



CEEDC

Canadian Energy & Emissions Data Centre

Energy Use and CO₂ Emissions in Canadian Iron and Steel and Ferro-Alloy Manufacturing Industries 1990 to 2017

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Executive Summary

The Canadian Industrial Energy End-use Data and Analysis Centre (CEEDC) is part of the School of Resource and Environmental Management at Simon Fraser University and houses extensive energy information relevant to Canada's industrial sectors. One of CEEDC's primary goals is to expand and improve the information on energy use and greenhouse gas (GHG) emissions by regularly collecting reliable data. This report for the Canadian Steel Producers Association (CSPA) provides detailed information for the Iron and Steel Mills and Ferro Alloy Manufacturing Industry (NAICS 3311).

This report reviews data on energy use, GHG emissions and production within the iron and steel industry. Energy use data are gathered from several sources. The Industrial Consumption of Energy (ICE) survey, conducted by Statistics Canada (StatCan), records the use of energy in physical units and is considered the most reliable source for energy analysis. Data for 1991 to 1994 have not been updated to NAICS categories and, while they can be obtained from the Report on Energy Supply and Demand (RESO), are presented for reference only.

Emissions data are calculated by multiplying the energy use of each fuel by CO₂ conversion factors obtained from Environment and Climate Change Canada. Physical production data were historically collected by StatCan in their monthly Steel Primary Forms, Steel Castings and Pig Iron (SPFI) survey and the Disposition of Shipments of Ingots and Rolled Steel Products survey. These series (and associated surveys) have been terminated and the data now come from the Worldsteel Association. Economic data (GDP) are available from StatCan.

In 1990, the steel industry experienced a protracted strike which resulted in an atypical energy and production year. Since 1990 has historically been used as the baseline, CEEDC conducted a regression analysis to generate adjusted values that reflect those estimated by the industry. These adjusted 1990 values are used in calculations for industry trends and intensity changes.

Activity in the iron and steel industry dropped sharply following the 2007/2008 economic recession reaching record lows in both production and energy use in 2009. The national picture suggests that the industry is beginning to recover, with both production and energy consumption generally increasing since then. Overall, energy consumption has dropped 18% from 1990 levels, and GHG (and CO₂) emissions are down over 23% (and down almost 5% from 2005). Intensity indicators, then, have dropped significantly over the period; the intensity of generating one tonne of steel (i.e., disposition data) has gone from 21 GJ/t in 1990 to just over 18 GJ/t in 2017, an improvement of 12%. This appears to be due to changes in efficiency as well as some change in process (i.e., while the proportion of electric arc furnace (EAF) steel was around 41% of total production up until 2010, it increased to 47% by 2017).

A provincial breakdown of data has been included for Ontario in this report. This is the first time that CEEDC has provided data at a provincial level in the iron and steel sector. Due to the

higher level of confidential data in the provincial sections of the RESD, we have had to make more assumptions on energy use and estimate a higher number of values. Some caution should be used when applying these estimates, but the data provided gives a good indication of the trends for Ontario. Overall, energy use in 2017 is 14% lower than in 1990 and 11% below 2005, while GHG emissions are 13% below 1990 and 8% below 2005. Energy and GHG intensities based on physical production have returned to their 1990 levels after being about 10% higher over the past few years.

While data from the Canadian steel industry have been reviewed and updated, improvement is needed in some areas including increasing consistency in the historically reported values for coke oven gas, and reassessing production values used in the development of the indicators. That said, StatCan has updated RESD values to resemble data more closely from ICE. While this process is not complete, the first indications are that the variation between RESD and ICE is diminishing.

Acknowledgments

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Canada

Nous reconnaissons l'appui financier du gouvernement du Canada

Contents

Executive Summary.....	i
Introduction	1
Objectives.....	1
Iron and Steel Industry.....	2
Data Sources.....	2
Surveys of the Iron and Steel Industry	2
Publicly Released Data.....	3
Key Indicators	5
Performance Metrics.....	5
Boundary Protocols for Intensity Comparison	6
Unit Protocols: Heating Values.....	7
Non-Energetic Use of Fuels	7
Production Protocols	7
Comparisons to Other Jurisdictions	8
National Trends.....	9
Production	9
Limitations and Issues	11
Energy Use and CO ₂ Emissions.....	12
Intensity Indicators.....	13
Limitations and Issues	16
Focus on Ontario.....	17
Production	17
Energy Use and CO ₂ Emissions.....	18
Intensity Indicators.....	20
Data Issues and Solutions	22
Summary	25
Quantity and Quality of Data Available for the Canadian Steel Industry	25
Energy Use	25
Greenhouse Gases	25

Production Data.....	26
Trends in Energy Use, Energy Intensity, and CO ₂ Emissions.....	26
Data Limitations and Issues.....	26
References	28
Acronyms	29
Appendices.....	30

Energy Use and CO₂ Emissions in Canadian Iron and Steel and Ferro-Alloy Manufacturing Industries 1990 to 2017

Introduction

Canadian industry increasingly sees the need for accurate data on energy use. The Canadian Energy and Emissions Data Centre (CEEDC) focuses on gathering energy and greenhouse gas (GHG) information relevant to Canada's industrial, residential, and transport sectors. In this capacity, one of CEEDC's primary goals is to expand and improve the existing knowledge on energy use through regular and timely collection of reliable data. These data can be used to:

- Reveal trends in energy use within Canada to determine the impacts of technology, processes, or attitudes about energy;
- Compare Canadian industry performance to other jurisdictions; and
- Monitor environmental impacts of energy use in industry, such as GHG emissions.

This report, in response to increased industry interest, defines the Canadian iron and steel industry, discusses current data sources and availability, and presents the most up-to-date energy use and GHG data for the industry. Data limitations, conflicts, and other issues are also highlighted and discussed.

Objectives

The objectives of this report are to:

- Demonstrate explicitly the quantity and quality of data available for the Canadian iron and steel industry;
- Discuss trends in energy use, energy intensity performance and CO₂ emissions for the steel industry;
- Identify limitations with respect to the data and the impact they have on portraying a consistent and accurate picture of the iron and steel industry; and
- Identify and prioritize data issues that could be used in discussion between the iron and steel industry and data collection agencies aiming to improve quality of data.

Iron and Steel Industry

Since 2001, data on the steel industry have been provided according to the North American Industry Classification System (NAICS). NAICS, which classifies establishments based on process or economic activity, is compatible to at least the two-digit code with the International Standard Industrial Classification (ISIC) system used by the United Nations. The number of digits in the NAICS categories indicates the level of detail in that group. The code for the Iron and Steel Mills and Ferro Alloy Manufacturing Industry is 3311.

NAICS 3311 comprises establishments primarily engaged in smelting iron ore and steel scrap to produce pig iron in molten or solid form; converting pig iron into steel by the removal, through combustion in furnaces, of the carbon in the iron. These establishments may cast ingots only, or produce basic shapes, such as plates, sheets, strips, rods, bars and other fabricated products. Electric arc furnace mini-mills are included, as are establishments primarily engaged in producing ferro-alloys.¹

Data Sources

Publicly available data on energy use for the Iron and Steel industry are collected by Statistics Canada (StatCan) using a variety of surveys that are completed by selected industry respondents and energy distribution agencies. Production data were collected by StatCan until May 2013 and are now obtained from the Worldsteel Association. GHG emissions data are calculated by multiplying the energy use of each fuel by Environment and Climate Change Canada's CO₂ conversion factors as published in their annual *National Inventory Report*.²

Surveys of the Iron and Steel Industry

Industrial Consumption of Energy

The Industrial Consumption of Energy survey is collected annually and provides estimates of energy use by manufacturing establishments in Canada classified to NAICS 31, 32, and 33. The survey questionnaire is sent to selected respondents and requests data on the use of various energy commodities such as electricity, natural gas, propane, diesel, wood and steam. The survey also asks for information on the different usages for these commodities. In the large energy consuming industries, the survey is a census; response levels vary from year to year and data are imputed for non-respondents.

¹ Statistics Canada, *North American Industry Classification (NAICS) 2012*, <http://www.statcan.gc.ca/eng/subjects/standard/naics/2012/index>

² See Appendix A.

Coke Monthly

The Coke Monthly survey is a mandatory census survey conducted by StatCan that collects information via monthly questionnaire from all coal coke plants in Canada on coal coke production and disposition, and coal charged to coke ovens.

Steel Primary Forms, Steel Castings and Pig Iron

This mandatory survey measured the quantities of steel products produced and shipped by Canadian manufacturers of steel primary forms, steel castings, and pig iron. Data on process (e.g., electric arc vs. basic oxygen furnaces) were also obtained. Data were collected monthly directly from survey respondents. **This survey was discontinued May 2013.**

Disposition of Shipments of Ingots and Rolled Steel Products

The Disposition of Shipments of Ingots and Rolled Steel Products survey measured monthly quantities of net shipments of ingots and rolled steel products to end-use markets by Canadian manufacturers. This was a mandatory census survey and data were collected directly from survey respondents. **This survey was discontinued May 2013.**

Annual Survey of Manufacturers

The ASM (also known as the Annual Survey of Manufacturers and Logging, ASML) is a survey of the manufacturing and logging industries in Canada intended to cover all establishments primarily engaged in manufacturing and logging activities, as well as the sales offices and warehouses which support these establishments. The details collected include principal industrial statistics (such as revenue, employment, salaries and wages, cost of materials and supplies used, cost of energy and water utility, inventories, etc.), as well as information about the commodities produced and consumed.

Publicly Released Data

Industrial Consumption of Energy

Data from the Industrial Consumption of Energy (ICE) survey are reviewed by CEEDC and by industry representatives prior to their public release. The previous year's data are also updated at this time (e.g., updated 2009 data are released with new 2010 data). Data are available on the StatCan website.

Coal and Coke Statistics

Changes in the Coal survey and the Coke Monthly survey resulted in a new data table for 2008 and later. The old data set contained only total coke production while the new table provides considerably more detail on coke production including the quantities of coal used.

Report on Energy Supply and Demand

Data from several surveys are compiled to form an energy balance table. Of these, data from the ICE survey, more fine-grained than the RESD, play the most important role as far as the iron

and steel industries are concerned. Unfortunately, the iron and steel industry as defined in the RESD does not match any specific NAICS definition of the industry (i.e., it is an amalgam of 3311 and part of 3312). In 2012, the RESD data for the years 2003 to 2010 were revised to incorporate more completely data from the ICE survey.

Pig Iron and Scrap Products Charged to Furnace

Collected on the Steel Primary Forms survey, data are available for 2004 to 2012. These data are in physical units (tonnes) and useful in understanding energy intensity of production. **This data series was discontinued May 2013.**

Steel Casting and Primary Form Steel Products

The Steel Primary Forms survey provides data (2004 to 2012) on the production and shipments of steel casting and primary forms steel products in physical units. It distinguishes between production and shipments, electric arc and basic oxygen furnaces, and provides some data on continuously cast steel products. These data are also useful in understanding energy intensities. **This data series was discontinued May 2013.**

Steel Tubular Products and Wire

The Steel Pipe and Tubing Survey, sent monthly, measured the quantities of steel pipe and tubular products that are produced and shipped by Canadian manufacturers. Data were reported for 2004 to 2012. **This data series was discontinued May 2013.**

The Steel Wire and Specified Wire Products Survey, sent monthly, measured the quantities of steel wire produced and shipped by Canadian manufacturers. Data were reported for 2004 to 2012. The data include information on wire fencing, nails, staples, galvanized wire, wire rope, and all other forms of wire. **This data series was discontinued May 2013.**

Iron and Steel Gross Domestic Product

The ASM provides data related to economic parameters associated with the iron and steel industry in Canada. While economic production data is less useful for understanding industry energy or GHG intensity, these data are often used for inter-industry and international comparisons. An industry's GDP is equivalent to the value it adds to the national GDP (i.e., it excludes value added by upstream industries). These data, as well as data on sales, can be used to calculate gross output (GO), defined as the total value of goods and services produced by an industry, a sum of its shipments including the change in value due to labour and capital investment (i.e., it includes the value added by all upstream industries). GO is larger than GDP. GO is an economic value preferred for analysis by StatCan. Unfortunately, GO values are released three years after GDP values.

Since the ICE survey focuses primarily on energy, is specific to the industry definition, and is a primary source (directly from the plants), its data are considered dependable and useful for energy analysis. Survey and data verification procedures are designed to reflect energy issues,

and data on non-purchased and atypical energy forms (i.e., self-generated electricity, coal to coke transformations, wood waste, etc.) are included.

Worldsteel Association, Steel Statistical Yearbook

StatCan collected data on production in the Iron and Steel industry until 2013. To replace these data, CEEDC currently uses data available from the Worldsteel Association as outlined in their annual *Steel Statistical Yearbook*.

Worldsteel Association obtains its data from the Canadian Steel Producers Association. Detailed data have not been made publicly available, but those data that are available from Worldsteel are the best available representation of production in the Canadian iron and steel industry. Because primary production and disposition data are available, both are used in this analysis.

Greenhouse Gas Data and the National Inventory Report

By and large, GHG data are derived from energy data. However, process emissions related to industrial production must be measured or calculated more directly. CEEDC uses information from Environment and Climate Change Canada for process emissions and to confirm fuel-based combustion emissions. The *National Inventory Report* is the official Canadian submission of GHG data to the United Nations Framework Convention on Climate Change. Fuel-based emissions associated with Canada's iron and steel industries are derived from RESD tables on energy use. In addition to this, large emitters that surpass a 50 Mt emission threshold (10 Mt for 2017 data) must report their facility level emissions to the Greenhouse Gas Reporting Program, where data is available for each facility (but process and combustion emissions are combined).

Key Indicators

Two indicators, *Energy Intensity* and *Emissions Intensity*, provide an assessment of an industry's energy use and emissions trends. Associated with these indicators, an index provides an understanding of trends relative to a reference year. For these, one must have available good annual data on energy by fuel type, energy and emissions coefficients, and production data useful for representative intensities. Additional indicators, such as *Fuel Emissions Intensity* (CO₂/GJ), and *Energy Mix* (GJ or %) can also be determined from these data.

Other indicators that help define energy and emissions intensity parameters include *Industry Structure*, the ratio of electric arc furnaces to integrated mills using basic oxygen furnaces and the *Coke Rate*, the ratio of coke to blast furnaces/iron produced to understand integrated mill energy intensities.

Performance Metrics

Intensities are dependent on a number of factors that include defining plant boundaries, process type, production unit in the denominator, energy content of fuels (i.e., fuel types and

heating values), state of input of raw materials, and more. Some are easy to determine (process used) while others may be more difficult to ascertain (plant boundaries) from publications.

Boundary Protocols for Intensity Comparison

The International Energy Agency (IEA), in their publication *Assessing Measures of Energy Efficiency Performance and Their Application in Industry*, underlines the importance of defining plant boundaries in order to establish useful metrics on energy intensity (IEA, 2008). Figure 3.1 demonstrates that a simple comparison of intensities could lead to very different results (e.g., IEA, 2008, p 30) because the calculation of intensities is affected by the degree to which one includes energy and supply generation facilities within the plant boundaries (coke generation, cogeneration, oxygen production, etc.). Comparison of intensities between plants or regions requires an understanding of how boundaries are drawn. IPCC guidelines, for example, exclude by-product gases that leave the plant boundary as defined below, while the EU Emissions Trading System includes these. While no absolute determination could be found in the literature, the Asia Pacific Partnership, in their 2007 report, found it necessary to gather data in order to *prepare common boundary definitions and to solve the problems of boundaries to carry out sector relevant benchmark and performance indicators* (APP, 2007). They propose a boundary relationship much like the large box in Figure 3.1, with GHG accounting of incoming and outgoing energy.

