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GREENHOUSE GAS EMISSIONS FROM A CONSUMPTION PERSPECTIVE

CANADIAN ENVIRONMENTAL
SUSTAINABILITY INDICATORS



Canada 

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CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS GREENHOUSE GAS EMISSIONS FROM A CONSUMPTION PERSPECTIVE

February 2025

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Greenhouse gas emissions from a consumption perspective

National greenhouse gas emissions inventories account for emissions caused by human activities in a given country, such as energy generation, industrial processes, and agriculture; some of the products of these activities are then exported and consumed elsewhere. The Greenhouse gas emissions from a consumption perspective indicator provides an alternative view, by looking at the emissions linked to goods and services consumed in a country, whether they were produced in that country or imported.

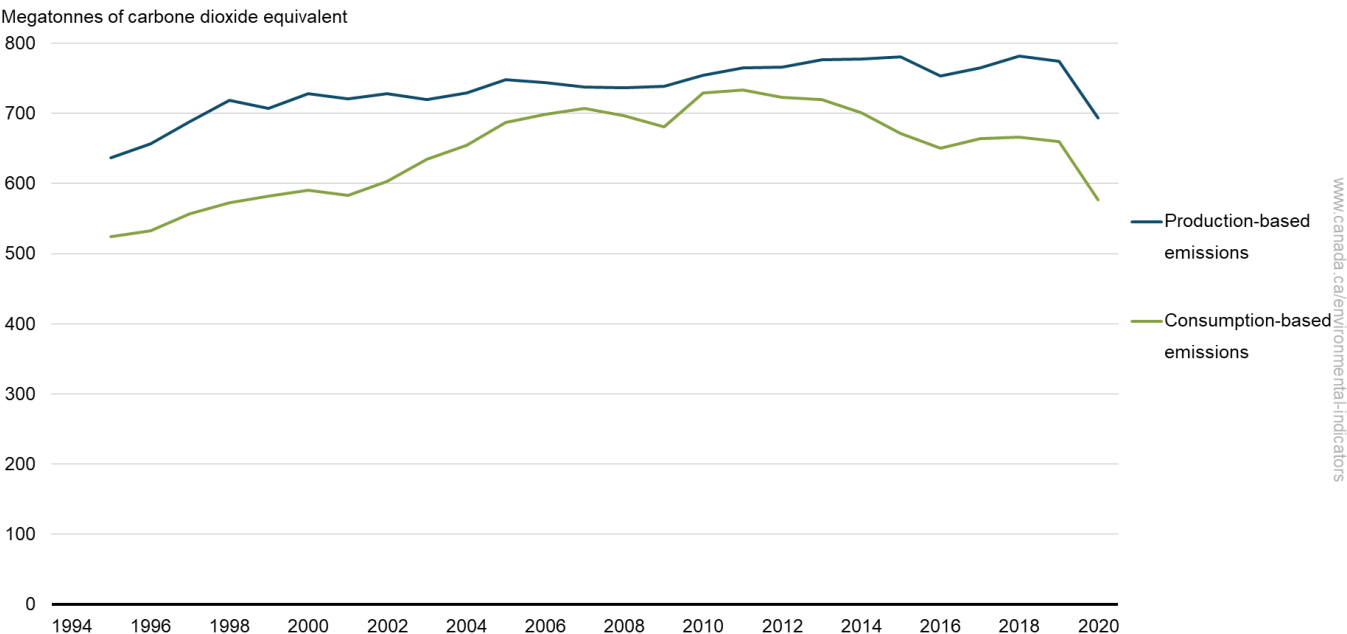
A country can be considered a net exporter of greenhouse gas (GHG) emissions when its production-based GHG emissions¹ are higher than its consumption-based emissions. When the reverse is true, the country can be considered a net importer of GHG emissions. The worldwide sums of net exports and net imports of GHG emissions are equal.

