A Crop for the 21st Century:

Carbon Credits and Agriculture in British Columbia

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Important Notice and Disclaimer:

The purpose of this paper is to provide an overview of carbon markets as well as a preliminary assessment of the project types from which the B.C. agricultural sector may be able to generate carbon offsets. Because the sale of carbon offsets is a nascent and evolving industry, the information provided in this report is subject to change as new information becomes available. The authors acknowledge this limitation and stress that other agricultural carbon offset projects including feed management strategies, gasification and/or pyrolysis, livestock management, land restoration, water management and sequestration of CO_2e by perennial grasses, etc., may also hold potential for B.C. agricultural offset projects. Conversely, there is a potential for carbon offset project types identified in this paper to become ineligible due to environmental or regulatory changes. Because the information provided in this document is intended to serve as an education purposes only, it should not be considered the basis for any business decision. Proponents and professionals working on carbon offsets should refer to relevant legislation and conduct the appropriate due diligence analysis and/or obtain appropriate advice regarding the undertaking of any carbon offset project.

List of Acronyms, Abbreviations and Units

AD	Anaerobic Digestion
ANSI	American National Standards Institute
BAU	Business As Usual
CAS	Climate Action Secretariat
CCX	Chicago Climate Exchange
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CFI	Carbon Financial Instrument
CH_4	Methane or Natural gas
CO_2	Carbon Dioxide
ERU	Emission Reduction Units
EU ETS	European Union Emission Trading Scheme
GHG	Greenhouse Gas
GWP	Global Warming Potential
GGRTA	Greenhouse Gas Reductions Target
HFC	Hydrofluorocarbon
IAF	International Accreditation Forum
IPCC	Intergovernmental Panel on Climate Change
IRR	Internal Rate of Return
ISO	International Standards Organization
JI	Joint Implementation
MCeX	Montreal Climate Exchange
NGO	Non-Governmental Organization
N_2O	Nitrous Oxide
OTC	Over the Counter

PCT	Pacific Carbon Trust
PFC	Perfluorocarbon
PSO	Public Sector Organization
QA	Quality Assurance
QC	Quality Control
RGGI	Regional Greenhouse Gas Initiative
RFS	Renewable Fuel Standard
SCC	Standards Council of Canada
SSR	Source, Sink or Reservoir
tCO_2e	Metric tonne of CO_2 equivalent
UNEP	United Nations Energy Programme
UNFCCC	United Nations Framework Convention on Climate Change
VER	Verified Emission Reductions or Voluntary Emission Reductions
VGS	Voluntary Gold Standard
WCI	Western Climate Initiative
WMO	World Meteorological Organization
WRI	World Resources Institute

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EXECUTIVE SUMMARY

- The Intergovernmental Panel on Climate Change (IPCC) has concluded that anthropogenic greenhouse gas (GHG) emissions are significantly impacting the earth's climate.

- Carbon offsets are financial instruments that are generated from GHG emission reduction, avoidance or removal enhancement (sequestration) projects that are not mandated to reduce GHG emissions. The purpose of carbon offsets is to incentivize entities to reduce their greenhouse gas emission levels, deemed to be a significant contributor to climate change, through market-based processes. Carbon offsets can be sold in both regulated and unregulated carbon markets.

- The opportunity for the B.C. agricultural sector to benefit from carbon offset projects should not be overestimated; however, certain types of projects represent real opportunities for the agricultural sector to generate revenue from the sale of carbon offsets. Carbon offsets can supplement current revenue streams, mitigate risk through diversification and cover the cost of environmental initiatives previously considered too expensive or too risky to be undertaken.

- The term "carbon market" refers to the buying and selling of carbon credits that have been either distributed by a regulatory body (e.g., government) or generated by voluntary greenhouse gas (GHG) emission reduction projects.

- There are three methods of achieving GHG emission reductions:
  1) reduction: the amount of GHG emissions entering the atmosphere is reduced e.g., the combustion of methane captured from manure storage pits,
  2) prevention or avoidance: GHG emissions are prevented or avoided from entering the atmosphere e.g., the utilization of cleaner energy technologies for new projects, and

3) removal enhancement: the quantity of GHG emissions taken out of the atmosphere is increased**.** Removal enhancement, also known as sequestration, removes carbon dioxide from the atmosphere and stores it as organic carbon in the soil or biomass e.g., afforestation projects.

- To determine the emission reductions of a carbon offset project, project proponents must first determine the baseline, which is an estimate of the GHG emissions that would have likely occurred had the project not been undertaken (also called the business-as-usual scenario).

- The stringency level of a particular carbon program's eligibility criteria is one of the most crucial factors in determining whether a GHG emission reduction could become a legitimate carbon offset.

- Currently, B.C. agricultural carbon offset project proponents can sell carbon offsets to the government-sponsored Pacific Carbon Trust (PCT) or on the voluntary market (unregulated market). In addition, the B.C. Provincial Government has legislated that a regulatory system, i.e., cap-and-trade system, will take effect in 2010 as part of its commitment to the Western Climate Initiative (WCI). B.C. agricultural carbon offset project proponents may also have an opportunity to sell carbon offsets under the WCI in the future.

- The WCI offset program likely presents less opportunity for B.C. agricultural carbon offset projects to sell their carbon offsets at prices that are sufficient to make these projects viable. This is primarily due to the recommendation by the offset design sub-committee that capped entities only be allowed to use carbon offsets to account for a maximum of 49% of their total emissions as well as the decision to increase supply by permitting extra-jurisdictional carbon offset projects to be included in the pool of eligible carbon offsets[1].

[1] It should be noted that these decisions on design of the WCI carbon offset program have not been finalized and could potentially be modified prior to commencement of the program.

- The voluntary market may provide a good fit for small-scale projects that are unable to pay the transaction costs associated with the eligibility requirements of the PCT or WCI.

- Project proponents may want to investigate whether their emission reduction project has the potential to be aggregated with other similar projects to achieve economies of scale by spreading the high transaction costs of validation, verification and other administrative fees over multiple projects.

- B.C.'s agricultural sector is different from most other provinces in both the size and scope of its operations. Consequently, viable agricultural carbon offset projects will reflect these unique attributes of the sector.

INTRODUCTION

This document was written with two primary objectives in mind:

1) to provide agricultural carbon offset project proponents with an overview of the current and emerging carbon offset opportunities in B.C.,

2) to provide the B.C. agricultural community with the necessary background knowledge to determine whether their own operations have the potential to generate legitimate carbon offsets.

Section one begins with a basic introduction to carbon trading, including the terms and concepts that are necessary to understand the nature and function of carbon offsets and carbon markets.

Section two presents an overview of the standard criteria that carbon offset projects must typically meet to qualify as legitimate, saleable carbon offsets.

Section three examines the major stages of a carbon offset project and provides practical information specific to project proponents[2] in B.C.'s agricultural sector.

Section four summarizes the three major types of carbon trading markets in B.C.: the Pacific Carbon Trust (PCT)[3], the Western Climate Initiative (WCI) and the voluntary market and assesses the potential for B.C.'s agricultural sector to supply carbon offsets to each of these markets.

Finally, section five concludes with four examples of agricultural carbon offset projects that hold potential to generate legitimate, saleable carbon offsets in B.C. This section assesses the possible strengths and limitations of each of these projects by drawing upon the information provided in the earlier sections.

[2] A project proponent is defined as a person who proposes to either carry out or engage another person in carrying out a project to generate carbon offsets.

[3] For the purpose of comparison within this paper, the PCT has been classified as a market; however, the authors acknowledge that this classification does not accurately fit within the traditional definition of a market.

1.0 CARBON TRADING OVERVIEW: THE BASICS

"Global carbon market activity was estimated to be worth more than US $66 billion in 2007."[4]

The world's top scientists have deemed the effects of climate change to be the most significant environmental crisis that humans currently face.[5] The B.C. Provincial Government has responded by making climate change a top priority and has chosen to address this issue on two primary fronts: 1) greenhouse gas (GHG) mitigation, and 2) climate adaptation. This document will focus on the economic opportunities associated with GHG mitigation; specifically, the market-based process of regulating pollution by assigning a monetary value to (GHG) emission reductions.

There are three primary approaches to achieving GHG emission reductions:

1) reduction: the amount of GHG emissions entering the atmosphere is reduced e.g., the combustion of captured methane from manure storage pits,

2) prevention or avoidance: GHG emissions are prevented or avoided from entering the atmosphere e.g., the utilization of cleaner energy technologies for new projects,

3) removal enhancement the quantity of GHG emissions being taken out of the atmosphere is increased**.** Removal enhancement, also known as sequestration, occurs when carbon dioxide is removed from the atmosphere and stored as organic carbon in soil or biomass e.g., afforestation projects.

For this paper, an *emission reduction* is defined as any of the three approaches mentioned above that leads to a decrease in the amount of GHG emissions in the atmosphere.

In B.C., there are multiple GHG mitigation strategies, policies and incentives capable of creating opportunities for certain sectors to engage in GHG emission reduction projects. Most notable among these opportunities has been the introduction of the various carbon markets. The following section provides an overview of the key characteristics of carbon markets and what these markets signify for potential carbon offset project proponents within B.C.'s agricultural sector.

