

FIRST ROUND OF EXPERT TECHNICAL REVIEW

For the Certification of a Greenhouse Gas Protocol and Calculator for
the Canadian Dairy Industry

Prepared by

Atlantic Dairy & Forage Institute



For

Alberta Environment

November 2008

December 5, 2008

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Director, Climate Change Policy Unit
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Dear: Director, Climate Change Policy Unit,

The Atlantic Dairy and Forage Institute (ADFI) is pleased to submit the First Expert Technical Review to Alberta Environment for ADFI's "Certification of a Greenhouse Gas Protocol and Calculator for the Canadian Dairy Industry". I hope this meets the requirements of the First Round of Expert Technical Review as outlined in the "Alberta Offset System Protocol Development Guidance Document – October 2008".

Thank you for your consideration and I look forward to participating in the Broader Stakeholder Review in December.

Sincerely,

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**FIRST ROUND OF
EXPERT TECHNICAL REVIEW**

1 Initial Version of Protocol
Reviewed

2 Expert Technical
Review Minutes

3 Appendix A
Participants of the Expert Technical Review

November 2008

SECTION 1



DRAFT

**Greenhouse Gas Protocol for the
Canadian Dairy Industry**

Prepared For

Atlantic Dairy & Forage Institute



20 October 2008

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Nomenclature, Acronyms, Abbreviations

AENV	Alberta Environment
AM	Approved Methodology (CDM)
AOS	Alberta Offsets System
CDM	Clean Development Mechanism (UNFCCC Kyoto Protocol)
CH ₄	Methane (GWP = 21)
CO ₂	Carbon dioxide (GWP = 1)
CO ₂ e	Carbon dioxide equivalent
COS	Canada's Offset System
GHG	Greenhouse gas(es)
GPG	Good Practice Guidance (e.g. GHGP-P)
GHGP-P	WRI/WBCSD GHG Protocol for Projects (December 2005)
GWP	Global Warming Potential (relative to CO ₂ 100 year basis)
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
N ₂ O	Nitrous Oxide (GWP = 310)
SGER	Specified Gas Emitters Regulation (Alberta)
SSRs	Sources, Sinks and Reservoirs (Greenhouse Gas)
UNFCCC	United Nations Framework Convention on Climate Change
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

1 Protocol Description

The Atlantic Dairy & Forage Institute¹ (“ADFI”) is funded by the Advancing Canadian Agriculture and Agri-Food (ACAAF) Program to develop a Greenhouse Gas Protocol and Calculator for the Canadian Dairy Industry (“Protocol and Calculator”) to quantify greenhouse gas (“GHG”) emission reductions from Canadian dairy farms. To accomplish the Protocol and Calculator development, ADFI has involved the Dairy Farmers of Canada (“DFC”), retained a number of consultants (ClimateCHECK, Macleod Agronomics, Émie Désilets, and Genivar), and received guidance from researchers and technical experts across Canada (Agriculture and Agri-Food Canada, Climate Change Central, and several universities).

The development of the Protocol and Calculator rests on the scientific knowledge and policy decisions achieved through previous effort by the participants in this project. ADFI has previously contributed to development of a whole farm GHG calculator for dairy operations in Atlantic Canada. DFC has completed demonstration projects to apply GHG mitigation strategies at the farm level. Agriculture and Agri-Food Canada derives the factors and equations used to populate Canada’s National Inventory Report (to fulfil Kyoto requirements) and to build the HOLOS² tool. ClimateCHECK and Macleod Agronomics were also involved with development of the Alberta-approved Pork Protocol and the associated Pork GHG Project Builder. The Protocol and Calculator thus integrates previous effort, but adapts this effort to meet the specific and rigorous requirements for monetizing GHG reduction credits in compliance or voluntary markets.

The Protocol and Calculator are designed to quantify tradable emission reduction credits according to the requirements of ISO14064-2, the standard forming the basis of the Alberta Offset System and Canada’s Offset System. First, a Science Discussion Paper compiled the science relevant to the quantification of the emissions associated with a baseline scenario, and of the emissions associated with a specified scope of project practices. Second, experts and stakeholders engaged by ADFI evaluated the Science Discussion Paper, and made decisions at a Consultation Workshop concerning options for implementation of this scientific knowledge. Finally, this document integrates the compiled scientific knowledge and the expert judgment of the reviewers in a format to comply with an ISO-based GHG program. The credibility of the Protocol and Calculator thus depends upon the authority of the compiled science, the expertise of the engaged experts and stakeholders, and the transparency of the ADFI-led process, all directed within the discipline imposed by the ISO 14064-2 standard.

It is important to note the proposed Dairy Protocol and Calculator use IPCC guidance and an ISO framework to achieve ‘accuracy in aggregate’. That is, the quantification of GHG emissions using the Dairy Protocol and Calculator is not intended to achieve the site-specific predictive capability of a process model, or to provide the comprehensive scenario testing capability of

¹ For a complete description of Atlantic Dairy and Forage Institute, refer to the website: <http://adfiresearch.org>.

² HOLOS is “a whole-farm modelling software program that estimates greenhouse gas (GHG) emissions based on information entered for individual farms”. For a complete description of (and to download) the Holos tool, refer to the website: http://www.agr.gc.ca/nlwis-snite/index_e.cfm?s1=tools_outils&page=intro.

the HOLOS tool. It is understood the emission coefficients and equations used have underlying uncertainty preventing site-specific accuracy. However, using the IPCC guidance and imposing the discipline of the ISO standard ensures the uncertainties of GHG reduction quantification are minimized (uncertainties are 'average out') as the Protocol and Calculator are applied over a large number of participating farms.

1.1 Purpose and Objectives

Development of the Protocol and Calculator, and achieving adoption of these tools by Canadian dairy farmers, will have three types of benefits. First, dairy farmers will be motivated to measure production parameters of importance to harmonious interaction with the environment. The Protocol will require participating farmers to manage more deliberately the flows of nutrients and energy on the farms, thereby minimizing the opportunity for pollution. Second, the Calculator is a tool to evaluate the environmental benefits of potential strategies to mitigate GHG emissions. With site-specific estimates of costs for these strategies, dairy farmers will be able to predict the costs and benefits for implementing environment-enhancing practices on their farm. Finally, the protocol and calculator are tools necessary for Canadian dairy farmers to evaluate possible participation in the emerging markets for GHG reduction credits. Using the Protocol and Calculator, farmers will assess the potential to generate GHG reduction credits on their farm³.

1.2 Scope

This protocol has been developed with the purpose of quantifying GHG emissions and emission reductions from dairy farms in Canada. GHG emissions are to be normalized to the unit of "GHG emissions per unit of fat corrected milk (FCM) produced".

In general, the scope of the Protocol and Calculator encompasses the animals, buildings, and land which constitute the biophysical system of a dairy farm. However, because of the complexity of the system, and because of on-going development of other GHG quantification protocols in Canada, some aspects of the animal/building/land system are simplified or excluded. These simplifications or exclusions are made according to the ISO 14064-2 principle of conservatism.

1.3 Project-Related GHGs

This protocol is intended to quantify emissions and emission reductions of carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) from dairy farms within Canada. The main sources of GHG emissions from dairy farms include CH₄ emissions from enteric fermentation and manure, N₂O emissions from manure, and CO₂ and N₂O emissions from feed production. Although the type of GHG emissions reduced under this protocol will be dependent on the specific project(s) undertaken, the majority of projects will result in emission reductions of CO₂, CH₄, and N₂O.

³ It is the responsibility of the user to ensure the Protocol and Calculator meets the specific requirements of the voluntary or compliance market in which the GHG reductions are intended to be traded.

1.4 GHG Emission Reduction Projects

All projects are required to take place on Canadian dairy farms. For the purpose of this protocol, a “dairy farm” is any farm which produces milk for eventual retail sale. For this Protocol, 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.

A variety of projects may be undertaken at the farm-level to reduce GHG emissions – detailed descriptions of typical projects are described in Section 1.4 of this protocol.

While a variety of projects may be undertaken to reduce GHG emissions on dairy farms, Table 1 presents typical projects and mitigation strategies which may take place.

Table 1 - Possible Mitigation Strategies

Potential Scenarios	Description
1	Annual milk productivity per cow is increased, thus reducing GHG emissions per unit of milk produced from all SSRs.
2	Diet is modified to reduce the proportion of gross energy converted to methane (Y_M)
3	Fewer heifers are retained as replacements to reduce emissions derived from replacement animals
4	Diet is modified to reduce GHG emissions from feed production
5	Pasture use is increased to reduce GHG emissions from manure storage and feed production
6	Timing of manure spreading is modified to reduce methane emissions from storage unit

1.5 Protocol Flexibility

1.5.1 Specialized Protocols

Other protocols relating to specific aspects of dairy farm operation are currently available or under development. This Protocol is designed to link and complement relevant protocols to provide additional flexibility and opportunity to mitigate GHG emissions and create GHG reduction credits.

Since the quantification of GHG reduction credits associated with energy efficiency is specialized, the energy use of the farm will not be addressed directly, although energy use is embedded in the emission factors associated with feed production. The Alberta Offset System has an approved quantification protocol for energy efficiency, and an appropriate protocol is in the ‘fast track’ of Canada’s Offset System. Participants in the Dairy Protocol are encouraged to

use these protocols dedicated for energy efficiency. As the project activities of the Protocol are expected to decrease emissions per kg of FCM, this decision is conservative.

The N₂O emissions associated with the operation of the dairy farms is partly excluded from the Dairy Protocol. Emissions of N₂O for the various types of manure storage are included, and the emissions associated with feed production are embedded in the feed production emission factors. However, emissions from spreading of manure on land are not included. This decision is taken, because the Dairy Protocol does not prescribe the detailed practices necessary to manage N, and because a dedicated protocol for management of N in agricultural soils is under development. The Nitrous Oxide Reduction Protocol will be submitted to the Alberta Offset System, and then to Canada's Offset System. Alternatively, if a GHG program requires the inclusion of N₂O emissions from manure applied to fields, the quantification approach in the Pork Protocol (approved for the Alberta Offset System and submitted to the 'fast track' of Canada's Offset System) could be used with little or no modification. The decision to exclude N₂O emissions from field-applied manure is conservative, because these emissions are expected to be decreased from the baseline scenario under the project conditions.

Other protocols dedicated to quantification of GHG emissions and reductions of specialized aspects of the dairy farm are available in the Alberta Offset System, and are expected in Canada's Offset System. These include protocols to address the use of biofuels, biogas from anaerobic digestion of manure, etc.

If multiple GHG quantification protocols are implemented on the dairy farm, the presence of each project must be declared, the scope of each protocol must be described, and the distribution of credits between the protocols must be documented. Some additional protocols, such as an energy efficiency protocol, may be additive to the Dairy Protocol. However, if a biogas protocol is implemented on the dairy farm, the potential may exist for double counting. The project proponent must demonstrate that the interactions of the different protocols are considered and that integrity is maintained.

1.5.2 Simple and Advanced Options

This protocol provides flexibility for the user by introducing Simple and Advanced approaches to GHG emission quantification from specific sources. At the basic level, the Simple approach for quantification will use an accepted value/emission factor or default assessment of feed quality or GHG emissions while the Advanced approach will require on-site measurement (with proper calibration and QA/QC procedures). Simple and Advanced approaches are not available for all quantifications; wherever flexibility is an option, the requirements and results of each approach will be stated. Protocol participants using the Simple approach will use a discount factor to decrease the number of GHG reductions created. Eligible GHG reductions and discount factors are detailed below (Table 2).

Because the potential for excess emissions of N₂O due to mismanagement of manure nitrogen, and because sophisticated and comprehensive management of manure N is not prescribed in the Dairy Protocol, users of the Dairy Protocol are encouraged to also enrol in the Nitrous Oxide

Emissions Reduction Protocol (NERP)⁴. Users who choose to enrol in the NERP will benefit from the reduction credits gained by participating in this forthcoming protocol, and will benefit from an increase in eligible GHG reductions under the Dairy Protocol. To be eligible for “advanced approach” benefits, participants in the Protocol must follow the advanced approach for all quantification calculations which offer such flexibility (no simple approaches may be followed). The discount factor scheme is outlined below (Table 2).

Table 2 - Eligible GHG Reductions and Discount Factors

Advanced Approaches Only Used in Dairy Protocol	Simple Approaches Used in Dairy Protocol	Enrolment in the NERP	% of GHG Credits to be Received under this Protocol
YES	NO	YES	100
YES	NO	NO	90
NO	YES	YES	90
NO	YES	NO	80

1.6 Current Legal Requirements and Climate Change Incentives

There are currently no legal requirements for Canadian dairy farms to regulate GHG emissions. Any GHG emission reduction is strictly voluntary. Requirements for manure management, however, do exist in some provinces and such regulations may disallow some Protocol activities for some farms. For example, if application of manure in fall is prohibited by regulation, a participating farm in this jurisdiction could not generate GHG reduction credits by applying the manure in spring. Protocol participants are required to document that their activities to decrease GHG emissions are not mandated by regulation.

As GHG standards and programs evolve, the requirements for participation in GHG quantification protocols may change. For example, the Dairy Protocol does not provide prescriptive guidance concerning the management of plant nutrients in manure (or digestate from anaerobic digester) on a dairy farm. Therefore, the potential exists for emissions of N₂O associated with excess application of nitrogen. If the dairy farm also participated in the Nitrous Oxide Emission Reduction Protocol, appropriate use of manure nitrogen would be assured and N₂O emissions avoided. At present, it is good practice for farmers to participate in available protocols to cover the manure management aspect of farm operations. In future, it is conceivable that offset programs may require farms to participate in protocols required to guide management of specialized aspects of the farm enterprise with high risk of GHG emissions.

⁴ Currently in development for the Alberta Offset System. Alternatively, other protocols to address N₂O emission reduction associated with N management may be developed in future, providing similar support to the manure management of the Dairy Protocol.

