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Industrial Consumption of Energy (ICE) Survey Summary Report of Energy Use in the Canadian Manufacturing Sector, 1995–2009

July 2011



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1 Foreword

Every year, Statistics Canada conducts the Industrial Consumption of Energy (ICE) survey,¹ which collects energy use data from establishments² in Canada's Manufacturing sector.³ 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.

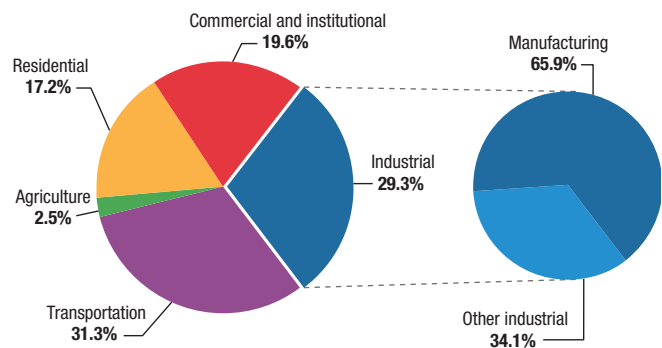
This summary report examines energy consumption patterns for the Canadian Manufacturing sector, using the results of the 2009 ICE survey. The estimates are based on the North American Industry Classification System (NAICS) and include all 21 subsectors of the Manufacturing sector (NAICS 31 to 33).⁴

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 consumption⁵ of the residential, agricultural, commercial and institutional, industrial and transportation sectors was

distributed in 2009. Total energy use by the industrial sector accounted for 29.3 percent of the total secondary energy use in Canada. The Manufacturing industries accounted for the largest share of energy in the industrial sector (65.9 percent).

Figure 1. Canada's secondary energy consumption by sector, 2009



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

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Note to readers: Statistics Canada regularly revises the ICE survey estimates to improve their quality constantly. 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 Although entitled the Industrial Consumption of Energy (ICE) survey, data published from the ICE survey do 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, because several data initiatives already gather information on these sectors.

² See Appendix A, Glossary, for a more in-depth description.

³ See Appendix B, North American Industry Classification System.

⁴ See Appendix A, Glossary, for a definition and Appendix B, North American Industry Classification System, for details.

⁵ The energy used by final consumers in various sectors of the economy.

2 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 from 1995 to 2009, using the results of the ICE survey.

The following are some of the key findings from the 2009 ICE survey:

- The 2009 energy consumption of the Manufacturing sector was 11 percent, or 240 petajoules⁶ (PJ), lower than in 2008. From 1995 to 2009, the Manufacturing sector's energy use decreased by 18 percent (or 445 PJ), which is approximately equal to the energy used in offices across Canada in 2008 for space heating, space cooling, lighting, water heating, as well as operating auxiliary equipment (such as computers) and motors.⁷
- According to Statistics Canada, weakened global and domestic demand for manufactured goods continued to drive down capacity utilization rates.⁸ Of the 21 subsectors in the manufacturing sector, 18 registered lower industrial capacity utilization rates in 2009 than in the previous year.⁹
- Although there are 21 subsectors within the Manufacturing sector, 4 subsectors accounted for 76 percent of all energy consumption of the sector in 2009 – Paper Manufacturing (NAICS 322), Primary Metal Manufacturing (NAICS 331), Petroleum and Coal Product Manufacturing (NAICS 324) and Chemical Manufacturing (NAICS 325). This summary report examines key findings among these four subsectors.

⁶ See Appendix A, Glossary, for a description of petajoule.

⁷ Natural Resources Canada, *Energy Use Data Handbook, 1990–2008*, Commercial Sector, Table 1, oee.nrcan.gc.ca/corporate/statistics/neud/dpa/tableshandbook2/com_00_1_e_4.cfm.

⁸ See Appendix A, Glossary, for a definition of capacity utilization rate.

⁹ Statistics Canada, The Daily, June 11, 2009, www.statcan.gc.ca/daily-quotidien/090611/dq090611a-eng.htm. "Manufacturers lowered their use of production capacity in the first quarter [of 2009] to 65.9%, down 7.8 percentage points from the fourth quarter of 2008. This was the largest quarterly decline on record for the entire manufacturing sector."

From 1995 to 2009

Table 1 compares energy consumption, output (as measured by gross domestic product [GDP]¹⁰) and energy intensity¹¹ of the overall Manufacturing sector and the four greatest energy users of the sector from 1995 to 2009. It shows that from 1995 to 2009, energy consumption in the Manufacturing sector decreased while its production increased; this resulted in an improvement in energy intensity.

Table 1. Comparison of energy consumption, GDP and energy intensity of the Manufacturing sector and selected subsectors, 1995–2009

	Total Manufacturing (NAICS 31–33)	Paper (NAICS 322)	Primary Metal (NAICS 331)	Petroleum and Coal Product (NAICS 324)	Chemical (NAICS 325)
Change in energy consumption	-17.9% -445.0 PJ	-41.1% -370.4 PJ	-16.7% -84.3 PJ	25.2% 73.8 PJ	-14.2% -39.4 PJ
Change in GDP	4.5% \$6.3 billion	-18.8% \$2.0 billion	4.1% \$0.3 billion	12.9% \$0.4 billion	6.0% \$0.7 billion
Change in energy intensity	-2.5%	-27.4%	-20.0%	10.9%	-19.1%

¹⁰ In this report, GDP figures are reported in constant 2002 dollars. See Appendix A, Glossary, for a description of GDP.

¹¹ Energy intensity is the amount of energy use per unit of activity. See Appendix A, Glossary, for a more in-depth description.

2 Executive summary

The Paper Manufacturing subsector's energy consumption declined by 370 PJ (or 41 percent) between 1995 and 2009. This was the largest decrease among the four subsectors. It was also the only subsector that experienced a decrease in GDP (19 percent) during the period. This is partially a result of the closing of many pulp and paper plants over the last few years.

The Petroleum and Coal Product Manufacturing subsector shows the only increase in energy use of the four subsectors – increasing 74 PJ (or 25 percent). It was also the only subsector that experienced an increase in energy intensity (11 percent) during the period. This could be due in part to the introduction of federal regulations aimed at reducing air pollutants.¹² Adhering to these regulations required further refinement of crude oil by the petroleum refineries, which in turn required more energy. These regulations are discussed further in Section 5.3.1 of this summary report.

From 2008 to 2009

In 2009, the Manufacturing sector continued to face the impact of the recession late in the year (third quarter). This resulted in decreased output and energy use. Since output fell more quickly than energy use, increases in energy intensity were witnessed in almost every Manufacturing subsector. Table 2 compares energy consumption, output (GDP) and energy intensity of the Manufacturing sector as a whole, as well as the four selected subsectors, from 2008 to 2009.

Table 2. Comparison of energy consumption, GDP and energy intensity of the Manufacturing sector and selected subsectors, 2008–2009

	Total Manufacturing (NAICS 31–33)	Paper (NAICS 322)	Primary Metal (NAICS 331)	Petroleum and Coal Product (NAICS 324)	Chemical (NAICS 325)
Change in energy consumption	-10.5% -240.5 PJ	-8.5% -49.4 PJ	-20.0% -105.1 PJ	-1.8% -6.6 PJ	-7.3% -18.9 PJ
Change in GDP	-12.7% \$21.3 billion	-13.3% \$1.3 billion	-25.1% \$2.9 billion	-0.8% \$30.0 million	-10.3% \$1.5 billion
Change in energy intensity	2.5%	5.6%	6.7%	-1.0%	3.3%

Petroleum and Coal Product Manufacturing was the only subsector analysed in this report with a decrease in energy intensity from 2008 to 2009.

¹² Environment Canada, Fuel Regulations, 2009, www.ec.gc.ca/energie-energy/default.asp?lang=En&n=EE068DA8-1.

3 Industrial energy data

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 the Manufacturing sector's energy consumption is essential to effectively monitoring the sector's energy efficiency.

Other data sources

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* (RES-D), Canadian Industry Program for Energy Conservation (CIPEC), Canadian Industrial Energy End-Use Data and Analysis Centre (CIEEDAC), and NRCan's Demand and Policy Analysis Division (DPAD).

Factors influencing industrial energy demand

Several factors influence energy demand in the Manufacturing sector. These factors can work alone or in combination to increase or decrease the total energy demand. It is difficult to attribute the observed changes 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, price effect, capacity utilization and scale effect, change in the composition of the subsector production, and energy efficiency measures.

A brief summary and description of the industrial data sources and the definitions of the factors influencing the industrial energy demand are provided in last year's report at oee.nrcan.gc.ca/publications/statistics/ice08/index.cfm.

