



The digital mosaic of Canada that appears on the cover of this publication is produced by Natural Resources Canada (Canada Centre for Remote Sensing) and is a composite of individual satellite images. The differences in the density of vegetation are illustrated through shading.

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)

© Her Majesty the Queen in Right of Canada, 2009

Cat. No. M144-154/2009 (Print)  
ISBN 978-1-100-50324-0

Cat No. M144-154/2009E-PDF (On-line)  
ISBN 978-1-100-13905-0

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

<b>1</b>	<b>Introduction.....</b>	<b>2</b>
<b>2</b>	<b>Factors that can influence the Manufacturing sector’s energy consumption .....</b>	<b>3</b>
<b>3</b>	<b>Energy consumption in the Manufacturing sector .....</b>	<b>4</b>
	3.1 Energy intensity and total energy consumption of the Manufacturing sector.....	4
	3.2 Energy intensity and energy consumption by subsector .....	5
	3.3 Energy consumption by energy source .....	7
<b>4</b>	<b>Top three energy consuming subsectors .....</b>	<b>10</b>
	4.1 Paper Manufacturing subsector (NAICS 322) .....	10
	4.1.1. Paper Manufacturing subsector energy consumption, output and energy intensity trends .....	10
	4.1.2 Paper Manufacturing subsector energy consumption trends by industry .....	11
	4.1.3 Paper Manufacturing subsector energy consumption by source.....	12
	4.2 Primary Metal Manufacturing subsector (NAICS 331) .....	13
	4.2.1 Primary Metal Manufacturing subsector energy consumption, output and energy intensity trends .....	13
	4.2.2 Primary Metal Manufacturing subsector energy consumption trends by industry .....	15
	4.2.3 Primary Metal Manufacturing subsector energy consumption by source.....	16
	4.3 Petroleum and Coal Product Manufacturing subsector (NAICS 324) .....	16
	4.3.1 Petroleum and Coal Product Manufacturing subsector energy consumption, output and energy intensity trends .....	16
	4.3.2 Petroleum and Coal Product Manufacturing subsector energy consumption trends by industry.....	18
	4.3.3 Petroleum and Coal Product Manufacturing subsector energy consumption by source .....	18
	<b>Appendix A Glossary .....</b>	<b>19</b>
	<b>Appendix B North American Industry Classification System .....</b>	<b>20</b>
	<b>Appendix C Sources.....</b>	<b>22</b>

Every year, Statistics Canada conducts the *Industrial Consumption of Energy* (ICE) survey, which collects energy use data from establishments<sup>1</sup> in Canada's Manufacturing sector.<sup>2</sup> The ICE survey is currently co-sponsored by the Office of Energy Efficiency (OEE) of Natural Resources Canada (NRCan) and Environment Canada (EC). 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 ICE 2007 survey. The estimates are based on the North American Industry Classification System (NAICS) and include all 21 subsectors of the Manufacturing sector (NAICS 31-33).<sup>3</sup>

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

For more information about ICE's methodology and history, as well as all the other reports mentioned above, refer to the

***Summary Report of Energy Use in the Canadian Manufacturing Sector from 1995 to 2005 on the OEE Web site at [oee.nrcan.gc.ca/Publications](http://oee.nrcan.gc.ca/Publications)***

This report was prepared by François Le Morvan and Amandeep Garcha, Samuel Blais was the project manager, while overall direction was provided by Andrew Kormylo, of the Demand Policy and Analysis Division of the OEE. An electronic version of the publication is available on the OEE Web site at [oee.nrcan.gc.ca/statistics](http://oee.nrcan.gc.ca/statistics).

For more information about this report or about 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-nrcan.gc.ca](mailto:euc.cec@nrcan-nrcan.gc.ca)

Web site: [oee.nrcan.gc.ca](http://oee.nrcan.gc.ca)

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).

<sup>1</sup>See Appendix A Glossary for a more in-depth description.

<sup>2</sup>See Appendix B North American Industry Classification System.

<sup>3</sup>See Appendix A Glossary for a definition and Appendix B North American Industry Classification System for details.

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, following are 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, etc.), are expected to reduce or increase the 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. That means that the next unit produced will use less energy than the previous one as 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: Energy efficiency measures are usually undertaken by industries 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.

Other factors such as weather, the introduction of a new technology, restructuring and the world economy are factors that have an impact on energy consumption in the Manufacturing sector. As mentioned earlier, the interaction of all these factors is hard to isolate and may differ from one industry to another.

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

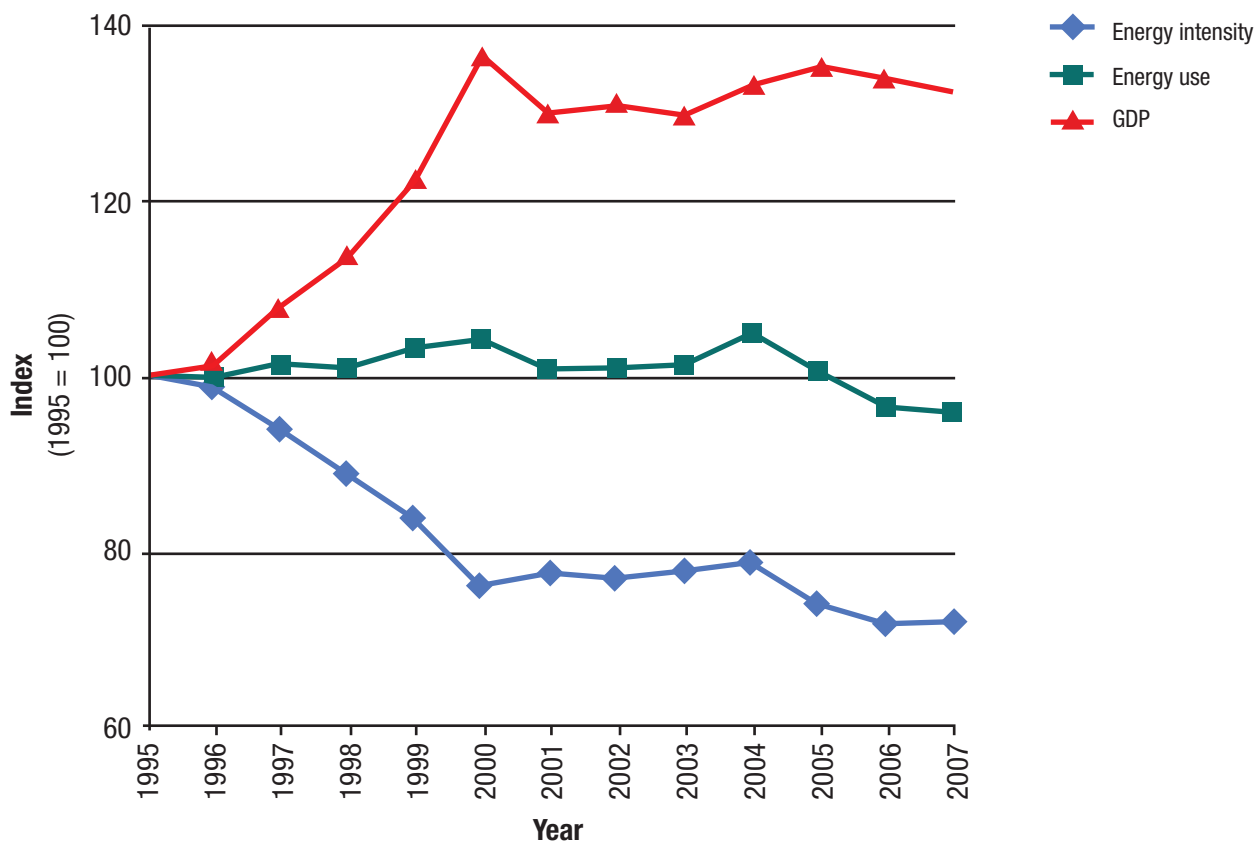
Energy intensity in the Manufacturing sector can be defined as the energy use per unit of output and can be measured as the ratio of energy use to GDP in constant 2002 dollars. This ratio, which will be used throughout the summary report, provides a measure of the energy efficiency that is easily comparable over time and between sectors.

### 3.1 Energy intensity and total energy consumption in the Manufacturing sector

In 2007, the Manufacturing sector consumed 2 387 petajoules (PJ) of energy, according to ICE estimates. To put this into perspective, this amount is almost twice as much energy consumption as all Canadian cars and light trucks (17.6 million vehicles; 1 238 PJ in 2006).<sup>4</sup>

Figure 1 illustrates the indexed growth of energy intensity, energy use and GDP over the 1995 to 2007 period. This graph shows that, between 1995 and 2000,

**Figure 1. Indexed growth of energy intensity, energy use and GDP for the Manufacturing sector, 1995–2007**



<sup>4</sup>Natural Resources Canada (2009), Office of the Energy Efficiency, *Energy Use Data Handbook* tables, Transportation sector, Table 1. [oee.nrcan.gc.ca/corporate/statistics/neud/dpa/handbook\\_tables.cfm?attr=0](http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/handbook_tables.cfm?attr=0).

