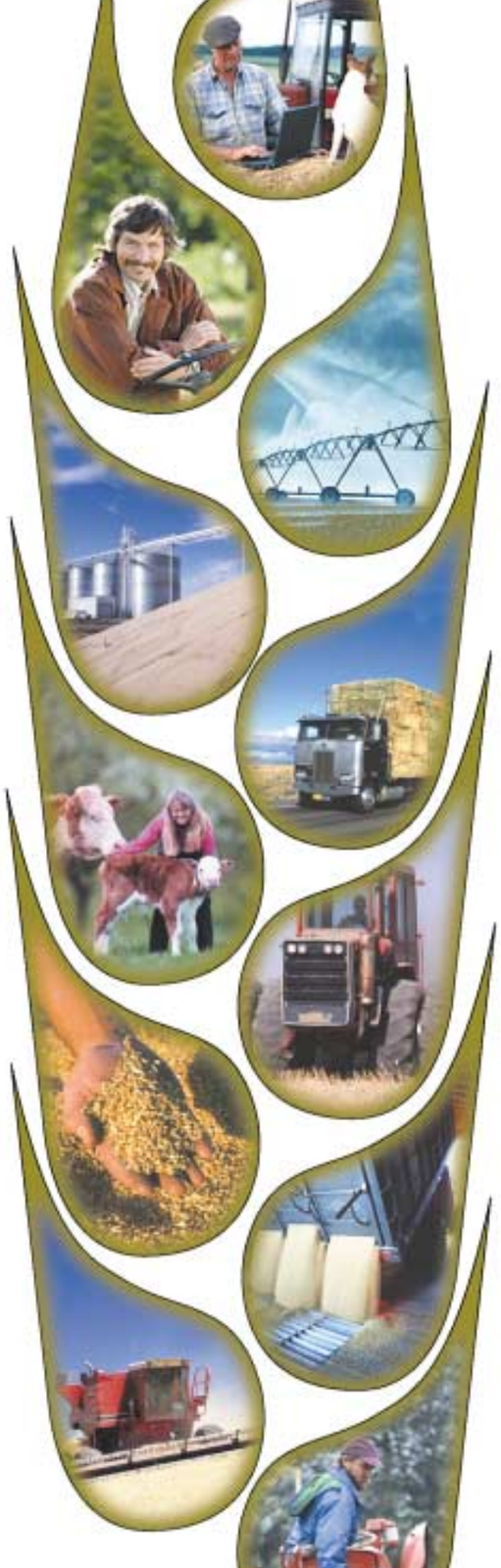


Fueling a new economy

EXPLORING THE
OPPORTUNITIES OF

ETHANOL PRODUCTION

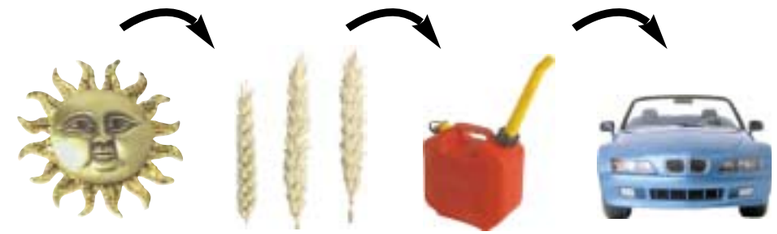
ethanol

WHAT IS ETHANOL?

The process of making alcohol has been around for thousands of years. In recent years the manufacturing process has been refined, leading to improved quality and efficiency of production. Ethanol can be produced from any biological feedstocks that contain sugar, or materials that can be converted into sugar, such as starch or cellulose.

Sugar cane and sugar beets produce most of the world's ethanol. In the United States, corn is the primary feedstock, while in Canada, corn and wheat are used. A large quantity of the ethanol produced in Canada and the United States is destined for use as fuel.

Ethanol is used as an automotive fuel by itself or can be mixed with gasoline to form what has often been called "gasohol" – the most common blend contains 10% ethanol, while other blends can contain up to 85%. Because the ethanol molecule contains oxygen, it allows the engine to more completely combust the fuel, resulting in less pollution. Since ethanol is produced from plants that harness the power of the sun, ethanol is also considered a renewable fuel. Therefore, ethanol has many advantages as an automotive fuel.