4 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 [North American Industry Classification System] 31 to 33). These establishments primarily transform materials or substances into new products.

This summary report examines energy consumption and energy intensity patterns for the Canadian Manufacturing sector. One way to define energy intensity in the Manufacturing sector is the energy use per unit of output; for example, 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 subsector that is easily comparable over time and between subsectors.

4.1 Energy intensity and total energy consumption in the Manufacturing sector

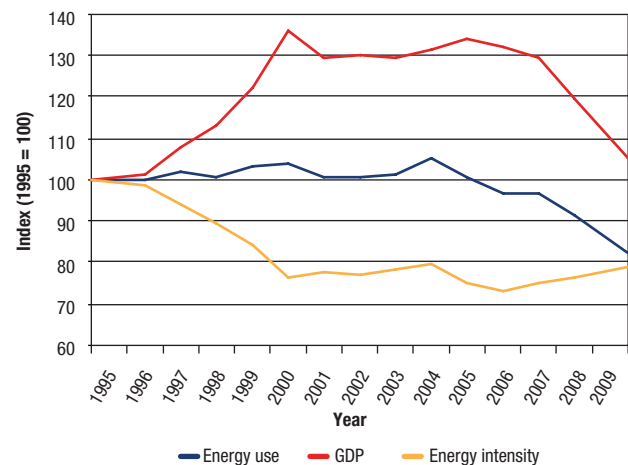
In 2009, the Manufacturing sector generated \$146.6 billion in GDP, in constant 2002 dollars, and according to ICE estimates, it consumed 2047 petajoules (PJ) of energy. To put this into perspective, this amount is roughly twice the energy consumed for space heating, space cooling and lighting by all Canadian households (1006 PJ) in 2008.¹³

Canada's Manufacturing sector used 18 percent less energy and produced 5 percent more output in 2009 than it did in 1995. The sector's overall energy intensity declined 3 percent, from 18 megajoules per dollar of GDP (MJ/\$GDP) to 14 MJ/\$GDP (although it has been on the rise since 2007).

¹³ Natural Resources Canada, *Energy Use Data Handbook, 1990–2008*, Residential Sector, Table 1, oee.nrcan.gc.ca/corporate/statistics/neud/dpa/tableshandbook2/res_00_1_e_4.cfm.

Figure 2 illustrates the indexed growth of energy intensity, energy use and GDP from 1995 to 2009. 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. Both output and energy consumption fell from 2007 to 2008 and continued to fall into 2009, although output fell at a faster rate than energy consumption.

Figure 2. Indexed growth of energy intensity, energy use and GDP for the Manufacturing sector, 1995–2009

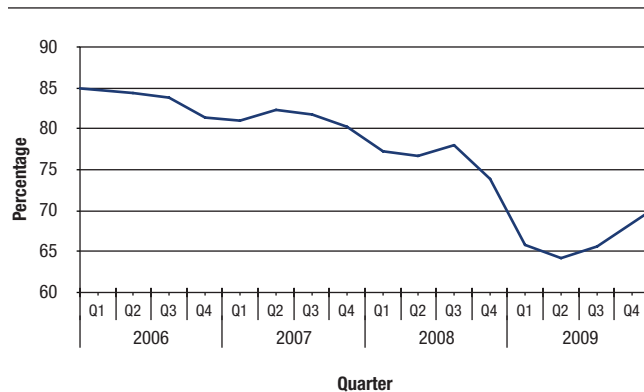


Caught in the global economic downturn, the Canadian economy started a downturn in 2008, which caused Canada to fall into a recession by the end of that year. According to a 2010 Bank of Canada report, “The global economic recovery is under way, supported by continued improvements in financial conditions and stronger domestic demand growth in many emerging-market economies ... Economic growth in Canada resumed in the

third quarter of 2009 and is expected to have picked up further in the fourth quarter.¹⁴

The fact that the downturn lasted late into the third quarter of 2009 explains, at least in part, the decrease in output between 2008 and 2009 (13 percent, from \$167.9 billion in GDP in 2008 to \$146.6 billion in GDP in 2009). Energy use also decreased over this period but at a lower rate (10 percent, from 2287 PJ to 2047 PJ). The Manufacturing sector, which was operating at a higher capacity utilization rate before the economic downturn, was likely benefitting from economies of scale, which disappeared when production dropped. In fact, Figure 3 shows that capacity utilization in the Manufacturing sector started its long decline in the second quarter of 2007 to reach its lowest point in the second quarter of 2009 (64.7 percent).¹⁵ The loss of these economies of scale contributed to the increase in energy intensity that the sector had experienced since 2007.

Figure 3. Manufacturing capacity utilization, 2006–2009



4.2 Energy intensity and energy consumption by subsector

Figure 4 compares the energy intensity of the four Manufacturing subsectors that consumed the most energy in 2009, over the study period. These four subsectors accounted for 23 percent of the sector's GDP and 76 percent of its energy consumption in 2009. The energy intensity varied across the selected subsectors, however. In 2009, it ranged from close to 19 MJ/\$GDP for the Chemical Manufacturing subsector (NAICS 325) to more

than 112 MJ/\$GDP for the Petroleum and Coal Product Manufacturing subsector (NAICS 324).

Petroleum and Coal Product Manufacturing was the only selected subsector that experienced an increase in energy intensity over the 14 years (1995–2009). Further analysis of each selected subsector is provided in Section 5.

Figure 4. Energy intensity of the four selected Manufacturing subsectors, 1995–2009

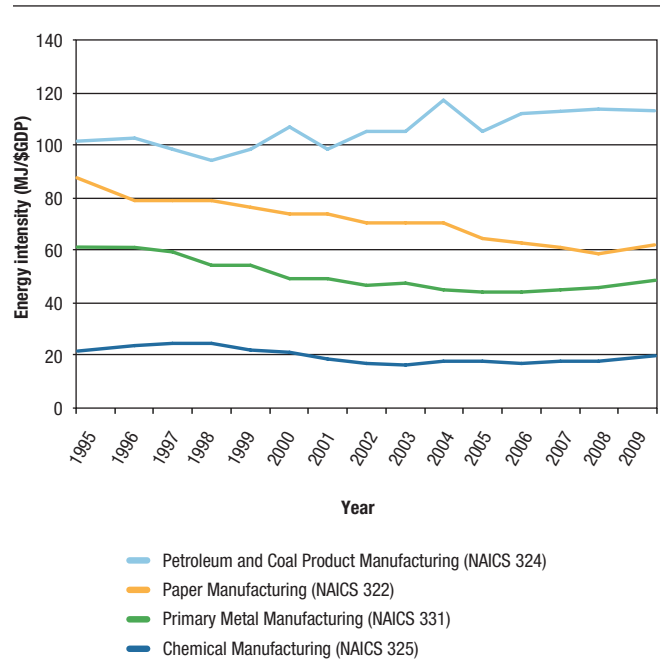


Figure 5 shows the energy use of the selected Manufacturing subsectors for 1995, 2008 and 2009. The two biggest changes in both levels and percentages were as follows:

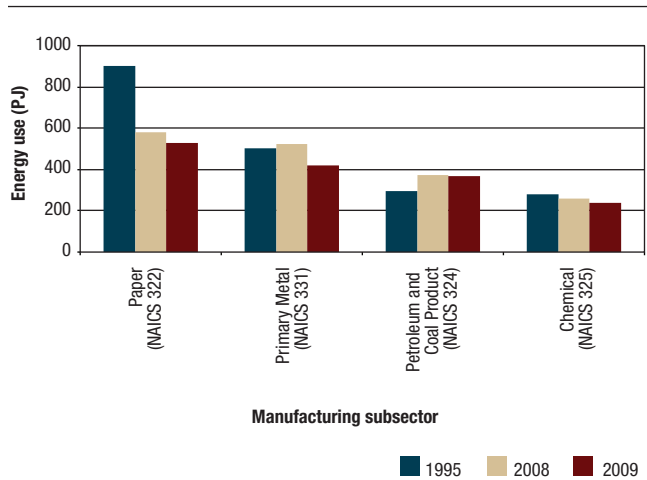
- Energy consumption in the Paper Manufacturing subsector decreased 41 percent (370 PJ) from 1995 to 2009.
- Energy consumption in the Petroleum and Coal Product Manufacturing subsector increased 25 percent (74 PJ) from 1995 to 2009, declining slightly from 2008 to 2009.

¹⁴ Bank of Canada, press release, January 19, 2010, www.bankofcanada.ca/en/fixed-dates/2010/rate_190110.html.

¹⁵ Statistics Canada, The Daily, December 14, 2009, www.statcan.gc.ca/daily-quotidien/091214/dq091214b-eng.htm.