This indicator compares production-based and consumption-based GHG emissions for Canada and select countries using data from the Organisation for Economic Co-operation and Development (OECD).²

Key results

- Since 1995, Canada's production-based GHG emissions have been higher than its consumption-based emissions, making the country a net exporter of GHG emissions over that period
- From 1995 to 2011, consumption-based emissions increased steadily except for a dip in 2009 following the 2008 financial crisis. Since 2011, consumption-based emissions have decreased overall

Figure 1. Production- and consumption-based greenhouse gas emissions from Canada, 1995 to 2020



[Data for Figure 1](#)

Note: Values for production- and consumption-based emissions presented in this indicator are based on the Organisation for Economic Co-operation and Development data. These numbers may differ from Canada's most recent official accounting of production-based greenhouse gas emissions. For more information see the data sources and methods section.

Source: Organisation for Economic Co-Operation and Development (2024) [Greenhouse Gas emissions Footprints Indicators](#).

¹ Production-based emissions account for emissions physically occurring within a country's borders.

² OECD data is used in order to make comparisons between countries. These numbers may differ from Canada's most recent official accounting of production-based greenhouse gas emissions. For more information see the data sources and methods section.

Consumption-based emissions are directly influenced by the volume of imports, the mix of energy sources used to produce the goods consumed (for example, goods produced through a process powered by coal plants are more emissions-intensive than those produced using hydroelectricity) and the volume of goods consumed. From 1995 to 2020, the difference between production- and consumption-based emissions in Canada has varied considerably, with the absolute difference varying between 3.4% and 22.6%.

Throughout the period from 1995 to 2020, Canada has remained a net exporter of GHGs, meaning that consumption-based emissions have been lower than production-based emissions. In the early 2000s consumption-based emissions increased faster than production-based emissions. As a result, net GHG exports decreased until the 2008-2009 global financial crisis during which consumption-based emissions decreased. After a short rebound following the financial crisis, consumption-based emissions began to decrease. This is likely the result of a number of factors, including the expansion of renewable energy that began in the early 2000s and continued throughout the 2010s, decrease in coal usage, improved waste diversion practices, implementation of more energy efficient technologies such as heat pumps and the failure of the manufacturing sector to fully recover following the 2008 global financial crisis.³ There was then a sharp decrease in consumption-based emissions in 2020 coinciding with the start of the global COVID-19 pandemic.

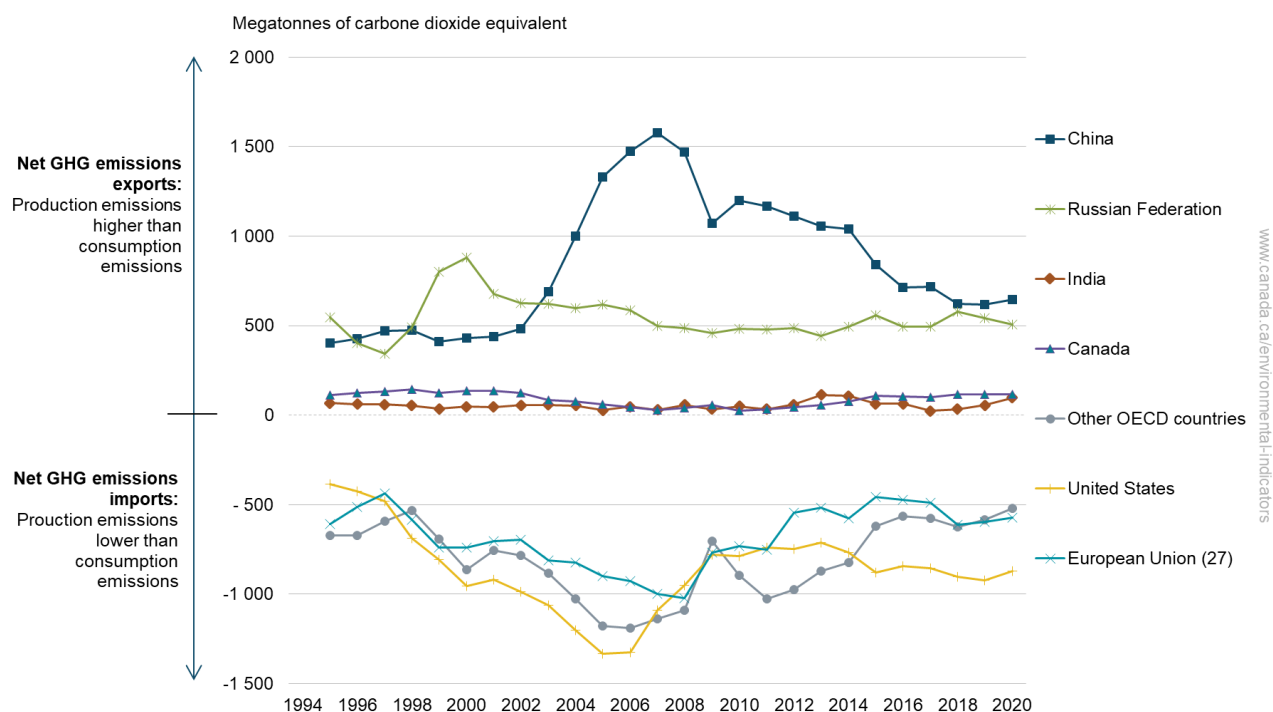
³ A summary of how Canada manufacturing performed following the 2008-2009 financial crisis can be found at [Canada's Manufacturing Sector: A Decade in Review](#) (PDF; 5.15 MB).

