A Basis for Greenhouse Gas Trading in Agriculture

Discussion Paper C3 – 01(a)

April 30, 2002

Final Report of the Emission Reduction Trading Protocol Team

KEY FINDINGS

- The Agriculture sector in Alberta is well positioned to capitalize on trades in CO2 emission removals through changed agriculture practices – up to 5 million tones/yr. to 2008.
- The sector is also well positioned to trade carbon removals and GHG reduction credits into a large final emitter cap and trade system, without itself being subject to GHG limitations or caps.
- However, a number of policy uncertainties remain including; GHG policy in Canada, definition of removal credits, bankability, credit for early action, future liability of stored carbon and possible regulation of the agriculture sector, ownership of the stored carbon and permanence of removals.
- In any type of commodity transaction there are risks. These risks are more apparent and may also be larger in the early years of trading. Currently only a couple of major GHG trades involving agriculture have occurred. It should be anticipated that many of the uncertainties would be eliminated as specific rules are developed and experience is gained from more trading. Until that time, these risks will keep some people from buying or selling carbon credits. However, there will be others who see opportunities and are willing to shoulder the risk in exchange for compensation.
- Notwithstanding policy uncertainties in the carbon market, several mechanisms and tools have been identified to hedge this risk including; creation of gold standard credits, partial sale of credits, leasing carbon removals, use of an aggregator, government purchase or incentives to kick-start trading, and options contracts.
- We believe there are enough risk-hedging tools now available to make verified emission reduction (removal) trades in agriculture feasible.

Introduction

Increasing global temperatures have been linked to increased levels of greenhouse gases in the atmosphere. A majority of scientists agree that increasing levels of these greenhouse gases (GHG), which are caused by the burning of carbon based fuels, land use changes, agricultural and industrial activities, contribute to changes in temperature, precipitation and weather patterns It is generally accepted that there are two approaches that can be used to reduce this build-up of GHGs. First, GHG emissions can be reduced and second, carbon dioxide (CO_2) can be absorbed, or sequestered, into terrestrial processes (e.g. soils and plants).

The extent of current discussions around climate change make it appear likely that there will be implementation of some type of carbon constraint to reduce emissions and/ or increase sequestration in the future. A variety of policy options for encouraging these approaches have been considered. Among these options is a system of tradable emission permits. Within this system there is an opportunity for producers in the agricultural sector to remove and reduce on-farm GHG emissions and generate credits (or offsets) that can be sold to sectors that face higher GHG control costs.

In May 2001, Climate Change Central, in partnership with government and private sector stakeholders, put together a working group called the Emissions Reduction Trading Protocol (ERTP) Team[1]. Their overall mission was to evaluate Alberta's opportunities for the removal and reduction of GHG's in the agricultural sector. Their goal was to develop:

- a work plan that involves inventory, measurement, and verification of GHG emission effects, through land management practices, and
- a guideline for Alberta agricultural-based GHG emission reduction and removal protocols that could be used as a basis for GHG trading between producers and potential buyers of GHG reductions

This report summarizes the work of the Emissions Reduction Trading Protocol (ERTP) Team and is intended to address the latter goal by providing information on the opportunities and risks to agriculture from participation in an emission-trading program. To this end, Appendix B in this report provides a sample term sheet that outlines the issues that may need to be addressed between buyers and sellers in any GHG reduction contract. Appendix C, furthers this effort by providing estimates of the amount GHG reduced with specific management practices and the type of verification that could be required to document those reductions. The estimates in Appendix C, should be viewed as only a first step toward addressing the subject of measurement and verification and are themselves the subject of a separate review and report.

Background

Countries around the world, including Canada, have adopted a series of international agreements aimed at slowing human caused climate change. The first agreement, the 1992 Framework Convention on Climate Change (the Rio Treaty) required all countries to identify, inventory and work voluntarily to reduce their GHG emissions. The second agreement, the 1997 Kyoto Protocol, required industrial countries as a first step, to decrease their greenhouse gas emissions by an average of 5% from 1990 levels for a five-year period from 2008 to 2012. Canada agreed to reduce its GHG emissions by 6% from 1990 levels. This is equivalent to a 30% reduction from what emissions are expected to be in 2008 if business is allowed to continue their current emission's growth (NCCP, 2000).

The Kyoto Protocol allows nations to meet their GHG emission targets using a variety of flexible instruments to facilitate cost effective compliance. Emissions trading at the domestic and international level can be considered the core of Kyoto Protocol.

Although there are a variety of ways to structure such a trading system, in its simplest form it places a limit (or cap) on emission from certain companies or sectors. Firms within these covered sectors are required to hold allowances for each unit of GHG emissions that they send to the atmosphere.[2] Sources able to cut their emissions at a

[1]Appendix A contains a list of ERTP members.

[2] A variety of terms are currently in use to describe the amount of carbon traded. The term allowance is generally used to refer to the amount of emissions allowed in regulation by any one firm. The term credit is typically used to refer to a specific level of emissions reduction or removal that results from some specific

relatively low cost have the financial incentive to make larger reductions and to sell the surplus allowance/credits to participants facing relatively high costs to reduce their own emissions. Sources facing relatively high costs to reduce their own emissions can save money by buying allowances/credits and not reducing their own emissions by as much.

If trading is allowed only between firms with explicit caps, this type of trading system is known as a closed market system. Conversely, there may also be the potential that sources not covered by a cap on emissions could reduce their emissions and generate credits that could be sold to those covered by the cap. When sources outside of capped sectors can participate in trading, this is known as an open market system and is the type currently being discussed for Canadian implementation. The existence of an open market system provides the basis of this paper because it is assumed that agriculture will not initially have a required emission limit and that farmers would be able to generate emission reduction credits by increasing the carbon content in their soils or by increasing the amount of permanent vegetation on their land.

