

Greenhouse Gas Inventories 101

What is a Greenhouse Gas Inventory?

A greenhouse gas (GHG) inventory, also known as a carbon footprint assessment, is a quantified list of an organization's greenhouse gas emissions and emission sources. It is a strategic tool for understanding, managing and communicating emissions resulting from an organization's activities.

The GHG Protocol

The World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI) [Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard](#) (2004) is considered international best practice for greenhouse gas accounting for organizations. It is articulated around the following principles:

- **Relevance:** The inventory appropriately reflects the emissions of the organization and is compiled in the spirit of serving decision-makers internal and external to the organization.
- **Completeness:** All “material” (significant) emission sources and activities within the chosen boundary are accounted for and reported, and any exclusions are disclosed and justified.
- **Consistency:** Consistent methodologies are used for meaningful comparison over time. Changes to data, inventory boundary, methods or relevant factors are transparently documented, and previous years including the base year are updated when “materially significant”.
- **Transparency:** All relevant issues are addressed based on a clear audit trail. All relevant assumptions are disclosed, and accounting and calculation methodologies and data sources are appropriately referenced.
- **Accuracy:** Quantification of emissions is systematically neither over nor under actual emissions, and uncertainties are reduced as much as possible. Decision-makers should be reasonably assured as to the integrity of the reported information.

Key Terms

Materiality: when the inclusion or exclusion of information influences the organization's decisions or actions

Boundary: the limit defining which emissions to include in a greenhouse gas inventory

Base year: the year against which emissions are compared over time

Double counting: when multiple organizations report the same emissions or emission reductions

Scopes

Greenhouse gas emissions are broken down into three categories, known as “scopes”, that delineate emission sources and avoid “double counting” between organizations, particularly at the level of national reporting.

- **Scope 1:** direct emissions from sources owned or controlled by the reporting organization
- **Scope 2:** indirect emissions from purchased grid electricity and other grid energy such as steam, hot water and chilled water
- **Scope 3:** other indirect emissions upstream and downstream of the organization’s activities

The GHG Protocol requires including all “material” (significant) Scope 1 and Scope 2 emissions since an organization has the most ownership and control over these activities.

Organizations are encouraged to include Scope 3 sources that are critical to their activities and strategic decisions. The decision to include Scope 3 emission sources is often based on a value chain analysis to determine their relevance and “materiality”. Relevant emissions are defined by McGill as: large, or believed to be so, relative to Scope 1 and 2 emissions; contributing to the university’s emissions and exposure to climate risk; deemed critical by key stakeholders; and showing potential for reduction.

Greenhouse Gases and Global Warming Potentials

All seven Kyoto Protocol greenhouse gases should be included where applicable and “material” (significant). This includes biogenic carbon dioxide, which is created from the combustion, harvesting, decomposition or processing of biological rather than fossil sources.

Global warming potentials (GWPs) are factors describing the radiative forcing impact of one unit of a specific greenhouse gas (e.g., methane) relative to one unit of carbon dioxide. They are used in greenhouse gas accounting to convert individual greenhouse gas emission totals to a single standardized unit for ease of comparison, namely carbon dioxide equivalent or CO₂e.

McGill applies 100-year GWPs without climate-carbon feedbacks to all emissions data in its inventory to calculate total emissions in tonnes of carbon dioxide equivalent (tCO₂e). GWP values are sourced from the most recent Intergovernmental Panel on Climate Change (IPCC) report available. Table 1 lists the Kyoto Protocol greenhouse gases and their respective GWPs.

Table 1. Kyoto Protocol GHGs and GWPs, IPCC 2021

Greenhouse Gas	Chemical Formula	100-Year GWP
Carbon dioxide	CO ₂	1
Methane	CH ₄	27.9
Nitrous oxide	N ₂ O	273
Hydrofluorocarbons (HFCs)	Various	Various
Perfluorocarbons (PFCs)	Various	Various
Nitrogen trifluoride	NF ₃	16,100
Sulphur hexafluoride	SF ₆	25,200

The Basic Equation

$$CO_2e = \sum_{i=1}^n Activity\ Data_i \times (EF_{GHG,i} \times GWP_{GHG})$$

Where:

CO_2e = total greenhouse gas emissions in carbon dioxide equivalent

Index i = each activity

n = the total number of activities

$Activity\ Data_i$ = the amount of fuel (mass or volume) consumed, kWh of electricity consumed, passenger-kilometres traveled, etc., depending on the activity in question, during the reporting period

$EF_{GHG,i}$ = the emissions factor for CO₂, CH₄, N₂O and other greenhouse gases for Activity i . Emissions factors are either developed in-house or published by third parties like environment ministries

GWP_{GHG} = the global warming potential of CO₂, CH₄, N₂O and other greenhouse gases

Greenhouse Gas Reporting at McGill

Since 2015, McGill has produced annual greenhouse gas inventories to inform targets related to sustainability efforts, emissions reduction, monitoring and reporting and compliance. Figure 1 shows which Scope 1, 2 and 3 emission sources McGill includes in its greenhouse gas inventory.

