Intent to Develop Alberta Offset System Quantification Protocol: *Covered Manure Storage*

Please contact Climate Change Central with any questions or clarification of requirements at contact@climatechangecentral.com.

This Intent to Develop an Alberta Offset System Quantification Protocol document is intended to provide Alberta Environment with an overview of the proposed protocol idea to demonstrate how this protocol will meet the requirements of the Alberta Offset System. The protocol developer is required to present this information to Alberta Environment and **must** receive approval in concept for the protocol before the protocol idea will be considered for development in the Alberta Offset System.

Familiarity with and general knowledge of the Alberta Offset System is required prior to initiating a protocol. Information on the Alberta Offset System is available on the Carbon Offset Solution website (http://carbonoffsetsolutions.climatechangecentral.com) and on the Alberta Environment website (http://environment.alberta.ca/02275.html).

Alberta Environment will review the submitted information in order to assess and provide feedback on the following elements:

- How the proposed protocol meets the eligibility criteria in section 7 of the *Specified Gas Emitters Regulation;*
- Applicability of the proposed protocol against purpose and intent of the Alberta Offset System;
- Baseline adoption levels and credit potential for Alberta;
- Baseline, project condition, and key assumptions for the proposed protocol;
- Key stakeholders and technical experts in the field; and
- Relevant science and technical information

General Description of the Proposed Protocol[1]

[Provide a written overview on the intent, purpose and relevant background information on the protocol.]

Intent

[Describe the protocol activity and reduction opportunity.]

Manure management systems in Canada are a source of methane emissions to the atmosphere. In Canada, liquid manure management systems account for about 13% of agricultural emissions, or about 4 million tonnes of carbon dioxide equivalent (Mt CO2e) per year (2006 Census). About 0.8 Mt CO2e of this total is emitted from liquid manure systems in Alberta each year. The swine and dairy industries are the largest sources of methane emissions from manure, due to the prevalence of liquid manure systems resulting from the cleaning and collection processes used in these confined types of feeding operations.

[1] **Some important notes to consider:**

- *Protocols should be based on best available science.*
- *Follow the ISO 14064:2 standard processes – specifically addressing principles of conservativeness, completeness, relevant, consistent with others, accuracy and be completely transparent in development and descriptive processes.*
- *Be very clear with respect to the Measurement, Monitoring and Verification requirements to allow little interpretation.*

Farmers can reduce methane emissions from liquid manure storage by using impermeable covers to capture the methane that is generated from the manure when it decomposes in anaerobic (low oxygen) environments. The methane is then destroyed by flaring, which reduces the global warming potential. There is also opportunity to combust the resulting biogas to replace fossil fuel intensive sources of electricity and / or heat. There are a number of GHG reduction protocols for manure storages in use internationally and throughout North America.

This protocol excludes solid beef manure that is more suited for use with purpose-built biodigester technology that is addressed in the approved Quantification Protocol for the Anaerobic Decomposition of Agricultural Materials (Biogas) Protocol. Linkages between the Biogas Protocol and the proposed Covered Manure Storage (CMS) Protocol will be explored in the development process.

Baseline [Explain the project baseline condition, adoption levels for the province, business as usual activity, general baseline assumptions, credit potential in Alberta, other relevant information.]

In Alberta, there are close to 2000 operations with uncovered liquid manure storages that may have the potential to create agricultural offsets. This practice is not standard operating procedure since less than 10% of these storages are covered in Alberta. Of the storages that are covered, only three in Alberta and one in Manitoba have the capacity to flare the biogas. If 50 to 75% of the 0.8 Mt CO2e per year emitted from manure storages in Alberta could be captured and flared, the credit potential for this protocol in Alberta could range from 0.4 to 0.6 Mt CO2e per year. The combustion of the biogas to replace of fossil fuel use for electricity or heat will result in about 0.1 Mt CO2e of additional emission reduction from avoided use of fossil fuels, for a total credit potential of from 0.5 to 0.7 Mt CO2e per year.

Project Condition [Explain the project condition, activity creating the emission reduction or removal, other relevant information.]

