Reducing Greenhouse Gases from Dairy Operations in Canada: A Double Dividend by Accessing Carbon Markets?

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Take Home Messages

- Carbon Markets exist in some jurisdictions (Alberta) and are imminent in U.S. and Canadian federal systems
- The agriculture sector can participate by selling carbon offsets to regulated companies for compliance purposes under Cap and Trade systems
- A Dairy Carbon Offset Quantification Protocol is near approval in the Alberta Offset System
- This protocol will allow dairy producers to participate in generating and selling carbon offsets in Alberta, and eventually in Canada once the federal offset system is in place

Introduction

The global carbon market is growing rapidly and is currently valued at over $126 B USD (World Bank 2009) – a tripling over the last few years. Carbon markets are established by governments choosing to place a price on carbon or greenhouse gas emissions through regulatory mechanisms known as emissions trading systems. This involves setting reduction targets, or 'caps' for those sectors that emit greenhouse gases over a certain threshold, and then allowing companies within those sectors flexible ways of meeting their caps through purchasing and selling government-issued permits (the number of which are equal to the capped emissions) amongst themselves and submitting them to the regulator at the end of every compliance period. The overall cap on an economy's greenhouse gas (GHG) emissions cannot go above a certain amount and is always accounted for – the trading that goes on within the overall cap allows companies to find lower cost ways of

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complying with the required GHG reductions, controlling costs across the whole economy. This is known as 'cap and trade'.

Many jurisdictions, particularly in North America, are also considering allowing Carbon Offsets in a Cap and Trade emissions trading system. Offsets are GHG emission reductions undertaken by companies outside of the capped sectors (ie, actions taken voluntarily by those who do not have regulated targets, like the agriculture sector). Regulated companies can offset their emissions by purchasing these offset credits from others who have reduced their greenhouse gas emissions or have sequestered soil carbon, through Offset Projects. In this way, conservation agriculture projects can provide offsets to large emitters of GHG who are regulated.

In North America, Alberta created the first compliance-based, multi-sector GHG emissions trading framework with an accompanying offset system in 2007 (Alberta Environment, 2007a). Almost 30% of the carbon offsets used by regulated companies are sourced from the agriculture sector in Alberta, providing a net return to the agriculture sector of approximately $16 million since 2007.

Since then, the Canadian and US federal governments have both put forward plans to implement Cap and Trade style systems. Optimistic predictions are that the US Congress may pass legislation in the first quarter of 2010, catalyzing action both north and south of the 49th parallel. If legislation fails to emerge from the US Congress, the US Environmental Protection Agency has the legal mandate to proceed with a cap and trade system under the Clean Air Act – Cap and Trade systems are coming in North America. The dairy sector in agriculture can be poised to take advantage of this market - the efforts started by the Atlantic Dairy and Forage Institute (ADFI) in conjunction with the Alberta Offset System represents a platform for dairy farms to engage in offset projects.

▪ Project-Based Greenhouse Gas Offset Credits

In regulated systems, a clear set of rules and standards are needed to enable trading of project-based offsets to the regulated sectors for compliance purposes – these are known as GHG quantification protocols. They set out the rules and procedures for accounting how many offset credits can be produced from a change in management practice. Without these standards, the buyer would not have confidence in the offset credits being generated. Typically, they are approved for use by the regulating agency. To date, the Alberta system has the largest number of agriculture-based GHG protocols anywhere in the world, and a large contribution of agricultural offsets in the Alberta Offset System as a result (primary agriculture is a non-regulated sector).