As noted earlier, no mandatory GHG emission limits or trading requirements exist. Nevertheless, some firms are currently buying and selling agricultural credits. This market is developing for three primary reasons: 1) in anticipation of future regulation that incorporates an open market system of emissions trading; 2) to increase knowledge on trading, 3) for enhancement of environmental image. According to one source there are 80 million tonnes of verified emission reductions (for GHGs) currently under contract (Vickers 2000).[3]

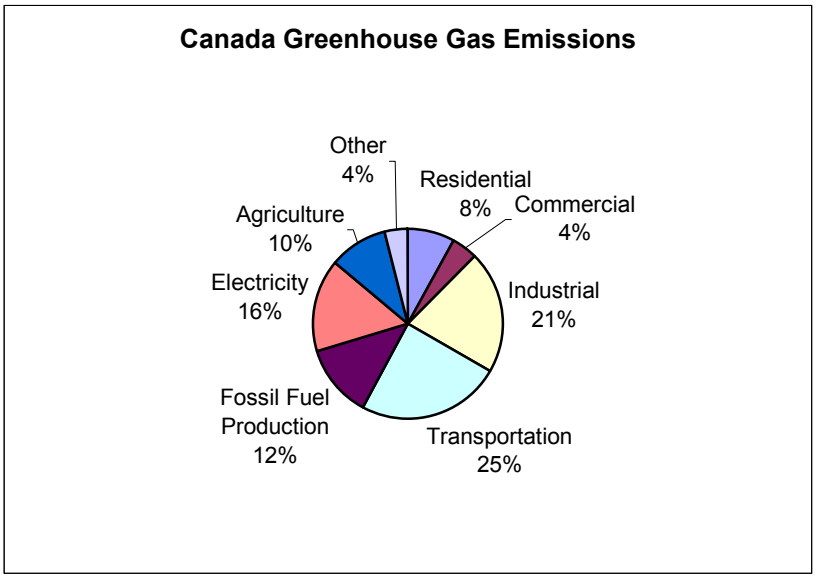
Before addressing the fundamentals of how credits are created in agriculture, it is necessary to understand the nature of GHG emissions and their potential reductions and removals in the sector. About 10% of Canada's total GHG emissions come from agriculture (see figure 1). The primary gases emitted are methane from animal production, fertilizer use, and nitrous oxide from manure management and fertilizer use (ACCT, 2000). A variety of management practices are available to reduce these emissions such as changing cattle feed so that less ruminant methane is produced**.** A variety of agricultural practices can also serve to remove GHG from the atmosphere. One such practice is the use of no-till (direct seeding) which restricts the level of soil disturbance thus leaving more plant material on and in the soil. Soil that is used to hold sequestered carbon it is often referred to as a carbon sink.

---

action or project. The term permit is sometimes used in a more generic sense applying to either allowances or credits.

[3] This figure includes agricultural credit purchases from one company, and as such does not reflect all agricultural credit trades.

Figure 1. Canada's Emissions Profile for 1999 GHG Emissions



Source: NCCP, 1999

Sequestration in Agricultural Soils

Cultivated agriculture land represents over two thirds of Canada's agricultural land base and provides significant potential to aid in efforts to address GHG emissions (Sinks, 1998). Janzen (1998) specifically notes that given our large amount of cropland (45.4 million hectares), an additional .2 tonnes of carbon per hectare can yield 8 million tonnes of carbon (or 29.34 million tonnes of $C0_2e$)[4]. This amounts to approximately six percent of Canada's 1990 CO_2 emissions (Janzen, 1998).

In order to obtain an increase in soil carbon, a new soil management practice must either 1) increase the amount of carbon entering the soil as plant residues, or 2) suppress the rate of soil carbon decomposition. Several land management practices can be implemented to increase the amount of carbon in agricultural soils. These practices include:

- Using low or no-tillage, direct seeding cultivation systems
- Reducing summerfallow
- Rotating crops
- Converting marginal cropland to perennial grassland or forest
- Managing nutrients and irrigation efficiently and effectively

[4] Carbon that is sequestered in soil is generally converted to carbon dioxide equivalents (CO2e) to facilitate comparisons between volumes of the different GHG's removed or reduced. It is generally assumed that 1 tonne of carbon =3.667 tonnes of CO2e gas.

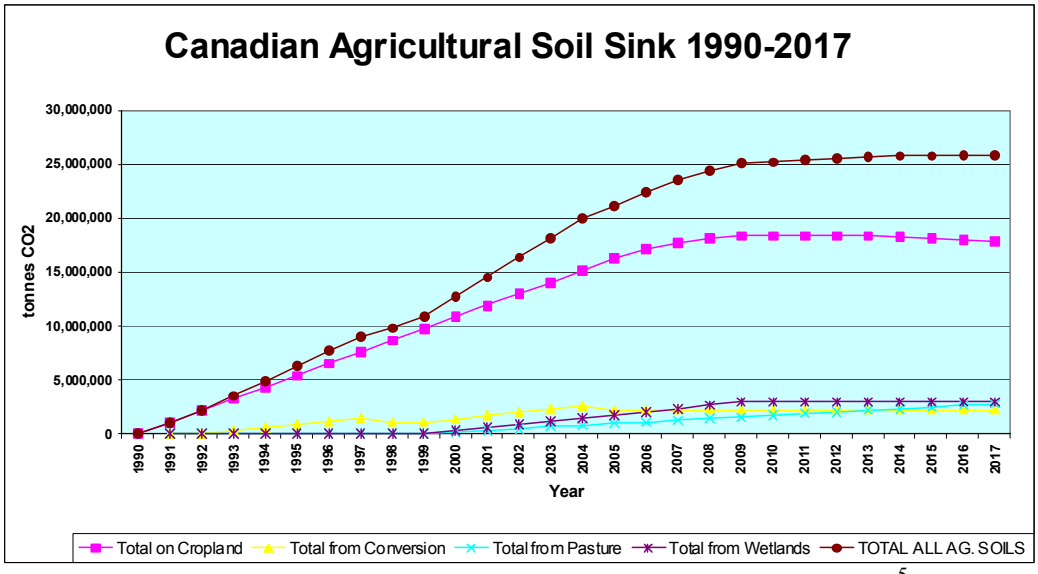
- Rotational grazing
- Applying manure, compost, and other organic amendments according to nutrient management plans
- Shelterbelt plantings

The amount of carbon added to soil (sequestered) under these practices depends on the specific practice, in addition to climate (temperature and rainfall), soil texture, crop type, nutrient and organic matter inputs, and history of farm practice. Sequestration under no-till (direct seeding), for example, has been estimated to be approximately 1.22 tonnes of $C0_2$ equivalent per Ha per year (McConkey, 2000 and Sinks, 2000). However, this rate of sequestration will not occur indefinitely, and might only be sustainable for 6-7 years. At some point, soils become saturated with carbon and their absorption rate declines.

