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Canada's Independent Agri-Food Think Tank

Emissions Trading in Agriculture: A Canadian Perspective

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EXECUTIVE SUMMARY

The Australian agricultural industry is proposing the introduction of a national emissions trading scheme in 2010 (Keogh, 2007). This proposed emissions trading system is expected to present potential challenges and opportunities for Australian farmers and the wider agriculture sector (Keogh, 2007). To prepare for these challenges, the Australian Farm Institute hosted an Agriculture and Emissions Trading Summit in Queensland, Australia, on April 21st and 22nd, 2008. The George Morris Centre was invited to participate in this summit by presenting an overview of the current status of Canadian emissions trading developments and the corresponding response of the Canadian agricultural sector. This paper complements the Summit presentation.

The purpose of this paper is to provide a comprehensive overview of the current status of Canada's commitment to greenhouse gas emission reductions, with specific focus on the role of emissions trading and agriculture in meeting this commitment. To fulfill this purpose, the paper includes a discussion of the "Made in Canada" approach to Canada's Kyoto commitment and the current emissions status in Canada. It also presents the status of emissions trading in Canada, including the domestic offset market, other emissions trading systems and the implications for agriculture. The paper concludes with a summary, conclusions and next steps for Canada in terms of emissions trading.

Currently, the Canadian federal government is developing a "Made in Canada" approach to address climate change, which will not meet Canada's Kyoto commitment (a 6% reduction in greenhouse gases below 1990 levels by 2012). Under the new approach, agriculture is expected to play a significant role in biological sink offsets. However, since agricultural producer participation in domestic offset markets will be voluntary, the success of emissions trading in Canada is heavily dependent on the level of agricultural producer participation.

The idea of trading appears to be widely accepted within the agricultural sector. However, despite this apparent willingness, the speculation is that participation by agricultural producers in emissions trading will be limited due to unresolved issues creating disincentives for producers. These issues include lengthy liability periods that impose uncertainty, high costs of supply relative to trading prices, and, potentially, high transaction costs. The issue of liability is a particularly large deterrent. Furthermore, pilot projects (section 3.1) have identified the provision of certainty for market participants as a key factor in successful emissions reduction systems.

To improve the probability of success of emissions trading in Canada, other actions need to be considered. The system, as proposed, may not induce agricultural producer participation, even though the non-permanence of greenhouse gas removal for the offset system rests predominantly on carbon sinks associated with agriculture. Therefore, design alternations, taking into account lessons learned through current emissions trading systems and pilot projects, are required. The primary change to the proposed design is the length of liability faced by producers. A shorter contract period, although not as effective in terms of carbon sequestration, will reduce uncertainty for producers, significantly increasing levels of participation. Although temporary offsets attempt to address this issue in part, it is not clear whether buyers of offsets will purchase

temporary credits, as it has been suggested that buyers want more stable and long-terms credits.

Another key barrier to producer participation is the high cost of implementing appropriate practices, relative to trading prices. Technological innovation in production practice implementation would greatly reduce this barrier. Although this issue is not easily addressed in a short period of time, investment in technological innovation may benefit emissions trading in Canada in the long run. Finally, although transaction costs are not currently an obvious deterrent to emissions trading, they contribute to the overall cost of supply faced by producers. Therefore, their reduction is a tangible and more immediate step to encouraging a successful emissions trading market.

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1. Introduction and Background

Climate change is a significant environmental problem and a unique challenge for industries, governments and individuals alike. Global economies are rising to the challenge, determining ways to reduce greenhouse gases (GHG) and placing significant attention on the development of emissions trading markets (i.e. carbon markets[1]). Within these markets, the agricultural sector has been identified as a means to provide biological carbon sinks[2] to offset current emissions.

The World Bank estimates that the world market for carbon amounts to about $100 billion (as cited by Mondovisione, 2008). Trading activity on public carbon markets has grown rapidly in recent years to reach US$30 billion in 2006 (Mondovisione, 2008). Furthermore, recent estimated figures from market participants show that the global carbon market activity was worth more than US$60 billion in 2007 (Mondovisione, 2008).

In 2000, the Intergovernmental Panel on Climate Change assessed criticisms on carbon sinks and determined that the ability of forests and agriculture to remove CO_2 from the atmosphere was backed by sound science and that the technology exists to measure and monitor the amount of CO_2 sequestered[3]. As a result, countries can now earn unlimited 'greenhouse gas reductions' (carbon credits) from forest and agricultural soil management practices to enhance carbon sinks, i.e., through no tillage or conservation tillage practices. Therefore, agriculture is in a unique position to offer emissions reductions to help meet global reduction targets around the world.

Haugen-Kozyra of Climate Change Central[4] (2008b) has explained the basis for the growing global interest in carbon and, ultimately, a carbon trading market. The following paragraphs, particularly relevant to this discussion, are an excerpt from her report summarizing the Carbon Forum America conference on carbon markets, held in San Francisco on February 26th & 27th, 2008.

"The global trade in carbon is growing exponentially and is driving a transformation in business practice and performance reporting around the world. Witness the trends in:

(1) Corporate social responsibility (CSR) initiatives in businesses and corporations focussed around carbon[5];
(2) Ballooning clean low-carbon or green technology development movements; and
(3) Consumer-based retail and wholesale carbon offset programs.

By way of example, every year a global group of Institutional Investors representing $51 trillion of management assets, demand carbon disclosure and reporting from over 3500

[1] Carbon – the market term for carbon dioxide equivalents – the common metric for Greenhouse Gas trading units in carbon markets around the world (Haugen-Kozyra, 2008b).
[2] Sink is any process, activity or mechanism that removes a greenhouse gas from the atmosphere (Government of Canada, 2008b).
[3] The process of increasing the carbon stored in a reservoir other than the atmosphere (Government of Canada, 2008b).
[4] Climate Change Central is a public-private not-for-profit organization which works to find effective ways to manage climate change challenges in Alberta.
[5] Witness the new Executive term – CSO or Corporate Sustainability Officer.

of the world's largest companies. This is known as the Carbon Disclosure Project[6], and the 'carbon performance' of these companies is made publicly available to influence shareholders, accountants, policy-makers, marketers and other investors.

At the corporate and governance level, we've seen significant movements this past year:

- *Carbon accounting principles have been incorporated into standard business accounting practices by Chartered Accountants in both the US and Canada in 2005;*
- *WalMart is driving GHG reductions down its supply chain by setting targets for transportation and products from major suppliers;*
- *Consumer programs for offsets by Westjet, Air Canada, and Alamo-Enterprise-National car rental agencies were announced in 2007.*
- *Three Wall Street banks – JP Morgan-Chase, Morgan Stanley and Citibank – set carbon principles for loaning money to electrical utility companies, essentially barring new developments in conventional coal-based electricity plants, unless they meet GHG production targets.*
- *Prime Minister Gordon Brown brings in a nation-wide initiative that sets a cap on allowable carbon costs for all government procurement programs in the UK;*
- *A US federal law brought into force in December 2007 bars the US military and postal service – the largest consumers of Alberta-derived gasoline and diesel in the US – from using fuel derived from non-conventional sources (i.e., oil sands) unless they meet the GHG footprint of conventional sources.*
- *HSBC and Toronto Dominion banks set targets for becoming carbon neutral in less than 10 years. The list goes on."*

The Carbon Forum America conference identified three emerging carbon markets (Haugen-Kozyra, 2008b):

(1) **Compliance-based** – typically involving facilities with high emissions that have a GHG regulatory backstop or reduction targets and need to buy offsets as part of their compliance strategy (e.g. more than 100 Alberta facilities equalling a demand of over 20 million tonnes of carbon per year). These markets can trade permits, offsets, or both, depending on the rules of the program;

(2) **Voluntary-based** – driven by corporate social responsibility initiatives, shareholder/investor concerns, or a desire to learn about carbon markets in a pre-compliance setting. This may involve large corporations or businesses (e.g. Chicago Climate Exchange). Typically, these markets trade project-based offsets; and,

(3) **A Growing Retail/Wholesale Market** – a host of market providers are beginning to offer carbon neutral products to consumers ranging from electricity and natural gas products, airline flights, car rental experiences and even emerging carbon-branded food products. These are typically project-based offsets.

The domestic offset market proposed for Canada is compliance-based, with voluntary participation. Within this proposed carbon market, agriculture will play a central role in emissions reduction, through the daily activities of farmers and ranchers including: capturing and storing carbon through photosynthesis; managing carbon, nitrogen and

[6] http://www.cdproject.net/

methane cycles in livestock and crop growth; producing renewable carbon neutral energy; and substituting bio-based feedstocks for traditional petroleum-based ones to create low-carbon opportunities to meet growing economic demands (Haugen-Kozyra, 2008b).

1.1 Purpose

The Australian agricultural industry is proposing the introduction of a national emissions trading scheme in 2010 (Keogh, 2007). This proposed emissions trading system is expected to present potential challenges and opportunities for Australian farmers and the wider agriculture sector (Keogh, 2007). To prepare for these challenges, the Australian Farm Institute hosted an Agriculture and Emissions Trading Summit in Queensland, Australia, on April 21st and 22nd, 2008. The George Morris Centre was invited to participate in this summit by presenting an overview of the current status of Canadian emissions trading developments and the corresponding response of the Canadian agricultural sector. This paper complements the Summit presentation.

