ASSESSMENT OF
ON FARM ANAEROBIC DIGESTER
GRID INTERCONNECTION
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GRID IN INTERCONNECTIONS

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EXECUTIVE SUMMARY

In Canada, major Federal and Provincial Government initiatives are underway to establish model demonstration pilot plants for energy co-generation and crop nutrient production from agricultural and municipal wastes. These efforts are to mitigate net greenhouse gas (GHG) emissions from agriculture while improving production efficiency, conserving resources and developing renewable resource technologies. One such renewable enabling technology is Anaerobic Digestion (AD).

This study serves to document the reality of market entry barriers to grid interconnection of AD Systems. From early reports on AD System demonstration projects across Canada, there appeared to be some interconnection barriers that were delaying implementation of those projects. Five potential sites were selected as case studies but due to time constraints, it was decided to complete three case studies. The three sites were located in Ontario, Saskatchewan and Alberta. The findings of this report are based on these three case studies.

The sites selected for the case studies included:

- Ontario Dairy Herd AD System Generating 50 kW;
- Saskatchewan Hog Farm AD System Generating 120 kW; and
- Alberta Outdoor Beef Feedlot AD System Generating 1000 kW.

Survey forms were created and sent to the case study participants prior to the onsite interviews. Interviews were conducted with the project owners, the serving utilities and interested stakeholders such as agricultural and electrical consulting professionals.

In reporting the outcomes from the surveys conducted they were described under three categories of barriers; Technical, Business Practices and Regulatory Barriers. The summary of barriers reported are as follows:

**Technical Barriers**

- Over concern of “islanding” condition;
- Power quality requirements; and
- Power flow studies and other engineering analyses.
Business Practice Barriers

- Lack of response after initial utility contact requesting interconnection
- Application and interconnection fees

Regulatory Barriers

- Unavailability of fair buy back rates
- Lack of Net Metering Programs across Canada
- Restrictive terms on existing Net Metering Program
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1 Introduction

In Canada, major initiatives are underway through Federal and Provincial Programs to establish model demonstration pilot plants for energy co-generation and crop nutrient production from agricultural and municipal wastes. The result is to mitigate net greenhouse gas (GHG) emissions from agriculture while improving production efficiency, conserving resources and developing renewable resource technologies.

One such renewable enabling technology is Anaerobic Digestion. Anaerobic Digestion (AD) is a biological process that produces a gas principally composed of methane (CH4) and carbon dioxide (CO2) otherwise known as biogas. These gases are produced from organic wastes such as livestock manure, food processing waste, etc. Anaerobic processes could either occur naturally or in a controlled environment such as a biogas plant. Organic waste such as livestock manure and various types of bacteria are put in an airtight container called a digester so the process could occur.

Farmers’ motivations for building and operating AD technology are as follows;

- Co-generation (combined heat and power –CHP) and Energy Independence
- Manure treatment cost savings
- Beneficial nutrient conversion
- Greatly reduced odour levels
- Pathogen control
- By product recovery; and
- Reduce greenhouse gas (GHG) emissions

CHP co-generation is considered as a form of Distributed Power. It is modular electric generation or storage located close to the point of use. With the increase of competition in the electric utility business combined with the arrival of environmentally friendly renewable resource technologies such as biomass, it has sparked strong interest in distributed power, particularly in on-site generation. For example it is estimated that in Ontario, livestock-sourced renewable energy could produce upwards of 200 MW of electricity and across Canada, upwards of 1500 MW.

The impressive efficiency and environmental gains offered by these various Distributed Power resource technologies have the potential to contribute significantly to the mitigation of air
pollution and global climate change through the reduction of GHG. However these Distributed Power technologies face certain market entry barriers which are the subject of this report.

From early reports on AD System demonstration projects across Canada, there appeared to be some interconnection barriers that were delaying implementation of those projects. This study serves to document the reality of market entry barriers to grid interconnection of AD Systems. The three case studies will focus on barriers to grid interconnection with utility systems.
2 Methodology

2.1 Selecting Case Studies

Natural Resources Canada (NRCan) and Agriculture and Agri-Foods Canada had a list of AD pilot/demonstration projects across Canada that were operational. Five potential sites were selected as case studies but due to time constraints, it was decided to complete three case studies. Three preferred sites were selected with the remaining two sites as alternates. The first three sites were located each in Ontario, Saskatchewan and Alberta. NRCan staff made initial contact with all three project principals and they agreed to participate. The findings and analysis of this report are based on these three case studies.

The plan was to conduct on site interviews with the Project Owner(s), the Utility serving the project site and other possible stakeholders such as technology project developers and consultants associated with the project. From the interviews, the information gathered would be used to write this report.

2.2 Survey Forms

Two survey forms were developed; one for the Project Owner(s), the other for the Utility serving the project site. The two survey forms are attached in Appendix A. The two survey forms were slightly different in that the Customer survey form was written to capture specific project details. The Utility survey form was written to capture information not only for the specific site being considered but also reflect the impact from a Program perspective.

The survey forms were sent out in advance of the interview for the interviewees to review and complete prior to the interview. It allowed the interviewees to reflect on the questions and be prepared for the interview. It also helped to keep to the topic on track as talking points and a means to capture comments made during the interview.

2.3 Conducting Interviews

The following interviews were conducted.

Ontario Dairy Herd AD System Generating 50 kW.

Separate interviews were held with:

- the two project owners at site;
- a Hydro One Distribution Network Management Engineer at his office in Toronto; and
a telephone survey held with a Provincial Government Agricultural representative.

**Saskatchewan Hog Farm AD System Generating 120 kW**

Separate interviews were held with:

- the AD Developer at site; and
- a SaskPower Distributed Generation Supervisor at his office in Regina.

