GREEN MATTERS
A newsletter from the Alberta Environmentally Sustainable Agriculture Council

Fuelling the Future

From AESA Council's Past Chair

By Bruce Beattie
Alberta Milk

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Crops like wheat are feedstocks that can be used for bioenergy production.

This issue of *Green Matters* takes another look at the development of energy production from biomass. Modern society has become almost totally reliant on a continuous and bountiful supply of relatively cheap energy, generated primarily by the burning of non-renewable fossil fuels. As evidence mounts about the negative effects on our environment from the emissions resulting from this activity, interest in finding alternative fuel sources has blossomed. Canadian agriculture is stepping forward to capture its share of this development.

WHAT'S INSIDE

Issue 29, Fall 2006

Low returns from traditional markets have been one of the drivers for the Canadian grains sector to consider bioenergy opportunities. The move to large, intensive livestock production has created nutrient management challenges, with biogas production providing an option to address some of the problems associated with dealing with large volumes of manure in a concentrated area. Agricultural processors are looking at bioenergy production as a way to deal with their processing wastes and reduce their energy costs.

High capital cost is one of the hindrances to adopting many of these technologies. While farmers are no strangers to risk management, the level of investment required necessitates a search for partners in these new ventures. Governments at most levels have recognized that they have a role to play, including providing some funding assistance to help bioenergy entrepreneurs with a range of activities like feasibility studies, pilot projects and facility construction. These projects are not unlike other investments that governments have made in infrastructure that benefits all society. Innovative taxation strategies can also facilitate these new ventures.

Along with any government role must also come a careful analysis of the potential for unintended and possible long-term consequences on the landscape as well as distortion of true value when subsidies and grants are provided to some of the players. Corn is the major component of ethanol production in the United States, but without subsidies and tariff protection, where would that industry be today? Vast areas of mono-culture, without adequate crop rotation could lead to increased disease and pest outbreaks, soil degradation, and loss of biodiversity.

There are many questions still to be answered and issues to consider about bioenergy. Ethanol contains only about two-thirds as much energy as gasoline; the higher the concentration of alcohol in fuel, the more fuel you have to use to go the same distance. Biodiesel blends can reduce engine wear and are more benign in emissions, but present problems for cold climate operations as the proportion of biodiesel increases. Also a network of biofuel blending and distribution facilities will need to be developed. The major players will be hesitant to invest in that infrastructure without a significant market demand for biofuels.

Bioenergy production is just one part of a suite of renewable energy strategies that together can reduce our collective impact on the environment. Together with solar, wind and geo-thermal, to name a few, science continues to search for ways to reduce emissions, and perhaps slow the rate of climate change.

Work needs to continue, with the development of pilot plants to learn about these technologies, to build knowledge around production and distribution in a Canadian context. It takes energy to produce energy whether fossil or biomass, but transport and transmission are also significant costs in both economic and environmental terms.

Farmers have been producing biofuel for centuries – it's called food. Now a new market has arisen, and the agriculture sector is intent on playing a major role.

Growing the Biogas Industry:
Methane from Alberta's Ag & Food Sector

Highmark Renewables Inc

Anaerobic digester and energy cogeneration plant near Vegreville

Interest in biogas production in Alberta is being driven by such factors as rising energy prices and the need to address issues like manure management, waste management and odour. Although the capital costs for biogas facilities are high, the long-term economic and environmental benefits make these facilities good options in some situations. Now the Alberta Government is offering three programs to help grow bioenergy production, including biogas, in the province.

Biogas is produced through anaerobic digestion. In this process, anaerobic bacteria (bacteria that don't need oxygen) convert carbon in materials like food processing wastes into various gases, mostly methane and carbon dioxide. The methane can be used to replace natural gas (which is about 90% methane) or produce electricity. Methane is a greenhouse gas, so collecting it reduces greenhouse gas emissions. Collecting the gas emissions also reduces odours. Heat from the process can be used for things like heating farm buildings. The digestion process also results in a compost-like biofertilizer. And, by adding water treatment equipment, the system can treat the wastewater for re-use.