Comparison of GHG emissions embodied in international trade

Key results

- Over the 1995 to 2020 period, China and the Russian Federation were the 2 most important net exporters of GHG emissions
- Canada and India were also net GHG emissions exporters over the same period
- During the same period, the United States, the European Union and other member countries of the Organisation for Economic Co-Operation and Development were net importers of GHG emissions

Figure 2. Difference between production- and consumption-based emissions from selected countries and regions, 1995 to 2020



[Data for Figure 2](#)

Note: OECD = Organisation for Economic Co-operation and Development. (27) refers to the 27 member states of the European Union as of May 2024. Countries in the "Other OECD" group include Australia, Chile, Colombia, Iceland, Israel, Japan, South Korea, Mexico, New Zealand, Norway, Switzerland, Türkiye and United Kingdom.

Source: Organisation for Economic Co-Operation and Development (2024) [Greenhouse Gas emissions Footprints Indicators](#).

Since 2003, the largest net exporter of GHG emissions was China. The United States was the largest net importer of emissions with the exception of the period between 2009 and 2014 which coincides with the aftermath of the 2008 financial crisis. Following the crisis, consumption-based emissions in the United States decreased faster than production-based emissions, resulting in GHG emissions imports decreasing until 2014, at which point consumption-based emissions began to once again increase faster than production-based emissions, although the rate of increase is much lower than the pre-financial crisis rate. During this period of falling consumption, the United Kingdom, which follows a similar trend to the United States albeit offset by roughly two years, was intermittently the largest net importer. This could be owed to the United Kingdom experiencing the 2008 financial crisis with a slight delay due to it not experiencing the specific housing crisis that gave way to the larger global financial crisis. China, in contrast experienced a decrease in GHG exports shortly after the financial crisis. This led to it nearly being surpassed in GHG exports by Russia which has been an exporter of emissions since 2000.

Canada's economy represents 2% of the world economy and produces less than 2% of the world's greenhouse gas emissions. As a result, Canada represents a relatively small portion of GHG emissions embodied in global trade.

About the indicator

What the indicator measures

The Greenhouse gas emissions from a consumption perspective indicator provides a view of the impact of Canada's consumption of goods and services, regardless of where they are produced, on the levels of greenhouse gases (GHGs) released into the atmosphere. It accounts for GHG emissions associated with products and services consumed in Canada and produced either domestically or abroad. The indicator also compares Canada's production- and consumption-based GHG emissions with a selection of other countries/regions.

Why this indicator is important

The release of greenhouse gases (GHGs) and their increasing concentrations in the atmosphere are the main drivers of climate change. The most common method of accounting for GHG emissions is to assign responsibility to the emitting entity, sector or region. This approach (often referred to as production-based emissions accounting) is used by Canada and other countries to report their national GHG emissions inventory to the United Nations Framework Convention on Climate Change. It is also the approach underlying Canada's official [National inventory report: greenhouse gas sources and sinks in Canada](#).

Production-based emissions accounting does not take into account the emissions associated with products imported for consumption in Canada. On the other hand, it includes emissions associated with the production of products and services that are exported, responding to demand abroad. The Greenhouse gas emissions from a consumption perspective indicators (Consumption-based emissions) account for emissions associated with products and services consumed in Canada and produced either domestically or abroad.