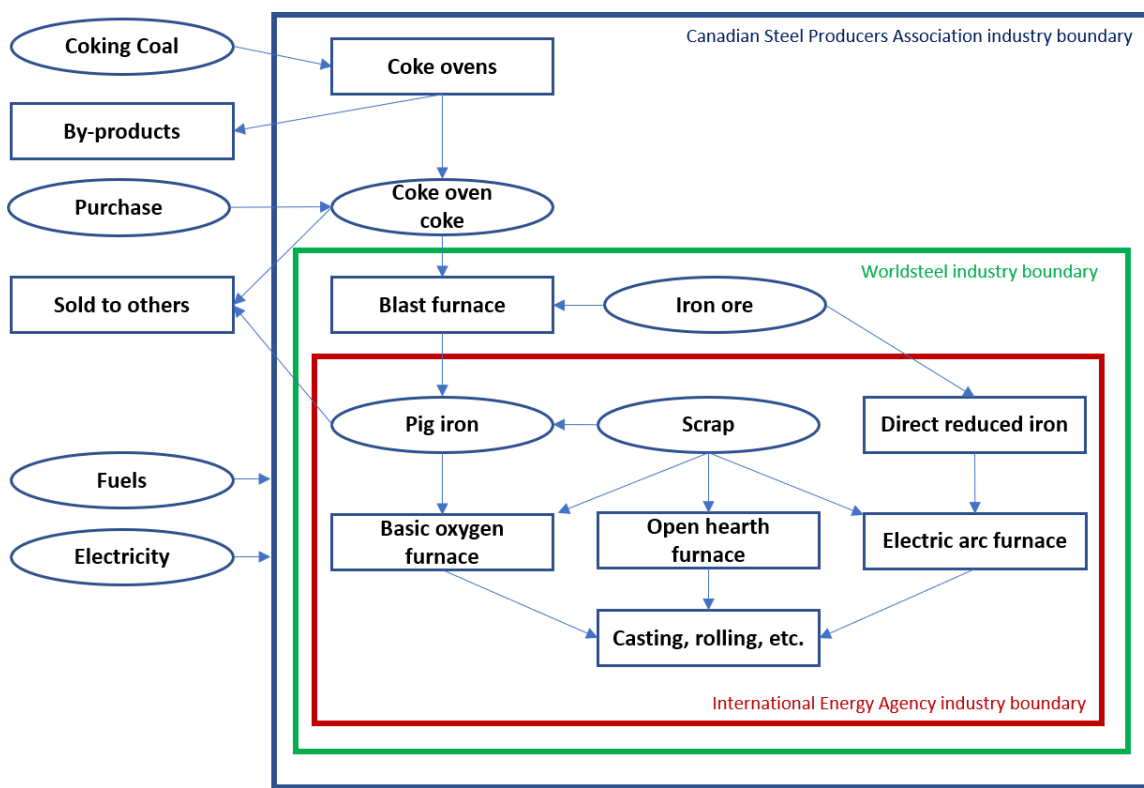


Figure 1: Possible system boundaries for the Iron and Steel industry

Unit Protocols: Heating Values

Views on the energy content of fuels vary. Some, like StatCan, use higher heating values (HHV) while others, like the IEA, use lower heating values (LHV). Estimates of LHV exclude the energy lost to the vaporisation of water generated during combustion. Some industry groups in Canada (cement and petroleum refining) also prefer to use LHV. This value can be up to 15% less than the HHV, depending on the hydrogen content of the fuel, and assumes that the latent heat of vaporisation cannot be captured and should not be included in the analysis. Others suggest that a use can be found for this heat, even if it is for space heating, and so should be included. Unfortunately, when one reads statistics on energy use, heating value, LHV or HHV, are seldom defined.

Non-Energetic Use of Fuels

Fuels that are not used for energy purposes may or may not be identified and may or may not be included in the energy statistics. The coking process, for example, generates products that can be sold or used in the plant.

Production Protocols

Even when dealing with one specific industry like steel manufacturing, changes in product mix can affect the amount of energy used independent of changes in efficiency. Thus, to develop a true picture of intensity, we need to know both the mix of products and the energy used in their production. While we have production data on many steel products, detailed energy data by product are not available. Therefore, to generate a physical intensity indicator, we need a more aggregate physical unit. As described above, data on at least two useful physical units of output are available, *production of primary forms* and *disposition*.

- *Production of Primary Forms* refers to the quantity of primary steel or tonnes raw steel generated. The ASM survey form directs respondents to list pig iron, direct reduced iron, and all types of scrap, reflecting the total tonnage of steel that has been cast.³ Production serves as a good measure of overall output because it includes all steel produced domestically, and because the bulk of the energy used in making steel products occurs in the production of primary steel. It does not, however, reflect the production of actual usable steel or finished products.
- *Disposition* values reflect the production and distribution of final steel forms (wire, rails, heavy, intermediate and light structural steel, concrete reinforcement steel, etc.) to end-use markets. While disposition includes all finished products ready for end-use, its magnitude is considerably less than the production value of steel because “home” scrap is excluded from the disposition total. The magnitude of the “home” scrap is not known. If the goal of the indicator is to establish the energy intensity of finished steel products

³ This includes “home” scrap, all scrap from the manufacture of steel mill products, “prompt” scrap from other primary manufacturing industries, and “obsolete” scrap from discarded durables.

(those which leave the mill for an end use), then this could be the preferred proxy for a denominator because it assumes that energy used to recycle “home” scrap is simply part of the process in the production of steel.

An additional complication is that the ASM survey form does not determine if the goods shipped are made of imported or domestic steel; that is, imported steel may be included in the disposition sum. As mentioned above, each tonne of imported steel deflates the intensity value of an indicator (the effect can be as great as 8%) because Canadian mills invested no energy in its primary production.

Internationally, steel production is measured in several different ways. The Worldsteel Association, for example, considers the primary unit as tonnes of liquid steel, measured when the steel has left the ladle and enters the caster. Steel cooled in its primary form is known as tonnes of raw steel – slabs, billets, blooms or semi-finished products; such data are gathered by StatCan. Government agencies in the US use production of finished products. The CSPA prefers to use shipments of finished products or disposition (similar to the United States’ definition except for inventory differences).

Phylipsen *et al.*, (1998) suggest two possible denominators for the iron and steel industry’s physical intensity indicator: total steel produced (crude or raw steel) and total steel produced (crude steel) *plus* the net amount of iron exported. Total steel produced is the denominator used most often.

With international comparisons important in this highly competitive industry, one must be sure that physical energy intensity indicators are comparable across countries. Worldsteel reports total steel as provided by various countries including Canada. To ensure comparability, CEEDC generates intensity indicators using both disposition and total raw steel.

Comparisons to Other Jurisdictions

The Iron and Steel Industry is one of the most important industrial activities from an energy perspective (5% of the world’s energy demand), so it is important to consider and compare energy intensity indicators between countries. Developing comparable indicators is difficult because of the ways in which the industry can be aggregated (Figure 3.1). In this document, the industry includes all processes found in the largest box of Figure 1. Thus, this assessment varies from that used by the IEA and Worldsteel.

There are studies that compare regions, in a limited way (e.g., Kim and Worrell, 2002; IEA, 2008), but there is no single, easily accessible data source that would provide such comparisons. The Worldsteel Association has details on steel production worldwide but little energy data. Databases containing energy use by industry exist but are not free.

National Trends

This section provides detailed information about energy use, CO₂ emissions, and materials production within the Canadian iron and steel industry. Data is shown for the Iron and Steel Mills and Ferro-Alloy Manufacturing Industry (NAICS 3311) unless indicated otherwise.

In 1990, the steel industry experienced a six-month labour disruption at its two largest plants. Lower overall production and a higher shipment-to-production ratio led to reduced CO₂ emissions and lower energy intensity indicators than in a “normal” year. To establish efficiency and CO₂ targets, the CSPA and CEEDC developed adjusted values for 1990 to normalize energy use and CO₂ emissions for this reference year. This modified value is used in our trend analyses. For details on methods and calculation see CIEEDAC 2007, *Baseline 1990 Data for the Canadian Iron and Steel Manufacturing Industries*.

Production

Industry production in monetary terms is measured by the industry’s annual contribution to gross domestic product (GDP) and the industry’s gross output (GO). In physical terms, the iron and steel industry’s outputs are the quantity of steel produced and the quantity of steel shipped annually (i.e., disposition). The difference between production (primary forms) and disposition includes the amount of stockpiled steel and the quantity of recycled steel from within the plant included in production.

Figure 2 shows physical and monetary output measures. Physical production generally showed steady growth to 2000 where it peaked at 16.5 million tonnes of total molten steel. After a drop in 2001, physical production fluctuated between 15 and 16 million tonnes annually until it showed a considerable decline in 2009 – likely impacted by the preceding economic recession – reaching a level 36% below the adjusted 1990 level and 40% below 2005. Production levels increased in 2010, but physical production of molten steel has remained relatively flat since then; production of primary forms in 2017 was 6% below 1990 adjusted levels and 11% below 2005.

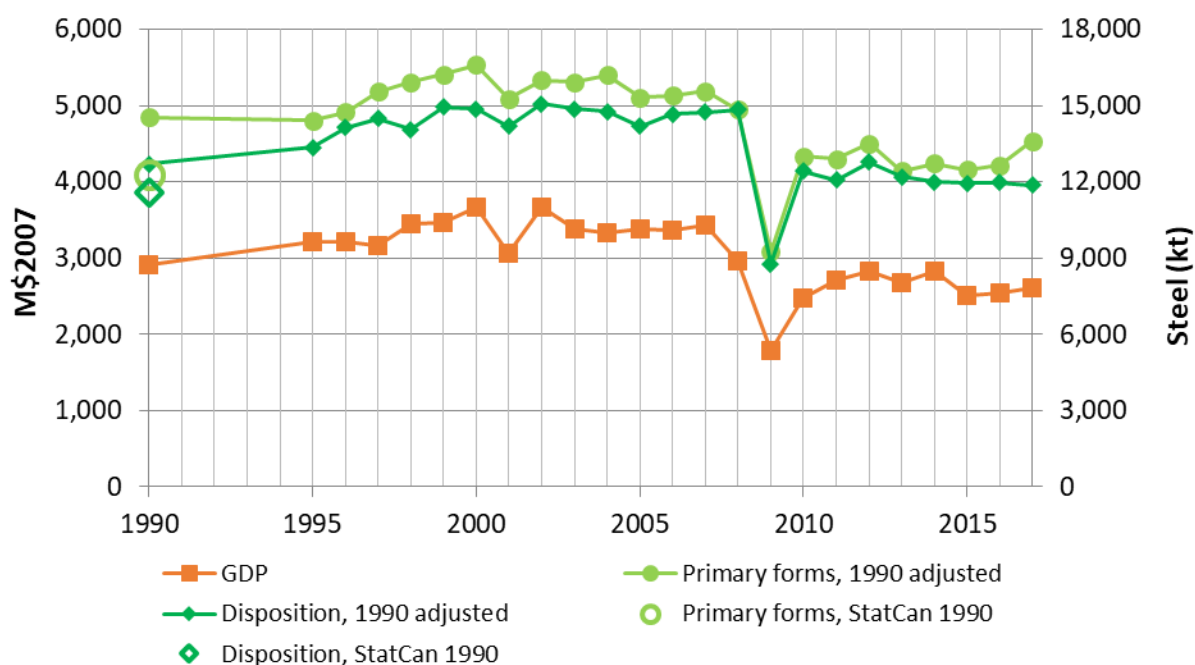


Figure 2: Output measures for the Iron and Steel industry

Source: StatCan and Worldsteel.

GDP fluctuates over the period, showing a steady increase to 2007 when it was 18% above 1990 before falling dramatically in 2009. After recovering from this decline, GDP in 2017 is 10% below 1990 levels and 23% below 2005.

CEEDC reviewed production data in terms of primary forms and disposition and determined that the quantity of primary forms was always slightly higher than disposition (see Table 1). Over the period, some discrepancies are observed; for example, in 2008, disposition matched production, likely due to little or no stockpiling of steel made in the previous year.

Table 1: Steel production and disposition

kt	1990	1995	2000	2005	2010	2014	2015	2016	2017
Steel, primary forms	14,531	14,414	16,597	15,327	13,003	12,730	12,473	12,646	13,614
Steel, disposition	12,696	13,349	14,865	14,197	12,423	11,984	11,954	11,977	11,860
Ratio D/P	87%	93%	90%	93%	96%	94%	96%	95%	87%

Note: Calculated 1990 adjusted values shown in italics.

Source: StatCan and Worldsteel.

Figure 3 illustrates the variations in the disposition to production ratio over time.

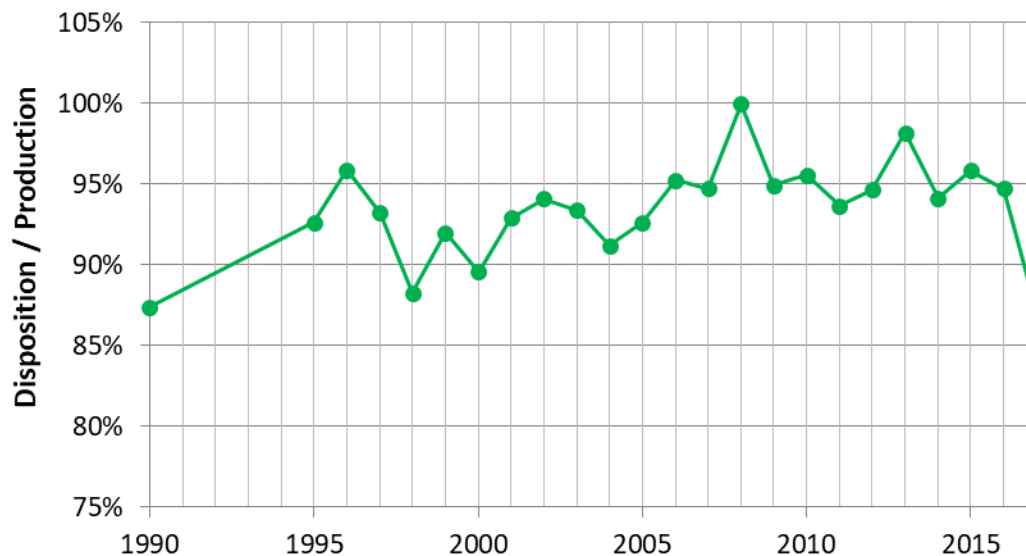


Figure 3: Ratio of steel disposition to production

Note: Calculated adjusted values shown for 1990.

Source: StatCan and Worldsteel.

Limitations and Issues

A review of the values presented here with StatCan and CSPA produced the following assessment:

1. Canadian plants provide data on tonnes of raw steel (TRS); production values reflect the tonnes of metal cast. This is typically about 1% less than tonnes of liquid steel (TLS) (i.e., a 1% loss occurs in the process of pouring and forming the castings). TLS is not measured or reported.
2. The processing of primary steel forms (TRS) at a mill to generate finished products for disposition generates scrap material that is recycled, or “home scrap”. Table 1 presents the ratio of disposition of finished products to production of primary forms. In StatCan’s assessment, such recycling does occur and could account for the difference. This assessment was corroborated by CSPA, but they too were unable to verify the percentage differences. Dr. Ernst Worrell of Utrecht University further supported this hypothesis, indicating that there is an approximately 8% difference between total crude steel production and total steel production (shipments minus change in stocks) due to the use of home scrap in the casting and rolling process and the loss of the carbon in pig iron.
3. The role of imported steel in the disposition values of Table 1 is not confirmed. Our goal in this report is to use a denominator for intensity that is related to energy used (i.e.,

how much energy was used to make how much steel). It seems unlikely that imports are included with the production data, but they find their way into disposition data.