Alberta already has five biogas facilities (see table). "I think it's kind of neat that we are in a hydrocarbon province and we've got more biogas projects than, say, Saskatchewan or Manitoba. It shows great vision on the part of the people who developed the projects," says Jim Jones, a Business Development Specialist with Alberta Agriculture and Food.

Common feedstocks for biogas production are manure (from hog, beef, dairy or poultry operations) or food processing wastes (for example, from dairy, meat or vegetable processing). Another feedstock option, which is in use in Europe, involves crops like wheat, barley, alfalfa and ryegrass that are cut as silage and used to generate biogas in a digester process called dry fermentation.

Europe is about a decade ahead of Canada in biogas development. Jones was part of an Alberta biogas mission to Europe last year, and he and others at Alberta Agriculture keep an eye on bioenergy developments in other jurisdictions to learn from them and develop better opportunities in Alberta.

The capital costs for biogas facilities are a major challenge for expanding the industry. For instance, the capital cost for a 1-megawatt facility is between about $4 and $7 million, depending on the facility's specific infrastructure. Jones says, "That would probably include two to three digesters with an engine, the cleaning-up equipment – to [clean the water for re-use] and remove the carbon dioxide and hydrogen sulphide from the methane – and the control room, as well as the cost of connecting to the electrical grid."

Payback time depends on a facility's capital and operating costs and its ability to capture value-added opportunities. Jones notes some typical payback periods: "Manure doesn't generate that much methane, so the payback is about 10 years. For dry fermentation of plant materials, the payback is about four to six years. And for food processing wastes, the payback is about three to four years – that tells you how much methane is being generated from those wastes."

In October 2006, the Alberta Government announced $239 million in programs to expand bioenergy production in the province. The $24-million Biorefining Commercialization and Market Development Program provides cost-shared funding for such things as feasibility studies, equipment costs, worker training, and marketing. The $6-million Bioenergy Infrastructure Development Program provides cost-shared funding for capital projects. Both programs run from 2006 to 2009. The remaining $209 million is a credit program for Alberta manufacturers of bioenergy; it runs from 2007 to 2011.

About 20 biogas projects are in various stages of development in Alberta. Jones feels the long-term potential for biogas production could be similar to that achieved by Alberta's wind power industry.

For information about biogas production, visit www.climatechangecentral.com and type 'biogas conference' into the search engine. For information on the Alberta Government's bioenergy programs, call the Ag Info Centre at 310-FARM (3276).

Biogas Facilities in Alberta

Company, Location	Feedstock	Purpose
Cargill Foods, High River	meat processing wastes	methane replaces some of the natural gas used to operate facility; odour reduction
Lamb Weston, Taber	potato renderings from potato processing	methane replaces some of the natural gas used to operate facility
Highmark Renewables, Vegreville	feedlot manure	electricity for sale to the grid; energy for operating the facility; manure management; biofertilizer
Iron Creek Hutterite Colony, Viking	various types of livestock manure and slaughterhouse wastes	energy for operating the facility; electricity for sale to the grid; manure management; water conservation; odour reduction
Peace Pork, Falher	hog manure	odour reduction; manure management

Biodiesel & Ethanol Production in Alberta

Commercial production of transportation biofuels is in its infancy in Alberta. It has some exciting potential benefits for rural economies and the environment, as well as some uncertainties.

Ethanol and biodiesel are the two main types of transportation biofuels. Ethanol is produced from carbohydrates – such as starch from grain or sugar from sugar cane – using a fermentation-distillation process. On the prairies, wheat is the main feedstock. Grain-based ethanol production yields a byproduct called distillers grain, which can be used as a high-protein feed.

Biodiesel is made from vegetable oils, like canola oil, or animal fats. It is produced by mixing the fat or oil with methanol and a catalyst. One byproduct is glycerine, which has a wide range of possible uses such as in cosmetics and pharmaceuticals.

Both biofuels are used as additives: ethanol is blended with gasoline and biodiesel with petroleum diesel. In comparison to the straight petroleum products, the blends provide advantages like reduced tailpipe emissions, lower greenhouse gas emissions and improved engine performance, as well as new market opportunities for the agricultural feedstocks.

