What is the Greenhouse Gas Contribution from Agriculture in Alberta?

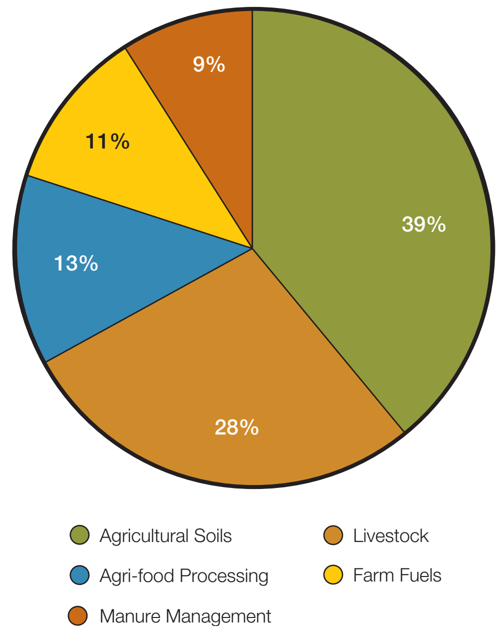
The most recent GHG inventory estimated that in 2002 nationwide, agricultural related GHG emissions contributed about 59,000 kt (kilotonnes) of carbon dioxide equivalents (CO_2e), which is about eight percent of Canada's total GHG emissions[1]. Of Alberta's total 2002 GHG emissions, the agricultural sector contributed about nine percent[1].

In 2003, Alberta Agriculture, Food and Rural Development (AAFRD) and the University of Alberta[2] completed the Alberta Agricultural GHG Assessment Emissions Inventory (Figure 2). From this report, total GHG emissions from the agriculture sector in Alberta were estimated to be 26.3 Mt (Megatonnes) CO_2e per year. In addition to emitting GHGs, agricultural soils along with pastures and rangelands in Alberta can sequester an estimated 5.9 Mt CO_2e and 23.4 Mt CO_2e per year, respectively. These large amounts of carbon sequestered by pasture and rangeland soils results in a net negative GHG emission estimate for Alberta's agriculture industry as a whole. The rate of carbon sequestration by these soils is expected to increase by 2008-2012 as more producers adopt sustainable management practices that reduce carbon losses associated with soil cultivation.

What Greenhouse Gases are Produced by the Livestock Sector in Alberta?

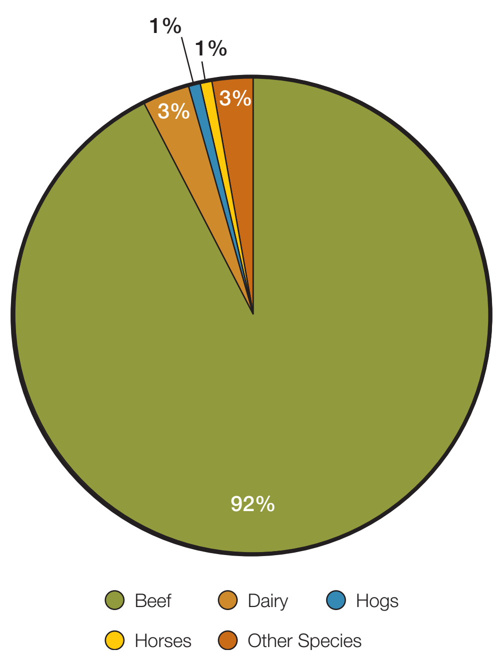
The main GHGs emitted by the livestock industry are methane (CH_4) from the digestive process (enteric fermentation) and methane and nitrous oxide (N_2O) from manure. Methane produced during digestion contributes an estimated 7.4 Mt CO_2e per year, approximately three percent of Alberta's total GHG emissions. The large methane contribution may be attributed to the fact that beef cattle make up the largest portion of livestock in Alberta, producing about 92 percent of the provincial livestock sector's GHG emissions (Figure 3). This compares with GHG emissions from manure management, which contributes 2.4 Mt CO_2e per year. Because GHG emissions from all livestock represent a loss of costly feed energy and nutrient inputs, the livestock industry has an economic stake in reducing its GHG emissions.

Figure 2 – Percent Contribution of GHG Emissions from Alberta's Agricultural Sector



Source: Alberta Agriculture, Food and Rural Development and University of Alberta 2003[2]

Figure 3 – Percent Contribution of 2001 GHG Emissions from Alberta's Livestock Sector



Source: Alberta Agriculture, Food and Rural Development and University of Alberta 2003[2]

How Can the Pork Sector Help to Address Greenhouse Gas Emissions?