1.7 Ownership of Rights and Environmental Attributes

Dairy farms in Canada may be owned by an individual agricultural producer, a community investment group, or food processing entity and/or a combination of these. Where multiple owners are involved, a clear distribution of rights must be documented with respect to GHG reduction credits generated using the Protocol.

Additionally, dairy farms may be operated by the owner or a third-party through contractual agreements — these arrangements can include lease of cows, quota, barns, land or any combination of these. Where a contractual agreement is in place, it must outline the ownership of the GHG reduction credits generated using the Protocol.

And, if more than one business entity is implementing GHG quantification protocols in the case of multiple protocols on the dairy farm, the ownership of credits must be declared and documented separately for each protocol.

2 Protocol Development

This protocol will be similar to the protocols developed under the National Offsets Quantification Team (NOQT) for the beef and pork sectors. Versions of these protocols are approved to generate compliance-based GHG credits under the Alberta Offsets System⁵, and are submitted to the ‘fast track’ process for adaptation of protocols for Canada’s Offset System. Also, the Canadian Pork Council developed a computer-based calculator using the NOQT quantification protocol for the pork sector⁶. Using the experiences of the retained consultants gained in developing protocols for other agricultural sectors, and with the support of the DFC, ADFI will build on previous efforts to provide a Protocol and Calculator to quantify GHG emissions from dairy farms in Canada.

2.1 Glossary of New Terms and Definitions

All definitions marked with the symbol † are from Alberta Agriculture and Rural Development.

Acid Detergent Fibre (ADF) - the fibrous, least-digestible portion of roughage. ADF consists of the highly indigestible parts of the forage, including lignin, cellulose, silica and insoluble forms of nitrogen. Roughages high in ADF are lower in digestible energy than roughages that contain low levels of ADF. As ADF levels increase, digestible energy levels decrease.†

Concentrates — A broad classification of feedstuffs which are high in energy and low in crude fibre (<18% Crude Fibre). This can include grains and protein supplements, but excludes feedstuffs like hay or silage or other roughage. †

Dry Cows – cows which are not producing milk (not lactating).

⁵ These Alberta-approved protocols are available from Carbon Offset Solutions (www.carbonoffsetsolutions.ca).

⁶ The calculator, the Pork GHG Project Builder, is available from the Canadian Pork Council (www.cpc-ccp.com).

Dry Matter - total weight of feed minus the weight of water in the feed, expressed as a percentage. May also be referred to as: dry, dry basis, dry result or moisture-free basis. You can convert from As-fed basis or dry matter basis by using the following formulas: DM basis = As-fed basis x (Dry Matter %/100) or As-fed basis = DM basis x (Dry Matter %/100).†

Dry Matter Intake (DMI) - all the nutrients contained in the dry portion of the feed consumed by animals.†

Edible Oils - Oils derived from plants that are composed primarily of triglycerides. Although many different parts of plants may yield oil, in commercial practice oil is extracted primarily from the seeds of oilseed plants. Whole seeds can be applied as a feed ingredient so long as the oil content is calculated on a dry matter basis to achieve the 4 to 6% content in the diet. †

Enteric Methane Emission - Methane (CH₄) released by cattle (or other ruminants) as part of the normal digestive process.

Fat Corrected Milk (FCM) – Quantity of milk, normalized to a common energy basis.

Forage – High fibre feed, produced from grasses and legumes. Examples of forages include hay, pasture or silage. Forage is often referred to as roughages.

Gestation - The carrying of an embryo or fetus.

Gross Energy – The total energy contained in feed; measured by calorimetry.

Hay – Dried forage used for feed.

Heifer – A young, female cow which has not given birth to a calf.

Ionophores – Antimicrobial compounds fed to animals to improve feed efficiency.

Lactation/Lactating – Process of producing and/or secreting milk.

Liquid Manure – Manure which has had water added to it during the collection, storage, or treatment process.

Methane (CH₄) - A greenhouse gas with global warming potential of 21.

Neutral Detergent Fibre (NDF) - is commonly called "cell walls." NDF gives a close estimate of fibre constituents of feedstuffs as it measures cellulose, hemi-cellulose, lignin, silica, tannins and cutins. Neutral detergent fibre has been shown to be negatively correlated with dry matter intake. As the NDF in forages increases, animals will be able to consume less forage. NDF is used in formulas to predict the dry matter intake of cattle.†

Nitrous Oxide (N₂O) - A greenhouse gas with global warming potential of 310.

Pasture - Land with vegetation used for grazing of cows and other livestock.

Protein - Complex compounds containing carbon, hydrogen, oxygen, nitrogen and usually sulphur are composed of one or more chains of amino acids. Proteins are essential in the diet of animals for growth, lactation and reproduction. In ruminants (for example, cattle), the rumen microbes break down about 80 per cent of the protein in the feed to ammonia, carbon dioxide, volatile fatty acids and other carbon compounds. The microbes then use the ammonia to synthesize their own body protein. As feed is passed through the rumen into the rest of the digestive tract, the micro-organisms containing about 65 per cent high quality protein are washed along too. The ruminant obtains most of its required protein by digesting these micro-organisms.†

Quota – The quantity of milk which a dairy farmer is permitted to sell.

Replacement Cattle – Young cattle (calves, heifers, bulls) which are raised on farm to replace milk cows removed from the herd.

Silage – High-moisture fodder which has been compressed and fermented, used as feed.

Solid Manure – Manure which has not undergone any treatment process involving the addition of water.

Total Mixed Ration (TMR) - Consists of all the feed ingredients — concentrates, forage, minerals and vitamins — mixed together to form the ration allowance for the animal.†

2.2 Description of Development Approach

This protocol has been developed in consultation with various groups and scientific experts, following the general process described below:

2.2.1 Protocol and Calculator Developed in Compliance with ISO 14064-2.

The Protocol and Calculator are developed in compliance with ISO 14064-2 in a program-neutral approach. However, it is expected the ADFI and DFC will submit the Protocol and Calculator for approval in the Alberta Offset System and/or Canada's Offset System. Thus, the requirements of the Alberta Offset System, and the expected requirements of Canada's Offset System, were used as good practice guidance. But, the current Protocol will likely require adaptation to specific requirements to be approved in any system.

2.2.2 Participants in Protocol and Calculator Development

2.2.2.1 Atlantic Dairy and Forage Institute (www.adfiresearch.org)

ADFI is a private, not for profit research establishment situated on a 150 acre dairy farm in New Brunswick, managed by a board of six elected directors in the region. It was established in 1996

to fill the remaining need in the Atlantic region after elimination of the Agri-Food Canada Dairy Research Program in Fredericton. With the assistance of former AAFC employees, the support of the Dairy Farmers of NB, and the transference of the AAFC dairy herd to the ADFI location, the ADFI was established. The mandate of ADFI is to provide research services for producers and industry manufacturers in the dairy industry. Approximately four years ago, the National Agricultural Greenhouse Gas Management Institute (NAGMI) was created by ADFI — with significant support from the New Brunswick Department of Agriculture and Aquaculture (NBDAA), the Dairy Farmers of Canada (DFC) and the Canadian Pork Council (CPC) — as a national not-for-profit applied research and development institution to further producer participation in greenhouse gas (GHG) research and related environmental issues. Since its initiation, NAGMI has begun to develop a whole farm greenhouse gas calculator for dairy operations in Atlantic Canada. The current Protocol and Calculator project is thus a continuation of ADFI's contribution to management of GHGs on Canadian dairy farms.

2.2.2.2 Dairy Farmers of Canada (www.dairygoodness.ca)

The Dairy Farmers of Canada (DFC) have completed demonstration projects to apply GHG mitigation strategies at the farm level. These include the Greenhouse Gas Mitigation Program (GHGMP) and Canada's Agricultural Producers Addressing Environmental Issues (CAPAEI) program. These demonstration projects, involving primarily the scientists to be consulted in the Protocol development process, confirm GHG mitigation strategies achieve emission reductions on Canadian dairy farms.

2.2.2.3 ClimateCHECK (www.climate-check.com)

Rob Janzen (Ph.D. P.Ag. VP Western Canada Operations) represents ClimateCHECK. ClimateCHECK provides services in GHG consulting, validation, verification, training and management for technologies, products, projects, inventories and programs, including development of GHG Methodologies and Protocols. Currently, Rob Janzen manages a number of ClimateCHECK protocol development and project origination engagements. These include: (1) assess opportunity to generate GHG reduction credits from a biomass-to-energy facility, (2) validate a protocol to quantify offset credits from capture and destruction of methane from livestock manures, (3) compile scientific knowledge to support development of a protocol to quantify GHG emission reductions through more effective use of nitrogen fertilizers, (4) analyse opportunities to generate GHG reduction credits by change of land use or by avoiding change of land management, (5) document GHG emission reduction credits from energy efficiency projects of a multi-national supplier of retail and commercial energy products, and (6) provide strategic advice to a major corporation in the North American oil and gas industry.

2.2.2.4 MacLeod Agronomics (www.macleodagronomics.com)

Cedric MacLeod (M.Sc. P.Ag.) coordinated the participation by the Canadian Pork Council in the Greenhouse Gas Mitigation Program (GHGMP), and advises in all aspects of the development of the Protocol and Calculator. Cedric represents MacLeod Agronomics, which is an agri-environmental consulting firm specializing in sustainable agriculture development projects. Having significant expertise in manure management, including strategies for reducing GHG, ammonia and odour emissions, Macleod Agronomics will provide support for developing the

manure management components of the Protocol and Calculator. MacLeod Agronomics is also actively involved in pasture management planning for cattle producers, and will also provide insight into the feed quality of pasture systems vs. stockpiled forages.

2.2.2.5 *Émie Désilets*

Émie Désilets (M.Sc.) coordinated the participation by DFC in the Greenhouse Gas Mitigation Program (GHGMP) and Canada's Agricultural Producers Addressing Environmental Issues (CAPAEI) program. Émie will facilitate and coordinate efforts by ADFI and DFC to communicate the Protocol and Calculator to dairy farmers across Canada.

2.2.2.6 *GENIVAR (www.genivar.com)*

Kalvin Kroker (P.Eng.) programmed the computer calculator based on the Pork Protocol, funded by the Canadian Pork Council. Calvin represents GENIVAR.

2.2.3 Source of Factors and Equations

The development of the Protocol and Calculator involved the Agriculture and Agri-Food Canada scientists contributing to the agricultural component of Canada's National Inventory Report. These same scientists are active in the development of Holos, a tool to predict GHG reductions from management scenarios on Canadian farms. The focus in the National Inventory Report and in Holos is to use IPCC factors where necessary, but to develop region-specific factors and coefficients wherever sufficient knowledge or empirical data exists. This approach emulates the quantification strategy used by the former National Offsets Quantification Team, and parallels the strategy used to develop quantification protocols for the Alberta Offset System.

2.2.4 Timeline and Professionals Involved

The name, affiliation, and contact information for all participating professionals are listed below (Table 3).

2.2.4.1 *Administration*

Financial support for the development of the Protocol and Calculator was granted by ACAAF to ADFI, as supported by DFC and the New Brunswick Department of Agriculture and Aquaculture (NBDAA). The Project Management team is comprised of Wiebe Dykstra, Marian Gilbert, Ron Maynard, David Walker, Pamela Craig/Josh Lamont, Cedric MacLeod, Émie Désilets, and Rob Janzen (See Table 3).

In this project, ADFI provides financial administration and NBDAA serves as secretariat. As secretariat, NBDAA facilitates correspondence with the participants in the process, and records and distributes the minutes of the teleconferences and Consultation Workshop.

2.2.4.2 *Initial Planning and Technical Evaluation*

The initial planning meeting for the development of the Protocol and Calculator was held in Lennoxville, Quebec, on 30 & 31 January 2008. Present at this meeting were David Walker, Cedric MacLeod, Pamela Craig, Émie Désilets, Rob Janzen, Daniel Massé, and Chaouki Benchaar. At this meeting Cedric MacLeod and Rob Janzen laid out the general approach to the development process, and Daniel Massé and Chaouki Benchaar presented the state of science

with respect to GHG reductions on dairy farms. All present at this meeting contributed to the development of a list of technical experts for invitation to participate as technical advisors to the Protocol and Calculator.

2.2.4.3 Prepare Science Discussion Paper

Rob Janzen of ClimateCHECK, with support from Eric Bremer (SymbioAg Consulting Inc), prepared a Science Discussion Paper to compile the scientific knowledge and policy decisions relevant to the development of the Protocol and Calculator. The Discussion Paper was organized around 'Decision Points', intended to focus the thinking of the scientific and technical advisors.

This version of the Science Document was completed and sent to ADFI and NBDAA on 06 May 2008. The project secretariat then sent the Science Discussion Paper to a list of researchers in Agriculture and Agri-Food Canada and a number of universities across Canada, requesting review and response to ensure the Science Discussion Paper accurately assessed opportunities and requirements to generate GHG reductions on dairy farms in Canada.

2.2.4.4 Review Science Discussion Paper

A number of scientific and technical advisors responded with reviews of the Science Discussion Paper. John Basarab, Karen Beauchemin, Alan Fredeen, Daniel Massé, Sean McGinn, Philippe Rochette, and Xavier Vergé provided comments to improve the Science Discussion Paper.

The responses to the first version of the Science Discussion Paper were reviewed by Rob Janzen to finalize the Science Discussion Paper. The revised version of the Science Discussion Paper was sent to ADFI and NBDAA on 30 May 2008. The project secretariat then sent the revised Science Discussion Paper to a list of researchers in Agriculture and Agri-Food Canada and a number of universities across Canada, who had already received invitations to participate to the Consultation Workshop (See Appendix 1 for the final Science Discussion Paper).

2.2.4.5 Consultation Workshop

The Consultation Workshop was held in Fredericton, New Brunswick, on 05 & 06 June 2008 (See Appendix 2 for the Agenda of the Consultation Workshop). The participants were Karen Beauchemin, Pamela Craig, Raymond Desjardins, Émie Désilets, Wiebe Dykstra, Alan Fredeen, Rob Janzen, Ron Maynard, Cedric MacLeod, Philippe Rochette, David Walker, and Xavier Vergé (see Table 3 for affiliation and contact information).