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[4] Ecosystem Marketplace, "State of the Voluntary Carbon Market: Picking up Steam". http://ecosystemmarketplace.com/documents/cms_documents/2008_StateofVoluntaryCarbonMarket.4.pdf (Accessed March, 2009)

[5] For more information see: http://climatecongress.ku.dk/newsroom/congress_key_messages/ (Accessed March, 2009)

1.1 Carbon Markets

The term "carbon market" simply refers to the buying and selling of carbon credits that have been either distributed by a regulatory body (e.g., government) or generated by voluntary GHG emission reduction projects. The entities involved in these transactions may range from individual consumers or project developers to organizations and countries.

1.2 Carbon Credits and Market Types

The term "carbon offset" represents a GHG emission reduction equal to one metric tonne of carbon dioxide equivalent (tCO_2e). **"Carbon credit"** is a general term, which can refer to both carbon allowances and carbon offsets that are traded or sold in various carbon markets. Carbon markets are divided into two principal categories: regulated markets and voluntary markets.

- **Regulated (compliance, mandated) markets** are typically cap-and-trade systems whereby a regulatory authority sets a cap (allowable limit), which is lower than the current emission levels, on the largest emitting measurable industries. Over time, the allowable emission limit is gradually decreased, resulting in fewer and fewer GHGs until the ultimate reduction goal is achieved. The authority either gives or auctions a specified number of carbon credits, known as allowances, to companies within these industries. The number of allowances each company is allotted is relative to their estimated GHG emissions cap and estimations of their respective emission levels. Therefore, a **carbon allowance** is a specific term for a contract where an authority, under a cap-and-trade regime, allows companies to emit one tCO_2e per allowance. In other words, a company must possess an allowance for every tonne of carbon dioxide equivalent it releases into the atmosphere. A company that reduces its emissions beyond its capped level can sell the excess allowances to other cap-and-trade participants that have not met their own capped obligations. In addition to allowances, some regulated markets permit capped companies to purchase non-regulated carbon credits, known as offsets. A **carbon offset** is a specific term that typically refers to voluntary project-based GHG emission reductions that are *generated outside* a cap-and-trade system, but can be sold in either the regulated or unregulated market. The regulatory authority usually establishes

offset eligibility criteria to ensure the environmental integrity of the program. The rationale for allowing carbon offsets under a cap-and-trade regime is to provide greater program flexibility by decreasing the cost of compliance for capped companies by increasing the available supply of credits. Only those sectors that are *not regulated* under a cap-and-trade system are eligible to generate carbon offsets.

- In contrast, the **unregulated (voluntary) market** does not rely on legally mandated carbon reductions to generate demand. This market involves the buying and selling of voluntarily generated carbon offsets by entities that wish to reduce their emissions for reasons other than regulatory. For example, a company may decide to purchase carbon offsets to demonstrate to its customers its commitment to addressing climate change.

A number of both compliance and voluntary markets have emerged in various regions around the world (Appendix B).

1.3 Carbon Offset Projects

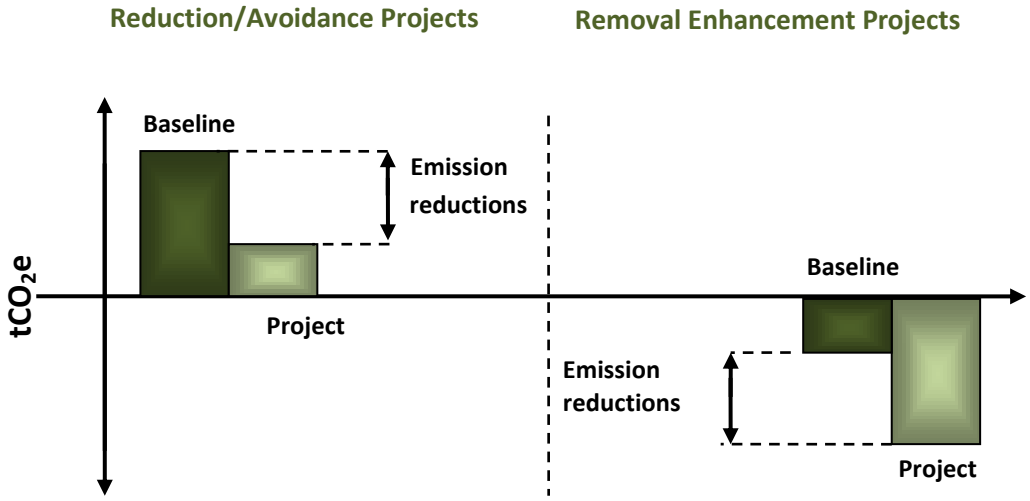
Depending upon the project type, there are two methods of calculating emission reductions: 1) emission reduction/avoidance projects, and 2) removal enhancement projects.

In order to calculate emission reductions/avoidance (offsets), the project proponent must first determine the baseline emission scenario. A baseline scenario is an estimation of the GHG emissions that would have occurred in the absence of the project activity. Once the GHG emissions for the baseline scenario are calculated, project proponents must then determine the GHG emissions that will occur as a result of the project activity. Finally, the net GHG emission reductions are calculated by subtracting the project activity's GHG emissions from the GHG emissions due to the baseline scenario. For example, a food processor that switches from natural gas to carbon neutral biomass heating would typically need to estimate the GHG emissions from the natural gas use that would have been emitted had the project not occurred and then, from this amount, subtract the net GHG emissions resulting from the biomass to determine the GHG emission reductions. For removal enhancement projects, the baseline scenario is a calculation of the amount of carbon dioxide emissions that would have been sequestered in the absence of the project activity. Once the

sequestered carbon dioxide for the baseline scenario is calculated, project proponents must then determine the additional amount of carbon dioxide sequestered as a result of the project activity. The net amount of carbon dioxide sequestered (offsets generated) is calculated by subtracting the carbon dioxide sequestered in the baseline from the carbon dioxide sequestered in the project activity. These two calculation methods are illustrated below in Table 2.

Table 2: Calculation methods for Carbon Offset Projects

Carbon offsets are created through projects/actions that reduce or avoid GHG emissions from entering the atmosphere, or removal enhancement projects/actions that increase the amount of carbon dioxide being removed from the atmosphere



1.4 Implication for B.C.'s Agricultural Sector

The Intergovernmental Panel on Climate Change (IPCC), a scientific intergovernmental body set up by the World Meteorological Organization (WMO) and by the United Nations Environment Programme (UNEP), has recognized agriculture as a sector with potential to generate carbon offsets for participating countries under the Kyoto Protocol.[6] Many carbon programs[7] around the world have followed this resolution by also including agriculturally derived carbon offsets as a mitigation

[6] For more information see: http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter8.pdf (Accessed June, 2008)

[7] A "carbon program" is a generic term referring to any government or non-government system that registers, certifies or regulates GHG emissions.

mechanism. The primary motivation for excluding the agricultural sector from national and international regulatory caps has been the inherent complexity and cost of measuring agricultural GHG emissions.[8] Therefore, project proponents within the agricultural sector are/will be eligible to generate voluntary project-based carbon offsets to sell in both the regulatory and voluntary markets both within B.C. and abroad.[9] This exclusion is also true in B.C. where the primary agricultural sector is not anticipated to be included under the regulatory system.

[8] GHG emissions generated within the agricultural sector are difficult to quantify as these emissions typically derive from non-point sources i.e., the GHG emissions occur diffusely throughout the sector.
[9] For more information see: http://www.pics.uvic.ca/assets/pdf/Cap%20and%20Trade.pdf (Accessed March, 2009)

2.0 CRITERIA FOR CARBON OFFSET PROJECTS

The stringency level of a carbon program's eligibility criteria is one of most crucial factors in determining whether a GHG emission reduction is capable of becoming a legitimate carbon offset. Although eligibility criteria vary among carbon programs in both type and rigor, all carbon programs require that carbon offset projects demonstrate the following: additional, real, measurable, verifiable, within scope and clear ownership. These criteria are important as they significantly affect the degree to which the agricultural sector can generate saleable carbon offsets. Consequently, a solid understanding of the carbon offset eligibility criteria is critical to effectively determine the opportunity available for potential agricultural carbon offset projects in B.C. The following section examines in detail the standard eligibility criteria that are commonly included in the determination of legitimate carbon offsets.

2.1 ADDITIONALITY

Additionality is generally regarded as the most decisive factor in determining the legitimacy of a carbon offset. It is also a highly contentious issue due to the often subjective nature of its determination. A carbon offset project must demonstrate that it has reduced, avoided or removed GHG emissions **beyond** what would have occurred had the carbon offset project not been undertaken**.** In other words, project proponent must prove that the offset project is **not simply business as usual**, but that it is the additional financial incentives from the sale of carbon offsets that caused the project proponent to undertake the project. The purpose of additionality is to ensure environmental integrity of the carbon program or, in other words, to ensure that a project developer isn't receiving carbon offset revenues for activities he or she would have undertaken regardless. There are four "tests" that a project may undergo to determine if it is additional:

1) regulatory surplus,
2) timing test,
3) implementation barriers, and
4) common practice.