The location where GHG emissions originate has little or no impact on climate change. Reducing production in a country and purchasing more products abroad may reduce production-based emissions domestically, but the effect on worldwide emissions is the same, unless the production taking place in other countries is more or less carbon-intensive than domestic production would have been. Focusing on consumption-based emissions accounting can support climate change policy by calling attention to the influence of household, business, and government choices on emissions.

Related indicators

The [Greenhouse gas emissions](#) indicator reports trends in total anthropogenic (human-made) GHG emissions at the national level, per person and per unit gross domestic product, by province and territory and by economic sector.

The [Greenhouse gas emissions from large facilities](#) indicator reports GHG emissions from the largest GHG emitters in Canada (industrial and other types of facilities).

The [Global greenhouse gas emissions](#) indicator provides a global perspective on Canada's share of global GHG emissions.

The [Greenhouse gas emissions projections](#) indicator provides an overview of Canada's projected GHG emissions up to 2040.

The [Greenhouse gas concentrations](#) indicator presents atmospheric concentrations as measured from sites in Canada and at a global scale for 2 greenhouse gases: carbon dioxide and methane.

Data sources and methods

Data sources

The data were retrieved in November 2024 from the July 2024 version of the Organisation for Economic Co-operation and Development's [Greenhouse Gas emissions Footprints Indicators](#).

More information

It should be noted that Statistics Canada also publishes estimates of greenhouse gas emissions by final demand category in its [physical flow accounts](#) data. Statistics Canada's data was used in making the Organisation for Economic Co-operation and Development's dataset; however the OECD dataset covers a larger time span and thus data prior to 2009 does not correspond to data from Statistics Canada. Note that Canada's official source on GHG emissions is [Canada's Official Greenhouse Gas Inventory](#) published by Environment and Climate Change Canada (ECCC). This inventory is used to create the Greenhouse Gas Account published by Statistics Canada and is also published as part of Canada's obligation under the United Nations Framework Convention on Climate Change (UNFCCC), but does not coincide with the methodological guidelines of the UN System of Environmental-Economic Accounting (SEEA) and thus is not used by the OECD as it can not be used alongside inter-country input-output tables. There are several methodological differences between each respective dataset. Generally speaking, the primary difference is that Statistics Canada calculates emissions from economic units without accounting for reabsorption or natural territory, whereas ECCC includes emissions not related to economic units but excludes emissions from biomass fuel and is limited to emissions from Canada's natural territory. The official GHG inventory published by ECCC is the data source used for the [Greenhouse gas emissions](#) indicator published by ECCC and thus differs from this indicator.

The database from the Organisation for Economic Co-operation and Development covers 76 countries, while the rest of the world comprises a single entry. This database is used because it accounts for international consumption and thus can differentiate between consumption and production related emissions.

The indicator provides information annually from 1995 to 2020, which is the latest year for which the Organisation for Economic Co-operation and Development's [inter-country input-output tables](#) were available at the time of production of this indicator.

Methods

The consumption-based greenhouse gas (GHG) emissions presented in the indicator were developed by the Organisation for Economic Co-operation and Development. The Organisation for Economic Co-operation and Development combined data from the 2023 editions of its [inter-country input-output tables](#) and its [Greenhouse gas footprint indicators](#) estimates. This approach relies on input-output tables from national accounts coupled with national emissions data allocated to industries. The approach includes emissions from industrial and agricultural processes used to create and use products and services (including those of all products and services used as intermediate inputs) along with emissions included in the distribution of a product or service.

More information

Greenhouse gas emissions by industry

The Organisation for Economic Co-operation and Development's GHG emissions estimates are based mostly on Air Emissions Accounts (AEAs) which are based on national inventories submitted under the United Nations Framework Convention on Climate Change (UNFCCC) with slight differences due to changes in how emissions are allocated to specific industries.⁴

⁴ A summary of how allocation is performed and how it differs from national inventories can be found in [Towards global SEEA Air Emission Accounts: Description and evaluation of the OECD methodology to estimate SEEA Air Emission Accounts for CO₂, CH₄ and N₂O in Annex-I countries to the UNFCCC](#).