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. In 2004, energy intensity decreased again despite a slight increase in manufacturing output.

Overall, Canada's Manufacturing sector used 4 percent less energy and produced 33 percent more output in 2007 than it did in 1995. The sector's overall energy intensity declined 28 percent, from 18 megajoules per dollar of GDP (MJ/\$GDP) to 13 MJ/\$GDP, over this period.

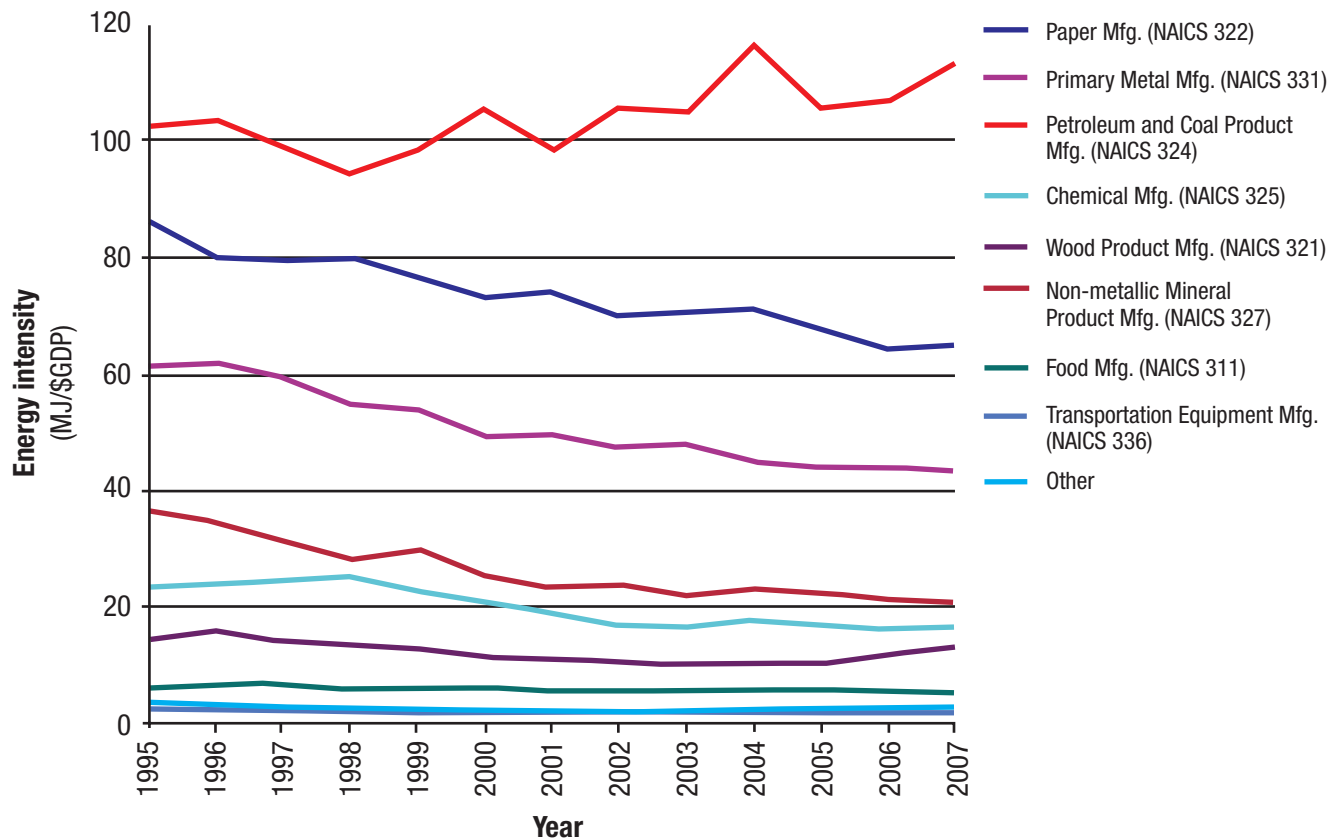
Between 1995 and 2007, the proportion of the subsectors that comprise the Manufacturing sector changed marginally. The Paper Manufacturing

(NAICS 322) 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.

### 3.2 Energy intensity and energy consumption by subsector

Figure 2 illustrates the energy intensity of selected Manufacturing subsectors. First, we note that the energy intensity varies greatly across subsectors. It ranges from close to 2 MJ/\$GDP for both the Transport Equipment Manufacturing (NAICS 336) subsector and the Other category<sup>5</sup> to more than a 100 MJ/\$GDP for the Petroleum and Coal Product Manufacturing (NAICS 324) subsector. Because the

**Figure 2. Energy intensity by selected subsector, 1995–2007**



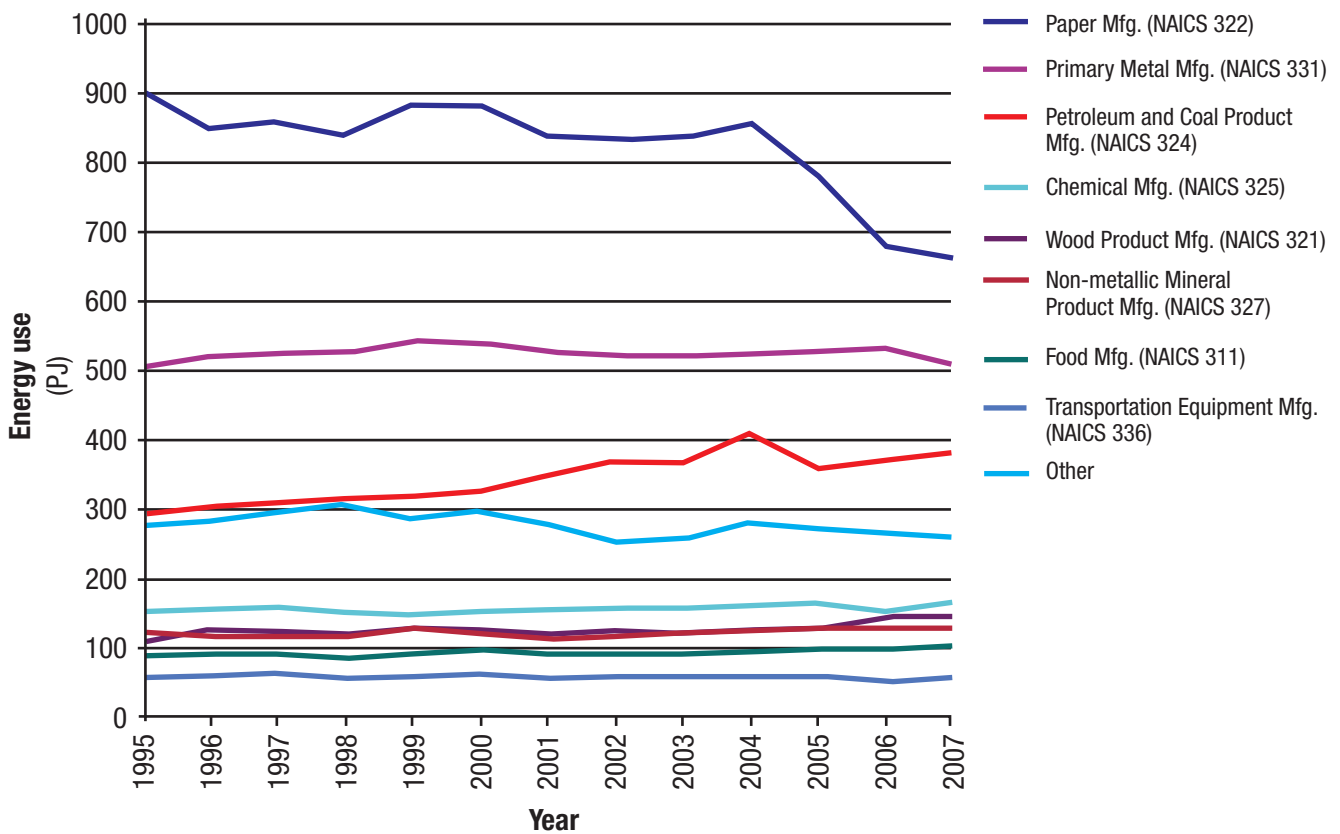
<sup>5</sup>The Other category includes Beverage and Tobacco Product Manufacturing (NAICS 312), Textile Mills (NAICS 313), Textile Product Mills (NAICS 314), Clothing Manufacturing (NAICS 315), Leather and Allied Product Manufacturing (NAICS 316), Printing and Related Support Activities (NAICS 323), Plastic and Rubber Products Manufacturing (NAICS 326), Fabricated Metal Product Manufacturing (NAICS 332), Machinery Manufacturing (NAICS 333), Computer and Electronic Product Manufacturing (NAICS 334), Electrical Equipment, Appliance and Component Manufacturing (NAICS 335), Furniture and Related Product Manufacturing (NAICS 337) and Miscellaneous Manufacturing (NAICS 339).

subsectors with the lowest energy intensity represent a large proportion in the Manufacturing sector output, overall, the average energy intensity is close to 15 MJ/\$GDP between 1995 and 2007.