**Alberta Outdoor Beef Feedlot AD System Generating 1000 kW**

Separate interviews were held with:

- the two project owners at site;
- two representatives of the Alberta Research Council; one at the site the other in Edmonton;
- an ATCO Commercial Services Supervisor in Calgary; and
- a high voltage consultant in Calgary.
3 Summary of interconnection barriers

3.1 Barriers Defined

These categories of barriers are for convenience of description only. For example they could be classified as technical versus no-technical barriers. However it was decided to provide the following three barrier types to help differentiate certain business practice/regulatory issues from each other.

3.1.1 Technical Barriers

Technical interconnection barriers include utility requirements intended to address engineering compatibility with the grid and grid operation. These barriers include specifications relating to power quality, dispatch, safety, reliability, metering, local distribution system operation, and control. Examples include engineering reviews, design criteria, engineering and feasibility studies, operating limits, and technical inspections required by distribution utilities. A summary of technical barriers are described in Section 3.3.

3.1.2 Business Practice Barriers

Business practice barriers relate to the contractual and procedural requirements for interconnection. Examples include contract length and complexity, contract terms and conditions, application fees, identification of an authorized utility contact, consistency of requirements, operational requirements, timely response, and delays. A summary of business practice barriers are described in Section 3.4.

3.1.3 Regulatory Barriers

Regulatory barriers include matters of policy that fall within the jurisdiction of Provincial Governments (Minister of Energy), energy related regulatory boards/commissions and the Government of Canada. These are issues that arise from or are governed by statutes, policies, tariffs, or regulatory filings by utilities, which are approved by the regulatory authority. Included in this category include such issues as; regulatory prohibition of interconnection, unreasonable backup and standby tariffs, local distribution system access pricing issues, transmission and distribution tariff constraints, independent system operators (ISO) requirements, exit fees, and environmental permitting were put into this category. A summary of regulatory barriers are described in Section 3.5.
3.2 Case Studies

The information gained from the interviews for each of the three project sites was summarized using the barriers mentioned above as a framework for reporting the information and is included in the report as follows;

- **Section 3.2.1** Ontario Dairy Herd Anaerobic Digester Generates 50 kW
- **Section 3.2.2** Saskatchewan Hog Farm Anaerobic Digester Generates 120 kW; and
- **Section 3.2.3** Alberta Outdoor Beef Feedlot Anaerobic Digester Generates 1000 kW

All three of the case study participants experienced some degree of market entry barriers. Despite the market entry barriers experienced; none were so severe to cause any of the reported projects to be abandoned.

### 3.2.1 Ontario Dairy Herd Anaerobic Digester Generates 50 kW

**AD System Background**

The farm is located in Eastern Ontario and is run by two brothers who both live in their own homes at the site. The property is about 500 acres, which supports about 140-150 milking cows. Their electric utility is Hydro One and is served by a single phase 7200 volt line. They are located about two km from the three phase line and are located near the end of the feeder from the Distribution Station (DS).

The methane gas from the anaerobic digester (AD) runs a reciprocating engine, which in turn is connected to a single phase synchronous 60 kW generator. The amount of methane generated is sufficient to run 24/7 and produce more electricity than they can use. The customer is participating in Hydro One’s Net Metering Program up to 50 kW. This means that Hydro One only allows them a maximum generated load of 50 kW and for self load displacement only. Further, their agreement only allows for reconciliation of electrical usage/generation over their billing period and they are not credited for any surplus energy should they have generated it over
the same period. They have the ability, over the period of a day, to generate more energy than their own use and deliver it to the grid. As a result they only run 15 to 18 hours per day generating 700 to 800 kWh for the same period of time.

The installation also includes a transfer switch which allows them to isolate their system from the grid, operate their generator and be self sufficient electrically in the event the Hydro One has an extended outage. Also the heat from the engine and exhaust is used through a heat exchanger to provide heat to the digester and also provides hydronic heating to both owners’ houses.

The whole AD project took 16 months to plan, purchase, install and commission the AD system into service. It took 12 months to complete the utility interconnection process (June 2002 to May 2003). For example, for the first three months, there was no response from the utility. It took to February 2003 to receive a draft interconnection document for review. The agreement was finally signed on May 16, 2003.

**The Utility -- Hydro One**

Hydro One is a provincially owned utility. It has responsibilities for the transmission systems within the province. In addition, they also serve about 1.2 Million retail customers across the province.

On December 9, 2004, the Ontario Government passed the Electricity Act (also known as Bill 100) which will reorganize Ontario’s electricity system to more effectively address the critical need for new supply, increased conservation and price stability for consumers across the Province. Regulated tariffs, approved through the Ontario Energy Board (OEB), apply to the transmission, local distributing costs and energy costs for most customers. The only unregulated, open market force at work is the energy commodity for large industrial and General Service customers. Licensed Retailers are also allowed to enter into contracts with any customer.

On January 5, 2005 the Ontario Government proposed a regulation that would permit “net metering”. Net metering would give credit to customers who generate their own power from renewable resources for any excess electricity they put back into the grid. Currently, net metering is available for projects that produce up to 50 kilowatts at the discretion of local energy distribution companies. The new regulation will require that distributors permit net metering for all eligible projects that produce up to 500 kilowatts. The government is soliciting for comments on the new proposed regulation and it is anticipated it will be enacted in Q2/Q3 2005.

All Local Distributing Companies (LDC’s) including Hydro One are required under the OEB Distribution System Code to provide new generators non-discriminatory access to their systems. The Code includes principles and prescriptive narratives for technical and commercial terms. Included in the prescriptive installation technical requirements includes the adherence to the CSA Ontario Electrical Safety Code.
Hydro One offers the following Embedded Generation services to their customers as follows:

- Net Metering up to 50 kW;
- Retail Generation; and
- Self Load Displacement Generation.