David Walker served as facilitator for the Workshop, and guided the discussions to arrive at consensus for each Decision Point. The discussions proceeded efficiently and constructively, without any participants objecting to, or abstaining from, any decision.

Pamela Craig recorded the minutes of the Consultation Workshop to document the decisions of the participants. After Pamela completed these minutes, including revisions from participants responses to the first draft, Pamela Craig left her position to pursue advanced education and Josh Lamont became the new Project Officer.

2.2.4.6 Implement Decisions of Consultation Workshop

Two decisions of the consultation Workshop required further development from the science advisors.

First, the Workshop participants determined the need to include in the Protocol and Calculator a means to address the relationship between diet composition and enteric methane emissions. Karen Beauchemin and Alan Fredeen collaborated to build a simple relationship between feed quality and Y_M factor (See Section 8.3).

Second, the Workshop participants emphasized the importance of a basic assessment of GHG emissions associated with feed use, without the complexity required to assess all emissions from all types of on-farm and off-farm sources of feed. Raymond Desjardins, Philippe Rochette, and Xavier Vergé provided an index of CO₂ and N₂O emissions, expressed as tonnes CO₂e per tonne feed as fed, for a range of feed ingredients and pasture (See Section 8.4).

2.2.4.7 Quantification Sections Submitted to GENIVAR for Preparation of Calculator

Rob Janzen of ClimateCHECK, with support from Eric Bremer (SymbioAg Consulting Inc), captured the quantification strategy for the Protocol and Calculator in an Excel workbook. This workbook allowed the quantification section to be tested, to ensure appropriate aspects of the dairy farm biophysical system were addressed. This workbook was provided on 30 September 2008 to Calvin Kroker, of GENIVAR, to begin the procedure of building an executable program which comprises the Calculator.

2.2.4.8 Protocol Document Completed

Rob Janzen of ClimateCHECK, with support from Mark Byvelds and Patrick Hardy (ClimateCHECK), completed the development of the Protocol document in compliance with the requirements of the ISO 14064-2 standard. The Dairy Farm Protocol was submitted to ADFI on 30 October 2008.

2.2.4.9 Protocol and Calculator Submitted for Program Approval

The goal of ADFI and DFC is to achieve approval of the Dairy Farm Protocol and Calculator in Canada's Offset System. After assessment of the current state of development of Canada's Offset System, however, ADFI concluded the most efficient means to fulfill the final goal was to achieve approval of the Protocol in the Alberta Offset System. Thus, ADFI has begun the process of adapting the program-neutral Protocol for submission to the Alberta protocol approval process.

The Alberta process requires submission of the Science Discussion Paper and the Minutes of the Consultation Workshop and completion of a first round of technical review before 15 November 2008. If the adapted Protocol passes initial review, a public consultation session will be held in Edmonton in December 2008. This review during the Alberta approval process will contribute to refining and vetting the Protocol and Calculator.

2.2.4.10 Protocol and Calculator Introduced to Dairy Farmers

The Protocol and Calculator will be finalized before mid January 2009. In Q1 2009, the Protocol and Calculator will be introduced to the dairy farmers of Canada for implementation. The application to ACAAF states:

The Dairy Farmers of Canada, with the participation of their provincial association partners, will deliver a workshop in Ottawa, following its DFC semi-annual meeting in February 2009 to introduce the quantification protocol and the associated GHG analysis software to the producer community and provincial association staff. This process will serve to validate the Protocol using commercial production data, and develop GHG emissions estimates for various production scenarios. The DFC's national communication network and publications will also be useful in disseminating information to dairy farmers.

Table 3 — Professionals involved in the development of the Dairy Protocol and Calculator.

NAME	TITLE	AFFILIATION	CONTACT
Project Management Team			
Wiebe Dykstra	Executive Director	Atlantic Dairy and Forage Institute	T: 506.534.2263 E: dykstra@nbnet.nb.ca
Marian Gilbert	Administrator	Atlantic Dairy and Forage Institute	T: 506.534.2268 E: margilin@xplornet.com
David Walker	Senior Innovation and Bio-Economy Advisor	New Brunswick Dept. of Agriculture & Aquaculture	T: 506.453.3467 E: david.walker@gnb.ca
Pamela Craig	Project Officer (until June 2008)	New Brunswick Dept. of Agriculture & Aquaculture	T: 506.453.3334 E: Pamela.Craig@gnb.ca
Josh Lamont	Project Officer (after June 2008)	New Brunswick Dept. of Agriculture & Aquaculture	T: 506.453.3334 E: Josh.Lamont@gnb.ca
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Émie Désilets	Consultant	Independent	T: 418.876.1353 E: Emie.Desilets@fsaa.ulaval.ca
Rob Janzen	VP Western Canada Operations	ClimateCHECK	T: 403.332.0115 E: rj@climate-check.com
Scientific and Technical Advisors			
John Basarab	Research Scientist	Alberta Agriculture and Rural Development	T: 403.782.8032 E: John.Basarab@gov.ab.ca
Karen Beauchemin	Research Scientist	Agriculture and Agri-Food Canada, Lethbridge	T: 403.317.2235 E: beauchemink@agr.gc.ca
Chaouki Benchaar	Research Scientist	Agriculture and Agri-Food Canada, Lennoxville	T: 819.565.9174 E: beenchaarc@agr.gc.ca
Raymond Desjardins	Research Scientist	Agriculture and Agri-Food Canada, Ottawa	T: 613.759.1522 E: Desjardins@agr.gov.ca
Alan Fredeen	Professor	Nova Scotia Agricultural College	T: 902.893.6649 E: afredeen@nsac.ca
Karen Haugen-Kozyra	Director, Policy Devt.	Climate Change Central	T: 780.408.4587

	and Offset Solutions		E: karenhk@climatechangecentral.com
Daniel Massé	Research Scientist	Agriculture and Agri-Food Canada, Lennoxville	T: 819.565.9174 E: massed@agr.gov.ca
Sean McGinn	Research Scientist	Agriculture and Agri-Food Canada, Lethbridge	T: 403.317.2225 E: mcginns@agr.gov.ca
Philippe Rochette	Research Scientist	Agriculture and Agri-Food Canada, Quebec	T: 418.210.5042 E: rochettep@agr.gov.ca
Xavier Vergé	Research Scientist	Agriculture and Agri-Food Canada, Ottawa	T: 613.694.2385 E: vergex@agr.gov.ca
Software Developer			
Kalvin Kroker	Computer Engineer	GENIVAR	T: 403.328.4717 E: krokerkd@phoenixengg.com
Sub-Contractor to ClimateCHECK			
Eric Bremer	Consulting Scientist	Symbio Ag Consulting	T: 403.394.4310 E: ericbremer@shaw.ca

2.3 Good Practice Guidance

Good practice guidance from the IPCC, WRI/WBCSD, and ISO 14064 is applied in the development of this protocol.

2.3.1 ISO 14064-2: Specification with Guidance at the Project Level for Quantification, Monitoring and Reporting of Greenhouse Gas Emission Reductions or Removal Enhancements

The ISO standard provides the basic framework used by the majority of offset systems worldwide. This framework ensures that all quantified emission reductions adhere to the following principles:

- *Completeness* -- Include all relevant GHG emissions and removals. Include all relevant information to support criteria and procedures
- *Consistency* -- Enable meaningful comparisons in GHG-related information
- *Accuracy* -- Reduce bias and uncertainties as far as is practical
- *Transparency* -- Disclose sufficient and appropriate GHG-related information to allow intended users to make decisions with reasonable confidence
- *Relevance* -- Select the GHG sources, GHG sinks, GHG reservoirs, data and methodologies appropriate to the needs of the intended user
- *Conservativeness* -- Use conservative assumptions, values and procedures to ensure that GHG emission reductions or removal enhancements are not over-estimated.

2.3.2 WRI/WBCSD GHG Protocol

The ISO standard is closely related to the GHG Protocol, which follows the many of the same general principles. The Project Protocol from the WRI/WBCSD is a comprehensive, policy neutral quantification tool for greenhouse gases.

2.3.3 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry, and Other Land Use

This protocol has used IPCC guidance, along with ISO framework, to achieve “accuracy in aggregate”. That is, the quantification of GHG emissions using the Dairy Protocol is not intended to achieve the site-specific predictive capability of a process model. It is understood that the emission coefficients and equations used have underlying uncertainty preventing site-specific accuracy. However, using the IPCC guidance and imposing the discipline of the ISO standard ensures the uncertainties of quantification are minimized as the Dairy Protocol is applied over a large number of participating farms.

2.3.4 National Inventory Report

The National Inventory Report (NIR) of GHG sources and sinks in Canada has been consulted during the development of this protocol. The report, required by the UNFCCC, details sources and sinks in Canada and includes quantification methodologies developed by scientists competent in the respective field of each SSR. The quantification methodologies used in the National Report are based on IPCC factors modified using Canada-specific data. This Protocol is consistent with the quantification methods as well as data such as coefficients and factors used during quantification. This consistency is assured by involvement in the development of the Protocol and Calculator by the same scientists involved in preparation of the National Inventory Report.

2.3.5 Holos

Agriculture and Agri-Food Canada, developers of Holos, describe this tool as follows:

Holos is a whole-farm modelling software program that estimates greenhouse gas (GHG) emissions based on information entered for individual farms. Holos estimates carbon dioxide, nitrous oxide and methane emissions from enteric fermentation and manure management, cropping systems and energy use. Carbon storage and loss from lineal tree plantings and changes in land use and management are also estimated resulting in a whole-farm GHG estimate. The main purpose of Holos is to envision and test possible ways of reducing GHG emissions from farms.

Many of the scientists of Agriculture and Agri-Food Canada involved in the development of the Dairy Protocol are major contributors to the development of Holos.

2.3.6 Pork GHG Project Builder

The Canadian Pork Council, developers of the Pork GHG Project Builder, describes this tool as follows:

The Pork Sector Greenhouse Gas Project Builder software package included here has been built using a standardized hog sector GHG quantification protocol to assist Canadian hog producers in analyzing their own farm-specific GHG profiles. This software provides hog producers with the tools necessary to analyse how specific management practice changes will affect GHG output on their farms. This allows GHG

emissions management to become a more viable consideration for hog operation managers.

The consultants retained to support development of the Pork GHG Project Builder (Macleod Agronomics, ClimateCHECK, GENIVAR) bring the experience of that project to the development of the Calculator associated with the Dairy Protocol.

3 Project Quantification

A fundamental requirement of ISO 14064-2 is the quantification of GHG emissions for the baseline scenario and project condition as determined in the protocol, including identification of SSRs relevant to the baseline and project. In the case of the Dairy Protocol, however, the baseline scenario and project condition differ only in the level of GHGs, as influenced by differing management practices, from the same SSRs. Therefore, quantification in the baseline scenario is the same as in the project condition.

All SSRs relevant to the baseline and project are identified. In addition to on-site SSRs, SSRs upstream and downstream of the baseline and project location (farm) are identified and described. The identified SSRs for the baseline and project are identified following the procedure described in Section 3.1. (Figure 1).

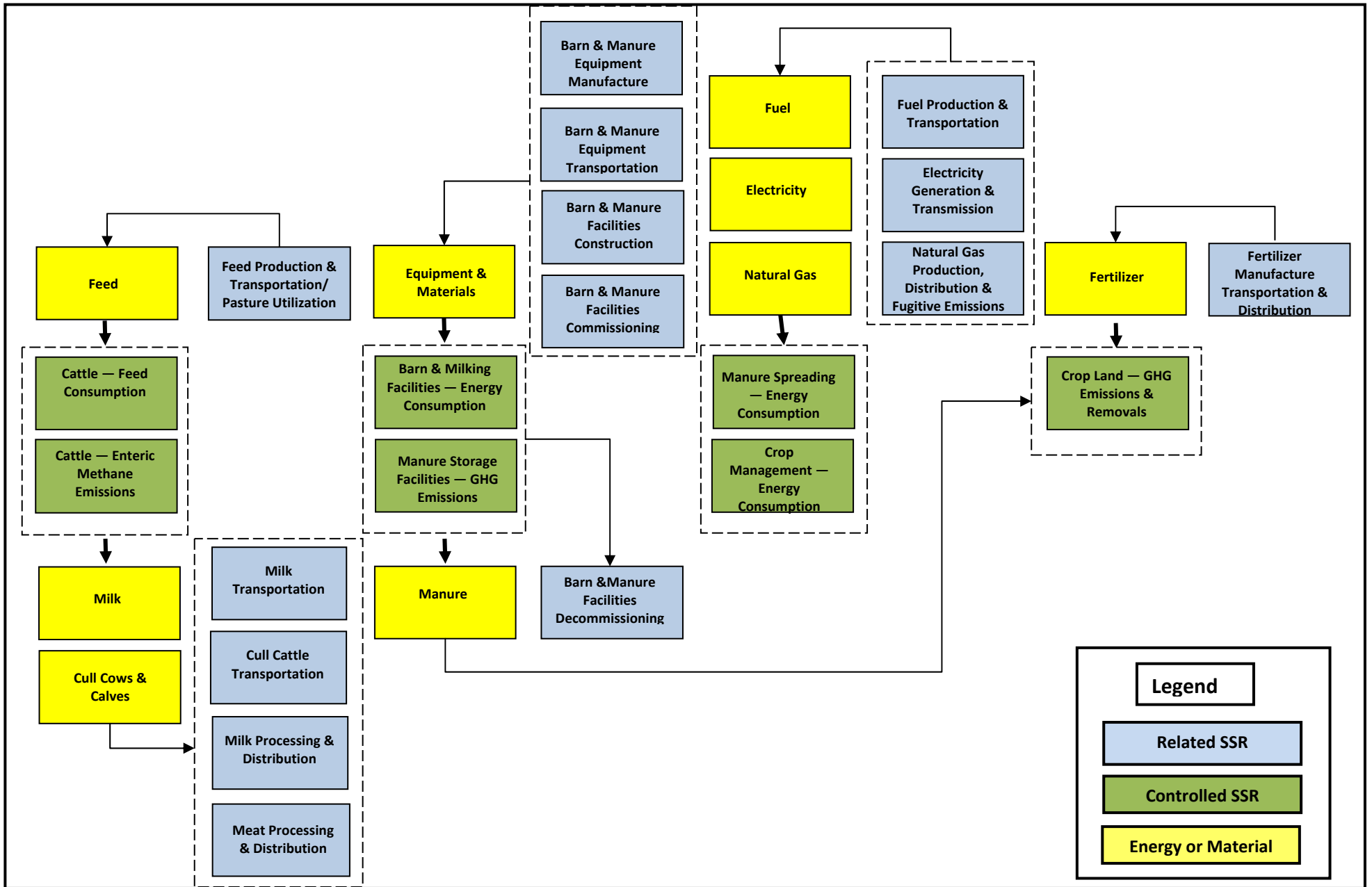


Figure 1 - Identified Baseline and Project SSRs.