The purpose of this paper is to provide a comprehensive overview of the current status of Canada's commitment to greenhouse gas emission reductions, with specific focus on the role of emissions trading and agriculture in meeting this commitment.

The following questions on the Canadian emissions trading system were provided by the Australian Farm Institute and guided the objectives for this paper:

- What is Canada's Kyoto Protocol commitment?
- What is the Canadian government's action to reduce emissions?
- What is Canadian agriculture's position on greenhouse gas emissions reductions?
- How important is agriculture in terms of national emissions?
    - What role will the sector play in meeting emission reduction targets, or in providing offsets?
- What is Canadian agriculture's response to current policy and on-the-ground action?
    - Does the sector agree with current policies?
    - What role does agriculture consider it should play, and what progress has been made in achieving changes if desired?
- In terms of offsets and emission reduction:
    - What on-farm actions (i.e., management practices) are recognized, and to what extent have such actions been undertaken? Is it all voluntary, and are non-permanent offsets recognized in official 'trading schemes'?
- The future:
    - What are the likely policy developments at the national and provincial level? Is there likely to be one system in Canada, or Province-based systems? Will an Emissions Trading Scheme operate at a national level? Will the farm sector be required to be direct participants?

1.2 Outline

To answer these questions, this paper is organized as follows. Section 2 is a discussion of Canada's approach to its Kyoto commitment and the current emissions status in the country. Section 3 presents the status of emissions trading in Canada, including the domestic offset market, other emissions trading systems and the implications for agriculture. Finally, section 4 includes a summary, conclusions and next steps for Canada in terms of emissions trading.

2. The Kyoto Protocol and Greenhouse Gas Emissions in Canada

This section reviews Canada's Kyoto Protocol commitment, the current status (through to 2005) of Canada's CO_2 emissions and emissions projections to 2020. The Harper[7] government's alternative proposal to meeting Canada's Kyoto commitment is also discussed. The section concludes with agriculture's contribution to carbon emissions and Canadian agriculture's role in emissions reductions.

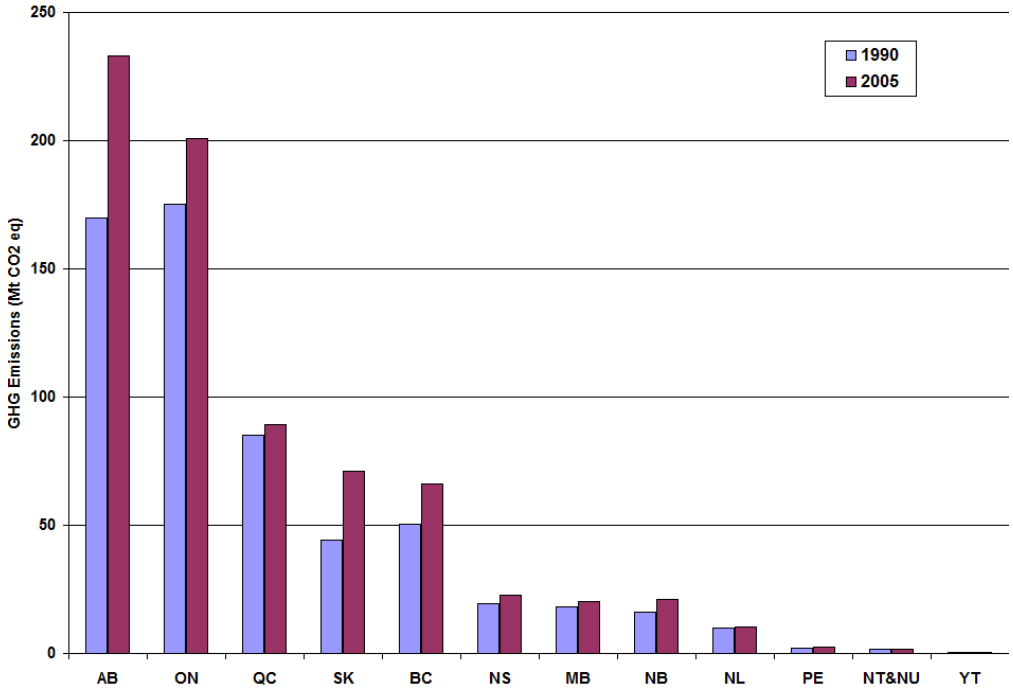
2.1 Canada's Kyoto Commitment

Under the Kyoto Protocol, the greenhouse gas reduction target for Canada is 6% below[8] 1990 levels[9] (refer to Figure 1 below for an illustration of 1990 emissions levels by province). The implication of this target is that the average emission reduction during the commitment period 2008 to 2012 must equate to 6% less than 1990 levels.

Jean Chrétien[10] and the Canadian federal government ratified the protocol under the premise that the provincial governments would implement the changes necessary to meet its target. However, this became particularly contentious for the provinces of Alberta and Ontario, the two highest emitters of greenhouse gases in Canada (refer to Figure 1 below).

[7] Current Canadian Prime Minister.
[8] Equates to 563 Mt CO_2 equivalent (Environment Canada, 2007a)
[9] 1990 levels were estimated at 596 Mt CO_2 equivalent (Environment Canada, 2007a)
[10] Canadian Prime Minister when the Kyoto Protocol was ratified (in power from 1993 until 2003).

Figure 1 Provincial Greenhouse Gas Emissions, 1990 and 2005

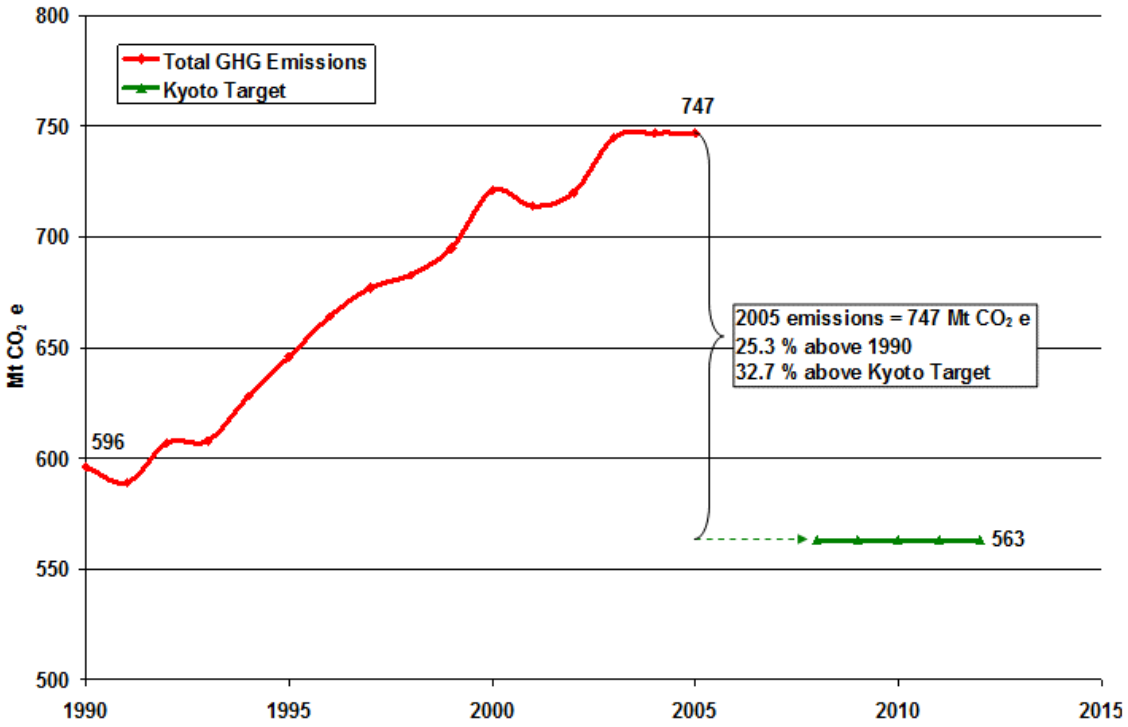


Source: (Environment Canada, 2007a)

2.2 Canada's Current Emissions Status

According to Environment Canada's most recent national inventory (2005), Canada's GHG emissions are 25.3% above 1990 levels, or 32.7% above Canada's legal commitment under the Kyoto Protocol (Environment Canada, 2007a). Figure 2 below is a graphical representation of the changes in greenhouse gas emissions in relation to Canada's Kyoto target.