For larger Retailer or Self Load Displacement Generation documentation, it can be found at; [http://www.hydroonenetworks.com/en/electricity_updates/generation/RFP External Tech Reqt.pdf](http://www.hydroonenetworks.com/en/electricity_updates/generation/RFP External Tech Reqt.pdf)

This report will make reference only to the Net Metering Program up to 50 kW.

**Technical Barriers**

The customer purchased a European manufactured generator that did not have the required certification approval for Ontario and hence was subject to special inspection. Also, because of the difference in frequency between North America and Europe, this contributed to the burn out of the generator which had to be replaced. With further control modification, the new generator then operated as expected.

Initially, in the absence of a Net Metering Program, Hydro One issued prescriptive technical and commercial terms intended for much larger installations. An initial deposit was collected from the customer and later returned to carry out an initial assessment of the impact of the proposed 50 kW generator to the distribution system. Under the current Net Metering Program, no system impact assessment study is carried out.

Large voltage fluctuations on the utility feeder line made the Interconnection process difficult. Some parts of the initial technical standard settings provided by Hydro One to the customer were too stringent, causing the generator to trip off unnecessarily. After the customer documented the voltage supply from Hydro One was outside the standard settings and allowed to widen them, no further unnecessary generator trips were experienced.

**Business Practice Barriers**

When the customer first formally contacted Hydro One in June 2002, he did not get a response for three months. However, after a Senior Network Management Engineer was assigned to the case, the process started to move forward which eventually brought about the final connection. At the time, Hydro One did not have a Net Metering Program and were treating each case as a
“one of”. There was also still a transition going on in the organization as a result of the Utility Restructuring Plan. At some point in time, the Ontario Government gave direction to Hydro One to initiate a Net Metering Program. The final documentation as noted above became available in October 2003. This was after the customer was finally connected on May 16, 2003. In the current Net Metering Program, there is a well documented process to follow and Hydro One claim to have staff trained and ready to respond to requests and applications in a timely and constructive manner.

The customer also had to pay for a bi-directional multi-register meter for about $1400 and provide a telephone connection to the meter.

**Regulatory Barriers**

The customer currently cannot net export green generation to the grid for a price without being classified as a Retail Generator.

Another current limitation is that the reconciling of the net import/export of energy at the site is set over a one month period. If you net export energy over that period of time, you are not compensated for it.

To date, the Net Metering Program limits the generated output to 50 kW. As mentioned earlier, in January 2005, the Ontario Government proposed a regulation that would permit “Net Metering” province wide. Net metering would give credit to customers who generate their own power from renewable resources for any excess electricity they put back into the grid. Currently, net metering is available for projects that produce up to 50 kilowatts at the discretion of local energy distribution companies. The new regulation will require that distributors permit net metering for all eligible projects that produce up to 500 kilowatts. The government is soliciting for comments on the new proposed regulation and it is anticipated it will be enacted in Q2/Q3 2005.

This proposed regulation is welcomed; however details cannot be found on possible system reinforcement or expansion that may be required to facilitate the generator connection and how the excess electricity would be credited and the value of it.

**Owner’s Time and Costs to Overcome Barriers**

The owner didn’t experience significant direct costs in overcoming the aforementioned barriers. However, he was not pleased with the extended period of time it took to get the Interconnection Agreement into place.
**Project Owner’s/Partners Proposed Solutions**

- If purchasing equipment, particularly outside of Canada, ensure the equipment is certified to be used in Ontario and the rest of Canada.

- Ensure the proposed legislation in Ontario for Net Metering up to 500 kW is implemented.

- Under the Net Metering Program, allow the customer to net export energy for a fair price to the grid.

- Initiate action to have the Government of Canada provide a premium for generated energy from Renewable Resource Technologies.

### 3.2.2 Saskatchewan Hog Farm Anaerobic Digester Generates 120 kW

**AD System Background**

The hog farm is located in the central part of Saskatchewan and has approximately 1200 sows that produce 28,000 to 30,000 pigs per year. The developer/System Owner of the AD system purchased a parcel of land adjacent to the hog operation and constructed his AD system. He obtains the pig manure in a piped slurry line from the hog producer to his property. The slurry is heated up and placed in the AD. The methane produced from the process is then used to power four – 30 kW three phase Microturbines totaling 120 kW. The electricity generated is delivered directly to the grid operating at 25 kV. The exhaust from the four microturbines is passed through a heat exchanger that transfers the heat to a closed loop back to AD System which heats up the manure slurry before entering the AD. What makes the project somewhat unique is that the microturbines are owned and operated by SaskPower as a demonstration project and the only role the System Owner played in the whole interconnection area was to have entered into a gas sales contract with SaskPower for the methane to run the four microturbines.

The AD project took approximately 12 months to complete. According to the System Owner, it took almost 18 months to complete the gas sales contract with SaskPower. The project was
completed in September 2003, and after commissioning, the first gas was produced on February 1, 2004.

**The Utility – SaskPower**

SaskPower is a provincially owned Crown Corporation, fully regulated and is the principal supplier and distributor of electricity in Saskatchewan.

SaskPower operates a diversified portfolio of generation stations with a total available capacity of approximately 3,500 megawatts (MW). SaskPower maintains more than 152,000 kilometres of power lines, the most extensive network in Western Canada. The customer base is more than 436,000 customers.

The Saskatchewan Government is committed to build a green and prosperous economy through their Green Power Portfolio. The Environmentally Preferred Program (EPP) is a cornerstone of the Portfolio and is helping evaluate viable, environmentally low-impact generation options for the future.

