How to Develop a Greenhouse Gas Emissions Plan

An Online Continuing Education Course for Engineers

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Introduction

There are segments of society that believe greenhouse gases, such as Carbon Dioxide (CO_2) have a negative impact on the environment and that reducing these greenhouse gases will improve the quality of life. Regardless of whether you feel greenhouse gases pose a serious environmental threat, it may make good business sense to take a proactive approach to managing greenhouse gases. Managing greenhouse gases – and taking credit for "being green" – can, in some cases, have a rather minor financial impact and may yield significant positive public relations.

Let's begin with a brief introduction to the general concept of greenhouse gases. *The greenhouse gas (GHG) footprint* refers to the amount of GHG that are emitted during the creation of products or services. It is more comprehensive than the commonly used *carbon footprint*, which measures only carbon dioxide, one of many greenhouse gases.

Greenhouse gases are being emitted through transport, land clearance, and the production and consumption of food, fuels, manufactured goods, materials, wood, roads, buildings, and services. For simplicity of reporting, it is often expressed in terms of the amount of carbon dioxide, or its equivalent of other GHGs, emitted.

Greenhouse gases trap heat and make the planet warmer. If we just look at the impacts of humans on greenhouse gas emissions (there are many other sources) the largest source of greenhouse gas emissions is from burning fossil fuels for electricity, heat, and transportation.

GHG Sources

The primary sources of greenhouse gas emissions in the United States are:

- Electricity production - Electricity production generates the largest share of greenhouse gas emissions. Over 70% of electricity production comes from burning fossil fuels, mostly coal and natural gas.

- Transportation - Greenhouse gas emissions from transportation primarily come from burning fossil fuel for cars, trucks, ships, trains, and planes. Over 90% of the fuel used for transportation is petroleum based, which includes gasoline and diesel.

- Industry - Greenhouse gas emissions from industry primarily come from burning fossil fuels for energy as well as greenhouse gas emissions from certain chemical reactions necessary to produce goods from raw materials.

- Commercial and Residential - Greenhouse gas emissions from businesses and homes arise primarily from fossil fuels burned for heat, the use of certain products that contain greenhouse gases, and the handling of waste.

- Agriculture - Greenhouse gas emissions from agriculture come from livestock such as cows, agricultural soils, and rice production.

- Land Use and Forestry - Land areas generally absorb CO_2 from the atmosphere but can also be a source of greenhouse gas emissions.

Figure 1 is a pie chart showing the breakdown of the various CO_2 emission sources.

