

COVERED MANURE STORAGE PROTOCOL DEVELOPMENT WORKSHOP



February 24 - 25, 2010

BACKGROUND

Manure storages related to livestock operations have been identified as a source of GHG emissions. Internationally, and throughout North America, GHG reduction protocols for livestock operations have been created to allow producers to reduce their GHG emissions through biogas capture and destruction process.

WORKSHOP NOTES – FEBRUARY 24

8:30 AM – 4:30 PM

WELCOME AND INTRODUCTIONS – Overview of the 2 days and General Approach
Karen Haugen-Kozyra, KHK Consulting

Key Points from Presentation (See Presentation)
Build consensus on science informed options.

To engage key scientific researchers, technical experts and project developers in Alberta and in North America, to provide advice and agreement on standardized protocols to assess GHG emission reductions from covering manure storages with impermeable material and flaring the captured methane in Canadian prairie conditions.

The workshop will focus on completing the outcomes listed below; either during the two-day workshop or through follow-up work, to support the development of a first generation GHG offset protocol related to covering manure storages, based on adapting existing knowledge and protocols to Alberta conditions.

General Process:

- Use a combination of a literature and existing protocol review in the form of a Science Discussion Document that will be circulated for review prior to the Workshop, sharing recent research results, researcher experience and small group discussion with large group evaluation of ideas and recommendations to achieve the workshop outcomes.
- The first day will be spent on understanding the context for carbon offsets and protocols, examining factors that affect methane emissions from manure storages; the quantification approaches used in existing protocols and coming to consensus on what is appropriate for application in Alberta; the second day will focus on the manure cover technologies, capture and collection methods and methane destruction conditions, as well as identifying science gaps for future research.

Introductions

- See Participant List
- Expertise from across Canada and the US

Focus for Day 1

Day One will provide an opportunity to learn about the current policy, quantification and inventory methodologies, various protocol approaches and will suggest proposed options for the best available quantification approaches for a CMS Protocol. Break-out sessions in the afternoon will work on proposed options and develop recommendations.

- Set the context: what is the policy, what's happening in AB?
- How GHG are currently quantified in Canada
- Factors affecting methane emissions from manure storage?
- Who other systems/protocols are addressing the capture and destruction of manure – comparison of methodologies
- Some facilitated discussion guided by some documents in a well guided process.

Looking for an 80% consensus vote because at the end of the day, Alberta Environment (AENV) will need the documentation and transparency of what we came to as a group.

Focus for Day 2

Confidently advance GHG protocol recommendations that address the desired components of a CMS Protocol.

Day two will engage participants in developing, evaluating and recommending criteria for the practical side of biogas collection, capture and destruction elements for inclusion in the protocol.

- More on the practical implementation aspects of the proposed protocol.

Key 'Hard' objectives:

- Adapt the best features of existing protocols in other programs to AB conditions for a first generation CMS protocol based on existing knowledge and protocols using ISO 14064-2 standards
- AB conditions include the environmental and policy conditions ensuring consistency with AB rules

'Soft' objectives:

- Opportunity to share knowledge and learning's, gain insights and new ideas. Influence and inform policy development at the policy level.

Voting will be done based on qualifications –some polling is general and some is technical and we need to ensure appropriate expertise.

SETTING THE SCENE – (i) Carbon Offsets and the Policy Drivers

- *See PowerPoint Presentation*
- Using mechanisms to put a value on carbon have a history and are used in a number of developed and developing systems. It is important to note that there are two commodities that are traded (i) allowances (permits to emit, issued by government, low risk, higher value) and (ii) offset based projects (higher risk, many parties involved, lower value)
- ~\$125 billion globally in Carbon traded globally
- From AB's perspective, this is a risk issue and that's why they were a first mover. First comprehensive regulatory framework in North America that covers multiple sectors and allows offsets as a compliance option.
- ~7. MT verified reductions in AB Offset System to date, 44 registered projects to date. Agriculture is ~2.2 million – mostly from tillage management - 13 different protocols used
- We have the demand for credits (regulation), the supply of credits (protocols) and there are rules and consequences. The framework sets up the market.
- Offset Eligibility Criteria have been set by Government of Alberta (GOA). Connect to www.carbonoffsetsolutions.ca for more information
- Need to ensure that offsets are real, quantifiable and measurable – that's why we are here today.

- Quantification protocols are science based, internationally compatible, streamlined, transparent, etc for use. A number have been developed for Agriculture sector
- Two major international enablers:
 - Country level accounting standards or 'Good Practice Guidance' – IPCC. Guidance on Tier I, II and III approaches. Very similar to the principles of ISO standards
 - Project Level (Offset) Accounting Standards
 - WRI GHG protocol/ ISO 14064-2
 - Promotes consistency and transparency
- Follow the information provided in Canada's inventory
- A ton is not always a ton... Credits are not always the same under different protocols.
- Starting to see a coalescing on accounting standards and levels of rigour
 - Practice needs to be additional and incremental – beyond Business As Usual (BAU)/common industry practice.
 - Management change must be measurable and quantifiable – agreement on best available science and data. Needs to account for all 6 GHGs per the Regulation, must stand up to review process
 - Permanent – must protect against carbon reversals
 - Ownership must be clear
 - Leakage must be addressed
 - Consistent metrics (functionally equivalent) i.e. per ha, per kg beef, etc.
 - Practice change must be verifiable
- Protocol Development
 - Identify preferred methodology
 - Relevant regulations
 - Stakeholder consultation
 - National emissions inventory
 - Applicable GHG program
 - ISO 14064-2
 - Technical review
- Protocol Development Process
 - Phases 1 – Planning and compilation
 - Phase 2 – State of Science Review; Prepare Science Discussion Paper
 - Phase 3 – Science Coordination Workshop (today and tomorrow)
 - Phase 4 – Technical Seed Document
- Then the draft protocol is standardized – but only if the outcome from Phase 3 and 4 are sanctioned to proceed. Then it enters the Alberta Protocol Review Process (3 steps). See Carbon Offset Solutions website
- ISO Principles
 - Relevance; Completeness; Consistency; Accuracy; Conservativeness; Transparency
- Many different types of baselines will be explored – looking to performance standard

SETTING THE SCENE – (ii) Covered Manure Storages in Alberta

Cody Metheral, P. Eng., Alberta Agriculture and Rural Development

- *See PowerPoint Presentation*
- Agriculture Operations Practices Act (AOPA) – provides a number of definitions, manure, manure storage facilities, etc
- Manure Storage facilities are either concrete or steel. New concrete guidelines coming soon.
- Post 2002, producers must have a minimum of 9 month storage
- Also an opportunity to use earthen manure storage with approved guidelines. There is a slope to sidewalls that needs to be considered.
- AB producers tend to keep beef, poultry on concrete pad. Swine or Dairy in earthen, concrete or steel storage.
- Industry Observations:

- Swine – state of decline.
 - ~ 1000 producers
 - Being converted from swine to poultry
- Dairy – stable development
 - 640 producers, producers numbers are declining as farm size increases
 - Milk quota increases are slow due to controlled growth.
- Covered Manure Storage in Alberta
 - Some producers cover with either permeable or impermeable covers
 - From NRCB, ~2000 CFO's across the province.
 - <10% of producers cover their manure storage by choice. Not standard operating practice. Some have requirements via permits.
 - Majority of producers in AB that have permit conditions that require them to cover are as a result of municipal permit conditions (pre 2002) or NRC permit conditions (post 2002). Majority of those that have permit conditions, have the condition as a result of old municipal conditions. I.e. if you want a facility in our county, you need a cover.
 - During the permitting process affected neighbours have the opportunity to provide input and request actions be taken to reduce odour.
- Covered Manure Storage potential
 - Benefits:
 - Reduce odour; Carbon credit generation; Biogas utilization
 - Disadvantages:
 - High capital investment; Monthly/annual verification cost; Material replacement costs

Conclusion:

Potential for covered manure storage protocol

Interest from industry

Financial incentive from GOA (Growing Forward)

If there is a return on investment, there will be investment.

DISCUSSION:

Q: Covered percentages (<10%) relate to what type of facilities?

A: It is proportion of all CFO's

Q: If an old municipal permit has requirement, it is legally required?

A: Might need to address on case by case basis. AENV will need to address.

Q: If an operator volunteers to put a cover on, what happens?