The EPP program was designed to provide the opportunity for SaskPower to partner with independent power producers to build and operate smaller-scale generation projects. Such projects will help SaskPower in its goal to provide for new load-growth to the year 2010 with environmentally low-impact generation that produces no new greenhouse gas emissions. The program is also a venue to evaluate technologies such as the AD System currently available for smaller-scale generation. Part of the process in implementing the EPP initiative was to listen to what independent power producers were saying, to be flexible and to revise the program where it could be improved.

Last year, the first phase of the program resulted in three project proposals totalling approximately 13 MW being selected. This year, in the second phase the remaining 32 MW will be selected. SaskPower has already received Expressions of Interest for additional EPP projects. These are currently being evaluated to identify those projects that meet the environmental objectives for the program. SaskPower plans to issue a formal Request for Proposals to those proponents with qualified projects. SaskPower will select the remaining 32 MW of the 45 MW program from the formal proposals. Interested parties had until March 22, 2005 to submit projects that meet the program’s environmental criteria and fall within the expanded capacity guidelines of 100 kilowatts (kW) to 25 megawatts (MW).

SaskPower has two Interconnection Requirement documents as posted on their Website:

- Non-Utility Generation Interconnection Requirements at Voltages 25 kV and Below; and
Non-Utility Generation Interconnection Requirements at Voltages 72 kV and Above
http://www.saskpower.com/services/nug/NUG72kV.pdf

Technical Barriers
In concert with the EPP, SaskPower owns and operates a number of enabling technology demonstration projects. By owning them it gives them first hand information on how they function in terms of reliability and availability. Unfortunately, results from some of the projects have not been too encouraging. However, they are committed to seeing the projects through to completion.

Business Practice Barriers
The System Owner expressed the view that the time to complete the gas sales contract was too long.

The typical connection charge is $350 and the customer has to pay for a bi-directional multi-register meter.

The Commercial Terms Agreement was not available. However the SaskPower representative quoted a rate of 3.126 cents per kWh. For installations larger than 100 kW, the rate is bid and negotiated as most are being awarded through the RFP process of the EPP.

In Saskatchewan, SaskPower is divided into four Regions. For small installations less than 100 kW, the customer deals with the Regional staff directly. For projects greater than 100 kW, the Regional Engineering Supervisor gets involved along with a Head Office person. For formal execution of the Interconnection Agreements, it was acknowledged the process needs to change to delegate the responsibility downward in the organization. Also SaskPower does not have a Net Metering Program underway but recognized it as a potential program in the future.

SaskPower acknowledged the Interconnection Agreement needed to be simplified and shortened.

Regulatory Barriers
At present there is no premium offered for energy created by renewable resource technologies such as biomass.

There is also no program in place to be compensated for accruing Green House Gas or Carbon Credits.
Owner’s Time and Costs to Overcome Barriers

The owner didn’t experience significant direct costs in overcoming the aforementioned barriers. However, he expressed some frustration in the extended period of time it took to complete the Sales Agreement.

Project Owner’s Proposed Solutions

- From the recent Federal Government Budget, the System Owner expressed optimism in the accelerated capital cost allowance (CCA) increased rate for Renewable resource technologies to 50% from the 30%.
- Lobby the Government of Canada to pay a premium for every kW. h produced by AD Systems.
- Also lobby for compensation for accruing Green House Gas or Carbon Credits.

3.2.3 Alberta Outdoor Beef Feedlot Anaerobic Digester Generates 1000 kW

AD System Background

This large outdoor finishing beef feedlot operation is located east of Edmonton, AB. The ranch is approximately 5500 acres in size and the feedlot operation is about 320 acres. It has standing capacity of 38,000 cattle, handling a total of 60-70,000 head per year. The Incorporated owners entered into an exclusive license agreement with the Alberta Research Council and the Government of Canada to develop a technology that converts manure into energy, bio-based fertilizers and reusable water, while reducing greenhouse gas emissions and...
other environmental impacts. The first phase demonstration project was set up adjacent to the owners’ feedlot.

The CHP installation is large. The methane gas from the AD runs a V20 reciprocating engine, which in turn is connected to a three phase synchronous 999 kW de-rated nameplate generator. The generated electricity is transferred to the three phase 25 kV distribution system owned by ATCO. The owner had to apply to the Alberta Energy and Utility Board to be licensed as a Power Pool Participant (generator on the grid) and gets an hourly price settlement from the Alberta Electricity System Operator. It is classified as a non dispatchable generator. For any electricity taken from the grid for both the AD System site and the feedlot operation, it is purchased through a separate Retailer.

There is a separate electrical service entrance for the feedlot operation which uses about 240 kW peak power and about 140 kW average power level.

The heat generated from the engine is used to pre-heat the water to be mixed with the dry manure. Currently the AD System is using about 20% of the manure to produce 1000 kW. The target is to use up to 60-70% of available manure that could produce up to 3000 kW. The 30% remaining manure will be used for fertilizing the owners’ fields.

The whole project took about 18 months to plan, purchase, install and commission the AD System into service (May 03 to Nov 04). The initial contact with ATCO to discuss interconnection issues occurred in May 03 and not very much happened for about seven months. After a Commercial Services co-ordinator from the ATCO Calgary office was appointed, the process started to move along. The total lapsed time to obtain the Interconnection Agreement with the Utility was 14 months (May 03 to July 04).

**The Utility – ATCO Electric**

The Province of Alberta, like many other jurisdictions around the world, has opened its electric power industry to competition. In this province, the shift to competition began with the Electric Utilities Act, which took effect in January 1996. In spring 2003 the Government of Alberta passed into law the new *Electric Utilities Act (EUA)* and two related regulations: the *Market Surveillance Regulation* and the *Code of Conduct Regulation*. The EUA is legislation that makes key changes to Alberta's electrical industry structure. Its fundamental component is the creation of the Alberta Electric System Operator, bringing the functions of the Power Pool and the Transmission Administrator into one statutory corporation. It also creates separate corporations and governance for the Market Surveillance Administrator and the Balancing Pool.

