Capturing Carbon Credits through Manure Digestion

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▪ Introduction

The issue of capturing Green House Gas (GHG) emissions and the sequestering of carbon credits is a new and emerging field for the agricultural sector. This entire concept is rapidly developing and there are a multitude of sources advising us all on how to get prepared. It is evident that the emission of GHG associated with the agricultural industry will be measured, and there will be regulations forthcoming to encourage the industry to capture and reduce emissions. One of the biggest incentives on the horizon appears to be the sale of potential carbon credits. Many practices within the agricultural industry allow the opportunity for GHG emissions to be captured and measured. The resultant difference between the emissions happening today and those associated with the application of new or different technologies represent the potential for financial gains for the individual producer. While this field is still very ambiguous, this paper takes a look at one method being applied to manure management that has the potential to capture those dollars.

▪ Overview of the Process

BioGem Power Systems Inc., is a small privately owed company operating out of Ponoka Alberta. In 2001, after much research, BioGem obtained the rights to an anaerobic digestion process that was being used extensively in Europe to capture the methane generated from manure from intensive livestock operations. Using animal manure as the major input, a biogas plant was built in East Central Alberta and put into operation in December 2001. Since that time, the plant has been operating successfully and the process has proven itself in the Canadian climate. With the Kyoto protocol being signed off by Canada in April of 1998 and ratified in December of 2002, it became evident that the move towards the reduction of GHG is inevitable. The gases emitted from existing manure handling procedures are similar to those being captured and used within the biogas facility. This reduction represents the potential for a carbon credit value, for which there now appears to be an emerging economy. As the nebulous world of carbon credits evolves, this process represents an opportunity for an intensive livestock operation to capture potential financial gain by introducing new technology to their manure handling practices. Not only is there a potential for gains in the field of carbon credits, the view that manure handling is a liability may change as that same manure may be a financial asset if properly managed through a biogas facility.

• Iron Creek Application

In December of 2001, BioGem Power Systems Inc., commissioned our first biogas plant operating on the outputs from an intensive livestock operation. This plant uses the process of anaerobic digestion in a closed system to produce methane gas. This gas fuels an engine that drives a generator producing electricity for internal use as well as sale to the grid. Slurry manure moves directly from the barn into a holding tank, and then is metered into the facility based on system demand. Three large digesters are where the core of the anaerobic digestion takes place. These digesters hold about 900,000 litres of effluent each and the gas created in the process is captured under large rubber bladders attached to the top of each tank. The methane gas is harvested from within these bladders. The facility operates on a continual flow through basis, which means that what volume is metered in daily is also discharged daily into a holding tank.

Thermal heat produced by the engine is captured through heat exchangers and transferred through a hydronic heating system. An average of 2% of the heat generated is used within the process to support the anaerobic digestion process while the producer utilizes another 60% of the heat within his facilities. The remainder of heat is presently vented to atmosphere, although there is currently considerable interest among greenhouse users to capture this resource.

The digested liquor is sent to a holding tank and has about a 15% loss of nutrient value from the original manure input. This very homogeneous liquid can be field applied as a fertilizer. At the existing facility, the digested liquor is further processed through a water treatment plant. The output from the water treatment process is clean utility water, about 95% of the original input volume of effluent. This water is returned to the producer for internal use. About 4% of the original volume of digested liquor is recovered in the water treatment plant in the form of a dry organic material, the same consistency as peat moss. This is being field applied as a soil amendment. This process has been up and operating for the majority of the past 20 months. The system is being modified to be able to accept the input of deads and offal. A macerator will be placed above the receiving tank and any additional organics pre-ground and introduced to the slurry.

Capital cost for a facility of this size would be in the range of $2.5 million CDN. This includes the water treatment facility. Plants are designed to the producers' specific needs and conditions, thus costs are specific to application. Operating costs vary but can be considered that $0.02/kW/hr of the revenue is used to operate both the biogas and water facility. Daily maintenance is taken care of by the producer and he estimates that one of his staff spends 45 minutes daily on routine work. This includes moving the manure into the system, cleaning and minor daily maintenance. Major maintenance, such as the 4000hr injector change out and tune-ups are performed by outside contract services.

▪ Why would biogas qualify?