The protocol activity is to cover earthen or concrete manure storages with an impermeable membrane to capture the methane produced by methanogenic bacteria in the manure in low oxygen conditions and destroy it by flaring. Methane is considered to have a global warming potential of 21 in Alberta's *Specified Gas Emitter Regulation*. The basis for this protocol is the reduction of GHG emissions since the end product of the flaring process is carbon dioxide with a global warming potential of one. This kind of project differs from the Anaerobic Decomposition of Agricultural Materials (Biogas Protocol) since the latter is designed for mixed-tank, mesophilic types of anaerobic digestion, with high capital investments in infrastructure (purposely built), whereas this project condition is covering existing manure storages to collect and combust the methane gases.

The science basis for quantifying emission reductions is an adaptation of internationally recognized developed as the basis for a Tier 2 regional approach to quantifying rates of methane emissions using peer reviewed research results (Mariner et al. 2004) for Canada's National Inventory Report (NIR, Environment Canada, 2010). The NIR approach represents

the best available science combined with best practice guidance (IPCC Tier 2 approach) to represent conservative GHG emissions associated with agricultural production in Canada.

The basis for estimating annual regional emission rates includes animal number, by type and age, to determine production of the volatile solids (Vs) that drive the methanogenesis process, as well as the maximum methane producing capacity, (B_o), using published values. The estimation equation also includes a regional monthly climate factor and a province-wide estimate of seasonal applications of manure to the land. In addition, a methane conversion factor (MCF) addresses differences between estimated and measured methane emissions. These factors have been linked in peer reviewed scientific publications that estimate emissions from liquid manure systems (Husted 1994, Harper et al. 2000, Sharpe and Harper, 1999, Sommer et al. 2000, 2002, 2007) .

The Baseline and Project Conditions will be established on a project-by-project basis to account for variations in site conditions and since it is common practice for farmers to keep records of feed and animal numbers. The proposed protocol will increase the accuracy of the Tier 2 NIR approach by including actual farm data for diet inputs for each animal on an average monthly basis to calculate amounts of the volatile solids that relate directly to methane production potential. In addition, actual farm data (not assumed provincial values) for manure emptying and spreading dates will be used, based on methods that were developed and reviewed for the currently approved Quantification Protocol for the Innovative Feeding of Swine and Storing and Spreading of Swine Manure (Pork) and Dairy Cattle Emission Reduction (Dairy) protocols. Actual air temperatures from the nearest weather station (not assumed provincial values) will also be used. This site-specific approach will adapt the regional equations to specific Alberta conditions of diet, and management practices and temperature to increase the accuracy of the regional estimates used within the NIR.

Calculations of net emissions will include nitrous oxide (N2O) emissions from liquid manure which have been found to be variable, but often insignificant (Wagner- Riddle et al. 2004). Carbon dioxide emissions from start-up sequences for flaring will be included in calculations of net emissions.

Applicability [Who is the intended user(s) for this protocol?]

Intended users of this protocol are primarily hog and dairy livestock operators who produce liquid manure that is contained within manure storages. There is interest in adapting this protocol beyond Alberta to hog producing areas of Saskatchewan, Manitoba and dairy producing regions in eastern Canada

Regulatory Requirements [Describe all relevant regulations that apply to this activity and explain how the activity is going beyond regulatory requirements.]

At present there are no regulations requiring methane capture and destruction for manure storages.

Alberta has an Agricultural Operations Practices Act (AOPA) that regulates livestock

management in confined feeding operations (CFO). In cases where specified minimum distances between a CFO and its neighbor are exceeded, farmers may be required to cover storages to reduce nuisance odors, by the National Resource Conservation Board (NRCB) which is the regulatory arm of AOPA. However, the requirement to cover storages is not common in Alberta. As well, this requirement does not specify that the methane must be destroyed by flaring, nor does it specify that the cover must be made of impermeable material. AOPA may grant a confined feeding operation a conditional approval that requires the installment of an impermeable synthetic cover, or, a permeable natural cover (e.g. straw) over an earthen manure storage. The approval officer may find that the natural cover with certain specifications is good enough to provide the required odour reduction.

Some municipal operating permits requiring the covering of storages may have been in place before the NRCB began regulating CFOs under AOPA (ca 2002), and these may have been maintained by the NRCB. However, none of these permits would have required collection and combustion of the biogas.

AOPA also specifies that rates of nitrogen applied as manure must not exceed agronomic rates of removal that are required by growing crops. This regulation will support the proposed CMS protocol by ensuring that possible leakage of GHG emissions from land applications of manure will be consistent between Baseline and Project Conditions.