GLOBAL PERSPECTIVES ON ETHANOL PRODUCTION AND USE

The production of fuel ethanol on a large scale began in Brazil in the 1970s during large oil price escalations and a collapse in the price of sugar, one of Brazil's largest export commodities. The government mandated fuel ethanol as a way to reduce foreign currency expenditures on oil and as a way to support their sugar cane industry. Today Brazil is the largest producer and consumer of fuel ethanol, with about 12 billion litres used in 2001.

Brazil will soon be passed by the United States in ethanol production and consumption. In California, the upcoming ban on octane-enhancing additives will create a demand for additional ethanol production. Combined with similar bans suggested for the North Eastern U.S., production could exceed 13 billion litres annually. Production is also fueled by the US agricultural lobby. In some states, such as Illinois, 45% of all gasoline sold contains some blended ethanol.

The circumstances in Canada are similar where ethanol is produced and distributed as an automotive fuel in the prairie provinces and Ontario.

HENRY FORD'S FIRST AUTOMOBILES RAN ON ETHANOL

Henry Ford originally designed his cars to run on ethanol. When gasoline became the dominant fuel the design was changed.

Today, all car manufacturers are producing vehicles that run on ethanol blended gasoline. The Ford Taurus and Explorer are vehicles that can use up to (85% ethanol-15% gasoline) E85.

These FFVs (flexibile fuel vehicles) automatically adjust for any mixture for hassle-free and environmentally-sound driving. On-board sensors monitor the fuel mixture and the on-board computer adjusts spark timing and fuel flow to optimize performance. As Yogi Barra once said, "It looks like deja vu all over again".

in Saskatchewan

GROWING INTEREST IN ETHANOL

Canadian farm producers have become aware of the opportunity to produce ethanol. Each region has its own reasons for examining the opportunities. For some, like the Cypress Agri Energy of the Shaunavon district, it's a combination of reasons; the local ownership of a short-line railway capable of hauling feed grain and finished product at economical costs, a local natural gas industry, a developing livestock industry and of course, the awareness as expressed their President Jack Salmon, that they must either grow or die.

For Rosthern's Twin Rivers group, ethanol development has been a long, slow and methodical process. This group started planning their project over 8 years ago, they have raised about $500,000 locally to fund pre-feasibility studies, site studies and the examination of the industry from almost every angle, according to their General Manager, Del Strobel.

The growth of feedlots and hog production has created increased interest in the distiller's grains, a co product of ethanol production. These high protein feed products have proven essential to the success of some ethanol plants with Pound-Maker Agventures of Lanigan providing an important model. Feedlot operators like Jim Robertson of Red Coat Cattle Feeders Inc have been encouraged by the plans of a multinational fertilizer company to establish an ethanol plant in the Belle Plain area, close enough for his operation to benefit.

The pattern is the same in other locations; Melville area producers are actively involved with Commercial Alcohols Ltd, an established ethanol producer from eastern Canada, to determine the suitability of their region for such a plant. First Nations are also considering their options, either as partners in a project or as sole owner operators.

In total, an estimated 20+ groups have been considering the ethanol option in Saskatchewan alone, with others in most provinces ranging as far as Prince Edward Island in eastern Canada.

While not all projects in the discussion stage today will result in ethanol projects being built, industry and government sources are optimistic that at least a few will get out of the gate and into production, with others following as the success of the industry is established.

SASK GOVERNMENT MANDATES ETHANOL

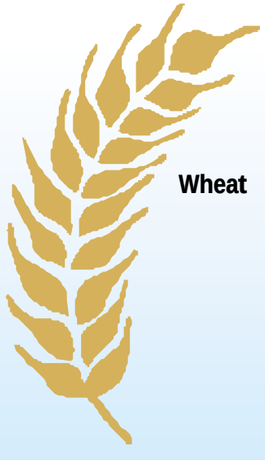
The following comments were received from the Hon. Eldon Lautermilch, Saskatchewan Minister of Industry and Resources.

"We are on the verge of boosting the economy of Saskatchewan's rural areas. Ethanol production is not the final, or only solution but can be a significant building block for an improved rural economy. It offers a significant new market for grain producers, direct benefits from ethanol production and the opportunity to expand cattle feedlot operation due to the large volumes of cattle feed that large scale ethanol production creates.