It is important to note that it is rarely necessary for a project to pass all four tests in order to demonstrate additionality.

2.1.1 Regulatory Surplus

At minimum, all offset projects must reduce GHG emissions beyond what is required by law. Therefore, if there is an existing law, regulation or statute mandating emission reductions in effect at the time of the project start date, it is extremely unlikely that a carbon program would consider the project to be additional. For example, if a government legislated that all farms undertake a specific practice that would reduce GHG emissions, directly or indirectly, a farmer would not be able to claim these GHG emission reductions as carbon offsets.

2.1.2 Timing Test

Carbon offset projects must start after a date that is specified by the carbon program. The rationale behind the timing test is that if an offset project started before the date specified by the carbon program, it is unlikely that carbon offsets could be justified as the reason for undertaking the project. The PCT has selected November 29th, 2007 as its start date. As a result, historical project activities such as reduced or no tillage practices initiated before this start date would be considered ineligible to generate carbon offsets.

2.1.3 Implementation Barriers

There are three main implementation barrier tests that are used to determine additionality. Carbon offset projects must meet at least one, but sometimes two or all three, of the following:

a) Financial barriers – There are two primary methods of illustrating that financial barriers were the reason that project implementation without carbon offset revenue was hindered: 1) capital constraint test and 2) internal rate of return test. The **capital constraint test** simply assesses whether a project would have been undertaken without the revenue derived from carbon offsets. The **internal rate of return (IRR) test** determines whether the offset project would have met the established targets for a business's internal rates of return without revenue from carbon offsets. For example, a project would pass the IRR test if the project proponent can prove that he or she would not have undertaken the project without receiving an acceptable rate of return. Because acceptable IRRs vary on a case-by-case basis,

this subjective test often requires an examination of the proponent's debt structure as well as rates of return on previous projects.

b) Technological barriers – A project would face a technological barrier if the project proponent were reluctant/unable to adopt a new technology due to its uncertain nature or a lack of technical expertise available to effectively manage the new technology. For example, if a greenhouse grower wished to purchase a more efficient heating system that used less fossil fuel-based natural gas, but was unable to do so in a cost effective manner due to a lack of available skilled professionals, this situation could constitute a technical barrier. The grower may have to demonstrate that the amount of money and time required to acquire the expertise of a skilled professional was prohibitively expensive.

c) Institutional barriers – Institutional barriers can be organizational, social or cultural. This broad category applies to all other possible reasons that have prevented a project proponent from implementing a carbon offset project that are not considered technical or financial. For example, a project would encounter an institutional barrier if the project met local resistance which caused the normal sales of a project proponent to be adversely affected. Carbon offsets could help recover losses incurred from the initiation of a project.

2.1.4 Common Practice

If a practice is commonly employed, the carbon offsets generated may not be considered additional. For example, if no-till farming were commonly employed throughout B.C., this farming activity may fail the common practice test and, thus, not be eligible to generate carbon offsets. It is important to note that different carbon programs have different methods of determining what is considered "common practice".[10] The PCT has decided **not** to include common practice as an eligibility criterion.[11]

[10] The level of penetration that represents common practice may differ between sectors and geographic areas. Consequently, there is no universal method for determining what constitutes "common practice". For more information on this topic see: http://www.ghgprotocol.org/files/ghg_project_protocol.pdf (Accessed May, 2008)

[11] For more information see: http://www.env.gov.B.C.ca/epd/codes/ggrta/offsets_reg.htm (Accessed March, 2009)

2.2 REAL

GHG emission reductions must be derived from specific identifiable actions and carbon offset projects must result in **absolute net reductions** of GHG in the atmosphere. There are two key issues that arise when determining whether the emission reductions are real: 1) permanence and 2) leakage.

2.2.1 PERMANENCE

Permanence is an important matter in removal/enhancement projects, such as soil sequestration, afforestation and reforestation projects. Permanence addresses the likelihood of **reversals** i.e., when carbon emissions that have been removed from the earth's atmosphere during the project escape back to the atmosphere in the future.[12] For example, issues surrounding permanence would arise if a farmer afforested some land to generate carbon offsets, but those trees caught fire, thereby releasing the sequestered carbon back into the atmosphere. In addition, the concept of permanence has raised important questions regarding whether the buyer or the seller holds the liability for the offset. To reduce the chance of reversals, some carbon offset programs require project proponents to create risk mitigation and contingency plans for a specified period of time. The PCT has requested that a risk mitigation and contingency plan be created for a period of 100 years.

2.2.2 LEAKAGE

Leakage occurs when an emission reduction activity in one location inadvertently increases, directly or indirectly, in total or in part, GHG emissions in another location. Awareness and inclusion of leakage in GHG quantification methodologies is critical to ensure that emission reductions are "real" i.e., not simply shifted to another location. For example, if a carbon offset project resulted in a reduction in production of a good or service in one location, which, in turn, caused the market to compensate by increasing production of the same good or service in another location, this compensation would be considered leakage.[13] When calculating the number of emission reductions,

[12] The associated risk with projects that have permanence concerns may lead to a decrease in offset price.

[13] The term "secondary effect" is also sometimes used in place of the term "leakage". For more information see: http://www.ghgprotocol.org/files/ghg_project_protocol.pdf (Accessed May, 2008)

a project proponent must calculate the net GHG emissions with the negative effects of leakage taken into account.

2.3 WITHIN SCOPE

Most carbon programs only recognize emission reductions from one or more of the six main types of GHGs illustrated in Table 1.[14] These GHGs are quantified according to their carbon dioxide equivalent global warming potential (GWP) (see Box below). These GHGs have been selected because they are considered to be anthropogenic, i.e., caused by human activity. Although water vapour is the most abundant GHG emission, it is not included as a within-scope GHG under any of the various carbon programs because human activity does not significantly affect global water vapour concentrations except at local levels.

Table 1: Within-Scope Greenhouse Gas Emissions

1) carbon dioxide (CO_2)	4) sulphur hexafluoride (SH_6)
2) methane (CH_4)	5) hydrofluorocarbons (HFCs)
3) nitrous oxide (N_2O)	6) perfluorocarbons (PFCs)

Typically, only significant amounts of carbon dioxide, methane and nitrous oxide are released into the atmosphere by agricultural activities (Paustian *et al.*, 2004).

[14] The IPCC has identified these six emissions as the most significant anthropogenic GHGs connected with climate change.

Global Warming Potential

Greenhouse gases differ in their ability to trap heat in the atmosphere; consequently, the Intergovernmental Panel on Climate Change (IPCC) has enabled comparison between these GHGs by using carbon dioxide as the standard referent. This quantification of a GHGs heat trapping ability is known as the **global warming potential** (GWP). Each GHG can be labelled according to its **carbon dioxide equivalents** (CO_2e) (Appendix A). For example, methane, which has a GWP of 21, is calculated such that one tonne of methane is equal to 21 tonnes of CO_2e. Because of this carbon referent, the terms "greenhouse gas emission" and "carbon emission" are often used interchangeably.

2.4 MEASUREABLE AND VERIFIABLE

GHG emission estimations must typically be accurate and transparent. One of the central tenets of most carbon programs is the conservativeness principle i.e., GHG emission reductions should be estimated in a conservative manner. To ensure that GHG emission reductions have not been overstated, project plans and project reports must be audited and reported by qualified third parties (see section 3).

2.5 CLEAR OWNERSHIP

To avoid issues surrounding the double counting of carbon offsets, most offset programs must either register their projects with a formal registry, such as The Climate Registry[15] or provide a superior claim of ownership to the emission reduction.[16] Project proponents typically need to resolve any ownership issues through contractual arrangements that clearly define the rights and responsibilities of all parties involved in the carbon offset project before the carbon offset's legal right can be transferred to the purchasing entity.

[15] For more information on registering offsets see: http://www.theclimateregistry.org/ (Accessed May, 2008)
[16] For more information see: http://www.env.gov.bc.ca/epd/codes/ggrta/pdf/offsets-reg.pdf (Accessed May, 2008)

3.0 Offset Project Development Process

There are a number of development stages a carbon offset project must undergo in order to generate legitimate carbon offsets. Although these stages may differ among various carbon programs, there are some generalizable features that are common to most programs. The following section provides an overview of the key stages that typically occur during the development of carbon offset projects.