"These two products are added to transportation fuels in relatively small percentages," explains Alan Ford of Alberta Agriculture and Food. "For ethanol, blends up to E10 (10% ethanol) are quite common and require no engine modifications. Blends as low as B2 (2% biodiesel) have some beneficial performance improvements. For blends higher than about B20, you have to be aware of how the engine will operate in cold conditions." Biodiesel use doesn't require engine modifications.

Capital costs for ethanol plants are fairly high; for example, a plant with a 150-million-litre annual capacity would cost about $130 million. The only commercial ethanol plant in Alberta is Permolex International's facility in Red Deer, which also produces flour, gluten and feed. The plant's current ethanol capacity is about 28 million litres per year. Construction is underway to expand that to about 40 million litres.

At present Alberta has no commercial biodiesel production, although there are two proposed plants. The relatively low cost for small-scale biodiesel production is sparking interest in farm-level and community-based production (see *Home-Grown Biodiesel*).

Because ethanol and biodiesel can be made from agricultural feedstocks, their production could lead to rural development opportunities. "We've got the capacity in terms of feedstock supplies to produce these products. The thing that is missing is the market demand that would pull it into transportation fuel market," says Ford.

> "We've got the capacity in terms of feedstock supplies to produce these products."

To create that demand, the federal government has proposed enacting a standard that would require Canada's transportation fuels to have a 5% renewable fuel content. Many jurisdictions, including the United States, already use this type of requirement to encourage biofuel production and use. If a national standard is put in place, the next challengewould be satisfying that demand, explains Ford. For example, about 5.5 billion litres of gasoline are used annually in Alberta, so a 5% standard would involve about 275 million litres of ethanol just for Alberta. He says, "It's very difficult to start at relatively small volumes and work with the petroleum retailers that deal in hundreds of millions of litres."

The federal government already has various policies and programs to encourage biofuel production and use, as have many provinces, including all three Prairie Provinces. Manitoba's Biofuels Act includes an E10 mandate, as well as measures to encourage community participation in production and use of Manitoba-grown feedstock. Saskatchewan has a standard that currently requires 1% ethanol in gasoline; the standard will rise to 7.5% as soon as there's enough processing capacity in the province to satisfy it. Saskatchewan also has an incentive program for ethanol that is produced and consumed in Saskatchewan, as well as measures to encourage smaller-scale ethanol production.

Alberta has not set its own standard because it prefers a national approach. However, the Province has announced a bioenergy plan that includes policy initiatives and programs totalling $239 million (see *Growing the Biogas Industry*).

Another key factor in the growth of transportation biofuel production is the price of petroleum. Ford says, "If oil prices stabilize at $60/barrel or go higher, then I think there will be more and more interest in biodiesel and ethanol because we could produce those products at a price that would substitute for some of the higher cost petroleum product."

Other factors that could influence biodiesel and ethanol production in Alberta include distance from the major Canadian markets in Ontario and British Columbia, competition with the rapidly growing U.S. biofuel industry, changing feedstock prices, changing byproduct markets and changing biofuel technologies.

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Biodiesel can be produced from vegetable oils, like canola oil.

Testing On-Farm Bioenergy Technologies

Rotary MicroPower Inc.

Pyrolysis system for converting chicken manure into a bioliquid

Pilot testing is a crucial step in moving innovative bioenergy technologies from lab prototypes to farm businesses. Two national programs are helping the agricultural industry to take this step.

The programs are: the Energy Co-generation from Agricultural and Municipal Wastes Program (ECoAMu), and the Environmental Technology Assessment for Agriculture Program (ETAA). All the projects supported under these two programs are taking place on farms. The project sites are located across Canada so people can see how the technologies perform in their own area.

"The focus for both programs is to demonstrate and evaluate the environmental and economic performance of advanced prototypes of technologies or management systems that could be used by farmers and commercialized by industry in the next five or six years," says Dr. Carlos Monreal of Agriculture and Agri-Food Canada. He is the lead and scientific authority for both programs.