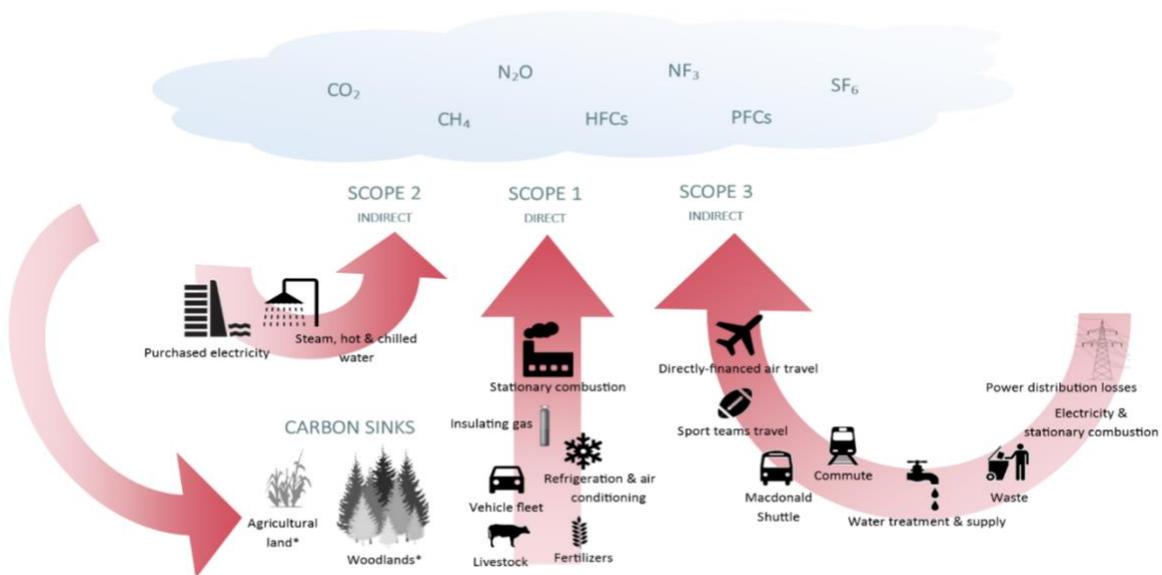


Figure 1. Scope 1, 2 and 3 emissions reported by McGill

The Office of Sustainability reports McGill's greenhouse gas emissions annually to the Board of Governors as one of three strategic key performance indicators linked to progress on sustainability. Data and emissions from our inventory are also reported to mandatory and voluntary external reporting programs, including:

- **Greenhouse Gas Reporting Program for GHGs** run by Environment and Climate Change Canada. We report emissions from the Downtown campus and voluntarily report emissions for Macdonald campus.
- **National Pollutant Inventory Report for airborne contaminants excluding GHGs** run by Environment and Climate Change Canada. We report CO₂ and NO_x for the Downtown campus and voluntarily report on all other Part 4 substances (e.g., sulphur dioxide, particulate matter, VOCs) for both Downtown and Macdonald campuses.
- **Inventaire québécois des émissions atmosphériques**, which includes both airborne contaminants and greenhouse gases. We report greenhouse gases and Part 4 contaminants (see above) for Downtown and voluntarily report them for Macdonald campus.
- **Inventaire des sources fixes d'émissions atmosphériques**, a municipal program managed by the City of Montreal that includes our Downtown and Macdonald campuses. Reporting is mandatory and includes the volume of fossil fuels consumed at each campus.
- **Relevé énergétique du réseau universitaire** managed by the Ministère de l'Enseignement supérieur du Québec. It is mandatory for all university-owned buildings and includes all sources of energy used in those buildings.
- **AASHE STARS**, the Association for the Advancement of Sustainability in Higher Education's Sustainability Tracking, Assessment & Rating System. It is a voluntary self-reporting framework for colleges and universities. McGill currently has a Gold rating and is committed to achieving a Platinum rating by 2030.

Read our latest greenhouse gas inventory report [here](#).

Online Resources

[McGill's greenhouse gas inventories](#)

[The GHG Protocol Corporate Standard](#)

US Environmental Protection Agency's "[GHG Inventory Development Process and Guidance](#)"

Carbon Trust's "[Practical steps for reporting on greenhouse gas emissions](#)"

The World Resources Institute [guide for office-based organisations](#)