Understanding Commercial Opportunities in the Biogas Sector in Canada

Alberta Agriculture Food and Rural Development

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Goodfellow Agricola Consultants Inc.

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Overview

In November 2005, Alberta Agriculture Food and Rural Development approached Goodfellow Agricola Consultants Inc. (GACI) to develop a paper, building on earlier work undertaken by GACI on behalf of Agriculture and Agri-Foods Canada, outlining key funding opportunities and policy and support programs that are relevant to the Biogas Sector in Canada.

Given the nature of the biogas sector in Canada (consisting primarily of early stage investments, the demonstration of new technologies and the adaptation of existing technologies to Canadian circumstances) it would have been impossible for the project team to identify and engage every potential and/or operational biogas facility in Canada. Indeed, the project specifically did not explore or provide commentary on municipal related digesters or those related to food processing plants which are principally operated as waste treatment/disposal operations. Fundamentally, this paper focuses on biogas systems that have been purpose built to maximize biogas production.

Likewise is was not possible to explore and document all of the early stage discussions that are taking place throughout Canada concerning the implementation of biogas technologies as many of these discussions are both private and of a commercial confidential nature. Instead, the project team interviewed knowledgeable individuals from both federal and provincial governments and from the private sector focussing on three broad types or groups of individuals: policy and program coordinators, project proponents and technology providers.

Over the course of the Alberta BioGas Conference, the project team would welcome any additional information that participants are aware of in order to ensure that this document remains as relevant and ‘ever-green’ as possible.

This report consists of four (4) brief chapters, as follows:

1.0 Introduction – The Biogas Sector in Canada
2.0 Potential Sources of Funding
3.0 Status of Existing Funding Opportunities
4.0 Enabling Policies and Programs in the Biogas Sector

1.0 Introduction – The Biogas Sector in Canada

This section provides a brief introduction to the biogas industry and the current drivers for the sector in Canada.

1.1 What is Biogas?

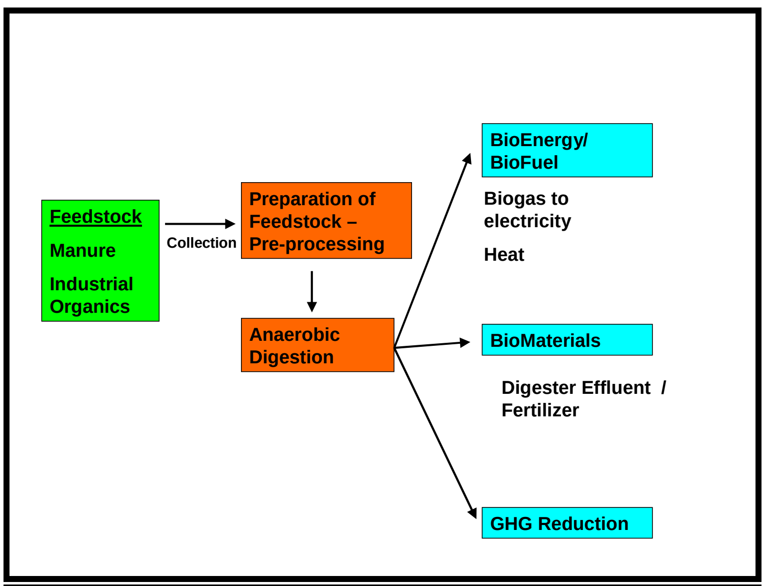
As an introduction to the topic of biogas production it is important to understand what is meant by the term "biogas". Although technical definitions vary, in general, biogas is a gas that is primarily composed of methane and produced by the anaerobic digestion of biomass, manure and/or biosolids, or the organic fraction of municipal solid waste.

The methane that is contained in the biogas can be separated, purified and used to generate electricity and heat through combustion in reciprocating engines or gas turbines. Biologically produced methane has also been brought forward as a potential sustainable source of hydrogen for use in fuel cell technologies.

1.2 The Biogas Value Chain

The generic value chain for the production of biogas is as follows:

Figure 1.1: Generic Value Chain for the Production of Biogas



In general, a feedstock (manure for instance) is collected and pre-processed in some manner. This pre-processing can consist of as little as mixing the manure to ensure a standard liquid content and homogenous distribution of matter to a more complex process of feedstock preparation to maximize the production of biogas. The processed feedstock is then introduced to the anaerobic digester.