A: It becomes a permitting condition, and it is enforceable. If it's written down and he commits, it's required.

Q: Important to distinguish between capturing and covering and destroying. Just covering doesn't necessarily reduce GHGs or change things.

A: Agreed. Also, old municipality permits didn't necessarily require such. Specify what type of cover.

Q: Are you aware of how many are capturing?

A: Very Few

Q: If a farmer sells his land and he has chosen to put on a cover, does permit go with the land?

A: If it is a condition it goes with it. If it is written, it's required

Q: Anaerobic digesters in the province? Numbers?

A: NRCB gets involved with those facilities if they are dealing strictly with manure. If it is any other additives they are permitted through AENV.

Q: Dairy and Swine are the focus because of liquid manure?

A: Yes. But need to consider some secondary storage after the capture of methane. I.e. post digester storage?

Q: Waste water from Slaughterhouse? I.e. for smaller producers, it's cheaper.

A: Will discuss later.

HOW GHGs ARE CURRENTLY QUANTIFIED IN CANADA – THE BASELINE CONDITION

Dr. Xavier Verge, AAFC

- See PowerPoint Presentation
- There is no CO₂ emissions from AG in National Inventory – only Methane and Nitrous Oxide
- We need activity data and emission factor to calculate emissions. I.e. animal data.
- We use Tier I and Tier II
 - Tier I – IPCC default Factor
 - Tier II – Country Specific Data – calculated
- Nitrous Oxide Emissions
 - Tier II methodology
 - Need to know how much and where the sources are:
 - Animal waste management systems
 - Pasture range and paddock
 - Crop residues
 - Synthetic N Fertilizer
- N₂O Emissions
 - Direct:**
 - Animal waste management; Pasture range and paddock; Crop residues; Synthetic fertilizer; Manure application
 - Indirect:**
 - N₂O volatilization; N₂O from leaching runoff
 - Emission factors from country specific data for liquid, solid and other systems for direct emissions
 - Indirect emissions factors
- Methane Emissions
 - Tier II for Manure Emissions
 - Combination of Tier I and II for Enteric Fermentation (Tier I for Hogs, Sheep, Goats, horses and bison and Tier II for Cattle)
 - Enteric fermentation determines the VS and therefore needs to be considered
 - VS – Based on what the animal eats, dry matter intake.
 - Maximum CH₄ that can be produced in the tank depends on the animal type
 - EPA methodology is based on IPCC equation
 - Correction factor needs to be adapted to Canada as it differs under climatic condition. Therefore 45% in Canada and 80% in US. Mostly due to temp difference. 80% based on a study done in Georgia, in Canada based on studies in Guelph
 - Volatile solids is based on excretion, once it's leaves the animal and goes into the tank.
 - In AB, we get Chinooks, has this been factored into the correction factor? Based on work in Guelph, and this is what we use. Perhaps it should be looked at. By the time it is worked into calculation, mean temperature is inputted into calculator.
 - This is based on air temperature, the biology depends on liquid temperature. Current discussion is for baseline.

- **Future Work**

- Climatic efforts on methane emissions
 - Manure characteristics (sampling at different depths, analysis)
 - Temperature measurement in the tanks (various depths, over long period)
 - Climatic data (air temperature, rainfall, etc.)
 - Methane emission measurements
- Looking at swine and cattle, both with and without covers. Work will be done – including one site in AB.

Q: when you say cattle – you mean dairy?

A: Yes, we don't have numbers on other.

Factors Affecting GHG Emissions from Manure Storages in Canada

Dr. Ermias Kebreab, UC Davis

- *See PowerPoint Presentation*
- Storage accounts for 17% of AG GHGs and reducing this would increase efficiency, create biofuel opportunities, increase air and water quality and potentially create an offset.
- Very little N₂O is produced and emitted from liquid manure tanks and lagoons because of Oxygen required for nitrification.
- Methane and CO₂ are the major GHG produced and their production is linked to one another
- Need to understand the manure composition, proteins, carbohydrates, and fats.
- Factors affecting methane production including:
 - Aeration
 - Need anaerobic conditions to produce methane but might inhibit N₂O
 - Aeration reduced emissions of methane by 66-79% in slurry, weaker in high DM slurry due to crust formation at the top of the slurry (unpublished)
 - Temperature
 - Methanogens are mostly psychrophiles so their activity increases with temperatures
 - Information is useful to maximize CH₄ production in digesters that can be used for fuel
 - Maximum activity around 60-65 degrees C
 - Animal species
 - Effect of animal species changes GHG emissions.
 - Swine and Poultry are highest, cattle lowest – based on Kebreab et al. unpublished
 - Quality and quantity of feed
 - Balanced diets meeting specific requirements lead to reduction in C and N substrates
 - Undigested carbohydrates are the largest contributor to methane emissions in manure. Improving digestibility reduces the C available during storage.
 - N excretion lineally related to N intake.
 - Reducing overfeeding in swine by 10 g CP/kg could reduce emissions TAN content by 10%
 - Diet manipulation can change emissions associated with manure.
 - Age and gender of animal
 - Changes by age, type and gender
 - Manure storage period
 - Longer storage results in more CH₄ emissions
 - Agitation, mixing or emptying increases emissions by 2-7 times (temporarily)
 - High spatial variability so heterogeneity should be considered
 - Storage management
 - Changing the slurry removal frequency to one time per day significantly reduces CH₄ emissions from the Danish and Italian cattle houses
 - CH₄ emissions during storage increases as a result for longer retention time in slurry stores (Sommer et al., 2009)

- Shorter slurry retention times in livestock houses and less slurry stored during summer reduces Ch4 emissions.
 - Manure characteristics
 - Hydrolysis rate is inhibited by higher VFA concentration. Diminishing return curve.
 - Methanogens are also affected by pH.
 - Berg et al. (2005) observed a reduction in GHG when stored manure pH dropped below 6
- Target for Mitigation
 - Anaerobic digestion (AD) of OM
 - Low temp AD have been shown to work in AB
 - Best results at high temp
 - Swine slurry produced more than cattle (Masse et al., 2003)
 - Less than 1% AD in Canada so potential to increase
 - UC Davis will be building a large digester to handle new Faculty and Res housing
 - Covers could be synthetic or natural
 - Reduce GHG by trapping gases
 - Porous natural covers may increase N2O formation
 - Straw cover observed to increase GHG emissions but reduce NH3
 - Bio-filtration a natural process that uses micro-organisms to degrade and oxidize pollutants such as Ch4 and also reduce odours, H2S and NH3 emissions
 - Composting has been reported to reduce CH4 emissions and CO3 emissions by up to 30% but at the risk of increasing N2O
 - Leytem et al (2010) measured increase GHG during aeration of composting
- A number of dietary, animal and physical factors need to be considered for GG emission estimates
- As much as possible, country/region/site specific parameters should be used
- Process based models may provide better estimates for baseline and project emissions

Q: With respect to the Modelling Methane Emissions slide – is manure added over time?

A: no - no additional manure is added. This was to have as much control as possible. Next phase was to add material and see how that changes things.

Q: Total solids are 8000 mg / L ?

A: yes, it's organic matter into manure tank.

Summary

- Animal classes and diets are important because excretion rates will change between animal classes and diets.
- Being able to decrease the amount of protein you feed pigs can result in decrease GHGs on the manure spreading side. Going down to a moderate rate of 140 g protein is still important and could be realized on the spreading side. This is where the pork and dairy protocols fit in. It is standard to advise in the industry to overfeed N and P for dairy and swine.
- In terms of what we know, we are getting there. There are gaps in the knowledge. TWG spent a lot of time trying to identify studies – i.e. how does pH change? Temp? Manure Characteristics?
- When we are talking about methane emissions generation from the baseline calculations, VS is the key driver. This is the input that you are tracking through the system. When we look at the potential for adding other feedstock's into a protocol, we are challenged that other feedstocks may not have VS characterization in the baseline. I.e. are their studies that can be pointed to and used? There are certain constraints – these will be discussed later.
- Feeding to reduce VS might work on uncovered storage, but in this case with a CMS, you might want to feed high fibre diets.