3.1 Procedure Used for the Identification of Relevant SSRs

The following procedure was used to identify relevant SSRs for the baseline scenario and project condition.

1. Identification of all SSRs controlled or *owned* by the project proponent relevant to the primary project activities.
2. Identification of all SSRs physically *related* to the primary project activities, by tracing products, materials and energy inputs/outputs upstream to origins in natural resources and downstream along their life-cycles. For example electricity production, fossil fuel production, etc...
3. Identification of all SSRs *affected* by the project through consideration of the economic and social consequences of the project. This was achieved by looking for activities, market effects, and social changes that result from or are associated with the project activity, and documenting the associated GHG emissions.
4. For each identified SSR the parameters required to estimate or measure the greenhouse gases are determined including materials and energy inputs/outputs, and information on activities, products and services.
5. Determination of the function⁷ provided by the system of SSRs in order to assist in assessing equivalence of service between the project and the baseline scenario.
6. Aggregation or disaggregation of identified SSRs. The number of SSRs defined and the degree of detail presented is determined in large part by data availability and required level of accuracy.
7. Review system of SSRs identified for the project by confirming that:
 - a. all relevant SSRs are identified;
 - b. each SSR is classified appropriately as controlled & owned, related or affected;
 - c. all GHG inputs and outputs for each element are identified; and
 - d. that the sequence of SSRs for the system is correct.
 - e. Repeat previous steps as necessary.

3.2 Justification for Procedure to Identify SSRs for the Baseline and Project

The SSR identification procedure described above is a generic “streamlined life cycle assessment” used to identify types of activities (e.g. production, transportation, installation, operation, maintenance, utilization, decommissioning, etc.) and associated inputs and outputs of energy or material that may be attributable to the project. This approach is similar to that used to develop Technical Seed Documents underlying government –approved quantification protocols in the Alberta Offset System, and is required by the forthcoming Canada’s Offset System.

⁷ The function is the products, goods and/or services provided by the SSRs identified for the project scenario.

3.3 Project SSR Identification

All SSRs relevant to the project have been described (Table). The SSRs have been categorized as ‘controlled’, ‘related’, or ‘affected’ according to typical practice. SSRs considered to lie within normal farm management are designated as ‘controlled’, while those which represent the flow of materials and energy from off-site sources are designated as ‘related’.

Table 4 - Identified Baseline and Project SSRs

SSR	Description	Controlled, Affected, Related
<i>Upstream SSRs Before Project</i>		
B1. Barn & Manure Equipment Manufacture	All activities (inputs of materials and energy) required to manufacture equipment used for barn and manure systems.	Related
B2. Barn & Manure Equipment Transportation	All activities (inputs of materials and energy) required to transport equipment used for barn and manure systems from the manufacturing location to the project location (farm).	Related
B3. Barn & Manure Facilities Construction	All activities (inputs of materials and energy) involved in the construction of the barn and manure systems.	Related
B4. Barn & Manure Facilities Commissioning	All activities (inputs of materials and energy) involved in the commissioning of the barn and manure systems.	Related
<i>Upstream SSRs During Project</i>		
B5. Fuel Production and Transportation	All activities (inputs of materials and energy) involved in the production and transportation of diesel fuel.	Related
B6. Electricity Generation and Transmission	All activities (inputs of materials and energy) involved in the generation of electricity.	Related
B7. Natural Gas Production, Distribution, and Fugitive Emissions	All activities (inputs of materials and energy) involved in the discovery and production of natural gas. Because natural gas is a GHG (primarily composed of CH ₄), fugitive emissions during production are included in this element.	Related
B8. Fertilizer Manufacture, Transportation and Distribution	All activities (inputs of materials and energy) involved in production, transportation, and distribution of fertilizer.	Related
B9. Feed Production and Transportation / Pasture Utilization	All activities (inputs of materials and energy) involved in the production (crop growing & harvesting) and transportation of feed.	Related
<i>Onsite SSRs During Project</i>		
B10. Cattle – Feed Consumption	All activities (inputs of materials and energy) involved in the use of feed. Feed or dairy	Controlled

	farm is both raised on farm and purchased from off-farm sources.	
B11. Cattle – Enteric Methane Emissions	Emissions produced as a result of digestion of feed by cattle, released through exhalation. Also refers to practices to manage feed composition to control enteric emissions.	Controlled
B12. Barn & Milking Facilities – Energy Consumption	Fuel and electricity used to operate the barn and milking facilities, including on-farm handling of feed and bedding.	Controlled
B13. Manure Storage Facilities – GHG Emissions	Fuel and electricity used to operate the manure storage facilities. Also refers to practices to reduce emissions of GHGs from the stored manure.	Controlled
B14. Manure Spreading – Energy Consumption	All activities (inputs of materials and energy) involved in the spreading of manure, with the exception of fuel use. Also refers to practices to reduce GHGs from the spread manure.	Controlled
B15. Crop Management – Energy Consumption	Fuel used to maintain till soil, and to raise and harvest crops.	Controlled
B16. Crop Land – GHG Emissions & Removals	GHG emissions and removals associated with typical land use, including emissions from fertilizer and decomposing crop residues.	Controlled
<i>Downstream SSRs During Project</i>		
B17. Milk Transportation	All activities (inputs of materials and energy) involved in the transport of milk that is an output of the project farm.	Related
B18. Cull Cattle Transportation	All activities (inputs of materials and energy) involved in the transport of cull cattle from the project farm.	Related
B19. Milk Processing & Distribution	All activities (inputs of materials and energy) involved in processing and distributing milk from the project farm for retail sale.	Related
B20. Meat Processing & Distribution	All activities (inputs of materials and energy) involved in the processing and distribution of meat from the project farm for retail sale.	Related
<i>Downstream SSRs After Project</i>		
B21. Barn & Manure Facilities Decommissioning	All activities (inputs of materials and energy) required to shut down the barn(s) and manure storage facility.	Related

4 Identification of the Baseline Scenario

The baseline scenario is the most appropriate and best estimate of GHG emissions and removals that would have occurred in the absence of any project(s). With respect to

developing the baseline scenario for the Protocol and Calculator, two sets of circumstances must be considered to determine a baseline scenario.

First, dairy farms across Canada can vary widely in their GHG emissions per kg of milk produced. Valacta, a technology transfer organization serving Quebec and the Atlantic provinces, provides data from a sample of farms in Quebec to exemplify this variability (Table). The range among these farms in dry matter feed used per kg of milk produced indicates a likely range of enteric methane emission per kg milk sold. As well, lower weight of milk produced per feed dry matter could also translate into greater volatile solids per kg milk and corresponding higher emissions of methane from stored manure per kg milk. Similarly, the range of 'budget N' and 'N use efficiency' point to differences in the amount of N available for spreading as manure per cow on these farms, raising the potential for differences in N₂O emissions from land receiving manure. In such circumstance, the selection of the baseline scenario is critical to ensure real and incremental GHG credits are generated in the projects. If the average dairy intensity calculated by Vergé *et al.* (2007) of all dairy farms was used as the baseline (1.0 kg CO₂e/kg milk), then GHG credits may not affect actual emissions, because efficient farms could claim GHG credits without further improvement and inefficient farms could choose not to participate.

Table 5: Feed Efficiency and Nutrient Budgets According to the Production Level — Valacta 2007 data

Production level (kg/cow/y)	Average	<6000	6000 - 6999	7000 - 7999	8000 - 8999	9000 - 9999	10 000 - 10 999	≥ 11 000
Number of herds	3 168	163	349	670	1 008	729	213	36
Cows per herd	51.3	40.7	44.0	47.2	51.7	58.4	57.4	58.6
Milk (kg/cow/y)	8 291	5 327	6 566	7 553	8 498	9 415	10 335	11 531
DM Consumption (kg/cow/y)	6 904	5 358	6 018	6 591	7 097	7 422	7 724	7 823
Milk (kg /kg DM)	1.2	1.0	1.1	1.1	1.2	1.3	1.3	1.6
Ingested N(kg/cow/y)	194.90	148.43	166.92	183.94	200.92	210.70	222.26	227.00
Total protein in diet (% DM)	17.6	17.3	17.3	17.4	17.7	17.7	18.0	18.1
Exported N (kg/cow/y) ^A	51.0	33.9	40.7	46.5	52.8	57.4	62.7	65.8
Budget N (kg/cow/y) ^B	143.8	114.6	126.1	137.5	148.2	153.4	160.0	161.0
N output (kg / 100 kg milk)	1.73	2.15	1.92	1.82	1.74	1.63	1.54	1.40
Efficiency of N use(%) ^C	26.2	22.8	24.4	25.3	26.3	27.2	28.2	29.0
Ingested P (kg/cow/y)	31.3	24.6	27.7	30.0	32.2	33.3	35.0	35.7
P in the ration (% DM)	0.45	0.46	0.46	0.46	0.45	0.45	0.45	0.46
Exported P(kg/cow/y)	9.5	6.3	7.7	8.8	9.9	10.7	11.7	12.3
Budget P(kg/cow/y)	21.8	18.3	20.0	21.2	22.4	22.6	23.3	23.4
P output (kg / 100 kg milk)	0.26	0.34	0.30	0.28	0.26	0.24	0.23	0.20
Efficiency of P use (%)	30.5	25.7	27.7	29.2	30.6	32.2	33.4	34.5

^A Exported: milk and animals leaving the herd.

^B Budget: Ingested minus Exported ≈ N excreted.

^C Efficiency of use: Exported N (milk and animals) / Ingested N.

Second, according to Canada Census data, the number of dairy cows and dairy farms steadily is declining, but total milk production continues to increase to meet the demand of increasing population. Decreased GHG emissions per unit milk are associated with increasing productivity per cow. However, this period of ‘easy efficiencies’ may be coming to an end. Dyer *et al.* (In Press) used a “semi-empirical index approach” to conclude GHG emissions per kg of milk have decreased by 35% for the period 1981 to 2001, but that “the overall rate of decline appears to be slowing down, suggesting that the dairy population and the related GHG emissions are starting to stabilize”. Thus, if the business-as-usual efficiency curve is stabilizing, it may be asserted that, in the period beginning about the year 2001, GHG reductions per unit milk may be incremental, representing implementation of exceedingly innovative measures.

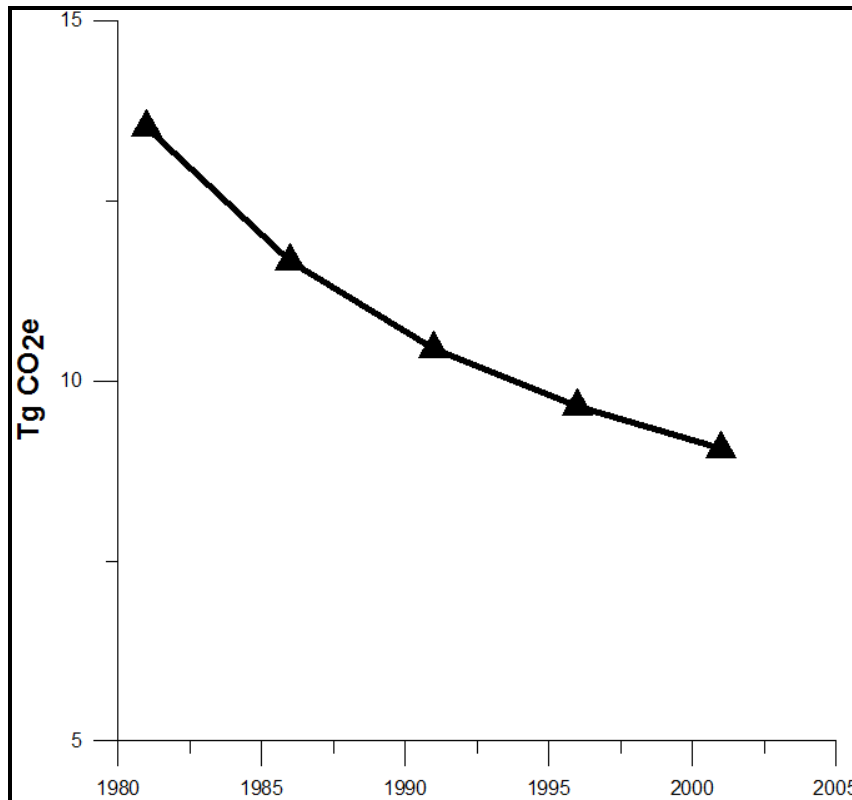


Figure 2 — GHG emissions from dairy farms in Canada from 1981 to 2001 reported by Dyer *et al.* (In Press), showing a stabilizing trend.

4.1 Evaluation of Possible Baseline Approaches

Several methods exist for determining a baseline for GHG emission comparison. Different approaches, along with descriptions and their ability to be applied under this protocol, are considered for the development of the Protocol and Calculator (Table 6).