There are three potential co-products from the digestion process:

1. Biogas which can be used to generate electricity, heat and/or other biofuels
2. Biomaterials such as fertilizer
3. GHG Reductions, although these co-products must be quantified, validated and there must be functioning market in GHG reductions before their value can be realized.

1.2.1 Variations from the Basic Value Chain

There are a number of potential variations on the basic value chain laid out in **Figure 1.1** above, including:

1. Collection (On farm processing versus central collection and processing) – Most current biogas facilities in Canada collect their feedstock from a single source, generally a large commercial farm. The potential exists, however, to collect feedstock from multiple sources and process this feedstock at a central location. Each of these models has economic advantages and disadvantages that must be weighed in evaluating their potential Return on Investment (ROI).

2. Feedstock (Single feedstock versus blended feedstock) – Again, most current Canadian biogas projects employ a single feedstock, primarily manure although several biogas facilities are in operation that employ municipal biosolids as their primary feedstock. Blended feedstock can help to optimize the production of biogas but require additional pre-processing before the feedstock can be introduced to the digester.

3. Pre-Processing (Processed versus unprocessed feedstock) – Some biogas facilities pre-process their feedstock (using a mix of technologies including hydrolysis and micronyzation among others) with the objective of increasing methane yields from anaerobic digestion while others utilize an unprocessed mixture.

4. Post-Processing (Cleaned methane versus 'raw' biogas) – Different technologies can be employed to scrub biogas in order to purify the methane that is produced so that it will burn both more cleanly and more efficiently.

Variations also exist in the types of technologies that are employed to digest the feedstock and to burn the biogas that is produced. In general, however, the technologies that are employed in Canadian biogas facilities are not uniquely Canadian technologies, but are adopted or adapted from existing (primarily European) technologies.

1.3 Types of BioGas Projects (Anaerobic Digesters)

There are four (4) broad categories of biogas generation technologies as defined by the source material (feedstock) that they consume:

1. **On-Farm Digesters**
    a. Using only their own manure for feedstock
    b. Using their own manure supplemented by industrial organics
2. **Centralized Digesters**
    a. Using manure and/or industrial organics from a number of sources as a feedstock
3. **Municipal Sewage Treatment Digesters**
    a. Using municipal biosolids as a primary feedstock
4. **Waste Water Treatment Systems**
    a. Used by food and beverage processing companies primarily as waste treatment systems. These systems do not necessarily (or are not even necessarily designed for) maximizing biogas production. In these systems the biogas that produced is often either flared off or co-fired into boilers to produce steam.

This report will not discuss technologies and opportunities relating to the third and fourth categories of biogas production as they are somewhat outside the scope of investigation. Instead, the remainder of this report will explore the economics associated with the first two categories of production – on-farm and centralized digesters.

1.4 Drivers for the Adoption of Biogas Facilities

Project proponents, in general, have one of two primary motives for the development of biogas facilities. The motive for implementing these technologies can have a significant impact on the project's expected outcomes and hence the types and efficiency of the technologies that are necessary.

The three primary motives for developing biogas facilities are as follows:

1. License to operate – As suburban developments continue to encroach on more traditional agricultural lands, concerns have been raised about traditional agricultural production methodologies, particularly those associated with the creation of unpleasant odours. In particular, concerns have been cited about the odours that are associated with the manure that is produced by hog farms and beef feedlots.

A related concern is the potential impact on groundwater supplies of the large volume of animal wastes associated with larger commercial farms (through leachates associated with the manure that is produced at the facilities). Biogas facilities offer the potential to mitigate these odours and reduce the associated risks in regard to operation and expansion of intensive livestock operations.

Increasingly, the 'license to operate' and certainly the ability to expand their operations for many commercial farms that are co-located with suburban developments will be linked to their ability address these issues associated with manure and other animal wastes.

2. Energy Generation – The second primary driver for the development of biogas facilities is the potential to produce electricity and heat by co-generating heat and electricity from the methane which can be used by the facility /farm itself or exported to nearby users (electricity and heat) or to the electrical grid.

