules – Canada," p. 29 (Cat. No. 57-003-XWE).

Figure 3:
Statistics Canada (2010), CANSIM, Table 379-0027, "Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS), monthly (dollars)," GDP vector: v41881527.

Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vector: v26562764.

Figure 4:
Statistics Canada (2010), CANSIM, Table 379-0027, "Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS), monthly (dollars)," GDP vectors: v41881528, v41881555, v41881564, v41881578, v41881581, v41881606, v41881617.

Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v2562775, v26562771, v26562785, v26562777, v26562788, v265562809, v26562815.

Figure 5:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26562775, v26562771, v26562785, v26562777, v26562788, v265562809, v26562815.

Figure 6:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26563025, v26563037, v26563048, v26563051, v26563143, v26563220, v26563309, v26563401, v26562856, v26562946, v26562949, v26562957, v26563001.

Figure 7:
Natural Resources Canada (2010), Office of the Energy Efficiency, *Energy Use Data Handbook Tables*, Industrial Sector, Table 7, "Industrial energy prices and background indicators" at oee/corporate/statistics/neud/dpa/handbook_ind_ca.cfm?attr=0.

Figure 8:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26562775, v26562771, v26562785, v26562777, v26562788, v265562809, v26562815, v26562841, v26562767, v26562768, v26562769, v26562770, v26562784, v26562804, v26562823, v26562834, v26562835, v26562836, v26562837, v26562854, v26562755.

Figure 9:
Statistics Canada (2010), CANSIM, Table 379-0027, "Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS), monthly (dollars)," GDP vector: v41881564.

Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vector: v26562777.

Figure 10:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26562778, v26562779, v26562780, v26562781, v26562782, v26562783.

Figure 11:
Statistics Canada (2010), CANSIM, Table 379-0027, "Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS), monthly (dollars)," GDP vector: v41881617.

Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vector: v26562815.

Figure 12:
Statistics Canada (2010), CANSIM, Table 379-0027, "Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS), monthly (dollars)," GDP vectors: v41881618, v41881619, v41881620, v41881621, v41881622.

Figure 13:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26562816, v26562817, v26562818, v26562820.

Figure 14:
Statistics Canada (2010), CANSIM, Table 379-0027, "Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS), monthly (dollars)," GDP vector: v41881578.

Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vector: v26562785.

Figure 15:
Statistics Canada (2010), CANSIM, Table 379-0027, "Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS), monthly (dollars)," GDP vector: v41881578.

Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vector: v26562788.

Figure 16:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26562789, v26562790, v26562791, v26562792, v26562793, v26562794, v26562796.

Figure 17:
Statistics Canada (2010), CANSIM, Table 379-0027, "Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS), monthly (dollars)," GDP vector: v41881555.

Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vector: v26562771.

Figure 18:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26562772, v26562776.

Statistics Canada (2010), CANSIM, Table 304-0014, "Manufacturers' sales, inventories, orders and inventory to sales ratios, by North American Industry Classification System (NAICS), Canada, monthly," Sales of goods manufactured vectors: v800226, v800234.

Figure 19:
Statistics Canada (2010), CANSIM, Table 379-0027, "Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS), monthly (dollars)," GDP vector: v41881606.

Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vector: v26562809.

Figure 20:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26562810, v26562812, v26562813.

Figure 21:
Statistics Canada (2010), CANSIM, Table 379-0027, "Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS), monthly (dollars)," GDP vector: v41881528.

Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vector: v26562775.

Figure 22:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26563242, v26563253, v26563662, v26563283.

Figure 23:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26563062, v26563320.

C.2 Tables

Table 1:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26563025, v26563037, v26563048, v26563051, v26563143, v26563220, v26563309, v26563401, v26562856, v26562946, v26562949, v26562957, v26563001.

Table 2:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26563025, v26563037, v26563048, v26563401, v26563220, v26562856, v26562946.

Table 3:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26563026, v26563064, v26563156, v26563233, v26563322, v26562869, v26562950, v26562963, v26563009.

Table 4:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26563032, v26563042, v26563049, v26563102, v26563187, v26563268, v26563360, v26563409, v26562905, v26562989, v41499399.

Table 5:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26563028, v26563072, v26563164, v26563241, v26563330, v26563402, v26562877, v26562947, v26562971.

Table 6:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v41958540, v26563075, v26563167, v26563244, v26563333, v26563404, v26562880, 41499395, v26562974, 28474347.

Table 7:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26563058, v26563150, v26563227, v26563316, 26562863, v26562960, v26563003.

Table 8:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v26563029, v26563039, v26563096, v26563182, v26563263, v26563354, v26563406, v26562899, v26562988, v26563018.

Table 9:
Statistics Canada (2010), CANSIM, Table 128-0006, "Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual," Energy consumption vectors: v43973136, v26563038, v26563062, v26563154, v26563231, v26563320, v26562867, v26562962, v26563007.

C.3 Other information mentioned in footnotes

Footnote 13, p.14 and footnote 19, p.20:
Statistics Canada (2010), CANSIM, Table 304-0014, "Manufacturers' sales, inventories, orders and inventory to sales ratios, by North American Industry Classification System (NAICS), Canada, monthly," Sales of goods manufactured vector: v800274.