



Estimating Greenhouse Gas Emissions

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Why Develop a Greenhouse Gas Inventory Now?

- What gets measured gets managed
 - Understand what processes are generating greenhouse gas emissions.
 - Understand emission trends.
 - Evaluate emission reduction methods, which can reduce costs!

Definitions - Greenhouse Gases

➤ Carbon Dioxide (CO₂)

[combustion of fossil fuels, chemical reactions]

➤ Methane (CH₄)

[fossil fuel production, decomposition of landfill waste, animal husbandry]

➤ Nitrous Oxide (N₂O)

[combustion of fossil fuels, nitric acid production, livestock manure management]

➤ Hydrofluorocarbons (HFCs)

[replacement for ozone depleting substances]

➤ Perfluorocarbons (PFCs)

[primary aluminum production]

➤ Sulfur Hexafluoride (SF₆)

[electrical utility industry equipment as a replacement to PCBs]

Definitions - CO₂ Equivalent (CO₂e)

- A common basis (CO₂) for estimating the greenhouse gas impact from a source using the global warming potential (potential heat trapping effect to the atmosphere) of each gas.

Global Warming Potential

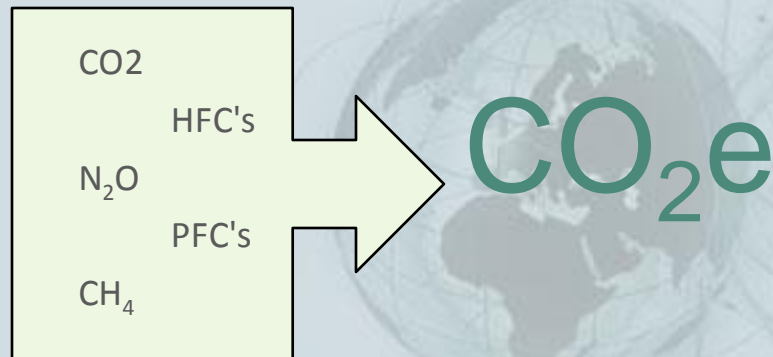
Greenhouse Gas	Formula	Atmospheric Lifetime (years)	Global Warming Potential
<i>Carbon dioxide</i>	CO_2	50 – 200	1
<i>Methane</i>	CH_4	12 +/- 3	21
<i>Nitrous oxide</i>	N_2O	120	310
<i>Sulfur hexafluoride</i>	SF_6	3,200	23,900
<i>HFCs:</i>	$\text{C}_x\text{H}_x\text{F}_x$	1.5 – 264	140 – 11,700
<i>PFCs:</i>	C_xF_x	2,600 – 50,000	6,500 - 9,200

Source: EPA Climate Leaders Greenhouse Gas Inventory Protocol, Design Principals (May 2005). Based on the IPCC Second Assessment Report (SAR).

CO₂e Calculation

300 MMBtu/hr Average Plant Load on Natural Gas

GHG	Annual Emissions (metric tons)		Global Warming Potential		CO ₂ e (metric tons)
CO ₂	140,242	X	1	=	140,242
CH ₄	2.6	X	21	=	54
N ₂ O	2.7	X	310	=	833
			TOTAL CO₂e		141,130



Definitions - Protocol

- Establishes standards and step-by-step guidance for use in quantifying and reporting GHG emissions.



Protocols Available

- Examples of protocols available to follow:
 - The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, World Resources Institute/World Business Council for Sustainable Development.
 - Design Principles, Climate Leaders Greenhouse Gas Inventory Protocol, U.S. Environmental Protection Agency.
 - ANSI/ISO/ASQ E14064-1:2006 Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removal.
 - California Climate Action Registry General Reporting Protocol, Reporting Entity-Wide Greenhouse Gas Emissions, California Climate Action Registry.
 - Draft General Reporting Protocol For the Voluntary Reporting Program, The Climate Registry.
 - Industry Groups
 - States

Definitions – Organizational Boundaries

- The boundaries that determine the operations owned or controlled by the reporting company.

