Environment and Climate Change Canada
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# GLOBAL GREENHOUSE GAS EMISSIONS

## CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

Canada

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# CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

# GLOBAL GREENHOUSE GAS EMISSIONS

## August 2024

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# Global greenhouse gas emissions

The release of greenhouse gases (GHGs) and their increasing concentration in the atmosphere is causing climate change, one of the most important environmental issues of our time. This change has an impact on the environment, human health and the economy. The increase in GHG concentrations is primarily due to human activities, such as the use of fossil fuels. Greenhouse gases remain in the atmosphere for periods ranging from a few years to thousands of years. As such, they have a worldwide impact, no matter where they were first emitted. This indicator highlights GHG emissions caused by human activity around the world.

Total global greenhouse gas emissions are the amount of emissions by an entire country or region, while per capita global greenhouse gas emissions are the amount of emissions an individual person emits in a particular country or region on average.

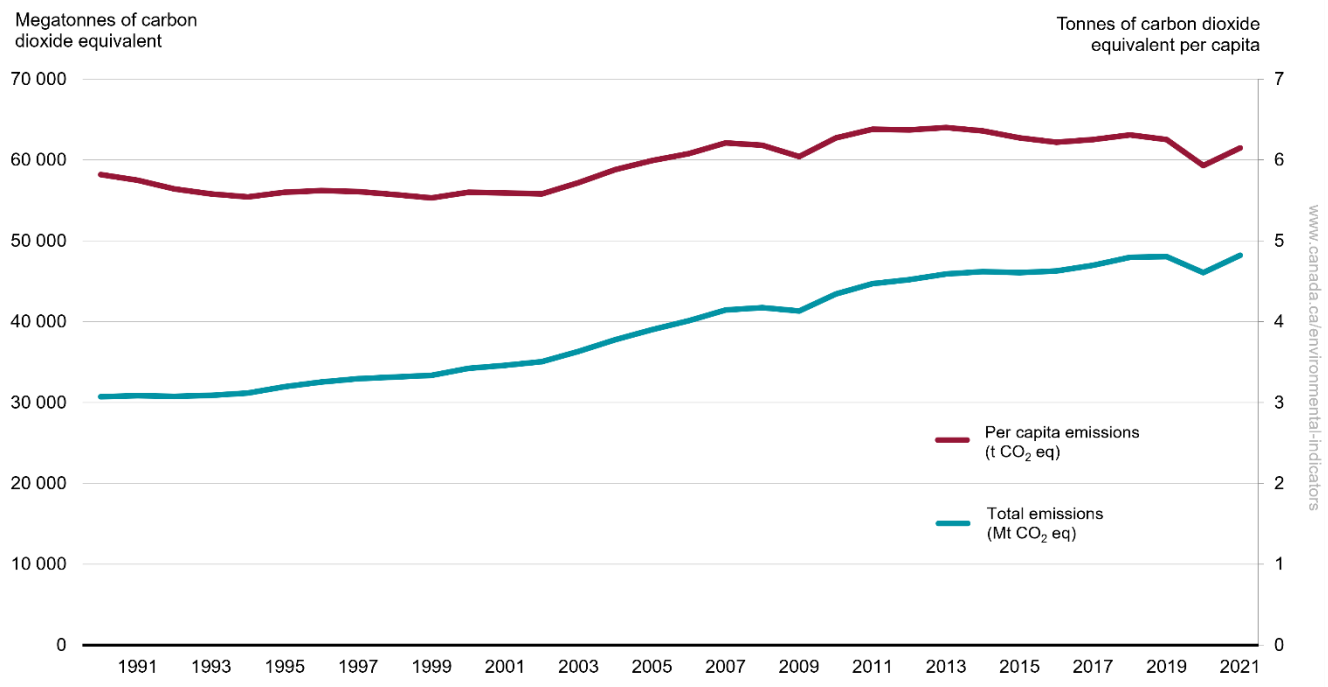
## Global emissions

This indicator presents greenhouse gas emissions at the global level, both in terms of total emissions and per capita emissions.