Over the past few years, changes in the market for electrical power have created significant additional opportunities that could be explored by the biogas sector including:

1. If electricity prices continue to rise, is there a potential Return on Investment (ROI) that could be realized strictly from the sale of the electricity and heat (or electricity by itself) that is co-generated by the bio gas facility?
2. In a regulatory environment in which there are differential prices for electricity that is produced from renewable and non-renewable sources (as has been and is being mandated by provinces in recognition of environmental/climate change considerations – in particular Ontario in its recent budget) is there a more compelling business model for biogas?
3. In an environment in which the electrical grid is perceived to be less reliable is there utility in implementing a biogas system that provides an on-site back up electrical system, ensuring that if the centralized electricity system fails that food processing or farming operations such as milking cows etc. can continue uninterrupted?

3. Disposal of Wastes - A third driver that has emerged recently is the need (based on changing environmental and health standards) to develop a new 'home' or disposal methodology for industrial organics such as Specific Risk Materials (SRMs), animal rendering materials that are not SRM, grease trap materials, dairy Fats, Oils and Grease (FOG) and other food processing residues.

In moving from the negative drivers that motivated early biogas developments to the more positive opportunity driven motivators that have emerged as of late, a different set of technical issues have emerged as well such as the need to determine which sources and volumes of feedstock would be necessary and under what price/tipping fee constraints to achieve a sufficient ROI.

As biogas facilities look to produce commercially viable volumes of electricity it will become increasingly important for them to ensure access to a constant supply of high quality feedstock. It will also become increasingly important for them to optimize the efficiency of biogas technologies by exploring different mixes of feedstock.

2.0 Potential Sources of Funding

This section provides a brief overview of the existing funding opportunities in the Biogas Sector in Canada in both the public and private sector.

2.1 Traditional Funding (Private sector)

The availability of funding sources such as debt and equity capital is predicated on several key factors:

1. Viability of the Business Plan
2. Quality of the Management Team
3. Potential Return on Investment
4. Potential for Growth and Expansion

At this time, for reasons that will be discussed in the next section of this report, it is very difficult to develop a viable business model on a stand-alone basis for biogas facilities in Canada. The feasibility of any such model is predicated on the market rate paid to producers for electricity as it is maintained at an artificially low level in most provinces. Frankly, there are very few business plans for biogas facilities in Canada that have yet to be proven to be profitable over time. Further the potential returns on investment for individual facilities are perceived to be low with a very limited potential for future growth within the individual facility. Finally, there are very few proven management teams with experience in this sector in Canada.

Given these restrictions it seems unlikely that there will be a high level of investment in this sector in terms of equity in-flows for the foreseeable future. Projects in this sector will be unable to access venture capital given that VC investments require the potential for large returns and explosive growth. This means that biogas projects will be looking to two sources for funding:

1. Project Financing (debt and very limited non-Venture Capital equity sources)
2. Assistance from government funding sources

Each of these two sources has its own related concerns and challenges.

2.2 Leveraging Additional Sources of Financing

Given that it is unlikely that individual biogas projects on a stand-alone-basis will attract high levels of equity investment in the immediate future, the most likely sources for additional funding would be from government funding sources and from traditional debt financing. Each of these sources of funding will be looking for specific types of information before they will make further investments:

Project Financing

1. ***Reduced Risk*** – At the present time there are very few existing biogas facilities in Canada that could be used to validate the longer term economic potential of this technology. Further, each of the existing sites (or many of them at a minimum) utilizes different technologies, feedstock and operating processes. This lack of standardization means that each project has a higher level of perceived uncertainty and hence a high level of risk. It is this high level of risk that leads to higher costs for investment capital.

Government Funding Programs

2. ***Reduced Overlap and Duplication*** – Most public sector funders are being or have been approached by a significant number of potential biogas project proponents to fund their projects. In the absence of clear differentiating factors between these projects there are fears that many of the projects may be duplicating each others efforts (particularly if the funding program is to provide funds for demonstration projects). Further, the early failure of some biogas projects has led to the perception that this technology may not be economically feasible for some applications in Canada. Finally, many government funding bodies focus on new and novel technologies. There is a perception that too many projects in the biogas sector present themselves as 'novel' when in reality they are very similar to a number of existing projects that have already been funded, i.e. wrapping an existing unfundable project in a "novelty blanket" to try to qualify for funding.