Canadian producers have been progressively increasing their use of practices like no-till and reduced summer fallow. Figure 2 illustrates the trend at the national level, while figure 3 depicts the Provincial trend. The use of these practices has increased for economic reasons, rather than GHG control. Notably increasing the amount of soil carbon improves water and nutrient retention, reduces soil erosion, and generally improves long term soil quality. The overall result is an increase in crop yield and additional farm income (SWCS, 2000).

From these graphs it can be seen that since 1990 soil carbon sequestration has been increasing. Projections suggest that without further incentives this total could increase at the national level to a total of approximately 24 million tonnes per year nationally and provincially 5 million tonnes per year by 2008 (Hastie, 2001, and Sinks, 1999).

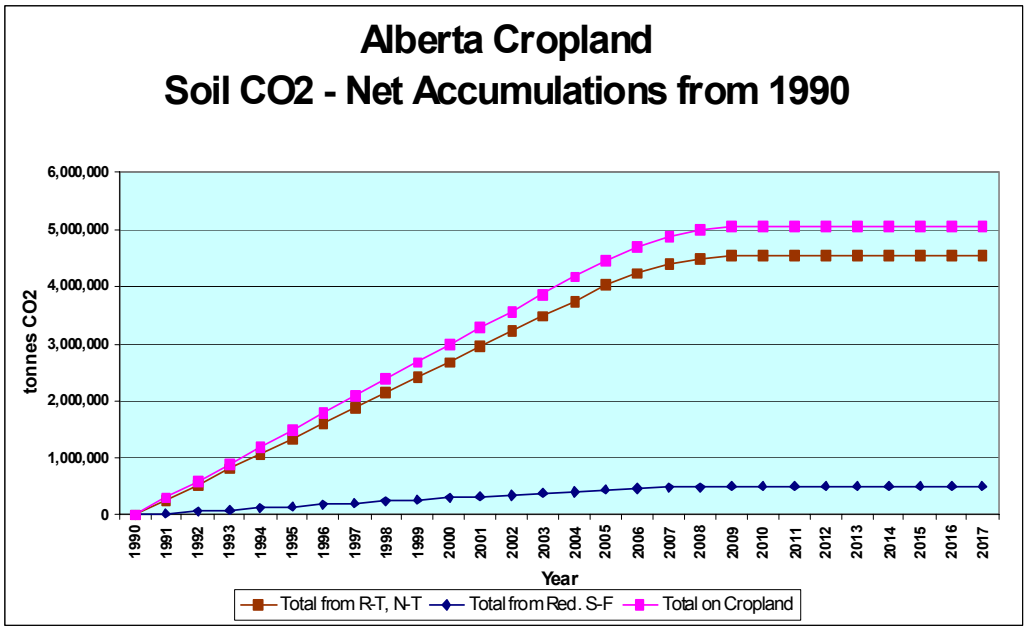
Figure 2 – Canadian Agricultural Soil Sink – 1990 to 2017 (tonnes/year)



Source: John Hastie Valdrew Environmental Services Ltd., Jan. 2001[5]

[5] Sequestration rates on graph refer to 1) conservation practices on cropland, 2) pasture management, 3) Converting marginal cropland to grass 4) wetland restoration, and 5) total on all agricultural land.

Figure 3. Alberta Agricultural Soil Sink (tonnes/year)



Source: John Hastie, Valdrew Environmental Services Ltd. Jan. 2001[6]

As previously mentioned, producers have adopted practices that increase soil carbon because they make economic sense. If a tradable permit system is implemented these practices could generate additional income for farmers in the form of payment for carbon credits. This cash incentive could result in even more sequestration efforts. However, the creation of carbon credits is not without its own risks. These risks will need to be overcome if more soil sequestration is required to meet the Kyoto targets. The following section outlines the concerns and risks associated with participating in a trading program.

Credit Creation Risks

Creating carbon sequestration credits is analogous to creating a new commodity that can be bought and sold in the market place. However, as with any commodity trade, there are risks. The level of risk associated with any type of commodity, including a carbon sequestration credit, can have an effect on the price of that commodity and even on the willingness of buyers and sellers to enter in to the market. From a buyer's perspective, the more risk associated with a commodity, the lower the price they will be willing to pay. From a seller's perspective, the more risk associated with their participation in the market, the higher will be their required price. Some of the risks associated with carbon credits are common in all markets and some are more unique.

[6] Graph Key, R-T, N-T refers to total from reduced till and no till; and total from Red, S-F refers to reduced summer fallow

Price risk is a common concern in all markets and the question is - whether price will be higher or lower in the future. Buyers and sellers continually assess this risk in every transaction and thus this risk is not unique to carbon credits. Similarly, there is concern that either the buyer or seller might default on the transaction. For example, a buyer is concerned that a seller might not provide the commodity they promised. The seller is concerned that the buyer will not take the agreed amount. This latter type of risk is generally called performance risk and exists in any type of commodity trade. Because carbon credits are a new commodity these risks may be, at least initially, somewhat larger.

In addition to the common market risks there are also some risks that are unique to carbon trades. A number of unique risks important to agriculture have been identified in Climate Change Central workshops and discussions within the ERTP team. These risks stem from a lack of regulatory rules that affect both the supply and demand for agricultural credits, the issue of permanence, and liability.

Policy Uncertainty

The unique risks associated with carbon credits as a commodity come largely from the lack of current regulatory rules. Without specific rules, there is no guarantee as to the definition of what counts as an emission reduction credit, how these credits may be used and whether they may be saved for future use. Furthermore, until regulations exist that strictly limit emissions, there will be little demand for any emission reductions credits that agriculture can provide. This lack of demand has a significant impact on the market value or price of credits. Specifically, without a demand, the market value of such credits will be very low. The premise of this paper, however, is that future GHG policy will have constraints on carbon emissions, and because of that that agricultural credits will have value. From that perspective, the following section attempts to illustrate the current risks associated with the policy uncertainty.