4 Energy consumption in the Manufacturing sector

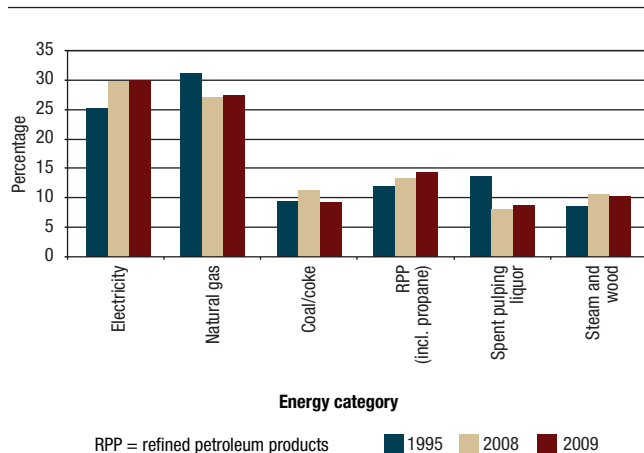
Figure 5. Energy consumption of the four selected Manufacturing subsectors, 1995, 2008 and 2009



4.3 Energy consumption by energy category

From 1995 to 2009, the energy consumed by the Manufacturing sector shifted from some energy sources¹⁶ toward others. Figure 6 outlines the variances in the share of energy categories in 1995, 2008 and 2009. The share of electricity increased the most, whereas the share of spent pulping liquor decreased the most.

Figure 6. Share of energy consumption of the Manufacturing sector by energy category, 1995, 2008 and 2009

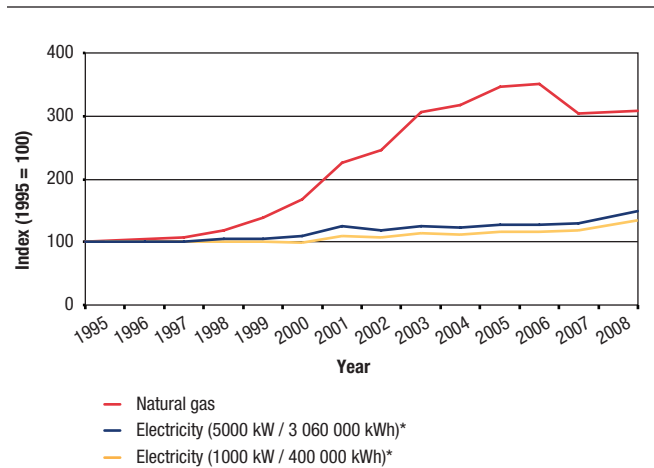


¹⁶ See Appendix A, Glossary, for a definition of energy source.

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 \$8.6 billion in 2009 (or 28 percent). This decline might explain, at least in part, the decreased use of spent pulping liquor since 2004 (a decrease of 41 percent). Similarly, refinery fuel gas¹⁷ is produced and used exclusively by the Petroleum and Coal Product Manufacturing subsector – and almost entirely by its Petroleum Refineries industry (NAICS 32411).¹⁸ This subsector saw its energy consumption increase by 25 percent from 1995 to 2009, which explains the increase in refined petroleum products during that period.

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.

Figure 7. Indexed growth of industrial natural gas and electricity prices, 1995–2008



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

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 an electricity-intensive industry, contributed to the increase in electricity use.

¹⁷ Included in "refined petroleum products" (RPP) in Figure 6.

¹⁸ See Appendix B, North American Industry Classification System.

As a complement to Figure 6, Table 3 illustrates the energy use by energy category and energy source for the Manufacturing sector in 1995 and 2009. Overall energy consumption in the sector fell by almost 18 percent over 1995–2009, with significant reductions in the consumption of most energy sources. Overall, energy consumption of the refined petroleum products (RPP) energy category is down only 1 percent. However, within the category, there were significant changes to the fuel mix. Heavy fuel oil and propane were down 53.9 percent and 46.7 percent respectively, while refinery fuel gas and middle distillates were both up, 55.5 percent and 43.3 percent respectively. Meanwhile, in the coal/coke energy category, petroleum coke and coal also experienced a slight increase in use.

Table 3. Manufacturing sector's energy use by energy source, 1995 and 2009

Energy category	Energy source	1995 energy		2009 energy		Growth, 1995–2009 (%)
		(PJ)	(%)	(PJ)	(%)	
<i>Electricity</i>	Electricity	624.7	25.1	614.5	30	-1.6
<i>Natural gas</i>	Natural gas	777.8	31.2	563.0	27.5	-27.6
<i>Coal/coke</i>	Coal	41.3	1.7	41.8	2.0	1.3
	Coke	102.9	4.1	56.1	2.7	-45.5
	Coke oven gas	27.4	1.1	19.9	1.0	-27.3
	Petroleum coke and coke from catalytic cracking catalyst	64.6	2.6	70.2	3.4	8.7
	Total, coal/coke	236.2	9.5	188.1	9.2	-20.4
<i>RPP* (incl. propane)</i>	Heavy fuel oil	139.8	5.6	64.4	3.1	-53.9
	Middle distillates	17.2	0.7	24.6	1.2	43.3
	Propane	12.3	0.5	6.6	0.3	-46.7
	Refinery fuel gas	127.6	5.1	198.5	9.7	55.5
	Total, RPP (incl. propane)	297.0	11.9	294.2	14.4	-1.0
<i>Spent pulping liquor</i>	Spent pulping liquor	343.6	13.8	177.6	8.7	-48.3
<i>Steam and wood</i>	Steam and wood	212.3	8.5	209.3	10.2	-1.4
Total		2 491.7	100.0	2 046.7	100.0	-17.9

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

Between 2008 and 2009, energy consumption in the Manufacturing sector fell by almost 10.5 percent, a significant one-year reduction. As outlined in Table 4, energy consumption of all energy sources decreased substantially from 2008 to 2009, with the exception of middle distillates and refinery fuel gas, which increased slightly.

Table 4. Manufacturing sector's energy use by energy source, 2008 and 2009

Energy category	Energy source	2008 energy		2009 energy		Growth, 2008–2009 (%)
		(PJ)	(%)	(PJ)	(%)	
<i>Electricity</i>	Electricity	679.3	29.7	614.5	30.0	-9.5
<i>Natural gas</i>	Natural gas	617.7	27.0	563.0	27.5	-8.9
<i>Coal/coke</i>	Coal	53.4	2.3	41.8	2.0	-21.8
	Coke	98.9	4.3	56.1	2.7	-43.2
	Coke oven gas	25.9	1.1	19.9	1.0	-23.0
	Petroleum coke and coke from catalytic cracking catalyst	78.5	3.4	70.2	3.4	-10.5
	Total, coal/coke	256.7	11.2	188.1	9.2	-26.7
<i>RPP* (incl. propane)</i>	Heavy fuel oil	76.2	3.3	64.4	3.1	-15.5
	Middle distillates	24.4	1.1	24.6	1.2	1.2
	Propane	8.2	0.4	6.6	0.3	-19.6
	Refinery fuel gas	198.1	8.7	198.5	9.7	0.2
	Total, RPP (incl. propane)	306.9	13.4	294.2	14.4	-4.2
<i>Spent pulping liquor</i>	Spent pulping liquor	184.2	8.1	177.6	8.7	-3.6
<i>Steam and wood</i>	Steam and wood	242.3	10.6	209.3	10.2	-13.7
Total		2 287.2	100.0	2 046.7	100.0	-10.5

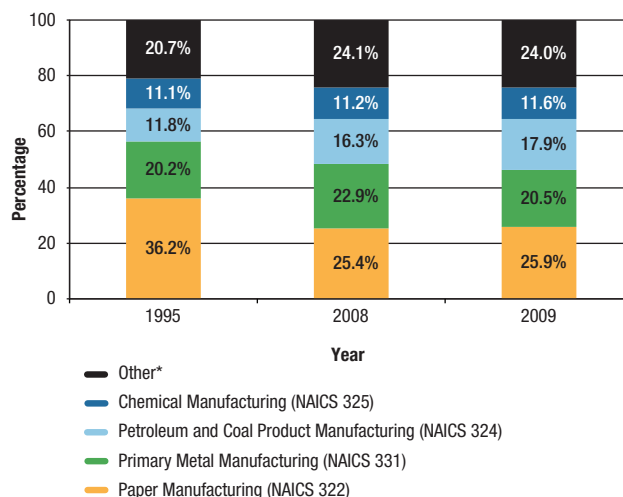
Note: Due to rounding, the numbers in the table may not add up.
*RPP = refined petroleum products

5 Selected Manufacturing subsectors

Although the Manufacturing sector has 21 subsectors,¹⁹ 76 percent of all energy consumption in 2009 was by only 4 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) and Chemical Manufacturing (NAICS 325). This section examines these four subsectors in greater detail.