It is worth noting that the Petroleum and Coal Product Manufacturing subsector was the only subsector that experienced an increase in energy intensity over the 12 year period. Further analysis of selected subsectors' energy intensity is provided in Section 4.

Figure 3 shows that most subsectors of the Manufacturing sector were using approximately the same amount of energy in 2007 as in 1995. However, there are two exceptions: the Petroleum and Coal Product Manufacturing subsector increased its energy consumption by 88 PJ (or 30 percent), and the Paper Manufacturing's energy consumption decreased by 243 PJ (or 27 percent).

**Figure 3. Energy use by selected subsector, 1995–2007**

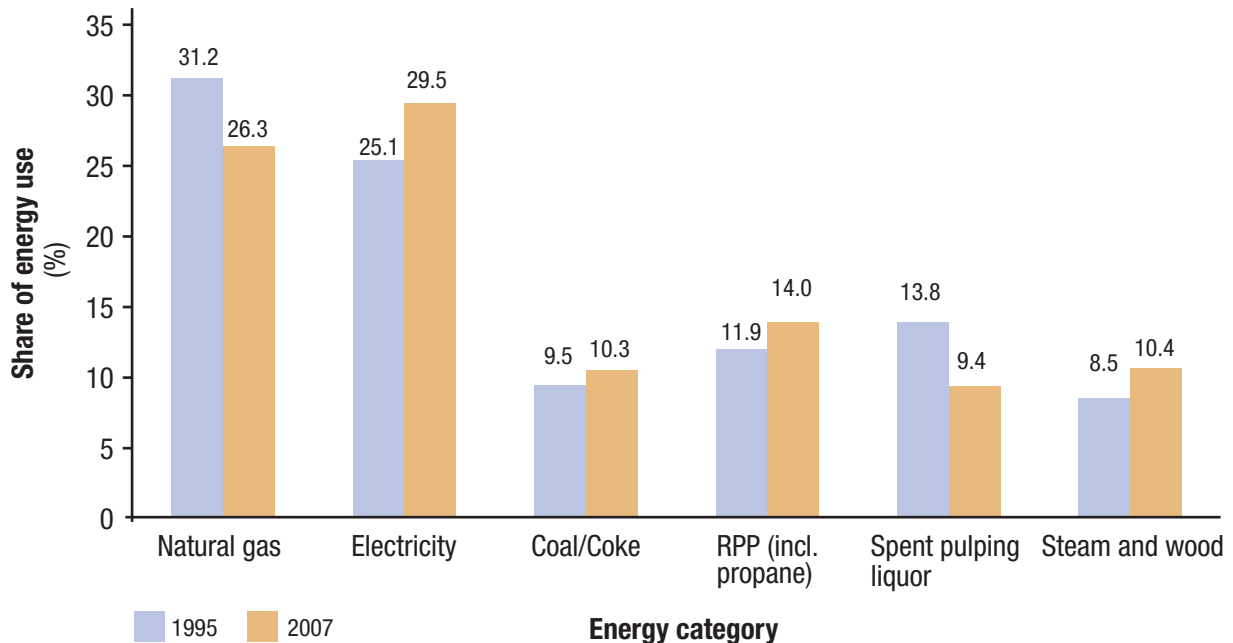


### 3.3 Energy consumption by energy source

During the 1995 to 2007 period, the energy consumed by the industrial sector shifted from some energy sources toward others. As Figure 4 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) remained relatively stable.

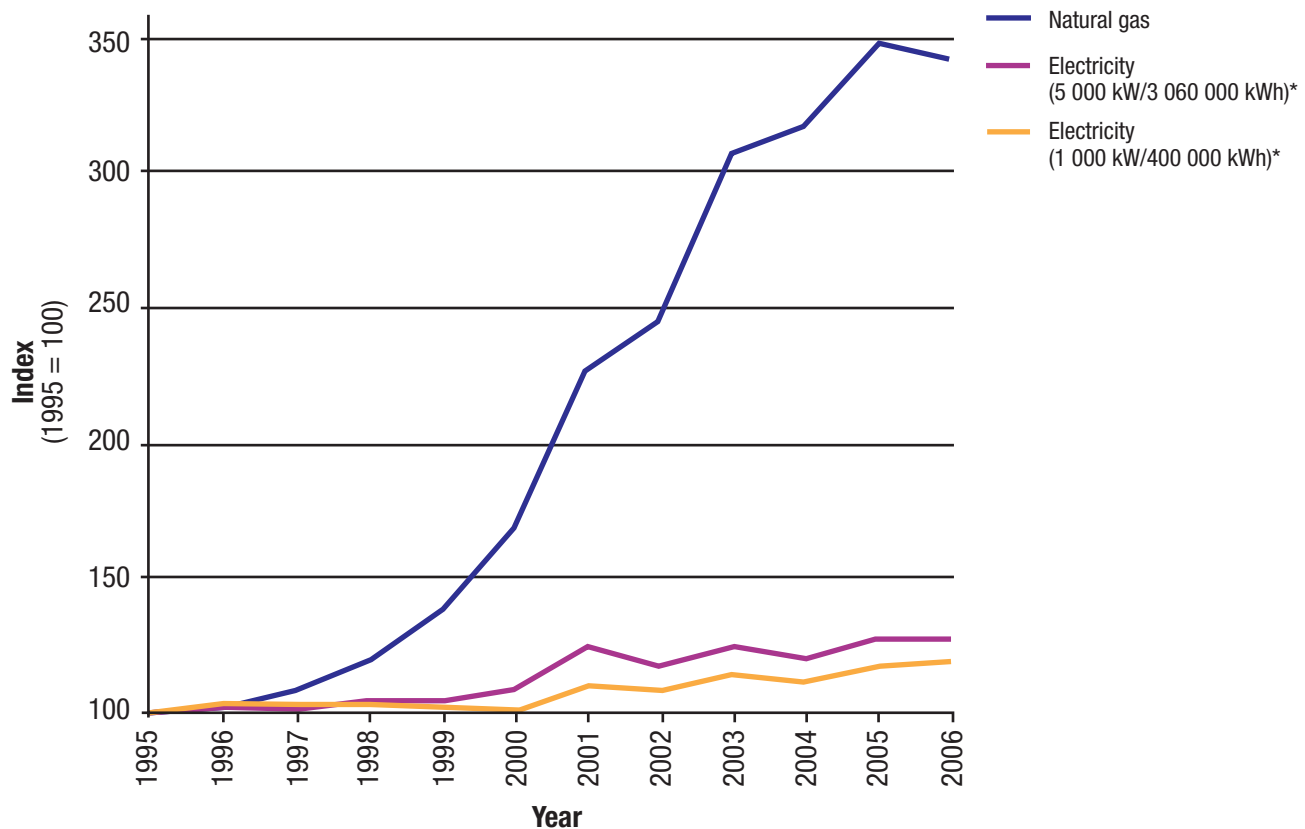
**Figure 4. Share of energy used by the Manufacturing sector by energy category, 1995 and 2007**



It should be noted that spent pulping liquor is produced and used only by the Paper Manufacturing subsector, which has been in decline since 2004, as shown by the drop in the subsector's GDP, from \$12.0 billion to \$10.2 billion (15 percent). This decline might explain, at least in part, the decreased use of this particular energy source in 2007. Similarly, refinery fuel gas is produced and used exclusively by the Petroleum and Coal Product Manufacturing subsector, and almost entirely by the Petroleum Refineries (NAICS 32411) industry.<sup>6</sup>

Electricity has replaced natural gas as the most used energy source since 2003. As shown in Figure 5, the rapid growth of the price of natural gas compared to that of electricity may somewhat explain this energy source switch.

<sup>6</sup>See Appendix B North American Industry Classification System.

**Figure 5. Indexed growth of industrial natural gas and electricity prices, 1995–2006**

\* kW refers to power hook-up, whereas kWh refers to monthly electricity consumption.

As a complement to Figure 4, Table 1 illustrates the energy use by energy category for the Manufacturing sector in 1995 and 2007. The table shows that the consumption 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 2007, such that overall energy consumption in the sector fell by more than 4 percent over the period.