"The main objective of the ECoAMu program is to demonstrate advanced co-generation pilot plants that could help us to reduce greenhouse gas emissions and to progress toward a more sustainable agriculture industry," says Monreal. He explains, "Cogeneration is the production of electrical and thermal energy from the biological and thermochemical conversion of biomass. Biomass, in this case, can mean livestock manures, municipal solid waste or straw, for example."

Between 2001 and 2006, the ECoAMu program allocated a total of $970,000 toward the construction of five pilot plants. Four involve anaerobic digesters using manure to produce biogas, electricity and heat, and one involves gasification of a mixture of wheat straw and municipal wastes to produce synthetic gas and methanol.

The ETAA program's objective is to assess innovative and sustainable technologies for adoption by farmers. This $10-million program, operating from 2003 to 2008, is providing funding for 13 projects, which are all underway. Each project involves two or more environmental technologies that relate to one or more of the following areas: animal wastes and manures; animal production; crop nutrients; pest management; and renewable energy.

Several ETAA projects have a bioenergy component. For instance, one project is using pyrolysis to convert chicken manure into a bioliquid. The bioliquid can be used as a biofuel or as a source of chemicals for the pharmaceutical or chemical industries. Another project is using a portable pilot plant, which can be moved from farm to farm, to produce biodiesel from distressed canola seed.

Monreal notes, "With the ETAA program, we tried to create some synergies between industry, farmer organizations and scientists from Agriculture Canada and universities so that we would have a multi-disciplinary, multi-organization team implementing [and evaluating] each project."

The researchers are measuring 11 environmental indicators (e.g. net energy use, pathogen hazard) to compare the new technologies with conventional technologies. They are also using life cycle analysis to calculate the energy, economic and environmental impact of the new technologies at the point where the technology is being used as well as upstream and downstream in the technology's life cycle.

The project results from both programs will help farmers and others to make decisions on adopting the new technologies and could help policy makers to develop policies and programs to encourage adoption. The results will be disseminated in various ways, including technical reports, presentations to farm organizations, and web-based documents.

Monreal emphasizes that the new technologies offer significant long-term benefits to farmers and society. "For example, there is a tremendous potential with manures. Provincial regulations about loading rates of manure on land are causing producers to look for other ways to use their manure. And excess manure application rates can cause water and air quality problems. The technologies that add value to manure, like producing bioenergy and biofertilizer, also reduce agriculture's environmental footprint…. [As well] the technologies contribute to rural development, for example, by providing jobs in designing, constructing and maintaining the facilities and in packaging and selling products like biofertilizer."

Clear Green Inc.

Anaerobic digester and energy cogeneration system near Cudworth, Saskatchewan

He adds, "From the technology side I don't see many impediments [to adoption]. The technologies are there. They just need to be fine-tuned a little bit for the different regions, and that's what is being done right now."

Perhaps the major barrier to adoption will be the high capital costs for some of the innovative technologies. Monreal says, "One of the key challenges is the uncertainty with respect to the return on the capital investment…. A farmer is going to make a decision whether or not to go along with technologies based on the economics. If the economics make sense, then farmers will adopt them. Agriculture and Agri-Food Canada is now conducting an economic analysis of these technologies."

COUNCIL PROFILES

R. Bryan/AF

Terry Dash, who represents Prairie Farm Rehabilitation Administration (PFRA) on AESA Council, is keeping very busy these days. He is currently PFRA's Technical Director for the Prairies West Region and the Acting Technical Director for B.C. Together, these two jobs give him responsibilities that include several major agricultural stewardship programs in Alberta, B.C., Yukon and the Northwest Territories.

Dash grew up in Regina and Kamloops. He attended the University of British Columbia, obtaining a Bachelor of Applied Science in Geological Engineering and a Masters in Civil Engineering. Dash worked for B.C. Hydro for several years and then in 1984 he joined PFRA.

"PFRA's purpose is to provide expertise and services to agricultural producers and stakeholders for the sustainable use of agricultural land and water resources," explains Dash. Created more than 60 years ago, PFRA has a long history of working with farmers and ranchers. Over the years, the agency's roles and activities have evolved to keep pace with the changing challenges faced by the agriculture industry.