As demonstrated in Figure 8, the share of energy consumption of the Paper Manufacturing subsector decreased substantially from 1995 to 2008 (11 percentage points) and remained at that level in 2009. The Primary Metal Manufacturing subsector's share increased slightly (3 percentage points) from 1995 to 2008 but decreased by the same amount from 2008 to 2009. The Petroleum and Coal Product Manufacturing subsector experienced an increase in its share of energy consumption over the entire period (6 percentage points). The share of the Chemical Manufacturing subsector remained relatively stable from 1995 to 2009.

Figure 8. Share of energy consumption in the Manufacturing sector, 1995, 2008 and 2009



*Other includes NAICS 311, 312, 313, 314, 315, 316, 321, 323, 326, 327, 332, 333, 334, 335, 336, 337 and 339.

5.1 Paper Manufacturing subsector (NAICS 322)

Establishments in the Paper Manufacturing subsector produce pulp, paper and paper products. The 2009 ICE survey estimated that this subsector consumed 531 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.

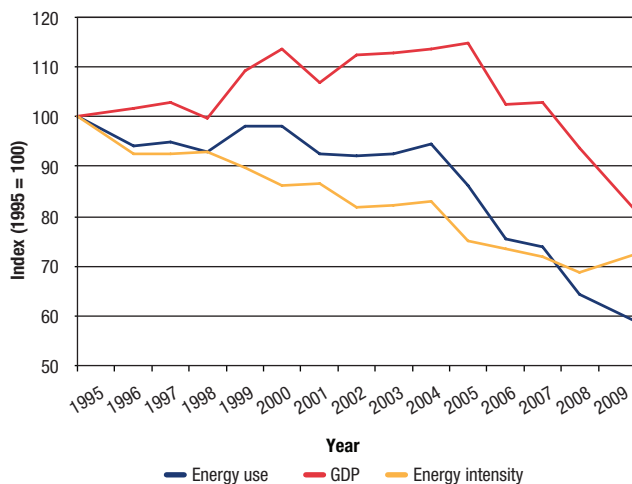
5.1.1 Paper Manufacturing subsector's energy consumption, output and energy intensity trends

Figure 9 illustrates the indexed growth of energy intensity, energy use and gross domestic product (GDP) from 1995 to 2009 for the Paper Manufacturing subsector. It shows similar trends between energy use and GDP as they rise

¹⁹ For a list of the 21 subsectors, see Appendix B, North American Industry Classification System.

and fall together over time. However, when the GDP grew 14 percent between 1998 and 2000 and 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 18 percent between 2004 and 2008, energy use declined 32 percent. The increasing gap between the two indicators resulted in a decrease of energy intensity over time. However, between 2008 and 2009, the GDP fell substantially (13 percent), while energy use decreased by only 9 percent. This resulted in an increase of energy intensity of almost 6 percent.

Figure 9. Indexed growth of energy intensity, energy use and GDP for the Paper Manufacturing subsector, 1995–2009



From 1995 to 2009, the Paper Manufacturing subsector's output decreased 19 percent, from \$10.6 billion to \$8.6 billion. At the same time, its energy consumption decreased 41 percent, from 901 PJ to 531 PJ. Consequently, the subsector's associated energy intensity diminished 27 percent, from 85 megajoules per dollar of GDP (MJ/\$GDP) to 62 MJ/\$GDP, or a 1.9 percent average annual decline.

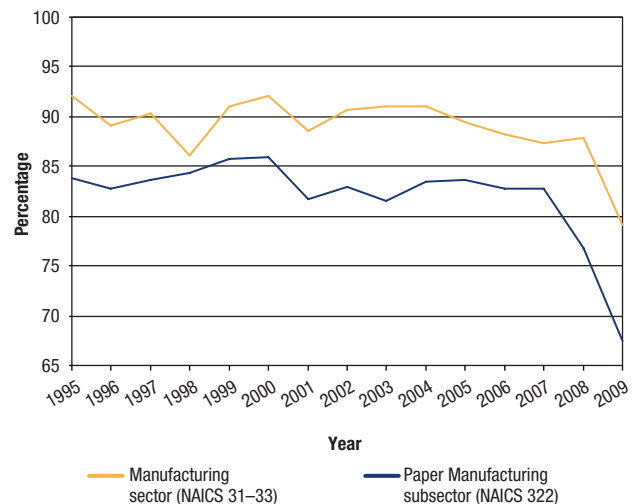
Of the four largest consumers of energy within the Manufacturing sector, Paper Manufacturing is the only subsector that had a decrease in GDP between 1995 and 2009.

Despite the significant decrease in GDP since 2004 in the Paper Manufacturing subsector, 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 from 2004 to 2008. However, from 2008 to

2009, energy intensity increased for the subsector, because it too faced the impact of the recession.

As shown in Figure 10, the drop in energy consumption in the Paper Manufacturing subsector from 2004 to 2008 cannot be entirely associated with capacity utilization. In fact, this subsector coped better than the rest of the Manufacturing sector with the recent economic downturn. While capacity utilization for the entire sector decreased 18.6 percent from 2007 to 2009, it decreased by only 9.5 percent for the Paper Manufacturing subsector.

Figure 10. Comparison of capacity utilization rates for the Manufacturing sector and Paper Manufacturing subsector, 1995–2009



In 2004, the Paper Manufacturing subsector consumed 330 PJ more than the second-most energy-consuming subsector (Primary Metal). In 2008, this gap was reduced to only 65 PJ, due in large part to poor market conditions for Canadian paper products, as indicated by the decline in GDP. By 2009, this gap had increased to 112 PJ, and energy intensity increased slightly.

5.1.2 Paper Manufacturing subsector's energy consumption trends by industry

Figures 11a and 11b illustrate the amount of energy used by the industries that comprise the Paper Manufacturing subsector for 1995–2009. The only industry that increased its energy consumption over the period was the Converted Paper Product Manufacturing industry (NAICS 3222), which was also the only industry to have an increase in energy consumption from 2008 to

5 Selected Manufacturing subsectors

2009 (5 percent) even though it experienced a decline in GDP from 2008 to 2009 (5 percent). This industry accounted for only 3 percent of the energy use of the Paper Manufacturing subsector in 2009. That year, the rest of the subsector's industries experienced a significant drop in energy consumption of 17 percent to 36 percent, mainly as a result of reduced output.

Figure 11a. Energy consumption of the Paper Manufacturing industries, 1995–2009

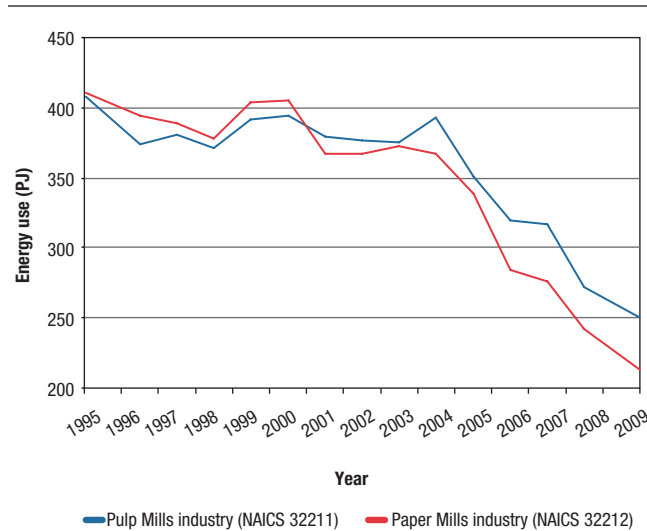
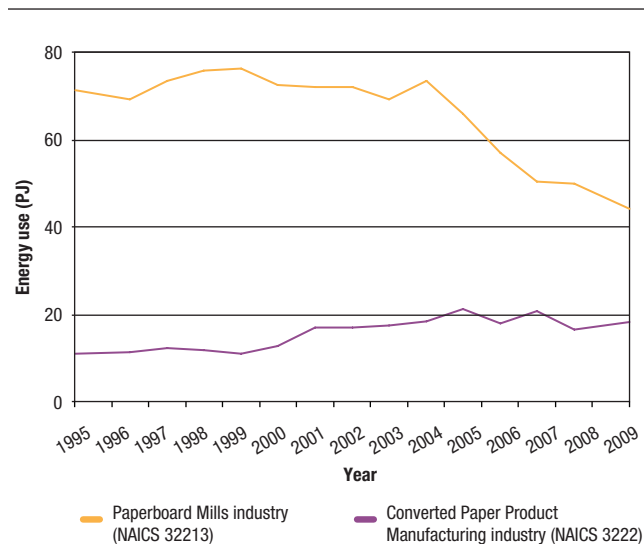


Figure 11b. Energy consumption of the Paper Manufacturing industries, 1995–2009



5.1.3 Paper Manufacturing subsector's energy consumption by source

Table 5 lists energy consumption by energy source for the Paper Manufacturing subsector in 1995 and 2009. Energy consumption for this subsector decreased by 41 percent from 1995 to 2009.