WHO'S ON FIRST – HOW OTHER SYSTEMS/PROTOCOLS ARE ADDRESSING THE CAPTURE AND DESTRUCTION OF METHANE FROM STORAGES

Dr. Rob Janzen, Climate-CHECK

- *See PowerPoint Presentation*
- Key Messages
 - Protocols and methodologies provide guidance for Alberta CMS protocol
 - Approach
 - Scope
 - Baseline estimation
 - Project monitoring and measurement
- Approach
 - Existing protocols make assumptions, according to conservativeness to address knowledge gaps:
 - First – baseline emissions are estimated as a function of regional air temp and not stored manure temp
 - Baseline emissions are estimated irrespective of facility configuration and operation
 - Project emissions are understood to differ from baseline emissions. That is because data to show otherwise is lacking, installing a cover is assumed (by potentially altering temperature, retention time, N content, pH) to change. Thus Ch₄ destruction is measured but emissions reductions generated cannot exceed baseline estimates.
 - Existing protocols consider covering of manure storage to be additional by exceeding regulation and common practice
 - Project condition includes secondary storage. The estimation on the front end ensures conservativeness and constrains reduction potential.
- Scope
 - Existing capture and destruction protocols exclude:
 - N₂O Emissions
 - Emissions from land-spreading of effluent
 - Some include:
 - Secondary storage
 - Emissions associated with beneficial use of biogas
 - Alberta offset System requires that:
 - All gases are addressed
 - Boundaries determined by addressing all Sources and Sinks (SSs)
 - Science plays a critical role in the development of AB protocols. Not as important in a number of other systems.
 - Existing Approved Alberta Protocols are Dairy and Pork and include:
 - N₂O emissions
 - Emissions from land-spreading effluent
 - Are consistent with AB comprehensive approach as a 'first generation' protocol – we know that there are knowledge gaps and that future work is needed. As science develops and evolves, a second version could take into account developments.
 - Include emissions from secondary storage
 - Exclude use of biogas (and exclude non-AG feedstock's)
 - Focus on capture and destruction as add on to pork and dairy protocols
 - Projects interested in use of biogas can implement approved biogas protocol
 - Also:
 - Approved Biogas Protocol – purpose of generation for use
 - Baseline Estimation
 - Climate Leaders and GHGS – according to regional estimates of methane produced for known live-weight of animals

- CDM use “most recent IPCC Tier II approach”. CDM process is often said to be rigorous however it is not transparent.
 - Climate Action Reserve – according to monthly temperature, but using ‘default’ VS estimates. No consideration of how the animals are fed, or how they perform.
- Existing AB protocols use farm specific approach which is based on Canada’s National Inventory Approach (which is like IPCC Tier II).
- Both Pork and Dairy allow input of farm-specific feeding and animal performance data to measure CH4
- Both allow practice of spreading in spring to decrease CH3 emissions from stored manure.
- Project Monitoring and Measurement
 - All protocols and Methodologies monitor animal populations
 - Climate Leaders and GHGS use annual average population and live weight
 - CAR uses annual average population based on Monthly population data
 - AB protocols use monthly animal data – including class (Swine – 5, dairy – 3)
 - Only AB uses farm specific feed and animal performance data
 - Volatile solids calculated based on quality of feed and feed conversion
 - All protocols and methodologies measure CH4 capture and destruction (may be generic, non regional, part of protocol)
 - Most address emissions from secondary storage (CDM, CAR, GHGS – 30% estimated baseline)
 - Most address fugitive emissions from secondary storage (CDM – 15%, CAR 5% of estimated baseline). CDM approach is designed for use in 3rd world countries so they are conservative as they assume fewer infrastructures.
 - CAR and GHGS approach have the most detail on measuring and monitoring
 - Incl. biogas flow, CH4 concentration in biogas, combustion efficiency of flair, temperature of flare, etc.

LUNCH BREAK

FACILITATED DISCUSSION OF THE APPLICABILITY OF EXISTING PROTOCOL APPROACHES - Decisions by Polling

Voting tools introduced (OptionFinder keypad polling system). Wireless keypads and software allowed instantaneous recording of responses to discussion points. All participants were invited to vote in this round pertaining to general questions. Later, voting will be specific to expertise in areas of Quantification and Technology. We are looking for consensus, defined as at least 80% agreement, among participants, with respect to developing a first generation Covered Manure Storage protocol - based on the adaptation of existing knowledge and protocols to Alberta conditions. Encouraged discussion of questions and rephrasing for clarity and/or to aid reaching consensus, as required.

Polling Vote #1 - Agreement

Alberta should adapt this approach of a calculated baseline and measured project emissions to move forward with a first generation protocol for covered manure storage at this time.

Strongly Agree – 26%

Agree – 68%

Disagree – 5%

Strongly Disagree – 0%

Poling Vote #2 - Agreement

Since the factors affecting GHG emissions from storage are complex and it is unknown how placing a cover/capture system changes conditions under the cover compared to baseline -- a conservative approach is needed to manage the risk of overestimating emission reductions from baseline to project.

Strongly Agree – 47%

Agree – 47%

Disagree – 0%

Strongly Disagree – 0%

Q: Question regarding Conservativeness – what does it mean?

A: It is a term we use to say we will always take the lower value as a means of dealing with unknown absolute quantification. In Alberta, we follow the ISO 14064:2 standard – so where things are uncertain, risk management options can be put in place to minimize the risk of overestimating the baseline emissions, or use conservative approaches.

A problem with being too conservative is that it can hinder the economics of this. If we are too conservative we could derail the whole thing. There is a point where research could show that there is a less conservative estimation method. Don't want to miss new research when it comes out. In jurisdictions where it is less conservative, they seem to be moving forward much faster. Some nations are more risk averse. This is a common belief in business developments in this area.

Workshops are to identify and collect what the gaps are and circulate this. We want to share what needs to be done in research. Under AENV rules, this protocol will be revisited. We hope that by that time, there has been some work and developments.

Polling Vote #3 - Agreement

To be consistent with all the other Alberta Offset System agricultural protocols, Good Practice Guidance (IPCC/National Inventory Methods; USEPA methodology) should be used in the calculation approach for the baseline emissions.

Strongly Agree – 32%

Agree – 58%

Disagree – 11%

Strongly Disagree – 0%

Comments: Comparing inventories with offset protocols. Inventory is to be unbiased and by definition is conservative. At a country level accounting there are limitations; but we can use this same approach with farm/project specific data at the farm level. We are adapting the same IPCC Tier II guidance into project level accounting. A lot of other systems are using a conservative approach and taking the lower of two. We want to move forward and adopt some of these techniques and move forward in the AB process with the idea that a second generation protocol could continue in the future. There are plans afoot for additional work in the area.

WHO'S ON SECOND – FRAMING THE BASIC ELEMENTS OF THE PROPOSED APPROACH

Dr. Rob Janzen, Climate-CHECK

- See PowerPoint Presentation
- Key Messages
 - Adapt the best features of existing protocol sin AB conditions for a first generation CMS protocol using ISO 14064-2.
 - Canada's National Inventory Methodology for Tier II calculations of emissions from liquid manure storages
 - Recommend acceptable GHG quantification methods that can be confidently advanced at this time
 - Discussion of the preferred baseline approach
 - Develop acceptable options concerning other (1) GHGs such as N₂O, (2) eligible feedstock's, (3) increased N levels and their forms in the digestate and (4) secondary storage concerns of released methane
- GHG Sources/Sinks – where GHGs are given off or sequestered. Almost exclusively talking about reducing the sources of GHGs
 - **Eligible feedstock's** – there are implications for broadening types of feedstocks used in the manure storage. Including other feedstock's has large implications.
 - Possible option is only eligible feedstock is manure
 - Possible option is broader set of feedstock's.
 - **Identifying GHG's** – Nitrous Oxide, the ABOS requires all gasses be assessed, and those identified within the boundary be included in the calculation. Existing pork and diary protocol both quantify these.

