

Climate Change, Greenhouse Gas Emissions and Alberta's Agriculture Industry



Bulletin #1

What is Climate Change?

The Earth's climate is constantly changing as a result of natural processes. The atmosphere has an effect like a greenhouse on the Earth's temperature. The energy from the sun reaching the Earth is balanced by the energy the Earth emits to space. Greenhouse gases (GHGs) trap some of the energy the Earth releases to space. The GHGs in the atmosphere act as a thermostat controlling the Earth's climate. Without this natural greenhouse effect, the average temperature on Earth would be -18°C instead of the current $+15^{\circ}\text{C}$. Therefore, life as we know it would be impossible.

The majority of the world's scientists studying this topic agree that the current rate of climate change is faster than at any time in the last 10,000 years because of human activity. Human activities affect GHG levels by introducing new sources of emissions or by removing natural sinks, such as forests. Sources are processes or activities that release GHGs; sinks are processes, activities or mechanisms that remove GHGs. The levels of GHGs are determined by a balance between sources and sinks.

Since the industrial revolution, concentrations of GHGs have been increasing steadily as a result of industrialization (increasing sources of emissions) and deforestation (declining sinks). Between 1970 and 2004, several key GHG emissions including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphurhexafluoride (SF_6) increased by 70 percent. The scientific evidence for this is very solid. In its fourth assessment report since 1990, the Intergovernmental Panel on Climate Change (IPCC) concluded that climate change is already happening and can be primarily attributed to human activity.

Global climate change will have substantial impacts on the environment including water resources, fisheries, forests, wildlife and ecosystems. Regional climate changes, particularly temperature increases, are already affecting different natural systems on all continents. Scientists also predict that climate change will increase climate variability; causing extreme weather events.



What are the Greenhouse Gases?

The major GHGs in our atmosphere are water vapor, CO₂, CH₄, HFCs, and N₂O. GHGs differ in their ability to absorb the radiation leaving the Earth. The ability of a gas to trap heat depends on its capacity to absorb and re-emit radiation and on how long the gas remains in the atmosphere.

In order to compare emissions from different sources, the global warming potential of each gas is compared to the global warming potential (GWP) of CO₂. For example, the GWP of one tonne of CH₄ is 21 times more potent than one tonne of CO₂ over a 100 year period (Table 1).

Table 1. Global Warming Potentials - Source IPCC, 1996¹

Greenhouse Gases	Relative Global Warming Potential in Carbon Dioxide Equivalents
CO ₂	1
CH ₄	21
N ₂ O	310

¹IPCC published the Global Warming Potentials for CH₄ and N₂O as 23 and 296 in 2001, and 25 and 298 in 2007; however the above GWPs are still used to be consistent with the National Accounting Frameworks.

Why Should We Be Paying Attention?

Canada and roughly 180 other countries adopted an international agreement in 1997 called the Kyoto Protocol which committed them to reduce GHG emissions that contribute to climate change. 2010 negotiations for global GHG reductions occurred in Copenhagen (Denmark). Canada pledged to take action and reduce GHGs on an industry-by-industry basis.

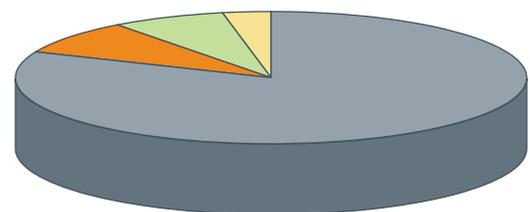
For example, regulations in the transportation industry have been put in place that require an average of 5 percent renewable fuel content in gasoline. These and other actions will assist Canada in reaching its goal to reduce GHG emissions to 17 percent below 2005 levels by 2020.

Attention to climate change has brought new focus to agriculture. Agriculture affects GHG levels and it is also vulnerable to the predicted impacts of climate change. The agricultural industry already has some tools such as direct seeding and other 'beneficial management practices' that can reduce GHG emissions or capture and store carbon in the soil.

Additionally, the agricultural industry will need to prepare for and adapt to climate change. For more information on adaptation to climate change in Alberta see others Bulletins this series entitled "Climate Change in Alberta" and "A Changing Climate for Agriculture - How Can We Prepare?"

Emissions from Agriculture in Canada

In Canada, the GHGs emitted by the various industry sectors are calculated and recorded annually in the National GHG Inventory. According to Environment Canada, agricultural emissions accounted for 62 megatonnes (Mt) or 8.4 percent of the total 2008 GHG emissions for Canada (Figure 1).