Table 5. Paper Manufacturing subsector's energy use by energy source, 1995 and 2009

Energy category	Energy source	1995 energy		2009 energy		Growth, 1995–2009 (%)
		(PJ)	(%)	(PJ)	(%)	
Electricity	Electricity	193.7	21.5	145.2	27.4	-25.0
Natural gas	Natural gas	156.5	17.4	74.8	14.1	-52.2
Coal/coke	Coal	2.4	0.3	X*	N/A	N/A
RPP** (incl. propane)	Heavy fuel oil	63.9	7.1	16.3	3.1	-74.4
	Middle distillates	3.2	0.4	1.4	0.3	-56.9
	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	177.6	33.5	-48.3
Steam and wood	Steam	9.1	1.0	15.6	2.9	72.0
	Wood	127.4	14.1	98.8	18.6	-22.4
	Total, steam and wood	136.5	15.1	114.4	21.6	-16.2
Total, undisclosed values		0.0	0.0	0.9	0.2	N/A
Total		901.1	100	530.7	100.0	-41.1

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 (33.5 percent, or 177.6 PJ, in 2009), decreased 48.3 percent (166 PJ) between 1995 and 2009. Since 2001, natural gas moved from the third most-used energy source to fourth, after spent pulping liquor, electricity and wood. Natural gas consumption decreased 52.2 percent, or 82 PJ, from 1995 to 2009. The use of heavy fuel oil, electricity and wood also decreased considerably from 1995 to 2009 (74.4 percent, 25.0 percent and 22.4 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 2009 (72.0 percent). The increasing use of steam combined with the significant drop in the use of heavy fuel oil contributed toward making the Paper Manufacturing subsector less greenhouse gas intensive.

Table 6. Paper Manufacturing subsector's energy use by energy source, 2008 and 2009

Energy category	Energy source	2008 energy		2009 energy		Growth, 2008–2009 (%)
		(PJ)	(%)	(PJ)	(%)	
Electricity	Electricity	168.9	29.1	145.2	27.4	-14.0
Natural gas	Natural gas	71.8	12.4	74.8 ()	14.1	4.2
Coal/coke	Coal	X*	N/A	X*	N/A	N/A
RPP** (incl. propane)	Heavy fuel oil	19.6	3.4	16.3	3.1	-16.8
	Middle distillates	1.6	0.3	1.4	0.3	-12.2
	Propane	X*	N/A	X*	N/A	N/A
	Total, RPP (incl. propane)	X*	N/A	X*	N/A	N/A
Spent pulping liquor	Spent pulping liquor	184.2	31.8	177.6	33.5	-3.6
Steam and wood	Steam	18.2	3.1	15.6	2.9	-14.3
	Wood	114.1	19.7	98.8	18.6	-13.4
	Total, steam and wood	132.3	22.8	114.4	21.6	-13.5
Total, undisclosed values		1.5	0.3	0.9	0.2	N/A
Total		580.1	100.0	530.7	100.0	-8.5

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

Most of the trends observed about energy sources used by the Paper Manufacturing subsector from 1995 to 2009 also applied for 2008 to 2009, with the exception of natural gas consumption, which increased by 4.2 percent, and steam, which decreased by 14.3 percent.

5.2 Primary Metal Manufacturing subsector (NAICS 331)

The Primary Metal Manufacturing subsector includes establishments that perform the smelting and refining of ferrous metals (those that contain iron, including iron-containing alloys such as steel) and non-ferrous metals

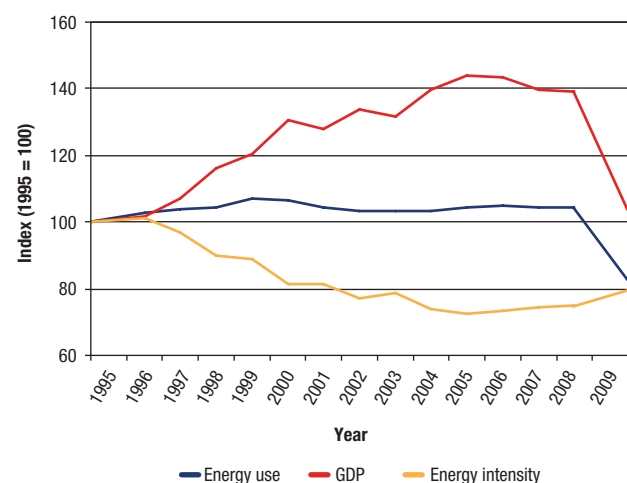
(those that do not contain iron, such as aluminum and copper). Smelting refers to the “heat treatment of an ore to separate the metallic portion.” Refining is “a separation process whereby undesirable components are removed to give a concentrated and purified product.”²⁰

The 2009 ICE survey estimates that the Primary Metal Manufacturing subsector consumed 419 PJ of energy, which accounted for 21 percent of the Manufacturing sector's energy consumption, and was the second-most energy-consuming subsector in the Manufacturing sector.

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

As seen in the Paper Manufacturing subsector, the energy intensity of the Primary Metal Manufacturing subsector declined steadily from 1995 to 2008. This decline was due to a 39 percent increase in output combined with stable energy use (only 4 percent growth). Between 1995 and 2008, this subsector saw its energy intensity decrease 25 percent, from more than 61 MJ/\$GDP to 46 MJ/\$GDP, or an average annual decrease of 1.9 percent. However, between 2008 and 2009, both GDP and energy use fell substantially (25 percent and 20 percent respectively). This resulted in an increase of energy intensity of almost 7 percent in that one year. Figure 12 illustrates this changing trend.

Figure 12. Indexed growth of energy intensity, energy use and GDP for the Primary Metal Manufacturing subsector, 1995–2009

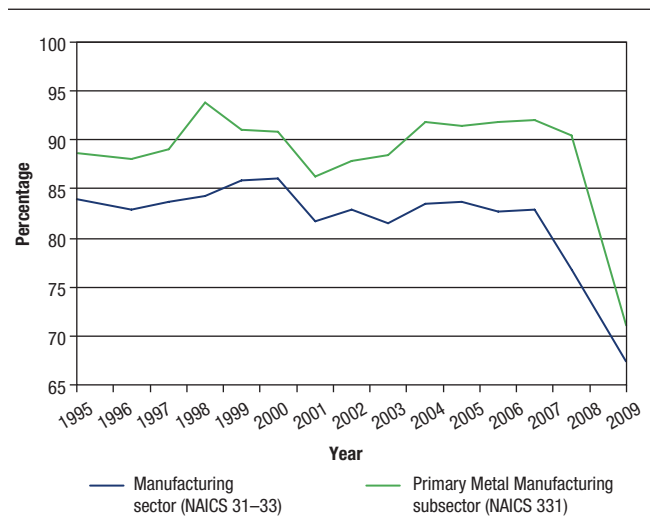


²⁰N.I. Sax and R.J. Lewis, *Hawley's Condensed Chemical Dictionary*, (15th Edition), (ISBN 978-0-471-76865-4).

5 Selected Manufacturing subsectors

As demonstrated in Figure 13, between 2008 and 2009, capacity utilization of the Primary Metal Manufacturing subsector (and in particular the Iron and Steel industry), decreased significantly (20.2 percent) compared with a 12.2 percent decrease for the overall sector. The subsector's decrease was affected by the continuing recession in the United States and its temporary import restriction on foreign steel²¹ in 2009.