3.1 Project Plan

A project plan (project design document) is a fundamental requirement and the first step of the carbon offset project development process. A project plan describes all aspects of the project in reasonable level of detail such as additionality, calculation of emission reductions, and monitoring plan. Project plans must typically be submitted to a third-party entity (validator) to determine if the project meets the criteria specified by the offset program. For example, the project plan requirements for the PCT are outlined in the *Emissions Offset Regulation.*[17] Notable features of the project plan include, but are not limited to:

- The title and statement of the projects objectives
- The name and address of all proponents responsible for carrying out the project
- A technical description of the project and a detailed explanation of how the project will achieve GHG emission reductions
- Identification of the quantification protocol used and justification for any adjustments made to that protocol
- A description of potential baseline scenarios that were considered when selecting the projects baseline scenario
- Identification and justification of the various carbon sinks, sources and reservoirs (SSRs) included in both the baseline scenario and the project activity

[17] B.C. Emissions Offsets Regulation, December 8, 2008, p. 4. For more information see: http://www.env.gov.bc.ca/epd/codes/ggrta/pdf/offsets-reg.pdf (Accessed May, 2008)

- The estimated GHG emission reductions for each year of the project including a description of the formulae used in the estimation

3.2 PROTOCOLS

An important component of the project plan is the identification of an appropriate carbon offset protocol. A protocol is defined as a set of standards and calculation tools for quantifying, measuring and reporting GHG reductions or removals for specific project types. The carbon offset project proponent has several choices when determining which protocol he/she will use:

- Submission of a *new* carbon offset protocol for review and approval by the authoritative body of the carbon program
- Submission of an *existing* carbon offset protocol that has previously been created for and accepted by another carbon offset program, such as the Clean Development Mechanism (CDM)
- Submission of an *adapted existing* protocol, such as from the CDM, so that it better represents the specific project
- Submission of an *accepted* existing carbon offset protocol that has already been approved by the carbon offset program for a similar type of project

An important component of a protocol is the determination of the project boundary. Project proponents must identify all the life-cycle GHG emission sinks, sources and reservoirs [18](SSRs) in both the project and the baseline to ensure that GHG emissions are neither displaced to another source nor transient in nature. Based upon the protocol, the project proponent determines which SSRs should be included/excluded within the project boundary and must provide justification for their inclusion/exclusion. The project boundary is defined as all SSRs that must be included in the GHG emission quantification calculation.

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[18] Sinks, sources and reservoirs are defined by the UNFCCC: A SINK is any process, activity or mechanism that removes a GHG, an aerosol or a precursor to a GHG from the atmosphere. A SOURCE is any process, activity or mechanism that releases a GHG, an aerosol or a precursor to a GHG into the atmosphere. A RESERVOIR means a component or components of the climate system where a greenhouse gas or precursor is stored. This approach of SSR identification is consistent with the recommendations of ISO 14064. For more information see http://unfccc.int/essential_background/convention/background/items/2536.php (Accessed January, 2009)

A carbon program's authoritative review panel will either accept or reject the protocol that has been selected and submitted by the project proponent. In the latter case, the protocol is usually sent back to the proponent for the necessary revisions to enable it to be accepted.

3.3 BASELINES

Baselines are inextricably linked to determining additionality because carbon offset projects must be compared against their business-as-usual (BAU) case. The BAU case determines the quantity of GHG emissions that would have occurred in the absence of the project activity. The project proponent typically must identify a number of possible alternatives termed "baseline scenarios" describing the plausible scenarios that could take place in the absence of the project activity. For example, a cattle rancher who is considering an afforestation project on marginal land could also decide to plant fruit trees, leave the land unused or expand the number of grazing cattle. All probable scenarios should be considered and evaluated. Therefore, it is important to note that the baseline scenario is not necessarily what occurred prior to project implementation. For example, B.C.'s *Emissions Offset Regulation* requires that project proponents demonstrate that the proposed baseline scenario represents the *most-likely* 'BAU' activity among a range of other possible economic activities. The baseline is an estimation that involves forecasting BAU emissions throughout the entire length of the project. However, the baseline scenario may need to be developed over a shorter period of time if a key aspect of the project activity becomes a mandatory activity that is regulated by government during the validation period i.e., the period that the project is valid to receive offsets. For example, parties that are likely to become regulated under the WCI cap-and-trade system may need to shorten their baseline scenarios to adjust for this directive.

3.4 VALIDATION

Most offset programs require that projects undergo third-party audits at various stages of development to reduce the potential for mistakes or fraud. A legitimate carbon offset project plan must be validated by an accredited third party[19] *before* the project commences to ensure that it qualifies as a genuine carbon offset project. Specifically, a validator examines GHG data, model structure and modelling assumptions for the forecasted carbon emission reduction projections in the project plan. In addition, a validator usually visits the project site and interviews the project proponent about the specifics of the methods claimed in the project plan. If a validator finds inconsistencies or problems in the project plan, the project proponent will be given a chance to address these inconsistencies prior to the completion of validation. International Standards Organization's (ISO) 14064-3 publication has become the *de facto* source for guidance on validation and verification procedures for most carbon programs around the world. It is important to note that a validator does not state the manner by which these inconsistencies or shortcomings are to be resolved as this would violate their status as an impartial third-party entity. Under the PCT, the standard validation period runs for ten years following the validation date. After this date, project proponents can attempt to revalidate the project and start the process again.

Some carbon programs require specific accreditation standards for validators and verifiers. For example, effective July 1, 2010, the PCT will require all validation and verification bodies to be an accredited body in accordance with ISO 14065 by the International Accreditation Forum (IAF). The IAF has accredited the Standards Council of Canada (SCC) [20] and the American National Standards Institute (ANSI)[21] to accredit firms and organizations to use ISO 14064-3.[22] For a description of each of the ISO standards related to offsets, see Appendix C.

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[19] The Alberta offset program does not include a validation process for some project types under its carbon program. The validation process is also occasionally foregone for certain entities in the voluntary market.

[20] http://www.scc.ca/en/programs/ghg/index.shtml (Accessed May, 2009)

[21] https://www.ansica.org/wwwversion2/outside/GHGgeneral.asp?menuID=200 (Accessed May, 2009)

[22] For further information on SCC's accreditation activities in this area see: http://www.scc.ca/en/programs/ghg/index.shtml (Accessed April, 2009)

3.5 PROJECT AGGREGATION

Project proponents may want to investigate whether their emission reduction project has the potential to be combined with other similar project types through an entity known as an "aggregator". An aggregator is a commercial entity that pools offsets from several offset projects and represents the collective interest of all project proponents. The primary benefit of an aggregator is that projects can achieve economies of scale by spreading the high transaction costs of validation, verification and other administrative fees over multiple projects. However, an aggregator charges a fee for this service which must be considered when assessing the economics of the project. Aggregators have been primarily used for agricultural and forestry carbon sequestration projects; however, this role will likely expand as more carbon offset projects are created and protocols become better established. Aggregators may also provide expertise in project financing, preparation of project plans/project documents, GHG emissions reduction quantification protocols and GHG data collection. In addition to aggregators, there are companies that specialize in helping project proponents through the entire project process including the sale of carbon offsets. In some cases, these entities may also act as retailers and wholesalers by purchasing the carbon offsets from many separate projects and reselling them in bulk. Project proponents who do not wish to spend time and energy on carbon offset project development may be inclined to utilize these services; however, like aggregators, the fee charged for this service should be adequately assessed prior to signing a contract.

3.6 ACCOUNTING METHODS

GHG emission reductions can be quantified by *ex ante* estimation or *ex post* estimation. *Ex ante* estimation calculates the emission reductions based upon predictions made *before* the project is undertaken. This *ex ante* calculation can be used for the validation procedures described in section 3.3. However, it can also be used to support project financing arrangements. Carbon offset programs that allow the project proponents to sell futures contracts (derivatives) based upon *ex ante* calculations can dramatically improve the project economics as the cash does not need to be discounted in accordance with the time value of money. These future contracts, however, may carry

increased risk that is typically reflected in a lower market price. To date, *ex ante* calculations have been most commonly incorporated into forestry carbon offset projects that have long time horizons. Conversely, e*x post* estimation is based upon verification *after* the emission reductions have occurred. Because *ex post* calculations are actual emission reductions, these carbon offsets typically command higher market prices as they carry substantially less risk than *ex ante* estimated carbon offsets. The *ex post* calculations are used during verification procedures described below in section 3.8.

3.7 CONTRACTS

Project proponents typically must enter into a contractual agreement for carbon offset sales either directly with carbon program or with an aggregator/broker. Contracts should address any issues regarding carbon offset ownership. Although no template is currently available for the PCT or WCI, the carbon industry's standard *(Certified) Emissions Reduction Purchasing Agreement* [23] provides a detailed example of a typical contract format for carbon programs.

3.8 MONITOR/MEASUREMENT

Once a project is in progress, it is important to monitor and measure the quantity of the remaining GHG emissions. This amount is subtracted from the estimated baseline scenario (section 3.2) to confirm the predicted reductions. The procedures for monitoring and reporting GHG emissions, removals and sequestration occurring within the project should be described in the project plan. While developing data quantification and monitoring protocols, project proponents must establish appropriate data management systems. Data management systems are an important component of the monitoring process as well as the quality control (QC) and quality assurance (QA) measures that accompany these systems.