I anticipate many opportunities for financial investments, the growth of entrepreneurial, managerial and marketing expertise. The creation of construction and operating jobs will follow as future ethanol plants and their related facilities such as cattle feedlots are built and operated.

As a first step, the government is providing a tax incentive for ethanol produced and consumed in the province. As the industry develops and supply becomes available, we will have the mechanism to mandate its sale throughout the province.

We want the industry to be built on the strengths of sound business plans and direct private investment. We will also work with the federal government and other jurisdictions to encourage the expanded use of ethanol fuels throughout Canada as well as to help provide opportunities to export Saskatchewan produced ethanol to other markets."



making ethanol

Grain is used to produce alcohol (ethanol) and its co-products in a well-developed dry milling process with little waste. The major steps in the dry milling process are outlined below.

Milling: The grain first passes through hammer mills, which grind it into a fine powder called meal. The meal is then fed to the mashing system

Mashing: The meal is mixed with water and enzymes, and passes through cookers. The action of heat liquifies the starch, and enzymes begin the process of breaking down the starch to sugars. The mash from the cookers is then cooled and pumped to a fermenter.

Fermentation: Yeast is added to the mash to convert the sugars to ethanol and carbon dioxide.

Distillation: The fermented mash, now called “beer”, contains about 10% alcohol, as well as all the non-fermentable solids from the grain and the yeast cells. The mash is then pumped to the distillation system, where the alcohol is removed from the solids and water. The alcohol leaves the top of the final column at about 96% strength, and the residue mash, called stillage, is transferred from the base of the column.

Dehydration: The alcohol from the top of the column passes through further dehydration where the remaining water is removed. The alcohol product at this stage is called anhydrous (pure) alcohol or ethanol.

CONVENTIONAL FERMENTATION

There is very little difference in the fermentation process for production of ethanol (Ethyl Alcohol) for industrial, beverage or fuel uses. Basically the process requires the conversion of starch to sugars by the use of enzymes and then fermenting those sugars by adding yeast. During fermentation the yeast converts the sugars to ethanol and carbon dioxide. The fermentation process itself does not produce a product with sufficient alcoholic strength to serve its final purpose. Distillation and dehydration are also required. There are precautions taken when producing ethanol, alcohol above 14% destroys the enzymes and fermentation stops. Successful fermentation demands close control of temperatures during the process. Whether the intended use is beverage alcohol, fuel ethanol or pharmaceutical additives, the processes are almost identical.

CELLULOSE TECHNOLOGIES

Cellulose is a part of many agricultural or forestry waste products. Straw, wood chips and even municipal solid wastes can be the inputs for an ethanol plant. Some see this as one method of reducing the environmental impact of the agricultural and forestry industries. The production of ethanol from these products is more complicated than production from grain. One of the processes is acid hydrolysis. This method uses an acid to breakdown the cellulose. This system makes fermentation easier but is relatively expensive and time-consuming. Although these processes show promise, it may be quite some time before they challenge the “standard” process of ethanol from grain, corn, sugar cane or sugar beets. These cellulose-based technologies could potentially provide significantly lower priced ethanol. Scientists at the Saskatchewan Research Council have been studying cellulose technologies for some time. Significant technical advancements have been made in Biomass Gasification and Pyrolysis over the last three years although neither technology is currently economic in the absence of fiscal incentives.

CANADIAN ETHANOL PLANTS

Of the six existing plants in Canada, all except the one in Quebec, produce alcohol using either corn or wheat as the feedstock. There is one plant in each of Alberta, Saskatchewan and Manitoba, these plants all depend on revenue from by-products to be profitable. The API plant in Red Deer, Alberta is the only one producing flour and gluten as by-products. Of the two in Ontario, the Commercial Alcohol Inc. plant in Chatham is Canada's largest.

Low grain prices, concern about climate change, and a changing political will, have increased interest in fuel ethanol, which is fostering an expansion in the industry. Several plants are now either on the drawing board or already under construction. As seen in the accompanying table this additional capacity will increase Canada's production by 636 million litres annually, bringing the total production to 874 million litres per year.