4. Product trade between firms within Canada and the U.S. may influence our data. A firm may ship a semi-finished product to another firm for finishing or may even ship a product out for processing only to have it come back for a final step. However, since only one firm will report this as a final product double counting is unlikely.

Energy Use and CO₂ Emissions

National trends in energy use for this report are developed using ICE data – considered most reliable and used wherever available – supplemented by data from the RESD and ASM. CO₂ emissions were calculated by multiplying the energy use of each fuel by the fuel's CO₂ conversion factor, obtained from Environment and Climate Change Canada. CEEDC has estimated suppressed energy values based on assumptions related to the consistency of historical fuel shares and the balance of fuels over the whole of the primary metals industry.

Figure 4 shows the total energy use and CO₂ emissions for the iron and steel industry. Data for 1991 to 1994 have not been updated to reflect the NAICS format and are omitted from this report. Note from the figure that both energy use and CO₂ emissions follow a similar pattern indicating the degree to which emissions are tied to fuel use.

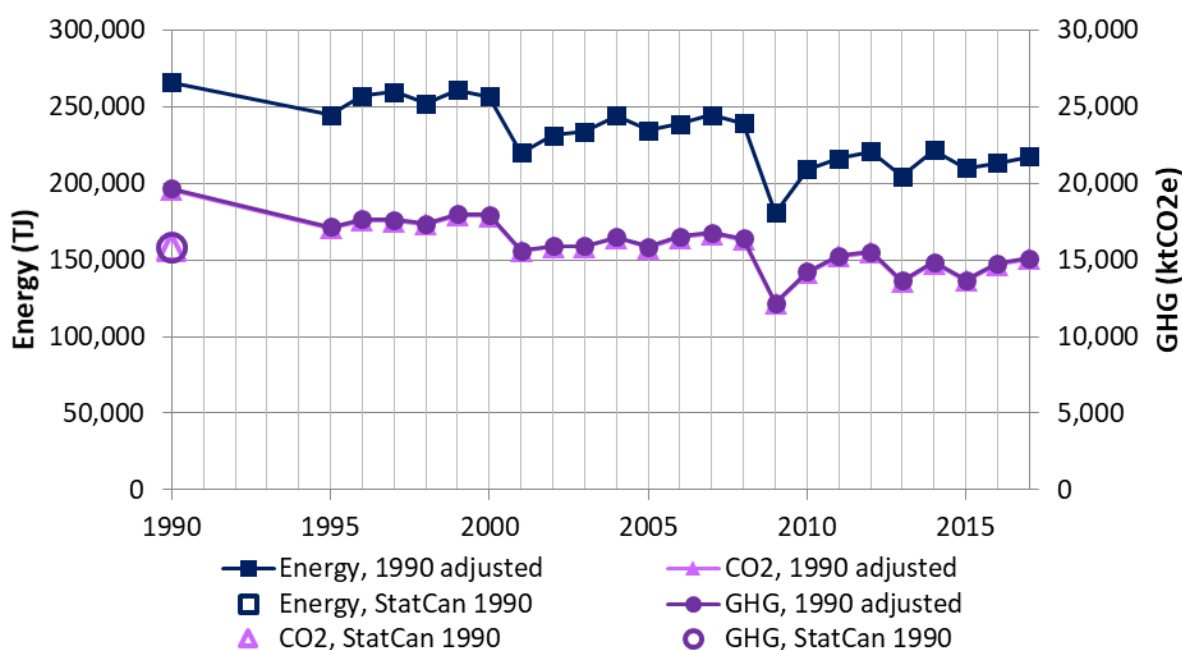


Figure 4: Energy Use and CO₂ Emissions

Note: CO₂ emissions from coke use are presented here as fuel combustion (StatCan convention) but use the emission factor from the ECCC NIR to be consistent with total emissions.

Source: StatCan; ECCC; CEEDC estimates of suppressed energy values.

All the sudden decreases in energy and emissions (1990, 2001, and 2009) are related to declines in production. As previously discussed, an industry strike was responsible for the decrease in 1990. Economic conditions were responsible for the 2001 and 2009 decreases.

Since 2009, energy consumption and emissions have been rising, albeit inconsistently. Nevertheless, in 2017 energy consumption remains 7% below 2005 levels, while GHG emissions are 5% below 2005.

Different surveys use different criteria in the collection of energy data, especially as it relates to how fuels are used (as feedstock or fuel) and energy content of fuels whether purchased or self-generated. The iron and steel industry produces some of its own fuel when it takes coking coal and generates coke from it for use in blast furnaces. In the conversion process, some by-products are made and sold, and coke oven gas is generated and used throughout the plant as a fuel alternative. The coke is used to reduce iron oxides to iron and is considered by some a feedstock and by others a fuel.⁴ Because of the dominance of coke and coke oven gas in the process, these issues have some impact on the calculation of energy use and emissions generation, as well as energy and emissions intensity indicators.

Intensity Indicators

Data on energy use, CO₂ emissions, and production are used by CEEDC to calculate intensity ratios (energy or emissions over output). These ratios indicate general trends useful to monitor progress in efficiency, identify market trends and efficiency improvement opportunities, do cross-country comparisons, and provide a basis for energy-focused policies and regulations.⁵

Two types of intensity indicators can be generated from the available data:

1. An indicator based on production measured in monetary terms (i.e., GDP or GO), is known as *economic* intensity. Because monetary data tend to be readily available in most countries that collect data on industry, this is the more common of the international indicators; and
2. An indicator using physical units in the denominator generates a *physical* intensity indicator. Because there is a strong link between making a unit of product and the energy required in its manufacture, this is the preferred measure.

⁴ Environment and Climate Change Canada follows *United Nations Framework Convention on Climate Change* good practice guidelines and assumes a value for coking coal as a feedstock that considers the carbon content of both the iron ore and the resultant pig iron after reduction of iron oxide has occurred. StatCan, however, considers coke inputs a fuel.

⁵ Intensity is the inverse of efficiency. Intensity refers to the amount of energy required to make a product (e.g. Energy/Product), while efficiency refers to the amount of product one can make with a unit of energy (e.g. Product/Energy). That said, in much of the literature, references to efficiency are equated with intensity.

Indicators based on physical rather than monetary units tend to be a better proxy for technological or process innovations; monetary units are affected by many factors not associated with energy, such as labour costs or selling price of the product.⁶

Energy and CO₂ intensity indicators are presented in Figure 5 and Figure 7. Intensity indicators, obtained by dividing energy use and CO₂ emissions by the various output measures, are shown as indices (normalized to the adjusted 1990 data). Using an index helps to demonstrate changes from a baseline.

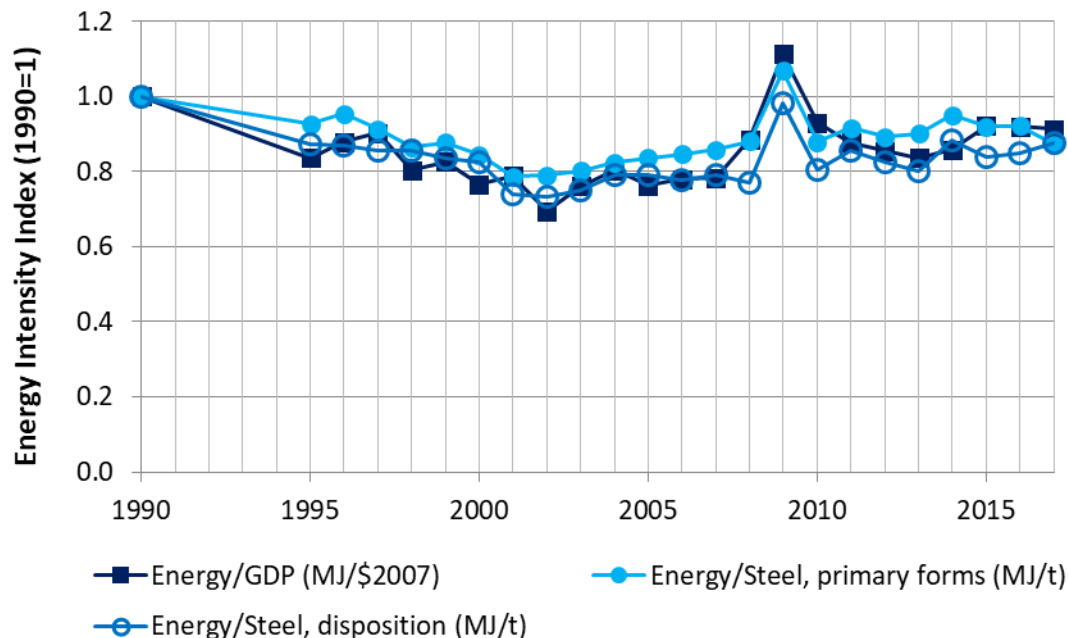


Figure 5: Energy intensity indicators

Note: Calculated adjusted values shown for 1990.

Source: StatCan; Worldsteel; CEEDC estimates of suppressed energy values.

Energy per tonne of disposed steel decreased from 1990 to its lowest point in 2002, fluctuating thereafter around 78% of the adjusted 1990 value. After an anomalous spike in 2009 (energy use diminished but not nearly as much as production), intensity based on disposed steel has averaged 84% of the adjusted 1990 value. Recent analysis by researchers at NRCan's Office of Energy Efficiency shows that the spike in 2009 was due to decreased capacity utilization; plants were still running and technologies, such as coke ovens and blast furnaces, remained active to maintain functionality even though less iron was produced.⁷

⁶ See CIEEDAC (1993) for more information on the issues of physical versus monetary units for calculating intensity indicators and on CEEDC's recommendations of appropriate units.

⁷ Research was completed by Michael Warbanski (OEE, NRCan) and supported by comments from Andy Mahut (U.S. Steel Canada, Inc.).

Indicators based on GDP show the same general trend. The lowest Energy/GDP intensity occurs in 2002 after which the index has had a general upwards trend reaching in 2017 to 9% below 1990.

Another way to understand intensity is to look at how much coke was required to produce a tonne of steel. The coke/production ratio can only be used to assess steel generated at integrated mills since steel generated at mini-mills using EAFs doesn't require coke. Figure 6 illustrates the changes in intensity in the generation of steel in integrated mills. The analysis provides an indication of the reason why 2009 intensity values seem disproportionately large compared to other years. The otherwise relatively flat line suggests that there's been little change in the amount of coke required to make a tonne of steel. But, as noted above, the level of capacity utilization may influence coke use per tonne of iron generated.

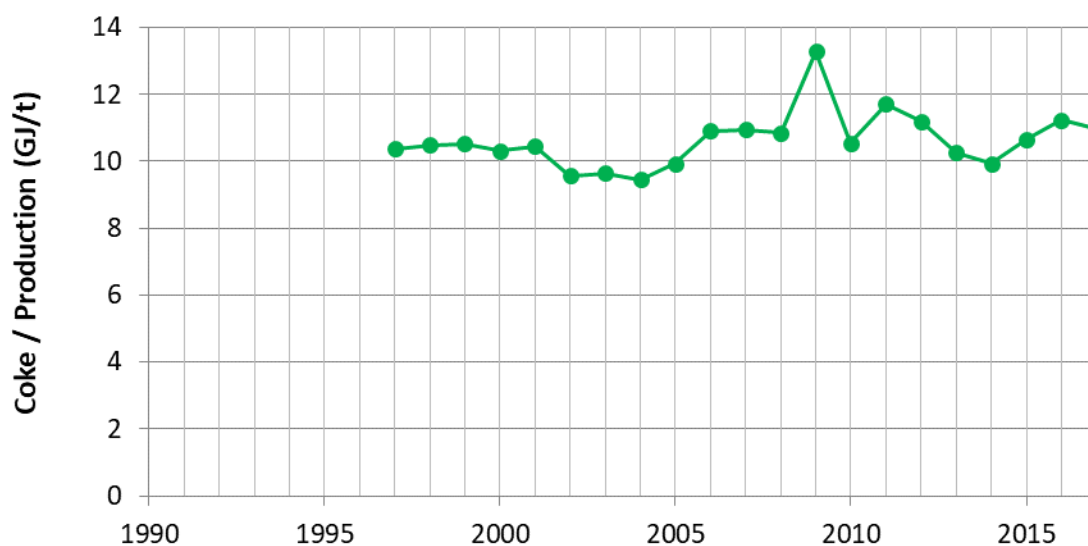


Figure 6: Coke to production ratio

Note: Calculated adjusted values shown for 1990.

Source: StatCan and Worldsteel.

Another factor that affects energy intensity is the degree to which steel is made from recycled products in EAFs compared to virgin steel generated in integrated mills. In Canada, we did not see a shift to EAF generated steel based on data available between 1997 and 2011. Over those years, about 41% of all steel produced annually in Canada came from EAF mills (mini-mills), with a range of 40%-42% over all steel mills in the sector. Because this variation is small, overall intensity improvement in the industry is unlikely to be the result of process change, at least in the production of raw steel. However, the highest EAF ratios (45%-47% of total production) occurred in 2013-2017 and may indicate a movement to the less energy intense EAF process; however, energy intensities shown in Figure 5 do not necessarily confirm this idea.

Data in Figure 7 indicate that CO₂ intensity indicators follow trends similar to the energy intensity indicators. Note that the amount of CO₂ generated per unit of *energy* used is slightly lower than in 1990. Because some energy data are confidential (coal, HFO, natural gas, and petcoke are confidential for most recent years), the total CO₂ value for years with confidential data are estimated.

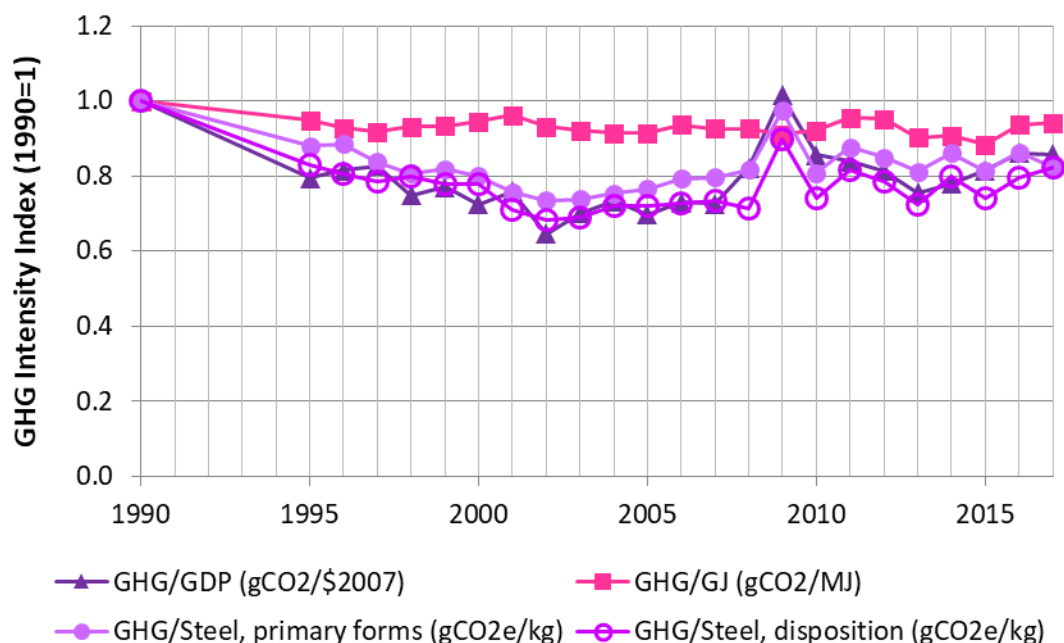


Figure 7: CO₂ intensity indicators

Note: Calculated adjusted values shown for 1990.