[23] For more information see: http://www.cerspa.org/ (Accessed April, 2009)

3.9 VERIFICATION

Project proponents must also submit a **project report** to be verified by a qualified, independent third party to sell their emission reductions as carbon offsets in the various markets. Project reports will not be verified if they are deemed by the verifier to have significant errors, omissions or misrepresentations, or if there have been significant changes to how the carbon offset project was carried out compared to the validated project plan. In addition, most carbon offset trading programs, including the PCT, stipulate that the validator and verifier must be separate entities to avoid a conflict of interest.[24] [25]Emission reductions are only recognized as carbon offsets after verification. The project proponent can choose to undertake the verification process as often as the proponent deems economic throughout the life of the project.

3.10 CARBON OFFSET RECOGNITION

Carbon offset recognition is a legal status where ownership title is transferred to the purchasing entity. However, some carbon programs such as the PCT, do not issue an official document or certificate in official recognition. Carbon offset recognition typically results subsequent to three conditions being met: 1) verification of a Project Report, 2) acquisition of title to the GHG reduction 3) the carbon offset has not been recognized in any other carbon program. Most carbon programs do not allow projects for an indefinite period of time. Carbon offset projects are valid for a specified period at which time they must either be revalidated or terminated.

[24] This stipulation is in accordance with ISO-14064-3 audit requirements. A notable exception to this is the Albertan Offset system which does not require validation for certain projects.

[25] Voluntary offset retailers have developed their own standards which create credits that use the generic term of Verified Emission Reductions (VERs). They share their acronym with Voluntary Emission Reductions (VERs) and the two are often using interchangeably which can cause confusion as in the former, the emission reductions or savings have been verified, whereas in the latter, this is not necessarily the case.

4.0 Carbon Markets Relevant to B.C.'s Agricultural Sector

The following section examines the three carbon markets most relevant to the B.C. agricultural sector at this time: the PCT, the WCI and the voluntary market. The section also provides a brief assessment of the anticipated potential for the B.C. agricultural sector to generate saleable carbon offsets for each of these markets.

4.1 Pacific Carbon Trust

4.1.1 Description

Under *the Greenhouse Gas Reduction Targets Act* (GGRTA),[26] the B.C. Provincial Government has legislated carbon-neutral status for the B.C. public sector beginning in 2010. In addition, the Provincial government committed to becoming carbon neutral for all essential government travel beginning in October, 2007. The Provincial government and all public sector organizations (PSOs) will attempt to decrease their total GHG emissions and purchase carbon offsets to account for the remainder. The Pacific Carbon Trust (PCT), which was launched in the fall of 2008, is a Crown corporation created in response to these government initiatives. For every tonne of carbon dioxide equivalent that is generated by essential government travel as well as by government-managed buildings and operations, the Province has initially committed to depositing $25 into the PCT. Because the PCT will operate on a cost-recovery basis, this deposit will either increase or decrease to more accurately reflect the price of carbon offsets. The price of carbon offsets will likely be negotiated on a project-by-project basis. However, there is a high level of certainty that the initial price for legitimate carbon offsets will fall between $10 and $20 per offset. Although the PCT's primary responsibility is to procure B.C.-based, quality offsets to help government, PSOs meet their GHG emission obligations, it has also promised to avail carbon offsets to other businesses and individuals that wish to voluntarily lessen their carbon footprints. The PCT began purchasing carbon offsets on January 1st, 2009.

[26] For more information on GGRTA see: http://www.leg.B.C.ca/38th3rd/1st_read/gov44-1.htm (Accessed March, 2009)

4.1.2 Potential for B.C.'s Agricultural Sector

The PCT is a strong potential buyer of carbon offsets generated by agricultural carbon offset projects in B.C. The PCT is expected to purchase over 700,000 carbon offsets per year beginning in 2010. Estimated government demand for carbon offsets over the next four years is illustrated in Table 1.

Table 1: Estimated Scope of Initial Demand by the PCT Carbon Offsets (in thousands of tCO_2e)

	2008	2009	2010	2011	2012
PSOs (Government) Travel	35(1)	30	30	30	30
PSOs (Government) Operations (2)			615-895	615-895	615-895
Local Government	--	--	--	--	--(3)
Non-regulated Companies and Individuals	--	100	100	100	100
Total Approximate Offset Demand	35	130	700-1,000	700-1,000	700-1,000

(1) In 2008, the number of tonnes of CO_2e for PSOs travel emissions includes approximately 5,000 tonnes for the October-December 2007 period.
(2) Provincial ministries and agencies, schools, colleges, universities, health authorities and Crown corporations.
(3) Estimates of expected offsets have not been assessed at this time.

Source: *Pacific Carbon Trust, Province of British Columbia: Request for Qualifications*, RFQ # PCT-2369

Because the PCT will only purchase carbon offsets from eligible projects that are undertaken within the province, B.C.'s agricultural sector *does not* have to compete with carbon offset projects from other neighbouring jurisdictions, such as Alberta, Saskatchewan, Montana and Washington. The PCT issues calls for project applications regularly which can be found by visiting their website.[27] Details regarding the PCT's eligibility criteria for GHG reductions or removals from projects can be found in the document: *Emissions Offset Regulation*.[28] Agricultural project proponents may also be

[27] For more information on the PCT see: http://www.pacificcarbontrust.ca/ (Accessed May, 2009)
[28] For more information on the Emissions Offset Regulation see: http://www.env.gov.B.C.ca/epd/codes/ggrta/pdf/offsets-reg.pdf (Accessed in March, 2009).

interested in reading the document: *B.C.'s Agricultural Sector and the Greenhouse Gas Reductions Target Act.*[29]

4.2 VOLUNTARY MARKET

4.2.1 DESCRIPTION

The voluntary market refers to entities (companies, governments, NGOs, individuals) that voluntarily purchase carbon offsets to reduce their carbon footprints. The act of purchasing carbon offsets is defined as voluntary as long as the carbon offsets are not employed to meet some regulatory purpose.[30] Unlike regulated carbon programs, the voluntary market is self-directed and has no commonly accepted standards regarding carbon offset criteria and protocols. In theory, the voluntary market is assumed to self-regulate as the quality of carbon offsets is reflected in the market price they are able to garner. Not surprisingly, the chief controversy surrounding the voluntary market has been the credibility of the carbon offsets due to a lack of transparency, no centralized regulatory system and no third-party standards. However, carbon offset consumers and the general public are becoming better educated regarding what constitutes a legitimate carbon offset. As a result, there is an increase in demand for third-party verified offsets from a trusted standard.[31] In addition, financing institutions are becoming increasingly involved in the voluntary market and ensuring greater legitimacy and stricter standards for their clients. Private businesses are responsible for the majority of carbon offset purchases in 2007 at 79%, citing corporate responsibility and branding as the primary motivators behind their purchasing decisions.[32] These voluntary consumers have also driven demand for more robust carbon offsets as they wish to avoid

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[29] For more information on the Agricultural Sector and the PCT see: http://www.agf.gov.bc.ca/resmgmt/ClimateActionPlan/GGRTA_Overview.pdf (Accessed May, 2008)

[30] The vast majority of retailers sell carbon offsets termed "verified emission reductions" (VERs) on the voluntary market.

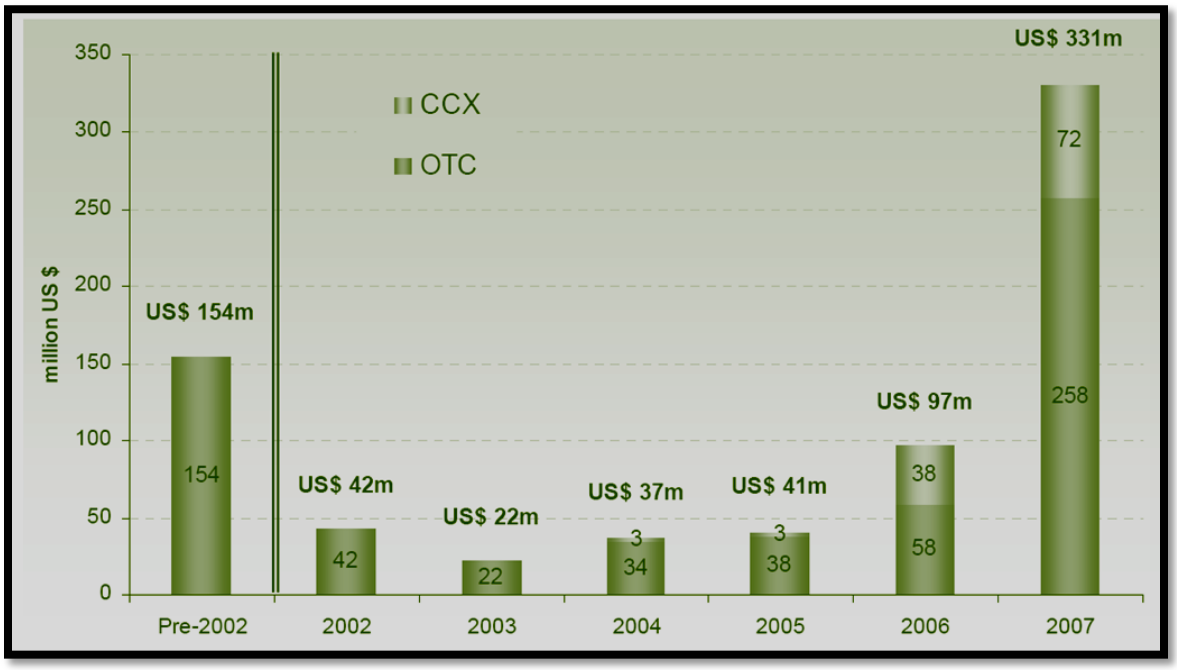
[31] A number of standards exist for carbon offsets, including the VCS, Green e, and the Gold Standard. More standards are being announced regularly.