Table 6 - Possible Baseline Scenarios

Baseline Approach	Description	Static or Dynamic	Accept or Reject (and Justify)
Project-Specific Historic Benchmark	This approach uses site-specific data and records to determine the baseline. The baseline is reviewed and determined at the beginning of the eligibility period.	Static	Accept (primary) – This approach provides the best estimate of real GHG emission reductions wherever reliable historical data is available.
Sector-Level Performance Standard	This approach, best applied wherever historical records are not available, assumes that the project farm operates following the typical emissions profile for regional dairy farms.	Static	Accept (secondary) – Performance standards provide a comparable baseline wherever project-specific historical information is not available.
Comparison	This approach compares the project farm against a comparable dairy farm which applies business-as-usual practice.	Dynamic	Reject – This approach is not feasible, primarily due to technical and expense difficulties.
Projection-Based	This approach uses time-series data or models to estimate GHG emission reductions arising from various projects/changes to practices.	Static	Reject – Currently, no proper tools exist to produce GHG projects to the required level of assurance.
Already Registered	This approach uses baseline data from previously registered dairy protocols.	Static	Reject – no similar protocols currently exist.

Based on the consensus of expert judgment in the Protocol and Calculator development process, the Project-Specific Historic Benchmark is selected as the primary approach. This approach requires individual farms to provide data to calculate a baseline for each farm in the project for the year of project registration. The participating experts selected this option, because it most clearly demonstrated additionality or incrementality, and because this approach would be the most effectively motivate all dairy farmers to continue improvement.

This option is compatible with the requirements of Canada’s Offset System, where:

1. The incentive is to use a recent baseline year (A ‘non-recent’ baseline year can be used, but the Protocol is only valid for eight years after the year of baseline); and
2. Credits may be issued only for credits achieved after 01 January 2008.

However, since the Protocol and Calculator is program-neutral, the Sector-Level Performance Standard is selected as a secondary approach. This approach could work well within the rules of the Alberta Offset System, where many of the approved agricultural protocols use 2001 as a baseline year. Using the secondary approach, the average dairy intensity calculated by Vergé et

al. (2007) of all dairy farms (1.0 kg CO₂e/kg milk) could be justified as the baseline based on evidence the average intensity is stabilizing. But, the difficulty would need to be acknowledged that farms with better-than-average efficiency could claim GHG credits without incremental improvement and inefficient farms could choose not to participate.

4.2 Functional Equivalence

A key consideration in developing the baseline scenario is to preserve functional equivalence to allow for accurate comparison between project and baseline data. Changes to production that are not a result of project implementation may include:

- Increases or decreases to cattle population; or
- Changes to farm milk production quota.

To ensure functional equivalence of the baseline scenario in this protocol, quantification of emissions is normalized to the basis of kg GHG per kg of FCM⁸. Normalization to this unit will ensure that GHG emissions will reflect the quantity of milk (FCM) produced within the quantification period.

4.2.1 Justification of Functional Equivalence

Volume of fat corrected milk has been selected as the standard unit for this protocol because it provides convenience in quantification for the user and convenience in verification for the verifier. FCM is easily measured and understood, as farm quota is issued on an FCM basis.

5 Baseline Quantification

5.1 Selection of Baseline SSRs

A fundamental requirement of ISO 14064-2 is the quantification of GHG emissions for the baseline scenario and project condition as determined in the protocol. All SSRs relevant to the baseline scenario must be identified, including on-site SSRs and SSRs upstream and downstream of the project location (farm). Since the baseline scenario and project condition differ only in management, baseline quantification will follow the selected approach from (Table). And, the SSRs for the baseline scenario will be the same as those from the project case (Figure 1) following the SSR identification procedure outlined in Section 3.1. The SSRs relevant to the project are described (Table). The SSRs have been categorized as ‘controlled’, ‘related’, or ‘affected’ according to typical practice. SSRs considered to lie within normal farm management are designated as ‘controlled’, while those which represent the flow of materials and energy from off-site sources are designated as ‘related’.

5.2 Baseline Data

The primary approach from the development process of the Protocol and Calculator is that the baseline is to be defined on an individual farm basis, using the year prior to project registration as the baseline year. Dairy producers must collect and use farm-specific data for baseline quantification. Using farm-specific baselines will provide more accurate quantification of GHG

⁸ FCM – Fat Corrected Milk

emission reductions, and will motivate incremental emission reductions to be generated on both inefficient and already efficient farms.

However, because the Protocol and Calculator are designed to be program-neutral, the secondary approach may also be used, if this fits the requirements of the GHG program. But, it must be acknowledged the use of a sector-level baseline may allow some farms to achieve lower-than-baseline emissions without implementing new projects/practices.

A program adapting the Protocol and Calculator for approval must provide sufficient guidance to prescribe the choice of baseline and thereby avoid gaming.

6 Comparing Project and Baseline SSRs

A fundamental requirement of ISO 14064-2 is the quantification of GHG emissions for the baseline scenario and project condition as determined in the protocol, including identification of SSRs relevant to the baseline and project. In the case of the Dairy Protocol, however, the baseline scenario and project condition differ only in the level of GHGs, as influenced by differing management practices, from the same SSRs. Therefore, selection of relevant SSRs for monitoring or estimating in the baseline scenario is the same as in the project condition.

6.1 Selection of Relevant Project and Baseline SSRs for Monitoring or Estimating

The following procedure illustrated in Figure was applied to determine if each identified SSR for the baseline and the project was relevant and to determine if it is necessary to quantify the GHG emissions by direct monitoring or estimation. This procedure was adapted from Canada's Offset System for Greenhouse Gases – Guide for Protocol Developers (August 2008-Draft version).

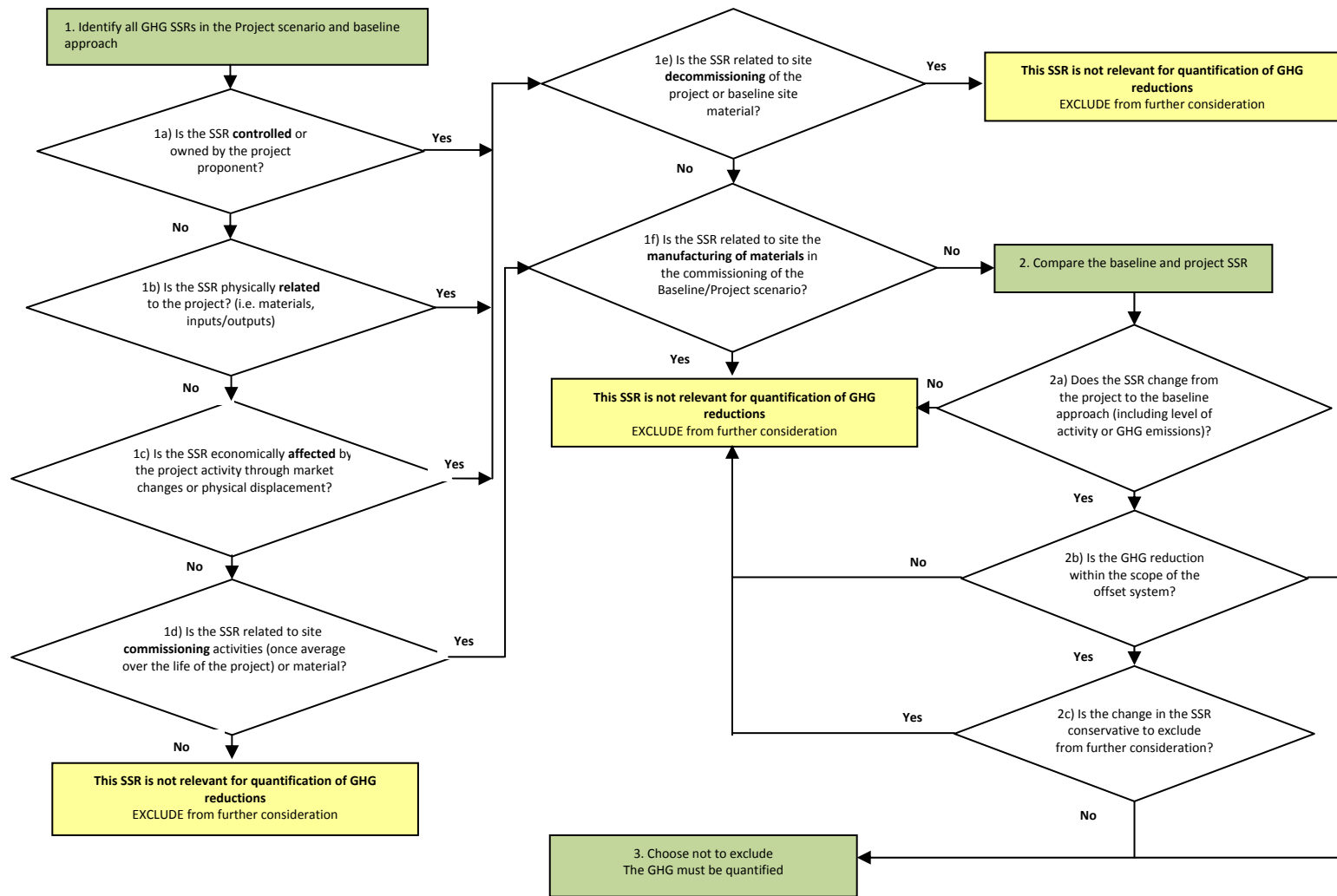


Figure 3 - Process for Identifying 'Relevant' SSRs for Baseline and Project

6.2 Inclusion/Exclusion of Project and Baseline SSRs

There exists no deviation in identified SSRs between the project case and baseline scenario for projects under this protocol. Activity levels for one or more SSR, however, will be subject to change as a result of project implementation. A comparison of the identified SSRs is presented (Table .

Table 7 - Project/Baseline SSR Comparison

Identified SSRs	Baseline (C, R, A)	Project (C, R, A)	Include or Exclude from Quantification	Justification for Exclusion
Upstream SSRs				
B1/P1. Barn & Manure Equipment Manufacture	Related	Related	Exclude	The emissions from this element are expected to be equal or lower in the project as compared to the baseline scenario.
B2/P2. Barn & Manure Equipment Transportation	Related	Related	Exclude	The emissions from this element are expected to be equal or lower in the project as compared to the baseline scenario.
B3/P3. Barn & Manure Facilities Construction	Related	Related	Exclude	The emissions from this element are expected to be equal or lower in the project as compared to the baseline scenario.
B4/P4. Barn & Manure Facilities Commissioning	Related	Related	Exclude	The emissions from this element are expected to be equal or lower in the project as compared to the baseline scenario.
B5/P5. Fuel Production and Transportation	Related	Related	Exclude	The emissions from this element are expected to be equal or lower in the project as compared to the baseline

				scenario.
B6/P6. Electricity Generation and Transmission	Related	Related	Exclude	The emissions from this element are expected to be equal or lower in the project as compared to the baseline scenario.
B7/P7. Natural Gas Production, Distribution, and Fugitive Emissions	Related	Related	Exclude	The emissions from this element are expected to be equal or lower in the project as compared to the baseline scenario.
B8/P8. Fertilizer Manufacture, Transportation and Distribution	Related	Related	Exclude	The emissions from this element are expected to be equal or lower in the project as compared to the baseline scenario.
B9/P9. Feed Production and Transportation / Pasture Utilization	Related	Related	Include	This element comprises some of the practices for GHG reduction included in the protocol. To accommodate on- and off-farm sources of feed, standardized assessment of 'embedded emissions' are used to account for GHG intensity of feedstuffs.
Onsite SSRs				
B10/P10. Cattle – Feed Consumption	Controlled	Controlled	Include	This element comprises some of the practices for GHG reduction included in the protocol.
B11/P11. Cattle – Enteric Methane Emissions	Controlled	Controlled	Include	This element comprises some of the practices for GHG reduction included in the protocol.
B12/P12. Barn & Milking Facilities – Energy Consumption	Controlled	Controlled	Exclude	The emissions from this element are expected to be equal or lower in the project as compared to the baseline

				scenario. Exclusion of this SSR represents conservativeness concerning quantification of reductions. Also, this Protocol encourages participants to enrol in an Energy Efficiency Protocol to capture potential reductions from decrease use of energy.
B13/P13. Manure Storage Facilities – GHG Emissions	Controlled	Controlled	Include	This element comprises some of the practices for GHG reduction included in the protocol.
B14/P14. Manure Spreading – Energy Consumption	Controlled	Controlled	Exclude	The emissions from this element are expected to be equal or lower in the project as compared to the baseline scenario. Exclusion of this SSR represents conservativeness concerning quantification of reductions.
B15/P15. Crop Management – Energy Consumption	Controlled	Controlled	Exclude	The emissions from this element are expected to be equal or lower in the project as compared to the baseline scenario. Exclusion of this SSR represents conservativeness concerning quantification of reductions.
B16/P16. Crop Land – GHG Emissions & Removals	Controlled	Controlled	Exclude/Include	The emissions from this element are expected to be equal or lower in the project as compared to the baseline scenario. These emissions and removals are addressed in part in the standard GHG intensity of feedstuffs.

Downstream SSRs				
B17/P17. Milk Transportation	Related	Related	Exclude	The emissions from this element are expected to be equal or lower in the project as compared to the baseline scenario.
B18/P18. Cull Cattle Transportation	Related	Related	Exclude	The emissions from this element are expected to be equal or lower in the project as compared to the baseline scenario.
B19/P19. Milk Processing & Distribution	Related	Related	Exclude	The emissions from this element are expected to be equal or lower in the project as compared to the baseline scenario.
B20/P20. Meat Processing & Distribution	Related	Related	Exclude	The emissions from this element are expected to be equal or lower in the project as compared to the baseline scenario.
B21/P21. Barn & Manure Facilities Decommissioning	Related	Related	Exclude	The emissions from this element are expected to be equal or lower in the project as compared to the baseline scenario.