The coal/coke and RPP categories are comprised of several types of energy sources. Table 2 breaks down these two energy categories. Although their shares of overall energy use by the sector have remained relatively stable over the 1995 to 2007 period, there was significant switching of energy sources within each of these categories.

Table 1. Manufacturing sector energy use by energy category, 1995 and 2007

Energy category	1995 Energy in PJ (%)	2007 Energy in PJ (%)	Growth (%)
Natural gas	777.8 (31.2)	628.9 (26.3)	-19.1
Electricity	624.7 (25.1)	705.3 (29.5)	12.9
Coal/coke	236.2 (9.5)	246.3 (10.3)	4.2
RPP (incl. propane)	297.0 (11.9)	335.1 (14.0)	12.8
Spent pulping liquor	343.6 (13.8)	223.6 (9.4)	-34.9
Steam and wood	212.3 (8.5)	248.1 (10.4)	16.8
<b>Total</b>	<b>2 491.7 (100)</b>	<b>2 387.3 (100)</b>	<b>-4.2</b>

Due to rounding, the numbers in the tables may not add up.

In the coal/coke category, the use of coal and petroleum coke increased significantly whereas the use of coal coke declined. Similarly, in the RPP

category, the use of heavy fuel oil and propane decreased, and the use of refinery fuel gas increased 67 percent in the Manufacturing sector.

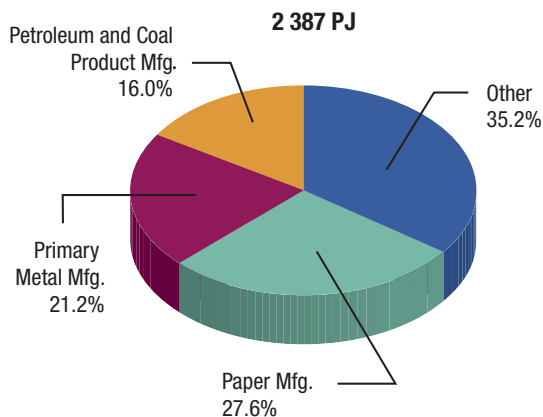
Table 2. Energy use by selected energy sources, 1995 and 2007

Energy category	Energy source	1995 Energy in PJ (%)	2007 Energy in PJ (%)	Growth (%)
Coal/coke	Coal	41.3 (17.5)	56.3 (22.9)	36.3
	Coal coke	102.9 (43.6)	80.9 (32.8)	-21.4
	Coke oven gas	27.4 (11.6)	24.7 (10.0)	-9.7
	Petroleum coke and coke from catalytic cracking catalyst	64.6 (27.3)	84.4 (34.3)	30.5
	<b>Total, Coal/coke</b>	<b>236.2 (100)</b>	<b>246.3 (100)</b>	<b>4.2</b>
RPP (incl. propane)	Heavy fuel oil	139.8 (47.1)	95.1 (28.4)	-32.0
	Middle distillates	17.2 (5.8)	17.8 (5.3)	3.5
	Propane	12.3 (4.1)	8.9 (2.7)	-27.6
	Refinery fuel gas	127.6 (43.0)	213.3 (63.7)	67.1
	<b>Total, RPP</b>	<b>297.0 (100)</b>	<b>335.1 (100)</b>	<b>12.8</b>

Due to rounding, the numbers in the tables may not add up.

The three subsectors that used the most energy in the Manufacturing sector in 2007 were Paper Manufacturing (NAICS 322), Primary Metal Manufacturing (NAICS 331) and Petroleum and Coal Product Manufacturing (NAICS 324). Together these three subsectors represented nearly 65 percent of Manufacturing sector energy use in 2007. Section 4 of this document examines each of these subsectors more closely.

**Figure 6. Share of energy consumption in the Manufacturing sector, 2007**



#### 4.1 Paper Manufacturing subsector (NAICS 322)

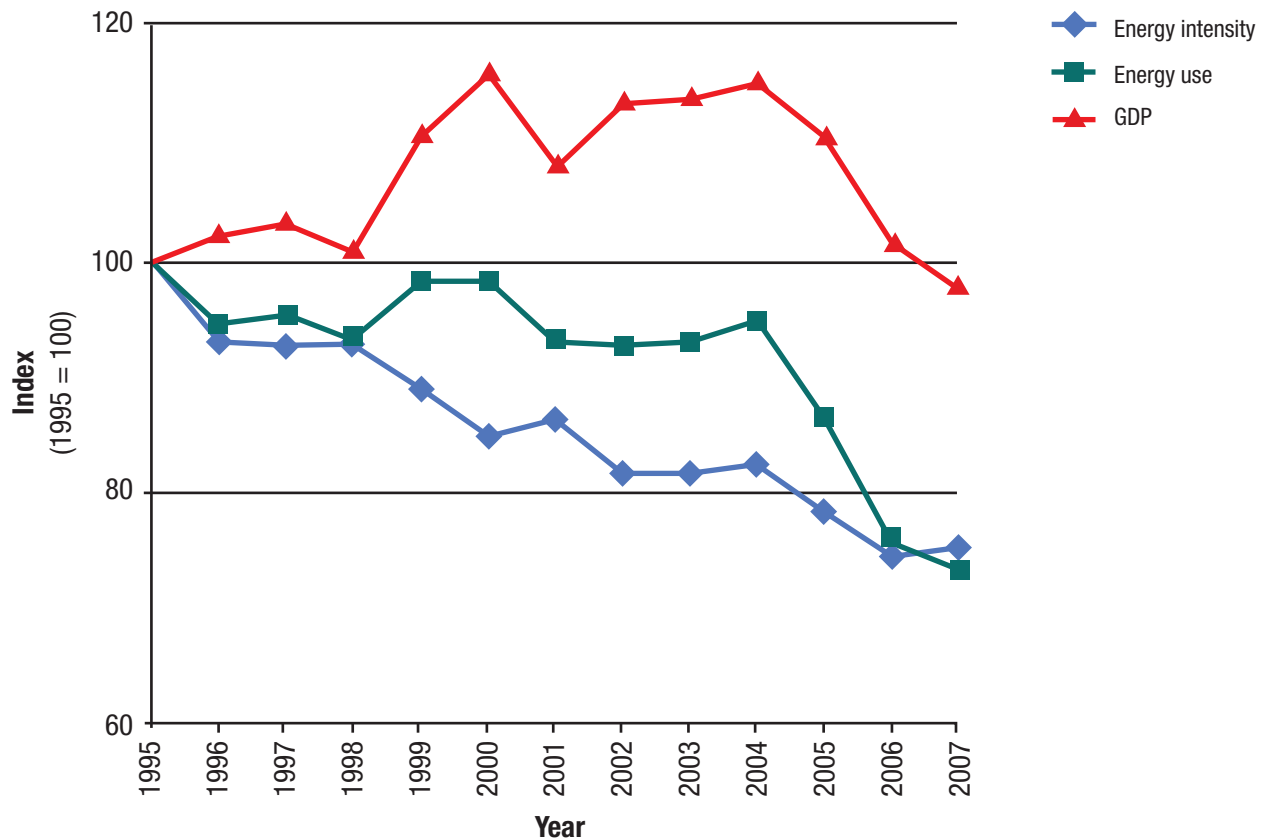
Establishments in the Paper Manufacturing subsector produce pulp, paper and paper products. The 2007 ICE survey estimated that this subsector consumed 658 PJ of energy, corresponding to 28 percent of the Manufacturing sector's energy consumption, thus making it the largest energy consuming manufacturing subsector in Canada.

##### 4.1.1 Paper Manufacturing subsector energy consumption, output and energy intensity trends

Figure 7 illustrates the indexed growth of energy intensity, energy use and GDP from 1995 to 2007 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 16 percent between 1998 and 2000, then 7 percent between 2001 and 2004, energy use increased only 6 percent and 2 percent over the same periods. Conversely, when the GDP fell 15 percent between 2004 and 2007, energy use declined 23 percent. The increasing gap between the two indicators results in a decrease of energy intensity over time.

Over the 1995 to 2007 period, the Paper Manufacturing subsector's output decreased 3 percent, from \$10.5 to \$10.2 billion, while its energy consumption decreased 27 percent, from 901 to 658 PJ. Consequently, its associated energy intensity diminished 25.0 percent, from 86 to 64 MJ/\$GDP, which is a 2.4 percent annual decline over the period.