### Key results

- Between 2005 and 2021, global GHG emissions increased by 24%, from 39 001 to 48 210 megatonnes of carbon dioxide equivalent (Mt $CO_2$ eq)
- Between 2005 and 2021, per capita global GHG emissions increased by 2.67%, from 5.99 to 6.15 tonnes of carbon dioxide equivalent (t $CO_2$ eq)

**Figure 1. Global total greenhouse gas emissions and per capita greenhouse gas emissions, 1990 to 2021**




Data for Figure 1

**Source :** World Resources Institute (2024) Climate Watch Country Historical Greenhouse Gas Emissions.

Global per capita emissions saw a notable low period (as low as 5.53 and a maximum of 5.64 t $CO_2$ eq per person) between 1992 and 2002. The fall of the USSR contributed to this decrease because of its ensuing economic slowdowns in Eastern Europe and Central Asia.[1]

Both total and per capita global GHG emissions saw a sharp increase from 2003 to 2007 (by 18.3% and 11.3%, respectively). This increase was partially driven by China's fossil-fuel powered economic growth and increased manufacturing during this period.[2] The global financial crisis in 2008 lead to an economic slowdown, reductions in manufacturing and lower demand for electricity. This crisis influenced the decline of total and per capita emissions (by 1.03% and 2.27%, respectively) from 2008 to 2009.[3]

The confinement measures introduced in many countries in 2020 due to the COVID-19 pandemic created an industrial slowdown and reductions in trade and travel by air and land. These impacts contributed to a 4.12% decrease in total GHG emissions and a 5.12% decrease in per capita global GHG emissions from 2019 to 2020. Following the relaxation of confinement measures in 2021, total global emissions climbed above pre-pandemic levels (4.65% increase from 2020 to 2021) and per capita global emissions were almost as high as in 2019 (3.71% increase from 2020 to 2021).

In 2015, Canada and 194 other countries reached the Paris Agreement to limit the global average temperature rise to well below 2°C and pursue efforts to limit the increase to 1.5°C. Under the Agreement, Canada committed to reduce its GHG emissions by 30% below 2005 levels by 2030. In 2021, Canada announced a commitment to cut its GHG emissions by 40% to 45% below 2005 levels by 2030.

According to the Intergovernmental Panel on Climate Change, reaching this goal implies large-scale changes in energy systems and potentially land use across the world. In addition, the efforts and associated costs needed to reach this goal will vary between countries, with the distribution of costs across countries potentially being different from the distribution of the actions themselves.[4]

Canada is committed to implementing its strengthened climate plan (2030 Emissions Reduction Plan) to ensure Canada not only meets, but exceeds its 2030 emissions reduction goal, and beginning work so that Canada can achieve net-zero emissions by 2050.

## Greenhouse gas emissions by country

This indicator presents total greenhouse gas emissions and per capita greenhouse gas emissions from Canada and the top 10 emitting countries and regions.

### Key results

- In 2021, total emissions:
  - were highest in China with 13 438 megatonnes of carbon dioxide equivalent (Mt $CO_2$ eq), corresponding to 27.9% of global GHG emissions, up from 18.4% in 2005. Since 2005, emissions from China increased by 86.9%
  - in Canada reached 676 Mt $CO_2$ eq, which made up 1.4% of total global GHG emissions. This places Canada as the 12th largest emitter in the world
- In 2021, Canada's per capita emissions:
  - were the second highest among the top 10 emitting countries and regions and Canada with 17.7 tonnes of carbon dioxide equivalent per person (t $CO_2$ eq)

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[1] University of Copenhagen Faculty of Science (2019) Soviet collapse saved the atmosphere from 7 billion tonnes of $CO_2$. Retrieved on June 17, 2024.