In most existing or developing Offset Systems tied to a regulatory cap and trade system, an offset credit must meet a number of criteria and the protocol and project implementer must ensure that these are met. In general, offsets must:

- Be '**Additiona**l' or beyond business as usual/common industry practice – result from the difference in GHG emissions between a baseline (pre-project practice) and project or new practice. So the protocol must establish a valid and defensible baseline and ensure that the new practice is not required by law;
- Be **Measurable and Quantifiable** – based on best available science and farm activity data. The protocol must stand up to a review process and account for all 6 GHGs (where applicable);
- Be **Verifiable** – stand up to an audit by a qualified 3rd party where the GHG accounting and tracking process must be clear, defensible, and have good QA/QC procedures;
- Be **Permanent** – must protect against carbon reversals; account and replace mechanisms;
- Be **Clearly Owned** – clear title to the offsets must be proven to the 3rd party verifier (e.g. agreements must exist between land lessee vs land title holders or technology providers and buyers); and
- Be **Not Double Counted** – the offsets must be registered, serialized for uniqueness and used once for compliance (no double selling for example into another regulatory system).

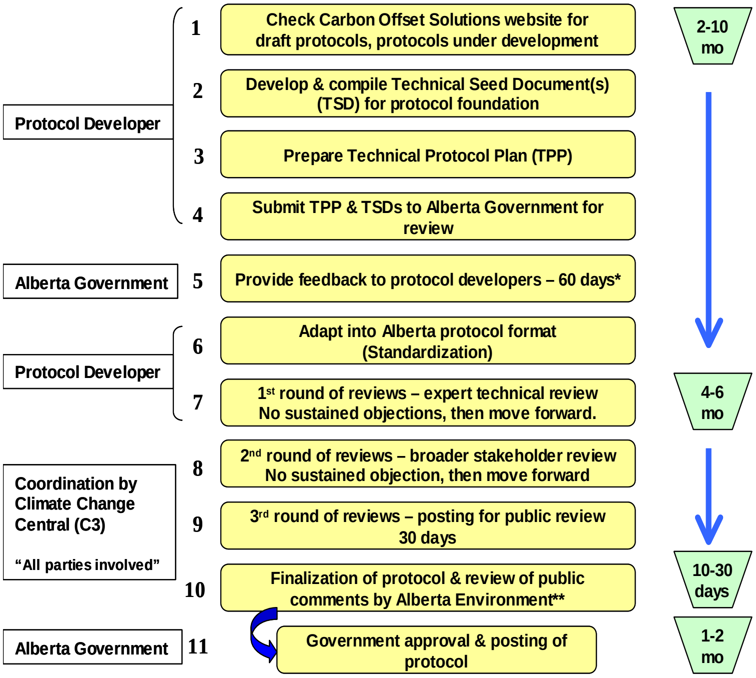
In Alberta, two additional criteria are in place – projects must occur in Alberta in order to be eligible for an offset to be used for compliance by a regulated company and actions must be taken after January 1, 2002 in order to be considered additional.

Developing Quantification Protocols – a Science-Based Business

The protocol development process in Alberta is based on the ISO 14064-2:2006 Project-Based standard that includes expert engagement, defensible scientific methodologies, a rigorous peer review process, and documented transparency to ensure a robust offset system that delivers real greenhouse gas reductions and net environmental benefits (Figure 1). The ISO 14064-2:2006 is quickly becoming the global standard for defining GHG offset credits. The Dairy Protocol sponsored by the Atlantic Dairy and Forage Institute has passed all stages of the process with imminent approval by the Alberta Government. This will enable offsets to be created from improved management practices in the dairy sector in Alberta, and set the stage for a Canadian protocol when the federal offset system begins.

In developing the Dairy Management Protocol, many federal, provincial and academic scientists were consulted and are compiled in supporting documentation called a Technical Seed Document (TSD) as part of the protocol development process. This information can be found on www.carbonoffsetsolutions.ca. The TSD helps guide the adaptation of the technical elements into the ISO 14064-2 Alberta Protocol template. The strength of a protocol ultimately relies on the extent to which the TSDs have been developed from science review and coordination of expert judgment on the subject matter. The TSDs should contain the most recent and relevant science from well-established sources – known as best practice guidance - and ratify the link between practice change or new technologies, and quantified GHG reductions. For the Alberta Dairy Protocol, workshops with experts were held to collectively review the science, adapted heavily from Canada's National GHG Emissions Inventory methodologies and decide on how to resolve technical issues under the discipline of the ISO 14064-2 principles.[1] Agricultural protocols typically proceed in a series of phases of collective decision-making about the certainty of the science at hand.