Additionality [Explain how this activity result in real, quantifiable, and verifiable reductions beyond business as usual activity and government regulations. How does this protocol result in new, incremental greenhouse gas emission reductions and/or removals that would not otherwise have occurred?]

The main feature of this protocol that will result in **real** GHG emission reductions that are new, incremental and would not have other wise occurred is the requirement to flare the captured biogas The common or business as usual practice in Alberta and most of Canada is the use of uncovered manure storages that emit methane. The practice of capturing the methane using impermeable covers and destroying it by flaring occurs on only three of the 2000 manure storages in Alberta, or, less than 1%. This rate of adoption is even lower in Manitoba where most of the hog production in Canada occurs, and in Eastern Canada where dairy operations are more prevalent.

The science basis for **quantifying** this emission is an adaption of the Tier 2 approach developed for the NIR (Environment Canada 2010). This approach will be adapted for the Project Condition using site specific inputs of animal numbers, diet and air temperatures.

Verification of both Baseline and Project Conditions will include a variety of on and off-farm sources, including ration records, feed bills, and flare monitoring techniques in use for other Alberta protocols, as described in more detail below.

Barriers [Identify barriers that would, in absence of the Offset protocol, disincent or prevent this activity or project from taking place.]

There are many barriers to the adoption of this practice.

i) Financial. Costs are very high at close to $ 50,000 for covers. If structured covers are required, that are built to withstand the build – up of gases and store them for effective intermittent flaring, then the costs can be even higher (and this is likely to be the case in Alberta). The required flaring and monitoring devices bring totals closer to $100,000. Although there is some cost recovery under the Growing Forward program, these have a maximum limit and as such would only cover about 40% of the cost of the cover alone, or $20,000. Depending on the type of liner in use at the storage, there may also be a need to install a gas collection system under the storage to minimize diffused gases through porous materials. This will raise the costs even higher.

ii) Operational. Covers are very cumbersome to use due to the need to remove them for maintenance and emptying if an appropriate design is not in place. Winter conditions are problematic due to accumulations of ice and snow on the covers, and mitigation strategies will be required to ensure this does not occur. Further, there may be a need to store gases over the winter and avoid flaring to minimize freezing and cracking in the flares due to high moisture levels in the gases. The protocol will need to lay out proper maintenance procedures for the covered storages.

iii) Informational and technology transfer. Experience with these kinds of covers is limited in North America and Alberta, although and the technology transfer expertise within government and the private sector is just starting to build. Some technology service providers do exist in the province, but it's expected that project developers will need to look at Manitoba, Quebec and some of the US states for more choices in technology configurations.

iv) Technological. Flaring efficiencies under biogas conditions (40:60% CO_2:CH_4) is an emerging science and transference of learnings from the oil and gas sectors is underway (with the assistance of Dr. Peter Gogolek, NRCan). However, monitoring devices for flare temperature and biogas CH4 content will need to be prescribed in the protocol.

Permanence [Are emission reductions and/or removals reversible. If so, how does the protocol developer propose to address permanence of Offset Credits associated with this activity?]

Permanence is not an issue since methane is destroyed.

Leakage [Will this protocol result in or threaten leakage of greenhouse gas emissions, and if so, how will these risks be mitigated? Include a discussion on possible scenarios that may occur.]

Possible increases in emission reductions or removals outside of a project's boundaries, or leakage, could take the form of land applications of manure. However, when a EMS is covered, the space under the cover fills with a higher proportion of ammonia gas. This results in elevated ammonia under partial pressures so that very little ammonium is transformed into ammonia gas and the nitrogen loss is greatly decreased. Studies in the North Carolina and Georgia Coastal Plains regions have shown that lagoons emit significantly less ammonia gas than previously thought. Much of the N input into lagoons was found to be denitrified (Harper et al., 2000, Sharpe and Harper 1999) by microbial and/or chemical processes.

Digestion of liquid manure actually increases its quality as a fertilizer since organic-bound nitrogen is converted into ammonium, which is available to plants. The increased concentrations of ammonium allow for a higher precision in fertilization and therefore reduced risk of nitrogen leakage. Normally, the amount of ammonium corresponds to 70% of the total nitrogen content in undigested manure, which increases by about 15% in digested manure (Taylor et al. 2010). Manure application in the proposed protocol will specify that agronomic rates of nitrogen (calibrated to crop demand and not overapplied) will be followed to guard against possible leakage of higher N20 emissions in the project. However, current studies of the GHG emission properties of digestate from biodigesters in Alberta conducted by Agriculture and Agri-Food Canada are suggesting that emissions of N20 may be even lower from digestate relative to raw manure. Nitrogen leaching may also be reduced by about 20% when digested manure replaces undigested manure.