Source: StatCan; Worldsteel; ECCC; CEEDC estimates of suppressed energy values.

Limitations and Issues

1. The physical energy intensity indicators using StatCan's 1990 values were compared to indicators based on the industry adjusted 1990 value from CEEDC 2007 (the report in which the adjusted values were reviewed and updated). While trend lines show approximately the same pattern, the change in physical energy intensity over time using adjusted values is larger than the reduction in intensity using the ICE 1990 data. The indicators based on production values are nearly identical, showing the same trend. The economic indicators show also similar trends but do not track each other as well. The adjusted CO₂ intensity indicators follow the same trends as the energy intensity indicators.

In other words, using the adjusted 1990 values not only changes the reference year value but indicates more improvement from the reference year. This is appropriate for

our analysis since we are trying to estimate the changes in the industry from typical operations in 1990.

2. As noted above, estimates of GHG emissions are determined by analyzing the confidential numbers for energy in the context of the whole primary metal smelting industry. We advise caution in the reliability of these values since the uncertainty of the estimations can be high.

Focus on Ontario

This section provides detailed information about energy use, CO₂ emissions, and materials production within the Ontario iron and steel industry. Ontario has the majority of iron and steel mills in Canada and represents over 80% of the total energy use for this sector. Data is shown for the Iron and Steel Mills and Ferro-Alloy Manufacturing Industry (NAICS 3311) unless indicated otherwise.

As noted above in the “National Trends” section, the CSPA and CEEDC developed adjusted values for 1990 to normalize energy use and CO₂ emissions for this reference year; a labour disruption in 1990 led to lower the usual energy intensity indicators. The national adjusted values have been scaled in this section to represent the energy and emissions for Ontario. Scaling is based on the GDP values for Ontario and Canada since physical production values are not available at the provincial level.

Production

Industry production in monetary terms is measured by the industry’s annual contribution to gross domestic product (GDP). In physical terms, the iron and steel industry’s outputs are the quantity of steel produced and the quantity of steel shipped annually (i.e., disposition). The difference between production (primary forms) and disposition includes the amount of stockpiled steel and the quantity of recycled steel from within the plant included in production.

Figure 8 shows representative physical and monetary output measures for Ontario. GDP fluctuates over the period before falling dramatically in 2009. After recovering from this decline, GDP in 2017 is 18% below 1990 levels and 26% below 2005.

Physical production is based on Ontario’s share of the iron and steel industry’s GDP each year applied to the national production (i.e. Ontario’s GDP for the sector divided by Canada’s GDP for the sector multiplied by the physical output). After a considerable decline in 2009 – likely impacted by the preceding economic recession – production levels increased in 2010, but physical production of molten steel has remained relatively flat since then. Production of primary forms in 2017 was 14% below 1990 adjusted levels and 15% below 2005.

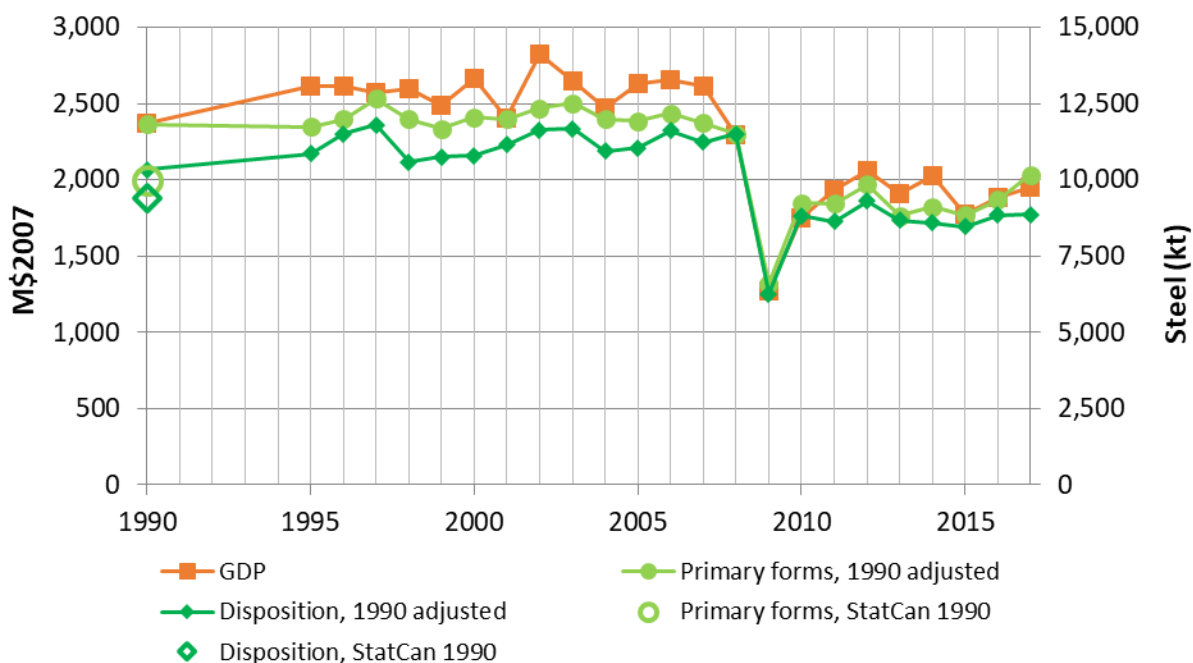


Figure 8: Output measures for the Ontario Iron and Steel industry

Source: StatCan and Worldsteel.

Energy Use and CO₂ Emissions

Provincial trends in energy use for this report are developed using RESD data and supplemented by data from the ICE (only available at the national level) and ASM surveys. CO₂ emissions were calculated by multiplying the energy use of each fuel by the fuel's CO₂ conversion factor, obtained from Environment and Climate Change Canada. CEEDC has estimated suppressed energy values based on assumptions related to the consistency of historical fuel shares and the balance of fuels over the whole of the primary metals industry.

Figure 9 shows the total energy use and CO₂ emissions for the iron and steel industry. Note from the figure that both energy use and CO₂ emissions follow a similar pattern indicating the degree to which emissions are tied to fuel use. Data for 1995 to 2004 and 2006 to 2009 have not yet been updated but will be included in future reports.

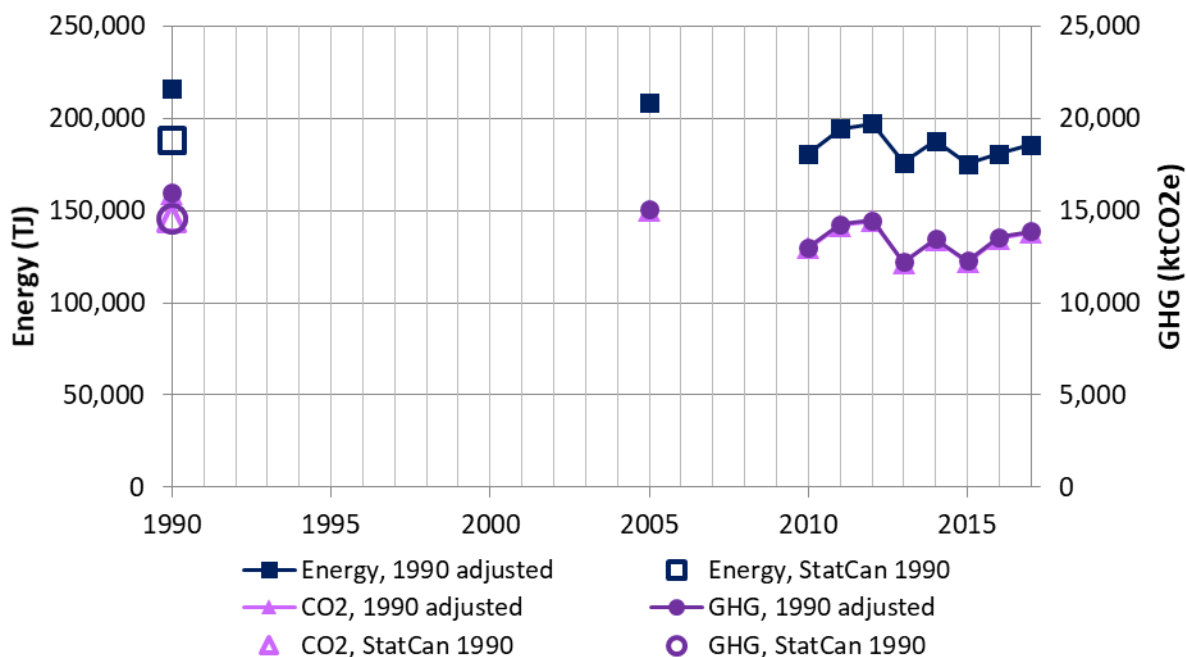


Figure 9: Ontario Energy Use and CO₂ Emissions

Note: CO₂ emissions from coke use are presented here as fuel combustion (StatCan convention) but use the emission factor from the ECCC NIR to be consistent with total emissions.

Data for 1995 to 2009 have not yet been updated but will be included in future reports.

Source: StatCan; ECCC; CEEDC estimates of suppressed energy values.

In 2017, energy consumption remains 11% below the 2005 level, while total GHG emissions are 8% below 2005.

Different surveys use different criteria in the collection of energy data, especially as it relates to how fuels are used (as feedstock or fuel) and energy content of fuels whether purchased or self-generated. The iron and steel industry produces some of its own fuel when it takes coking coal and generates coke from it for use in blast furnaces. In the conversion process, some by-products are made and sold, and coke oven gas is generated and used throughout the plant as a fuel alternative. The coke is used to reduce iron oxides to iron and is considered by some a feedstock and by others a fuel.⁸ Because of the dominance of coke and coke oven gas in the process, these issues have some impact on the calculation of energy use and emissions generation, as well as energy and emissions intensity indicators.

⁸ Environment and Climate Change Canada follows *United Nations Framework Convention on Climate Change* good practice guidelines and assumes a value for coking coal as a feedstock that considers the carbon content of both the iron ore and the resultant pig iron after reduction of iron oxide has occurred. StatCan, however, considers coke inputs a fuel.

Intensity Indicators

Data on energy use, CO₂ emissions, and production are used by CEEDC to calculate intensity ratios (energy or emissions over output). These ratios indicate general trends useful to monitor progress in efficiency, identify market trends and efficiency improvement opportunities, cross-country comparisons, and provide a basis for energy-focused policies and regulations.⁹

Indicators based on physical rather than monetary units tend to be a better proxy for technological or process innovations; monetary units are affected by many factors not associated with energy, such as labour costs or selling price of the product. The physical production presented here for Ontario is based on the provincial share of national GDP for the sector. Any provincial differences in changes to labour costs or product inputs could affect the reliability of these physical production estimates.

Energy and CO₂ intensity indicators are presented in Figure 10 and Figure 12. Intensity indicators, obtained by dividing energy use and CO₂ emissions by the various output measures, are shown as indices (normalized to the adjusted 1990 data). Using an index helps to demonstrate changes from a baseline.

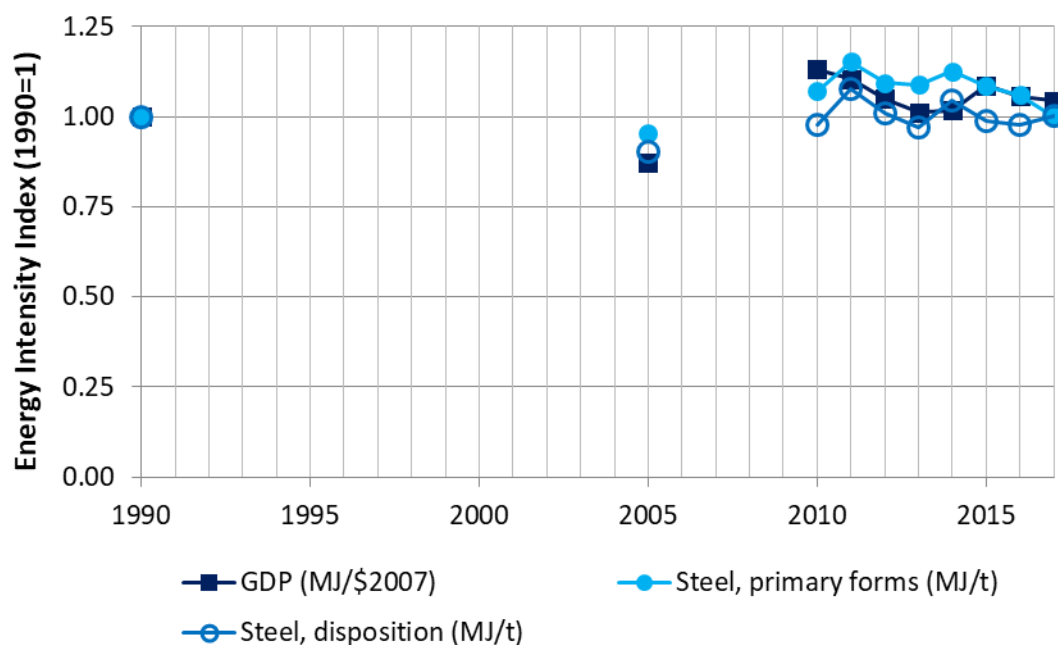


Figure 10: Ontario Energy intensity indicators

Note: Calculated adjusted values shown for 1990.

Source: StatCan; Worldsteel; CEEDC estimates of suppressed energy values.

⁹ See the National Trends – Intensity Indicators section for a discussion of intensity vs. efficiency.

Energy per tonne of steel produced and disposed has remained relatively flat over the past few years. Compared to the national average, where energy intensity has decreased to 80%-90% of its 1990 value, the values for Ontario remain very close to their 1990 values after being 10% above for the past few years. This could be due to the geographical distribution of basic oxygen furnaces (for primary steel production) and electric arc furnaces (used primarily for recycled steel production). The indicator based on GDP shows the same general trend.

Another way to understand intensity is to look at how much coke was required to produce a tonne of steel. The coke/production ratio can only be used to assess steel generated at integrated mills since steel generated at mini-mills using EAFs doesn't require coke. Figure 11 illustrates the changes in intensity in the generation of steel in Ontario's integrated mills. The relatively flat line suggests that there's been little change in the amount of coke required to make a tonne of steel. Again, the values for Ontario compared to the Canadian average are higher: Ontario mills average about 15 GJ/t of steel produced, while the national average over the same period is 11 GJ/t.

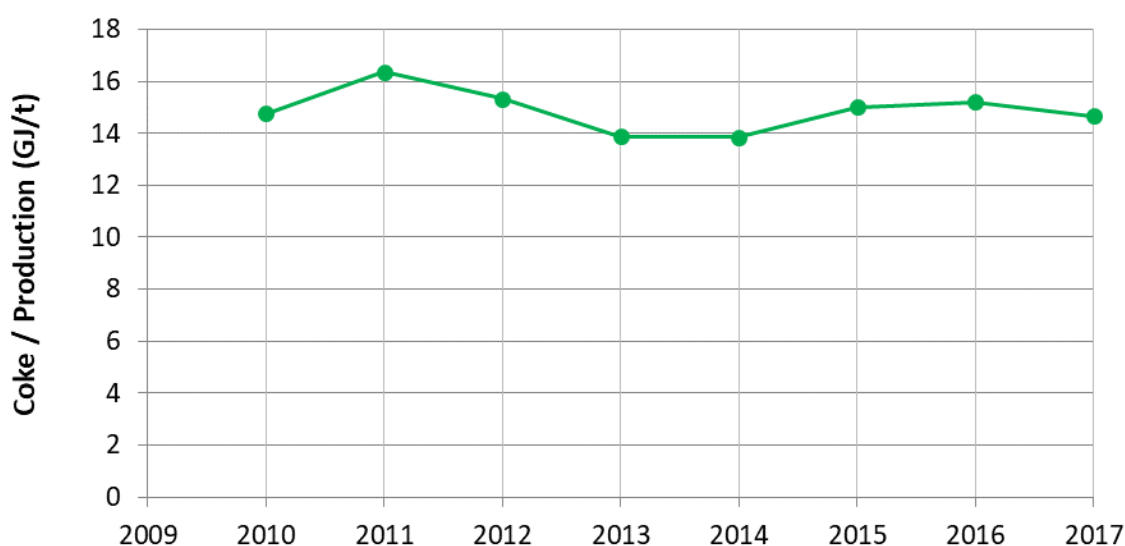


Figure 11: Ontario Coke to production ratio

Note: Calculated adjusted values shown for 1990.