The Definition of a Credit. Depending on whether a credit is generated from an emission reduction or an atmospheric removal, it is defined two ways, 1) the level of emission reduction measurable in tonnes of CO_2 <u>not</u> emitted per year, or 2) the amount of carbon stored, or sequestered. While this sounds quite straight forward, it isn't. Specific rules don't exist so there is uncertainty surrounding what actions result in emission reductions. It is unknown as to whether actions that result only in direct reductions like changing feed and reducing animal ruminants will be counted or if indirect reductions like changing to energy efficient lighting in farm buildings be considered credit creation?[8] For a more complete definition of certified emission reductions, emission reduction credits and RMU's see Appendix D.

[7] It is important to note that current carbon credit discussions use both the terms CO2 gas and carbon. As noted in footnote 3 these terms are not equivalent.

[8] Changing to more efficient energy lighting results in only an indirect emission savings because while less energy is used, there is no guarantee that emissions into the atmosphere are truly less. For a direct reduction to occur it must be shown that increased energy efficiency results in less energy being produced and consequently less fuel (like coal) is used to generate electricity.

Bankability. The rules defining the bankability of credits is yet another area that needs clarification. The issue of bankability is important for several reasons. If credits are not bankable or have only limited bankability they must be used in the year created, in other words they have a specific "vintage". If bankability is disallowed, credits created in previous years cannot be used to offset emissions in current or future years. As a result, these credits would not have a value in the market. For example without bankability, if a producer entered into a contract to sequester carbon and trade those credits, they would only be able to trade vintage year credits for the incremental amount of carbon sequestered each year of the contract after the regulation was in place. Producers would not be able to sell credits for carbon sequestered prior to the contract. With bankability, producers could create credits and save or sell them at some point in the future and the credits would have the same value as the year they were created. The policy uncertainty about bankability keeps many producers and buyers from entering into credit contracts.

Credit for Early Action. A related issue to bankability is whether credit will be given for emission reduction actions prior to the establishment of regulations. If regulations were established today, carbon sequestered prior to today is considered historically sequestered carbon (i.e. according to Hastie historically sequestered carbon amounts to 13 million tonnes CO_2e in Canada and 3 million tonnes CO_2e in Alberta, see figures 2 and 3). There is concern that this carbon would not be recognized in a future domestic emissions trading market because federal officials have repeatedly indicated that there will be no credit given for early action.

Future Liability for Stored Carbon. Historically sunk carbon also raises the issue of future liability because at some point in time, producers may want to revert to conventional farming practices that release stored soil carbon into the atmosphere. If agricultural emissions are regulated in the future, this release of stored carbon could be counted as an emission, and the producer could be penalized. Alternatively, there is concern that government might require that soil carbon storage be permanent and could restrict the use of conventional tillage and summer fallow practices. Any requirement that soil carbon be stored indefinitely reduces the flexibility of agricultural practices on the land. This type of permanent restriction is similar to an easement and may serve to reduce the market value of that land.

In current policy discussions there is a high probability that agricultural emissions will not be regulated in the near term. It is not considered a capped part of any trading policy scenario currently under consideration by the Federal Government (AMG, 2000). This does not preclude the chance that agriculture might be regulated in the future. Based on Canada's emission inventory, the agricultural sector accounts for 10% of all GHG emissions (see figure 4). Because of the threat that future regulations might limit agricultural emissions, the agricultural community wants to ensure that they have sufficient sequestration potential to at least cover their own emissions[9]. In addition, they want to ensure that they could cover the emissions that would result should they decide to switch to a farm practices that would release historically stored carbon.

[9] Agricultural Industry Climate Change/Greenhouse Gas Forum, March 13-14, 2000.

A related issue in regulatory liability discussions is the fear that participation in a trading program could, by its existence, lead to more regulation of agriculture soils. The justification for this belief comes from the idea that government will see producers are creating carbon credits with no adverse impact and so soil sequestration could be legislated. The probability of this risk becoming real is uncertain. In fact, some argue that not participating in efforts to address GHGs increases regulatory risk. (Donnelly, 2001) Whether participation changes the regulatory risk is unknown but the fact remains that farmers have tended in the past few years to increase the level of carbon in their soil to improve their farm performance. Thus it seems reasonable to suggest that the risk is already there with or without participation.

Ownership. One of the key issues surrounding the sale of any commodity is ownership. Over the years legal rules and procedures have been created to specify ownership and thus eliminate risk and uncertainty for most types of private property. For example, land registries were created to give evidence of land ownership so that buyers could know whether the seller in fact owned the land it was offering for sale. No such system currently exists for greenhouse gas credits. The question of ownership is further muddied when the owner of the land is different from the operator. In this case, if carbon is stored by a producer/operator rather than by the actual owner of the farm – the question is who owns the potential credits, the owner or the person who stored the carbon? As a result, the buyer must satisfy themselves through independent investigation and legal assurances from the seller that the seller in fact owns the emission reduction credit.

The question of ownership is further complicated by the issue of whether agricultural sinks are a private or public good. If soil carbon and the associated soil sink is a private good, private organizations and individuals may enter into contracts that provide for the exchange of GHG credits that might arise through the enhancement of agricultural sinks. If they are public goods, the government is the likely the owner and changes in soil carbon will likely have to be approved and provided for in the form of allotments or leases administered by government officials, much like grazing rights or oil and gas leases on crown lands.

In the debate on sink ownership, legal precedent may serve as a guide to ownership. Currently producers have the right (unless legally excluded in a prior purchase agreement) to sell their soil, change or amend their soil as necessary, or even dig out and sell the aggregate found on their land (Tyrrell, 2002). This seems to imply that a farmer has the right of ownership to their soil and thus to any carbon sequestered in that soil. Until a legal opinion on this issue is put forth by government, however, ownership of soil carbon still seems to present some risk.

Permanence

In addition to the lack of regulatory certainty, the issue of whether soil sequestration provides permanent carbon storage has received considerable attention. For sinks, the term permanence generally refers to the idea that carbon once sequestered in soil may not stay there forever. As noted earlier, after switching to a no till practice to sequester carbon, a farmer may find the need to till again at some future date (perhaps to deal with weeds). Additionally soils have a finite ability to absorb carbon. At some point, soils

become saturated with carbon and when this occurs there will be some carbon flux from year to year.