Overcoming both of these challenges will require a commitment on the part of the biogas sector itself to provide a level of coordination between and among projects and technologies so that key funders can increase their level of comfort with the sector in general and, as a result, provide higher levels of capital for new projects.

3.0 Status of Existing Funding Opportunities

The third section of this report provides some brief commentary on the status of the funding opportunities that were identified in earlier work undertaken by Goodfellow Agricola Consultants Inc. on behalf of Agriculture and Agrifoods Canada.

3.1 What are the Funding Opportunities and are they still Valid?

The two primary opportunities that were identified in the previous report developed by the consultant were as follows:

1. More effective and efficient single source, single feedstock projects (low cost, “no fuss no muss” systems)
2. Larger centrally located multi-source, multi-feedstock projects.

In general, these two opportunities represent very different types and scales of project. While a project to develop a single-site, stand alone facility can cost as little as a half million dollars or less, a full scale centralized facility can cost upwards of twelve (12) to fifteen (15) million dollars to develop and implement.

While many organizations, firms and projects continue to explore these two directions with a very limited exception most of these opportunities are still in the “project under development” phase.

3.2 What are the Constraints preventing these Opportunities from being realized?

The primary constraint that is preventing these opportunities from being realized is the economics of their associated business models. In many provinces the cost of electricity is currently subsidized to such an extent that the true ROI associated with many biogas projects is negative i.e. **consumers are not paying the full cost of the production of the electricity they consume so small producers do not receive adequate returns on the electricity that they bring to market**. This is likely to become less of an issue as provinces such as Ontario create incentives in terms of preferential pricing for electricity that is generated by renewable technologies.

A second constraint is the **lack of a centralized body or data source to collect and integrate sector knowledge.** Currently, each proponent for a biogas project must identify their own technology, develop their own methodologies for the implementation of the technology, address all potential regulatory concerns and conduct their own evaluation of the project outcomes. Lack of knowledge about potential technologies and standardized technologies and project plans is a major barrier to the further development of this sector in Canada.

Finally, a lack of successful examples of longer term operational biogas facilities in Canada has led to an environment in which there is a **perceived high level of risk** around investments in biogas facilities (as discussed in more depth in the previous section). This higher level of uncertainty and risk leads to higher associated costs of capital which further compromises the ROI for biogas projects.

3.3 What is the extent of the Opportunity to Commercialize Biogas Technologies in Canada?

Given the right environment – **favourable pricing**, tested technologies and project plans, and access to competitive investment capital – there is a significant opportunity for the development of biogas facilities in Canada. At the current time, however, these conditions are not generally in place leading to a situation in which projects are developed in an ad hoc fashion and are reliant on external risk capital from public sources.

4.0 Enabling Policies and Programs in the Biogas Sector

There are number of funding programs across Canada that can or do provide support for the development of biogas projects. For a complete listing of funding opportunities please refer to the recently completed **Inventory of Canadian Bioproducts Funding Sources (ICBFS)** found at http://www.bio-productscanada.org/bpp which the report's author assisted in compiling.

4.1 Existing Policies and Programs

Unlike other less mature sub-sectors within the renewable energy sector, biogas facilities have been in operation globally for more than two decades. As such, there is a lower level of technology risk associated with these technologies than with other less developed renewable technologies. Given the existence of proven technology, much of the risk associated with implementation of a biogas project in Canada involves two key attributes:

1. Price received for electricity generated (or more accurately Return on Investment)
2. Lack of consistent business models and practices to provide a comfort level to investors

4.1.1 Price

There are a number of programs in place at the national, provincial and regional level that can provide support for biogas opportunities. Many of these opportunities have been documented and summarized in the **Inventory of Canadian Bioproducts Funding Sources (ICBFS),** a database developed by the Bioproducts Business Network in Ottawa with the support of Industry Canada.

One emerging best practice in relation to the price that is paid for renewable energy is the introduction of differential wholesale pricing for electricity. In its recent budget the government of Ontario introduced the following measures to encourage the production of electricity by small-scale producers of renewable energy,

> *To encourage smaller-scale, distributed generation in Ontario, the government has passed a regulation on net metering to enable homeowners, farms and businesses generating renewable electricity to receive credit for the excess electricity they produce. In addition, the Ontario Power Authority (OPA) is moving forward with a standard offer program aimed at small-scale generation that will be connected to the lower-voltage distribution system, increasing the availability of renewable power and promoting economic development within communities. (Ontario Budget 2006)*

By offering preferential pricing for electricity generated from renewable biomass sources ($0.11 per KWH plus a $0.03 premium if supplied during peak demand periods) the Ontario government is improving the potential ROI for biogas facilities with sufficient production to return electricity to the grid.