In general, implementing management practices can reduce total GHG emissions for the agricultural sector by:

- Reducing emissions through management practices such as improved feeding efficiency or manure management;
- Removing emissions through management practices that increase carbon in soils, pastures, and trees; and
- Replacing fossil fuels with renewable energy

The majority of methane and nitrous oxide from pork operations come from buildings, manure storage, and land application of manure[3]. The GHG emissions produced by the Alberta swine industry in 2002 amounted to approximately 733 kt of CO_2e, of which methane accounted for more than 50 percent[4]. This contributes about one percent of Alberta's total GHG emissions (Figure 3). Although the GHG emissions estimated by the swine industry are not substantial in comparison with other industries in Alberta, they are large enough to consider options to reduce them[4]. Experts estimate that the swine industry in Alberta could reduce GHG emissions by as much as 300 kt of CO_2e annually[4].

Credit: Alberta Agriculture, Food and Rural Development

Research is ongoing as how to best reduce GHG emissions in many aspects of hog operations. In the meantime, a number of common sense approaches exist to improve production efficiency which minimizes GHG emissions produced by hog operations. One key method in reducing GHG emissions is to formulate diets to match nutritional requirements as much as possible. This helps minimize excess feed protein lost as manure nitrogen and reduces the amount of nitrogen added to the atmosphere as nitrous oxide.

Did You Know These Terms?

Anthropogenic
An action or activity caused by humans.

Carbon Dioxide Equivalent (CO_2e)
Is a universal standard of measurement against which the impact of different GHGs in the atmosphere can be evaluated. It is calculated using the global warming potential (GWP), which is a measurement of how much heat is retained by the Earth's ecosystem through the addition of a particular gas to the atmosphere. Nitrous oxide (N_2O) and methane (CH_4) are 310 and 21 times more powerful, respectively, than carbon dioxide (CO_2) at trapping heat in the atmosphere.

Carbon Sequestration
The uptake and storage of carbon. Trees and plants, for example, absorb carbon dioxide, release the oxygen, and store the carbon through photosynthesis.

Climate
The average weather for a specific region and time period (usually for 30 years). Elements of climate include temperature, precipitation, sunshine, humidity, and wind velocity.

Climate Change
A slow change in the composition of the global atmosphere, which is thought to be caused directly and indirectly by various human activities that is in addition to natural climate variability over time.

Denitrification
A process, that occurs in the absence of oxygen, where nitrate (NO_3) is converted to nitrous oxide gas, a potent GHG and to dinitrogen gas (N_2).

Feed Efficiency (FE)
Is the relative amount of feed per unit of live weight gain for an animal.

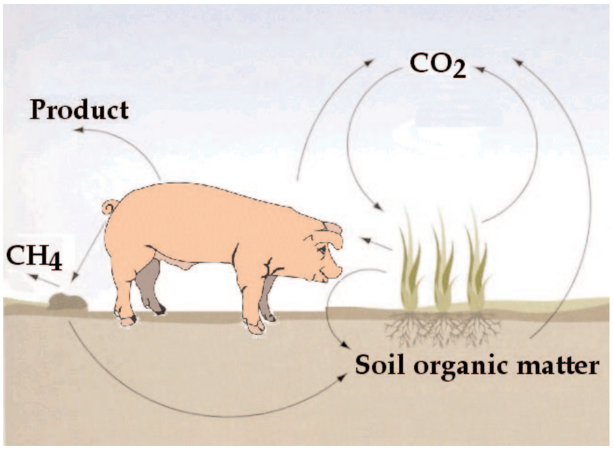
Global Warming
An average increase in the earth's atmospheric temperature, caused by increasing levels of atmospheric GHGs trapping more and more of the sun's heat energy in the atmosphere as it is reflected off of the earth's surface.

Global Warming Potential
The relative potential of a specific GHG to trap the sun's heat energy in the earth's atmosphere relative to carbon dioxide. The global warming potentials of CH_4 and N_2O are 21 and 310, respectively.

Greenhouse Gases (GHGs)
Are gases that trap the sun's heat in the atmosphere, preventing its release into space, thus creating a warming effect on the surface of the earth. While GHGs such as water vapour, carbon dioxide, nitrous oxide, and methane occur naturally, human activities increase the levels of these gases and are responsible for creating new ones (e.g. hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride).

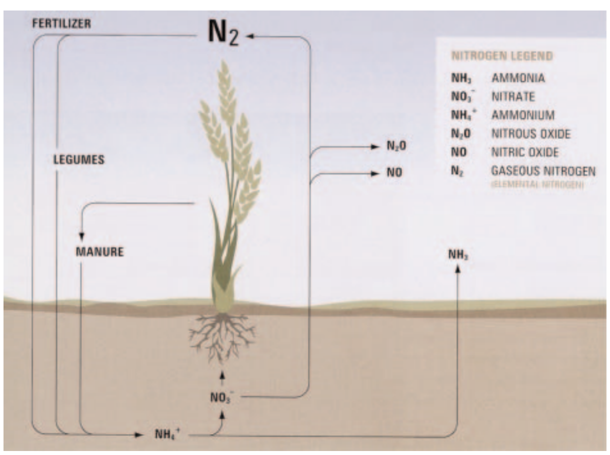
- ***Carbon Dioxide (CO_2)***
  The most common GHG which is produced from respiration (Figure 4) and when any carbon-containing compound is burned. Its atmospheric levels have increased by 30 percent above levels known to exist before the industrial revolution[1].
- ***Methane (CH_4)***
  A GHG produced by bacteria when organic matter decomposes in the absence of oxygen (anaerobic). Some of the main sources of methane include wetlands, digestion of livestock feed (Figure 4), and fossil fuel extraction. Methane is 21 times more potent a GHG than CO_2 and its atmospheric levels have increased by 145 percent above pre-industrial levels[1].
- ***Nitrous Oxide (N_2O)***
  A GHG produced naturally in soils and water without the presence of oxygen through incomplete denitrification (Figure 5). Humans contribute to nitrous oxide through the application of nitrogen fertilizers and manure. Nitrous oxide is 310 times more potent a GHG than CO_2. Its atmospheric levels have increased by 17 percent above pre-industrial levels[1].