Permanence, however, is not unique to GHG emissions in the agricultural sector. This same risk can also been seen with emission reductions from other sectors. With electricity producers, for example, if they reduce their use of coal, they can claim a reduction in emissions. This type of emission reduction, however, may not be permanent. Not burning a tonne of coal today does not mean that someone else will not burn it today, or even that the same firm will not burn it tomorrow. Perhaps the only type of emission reduction that might be considered permanent is a switch in technology. The large scale conversion to hydrogen fuel cells in automobile, for example, would reduce GHG emissions. Such a technology change would likely not be reversed and thus could be considered a permanent emission reduction.

Over time, markets and the regulatory and legal frameworks in which they operate evolve. The implementation of the initial rules however, will no doubt alleviate much of this risk that potential buyer and sellers currently face. Until that time, however, there are certain strategies that can be used to minimize this uncertainty. The following section attempts to outline some of these strategies.

Risk Minimization

In any type of commodity transaction there are risks. Will the seller provide all that they promised; will the buyer buy all that they requested? Will there be supply/demand interruptions beyond those anticipated by the buyer or seller? Will market prices change significantly over the course of the contract? These risks and others, that can be anticipated, are usually addressed in market rules and in the specific bilateral commodity contracts between the buyer and seller. Appendix B provides a sample term sheet that specifies some of the provisions that might be necessary in a carbon credit contract.

Current discussions around minimizing some of the risks associated with soil carbon credits have tended to focus on the use of leasing arrangements. In these arrangements credits are leased and not sold - meaning that the seller eventually gets those credits back. If rules defining credits specify that they are bankable, this may solve the problem of liability for farmers. If this is the case, however, the buyer will have to find replacement credits, which may reduce the attractiveness of agricultural credits and thus their price.[10] The more significant problem with leasing arises if credits are not bankable. If this is the case, then the return of vintage credits from previous years will not cover a producer's current or potential liability in the future, unless governments can provide this regulatory certainty to producers.

A market for GHG credits is new and not yet part of a formal legal system as such, anticipating risks is difficult. Buyers and sellers, therefore may want to be more

[10] Some people have suggested that at the end of a leasing arrangement, all buyer and seller obligation would end and that sellers would be able to re-lease the previous carbon sequestered as new credits. In this scenario, there exists no real reduction in emissions only a delay.

conservative in their trading practices by dealing in only "gold standard" credits, partial sales or work with aggregators who assume transaction risk.

Gold Standard Credits. To get around regulatory uncertainty, it may be prudent to only deal in credits that are real, measurable, verifiable, and surplus to existing regulation. In other words, emission reductions or removals that indisputable, and are defined according to the best available scientific principles.[11] It also means that they should be verifiable by an unbiased third party agreed to by all parties in a transaction. An independent third party is then responsible for verifying that the emission reductions or removals are created and reported according to some predetermined criteria.

One criteria that is common in current transactions is that the credits must be generated specifically for emission reduction and not because of some other regulatory requirement. For example, should governments provide agriculture incentives to implement some of the best management practices identified previously, concern exists that carbon sequestered by those producers would not be allowed to be counted as sequestration credits nor sold in the market. The informal term for these types of credits is "anyway" credits. Meaning that carbon would have been sequestered "anyway" and was not sequestered as a direct action to reduce GHGs**.** Current thought on the issue of "anyway " credits is that while these may be legitimate emission reductions, they are not surplus reductions below business as usual and thus do nothing more to protect the atmosphere.

Another criteria for gold standard credits is that they will be generated as a result of future actions and are not based on historical ones. This implies that gold standard credits must be based on incremental reductions or removals that will occur after regulation or at least after negotiation of an emission reduction transaction. These actions would thus not be based on past efforts.

Partial Credit Sale. In addition to only dealing in gold standard credits, farmers can also reduce much of their risk by only selling part of the sequestration credits that they create. Specifically, performance risk can be reduced by only selling a portion of one's potential sink capacity. Thus if a producer must use conventional tillage because of something like excessive weeds, they have a sufficient quantity of land under increased sequestration elsewhere to compensate. Finally, by only selling part of the credits that they create, they could potentially have credits to cover their own direct emissions should they ever be regulated.

Use of an Aggregator. Market risk can also be reduced by using an aggregator. An aggregator is an organization that assembles a group of sellers together to act as one collective seller. For example, in the U.S., the Pacific Northwest Direct Seed Association

[11] Sequestration can be determined by laboratory analysis of the carbon content of soil samples, by modeling, or by a combination of modeling calibrated by field samples. Because the cost of repeated precisions sampling could be greater than the price of carbon sequestered, direct sampling alone is not likely to be economically feasible for sequestration credit trades. Models on the other hand may not be as reliable as field estimation and because of this buyers may only buy the smallest amount of the predicted range of sequestration. Combined modeling with field sampling would be yet another option and could result in more assurance with a more moderate cost.

has taken on the role of the aggregator. This group is currently in negotiations to trade the carbon credits collected from a large group of no-till producers. The aggregator makes an agreement with each producer and then a single agreement with a seller. By having a significant number of sellers, each of whom does not sell all of their sequestration credits, the aggregator can manage the risk that any one producer might not want to sell their credits. Should this occur (because the producer wanted to sell their land unencumbered, or because they wanted cover their risk of regulation or simply because they wanted to till again) an aggregator would be in a position to give those credits back to the producer (assuming they are bankable) or would be able to easily obtain replacement incremental vintage credits from other producers in the group.

The use of an aggregator is viewed by this team to be one of the most viable strategies to facilitate the trade of agricultural sequestration credits for two basic reasons. First, the use of an aggregator can serve to provide sufficient quantity for prospective buyers. The minimum tonnage suggested by one potential buyer of carbon credits is at least 10,000 tonnes (Cionna, 2002). In comparison, if a 2000 acre farm were to switch entirely from conventional tillage to no-till, it could only generate 2,440 tonnes per year (as per estimates provided in appendix C). Second reason the use of an aggregator is thought to be most viable is because it can directly address the issue of liability. The use of an aggregator provides producers with the flexibility to cover their own liability much like an insurance policy does. The tradeoff, however, is the lower price that farmers would receive for their credits. The issue of lower price may not be significant for some farmers if the payment for credits is viewed as a bonus payment for actions already underway.