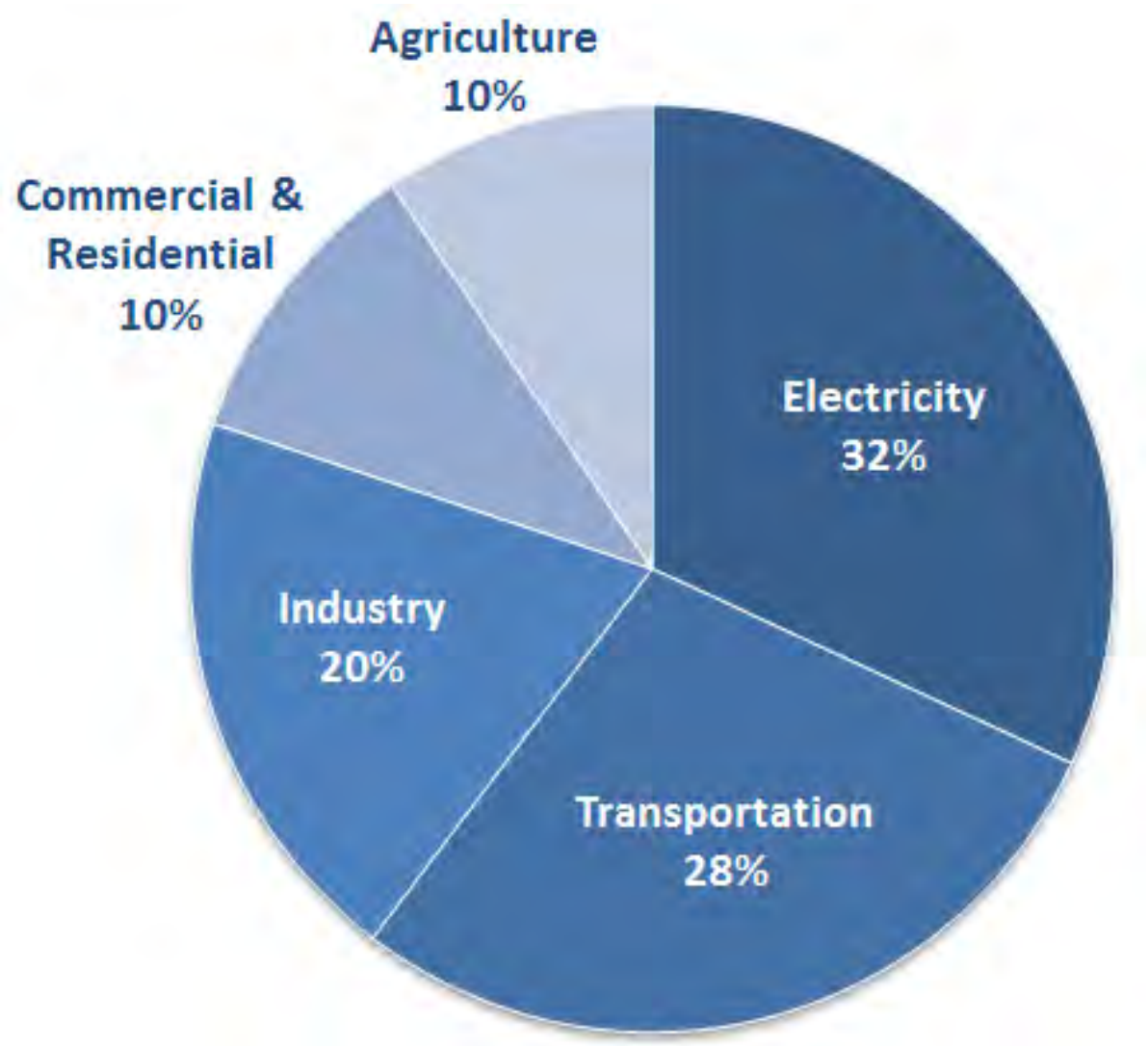

Figure 1

Types of Greenhouse Gases

The most common greenhouse gases include carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), and Fluorinated gases such as SF_6.

This section provides information on emissions and removals of the main greenhouse gases to and from the atmosphere.

- Carbon dioxide (CO_2) : Carbon dioxide enters the atmosphere through burning fossil fuels, solid waste, trees and wood products, and also as a result of certain chemical reactions. Carbon dioxide is removed from the atmosphere when it is absorbed by plants as part of the biological carbon cycle.

- Methane (CH_4) : Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills.

- Nitrous oxide (N_2O) : Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.

- Fluorinated gases : Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes.

See Figure 2 for the relative greenhouse gas potential of each of these gases.

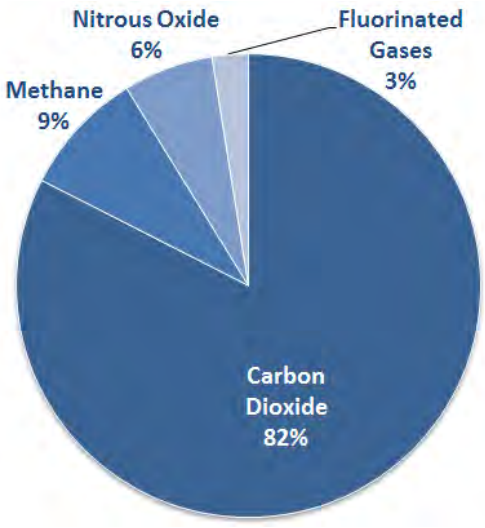

Figure 2

Each gas's effect on climate change depends on three main factors:

1. **How much** of these gases are in the atmosphere? The *concentration,* or *abundance*, is the amount of a particular gas in the air. Larger emissions of greenhouse gases lead to higher concentrations in the atmosphere. Greenhouse gas concentrations are measured in parts per million, parts per billion, and even parts per trillion.

2. **How long** do they stay in the atmosphere? Each of these gases can remain in the atmosphere for different amounts of time, ranging from a few years to thousands of years. All of these gases remain in the atmosphere long enough to become well mixed, meaning that the amount that is measured in the atmosphere is roughly the same all over the world, regardless of the source of the emission.

> **Global-warming potential** (GWP) is a relative measure of how much heat a greenhouse gas traps in the atmosphere. It compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a similar mass of carbon dioxide. A GWP is calculated over a specific time interval and is expressed as a factor of carbon dioxide (whose GWP is standardized to 1).

3. **How strongly** do they impact global temperatures? Some gases are more effective than others at making the planet warmer. For each greenhouse gas, a *Global Warming Potential* (GWP) has been calculated to reflect how long it remains in the atmosphere, on average, and how strongly it absorbs energy. Gases with a higher GWP absorb more energy, per pound, than gases with a lower GWP, and thus contribute more to warming Earth.

GHG Management Plan

This course is a guide to estimating and reducing a company's GHG emissions. It is based on the Environmental Protection Agency's (EPA's) "Guide for Greenhouse Gas Management for Small Business and Low Emitters". While the course presents an overview of how to inventory and calculate GHG gas emissions for businesses, the EPA has an excellent computer spreadsheet that makes the task very simple. The spreadsheet may be found at www.epa.gov.

The purpose of the tools presented in this course is to enable small businesses to:

- Create a comprehensive inventory of all GHG emissions;
- Develop an Inventory Management Plan (IMP) for data consistency over time; and
- Set a GHG reduction goal and track progress.

This course walks the user through the four key steps of developing a greenhouse gas management plan. Briefly, the steps include:

Step 1: Set base expectations.

This first step includes defining th… cussing the principles of greenhouse ga… ermining the organiz…

Step 2: Calcula…

In this ste… to identify ease emission …

Step 3: Create a…

This step i… developing and inventory m…

Step 4: Set a Goal

In this step … goals for managing a…

The course begins in Chapte… the GHG inventory methodology and how to calculate GHGs. Chapters 2, 3, and 4 show how to inventory and calculate the GHG impact of various sources. Chapter 5 explains how to develop an Inventory Management Plan (IMP). And finally, Chapter 6 brings it all together with a case study of a small manufacturing plant and shows an actual example of how to calculate GHG emissions.

The emissions values listed in this course are representative only and are based on 2008 data. For the most up to date data on emission values, visit www.EPA.gov.