"More than 1800 BMP projects have been approved or completed to date under the CAFSP."

At present, one of PFRA's major roles is "to provide technical support to producers who are taking advantage of the land and water programs offered under the [national] Agricultural Policy Framework. That includes programs like Environmental Farm Planning, the National Farm Stewardship Program, the National Water Supply Expansion Program and the Greencover Program. All of those programs are to assist producers in the implementation of environmental actions and to develop secure water supplies for agriculture," explains Dash.

The Environmental Farm Plan (EFP) program and the Farm Stewardship Program are both industry-supported initiatives. The EFP program helps producers to identify environmental risks and opportunities on their operations. The Farm Stewardship Program helps producers implement beneficial management practices to address identified environmental risks. (A beneficial management practice is an agricultural practice that benefits the long-term economic and environmental viability of the agriculture industry and that ensures the health of the natural resources that agriculture relies on.)

Both of these Canada-wide programs are tailored to meet the specific needs of each province and territory. Alberta's EFP program started in 2002. So far almost 4000 Alberta producers have completed an Environmental Farm Plan.

The Canada-Alberta Farm Stewardship Program (CAFSP) started in February 2005, and more than 1800 BMP projects have been approved or completed to date. The program's technical assistance and incentive dollars are integral to the success of these projects. Project costs, which total over $20 million, are shared between the producer and the federal government, signalling the importance that producers place on environmental sustainability despite tough economic times.

ENVIRONMENTAL LAW CENTRE

The Environmental Law Centre (ELC) plays a unique role on AESA Council for several reasons. "In part, it's because, rather than focusing on just one or two environmental issues, we tend to be wider ranging. That helps us to bring a broader view to the table, so we can see how the different pieces fit together. And in part it's because, when issues related to law and policy come to the AESA table, we are able to apply our experience and training as lawyers to assist in dealing with those issues," explains Cindy Chiasson. She is the ELC's Executive Director and represents it on AESA Council.

The ELC brings its broad, objective outlook and its expertise in environmental law and policy to all its activities. Established in 1982, this registered charitable organization provides its skills and services to governments, industry, environmental agencies and members of the public across Canada.

Chiasson says, "There are two key elements to what we do as an organization. One is working to ensure law and policy to protect the environment. The other is to assist and facilitate public participation in environmental decision-making. Those two elements feed into all the services we provide, the types of research we do, and the changes in law or policy that we seek to have put into place."

The Centre offers various free services to help the public to take part in environmental decision-making. She says, "[For instance,] if people have a question about environmental law or policy, they can contact us by phone, email or dropping by, and we'll work on finding an answer. If they have a more detailed question, they can talk to one of our lawyers."

People can also borrow materials from the ELC's extensive library free of charge. And the library catalogue is now searchable through the ELC's website.

You can also ask ELC staff members to make presentations to your group. For example, they have talked to agricultural producers about the legal aspects of such issues as energy developments on their lands and conservation easements (voluntary agreements to limit new developments on a property.)

Agriculture is one of the Centre's four strategic topic areas, along with energy, water and land. As part of this, the ELC conducts research on agriculture-related issues. For instance, to mark its 25th anniversary in 2007, it will be examining the issues around determining the "public interest." This term is used in the mandates of regulators like Alberta's Energy and Utilities Board and Natural Resources Conservation Board and in other environmental legislation.

For more information about the ELC, visit www.elc.ab.ca or call 1-800-661-4238.

Home-Grown Biodiesel

"I think biodiesel is potentially one of those very rare opportunities that is actually a win-win-win-win," says Garry Ropchan, Research Coordinator for the Central Peace Conservation Society (CPCS). Together with Melissa Fuchs, CPCS's Extension Specialist, he's leading a demonstration project at a farm near Wanham to produce biodiesel from canola seed.

Ropchan sees biodiesel production as a possible value-added opportunity for local farmers. He says, "Producers can get involved because biodiesel production can be done on a small scale, with lower start-up costs than some other value-added options…. And biodiesel has superior qualities in terms of the environment and superior performance in your engine."