- **Identify Controlled/Related Sources & Sinks** – some decision is required
 - Possible option – the project activity proposed under the protocol is not expected to create emissions outside of the project boundary because ... (the group to justify or suggest risk control measure)
- **Selecting the Sources/Sinks in Project Boundary**
 - The sources and sinks determined to be within the scope or boundary of the proposed protocol that determine the activities eligible for offset reduction are the covered manure storage facility.
- **Baseline criteria** – in order to generate reductions relative to baseline, covering manure storage must be additional Quantification to common practice
 - Decision point: installation of an impermeable ... exceeds BAU in the Prairies
 - Decision Point: Installation of a impermeable... is additional to regulation in the prairies
- **Baseline Period** - Want to ensure we get an accurate picture of the baseline.
 - Proposed Option – should quantify baseline CH₄ and N₂O emissions using manure management practices that occurred for the 3-year period preceding the installation of the cover.
- **Quantification of GHG emissions**
 - Factors influencing quantification of GHGs from methane capture and destruction projects –
 - Possible Option – the method selected to estimate the baseline emissions should be performed for each project year to provide the reference against which reductions should be quantified. (i.e. a dynamic baseline)
- **Emissions of CH₄ and N₂O during the handling and spreading of manure** – in general existing protocols exclude land application. Pork and Dairy farm protocols do not exclude land spreading of manure.
 - Possible Option is to require co-implementation

Facilitated Discussions – Where Do We Go From Here?

Two Breakout Groups to work through Discussion Guides that contained suggested options for revision. Each group will revise options and present back to all participants using Power Point slides with headings of:

- Recommended Option to the Workshop
- Recommendation for Acceptance
- Gaps
- Recommended Schedule for Action

Further discussion and revision is encouraged before voting on options by eligible voters. Category 1 – BSc or higher in agriculture or related science; engineering expertise in the specific area (methane emissions / GHG from storages); P.Ag. or P. Eng. or related professional designation and /or at least 2 years of relevant experience. The “Accept with more work” option was considered to be in the context of developing a first generation protocol based on existing knowledge and protocols. Participants were asked to elaborate on what further work was needed.

Results Presentations

Discussion Group # 1

- Question presented to group – from Section 5.2 (P. 9 of the SDD) – GHG Sources/Sinks Relevant to Scenarios
- *Eligible Feedstocks - the potential exist for non-manure organic materials to be mixed with manure, like some liquid wastes diverted from landfill. The current quantification methodologies rely on Volatile Solids in the manure (as a straight emission factor per head, or derived through feed content and DMI) as the basis for quantifying methane emissions. If other co-substrates are to be included – there would have to be an available accepted means of Vs characterization for these co-substrates or some other available accepted correlation of these substrates and their methane generating potential in the storage configurations being discussed here.*
 - **Possible Option** – *the eligible feedstocks for use in this protocol are manure only. Additional materials such as wash water or from washroom facilities in the barn will be considered part of the manure slurry produced by the barn.*
- Group Recommended Option Q1: for the workshop
 - To work with farm manure only for the baseline

- With appropriate permitting, off farm manure and other feedstock can be added but it's up to the producer or developer to make the case for revising the baseline (providing data, etc.)
- GAP: Give consideration to linking protocols (biogas – improve secondary storage). Also gaps in VS of other feedstocks. Work is ongoing in this area. ARC has done a lot of work in this area.
- Probably advisable to have a meeting with AENV to ensure that use of flexibility mechanism is appropriate.
- Recommended schedule for Action: Improve linkages with biogas and wastewater protocols.
- *Q? If you are going to add new feedstock's, and the project developer must determine baseline, how are you going to verify that? The person doing that has a vested interest.*
- *A: In a lot of existing protocols, you can use site specific factors. You need to justify these (to the comfort of the regulator). Baseline condition would need to be approved by regulator.*
- ARC measured about 25 different AG feedstocks. AB Ag, AFC and Highmark Renewables is working to expand on this.
- Study was originally done for anaerobic digesters, nothing to do with earthen manure storage. Study is still applicable.
- *Q? Additional feedstock's may run into different regulations for spreading of manure – need to consider this. I.e. SRMs. Most of the material that is being talked about do not have a problem with the additional feedstock's as it is not likely going to happen.*

Polling Vote #4a – Agreement

1a). On-farm manure only for the baseline. *{for the proposed protocol applicability}*

Accept – 88%

Accept with more work – 12%

Option is a no-go – 0%

17 eligible voters

- Propose to vote on: Manure Only. Consensus reached
- Re-phrase to add a flexibility mechanism to address additional feedstock's on a case by case basis. Onus is on the project developer to prove this is an option. Consensus reached

Polling Vote #4b – Agreement

1b) A flexibility mechanism can be added on a case-by-case basis wherein with appropriate permitting, off-farm manure & other feedstocks can be added, but it's up to the producer or developer to make the case for revising the baseline (providing data, etc.)

Accept – 69%

Accept with more work – 25%

Option is a no-go – 6%

16 voters

- Question presented to group – from Section 5.3 (P. 10) – Identifying Greenhouse Gases
- *Nitrous Oxide - the boundary for the protocol includes all GHG sources and sinks (SSs) determined to be relevant for calculation of reductions (see diagram P.12 - SS4; Post-capture manure handling and application). In most cases, existing protocols and methodologies concerning capture and destruction of CH4 exclude quantification of N2O. The justification for this ranges from 'N2O emission quantification is complex', 'N2O sources are outside the boundary determined', or 'N2O emissions are expected to be similar in baseline and project'. However, under the ISO 14064-2 standard and in the Alberta Offset System (compliance-based system), all gases within the boundary (as determined through an assessment of the SSs), are expected to be included in the quantification – except those that can be demonstrated to be the same in the baseline as the project. There is evidence that post-digestion, higher available ammonium levels exist, which may lead to higher N2O levels on land spreading in the project condition. Justification would need to be made for why N2O would be excluded on the basis of similar SSs in the baseline and project. The Alberta Pork and Dairy protocol both quantify these sources of N2O.*

- **Possible Option** – *The proposed Covered Manure Storage Protocol will quantify all sources of N₂O within the project boundary.*

- Group Recommendation Question 2: Identifying GHGs
 - Recommended Option 3: *open storage (baseline) and covered storage with collection/combustion are expected to be similar.*
 - GAP: lack of knowledge about N₂O production and fluxes. Expect N₂O losses from the baseline and CMS will be low.
 - Still needs more research in the future
 - Especially from field applied effluent and secondary storage
 - Consensus reached

Polling Vote #5 – Agreement

Option 3: open storage (baseline) and covered storage with collection/combustion are expected to be similar (given BMPs for N are followed)

Accept – 73%

Accept with more work – 27%

Option is a no-go – 0%

15 voters

- Question presented to group – from Section 7.0 (P. 25) – Emissions from CH₄ and N₂O during handling and spreading of manure removed from covered storage
- *In general, the existing capture and destruction protocols exclude land application from the scope of quantification. The CAR protocol provides limited guidance for quantification of CH₄ emissions (N₂O is still excluded) arising from management of 'digestate'. This protocol prescribes that, if no secondary storage is used, project proponents shall quantify CH₄ emissions during composting or land spreading of the 30% of volatile solids which remain in the 'digestate'.*

The Pork and Dairy farm protocols of the Alberta Offset System do not exclude land spreading of manure from the scope of quantification, although these protocols do conclude that negligible CH₄ is emitted during and after land spreading of post-covered manure. These protocols require project participants to quantify nitrogen excreted from animals, and quantify N₂O emissions associated with this activity.

- **Possible Option** – *CH₄ and N₂O emissions from the land spreading of post-cover manure should use the same quantification method used for manure slurry in the Pork and Dairy farm protocols;*

- Recommendation from Group - CH₄ and N₂O emissions from land spreading should be quantified in the same way as in the Pork and Dairy Protocols
 - Recommended Schedule of Action:
 - Standardize terminology: effluent vs. digestate
 - Replace 30% VS carry over IPCC value with site specific value. This is too restrictive (conservative) and should be re-examined in future research.
 - Refine N-excretion values, to bring up to date – some of them are from a long time ago, animals and feeding processes have changed.
 - In the pork and dairy protocols, keep track of N content of feed via records and can calculate the N in product and therefore they can calculate the N excreted. Use financial records to establish the N content in the manure and thus drives the calculations. Emission factors specific to each eco district in Canada are site specific.
 - Gaps same as #2
 - Consensus reached

Polling Vote #6 – Agreement

CH₄ and N₂O emissions from the land spreading should be quantified in the same way as in the Pork and Dairy farm protocols

Accept – 81%

Accept with more work – 19%

Option is a no-go – 0%

16 voters

Discussion Group #2

- Question presented to group – from Section 5.4 (P. 11-13) – Identifying Sources and Sinks/Project Boundary
- *Figure 2 (P. 12) shows the owner-controlled and related SSs potentially relevant for the CMS protocol with (methane collection and destruction project scenario) and without (baseline condition; open storage). No affected SSs (or leakage outside the project boundary) are expected to be associated with the project activity. But, if the decision in the above question is to exclude activities/emissions from land spreading of slurry, criteria will be required to ensure N₂O emissions are managed to remain at or below baseline levels (e.g. NH₄ measurements, NH₃ scrubbing?).*
 - **Possible Option** - *The project activity proposed under the Covered Manure Storage Protocol is not expected to create emissions outside the project boundary.*
 - **Possible Option** – *the sources and sinks determined to be within the scope or boundary of the proposed protocol that determine the activities eligible for offset reduction are the covered manure storage facility, the instrumentation (flow, CH₄ content, temperature), the flaring device and possibly:*
 - *Energy production (boiler, generator, pipeline)*
 - *Secondary storage*
 - *Post-storage (solids separation, drying, composting)*
 - *End use (transport, land spreading)*

If these are energy production were to be included, how would the protocol approach have to change?