4.1.2 Lack of Consistent Business Models and Practices

One of the key challenges facing the biogas sector in Canada is the lack of consistent business models and practices in the sector. The presence of a set of well understood and clearly defined business models and practices would enable investors to have a higher comfort level with investments in this sector. **Unfortunately, however, the lack of cohesion and coordination in the sector had led to an environment in which these common issues of importance to all projects are not being addressed in a coherent fashion i.e. each project proponent invests an inordinate amount of energy and capital on their own ad hoc approach and not enough time and effort is invested in raising the overall level of awareness and comfort with the sector as a whole.**

Although many project proponents have attempted to adopt different technologies to Canadian climatic conditions efforts to centralize and synthesize the outcomes of these projects have had limited success to date. Further, funding agencies have become saturated with one-off proposals for biogas projects. In the absence of a coordination function to explain how these projects differ from one another and why they are important in their own right it is unlikely that many funding bodies will continue to fund projects in this sector.

Perhaps then this is the most important lesson that emerged in the process of developing this report – the biogas sector in Canada has reached a sufficient level of maturity that it requires some form of coordinating body to allow for the standardization and validation of technologies and projects in order to minimize redundancy in terms of regulatory, research, demonstration and other common issues in the sector and in order to maximize the economic benefits for project proponents and for public funders.

4.2 Best Practices in Developing Biogas Projects

To conclude, several best practices were identified in relation to the development of viable biogas projects.

1. **Source of Feedstock** – It is important not to assume that a digester can only utilize materials from a single source. As the biogas sector matures in Canada it is likely that more centralized or mixed feedstock digesters will implemented that can process feedstock from many different sources. It is important to work from the right end of the value chain, in other words "how can we make money from the end products" versus "what are we going to do with our manure". If you focus on the second question you can easily end up in a situation where sub-optimal decisions are taken.

2. **Valuation / Monetizing of Heat as a Co-product** – In developing business models and business cases for biogas projects it is critical not to count on the sale of heat as a source of revenue stream if no market exists for waste or process heat in that geographic location. For most projects, particularly in the case of centralized anaerobic digesters, it is extremely difficult to make use of much of the excess process heat produced by electricity generators unless the digester is co-located within an eco-industrial cluster (see Annex II for a brief discussion of the potential for integrating an anaerobic digester as part of a broader eco-industrial park).

3. **Cost of Transportation and Storage** – In a centralized anaerobic digestion system the costs associated with the transportation and storage of manure can be prohibitive rendering projects uneconomically viable. In comparison, industrial organics will arrive at the anaerobic digester facility without any transportation costs to be covered by the operator, and with an associated tipping fee to be paid on delivery.

Annex I: Status of Commercial Biogas Projects in Canada

This annex provides an overview of some of the key projects that have been/are being proposed in the biogas sector in Canada and the key contacts in each of the regions. It is based on interviews with key stakeholder in the biogas sector across Canada. The inventory is representative of what is transpiring in Canada and is based upon information that is publicly known by the interviewees. A greater quantity of information is available about projects that are operating/or have operated; or those under construction, or those that have received public funding for feasibility studies; than the potential projects that are still under discussion.

Province / Region: British Columbia

Key Contacts: Gustaf Rogstrand,
BC Ministry of Agriculture and Lands

Available Provincial Programs: There is an energy purchase price agreement currently being contemplated in B.C. as well the current regulations about bringing waste organics on to farms are being looked at.

Project		***Status***			
Name / Proponent	Pre Feasibility	Feasibility Study (outcome)	Under Construction	Built and Working	Built not currently working

- There are no currently operating commercial facility in B.C (including one built on dairy farm on Vancouver Island in the 1990's which is no longer operating, and a research facility that was built in the lower mainland (3 cubic meters) but is not operating currently).