**Figure 7. Indexed growth of energy intensity, energy use and GDP for the Paper Manufacturing subsector, 1995–2007**



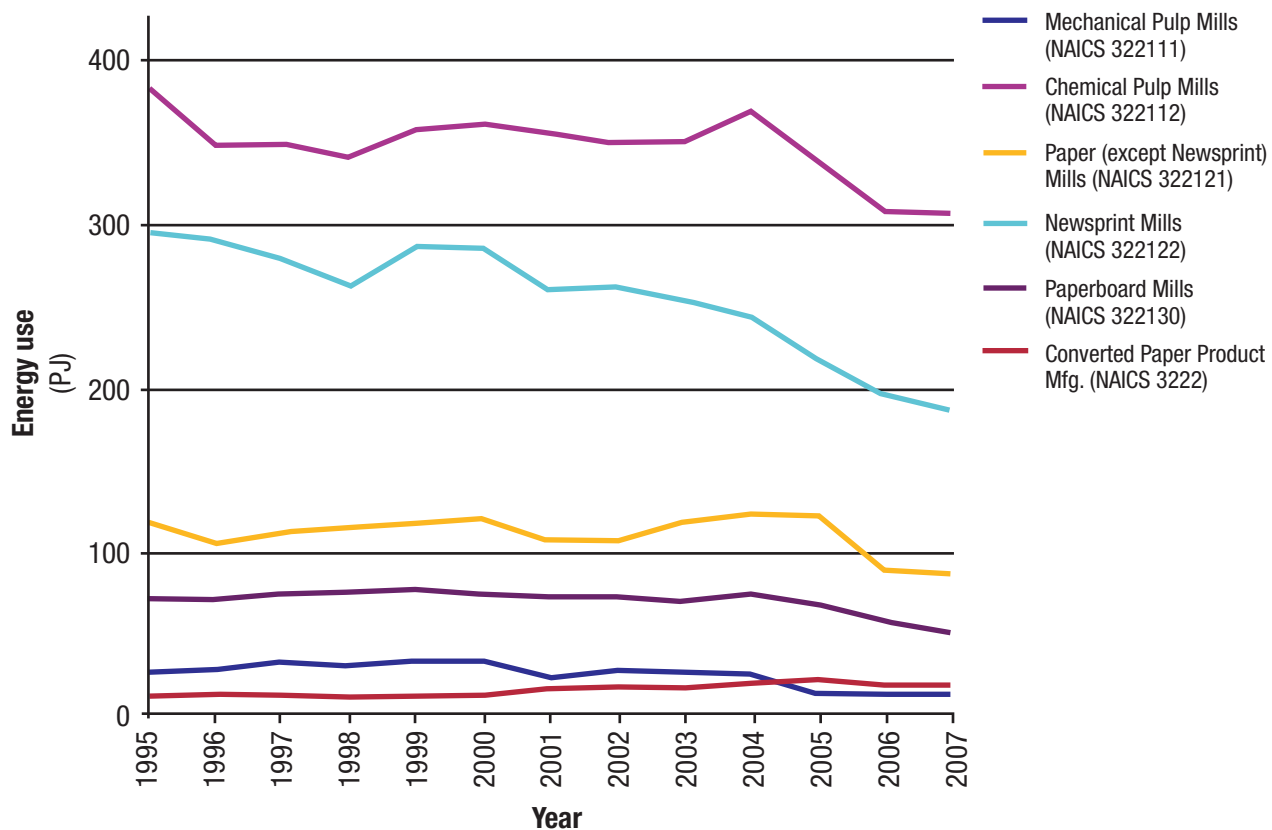
Of the eight largest manufacturing consumers of energy,<sup>7</sup> Paper Manufacturing is the only subsector that had a decrease in GDP between 1995 and 2007. It is possible that this subsector's output was reduced by closing the least efficient operations first, which would help explain the reduction in energy intensity over the time period.

#### 4.1.2 Paper Manufacturing subsector energy consumption trends by industry

Figure 8 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 (NAICS 3222) industry. This industry accounted for only 3 percent of the energy use of entire Paper Manufacturing subsector in 2007. All the remaining industries experienced a significant drop in energy consumption of 20 to 49 percent, mainly as a result of reduced output.

<sup>7</sup>Refer to Figure 3.

Figure 8. Energy use by the Paper Manufacturing industries, 1995–2007



#### 4.1.3 Paper Manufacturing subsector energy consumption by source

Table 3 lists the energy consumption by energy source for the Paper Manufacturing subsector in 1995 and 2007.

The Paper Manufacturing subsector is the only producer and consumer of spent pulping liquor. The demand for this type of energy, which is the most commonly used energy source in the subsector

(34 percent or 224 PJ in 2007), decreased 35 percent (120 PJ). Since 2000, natural gas has moved from the third most-used energy source to fourth, after spent pulping liquor, electricity and wood. The use of wood and electricity both decreased somewhat (9 percent and 3 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 over the 1995 to 2007 period.

Table 3. Paper Manufacturing subsector energy use by energy source, 1995 and 2007

Energy category	Energy source	1995 Energy in PJ (%)	2007 Energy in PJ (%)	Growth (%)
Electricity	Electricity	193.7 (21.5)	187.9 (28.5)	-3
Natural gas	Natural gas	156.5 (17.4)	72.6 (11.0)	-54
Coal/coke	Coal	2.4 (0.3)	1.4 (0.2)	-41
RPP (incl. propane)	Heavy fuel oil	63.9 (7.1)	33.8 (5.1)	-47
	Middle distillates	3.2 (0.4)	1.8 (0.3)	-46
	Propane	1.3 (0.1)	0.8 (0.1)	-40
	<b>Total, RPP</b>	<b>68.5 (7.6)</b>	<b>36.4 (5.5)</b>	<b>-47</b>
Spent pulping liquor	Spent pulping liquor	343.6 (38.1)	223.6 (34.0)	-35
Steam and wood	Steam	9.1 (1.0)	20.3 (3.1)	124
	Wood	127.4 (14.1)	116.0 (17.6)	-9
	<b>Total, Steam and wood</b>	<b>136.5 (15.1)</b>	<b>136.3 (20.7)</b>	<b>-0.1</b>
<b>Total</b>		<b>901.1 (100)</b>	<b>658.2 (100)</b>	<b>-26.9</b>

Due to rounding, the numbers in the tables may not add up.

## 4.2 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.”<sup>8</sup>

The 2007 ICE survey estimates that the Primary Metal Manufacturing subsector consumed 507 PJ of energy, which is 21 percent of the Manufacturing sector’s energy consumption, and makes it the second largest energy consuming subsector in Canada’s Manufacturing sector.

### 4.2.1 Primary Metal Manufacturing subsector 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 (less than 1 percent growth). Between 1995 and 2007, this subsector saw its energy intensity decrease 29 percent, from over 60 MJ/\$GDP to 43 MJ/\$GDP, or an average annual decrease of 2.8 percent. Figure 9 illustrates this downward trend.

<sup>8</sup>N.I. Sax and R.J. Lewis, *The Condensed Chemical Dictionary*, Tenth Edition (ISBN 0-442-28097-1).

**Figure 9. Indexed growth of energy intensity, energy use and GDP for the Primary Metal Manufacturing subsector, 1995–2007**