[1] This may only be relevant for activity based protocols or where the relationship between GHG impacts and the practice at hand is less robust. Using the principles of completeness and conservativeness in the ISO 14064-2 standard are applied here.



* Timing may vary depending on the volume of protocol proposals received.
** Additional time may be required depending upon the public comments received.

Figure 1. The Alberta Protocol Development and Review Process.

■ Greenhouse Gases in the Dairy Sector

The three main GHGs to be considered on dairy farms are nitrous oxide (N_20 – emitted from fertilizers and manures), carbon dioxide (CO_2–emitted from fuel use and removed from the atmosphere by sequestering soil carbon) and methane (CH_4–from enteric fermentation and manure management). Both nitrous oxide and methane are more potent GHGs than carbon dioxide - 310 times and 21 times more potent, respectively. Thus, in the GHG accounting process laid out in the protocol, the calculations report all 3 GHGs on the basis of a molecule of carbon dioxide, known as carbon dioxide equivalents or 'CO_2e'. One tonne of emissions reductions calculated on a CO_2e basis equals 1 offset credit.

To understand the relative split of emissions of GHGs throughout the dairy supply chain, the work of the Dairy Management Inc and Innovation Centre in the US provides a useful starting point with their Carbon Footprint of

Greenhouse Gas emissions for the US Dairy Industry (Figure 2).

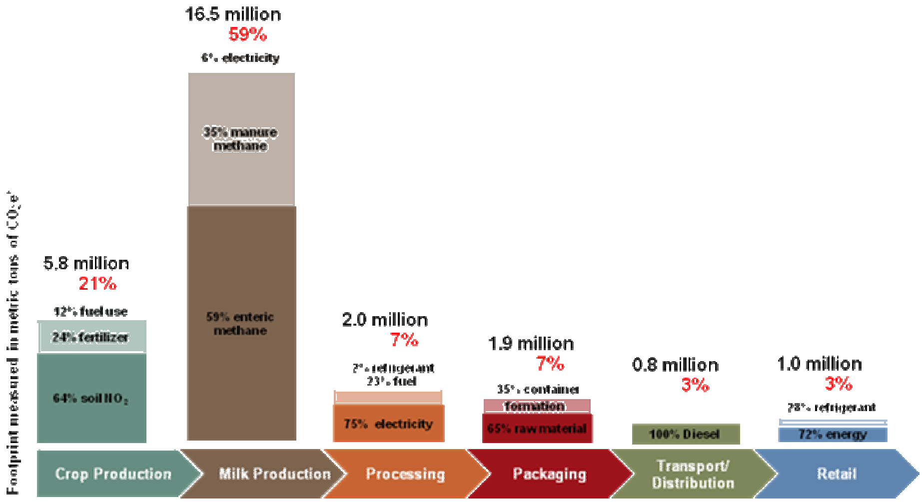


Figure 2. Scan-level carbon footprint of Fluid Milk Production and Distribution in the United States (Innovation Centre for US Dairy, 2009)

Although the absolute amounts of GHG emissions would differ between Canada and the US dairy production, the relative contribution of each greenhouse gas in each element, would likely be quite similar. From Figure 2, it can be seen that the most promising opportunity to reduce GHGs and develop offset projects would come from management changes on the primary side of the industry – cropping and milk production.

Many dairy farmers would argue that all possible cost-effective improvements in milk production efficiency have been made – and indeed, significant gains in milk production have occurred and have stabilized within the current cost structure of the industry. Dyer *et al.* (2008) report that the 57% decrease in dairy cattle population in Canada from 1981 to 2001, made possible by increasing milk per cow, resulted in about 49% decrease in GHGs from primary production in the period. These authors, however, point out that this trend is stabilizing. But, in order to earn offsets, further or 'additional' improvements need to be made. It's recognized that financial barriers exist to investing in a new barn or field equipment that may increase milk production, but additional revenues accruing from adoption of practices that result in reduced GHG emissions (an environmental good/service), can help to defray costs of these improvements.