Figure 13. Comparison of capacity utilization rates for the Manufacturing sector and Primary Metal Manufacturing subsector, 1995–2009



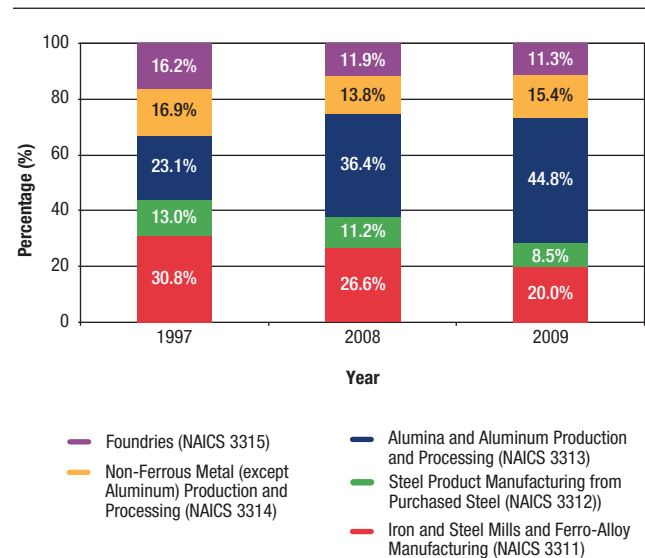
The Primary Metal Manufacturing subsector experienced the largest decrease in output among the four subsectors from 1995 to 2009. Figure 14 illustrates the share of GDP among the Canadian Primary Metal Manufacturing industries for 1997,²² 2008 and 2009. As this figure shows, the subsector experienced some structural changes over the years. The largest decrease in output was experienced by the Iron and Steel Mills and Ferro-Alloy Manufacturing (NAICS 3311) industry, (4.2 percentage points from 1997 to 2008 and, more significantly, 6.6 percentage points from 2008 to 2009). In contrast,

²¹ The provisions of the *American Reinvestment and Recovery Act of 2009* (the ARRA) explicitly limited foreign companies' access to the estimated US\$275 billion in procurement funds contained in the US\$787-billion stimulus package. As a result, ARRA-financed procurement at the state and local levels for iron, steel and manufactured products was effectively closed to Canadian bidders. House of Commons Canada, *Canada-United States Agreement on Government Procurement, Report of the Standing Committee on International Trade*, May 2010, publications.gc.ca/collections/collection_2011/parl/XC75-403-1-1-01-eng.pdf.

²² The data for 1995 and 1996 were not available for all industries.

the Alumina and Aluminum Production and Processing (NAICS 3313) industry's share of the subsector's GDP increased 13.3 percentage points from 1997 to 2008 and another 8.4 percentage points from 2008 to 2009. The latter was due to an almost twofold increase in the sale of manufactured goods of the Primary Production of Alumina and Aluminum (NAICS 331313) industry between 1995 and 2009.

Figure 14. Distribution of GDP* of the Primary Metal Manufacturing subsector by industry, 1997, 2008 and 2009



*GDP at basic price in constant 2002 dollars; 1997 share is based on the sum of the sub-industries, which is slightly different than the sector estimate.

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

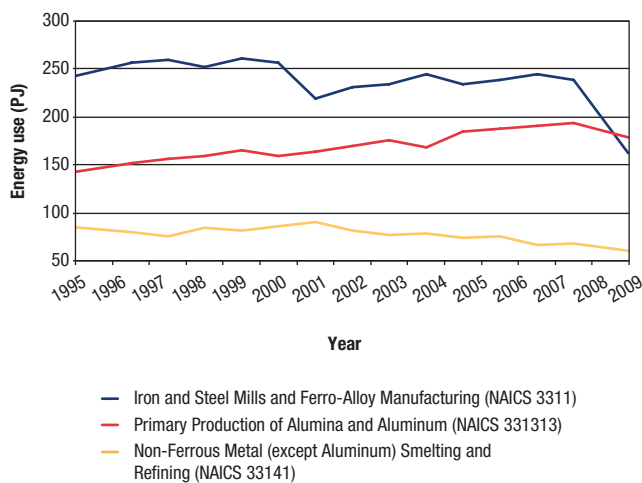
Figure 15 illustrates energy use for the three largest industries in the Primary Metal Manufacturing subsector.²³ These industries accounted for 96 percent of the subsector's energy use in 2009.

Even though energy use in the subsector remained relatively constant from 1995 to 2008 and then decreased substantially between 2008 and 2009 (20 percent), this was not always the case at the industry level. Energy consumption of the Primary Production of Alumina and Aluminum industry (NAICS 331313) increased 35 percent between 1995 and 2008 and then decreased 7 percent between 2008 and 2009. The

²³ Due to data limitations for some industries, five- and six-digit NAICS codes are presented.

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 the aforementioned increase with 2 percent and 18 percent reductions in their respective energy consumption, for the period 1995 to 2008, and further 32 percent²⁴ and 11 percent reductions in their respective energy consumption from 2008 to 2009.

Figure 15. Energy consumption of selected Primary Metal Manufacturing industries, 1995–2009



5.2.3 Primary Metal Manufacturing subsector's energy consumption by source

Table 7 shows the energy consumption by energy source for the Primary Metal Manufacturing subsector in 1995 and 2009. Considering the substantial increase in energy use in the Primary Production of Alumina and Aluminum industry between 1995 and 2009, it is not surprising that electricity consumption continued to grow in this subsector, because this industry is known to be electricity intensive.²⁵ Offsetting this increase in electricity consumption was the combined decrease in the use of all other energy sources (with the exception of middle distillates).

Although electricity consumption increased overall between 1995 and 2009, it decreased between 2008 and 2009, as outlined in Table 8. There was also a substantial decrease in the use of coal coke and coke oven gas between 2008 and 2009 (39 percent). This latter decrease ties in with the decrease in output of the Iron and Steel Mills industry from 2008 to 2009, described in Section 5.2.2.

Table 7. Primary Metal Manufacturing subsector's energy use by energy source, 1995 and 2009

Energy category	Energy source	1995 energy		2009 energy		Growth, 1995–2009 (%)
		(PJ)	(%)	(PJ)	(%)	
Electricity	Electricity	214.4	42.6	220.1	52.5	2.6
Natural gas	Natural gas	128.4	25.5	91.6	21.8	-28.7
Coal/coke	Coal	9.9	2.0	8.9	2.1	-10.1
	Coal coke and coke oven gas	129.6	25.7	75.3	17.9	-41.9
	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	14.0	3.3	-9.0
	Middle distillates	2.4	0.5	2.9	0.7	21.7
	Propane	1.1	0.2	X*	N/A	N/A
	Total, RPP (incl. propane)	18.8	3.7	X*	N/A	N/A
Steam and wood	Steam and wood	0.4	0.1	X*	N/A	N/A
Total, undisclosed values		0.0	0.0	6.8	1.6	N/A
Total		503.8	100.0	419.5	100.0	-16.7

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

²⁴The Iron and Steel Mills industry experienced a significant decrease (44 percent) in GDP from 2008 to 2009, due largely to the United States' statute requiring recipients of stimulus money to buy American iron and steel only. Indeed, exports to the United States (the largest market for these products) from this industry decreased 46.7 percent between 2008 and 2009. (Source: Industry Canada, Trade Data Online, strategis.ic.gc.ca/tdo.)

²⁵John Nyboer and Adam Baylin-Stern, *A Review of Energy Consumption and Related Data – Canadian Aluminum Industries, 1990 to 2008*, page 2. Canadian Industrial Energy End-Use Data and Analysis Centre, 2010.

Table 8. Primary Metal Manufacturing subsector’s energy use by energy source, 2008 and 2009

Energy category	Energy source	2008 energy		2009 energy		Growth, 2008–2009 (%)
		(PJ)	(%)	(PJ)	(%)	
Electricity	Electricity	241.3	46.0	220.1	52.5	-8.8
Natural gas	Natural gas	111.8	21.3	91.6	21.8	-18.1
Coal/coke	Coal	14.2	2.7	8.9	2.1	-37.3
	Coal coke and coke oven gas	124.0	23.6	75.3	17.9	-39.3
	Petroleum coke	X*	N/A	X*	N/A	N/A
	Total, coal/coke	X*	N/A	X*	N/A	N/A
RPP** (incl. propane)	Heavy fuel oil	21.3	4.1	14.0	3.3	-34.3
	Middle distillates	3.2	0.6	2.9	0.7	-10.1
	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 and wood	X*	N/A	X*	N/A	N/A
Total, undisclosed values		8.7	1.7	6.8	1.6	N/A
Total		524.6	100.0	419.5	100.0	-20.0

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

5.3 Petroleum and Coal Product Manufacturing subsector (NAICS 324)

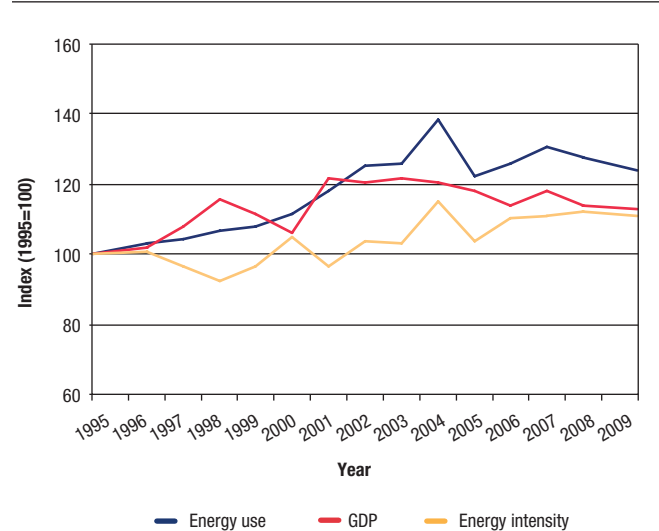
Establishments in the Petroleum and Coal Product Manufacturing subsector transform crude petroleum and coal into usable products. Petroleum Refineries (NAICS 32411) is the subsector’s main industry for energy use. The petroleum refining process separates various hydrocarbons contained in crude oil to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

The 2009 ICE survey estimates that the subsector consumed 367 PJ of energy in 2009. This amount is 18 percent of the Manufacturing sector’s energy consumption, ranking Petroleum and Coal Product Manufacturing third in the most energy-consuming subsectors of Canada’s Manufacturing sector.