■ 81.3% Energy ■ 8.4% Agriculture ■ 7.2% Industrial Processes ■ 3.0% Other

Figure 1. Canada's Greenhouse Gas Emissions by Industry Sector for 2008 (in CO₂e).

In contrast, emissions from fossil fuel production, processing, transmission, and distribution within the energy industry in Canada accounts for about 81 percent of the total amount of GHG emitted. Although CO₂ is the major GHG emitted by other industries, agriculture mainly emits CH₄ from livestock enteric fermentation and N₂O from inorganic fertilizer and manure use. In 2008, the agricultural industry contributed about 70 percent of total



Canadian N_2O emissions and about 26 percent of total Canadian CH_4 emissions.

Of Canada's 2008 total GHG emissions from agriculture, 31.7 percent was emitted in Alberta (Figure 2).

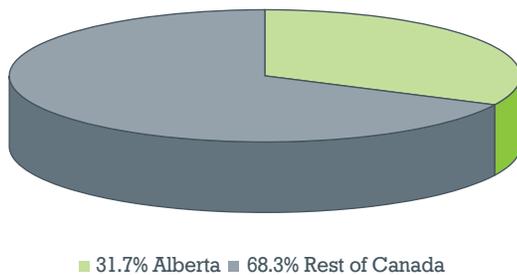


Figure 2. Canada's Greenhouse Gas Emissions from Agriculture for 2008.

Comparing Alberta's various industry sectors, the majority of Alberta's GHG emissions originate from the energy sector. In 2008, Alberta's agricultural industry accounted for approximately 8 percent of the province's total GHG emissions, while energy accounted for 85.6 percent, and industrial processes contributed 5.5 percent.

The three main sources of Alberta's GHG emissions from agriculture as reported for that same year were soils (44.5%), enteric fermentation (43.5%), and manure (11%) (Figure 3).

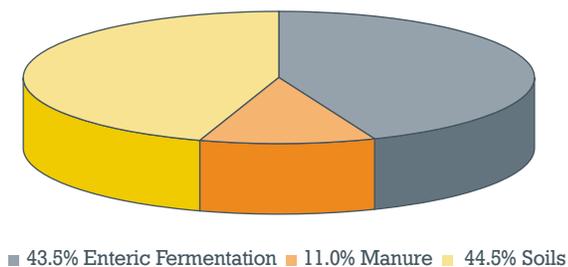


Figure 3. Alberta's GHG Emissions from Agriculture for 2008 by Source (in CO_2e).

Opportunities for Agriculture

Agriculture is in a unique position because of its ability to 'capture' atmospheric carbon in growing crops and storing a portion of that carbon in soil organic matter. This process is referred to as carbon sequestration or carbon storage. Agricultural soils can be a source (by emitting CO_2) or a sink (by storing CO_2) for CO_2 depending on soil management practices. As the Canadian Prairies occupy over 54 million acres of Canada's farmland, agriculture can make a significant contribution to meeting Canada's GHG reduction targets.

Beneficial management practices in the agricultural sector:

- **Reduce** emissions (improve feeding efficiency or manure management)
- **Remove** emissions (increase carbon in soils, pastures or trees)
- **Replace** fossil fuels (use renewable energy)

Conservation farming practices, such as direct seeding, and good fertilizer placement, have increased soil organic carbon levels helping to 'offset' GHG emissions and reduce the industry's net contribution. Reducing GHG emissions simply means that crops and livestock are raised more efficiently, thus reducing wasteful input losses.

Adoption of conservation practices will not only help to reduce GHG emissions but can also benefit water, soil and air quality. To view sector-specific strategies to reduce GHGs, see other Bulletins in this series.

The Government of Alberta passed legislation that ultimately created a market for carbon trading. Although Alberta is the first province in Canada to do so, other provincial governments and the federal government have indicated that they are developing offset systems that will be complimentary to Alberta's.



The agricultural industry has an opportunity to increase revenues by sequestering carbon and selling the emission removal credits (for more information see other Bulletins in this series). There are several agricultural management practices that qualify and protocols available that guide the quantification and verification of carbon sequestration to ensure commodity quality and standardization. See www.carbonoffsetsolutions.ca for more information.

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For more information contact Agriculture and Rural Development directly at (780) 310-FARM (3276) or Toll Free at 1 (866) 882-7677.

This document last updated: January, 2011

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