Source: StatCan and Worldsteel.

Data in Figure 12 indicate that CO₂ intensity indicators follow trends similar to the energy intensity indicators. Note that the amount of CO₂ generated per unit of *energy* used is also approximately the same as in 1990. Because some energy data are confidential (coal, HFO, natural gas, and petcoke are confidential for most recent years), the total CO₂ value for years with confidential data are estimated.

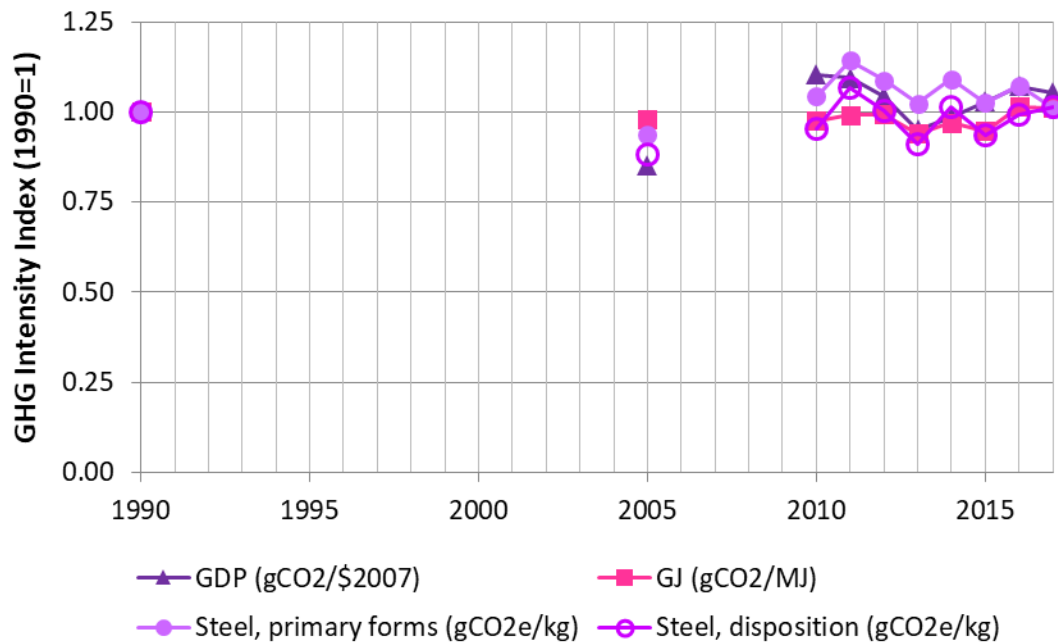


Figure 12: Ontario CO₂ intensity indicators

Note: Calculated adjusted values shown for 1990.

Source: StatCan; Worldsteel; ECCC; CEEDC estimates of suppressed energy values.

Data Issues and Solutions

1. Confidentiality constraints are the primary issue related to how well we can understand energy and emissions in the iron and steel sector of the Canadian economy. Historically, all parties, including CSPA, StatCan, CEEDC, NRCAN, and ECCC have been involved and are trying to find ways to reduce confidential data.
2. Within the ICE data, the method/values used to calculate energy released from coke oven gas (COG) vary. Historically, StatCan calculated COG energy use by multiplying coking coal by a fixed coefficient (for 1990 – 1997, it was 0.22). In the update of ICE data for values from 1995 and later, the value for COG has been taken as reported by the submitting steel producers.

Currently, RESD COG data are identical to that in ICE and the ratio of coal to coke varies in the RESD.

Table 2: Coal transformation to coke and coke oven gas

TJ	1990	1995	2000	2005	2010	2014	2015	2016	2017
Coal transformed	144,893	121,884	123,976	125,547	113,524	89,467	87,307	83,783	85,181
Coke produced	106,899	94,655	93,461	95,272	78,422	66,483	65,536	63,256	63,513
Coke Oven Gas produced	31,877	26,815	28,092	30,443	22,306	22,984	23,222	22,037	22,057
Coke / Coal	74%	78%	75%	76%	69%	74%	75%	75%	75%
COG / Coal	22%	22%	23%	24%	20%	26%	27%	26%	26%
(Coke + COG) / Coal	96%	100%	98%	100%	89%	100%	102%	102%	100%

Note: Values shown are for total production, not consumption in the iron and steel sector.

CEEDC estimates for suppressed confidential values highlighted in green.

Source: StatCan RESD; CEEDC estimates.

- Aside from losses in energy when coal is transformed to coke, the sum of coke and coke oven gas should be marginally less than the coking coal used (3% - 4% lost in conversion). From Table 2, we see variation in this ratio (values not shown vary by up to 10%). This matter has been discussed with StatCan and we have been unable to determine why this variation exists. There could be survey errors where input data from respondents are incorrect, some alternative uses for coal, errors in stockpile estimation, or issues related to how stockpiles of coal are accounted for.
- CEEDC's industry partners have raised questions regarding differences between the energy values reported for steel smelting in the RESD and ICE. Recent editions of RESD data appear to be in good agreement with the total of ICE data for NAICS 3311, 3312, 331511, and 331514. This confirms that ICE survey data is included in the development of the RESD tables.

Table 3 provides a comparison of RESD and ICE for recent years. The data in the table contain a lot of information now considered confidential. Using both RESD and ICE data helps CEEDC to estimate the confidential data for all industry sectors; this information is needed to calculate total GHG emissions by NAICS sector. The comparison of values below indicates that our estimation methods provide a reasonable result for the Iron and Steel industry.

Table 3: Comparison of RESD and ICE data for Iron and Steel

TJ	2015		2016		2017	
	RESD	ICE	RESD	ICE	RESD	ICE
Coal	12,802	13,102	12,408	12,584	14,500	14,736
Coke	71,677	71,537	78,945	78,812	79,808	79,735
Coke Oven Gas	21,181	21,181	19,994	19,994	19,744	19,744
Petcoke	203	105	237	326	200	147
Natural Gas	78,699	73,507	76,600	71,631	79,610	73,510
Electricity	32,303	29,111	31,762	28,984	31,926	28,191
Middles Distillates	595	754	947	869	750	799
Heavy Fuel Oil	305	521	167	117	550	568
Propane	300	4	171	6	168	5
Wood		0		0		0
Total	218,064	209,805	221,230	213,324	227,256	217,435
Confidential	92,903	87,217	122,291	84,659	95,778	88,961

Note: RESD data is for "Iron and Steel"; ICE data includes NAICS 3311, 3312, 331511, and 331514.

Shaded cells are considered confidential and show CEEDC estimates.

Source: StatCan RESD and ICE; CEEDC estimates.

- There are issues related to the assessment of GHGs for the industry that require resolution. These issues include the estimation of process emissions in the production of lime, carbon content of pig iron and steel, and allocation of emissions related to cogenerated electricity. Through a discussion between stakeholders, these issues are currently being reviewed.

Summary

Quantity and Quality of Data Available for the Canadian Steel Industry

Energy Use

Statistics Canada (StatCan) records the use of energy from two separate sources, of which only one, the *Industrial Consumption of Energy* (ICE) survey, provides specific detail on energy use in physical units. The other source is the *Annual Survey of Manufacturers* (ASM), which provides data on energy expenditures, is used minimally in this report.

Relatively good records of use in this industry exist from a unified data set going back to the mid-1970s from the RESD. Unfortunately, the methodologies used to develop RESD and ICE data sets were not the same: RESD is an amalgamation of data obtained from a number of surveys whereas the ICE data are gathered from one survey and the RESD industry boundaries are different than those in ICE. StatCan has aligned ICE and RESD data for all industries such that there is far less difference in their values now (once sector boundaries are considered).

To further complicate the issue, the methodologies for obtaining the values for these two data sets also vary. RESD numbers are primarily tabulations of respondents to the ICE survey.¹⁰ However, ICE uses a method known as cut-off sampling, where very small sample units are estimated based on shipments from the ASM and this adjustment increases the ICE estimate without affecting the RESD estimate. Additionally, the adjustment is not applied to coal, coal coke, petroleum coke, and coke oven gas which results in higher estimates for natural gas and heavy fuel oil in ICE estimates than in the RESD (Grenier, personal communication, 2000). This report uses ICE data supplemented by RESD data.

Greenhouse Gases

Environment and Climate Change Canada (ECCC) publishes its *National Inventory Report* annually. This publication provides data on process emissions, as well as coefficients that can be used to determine CO₂, CH₄, and N₂O emissions based on fuel use. The coefficients are defined in Appendix A and GHG specific data can be found in Appendix B.

There are several issues related to the analysis of GHG emissions. These include the definition/handling of process vs. fuel-based GHG emissions, the degree to which the energy (and estimated GHG) data are considered confidential, the role of electricity production in the industry, and difference in levels of energy use. These issues are addressed below under the appropriate sections.

¹⁰ The exceptions are electricity, where supplier data from the *Electricity Supply/Disposition Quarterly* are used, and middle distillates, where supplier data from the *Quarterly End-Use of Refined Petroleum Products* are used.

Production Data

Data on production of steel come from several sources and are of two types: physical and monetary. The *Annual Survey of Manufacturers* (and its monthly corollary, the *Monthly Survey of Manufacturers*) provides monetary data including Gross Domestic Product (GDP). These GDP data, along with data on cost of materials, labour, energy, and other economic indicators, are used to generate Gross Output (GO) values for the industry. GO is roughly equivalent to the value of shipments and includes the value added as well as the value of inputs to production. Unfortunately, StatCan only publishes GO values three years after GDP data.

Physical production data were previously collected by StatCan in a number of different surveys, all of which were terminated in 2013. Data are now obtained from the Canadian Steel Producers Association through the Worldsteel Association. The protocols used to collect these production data mirror the standards set by StatCan to ensure a consistent, robust data series.

Trends in Energy Use, Energy Intensity, and CO₂ Emissions

Total energy use and associated emissions in 2017 are around 80% of what they were in 1990. GDP and physical intensity indicators, which spiked in 2009 due to the economic slowdown, have returned to typical levels and are 15% lower than they were in 1990 (adjusted). Carbon intensity of the total fuel has not really changed much in the last 20 years.

A number of points about the energy use, CO₂ emissions, and intensities in the Canadian steel industry are worth discussing.

1. The energy and CO₂ curves in Figure 4 track each other closely, suggesting that the lower CO₂ intensity of production in this industry is due to overall efficiency improvements with little or no fuel switching (GHG intensity of the fuels has changed little).
2. Coke to production ratios can help to illustrate the efficiency of integrated mills. Based on this simple ratio of coke/production, efficiency changes have been minimal.
3. While large fluctuations are evident, production (TRS) is generally about 5% greater than shipments (disposition).

Data Limitations and Issues

The following data issues need to be addressed:

1. The level of confidential data related to coal, coke, and COG in the RESD and ICE data sets should be reduced wherever possible. These fuels are the key energy sources in the iron and steel industry and are the most crucial to relevant analysis.
2. We have clarified issues related to physical production data in this report. Two primary production indicators can be generated from the data: production and disposition. Analysts

should be careful as to which indicator they may wish to use, especially if international comparisons are to be made.

- a) Production of primary forms provides an intensity indicator for the most energy intense function of the steel industry, the smelting of steel. This is similar to the indicator most often used internationally by the Worldsteel Association. The value of the indicator slightly overestimates the energy used per tonne of raw steel because energy used in the manufacture of finished steel products is included in the total energy number.¹¹
- b) Disposition data provides an indicator of the embodied energy in the unique set of products that are made in Canada. This value cannot be easily compared to international data because each country is unlikely to generate the same mix of products. In part, this value may be confounded by the degree to which raw steel is imported to be “finished” domestically. On the other hand, it is an indicator used in other regions of the world, most notably the United States.

¹¹ As noted earlier, this number is estimated to be small; most of the energy used is in smelting.

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Acronyms

ASM - Annual Survey of Manufacturers
ASML - Annual Survey of Manufacturers and Logging
BOF - basic oxygen furnace
CANSIM - Canadian Socio-economic Information Management
CEEDC - Canadian Industrial Energy End-use Data and Analysis Centre
COG - coke oven gas
CSPA - Canadian Steel Producers Association
DR - direct reduced iron
EAF – electric arc furnace
GDP – Gross Domestic Product
GHG - greenhouse gas
GO – Gross Output
HHV – higher heating value
ICE - Industrial Consumption of Energy
IEA – International Energy Agency
IPCC – Intergovernmental Panel on Climate Change
ISIC - International Standard Industrial Classification
LHV – lower heating value
NAICS - North American Industry Classification System
NIR - National Inventory Report
NRCan - Natural Resources Canada
OHF - open hearth furnace
RESO- Report on Energy Supply and Demand
SPF - primary steel forms
StatCan - Statistics Canada
TLS - tonnes of liquid steel
TRS - tonnes of raw steel
WSA - Worldsteel Association

Appendices

Appendix A

- Table 1: Energy coefficients, GJ/physical unit
- Table 2: CO₂ emissions coefficients, tonnes/physical unit
- Table 3: CH₄ emissions coefficients, kg/physical unit
- Table 4: N₂O emissions coefficients, kg/physical unit

Appendix B

The tables in Appendix B are generated from CEEDC's master database on all industry in Canada.