NESASK GROUP FIRST OUT OF CHUTE

Only a few days after the Saskatchewan provincial government announced its plans to support an expanded ethanol industry for the province, NESask Group announced plans to develop a 100 million-litre facility. Their plans had been underway for some time and with the government's announcement, their plans took on additional significance. According to Jim Boxall, the Chairman of Tisdale Alfalfa Dehy Ltd. (NESask Ethanol Project sponsor) this alfalfa processor sees the move into ethanol as a related business activity. Tisdale Alfalfa Dehy has been a big player in exporting alfalfa pellets to markets in Canada, the US and developing offshore markets in Japan, Korea and elsewhere.

TECHNOLOGY AND BUSINESS SUPPORT

Canada has several national and provincial research organizations that support farmers and potential ethanol producers in both scientific and commercial aspects. The Saskatchewan Research Council has some very modern fermentation equipment to test different feedstock, enzymes and yeasts under rigorously controlled conditions for effective product and process development. This biotechnology research is augmented by the efforts of Canada Agriculture and Agri-Foods (AAFC), Saskatoon Research Centre, which in addition to product research, supports adding value to crops grown in western Canada by helping proponents commercialize their products. Personnel at the Saskatoon Research Centre of AAFC have developed an economic analysis spreadsheet that illustrates capital and operating costs associated with ethanol production. The spreadsheet, which was developed for research, can also be used with other process plants including bio-diesel. It can assist project proponents to understand key commercial variables and the various rates of return they might expect to receive over time. These organizations and their ongoing programs provide critical information to the ethanol industry.

FEDERAL SUPPORT FOR DEVELOPMENT

The Government of Canada supports ethanol development and use mainly through four types of measures:

- research and development programs that support the market development of technologies to overcome technical barriers to ethanol market penetration;
- the exemption of 10 cents per litre federal excise tax for the ethanol portion of blended gasoline;
- the inclusion of ethanol powered vehicles in federal vehicle fleet; and
- the the Future Fuels Initiative.

The Future Fuels initiative was announced in November 2001 under Canada's Action Plan 2000 on Climate Change. It aims at an increase of 750 million litres in Canada's annual capacity to produce ethanol, which represents a four-fold increase in current production. Such an increase could result in 25 % of Canada's total gasoline supply containing 10-percent ethanol. The Future Fuels initiative is jointly delivered by Natural Resources Canada (NRCan) and Agriculture and Agri-Food Canada.

The major component of the Future Fuels Program is the renewal of the National Biomass Ethanol Program (NBEP). The renewed NBEP will help overcome lender resistance to investing in large ethanol plants because of uncertainty about excise tax policy. Under Future Fuels, NBEP provides for $140 million in contingent loan guarantees to encourage financing for three to six new ethanol plants. The loan guarantee program would only come into effect if all or part of the excise gasoline tax on ethanol were imposed prior to Decmber 31st, 2010.

In addition to the loan guarantees, the Future Fuels Program adds $3 million over five years for a public outreach component to provide essential market information to retail consumers. The initiative also provides for such activities as public education on fuel ethanol, analysis of fuel ethanol markets and producer economics, research on possible renewable fuel standard, and liaison with provinces and industries interested in the ethanol plant expansion.

ETHANOL PRODUCTION IN CANADA

Current Producers	Location	Capacity (millions of litres)	Other Information
Mohawk Oil, Canada Ltd.	Minnedosa, Man.	10	Wheat-based
Pound-Maker Agventures Ltd.	Lanigan, Sask.	12	Wheat-based, partnered with feedlot
Commercial Alcohols Inc.	Tiverton, Ont.	23	Corn-based
Commercial Alcohols Inc.	Chatham, Ont.	150	Corn-based
API Grain Processors	Red Deer, Alta.	26	Wheat-based, also makes flour and gluten
Tembec	Temiscaming, Que.	17	Forestry product based
Total annual production capacity		**238**	
Proposed or Under Construction.			
Seaway Grain Processors Inc.	Cornwall, Ont.	66	Corn-based
Commercial Alcohols Inc.	Varennes, Que.	120	Corn-based
Commercial Alcohols Inc.	Chatham, Ont.	150	Corn-based
New Saskatchewan Projects	Saskatchewan	Potential 300	Wheat-based
Total annual production capacity,		**636**	