▪ The GHG Protocol for the Canadian Dairy Industry

The Dairy Protocol is intended to quantify emissions and emission reductions of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) for dairy farms in Canada (ADFI-ClimateCHECK 2009). The common reporting metric of GHG emissions between the baseline practices and the project conditions identified in the protocol are normalized to the unit of “GHG emissions per unit of fat corrected milk (FCM) produced”. Dairy farms under this protocol are described as any farm that produces milk for eventual retail sale. A “dairy farm” may conduct other farming practices such as beef or veal farming, while maintaining its status as a “dairy farm” provided that it continues to produce milk for retail sale.

Under the protocol, there are several Project Conditions to reduce GHG emissions:

- Annual milk productivity per cow is increased
- Diet is modified to reduce the amount of gross energy converted to methane (Ym – methane emission factor)
- Fewer heifers are retained as replacements to reduce emissions derived from replacement animals
- Timing of manure spreading is modified to reduce methane emissions from storage units.

Other management changes originally identified as possible candidates were better pasture quality and use, but the GHG quantification science is developing in this area, and until further research occurs to fill gaps in understanding of this GHG reduction and removal strategy, it was dropped at this time.

The protocol also provides flexibility in its use by applying either the Basic or Advanced options. The Basic approach for quantifying offsets uses accepted emission factors or defaults for feed quality/GHG emissions, while the Advanced approach will require on-site measurement (with proper calibrations and QA/QC procedures, including sign-off by a consulting nutritionist). The Basic approach uses a discount factor to decrease the number of GHG reductions created – by 20% because of the less rigorous accounting.

▪ Protocol Project Scope and Applicability

As stated above, the quantification of reductions in GHG emissions result from practice changes that decrease CO_2, CH_4, N_2O emissions per unit of FCM. These include practices that increase milk productivity, diet modification, lower replacement rate, and avoided methane emissions from manure storage through spreading of manure in spring rather than fall, where the manure storage would normally be fermenting and emitting methane throughout the hot summer months. The project boundary is the whole farm - barn, cattle, manure storage and feed production. Several other protocols exist that can be co-implemented with this protocol such as reduced tillage, biodigesters and energy efficiency for dairy barns.

The basis for the emission reductions in the Dairy Protocol include the following additional practices:

- Milk productivity — better genetics or husbandry to achieve equal milk with less feed
- Diet modification — higher quality feed or supplements (edible oils, ionophores or distillers grains) to decrease enteric methane per unit feed
- Replacement rate — fewer non-productive cows
- Season of spreading — avoid storing manure in warm months where methane emissions can be higher.

The ISO 14064:2 standard requires lifecycle assessments of both the project and baseline conditions. These are shown in Figures 3 and 4. Note that they are practically identical; increases in efficiency allow for emission reductions.