Figure 2 Canada's Greenhouse Gas Emissions, 1990-2005



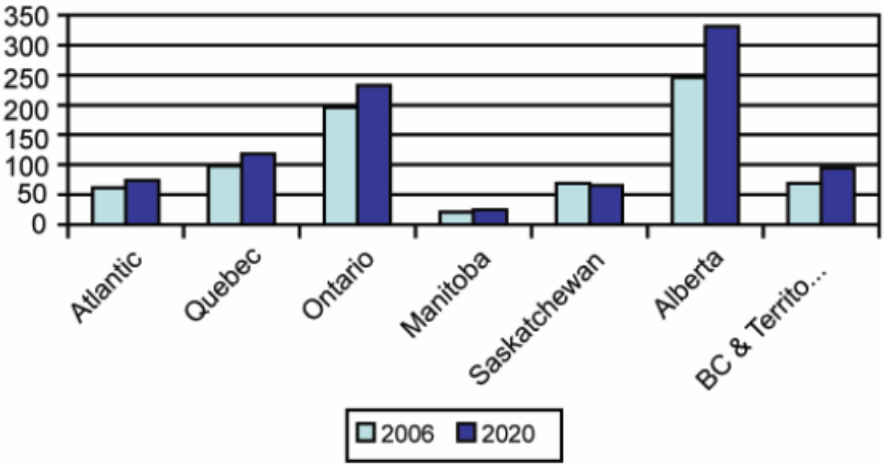
Source: (Environment Canada, 2007a)

The Government of Canada released its reference baseline emissions projections to 2020 in March 2008. According to these projections, total greenhouse gas emissions are expected to reach 820 megatonnes (Mt[11]) of CO_2 equivalent by 2010, 880 by 2015 and 937 by 2020, assuming business as usual (Government of Canada, 2008a). The projections, which take into account key macroeconomic indicators (e.g., GDP, etc), energy demand, energy prices, and energy production, were used to define emissions level reductions needed to meet the federal goals described in the "Made in Canada" approach below.

A review of individual provinces revealed that, although GHG emissions are expected to increase for most provinces, Alberta and Ontario are expected to contribute to more than half of the overall increase in national emissions (Government of Canada, 2008a). The provincial projections are illustrated in Figure 3 below.

[11] Mega = 10^6. Therefore, megatonnes implies million tonnes.

Figure 3 Projected Provincial Greenhouse Gas Emissions, 2006 and 2020



Source: (Government of Canada, 2008c)

2.2.1 A "Made-in-Canada" Approach to Climate Change

As a result of the provincial contentiousness of the Kyoto protocol (discussed above), Stephen Harper (Canada's current Prime Minister since 2006) has backed away from Canada's commitment to the Kyoto Protocol and meeting the nation's targets. In late 2006, Harper's Minister of Environment unveiled a new "made-in-Canada" proposal to be implemented in lieu of the Kyoto Protocol: *Canada's Clean Air Act (Bill C-30)*.

The *Clean Air Act* proposes to reduce greenhouse emissions by 60-70% of 2006 levels by 2050 (Government of Canada, 2007b). However, the *Act* has been highly criticized, as it ignores Kyoto targets. Currently, Canada's Kyoto targets appear near impossible to obtain, while the *Clean Air Act* targets for 2050 appear to be too modest in comparison. The fulfillment of emissions targets mandated by the *Act* would result in Kyoto targets being met several decades after the international obligations.

The new federal approach sets out emissions intensity targets, which specify that "existing" facilities must make a 6% improvement each year from 2007 to 2010, fulfilling an enforceable 18% reduction from 2006 emission intensity by 2010, and a 2% annual improvement thereafter. New facilities will have a three year grace period, clean fuel standards and 2% annual improvement obligation (Government of Canada, 2007b).

The regulations also outline mid and longer term objectives, with an ultimate goal of a 60-70% reduction below 2006 levels of GHG emissions by 2050 (refer to Table 1). It should be noted that primary agriculture is not included in the federal approach for emissions reduction, as the regulatory framework focuses primarily on industrial[12]

[12] The regulations will mandate reductions in emissions of greenhouse gases and air pollutants from the following industrial sectors: electricity generation produced by combustion, oil and gas

reductions. However, to achieve this reduction target, the federal government has proposed an emission offset system for greenhouse gases, which will use domestic offset credits. Agriculture management practices are identified as part of the reduction solution (described in more detail in Section 3 below).

Table 1 Federal Greenhouse Gas Emission Reduction Targets

	GHG Emission Reduction Targets			
	Short-term (pre 2020)	**Mid-term (2020)**	**Long-term (2050)**	**Legislation**
Federal Government	Emissions intensity targets (as described in paragraph above)	20% below 2006 levels by 2020 (~3% above 1990 levels)	60-70% below 2006 levels	http://www.ec.gc.ca/doc/media/m_124/report_eng.pdf

Source: (Taylor and MacSkimming, 2007)

However, *Canada's Clean Air Act* has been tabled by the House of Commons since March 30, 2007 (Parliament of Canada, 2007); the *Act* must pass three readings in the House of Commons and three readings in the Senate to receive Royal Assent. Currently, *Canada's Clean Air Act* has only passed the first reading in the House of Commons (Parliament of Canada, 2007). This delay has stalled some of the proposed emissions trading initiatives for Canada (as described in the next section).

Despite the new "made-in-Canada" federal approach, many provinces are still dedicated to meeting the 6% reduction targets from 1990 emission levels. Appendix A illustrates the various provincial initiatives and the corresponding reduction targets set out by the individual provinces. Although all the provinces have established an emissions reduction target, Manitoba, New Brunswick, Quebec, Prince Edward Island and Newfoundland/Labrador are among the provinces that still intend to meet the Kyoto emissions reduction target by 2012.

2.2.2 Putting Canada's Agriculture Emissions into Context

Greenhouse gas emissions from agricultural sources include methane (CH_4) and nitrous oxide (N_2O) emissions from animal production, namely, enteric fermentation[13] (CH4) and manure management[14] (N_2O[15] and CH_4), as well as N_2O released from agricultural

(including upstream oil and gas, downstream petroleum, oil sands, and natural gas pipelines), forest products (including pulp and paper and wood products), smelting and refining (including aluminum, alumina, and base metal smelting), iron and steel, iron ore pelletizing, potash, cement, lime, and chemicals production, including fertilizers (Government of Canada, 2007b).

[13] Environment Canada (2007a) defines enteric fermentation as follows, "*During the normal digestive process, microorganisms break down carbohydrates into simple molecules for absorption, where CH4 is produced as a by-product. This process results in CH4 in the rumen, which is emitted by eructation and exhalation. Some CH4 is released later in the digestive process by flatulation. Ruminant animals, such as cattle, generate the most CH4.*" The data value for CH4 represents: dairy, beef and other.

[14] Environment Canada (2007a) defines manure management as follows: "*Shortly after manure is excreted, it begins to decompose. If little oxygen is present, the decomposition is mainly anaerobic and thus produces CH4. The quantity of CH4 produced depends on the manure characteristics linked to animal types and diets and on the type of waste management system—in*

soils[16] (Environment Canada, 2007a). Carbon dioxide emissions from cropland are also relevant, but calculated separately under land use.

Total GHG emissions from the Canadian agriculture sector were 46 megatonnes in 1990[17] (7.7% of total emissions), but have since increased to 57 Mt in 2005 (the most recent inventory of data) (Environment Canada, 2007a). The 10.8 Mt (24%) increase between 1990 and 2005 was primarily the result of expansion in the beef cattle, swine, and poultry industries, as well as an increase in synthetic nitrogen fertilizer application in the Prairie provinces (Environment Canada, 2007a). This increase contributed the equivalent of 7.2% to the overall national increase in greenhouse gas emissions between 1990 and 2005 (Environment Canada, 2007a). Interestingly, however, the 2005 proportion of total emissions attributable to agriculture was comparable to the 1990 proportion (i.e., 7.6% versus 7.7% of total emissions in 2005 and 1990, respectively).

Table 2 below presents the distribution of source and sink greenhouse gas emissions in agriculture in both 1990 and 2005 (note that forestry is incorporated as one of the sink categories in the table).

particular, how well it is aerated." The data value for manure management represents: Dairy, beef, poultry, swine and other for CH4 emissions

[15] Environment Canada (2007a) defines N_20 as follows, "*The production of N_2O during storage and treatment of animal waste occurs during nitrification and denitrification of nitrogen contained in the manure. Nitrification is the oxidation of ammonium (NH4+) to nitrate (NO3−), and denitrification is the reduction of NO3− to N2O or N2. In general, the amount of N2O produced increases with greater aeration of the waste."* The data value for all animal types was used for N20 emissions.

[16] Environment Canada (2007a) defines soil N_20 emissions as follow: "*Emissions of N2O from agricultural soils consist of direct and indirect emissions as well as emissions from manure on pasture, range, and paddock. Direct sources are emissions from nitrogen that has entered the soil from synthetic fertilizers, animal manure applied as fertilizer, crop residue decomposition, and modification by tillage practices. Other direct sources include summer fallow, irrigation, and cultivation of histosols. Indirect sources are emitted off-site through volatilization and leaching of synthetic fertilizer, manure, and crop residue nitrogen*."

[17] This proportion of emissions does not include energy-related emissions (e.g., heating of buildings, fuel consumption of tractors, etc.), which are counted in other categories.