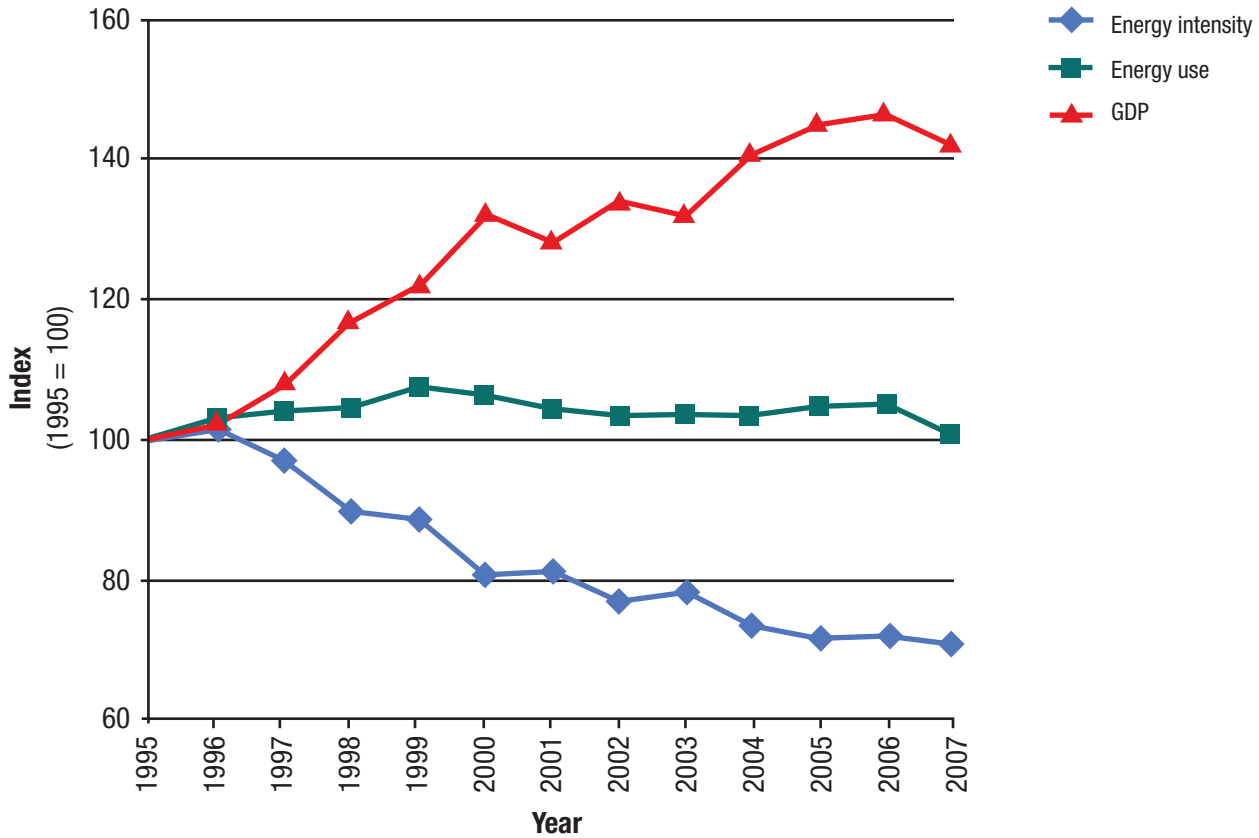
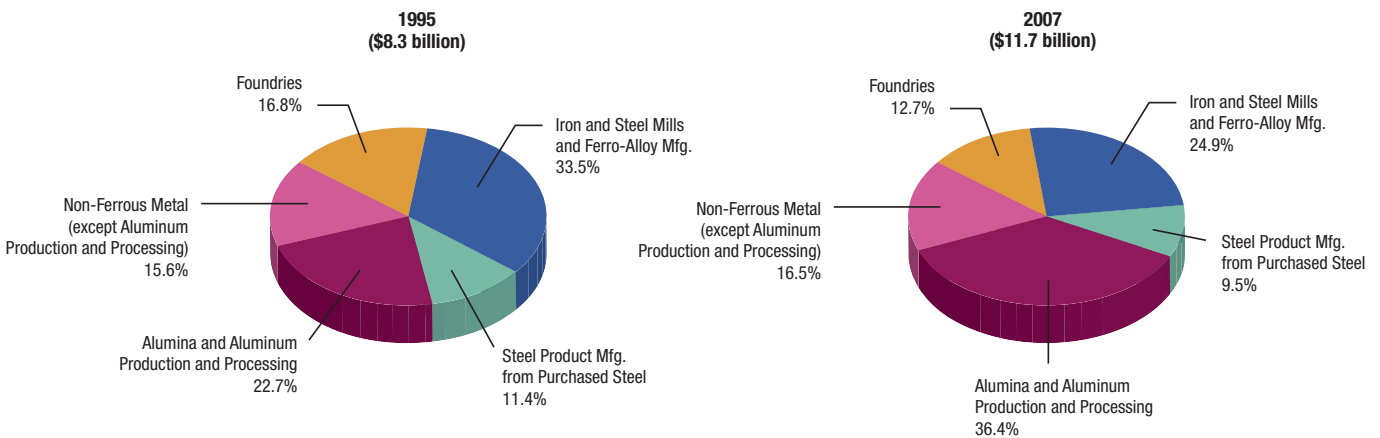


Figure 10 illustrates the distribution of GDP among the Canadian Primary Metal industries for 1995 and 2007. As this figure shows, the Primary Metal Manufacturing subsector experienced some structural changes over the period. The proportion of the Iron and Steel Mills and Ferro-Alloy Manufacturing (NAICS 3311) industry’s GDP decreased 8 percentage points, from

33 to 25 percent, whereas the Alumina and Aluminum Production and Processing (NAICS 3313) industry’s share of the subsector’s GDP increased 14 percentage points. The latter was due to a 132 percent growth in the GDP of Primary Production of Alumina and Aluminum (NAICS 331313) industry.

**Figure 10. Distribution of GDP\* of the Primary Metal Manufacturing subsector by industry, 1995 and 2007**



\*GDP at Basic prices in constant 2002 dollars

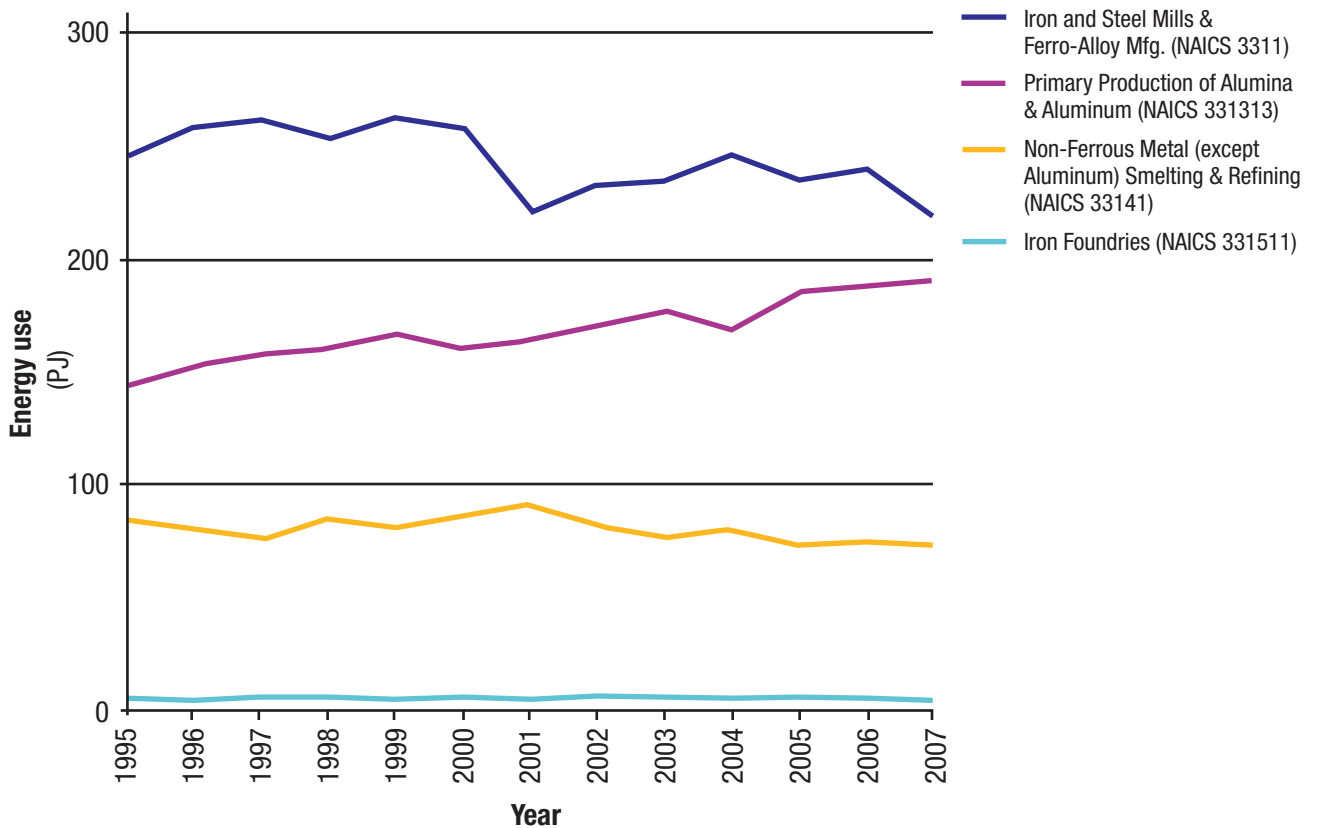
#### 4.2.2 Primary Metal Manufacturing subsector energy consumption trends by industry

Figure 11 illustrates energy use for the four largest industries within the Primary Metal Manufacturing subsector.<sup>9</sup> These four industries accounted for 96 percent of the subsector's energy use in 2007.

Even though energy use in the subsector remained relatively constant from 1995 to 2007, it was not the case at the industry level. Energy consumption of

the Primary Production of Alumina and Aluminum (NAICS 331313) industry increased 33 percent due to increasing GDP (132 percent), while the Iron and Steel Mills and Ferro-Alloy Manufacturing (NAICS 3311) industry and the Non-ferrous Metal (except Aluminum) Smelting & Refining (NAICS 33141) industry partially offset that increase with 11 percent and 13 percent reductions in their respective energy consumption.