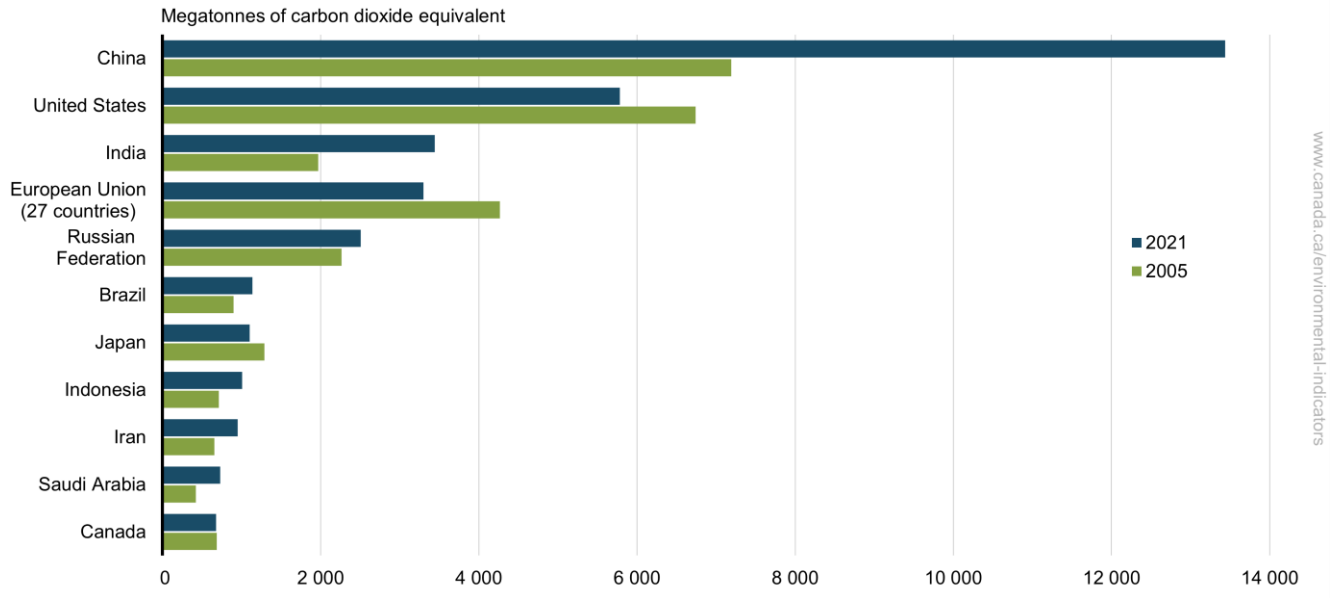
[2] Chong Wei (2022) Historical trend and drivers of China's $CO_2$ emissions from 2000 to 2020. Retrieved on June 17, 2024.

[3] Zhange et al. (2023) What can we learn from the 2008 financial crisis for global power decarbonization after COVID-19?. Retrieved on June 17, 2024.

[4] Intergovernmental Panel on Climate Change (2014) Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change – Summary for Policy Makers (PDF; 2.0 MB). Retrieved on June 17, 2024.

- decreased by 16.9% since 2005, from 21.28 to 17.69 t $CO_2$ eq per person

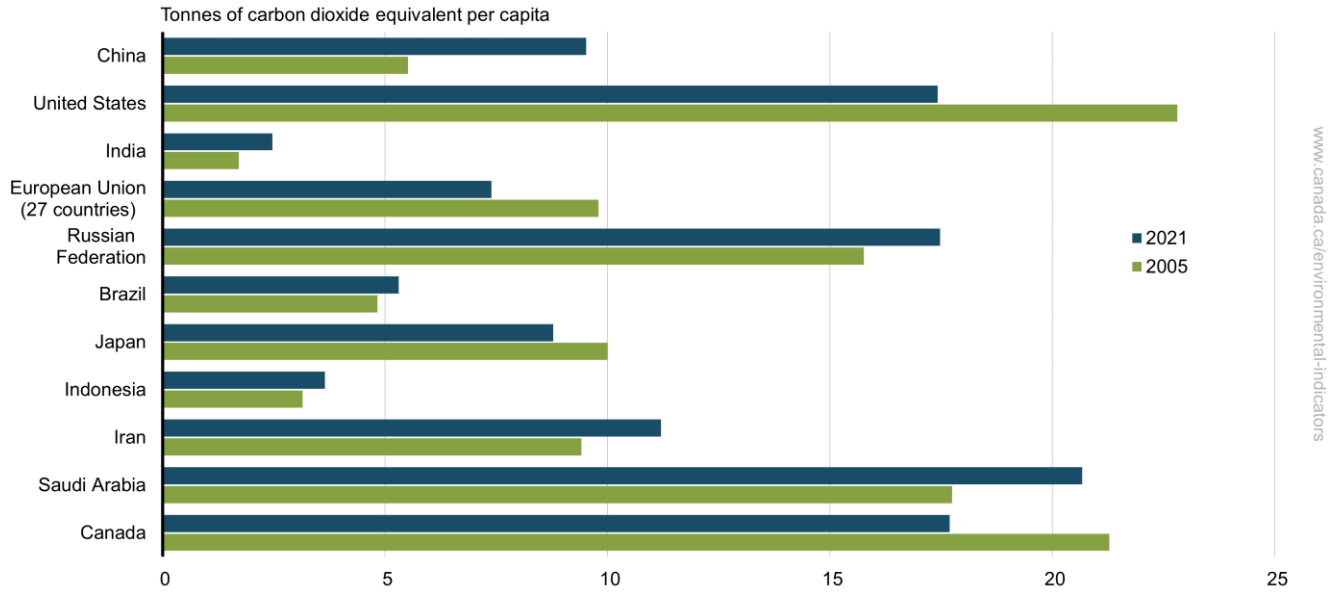
**Figure 2. Total greenhouse gas emissions from Canada and the top 10 emitting countries and regions, 2005 and 2021**