Leasing Carbon Removals – some stakeholders have advocated the concept of leased carbon removals as an alternative to any form of carbon sale (Bennett, 2000). Leasing would require that valid carbon credits be returned to the producer at the end of the contract. If a buyer for leased tons could be found, the price paid for those credits would likely be substantially less than for credits sold outright. This would be similar in analogy to the price paid for the purchase of a house as compared to the rental price. Most team members, however, believe that leasing is not an option that most buyers would consider and as such, believe that leasing may not be a viable method to reduce risk. While there may be buyers willing to pay for leased tons in the short term, it is not believed that this option could be used extensively.

Government Purchase or Incentive for Carbon Removals. Another way that risk can be reduced for agricultural producers is if the one or more levels of government chooses to offset risk through direct purchase or partial purchase of carbon removals. The federal/provincial PERRL initiative could in theory, purchase or even lease carbon removals from producers. Several bills in the U.S. have taken this form of risk offsetting. This might be done on a temporary basis to help kick-start the private market.

Option Contracts. Another method of reducing the liability risk is to enter into an options contract on future carbon credits. An options contract, allows buyers or sellers to pay for the option of buying or selling a specific commodity at a specific price in the future. It is important to note that in an options contract a buyer or seller has the right,

but not the obligation, to buy or sell a specific commodity within a specific period of time at a specific price. The option contract to buy is called a "call" option and the option to sell is called a "put" option.

The use of options contracts in agriculture is a relatively new phenomenon in Canada but has been used extensively for other commodities like metals to hedge against price, performance and other types of market risk. The following list characterizes a typical transaction.

When a buyer and seller enter into an option contract:

- The buyer and seller agree as to the volume, future time for delivery and price of the commodity
- They buyer pays a "premium" or upfront payment for the right to take delivery of the agreed upon commodity in the future. The seller, by accepting the upfront payment and agreeing to the terms of the option contract, is obligated to deliver the agreed upon commodity in the future.
- A "put" option in the contract specifies that there is some quantity that a buyer will purchase. In this case, the potential supplier may or may not have an obligation to offer the commodity for sale, (depends on how the contract is structured) but if it is offered, the buyer has the obligation to pay for them.
- A "call" option in the contract specifies that there is some quantity that a seller will agree to provide in the future. There is no obligation on the part of the buyer to purchase this commodity if it is offered for sale, but should the buyer decide to exercise this option, the seller has the obligation to provide the commodity at the option price.
- The right of first refusal provision requires the seller to offer any additional credits created (beyond the firm amount committed) that might be generated because of the buyer's investment back to the buyer at a prior agreed upon price, before offering them to anyone else in the marketplace. There could be an upper limit on the volume covered by the provision and any amount over this could be offered to another buyer. Should the initial buyer not want to purchase the additional units, the supplier is again released to offer them to another firm. Pricing on the credits created under a first refusal provision could be the same as the pricing for the put option, or could be indexed to some market indicator.
- The timing of delivery can vary depending upon what the buyer and seller agree to. For peas, the option agreement is usually settled in the spring for delivery in the following fall. For GHG reductions/removals, the option agreement tends to have longer timelines with delivery occurring over a series of years for five to ten years in the future.
- Follow-up payment obligations of the buyer are triggered by the delivery of the agreed upon volume of the commodity at the agreed upon date.
- When the term of the option agreement expires, the seller and buyer have no further obligation to one another.

Buyers and sellers, because of the early stage of development of the GHG market may also need to come to some agreement on a variety of other issues. For example, credit verification monitoring and even terms for contract reevaluation will need to be agreed

on. In this latter case, this may require agreement on the formula to price readjustment, should price be higher or lower in the future. For example, the buyer may agree that if there is a fully functioning market for GHGs in the future and the market price at the time of delivery is significantly higher than the contracted price, that the buyer will pay some portion of this price difference. However, the amount that the buyer will pay in addition to the agreed upon price varies and this type of agreement usually involves a give and take between buyers and sellers. That is, if the buyer agrees to a formula for adjusting price in the case where the market price is higher in the future, it usually means that the seller will also agree to a formula where the seller will receive a somewhat lower price if the market price in the future is less than the contracted price.

Options contracts can even be used to reduce the liability concerns associated with future regulation on agricultural emissions. Specifically, if bankability is not allowed to meet regulatory requirements specific vintage credits are required, a producer could pay a premium on a call option for future credits that would cover their liability when their contract for sequestration is concluded. A call option though, does not require a producer to actually buy those credits, and in fact such a purchase would not be needed if agricultural emissions were not regulated.

Conclusion

This team has found that even with existing policy uncertainty in the carbon market some risks can be reduced such that trades in agriculture can be feasible. A principle method of reducing risk is with the use of an aggregator. Aggregators provide a beneficial service to both buyers and sellers because they can generate a large block of credits, which serves to reduce the cost of identifying a large number of sellers. From the seller's perspective, an aggregator can serve to reduce the risk of liability, thus making it worthwhile for producers to sell their credits. Other risks can be reduced by use of only gold standard credits and option contracts.

In any type of commodity transaction there are risks. These risks are more apparent and may also be larger in the early years of trading. Currently only a couple of major GHG trades involving agriculture have occurred. It should be anticipated that many of the uncertainties would be eliminated as specific rules are developed and experience is gained from more trading. Until that time, these risks will keep some people from buying or selling carbon credits. However, there will be others who see opportunities and are willing to shoulder the risk in exchange for compensation.

REFERENCES

AMG, 2000. An Assessment of the Economic and Environmental Implications for Canada of the Kyoto Protocol**.** National Climate Change Process, Analysis and Modeling Group. November.