1. Genesis (Linda Skene). This project has applied to SDTC and TEAM, originally it was suppose to be a centralized A.D. in the Okanagan Valley but the project has now been relocated to the lower mainland and is no longer to be a centralized digester but rather an on-farm digester using dairy (80-100 cows) and hog (3000 head) manure. They are contemplating the use of food and beverage processing wastes if they can get approval. There would be a gasifier associated with the A.D. the project is currently addressing funding challenges.

   X (on farm, judged as such as the project has changed substantially)

2. There is a project in the discussion stage (pre-feasibility study phase) in the Abbotsford area that is getting some attention that would use sewage from Abbotsford, dairy manure and food and beverage processing wastes. Would be using U.S. technology “ANGAR Technology”. The digester effluent would be used on a local sod farm

   X (on farm)

3. There are probably 5-7 dairy farm related A.D. projects in the “coffee shop chattering phase”, all located in the Lower Mainland, i.e. in the “if the electricity prices were higher, if help with the capital could be found” phase.

Province / Region: Alberta

Key Contacts: Jim Jones, Alberta Agriculture

Available Provincial Programs: AVAC

Alberta Environmentally Sustainable Agriculture

Project		***Status***			
Name / Proponent	Pre Feasibility	Feasibility Study (outcome)	Under Construction	Built and Working	Built but not currently working

1. Peace Pork (Rocky Morrell, using University of Florida technology, built on 12,000 head hog farm) experiencing technology challenges.

   Built but not currently working: **X (on-farm)**

2. IMUS (Hymark Renewables / Kotelko family) Using manure from 7500 feeder cattle could expand to include full number of cattle in feedlot which is 36,000. Uses Alberta Research Council technology – Xia-Moei Lee)

   Built and Working: **X (on-farm)**

3. Iron Creek Hutterite Community (Grant Meikle, BioGem technology) In the process of being re-commissioned

   Built but not currently working: **X (on-farm)**

4. ECBNA (Thane Hulburt/ Stephan Michalski) Shows feasibility. They are in the process of addressing siting challenges.

   Feasibility Study (outcome): **X (centralized)**

5. Lamb-Weston (Division of ADM) Potato lagoon sludge. Use the biogas to fire boiler)

   Built and Working: **X (waste water treatment)**

6. Cargill (High River). Captures methane using bladder over lagoon to fire generator $35,000 month value of gas collected.

   Built and Working: **X (waste water treatment)**

7. "Red Deer Project" (Speak with Rick Tofani, Director of Innovation at Red Deer College), 403-343-4070. But not yet feasible under current conditions, transportation costs for manure.

   Feasibility Study (outcome): **X (centralized)**

Probably another 15 in very early phases of discussion but details not disclosed, including one that is tied in with a coal bed methane extraction operation.

Province / Region: Saskatchewan

Key Contacts: Ron Kehrig, AgWest Bio Inc.
Mark Stumburg, AAFC, Moose Jaw
Ben Voss

Project		***Status***			
Name / Proponent	Pre Feasibility	Feasibility Study (outcome)	Under Construction	Built and working	Built but not working

1. CPIG BioGas Plant, Cudworth (Clear Green technology - Ben Voss)
   X (on-farm) (Built and working)

2. Clear Green another project in the planning phase. Stomp Pork.
   X (on-farm) (Feasibility Study)

3. PAMI (Patricia Lung) in Humbolt (a 50 gallon research facility to test various A.D. recipes – slaughter offal. Also funded by NRCan). 1-800-567-7264, 306-682-2555
   (None of the above this is a research facility)

4. Pound Maker Ethanol (Keith Rebber and Brad Wildeman) The Company is in the early stages of exploring setting up an A.D. to provide front end heat and electricity). Keeping a close eye on Hymark Renewables / IMUS to see how this works out first.
   X (centralized) (Pre Feasibility)

5. Ethanol facility in Weyburn / Brad Hill (company is in very early stages of considering an A.D. to provide front end heat and electricity)
   X (centralized) (Pre Feasibility)

Province / Region: Manitoba

Key Contacts: Doug Jackson

Available Provincial Programs: Manitoba looking at differential pricing of electricity to stimulate development. Talk of legislation on managing hog manure.