Conservativeness [How does the proposed protocol idea address conservativeness in emission reduction quantifications?]

Conservativeness will be addressed on a number of fronts:

1) Baseline estimation with constrained reduction potential. Covering manure storages potentially results in altered physical and chemical conditions within the storage. This could lead to higher or lower methane emissions compared to the Baseline Condition. However, scientific literature is not conclusive in this regard. Inquiries among scientific experts in this area have not yielded any further insights. At least 4 other protocols exist globally in this area and all use a similar approach to conservatively address this issue and quantify the emission reductions from covered manure storages. For the baseline condition, uncovered manure emissions are estimated as a function of ambient air temperature and volatile solids content using IPCC equations. For the project condition, all of the protocols require monitoring of flow rate, methane concentration, and combustion efficiency of captured gases. Measured Project emissions cannot be compared directly to the estimated Baseline emissions, because the installation of the cover may impose changes to the physical and chemical (i.e. temperature, nitrogen content, etc.) controls on emissions. For conservativeness, the existing capture-and-destruction protocols quantify GHG reductions as the *lower* of either estimated Baseline emissions or, the measured Project destruction of CH_4 (Figure 1). In addition, some existing protocols also subtract estimated emissions from secondary storage (i.e. manure slurry stored after removal from the covered portion of the manure storage system) from the measured Project emissions as an even more aggressively conservative approach to GHG reduction quantification[2]. The estimation of baseline emissions in this manner is consistent with the approved Alberta Pork and Dairy protocols. The CMS protocol will use a calculated approach to estimate rates of emissions from uncovered storages to represent the Baseline Condition, and will follow the conservative quantification of reductions as outlined in Figure 1.

Some Project Developers in Alberta would prefer that the proposed CMS protocol is based on metering amounts of flared biogas. In this approach, the Baseline Condition would be

[2] The CDM methodology (ACM0010) also requires 15% of total estimated CH_4 emissions to be deducted to account for fugitive emission from the cover, but for simplicity this is not included in this introduction to quantification.

assumed to generate the amount of biogas that is flared. However, as discussed above, there is insufficient evidence to assume that the cover does not change temperature, and pressure conditions, and thus, no basis for the annual estimation of the CH_4 which would have been emitted if no cover were installed to minimize the potential for over-estimation of reductions.

2) Coefficients. Equations used to estimate rates of methane emissions based on relationships between animal feed and air temperature that are used as the basis for IPCC Tier 2 estimates reported in Canada's National Inventory Report (Environment Canada, 2010). Proposed improvements to National Inventory Report Tier II estimates for this protocol include:
    a. Use of regional or site-specific air temperature measurements rather than provincial averages. Since lower temperatures result in lower amounts of methane generation, rates of emissions calculated in Alberta will be lowered accordingly.
    b. Use of on-farm feed data rather than industry averages, based on procedures outlined in the approved Pork and Dairy Protocols.

3) Use of Methane Conversion Factor. A recent Canadian study by Park et al. 2004 measured a very conservative coefficient of 0.45 to represent a site-specific methane conversion factor (MCF) at three manure storage systems in Guelph, Ontario, relative to a 0.80 MCF calculated by the US EPA at two manure storage systems in South Carolina (Mangino et al 2001). However, the Mangino et al 2001 study was recently challenged by Lory et al. (2010), who found fundamental errors in the approach used to calculate methane emissions from anaerobic lagoons. They concluded that US EPA approach could significantly underestimate methane emissions from anaerobic lagoons. As an alternative, they proposed a new approach that addresses the shortcomings of US EPA methodology. The methane producing potential (B_o) is an essential component of IPCC equations for calculating methane emissions from manure. Using country-specific B_o factors based on recent measurement data or research should improve the reliability of the resulting emissions.