The *Code of Conduct Regulation* AR 160/2003 (Code) applies to the retail electricity market in Alberta. The objects of this regulation include creating a level playing field for retailers, while at the same time ensuring that customers and customer information are adequately protected.
Competition in the retail market is working reasonably well in the commercial/industrial segment. However, it remains thin at the residential level as consumers continue to be slow in moving off regulated default supply.

ATCO Electric is an investor owned utility serving more than 169,000 customers in the northern and east-central Alberta as well as parts of the Northwest Territories and the Yukon. ATCO Electric delivers power to homes, farms and businesses, in cities, town, Native Reserves and Metis Settlements – more than 200 communities in all. It is also the supplier of electricity to the Outdoor Beef Feedlot Anaerobic Digester Project east of Edmonton.

As a result of the deregulated market, power producers were provided open access and allowed access to the distribution and transmissions systems. They are now able to sell electrical energy directly to the AESO and receive financial compensation based on the open market price. ATCO Electric, as a distributor, has a number of technical and prescriptive documents available to customers who are interested in being a power producer. However, Alberta does not have a Net Metering Program that allows renewable type technologies to be easily connected to the grid. To date ATCO has completed about 50 projects involving interconnection of generators to their system.

The following ATCO internet site provides a whole list of documents to assist with the interconnection of generators to ATCO Electric’s distribution system. The charge to carry out the initial engineering assessment ranges from $300 to $1500. Further charges occur if additional studies are required. It should also be noted that as part of the Commercial Terms, Tariff Schedule D32 is applied. This price schedule comprises the delivery charges for generating customers who require standby power to on-site load. It also addresses the manner in which operations & maintenance charges and administration & general charges are applied to the incremental interconnection costs charged to the generating customer.


**Technical Barriers**

As the AD System used a large synchronous generator, three studies were carried out by ATCO to determine the suitability of the generator to the distribution feeder, station and transmission facilities. The customer and his consultant felt that there was too much concern of islanding and the protective systems required to prevent it. There was a question whether it should be based on voltage control or power factor control.

After the Utility provided the operating protective settings and were installed on the AD System, the generator frequently tripped off. The reason was the settings were too restrictive for the actual operating conditions of the feeder line. After the consultant demonstrated the actual operating conditions of the line, the customer was allowed to widen the settings. After installing the new settings, there were no further inadvertent generator trips.
Business Practice Barriers

Initially, there was a delay in ATCO’s response to the customers’ initial approach to be connected. However, once he retained a consultant with distribution and interconnection experience, the process moved along much faster. It was also greatly helped by the appointment of an ATCO Commercial Services person from Calgary that acted as the champion for the customer within his organization and acted as a facilitator for both parties in meeting the timelines agreed to at one of the meetings. ATCO feels, that while the initial response was unacceptable, their organization has gone through a learning experience and is better trained and willing to respond to such requests. A “cookie cutter” approach can’t be used for these types of projects. Each proposal needs to be reviewed on an individual basis.

There was also a delay in obtaining a permit from the Alberta Energy and Utility Board to be licensed as a Power Pool Participant. The ATCO representative helped facilitate the application and approval was granted.

Regulatory Barriers

For smaller AD System installations e. g. <500 kW, there is no Net Metering Plan in place for Renewable Technologies in Alberta. Such a program would encourage more installations with its simplicity and low cost. Also for smaller systems that don’t qualify to be a power pool participant there are no means available to be compensated for green energy that is net generated to the grid?

From the customer’s perspective, there is a general concern, that depending where your facility is in relation to the distribution network, you could experience substantial fees to upgrade the distribution facilities initially to accept your generated output or later should you plan to increase your output. This customer sees it as a potential problem as he plans to increase his generated output in the near future.

At present there is no premium offered for energy created from AD Systems and GHG or carbon credits.

Owner’s Time and Costs to Overcome Barriers

The owner didn’t experience significant direct costs in overcoming the aforementioned barriers. However, he expressed some frustration in the extended period of time it took to get the Interconnection Agreement into place.

Project Owner’s/Partners Proposed Solutions

- From a project planning perspective, be better prepared in knowing the “rules” and what to expect.
For large projects, retain the services of a Consultant with experience in electrical distribution networks and interconnection.

Have the Utility rethink the protective schemes that would focus on criteria to keep customer generators on line as long as possible when disturbances occur, rather than having them trip off early to avoid islanding conditions.

To help and support the development and deployment of renewable resource technologies, the Government of Canada initiate a Renewable Power Incentive.

Promote the idea of the Government of Canada to purchase offset credits for Green House Gases (GHG) accruing from renewable resource technologies such as biomass.

3.3 Summary of Technical Barriers Reported

Many of the technical barriers to distributed power relate to the utility’s responsibility to maintain the reliability, safety, and power quality of the electric power system. All three utilities interviewed had good technical interconnection requirements. Typical technical barriers encountered in the case studies are interconnection requirements that the utility may unnecessarily require to ensure reliability, safety, and power quality. These may include:

- Over concern of “islanding” condition;
- Power quality requirements; and
- Power flow studies and other engineering analyses.

3.3.1 Safety Standards

The principal safety concern among utilities with respect to connecting generation equipment to the grid is protection against “islanding,” the condition where a generating facility continues to supply power to a portion of the grid when the balance of grid has been de-energized (during a power outage, for example). This condition is of concern in two scenarios: where the distributed generator is either “feeding a short circuit” thus potentially causing a fire, and where a lineman might mistakenly come in contact with what is otherwise thought to be a de-energized line. On one project, the consulting engineer indicated that in his opinion the extra studies undertaken to examine it further were unnecessary.