Figure 4 – The Carbon Cycle



Credit: Adapted from: Figure 9 in Janzen, H.H., Desjardins, R.L., Asselin, J.M.R., and Grace B. (eds). 1999. The Health of Our Air: Toward Sustainable Agriculture in Canada. Agriculture and Agri-Food Canada, Publication 1981/E. Reproduced with the permission of the Minister of Public Works and Government Services Canada, 2005.

Figure 5 – The Nitrogen Cycle



Credit: Adapted from: Figure 21 in Janzen, H.H., Desjardins, R.L., Asselin, J.M.R., and Grace B. (eds). 1999. The Health of Our Air: Toward Sustainable Agriculture in Canada. Agriculture and Agri-Food Canada, Publication 1981/E. Reproduced with the permission of the Minister of Public Works and Government Services Canada, 2005.

Greenhouse Effect

The warming of the Earth's atmosphere caused by the presence of GHGs in the atmosphere that trap the sun's heat energy. This effect is responsible for maintaining the Earth's surface at a temperature that makes it habitable for life as we know it. However, the concentrations of GHGs in the atmosphere are increasing and as such, they are preventing more heat from escaping which means the earth slowly heats up. This is called the enhanced greenhouse effect – which causes global warming and it is changing our climate.

Offsets

GHG reductions and/or removals arising from an eligible management practice that a producer has implemented.

Removal

The process of removing GHGs from the atmosphere by sinks. For example, planting tree shelterbelts would remove some carbon dioxide out of the atmosphere by storing it in the trees.

Sinks

A process that removes GHGs from the atmosphere, either by destroying them through chemical processes or storing them in another form. As an example, carbon dioxide is often stored in ocean water, plants or soils.

Sources

Any process or mechanism, which release GHGs in the atmosphere; the opposite of sinks.

Weather

State of the atmosphere with respect to temperature, moisture, sunshine, and wind velocity for a certain period of time at a specific location.

Volatilization

Process where a substance is converted from liquid to a gaseous state. For example, nitrogen exists in the liquid ammonium (NH_4^+) form in liquid hog manure but can be given off, or volatilized, as ammonia gas (NH_3) when liquid manure is surface applied.

how to use this booklet

This booklet provides information on different management strategies associated with the reduction and removal of GHGs from the atmosphere. Reducing an agricultural operation's GHG production can help to reduce its environmental footprint, improve production efficiencies, and may offer a return on investment. The following table allows a producer to evaluate different management practices that could be implemented on an agricultural operation and also provides references for additional sources of information. Many such practices are already in use on Canadian hog operations, however under the guise of improving production efficiencies. It is important to note that while improving production efficiency, these practices also have a positive impact on reducing agricultural GHG emissions.

Table 1 – Management Practices that Reduce Greenhouse Gases and/or Sequester Carbon

Put a check (✓) in the box that best reflects your management strategy.

Description of Management Practice	Is this a Current Practice?	Is this Worth Considering?	Is this not Feasible?	For more Information see
Herd Health • Use genetic selection to improve nutrient utilization and feed conversion				***Section 1*** Page 10
Feed Management • Feed reduced protein diets, balanced with amino acids				***Section 2*** Page 11
• Include phytase enzymes in feed rations				Page 13
• Phase feeding				Page 14
• Split-sex feeding				Page 15
• Move to wet/dry feeding systems				Page 15
Barn Management • Maintain efficient operation of barn climate control systems and components				***Section 3*** Page 16
Manure Handling and Storage Management • Manure storage cover systems				***Section 4*** Page 17
• Anaerobic biodigestor technology				Page 19
• Compost manure				Page 20
• Manure storage and the barn				Page 20
Manure Application Management • Analyze both manure and soil prior to application				***Section 5*** Page 21
• Apply manure rates that match crop nutrient requirements				Page 21
• Apply manure to cropland in spring, or in-crop, rather than in fall				Page 22
• Inject manure to minimize ammonia nitrogen losses				Page 22
Controlling Odours and GHGs • Use shelterbelts and natural windbreaks to disperse odours and sequester carbon				***Section 6*** Page 23