Although the more conservative MCF factor of 0.45 is proposed for use in this protocol as it was developed in Canadian conditions and used by prominent Canadian researchers, some Project Developers in Western Canada would like to see the US EPA value of 0.70 that was measured in South Carolina apply to Alberta. Seasonal measurements of emission rates from an uncovered storage are currently being studied in Alberta, although additional study sites are needed. Use of the South Carolina coefficient in this protocol would not represent a conservative approach.

4) First Generation Approach. Although some gaps exist in the knowledge base around the practice change of covering manure storages, the consensus of scientific and technical experts gathered at a Consultation Workshop to review the soundness of the scientific and policy approaches was that there is a sufficient basis for developing a first generation protocol in the Alberta Offset System. Agreement among the workshop participants ranged between 89% and 95% on a variety of questions addressing this topic. Development of this protocol will stimulate the work that is needed to compile the

required information. As science advances and gaps are filled, coefficients can be adjusted on a go-forward basis during the periodic (5 year) review of the basis for the proposed CMS protocol.

Aggregation [Is this protocol likely to result in aggregated projects? If so, are there risks associated with aggregated projects, and how does the protocol propose to handle these risks?]

It is likely that individual sites would generate enough offsets to form a project. If multiple sites are aggregated, there may be risks associated with different types of monitoring and flaring equipment. However this protocol will require sophistication on the part of the producer and the aggregator, so risks associated with potential multiple projects should not be large. In addition, the protocol will lay out performance design specifications with attendant maintenance checks to ensure proper operation of the cover and the system.

Verification [What types of records are available to support implementation and verification of the proposed activity or project?]

Calculations for estimating baseline emissions will be laid out clearly in the protocol and supporting documentation. Monitoring requirements for flaring will be specified with the protocol as in other approved protocols within the Alberta system. Pork and dairy operations are largely production management types of operations. The operators are under contract to manage the operations a certain way (feeding, diets, barn hygiene, food safety and Hazard Assessment Critical Control Point (HACCP) systems). As such, record keeping is part of this production management type of operation. The kinds of records to support the activities required by the protocol are:

- Daily or Monthly animal tracking records (see Section 6 for templates)
- PigCHAMP or pigWIN feed and production data management systems;
- Dairy Herd Inventory feed and production data management systems;
- Records of deaths
- Receipts for hogs/milk/dairy animals purchased or sold, including weights
- Sign-off by Licensed Professional Nutritionist for diet formulation
- Measured feed lab reports (%ash, digestible energy, dry matter content, crude protein content)
- Field records documenting which fields; type of spreading; time of spreading; calibration records to determine volume of manure spread to derive application rates of manure (average rate per hectare between baseline and project); Invoice if custom spreading or load tickets (if on farm labor and equipment used for spreading
- Estimated capacity at 100% fill from the Development Permit or NRCB Approval Permit on file
- Date stamped photos showing the agitation equipment used, and the amount of manure remaining in the storage facility after the spreading event;

Ownership [Identify issues around ownership that pertain to this activity or project.]

Will belong to the owner of the land location where the practice change occurred.

Related Protocols and/or Methodologies [Do other jurisdictions, programs or offset systems have

similar or related protocols available, and if so, discuss similarities and differences between the proposed protocol idea for Alberta relative to other jurisdictions.]

Several related protocols/methodologies for this project-type exist. The following is a list of the systems/programs who have developed similar types:

- Climate Action Reserve – *Livestock Project Reporting Protocol – Capturing and Destroying Methane from Manure Management Systems. Draft Version 3.0 for Public Comment*
- Clean Development Mechanism – *(ACM0010) Consolidated Baseline Methodology for GHG Emission Reductions from Manure Management Systems*
- USEPA Climate Leaders – *Managing Manure with Biogas Recovery System*s
- Greenhouse Gas Services (GHGs) – *Methodology for Agricultural Livestock Manure Management System Methane Capture and Destruction Projects*

These capture-and-destruction protocols provide a range of approaches to estimate Baseline emissions, varying in the degree of sensitivity to site-specific factors such as animal numbers, diet composition and average monthly temperature. In the Project period, these capture-and-destruction protocols require monitoring of flow rate, methane concentration, and combustion efficiency of captured gases. These measured Project emissions cannot be compared directly to the Baseline emissions (see discussion in Conservativeness section above), because the installation of the cover may impose changes to the physical and chemical (i.e. temperature, nitrogen content, etc.) controls on emissions. Further, data are lacking to determine the influence of these changes on emissions — that is, data to compare conditions and associated emissions in covered and non-covered manure storage is not documented in existing capture-and-destruction protocols, and has not been discovered during the preparation of this Science Discussion Document. For conservativeness, then, the existing capture-and-destruction protocols quantify GHG reductions as the lower of estimated Baseline emissions or measured Project destruction of CH_4. In addition, some existing protocols also subtract estimated emissions from secondary storage (i.e. manure slurry stored after removal from the covered portion of the manure storage system) from the measured Project emissions as an even more aggressively conservative approach to GHG reduction quantification