When AEAs are not available for a given country on a given year, emissions are estimated using a variety of external databases for different emission types.⁵

Inter-country input-output tables

The Organisation for Economic Co-operation and Development's inter-country input-output tables describe the sale and purchase relationships between producers and consumers within an economy and between countries. It relies on data submissions from national statistical institutes. While the Organisation for Economic Co-operation and Development asks that data be provided in accordance with the International standard industrial classification of all economic activities, Revision 4, in practice, it accepts any relevant data (input-output and/or supply-use tables) at the most detailed and possible level in any detailed format and then converts it on a harmonized basis. In the harmonization process, the Organisation for Economic Co-operation and Development ensures that data tables for all countries are:

- in an industry-by-industry format
- expressed in [basic prices](#)
- aligned with the industry classifications used in the Organisation for Economic Co-operation and development system
- aligned in their treatment of concepts (most notably, the treatment of financial intermediation services indirectly measured, and differences in the treatment of other items, such as non-resident expenditures and resident expenditures abroad).

Estimates of consumption-based GHG emissions using the Multi-Regional Input-Output approach

The Organisation for Economic Co-operation and Development estimates consumption-based GHG emissions by developing GHG emissions intensities for all outputs produced by all industries for all countries included in the database. To do this, the total emissions by industry estimated by the Organisation for Economic Co-operation and Development from their data is divided by total output for each industry (from the inter-country input-output tables). In the 2024 release of greenhouse gas emissions indicators, this included a variety of greenhouse gases including carbon dioxide, methane and nitrous oxide.

As a second step, symmetrical industry-by-industry input-output tables are used to develop a Leontief inverse matrix and the final demand matrix. Also known as the total requirements matrix, the Leontief inverse is a representation of all the direct and indirect inter-industry inputs required to provide one unit of output to final demand. Final demand is the sum of household final consumption, general government final consumption, changes in inventories and gross fixed-capital formation.

The final step in estimating consumption-based GHG emissions involves multiplying the emissions intensity matrix by the Leontief inverse and the final demand matrix. The result of this final multiplication is a matrix which represents consumption-based emissions in country [s] that are emitted in industry [i] located in country [r]. Country [s] is the country where the final consumption of the output from industry [i] occurs. Country [r] is the country where production of output from industry [i] occurs. In cases where [s] is the same as [r], production-based and consumption-based emissions are the same.

Recent changes

In the 2025 release of this indicator, non-CO₂ emissions are now also considered instead of a sole focus on CO₂ emissions due to fuel combustion. OECD also changed its methodology from previous iterations relying primarily on Air Emissions Accounts (AEAs) and using other sources such as the International Energy Agency estimates of CO₂ emissions from fuel combustion when AEAs are not available for use in a given country at a given time.

Caveats and limitations

The greenhouse gas emissions estimates presented in the indicator are partially based on estimates from other data sources. These data sources produce estimates that differ from emissions reported in AEAs which are based on emissions reported in National Inventories of countries.

⁵ A summary of databases used can be found in [Measuring Greenhouse Gas Footprints in Global Production Networks](#).

More information

Differences between emission estimates

External data sources used to fill gaps where data from AEAs are not present are produced by third parties separate from governments. They use their own methodologies and systems which oftentimes are forced to make some basic simplifying assumptions due to their limited ability to perform their own investigations into different industries in different countries. Different datasets used come with different factors that may cause produced values to differ from what a national inventory would report. These factors include but are not limited to the following:

- A dataset may use average net caloric values of fuels which would be used to convert physical consumption data into energy data. These averages may be less accurate than those used by country specific experts that are more familiar with the specific caloric values of fuels within a given region.
- A dataset may use average carbon contents of resources which may differ from the carbon content of fuels used within specific regions.
- Military emissions may be treated differently in third party datasets than in national inventories.
- Energy consumption data based on energy balances may differ from those used to produce a national inventory.
- A dataset may use different units.

Development of worldwide national accounts

In developing the Inter-country input-output tables, the Organisation for Economic Co-operation and Development converts data it receives from national agencies on a harmonized basis (a process discussed in the [Inter-country input-output tables](#) section). As a result, national data presented in the Inter-country input-output tables might differ from those presented by national statistical agencies such as Statistics Canada's [National symmetric input-output tables](#).