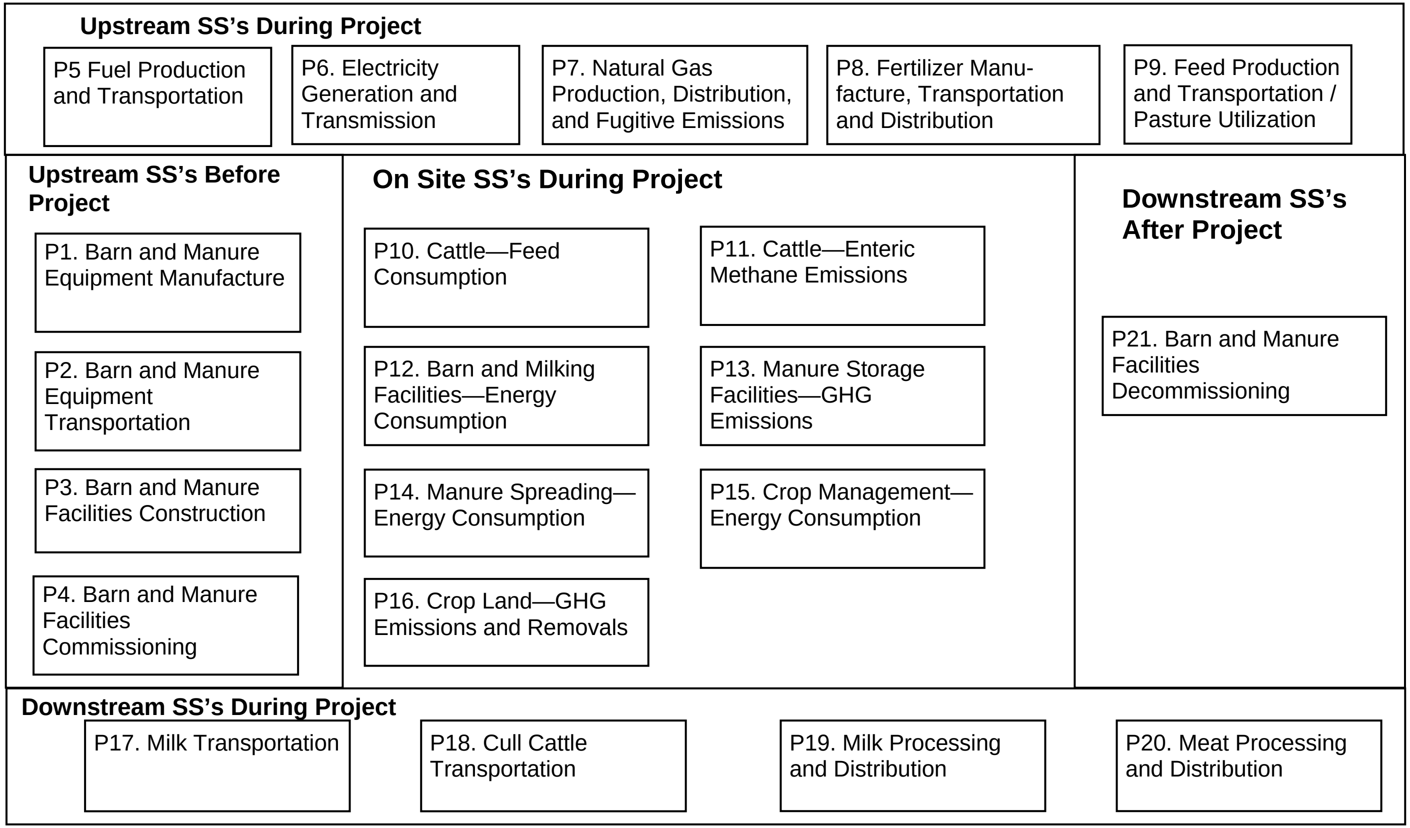


Figure 3. Sources and sinks (SS) for the Project Condition under the Dairy Protocol.