Summary of Similarities Between the Protocols:

1. Covering manure storages are considered to be additional by exceeding regulation and common practice;
2. Baseline emissions are estimated as a function of regional air temperature (not stored manure temperature);
3. Baseline emissions are estimated irrespective of facility configuration and operation (unique design considerations to control fugitive emissions or other types of issues are not considered. All operations are assumed to perform similarly);
4. All exclude N20 emissions from storages in quantification;
5. Some include emissions from secondary storage of effluent from the covered primary;
6. All exclude emissions from landspreading of effluent (a potential leakage impact)
7. Installing a cover (project condition) is assumed to alter conditions from baseline (through changes in temperature, retention time, N content, pH etc). Although methane production is metered and measured in all of the project conditions to ensure methane production is occurring, the quantified emission reductions cannot be greater than the

baseline estimates, or CH4 production in the project – whichever is lower. Since data are lacking to show how much the cover alters the conditions – this is the conservative approach taken in all of these protocols.

How this Protocol will align and deviate from the common approaches:

- Follows the conservative baseline-estimated constrained reduction potential calculation;
- Includes emissions from land-spreading of the effluent and put in controls to ensure that emissions from land spreading are not exceeded in the project;
- Includes emissions from secondary storages;
- Minimizes risk of fugitive emissions by specifying performance design specifications for storages
- Improves on open biogas flares efficiencies by specifying performance design specifications
- Provides for better accuracy since regional estimates for animal diet formulation and population numbers will not be used – actual farm-specific feed and animal performance data will be gathered to support the calculations

The Alberta approved Pork, Dairy and Biogas protocols are related to and will compliment this proposed CMS protocol.

Other Benefits [List all associated benefits that will result from this activity. These other benefits can include environmental benefits, economic benefits, etc.]

There are many co-benefits to this proposed protocol that are very important to agriculture. Anaerobic digestion is an effective method for reducing odour-causing substances, especially if used in conjunction with a hydrogen sulphide scrubbing system. Ammonia emissions are reduced when the space under the cover fills with a higher proportion of ammonia gas, resulting in decreased nitrogen losses.

There is also interesting potential for the biogas to be used as a renewable energy source of heat or electricity. Linkages to the approved Biogas Protocol will allow opportunities to obtain additional carbon offsets. In some areas, methane can be stored for use as a back-up power supply for energy generated from wind turbines.

The quality of liquid manure as a fertilizer is increased after digestion allows for a higher precision in fertilization and reduced risk of nitrogen leakage. Nitrogen leaching may be reduced by about 20% when digested manure is used in place of undigested manure.

Adverse Effects [List any adverse effects that may result from implementing this activity or project.]

The potential for inadvertent flaring of concentrated areas of fugitive emissions surrounding the Covered Manure Storage was raised as a concern at a Consultation Workshop of technical experts in February, 2010. However, recent discussions with Dr. Deanne Meyers, Livestock Waste Management Specialist at University of California, Davis indicate that this has not happened in California where a number of different types of covered storages are in use. If further investigation indicates that this is a problem, methods of monitoring pressure thresholds that will prevent conditions that might result in fugitive emissions can be prescribed within design

specifications - such as venting systems, increases in cover storage capacity, flaring rates, or the use of impermeable liners.

Hydrogen sulphide (H2S) is produced from anaerobic degradation of organic material containing sulphur. Anaerobic digestion facilities produce biogas with high concentrations of H2S that can be managed by directing all raw biogas to the flare for combustion.

References [Provide a list of relevant references.]