In one case study, as the AD System used a large synchronous generator, three studies were carried out by the utility to determine the suitability of the generator to the distribution feeder, station and transmission facilities. The customer and his consultant felt that there was too much concern of islanding and the protective systems required to prevent it. There was a question whether the protective system should be based on voltage control or power factor control.
Also, in one of the case studies, the owner purchased some of his equipment from Europe. Unfortunately, the equipment was not CSA certified and approved, so he had to pay fees to the Electricity Safety Authority to carry out a special inspection in order for it to be used.

3.3.2 Power Quality Standards

Power quality concerns include voltage and frequency disturbances, voltage flicker, and waveform distortion. Distributed power facilities, like central-station facilities, can have either a detrimental or a beneficial effect on power quality. All three Utilities had good Interconnection documents that included the customer protective settings for the above power quality terms. However, in two of the three case studies, they experienced frequent generator trips.

After the Utility provided the operating protective settings and were installed on the AD System, the generator frequently tripped off. The reason was the settings were too restrictive for the actual large voltage fluctuations on the feeder line. After the consultant demonstrated the actual operating conditions of the line, the customer was allowed to widen the settings. After installing the new settings, there were no further inadvertent generator trips.

3.3.3 Local Distribution System Capacity Constraints

The general approach among utilities in dealing with local distribution system capacity constraints is to conduct pre-interconnection studies before interconnecting distributed generators. These studies evaluate the potential effects of the distributed generating facility on the specific portion of utility system to be affected, and determine whether any upgrades or other changes are needed to accommodate the generating facility. The cost of these studies usually is passed on to the distributed generator. This practice is often blessed by the regulatory bodies under the “user pays” principle.

Two of the three case studies identified general concern in this area. Their main focus was if they wanted to increase the size of their load, they could be looking at substantial costs to strengthen the system to accommodate the new load.

3.4 Summary of Business Practice Barriers Reported

Business practices for these purposes include the contractual and procedural requirements imposed by the utility before it allows interconnection. All such business practices are, in principle, subject to regulatory authority. The question is how well is this being monitored and reported?

The practices that most often create barriers centered around the following:

- Lack of response after initial utility contact requesting interconnection; and
Application and interconnection fees.

### 3.4.1 Lengthy Time to Complete Process

In all three case studies there were complaints of the lengthy time taken to receive final approval for interconnection. For all three case studies, the time taken to get interconnection approval ranged from 12 to 18 months. However, all of the case study owners indicated they didn’t experience significant direct costs in overcoming the interconnection barriers.

In fairness to the three utilities, when the three applications were made in the 2002/03 year period, these projects were one of the first ones for each of the utilities. As a result internal administrative procedures were developed and technical and commercial agreements were created/improved. Again the owners in all three case studies acknowledged that once a Customer Service representative was assigned to the project, that person helped facilitate the process through to completion.

Another reason for the process to be improving is the different regulatory codes that are being created by the provincial energy boards/commissions. For example in the Ontario Distribution System Code, it provides principles and prescriptive technical and commercial requirements for connecting embedded generators. In addition there is a time expectation to carry out the work in accordance with the Customer Service Performance Based Regulation for Distributors.

### 3.4.2 Fees Charged

In one case study, the owner offered his opinion that the interconnection charges were excessive. Also one utility had a special rate which comprised of the delivery charges for generating customers who require standby power for on-site load. It also addresses the manner in which operations & maintenance charges and administration & general charges are applied to the incremental interconnection costs charged to the generating customer.

From one case study owner’s perspective, there was a general concern, that depending where your facility is in relation to the distribution network, you could experience substantial fees to upgrade the distribution facilities initially to accept your generated output or later should you plan to increase your output. This customer sees it as a potential problem as he plans to increase his generated output in the near future.

One Case study owner also expressed how a meter for a 50 kW project could cost ~$1400? The meter is a smart demand meter that includes a bi-directional multi-register and telephone communications capabilities.
3.5 Summary of Regulatory Barriers Reported

From the three case studies, the following Regulatory Barriers were noted:

- Unavailability of fair buy back rates;
- Lack of Net Metering Programs across Canada;
- Restrictive terms on existing Net Metering Program; and
- Lack of Federal Government Programs to support premium payment for green generated electricity and to purchase offset credits for Green House Gases (GHG) accruing from renewable resource technologies such as biomass.
4 Conclusions

AD System owners/developers, stakeholders and utility staff from three projects across Canada were interviewed to record problems that were encountered in seeking utility grid interconnections. The comments put forth in this study present the barriers from the perspective of the proponents as documented from the personal interviews carried out with each case study group. All AD project applications for interconnection were made between 2002 and 2003. The comments received show that the barriers are very real and they can block what otherwise appears to be valuable projects. Of the three case studies, almost all of them reported at least one barrier in each of the categories: technical, business practice, and regulatory.

Technical barriers principally centered on equipment or testing required by utilities for safety, reliability, and power quality. Project proponents often felt that these requirements were unnecessarily costly because of their over concern for distribution protection, the initial tight power quality protection settings and capital costs associated with possible local distribution system capacity constraints.

For Business Practice Barriers reported, the most common problem was the difficulty and length of time to complete the necessary agreements. In all cases, once a Utility Customer Service representative was appointed to the projected, it went much smoother. The other major business practices barrier included fees charged for connection and metering costs for a small project.