the business case

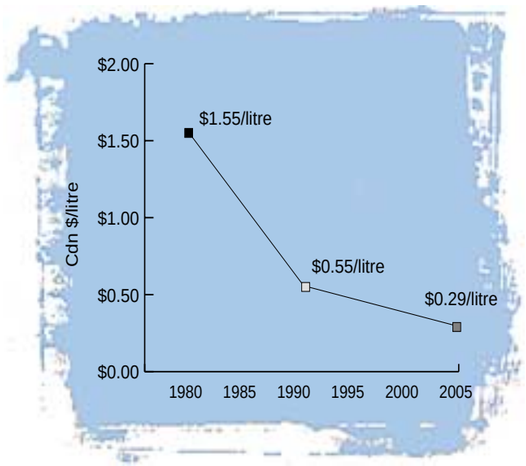
RATIONALE FOR PARTNERSHIPS

Some agricultural producers see ethanol production as a solution to selling their wheat at higher prices and in larger volumes. While it is true that feedstocks are critical to the success of any plant, several other factors are equally important. Skills that producers themselves may not always possess. Marketing, finance and management are three areas where the success or failure of any plant is equally vulnerable. Where ethanol plants are undertaken in conjunction with cattle feedlots, the viability of both operations may benefit and the economic impact on the community is magnified. One of the ways to reduce the likelihood of climate change is to use ethanol which is produced from renewable resources such as grain or cellulose. For this reason, developing partnerships with firms that have expertise, capital and marketing capabilities is seen by many as essential to the creation of a sound enterprise.

ETHANOL COSTS

The cost of building an ethanol production facility ranges from $0.65-$1.00 Can. per litre of capacity. There are varying opinions regarding the optimal size of a plant. Most new plants being constructed are in the 100-150 million litres/year capacity. This means an initial investment of about $100 million.

The efficiency of ethanol production has improved immensely over the years but it is still not directly cost competitive with gasoline. From 1980 to 1991 the cost of producing ethanol dropped to about 35% of the 1980 level. Projections are that soon the cost will be about 20% of the 1980 value. This progress has been made possible almost entirely by increased efficiency in the production process. The costs of ethanol from existing plants are in the range of $0.35-$0.45/litre. The present combined federal and provincial government support programs are in the range of $0.20-$0.35/litre. This means ethanol begins to be competitive with gasoline priced at $0.20/litre at the refinery.



SUPPORTS VOLUNTARY PROGRAMS

The gasoline industry in Canada has been using ethanol as an additive for many years. In Western Canada, Mohawk Oil was the first company to promote ethanol based fuels. Mohawk itself has a production facility at Minnedosa, Manitoba. In Eastern Canada, Petro Canada and Sunoco are currently engaged in major expansions to the ethanol supply through partnerships with Commercial Alcohols Ltd of Chatam Ontario who is constructing several large plants to provide feedstock to these gasoline retailers. But, the industry is adamant that the introduction of ethanol fuels should be voluntary rather than government mandated. Their views seem to be based on the complexities of oil refining and distribution processes, pipeline capacities, distribution arrangements and the need to incorporate a variety of fuel additive technologies rather than just one.

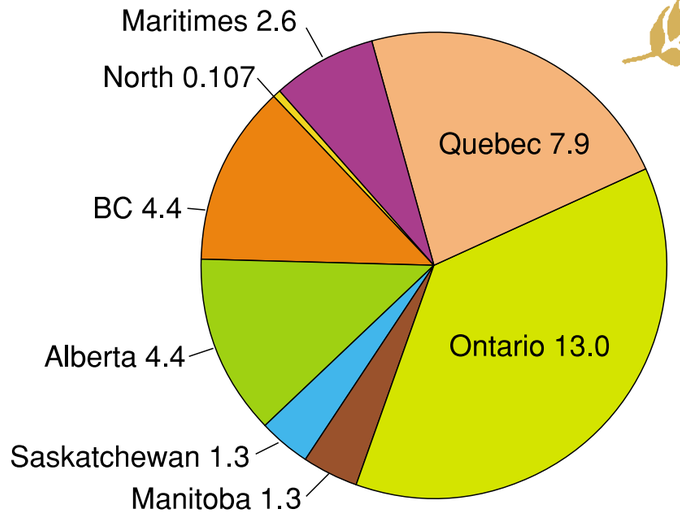
tax & regulation

CANADIAN GASOLINE USE

BY PROVINCE (billions of litres per year)