- NAICS Energy Use Report
- NAICS Carbon Dioxide Report
- NAICS Methane Report
- NAICS Nitrous Oxide Report
- NAICS Total GHG Report

Appendix A – Conversion Coefficients

Fuel	Unit	Source	1990	1995	2000	2005	2010	2013	2014	2015	2016	2017
Energy												
HHV	GJ/unit											
Aviation gasoline	kL	RESO	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5
Aviation turbo	kL	RESO	36.4	36.4	36.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4
Biodiesel	kL	AFDC	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3
Butane	kL	ICE	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Coal	t	ICE	27.6	27.8	27.3	26.1	26.8	27.0	27.0	27.1	27.2	26.8
Coke	t	ICE	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8
Coke on Cat Crackers	t	Petcoke	37.1	37.1	38.6	38.6	38.6	38.6	38.6	38.7	38.6	38.6
Coke Oven Gas	ML	ICE	18.6	18.6	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1
Diesel	kL	RESO	38.7	38.7	38.7	38.3	38.3	38.3	38.3	38.3	38.3	38.3
Ethanol	kL	AFDC	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3
Gasoline	kL	RESO	34.7	34.7	34.7	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Heavy Fuel Oil	kL	ICE	41.7	41.7	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Kerosene	kL	MD	38.7	38.7	38.7	38.7	38.7	38.7	38.5	38.5	38.5	38.4
Light Fuel Oil	kL	MD	38.7	38.7	38.7	38.7	38.7	38.7	38.5	38.5	38.5	38.4
Liquified Petroleum Gas	kL	RESO	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
Middle Distillates	kL	ICE	38.7	38.7	38.7	38.7	38.7	38.7	38.5	38.5	38.5	38.4
Natural Gas	ML	ICE	37.8	38.1	38.0	38.3	38.5	38.9	39.0	39.2	39.0	39.2
Petcoke	t	ICE	37.1	37.1	38.6	38.6	38.6	38.6	38.6	38.7	38.6	38.6
Propane	kL	ICE	25.5	25.5	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3
Refinery Fuel Gas	ML	ICE	41.7	41.7	42.5	42.5	42.5	36.1	36.1	36.1	36.1	36.1
Spent Pulping Liquor	t	ICE	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
Still Gas	ML	RESO	37.3	37.3	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1
Wood	t	ICE	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Uranium	kg	STC, EPTGD	685.9	648.0	697.7	704.5	704.5	704.5	704.5	704.5	704.5	704.5

CO2												
	tCO2/unit											
Aviation gasoline	kL	NIR, Table A6-12	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37
Aviation turbo	kL	NIR, Table A6-12	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56
Biodiesel	kL	NIR, Table A6-12	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47
Butane	kL	NIR, Table A6-3	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
Coal	t	NIR, Table A6-8	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19
Coke	t	NIR, Table A6-9	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17
Coke on Cat Crackers	t	Petcoke	3.67	3.67	3.60	3.74	3.71	3.71	3.71	3.71	3.72	3.72
Coke Oven Gas	ML	NIR, Table A6-9	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69
Diesel	kL	NIR, Table A6-4	2.69	2.69	2.69	2.69	2.69	2.69	2.69	2.69	2.69	2.69
Ethanol	kL	NIR, Table A6-12	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51
Gasoline	kL	NIR, Table A6-4	2.32	2.32	2.32	2.32	2.32	2.32	2.32	2.32	2.32	2.32
Heavy Fuel Oil	kL	NIR, Table A6-4	3.16	3.16	3.16	3.16	3.16	3.16	3.16	3.16	3.16	3.16
Kerosene	kL	NIR, Table A6-4	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56
Light Fuel Oil	kL	NIR, Table A6-4	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75
Liquified Petroleum Gas	kL	Propane	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52
Middle Distillates	kL	MD	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75
Natural Gas	ML	NIR, Table A6-1	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92
Petcoke	t	NIR, CRF	3.67	3.67	3.60	3.74	3.71	3.71	3.71	3.71	3.72	3.72
Propane	kL	NIR, Table A6-3	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52
Refinery Fuel Gas	ML	NIR, CRF	1.88	1.91	1.85	1.89	1.97	2.12	2.12	2.13	2.13	2.13
Spent Pulping Liquor	t	NIR, Table A6-32	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Still Gas	ML	RFG	1.88	1.91	1.85	1.89	1.97	2.12	2.12	2.13	2.13	2.13
Wood	t	NIR, Table A6-32	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Process Coefficients												
Cement Clinker	t	NIR, CRF	0.55	0.55	0.55	0.55	0.55	0.54	0.54	0.54	0.54	0.54
Cement Waste Fuel	GJ	NIR, Table A6-11	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Lime	t	NIR, CRF	0.77	0.77	0.76	0.76	0.75	0.75	0.75	0.75	0.76	0.76
Aluminium	t	NIR, CRF	1.74	1.68	1.64	1.67	1.67	1.66	1.66	1.65	1.63	1.63
Ammonia	t	NIR, CRF	0.78	0.71	0.66	0.65	0.60	0.68	0.62	0.64	0.61	0.61

Fuel	Unit	Source	1990	1995	2000	2005	2010	2013	2014	2015	2016	2017
CH4 kgCH4/unit												
Aviation gasoline	kL	NIR, Table A6-12	2.200	2.200	2.200	2.200	2.200	2.200	2.200	2.200	2.200	2.200
Aviation turbo	kL	NIR, Table A6-12	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029
Biodiesel	kL	Diesel	0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133
Butane	kL	NIR, Table A6-3	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
Coal	t	NIR, Table A6-10	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030
Coke	t	NIR, Table A6-10	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030
Coke on Cat Crackers	t	Petcoke	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Coke Oven Gas	ML	NIR, Table A6-10	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Diesel	kL	NIR, Table A6-4	0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133
Ethanol	kL	Gasoline	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Gasoline	kL	NIR, Table A6-4	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Heavy Fuel Oil	kL	NIR, Table A6-4	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120
Kerosene	kL	NIR, Table A6-4	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
Light Fuel Oil	kL	NIR, Table A6-4	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
Liquified Petroleum Gas	kL	Propane	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
Middle Distillates	kL	MD	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
Natural Gas	ML	NIR, Table A6-2	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037
Petcoke	t	NIR, Table A6-4	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Propane	kL	NIR, Table A6-3	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
Refinery Fuel Gas	ML	NIR, Table A6-7	0.033	0.034	0.034	0.032	0.032	0.031	0.031	0.031	0.031	0.031
Spent Pulping Liquor	t	NIR, Table A6-32	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Still Gas	ML	RFG	0.033	0.034	0.034	0.032	0.032	0.031	0.031	0.031	0.031	0.031
Wood	t	NIR, Table A6-32	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090
<i>Process Coefficients</i>												
Cement Waste Fuel	GJ	NIR, Table A6-11	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030
N2O kgN2O/unit												
Aviation gasoline	kL	NIR, Table A6-12	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230
Aviation turbo	kL	NIR, Table A6-12	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071
Biodiesel	kL	Diesel	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
Butane	kL	NIR, Table A6-3	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108
Coal	t	NIR, Table A6-10	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Coke	t	NIR, Table A6-10	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Coke on Cat Crackers	t	Petcoke	0.021	0.021	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
Coke Oven Gas	ML	NIR, Table A6-10	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Diesel	kL	NIR, Table A6-4	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
Ethanol	kL	Gasoline	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Gasoline	kL	NIR, Table A6-4	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Heavy Fuel Oil	kL	NIR, Table A6-4	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
Kerosene	kL	NIR, Table A6-4	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031
Light Fuel Oil	kL	NIR, Table A6-4	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031
Liquified Petroleum Gas	kL	Propane	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108
Middle Distillates	kL	MD	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031
Natural Gas	ML	NIR, Table A6-2	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033
Petcoke	t	NIR, Table A6-6	0.021	0.021	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
Propane	kL	NIR, Table A6-3	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108
Refinery Fuel Gas	ML	Still Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Spent Pulping Liquor	t	NIR, Table A6-32	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Still Gas	ML	NIR, Table A6-4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wood	t	NIR, Table A6-32	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060
<i>Process Coefficients</i>												
Cement Waste Fuel	GJ	NIR, Table A6-11	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Adipic Acid	t	NIR, Table A6-15	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
Nitric Acid	t	NIR, CRF	3.384	3.269	3.640	3.434	4.121	3.775	3.932	4.197	3.782	3.782
Other GHGs tCO2e/unit												
Aluminium	t	PFCs	4.84	2.90	2.09	1.32	0.62	0.54	0.37	0.33	0.23	0.23
Magnesium	t	SF6	117.12	41.84	41.50	27.40	43.26	43.26	43.26	43.26	43.26	43.26

Appendix B – Production, Energy, and Emissions

Energy Use and Intensity Indicators

NAICS 3311 Iron and steel mills and ferro-alloy manufacturing
Canada

Adjusted 1990 value	CEEDC estimate	1990	1995	2000	2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Energy															
Coal	TJ	372	270	486	0	337	3,030	8,719	9,897	11,179	11,280	11,837	13,102	12,584	14,736
Coke Oven Gas	TJ	34,984	27,391	27,120	29,530	25,893	19,894	26,813	25,951	26,125	24,249	22,666	21,181	19,994	19,744
Coke	TJ	115,664	97,878	99,063	88,965	97,284	73,086	80,697	87,557	87,430	70,292	76,671	71,537	78,812	79,735
Electricity	TJ	32,405	32,903	34,976	32,483	29,994	24,163	27,739	27,678	28,464	24,343	29,436	29,111	28,984	28,191
Heavy Fuel Oil	TJ	11,457	8,527	7,548	8,817	12,133	2,357	91	31	95	3	50	521	117	568
Middle Distillates	TJ	1,117	1,231	959	832	529	1,155	1,144	1,132	643	902	681	754	869	799
Natural Gas	TJ	69,622	75,907	86,494	73,371	71,828	55,040	63,350	62,439	66,100	72,944	79,278	73,507	71,631	73,510
Petcoke	TJ	0	0	66	0	0	0	472	1,560	579	515	796	105	326	147
Propane	TJ	213	352	60	10	187	76	44	6	7	6	6	4	6	5
Wood	TJ	0	0	0	706	1,001	2,006	0	0	0	0	0	0	0	0
Total	TJ	265,834	244,458	256,771	234,714	239,185	180,809	209,082	216,250	220,623	204,533	221,419	209,805	213,324	217,435

Activity															
Steel, primary forms	kt	14,531	14,414	16,597	15,327	14,845	9,245	13,003	12,891	13,510	12,417	12,730	12,473	12,646	13,614
Steel, disposition	kt	12,696	13,349	14,865	14,197	14,837	8,777	12,423	12,070	12,786	12,192	11,984	11,954	11,977	11,860
GDP	M\$2007	2,918	3,208	3,675	3,378	2,964	1,783	2,469	2,704	2,831	2,684	2,829	2,500	2,547	2,616

Intensity															
Energy/Steel, primary forms	MJ/t	18,294.5	16,959.6	15,471.0	15,313.4	16,112.1	19,556.8	16,079.7	16,775.6	16,330.0	16,472.0	17,393.5	16,820.7	16,868.9	15,971.4
Energy/Steel, disposition	MJ/t	20,938.4	18,313.6	17,273.4	16,532.1	16,120.7	20,600.0	16,830.0	17,916.0	17,255.6	16,776.0	18,476.3	17,551.0	17,811.1	18,333.5
Energy/GDP	MJ/\$2007	91.1	76.2	69.9	69.5	80.7	101.4	84.7	80.0	77.9	76.2	78.3	83.9	83.8	83.1

Index (1990=1)															
Energy/Steel, primary forms	MJ/t	1.00	0.93	0.85	0.84	0.88	1.07	0.88	0.92	0.89	0.90	0.95	0.92	0.92	0.87
Energy/Steel, disposition	MJ/t	1.00	0.87	0.82	0.79	0.77	0.98	0.80	0.86	0.82	0.80	0.88	0.84	0.85	0.88
Energy/GDP	MJ/\$2007	1.00	0.84	0.77	0.76	0.89	1.11	0.93	0.88	0.86	0.84	0.86	0.92	0.92	0.91

Energy Use and Intensity Indicators

NAICS 3311 Iron and steel mills and ferro-alloy manufacturing
Canada

StatCan 1990 value	CEEDC estimate	1990	1995	2000	2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Energy															
Coal	TJ	10	270	486	0	337	3,030	8,719	9,897	11,179	11,280	11,837	13,102	12,584	14,736
Coke Oven Gas	TJ	31,581	27,391	27,120	29,530	25,893	19,894	26,813	25,951	26,125	24,249	22,666	21,181	19,994	19,744
Coke	TJ	88,057	97,878	99,063	88,965	97,284	73,086	80,697	87,557	87,430	70,292	76,671	71,537	78,812	79,735
Electricity	TJ	24,673	32,903	34,976	32,483	29,994	24,163	27,739	27,678	28,464	24,343	29,436	29,111	28,984	28,191
Heavy Fuel Oil	TJ	10,774	8,527	7,548	8,817	12,133	2,357	91	31	95	3	50	521	117	568
Middle Distillates	TJ	940	1,231	959	832	529	1,155	1,144	1,132	643	902	681	754	869	799
Natural Gas	TJ	64,520	75,907	86,494	73,371	71,828	55,040	63,350	62,439	66,100	72,944	79,278	73,507	71,631	73,510
Petcoke	TJ	0	0	66	0	0	0	472	1,560	579	515	796	105	326	147
Propane	TJ	1	352	60	10	187	76	44	6	7	6	6	4	6	5
Wood	TJ	0	0	0	706	1,001	2,006	0	0	0	0	0	0	0	0
Total	TJ	220,556	244,458	256,771	234,714	239,185	180,809	209,082	216,250	220,623	204,533	221,419	209,805	213,324	217,435

Activity															
Steel, primary forms	kt	12,281	14,414	16,597	15,327	14,845	9,245	13,003	12,891	13,510	12,417	12,730	12,473	12,646	13,614
Steel, disposition	kt	11,565	13,349	14,865	14,197	14,837	8,777	12,423	12,070	12,786	12,192	11,984	11,954	11,977	11,860
GDP	M\$2007	2,918	3,208	3,675	3,378	2,964	1,783	2,469	2,704	2,831	2,684	2,829	2,500	2,547	2,616

Intensity															
Energy/Steel, primary forms	MJ/t	17,959.6	16,959.6	15,471.0	15,313.4	16,112.1	19,556.8	16,079.7	16,775.6	16,330.0	16,472.0	17,393.5	16,820.7	16,868.9	15,971.4
Energy/Steel, disposition	MJ/t	19,071.5	18,313.6	17,273.4	16,532.1	16,120.7	20,600.0	16,830.0	17,916.0	17,255.6	16,776.0	18,476.3	17,551.0	17,811.1	18,333.5
Energy/GDP	MJ/\$2007	75.6	76.2	69.9	69.5	80.7	101.4	84.7	80.0	77.9	76.2	78.3	83.9	83.8	83.1

Index (1990=1)															
Energy/Steel, primary forms	MJ/t	1.00	0.94	0.86	0.85	0.90	1.09	0.90	0.93	0.91	0.92	0.97	0.94	0.94	0.89
Energy/Steel, disposition	MJ/t	1.00	0.96	0.91	0.87	0.85	1.08	0.88	0.94	0.90	0.88	0.97	0.92	0.93	0.96
Energy/GDP	MJ/\$2007	1.00	1.01	0.92	0.92	1.07	1.34	1.12	1.06	1.03	1.01	1.04	1.11	1.11	1.10

CO2 Emissions and Intensity Indicators

NAICS 3311 Iron and steel mills and ferro-alloy manufacturing
Canada

Adjusted 1990 value	CEEDC estimate	1990	1995	2000	2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Energy															
Coal	ktCO2	29	21	39	0	28	254	734	847	945	920	966	1,094	1,031	1,192
Coke Oven Gas	ktCO2	1,291	1,011	1,001	1,060	929	714	962	931	938	870	814	760	718	709
Coke	ktCO2	13,762	11,465	11,814	10,308	10,804	8,138	9,163	10,078	10,173	8,037	8,929	8,036	9,311	9,420
Electricity	ktCO2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heavy Fuel Oil	ktCO2	867	645	571	655	901	175	7	2	7	0	4	39	9	42
Middle Distillates	ktCO2	79	88	68	59	38	82	81	81	46	64	48	54	62	57
Natural Gas	ktCO2	3,543	3,834	4,366	3,710	3,616	2,767	3,184	3,151	3,309	3,650	3,958	3,667	3,558	3,641
Petcoke	ktCO2	0	0	6	0	0	0	39	130	48	43	67	9	27	12
Propane	ktCO2	13	21	4	1	11	5	3	0	0	0	0	0	0	0
Wood	ktCO2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	ktCO2	19,584	17,085	17,868	15,792	16,327	12,135	14,173	15,220	15,467	13,585	14,786	13,658	14,715	15,072
Activity															
Steel, primary forms	kt	14,531	14,414	16,597	15,327	14,845	9,245	13,003	12,891	13,510	12,417	12,730	12,473	12,646	13,614
Steel, disposition	kt	12,696	13,349	14,865	14,197	14,837	8,777	12,423	12,070	12,786	12,192	11,984	11,954	11,977	11,860
GDP	M\$2007	2,918	3,208	3,675	3,378	2,964	1,783	2,469	2,704	2,831	2,684	2,829	2,500	2,547	2,616
Intensity															
CO2/Steel, primary forms	gCO2/kg	1,347.7	1,185.3	1,076.6	1,030.3	1,099.8	1,312.5	1,090.0	1,180.7	1,144.8	1,094.0	1,161.5	1,095.0	1,163.6	1,107.1
CO2/Steel, disposition	gCO2/kg	1,542.5	1,279.9	1,202.0	1,112.3	1,100.4	1,382.5	1,140.9	1,261.0	1,209.7	1,114.2	1,233.8	1,142.6	1,228.6	1,270.9
CO2/GDP	gCO2/\$2007	6.7	5.3	4.9	4.7	5.5	6.8	5.7	5.6	5.5	5.1	5.2	5.5	5.8	5.8
CO2/GJ	gCO2/MJ	73.7	69.9	69.6	67.3	68.3	67.1	67.8	70.4	70.1	66.4	66.8	65.1	69.0	69.3
Index (1990=1)															
CO2/Steel, primary forms	gCO2/kg	1.00	0.88	0.80	0.76	0.82	0.97	0.81	0.88	0.85	0.81	0.86	0.81	0.86	0.82
CO2/Steel, disposition	gCO2/kg	1.00	0.83	0.78	0.72	0.71	0.90	0.74	0.82	0.78	0.72	0.80	0.74	0.80	0.82
CO2/GDP	gCO2/\$2007	1.00	0.79	0.72	0.70	0.82	1.01	0.86	0.84	0.81	0.75	0.78	0.81	0.86	0.86
CO2/GJ	gCO2/MJ	1.00	0.95	0.94	0.91	0.93	0.91	0.92	0.96	0.95	0.90	0.91	0.88	0.94	0.94