Table 2 Greenhouse Gas Emissions for Source and Sink Categories of Agriculture, 1990 and 2005

GHG Source/Sink Categories		GHG Emissions (Mt CO_2 eq)		
		1990	2005	% Change*
AGRICULTURE		46	57	23.6%
a.	Enteric Fermentation	18	25	33.4%
b.	Manure Management	7	9	28.6%
c.	Agriculture Soils	21	23	13.4%
LAND USE, LAND-USE CHANGE AND FORESTRY		-120	-17	-86.0%
a.	Forest Land	-150	-27	-82.0%
b.	Cropland	14	0.52	-96.4%
c.	Grassland	N/A	N/A	N/A
d.	Wetlands	5	2	-68.5%
e.	Settlements	9	8	-12.5%

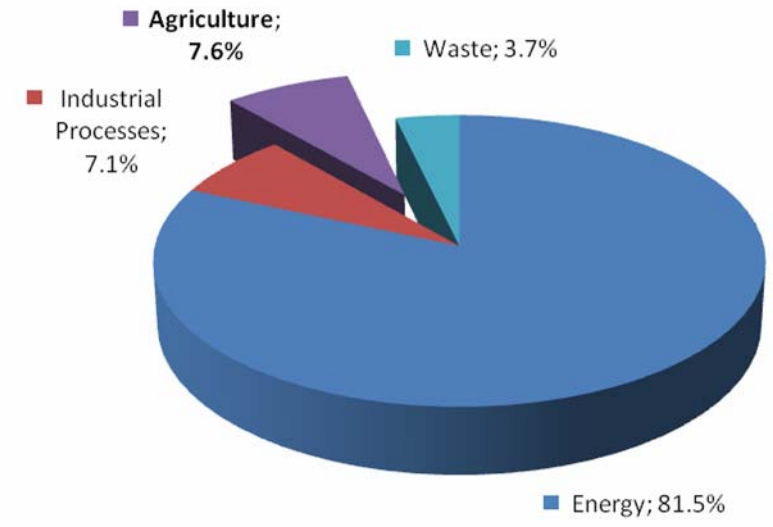
* From 1990 to 2005

Source: (Environment Canada, 2007a)

The Government of Canada projects that agriculture emissions will increase to 68.2 megatonnes of CO_2 equivalent by 2010, 72.5 by 2015 and 77.3 megatonnes by 2020 (Government of Canada, 2008a).

Figure 4 below presents the proportion of total emissions by industry in 2005. As the figure shows, agriculture does not contribute a significant portion of greenhouse gas emissions when compared to the energy sector (7.6% versus 81.5%).

Figure 4 Canada's Greenhouse Gas Emissions by Industry, 2005



Source: (Environment Canada, 2007a)

2.2.3 Agriculture's Role in Emissions Reductions

As discussed above, Canadian agriculture is not a substantial contributor of greenhouse gas emissions as compared to other sectors. The agriculture sector is not regulated under the Climate Change Plan and reducing GHG emissions in agriculture is voluntary (AAFC, 2005). However, the agricultural sector is in a unique position, as it has the capability to reduce greenhouse gas emissions through biological carbon sinks (i.e., sequestration). Canadian agriculture's role in meeting emissions reduction targets is primarily through the use of beneficial management practices on the farm and/or in providing offset credits. The role of the agricultural sector is described in more detail in the following sections.

3. Status of Emissions Trading in Canada and Implications for Agriculture

This section reviews the current status of emissions trading in Canada and discusses Canadian agriculture's role in the provision of offset credits. The section concludes with agriculture's response to the domestic emissions trading opportunity.

3.1 Canadian Emissions Trading Pilot Projects

In the last several years, there have been many pilot projects that have occurred in Canada that have been used as a backdrop for the development of the domestic offset system (Lindberg, 2004).

The first voluntary greenhouse gas emissions (GHG) trading pilot projects that were established in Canada were the Ontario-Quebec Pilot Emissions Reduction Trading (PERT) program, in operation from 1996-2000, and the Greenhouse Gas Emissions Reduction Trading (GERT) program, jointly established in 1998 by federal and provincial governments in collaboration with industry and environmental groups. PERT involved emissions trading for several air pollutants, including greenhouse gasses, in the Windsor-Quebec corridor. GERT, originally slated to run from 1998 to 2000, was extended until December 31st, 2001. It certified emissions reductions and registered trading of certified reductions, and participating governments committed to recognizing certified reductions "as progress towards possible compliance obligations" in future domestic offset trading systems. The results of PERT and GERT were used to develop more detailed pilot programs, which are described below.

The section presents some of the preliminary findings and lessons learned from recent pilot projects undertaken in Canada.

Climate Change Central Emissions Trading Simulation

In September 2001, Climate Change Central (CCC) hosted Western Canada's first greenhouse gas emissions trading simulation in Calgary, Alberta. Participants from industry, government and environmental groups experienced a simulated greenhouse gas trading environment. The exercise highlighted many of the challenges and issues to

be addressed in defining a legally-robust trading agreement (Climate Change Central, 2007).

In November 2003, CCC's hosted a second simulation workshop with 50 Canadian companies (in Calgary, Alberta) to trade greenhouse gases, sulphur dioxide and nitrous oxide. The second emissions trading simulation marked the first time in Canada that all three of these emissions had been traded (Climate Change Central, 2003). The second simulation offered unique insight into multi-pollutant regulation (Climate Change Central, 2003). The key learnings from the simulation included (Climate Change Central, 2003):

- Trading is more cost effective than meeting targets exclusively through internal reductions;
- Participants did not always trade their excess permits;
- Uncertainty inhibited trading;
- Participants became better traders with experience.

Pilot Emission Removals, Reductions and Learnings (PERRL) Initiative, 2005

PERRL was a federal initiative, delivered by Environment Canada and supported by Natural Resources Canada (among other federal departments). The initiative was developed with the objectives of contributing to Canada's Action Plan 2000 for climate change and of providing lessons learned for future emissions trading initiatives in Canada. The initiative, which extended from 2002 to 2008, allocated federal funding of $15 million to pilot projects. Projects under PERRL did not involve "carbon credits" per say and had no impact on Canada's Kyoto commitments (Environment Canada, 2008). PERRL was designed on the basis of a public reverse-auction process, which involved applicants proposing an emissions reduction/removal project and a payment-per-tonne for the attributed reductions/removals (Environment Canada, 2008). Although a variety of emissions reduction projects were undertaken under PERRL funding (three rounds for a total of 13 projects in a variety of sectors[18]), the following is a brief overview of two pilot projects that were specific to agriculture.

One agricultural project carried out within the PERRL framework consisted of converting approximately 4,450 acres of conventionally cultivated land to permanent prairies in order to sequester carbon in the agricultural soil. The ground conversion took place between 2005 and 2007 and had sequestrated 11,880 tonnes of CO_2 equivalent by December 31, 2007. The project represented new land converted to meadows (not simply the establishment of meadows already envisaged in the rotation plan of the farm). The project took place in the agricultural area of Centre-du-Québec in the municipality du Nicolet, Victoriaville and Drummondville (Environment Canada, 2008). The farmers were paid a fixed price per tonne of $6.50/tonne of CO_2 equivalent for the carbon sequestered.

The second agriculture sink project under PERRL was the Saskatchewan Soil Conservation Association's (SSCA) initiative involving the implementation of zero tillage practices on agricultural land where reduced tillage was taking place. The project was carried out in Ontario and the Prairies and resulted in total CO_2 equivalent reductions of 54,447 tonnes at a price of $18.71 per tonne.

[18] "Pools of projects" considered under PERRL included: landfill gas capture and combustion; CO_2 capture and geological storage; renewable/clean energy; and biological sequestration (Environment Canada, 2008).

This pilot project, which took place between 2005 and 2007, represented the first agricultural soil sink offset trade in Canada (Environment Canada, 2008).

Although PERRL has come to a close, it has been evaluated by Environment Canada in fulfillment of the initiative's objective to provide lessons learned for emissions trading in Canada (Environment Canada, 2006). The following are the key lessons learned, as described by Environment Canada in its evaluation, in terms of design of similar programs in the future:

- *Lesson 1 – Learnings should be shared on an ongoing basis and in a formalized manner*
- *Lesson 2 – Learnings should be shared with the key communities of interest*
    - A key lesson learned from the evaluation of the PERRL Initiative is that the area of project-based GHG emission reduction measurement is young and complex. Nevertheless, other programs in this area, including proposed ones, have since been developed and/or continue to exist (e.g., Canada's Domestic Offset System, voluntary-based initiatives). In this context, the PERRL learnings paper should ensure, for example, that its content be applicable to the challenges or circumstances of these programs.
- *Lesson 3 – To the extent possible, simple program guidelines and requirements should be adopted*
    - This is likely to increase participation and hence enrich information sets. In the case of PERRL, less stringent application and reporting requirements would have been welcomed by stakeholders especially in light of the fact that PERRL was a learning initiative. Indeed, the PERRL evaluation finding that some sectors have already engaged into developing their own methodologies and that different entities are at different stages of their learning curve is an indication of the need for a more tailored and/or flexible approach.
- *Lesson 4 – There is a need for increased coordination among programs/groups within the climate change policy area*
    - PERRL's success was highly influenced by the parallel development of a key climate change policy, namely Canada's Domestic Offset System. In particular, the potential exclusion of PERRL project proponents from the financial opportunities that this proposed System may bring about (i.e., purchases of emission reduction credits by the proposed Climate Fund as well as by other potential buyers) has impinged on PERRL's ability to achieve a number of its outcomes. Coordination would clearly provide more certainty to the Canadian entities that are playing a key role in reducing GHG emissions in Canada.

(Environment Canada, 2006)

3.2 Domestic Greenhouse Gas Offset System

In April 2007, Environment Canada announced the Clean Air Regulatory Agenda, which included the development of a domestic greenhouse gas offset system (Environment Canada, 2007b). Canada's domestic emissions trading system is intended to encourage cost-effective domestic reductions or removals (i.e., carbon storage) of greenhouse gas

emissions in activities that are not covered by federal greenhouse gas regulations (Government of Canada, 2007a).