5.3.1 Petroleum and Coal Product Manufacturing subsector’s energy consumption, output and energy intensity trends

Figure 16 illustrates the indexed growth of energy intensity, energy use and GDP for the Petroleum and Coal Product Manufacturing subsector from 1995 to 2009. From 1995 to 1998, both output and energy use increased in the subsector. However, energy use increased at a slower pace, causing energy intensity to fall. Between 1998 and 2007, output remained fairly constant, while energy use increased 23 percent. The combination of these two factors yielded a 19 percent increase in energy intensity in that period. Between 2007 and 2009, GDP and energy use decreased by 5 percent each, leaving energy intensity relatively unchanged.

Figure 16. Indexed growth of energy intensity, energy use and GDP for the Petroleum and Coal Product Manufacturing subsector, 1995–2009



Canada’s Petroleum and Coal Product Manufacturing subsector used 25 percent more energy and produced 13 percent more output in 2009 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 (NAICS 32411) represents 95 percent of the subsector’s energy consumption, it can be inferred that this industry made a significant contribution to the 11 percent growth in the subsector’s energy intensity between 1995 and 2009.

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*. These regulations set limits on the amount of sulphur and benzene in diesel and gasoline that can be produced, imported or sold, to comply with stringent new standards for exhaust emissions. Complying with these regulations requires further refinement of crude oil, which in turn requires more energy. This may help explain the increased energy intensity of the Petroleum and Coal Product Manufacturing subsector.

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

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

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

Table 9 shows energy consumption by energy source for the Petroleum and Coal Product Manufacturing subsector in 1995 and 2009. It was the only subsector in the Manufacturing sector to increase its energy consumption between 1995 and 2009 (25.2 percent), although it did experience a decrease in energy consumption between 2008 and 2009 (1.8 percent) (see Table 10). Due to the unavailability of certain 2009 data, it is not possible to determine changes in coal/coke and steam and wood use from 1995 to 2009. From available data, the only energy sources that decreased from 1995 to 2009 were heavy fuel oil and propane, although they were not among the most-used in the subsector. 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 had increased 55.5 percent (70.9 PJ) since 1995.

As outlined in Table 10, the consumption of refinery fuel gas remained virtually unchanged between 2008 and 2009. Natural gas consumption decreased significantly (14 percent) between 2008 and 2009.

Table 9. Petroleum and Coal Product Manufacturing subsector's energy use by energy source, 1995 and 2009

Energy category	Energy source	1995 energy		2009 energy		Growth, 1995–2009 (%)
		(PJ)	(%)	(PJ)	(%)	
Electricity	Electricity	17.3	5.9	23.7	6.5	37.0
Natural gas	Natural gas	51.0	17.4	53.8	14.7	5.4
Coal/coke	Coal	0.9	0.3	X*	N/A	N/A
	Petroleum coke	48.4	16.5	51.2	14.0	5.9
	Total, coal/coke	49.3	16.8	X*	N/A	N/A
RPP** (incl. propane)	Refinery fuel gas	127.6	43.6	198.5	54.1	55.5
	Heavy fuel oil	41.7	14.3	24.7	6.7	-40.9
	Propane	4.9	1.7	0.8	0.2	-83.6
	Middle distillates	0.4	0.1	X*	N/A	N/A
	Total, RPP (incl. propane)	174.7	59.6	X*	N/A	N/A
Steam and wood	Steam and wood	0.6	0.2	X*	N/A	N/A
Total, undisclosed values		0.0	0.0	14.0	3.8	N/A
Total		293.0	100.0	366.7	100.0	25.2

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

Table 10. Petroleum and Coal Product Manufacturing subsector’s energy use by energy source, 2008 and 2009

Energy category	Energy source	2008 energy		2009 energy		Growth, 2008–2009
		(PJ)	(%)	(PJ)	(%)	
Electricity	Electricity	22.8	6.1	23.7	6.5	4.1
Natural gas	Natural gas	62.6	16.8	53.8	14.7	-14.1
Coal/coke	Coal	X*	N/A	X*	N/A	N/A
	Petroleum coke	51.0	13.7	51.2	14.0	0.4
	Total, coal/coke	X*	N/A	X*	N/A	N/A
RPP** (incl. propane)	Refinery fuel gas	198.1	53.1	198.5	54.1	0.2
	Heavy fuel oil	24.9	6.7	24.7	6.7	-1.0
	Propane	1.2	0.3	0.8	0.2	-33.0
	Middle distillates	X*	N/A	X*	N/A	N/A
	Total, RPP (incl. propane)	X*	N/A	X*	N/A	N/A
Steam and wood	Steam and wood	X*	N/A	X*	N/A	N/A
Total, undisclosed values		12.6	3.4	14.0	3.8	N/A
Total		373.3	100.0	366.7	100.0	-1.8

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

5.4 Chemical Manufacturing subsector (NAICS 325)

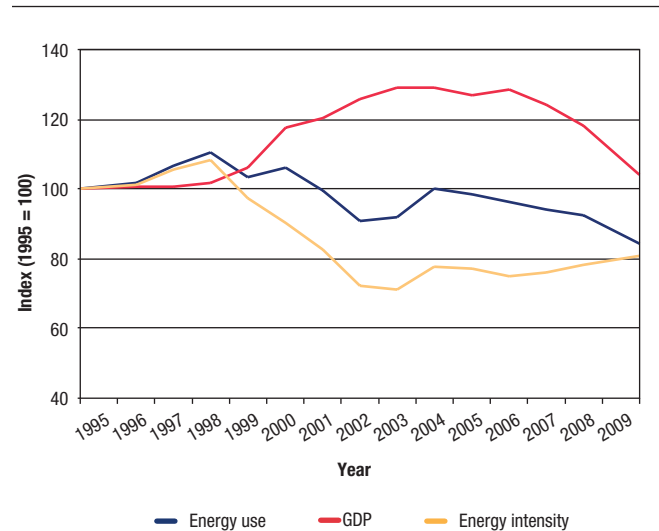
Establishments in the Chemical Manufacturing subsector manufacture chemicals and chemical products from organic and inorganic raw materials.²⁶ The 2009 ICE survey estimated that the Chemical Manufacturing subsector consumed 238 PJ of energy in 2009, corresponding to 12 percent of the Manufacturing sector’s energy consumption.

²⁶ For a detailed description of the 18 industries that comprise this subsector, refer to *North American Industry Classification System (NAICS – Canada) 2007*, section NAICS 325 (the industries have five-digit numbers), Statistics Canada, www.statcan.gc.ca/pub/12-501-x/12-501-x2007001-eng.pdf.

5.4.1 Chemical 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 2009 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. From 2003 to 2006, growth in GDP and energy use was relatively flat. From 2007 to 2009, both GDP and energy use decreased (15 percent and 9 percent respectively), causing energy intensity to rise by 7 percent.

Figure 17. Indexed growth of energy intensity, energy use and GDP for the Chemical Manufacturing subsector, 1995–2009



Over the 14 years, Canada’s Chemical Manufacturing subsector increased its output by 6 percent while reducing its energy consumption by 14 percent. This resulted in a 19 percent decrease in energy intensity, from 23 MJ/\$GDP to 19 MJ/\$GDP, or an average annual decrease of 1.4 percent.