Regulatory Barriers reported included; the unavailability of fair buy back rates, particularly for smaller projects; restrictive terms on existing Net Metering program; lack of Net Metering Programs across Canada; and a lack of Federal Government Programs to support premium payment for green generated electricity and to purchase offset credits for GHG accruing from renewable resource technologies such as biomass.
5 References

Making Connections;
Case Studies of Interconnection Barriers and their impact on Distributed Power Projects
May 2000, National Renewable Energy Laboratory

ManureNet
http://res2.agr.ca/initiatives/manurenet/en/man_digesters.html#Selecting


Hydro One; For larger Retailer or Self Load Displacement Generation documentation, it can be found at; http://www.hydroonenetworks.com/en/electricity_updates/generation/RFP_External_Tech_Reqt.pdf

SaskPower Interconnection Requirement documents;

- Non-Utility Generation Interconnection Requirements at Voltages 25 kV and Below; and http://www.saskpower.com/services/nug/NUG25kV.pdf
- Non-Utility Generation Interconnection Requirements at Voltages 72 kV and Above http://www.saskpower.com/services/nug/NUG72kV.pdf

ATCO Electric; Interconnection Requirements;

Government of Canada;February 23, 2005 Budget
6 Link to Stakeholders Web Sites

Agriculture and Agri-Food Canada
http://www.agr.gc.ca/index_e.phtml

Natural Resources Canada
http://www.nrcan.gc.ca/inter/index_e.php

Ontario Ministry of Agriculture and Food
http://www.gov.on.ca/OMAFRA/

Ontario Federation of Agriculture
http://www.ofa.on.ca/sitehome.asp

Dairy Farmers of Ontario
http://www.milk.org

Canadian Cattlemen’s Association
http://www.cattle.ca/

The Federation of Canadian Municipalities (FCM)
http://www.fcm.ca/newfcm/Java/frame.htm

IPPSA
http://www.ippsa.com/

APPrO, the Association of Power Producers of Ontario
http://www.newenergy.org/

Canadian Distributed Resources Association (CANDRA)
www.ceatech.ca/special_groups.html

Electro-Federation Canada
www.electrofed.com

CANMET Energy Technology Center - Varennes
http://ctec-varennes.nrcan.gc.ca

PowerConnect
http://www.powerconnect.ca

Canadian Electricity Association
http://www.canelect.ca/english/home.html
APPENDIX A

Survey Forms Used to Interview Project Owners/Developers and Utility Personnel
NRCAN
ON-FARM ANAEROBIC DIGESTER
GRID INTERCONNECTIONS
PROJECT OWNER/DEVELOPER SURVEY FORM

Please Complete Survey Prior to On-Site Interview
If you have any questions please contact;
Wayne Ruhnke
Ruhnke Consulting Inc.
wruhnke@sympatico.ca
(905) 420-8059

1 SURVEY PARTICIPANTS INFORMATION
Please provide the following information. Place an X in any of the check boxes that are applicable to your project. Throughout the survey, additional space is provided for any comments you would like to make.

1.1 Confidentiality
The information gathered through this survey will be included in a report that will be made available to the general public.

1.2 Interviewer

<table>
<thead>
<tr>
<th>INTERVIEWER:</th>
<th>WAYNE RUHNKE</th>
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<tr>
<td>PROPOSED INTERVIEW DATE AND PLACE:</td>
<td>ACTUAL INTERVIEW DATE:</td>
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1.3 Project Owner

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<th>OWNERS NAME(S)</th>
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| PHONE NUMBER(S): | EMAIL: |

1.4 Project Developer

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| PHONE NUMBER(S): | EMAIL: |
1. 5 Utility Providing Grid Interconnection

PROGRAM NAME:
UTILITY’S CONTACT NAME(S):
ORGANIZATION NAME:
MAILING ADDRESS

PHONE NUMBER(S):
EMAIL:

2 PROJECT INFORMATION

2. 1 Details of Generator Connected to Anaerobic Digester

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<tr>
<th>TYPE OF GENERATOR:</th>
<th>SYNCHRONOUS □</th>
<th>INDUCTION □</th>
<th>INVERTER □</th>
<th>UNKNOWN □</th>
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<tr>
<td>RATED GENERATION</td>
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<tr>
<td>CAPACITY (KW)</td>
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<td>CAPACITY FACTOR OR</td>
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<td>DUTY CYCLE:</td>
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2. 2 Other Project Details

| DURATION (MO.) TO COMPLETE THE WHOLE PROJECT |
| DATE PROJECT BROUGHT ON LINE (IF PROJECT ABANDONED PLEASE INDICATE): |
| DURATION (MO.) TO COMPLETE THE UTILITY INTERCONNECTION PROCESS |
| DATE OF FIRST CONTACT WITH UTILITY |
| DATE UTILITY GAVE FINAL APPROVAL |
| TYPE(S) OF POWER APPLICATION: | POWER QUALITY | ENERGY PRODUCTION |
| RELIABILITY | GREEN MARKET SUPPLY |
| PEAK CLIPPING | CHP |
| OTHER |
| DESIGN CONFIGURATION: | ON WHAT SITE? |
| CONNECTED TO WHAT FACILITIES? |
| TO RUN UNDER WHAT CONDITIONS? |
| POTENTIAL BENEFITS: | RENEWABLE |
| ONSITE GENERATION |
| OTHER |
3. POSSIBLE TYPES OF BARRIERS ENCOUNTERED

3.1 Technical Barriers
Utility requirements are necessary to ensure interconnected generators are compatible with the grid from an engineering and operations perspective. Following are some examples of potential Technical Barriers you may have experienced. Please check off those that directly affected your installation.

Examples

3.1.1 Requirements for protective equipment and safety measures to avoid hazards to utility property and personnel.

3.1.2 Power quality in the grid

3.1.3 Equipment and custom engineering analysis

3.1.4 Other(s) (describe)

Please describe the barrier(s) checked off above.
3.3 Regulatory Barriers

These types of potential barriers are primarily posed by utility rate structures and various permitting agencies applicable to customers who install distributed generation facilities. Following are some examples of Regulatory Barriers you may have experienced. Please check off those that directly affected your installation.