- Recommendations from Group - Question: selecting sources, sinks in the project boundary
 - Credits should be awarded for the project in comparison to the baseline scenario, if participants desire additional credits they should consult other protocols i.e. biogas (see Q1). If outside feedstock's are brought in, they are likely looking to generate biogas and therefore should likely be looking to other protocols.
 - GAP: again, linkage between protocols – future discussion required
 - Consensus reached
- Question: Identifying controlled/related sinks and sources
 - All sorts of configurations – might be a negative pressure air, might co-fire flare, might be periodic flaring
 - Option 3b – the TWG analyse the threshold for which fossil fuel volumes/use and CH₄/N₂O emissions. Do the calculations and present to AENV. If they deem it not significant, than we can likely exclude it. Obviously they will meter Natural Gas (NG) going into co-firing.
 - What if producer doesn't want diesel or co-gen? Iron Creek. Likely rare case where a covered earthen manure storage will be used.
 - Needs to be included in the quantification based on the fuel we are using.
 - Consensus reached
- Question: the TWG analyse the potential and put controls in on km piping/diameter of piping and type of equipment (fans, pumps unlikely compression)
 - Consensus reached

Polling Vote #7 – Agreement

Credits should be awarded for the project in comparison to the baseline scenario, If participants desire additional credits they should consult other protocols, e.g. the biogas protocol. (see Q1)

Accept – 94%

Accept with more work – 6%

Option is a no-go – 0%

17 voters

Polling Vote #8 – Agreement

The TWG analyse the threshold for which fossil fuel volumes/use and CH₄/N₂O emissions become significant.

Accept – 82%

Accept with more work – 18%

Option is a no-go – 0%

17 voters

Polling Vote #8b - Agreement

The TWG analyse the potential and put controls in on km piping/diameter of piping and type of equipment (fans, pumps unlikely compression)

Accept – 88%

Accept with more work – 12%

Option is a no-go – 0%

17 voters

- Question presented to group – from Section 6.0 (P. 16) – Baseline
- **Baseline Criteria** – *existing methane capture/destruction protocols use a Performance Standard approach to pass the additionality criteria – i.e., typical baseline emissions are from an uncovered manure storage and the practice of installing a methane capture/destruction system is beyond business as usual, meeting a program-wide performance threshold – i.e. a standard of performance applicable to all manure management projects. It is expected that installation of an impermeable cover would meet the performance standard test in the Prairie region.*
Further, to pass the regulatory test, there appear to be no provincial or federal regulations or local agency ordinances/rulings requiring the installation of a biogas control system. Investigation by the Technical Working Group is ongoing concerning the requirements to meet the Regulatory Test or the Prairie region. In particular, there may be changes forthcoming concerning odour control and/or ammonia emission standards which may require installation of covers
 - **Decision Point** – *installation of an impermeable cover on a manure storage facility exceeds business-as-usual practice in the Prairie region.*
 - **Decision Point** - *Installation of an impermeable cover on a manure storage facility is additional to regulation in the Prairie region.*
- Group Recommendation - Question: Some covers exist but few capture /destroy methane (maybe 2-3 have a C&D device).
- Recommendation: Installation of an impermeable cover/methane destruction passes the additionality test and the regulatory test. Caveat – investigate conditions of Growing Forward 60% contribution to incentive from Feds. ABs 40% - they will likely not want anything. Needs to be investigated further.
 - Consensus reached

Polling Vote #9 - Agreement

Installation of an impermeable cover / methane destruction passes the additionality test and the regulatory test. [Caveat - investigate conditions on Growing Forward 60% contribution to incentive]

Accept – 94%

Accept with more work – 6%

Option is a no-go – 0%

17 voters

- Questions presented to group – from Section 6.4 (P. 18-22) – Quantification of GHG Emissions/Co-Implementation
- **Factors Influencing Quantification of GHGs from methane capture/destruction projects** – *all existing protocols use a calculated or modeled approach to quantify the baseline emissions based on animal inventories or feed use and composition during the baseline period. The summarized literature review on pp. 18-20 of the Discussion Document, show our current understanding of the factors that influence methane emissions from both covered and uncovered manure storage systems is incomplete. So in keeping with existing protocol approaches and adhering to the principles of the ISO14064:2 framework:*
 - **Possible Option** - *the method selected to estimate baseline emissions should be performed for each project year to provide the reference against which reductions should be quantified.*
 - **Possible Option** - *in acknowledgement of incomplete understanding of methane emissions, the method should follow existing CMS protocols where baseline emissions are calculated conservatively and project reductions are based on these calculations.*
- **Quantification Approach** - *some protocols use regional default factors to estimate the amount of CH₄ and N₂O emitted annually from manure produced by the recorded inventory of livestock. At the other end of the specificity spectrum, the approved Alberta Pork/Dairy Protocol require monitoring of diets and productivity of livestock raised to estimate volatile solids and nitrogen excretion, estimates CH₄ emissions monthly based on ambient temperature and on the amount and character of manure stored, and quantifies CH₄ and N₂O emissions based on time of year of manure spreading. For consistency purposes, and to avoid overly conservative Tier I factors, co-implementation with these two protocols would simplify the CMS protocol, without have to necessarily require implementation of all elements of the Pork/Dairy protocols.*
- **Possible Option** – *Baseline CH₄ emissions are quantified according to the calculated methane emission method used in the approved Alberta Pork/Dairy Quantification Protocol and the methods used in Canada's National Emissions Inventory;*
- **Basic/Advanced Approach** - *similar to the option provided in the GHGS protocol, participants could be given the option to apply default factors against livestock inventory to fulfill the requirements of a Basic approach. Alternatively, participants could implement an Advanced approach where emissions are calculated using detailed data of feed quantity and composition and livestock productivity as per above. To account for the potential to overestimate emission reductions using the default approach, the total reductions generated using the Simple or Basic approach would be discounted.*
 - **Possible Option** – *an option would exist to generate discounted amounts of offsets using a Basic approach, or achieve full quantify of offsets using the Pork/Dairy/Inventory approach of farm-specific Advanced approach;*
- Recommendations from Group - Question: Baseline Criteria
 - Rule of thumb is 3 year (consistent with other protocols – because things change over time)
 - Recommendation: baseline practices are collected for a 3 year period for the CMS protocol prior to covering for the baseline condition. Default diets information can be used in as per the pork/dairy protocols. A number of farm level data will need to be collected.
 - Consensus reached

Polling Vote #10 - Agreement

Baseline practices be collected for a 3-year period for the CMS protocol prior to covering for the baseline position. Default diets information can be used per the pork/dairy protocols.

Accept – 88%

Accept with more work – 12%

Option is a no-go – 0%

17 voters

- Recommendations from Group - Question: Quantification of GHG Emissions – comparing baseline to project
 - Calculating baseline every year allows capture of animal number changes, annual changes in temp, etc.
 - Recommendation: baseline should be calculated each project year to provide the reference for reductions that are quantified. This would be consistent with addition of new feedstock's.
 - Don't need to necessarily claim offset credits annually.
 - Consensus

Polling Vote #11 - Agreement

Baseline should be calculated each project year to provide the reference for reductions that are quantified.