Project ***Status***

Name / Proponent	Pre Feasibility	Feasibility Study	Under Construction	Built and Working	Built but not Working
1. "St. Malo Project" / Topeka Farms. Would be using thermophilic German technology "SMUCK". 1500 sow farrow to finish operation plus corn silage, plus industrial organics. Currently addressing financing challenges, still seeking permits to move industrial organics to the farm site.	**X (on-farm)**				
2. "BioTerre Toulan Project" Built but not currently operating as operation was undercapitalized. New investor with 6000 hogs now on scene and would like to restart					**X (on-farm)**
3. "Brandon Project" / Sampson Engineering. To be built using mesophilic technology on a Hutterite Colony hog operation. Municipal / industrial waste water treatment technology adapted to an agriculture application. Funding is being sought, would like to build in next 12 months		**X (on-farm)**			

Province / Region: Ontario

Key Contacts: Anna Corrola, University of Guelph,
Don Hillborn, OMAFRA
Jake deByrun, OMAFRA

Available Provincial Programs: Up to $60,000 program for on-farm manure storage and treatment facility. Standard pricing introduced on March 21st to incent electricity produced by biogas from A.D.

Project		***Status***			
Name / Proponent	Pre Feasibility	Feasibility Study	Under Construction	Built and Working	Built but not Working

1. Klaesi Brothers (Cobden) Using Bohne Technology on their dairy farm, working on project to add industrial organics into feedstock mix)
   X (on-farm) (Built and Working)

2. Ste.Anne de Prescott. Feasible not shown due to of hauling costs of manure. Several of original members may go on their own with on farm digesters.
   X (centralized – not feasible) (Feasibility Study)

3. Heinzle Brothers, Ste. Anne de Prescott, 250 dairy cows / Keller Engineering supported by Bill Kemp. Spin out referred to in no. 2 above.
   X (on-farm) (Pre Feasibility)

4. Lafleche Environmental (centralized system, feasibility shown but investor still contemplating investment)
   X (centralized – feasibility shown) (Feasibility Study)

5. Chatham-Kent for all intents and purposes project has been abandoned
   X (centralized but not feasible) (Feasibility Study)

6. Lynn Cattle Company in Lucan using Rentech technology. To be co-located with an ethanol plant
   X (on-farm to be operating in May) (Under Construction)

7. Circle D Farms - Thunder Bay Project / EEC Corporation (Dave Leskowski)
   Funded by Northern Ontario Heritage fund. Some discrepancy as to whether the facility is currently operating

   X (on-farm)?

8. Delft Blue Project

   X (feasibility study completed out for tenders to build)

9. Canadian Agra / Bruce Energy Centre / Hanna Ayyad to co-locate with an ethanol plant, www.canadian-agra.com

   X (centralized)

10. Waterloo-Wellington Community Futures Development Corporation / Hillier Meats / Rick Whittaker

    X (centralized)

11. Perth community Futures Development Corporation / Jaret Henhoffer, 519-595-7570, www.perthcfdc.ca

    X (centralized)

12. Nairn Farm - Ste. Maries 250 cow dairy farm – Richard St. Jean of Geomatrix

    X (on-farm)

13. Greenhouse in Niagara – Martin Lensink, 905-935-5815

    X (centralized)

14. Molson, Organic Resources International, Rothsay and Bi-Pro have all been exploring
15. A dozen dairy farmers or so including Stanton Brothers in Ilderton (1000 dairy cows), Cor Whale (200 dairy cows), BLT Farms (Len Jewitt)

Province / Region: Quebec

Key Contacts: Michel Lachance, CQVB,
Serge Guiot, NRC-BRI
Suzelle Barrington, Macdonald / McGill
Daniel Massey, AAFC

Available Provincial Programs: 70% of the cost of a project up to $200,000 for the installation of a manure storage / treatment facility

Project		***Status***			
Name / Proponent	Pre Feasibility	Feasibility Study (outcome)	Under Construction	Built and working	Built but not working

1. Ferme Famille St.Hillaire, / Richard Royer, St. Odilon, 10,000 hog farrow to finish operation using BioTerre system. Project with Hydro Quebec to produce 50-60 kilowatts
   X (on-farm) (Built and working)

2. Ferme Richard Peloquin / Richard Royer, bioterre-systems@yahoo.ca, Ste. Edwidge de Clifton, using BioTerre Systems Inc. Technology funded Eco-AMU and SDTC.
   X (on-farm) (Built and working)

