FACT SHEET: Greenhouse Gases

(Advanced)

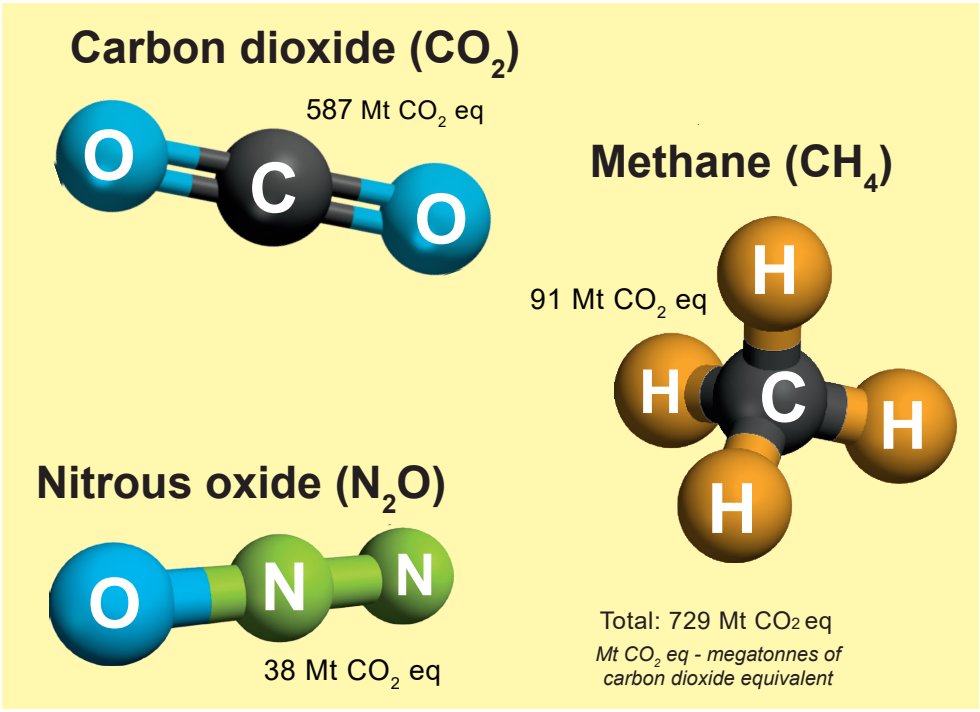
What Are Greenhouse Gases?

The greenhouse effect is the way in which heat is trapped close to the surface of the Earth by "greenhouse gases" (GHG's). These heat-trapping gases are mostly transparent to the visible radiation from the sun which reaches the Earth's surface and warms it. The energy is then emitted from the surface as infrared radiation which is then trapped and re-emitted by the greenhouse gases. The more GHG's present, the more warming occurs. This increased warming has led to climate change.

How much does each gas contribute to global warming?

Three key factors determine this:

1. How much of it exists in the atmosphere?
2. Lifetime—how long does it remain in the atmosphere?
3. How effective is it at trapping heat?



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Major Greenhouse Gases

Carbon Dioxide - CO_2

- 80 percent of human-caused GHG's in Canada.
- Sticks around for quite a while;
  - 40 percent still remains after 100 years
  - 20 percent after 1,000 years
  - 10 percent as long as 10,000 years later
- Produced by burning fossil fuels (coal, natural gas, and oil), solid waste, trees and other biological materials, and also as a result of certain chemical reactions (e.g. manufacture of cement).

Methane - CH_4

- 13 percent of human-caused GHG's in Canada.
- Lasts in the atmosphere for far less time than carbon dioxide (about a decade),
- Its global warming impact is 34 times greater than that of carbon dioxide.
- Emitted during;
  - production and transport of coal, natural gas, and oil.
  - digestive process of livestock and other agricultural practices.
  - decay of organic waste in municipal solid waste landfills.

Nitrous Oxide - N_2O

- 5.2 percent of human-caused GHG's in Canada
- Remains in the atmosphere a little more than a century
- Powerful greenhouse gas: 300 times that of CO_2
- Emitted during agricultural (use of nitrogen based fertilizers) and industrial activities, combustion of fossil fuels and solid waste, as well as during treatment of wastewater

Fluorinated Gases

- Less than 2 percent of global human-caused GHG's
- Has long atmospheric lifetime - tens of thousands of years.
- Very powerful greenhouse gas: 23,000 times that of carbon dioxide
- The only synthetic (man-made) gas - it does not exist in nature
- Emitted from a variety of manufacturing and industrial processes including production of air conditioners and refrigerators.

Water Vapor

- The most abundant greenhouse gas, but naturally occurring.
- Different because its concentration changes due to the warming that results from the other greenhouse gases.
- Warmer air holds more water which absorbs more heat, causing even greater warming. (However, as increased water vapor also increases cloud cover that reflects the sun's energy away from the earth, the net impact of this is still uncertain.)

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Greenhouse Gas Sources in Canada

44% - Stationary Energy Combustion

- This includes burning coal, oil and natural gas to produce electricity and heat.
- This is the largest single source of GHG's.

30% - Transportation Energy

- Burning petroleum-based fuels (gasoline and diesel) is the main energy source for transportation.
- Carbon dioxide is the primary gas emitted, though fuel combustion also releases small amounts of methane and nitrous oxide and vehicle air conditioning and refrigerated transport release fluorinated gases as well.
- The majority of transport emissions in Canada are related to road transportation, which includes personal and commercial vehicles.
- The growth in emissions is largely due to the increased number of vehicles

8.1% - Agriculture

- Livestock – methane is produced by manure decomposition and as beef and dairy cow digestion.
- Fertilizers - the use of inorganic nitrogen fertilizers often releases nitrous oxide.