[32] For more information see: http://ecosystemmarketplace.com/documents/cms_documents/2008_StateofVoluntaryCarbonMarket.4.pdf (Accessed March, 2009)

any negative repercussions to brand identity from the purchase of carbon offsets with poor credibility.

Currently, the voluntary market is small and exceptionally fragmented; consequently, it is difficult to accurately determine its total market size. However, the market has experienced significant growth over the past three years (Figure 1) and it is expected to continue at an explosive rate up through 2012. According to *the State of the Voluntary Market 2007*, approximately 65.5 million carbon offsets were transacted on the voluntary market in 2007, more than double the amount of the previous year.[33]

Figure 1: Estimated Values of Transactions on the Voluntary Market



Source: *Ecosystem Marketplace, New Carbon Finance*

[33] For more information see: http://ecosystemmarketplace.com/documents/cms_documents/2008_StateofVoluntaryCarbonMarket.4.pdf (Accessed March, 2009)

4.2.2 Potential for B.C.'s Agricultural Sector

The degree of opportunity the voluntary market presents for B.C.'s agricultural sector is difficult to appraise; however, it is clear that the voluntary market is growing at a phenomenal rate. Unlike the regulated market, the voluntary market has more scope to invest in small-scale projects with environmental co-benefits. Project proponents can also avoid the bureaucratic procedures and/or stringent eligibility criteria of some regulated carbon programs, thereby decreasing the transaction costs associated with their carbon offset projects. Consequently, this market could provide a good fit for some of the small-scale B.C. agricultural carbon offset projects that are unable[34] to meet the requirements of the WCI or the PCT. The price of carbon offsets in the voluntary market is subject to dramatic fluctuations; accordingly, voluntary carbon offset project proponents may be exposed to significantly greater risk than the more stable regulatory markets.

4.3 Western Climate Initiative[35]

4.3.1 Description

Launched in February, 2007, the Western Climate Initiative (WCI) began as collaboration among Arizona, California, New Mexico, Oregon and Washington to develop regional strategies to address climate change. On April 24th, 2007, B.C. announced that it had joined the program, turning the WCI into an international partnership. Manitoba, Ontario and Quebec have since joined while several other Canadian Provinces, American States and Mexican States are observing the initiative with the possible intention of joining. The WCI Partners released their "Design Recommendations for the WCI Regional Cap-and-Trade Program" on September 23, 2008.[36] The final design recommendations state that B.C., along with the other WCI participants, will initiate a cap-and-trade program enforced in compliance periods from 2012 to 2020. Capped entities will initially be restricted to large emitters (>25,000 tCO_2e) such as large electrical generators, industrial fuel burners and industrial process

[34] Small projects may be unable to meet the standards because the transaction costs are prohibitively high.

[35] The B.C. Government recently introduced *the B.C. Cap and Trade Act*, which was designed to provide the framework for B.C. to enter the Western Climate Initiative (WCI) and, consequently, is expected to function in a similar manner as the WCI. More information can be found at: http://www.leg.B.C..ca/38th4th/1st_read/gov18-1.htm (Accessed March, 2009).

[36] For more information see: http://www.westernclimateinitiative.org/the-wci-cap-and-trade-program/design-recommendations (Accessed May, 2009)

emitters. However, the entities and facilities with annual emissions > 10,000 tCO_2e must begin reporting their emissions in 2011. Coverage for these smaller commercial and industrial emitters is proposed to commence in 2015.

4.3.2 Potential for B.C.'s Agricultural Sector

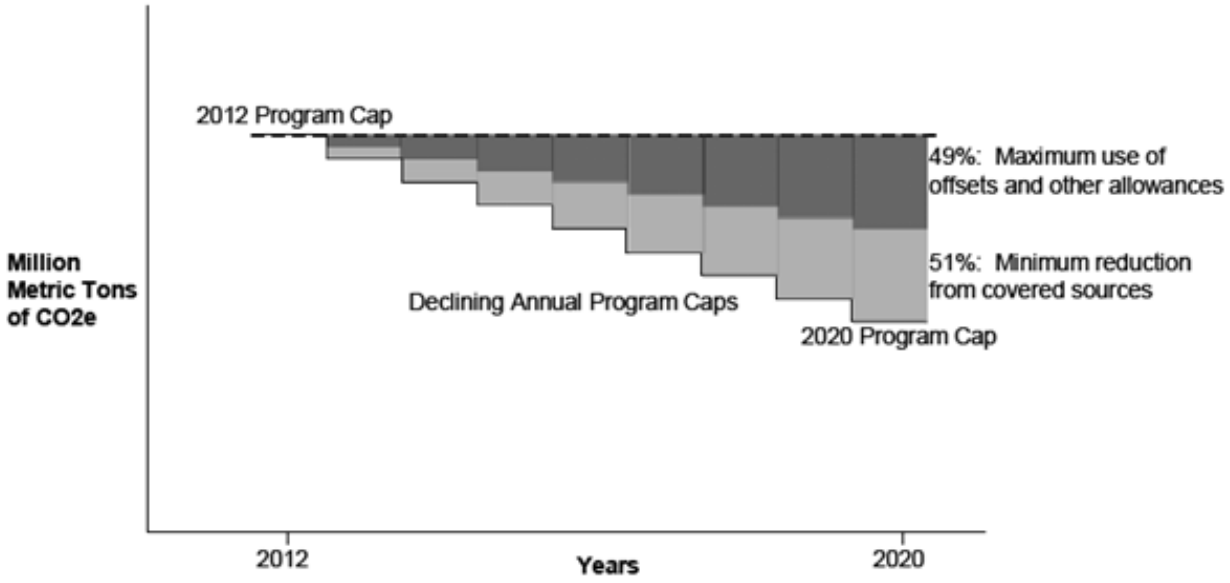
The WCI has decided to initially exclude the agricultural sector as a GHG emission source due to the complexity and cost of monitoring emissions. As a result, the B.C. agricultural sector *will be eligible* to generate carbon offsets for sale to regulated participants that are unable to meet their carbon reduction targets. However, it is clear that these guidelines will take some time to develop and, subsequently, carbon offset projects will not be immediately realized. The eligibility criteria for carbon offset projects under the WCI will likely be similar to the criteria proposed under the PCT. The WCI offset subcommittee has recommended carbon offsets be included in the program as a flexibility mechanism, but the number of carbon offsets and tradable allowances be limited to maximum of 49 percent[37] of the compliance member's emission obligations (2012-2020).[38] In addition, the subcommittee has recommended that the WCI include carbon offsets from extra-jurisdictional carbon offset programs including the Clean Development Mechanism of the Kyoto Protocol (Figure 1).[39]

[37] Each WCI Partner jurisdiction will have the discretion to set a lower percentage limit. For more information see: http://www.westernclimateinitiative.org/the-wci-cap-and-trade-program/design-recommendations (Accessed June, 2009)

[38] Reporting emissions for those entities under the cap will commence in 2011.

[39] For more information see: http://www.westernclimateinitiative.org/the-wci-cap-and-trade-program/design-recommendations (Accessed June, 2009)

Figure 1: 49% carbon offset limit under the WCI



Source: Design Recommendations for the WCI Regional Cap-and-Trade Program

These recommendations suggest that B.C. carbon offset projects will be competing against carbon offset projects from all over North America as well as for a constricted demand, thus, likely lowering the price and opportunity for the B.C. agricultural sector. However, it should also be noted that the subcommittee prioritized specific carbon offset projects for participation in the carbon offset system including agriculture (soil sequestration and manure management), forestry (afforestation, reforestation, forest management, forest products), and waste management (landfill gas and waste water management).

5.0 Potential Agricultural Offset Projects Opportunities in B.C.

A range of carbon offset project types exist for the B.C. agricultural sector that have the potential for sale in any of the three of the carbon markets identified in this paper. Five project types are examined and an assessment is provided for each project type based on its development potential and carbon offset market applicability. The following is not intended to be a complete list of carbon offset projects and is subject to change as new information and technologies become available, due to the evolving nature of the industry. These examples are intended to provide potential project proponents with a fuller understanding of the issues surrounding agricultural GHG emission reduction projects. Furthermore, we strongly encourage project proponents to consider new GHG emission reduction projects and opportunities.