At the time of the announcement, the Offset System was expected to begin prior to the air emissions regulations entering into force in order to provide time for projects to generate emissions reductions (Campbell, 2007). The greenhouse gas compliance options are expected to include (Government of Canada, 2007a):

- In-house reductions
- Climate change technology fund
- Trading
    - Domestic inter-firm trading system - where regulated firms can buy and sell emissions credits among themselves
    - Domestic offset system – where regulated firms can invest in emission reductions outside the regulated system.
        - This is where agriculture can play a role.
    - Clean development mechanism
    - Explore Canada-US linkages
- Credit for early action

On February 26, 2008, the Canadian federal government announced the allocation of $66 million in the federal budget *"to lay the groundwork for a regulatory system for industrial emissions that would price carbon and introduce carbon trading in Canada" (CBC News, 2008).* On March 10, 2008, the Government of Canada followed up with a series of detailed reports addressing each of the above compliance options announced in 2007. Of interest here is the proposed domestic offset system[19] for greenhouse gases. The offset system will enable individuals, businesses and organizations to earn offset credits for implementing projects beyond normal business activities (i.e., "business as usual") that result in emission reductions or removals as long as these reductions are quantifiable, verifiable and unique (Government of Canada, 2008b). The offset credits will represent an emission reduction or removal by an unregulated activity (i.e., activities not expected to be covered by proposed industrial air emissions regulations such as agriculture biodigesters or soil management).

Environment Canada has been designing the Offset System for a number of years. This process has included extensive consultations with provinces and territories, and with industry and other stakeholders, and builds on the experience from three Canadian emission-reduction pilot programs[20] as well as existing international project-based crediting schemes. Most recently, the Government held consultations on the design of the Offset System based on the elements of the Offset System proposed in March 2008 (i.e., "Turning the Corner" documentation).

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[19] The Government will administer the Offset System under the *Canadian Environmental Protection Act, 1999* (Government of Canada, 2008b), which is being amended as part of Bill C-30.

[20] The three pilot projects were: PERT – Pilot Emission Reductions Trading, GERT – Greenhouse Gas Emission Reductions Trading pilot, and PERRL – Pilot Emission Removals, Reductions and Learnings Initiative (Government of Canada, 2008b). Information on PERRL is still available online at www.ec.gc.ca/PERRL. Additional information is also included in Section 3.2.1 below.

The credit creation process will be as follows (Government of Canada, 2008b):

- A protocol developer will create a quantification protocol for the project type and Environment Canada will approve the protocol.
- A project proponent must apply to have the project registered.
- Environment Canada registers the project.
- A Project proponent reports the greenhouse gas reductions achieved from a registered project and ensures that a verifier has provided a reasonable level of assurance on the reductions claim.
- Environment Canada certifies the reductions and issues offset credits.

Each offset credit will represent one tonne of CO_2 equivalent. Offset credits will be tradable and bankable within the unit tracking system. The proposed industrial air emissions regulations (i.e., the *Clean Air Act*) will set out the conditions under which regulated entities will be able to use offset credits for compliance (Government of Canada, 2008b).

Environment Canada has laid out the schedule for releasing the eligibility and application requirements. For "protocol developers", "project proponents" and "verification bodies", guidance documents will be published in the spring and summer of 2008. Environment Canada has also indicated that it will begin reviewing quantification protocols in the summer of 2008 and project applications in the fall of 2008 (Government of Canada, 2008b).

The domestic offset program is expected to be launched in 2009.

3.2.1 Non-permanence of Greenhouse Gas Removals

Because agriculture's role in emissions reductions has been classified as "biological sink projects", it is important to review the proposed rules for non-permanence of greenhouse gas removals proposed by Environment Canada, as these rules will dictate how agriculture will react and ultimately determine participation.

There are two types of credits for biological sink projects being proposed to address the issue of non-permanence of greenhouse gas removals (Government of Canada, 2008b):

- Offset credits - which include an obligation on the project proponent to maintain carbon storage for a certain period (i.e., the liability period); *or*
- Temporary credits

Each of these types of credits is described in more detail below.

Offset Credits

The possible features of a sink project with a liability requirement are as follows (Government of Canada, 2008b):

- The removal of greenhouse gases associated with offset credits issued for biological sink projects will have to be maintained by the Project Proponent for a fixed period of time – the "liability period."

  - The specific length of the liability period has not yet been determined. As indicated above, the specific Project Proponent details are expected in spring/summer of 2008.
  - That being said, personal communication with Karen Haugen-Kozyra of Climate Change Central (2008a), suggests that when the representatives from the National Offset Quantification Team (which included federal, provincial and territory representation) were developing the GHG quantification protocols and interacting with the policy leads in Environment Canada and Agriculture and Agri-Food Canada, liability periods of 20 to 25 years for agricultural soil sinks (and 40 to 45 years for forestry sinks) were contemplated. The caveat to this period of time is that it will only start after the last tonne of carbon is sequestered.
- The liability period will extend for a fixed number of years after the last credit is issued to the Project.
  - Therefore, the farmer will be responsible for maintaining the carbon in the soil for the 'X' years required to reach sequestration saturation (i.e., the last credit is issued), plus an additional 'X' years of liability. As an example, if 15 years were required to reach carbon sequestration saturation and 25 years were required for the liability period, the farmer would be responsible for the carbon for 40 years. This has significant implications for the farmer that are discussed in more detail below.
- If the greenhouse gas removal is reversed during the liability period, the Project Proponent will be required to address the reversal to ensure that the environmental integrity of the Offset System is maintained.
- The reversal could be addressed, for example, by replacing the offset credits affected by a reversal with another offset credit.
- When the liability period ends, the Project Proponent will be free of any obligation to maintain the storage of the carbon for the purposes of the Offset System.
- Project Proponents may be required to provide the Government with some type of security to ensure that the obligations associated with a potential reversal will be met.
  - Specific details regarding security are also expected in the Project Proponent eligibility requirements to be released in the summer of 2008.

Temporary Credits

The possible features of the temporary credits are as follows (Government of Canada, 2008b):

- The number of temporary credits issued each year to a project will be equal to the number of incremental tonnes of CO_2 equivalent stored by the project.
- A temporary credit could be issued each year the incremental tonne is maintained in the reservoir during the crediting period.
- Temporary credits will be issued *ex post* – that is, after the storage has taken place.
- The crediting period will extend for a fixed number of years beyond the date the last new incremental tonne from the project is sequestered.
- The Project Proponent of a sink project that is issued temporary credits will have no liability in the event of a reversal.

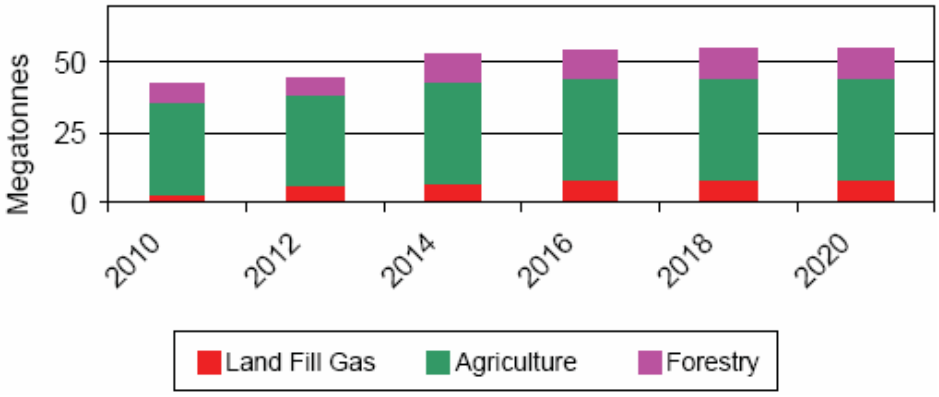
3.2.2 Agriculture's Role in Domestic Offset Credits

In 2005, the National Carbon and Greenhouse Gas Emission Accounting and Verification System for Agriculture (NCGAVS) was developed (AAFC, 2005). NCGAVS is a scientific, transparent, and verifiable accounting system for reporting soil carbon stocks, carbon stock changes, and nitrous oxide emissions for Canadian agricultural land at the provincial, regional, and national level. The purpose of the NCGAVS is to facilitate the fulfillment of international commitments under the Kyoto Protocol and to support sustainable agriculture (AAFC, 2005).

NCGAVS reports the amount of agricultural carbon sinks and GHG emissions as required under the United Nations Framework Convention on Climate Change and the Kyoto Protocol. The accounting system is linked to the national inventory of GHG emissions and serves as a backbone for the inventory of carbon credits in domestic and international emission trading schemes (AAFC, 2005).

The Government of Canada expects that agricultural industries (as well as landfill gas capture and forestry) will be a major source of offsets. In total, the three sink options (i.e., agriculture, forestry and landfill) will account for approximately 55 megatonnes of CO_2 equivalent reductions, of which agriculture is the largest share. Figure 5 depicts the projected[21] greenhouse gas reductions through to 2020.