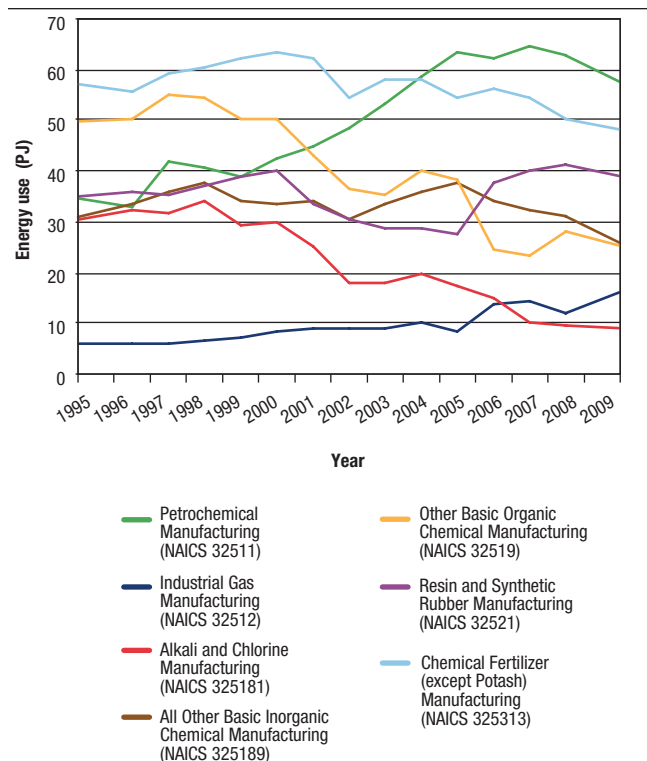
5.4.2 Chemical Manufacturing subsector’s energy consumption trends by industry

Figure 18 illustrates the seven industries for which data are available for the entire study period. In 2009, these industries accounted for 90 percent of the Chemical Manufacturing subsector’s energy use. Between 1995 and 2009, the largest changes in energy consumption occurred

in Industrial Gas Manufacturing (NAICS 32512), with a 155 percent increase, and Alkali and Chlorine Manufacturing (NAICS 325181), with a 73 percent decrease. The Petrochemical Manufacturing industry (NAICS 32511) increased its energy consumption the most (21 PJ). Notably, between 2008 and 2009, energy consumption decreased for the seven industries, with the exception of Industrial Gas Manufacturing (NAICS 32512).

There does not seem 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 North American Industry Classification System (NAICS) is based on the primary product produced by an establishment. In the Chemical Manufacturing subsector, production processes can be modified such that different products become an establishment’s primary product, potentially moving that establishment from one industry to another at any given time. In addition, such factors as increased energy efficiency and decreased production can influence the yearly variation in energy consumption.

Figure 18. Energy consumption of selected Chemical Manufacturing industries, 1995–2009



5.4.3 Chemical Manufacturing subsector’s energy consumption by source

Table 11 shows the energy consumption by energy source for the Chemical Manufacturing subsector in 1995 and 2009. Natural gas consumption – the most widely used energy source in the subsector – decreased by 15 percent between 1995 and 2009. As in the Paper and Primary Metal subsectors, the rapid increase in the industrial price of natural gas²⁷ may help explain this trend. Both electricity and steam consumption decreased from 1995 to 2009, but these decreases were greater between 2008 and 2009, as demonstrated in Table 12. It is not possible to analyse the trend in the energy consumption of the categories of coal/coke, refined petroleum products and wood because data for 2008 and 2009 were not available.

Table 11. Chemical Manufacturing subsector’s energy use by energy source, 1995 and 2009

Energy category	Energy source	1995 energy		2009 energy		Growth, 1995–2009 (%)
		(PJ)	(%)	(PJ)	(%)	
Electricity	Electricity	71.6	25.8	65.1	27.3	-9.2
Natural gas	Natural gas	177.4	63.9	151.6	63.7	-14.5
Coal/coke	Coal	0.0	0.0	X*	N/A	N/A
	Petroleum 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	X*	N/A	N/A
	Middle distillates	1.2	0.4	X*	N/A	N/A
	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	19.5	8.2	-8.3
Wood	Wood	0.0	0.0	X*	N/A	N/A
Total, undisclosed values		0.0	0.0	1.9	0.8	N/A
Total		277.5	100	238.1	100	-14.2

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

²⁷ Refer to Figure 7 in this report.

5 Selected Manufacturing subsectors

Table 12. Chemical Manufacturing subsector's energy use by energy source, 2008 and 2009

Energy category	Energy source	2008 energy		2009 energy		Growth, 2008–2009
		(PJ)	(%)	(PJ)	(%)	
<i>Electricity</i>	Electricity	75.0	29.2	65.1	27.3	-13.3
<i>Natural gas</i>	Natural gas	154.5	60.1	151.6	63.7	-1.9
<i>Coal/coke</i>	Coal	X*	N/A	X*	N/A	N/A
	Petroleum coke and coke from catalytic cracking	X*	N/A	X*	N/A	N/A
	Total, coal/coke	X*	N/A	X*	N/A	N/A
<i>RPP** (incl. propane)</i>	Heavy fuel oil	X*	N/A	X*	N/A	N/A
	Middle distillates	X*	N/A	X*	N/A	N/A
	Propane	X*	N/A	X*	N/A	N/A
	Total, RPP (incl. propane)	X*	N/A	X*	N/A	N/A
<i>Steam</i>	Steam	24.7	9.6	19.5	8.2	-21.0
<i>Wood</i>	Wood	X*	N/A	X*	N/A	N/A
Total, undisclosed values		2.7	1.0	1.9 ()	0.8	N/A
Total		257.0	100.0	238.1	100.0	-7.3

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

6 Conclusion

The global economic downturn that started in 2008 continued to affect economic activity in Canada and in the United States and other countries to which Canada exports goods and services. It also weakened domestic and foreign demand for manufacturing products. As a result, most indicators of activity in the Canadian Manufacturing sector declined in 2009 for the second consecutive year.

According to Statistics Canada, weakened global and domestic demand for manufactured goods continued to drive down capacity utilization rates.²⁸ Of the 21 subsectors in the Manufacturing sector, 18 registered lower capacity utilization rates in 2009 than in 2008.

However, the capacity utilization rate in the Manufacturing sector has been on an upward trend since the second quarter of 2009, when it reached a record low of 64.8 percent. The rate in the third quarter of 2010 of 81.2 percent is comparable with the rate in the fourth quarter of 2007.²⁹ Of the 21 major subsectors in the Manufacturing sector, 15 posted gains in capacity use in the third quarter of 2010, while 6 recorded declines.

Further analysis, including results of the 2010 Industrial Consumption of Energy Survey, will be presented in our next report, due for publication in 2012.

²⁸ See Appendix A, Glossary, for a definition of capacity utilization rate.

²⁹ Statistics Canada, *The Daily*, December 13, 2010, www.statcan.gc.ca/daily-quotidien/101213/dq101213b-eng.htm.

A Glossary

Capacity utilization rate, industrial: The ratio of an industry's actual output to its estimated potential output. The measures of actual output used in the production of the rates of capacity use are the measures of real gross domestic product at factor cost, seasonally adjusted, by industry.

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

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).

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.

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.

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.

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.

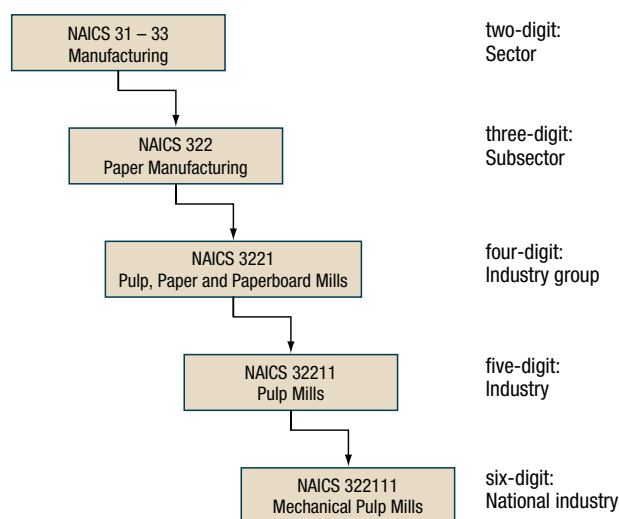
B North American Industry Classification System

The North American Industry Classification System (NAICS) provides common definitions of the industrial structure of Canada, Mexico and the United States. Developed jointly by the statistical agencies of these 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. 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 in NAICS Canada 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, 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 four three-digit NAICS codes (subsectors) analysed in this summary report are as follows:

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 Product 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 Product Manufacturing)
- smelting and refining ores and concentrates (331, Primary Metal Manufacturing)

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

- 311 Food Manufacturing
- 312 Beverage and Tobacco Product Manufacturing
- 313 Textile Mills
- 314 Textile Product Mills
- 315 Clothing Manufacturing
- 316 Leather and Allied Product Manufacturing
- 321 Wood Product Manufacturing
- 323 Printing and Related Support Activities
- 326 Plastics and Rubber Products Manufacturing
- 327 Non-Metallic Mineral Product 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.