**Figure 11. Energy use by selected Primary Metal Manufacturing industries, 1995–2007**



<sup>9</sup>Due to data limitation for some industries, 5- and 6-digit NAICS codes details are presented.

### 4.2.3 Primary Metal Manufacturing subsector energy consumption by source

Table 4 shows the energy consumption by energy source for the Primary Metal Manufacturing subsector in 1995 and 2007.

**Table 4. Primary Metal Manufacturing energy use by energy source, 1995 and 2007**

Energy category	Energy source	1995 Energy in PJ (%)	2007 Energy in PJ (%)	Growth (%)
Electricity	Electricity	214.4 (42.6)	244.8 (48.3)	14
Natural gas	Natural gas	128.4 (25.5)	116.9 (23.1)	-9
Coal/coke	Coal	9.9 (2.0)	X* (N/A)	N/A
	Coal coke, COG & Petroleum coke	131.8 (26.2)	106.5 (21.0)	-19
	<b>Total, Coal/coke</b>	<b>141.7 (28.2)</b>	<b>N/A (N/A)</b>	<b>N/A</b>
RPP (incl. propane)	Heavy fuel oil	15.4 (3.0)	18.7 (3.7)	22
	Middles distillates	2.4 (0.5)	3.2 (0.6)	37
	Propane	1.1 (0.2)	1.0 (0.2)	-7
	<b>Total, RPP</b>	<b>18.8 (3.7)</b>	<b>22.9 (4.5)</b>	<b>22</b>
Steam and wood	Steam and wood	0.4 (0.1)	X* (N/A)	N/A
<b>Total</b>		<b>503.8 (100)</b>	<b>506.7 (100)</b>	<b>0.6</b>

Due to rounding, the numbers in the tables may not add up.

\* Undisclosed value for confidentiality reasons.

Considering the increase in both energy use and GDP in the Primary Production of Alumina and Aluminum industry, it not surprising that we observe growing electricity consumption between 1995 and 2007, as this industry is known to be electricity intensive. Offsetting this increase in electricity consumption is the combined decrease of natural gas, coal coke, petroleum coke and coke oven gas.

## 4.3 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. The Petroleum Refineries (NAICS 32411) industry 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.

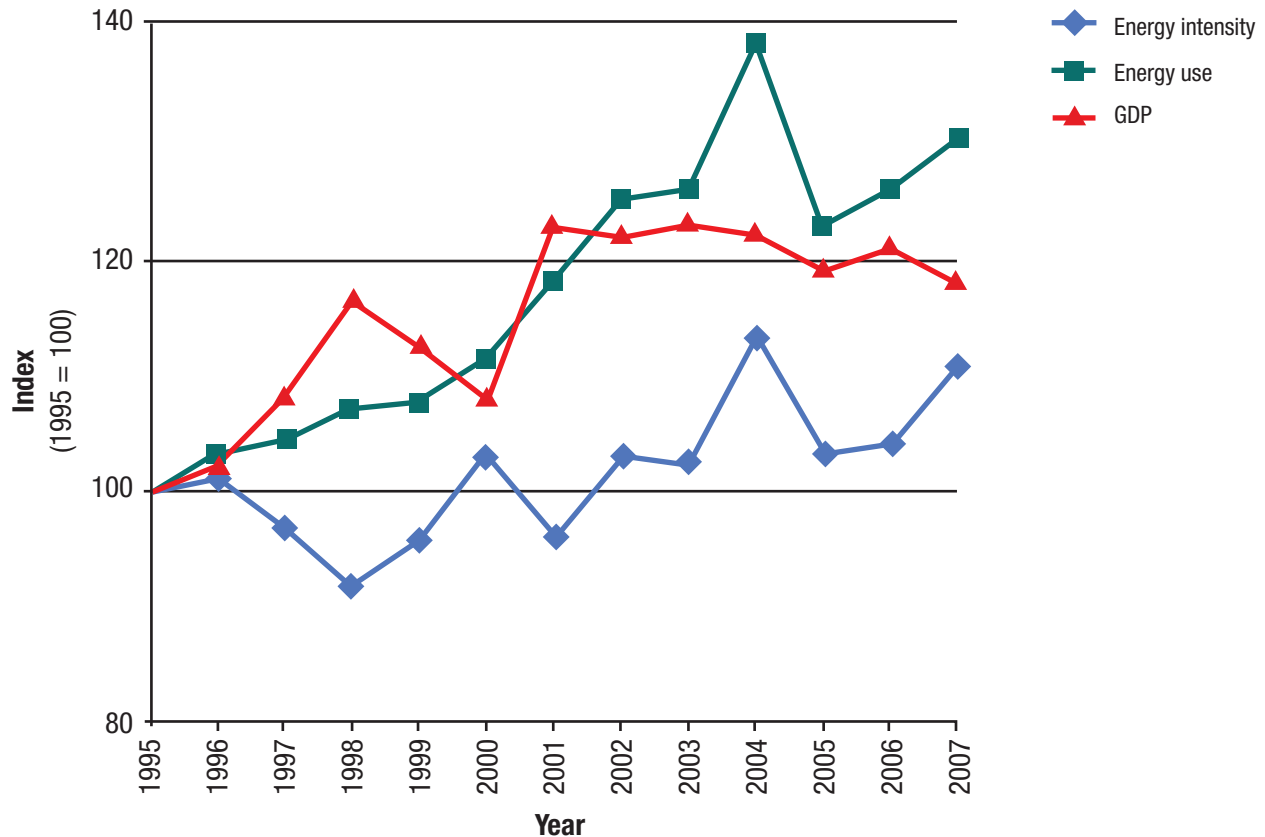
The 2007 ICE survey estimates that the Petroleum and Coal Product Manufacturing subsector consumed 382 PJ of energy, which is 16 percent of the Manufacturing sector's energy consumption, making it the third largest energy consuming subsector in Canada's Manufacturing sector.

### 4.3.1 Petroleum and Coal Product Manufacturing subsector energy consumption, output and energy intensity trends

Figure 12 illustrates indexed growth of energy intensity, energy use and GDP for the Petroleum and Coal Product Manufacturing subsector over the 1995 to 2007 period.

From 1995 to 1998, both output and energy use increased, the latter at a slower pace, which caused 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 use in 2004.

**Figure 12. Indexed growth of energy intensity, energy use and GDP for the Petroleum and Coal Products Manufacturing subsector, 1995-2007**



Overall, Canada's Petroleum and Coal Product Manufacturing subsector used 30 percent more energy and produced 18 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 80 percent of the subsector's Manufacturing Value Added (a proxy for GDP since GDP data for this industry are not available), we can infer that this industry made a

significant contribution to the 11 percent growth in energy intensity of the subsector between 1995 and 2007.

Since 1995, several regulations, such as *Sulphur in Diesel Regulations*, the *Sulphur in Gasoline Regulations* and the *Benzene in Gasoline Regulations*,<sup>10</sup> aimed at reducing air pollutants, were introduced. Meeting these regulations requires further refinement of crude oil, which, in turn, requires more energy. This may help to explain the increase in energy intensity mentioned above.

<sup>10</sup>Environment Canada, Fuel Regulations, 2009. [www.ec.gc.ca/cleanair-airpur/Pollution\\_Sources/Fossil\\_Fuels/Fuel\\_Regulations-WSFB0BA68A-1\\_En.htm](http://www.ec.gc.ca/cleanair-airpur/Pollution_Sources/Fossil_Fuels/Fuel_Regulations-WSFB0BA68A-1_En.htm).

#### 4.3.2 Petroleum and Coal Product Manufacturing subsector energy consumption trends by industry

The ICE survey collects information for only the Petroleum Refineries industry, which accounts for about 96 percent of all energy used to process petroleum and coal.

#### 4.3.3 Petroleum and Coal Product Manufacturing subsector energy consumption by source

Table 5 shows the energy consumption by energy source for the Petroleum and Coal Product Manufacturing subsector in 1995 and 2007.

Table 5. Petroleum and Coal Product Manufacturing subsector energy use by energy source, 1995 and 2007

Energy category	Energy source	1995 Energy in PJ (%)	2007 Energy in PJ (%)	Growth (%)
Electricity	Electricity	17.3 (5.9)	21.7 (5.7)	25
Natural gas	Natural gas	51.0 (17.4)	57.3 (15.0)	12
Coal/coke	Coal	0.9 (0.3)	X* (N/A)	N/A
	Coal coke, COG & Petroleum coke	48.4 (16.5)	55.9 (14.6)	15
	<b>Total, Coal/coke</b>	<b>49.3 (16.8)</b>	<b>N/A (N/A)</b>	<b>N/A</b>
RPP (incl. propane)	Refinery fuel gas	127.6 (43.6)	213.3 (55.9)	67
	Other RPP (incl. propane)	47.0 (16.0)	X* (N/A)	N/A
	<b>Total, RPP (incl. propane)</b>	<b>174.6 (59.6)</b>	<b>N/A (N/A)</b>	<b>N/A</b>
Steam and wood	Steam and wood	0.6 (0.2)	X* (N/A)	N/A
<b>Total, undisclosed values</b>		0.0 (0.0)	33.5 (8.8)	N/A
<b>Total</b>		<b>293.0 (100)</b>	<b>381.7 (100)</b>	<b>30</b>

Due to rounding, the numbers in the tables may not add up.

