



MEASURING GREENHOUSE GAS EMISSIONS

Greenhouse gases (GHGs) are gases in the earth's atmosphere that trap heat from the sun, creating a greenhouse effect that warms the planet. While this natural process is essential for life, an excess of GHGs due to human activities is causing climate change. Seven important GHGs are measured. Each one has different warming impacts on the climate over a 100-year period, which are expressed as global warming potentials (GWPs).

Carbon dioxide (CO₂) = GWP 1

Methane (CH₄) = GWP 28

Nitrous oxide (N₂O) = GWP 265

Hydrofluorocarbons (HFCs) = GWP ranges from 4 to 12,400

Perfluorocarbons (PFCs) = GWP ranges from 6,630 to 11,100

Sulfur hexafluoride (SF₆) = GWP 23,500

Nitrogen trifluoride (NF₃) = GWP 16,100

WHY ARE ORGANIZATIONS MEASURING THEIR GHG EMISSIONS

An emissions inventory is a comprehensive accounting of all GHGs a company emits, both directly and indirectly. Companies are increasingly undertaking this process for the following reasons:

Regulatory compliance

Facilities in Ontario that emit 10,000 tonnes or more of CO₂e per year must report their emissions to the provincial government. This includes facilities in sectors such as manufacturing, electricity generation, mining and waste management.

Investor and stakeholder pressure

Environmental, social and governance (ESG) criteria are increasingly becoming central to investment decisions. Investors demand greater transparency on how companies manage climate risks and their emissions. An emissions inventory is a key component of ESG reporting.

Risk management

There are both financial and reputational risks associated with managing emissions. Carbon pricing, operational cost increases, fines for non-compliance and investor concerns are just a few of the risks corporate managers must consider.

Many of Ontario's largest companies are going beyond simply meeting their regulatory reporting requirements. They are also measuring their carbon emissions and reporting them publicly and voluntarily. Royal Bank of Canada, Manulife Financial, Loblaw Companies Limited, Rogers Communications, Barrick Gold Corporation, Canadian National Railway and Suncor Energy are among those that have taken this extra step.

THE THREE-SCOPE CARBON-ACCOUNTING FRAMEWORK

The three-scope carbon accounting framework helps organizations track, manage and reduce their total carbon footprint across different operational areas. The carbon-accounting system was developed by the GHG Protocol in partnership with the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). The GHG Protocol was launched in 1998 to provide a standardized framework for measuring and managing greenhouse gas emissions across businesses and organizations. It is recognized by many international bodies, including the United Nations Framework Convention on Climate Change (UNFCCC), the International Organization for Standardization (ISO) and the CDP (formerly known as the Carbon Disclosure Project).

MEASURING GHG EMISSIONS

The first step in measuring GHG emissions is to establish an organizational boundary. Is the boundary an entire province, a large company with many different businesses, a municipality or a small company or event? The GHG Protocol provides three options to set an organizational boundary: equity share, financial control and operational control. With this organizational boundary in place, the operational boundary is then determined and emissions are grouped into categories called scopes.

GHG EMISSIONS SCOPES

The GHG Protocol defines three scopes of emissions to help organizations quantify and manage their greenhouse gas emissions. Scopes 1, 2 and 3 cover different types of emissions, providing a comprehensive, consistent and transparent framework to track the environmental impacts of direct and indirect GHG emissions.

SCOPE 1: DIRECT EMISSIONS

These are direct GHG emissions from:

- Onsite fuel combustion (e.g., natural gas for heating)
- Company-owned vehicles (e.g., fuel burned in trucks, cars or forklifts)
- Fugitive emissions (e.g., refrigerant leaks, chemical processes)

Scope 1 emissions are usually the easiest to quantify because they are emissions from an company's own operations. They are calculated by collecting data on fuel consumption or chemical use and applying relevant emission factors (e.g. kg CO₂e per litre of fuel burned).