Biodiesel is non-toxic and biodegradable. In comparison to petroleum diesel, it is safer to handle and transport, and it has lower tailpipe emissions and lower greenhouse gas emissions. As an additive to petroleum diesel, biodiesel improves lubricity and reduces engine wear. Canola makes a particularly good biodiesel feedstock because of the seed's high oil content and the oil's superior properties for use in cold weather compared to other bio-feedstocks such as soybean.

With funding from the Agricultural Opportunity Fund, the Agricultural Research and Extension Council of Alberta, the Alberta Canola Producers Commission and Birch Hills County, CPCS formed a partnership with Bio Fuels Canada Ltd. of Calgary to purchase and set up the equipment to produce biodiesel. Ropchan plans to run some trial batches and to have the system ready for full operation in the spring.

He says, "Producing biodiesel is a brand new thing for us, so there's going to be a lot of trial and error. … By having CPCS get the initial experience, we'll encounter the pitfalls first, so we can make it smoother for producers who venture down this road in the future."

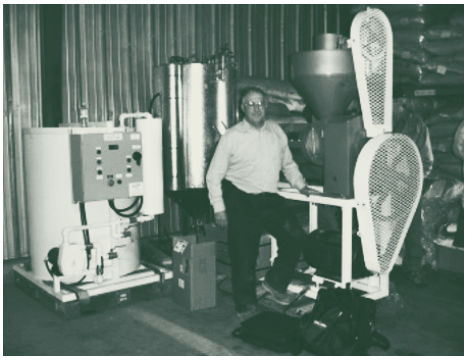
CPCS's biodiesel processing system has a cold screw press with the capacity to crush 10 tonnes of canola seed in 24 hours, producing about 4000 litres of canola oil. The oil is allowed to settle to remove any bits of canola seed or meal, and then the oil is heated to about 50ºC in an 800-litre preheater tank. Next the oil is placed in a 400-litre reactor tank and heated to 90ºC. Then methanol and lye are added and the oil is heated for an hour at 90ºC. And last, the oil is allowed to settle for about 8 hours. The process results in biodiesel and two byproducts, glycerine and canola meal.

The process must be done properly to safely and consistently produce the high quality diesel fuel essential for good engine operation. CPCS will have samples tested by the Alberta Research Council to ensure that the biodiesel meets the ASTM 6751 quality standard.

The costs for the press, preheater and reactor tank total $33,500. Danette Electrical Engineer Services Ltd. looked after the electrical work to meet the equipments' requirements.

The project will evaluate the technical and economic aspects of biodiesel production. For instance, they will determine input amounts and costs, as well as the effects of different grades of canola seed on biodiesel quality. They'll also look into various market opportunities.

Ropchan sees some exciting possibilities beyond on-farm use of the biodiesel, such as: using the canola meal as a high protein feed supplement; selling the glycerine, which has various possible uses; selling the canola oil; and selling the biodiesel as an additive or a fuel. He adds, "I count myself lucky to be on the leading edge of bringing a new opportunity to Alberta producers."



G. Ropchan/CPCS

CPCS's seed press, reactor tank and preheater tank (right to left) being examined by Danette engineer.

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Aussi disponible en français.

Green Matters is the newsletter of the Alberta Environmentally Sustainable Agriculture (AESA) Council. AESA Council consists of representatives from Alberta's agriculture and food processing industry, environmental organizations and municipal, provincial and federal governments.

AESA Council's vision is that Alberta has a thriving agriculture and food industry that is operating in an environmentally responsible manner. Its mission is to lead the agriculture and food industry in addressing environmental challenges. And its goal is to develop and deliver collaborative environmental stewardship initiatives that result in sustainable growth of Alberta's farm, ranch and agri-food processing industry.

The purpose of *Green Matters* is to provide a forum for discussion of environmental issues in Alberta's agriculture and food processing industry.

To subscribe to *Green Matters,* call 780-422-4385. Green Matters is also available online at www1.agric.gov.ab.ca.

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Canada Alberta AESA Alberta Environmentally Sustainable Agriculture Program

The Agricultural Policy Framework (APF) – A Federal-Provincial-Territorial Initiative