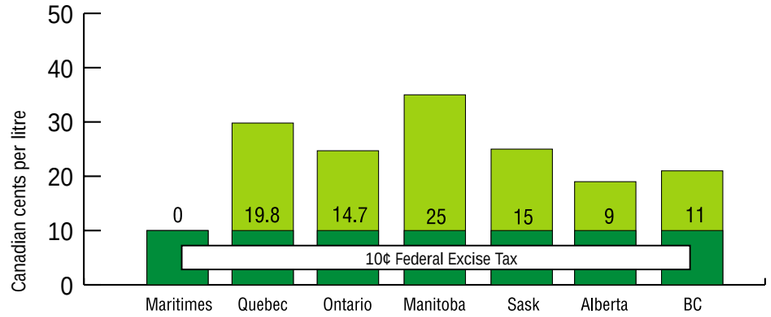
POTENTIAL ETHANOL USE

Gasoline is blended with ethanol and in most provinces is sold as E10. At that level, potential provincial consumption of ethanol would be 10% of the amount of gasoline in the adjoining pie chart.



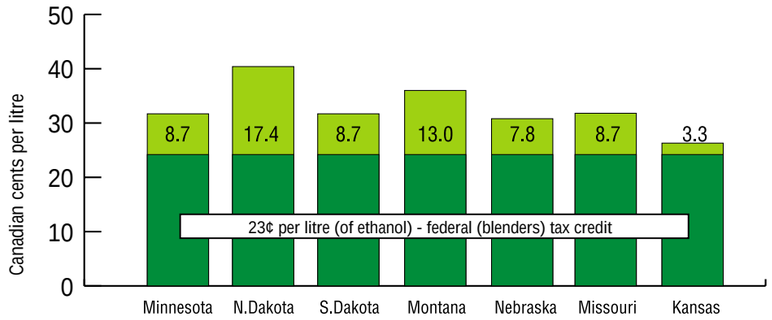
Canada's Gasoline Consumption
36 billion litres per year

CANADIAN ETHANOL SUBSIDIES



UNITED STATES ETHANOL SUBSIDIES

(Selected States)



SOME U.S. PROGRAMS

(All figures in US dollars)

Minnesota: $3 million per plant, 10 year program.

N.Dakota: 40 cents per gallon for specified plants, ethanol must be sold in the state.

S.Dakota: Max $1 million per year per plant, $10 million cap per plant.

Montana: $3 million per company, program ends in 2005.

Nebraska: Expanded production receives 7.5 cents per gallon to a maximum of 10 million gallons. New production receives 18 cents per gallon to a maximum off 15.6 million gallons

Missouri: First 12.5 million gallons get 20 cents, next 12.5 million get 5 cents, maximum per plant $3.125 million annual cap.

Kansas: $3.5 million annual cap.

In addition to ethanol subsidies, U.S. Agricultural subsidies further reduce the cost of ethanol production.

economic impacts

CLIMATE CHANGE & RURAL ECONOMIC DEVELOPMENT

If unchecked climate change will have a significant effect on the Prairie Provinces. Droughts will be more frequent, the drier weather will make crops more susceptible to insects and disease and there will be more forest fires. None of this is good news for the rural economy. Adaptation by rural regions ahead of climate change will enable them to develop programs which can maintain the way of life important to so many people. One of the ways to ensure continued renewable development is to consider ethanol production. The plant feedstock, whether grain or cellulose, is a renewable resource. The 'waste' products can be inputs to other economic developments in the area. These two operations alone can provide jobs, income for the rural economy and the real possibility for further spin off operations. It is an approach well worth investigating.

AGRICULTURAL IMPACTS

When any discussion concerning ethanol plants takes place, the numbers are impressive. Pound-Maker Agventures Ltd's relatively small ethanol plant near Lanigan consumes about 95 acres of grain production per day. That's a total of 1,200,000 bushels of feed grain per year to keep its 12 million litre ethanol plant in operation. This is an important new market for the local producers who grow the grain.

The recently announced NESask project proposes to produce 100 million litres per year. An operation on of this scale would require 300,000 tonnes of feed grain per year and an estimated 250,000 acres to produce the feedstock. Expressed another way, the NESask project would consume the production from about 800 acres per day.