Definitions – Operational Boundaries

- **Scope 1: Direct GHG Emissions**
Emissions occur from sources owned or controlled by the company.
- **Scope 2: Indirect GHG Emissions**
Emissions from the generation of purchased energy.
- **Scope 3: Other Indirect GHG Emissions**
Optional reporting category for all other indirect emissions.

Definitions – Base/Baseline Year

- Historic datum against which emissions are tracked over time.
 - For voluntary reductions – Choose the earliest year with reliable data. Some companies choose 1990 to be consistent with the Kyoto Protocol.
 - For Cap and Trade System – The year/inventory against which your compliance obligations will be evaluated. The base year will be established in the rule.
 - The Western Climate Initiative is considering 2005.

Where Do I Start?

➤ Inventory Management Plan

Internal process to institutionalize the collection, calculation and maintenance of greenhouse gas data. Can include:

- Company Information
- Boundary Conditions
(Organizational, Operational)
- Emissions Quantification
- Data Management
- Base Year
- Management Tools
- Auditing and Verification
- Determination of GHG Credits
Associated with Specific Initiatives

Determine Organizational Boundaries

Two approaches to choose from:

- Equity Share Approach

- Accounts for GHG emissions according to share of equity (economic interest) in the operation.

- Control Approach

- Accounts for GHG emissions from operations over which there is control (financial or operational).

Determine Emissions Sources

➤ Scope 1

➤ Generation of electricity, heat or steam by combustion of fuels

[boilers, furnaces, fire water pumps, space heaters, generators]

➤ Physical or chemical processing

[cement, aluminum, ammonium manufacture, waste processing]

➤ Combustion of fuels in company owned mobile sources for the transportation of materials, products, waste, or employees

[trucks, cars, buses, trains, planes, ships]

➤ Intentional or unintentional releases from fugitive sources.

[methane from coal mines and venting, refrigeration and air conditioning equipment, methane from gas transport, landfill waste decomposition]

Determine Emissions Sources

➤ Scope 2

➤ Greenhouse gas emissions resulting from fossil fuel combustion for imported energy that was consumed in owned or controlled equipment and operations.

- Electricity
- Steam
- Chilled Water

Determine Emissions Sources

➤ Scope 3

- Transportation Activities – employee business travel, employee commutes, transportation of fuels, purchased materials, sold products, and/or waste.
- Production/manufacture of purchased materials and fuels.
- Use of sold products and services.
- Out-sourced activities.
- Waste disposal.
- Electricity related activities not included in Scope 2.

Determine Estimation Methods

- Monitoring and Direct Measurement
- Mass Balance
- Emission Factors
- Engineering Estimates



Emission Factor Sources

- Examples of emission factor sources:
 - AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, U.S. Environmental Protection Agency.
 - U.S. Environmental Protection Agency, Climate Leaders.
 - World Resources Institute/World Business Council for Sustainable Development.
 - Industry Groups
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Calculation Tools

Examples of some calculation tools currently available:

➤ Cross-sector tools include:

- Stationary Combustion
- Mobile Combustion
- Use of HFCs in refrigeration and air-conditioning equipment

➤ Sector specific tools include:

- Aluminum
- Iron and Steel
- Cement
- Lime
- Office-based organizations
- Pulp and paper mills
- Semi-conductors
- Wood product manufacturing
- Nitric acid, ammonia, and adipic acid manufacturing
- Petroleum industry

Calculating Emissions

- Scope 1
 - Purchased quantities of commercial fuels X Emission Factor
- Scope 2
 - Metered electricity consumption X Emission Factor
- Scope 3
 - Activity data (such as fuel usage, passenger miles) X Emission Factor

Third Party Verification

- Perform early before reporting is mandatory.
 - Determine discrepancies or mistakes in the greenhouse gas inventory
- Most likely will become part of a cap and trade system.



Questions?