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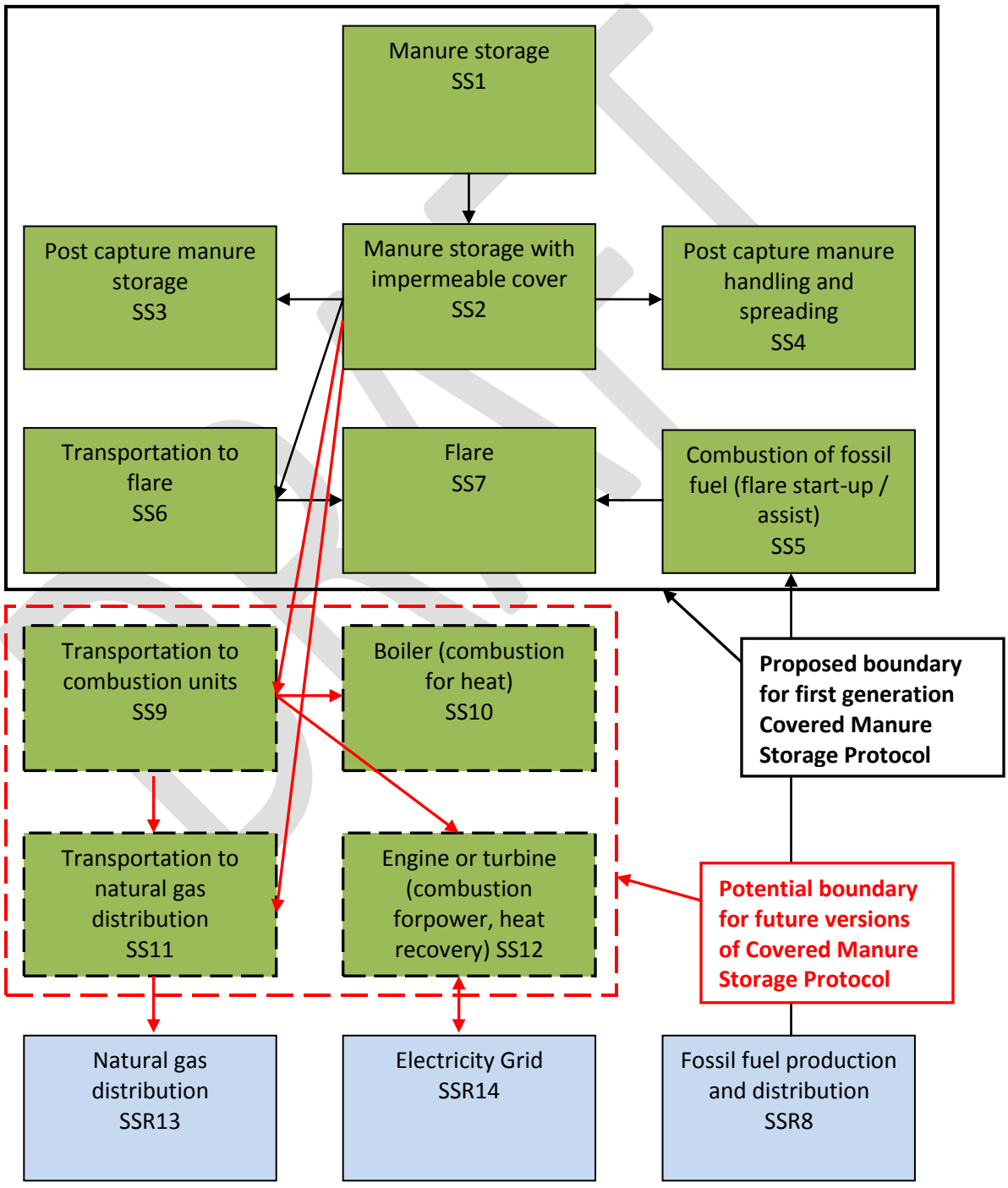
Proposed Timing for Submission into the Offset System Review Process [Please identify the anticipated submission date for this protocol to be considered for Stakeholder review (formerly 2nd Round Stakeholder Review). Note: the Stakeholder review is held once per year in fall.]

October 2012

Appendix A. **Diagram of controlled and related SSs within the boundary of the proposed protocol, with potential boundary for future versions to include beneficial use of biogas.**



Appendix B. **Three scenarios of Project and Baseline emissions to illustrate the method of calculating CH_4 emission reductions used in existing quantification protocols.** CH_4 measured and destroyed in Project is: 1) greater than, 2) equal to, and 3) less than CH_4 estimated in Baseline Conditions.