Traditional methods of manure disposal for intensive livestock operations allow virtually all green house gas components to be emitted to atmosphere at one phase or another. The biogas advantage is one that there is a reduction of GHG emissions associated with traditional practices of storage and distribution of raw manure. The manure enters into a closed system in which anaerobic digestion occurs. The gas produced, usually in the range of 65% methane content, is burned within a piston driven engine that drives a generator. The engine is specifically designed to consume biogas and the difference in composition of the exhaust emissions are the reductions in GHG's. (See **Table 1 and 2** for gas compositions).

Table 1. Gas Analysis, Engine Intake, Iron Creek, 2 Samples, Oct. 8 2003

Gas	Percentage
Helium, He	0.02%
Nitrogen, N_2	7.95%
Carbon Dioxide, CO_2	29.82%
Hydrogen Sulphide, H_2S *	0.0000
Methane, CH_4	62.21%
Total - All Components	100%

H_2S determined by GC/SCD: 0.00 ppm (mol/mol) Norwest Labs, Edmonton Alberta.

Table 2: Engine Emission Analysis, European Results, Summer 2002

Engine Type	Output Rating	Fuel Source	Nitrous Oxide, mg/m^3	Carbon Dioxide, mg/m^3	Non-methane hydrocarbon, mg/m^3
Deutz	200kW	Biogas	510	914	n/a
Deutz	300kW	Biogas	510	914	n/a
Mann	100kW	Biogas	460	445	150
Mann	200kW	Biogas	472	490	150
Mann	300kW	Biogas	425	400	100

Note: Emission tests are preliminary findings only. Actual field tests are scheduled for the existing system to compare operating condition inputs and emissions.

In addition the energy produced through the operation of the facility is green power, which directly offsets other energy outputs that may be less environmentally friendly. A study referenced by the Canadian Ready-Mixed Concrete Association indicated "…an integrated waste management facility, (based on 100,000 metric tones of agricultural manure and organic waste per year) could reduce GHG emissions by as much as 15,000 metric tonnes of CO2 equivalent per year…" The existing facility has an annual input of an estimated 40,000 metric tonnes of organic slurry. The actual GHG reductions are part of an ongoing study to define the carbon credit potential for this process.

▪ Challenges Defining the Carbon Credit Issue

There is a real "grey zone" around the information associated with carbon credits and their potential application to the agricultural community. A multitude of organizations and consultants have been deluging us with terms, buzz words and phrases associated with carbon credits. What needs to be developed and implemented is an understandable and usable system for defining the GHG emission program for agriculture. A control system such as the ISO system used in many other industries will likely be developed to be the basis for measuring, quantifying, auditing and reporting GHG emissions and subsequent carbon credits. The potential value of those carbon credits will be set by the free market as that entire economy develops. It is our view that the potential value of those credits will be huge as the world economies and businesses compete for those credits. Although one small facility is a very minor player in the system, the combining of the outputs of many facilities create a commodity base in carbon credits that could be bartered on the open market.

What needs to happen from here?

To define and capture those elusive dollars associated with carbon credits a few things need to happen. The best path forward is for the agricultural industry to take a lead role in the definition of the process to reduce GHG emissions. The government has agreed to the reduction of GHG as evidenced by Canada's support of the Kyoto accord. Manure emissions from intensive livestock operations are a very real contributor to GHS emissions. It is only a matter of time before the regulatory agencies define what those emissions are and what impact they represent to the environment. By proactive interaction at the front end of the definition process, the agricultural industry can have a major influence as to how future regulations are constructed and applied. This will help to avoid a directive approach by the government as to measures to mitigate GHG emissions with respect to manure management protocols that may impose unrealistic goals, costs and timelines on the producers. As well, the government has a history of positive support for industries that are proactive in policy development. The agricultural industry does need to stay involved and define just how the strategy for reduction of GHG will be implemented and use the government expertise to establish a credible baseline for those measures. Free enterprise will definitely rise to the challenge of defining just *"Where are the Dollars in Carbon Credits?"*

References

Canadian Ready Mixed Concrete Association, Publication: Concrete Thinking in Agricultural Solutions, Feasibility Study Results, Integrated Waste Management Pilot Project, 2002.