CO2 Emissions and Intensity Indicators

NAICS 3311 Iron and steel mills and ferro-alloy manufacturing
Canada

StatCan 1990 value	CEEDC estimate	1990	1995	2000	2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Energy															
Coal	ktCO2	1	21	39	0	28	254	734	847	945	920	966	1,094	1,031	1,192
Coke Oven Gas	ktCO2	1,166	1,011	1,001	1,060	929	714	962	931	938	870	814	760	718	709
Coke	ktCO2	10,477	11,465	11,814	10,308	10,804	8,138	9,163	10,078	10,173	8,037	8,929	8,036	9,311	9,420
Electricity	ktCO2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heavy Fuel Oil	ktCO2	815	645	571	655	901	175	7	2	7	0	4	39	9	42
Middle Distillates	ktCO2	67	88	68	59	38	82	81	81	46	64	48	54	62	57
Natural Gas	ktCO2	3,283	3,834	4,366	3,710	3,616	2,767	3,184	3,151	3,309	3,650	3,958	3,667	3,558	3,641
Petcoke	ktCO2	0	0	6	0	0	0	39	130	48	43	67	9	27	12
Propane	ktCO2	0	21	4	1	11	5	3	0	0	0	0	0	0	0
Wood	ktCO2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	ktCO2	15,808	17,085	17,868	15,792	16,327	12,135	14,173	15,220	15,467	13,585	14,786	13,658	14,715	15,072
Activity															
Steel, primary forms	kt	12,281	14,414	16,597	15,327	14,845	9,245	13,003	12,891	13,510	12,417	12,730	12,473	12,646	13,614
Steel, disposition	kt	11,565	13,349	14,865	14,197	14,837	8,777	12,423	12,070	12,786	12,192	11,984	11,954	11,977	11,860
GDP	M\$2007	2,918	3,208	3,675	3,378	2,964	1,783	2,469	2,704	2,831	2,684	2,829	2,500	2,547	2,616
Intensity															
CO2/Steel, primary forms	gCO2/kg	1,287.3	1,185.3	1,076.6	1,030.3	1,099.8	1,312.5	1,090.0	1,180.7	1,144.8	1,094.0	1,161.5	1,095.0	1,163.6	1,107.1
CO2/Steel, disposition	gCO2/kg	1,367.0	1,279.9	1,202.0	1,112.3	1,100.4	1,382.5	1,140.9	1,261.0	1,209.7	1,114.2	1,233.8	1,142.6	1,228.6	1,270.9
CO2/GDP	gCO2/\$2007	5.4	5.3	4.9	4.7	5.5	6.8	5.7	5.6	5.5	5.1	5.2	5.5	5.8	5.8
CO2/GJ	gCO2/MJ	71.7	69.9	69.6	67.3	68.3	67.1	67.8	70.4	70.1	66.4	66.8	65.1	69.0	69.3
Index (1990=1)															
CO2/Steel, primary forms	gCO2/kg	1.00	0.92	0.84	0.80	0.85	1.02	0.85	0.92	0.89	0.85	0.90	0.85	0.90	0.86
CO2/Steel, disposition	gCO2/kg	1.00	0.94	0.88	0.81	0.81	1.01	0.83	0.92	0.88	0.82	0.90	0.84	0.90	0.93
CO2/GDP	gCO2/\$2007	1.00	0.98	0.90	0.86	1.02	1.26	1.06	1.04	1.01	0.93	0.96	1.01	1.07	1.06
CO2/GJ	gCO2/MJ	1.00	0.98	0.97	0.94	0.95	0.94	0.95	0.98	0.98	0.93	0.93	0.91	0.96	0.97

GHG Emissions and Intensity Indicators

NAICS 3311 Iron and steel mills and ferro-alloy manufacturing
Canada

Adjusted 1990 value	CEEDC estimate	1990	1995	2000	2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Energy															
Coal	ktCO2e	30	21	39	0	28	255	736	850	948	923	968	1,097	1,035	1,195
Coke Oven Gas	ktCO2e	1,316	1,030	1,020	1,080	947	728	981	949	955	887	829	775	731	722
Coke	ktCO2e	13,788	11,488	11,837	10,328	10,826	8,155	9,182	10,098	10,194	8,053	8,947	8,052	9,329	9,438
Electricity	ktCO2e	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heavy Fuel Oil	ktCO2e	873	649	575	659	907	176	7	2	7	0	4	39	9	42
Middle Distillates	ktCO2e	80	88	68	59	38	83	82	81	46	64	49	54	62	57
Natural Gas	ktCO2e	3,562	3,855	4,390	3,731	3,637	2,782	3,201	3,168	3,327	3,670	3,980	3,687	3,577	3,661
Petcoke	ktCO2e	0	0	6	0	0	0	39	130	48	43	67	9	27	12
Propane	ktCO2e	13	21	4	1	11	5	3	0	0	0	0	0	0	0
Wood	ktCO2e	0	0	0	1	2	4	0	0	0	0	0	0	0	0
Total	ktCO2e	19,661	17,153	17,939	15,860	16,396	12,187	14,231	15,279	15,526	13,641	14,844	13,713	14,771	15,129
Activity															
Steel, primary forms	kt	14,531	14,414	16,597	15,327	14,845	9,245	13,003	12,891	13,510	12,417	12,730	12,473	12,646	13,614
Steel, disposition	kt	12,696	13,349	14,865	14,197	14,837	8,777	12,423	12,070	12,786	12,192	11,984	11,954	11,977	11,860
GDP	M\$2007	2,918	3,208	3,675	3,378	2,964	1,783	2,469	2,704	2,831	2,684	2,829	2,500	2,547	2,616
Intensity															
GHG/Steel, primary forms	gCO2e/kg	1,353.1	1,190.0	1,080.8	1,034.7	1,104.5	1,318.2	1,094.4	1,185.3	1,149.2	1,098.6	1,166.1	1,099.5	1,168.0	1,111.3
GHG/Steel, disposition	gCO2e/kg	1,548.6	1,285.0	1,206.8	1,117.1	1,105.1	1,388.5	1,145.5	1,265.8	1,214.4	1,118.8	1,238.7	1,147.2	1,233.2	1,275.6
GHG/GDP	gCO2e/\$2007	6.7	5.3	4.9	4.7	5.5	6.8	5.8	5.7	5.5	5.1	5.2	5.5	5.8	5.8
GHG/GJ	gCO2e/MJ	74.0	70.2	69.9	67.6	68.6	67.4	68.1	70.7	70.4	66.7	67.0	65.4	69.2	69.6
Index (1990=1)															
GHG/Steel, primary forms	gCO2e/kg	1.00	0.88	0.80	0.76	0.82	0.97	0.81	0.88	0.85	0.81	0.86	0.81	0.86	0.82
GHG/Steel, disposition	gCO2e/kg	1.00	0.83	0.78	0.72	0.71	0.90	0.74	0.82	0.78	0.72	0.80	0.74	0.80	0.82
GHG/GDP	gCO2e/\$2007	1.00	0.79	0.72	0.70	0.82	1.01	0.86	0.84	0.81	0.75	0.78	0.81	0.86	0.86
GHG/GJ	gCO2e/MJ	1.00	0.95	0.94	0.91	0.93	0.91	0.92	0.96	0.95	0.90	0.91	0.88	0.94	0.94

GHG Emissions and Intensity Indicators

NAICS 3311 Iron and steel mills and ferro-alloy manufacturing
Canada

StatCan 1990 value	CEEDC estimate	1990	1995	2000	2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Energy															
Coal	ktCO ₂ e	1	21	39	0	28	255	736	850	948	923	968	1,097	1,035	1,195
Coke Oven Gas	ktCO ₂ e	1,188	1,030	1,020	1,080	947	728	981	949	955	887	829	775	731	722
Coke	ktCO ₂ e	10,497	11,488	11,837	10,328	10,826	8,155	9,182	10,098	10,194	8,053	8,947	8,052	9,329	9,438
Electricity	ktCO ₂ e	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heavy Fuel Oil	ktCO ₂ e	821	649	575	659	907	176	7	2	7	0	4	39	9	42
Middle Distillates	ktCO ₂ e	67	88	68	59	38	83	82	81	46	64	49	54	62	57
Natural Gas	ktCO ₂ e	3,301	3,855	4,390	3,731	3,637	2,782	3,201	3,168	3,327	3,670	3,980	3,687	3,577	3,661
Petcoke	ktCO ₂ e	0	0	6	0	0	0	39	130	48	43	67	9	27	12
Propane	ktCO ₂ e	0	21	4	1	11	5	3	0	0	0	0	0	0	0
Wood	ktCO ₂ e	0	0	0	1	2	4	0	0	0	0	0	0	0	0
Total	ktCO ₂ e	15,875	17,153	17,939	15,860	16,396	12,187	14,231	15,279	15,526	13,641	14,844	13,713	14,771	15,129
Activity															
Steel, primary forms	kt	12,281	14,414	16,597	15,327	14,845	9,245	13,003	12,891	13,510	12,417	12,730	12,473	12,646	13,614
Steel, disposition	kt	11,565	13,349	14,865	14,197	14,837	8,777	12,423	12,070	12,786	12,192	11,984	11,954	11,977	11,860
GDP	M\$2007	2,918	3,208	3,675	3,378	2,964	1,783	2,469	2,704	2,831	2,684	2,829	2,500	2,547	2,616
Intensity															
GHG/Steel, primary forms	gCO ₂ e/kg	1,292.7	1,190.0	1,080.8	1,034.7	1,104.5	1,318.2	1,094.4	1,185.3	1,149.2	1,098.6	1,166.1	1,099.5	1,168.0	1,111.3
GHG/Steel, disposition	gCO ₂ e/kg	1,372.7	1,285.0	1,206.8	1,117.1	1,105.1	1,388.5	1,145.5	1,265.8	1,214.4	1,118.8	1,238.7	1,147.2	1,233.2	1,275.6
GHG/GDP	gCO ₂ e/\$2007	5.4	5.3	4.9	4.7	5.5	6.8	5.8	5.7	5.5	5.1	5.2	5.5	5.8	5.8
GHG/GJ	gCO ₂ e/MJ	72.0	70.2	69.9	67.6	68.6	67.4	68.1	70.7	70.4	66.7	67.0	65.4	69.2	69.6
Index (1990=1)															
GHG/Steel, primary forms	gCO ₂ e/kg	1.00	0.92	0.84	0.80	0.85	1.02	0.85	0.92	0.89	0.85	0.90	0.85	0.90	0.86
GHG/Steel, disposition	gCO ₂ e/kg	1.00	0.94	0.88	0.81	0.81	1.01	0.83	0.92	0.88	0.82	0.90	0.84	0.90	0.93
GHG/GDP	gCO ₂ e/\$2007	1.00	0.98	0.90	0.86	1.02	1.26	1.06	1.04	1.01	0.93	0.96	1.01	1.07	1.06
GHG/GJ	gCO ₂ e/MJ	1.00	0.97	0.97	0.94	0.95	0.94	0.95	0.98	0.98	0.93	0.93	0.91	0.96	0.97

Energy Use and Intensity Indicators

NAICS 3311 Iron and steel mills and ferro-alloy manufacturing
Ontario

Adjusted 1990 value	CEEDC estimate	1990	2005	2010	2011	2012	2013	2014	2015	2016	2017
Energy											
Coal	TJ	303	0	4,332	5,476	6,720	9,926	10,000	12,044	8,413	10,000
Coke Oven Gas	TJ	28,469	29,530	21,973	25,950	26,125	24,249	22,666	21,181	19,994	19,744
Coke	TJ	94,124	89,746	80,288	87,415	87,167	67,532	76,601	71,426	78,695	79,618
Diesel	TJ	0	712	1,081	510	400	591	400	140	766	800
Electricity	TJ	26,370	22,056	21,350	22,000	22,000	19,078	21,177	21,912	17,900	18,022
Gasoline	TJ	0	140	133	65	150	0	0	0	11	41
Heavy Fuel Oil	TJ	9,324	7,286	978	568	300	179	50	48	254	250
Middle Distillates	TJ	909	16	222	300	234	117	188	367	269	1
Natural Gas	TJ	56,656	58,856	50,290	52,014	53,917	54,149	56,347	47,703	54,508	56,905
Petcoke	TJ	0	0	0	0	0	0	0	0	0	0
Propane	TJ	173	23	23	25	23	28	157	132	100	76
Wood	TJ	0	0	0	0	0	0	0	0	0	0
Total	TJ	216,326	208,367	180,706	194,244	197,039	175,849	187,793	175,224	180,908	185,706

Activity											
Steel, primary forms	kt	11,825	11,924	9,234	9,213	9,841	8,827	9,120	8,836	9,336	10,166
Steel, disposition	kt	10,332	11,045	8,823	8,626	9,313	8,667	8,585	8,468	8,842	8,856
GDP	M\$2007	2,375	2,628	1,753	1,933	2,062	1,908	2,027	1,771	1,880	1,953

Intensity											
Energy/Steel, primary forms	MJ/t	18,294.5	17,475.0	19,569.3	21,084.2	20,022.5	19,921.7	20,591.8	19,831.0	19,377.9	18,267.8
Energy/Steel, disposition	MJ/t	20,938.4	18,865.8	20,482.4	22,517.5	21,157.5	20,289.4	21,873.6	20,692.0	20,460.3	20,969.5
Energy/GDP	MJ/\$2007	91.1	79.3	103.1	100.5	95.6	92.2	92.7	98.9	96.2	95.1

Index (1990=1)											
Energy/Steel, primary forms	MJ/t	1.00	0.96	1.07	1.15	1.09	1.09	1.13	1.08	1.06	1.00
Energy/Steel, disposition	MJ/t	1.00	0.90	0.98	1.08	1.01	0.97	1.04	0.99	0.98	1.00
Energy/GDP	MJ/\$2007	1.00	0.87	1.13	1.10	1.05	1.01	1.02	1.09	1.06	1.04