The level of aggregation found in the Organisation for Economic Co-operation and Development's Inter-country input-output tables (36 industries) means that the scope of potential analysis of specific products is limited. In addition, cross-country variations in data definitions mean that a specific product might not always fall under the same International Standard Industrial Classification category across all countries.

Consumption-based GHG emissions

The multi-regional input-output approach used by the Organisation for Economic Co-operation and Development to estimate consumption- and production-based GHG emissions by country and industry combines GHG emissions estimates by industry with Inter-country input-output tables. As a result, the accuracy of the results of the Multi-Regional Input-Output analysis is subject to the same caveats as those mentioned above in this section. In addition, the Multi-Regional Input-Output analysis does not include the impact of product disposal and is thus a "cradle-to-gate" rather than "cradle-to-grave" analysis.⁶ Furthermore, as the data from the Inter-country input-output tables are in nominal terms, emissions intensity improvements may be partly explained by changes in price levels over time.

It should also be noted that there can be a time disconnect between the Organisation for Economic Co-operation and Development's consumption-based GHG emissions data and its production-based emissions data and other similar GHG emissions data sources, such as Canada's National Inventory Report. This is due to the fact that the Organisation for Economic Co-operation and Development's GHG emissions estimates are tied to Inter-country input-output tables, which include inventory movements (for example, when products are moved from one country to another in the production process) that, by definition, can create a disconnect between the time a product is made and when it is consumed. In the National Inventory Report, the emissions are accounted for in the year when they actually occur, while in

⁶ Norman J et al. (2007) [Economic input-output life cycle assessment of trade between Canada and the United States](#). Environmental Science and Technology 41(5):1523-1532.

the case of the consumption-based GHG emissions estimates, inventory movements could influence when consumption-based emissions are reported.

The Organisation for Economic Co-operation and Development also takes into account the fact that in some countries, some data are suppressed to preserve confidentiality and that there are also some rounding errors which need to be corrected. In addition, adjustments to country-specific data might also be required to deal with valuation differences in imports.⁷ The Organisation for Economic Co-operation and Development must develop estimates of trade flows between countries, using available information on import use or making assumptions when that information is not available.⁸

Resources

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Related information

[Canada's action on climate change](#)

[Environment and Climate Change Canada - Climate change](#)

Environment and Climate Change Canada (2024) [National inventory report: greenhouse gas sources and sinks in Canada](#).

⁷ A discussion of the process and assumptions made in order to convert country-submitted data is available in the [OECD Input-Output Database: 2006 edition](#).

⁸ A description of the process and assumptions made in order to convert country-submitted data can be found in [Trade in value-added: concepts, methodologies and challenges](#) (PDF; 973 KB) and [Estimating consumption-based CO₂ emissions using the OECD ICIO 2015](#).

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Annex

Annex A. Data tables for the figures presented in this document

Table A.1. Data for Figure 1. Production- and consumption-based greenhouse gas emissions from Canada, 1995 to 2020

Year	Production-based emissions (megatonnes of equivalent carbon dioxide)	Consumption-based emissions (megatonnes of equivalent carbon dioxide)	Net emissions exports (megatonnes of equivalent carbon dioxide)	Net emissions imports (megatonnes of equivalent carbon dioxide)
1995	637.1	523.8	113.3	n/a
1996	656.3	532.8	123.5	n/a
1997	687.9	557.2	130.7	n/a
1998	718.2	572.3	145.9	n/a
1999	707.1	581.9	125.1	n/a
2000	728.2	590.4	137.8	n/a
2001	720.7	583.0	137.6	n/a
2002	727.7	603.5	124.2	n/a
2003	720.0	634.8	85.2	n/a
2004	729.4	654.7	74.7	n/a
2005	747.9	687.2	60.7	n/a
2006	744.2	699.1	45.2	n/a
2007	737.7	707.6	30.1	n/a
2008	736.7	696.1	40.6	n/a
2009	738.5	680.8	57.8	n/a
2010	754.6	729.5	25.0	n/a
2011	765.2	733.3	31.9	n/a
2012	766.1	722.4	43.7	n/a
2013	776.8	720.0	56.8	n/a
2014	777.5	700.5	77.0	n/a
2015	780.4	670.9	109.5	n/a
2016	753.6	650.9	102.6	n/a
2017	765.1	663.8	101.3	n/a
2018	781.7	666.6	115.1	n/a
2019	774.6	659.4	115.3	n/a
2020	693.5	576.6	116.9	n/a