ACCT, 2000. "Options Report: Reducing Greenhouse Gas Emissions From Canadian Agriculture. Jan. 2000. Agriculture and Agri-Food Climate Change Table. Publication # 2028/E. http://nccp.ca/NCCP/national_process/issues/agriculture_e.html#options

Bennett, John, and Dave Mitchell. 2000. Emissions Trading and the Transfer of Risk: Concerns for Farmers. Saskatchewan Soil Conservation Association. ssca.usask.ca/Positions/risk.htm

Ciona, Cheryl, 2002. EPCOR Utilities. Personal Communication. Feb. 21

Donnelly, Aldyen, 2002. President of the Greenhouse Management Consortium (GemCO) Personal Communication, Feb 1.

Janzen, H.H., Campbell, C.A., Izaurralde, R.C., Ellert, B.H., Juma, N., McGill, W.B., and Zentner, R.P. 1998. Management effects on soil C storage on the Canadian Prairies. Soil and Tillage Research 47:181-195.

McConkey, Brian, et al. 2000. "Carbon Sequestration and Direct Seeding. Semiarid Prairie Agricultural Research Center, Agriculture and Agri-Food Canada. Http://ssca.usask.ca/2000proceeding/McConkey.htm

NCCP, 1999. Canada's Emission Outlook: An Update. National Climate Change Process. December, 1999

NCCP, 2000. Canada's National Implementation Strategy on Climate Change. National Climate Change Process. Oct. www.nccp.ca/NCCP/pdf/media/JMM-fed- en.pdf

Planetark, 2002. wwwplanetark.org/dailynewsstory.cfm/newsid/14442/story.htm. Feb. 8.

PFRA, 1999. Prairie Farm Rehabilitation Administration. Annual Carbon Accumulations in Agroforestry Plantations. An Agrifood Innovation Fund Project. Agriculture and Agrifood Canada. Saskatchewan. http://www.agr.gc.ca/pfra/shbpub/shbpub.htm.

PSCB, 1998. Prairie Soil Carbon Balance Project. Proceedings of the Prairie workshop on carbon sequestration in the agricultural sector. October 16-18, 1997. Edmonton. Alberta. Alberta Agriculture, Food and Rural Development.

Sinks, 1999. Land-Use, Land-Use Change and Forestry in Canada and the Kyoto Protocol. Sinks Options Paper, National Climate Change Process. September 23.

Sinks, 1998. National Sinks Table Foundation Paper. National Climate Change Process. Final Report, Nov. 17.

SWCS, 2000. "Growing Carbon: A New Crop That Helps Agricultural Producers and the Climate Too". Soil and Water Conservation Society. www.swcs.org.

Tyrrell, John, 2002. Lawyer. Borden Ladner Gervais, LLP. Calgary, AB Personal communication Feb 5, 2002.

Vickors, Paul. 2002. TransAlta, Managing Director Carbon Market Initiative. Paper Presented at DETW Emission Reduction Credit Trading Workshop. Feb 1 . Calgary.

World Commission on Environment and Development. 1987. Our Common Future. Oxford: Oxford University Press. 43.

APPENDIX A

ERTP Members

Leah Lawrence	Climate Change Central
Don MacDonald	Alberta Environment
Karen Haugen-Kozyra	Alberta Agriculture, Food and Rural Development
Cynthia Edwards	Ducks Unlimited
Ken Stickland	Ken-Agra Management Services
Cheryl Ciona	Epcor
John Hastie	Valdrew Environmental Services
Jack Gorr	Western Canadian Wheat Growers
Janet Peace	Climate Change Central

APPENDIX B

Sample Term Sheet

This term sheet is sample only. There are many forms that a term sheet can take; many forms in which a greenhouse gas (GHG) emission reduction transaction can take place. By placing this term sheet in the public domain we are by no means suggesting it presents the terms under which an agricultural GHG emission reduction and removal deal may take place in Alberta at this time or in the future.

BID

The buyer wishes to option a guaranteed quantity of GHG emission reductions and certain first refusal rights to further emission reductions that will arise from changes in land use. A schedule to the Agreement will outline specific actions to create GHG emission reductions, the general location of actions, and general procedures for estimating, measuring, verifying and reporting emission reductions arising from these actions.

Criteria	All emission reductions must meet the following basic criteria: - Real: A reduction of actual emissions resulting from a specific and identifiable action or undertaking. - Measurable: The actual level of emissions and emission reductions can be quantified. - Surplus: A reduction that, at the delivery date, is not otherwise required by law. - Verifiable: The calculation methodology is acceptable, transparent, and replicable. Raw data must be available to verify/audit calculations. - Owned: The ownership of the emission reductions must be clearly defined and not in dispute. Must also satisfy schedule outlining specific actions to create GHG emission reductions, the general location of actions, and the general procedures for estimating, measuring, verifying and reporting emission reductions arising from these actions.
Classification of emission reductions	FIRM = A set amount of tonnes carbon dioxide equivalent emission reductions offered by seller for annual delivery to buyer. RIGHT OF FIRST REFUSAL = Should the seller have tonnes carbon dioxide equivalent emission reductions available beyond the quantity of FIRM tonnes in any given year they must offer these tonnes first to the buyer. The buyer may then choose to pay for and accept delivery of these tonnes, or the buyer may decline delivery of these tonnes. If the buyer declines delivery, the seller may offer these RIGHT OF FIRST REFUSAL tonnes to any other buyer.

<table>
<tr><td>Classification of emission reductions (cont'd)</td><td>If the seller and buyer agree to verify the creation of emission reductions on anything more than conservative science the seller must commit to spot sampling as further verification. The seller then has the option of offering more RIGHT OF FIRST REFUSAL tonnes carbon dioxide equivalent emission reductions to the buyer.</td></tr>
<tr><td>Amount</td><td>FIRM = X amount of tonnes carbon dioxide equivalent emission reductions per year OR over a time period, to be delivered on schedule determined by seller.

RIGHT OF FIRST REFUSAL = up to X amount of tonnes carbon dioxide equivalent emission reductions</td></tr>
<tr><td rowspan="3">Price</td><td>OPTION PREMIUM
Premium will be paid upon completion of Agreement
$X per tonne FIRM
$X per tonne RIGHT OF FIRST REFUSAL</td></tr>
<tr><td>FIRM
Delivery Price paid in January of the year following the vintage year, when emission reductions are transferred from seller to buyer.