7.7% - Industrial Processes

- This includes the manufacturing of goods and raw materials (like cement and steel), food processing and construction.
- The majority of man-made emissions is carbon dioxide, though methane, nitrous oxide, and fluorinated gases are also released.

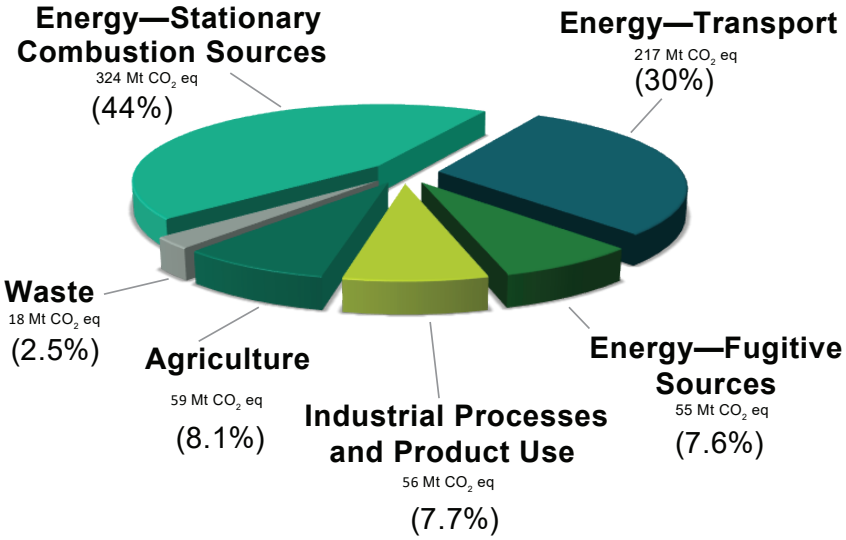
7.6% - Fugitive Energy Sources

- These are emissions of gases from pressurized equipment due to leaks and other unintended releases.
- Fugitive GHG emissions from fossil fuel production (coal, oil and natural gas) have decreased, largely the result of provincial regulations

2.5% - Waste

- Includes emissions from the treatment and disposal of liquid and solid wastes (landfills, wastewater treatment, incineration of waste).
- Primary emission is methane (CH_4)

Breakdown of Canada's Emissions by IPCC Sector (2018)

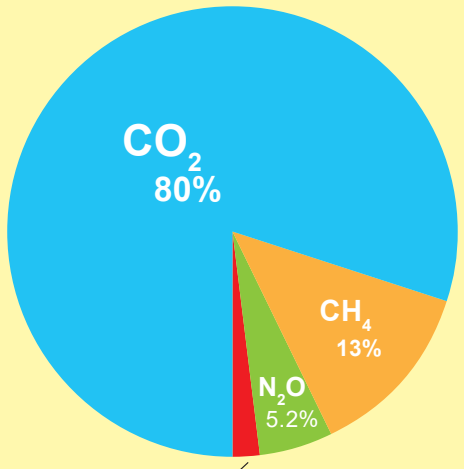


Total: 729 Mt CO_2 eq *Note: Totals may not add up to due to rounding.

Intergovernmental Panel on Climate Change (IPCC) - body of the United Nations providing objective, scientific information relevant to human-induced climate change

National Inventory Report 1990–2018: Greenhouse Gas Sources and Sinks in Canada—Executive Summary 2020 Edition Canada.ca/ghg-inventory

Breakdown of Canada's Emissions by GHG (2018)



Based on the National Inventory Report 1990–2018: Greenhouse Gas Sources and Sinks in Canada—Executive Summary 2020 Edition Canada.ca/ghg-inventory

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Loss of Greenhouse Gas Storage

The list of sources does not take into account the loss of natural systems that absorb and store carbon dioxide from the atmosphere (called carbon sinks).

- When trees or plants are harvested or disturbed, they no longer absorb carbon dioxide (via photosynthesis - a process by which they turn carbon dioxide into glucose). This disturbance includes forest conversion for resource extraction and cropland expansion
- When they are burned or decompose, they release carbon dioxide back into the atmosphere.
- An increase of agricultural land being converted from perennial to annual crops and a declining use of conservation tillage on cropland has reduced the amount of carbon dioxide stored.

Other Resources

General Information

Greenhouse Effect - Government of Canada
https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-effect.html

Greenhouse Gas Emissions - Government of Canada
https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/greenhouse-gas-emissions.html

United Nations Climate Change Information Kit (PDF Booklet)
http://unfccc.int/resource/iuckit/cckit2001en.pdf

Greenhouse Effect 101 - NRDC US
https://www.nrdc.org/stories/greenhouse-effect-101

Videos

1 °C and its impacts: what does climate change mean for Canada?
https://www.youtube.com/watch?v=9SvlT6z5nhc -

State of the Climate 2018 - Updated version (February 2019)
https://www.youtube.com/watch?v=6r5wKrC7p50

Climate Change 101 with Bill Nye - National Geographic
https://www.youtube.com/watch?v=EtW2rrLHs08

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Greenhouse gases are measured in

Metric tons of carbon dioxide equivalent

MTCO2 Eq.

A metric measure used to compare the emissions from different greenhouse gases based upon their global warming potential (GWP).

The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by its associated GWP.

50% of the greenhouse gases from landfills is methane which has a global warming impact 34 times greater than carbon dioxide.