Example

If a factory burns 10,000 litres of diesel fuel, the emission factor for diesel combustion (2.69 kgCO₂e per litre) is multiplied by the fuel consumption: 10,000 litres × 2.69 kgCO₂e/litre = 26,900 kgCO₂e (or 26.9 metric tonnes of CO₂e).

SCOPE 2: INDIRECT EMISSIONS FROM ENERGY USE

Scope 2 emissions are indirect GHG emissions from external sources that produce energy for consumption by others, including:

- Purchased electricity
- Purchased steam, heat or cooling

Emissions occur at the power plants generating the energy, but they are accounted for by the organization using the energy as Scope 2 emissions. Quantifying Scope 2

emissions involves tracking energy consumption (kWh or MWh) and multiplying it by the emission factor associated with the energy producer. Companies often use location-based factors (regional or national grid emissions) or market-based factors that track emissions from energy with more producer granularity.

Example

If an office consumes 100,000 kWh of electricity, and the local grid has an emission factor of 0.03 kgCO₂e per kWh: 100,000 kWh × 0.03 kgCO₂e/kWh = 3,000 kgCO₂e (or 3 metric tonnes of CO₂).

Ontario's emissions from electricity in 2024 (30 grams of CO₂e/kWh) are twice the amount per kWh as in British Columbia but 24 times less than in Saskatchewan. Saskatchewan (730 grams CO₂e/kWh), Nova Scotia (690 grams CO₂e/kWh), and Alberta (540 grams CO₂e/kWh) have Canada's most emissions intensive provincial grids while British Columbia (15 grams CO₂e/kWh), Manitoba (2.0 grams CO₂e/kWh) and Quebec (1.7 grams CO₂e/kWh) have the lowest.

Source: canada.ca

SCOPE 3: INDIRECT EMISSIONS FROM THE VALUE CHAIN

Scope 3 emissions are all other indirect GHG emissions that occur in the value chain. These emissions are not directly controlled by the organization but are a consequence of its operations. These emissions are grouped into 15 categories under the headings of upstream and downstream:

Upstream emissions

- Purchased goods and services
- Capital goods

- Fuel- and energy-related emissions not covered in scopes 1 or 2
- Transportation
- Waste management
- Business travel
- Employee commuting
- Leased assets

Downstream emissions

- Transportation
- Processing of sold products
- Use of sold products
- End-of-life treatment of sold products
- Leased assets
- Franchises
- Investments

Scope 3 is the broadest and often the largest category, making it more complex to quantify. Estimation methods vary depending on the type of activity. For example, emissions from business travel are calculated by multiplying travel costs or distances by relevant emission factors (e.g., CO₂e/\$ spent or CO₂e/km for flights or car rentals). For purchased goods, lifecycle assessment (LCA) or supplier-provided data might be used to estimate emissions associated with the production and transportation of materials.

Example

If a company purchases 1,000 kg of steel, and the emission factor for steel production is 1.9 kgCO₂e per kg of produced steel: 1,000 kg × 1.9 kg CO₂e/kg = 1,900 kg CO₂e (or 1.9 metric tons of CO₂e).



TRACKING THE THREE SCOPES

Scope 1 and 2 emissions are the main focus of regulatory reporting and are the most commonly measured. The GHG Protocol requires that companies account for all scope 1 and 2 emissions.

Scope 3 emissions are measured by companies and organizations that want to improve their ESG performance, undertake a product carbon footprint or lifecycle analysis or meet the requirements of supply chain partners measuring emissions. Scope 3 emissions can represent the largest source of emissions for companies, so they also offer the most opportunity for GHG reductions.

Tracking all three scopes begins with creating a GHG inventory. This gives companies a baseline against which to measure. It also gives them a complete view of their carbon footprint to help support more effective strategies for GHG reduction.

Additional sources

[GHG Protocol: A Corporate Accounting and Reporting Standard](#)

[GHG Protocol Scope 2 Guidance](#)

[GHG Protocol Corporate Value Chain \(Scope 3\) Standard](#)

[Canada's official greenhouse gas inventory](#)