7 Quantification of GHG Emissions and Reductions

The relevant SSRs included in the quantification, identified (**Error! Reference source not found.**) have been reviewed to determine their risk for the project and baseline. Those SSRs which are expected to result in larger quantities of GHG emissions/removals have been identified as higher risk. According to Vergé *et al.* (2007), the included SSRs, ranked in order of highest expected GHG emissions/ removals to lowest are:

1. Cattle Enteric Methane Emissions – 43%
2. Manure Storage Facilities – GHG Emissions 32% of total dairy emissions, differentiated as 12% of CH₄, 20% of N₂O; (Vergé et al 2007)
3. Cattle Feed Production – 24% (Vergé et al 2007)

7.1 Quantification Method

GHG emission reductions are calculated using Equation 1, below.

$$\text{GHG Emission Reductions} = (\text{Baseline Emissions} - \text{Project Emissions}) * \text{Milk} \quad [1]$$

Where:

Baseline GHG Emissions and **Project GHG Emissions** are the GHG emissions quantified per kg FCM for the baseline and project scenarios, respectively; and
Milk is the total milk production in the Project.

GHG emissions for both the project and baseline scenario are calculated generally using Equation 2. Various multiplication factors are used for the quantification of each SSR and are described in their respective sections of this protocol.

$$\text{GHG Emissions} = \text{Activity Level} \times \text{Multiplication Factors} \quad [2]$$

Where:

Activity Level represents the “quantity” of a particular input, dependant on SSR
Multiplication Factors represents the various factors used to convert the activity level to an appropriate unit of GHGs

Activity levels will be either measured or estimated, depending on the SSR while multiplication factors will be acquired from current published documentation.

7.2 Application of Discount Factor

Once all GHG emission reductions have been properly calculated, the appropriate discount factor must be applied. The discount factor used to determine eligible GHG reductions (in Table 2) are dependent on the quantification approach used to determine GHG emissions and reductions.

The discount factor is to be applied by multiplying the total GHG emissions from all SSRs by the discount factor, yielding total eligible GHG emission reductions.

7.3 Manure Storage Facilities – GHG Emissions

7.3.1 Simple Approach — CH₄ Emissions - Method 1: Annually

Methane emissions from manure storage are calculated using Equation 3.

$$E_{SSR13, CH_4} = \sum_{S,G} VS_G * N_G * 365 * 0.24 * 0.67 * MCF_S * MS_{S,G} * 21 / 1000 \quad [3]$$

Where:

- E_{SSR13,CH4}** = Methane emissions from manure management, tonnes CO_{2e} yr⁻¹
- S** = Manure management system (liquid, solid or pasture)
- G** = Animal group
- VS_G** = Daily volatile solids excreted by a specific animal group, kg DM head⁻¹ day⁻¹
- N_G** = Number of animals in a specific animal group
- 365** = Number of days per year
- 0.24** = Maximum methane-producing capacity from dairy manure (m³ CH₄ kg⁻¹ of VS excreted)
- 0.67** = Coefficient to convert m³ to kg for methane, kg CH₄ m⁻³ CH₄
- MCF_S** = Methane conversion factor: percent of VS converted to methane for the defined manure management system (Table)
- MS_{S,G}** = Fraction of animal group G's manure handled by the defined manure management system
- 21** = Global warming potential of methane
- 1000** = kg per tonne

The “daily volatile solids excreted by a specific animal group”, VS_G, in Equation 3 is calculated using Equation 4, below.

$$VS = (GE * (1-DE/100) + 0.04 * GE) * 0.92 / 18.45 \quad [4]$$

Where:

- VS** = Daily volatile solids excreted per day on a dry matter basis, kg head⁻¹ day⁻¹
- GE** = Gross energy intake, MJ head day⁻¹
- DE** = Digestible energy expressed as a percentage of gross energy
- 0.04** = Urinary energy excretion expressed as a fraction of GE
- 0.92** = Fraction ash-free content of manure
- 18.45** = Average energy content of dry matter (MJ kg⁻¹)

The “methane conversion factor”, MCF_S, in Equation 3 is listed by manure system and region (Table).

Table 8 - Methane Conversion Factors (MCF_s)

Manure System	Region	MCF (%) [†]
Solid	All regions	1.0
Liquid	BC	25.8
	Prairies	28.3
	ON	30.1
	PQ	28.4
	Atlantic	29.4
Pasture	All regions	1.0

[†]Based on Marinier et al. 2004 and Vergé et al. 2007

7.3.2 Advanced Approach — CH₄ Emissions - Method 2: Monthly

To account for the influence of temperature and timing of manure removal on methane emissions from liquid manure storage units, methane emissions can also be calculated monthly, following Equation 5.

$$E_{SSR13,CH4,L} = \sum_m (VS_{prod,m} + VS_{avail,m-1}) * f * 0.24 * 0.67 * 21 / 1000 \quad [5]$$

Where:

$E_{SSR13,CH4,L}$ = Methane emissions from a liquid manure storage unit, tonnes CO_{2e} yr⁻¹

m = Month (for a one year period)

$VS_{prod,m}$ = Volatile solids added to manure storage unit during month (tonnes) (calculated for all animal groups contributing to unit)

$VS_{avail,m-1}$ = Volatile solids in the storage unit at the end of the previous month available to be consumed by decomposer microorganisms

f = Fraction of available volatile solids consumed during month, Vant Hoff Arrhenius factor

$VS_{avail,m-1}$, above, is calculated using Equation 6;

$$VS_{avail,m} = VS_{avail,m-1} + VS_{prod,m} - VS_{consumed,m} - VS_{stabilized,m} - VS_{removed} \quad [6]$$

Where:

$VS_{avail,m}$ = Volatile solids available to be decomposed at end of current month (tonnes)

$VS_{avail,m-1}$ = Volatile solids available to be decomposed at end of previous month (tonnes)

$VS_{prod,m}$ = Volatile solids added to manure storage unit during month (tonnes)

$VS_{consumed}$ = Volatile solids consumed during month (tonnes)

$$= (VS_{prod,m} + VS_{avail,m-1}) * f$$

$VS_{stabilized}$ = Volatile solids stabilized into non-available forms (tonnes)

$$= VS_{prod,m} * (1-f) * 0.55$$

$VS_{removed}$ = Volatile solids removed from manure storage during month (tonnes)

The “fraction of available volatile solids consumed during month”, f , in Equation 5 is calculated using Equation 7, below.

$$f = \exp[E(T_2 - T_1)/(RT_1T_2)] \quad [7]$$

Where:

E = activation energy constant (63,515 J mol⁻¹)

T₂ = average monthly temperature (°K = °C + 273, T₂ ≥ 5 °C)

T₁ = 303 °K

R = ideal gas constant (8.317 J K⁻¹ mol⁻¹)

7.3.3 N₂O Emissions from Manure Storage

Nitrous oxide emissions from manure storage can be calculated using Equation 8. The assessment of the protein content of the diet and the intake of feed is provided by the nutritionist formulating the rations for the dairy cows, and this professional will attest to the accuracy of the monitoring procedures used.

$$E_{SSR13,N2O} = \sum_G (\text{Feed}N_G - \text{Milk}N_G - \text{LWgain}N_G) * 365 * N_G * E_{N2O,G} * 310 / 1000 \quad [8]$$

Where:

E_{SSR13,N2O} = N₂O emissions from manure storage, tonnes CO_{2e} yr⁻¹

G = Animal group

FeedN_G = Feed N intake for a specific animal group, kg N head⁻¹ day⁻¹
= DMI * CP/100 * 0.16

Where:

DMI = daily dry matter intake, kg head day⁻¹

CP = crude protein content of diet, % of DMI

0.16 = fraction N in feed protein

MilkN_G = N retained in milk N for a specific animal group, kg N head⁻¹ day⁻¹
= Milk * Milk protein/100 * 0.157

Where:

Milk = daily milk production, kg head day⁻¹

Milk protein = protein content of milk, % on weight basis

0.157 = fraction N in milk protein

LWgainN_G = N retained in liveweight gain for a specific animal group, kg N head⁻¹ day⁻¹
= LWgain * 0.027

Where:

LWgain = daily liveweight gain, kg head day⁻¹

0.027 = fraction N in liveweight gain

365 = Number of days per year

N_G = Number of animals in a specific animal group

E_{N2O,G} = N₂O emitted per kg of N excreted for a specific animal group, g N₂O kg⁻¹ excreted N

= F_{G,S} * E_{N2O,S}

Where:

F_{G,S} = Fraction of excreted N handled by manure management system for a specific animal group

$E_{N_2O,S}$ = N₂O emitted per kg of N excreted in a specific manure management system (Table 9), g N₂O kg⁻¹ excreted N
310 = Global warming potential of N₂O
1000 = kg per tone

Table 9 - Direct and Indirect N₂O Losses from Manure Storage Units for Different Manure Management Systems

Variable	Solid	Liquid	Pasture
Direct N ₂ O losses, g N kg ⁻¹ excreted N	7.9	7.9‡	0
Indirect N ₂ O losses [†] , g N kg ⁻¹ excreted N	4.7	6.3	0
N ₂ O losses, g N kg ⁻¹ excreted N	12.6	14.1	0

[†]Assumed no N losses due to leaching

‡Assumed liquid storage units had natural crust covers

7.4 Cattle – Enteric Methane Emissions

Methane emissions from enteric fermentation can be calculated using Equation 9, below.

$$E_{SSR11} = \sum_G GE_G * (Y_{mG} / 100) * N_G * 365 / 55.65 * 21 / 1000 \quad [9]$$

Where:

E_{SSR11} = Methane emissions from enteric fermentation, tonnes CO_{2e} yr⁻¹

G = Animal group

GE_G = Gross energy intake for a specific animal group (based on measured dry matter intake or Section 7.4.1), MJ head day⁻¹

Y_{mG} = Percent of gross energy in feed converted to methane for a specific animal group (Section 7.4.1)

N_G = Number of animals in a specific animal group

365 = Number of days per year

55.65 = Energy content of methane, MJ per kg methane

21 = Global warming potential of methane

1000 = kg per tonne

Dairy animals are generally grouped into milking cows (one to three groups), dry cows and replacement heifers (grouped by age). Male animals are excluded from calculations because adult bulls are rarely kept and bull calves are generally sold at a young age.

Replacement heifers are handled as one group, starting after weaning (assumed at end of two months) and extending until first calving (input variable). Weight gain is assumed to be constant over the growth period. GHG emissions are calculated for each month, based on calculated weights. Heifer ages are assumed to be distributed uniformly over the growth

period. Pasture use and manure handling system can be set differently for older heifers than younger heifers.

Y_M is defined as the percentage of gross energy intake by the dairy cow that is converted to methane in the rumen. The IPCC (2006) uses Y_M is 6.5 (± 1)% for ruminants, including dairy cows. In other words, 6.5% of the gross energy consumed is converted in the rumen to methane energy. The standard deviation of $\pm 1\%$ reflects the fact that diets can alter the conversion rate.

7.4.1 Simple Approach

“Gross energy intake”, GE_G , in Equation 9 may be estimated using the energy required for a representative animal in each group using the approach outlined by IPCC (2006) (Table 1).

Table 10 - Calculations of Net Energy Requirements Using IPCC Equations

$NE_m = Cf_1 * LW^{0.75}$ Where: NE_m = Net energy for maintenance, MJ head ⁻¹ day ⁻¹ Cf_1 = Maintenance energy coefficient, MJ day ⁻¹ kg ⁻¹ (0.386 for cows in lactation, 0.322 for heifers and dry cows) LW = Average liveweight (kg)
$NE_a = 0.17 * F_{pstr} * NE_m$ Where: NE_a = Net energy for activity, MJ head ⁻¹ day ⁻¹ 0.17 = Coefficient for animals on pasture with sufficient forage for modest energy expense of feed acquisition F_{pstr} = Fraction of time spent on pasture
$NE_p = 0.1 * F_{preg} * NE_m$ Where: NE_p = Net energy for pregnancy, MJ head ⁻¹ day ⁻¹ F_{preg} = Fraction of animal group that are pregnant
$NE_l = Milk * (1.47 + 0.40 * Fat)$ Where: NE_l = Net energy for lactation, MJ head ⁻¹ day ⁻¹ $Milk$ = Amount of milk produced, kg head ⁻¹ day ⁻¹ Fat = Fat content of milk, % by weight
$NE_g = 22.02 * (BW/0.8/MW)^{0.75} * WG^{1.097}$ Where: NE_g = Net energy for growth, MJ head ⁻¹ day ⁻¹ BW = Average live body weight for animals in group, kg MW = Mature live body weight of an adult cow, kg WG = Average daily weight gain, kg day ⁻¹
$REM = 1.123 - 0.004092 * DE + 0.00001126 * DE^2 - 25.4 / DE$ Where:

REM = Ratio of net energy available for maintenance to digestible energy consumed DE = Digestible energy expressed as a percentage of gross energy
REG = 1.164 – 0.005160*DE + 0.00001308*DE ² – 37.4/DE
Where: REM = Ratio of net energy available for growth to digestible energy consumed DE = Digestible energy expressed as a percentage of gross energy
GE = [(NE _m + NE _a + NE _l + NE _p)/REM + NE _g /REG]/(DE/100)
Where: GE = Gross energy, MJ head ⁻¹ day ⁻¹

7.4.1 Advanced Approach

Methane emissions from enteric fermentation may also be calculated more accurately by measuring the dry matter intake, DMI, on a daily basis using Equation 10.

$$GE_G = DMI/18.45 \quad [10]$$

Where:

DMI = Dry matter intake, kg head⁻¹ day⁻¹

18.45 = Average energy content of dry matter (MJ kg⁻¹)

The DMI value will be determined as the sum of all ration ingredients, but monitoring of individual ration ingredients is needed in the Advanced approach to determine the Y_M value.