2004 $ X
2005 $ X
2006 $ X
2007 $ X
2008 $ X
2009 $ X
2010 $ X
2011 $ X
2012 $ X</td></tr>
<tr><td>Note: Price may vary from year to year.</td></tr>
</table>

Price (cont'd)	**RIGHT OF FIRST REFUSAL** Delivery Price paid in the year following the vintage year, 60 days after seller offers tonne emission reductions to buyer and 30 days after buyer accepts.
	2004 $ X 2005 $ X 2006 $ X 2007 $ X 2008 $ X 2009 $ X 2010 $ X 2011 $ X 2012 $ X
	Note: Price may vary from year to year.
Price Flexibility	In the event that there is an established market for emission reductions, and the emission reductions in question in this Agreement qualify for that market, there will be a relationship between the Price paid by Buyer to Seller and the market price. Price = FP + (35% x (MP-FP)) Or Price = RFRP + (35% x (MP-RFRP) Where 'FP' is the firm price specified above, 'RFRP' is the Right of First Refusal Price specified above, and 'MP' is the Market Price.
Start Date	Upon completion of Agreement, and no later than December 31, 2002 OPTION PREMIUM will be paid to seller. Buyer has until February 15, 2003, EXERCISE DATE, to exercise the option. Should the buyer exercise the option, delivery will commence in January 2005, of 2004 vintage year tonnes and continue every year until the terms of the agreement expire. If buyer does not exercise option the deal will terminate and there will be no requirement for any delivery from seller to buyer.
Payment terms	OPTION PREMIUM to be paid with 60 days of completion of Agreement. Payment for FIRM and RIGHT OF FIRST REFUSAL tonnes will be paid within 30 days of delivery to buyer.
Length of Purchase	Agreement will deliver tonnes of the vintage years 2004-2012, where final delivery takes place in January 2013.

Term of Agreement	Agreement will remain in effect until December 31, 2013. If option is not exercised the Agreement terminates February 16, 2003.
Creation	An emission reduction is created and is potentially transferable: - When a reliable method for estimating/measuring, verifying and reporting the emission reductions can be agreed and is publishable. - When all parties with a rightful claim to the emission reduction can agree who owns and has the right to sell related emission reductions.
Transfer & Delivery	Emission reductions created by the seller and sold to the buyer will be transferred no later than January 31 of each year following the vintage year. Delivery entails a creation and verification report as well as a transfer certificate.
Verification and Reporting	Detailed protocols for estimating, auditing and reporting emission reductions will be developed and included as a schedule to this Agreement. All emission reductions to be transferred by the seller must be verified by a third party. Third party and payment will be mutually agreed upon prior to the completion of the Agreement. Changes to the identity of the third party must be approved by both buyer and seller and must be in writing.
Failure to Deliver	If the seller fails to deliver the full amount of FIRM tonne of emission reductions the buyer has any one of the following remedies: - Entitlement to liquidated damages necessary to compensate the buyer to acquire an alternative supply of emission reductions of a similar quality. - Require the seller to find an alternative supply of emission reductions of a similar quality at their own cost.
Failure to Accept Delivery	After the buyer exercises option, if buyer refuses to accept delivery or refuses to pay the seller for delivery at any time during 2005-2013, the seller is entitled to one of the following remedies: - Entitlement to liquidated damages necessary to compensate the seller for delivery of the firm tonne to an alternative buyer of emission reductions of a similar quality.

APPENDIX C

Greenhouse Gas Emission Reductions

Management Practice	Potential GHG Mitigation **Tonnes of C02 equivalent per year/per hectare** **(Source)**	Verification Requirement
Reduced Summerfallow to 1 in 5	.44 (McConkey, 2000 PSCB and Sink Table Option Paper)	Crop production statistics for two years before and for at least five years after the change in management practice to demonstrate change in and maintenance of management practice.
Rotational/managed grazing/pasture fertilization	.73 (Sinks Table Option Paper, 1999)	Documentation of management activities undertaken two years prior and for at least five years after the management practice was implemented
No tillage or reduced tillage	1.22 (McConkey, 2000 PSCB and Sink Table Option Paper)	Crop production statistics for two years before and for at least six years after the change in management practice to demonstrate change in and maintenance of management practice. Fuel consumption record and equipment use records two years before and for at least six years after the change in management practice to demonstrate reduced fuel consumption. Fertilizer consumption records for two years before and for at least six years after the change in management practice.
Woodlot planting on grassland	2.46	Demonstration that each hectare has been maintained as biomass production for 7 to 40 years, depending on the species.

Conversion of cropland to grassland	2.94 (first five years) 2.2 (thereafter) (Sinks Table Option Paper, 1999)	Provide documentation on crop and hay/pasture history for two years prior and each year after for term of contract.
Shelterbelt Planting	4.66 (PFRA, 1999)	Demonstration that each hectare has been maintained as biomass production for 7 to 40 years, depending on the species.
Woodlot planting on cropland (Planting trees on land that was previously used for crops)	4.66 (PFRA, 1999)	Demonstration that each hectare has been maintained as biomass production for 7 to 40 years, depending on the species.
Fertilizer efficiency		Fertilizer consumption records for two years before and at least six years after the change in management practices is implemented. Including the time of application, type and quantity of fertilizer and method of application.
Improved crop rotations -- pulse/grass/legume in rotation		Practice is usually defined as reduced tillage.

APPENDIX D

Certified Emission Reductions (CERs) or Certified Emission Reduction Units - are verified and authenticated units of GHG reductions from abatement or sequestration projects which are certified by the Clean Development Mechanism.[12]

Emission Reduction Credits(ERUs) – ERUs are emission reduction units resulting from projects aimed at reducing anthropogenic emissions by sources or enhancing anthropogenic removals by sinks of GHGs in any sector of the economy.[13]

Removal Units (RMUs) – RMUs are credits that are produced by domestic carbon sequestration. RMU's are to be used exclusively for the purpose of establishing compliance with Kyoto. RMU's cannot be banked for future commitment periods.[14]

[12] The Kyoto Protocol to the Convention on Climate Change, Article 12.

[13] The Kyoto Protocol to the Convention on Climate Change, Article 6.

[14] Marrakech Accords