Accept – 100%

Accept with more work – 0%

Option is a no-go – 0%

17 voters

- **GAPS IDENTIFIED:**
 - N2O emissions from soil by different manure and manure application types;
 - Measurement on bio-chem.-physical changes under covers/uncovered storages;
 - Regional climatic influences on cover performance;
 - Understanding suitable cover/collection systems;
 - Economics of these configurations.

_____ **END DAY 1 WORKSHOP** _____

WORKSHOP NOTES – FEBRUARY 25**8:30 AM – 12:30 PM**

- Clarification on defining Gaps from previous day – will need to assess the time frame – is it in 1 year, 2 years, 5 etc.

COLLECTING BIOGAS FROM COVERED MANURE STORAGE – PROPER APPLICATION OF THE SYSTEM*Andrew Mills, Layfield Environmental Systems*

- *See PowerPoint Presentation*
- A number of times we were talking about earthen manure storage lagoons, but there are many other types.
- Want to collect the gas for a purpose, rarely does it have anything to do with GHGs.
- Almost always, our biogas systems are built for professional operators. Most of our discussions yesterday are for smaller operations.
- Two types of ponds (slurry storage ponds, water treatment pond), two types of tanks (slurry tank, anaerobic digester) – we will need to ensure that we are using the right term and that it is consistent.
- Biogas containers, the main problem in all covers is the level of liquid within the pond. Biogas covers work best when the level doesn't change much. If you peel the cover back, there can be damage due to agitator.
- Slurry storage ponds are for typically swine. Covers are to keep down odors. Problems are level changes, pulling cover back.
- Negative blowers remove gas to protect cover from the wind. Floating covers are an exercise of controlling the slack in the cover and keeping the cover in place. This is an excellent odour control cover.
- Covers can be partial covers – don't need to cover the entire pond.
- Water treatment pond – either dairy or food processing. Focus is H₂O treatment, separate solids prior to treatment. In most cases biogas use is the benefit. If covers lift, we need to stabilize them against the wind. Can store gas under the cover but need to minimize level changes. If there is too much slack in the cover, cover will go too high and you will have trouble with the wind. Cover is floated in place so it's tight. Discussion of Valley Fig Food Processor in Fresno California.
- Discussion of vintage Dairy in Riverdale. 4000 milking cows. 5 acre water treatment pond. Currently produce 140000 cu ft per day cleaned biogas – sold to the gas utility.
- Cargill Food – burp Pipe, if the cover lifts too high, the cover will lower. This will vent gas but it is a safety feature. When covers have concrete tubes, they can't be removed. They are permanent. This is the predominant design for gas storage covers across N. Am.
- Slurry Storage Tanks – very difficult to address level changes. Floating designs tend not to be attached to the wall. Real problems with how to open covers on the tank. Not many are biogas designs. Level changes are a big issue. Gas handling is difficult as it can't be sealed.
 - Firestonesp.com – can't seal under the straps and therefore no way to get biogas off the pond. Straps prevent cover from falling down when slurry is drained out the bottom.
 - Chilliwack BC Hog Barn – Cover to assist in rain – don't want to treat more than you have to because rain could have a huge impact on the volume of waste.
- Anaerobic Digesters – controlled temperatures, plug flow, complete mix. Designed for a particular solids content and very carefully controlled. Covers are supported above the liquid – a structural roof – either gas supported or other. Gas supported is gaining popularity. Very high gas pressures involved. Circus tent design are very popular in Europe. Typically a deck at the top of the tank that prevents any cover from coming down. Highmark Feed – uses an unsupported bladder on top of the deck. Cover is on top of an insulated deck. Cover is supported by the pressure of the gas in the liquid tank. Important to know that this is different as this is an anaerobic digester – beyond the scope of what we are talking about.
- Insulated covers – designed for least loss prevention to extend treatment season or protect heat sensitive bacteria. Needs constant operating level and combines with gas collection. Could be used in a tank or pond. Example of insulated panels incorporated on top of the gas cover. Usually being operated by people with a source of heat and measure efficiency in terms of heat loss decline.

- Materials:
 - Unsupported:
 - High density polyethylene
 - Linear low density polyethylene
 - Material prices: simple cover: 5-10 years – cost .35-2 per square foot – mostly due to damage from pullback
Constant 10-20 years 2-5
Structural 20+ years 5-7
Insulated cover-10-20 years
Defined sump 20+ years
- Maintenance
 - Regular inspections are important
 - Inspect covers as frequently as engines generating the electricity from the biogas
 - Can find small holes by smells
 - Inspect covers at least yearly
- Permeability: movement of gas through a plastic membrane is by diffusion driven by concentration gradient. Leakage will usually come from problems in installation, holes or other defects. It will not come through the plastic. Gas can escape an earthen lined pond via going under the anchor trench. There is significant leakage under the anchor trench in most designs. This is a larger deal than the permeability of the cover.
- Pullback: negative air pressure covers are inexpensive and lightweight but every time they pulled it back, they ran into trouble.
- Variable level tanks – paper presented in Iowa last year. New type of cover in development for slurry storage in small Ag applications. This is a cover that you can move up and down and you can pump out without moving the cover. The trick is the hatch at one end. Hatch is essentially a throw away cover where as the main cover remains in place. Applied for patent. Cover weights are filled with liquid therefore you could drain and could remove the cover if you had to.

Q: are you digging this deeper than the traditional earthen manure storage?

A: don't dig the pond.

Q: do you size this according to the expected methane emission rates?

A: no, sized for the expected changes in level of liquid.

Q: does the ammonia diffuse through the soil?

A: don't know

Q: how big is it?

A: as big as you need it. Have floated a 3M ft2 cover.

Q: what if there is a hole in the middle?

A: you walk out and fix it. There is tension and you can walk on it. There are safety issues that need to be addressed.

Q: could you put in two holes?

A: yes with structural limits. Recall that where you put in a hole, you don't collect gas. There are much better agitators than the old propeller – jet pumps.

Q: has anyone quantified the amount of methane that escapes the sides of an unlined?

A: no

Q: Do we know gas conductivity?

A: no, research is needed.

Q: fabric vs. geo-synthetic? Do we know the range of permeability?

A: there is methane transfer data we can track down.

During failure testing to see how much air can be pumped before a cover will break, Xiaomei found that no gas was detected on the outside of the cover prior to the breaking.

Q: liners at the bottom, vs. the covers? Are they the same materials?

A: they can be the same or they can be different. Depends on scale, size, and goal. In promoting one piece cover – it is a lighter weight liner and cover. Need to decide what price point we need.

Q: relative size of the savings for the water processing?

A: there was a substantial cost savings. Can be circulated. Payback was almost entirely on water treatment savings however the electricity cost savings were more than they hoped for.

GAPS:

- Find the permeability data
- Business of variations in cover height. Exp slurry storage because it requires you empty the pond at a minimum annually. Still a problem and needs to be solved.
- Terminology – are we using the right terms. How tight do we make the boundaries in this protocol? Do we allow crossover of the boundaries?

PROPER CARE AND FEEDING OF FLARES AND FLARE DESIGN

Dr. Peter Gogolek, Natural Resources Canada

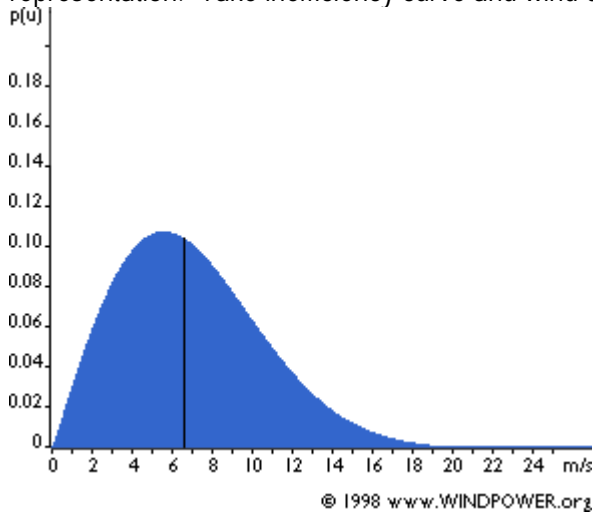
- *See PowerPoint Presentation*
- Flaring technologies- enclosed flare vs. elevated flare.
- A lot of published research on flaring efficiency is looking at steam assist and air assist. Installed in industrial applications with a goal of eliminating flare smoking. More complicated than technology applied to this application.
- Flaring is primarily a safety device. Biogas is primarily a mixture of methane and CO₂. Methane from 40-80%.
- Flaring comes from a number of sources including biogas, production flares (O&G), refineries or chemical plants, steel mills. These flare types differ in their purpose.
- Effect of wind is important. Wind can push the flame into wake. Strong effect on the emissions flaring.
- How to you measure the performance of a flare. The objective is to convert the flame from CH₄ to CO₂ and H₂O. Tend to report conversion inefficiency (rather than efficiency), fuel slip, destruction efficiency. Regulations require 200 BTU/scoff (20% methane) to guarantee 98% DE.
- 4 different performance expectations (presented in the SDD)

Q: Are C&D applicable for biogas?