The default Y_M value of IPCC was refined by Karen Beauchemin and Alan Fredeen to account for changes in ration formulation practices to modify proportion of gross energy converted to enteric CH₄ (Table 11). The assessment of the quality of forages is provided by the nutritionist formulating the rations for the dairy cows, and this professional will attest to the accuracy of the monitoring procedures used. This protocol will use the following rules for the Y_M for dairy cows:

Table 11 - Estimates of the Percentage of Gross Energy Converted to Methane (Y_M) for Various Diets

Diet Description	Concentrate kg/ kg milk (as is basis)	Y _M (% of GE)
Default (unknown diet composition)		6.5
<i>Feeding forages of known quality with grain</i>		
Low quality grass or legume forages including hay, silage and pasture (> 50% NDF; 25% ADF) with low grain); excludes small grain silage and corn silage	< 0.25	7.5
Low quality grass or legume forages including hay, silage	< 0.25	7.0

and pasture (> 50% NDF; 25% ADF) with low grain supplement		
Moderate forage quality (40-50%NDF; 20- 30% ADF) and low grain supplement	< 0.25	7.0
Moderate forage quality (40-50%NDF; 20- 30% ADF) and high grain supplement	> 0.25	6.5
High forage quality (including cereal silages, corn silage) and low grain supplement	< 0.25	6.5
High forage quality (including cereal silages, corn silage) and high grain supplement	>0.25	6.0
Situations in which adjustments apply to Ym values above		
1. Use of monensin ionophores either as CRC bolus or in feed		10% reduction of Ym
2. Feeding fats*		
Calcium salts of palm oil (or similar bypass fats)		No reduction
Oilseeds		5% reduction for every 1% added fat on DM basis
3. Corn distillers dried grain with solubles (DDGS) fed		0.5% reduction applied to Ym for every 1.0% DDGS in diet DM
* Feeding fats, DDGS and ionophores together are additive		

7.5 GHG Emissions from Feed Production

Emission factors applied in this protocol are expressed in CO₂ equivalent (CO₂e) and combine N₂O and CO₂ emissions. CH₄ has been excluded because emissions of this gas are not considered to be significant in Canadian cropping systems.

- Nitrous oxide sources are from N-fertilizer application (chemical or organic), crop residues, leaching and volatilization. IPCC equations adapted for Canada by Rochette *et al.*, (2008) were used.
- Carbon dioxide sources are from fossil fuel use for field work, electricity, crop drying and fertilizer and machinery supply. The F4E2 model was used (Dyer and Desjardins, 2003, 2005).

Feedstuffs for cattle are divided into 10 categories, each with its own emission factor. The 10 categories are presented below while emission factors are presented in Table :

- Four Grains:
 - 1) Corn grains
 - 2) Other small grains
 - 3) Soybeans (and other legumes)

- 4) Canola meal and other protein supplements
- Four Forages:
 - 5) Legume hay/silage
 - 6) Non-legume hay/silage
 - 7) Corn silage
 - 8) Small grain silage
- 9) Pasture
- 10) “Other” – including DDG’s – with estimates averaged

7.5.1 Manufactured Feed Production

Emissions arising from the production of feed can be calculated using specific emission factors for various regions and types of feed. Equation 11, below, is the basic equation and is used along with data found in Table to determine offsets from feed production.

$$E_{SSR9} = \sum_{G,F} \text{FeedDM}_{G,F} * \text{FeedCO2e}_F \quad [11]$$

Where:

- E_{SSR9}** = GHG emissions from feed production (excluding pasture), tonnes CO₂e yr⁻¹
- G** = Animal group
- F** = Feed type
- FeedDM_{G,F}** = Amount of feed of a specific type consumed by a specific animal group, tonnes DM yr⁻¹
- FeedCO2e_F** = GHG emitted per tonne of feed, tonnes CO₂e tonne⁻¹ feed DM

Feed CO₂e were calculated for each province, combining both N₂O and CO₂ (Table).

N₂O emissions were calculated from N-fertilizer application (chemical or organic), crop residues, leaching and volatilization using IPCC equations adapted for Canada by Rochette *et al.* (2008).

- CO₂ emissions were calculated from fossil fuel use for field work, electricity, crop drying and fertilizer and machinery supply using the F4E2 model (Dyer and Desjardins, 2003, 2005).

CH₄ emissions were assumed to be negligible in Canadian cropping systems.

The feed category “Others” refers to dried distillers grains (DDGs). Calculated emissions consider only DDGs from grain corn and wheat. The calculations is as follows: assuming that 1t corn produces 309kg DDGs and 1t wheat produces 295kg DDGs, the emission factor for these two crops shall be inflated by 3.24 (i.e. 1/0.309) for corn and 3.39 (i.e. 1/0.295) for wheat.

Table 12 - Emission factors (tCO₂e / tonne of feed) for different crop category

	Crop category									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	(tCO ₂ e/t.feed)									
NF	n.a.	n.a.	n.a.	n.a.	0.06	0.26	n.a.	n.a.		n.a.
PE	n.a.	0.55	0.31	n.a.	0.07	0.21	n.a.	0.24	see	1.73
NS	0.46	0.67	n.a.	n.a.	0.06	0.24	0.12	0.27		1.69
NB	n.a.	0.65	n.a.	n.a.	0.05	0.23	0.10	0.27		1.74
PQ	0.46	0.77	0.36	1.30	0.06	0.18	0.10	0.30		1.85
ON	0.41	0.58	0.34	1.21	0.05	0.18	0.10	0.21	Table 2	1.52
MB	0.36	0.43	0.20	0.82	0.04	0.22	0.07	0.20		1.21
SK	n.a.	0.29	n.a.	0.78	0.05	0.21	n.a.	0.14		0.87
AB	0.29	0.35	n.a.	0.83	0.04	0.21	0.05	0.15		1.00
BC	n.a.	0.48	n.a.	1.30	0.05	0.22	0.05	0.18		1.49

n.a. = not available (meaning that, according to the agricultural census, these specific crops are not cultivated in the province)

- (1) Corn grains
- (2) Other small grains
- (3) Soybeans
- (4) Canola
- (5) Legume hay/silage
- (6) Non-legume hay/silage
- (7) Corn silage
- (8) Small grain silage
- (9) Unimproved Pasture
- (10) "Other" (DDGs – from corn and wheat)

7.5.2 Pasture Feed Utilization

For pasture, the ninth category, results are given per animal and per year because animal weight varies. Hence, Emission factors are presented for an equivalent of 1000kg of live weight (LW) per year (kgCO₂e./(tLW.yr)). As an example, for a cow which weights 600kg the emission factor must be multiplied by 0.6.

In this protocol pasture refers to “unimproved pasture”. As a result, N₂O emissions are only due to deposited manure. Direct N₂O emissions from manure decomposition and indirect emissions such as volatilization and leaching are included, but N₂O from N-chemical fertilizers and crop residues is excluded, as is CO₂ from fossil energy. Methane emissions from enteric fermentation and manure are not included for the following reasons:

- 1) enteric fermentation emissions do not apply to crops;
- 2) CH₄ emissions from manure deposited on pasture are considered negligible.

GHG emissions from pasture feed can be calculated using Equation 12:

$$E_{SSR9, pstr} = \sum_G PstrCO2e_G * LW_G * F_{pstr,G} * N_G \quad [12]$$

Where:

E_{SSR9,pstr} = GHG emissions from pasture feed utilization, tonnes CO₂e yr⁻¹ (Table 13)

G = Animal group

PstrCO₂e_G = GHG emissions from unimproved pasture per tonne liveweight per year for a specific animal group, tonnes CO₂e tonne⁻¹ LW yr⁻¹

LW_G = Average liveweight for a specific animal group, tonne

F_{pstr,G} = Fraction of annual dry matter intake obtained from pasture

N_G = Number of animals

Table 13 - Emission Factors for Unimproved Pasture Feed Utilization by Different Animal Groups

	Dairy Cows	Heifers (>1yr)	Calves
	Tonnes CO ₂ e LW ⁻¹ yr ⁻¹		
Atl Prov.	1.90	1.34	1.16
PQ	1.90	1.34	1.16
ON	1.90	1.34	1.16
MB	1.87	1.32	1.15
SK	1.83	1.29	1.12
AB	1.80	1.27	1.10
BC	1.81	1.28	1.11

LW: Liveweight (tonnes)

7.5.3 Feed Transportation

Practices and GHG emissions associated with the transportation of produced feed are not expected to change from baseline to project and, as a result, do not need to be quantified.

8 Monitoring Plan

ID number (SSR)	Data type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording Frequency	Proportion of data monitored	How will data be archived? (electronic paper)	For how long is archived data kept?	Comments
Enteric Fermentation									
Enteric Methane - 1	Gross energy intake for a specific animal group	GE _G	MJ head ⁻¹ day ⁻¹	m (advanced) e (simple)	Daily (advanced) Monthly (simple)	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 2	Percent of gross energy in feed converted to methane for a specific animal group	Y _{mG}	%	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 3	Number of animals in a specific animal group	N _G	Head/year	c	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 4 (simple)	Net energy for maintenance	NE _m	MJ head ⁻¹ day ⁻¹	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 5 (simple)	Maintenance energy coefficient	Cf ₁	MJ head ⁻¹ kg ⁻¹	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 6 (simple)	Average live weight of cows	LW	kg	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane –	Net energy for activity	NE _a	MJ head ⁻¹ day ⁻¹	e	Monthly	100%	Electronic	Minimum of two years after last	

7 (simple)								issuance of carbon credit	
Enteric Methane – 8 (simple)	Fraction of time spent on pasture	F_{pstr}	%	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 9 (simple)	Net energy for pregnancy	NE_p	$MJ\ head^{-1}\ day^{-1}$	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 10 (simple)	Fraction of animal group that are pregnant	F_{pregp}	%	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 11 (simple)	Net energy for lactation	NE_l	$MJ\ head^{-1}\ day^{-1}$	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 12 (simple)	Amount of milk produced	Milk	$Kg\ head^{-1}\ day^{-1}$	m	Daily	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 13 (simple)	Fat content of milk	Fat	% by weight	m	Daily	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 14 (simple)	Net energy for growth	NE_g	$MJ\ head^{-1}\ day^{-1}$	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 15 (simple)	Average live body weight for animals in group	BW	kg	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 16 (simple)	Mature live body weight for an adult kow	MW	kg	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon	

								credit	
Enteric Methane – 17 (simple)	Average daily weight gain	WG	Kg/day	e	Daily	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 18 (simple)	Ratio of net energy available for maintenance to digestible energy consumed	REM		c	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 19 (simple)	Digestible energy expressed as a percentage of gross energy	DE	% of gross energy (GE)	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 20 (simple)	Ratio of net energy available for growth to digestible energy consumed	REG		c	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 21 (advanced)	Dry matter intake for each ration ingredient (including edible oils, ionophores, etc.)	DMI	Kg head ⁻¹ day ⁻¹	m	Daily	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Enteric Methane – 22 (advanced)	Measure of quality of forage (NDF)	NDF		m	Monthly	100	Electronic	Minimum of two years after last issuance of carbon credit	This data could be provided by nutritionist judgment for diet formulation.
Manure Storage									
Manure Storage – 1 (annually)	Daily volatile solids excreted by a specific animal group	VSG	kg DM head ⁻¹ day ⁻¹	m	Daily	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Manure Storage – 2 (annually)	Number of animals in a specific animal group	N _G	Head/year	m	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	

Manure Storage – 3 (annually)	Methane conversion factor	MCF_S	%	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Manure Storage – 4 (annually)	Fraction of animal group G's manure handled by the defined manure management system	$MS_{S,G}$	%	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Manure Storage – 5 (annually)	Daily volatile solids excreted per day on a dry matter basis	VS	$kg\ head^{-1}\ day^{-1}$	e	Daily	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Manure Storage – 6 (annually)	Gross energy intake	GE	$MJ\ head^{-1}\ day^{-1}$	e	Daily	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Manure Storage – 7 (annually)	Digestible energy	DE	%	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Manure Storage – 8 (monthly)	Volatile solids added to manure storage unit during month for all animal groups contributing to unit	$VS_{prod,m}$	tonnes	m	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Manure Storage – 9 (monthly)	Volatile solids in the storage unit at the end of the previous month available to be	$VS_{avail,m-1}$	tonnes	m	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Manure Storage – 10 (monthly)	Fraction of available volatile solids consumed during month	f		c	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Manure Storage – 11	Volatile solids available to be	$VS_{avail,m}$	tonnes	m	Monthly	100%	Electronic	Minimum of two years after last	

(monthly)	decomposed at end of current month							issuance of carbon credit	
Manure Storage – 12 (monthly)	Volatile solids available to be decomposed at end of previous month	VS _{avail,m-1}	tonnes	m	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Manure Storage – 13 (monthly)	Volatile solids added to manure storage unit during month	VS _{prod,m}	tonnes	m	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Manure Storage – 14 (monthly)	Volatile solids consumed during month	VS _{consumed}	tonnes	m	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Manure Storage – 15 (monthly)	Volatile solids stabilized into non-available forms	VS _{stabilized}	tonnes	m	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Manure Storage – 16 (monthly)	Volatile solids removed from manure storage during month	VS _{removed}	tonnes	m	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Manure Storage – 17 (monthly)	Average monthly temperature	T ₂	°C	m	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
N₂O Emissions									
N ₂ O Emissions - 1	Feed N intake for a specific animal group	FeedN _G	Kg N head ⁻¹ day ⁻¹	m	Daily	100%	Electronic	Minimum of two years after last issuance of carbon credit	
N ₂ O Emissions - 2	Dry matter intake	DMI	Kg head ⁻¹ day ⁻¹	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
N ₂ O Emissions -	Crude protein content of diet	CP	% of DMI	e	Monthly	100%	Electronic	Minimum of two years after last	

3								issuance of carbon credit	
N ₂ O Emissions - 4	Nitrogen retained in milk for a specific animal group	MilkN _G	Kg N head ⁻¹ day ⁻¹	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
N ₂ O Emissions – 5	Daily milk production	Milk	Kg head ⁻¹ day ⁻¹	m	Daily	100%	Electronic	Minimum of two years after last issuance of carbon credit	
N ₂ O Emissions - 6	Protein content of milk	Milk protein	% on weight basis	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
N ₂ O Emissions - 7	Nitrogen retained in liveweight gain for a specific animal group	LWgain N _G	Kg N head ⁻¹ day ⁻¹	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
N ₂ O Emissions - 8	Daily liveweight gain	LWgain	Kg head ⁻¹ day ⁻¹	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
N ₂ O Emissions - 9	Number of animals in a specific animal group	N _G	Head/year	m	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
N ₂ O Emissions - 10	N ₂ O emitted per kg of N excreted for a specific animal group	E _{N2O,G}	kg N ₂ O kg ⁻¹ excreted N	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
N ₂ O Emissions - 11	Fraction of excreted N handled by manure management system for a specific animal group	F _{G,S}	%	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
N ₂ O	N ₂ O emitted per kg	E _{N2O,S}	Kg N ₂ O	e	Monthly	100%	Electronic	Minimum of two	

Emissions - 12	of N excreted in a specific manure management system		kg excreted N ⁻¹					years after last issuance of carbon credit	
Feed									
Manufactured Feed - 1	Amount of feed of a specific type consumed by a specific animal group	FeedD M _{G,F}	tonnes DM yr ⁻¹	m	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Manufactured Feed - 2	GHG emitted per tonne of feed	FeedCO 2e _F	tonne ⁻¹ feed DM	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Pasture Feed - 1	GHG emissions from unimproved pasture per tonne liveweight per year for a specific animal group	PstrCO2 e _G	tonnes CO2e tonne ⁻¹ LW yr ⁻¹	c	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Pasture Feed - 2	Average liveweight for a specific animal group	LW _G	tonne	e	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	
Pasture Feed - 3	Fraction of annual dry matter intake obtained from pasture	F _{pstr,G}	%	e	Monthly	100%	Electronic	Minimum of two years after last Pasture Feed - 4issuance of carbon credit	
Pasture Feed - 4	Number of animals in a specific group	N _G	Head/year	m	Monthly	100%	Electronic	Minimum of two years after last issuance of carbon credit	

9 Management of Data Quality

9.1 Data Quality Management and Contingency Procedures

This protocol has been designed to apply to a range of dairy farms and to allow for accurate comparisons between project and baseline conditions at specific operations, as well as between different farms. All farms must process the data to calculate GHG emissions on the basis of fat corrected milk produced. The project proponent must provide documentation of the procedures, management systems, and controls used for managing data and information relating to both the project and baseline scenario.