When cattle feedlot operations are associated with ethanol projects, the impacts really expand. Pound-Maker Agventures presently operates a feedlot with a capacity of 28,500 head of cattle feeding at any given time. Even though the cattle consume the spent distillers grain from the ethanol plant, that material only provides about 15% of their feed requirements.

For Pound-Maker, additional feed grain and forage require another 65,000 tonnes of feed grain and 22,000 tonnes of forage. This requires about 175 acres of production daily to grow this feed. In the NESask case the numbers are a lot bigger. With a potential marketing of 400,000 head, the NESask ethanol project will require an estimated 240,000 tonnes of feed grain for the cattle, 420,000 tonnes of forage and 100,000 round bales for straw requirements. It is estimated that the total acreage required for feed production will be something like 400,000 acres.

Although the NESask project is based on projections, it is clear that large-scale ethanol production will create new markets for Saskatchewan's agricultural industry and impact favorably on the rural economy.

environment

BIO DIGESTERS

A developing technology shows promise for an environmentally acceptable way of disposing of manure from large dairy, poulty, hog, and cattle feedlot operations. Manure is passed through digesters in which micro organisms use the sludge as food. The products given off during the process are carbon dioxide, methane (which is natural gas) and hydrogen sulfide. One 400 head dairy cattle operation can produce enough methane from manure to operate an electric generator capable of supplying over 70 homes. Manure producing animals do not depend on sunshine as do solar panels, nor wind as do wind turbines, thus there is a continuous supply of co-generated power. This technology is one more way that environmentally friendly processes can add diversification and economic benefits to a rural economy.

WATER ISSUES

Cattle feedlots can be designed to accompany ethanol production facilities. The objective is a profitable partnership for both enterprises. The stillage products of the ethanol production are excellent inputs to cattle feedlots. The high protein content of the co-products is valued for cattle finishing operations.

Feedlots do add some additional challenges to ethanol plant operation because they require additional water supplies which can be a concern in some locations, they add urine and manure disposal requirements. The problems of Intensive Livestock Operations (ILOs) can be managed when they are addressed in the design of the operation and when they are managed with environmental issues in mind.

ENERGY AND CO_2 BALANCE

There is some difference of opinion on the validity of the energy balance associated with ethanol production. The energy balance is calculated by adding all the energy inputs involved in grain production and comparing that to the energy contained in the ethanol produced. Inputs include the fuel used in farming operations such as tractor, truck and combine fuels, the energy used to produce fertilizer and the cost of irrigation in the cases where it is used. The energy used in the plant to produce ethanol is also factored into the calculation. If the energy in the ethanol is less than the combined total of the inputs then producing it is considered energy-inefficient. Most, but not all, researchers agree that ethanol production is an energy-efficient activity.

CO_2 is of concern among scientists because of its effect on global warming. It is a major by-product of ethanol production. It can be used in flash freezing of foods and in carbonated drinks. Scientists generally agree that on an overall ethanol production and use cycle basis more CO_2 is absorbed than is released.

TARGETING TRANSPORTATION

Transportation is the largest source of Canada's greenhouse gas emissions, contributing about a quarter of total emissions. In the context of Canada's Kyoto commitments on GHG emission reductions, the Government of Canada considers the development and use of ethanol to be an effective way to reduce these emissions and address the issue of climate change. Blended into transportation fuels, ethanol from biomass offers important environmental benefits, while contributing to regional economic growth and job creation, particularly in rural communities. Compared to conventional fuels, ethanol reduces greenhouse gas emissions and offers air quality benefits. The potential for Canada to capitalize on this environmentally advantageous fuel is great; renewable feedstocks for ethanol production are abundant in several provinces.

For more information, please visit the following websites:

Natural Resources Canada .....www.NRCan.gc.ca
Agriculture and Agri-Food Canada .....www.agr.gc.ca
Farm Credit Canada .....www.fcc-sca.ca

Canada

Saskatchewan Industry and Resources

SARM

Sask Water

SRC technology is our business

TWF inc

- **Eden Regional Economic Development Authority** - Tisdale
- **Cypress Agri Energy** - Shaunavon
- **Redcoat Cattle Feeders Inc** - Hazenmore
- **Regina Regional Economic Development Authority** - Regina
- **NESask Ethanol Project** - Tisdale
- **Mid Sask REDA and Community Futures** - Outlook

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