5.1 Manure Management – (Methane Capture and Anaerobic Digestion)

Livestock operations are a significant emitter of methane (CH_4), which has a global warming potential (GWP) 21 times greater than carbon dioxide over a 100-year period (Appendix A). This methane, a by-product of liquid manure decomposition from livestock farms in various regions of B.C., can be captured and either flared or converted to useable energy by employing anaerobic digestion (AD) technologies.[40] Emission reductions are generated by capturing and transforming methane through combustion into the less potent carbon dioxide. Based upon a B.C. dairy cow census from 2006, a rough estimate is that methane combustion of dairy cow waste alone could yield 110,000 tCO_2e reductions per year.[41] In addition, AD augmented by upgrading the biogas to biomethane (natural gas grade) can generate additional GHG emission reductions by displacing the use of GHG emitting fossil fuels.

[40] A recent feasibility study of the Fraser Valley by Electrigaz Technologies found that the energy potential of readily available organic material is capable of generating approximately 30 MW of electricity.
[41] The estimate did not include other available sources such as pigs, poultry energy crop, food waste or other sources.

Pros

- large available supply of off-farm organic waste suitable for methane capture,[42]
- likely to pass tests of additionality under all three carbon markets,
- relatively easy to monitor and validate/verify (potentially low transaction costs),
- low possibility of leakage,
- no risk of reversals as emissions reductions are permanent, and
- many co-benefits such as reduced nutrient runoff in lakes and rivers, reduced odour issues, diversified revenue streams, rural economic development, etc.

Cons

- significant upfront capital commitment required for AD,
- flaring of captured methane may encounter local resistance, and
- many farms are not of a suitable size to make AD cost effective even with additional revenue from carbon offsets.

5.2 Replacing or Reducing Fossil Fuel Use [43]

Operations that upgrade or change their existing technology or processes to replace or reduce fossil fuel consumption have the potential to generate carbon offsets. For example, greenhouse growers that use natural gas to heat their operations may be eligible to receive offsets if they switch to carbon-neutral energy sources such as biomass, biomethane, geothermal etc.

Pros

- likely to pass tests of additionality under all three carbon markets,
- relatively easy to monitor and validate/verify (potentially low transaction costs),

[42] Electrigaz Technologies estimated that 2.8 M tonnes/year of organic waste would be readily available for AD and/or flaring in the Fraser Valley.

[43] Under the Renewable Fuel Standard (RFS), the Provincial government has regulated a five percent renewable fuel mix (ethanol, biodiesel etc.) for both gasoline and diesel by 2010. Therefore, operations that switch from fossil fuels to biofuels will not pass the regulatory surplus test of additionality unless they exceed this five percent fuel mix. However, projects that reduce fossil fuel consumption or use sources not covered under the RFS are still eligible to receive carbon offsets.

- facilitates the transition of carbon intensive projects to carbon-neutral technologies, thereby avoiding proposed future B.C. carbon tax payments, and
- no risks of reversals as emissions reductions are permanent,

Cons

- significant upfront capital investment,
- possible leakage issues associated with feedstock,
- possibly more difficult to pass the financial test of additionality than other carbon offset projects if the fuel savings are significant since the investment may appear financially attractive without the sale of carbon offsets.

5.3 Small-scale Afforestation and Agro-forestry

There is potential to sequester carbon on agricultural lands by planting trees and/or perennial forage. Small-scale afforestation and agroforestry includes an array of land management practices that couple forestry with agriculture, including the planting of shelterbelts and riparian zones/buffer strips with woody species. Another example is silvopasture, in which trees are planted within a perennial forage livestock grazing system. Many agroforestry practices increase both above-ground carbon sequestration and soil carbon sequestration.

Pros

- many co-benefits such as enhanced soil attributes, wildlife diversity, improved water quality and aesthetics,
- capable of meeting the eligibility requirements in all three markets,
- potential for aggregation with similar afforestation projects, and
- practices are easy to implement and understand.

Cons

- concerns that carbon offset projects will occur at the expense of agricultural productivity,
- transaction costs may be prohibitively high for some small-scale projects.

- quantification protocols not well established (higher transaction costs) and,
- long liability periods and concerns regarding possible emission reversals.

5.4 Nutrient Management

The primary sources of nitrous oxide (N_2O) emissions from agriculture are synthetic fertilizers and manure from ruminant and poultry livestock. These emissions are often exacerbated by inappropriate application and poor soil drainage. Although the total number of nitrous oxide emissions in an agricultural operation is typically quite low, these emissions have almost three hundred times greater GWP than carbon dioxide (Appendix A). Improvements in farm practices, such as reduced fertilizer use, the use of controlled-release fertilizers, the timing optimization of nitrogen application and water management are possible methods of reducing nitrous oxide and, thus, generating carbon offsets.

Pros

- there are potential co-benefits such as higher-quality soils and less nutrient leakage from the farming system,
- capable of meeting the eligibility requirements in all three markets,
- no risks of reversals as emissions reductions are permanent, and
- relatively easy to implement.

Cons

- small number of emission reductions when compared with other agricultural projects, thus may not cover transaction costs
- available nutrient management GHG emission reduction information, such as quantification protocols is limited i.e., difficult to monitor and verify, and
- changes in management practices may increase GHG emissions from other sources i.e., leakage.

5.5 Boiler and Operations Efficiency Improvements

Agricultural operations that consume heat from natural gas boilers, such as the food processing industry, may be able to generate carbon offsets by implementing energy efficiency measures that result in a net decrease of natural gas consumption. For example, there are a variety of efficiency measures that exist for the recovery of industrial waste heat e.g., installing a plate heat exchanger.

Pros

- capable of meeting the eligibility requirements in all three markets,
- no risks of reversals as emissions reductions are permanent, and
- relatively easy to implement and monitor.

Cons

- likely to be more difficult to pass the financial test of additionality than other carbon offset projects if the fuel savings are significant since the investment may appear financially attractive without the sale of carbon offsets,
- potentially difficult to achieve reductions in fossil fuel consumption that are significant enough to compensate for the transaction costs associated with a carbon offset project, and
- potentially difficult to aggregate projects.

6.0 General Conclusions

Taken as a whole, the opportunity for the B.C. agricultural sector to benefit from carbon offset projects should not be overestimated; certain project types have a real potential to generate revenue from the sale of carbon offsets. Because the B.C. agricultural sector is not expected to be included under a regulatory cap for the foreseeable future, the sector will be eligible to generate offsets from all three markets discussed in this document: the PCT, the WCI and the voluntary market. The unique attributes of the agricultural sector in B.C. such as farm size and scope, may result in less-conventional agricultural carbon offset projects. For example, the often cited zero-tillage practice as a method of generating offsets may encounter difficulties meeting the criteria outlined in the PCT and/or the transaction costs may be prohibitively high. However, methane capture and destruction from the relatively large volumes of manure in the province and reducing/replacing fossil fuel consumption both hold greater promise as a method of generating carbon offsets. In addition, other projects such as fertilizer management and drainage, small-scale afforestation/agro-forestry, and energy efficiency improvements may hold potential as viable carbon offset projects.

To evaluate carbon offsets and the eligibility criteria used to determine what constitutes a legitimate offset, it is important to keep in mind the original purpose of an offset program: to create an opportunity for projects that would not have been able to occur *without* the revenue from carbon offsets. It is unlikely that carbon offset projects will become a primary source of revenue for farmers in B.C. A more realistic perspective is to view carbon offset projects as a means for farmers to supplement current revenue streams, mitigate risk through diversification and cover the cost of beneficial environmental initiatives that were previously considered too expensive and risky to be undertaken.

7.0 GLOSSARY OF CARBON TERMS

Additionality – is an important eligibility criterion that requires carbon offset projects to demonstrate that the additional revenue from the sale of carbon offsets was the primary motivation for undertaking the project.

Afforestation – is the planting of new forests on lands that have not been recently forested.

Aggregators – are middlemen who aggregate a number of small offset projects in order to sell to a large emitter that requires a large quantity of carbon offsets.

Agro-forestry – is a land management system in which woody species are grown in conjunction with crops and/or livestock.

Allowance – is a certificate issued (auctioned or given) by a regulator body which allows any one firm under a specific cap to emit one metric tonne of carbon dioxide equivalent.

Anaerobic digestion – promotes the decomposition of organic substances in the absence of oxygen with the primary product being methane.

Anthropogenic – is a term used to describe GHG emissions that are caused by human activity and not part of Earth's natural cycles.

Baseline Candidate – is one of many possible baseline alternatives. The baseline candidate that is most likely to have occurred in the absence of the project activity is typically considered the baseline scenario.

Baseline Scenario – is the establishment of the amount of carbon dioxide output that would take place at a facility under normal operations i.e., in the absence of the project activity.

Business-As-Usual – is a scenario of future GHG emissions which assumes that there will be no major changes in actions or attitudes related to GHG emission reductions.

Cap – is a GHG emission limit/quota that is established by a regulatory body to create scarcity in the market.

Carbon Dioxide Equivalent – is a metric used to compare the potency of emissions from the various GHGs based on their global warming potential (GWP). The carbon dioxide equivalent for a gas is derived by multiplying the number of tonnes of the gas by its associated GWP.

Carbon Financial Instrument (CFI) – is a term used to describe carbon credits on the Chicago Carbon Exchange.