Figure 5 Greenhouse Gas Reductions from Landfill Gas, Agriculture and Forestry, 2010-2020



Source: (Government of Canada, 2008c)

Although each province has identified various ways to reduce CO_2 emissions, including those with agricultural links, Saskatchewan and Quebec have outlined reductions that are specific to agriculture (Government of Canada, 2008c):

[21] The emissions reduction estimates for these activities and sectors capture the reductions attributable to all of the federal and provincial/territorial measures assumed in the Government's forecast policy scenario. The reductions are expected to be generated through the price signal for offsets under greenhouse gas regulations, improvements in emissions management, and energy cost-driven changes in energy consumption and operational practices (Government of Canada, 2008c).

- Saskatchewan - The government will encourage the establishment of agricultural soil sinks, which are expected to provide reductions of 25 megatonnes CO_2 equivalent by 2012 and 37 megatonnes by 2050.
- Quebec - The combination of waste treatment and recovery of agriculture biomass is expected to generate 0.3 megatonnes of GHG emission reductions.

3.2.3 Potential Offset Projects for Agriculture

Potential offset projects exist for Canadian farmers who adopt beneficial management practices (such as reduced tillage, reduced summer fallow, and increased perennial forages and pasture) that remove carbon dioxide from the atmosphere and store it as carbon in the soil. In addition, agricultural offset protocols for biogas, beef, pork and dairy are also expected (Campbell, 2007) through improved feeding strategies and/or manure management. The most recent documentation (March 2008) released by the Government of Canada describes agriculture's role as (Government of Canada, 2008b):

- Reducing the intensity of tillage operations.
- Adopting crop rotations and grazing management practices that sequester more carbon in the soil.
- Increasing the use of permanent cover.

The potential project types identified by the Government for agriculture include (Government of Canada, 2008b):

- Tillage practices
- Nutrient management
- Innovative feeding of livestock
- Manure storage/spreading

3.2.4 Canadian Agriculture's Response to Offset Projects

This section discusses the implications for agriculture of the domestic offset market, including the issues stemming from the current proposed offset system and the likelihood of the agriculture industry's participation given these issues. The discussion is based on Weersink et al., 2005 and Haugen-Kozyra, 2008.

In 2005, Weersink et al. conducted research that investigated agriculture's role in meeting Canada's Kyoto commitment. The research concluded that voluntary adoption of beneficial management practices was the primary means by which farmers could cut net greenhouse gas emissions. However, the researchers also found that an offset system would not be a major driver in agriculture due to:

- the relatively low prices likely to be offered by large final emitters facing an emission cap;
- discounts applied to those prices for temporary sequestration;
- the low elasticity of supply of CO_2 abatement;
- the transaction costs and risk premiums associated with signing carbon contracts (Weersink et al., 2005).

These issues and their implications in terms of deterring agricultural producer participation in an offset market are discussed below.

Under the domestic offset system, agricultural producers are likely to face relatively low prices from large final emitters facing an emissions cap. Furthermore, discounts will be applied to credit prices for temporary sequestration. The speculation is that these discounts will be in the magnitude of 7.5% per tonne and that, despite this discount, buyers may not be interested in temporary credits because they require long term stable carbon credits. As is expected, a low buying price is likely to deter supply of any good or service, including the supply of credits in the form of carbon sequestration. Prices must be high enough to cover the costs of supply, including transaction costs and opportunity costs of the production (discussed below). Considering the varied nature of these costs (i.e., costs will differ between producers), it is uncertain whether the prices offered by final emitters will be high enough to induce supply (Weersink et al., 2005).

A related issue to pricing is the nature of the supply curve[22] for emissions reductions facing agricultural producers. Since changes to production practices to provide emissions reductions likely involve high fixed investment costs (e.g. purchase of no-till equipment), producers will implement them on an incremental, rather than continuous, basis. As such, the supply curve facing an individual supplier is discontinuous; producers will not adopt any emissions reduction practices for certain ranges of prices, and will adopt individual practices with sufficiently high prices (incrementally, as prices rise). Overall, the aggregate supply curve facing all producers is relatively steep, or inelastic (indicating that a high price is required for a small change in production practices), due to the incremental and high cost nature of implementing production practices to reduce emissions (Weersink et al., 2005).

Transaction costs associated with signing carbon contracts are another potential issue facing agricultural producers in offset market participation. Transaction costs, in this context, refer to the costs associated with the exchange of credits between suppliers and buyers (but not the cost of the emission reduction itself). Transactions costs are shared between the contracting parties (i.e., suppliers and buyers) and are greatly dependent on the facility of measuring emissions reductions to offer verification to the buyer that the contract is fulfilled (in terms of the amount of emissions reduction taking place). According to Weersink et al. (2005), these costs are likely to be quite high if actual carbon levels in the soil are monitored. The transaction costs in Alberta are 30% on a carbon credit price of $10 (Haugen-Kozyra, 2008a). However, it is expected that market innovation will reduce transaction costs (Haugen-Kozyra, 2008a). Therefore, overall, it is still undetermined if transaction costs will be a barrier to producer participation in an offset market.

Finally, the risk premium involved with signing a contact imposes an additional cost on the producer in terms of the loss of flexibility in land management. The producer loses the option value associated with his/her land. The consequence is a decrease in the benefits derived from signing the contract (and, ultimately, of participating in an offset market). The liability period for the domestic offset market is anticipated to extend to 25 years after sequestration saturation occurs. This contemplated liability period is intended to act as a legal instrument registered against land for “security.” However, this liability period translates to producers being locked into contracts for long periods of time, increasing the risk premium associated with the offset market exchange. The

[22] The supply curve illustrates the relationship between the price offered to suppliers for a good and the amount of the good that will be supplied at a given price.

implications for producers are that farmers who rent land will be unlikely to participate due to the long-term period of liability. Furthermore, even producers who do not rent land will face decreased option value as a result of the liability period, since they may be unable to rent, sell or change production practices in the future. This uncertainty will likely be a deterrent to participation in the offset market (Haugen-Kozyra, 2008b).

Taking into account the issues discussed above, Weersink et al. concluded that although Canadian farmers are likely to participate to only a limited extent in the carbon offset market, many will find it profitable to adopt one or more of the BMPs for reducing net GHG emissions. Canadian agriculture is likely to contribute significantly to net emission reductions by voluntarily sequestering carbon due to the adoption of zero till in the last decade and possibly by cutting fertilizer levels in the next decade. The contribution will be mainly a response to meeting personal economic objectives rather than being induced by direct incentives through the offset program (Weersink et al., 2005).

3.3 Other Emissions Trading Systems and Implications for Agriculture

Currently, only a few major greenhouse gas trades involving agriculture have occurred in Canada. Many of the uncertainties identified above are expected to be eliminated as specific rules are developed and experience is gained from additional trading. Until that time, these risks will keep agricultural producers from selling carbon credits. However, there will be others who see opportunities and are willing to shoulder the risk in exchange for compensation (Climate Change Central, 2002). The following is a discussion of existing emissions trading systems and pilot projects with potential implications for agriculture and the lessons learned from these systems.

3.3.1 Agricultural Offset Trades Occurring in Canada

Alberta Climate Change and Emissions Management Act and Related Trading

The *Alberta Climate Change and Emissions Management Act* (Alberta Government, 2007) provides authority to the Alberta Government to set greenhouse gas emissions intensity standards for facilities within the province. The new regulations require that facilities producing more than 100,000 tonnes of greenhouse gases annually reduce their emissions by 12% by January 1st, 2008 (The Calgary Herald, 2008).

In lieu of reducing emissions intensity on-site to comply with the new regulations, facilities can either purchase credits from the Climate Change and Emissions Management Technology Fund (which is designed to make future energy production greener), administered by the Provincial Minister, or offset their emissions by undertaking “real and demonstrable” greenhouse gas emissions-reduction initiatives in Alberta. The required reductions can be achieved by paying into the technology fund at $15/tonne of emissions over the target, or by purchasing recognized emissions-reduction credits that are currently selling from $6 to $8/tonne (The Calgary Herald, 2008). Purchase of one credit is equivalent to the reduction of one tonne CO_2 equivalent. If a facility reaches emissions intensity below compliance levels, it can trade its surplus credits with other facilities. This implies that the price of CO_2 equivalent for agricultural offset projects will be capped at $15/tonne, since facilities will always choose to contribute to the Fund instead of buying offsets at a higher price.

The offsetting technique for regulatory compliance has significant implications for Alberta agriculture since agricultural operations are a primary source of carbon credit offsets for facilities aiming to meet regulated emission intensity levels. It is important to note that, unlike other credit exchange situations, offsetting initiatives must take place within the province of Alberta.

For the biological carbon sinks where agriculture has a role to play, the following types of projects are eligible in the Alberta plan: Afforestation, Beef Feeding, Beef Lifecycle, Biofuels, Biomass Combustion, Composting, Reduced Tillage, Pork Operations, and others. Although there are many categories, reduced tillage/no tillage has been the only agricultural offset projects in the program to date.
The 'rules' of the Alberta offset system for biological carbon sinks are as follows:

- Result from actions taken on or after January 1, 2002;
- Be real, demonstrable, quantifiable;
- Not be required by law;
- Have clearly established ownership;
- Be counted once for compliance purposes.
- Be verified by a qualified third party; and,
- Have occurred in Alberta.

Source: (Agri-Trend Aggregation Inc, 2007)

Projects must be defined, implemented and reported for offset submission to occur (Agri-Trend Aggregation Inc, 2007).