Data for Figure 2

**Note:** Greenhouse gas emissions for each country and region presented in this comparison were calculated by the World Resources Institute. For certain countries, including Canada, these values differ from the official estimates of greenhouse gas emissions submitted to the United Nations Framework Convention on Climate Change. For more information, please consult the Caveats and limitations section.
**Source :** World Resources Institute (2024) Climate Watch Country Historical Greenhouse Gas Emissions.

**Figure 3. Per capita greenhouse gas emissions for Canada and the top 10 emitting countries and regions, 2005 and 2021**




Data for Figure 3

**Source :** World Resources Institute (2024) Climate Watch Country Historical Greenhouse Gas Emissions.

In 2021, Canada ranked as the 12th largest GHG emitting country/region. Canada's share of global emissions decreased from 1.76% in 2005 to 1.40% in 2021. Like that of other economically developed countries, Canada's share is anticipated to continue to decline due to the expected rapid increase in emissions from economically developing and emerging countries, particularly China (+86.9% from 2005 to 2021), India (+75.1%), Brazil (+26.4%), and Indonesia (+41.3%).

Canada's total emissions decreased by 1.40% (from 686 to 677 Mt $CO_2$ eq) from 2005 to 2021. This is a smaller decrease than that of other western countries and regions, notably the United States' decrease by 14.2% (from 6 740 to 5 783 Mt $CO_2$ eq) and European Union's 22.6% decrease (from 4 267 to 3 301 Mt $CO_2$ eq).

Canada has the second-highest GHG emission per capita rate among the top 10 emitting countries and regions and Canada. If Canada's GHG emissions per year were shared equally by each person in Canada, each person would emit 17.7 t $CO_2$ eq per year, which is 3 times the global rate. That is the same amount of GHG emissions released as someone driving around the world in a gasoline-powered car twice per year (about 73 436 km total).[5]

Canada's per capita emissions have decreased by 16.9% since 2005, while the United States' have decreased by 23.6% and the European Union's by 24.6%. The 3 countries in the top 10 total emitters with the lowest GHG emissions per capita are India (2.47 t $CO_2$ eq), Indonesia (3.65 t $CO_2$ eq) and Brazil (5.31 t $CO_2$ eq).

# About the indicator

## What the indicator measures

The Global greenhouse gas emissions indicator reports global human emissions of GHGs from 1990 to 2021. The Greenhouse gas emissions by country indicator reports emissions coming from the top 10 total emitting countries and regions and Canada for 2005 and 2021. Both indicators measure total and per capita emissions. Emissions from energy and non-energy related sources are included in this indicator, while emissions from land use, land

[5] Environmental Protection Agency (2024) Greenhouse Gas Equivalencies Calculator. Retrieved June 17, 2024.

use change, and forestry are excluded. The emissions of GHGs include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride.

### Why this indicator is important

The indicator provides a global perspective on the world's historical GHG emissions and Canada's part in global GHG emissions, both in total and per capita.

### 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 Greenhouse gas emissions projections indicator provides an overview of Canada's projected GHG emissions up to 2035.

The Carbon dioxide emissions from a consumption perspective indicator shows the impact of Canada's consumption of goods and services, regardless of where they are produced, on the levels of carbon dioxide released into the atmosphere.

The Land-based greenhouse gas emissions and removals indicator tracks exchanges of greenhouse gas emissions and removals between the atmosphere and Canada's managed lands.

## Data sources and methods

### Data sources

The emissions and emissions per capita data used to compile the Global greenhouse gas emissions indicator were retrieved from the Climate Watch Country Historical Greenhouse Gas Emissions dataset developed by the World Resources Institute. The dataset is accessible through the Climate Watch GHG Emissions platform which presents data from various sources. It was previously published through the World Resources Institute's Climate Analysis Indicator Tool (CAIT). The data are based on the May 2024 version of the dataset.