3. Les Oeufs d'Or Inc. – Val Dor / M. Beauvais to be using LIPP technology from Germany, contact Roland Mittner for information. Commercial misunderstanding delays ongoing operation.
   X (on-farm) (Built but not working)

4. Envirogain – Aerobic and anaerobic then finished off in municipal water treatment facility.
   X (R&D demo project) (Built and working)

5. Prolab in Thetford Mines / Jean-Guy Grenier. Farm and municipal wastes.
   X (R&D demo project) (Built and working)

6. Tembec Inc. / Lyle Biglow, (processing pulp and paper wastes using Paques technology from Ireland) lyle.biglow@tembec.com
7. A. Lassonde / Claude Kirouac, (waste water treatment plant using Biothane Technology. One 400 cubic meter system)
8. Agro-Pur in Notre Dame de Bon Conseil / Pierre Fillion, Claude Hade (Waste water treatment plant at dairy plant. Two 400 cubic meter systems for heat)
9. Nabisco Ltee. / R. Doucet, Real Letourneau (waste water treatment plant at flour mill / bakery)

10. ADM/Olgilvie / Jean-Guy Lalonde & Pierre Dumochel, (waste water treatment plant at a flour mill)
11. Les Aliments Carriere Inc. / Nicole Plamondon (waste water treatment from vegetable processing)
12. Interquisa / David Boulanger, (waste water treatment using Biothane technology)
13. Municipalite de Repentigny / Christian Boulanger, (municipal waste water treatment)
14. E.B.I. Energie / Daniel Babineau, (bioreactor landfill site)
15. Bio-Meth Inc. / Daniel Tremblay, (bioreactor landfill site technology provider)

Province / Region: Atlantic

Key Contacts: John Argall, BioAtlantech,
Richard Ablett, AgriTech Park Truro,

Project		***Status***			
Name / Proponent	Pre Feasibility	Feasibility Study	Under Construction	Built and Working	Built but Working

1. McCain's currently collect biogas as part of waste water management system but flares the BioGas.

   X (waste water treatment) (Built and Working)

2. Gerald Comeau, University of Utah technology for DME production. Conversion of methane to DME

   X (post methane production transformation) (Pre Feasibility)

3. Cavendish Farms / Manuel Becker / Robert Irving exploring building a BioGas plant in PEI to be located with French Fry Plant (potato peel, sludge, waste starch). German technology.

   X (using industrial organics) (Feasibility Study)

Province / Region: National

Key Contacts: Blaine Kennedy, SDTC,
Jody Barclay, NRCan
Bruce Bowman, AAFC: Manure Net,
Cedric McLeod, Fredericton on retainer with
Canadian Pork Council,

Annex II: Commentary on Incorporating an Anaerobic Digester as Part of an Eco-Industrial Cluster

This annex provides some brief commentary on the application of an anaerobic digester in the context of an eco-industrial cluster.

1. What is an eco-industrial cluster?

At its most basic level, an eco-industrial park or cluster is a collection of companies and/or institutions that are located in close proximity to one another and that make use of each others waste outputs as feedstock inputs.

2. Why is the eco-industrial model of interest in relation to anaerobic digesters?

One of the key challenges with the business model associated with anaerobic digesters is the ability to realize value from co-products such as heat, and reduce the costs associated with handling digester effluent. By locating an anaerobic digester in a functioning eco-industrial cluster, it is possible to make use of the process heat that is generated by the digester to heat nearby building and facilities. It is also possible to make use of the electricity that is generated by the digester to power related buildings and facilities without the expense and difficulty of connecting the digestion facility to the grid. The business model is further improved if co-products such as the spent digestion materials can be used as fertilizer or top cover for other businesses.

3. Are there functioning examples of anaerobic digesters that are being used in this context?

To-date, the most advanced work on the use of anaerobic digestion in this context has been undertaken by Lafleche Environmental Inc., a Canadian company based out of Moose Creek, Ontario. Various research partners have also been engaged in this process including the University of Ottawa and the National Research Council (please see Figure A1 (over)).

Key Messages:

An eco-industrial cluster improves the likelihood of:

- Accessing on a more consistent basis a broader range of feedstocks
- Generating clients for process heat
- Off grid electricity buyers
- Off setting disposal costs

Figure A1: Mapping an Eco-Industrial Cluster