The project proponent shall establish and apply quality management procedures to manage data and information. Written procedures should be established for each record keeping task, outlining (1) the person responsible, (2) when the task is to be performed, and (3) where the records are to be kept.

The burden is on the proponent to ensure data quality management complies with all requirements of the GHG offset program/body. The primary principle is that all procedures must be designed, and records maintained, to meet the 'verifiable' requirement.

9.2 Record Keeping

The project proponent shall keep the information listed below for the time period stated (Table 4). All information must be available to the verifier upon request.

Table 14 – Record Keeping Requirements

Kept for Duration of Project's GHG Credit-Production
Raw baseline period energy, feed, milk production, livestock, and manure management data, independent variable data, and static factors within the measurement boundary
A record of all adjustments made to raw baseline data with justifications
All analysis of baseline data used to create mathematical model(s)
All data and analysis used to support estimates and factors used for quantification
Expected end of life date of equipment removed or renovated under the project
Common practices relating to possible GHG reduction scenarios discussed in this protocol (such as manure management practices)
Metering equipment specifications (model number, serial number, manufacturer's calibration procedures)
Kept for 2 Years After Generation
Raw reporting period energy, feed, milk production, livestock, and manure management data, independent variables, and static factors within the measurement boundary

A record of changes in static factors along with all calculations for non-routine adjustments
All calculations of GHG emissions/reductions and emission factors
Measurement equipment maintenance activity logs
Measurement equipment calibration records
Initial and annual verification records and audit results

9.3 Data Management System

The project proponent must put in place a system that meets the following criteria:

- All records must be kept in areas that are easily located;
- All records must be legible, dated and revised as needed;
- All records should be maintained in an orderly manner;
- All documents must be retained for the life of the project;
- Electronic and paper documentation are both satisfactory; and
- Copies of records should be stored in two locations to prevent loss of data.

9.4 Quality Control Procedures

The project proponent shall provide quality control procedures for:

- ensuring that the changes to operational procedures (including feed intake, manure management, etc.) continue to function as planned and achieve GHG reductions
- ensuring that the measurement and calculation system and GHG reduction reporting remains in place and accurate
- checking the validity of all data before it is processed, including emission factors, static factors, and acquired data
- performing recalculations of quantification procedures to reduce the possibility of mathematical errors
- storing the data in its raw form so it can be retrieved for verification
- protecting records of data and documentation by keeping both a hard and soft copy of all documents
- recording and explaining any adjustment made to raw data in the associated report and files.
- a contingency plan for potential data loss

10 References

Dyer, J.A., X.P.C. Vergé, R.L. Desjardins and D. Worth. In Press. Long Term Trends in the GHG Emissions from the Canadian Dairy Industry.

Vergé, X.P.C., J.A. Dyer, R.L. Desjardins, and D. Worth. 2007. Greenhouse gas emissions from the Canadian dairy industry in 2001. *Agric. Syst.* 94:683-693.

11 Appendix 1 — Science Discussion Document

File in pdf format attached

12 Appendix 2 — Agenda of National Consultation Workshop

CDCNW Canadian Dairy Calculator National Workshop

June 5-6, 2008 Fredericton, NB

National Workshop, June 5 – 6, 2008

For the ACAAF funded project: “Certification of a Greenhouse Gas Protocol and Calculator for the Canadian Dairy Industry”

Facilitator: David Walker, NBDAA Project Executive

Thursday, June 5

- 8:30-9:00 am Welcome from ADFI Chairperson, Wiebe Dykstra, Introduction around the table of participants and observers, Brief introduction of the Atlantic Dairy and Forage Institute, and Overview of the process involved in developing the greenhouse gas protocol and calculator for the dairy industry (Dr. Rob Janzen)
- 9:00-10:15 am Summary of paper and comments from reviewers (Dr. Rob Janzen), and presentation of key issues raised from review process.
- 10:15-10:30 am Break
- 10:30 am-noon Group discussions of issues which arose
- Noon- 1:00 pm Lunch ordered in.
- 1:00-3:00 pm Continuation of group discussions if necessary. And, begin “Decision Points” (re: science discussion paper) for protocol and calculator development
- 3:00-3:20 pm Nutrition Break
- 3:20-4:00 pm Continuation of “Decision Points” for protocol and calculator development
- 4:00-5:00 pm Summary: Preparation for what is needed for final decision points tomorrow... we left the more contentious decision points to be decided tomorrow!

Friday, June 6

- 8:00-8:30 am Breakfast
- 8:30-9:00 am Final comments before we finish decision points
- 9:00-10:30 am Final decision points
- 10:30-10:45 am Break
- 10:30 am-noon Final comments from participants and opportunity to provide direction for Rob in completing the protocol

SECTION 2



First Round of Expert Technical Review

of the ACAAf funded project

“Certification of a Greenhouse Gas Protocol and Calculator for the Canadian Dairy Industry”

November 6, 2008

Project leader: The Atlantic Dairy and Forage Institute
Project support: The Dairy Farmers of Canada
The New Brunswick Department of Agriculture and Aquaculture
Project funded by: Advancing Canadian Agriculture and Aquaculture



Agriculture and
Agri-Food Canada

Agriculture et
Agroalimentaire Canada

Canada

New  Nouveau
Brunswick
C A N A D A
Agriculture and
Aquaculture Agriculture et
Aquaculture

First Round of Expert Technical Review –

Held November 6th, 2008 by Conference Call 3:30-6:00 PM (AST)

Participants:

David Walker (Chair) – New Brunswick Department of Agriculture and Aqua-Culture

Josh Lamont (Secretary) – Atlantic Dairy and Forage Institute - Project Officer

Rob Janzen (Protocol Developer) Climate-CHECK

Karen Haugen-Kozyra – (C3 representative) Climate Change Central

Alan Fredeen – Nova Scotia Agriculture College

Raymond Desjardins – Agriculture and Agri-Food Canada

Xavier Vergé - Agriculture and Agri-Food Canada

Cedric MacLeod – MacLeod Agronomics

Ron Maynard – Dairy Farmers of Canada

Wiebe Dykstra – Atlantic Dairy and Forage Institute – Executive Director

1. Introductions

David Walker (Chair) – New Brunswick Department of Agriculture and Aqua-Culture

Josh Lamont (Secretary) – Atlantic Dairy and Forage Institute - Project Officer

Rob Janzen (Protocol Developer) Climate-CHECK

Karen Haugen-Kozyra – (C3 representative) Climate Change Central

Alan Fredeen – Nova Scotia Agriculture College

Raymond Desjardins – Agriculture and Agri-Food Canada

Xavier Vergé - Agriculture and Agri-Food Canada

Cedric MacLeod – MacLeod Agronomics

Ron Maynard – Dairy Farmers of Canada

Wiebe Dykstra – Atlantic Dairy and Forage Institute – Executive Director

2. Why We're Here – Alberta Policy Context –

3. Principles to guide Protocol Decisions / Development – Karen Haugen-Kozyra

- 4 principles -
 - Environmental Integrity – Considering all GHG sources controlled, affected and related to the Project;
 - Usability - Reasonableness (to balance the environmental integrity) – using consistent approaches to decide what needs to be quantified in baseline and project;
 - Adapting precedent set elsewhere – Borrowing from tools, methodologies and approaches used in other Systems; and
 - Life cycle or partial life cycle analysis approach – As outlined by the ISO 14064-2 framework.

4. Introduction to the Protocol – Rob Janzen

- Brief explanation of the Protocol to make sure everyone is comfortable with the layout of the protocol

5. Review of Protocol – Rob Janzen

Issue 1

- RD – I do not like the use of “averaged out”, could create a bias
- RJ – I am willing to change the wording
- DW- Would you be able to suggest wording Raymond?
- RD – Yes, will send Rob wording

Solution – Raymond Desjardins is going to send better wording to Rob

Issue 2

- RD – FCM (Fat Corrected Milk) is it 3.25% or other
- AF – 4% is most used in research, but should be stated what percent
- CJ – Farmers use 3.25%
- RJ – Quota is based on Fat corrected Milk
- AF – No on kg of butter fat
- RJ – Use industry number
- DW - Should talk with Dairy Farmers of Canada
- DW – Should state what we are using 3.25% ,3.5%, or 4%
- RJ – We want to use industry standard?
- DW - Yes
- KHK – Use industry standard
- RD – Calculation based on kg of milk
- RD – Going to look at data and get back to Rob
- AF – Mitigation strategies may lower milk fat concentration, could have reduction of methane but also a reduction in fat content
- RD – Will rework equations to reflect KG of fat
- RM – Will get someone from Dairy Farmers of Canada to help

Solution – Raymond Desjardins is going to talk with Dairy Farmers of Canada and get Rob definition of FCM and percentage to use in Protocol.

Issue 3

- RD- Problem with wording for scenario 4 in table 1.4
- RJ – Will remove scenario 4
- AF - Scenario 1 needs to be reworded
- RJ - Will change with information from Raymond and Xavier

Solution – Rob is going to remove scenario 4 and reword scenario 1

Issue 4

- RD- The equations from Xavier already include N₂O. Need to rework paragraph as worried about double counting or overlap
- RJ – Will remove the NERP (Nitrous Oxide Emissions Reduction Protocol) and change the discount factors

Solution – Since N₂O emissions are counted in the equations no need to link the NERP to this protocol

Issue 5

- DW – Change the word “Simple” in the Simple and Advanced Options to “Basic”
- RJ – OK

Solution - Rob will change the word from “Simple” to “Basic”

Issue 6

- RD – The reference to table 8.3 is wrong as there is no table 8.3. Thinks it is probably supposed to be 7.4
- RJ – Yes, will change from 8.3 to 7.4

Solution – Rob will change reference from 8.4 to 7.4

Issue 7

- RD “Using the secondary approach, the average dairy intensity calculated [should be] using the secondary approach, the average GHG emission intensity for the dairy industry”

Solution – Rob will change wording

Issue 8

- RD – Selection of baseline could create a biased for good farmer / bad farmer. Allow good farmers to benefit and push bad farmers away from using this protocol.
- RJ – Use 2001 baseline to remain constant
- KHK – The beef protocol used a 3 year project specific baseline
- CJ – Not going to define a regional baseline
- RJ- Primary no
- CJ – Secondary Yes
- RJ – 2007 paper written by Xavier notes baselines
- XV – Depends on stats, Stats Can or somewhere else
- CJ – Make the baseline and go a 3 year
- RJ – Use the same language as other protocols

Solution – Going to use the same language as the other protocols. (Beef, Pork)

Issue 9

- KHK – Having both Exclude and Include in B16/P16 in Table 7 is confusing
- RJ- Will use include

Solution – Rob will use include in section B16/P16 in Table 7

Issue 10

- Section 7.2

Solution – Changing as we are unlinking the NERP (N₂O) Protocol

Issue 11

- AF – concerned about Table 11, methane reductions with use of ionophores are based on short term studies, microbes are known to adapt to new conditions. Not sure of long term effects. Worried about the overestimation of methane mitigation,

Solution – Alan Fredeen, and Karen Beauchemin are going to re-work the table and calculations and get new table and calculations to Rob.

Group – Very pleased with Protocol and have **No Sustained Objections**

Alan Fredeen
Raymond Desjardins
Xavier Vergé
Cedric MacLeod
Ron Maynard

SECTION 3

Appendix A

Participants of the Expert Technical Review

David Walker - NBDAA*

Alan Fredeen - NSAC*

Raymond Desjardins -AAFC*

Xavier Vergé - AAFC*

Karen Haugen-Kozyra - C3*

Rob Janzen - Climate Check (Developer)

Cedric MacLeod - MacLeod Argonomics

Wiebe Dykstra - ADFI* Executive Director

Ron Maynard - Dairy Farmers of Canada

Josh Lamont - ADFI* Project Officer

NBDAA - New Brunswick Department of Agriculture and Aquaculture

NSAC - Nova Scotia Agriculture College

AAFC - Agriculture and Agri-Food Canada

C3 - Climate Change Central

ADFI - Atlantic Dairy and Forage Institute