#### More information

The World Resources Institute's dataset uses information and emissions from different sources:

- Robbie M. Andrew for global and country-level $CO_2$ emissions from cement production
- Food and Agriculture Organization of the United Nations for Land Use Change and Forestry Data
- Global Carbon Project for their Global Carbon Budget reports
- International Energy Agency for their Greenhouse Gas Emissions from Energy
- United States Environmental Protection Agency for their Global Non-CO2 Greenhouse Gas Emission Projections & Mitigation Potential: 2015-2050

It covers anthropogenic GHG emissions across the world, excluding emissions attributed to land use, land use change, and forestry. The data are reported by the World Resources Institute's 2 to 3 years after data collection. The latest year available at the time of the update was 2021.

The population data used by the World Resources Institute to calculate the GHG emissions per capita are retrieved from the World Bank's World Development Indicators.

### Methods

The indicator is composed of the total and per capita GHG emission totals for the world from 1990 to 2021, and total and per capita GHG emissions for Canada and the top 10 emitting countries/regions for 2005 and 2021, as retrieved from the World Resources Institute's Climate Watch Country Historical Greenhouse Gas Emissions dataset. The dataset is available on the platform.

### More information

The national GHG emission totals from the World Resources Institute's Climate Watch Country Historical Greenhouse Gas Emissions are compiled by using as many as 5 different GHG emissions data sources. The selection of these data sources is done using different completeness criteria like geographic coverage, temporal coverage, and accuracy. For more information on the data sources selection and the national and global emissions compilation consult the Climate Watch Country Greenhouse Gas Emissions Data and Methodology.

Greenhouse gas emissions are reported in carbon dioxide equivalent ($CO_2$ eq), determined by multiplying the amount of emissions of a particular gas by its global warming potential. The Climate Watch Country Historical Greenhouse Gas Emissions dataset uses the 100-year global warming potentials from the Intergovernmental Panel on Climate Change's Fourth Assessment Report.

Greenhouse gas emissions per capita are determined by dividing a country/region's total greenhouse gas emissions by its population.

## Recent changes

The time coverage of the indicator has been modified and now presents data for all years from 1990 to 2021. It previously presented data for 2005 and 2020.

The indicator has been reorganized to include 2 sections: Global emissions and Greenhouse gas emissions by country, each of which include data on total GHG emissions and per capita GHG emissions. Previously, the indicator divided information by total emissions and per capita emissions, with each section containing information for both the entire world, and by country.

## Caveats and limitations

The latest 2 years reported (2020 and 2021) coincide with the first and second years of the COVID-19 pandemic which affected a wide range of economic sectors, including the energy and transport sectors. The trends presented must be interpreted in the context of the economic slowdown that influenced results from 2019 to 2020, and the economic rebound that influenced them from 2020 to 2021.

The emissions in the World Resources Institute's Climate Watch Country Historical Greenhouse Gas Emissions dataset as of May 2024 may reflect revisions of data previously published by that organization. The emissions reported by the World Resources Institute are also different from the emissions reported by member countries in their National Inventory Report to the United Nations Framework Convention on Climate Change.

### More information

Due to the differences in data sources and methodologies used, Climate Watch estimated country GHG emissions may be different than official inventories prepared by countries. Caution is advised when comparing data released in different years and reports.

Emissions from international bunker fuels (which are estimated based on the location of marine and aviation refueling) are not reflected in reported countries and regions emissions totals. However, they are included in the total world emissions.

Greenhouse gas data in the Climate Analysis Indicators Tool have uncertainties since they are using many different data sources. Despite the uncertainties, the World Resources Institute has chosen to err on the side of inclusiveness, by capturing the widest possible range of GHG sources and sinks that contribute to global climate change. For more information on uncertainties please consult the Climate Watch Country Greenhouse Gas Emission Data and Methodology Technical Note.

# Resources

## References

International Energy Agency (2019) Fuel Economy in Major Car Markets: Technology and Policy Drivers, 2005-2017 (PDF; 6.5 MB). Retrieved June 17, 2024.

United States Environmental Protection Agency (2021) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2019 (PDF; 3 MB). Retrieved June 17, 2024.

World Resources Institute (2024) Climate Watch Country Historical Greenhouse Gas Emissions. Retrieved on June 17, 2024.