Energy Use and Intensity Indicators

NAICS 3311

Iron and steel mills and ferro-alloy manufacturing

Ontario

StatCan 1990 value	CEEDC estimate	1990	2005	2010	2011	2012	2013	2014	2015	2016	2017
Energy											
Coal	TJ	0	0	4,332	5,476	6,720	9,926	10,000	12,044	8,413	10,000
Coke Oven Gas	TJ	31,580	29,530	21,973	25,950	26,125	24,249	22,666	21,181	19,994	19,744
Coke	TJ	88,181	89,746	80,288	87,415	87,167	67,532	76,601	71,426	78,695	79,618
Diesel	TJ	1,071	712	1,081	510	400	591	400	140	766	800
Electricity	TJ	17,202	22,056	21,350	22,000	22,000	19,078	21,177	21,912	17,900	18,022
Gasoline	TJ	0	140	133	65	150	0	0	0	11	41
Heavy Fuel Oil	TJ	10,627	7,286	978	568	300	179	50	48	254	250
Middle Distillates	TJ	0	16	222	300	234	117	188	367	269	1
Natural Gas	TJ	39,836	58,856	50,290	52,014	53,917	54,149	56,347	47,703	54,508	56,905
Petcoke	TJ	0	0	0	0	0	0	0	0	0	0
Propane	TJ	0	23	23	25	23	28	157	132	100	76
Wood	TJ	0	0	0	0	0	0	0	0	0	0
Total	TJ	188,497	208,367	180,706	194,244	197,039	175,849	187,793	175,224	180,908	185,706

Activity											
Steel, primary forms	kt	9,994	11,924	9,234	9,213	9,841	8,827	9,120	8,836	9,336	10,166
Steel, disposition	kt	9,411	11,045	8,823	8,626	9,313	8,667	8,585	8,468	8,842	8,856
GDP	M\$2007	2,375	2,628	1,753	1,933	2,062	1,908	2,027	1,771	1,880	1,953

Intensity											
Energy/Steel, primary forms	MJ/t	18,861.7	17,475.0	19,569.3	21,084.2	20,022.5	19,921.7	20,591.8	19,831.0	19,377.9	18,267.8
Energy/Steel, disposition	MJ/t	20,029.5	18,865.8	20,482.4	22,517.5	21,157.5	20,289.4	21,873.6	20,692.0	20,460.3	20,969.5
Energy/GDP	MJ/\$2007	79.4	79.3	103.1	100.5	95.6	92.2	92.7	98.9	96.2	95.1

Index (1990=1)											
Energy/Steel, primary forms	MJ/t	1.00	0.93	1.04	1.12	1.06	1.06	1.09	1.05	1.03	0.97
Energy/Steel, disposition	MJ/t	1.00	0.94	1.02	1.12	1.06	1.01	1.09	1.03	1.02	1.05
Energy/GDP	MJ/\$2007	1.00	1.00	1.30	1.27	1.20	1.16	1.17	1.25	1.21	1.20

CO2 Emissions and Intensity Indicators

NAICS 3311

Iron and steel mills and ferro-alloy manufacturing

Ontario

Adjusted 1990 value	CEEDC estimate	1990	2005	2010	2011	2012	2013	2014	2015	2016	2017
Energy											
Coal	ktCO2	24	0	365	469	568	809	816	1,006	690	809
Coke Oven Gas	ktCO2	1,051	1,060	789	931	938	870	814	760	718	709
Coke	ktCO2	11,199	10,398	9,117	10,061	10,143	7,721	8,921	8,023	9,297	9,406
Diesel	ktCO2	0	50	76	36	28	42	28	10	54	56
Electricity	ktCO2	0	0	0	0	0	0	0	0	0	0
Gasoline	ktCO2	0	9	9	4	10	0	0	0	1	3
Heavy Fuel Oil	ktCO2	705	541	73	42	22	13	4	4	19	19
Middle Distillates	ktCO2	65	1	16	21	17	8	13	26	19	0
Natural Gas	ktCO2	2,883	2,976	2,527	2,625	2,699	2,709	2,813	2,380	2,707	2,818
Petcoke	ktCO2	0	0	0	0	0	0	0	0	0	0
Propane	ktCO2	10	1	1	1	1	2	9	8	6	5
Wood	ktCO2	0	0	0	0	0	0	0	0	0	0
Total	ktCO2	15,937	15,037	12,972	14,191	14,426	12,175	13,418	12,216	13,510	13,824

Activity											
Steel, primary forms	kt	11,825	11,924	9,234	9,213	9,841	8,827	9,120	8,836	9,336	10,166
Steel, disposition	kt	10,332	11,045	8,823	8,626	9,313	8,667	8,585	8,468	8,842	8,856
GDP	M\$2007	2,375	2,628	1,753	1,933	2,062	1,908	2,027	1,771	1,880	1,953

Intensity											
CO2/Steel, primary forms	gCO2e/kg	1,347.7	1,261.1	1,404.8	1,540.4	1,465.9	1,379.3	1,471.3	1,382.6	1,447.1	1,359.8
CO2/Steel, disposition	gCO2e/kg	1,542.5	1,361.4	1,470.3	1,645.1	1,549.0	1,404.8	1,562.9	1,442.6	1,527.9	1,560.9
CO2/GDP	gCO2/\$2007	6.7	5.7	7.4	7.3	7.0	6.4	6.6	6.9	7.2	7.1
CO2/GJ	gCO2/MJ	73.7	72.2	71.8	73.1	73.2	69.2	71.5	69.7	74.7	74.4

Index (1990=1)											
CO2/Steel, primary forms	gCO2e/kg	1.00	0.94	1.04	1.14	1.09	1.02	1.09	1.03	1.07	1.01
CO2/Steel, disposition	gCO2e/kg	1.00	0.88	0.95	1.07	1.00	0.91	1.01	0.94	0.99	1.01
CO2/GDP	gCO2/\$2007	1.00	0.85	1.10	1.09	1.04	0.95	0.99	1.03	1.07	1.05
CO2/GJ	gCO2/MJ	1.00	0.98	0.97	0.99	0.99	0.94	0.97	0.95	1.01	1.01

CO2 Emissions and Intensity Indicators

NAICS 3311

Iron and steel mills and ferro-alloy manufacturing

Ontario

StatCan 1990 value	CEEDC estimate	1990	2005	2010	2011	2012	2013	2014	2015	2016	2017
Energy											
Coal	ktCO2	0	0	365	469	568	809	816	1,006	690	809
Coke Oven Gas	ktCO2	1,166	1,060	789	931	938	870	814	760	718	709
Coke	ktCO2	10,492	10,398	9,117	10,061	10,143	7,721	8,921	8,023	9,297	9,406
Diesel	ktCO2	74	50	76	36	28	42	28	10	54	56
Electricity	ktCO2	0	0	0	0	0	0	0	0	0	0
Gasoline	ktCO2	0	9	9	4	10	0	0	0	1	3
Heavy Fuel Oil	ktCO2	804	541	73	42	22	13	4	4	19	19
Middle Distillates	ktCO2	0	1	16	21	17	8	13	26	19	0
Natural Gas	ktCO2	2,027	2,976	2,527	2,625	2,699	2,709	2,813	2,380	2,707	2,818
Petcoke	ktCO2	0	0	0	0	0	0	0	0	0	0
Propane	ktCO2	0	1	1	1	1	2	9	8	6	5
Wood	ktCO2	0	0	0	0	0	0	0	0	0	0
Total	ktCO2	14,563	15,037	12,972	14,191	14,426	12,175	13,418	12,216	13,510	13,824

Activity											
Steel, primary forms	kt	9,994	11,924	9,234	9,213	9,841	8,827	9,120	8,836	9,336	10,166
Steel, disposition	kt	9,411	11,045	8,823	8,626	9,313	8,667	8,585	8,468	8,842	8,856
GDP	M\$2007	2,375	2,628	1,753	1,933	2,062	1,908	2,027	1,771	1,880	1,953

Intensity											
CO2/Steel, primary forms	gCO2e/kg	1,457.2	1,261.1	1,404.8	1,540.4	1,465.9	1,379.3	1,471.3	1,382.6	1,447.1	1,359.8
CO2/Steel, disposition	gCO2e/kg	1,547.4	1,361.4	1,470.3	1,645.1	1,549.0	1,404.8	1,562.9	1,442.6	1,527.9	1,560.9
CO2/GDP	gCO2/\$2007	6.1	5.7	7.4	7.3	7.0	6.4	6.6	6.9	7.2	7.1
CO2/GJ	gCO2/MJ	77.3	72.2	71.8	73.1	73.2	69.2	71.5	69.7	74.7	74.4

Index (1990=1)											
CO2/Steel, primary forms	gCO2e/kg	1.00	0.87	0.96	1.06	1.01	0.95	1.01	0.95	0.99	0.93
CO2/Steel, disposition	gCO2e/kg	1.00	0.88	0.95	1.06	1.00	0.91	1.01	0.93	0.99	1.01
CO2/GDP	gCO2/\$2007	1.00	0.93	1.21	1.20	1.14	1.04	1.08	1.12	1.17	1.15
CO2/GJ	gCO2/MJ	1.00	0.93	0.93	0.95	0.95	0.90	0.92	0.90	0.97	0.96

GHG Emissions and Intensity Indicators

NAICS 3311

Iron and steel mills and ferro-alloy manufacturing

Ontario

Adjusted 1990 value	CEEDC estimate	1990	2005	2010	2011	2012	2013	2014	2015	2016	2017
Energy											
Coal	ktCO ₂ e	24	0	366	470	570	812	818	1,009	692	811
Coke Oven Gas	ktCO ₂ e	1,071	1,080	804	949	955	887	829	775	731	722
Coke	ktCO ₂ e	11,221	10,419	9,135	10,082	10,163	7,737	8,939	8,040	9,315	9,424
Diesel	ktCO ₂ e	0	52	79	37	29	43	29	10	56	59
Electricity	ktCO ₂ e	0	0	0	0	0	0	0	0	0	0
Gasoline	ktCO ₂ e	0	9	9	4	10	0	0	0	1	3
Heavy Fuel Oil	ktCO ₂ e	710	545	73	42	22	13	4	4	19	19
Middle Distillates	ktCO ₂ e	65	1	16	21	17	8	13	26	19	0
Natural Gas	ktCO ₂ e	2,899	2,993	2,541	2,639	2,714	2,724	2,829	2,393	2,722	2,834
Petcoke	ktCO ₂ e	0	0	0	0	0	0	0	0	0	0
Propane	ktCO ₂ e	10	1	1	2	1	2	10	8	6	5
Wood	ktCO ₂ e	0	0	0	0	0	0	0	0	0	0
Total	ktCO₂e	16,000	15,100	13,025	14,247	14,482	12,227	13,471	12,264	13,562	13,877

Activity											
Steel, primary forms	kt	11,825	11,924	9,234	9,213	9,841	8,827	9,120	8,836	9,336	10,166
Steel, disposition	kt	10,332	11,045	8,823	8,626	9,313	8,667	8,585	8,468	8,842	8,856
GDP	M\$2007	2,375	2,628	1,753	1,933	2,062	1,908	2,027	1,771	1,880	1,953

Intensity											
GHG/Steel, primary forms	gCO ₂ e/kg	1,353.1	1,266.4	1,410.5	1,546.5	1,471.6	1,385.2	1,477.1	1,388.0	1,452.6	1,365.0
GHG/Steel, disposition	gCO ₂ e/kg	1,548.6	1,367.2	1,476.3	1,651.6	1,555.1	1,410.8	1,569.1	1,448.3	1,533.8	1,566.9
GHG/GDP	gCO ₂ e/\$2007	6.7	5.7	7.4	7.4	7.0	6.4	6.6	6.9	7.2	7.1
GHG/GJ	gCO ₂ e/MJ	74.0	72.5	72.1	73.3	73.5	69.5	71.7	70.0	75.0	74.7

Index (1990=1)											
GHG/Steel, primary forms	gCO ₂ e/kg	1.00	0.94	1.04	1.14	1.09	1.02	1.09	1.03	1.07	1.01
GHG/Steel, disposition	gCO ₂ e/kg	1.00	0.88	0.95	1.07	1.00	0.91	1.01	0.94	0.99	1.01
GHG/GDP	gCO ₂ e/\$2007	1.00	0.85	1.10	1.09	1.04	0.95	0.99	1.03	1.07	1.05
GHG/GJ	gCO ₂ e/MJ	1.00	0.98	0.97	0.99	0.99	0.94	0.97	0.95	1.01	1.01

GHG Emissions and Intensity Indicators

NAICS 3311

Iron and steel mills and ferro-alloy manufacturing

Ontario

StatCan 1990 value	CEEDC estimate	1990	2005	2010	2011	2012	2013	2014	2015	2016	2017
Energy											
Coal	ktCO ₂ e	0	0	366	470	570	812	818	1,009	692	811
Coke Oven Gas	ktCO ₂ e	1,188	1,080	804	949	955	887	829	775	731	722
Coke	ktCO ₂ e	10,512	10,419	9,135	10,082	10,163	7,737	8,939	8,040	9,315	9,424
Diesel	ktCO ₂ e	78	52	79	37	29	43	29	10	56	59
Electricity	ktCO ₂ e	0	0	0	0	0	0	0	0	0	0
Gasoline	ktCO ₂ e	0	9	9	4	10	0	0	0	1	3
Heavy Fuel Oil	ktCO ₂ e	809	545	73	42	22	13	4	4	19	19
Middle Distillates	ktCO ₂ e	0	1	16	21	17	8	13	26	19	0
Natural Gas	ktCO ₂ e	2,038	2,993	2,541	2,639	2,714	2,724	2,829	2,393	2,722	2,834
Petcoke	ktCO ₂ e	0	0	0	0	0	0	0	0	0	0
Propane	ktCO ₂ e	0	1	1	2	1	2	10	8	6	5
Wood	ktCO ₂ e	0	0	0	0	0	0	0	0	0	0
Total	ktCO ₂ e	14,625	15,100	13,025	14,247	14,482	12,227	13,471	12,264	13,562	13,877

Activity											
Steel, primary forms	kt	9,994	11,924	9,234	9,213	9,841	8,827	9,120	8,836	9,336	10,166
Steel, disposition	kt	9,411	11,045	8,823	8,626	9,313	8,667	8,585	8,468	8,842	8,856
GDP	M\$2007	2,375	2,628	1,753	1,933	2,062	1,908	2,027	1,771	1,880	1,953

Intensity											
GHG/Steel, primary forms	gCO ₂ e/kg	1,463.5	1,266.4	1,410.5	1,546.5	1,471.6	1,385.2	1,477.1	1,388.0	1,452.6	1,365.0
GHG/Steel, disposition	gCO ₂ e/kg	1,554.1	1,367.2	1,476.3	1,651.6	1,555.1	1,410.8	1,569.1	1,448.3	1,533.8	1,566.9
GHG/GDP	gCO ₂ e/\$2007	6.2	5.7	7.4	7.4	7.0	6.4	6.6	6.9	7.2	7.1
GHG/GJ	gCO ₂ e/MJ	77.6	72.5	72.1	73.3	73.5	69.5	71.7	70.0	75.0	74.7

Index (1990=1)											
GHG/Steel, primary forms	gCO ₂ e/kg	1.00	0.87	0.96	1.06	1.01	0.95	1.01	0.95	0.99	0.93
GHG/Steel, disposition	gCO ₂ e/kg	1.00	0.88	0.95	1.06	1.00	0.91	1.01	0.93	0.99	1.01
GHG/GDP	gCO ₂ e/\$2007	1.00	0.93	1.21	1.20	1.14	1.04	1.08	1.12	1.17	1.15
GHG/GJ	gCO ₂ e/MJ	1.00	0.93	0.93	0.95	0.95	0.90	0.92	0.90	0.97	0.96