According to personal communications with Karen Haugen-Kozyra (2008a), the bilateral trade[23] agreements have been in place for the last six months (as of March 2008) and there have already been several trades made between final emitters and agricultural aggregators. The following are the largest transactions that have occurred to date[24] (Canadian Standards Association, 2008):

- EPCOR purchased two million tonnes of emissions-reduction credits through a reduced-tillage program it helped launch with a company named Carbon Reduction Offset Projects (CROP)[25] Ltd (Haugen-Kozyra, 2008a; The Calgary Herald, 2008).
    - The program currently has more than half a million acres under contract, from which more than 60,000 tonnes of emission reductions have so far been third-party verified (The Calgary Herald, 2008).
    - The start date of this project was January 1st, 2002 and the end date is December 31st, 2009.

[23] Trade between two parties

[24] The Canadian Standards Association hosts the Greenhouse Gas Clean Registry Project, where Alberta's offset projects are registered. In total, there are currently 38 projects listed in the GHG Clean Project Registry. Of the 38, 16 (42%) are agriculture projects (no tillage, reduced summer fallow, methane venting reduction and a wind energy farm) (Canadian Standards Association, 2008).

[25] Carbon Reduction Offset Projects Ltd (CROP) is a subsidiary of Parkland Agri Services Corp. CROP's business activities are focused on new business opportunities associated with data management and agricultural environmental opportunities. Parkland Agri Services Corp. is an agricultural input supply business with 10 retail outlets in central Alberta, serving more than 2,000 farmers (CNW Group, 2008).

- Project partners Agri-trend Aggregation Inc. and AgShare Agency Ltd. have a reduced tillage/no tillage project valued at 2,000,000 tonnes of CO_2 equivalent.
    - The project consists of the aggregation of carbon offsets generated from the direct and indirect reductions[26] of GHG emissions through implementing no-till and reduced tillage systems on agricultural lands in Alberta.
    - The start date of this project was January 1st, 2002 and the end date is December 31st, 2015.
- Emissions Credits Corporation[27] traded 400,000 tonnes of agricultural-based emission reduction offsets to TransAlta Corporation (World Energy Solutions, 2008).
    - A spring auction of 500,000 tonnes of carbon offsets is planned with World Energy Solutions (announced April 3, 2008) (World Energy Solutions, 2008).

Although the current Alberta system lacks price discovery[28], both the emitting facilities and agricultural lenders have found a mutually satisfying price at which a trade can occur. This is likely because the risk and liability is absorbed by the broker. However, the risk comes at a price as the fees for transactions are at 30%. However, it is expected that the market will innovate to try to drive down the transactions costs (to increase producer participation) (Haugen-Kozyra, 2008a).

Other provinces and the federal government are paying close attention to the applicability and usability of the Alberta system.

Chicago Climate Exchange

The Chicago Climate Exchange (CCX) was launched in 2003 and was the world's first active voluntary, legally binding integrated trading system to reduce emissions of all six major greenhouse gases (GHGs)[29], with offset projects worldwide (Chicago Climate Exchange, 2007).

The CCX has developed simple standardized rules for issuing Carbon Financial Instrument® (CFI™) contracts for carbon emission soil sequestration activities in the agricultural sector (Chicago Climate Exchange, 2007). Eligibility for carbon emission soil sequestration projects (continuous conservation tilling and grass planting) on the CCX are as follows (Chicago Climate Exchange, 2007):

- Conservation tillage: A minimum five year contract which guarantees continuous no-till, strip till or ridge till on enrolled acres (2006-2010).

[26] The reduction in frequency and intensity of tillage under a reduced-till or no-till system results in reduced fossil fuel use by farm equipment, reduced fossil fuel use for the production of fertilizer and other amendments, and a decrease in the amount of soil carbon and nitrogen that is released to the atmosphere.
[27] Emissions Credits Corporation is Alberta's largest agricultural aggregator of sequestered carbon offsets produced exclusively from farmland in Alberta (World Energy Solutions, 2008).
[28] The process of determining the price level of a commodity based on supply and demand factors.
[29] carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons & sulphur hexafluoride

- Grass planting: projects initiated on or after January 1, 1999 in CCX in eligible areas (i.e., counties) may qualify.
- Carbon sequestration projects must be enrolled through a CCX-registered Offset Aggregator.
- All projects must be independently verified by a CCX-approved verifier.
    - The verification is to guarantee transparency, rigour and integrity, and to ensure members have standardized procedures for managing GHGs. Verification may include site visits to accurately assess the project's actual annual GHG sequestration or destruction. An offset project is subject to initial verification, as well as annual verification[30] for the duration of its enrollment in CCX.
- Contracts are issued at a standardized rate of CO_2 per acre per year to land managers. One CFI contract is equal to 100 metric tons of CO_2e.

Offset Projects are issued CFI contracts on an annual basis, with the CFI Vintage applying to the program year in which GHG mitigation took place. For example, a tillage reduction project that occurred during the calendar year 2005 would earn a given quantity of 2005 Vintage CFI contracts.

Canadian Participation in the CCX

On April 3rd, 2008, a total of 11.6 million soil carbon offsets had been exchanged on the CCX. Canadian farm-based credits are making up a significant share of the trade in the voluntary carbon market in the US (Haugen-Kozyra, 2008b). C-Green Aggregators Ltd, based in Saskatchewan, was the only Canadian aggregator for soil carbon offsets (Chicago Climate Exchange, 2007).

Personal communication with Jeff Gross, C-Green Aggregators Ltd, (2008) suggests that 6 million tonnes of CO_2 offset credits were traded between January 2007 and November 2007 (approximately 50% of current exchanges for this category on the CCX). This value represents 2,200 farmers, 575,000 acres and approximately 25% of the available credits in Canada (Gross, 2008).

Of the offset projects by C-Green Aggregators Ltd, 10% have been verified to date using in-field audits and satellite imagery provided by a certified verifier (a crop insurance agency). Of the audits conducted to date, less than a quarter percent have had problems with maintaining their offsets.

The average price received for the C-Green Aggregators Ltd offset projects (i.e., one ton of CO_2 equivalent) has ranged from \$2-\$4/ton of CO_2e per acre. The transaction costs (as stated by the aggregator) are 15% commission plus an exchange rate (noted as US12.5 cents in the 2006 Q&A). The liability period of a contract is four to five years and the issuance rates[31] are 0.20 tons per acre for brown and dark brown soil and 0.40 tons per acre for black and grey wooded soil (C-Green Aggregators Ltd, 2006).
The lessons learned from this system in terms of emissions trading, with implications for agriculture included: there are a lot of "scam artists" with a new market. The scams

[30] Verification reports are reviewed by CCX staff as well as the CCX provider of regulatory services, FINRA, for completeness (Chicago Climate Exchange, 2007).
[31] The amount of carbon credits issued by soil type per acre of land.

tended to be with respect to the price of carbon, which resulted in a lot of misinformation for farmers. For example, there was "coffee shop" talk that carbon was trading for $20/ton. Thus, when the farmers learned the real price, it left a "bad taste" in their mouth for trading. As a result, a major education piece has had to be developed to reduce the misinformation and to help prevent scams in the market (Gross, 2008).

Gross (2008) speculates that of all potential offset projects in Canada, only 50% will be available for trading. Personal communication with Gross (2008) suggests that C-Green is attempting to secure the last 25% of the available market in Canada. Expectations are that up to 9 million tonnes of Canadian soil carbon offsets will be traded during the 2007-2011 time period (Haugen-Kozyra, 2008b).

Montréal Climate Exchange

The Montréal Climate Exchange (MCeX) carbon futures contract development began in December 2005 with a preliminary agreement between the Montréal Exchange (MX) and the Chicago Climate Exchange (CCX). The agreement was finalized in July 2006. Once implemented, the Montréal Climate Exchange will be the first environmental products market in Canada (Montreal Climate Exchange, 2008).

According to the MX and CCX (Montreal Climate Exchange, 2008), "the new MCeX futures contract is expected to generate the price signal required by large greenhouse gas emitters to manage the risk associated with the so-called 'price of a tonne of carbon'." It is also a method of managing risk associated with price fluctuations using carbon futures contracts (Mondovisione, 2008).

The Montréal Climate Exchange announced on March 14, 2008, that it will "launch trading of futures contracts on Canada carbon dioxide equivalent (CO_2e) units on May 30, 2008, subject to regulatory approval." In October 2007, the MX filed an application with its lead regulator, the Autorité des marches financiers (AMF), requesting approval of market rules designed to govern the trading of MCeX environmental products on its electronic trading platform, SOLA®. A decision on the AMF application is expected in the near future (Mondovisione, 2008).

4. Summary, Conclusions and Next Steps for Canada and Canadian Agriculture

The purpose of this paper was to provide a comprehensive overview of the current status of Canada's commitment to greenhouse gas emission reductions, with specific focus on the role of emissions trading and agriculture in meeting this commitment.

To fulfill this purpose, this paper included a discussion of the "Made in Canada" approach to Canada's Kyoto commitment and the current emissions status in Canada. It also presented the status of emissions trading in Canada, including the domestic offset market, other emissions trading systems and the implications for agriculture. This section concludes the paper with a summary, conclusions and next steps for Canada in terms of emissions trading.

4.1 Summary

Currently, the Canadian federal government is developing a "Made in Canada" approach to addressing climate change. Under this approach, Kyoto emissions targets will not be met until decades after the commitment deadlines. However, some provinces in Canada are still planning on complying with Kyoto commitments.