## Related information

Canada's action on climate change

Climate change

Greenhouse gas emissions

# Annex

## Annex A. Data table for the figures presented in this document

**Table A.1. Data for Figure 1. Global emissions and per capita greenhouse gas emissions, 1990 to 2021**

| Year | Global emissions (megatonnes of carbon dioxide equivalent) | Per capita global emissions (tonnes of carbon dioxide equivalent per person) |
|---|---|---|
| 1990 | 30 708.31 | 5.82 |
| 1991 | 30 854.08 | 5.75 |
| 1992 | 30 760.80 | 5.64 |
| 1993 | 30 896.88 | 5.58 |
| 1994 | 31 164.96 | 5.54 |
| 1995 | 31 949.87 | 5.60 |
| 1996 | 32 545.41 | 5.62 |
| 1997 | 32 942.62 | 5.61 |
| 1998 | 33 152.61 | 5.57 |
| 1999 | 33 346.20 | 5.53 |
| 2000 | 34 225.00 | 5.60 |
| 2001 | 34 604.52 | 5.59 |
| 2002 | 35 027.24 | 5.58 |
| 2003 | 36 318.41 | 5.72 |
| 2004 | 37 785.32 | 5.88 |
| 2005 | 39 001.40 | 5.99 |
| 2006 | 40 115.67 | 6.08 |
| 2007 | 41 424.75 | 6.21 |
| 2008 | 41 725.46 | 6.18 |
| 2009 | 41 297.04 | 6.04 |
| 2010 | 43 420.56 | 6.27 |
| 2011 | 44 688.81 | 6.38 |
| 2012 | 45 190.00 | 6.37 |
| 2013 | 45 892.25 | 6.40 |
| 2014 | 46 184.25 | 6.36 |
| 2015 | 46 073.06 | 6.27 |
| 2016 | 46 264.29 | 6.22 |
| 2017 | 46 981.68 | 6.25 |
| 2018 | 47 960.07 | 6.31 |
| 2019 | 48 046.60 | 6.25 |
| 2020 | 46 066.32 | 5.93 |
| 2021 | 48 209.50 | 6.15 |

**Source :** World Resources Institute (2024) Climate Watch Country Historical Greenhouse Gas Emissions.

**Table A. 2. Data for Figure 2. Total greenhouse gas emissions from Canada and the top 10 emitting countries and regions, 2005 and 2021**

| Country or region | 2005 total greenhouse gas emissions (megatonnes of carbon dioxide equivalent) | 2021 total greenhouse gas emissions (megatonnes of carbon dioxide equivalent) |
|---|---|---|
| China | 7 192.18 | 13 438.97 |
| United States | 6 740.01 | 5 782.55 |
| India | 1 966.93 | 3 444.46 |
| European Union (27) [A] | 4 266.99 | 3 301.27 |
| Russian Federation | 2 262.35 | 2 507.34 |
| Brazil | 898.79 | 1 136.45 |
| Japan | 1 289.90 | 1 103.39 |
| Indonesia | 713.43 | 1 007.81 |
| Iran | 656.79 | 952.17 |
| Saudi Arabia | 422.65 | 730.64 |
| Canada | 686.29 | 676.50 |

**Note:** Greenhouse gas emissions for each country and region presented in this comparison were calculated by the World Resources Institute. For certain countries, including Canada, these values differ from the official estimates of greenhouse gas emissions submitted to the United Nations Framework Convention on Climate Change. For more information, please consult the Caveats and limitations section.
[A] European Union (27) includes: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden.
**Source :** World Resources Institute (2024) Climate Watch Country Historical Greenhouse Gas Emissions.

**Table A.3. Data for Figure 3. Per capita greenhouse gas emissions for Canada and the top 10 emitting countries and regions, 2005 and 2021**

| Country or region | 2005 greenhouse gas emissions per capita (tonnes of carbon dioxide equivalent) | 2021 greenhouse gas emissions per capita (tonnes of carbon dioxide equivalent) |
|---|---|---|
| China | 5.52 | 9.52 |
| United States | 22.81 | 17.42 |
| India | 1.71 | 2.47 |
| European Union (27) [A] | 9.80 | 7.39 |
| Russian Federation | 15.76 | 17.48 |
| Brazil | 4.83 | 5.31 |
| Japan | 10.01 | 8.78 |
| Indonesia | 3.15 | 3.65 |
| Iran | 9.41 | 11.20 |
| Saudi Arabia | 17.75 | 20.67 |
| Canada | 21.28 | 17.69 |

**Note:** [A] European Union (27) includes: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden.
**Source :** World Resources Institute (2024) Climate Watch Country Historical Greenhouse Gas Emissions.

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