A: yes, in fact a lot of enclosed flares are used for LFG which is biogas.

- CO₂ dilution as a large effect on the efficiency. Much more so that nitrogen. There can be a problem.
- Correlation of wind and dilution – correlation incorporates pipe size, wind speed, fuel rate, heat content and flammability units
- Implications for biogas:
 - CO₂ dilution has stronger effect than N
 - On stability
 - On conversion efficiency
 - Significant inefficiency due to wind
 - Energy content threshold of 200 BTU/SCF does not guaranteed 98% efficiency
 - Have a correlation incorporating pipe size, wind, fuel rate, heat content.

- Wind speed data is available at: www.windatlas.ca/en/index.php - have Weibull distributions as a convenient representation. Take inefficiency curve and wind distribution to calculate annual average emissions.



-
- Winds have significant seasonal variations and should be incorporated as it would be more accurate as to how the wind affects the performance of the flare.
- Enclosed flares are best, elevated flares are okay as long as they are sized appropriately.
- Need flare sized to have a good exit velocity
- Best if gas flow variation is small i.e. spring empty instead of fall
- Flame detection has to account for wind effects (multiple TC). May need multiple thermocouples. Ensure you have one downwind of predominant wind.
- Conclusions
 - Current practice of estimation of flare efficiency is based on work not related to biogas
 - Local wind conditions are important
 - Enclosed is best but \$\$\$
 - Elevated is good enough if sufficient exit velocity and local wind speeds are not too high and don't coincide with high methane release times. Methane 50% by volume or better but need to look at correlation.
 - Annual emissions can easily be estimated from wind speed distribution (Weibull) and inefficiency curve for biogas (methane/co2 mixture)
- Asked Peter to look at open flares as these applications are lower cost and likely would have them. He's put in significant work to look at how to maximize these. Need to think about practical applications and how expensive these would be.
- Certainly monitoring costs might eat away at offsets. An array of three thermocouples would be adequate and not expensive. If you are only measuring the methane you might be selling yourself short. Don't know what would be practical in terms of monitoring gas.

Q: is 50% methane content by volume appropriate?

A: need to calculate back a bit, can't be done right now. Can get a number. What is the threshold wind speed – they are linked. In a calm area, you can stretch the methane content down to ~ 45% ish....

Q: in dealing with average wind speeds... we have wind gusts - it's the standard deviation that's important. it's not that uncommon to reach 45Km per hour. Other factor that is important is the flow rate of the gas. In order to set the standards, the flow rate of the biogas is important. What kind of range of flowrates that can be used? What is the min?

A: we aren't necessarily dealing with an average but the distribution. It does not take into account the gusts. Spent some time trying to think of experiments to measure the effect of gusts, but couldn't. Tended to be neglected. Taking an average wind speed for a given location isn't quite adequate. 45km per hour covers the 90th percentiles...it equates to 12.5 m/s and is quite rare – especially in the summer. Largest amount of winds that will be experienced are accounted for (see distribution of wind speed). Traditionally to be on the safe side, you would want an exit velocity of a little bigger than the average wind speed.

With a wind velocity of 4 m/s, work for a flowrate of 5m/s? Can be achieved by changing pipe size... given a volume of gas, a smaller pipe will increase the exit velocity.

Q: what about a wind screen that can be put up wind of prevailing wind? It's pretty straight forward to perhaps create a wind screen to cut the wind?

A: sounds interesting, might have applicability in the prairies given prevailing winds. Even if wind rows, showed a range, you could build an arc type. Flares are generally about 10 m high to ensure combustion is at a safe height. Still need to know the reduced wind speed that the flare is receiving. Cost of doing that should be too high... could almost do an amateur wind speed.

Q: would it be practical to put in a variable size Orpheus to change the exit velocity of the biogas?

A: excellent suggestion, problem is you need to be able to make sure that it is fairly robust for temperature variations. If you get the flame coming down will go through thermal cycling's and tends to make things work less efficiently. Good idea, but perhaps difficult in practice. Being considered at the large scale at refineries.

Q: the mixture of gases coming off a lagoon, being variable, how is it better to improve the flaring?

A: depends on the cost of doing this. What's the cost of some sort of system that allows the gas to be under pressure? Anything that would improve the quality of the gas is good but needs to be balanced with the cost of those things. If you are really confident that min methane concentration is 50% than you likely don't need to do anything.

If we don't get to everything, its okay, we can follow-up and continue discussion.

KEY MESSAGES

Dr. Rob Janzen, Climate-CHECK

CDM and IPCC guidelines where physical leakage from Anaerobic Digester - 15% of total biogas. If project participants use lower values for leakage, they should provide measurements proving lower value. CAR uses 5% for fugitive emissions of a 'bank to bank' impermeable cover.

Possible Option for fugitive emissions – the protocol should assume a loss equivalent to 15% of CH₄ emissions that would occur in the absence of the protocol.

Emissions form secondary storage of manure – CAR, GHGS calculate CH₄ emissions in non-covered secondary storages – 30% of VS entering covered storage transferred to secondary storage:

Possible Option – emissions from secondary storage based on 30% that would have occurred

Another Option: allow methane emissions to be quantified form the secondary storage accounting.....

Emissions from biogas transportation to flare

Existing protocols address potential of future emissions of Ch₄ from the capture system, but emissions from the piping system seem to be included in the general collection efficiency, or excluded.

Possible Option: consider fugitive emissions form piping biogas form the cover

Emissions from combustion devices

Involves data from biogas flow volume, CH₄ concentrations in the biogas, combustion efficiency of the flare or the other combustion device, operational status of the flare

Possible option: align gas monitoring and measurement with CAR

Other option: develop new criteria? If so, what?

Could say if it's not 50%, it's a no go.

All protocols require a detection device within the flare. Could specify three thermocouples around the flare. However might be more appropriate to examine this further before making a decision. i.e. \$\$\$, monitoring cost, etc

Emissions form Combustion Device(s)

Flare Efficiency of Methane Destruction (pp 28)

Recommendations appear in the protocols for biogas flares and solution gas. Both open and enclosed flares are allowed. The 96% value in Table 3 of the SDD should say 98%. Note that there is a protocol in AB that has a value for open flare *B) of 25% - in the LFG protocol.

Q: question surrounding Table 3

A: the research is mostly for Oil & Gas (O&G). The top one is for refineries – industrial flares. Also based on work in the 1980's where wind was not considered.

Cover types and configurations

Many configurations of storages cover types and configurations. Need to identify gaps that need to be addressed. May need to do a bit of work – information gathering.

Possible Option: impermeable covers with bank to bank seals on constant level storage configurations

Possible Option: negative pressure configurations with 'tight' cover are more appropriate for the protocol

Facilitated Discussion

DISCUSSION OF CRITERIA TO INCLUDE FOR FLARES/METHANE CONVERSION IN THE CMS PROTOCOL

- As for Day 1 all participants worked through Discussion Guide containing suggested options for revision. Options were discussed and revised accordingly
- Voting on options was by eligible voters in Categories 2 and 3. Category 2 – Engineering degree in a related area (chemical, mechanical, project, environmental), or where appropriate, a BSc or higher in the discipline of environmental sciences and emissions management; P.Ag. or P. Eng. or related professional designation. Category 3 – Core business interests that are likely to be affected by the outcome.

Discussion Point #1: FROM SECTION 7.2 (P. 25) - EMISSIONS FROM MANURE STORAGE COVER, PIPING, FLANGES, ETC.