\* Undisclosed value for confidentiality reasons.

Due to the unavailability of certain 2007 data, it is not possible to determine the trend in coal/coke and steam and wood use over the 1995 to 2007 period. However, depending on how the “Total, undisclosed values” is actually distributed across the “X (N/A)” entries, the decline in other RPP (including propane) was at least 29 percent. Indeed, even if the values for coal and steam and wood were zero, other RPP (including propane) would equal the Total, undisclosed values (i.e. 33.5 PJ), which would be less than its 1995 level of 47 PJ.

The use of 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 67 percent (86 PJ) since 1995.

**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 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. GDP figures are reported in constant 2002 dollars.

**Petajoule:** One petajoule equals  $1 \times 10^{15}$  joules. A joule is the international unit of a measure of energy – the energy produced by the power of 1 watt flowing for 1 second. There are 3.6 million joules in 1 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 is designed to provide 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

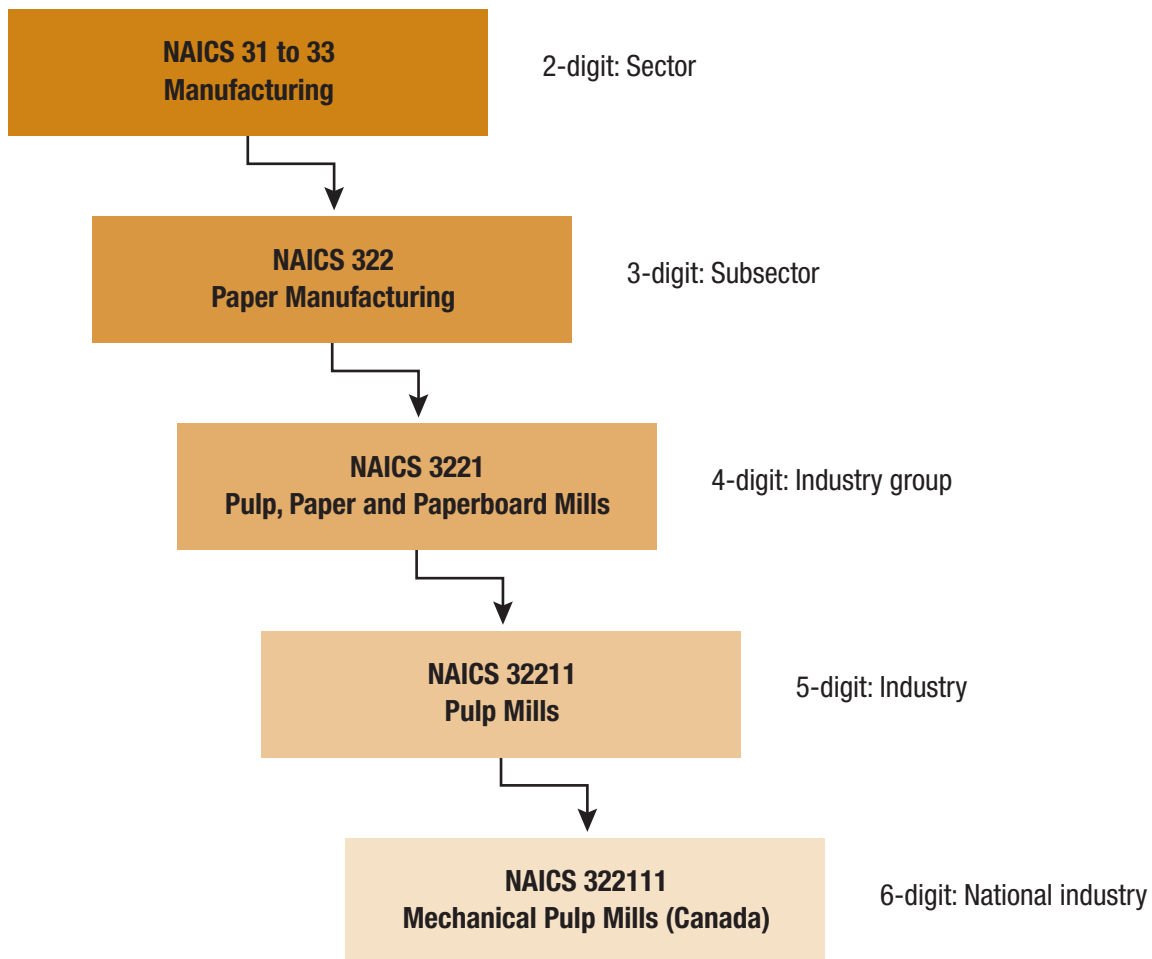
The North American Industry Classification System (NAICS) is an industry classification that provides common definitions of the industrial structure of Canada, Mexico and the United States. Developed jointly by the statistical agencies of these three countries, NAICS was adopted in 1997 and revised in 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, and replaces NAICS Canada 2002. Table B.2 lists the 20 sectors.

**Table B.2 Sectors included in NAICS 2002**

<b>Sector</b>	<b>NAICS</b>
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, 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

**For a complete description of the structure of the Manufacturing sector visit**

**Statistics Canada's Web site:**

**<http://stds.statcan.gc.ca/naics-scian/2007/ts-rt-eng.asp?criteria=31-33>**

**Figure 1:**

Statistics Canada (2009), CANSIM, Table 128-0006 “Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual” Energy consumption vector: v26562764.

Informetrica Limited (2009), GDP data.

**Figure 2:**

Statistics Canada (2009), CANSIM, Table 128-0006 “Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual” Energy consumption vectors: v26562777, v26562815, v26562785, v26562771, v26562809, v26562788, v26562837, v26562841, v26562767, v26562768, v26562769, v26562770, v26562784, v26562804, v26562823, v26562834, v26562835, v26562836, v26562854, v26562855.

Informetrica Limited (2009), GDP data.

**Figure 3:**

Statistics Canada (2009), CANSIM, Table 128-0006 “Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual” Energy consumption vectors: v26562777, v26562815, v26562785, v26562771, v26562809, v26562788, v26562837, v26562841, v26562767, v26562768, v26562769, v26562770, v26562784, v26562804, v26562823, v26562834, v26562835, v26562836, v26562854, v26562855.

**Figure 4:**

Statistics Canada (2009), CANSIM, Table 128-0006 “Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual” Energy consumption vector: v26563025, v26563037, v26563048, v26563051, v26563143, v26563220, v26563309, v26563401, v26562856, v26562946, v26562949, v26562957, v26563001.

**Figure 5:**

Natural Resources Canada (2009), Office of the Energy Efficiency, *Energy Use Data Handbook* Tables, Industrial Sector, Table 7. [oeecorporate/statistics/neud/dpa/tableshandbook2/agg\\_00\\_7\\_e\\_3.cfm?attr=0](http://www.oeecorporate/statistics/neud/dpa/tableshandbook2/agg_00_7_e_3.cfm?attr=0)

**Table 1 and 2:**

Statistics Canada (2009), 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 6:**

Statistics Canada (2009), CANSIM, Table 128-0006 “Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual” Energy consumption vectors: v26562777, v26562815, v26562785, v26562771, v26562809, v26562788, v26562837, v26562841, v26562767, v26562768, v26562769, v26562770, v26562784, v26562804, v26562823, v26562834, v26562835, v26562836, v26562854, v26562855.

**Figure 7:**

Statistics Canada (2009), CANSIM, Table 128-0006 “Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual” Energy consumption vector: v26562777.

Informetrica Limited (2009), GDP data.

**Figure 8:**

Statistics Canada (2009), 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.

**Table 3:**

Statistics Canada (2009), 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.

**Figure 9:**

Statistics Canada (2007), CANSIM, Table 128-0006 “Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual” Energy consumption vector: v26562815.

Informetrica Limited (2009), GDP data.

**Figure 10:**

Informetrica Limited (2009), GDP data.

**Figure 11:**

Statistics Canada (2009), 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.

**Table 4:**

Statistics Canada (2009), 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.

**Figure 12:**

Statistics Canada (2009), CANSIM, Table 128-0006 “Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS), annual” Energy consumption vector: v26562785.

Informetrica Limited (2009), GDP data.

**Table 5:**

Statistics Canada (2009), 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.