Carbon Program – is a generic term referring to any government or non-government system that registers, certifies or regulates GHG emission levels.

Clean Development Mechanism (CDM) – is a carbon program under the Kyoto Protocol which allows developing countries to participate in the Protocol by developing carbon offset projects that assist developed countries with meeting their reduction targets.

Conservativeness principle – refers to the principle of using conservative estimates when quantifying GHG emission reductions.

Ex-ante accounting – is an accounting system that occurs when the offsets are counted before they have been created. This accounting system is considered to be high risk, so it often results in lower prices for carbon offsets.

Ex-post accounting – is an accounting system that occurs when the offsets are counted after they have been created. This accounting system is low risk, so it often results in higher prices for carbon offsets.

Greenhouse Gas (GHG) – is any gas that contributes to the 'greenhouse effect' on earth. The Kyoto Protocol covers six common types of GHGs produced by human activities: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. An important naturally occurring GHG that is not covered by the Protocol is water vapour.

Leakage – refers to the increases in GHG emissions or decreases in GHG removals outside the project boundary that arise due to the project activity, regardless of location or intentional or accidental. For example, avoiding deforestation in one location might lead to acceleration in deforestation in a different location. Leakage can apply to all types of carbon dioxide reduction projects.

Non point source – refers to GHG emissions coming from multiple diffuse sources.

Permanence – refers to the length of time carbon will remain stored after being sequestered in vegetation.

Point Source – refers to a single identifiable source that discharges pollutants into the environment, such as smokestacks, sewers, ditches, or pipes.

Project Plan – refer to the document that describes all aspects of the project in reasonable level of detail, such as additionality, calculation of emission reductions, and monitoring plan (quality assurance or control procedures), and is submitted to be validated by a third party prior to project implementation.

Project proponent – refers to the person who proposes either to carry out or to engage another person in carrying out a project to generate carbon offsets.

Project Report – refers to the document that contains detailed information and data about the emission reductions claimed by the project and is submitted to the appropriate third party for verification.

Protocol – is a set of standards and calculation tools for quantifying, measuring and reporting GHG reductions or removals for specific project types.

Public Sector Organization – means any of the following:

(a) the Provincial government;

(b) an organization or corporation that is not part of the Provincial government but is included within the government reporting entity under the *Budget Transparency and Accountability Act*, unless excluded by regulation under this Act;

(c) any other public organization or corporation included by regulation.

Reforestation – is the replanting of forests on lands that have recently been harvested.

Reversal – is a loss to the atmosphere of an amount of carbon or GHGs stored or sequestered in reservoirs.

Regulated Market – is typically a cap-and-trade system whereby a regulatory authority sets a limit on the amount that entities within the jurisdiction are entitled to emit.

Sequestration – is a term to describe the process of atmospheric carbon becoming fixed in biomass or soils.

Sinks, Sources and Reservoirs – are defined by the UNFCCC: "A **sink** is any process, activity or mechanism that removes a GHG, an aerosol or a precursor to a GHG from the atmosphere. A **source** is any process, activity or mechanism that releases a GHG, an aerosol or a precursor to a GHG into the atmosphere. A **reservoir** means a component or components of the climate system where a GHG is stored."

Verified Emission Reductions (VER) – are units of GHG emission reductions that have been verified by an independent auditor.

Voluntary Emission Reductions (VER) – are units of GHG emission reductions that may or may not have been verified by an independent auditor.

8.0 APPENDICES

Appendix A: A list of the Six Major GHGs and their Global Warming Potential Coefficients

Carbon dioxide (CO_2) has been assigned a global warming potential (GWP) of exactly 1 as the referent unit. As a result, all GHGs can be compared to carbon dioxide by their GWP coefficients.[44] For example, one tonne of methane is equal to twenty one tonnes of carbon dioxide in its ability to trap infra-red heat radiating from the earth over a one-hundred-year period.

GWP Values from 2007 IPCC Assessment Report 2 [45]	
Greenhouse Gas	**100 Year (standard)**
Carbon Dioxide	1
Methane	21
Nitrous Oxide	310
Hydrofluorocarbons	650 to 11,700
Perfluorocarbons	6,500 to 9,200
Sulphur Hexafluoride	23,900

[44] The IPCC publishes an Assessment Report (current No. 4) that provides GWPs for relevant GHGs over 20, 100 and 500 years. GWP coefficients for 100 year time horizons are the most commonly cited in carbon offset quantification protocols. The GWP coefficients provided in this table are taken from the IPCC Assessment Report No. 2. The earlier version coefficients are reported because these values are in keeping with the conservativeness principle.

[45] For more information see: http://ipcc-wg1.ucar.edu/wg1/wg1-report.html (Accessed May, 2009)

Appendix B: A List of Compliance and Voluntary Carbon Trading Schemes

Compliance Regimes:	Launched	Location	Description	Web Link
Kyoto Protocol	2005	**International**	The Kyoto Protocol requires industrial countries (Annex 1) to decrease their GHG emissions by an average of five percent below 1990 baseline levels for a five-year period (2008-2012).	http://unfccc.int/2860.php
European Union Emissions Trading Scheme (EU ETS)	2005	**The European Union**	Developed in response to the Kyoto Protocol, this trading scheme has grown into the largest emission trading program in the world. The Scheme operates under a cap-and-trade system with the inclusion of EU ETS offset projects.	http://ec.europa.eu/environment/climat/emission.htm
The New South Wales GHG Abatement Scheme (GGAS)	2003	**Regions of Australia**	Commenced on January 1st, 2003, the mandatory GGAS aims to reduce GHG emissions associated with the production and use of electricity. It will achieve this by using project-based activities to offset the production of GHG emissions.	http://www.greenhousegas.nsw.gov.au/
Regional Greenhouse Gas Initiative (RGGI)	2005	**Regions of North-Eastern Atlantic States**	RGGI is a co-operative effort by seven North-eastern and Mid-Atlantic States to reduce emissions by implementing a multi-state, cap-and-trade program with an offset trading system.	http://www.rggi.org/
Canada's Federal Domestic GHG Offset System	2010	**Canada-wide**	In April, 2007, Environment Canada announced the Clean Air Regulatory Agenda, which contained the framework for a domestic GHG offset system. Based on the results of three federal offset pilot programs, in March, 2008, the Government of Canada published the final version of the Regulatory Framework for Industrial Greenhouse Gas Emissions to reduce these emissions within its territory starting in 2010.	http://www.ec.gc.ca/doc/virage-corner/2008-03/526_eng.htm
Voluntary Regimes:				
Chicago Climate	2003	**International**	The world's first active, voluntary, legally binding GHG trading exchange that includes offset projects from around the world. The Exchange is	http://www.chicagocli

Exchange (CCX)			unique as it functions as a voluntary cap-and-trade system that allows members that cannot achieve their reduction targets internally to purchase carbon offsets.	matex.com/
Montreal Climate Exchange (MCeX)	2008	**Canada-wide**	This joint venture with the Chicago Climate Exchange® launched trading of futures contracts of carbon offsets on May 30, 2008.	http://www.m-x.ca/accueil_en.php
Retail (Open) Market	N/A	**International**	N/A	N/A

Appendix C: Description of GHG-related ISO Standards

ISO Standard	Title	Description
ISO 14064-1	Specification with guidance at the **organizational level** for quantification and reporting of greenhouse emissions and removals.	ISO 14064-1:2006 specifies principles and requirements at the **organization level** for quantification and reporting of greenhouse gas (GHG) emissions and removals. It includes requirements for the design, development, management, reporting and verification of an organization's GHG inventory.
ISO 14064-2	Specification with guidance at the **project level** for quantification and reporting of greenhouse emissions reductions or removal enhancements.	ISO 14064-2:2006 specifies principles and requirements and provides guidance at the **project level** for quantification, monitoring and reporting of activities intended to cause greenhouse gas (GHG) emission reductions or removal enhancements. It includes requirements for planning a GHG project, identifying and selecting GHG sources, sinks and reservoirs relevant to the project and baseline scenario, monitoring, quantifying, documenting and reporting GHG project performance and managing data quality.
ISO 14064-3	Specification with guidance for the validation and verification of greenhouse gas assertions	ISO 14064-3:2006 specifies principles and requirements and provides guidance for those conducting or managing the validation and/or verification of greenhouse gas (GHG) assertions. It can be applied to organizational or GHG project quantification, including GHG quantification,

		monitoring and reporting carried out in accordance with ISO 14064-1 or ISO 14064-2. ISO 14064-3:2006 also specifies requirements for selecting GHG validators/verifiers, establishing the level of assurance, objectives, criteria and scope, determining the validation/verification approach, assessing GHG data, information, information systems and controls, evaluating GHG assertions and preparing validation/verification statements.
ISO 14065	Requirements for greenhouse gas **validation and verification bodies** for use in accreditation or other forms of recognition	ISO 14065:2007 specifies principles and requirements for bodies that undertake validation or verification of greenhouse gas (GHG) assertions. It is GHG programme neutral. If a GHG programme is applicable, the requirements of that GHG programme are additional to the requirements of ISO 14065:2007

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