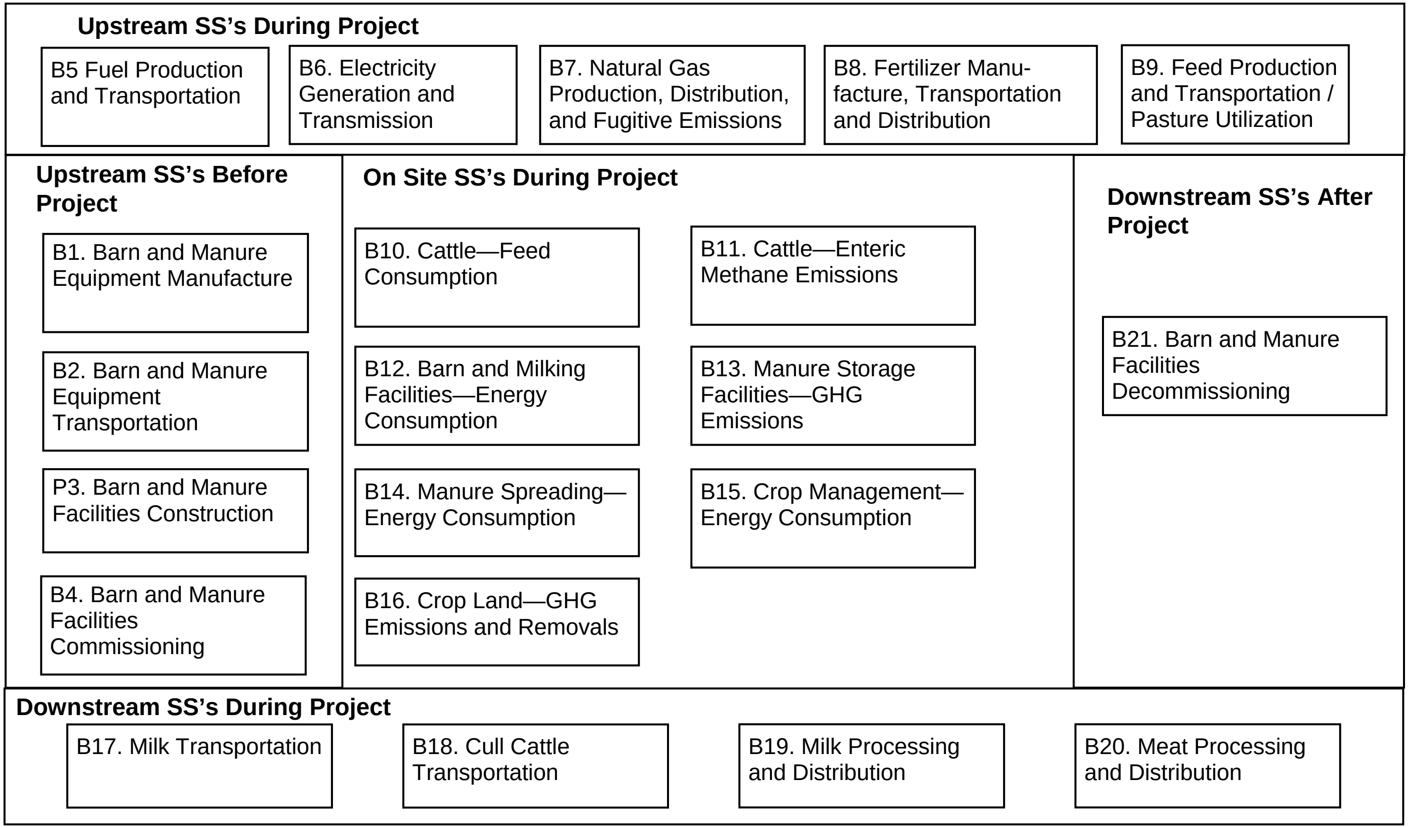


Figure 4. Sources and sinks (SS) for the Baseline Condition under the Dairy Protocol.

The basic equations that govern the quantification of the Emission Reductions under the Protocol are:

$$\text{Emission Reduction} = [(\text{Emissions}_{\text{Baseline}} - \text{Emissions}_{\text{Project}}) * \text{Discount}] * \text{Milk}$$

$$\text{Emissions}_{\text{Baseline}} = \text{Enteric} + \text{Stored Manure} + \text{Feed}$$

$$\text{Emissions}_{\text{Project}} = \text{Enteric} + \text{Stored Manure} + \text{Feed}$$

That is:

Emissions $_{\text{Baseline}}$ = the sum of the GHG emissions under the baseline scenario (kg CO_2e / kg FCM)

Emissions $_{\text{Project}}$ = the sum of the GHG emissions under the project condition (kg CO_2e / kg FCM)

Discount = factor for Basic (0.8) or Advanced (1.0) approach

Milk = total kg of FCM produced under project condition

The feed component includes all the embedded energy emissions that occur with different feed mixes.

■ Summary

In many cases, improvements in production efficiency are cost effective in the dairy sector. However, financial issues may pose a barrier to adoption as these improvements may require investment in expensive barn or field equipment. Given the current state of the farm economy and the increasing costs of milk production, payments for ecosystem services such as GHG emission reductions will enable adoption of practices that result in reduced GHG emissions.

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