Examples

3.3.1 Commodity Pricing including buy back rates (net metering/billing)

3.3.2 Monopoly Distribution including discounting, backup or standby charges, uplift charges and utility rules.

3.3.3 Market Rules including size limits (maximum kW connected), transmission charges, stranded debt, IMO rules, ancillary service charges, scheduling and loss imputation.

3.3.4 Permitting including municipal, Building Code, Electrical Inspection, environmental etc.

3.3.5 Technical Standards e.g. Utility Distribution standards, CSA standards for project equipment, installation, interconnection and ongoing operations.

3.3.6 Other(s) (describe)

Please describe the barrier(s) checked off above.

3.4 Pivotal Barrier

3.4.1 Description of Pivotal Barrier
Please describe the Pivotal Barrier relating to grid interconnection issues that was most crucial in your project.

3.5 Other Barriers
Please list the other barriers relating to grid interconnection issues in descending order along with any other barrier(s) not previously mentioned.

3.6 Time and Costs to Overcome Barriers
Please estimate;
The estimated time (hrs.) spent on grid interconnection issues; and

Direct costs ($) you experienced in overcoming the grid interconnection barrier(s) for your project to succeed.

3.7 Other Comments
Please provide any other comments/concerns, positive or negative you may have regarding your experience in successfully implementing your Anaerobic Digester Grid Interconnection Project.
4 LESSONS LEARNED

Please provide a summary of your “Lessons Learned” from implementing your Anaerobic Digester Grid Interconnection Project.

5 PROPOSED SOLUTIONS

Please provide suggestions and ideas that would improve the overall effectiveness of implementing an Anaerobic Digester Grid Interconnection project similar to your project.
Please Complete Survey Prior to On-Site Interview
If you have any questions please contact;
Wayne Ruhnke
Ruhnke Consulting Inc.
wruhnke@sympatico.ca
(905) 420-8059

1 SURVEY PARTICIPANTS INFORMATION
Please provide the following information. Place an X in any of the check boxes that are applicable to your program. Throughout the survey, additional space is provided for any comments you would like to make. Also please provide an electronic copy of your Net Billing/Metering Program and Interconnection Agreement.

1.1 Confidentiality
The information gathered through this survey will be included in a report that will be made available to the general public.

1.2 Interviewer

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2.0 UTILITY GRID INTERCONNECTION PROGRAM INFORMATION

2.1 Main Offerings of Program

2.2 Other Program Details
3 POSSIBLE TYPES OF BARRIERS ENCOUNTERED

3.1 Technical Barriers
Utility requirements are necessary to ensure interconnected generators are compatible with the grid from an engineering and operations perspective. Following are some examples of potential Technical Barriers that customers may have experienced. Please check off those that are addressed as part of your Program offering.

Examples

3.1.1 Requirements for protective equipment and safety measures to avoid hazards to utility property and personnel.

3.1.2 Power quality in the grid

3.1.3 Equipment and custom engineering analysis

3.1.4 Other(s) (describe)

Please describe the barrier(s) checked off above.
### 3.2 Business Practice Barriers
These potential barriers could arise from contractual and procedural requirements for Interconnection. Following are some examples of Business Practice Barriers that customers may have experienced. Please check off those that are addressed as part of your Program offering.

**Examples**

#### 3.2.1
- [ ] Utility obstructing the Project.

#### 3.2.2
- [ ] Lack or utility experience dealing with the issues.

#### 3.2.3
- [ ] Utility was unfamiliar with the process (had no standard procedures to follow).

#### 3.2.4
- [ ] Utility had not designated a point of contact person for distributed generation projects.

#### 3.2.5
- [ ] Lack of procedures for approving Interconnection Applications, interconnection fees, insurance requirements and operational requirements.

#### 3.2.6
- [ ] Other(s) (describe)

Please describe the barrier(s) checked off above.
3. 3 Regulatory Barriers
These types of potential barriers are primarily posed by utility rate structures and various permitting agencies applicable to customers who install distributed generation facilities. Following are some examples of Regulatory Barriers customers may have experienced. Please check off those that are addressed as part of your Program offering.

Examples

3. 3. 1
☐ Commodity Pricing including buy back rates (net metering/billing)

3. 3. 2
☐ Monopoly Distribution including discounting, backup or standby charges, uplift charges and utility rules.

3. 3. 3
☐ Market Rules including size limits (maximum kW connected), transmission charges, stranded debt, IMO rules, ancillary service charges, scheduling and loss imputation.

3. 3. 4
☐ Interconnection Agreement

3. 3. 5
☐ Technical Standards e. g. Utility Distribution standards, CSA standards for project equipment, installation, interconnection and ongoing operations.

3. 3. 6
☐ Other(s) (describe)

Please describe the barrier(s) checked off above.
3. 4  Pivotal Barrier

3. 4. 1  Description of Pivotal Barrier
Please describe the Pivotal Barrier relating to grid interconnection issues that you see as most crucial in preventing your Program to be more successful.

3. 5  Other Barriers
Please list the other barriers relating to grid interconnection issues in descending order along with any other barrier(s) not previously mentioned.

3. 6  Program Tie-in to Corporate Goals and its Cost Effectiveness
Please describe the connection of the Net Billing/Metering and Grid Interconnection Program to your Corporate Goals.

Please describe the results obtained to date from your Program and the cost effectiveness of it.
3. 7 **Other Comments**
Please provide any other comments/concerns, positive or negative you may have regarding your experience in successfully implementing your Program, with emphasis towards Anaerobic Digester Grid Interconnection Projects.

4 **LESSONS LEARNED**

Please provide a summary of your “Lessons Learned” from implementing your Program, with emphasis towards Anaerobic Digester Grid Interconnection Projects.

5 **PROPOSED SOLUTIONS**

Please provide suggestions and ideas that would improve the overall effectiveness of implementing more projects through your Program with an emphasis on Anaerobic Digester Grid Interconnection projects.