Agriculture is expected to play a significant role in biological sink offsets under the "Made in Canada" approach. Biological sink options include tillage practices, nutrient management, innovative feeding of livestock and manure storage/spreading practices. However, since agricultural producer participation in domestic offset markets will be voluntary, the success of emissions trading in Canada is heavily dependent on the level of agricultural producer participation.

The concept of utilizing and enhancing carbon sinks may be a benefit to Canadian agriculture. At the farm level, there is the potential for increased yields, income and land values. Environmentally, benefits include cleaner air, less erosion, and improved nutrient absorption and water retention (Brethour, 2003). However, in order for producers to benefit from, and, therefore, participate in, the domestic offset projects, several important and unresolved issues must be addressed. These include the need for producers to pool their land in order to provide a useful sink capacity, contract requirements and other legal issues. Some of the specific technical details that are still being tackled that specifically affect Canadian agriculture include:

- What type of verification and monitoring will take place?
- How long will a producer be bound to sequester the carbon?
- What is the future liability of stored carbon?

Other issues impacting participation levels by producers include lengthy liability periods. Long contract requirements will attribute to the uncertainty facing producers, particularly when considering the likelihood of low offset prices relative to the costs of supplying carbon sequestration, as well as the loss due to uncertainty of land use (with lengthy contracts). It is still uncertain whether transaction costs will be a barrier to market participation.

Canadian producers are already participating or are expected to participate in emissions trading through systems other than the proposed domestic offset system. These include the Alberta Climate Change and Emissions Management Act trading scheme, the Chicago Climate Exchange and the Montreal Climate Exchange (which will likely be linked to the domestic offset system).

Finally, several pilot projects in emissions reductions have already been conducted in Canada. The PERRL initiative was implemented specifically for the purpose of generating lessons learned for future program design. The primary lessons learned through the initiative included the importance of sharing lessons formerly and quickly, maintaining simplicity in the program parameters and ensuring that participants in emissions reductions projects do not face uncertainty.
The Climate Change Central Emissions Trading Simulation in Alberta concluded that trading is more cost effective than meeting targets exclusively through internal

reductions, that participants did not always trade their excess permits, that uncertainty inhibited trading, and that participants became better traders with experience.

4.2 Conclusions and Next Steps

Canada is driving forward with a domestic offset system, while many provinces also have their own specific agendas for emissions trading. The specifics of the protocols proposed for the national offset system are expected to be released this summer, which will determine whether provincial and federal initiatives align. Under the proposed national system, the government has identified agriculture as a key player in emissions reductions.

The idea of trading appears to be widely accepted within the agricultural sector. For example, the Canadian Federation of Agriculture suggests that "the government should work with the sector to examine the implications of the use of Kyoto and non-Kyoto mechanisms, including domestic emissions trading systems and targeted measures. As emission trading systems continue to develop rapidly world-wide, the CFA urges the Canadian government to release their response on offset discussions immediately, and expedite developments of a Canadian specific-system" (Canadian Federation of Agriculture, 2008). Despite this apparent willingness, the speculation is that participation by agricultural producers in emissions trading will be limited due to unresolved issues creating disincentives for producers. These issues include lengthy liability periods imposing uncertainty, high costs of supply relative to trading prices, and, potentially, high transaction costs. The issue of liability is a particularly large deterrent. Furthermore, both pilot projects identified the provision of certainty for market participants as a key factor in successful emissions reduction systems.

The next steps for Canada include the finalization of the details of the domestic offset system by the summer of 2008 and the undertaking of negotiations/agreements with provinces to use the domestic system. The launch of the domestic trading system is expected in 2009. Finally, Canada plans to align its offset systems with that of the United States and, possibly, Mexico.

To improve the probability of success of emissions trading in Canada, other actions need to be considered. The system, as proposed, may not induce agricultural producer participation, even though the non-permanence of greenhouse gas removal for the offset system rests predominantly on carbon sinks associated with agriculture. Therefore, design alternations, taking into account lessons learned through current emissions trading systems and pilot projects, are required. The primary change to the proposed design is the length of liability period faced by producers. A shorter contract period, although not as effective in terms of carbon sequestration, will reduce uncertainty for producers, significantly increasing levels of participation. Although temporary offsets attempt to address this issue in part, it is not clear whether buyers of offsets will purchase temporary credits, as it has been suggested that buyers want more stable and long terms credits.

Another key barrier to producer participation is the high cost of implementing appropriate practices, relative to trading prices. Technological innovation in production practice implementation would greatly reduce this barrier. Although this issue is not easily addressed in a short period of time, investment in technological innovation may benefit

emissions trading in Canada in the long run. Finally, although transaction costs are not currently an obvious deterrent to emissions trading, they contribute to the overall cost of supply faced by producers. Therefore, their reduction is a tangible and more immediate step to encouraging a successful emissions trading market.

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Appendix A

	GHG Emission Reduction Targets			
	Short-term (pre 2020)	**Mid-term (2020)**	**Long-term (2050)**	**Legislation**
British Columbia	Unspecified* interim targets to be set for 2012 and 2016	33% below 2007 levels by 2020 (10% below 1990 levels)	At least 80 per cent below 2007 levels by 2050.	February 2007 Throne Speech (http://www.leg.bc.ca/38th3rd/4-8-38-3.htm)
Alberta	Emissions intensity targets ("established" facilities: 12% improvement; "new" facilities: targets apply in their 4th year of commercial operations based upon 3rd year intensity, with a cumulative 2% improvement required for each of the years between their fourth and eighth years of operations)	50% GHG emissions intensity reduction from 1990 levels by 2020	Reduce emissions by 50% relative to business-as-usual by 2050 or 14% relative to 2005	*Specified Gas Emitters Regulation* (http://www.qp.gov.ab.ca/documents/Regs/2007_139.cfm?frm_isbn=9780779725403) (short-term targets: all in this column as set out in, and subject to, the Regulation) *Climate Change and Emissions Management Act* (in force) (http://www.qp.gov.ab.ca/documents/Acts/C16P7.cfm?frm_isbn=9780779723386) (mid-term target) Government of Canada's *Detailed Emissions and Economic Modelling* (long-term target) (http://www.ec.gc.ca/doc/virage-corner/2008-03/pdf/571_eng.pdf)
Saskatchewan	Emissions stabilized by 2010	32% below 2004 levels by 2020	80% below 2004 levels by 2050	"Energy and Climate Change Plan 2007" (http://www.saskatchewan.ca/Default.aspx?DN=b92e42b6-6ab2-448a-a8d7-f698cad62eec)
Manitoba	6% below 1990 levels	Unspecified	Unspecified	Referenced in August 2007

	GHG Emission Reduction Targets			
	Short-term (pre 2020)	**Mid-term (2020)**	**Long-term (2050)**	**Legislation**
	by 2012 (below 2000 levels by 2010)			publication by The Council of the Federation (an Inter-provincial and territorial body) "Climate Change: Leading Practices by Provincial and Territorial Governments in Canada" (http://www.councilofthefederation.ca/pdfs/CCInventoryAug3_EN.pdf) ("Council of the Federation Leading Practices")
Ontario	6% below 1990 levels by 2014	15% below 1990 levels by 2020	80% below 1990 levels by 2050	Announced in speech given by Premier in June 2007 (http://www.premier.gov.on.ca/news/Product.asp?ProductID=1414)
Quebec	6% below 1990 levels by 2012 (Canada's Kyoto Protocol target is 6% below 1990 levels on average over 2008 to 2012 period)	Unspecified	Unspecified	"Québec and Climate Change: A Challenge for the Future" (http://www.mddep.gouv.qc.ca/changements/plan_action/2006-2012_en.pdf)
New Brunswick	1990 levels by 2012	10% below 1990 levels by 2020	Unspecified	"Climate Change Action Plan – 2007-2012" (http://www.gnb.ca/0009/0369/0015/0001-e.asp) (short-term target) New England Governors and Eastern Canadian Premiers "Climate Change Action Plan 2001" ("NEG/ECP Plan")

	GHG Emission Reduction Targets			
	Short-term (pre 2020)	**Mid-term (2020)**	**Long-term (2050)**	**Legislation**
				(http://www.negc.org/documents/NEG-ECP%20CCAP.pdf) (mid-term target)
Nova Scotia	Unspecified	10% below 1990 levels	Unspecified	Environmental Goals and Sustainable Prosperity Act (in force) (http://www.gov.ns.ca/legislature/legc/bills/
Prince Edward Island	1990 levels by 2010	10% below 1990 levels	Unspecified	NEG/ECP Plan
Newfoundland and Labrador	1990 levels by 2010	10% below 1990 levels	Unspecified	NEG/ECP Plan

*For NEG/ECP Provinces that elected in Council of the Federation Leading Practices not to cite the NEG/ECP Plan's short and mid-term targets (the Council of the Federation Leading Practices being a document which contains a list of GHG reduction targets by province approved by the provinces), and where these or other targets do not appear in other official climate change-related documents of the Province, the target for this period is treated as "unspecified". The NEG/ECP Provinces are the four Atlantic Provinces and Quebec (Taylor and MacSkimming, 2007).
Source: (Taylor and MacSkimming, 2007) and (Government of Canada, 2008c).