- *CDM ACM0010 recommends using IPCC guidelines where physical leakage from anaerobic digesters are 15% of total biogas production. In the CDM protocol, where project participants use lower values for percentage of physical leakage, they should provide measurements proving that this lower value is appropriate for the project. The CAR protocol uses a factor of 5% for fugitive emissions of a 'bank to bank' impermeable cover.*
 - *Possible Option for Fugitive Emissions – the CMS protocol should assume a loss of fugitive emissions equivalent to 15% of CH₄ emission that would have occurred in the absence of the cover. These potential emissions result from leaking or venting through or around the cover.*
 - *Alternate Option – the CMS protocol should assume a loss as fugitive emissions equivalent to 5% of CH₄ emission that would have occurred in the absence of the cover.*

DISCUSSION TABLED DUE TO PREVIOUS PRESENTATION AND DISCUSSION

DISCUSSION POINT #2: From Section 7.3 (SS3, P. 26) – Emissions from secondary storage of manure recovered from covered storage (stored in uncovered temporary holding unit until spread on land/processed further)

- *The CAR protocol and GHGS Methodology, build on the method used in CDM ACM0010, where CH₄ emissions in non-covered secondary storages are calculated on the basis of 30% of volatile solids entering the covered storage are transferred undigested to the secondary storage.*
 - *Possible Option – emissions from secondary storage are based on 30% of the emissions that would have occurred in the absence of the cover*
 - *Other Possible Option – allow methane emissions to be quantified from the secondary storage according to the same quantification method used for manure slurry in the Alberta Pork and Dairy protocols. – this allows for management options that reduce the methane emissions from the 30% Vs carryover.*

GROUP DISCUSSION

- Discussion of applicability of 30% - is it appropriate? This is an assumption that putting a cover changes things in undisclosed ways. If we can confidently say that putting a cover on won't change the amount of emissions, we can confidently say that emissions that happened in the secondary storage would have happened in the baseline. It is possible that the installation of a cover changes the generation of methane –this accounts for the risk that putting a cover on alters the dynamics of methane emissions. This is a problem with adapting a protocol.
- Recent survey with dairy producers showed that very few had secondary storage. May not be a big deal.
- It will however be a criterion that says if you have a secondary storage... If you want to collect methane, you need to control volume in the covered part. There may be innovation over time.
- If one uses secondary storage, one must account for emissions from it. This can be documented fairly easily via air photos. If you don't have secondary storage, you don't apply this.
- Catastrophic events need to consider free venting. This can kill the credit.
- Concern over flaring - especially cost of flaring

Polling Vote #1 – Requires Further Work

Emissions from secondary storage are based on 30% of the emissions that would have occurred in the absence of the cover.

Accept – 33%

Accept with more work – 44%

Option is a no-go – 22%

9 voters

Polling Vote #2 - Agreement

Allow methane emissions to be quantified from the secondary storage according to the same quantification method used for manure slurry in the AB P&D protocols (allows management options to reduce CH₄ emissions from the 30% carryover)

Accept – 100%

Accept with more work – 0%

Option is a no-go – 0%

10 voters

Polling Vote #3 - Agreement

Consider fugitive emissions from piping biogas from the cover to the flare as part of the general collection efficiency of the system as in other protocols.

Accept – 70%

Accept with more work – 20%

Option is a no-go – 10%

10 voters

Polling Vote #3b - Agreement

3b) Adopt the CDM approach in which if piping is less than 1 km then fugitive emissions are considered to be zero.

Accept – 90%

Accept with more work – 10%

Option is a no-go – 0%

10 voters

DISCUSSION POINT: Section 5.4 - Nitrous oxide is expected to be a minimal source in the biogas flare or other methane combustion device (SS7; Table 2) and are not considered in other existing protocols.

- Possible Option – The N₂O emissions from flared biogas can be excluded from quantification (group to justify this option).

Polling Vote #4 - Agreement

The N₂O emissions from flared biogas can be excluded from quantification.

Accept – 90%

Accept with more work – 10%

Option is a no-go – 0%

10 voters

Nitrous oxide is expected to be a minimal source in the biogas flare or other methane combustion devices and is not considered in other protocols.

- Nitrous oxide happens under restrictive conditions, generally from carbon nitrogen bonded compound of the fuel at low temperatures (800-900 C). Flaring would be a lot hotter so really no way you could have nitrous oxide formed.
- If we are restricting only for flared biogas (as in the option), doesn't matter. But if you are having any other methane destruction devices it might be an issue. I.e. co-firing with NG or propane in ICE.

The N₂O Emissions form flared biogas can be excluded from quantification.

Lower cost configurations of covers and flares won't be used to generate electricity. In some cases it is used to heat barns but in most cases it's flares.

Q: what about bio-filters?

A: excluded.

Could consider be put in as a flexibility mechanism and could be used with appropriate justification.

Q: what about putting a 'ring' around the project area?

A: this was discussed yesterday. Refer to SDD.

Cover/Storage Type
Bank to bank, sealed (non permanent seals) cover
Variable or constant level
Constant or variable level of gas under the cover
Bank to bank with non permanent perimeter seals
Leakage under the anchor trench – major issue
Research Gap – Partial Covers; kept flat (gas diffusion into uncovered part)
Research Gap - Bank to bank cover with hatches
Keeping the cover taught – with weight system that's secured; measure leakage on the anchor trench

As soon as you say a constant level of storage, it's an anaerobic digester. On a constant level pond you need to use secondary storage.

Q: Do these partial covers work in freezing conditions.

A: It freezes into the ice but because it is black, it thaws first and doesn't get harmed. Going up is not a problem, whereas going down suddenly is an issue.

Note: you can't say "Negative Air Pressure" system because it's patented and trademarked.

Want it to cover the extent of the pond that you want to collect biogas from, and need to be able to measure leakage.

Q: Most lagoons exist today. Required to have compacted clay liner or synthetic liner (since 2002). Very few have synthetic liners. If most of these lagoons exist today, sometimes there is \$\$ in the protocol to offset the cost of installing a cover. We are largely thinking existing lagoons – not new installations. Do we need to consider the fact that we are retrofitting.

A: Absolutely, because organics can get into clay. Either need to over excavate or put in vents so the liner doesn't bubble up from biogas developing under the liner retrofit. This is a common industry practice but can be done.

Q: Have you compared idea's with competitors in other industries? That are trying or are developing business solutions? WW and O&G?

A: Andrew has been doing work in CA. Could be a research area.

Q: Have you looked at methane hydrates?

A: No – research gap

COMPILATION AND PRIORITIZATION OF RESEARCH GAPS/ EVALUATION OF WORKSHOP

- Will follow up by email and/or webinar

USE OF WORKSHOP RESULTS AND NEXT STEPS

Sheilah Nolan, Alberta Agriculture and Rural Development

- Background
 - Limited funds to pursue carbon offset opportunities in 2009
 - Attractive co-benefits of reduced odour and ammonia emissions from covering storages
 - Expertise from work on related protocols was transferrable to new topic areas
 - Led to this investigation of the potential of adapting existing lagoon cover protocols to AB conditions.
- Gap Types
 1. First Generation – Needed to adapt existing knowledge and protocols to AB conditions
 2. Ongoing - Forge links with other AB protocols, e.g.
 - a. Pork, dairy – feedstock and manure spreading calculations
 - b. Biogas – energy
 3. Second Generation – Needed to develop future protocols drawing on improvements in science
 - TWG will compile identified gaps and circulate to participants for further input, identification of time frames required and prioritization
- Funding for Research – possibilities to address gaps?
 - Federal growing forward Agriflexibility fund - \$500M from 10/14 to improve environmental sustainability, support innovation and emerging opportunities
 - AB Climate Change and Emissions Management Fund CCEMC - \$ 120 M, industry led proposals to reduce GHG emissions, start with letters of intent, check website for details
 - Alberta Meat and Livestock Agency (ALMA) - \$12 M in 09/10 for marketing, product differentiation and cost reduction
 - Other ? – will keep informed as become aware
- Thank you to:
 - Karen Haugen-Kozyra - outstanding job of facilitating
 - Rob Janzen – provided solid basis for framing context and for discussion
 - Climate Change Central staff Amanda Stuparyk and Tanya Maynes - workshop organization and notes
 - Fiona Law - assistance with automated voting
 - Workshop participants – highly valued input, we've learned a great deal
 - Looking forward to further discussion by email or webinar

Final Additional Comments

1. *If you look into flaring, look into data at lower flow rates – including methane concentrations.*
2. *What about ambient temperature – it could be a factor on flaring.*