Note: n/a = not applicable. Data are presented as rounded figures. However, all calculations have been performed using unrounded data. Values for production- and consumption-based emissions presented in this indicator are based on the Organisation for Economic Co-operation and Development data. These numbers may differ from Canada's official accounting of production-based greenhouse gas emissions.

Source: Organisation for Economic Co-Operation and Development (2024) [Greenhouse Gas emissions Footprints Indicators](#).

Table A.2. Data for Figure 2. Difference between production- and consumption-based emissions from selected countries and regions, 1995 to 2020

Year	China (megatonnes of equivalent carbon dioxide)	Russian Federation (megatonnes of equivalent carbon dioxide)	India (megatonnes of equivalent carbon dioxide)	Canada (megatonnes of equivalent carbon dioxide)	Other OECD countries (megatonnes of equivalent carbon dioxide)	United States (megatonnes of equivalent carbon dioxide)	European Union (27) (megatonnes of equivalent carbon dioxide)
1995	404.5	545.0	67.1	113.3	-672.8	-383.7	-607.9
1996	427.0	404.2	62.1	123.5	-672.4	-423.3	-514.0
1997	469.6	344.5	60.2	130.7	-591.5	-481.5	-438.4
1998	474.6	489.3	54.0	145.9	-534.2	-686.2	-583.0
1999	409.2	802.1	34.7	125.1	-690.9	-809.4	-738.1
2000	429.8	878.7	47.6	137.8	-863.2	-952.9	-740.6
2001	436.7	676.9	44.8	137.6	-754.1	-919.3	-704.1
2002	480.5	627.1	55.3	124.2	-782.3	-988.0	-694.7
2003	690.4	619.9	58.0	85.2	-881.2	-1 063.3	-810.6
2004	1 001.6	598.0	53.7	74.7	-1024.5	-1 202.3	-821.4
2005	1 331.9	617.6	27.9	60.7	-1178.1	-1 334.2	-898.7
2006	1 472.2	586.1	48.2	45.2	-1190.8	-1 325.9	-928.8
2007	1 576.0	496.9	29.2	30.1	-1136.5	-1 091.0	-1 000.3
2008	1 471.1	488.1	56.7	40.6	-1090.6	-951.5	-1 022.4
2009	1 069.7	459.6	34.4	57.8	-703.3	-781.4	-768.1
2010	1 198.0	480.7	48.9	25.0	-893.4	-786.3	-733.0
2011	1 165.3	476.8	34.5	31.9	-1025.4	-739.1	-750.8
2012	1 111.6	486.4	59.7	43.7	-973.9	-746.8	-544.4
2013	1 057.6	440.7	113.1	56.8	-870.6	-712.3	-518.5
2014	1 041.4	492.7	107.5	77.0	-824.7	-768.9	-578.4
2015	842.0	556.4	64.2	109.5	-619.3	-880.0	-457.6
2016	714.7	495.2	63.8	102.6	-565.3	-845.1	-474.4
2017	718.4	495.9	23.6	101.3	-575.6	-853.9	-489.7
2018	619.8	576.1	33.9	115.1	-625.3	-903.4	-611.1
2019	619.2	541.9	54.8	115.3	-584.8	-921.0	-598.3
2020	644.2	504.5	96.4	116.9	-522.1	-870.4	-573.5

Note: OECD = Organisation for Economic Co-operation and Development. (27) refers to the 27 member states of the European Union. Countries in the "Other OECD" group include Australia, Chile, Colombia, Iceland, Israel, Japan, South Korea, Mexico, New Zealand, Norway, Switzerland, Türkiye and United Kingdom.

Source: Organisation for Economic Co-Operation and Development (2024) [Greenhouse Gas emissions Footprints Indicators](#).

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